STATE BOARD OF EDUCATION

PROCLAMATION 2014

April 2012

Texas Education Agency
Austin, Texas

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Introduction

This proclamation serves as notice to both publishers and the public that the State Board of Education (SBOE) is inviting bids to furnish new instructional materials for the following courses.

Mathematics

- Mathematics, grades K–8
- Mathematics (Spanish), grades K–5

Technology Applications

- Technology Applications, grades K–8
- Fundamentals of Computer Science
- Computer Science I
- Computer Science II
- Computer Science III
- Digital Forensics
- Discrete Mathematics
- Game Programming and Design
- Mobile Application Development
- Robotics Programming and Design
- Digital Design and Media Production
- Digital Art and Animation
- 3-D Modeling and Animation
- Digital Communications in the 21st Century
- Digital Video and Audio Design
- Web Communications
- Web Design
- Web Game Development

Science

- Science, grades K–8
- Science (Spanish), grades K–5
- Aquatic Science
- Astronomy
- Biology
- Chemistry
- Earth and Space Science
- Environmental Systems
- Integrated Physics and Chemistry
- Physics
- Principles of Technology
- Scientific Research and Design
- Anatomy and Physiology
- Engineering Design and Problem Solving
- Medical Microbiology
- Pathophysiology
- Advanced Animal Science
- Advanced Biotechnology
- Advanced Plant and Soil Science
- Food Science
- Forensic Science

To be eligible for adoption, instructional materials submitted in response to this proclamation must meet at least 50% of the elements of the Texas Essential Knowledge and Skills (TEKS)—for the subject and grade level for which the materials are intended—in both the student version and the teacher version of the instructional materials. The materials must also comply with applicable manufacturing standards and be free from factual errors at the time of implementation in schools.

Instructional materials submitted in response to this proclamation will undergo a full and complete investigation by a state review panel to identify the extent to which the materials meet the required TEKS and to identify factual errors. At the completion of the review, the state review panels will report their findings to the commissioner of education.

The panels' findings serve as the basis for the commissioner of education's recommendation to the SBOE regarding the adoption of materials. The SBOE is scheduled to make its determination regarding the adoption of materials submitted in response to this proclamation in November of 2013. The SBOE's determination is final.

Instructional materials adopted under this proclamation are scheduled to be implemented beginning in the 2014–2015 school year. Adopted materials are eligible for purchase with funds from the Instructional Materials Allotment, and will be ordered by school districts and open-enrollment charter schools through the Texas Education Agency's (TEA) Educational Materials (EMAT) system. The intrastate freight costs for adopted instructional materials will be paid by the TEA.

This proclamation contains the TEKS for the subjects and grade levels for which bids are being invited. It also contains a detailed schedule of adoption procedures, the 2010–2011 enrollment for each course included in the proclamation, specifications for providing digital files for the production of Braille and large-type versions of adopted instructional materials, and a glossary of terms. Additional information and specific instructions for addressing the requirements of this proclamation will be released on the TEA website.

In addition to this proclamation, all interested publishers and other content providers should carefully read and fully understand both the state statutes and the administrative rules that govern the review and adoption of instructional materials. The language of Chapter 31 of the Texas Education Code (TEC) is available on the Texas Legislature's website. The language for Senate Bill 6, passed by the 82nd Texas Legislature is available on the TEA's website. The language of Subchapters A through C of Title 19, Chapter 66 of the Texas Administrative Code is available on the Texas Secretary of State's website. It is imperative for each participant in the adoption to carefully read and fully understand all of this information.

Schedule of Adoption Procedures

2012

January 2012: *SBOE Meeting*

- Commissioner of education presents *Proclamation 2014* (for adoption in 2013 and implementation in the 2014–2015 school year) to the State Board of Education (SBOE) for discussion.

February/March 2012

- Texas Education Agency (TEA) conducts meeting to discuss *Proclamation 2014* with interested publishers.

April 2012: *SBOE Meeting*

- Commissioner of education presents *Proclamation 2014* to the SBOE for action.
- SBOE issues *Proclamation 2014*.

July 2012: *SBOE Meeting*

- SBOE adopts *Proclamation 2014 Questions and Answers* document.
- The SBOE may set Permanent School Fund (PSF) payout rate for the 2014–2015 biennium.

August 2012

- TEA releases *Proclamation 2014 Publisher Handbook*.
- TEA conducts publisher orientation meeting for parties interested in filing *Statements of Intent to Bid.*

September 2012

- TEA posts *Nomination to State Review Panel* forms to TEA website and distributes to the SBOE, Texas state officials, school districts and open-enrollment charter schools, universities, and regional Education Service Centers (ESCs). Those submitting nominations shall file completed forms by December 14, 2012.

November 2012

- The SBOE may set PSF payout rate for the 2014–2015 biennium.

Friday, December 7, 2012

- **Deadline** for publishers to file *Statements of Intent to Bid Instructional Materials*. Publishers shall provide detailed specifications regarding price, hardware, software, and/or special equipment needed to review any item included in an instructional materials submission. Publishers shall file all documents by 5:00 P.M. CST.

  Note: Only those who file a Statement of Intent to Bid by 5:00 P.M. CST on December 7, 2012 will be allowed to participate in the adoption process. Please see SBOE rules 19 TAC §66.48 (a–e) *for additional information.*

Friday, December 14, 2012

- **Deadline** for persons to file *Nomination to State Review Panels* forms. Those submitting nominations shall file all documents by 5:00 P.M. CST.

  Upon initial contact by a representative of the TEA, state review panel nominees begin a "no-contact" period in which they may not have either direct or indirect contact with any person having an interest in the content of instructional materials under evaluation by the panel.

2013

January–February 2013

- TEA reviews *Nomination to State Review Panel* forms and recommends nominees to the commissioner of education.

Friday, February 8, 2013

- Each ESC designates the person who will supervise the sample instructional materials and publishes a schedule specifying hours and dates sample materials may be reviewed by the public.
- Each ESC publishes a news release and notifies area schools concerning sample instructional materials. In the notice, the ESC shall include the person to be contacted regarding sample instructional materials and the hours and dates samples will be available for review by the public.

March 2013

- TEA notifies state review panel candidates of appointment.

Friday, April 19, 2013

- **Deadline** for publishers to submit one (1) complete, electronic, pre-adoption sample copy of instructional materials (excluding Spanish mathematics materials) along with one (1) completed *Correlations to the Texas Essential Knowledge and Skills* (TEKS) form to the TEA. Publishers shall file all materials by 5:00 P.M. CDT.
- **Deadline** for publishers to submit one (1) complete, electronic, pre-adoption sample copy of instructional materials (excluding Spanish mathematics materials) along with one (1) completed *Correlations to the Texas Essential Knowledge and Skills* (TEKS) form to each of the twenty ESCs. Publishers shall file all materials by 5:00 P.M. CDT.
- **Deadline** for publishers to provide a complete description of all items included in a student and teacher component. Publishers shall file all documents by 5:00 P.M. CDT.

  Electronic samples must allow for multiple simultaneous users.

  Publishers providing Internet-based instructional materials shall supply the TEA and ESCs with appropriate information, such as locator information and passwords, required to ensure public access to their programs until final samples are submitted in April 2014. Access to electronic samples should be available for multiple simultaneous users.

  Publishers shall ensure that all samples are complete as to content. Electronic instructional materials, including Internet-based products, must be functional for review purposes.

  The TEA, ESCs, and affected publishing companies shall work together to ensure that hardware or special equipment necessary for review of any item included in a student and/or teacher component of an instructional materials submission is available in each ESC.

  Note: The TEA may require additional samples for use by contracted reviewers, members of the SBOE, and others.
- **Deadline** for publishers to file *Forms B* and *M,* and *Warranty,* providing the physical specifications of the instructional materials (excluding Spanish mathematics materials) being submitted and certifying their adherence to prescribed manufacturing standards. Publishers shall file all documents by 5:00 P.M. CDT.

Friday, April 19, 2013 (continued)

- **Deadline** for publishers to file a signed *Affidavit of Authorship* certifying that each individual whose name is listed as an author or contributor of content was engaged in the development of the materials. In the affidavit, the publisher shall also state in general terms each author's involvement in the development. Publishers shall file all documents by 5:00 P.M. CDT.
- **Deadline** for publishers to provide each school district and open-enrollment charter school with information that fully describes instructional materials submitted under *Proclamation 2014*. Publishers shall file all documents by 5:00 P.M. CDT.

Friday, April 26, 2013

- **Deadline** for ESCs to notify the commissioner of education of any irregularities in sample shipments of all materials. ESCs shall file notification on forms provided by the TEA by 5:00 P.M. CDT.

  Within five (5) working days, the TEA will notify the appropriate publisher of any irregularities in the sample shipments.

Friday, May 10, 2013

- TEA provides instructions to publishers for delivery of materials for the state review panels. Shipments shall include all samples, which must be complete as to content and functional for review purposes, and their correlations to the TEKS. Shipments shall include only materials that will be included on the official bid. Ancillary materials are not permitted at the state review panel meetings. A publisher of instructional materials that require hardware or special equipment shall provide appropriate hardware or equipment for the review.

Friday, May 17, 2013

- **Deadline** for publishers to submit one (1) complete, electronic, pre-adoption sample copy of Spanish mathematics instructional materials along with one (1) completed *Correlations to the Texas Essential Knowledge and Skills* (TEKS) form to the TEA. Publishers shall file all materials by 5:00 P.M. CDT.
- **Deadline** for publishers to submit one (1) complete, electronic, pre-adoption sample copy of Spanish mathematics instructional materials along with one (1) completed *Correlations to the Texas Essential Knowledge and Skills* (TEKS) form to each of the twenty ESCs. Publishers shall file all materials by 5:00 P.M. CDT.
- **Deadline** for publishers to file *Forms B* and *M,* and *Warranty,* providing the physical specifications of the Spanish mathematics instructional materials being submitted and certifying their adherence to prescribed manufacturing standards. Publishers shall file all documents by 5:00 P.M. CDT.
- Each ESC makes samples of instructional materials (excluding Spanish mathematics materials) submitted for adoption available for public examination. The materials must remain available to the public throughout the review and adoption period.

Friday, June 7, 2013

- Each ESC makes samples of Spanish mathematics instructional materials submitted for adoption available for public examination. The materials must remain available to the public throughout the review and adoption period.

June–July, 2013

- TEA conducts orientation and training sessions for state review panel.
- The state review panel evaluates instructional materials submitted for adoption.
- Commissioner of education issues preliminary recommendations that instructional materials be placed on the adopted list or rejected.

July 2013: *SBOE Meeting*

- SBOE may hold public hearing on instructional materials submitted for adoption.

Friday, August 2, 2013

- **Deadline** for publishers to file *Publisher's Certification of Editorial Review* affirming that instructional materials have been edited for accuracy, content, and compliance with requirements of the proclamation. Publishers shall file all documents by 5:00 P.M. CDT.
- **Deadline** for publishers to file *Identification of Factual Errors by Publisher* form listing the corrections to be made to the instructional materials submitted for adoption. Publishers shall file all documents by 5:00 P.M. CDT.

Friday, September 6, 2013

- **Deadline** for Texas residents to file lists of alleged factual errors in instructional materials under consideration for adoption. Residents shall file all documents by 5:00 P.M. CDT.
- **Deadline** for Texas residents to file official written comments concerning instructional materials submitted for adoption. Residents shall file all documents by 5:00 P.M. CDT.
- Prior to the September hearing, the TEA will provide written comments and lists of alleged factual errors to the SBOE, participating publishers, ESCs, and persons who have filed written requests.
- **Deadline** for publishers who elect to protest the preliminary recommendation to file request for show-cause hearings. Publishers shall file all documents by 5:00 P.M. CDT.

September 2013

- Prior to the SBOE meeting, commissioner of education publishes schedule and procedures for the public hearing to be held by the SBOE.
- Members of the general public request to appear at the public hearing before the SBOE; priority will be given to Texas residents. Parties shall file all documents, which shall identify subjects, titles, and publishers of instructional materials to be addressed, with the TEA's division of Instructional Materials and Educational Technology.

Friday, September 13, 2013

- **Deadline** for publishers to provide the name, address, and telephone number of the production manager of each printed instructional materials being prepared for submission. Publishers shall file all documents by 5:00 P.M. CDT.

September 2013

- Prior to the SBOE meeting, the TEA releases copies of official written comments from Texas residents via the TEA website.

September 2013: *SBOE Meeting*

- SBOE holds public hearing on instructional materials submitted for adoption. The archived webcast will be available through the TEA website.

10 working days after the close of the hearing

- **Deadline** for publishers and any person who participated in a hearing before the SBOE to file responses to official written comments from Texas residents and to testimony presented at the public hearing. Respondents shall file all documents by 5:00 P.M. CDT.

10 working days after receiving official written comments

- The commissioner of education releases copies of responses to written and/or oral testimony to members of the SBOE, ESCs, participating publishers, and persons who have filed written requests.

Friday, September 27, 2013

- **Deadline** for publishers to file one signed original copy and one electronic copy of the *Official Bid Form*. Publishers shall file all documents by 5:00 P.M. CDT.

Friday, October 4, 2013

- **Deadline** for persons to file complaints alleging violations of statutes, rules, or procedural irregularities. Persons shall file all documents by 5:00 P.M. CDT.

  The commissioner of education may hold a formal or informal hearing in the case of an apparent violation of statute. Upon determining that a violation has occurred, the commissioner shall report the findings to the SBOE.
- The commissioner of education issues *Report of the Commissioner of Education Concerning Required Corrections of Factual Error*s, listing all corrections of factual errors required in the instructional materials under consideration for adoption. The commissioner of education will release the report to the SBOE, affected publishers, ESCs, and other persons, such as Braillists, needing immediate access to the information.
- Commissioner of education issues *Recommendations for the Adoption List of Instructional Materials*, giving advice to the SBOE regarding the adoption of instructional materials.
- **Deadline** for publishers to send NIMAS test files and associated print pages. Publishers shall submit all materials by 5:00 P.M. CDT.

Friday, October 18, 2013

- **Deadline** for publishers to file written confirmation of their intent to make all corrections identified in the *Report of the Commissioner of Education Concerning Required Corrections of Factual Errors* and required by the SBOE. Publishers shall file all documents by 5:00 P.M. CDT.

November 2013: SBOE Meeting

- SBOE committee considers final recommendations of the commissioner of education regarding the adopted lists.
- SBOE considers instructional materials submitted under *Proclamation 2014* for adoption.
- SBOE affirms PSF distribution for fiscal year 2014.

Friday, December 6, 2013

- **Deadline** for publishers of adopted instructional materials to provide three (3) copies of printed student materials and NIMAS computer files. Publishers shall submit all materials to either the TEA or the designated contractor by 5:00 P.M. CST.

  Publishing companies submitting electronic instructional materials for adoption are required to comply with the technical standards of the Federal Rehabilitation Act, Section 508 www.Section 508.gov. Materials delivered online must meet minimum web-based standards, available at http://www.w3.org/standards

Friday, December 20, 2013

- **Deadline** for publishers to file the *Register of Contact* form indicating all visits, meetings, or contact with SBOE members, including the date, time, location, and purpose of the communication. Publishers shall file all documents by 5:00 P.M. CST.

2014

Friday, February 14, 2014

- **Deadline** for publishers to file *Identification of Editorial Changes by Publisher* form listing the editorial revisions made to the instructional materials submitted for adoption. Publishers shall file all documents by 5:00 P.M. CST.

April 2014

- School districts and open-enrollment charter schools begin submitting orders for new instructional materials through EMAT.

Friday, May 2, 2014

- **Deadline** for publishers to file signed *Publisher's Affidavit* verifying that all required corrections have been made. Publishers shall file all documents by 5:00 P.M. CDT.
- **Deadline** for publishers to provide one (1) complete copy of adopted instructional materials that incorporates all required corrections to the TEA. Corrected samples shall be identical in content to materials that will be provided to school districts after purchase and representative of the final program. Publishers shall submit all materials by 5:00 P.M. CDT.

  Publishers providing Internet-based instructional materials shall supply the TEA with appropriate information, such as locator information and passwords, required to ensure access to their programs throughout the life of the adoption.
- **Deadline** for publishers to provide three (3) complete copies of adopted student editions that incorporate all required corrections with the Braille contractor designated by the TEA. Corrected samples shall be identical in content and format to materials that will be provided to school districts after purchase. Publishers shall submit all materials by 5:00 P.M. CDT.
- **Deadline** for publishers to provide one (1) complete copy of adopted student editions that incorporates all required corrections with the designated producer of large-print materials and one (1) copy of student editions that incorporate all required corrections with the designated producer of audio materials. Corrected samples shall be identical in content and format to materials that will be provided to school districts after purchase. Publishers shall submit all materials by 5:00 P.M. CDT.
- **Deadline** for publishers to provide one (1) complete copy of adopted instructional materials that incorporates all required corrections with each of the twenty ESCs. Corrected samples shall be identical in content to materials that will be provided to school districts after purchase and representative of the final program. Publishers shall submit all materials by 5:00 P.M. CDT.

  Publishers providing Internet-based instructional materials shall supply the ESCs with appropriate information, such as locator information and passwords, required to ensure access to their programs throughout the life of the adoption.

  Note: The TEA may require additional corrected samples for use by contracted reviewers, members of the SBOE, and others.

June–August 2014

- Publishers distribute adopted instructional materials to school districts and open-enrollment charter schools.

  Each publisher shall guarantee delivery of or access to instructional materials at least ten business days before the opening day of school of the year for which the materials are ordered if the materials have been ordered by a date specified in the sales contract.

Additional Information

- Instructional materials must meet at least 50% of the elements (student expectations) of the Texas Essential Knowledge and Skills (TEKS)—for the subject and grade level for which the materials are intended—in both the student version and the teacher version of the instructional materials.
- If a student expectation is subdivided into constituent parts or "breakouts", then each individual breakout must be sufficiently covered in order for the student expectation to be considered addressed and counted toward the 50% minimum requirement.
- Instructional materials must be free from factual errors at the time of implementation in schools.
- Printed materials intended for use by the student must comply with the standards in the latest edition of *Manufacturing Standards and Specifications for Textbooks,* approved by the Advisory Commission on Textbook Specifications.
- Instructional Materials delivered electronically must meet the technical standards of the Federal Rehabilitation Act, Section 508.
- Materials delivered online must meet minimum web-based standards, available at http://www.w3.org/standards.
- All materials submitted for adoption in response to Proclamation 2014 must align with the English Language Proficiency Standards.
- The submission of open-source materials is welcome under Proclamation 2014.
- All official samples submitted to satisfy the requirements of the proclamation must be provided electronically.
- Electronic samples must allow for multiple simultaneous users.
- All Technology Applications products submitted for adoption must be electronically delivered. Print materials for Technology Applications will not be considered for adoption.
- Bids for all Technology Applications products submitted for adoption must include annual pricing. Bids that include a multi-year pricing option for the products are welcome.

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Requirements of Participating Content Providers

Below is a list of requirements that each organization participating in the adoption under Proclamation 2014 will be expected to fulfill. The deadline for fulfilling each of the expectations is provided in the schedule of adoption procedures, and detailed information about each of these requirements—as well as the forms necessary to fulfill them—will be posted on the TEA website as soon as it is available. An organization's inability to fulfill any of the requirements by the deadlines given in this proclamation may, at the discretion of the commissioner of education, result in that organization's materials being removed from consideration for adoption.

- **Statement of Intent to Bid:** Participants planning to submit instructional materials for adoption must file one *Statement of Intent to Bid* form for each product and course bid. A publisher that does not submit a *Statement of Intent to Bid* by the deadline given in the proclamation will not be eligible to participate in the adoption. Each print product, and each component of a print product, must have its own 13-digit ISBN. Each electronic product must have a unique identifying number.
- **Description of Submitted Materials:** Participants submitting instructional materials for adoption must provide each school district and open-enrollment charter school with information that fully describes each of the organization's submitted instructional materials.
- **Pre-Adoption Samples:** Participants submitting instructional materials for adoption must submit electronic samples of each product bid. Samples must be sent to the TEA, each of the 20 education service centers (ESCs), and any school district or open-enrollment charter school that submits a request.
- **Forms B, M and Warranty:** Participants submitting instructional materials for adoption must certify that all materials meet manufacturing standards. For print products, participants must submit a *Form B & Warranty* for each student component in a program. For electronic products, participants must submit a *Form M & Warranty* for each component of electronic media.
- **Pre-Adoption Samples for State Review Panels:** Participants submitting instructional materials for adoption must submit samples to the state review panels. The TEA will provide detailed instructions for submitting samples to the state review panels.
- **Affidavit of Authorship or Contribution:** Participants submitting instructional materials for adoption must certify that each individual whose name is listed as an author or contributor of instructional materials contributed to the development of the materials. Publishers must file one signed and notarized *Affidavit of Authorship or Contribution* form for each product and course bid.
- **Correlation to the TEKS:** Participants must indicate where in the product(s) they believe that the required TEKS are addressed. Publishers must file one form for each product and course bid. For print products, the correlations must be submitted on the form provided by the TEA. For electronic products, the correlations must be included within the product and link to the exact locations where each student expectation is addressed.
- **Certification of Editorial Review:** Participants submitting instructional materials for adoption must affirm that all instructional materials have been edited for accuracy, content, and compliance with the requirements of the proclamation. Publishers must file one *Certification of Editorial Review* form for each product and course bid.

- **List of Publisher Corrections:** Participants submitting instructional materials for adoption must provide a list of all corrections and editorial changes necessary to each student and teacher component of an instructional material submission. All factual errors must be corrected before adopted materials are implemented in schools.
- **Electronic Files for the Production of Braille and Large-Type Materials:** Participants submitting print instructional materials for adoption must provide NIMAS-compliant electronic files, and agree to allow the TEA or its agents to reproduce adopted instructional materials in a format suitable for students and teachers with visual impairments. Additionally, participants must provide the TEA with contact information for each production manager of instructional material.
- **Official Bid Form:** Participants submitting instructional materials for adoption must submit one *Official Bid* form for each product and course bid, giving the official bid price of the instructional materials
- **Publisher's Intent to Correct:** Participants submitting instructional materials for adoption must confirm their willingness to make all identified corrections to the materials submitted for adoption as required by the SBOE.
- **Register of Contact:** Participants submitting instructional materials for adoption must submit a register indicating all visits, meetings, or contact with SBOE members, including the date, time, location, and purpose of the communication.
- **Affidavit of Corrections:** Participants that have materials adopted by the SBOE must verify that all corrections required as a condition of adoption have been made. Participants must submit one *Affidavit of Corrections* for each product and course bid.
- **Post-Adoption Samples:** Participants that have materials adopted by the SBOE must submit corrected sample copies of adopted instructional materials to the TEA, ESCs, the Braille producer, the designated large-print producer, the producer of audio materials, and to each school district and open-enrollment charter school that requests one.
- **Contract:** Participants that have materials adopted by the SBOE will be asked to enter into a contract to provide the instructional materials to all districts and charter schools that order them for an initial contract period of eight years and that may include one contract extension for a period of not more than four years.

Student Enrollment by Grade Level/Course

Enrollment numbers for kindergarten through eighth grade represent reported student enrollment for those grade levels for the 2010–2011 school year. The enrollment numbers for elective courses in middle school and all high school courses represent the reported enrollment for those courses for the 2010–2011 school year. The enrollment information for Spanish comes from the reported enrollment of limited English proficient students in bilingual education programs in each grade.

Course	2010–2011 Enrollment
Elementary Grades	
Grade K	374,178
Grade 1	387,884
Grade 2	379,887
Grade 3	375,432
Grade 4	374,078
Grade 5	372,498
Grade 6	361,662
Grade 7	357,344
Grade 8	354,244
Elementary Grades (Spanish)	
Grade K	77,799
Grade 1	78,423
Grade 2	73,416
Grade 3	68,391
Grade 4	55,025
Grade 5	38,969
Science and CTE Courses for Science Credit	
Aquatic Science	26,689
Astronomy	14,919
Biology	407,915
Chemistry	341,270

Course	2010–2011 Enrollment
Science and CTE Courses for Science Credit (continued)	
Earth and Space Science	14,408
Environmental Systems	47,517
Integrated Physics and Chemistry	140,207
Physics	233,977
Principles of Technology	17,493
Scientific Research and Design	10,287
Anatomy and Physiology	60,719
Engineering Design and Problem Solving	1,407
Medical Microbiology	4,679
Pathophysiology	4,335
Advanced Animal Science	4,908
Advanced Biotechnology	578
Advanced Plant and Soil Science	975
Food Science	7,738
Forensic Science	12,309
Technology Applications*	
Fundamentals of Computer Science	475
Computer Science I	10,026
Computer Science II	729
Computer Science III	159
Digital Forensics	101
Discrete Mathematics	Enrollment Not Available
Game Programming and Design	975
Mobile Application Development	240
Robotics Programming and Design	285
Digital Design and Media Production	7,623

**Because 2011–2012 enrollment data for some Technology Applications courses is unavailable, enrollment data for all of the Technology Applications courses is from the 2012–2013 school year.*

Course	2010–2011 Enrollment
Technology Applications (continued)*	
Digital Art and Animation	6,977
3-D Modeling and Animation	159
Digital Communications in the 21st Century	958
Digital Video and Audio Design	2,901
Web Communications	451
Web Design	4,621
Web Game Development	95

**Because 2011–2012 enrollment data for some Technology Applications courses is unavailable, enrollment data for all of the Technology Applications courses is from the 2012–2013 school year.*

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Chapter 112. Texas Essential Knowledge and Skills for Science

Subchapter A. Elementary

§112.11. Science, Kindergarten, Beginning with School Year 2010-2011.

(a) Introduction.

(1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."

(2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.

(3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 80% of instructional time.

(4) In Kindergarten, students observe and describe the natural world using their five senses. Students do science as inquiry in order to develop and enrich their abilities to understand scientific concepts and processes. Students develop vocabulary through their experiences investigating properties of common objects, earth materials, and organisms.

(A) A central theme throughout the study of scientific investigation and reasoning; matter and energy; force, motion, and energy; Earth and space; and organisms and environment is active engagement in asking questions, communicating ideas, and exploring with scientific tools. Scientific investigation and reasoning involves practicing safe procedures, asking questions about the natural world, and seeking answers to those questions through simple observations and descriptive investigations.

(B) Matter is described in terms of its physical properties, including relative size and mass, shape, color, and texture. The importance of light, heat, and sound energy is identified as it relates to the students' everyday life. The location and motion of objects are explored.

(C) Weather is recorded and discussed on a daily basis so students may begin to recognize patterns in the weather. Other patterns are observed in the appearance of objects in the sky.

(D) In life science, students recognize the interdependence of organisms in the natural world. They understand that all organisms have basic needs that can be satisfied through interactions with living and nonliving things. Students will investigate the life cycle of plants and identify likenesses between parents and offspring.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and uses environmentally appropriate and responsible practices. The student is expected to:

(A) identify and demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately;

(B) discuss the importance of safe practices to keep self and others safe and healthy; and

(C) demonstrate how to use, conserve, and dispose of natural resources and materials such as conserving water and reusing or recycling paper, plastic, and metal.

(2) Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations. The student is expected to:

(A) ask questions about organisms, objects, and events observed in the natural world;

(B) plan and conduct simple descriptive investigations such as ways objects move;

(C) collect data and make observations using simple equipment such as hand lenses, primary balances, and non-standard measurement tools;

(D) record and organize data and observations using pictures, numbers, and words; and

(E) communicate observations with others about simple descriptive investigations.

(3) Scientific investigation and reasoning. The student knows that information and critical thinking are used in scientific problem solving. The student is expected to:

(A) identify and explain a problem such as the impact of littering on the playground and propose a solution in his/her own words;

(B) make predictions based on observable patterns in nature such as the shapes of leaves; and

(C) explore that scientists investigate different things in the natural world and use tools to help in their investigations.

(4) Scientific investigation and reasoning. The student uses age-appropriate tools and models to investigate the natural world. The student is expected to:

(A) collect information using tools, including computers, hand lenses, primary balances, cups, bowls, magnets, collecting nets, and notebooks; timing devices, including clocks and timers; non-standard measuring items such as paper clips and clothespins; weather instruments such as demonstration thermometers and wind socks; and materials to support observations of habitats of organisms such as terrariums and aquariums; and

(B) use senses as a tool of observation to identify properties and patterns of organisms, objects, and events in the environment.

(5) Matter and energy. The student knows that objects have properties and patterns. The student is expected to:

(A) observe and record properties of objects, including relative size and mass, such as bigger or smaller and heavier or lighter, shape, color, and texture; and

(B) observe, record, and discuss how materials can be changed by heating or cooling.

(6) Force, motion, and energy. The student knows that energy, force, and motion are related and are a part of their everyday life. The student is expected to:

(A) use the five senses to explore different forms of energy such as light, heat, and sound;

(B) explore interactions between magnets and various materials;

(C) observe and describe the location of an object in relation to another such as above, below, behind, in front of, and beside; and

(D) observe and describe the ways that objects can move such as in a straight line, zigzag, up and down, back and forth, round and round, and fast and slow.

(7) Earth and space. The student knows that the natural world includes earth materials. The student is expected to:

(A) observe, describe, compare, and sort rocks by size, shape, color, and texture;

(B) observe and describe physical properties of natural sources of water, including color and clarity; and

(C) give examples of ways rocks, soil, and water are useful.

(8) Earth and space. The student knows that there are recognizable patterns in the natural world and among objects in the sky. The student is expected to:

(A) observe and describe weather changes from day to day and over seasons;

(B) identify events that have repeating patterns, including seasons of the year and day and night; and

(C) observe, describe, and illustrate objects in the sky such as the clouds, Moon, and stars, including the Sun.

(9) Organisms and environments. The student knows that plants and animals have basic needs and depend on the living and nonliving things around them for survival. The student is expected to:

(A) differentiate between living and nonliving things based upon whether they have basic needs and produce offspring; and

(B) examine evidence that living organisms have basic needs such as food, water, and shelter for animals and air, water, nutrients, sunlight, and space for plants.

(10) Organisms and environments. The student knows that organisms resemble their parents and have structures and processes that help them survive within their environments. The student is expected to:

(A) sort plants and animals into groups based on physical characteristics such as color, size, body covering, or leaf shape;

(B) identify parts of plants such as roots, stem, and leaves and parts of animals such as head, eyes, and limbs;

(C) identify ways that young plants resemble the parent plant; and

(D) observe changes that are part of a simple life cycle of a plant: seed, seedling, plant, flower, and fruit.

§112.12. Science, Grade 1, Beginning with School Year 2010-2011.

(a) Introduction.

(1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."

(2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.

(3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 80% of instructional time.

(4) In Grade 1, students observe and describe the natural world using their five senses. Students do science as inquiry in order to develop and enrich their abilities to understand the world around them in the context of scientific concepts and processes. Students develop vocabulary through their experiences investigating properties of common objects, earth materials, and organisms.

(A) A central theme in first grade science is active engagement in asking questions, communicating ideas, and exploring with scientific tools in order to explain scientific concepts and processes like scientific investigation and reasoning; matter and energy; force, motion, and energy; Earth and space; and organisms and environment. Scientific investigation and reasoning involves practicing safe procedures, asking questions about the natural world, and seeking answers to those questions through simple observations and descriptive investigations.

(B) Matter is described in terms of its physical properties, including relative size and mass, shape, color, and texture. The importance of light, heat, and sound energy is identified as it relates to the students' everyday life. The location and motion of objects are explored.

(C) Weather is recorded and discussed on a daily basis so students may begin to recognize patterns in the weather. In addition, patterns are observed in the appearance of objects in the sky.

(D) In life science, students recognize the interdependence of organisms in the natural world. They understand that all organisms have basic needs that can be satisfied through interactions with living and nonliving things. Students will investigate life cycles of animals and identify likenesses between parents and offspring.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and uses environmentally appropriate and responsible practices. The student is expected to:

(A) recognize and demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately;

(B) recognize the importance of safe practices to keep self and others safe and healthy; and

(C) identify and learn how to use natural resources and materials, including conservation and reuse or recycling of paper, plastic, and metals.

(2) Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations. The student is expected to:

(A) ask questions about organisms, objects, and events observed in the natural world;

(B) plan and conduct simple descriptive investigations such as ways objects move;

(C) collect data and make observations using simple equipment such as hand lenses, primary balances, and non-standard measurement tools;

(D) record and organize data using pictures, numbers, and words; and

(E) communicate observations and provide reasons for explanations using student-generated data from simple descriptive investigations.

(3) Scientific investigation and reasoning. The student knows that information and critical thinking are used in scientific problem solving. The student is expected to:

(A) identify and explain a problem such as finding a home for a classroom pet and propose a solution in his/her own words;

(B) make predictions based on observable patterns; and

(C) describe what scientists do.

(4) Scientific investigation and reasoning. The student uses age-appropriate tools and models to investigate the natural world. The student is expected to:

(A) collect, record, and compare information using tools, including computers, hand lenses, primary balances, cups, bowls, magnets, collecting nets, notebooks, and safety goggles; timing devices, including clocks and timers; non-standard measuring items such as paper clips and clothespins; weather instruments such as classroom demonstration thermometers and wind socks; and materials to support observations of habitats of organisms such as aquariums and terrariums; and

(B) measure and compare organisms and objects using non-standard units.

(5) Matter and energy. The student knows that objects have properties and patterns. The student is expected to:

(A) classify objects by observable properties of the materials from which they are made such as larger and smaller, heavier and lighter, shape, color, and texture; and

(B) predict and identify changes in materials caused by heating and cooling such as ice melting, water freezing, and water evaporating.

(6) Force, motion, and energy. The student knows that force, motion, and energy are related and are a part of everyday life. The student is expected to:

(A) identify and discuss how different forms of energy such as light, heat, and sound are important to everyday life;

(B) predict and describe how a magnet can be used to push or pull an object;

(C) describe the change in the location of an object such as closer to, nearer to, and farther from; and

(D) demonstrate and record the ways that objects can move such as in a straight line, zig zag, up and down, back and forth, round and round, and fast and slow.

(7) Earth and space. The student knows that the natural world includes rocks, soil, and water that can be observed in cycles, patterns, and systems. The student is expected to:
   (A) observe, compare, describe, and sort components of soil by size, texture, and color;
   (B) identify and describe a variety of natural sources of water, including streams, lakes, and oceans; and
   (C) gather evidence of how rocks, soil, and water help to make useful products.

(8) Earth and space. The student knows that the natural world includes the air around us and objects in the sky. The student is expected to:
   (A) record weather information, including relative temperature, such as hot or cold, clear or cloudy, calm or windy, and rainy or icy;
   (B) observe and record changes in the appearance of objects in the sky such as clouds, the Moon, and stars, including the Sun;
   (C) identify characteristics of the seasons of the year and day and night; and
   (D) demonstrate that air is all around us and observe that wind is moving air.

(9) Organisms and environments. The student knows that the living environment is composed of relationships between organisms and the life cycles that occur. The student is expected to:
   (A) sort and classify living and nonliving things based upon whether or not they have basic needs and produce offspring;
   (B) analyze and record examples of interdependence found in various situations such as terrariums and aquariums or pet and caregiver; and
   (C) gather evidence of interdependence among living organisms such as energy transfer through food chains and animals using plants for shelter.

(10) Organisms and environments. The student knows that organisms resemble their parents and have structures and processes that help them survive within their environments. The student is expected to:
   (A) investigate how the external characteristics of an animal are related to where it lives, how it moves, and what it eats;
   (B) identify and compare the parts of plants;
   (C) compare ways that young animals resemble their parents; and
   (D) observe and record life cycles of animals such as a chicken, frog, or fish.

§112.13. Science, Grade 2, Beginning with School Year 2010-2011.

(a) Introduction.
   (1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."
   (2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.
   (3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information,

while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 60% of instructional time.

(4) In Grade 2, careful observation and investigation are used to learn about the natural world and reveal patterns, changes, and cycles. Students should understand that certain types of questions can be answered by using observation and investigations and that the information gathered in these may change as new observations are made. As students participate in investigation, they develop the skills necessary to do science as well as develop new science concepts.

(A) Within the physical environment, students expand their understanding of the properties of objects such as shape, mass, temperature, and flexibility then use those properties to compare, classify, and then combine the objects to do something that they could not do before. Students manipulate objects to demonstrate a change in motion and position.

(B) Within the natural environment, students will observe the properties of earth materials as well as predictable patterns that occur on Earth and in the sky. The students understand that those patterns are used to make choices in clothing, activities, and transportation.

(C) Within the living environment, students explore patterns, systems, and cycles by investigating characteristics of organisms, life cycles, and interactions among all the components within their habitat. Students examine how living organisms depend on each other and on their environment.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures. The student is expected to:

(A) identify and demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately;

(B) describe the importance of safe practices; and

(C) identify and demonstrate how to use, conserve, and dispose of natural resources and materials such as conserving water and reuse or recycling of paper, plastic, and metal.

(2) Scientific investigation and reasoning. The student develops abilities necessary to do scientific inquiry in classroom and outdoor investigations. The student is expected to:

(A) ask questions about organisms, objects, and events during observations and investigations;

(B) plan and conduct descriptive investigations such as how organisms grow;

(C) collect data from observations using simple equipment such as hand lenses, primary balances, thermometers, and non-standard measurement tools;

(D) record and organize data using pictures, numbers, and words;

(E) communicate observations and justify explanations using student-generated data from simple descriptive investigations; and

(F) compare results of investigations with what students and scientists know about the world.

(3) Scientific investigation and reasoning. The student knows that information and critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions. The student is expected to:

(A) identify and explain a problem in his/her own words and propose a task and solution for the problem such as lack of water in a habitat;

(B) make predictions based on observable patterns; and

(C) identify what a scientist is and explore what different scientists do.

(4) Scientific investigation and reasoning. The student uses age-appropriate tools and models to investigate the natural world. The student is expected to:

(A) collect, record, and compare information using tools, including computers, hand lenses, rulers, primary balances, plastic beakers, magnets, collecting nets, notebooks, and safety goggles; timing devices, including clocks and stopwatches; weather instruments such as thermometers, wind vanes, and rain gauges; and materials to support observations of habitats of organisms such as terrariums and aquariums; and

(B) measure and compare organisms and objects using non-standard units that approximate metric units.

(5) Matter and energy. The student knows that matter has physical properties and those properties determine how it is described, classified, changed, and used. The student is expected to:

(A) classify matter by physical properties, including shape, relative mass, relative temperature, texture, flexibility, and whether material is a solid or liquid;

(B) compare changes in materials caused by heating and cooling;

(C) demonstrate that things can be done to materials to change their physical properties such as cutting, folding, sanding, and melting; and

(D) combine materials that when put together can do things that they cannot do by themselves such as building a tower or a bridge and justify the selection of those materials based on their physical properties.

(6) Force, motion, and energy. The student knows that forces cause change and energy exists in many forms. The student is expected to:

(A) investigate the effects on an object by increasing or decreasing amounts of light, heat, and sound energy such as how the color of an object appears different in dimmer light or how heat melts butter;

(B) observe and identify how magnets are used in everyday life;

(C) trace the changes in the position of an object over time such as a cup rolling on the floor and a car rolling down a ramp; and

(D) compare patterns of movement of objects such as sliding, rolling, and spinning.

(7) Earth and space. The student knows that the natural world includes earth materials. The student is expected to:

(A) observe and describe rocks by size, texture, and color;

(B) identify and compare the properties of natural sources of freshwater and saltwater; and

(C) distinguish between natural and manmade resources.

(8) Earth and space. The student knows that there are recognizable patterns in the natural world and among objects in the sky. The student is expected to:

(A) measure, record, and graph weather information, including temperature, wind conditions, precipitation, and cloud coverage, in order to identify patterns in the data;

(B) identify the importance of weather and seasonal information to make choices in clothing, activities, and transportation;

(C) explore the processes in the water cycle, including evaporation, condensation, and precipitation, as connected to weather conditions; and

(D) observe, describe, and record patterns of objects in the sky, including the appearance of the Moon.

(9) Organisms and environments. The student knows that living organisms have basic needs that must be met for them to survive within their environment. The student is expected to:

(A) identify the basic needs of plants and animals;

(B) identify factors in the environment, including temperature and precipitation, that affect growth and behavior such as migration, hibernation, and dormancy of living things; and

(C) compare and give examples of the ways living organisms depend on each other and on their environments such as food chains within a garden, park, beach, lake, and wooded area.

(10) Organisms and environments. The student knows that organisms resemble their parents and have structures and processes that help them survive within their environments. The student is expected to:

(A) observe, record, and compare how the physical characteristics and behaviors of animals help them meet their basic needs such as fins help fish move and balance in the water;

(B) observe, record, and compare how the physical characteristics of plants help them meet their basic needs such as stems carry water throughout the plant; and

(C) investigate and record some of the unique stages that insects undergo during their life cycle.

§112.14. Science, Grade 3, Beginning with School Year 2010-2011.

(a) Introduction.

(1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."

(2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.

(3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific methods, analyzing information, making informed decisions, and using tools to collect and record information while addressing the content and vocabulary in physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 60% of instructional time.

(4) In Grade 3, students learn that the study of science uses appropriate tools and safe practices in planning and implementing investigations, asking and answering questions,

collecting data by observing and measuring, and by using models to support scientific inquiry about the natural world.

(A) Students recognize that patterns, relationships, and cycles exist in matter. Students will investigate the physical properties of matter and will learn that changes occur. They explore mixtures and investigate light, sound, and heat/thermal energy in everyday life. Students manipulate objects by pushing and pulling to demonstrate changes in motion and position.

(B) Students investigate how the surface of Earth changes and provides resources that humans use. As students explore objects in the sky, they describe how relationships affect patterns and cycles on Earth. Students will construct models to demonstrate Sun, Earth, and Moon system relationships and will describe the Sun's role in the water cycle.

(C) Students explore patterns, systems, and cycles within environments by investigating characteristics of organisms, life cycles, and interactions among all components of the natural environment. Students examine how the environment plays a key role in survival. Students know that when changes in the environment occur organisms may thrive, become ill, or perish.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following school and home safety procedures and environmentally appropriate practices. The student is expected to:

(A) demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including observing a schoolyard habitat; and

(B) make informed choices in the use and conservation of natural resources by recycling or reusing materials such as paper, aluminum cans, and plastics.

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and outdoor investigations. The student is expected to:

(A) plan and implement descriptive investigations, including asking and answering questions, making inferences, and selecting and using equipment or technology needed, to solve a specific problem in the natural world;

(B) collect data by observing and measuring using the metric system and recognize differences between observed and measured data;

(C) construct maps, graphic organizers, simple tables, charts, and bar graphs using tools and current technology to organize, examine, and evaluate measured data;

(D) analyze and interpret patterns in data to construct reasonable explanations based on evidence from investigations;

(E) demonstrate that repeated investigations may increase the reliability of results; and

(F) communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.

(3) Scientific investigation and reasoning. The student knows that information, critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) draw inferences and evaluate accuracy of product claims found in advertisements and labels such as for toys and food;

(C) represent the natural world using models such as volcanoes or Sun, Earth, and Moon system and identify their limitations, including size, properties, and materials; and

(D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.

(4) Scientific investigation and reasoning. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:

(A) collect, record, and analyze information using tools, including microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, wind vanes, rain gauges, pan balances, graduated cylinders, beakers, spring scales, hot plates, meter sticks, compasses, magnets, collecting nets, notebooks, sound recorders, and Sun, Earth, and Moon system models; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums; and

(B) use safety equipment as appropriate, including safety goggles and gloves.

(5) Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to:

(A) measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float;

(B) describe and classify samples of matter as solids, liquids, and gases and demonstrate that solids have a definite shape and that liquids and gases take the shape of their container;

(C) predict, observe, and record changes in the state of matter caused by heating or cooling; and

(D) explore and recognize that a mixture is created when two materials are combined such as gravel and sand and metal and plastic paper clips.

(6) Force, motion, and energy. The student knows that forces cause change and that energy exists in many forms. The student is expected to:

(A) explore different forms of energy, including mechanical, light, sound, and heat/thermal in everyday life;

(B) demonstrate and observe how position and motion can be changed by pushing and pulling objects to show work being done such as swings, balls, pulleys, and wagons; and

(C) observe forces such as magnetism and gravity acting on objects.

(7) Earth and space. The student knows that Earth consists of natural resources and its surface is constantly changing. The student is expected to:

(A) explore and record how soils are formed by weathering of rock and the decomposition of plant and animal remains;

(B) investigate rapid changes in Earth's surface such as volcanic eruptions, earthquakes, and landslides;

(C) identify and compare different landforms, including mountains, hills, valleys, and plains; and

(D) explore the characteristics of natural resources that make them useful in products and materials such as clothing and furniture and how resources may be conserved.

(8) Earth and space. The student knows there are recognizable patterns in the natural world and among objects in the sky. The student is expected to:

(A) observe, measure, record, and compare day-to-day weather changes in different locations at the same time that include air temperature, wind direction, and precipitation;

(B) describe and illustrate the Sun as a star composed of gases that provides light and heat energy for the water cycle;

(C) construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions; and

(D) identify the planets in Earth's solar system and their position in relation to the Sun.

(9) Organisms and environments. The student knows that organisms have characteristics that help them survive and can describe patterns, cycles, systems, and relationships within the environments. The student is expected to:

(A) observe and describe the physical characteristics of environments and how they support populations and communities within an ecosystem;

(B) identify and describe the flow of energy in a food chain and predict how changes in a food chain affect the ecosystem such as removal of frogs from a pond or bees from a field; and

(C) describe environmental changes such as floods and droughts where some organisms thrive and others perish or move to new locations.

(10) Organisms and environments. The student knows that organisms undergo similar life processes and have structures that help them survive within their environments. The student is expected to:

(A) explore how structures and functions of plants and animals allow them to survive in a particular environment;

(B) explore that some characteristics of organisms are inherited such as the number of limbs on an animal or flower color and recognize that some behaviors are learned in response to living in a certain environment such as animals using tools to get food; and

(C) investigate and compare how animals and plants undergo a series of orderly changes in their diverse life cycles such as tomato plants, frogs, and lady bugs.

§112.15. Science, Grade 4, Beginning with School Year 2010-2011.

(a) Introduction.

(1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."

(2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.

(3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 50% of instructional time.

(4) In Grade 4, investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations and that methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. They have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.

(A) Within the natural environment, students know that earth materials have properties that are constantly changing due to Earth's forces. The students learn that the natural world consists of resources, including renewable and nonrenewable, and their responsibility to conserve our natural resources for future generations. They will also explore Sun, Earth, and Moon relationships. The students will recognize that our major source of energy is the Sun.

(B) Within the living environment, students know and understand that living organisms within an ecosystem interact with one another and with their environment. The students will recognize that plants and animals have basic needs, and they are met through a flow of energy known as food webs. Students will explore how all living organisms go through a life cycle and that adaptations enable organisms to survive in their ecosystem.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations, following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations; and

(B) make informed choices in the use and conservation of natural resources and reusing and recycling of materials such as paper, aluminum, glass, cans, and plastic.

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and outdoor investigations. The student is expected to:

(A) plan and implement descriptive investigations, including asking well-defined questions, making inferences, and selecting and using appropriate equipment or technology to answer his/her questions;

(B) collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawings, writing, and concept maps;

(C) construct simple tables, charts, bar graphs, and maps using tools and current technology to organize, examine, and evaluate data;

(D) analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured;

(E) perform repeated investigations to increase the reliability of results; and

(F) communicate valid, oral, and written results supported by data.

(3) Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) draw inferences and evaluate accuracy of services and product claims found in advertisements and labels such as for toys, food, and sunscreen;

(C) represent the natural world using models such as rivers, stream tables, or fossils and identify their limitations, including accuracy and size; and

(D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.

(4) Scientific investigation and reasoning. The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry. The student is expected to:

(A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, mirrors, spring scales, pan balances, triple beam balances, graduated cylinders, beakers, hot plates, meter sticks, compasses, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums; and

(B) use safety equipment as appropriate, including safety goggles and gloves.

(5) Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to:

(A) measure, compare, and contrast physical properties of matter, including size, mass, volume, states (solid, liquid, gas), temperature, magnetism, and the ability to sink or float;

(B) predict the changes caused by heating and cooling such as ice becoming liquid water and condensation forming on the outside of a glass of ice water; and

(C) compare and contrast a variety of mixtures and solutions such as rocks in sand, sand in water, or sugar in water.

(6) Force, motion, and energy. The student knows that energy exists in many forms and can be observed in cycles, patterns, and systems. The student is expected to:

(A) differentiate among forms of energy, including mechanical, sound, electrical, light, and heat/thermal;

(B) differentiate between conductors and insulators;

(C) demonstrate that electricity travels in a closed path, creating an electrical circuit, and explore an electromagnetic field; and

(D) design an experiment to test the effect of force on an object such as a push or a pull, gravity, friction, or magnetism.

(7) Earth and space. The students know that Earth consists of useful resources and its surface is constantly changing. The student is expected to:

(A) examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants;

(B) observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice; and

(C) identify and classify Earth's renewable resources, including air, plants, water, and animals; and nonrenewable resources, including coal, oil, and natural gas; and the importance of conservation.

(8) Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon system. The student is expected to:

(A) measure and record changes in weather and make predictions using weather maps, weather symbols, and a map key;

(B) describe and illustrate the continuous movement of water above and on the surface of Earth through the water cycle and explain the role of the Sun as a major source of energy in this process; and

(C) collect and analyze data to identify sequences and predict patterns of change in shadows, tides, seasons, and the observable appearance of the Moon over time.

(9) Organisms and environments. The student knows and understands that living organisms within an ecosystem interact with one another and with their environment. The student is expected to:

(A) investigate that most producers need sunlight, water, and carbon dioxide to make their own food, while consumers are dependent on other organisms for food; and

(B) describe the flow of energy through food webs, beginning with the Sun, and predict how changes in the ecosystem affect the food web such as a fire in a forest.

(10) Organisms and environments. The student knows that organisms undergo similar life processes and have structures that help them survive within their environment. The student is expected to:

(A) explore how adaptations enable organisms to survive in their environment such as comparing birds' beaks and leaves on plants;

(B) demonstrate that some likenesses between parents and offspring are inherited, passed from generation to generation such as eye color in humans or shapes of leaves in plants. Other likenesses are learned such as table manners or reading a book and seals balancing balls on their noses; and

(C) explore, illustrate, and compare life cycles in living organisms such as butterflies, beetles, radishes, or lima beans.

§112.16. Science, Grade 5, Beginning with School Year 2010-2011.

(a) Introduction.

(1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."

(2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.

(3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 50% of instructional time.

(4) In Grade 5, investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations and that methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. They have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.

(A) Within the physical environment, students learn about the physical properties of matter, including magnetism, physical states of matter, relative density, solubility in water, and the ability to conduct or insulate electrical and heat energy. Students explore the uses of light, thermal, electrical, and sound energies.

(B) Within the natural environment, students learn how changes occur on Earth's surface and that predictable patterns occur in the sky. Students learn that the natural world consists of resources, including nonrenewable, renewable, and alternative energy sources.

(C) Within the living environment, students learn that structure and function of organisms can improve the survival of members of a species. Students learn to differentiate between inherited traits and learned behaviors. Students learn that life cycles occur in animals and plants and that the carbon dioxide-oxygen cycle occurs naturally to support the living environment.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations; and

(B) make informed choices in the conservation, disposal, and recycling of materials.

(2) Scientific investigation and reasoning. The student uses scientific methods during laboratory and outdoor investigations. The student is expected to:

(A) describe, plan, and implement simple experimental investigations testing one variable;

(B) ask well-defined questions, formulate testable hypotheses, and select and use appropriate equipment and technology;

(C) collect information by detailed observations and accurate measuring;

(D) analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence;

(E) demonstrate that repeated investigations may increase the reliability of results;

(F) communicate valid conclusions in both written and verbal forms; and

(G) construct appropriate simple graphs, tables, maps, and charts using technology, including computers, to organize, examine, and evaluate information.

(3) Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) evaluate the accuracy of the information related to promotional materials for products and services such as nutritional labels;

(C) draw or develop a model that represents how something works or looks that cannot be seen such as how a soda dispensing machine works; and

(D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.

(4) Scientific investigation and reasoning. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:

(A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, prisms, mirrors, pan balances, triple beam balances, spring scales, graduated cylinders, beakers, hot plates, meter sticks, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observations of habitats or organisms such as terrariums and aquariums; and

(B) use safety equipment, including safety goggles and gloves.

(5) Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to:

(A) classify matter based on physical properties, including mass, magnetism, physical state (solid, liquid, and gas), relative density (sinking and floating), solubility in water, and the ability to conduct or insulate thermal energy or electric energy;

(B) identify the boiling and freezing/melting points of water on the Celsius scale;

(C) demonstrate that some mixtures maintain physical properties of their ingredients such as iron filings and sand; and

(D) identify changes that can occur in the physical properties of the ingredients of solutions such as dissolving salt in water or adding lemon juice to water.

(6) Force, motion, and energy. The student knows that energy occurs in many forms and can be observed in cycles, patterns, and systems. The student is expected to:

(A) explore the uses of energy, including mechanical, light, thermal, electrical, and sound energy;

(B) demonstrate that the flow of electricity in circuits requires a complete path through which an electric current can pass and can produce light, heat, and sound;

(C) demonstrate that light travels in a straight line until it strikes an object or travels through one medium to another and demonstrate that light can be reflected such as the use of mirrors or other shiny surfaces and refracted such as the appearance of an object when observed through water; and

(D) design an experiment that tests the effect of force on an object.

(7) Earth and space. The student knows Earth's surface is constantly changing and consists of useful resources. The student is expected to:

(A) explore the processes that led to the formation of sedimentary rocks and fossil fuels;

(B) recognize how landforms such as deltas, canyons, and sand dunes are the result of changes to Earth's surface by wind, water, and ice;

(C) identify alternative energy resources such as wind, solar, hydroelectric, geothermal, and biofuels; and

(D) identify fossils as evidence of past living organisms and the nature of the environments at the time using models.

(8) Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon system. The student is expected to:

(A) differentiate between weather and climate;

(B) explain how the Sun and the ocean interact in the water cycle;

(C) demonstrate that Earth rotates on its axis once approximately every 24 hours causing the day/night cycle and the apparent movement of the Sun across the sky; and

(D) identify and compare the physical characteristics of the Sun, Earth, and Moon.

(9) Organisms and environments. The student knows that there are relationships, systems, and cycles within environments. The student is expected to:

(A) observe the way organisms live and survive in their ecosystem by interacting with the living and non-living elements;

(B) describe how the flow of energy derived from the Sun, used by producers to create their own food, is transferred through a food chain and food web to consumers and decomposers;

(C) predict the effects of changes in ecosystems caused by living organisms, including humans, such as the overpopulation of grazers or the building of highways; and

(D) identify the significance of the carbon dioxide-oxygen cycle to the survival of plants and animals.

(10) Organisms and environments. The student knows that organisms undergo similar life processes and have structures that help them survive within their environments. The student is expected to:

(A) compare the structures and functions of different species that help them live and survive such as hooves on prairie animals or webbed feet in aquatic animals;

(B) differentiate between inherited traits of plants and animals such as spines on a cactus or shape of a beak and learned behaviors such as an animal learning tricks or a child riding a bicycle; and

(C) describe the differences between complete and incomplete metamorphosis of insects.

Subchapter B. Middle School

§112.18. Science, Grade 6, Beginning with School Year 2010-2011.

(a) Introduction.

(1) Science, as defined by the National Academy of Science, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(2) Scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions become theories. Scientific theories are based on natural and physical phenomena and are capable of being tested by multiple, independent researchers. Students should know that scientific theories, unlike hypotheses, are well-established and highly reliable, but they may still be subject to change as new information and technologies are developed. Students should be able to distinguish between scientific decision-making methods and ethical/social decisions that involve the application of scientific information.

(3) Grade 6 science is interdisciplinary in nature; however, much of the content focus is on physical science. National standards in science are organized as multi-grade blocks such as Grades 5-8 rather than individual grade levels. In order to follow the grade level format used in Texas, the various national standards are found among Grades 6, 7, and 8. Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include change and constancy, patterns, cycles, systems, models, and scale.

(4) The strands for Grade 6 include:

(A) Scientific investigations and reasoning.

(i) To develop a rich knowledge of science and the natural world, students must become familiar with different modes of scientific inquiry, rules of evidence, ways of formulating questions, ways of proposing explanations, and the diverse ways scientists study the natural world and propose explanations based on evidence derived from their work.

(ii) Scientific investigations are conducted for different reasons. All investigations require a research question, careful observations, data gathering, and analysis of the data to identify the patterns that will explain the findings. Descriptive investigations are used to explore new phenomena such as conducting surveys of organisms or measuring the abiotic components in a given habitat. Descriptive statistics include frequency, range, mean, median, and mode. A hypothesis is not required in a descriptive investigation. On the other hand, when conditions can be controlled in order to focus on a single variable, experimental research design is used to determine causation. Students should experience both types of investigations and understand that different scientific research questions require different research designs.

(iii) Scientific investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by

investigations, and the methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. Models have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.

(B) Matter and energy.

(i) Matter can be classified as elements, compounds, or mixtures. Students have already had experience with mixtures in Grade 5, so Grade 6 will concentrate on developing an understanding of elements and compounds. It is important that students learn the differences between elements and compounds based on observations, description of physical properties, and chemical reactions. Elements are represented by chemical symbols, while compounds are represented by chemical formulas. Subsequent grades will learn about the differences at the molecular and atomic level.

(ii) Elements are classified as metals, nonmetals, and metalloids based on their physical properties. The elements are divided into three groups on the Periodic Table. Each different substance usually has a different density, so density can be used as an identifying property. Therefore, calculating density aids classification of substances.

(iii) Energy resources are available on a renewable, nonrenewable, or indefinite basis. Understanding the origins and uses of these resources enables informed decision making. Students should consider the ethical/social issues surrounding Earth's natural energy resources, while looking at the advantages and disadvantages of their long-term uses.

(C) Force, motion, and energy. Energy occurs in two types, potential and kinetic, and can take several forms. Thermal energy can be transferred by conduction, convection, or radiation. It can also be changed from one form to another. Students will investigate the relationship between force and motion using a variety of means, including calculations and measurements.

(D) Earth and space. The focus of this strand is on introducing Earth's processes. Students should develop an understanding of Earth as part of our solar system. The topics include organization of our solar system, the role of gravity, and space exploration.

(E) Organisms and environments. Students will gain an understanding of the broadest taxonomic classifications of organisms and how characteristics determine their classification. The other major topics developed in this strand include the interdependence between organisms and their environments and the levels of organization within an ecosystem.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student, for at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards; and

(B) practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

(A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;

(B) design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;

(C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;

(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and

(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) use models to represent aspects of the natural world such as a model of Earth's layers;

(C) identify advantages and limitations of models such as size, scale, properties, and materials; and

(D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.

(4) Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

(A) use appropriate tools to collect, record, and analyze information, including journals/notebooks, beakers, Petri dishes, meter sticks, graduated cylinders, hot plates, test tubes, triple beam balances, microscopes, thermometers, calculators, computers, timing devices, and other equipment as needed to teach the curriculum; and

(B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.

(5) Matter and energy. The student knows the differences between elements and compounds. The student is expected to:

(A) know that an element is a pure substance represented by chemical symbols;

(B) recognize that a limited number of the many known elements comprise the largest portion of solid Earth, living matter, oceans, and the atmosphere;

(C) differentiate between elements and compounds on the most basic level; and

(D) identify the formation of a new substance by using the evidence of a possible chemical change such as production of a gas, change in temperature, production of a precipitate, or color change.

(6) Matter and energy. The student knows matter has physical properties that can be used for classification. The student is expected to:

(A) compare metals, nonmetals, and metalloids using physical properties such as luster, conductivity, or malleability;

(B) calculate density to identify an unknown substance; and

(C) test the physical properties of minerals, including hardness, color, luster, and streak.

(7) Matter and energy. The student knows that some of Earth's energy resources are available on a nearly perpetual basis, while others can be renewed over a relatively short period of time. Some energy resources, once depleted, are essentially nonrenewable. The student is expected to:

(A) research and debate the advantages and disadvantages of using coal, oil, natural gas, nuclear power, biomass, wind, hydropower, geothermal, and solar resources; and

(B) design a logical plan to manage energy resources in the home, school, or community.

(8) Force, motion, and energy. The student knows force and motion are related to potential and kinetic energy. The student is expected to:

(A) compare and contrast potential and kinetic energy;

(B) identify and describe the changes in position, direction, and speed of an object when acted upon by unbalanced forces;

(C) calculate average speed using distance and time measurements;

(D) measure and graph changes in motion; and

(E) investigate how inclined planes and pulleys can be used to change the amount of force to move an object.

(9) Force, motion, and energy. The student knows that the Law of Conservation of Energy states that energy can neither be created nor destroyed, it just changes form. The student is expected to:

(A) investigate methods of thermal energy transfer, including conduction, convection, and radiation;

(B) verify through investigations that thermal energy moves in a predictable pattern from warmer to cooler until all the substances attain the same temperature such as an ice cube melting; and

(C) demonstrate energy transformations such as energy in a flashlight battery changes from chemical energy to electrical energy to light energy.

(10) Earth and space. The student understands the structure of Earth, the rock cycle, and plate tectonics. The student is expected to:

(A) build a model to illustrate the structural layers of Earth, including the inner core, outer core, mantle, crust, asthenosphere, and lithosphere;

(B) classify rocks as metamorphic, igneous, or sedimentary by the processes of their formation;

(C) identify the major tectonic plates, including Eurasian, African, Indo-Australian, Pacific, North American, and South American; and

(D) describe how plate tectonics causes major geological events such as ocean basins, earthquakes, volcanic eruptions, and mountain building.

(11) Earth and space. The student understands the organization of our solar system and the relationships among the various bodies that comprise it. The student is expected to:

(A) describe the physical properties, locations, and movements of the Sun, planets, Galilean moons, meteors, asteroids, and comets;

(B) understand that gravity is the force that governs the motion of our solar system; and

(C) describe the history and future of space exploration, including the types of equipment and transportation needed for space travel.

(12) Organisms and environments. The student knows all organisms are classified into Domains and Kingdoms. Organisms within these taxonomic groups share similar characteristics which allow them to interact with the living and nonliving parts of their ecosystem. The student is expected to:

(A) understand that all organisms are composed of one or more cells;

(B) recognize that the presence of a nucleus determines whether a cell is prokaryotic or eukaryotic;

(C) recognize that the broadest taxonomic classification of living organisms is divided into currently recognized Domains;

(D) identify the basic characteristics of organisms, including prokaryotic or eukaryotic, unicellular or multicellular, autotrophic or heterotrophic, and mode of reproduction, that further classify them in the currently recognized Kingdoms;

(E) describe biotic and abiotic parts of an ecosystem in which organisms interact; and

(F) diagram the levels of organization within an ecosystem, including organism, population, community, and ecosystem.

§112.19. Science, Grade 7, Beginning with School Year 2010-2011.

(a) Introduction.

(1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(2) Scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions become theories. Scientific theories are based on natural and physical phenomena and are capable of being tested by multiple, independent researchers. Students should know that scientific theories, unlike hypotheses, are well-established and highly reliable, but they may still be subject to change as new information and technologies are developed. Students should be able to distinguish between scientific decision-making methods and ethical/social decisions that involve the application of scientific information.

(3) Grade 7 science is interdisciplinary in nature; however, much of the content focus is on organisms and the environment. National standards in science are organized as a multi-grade blocks such as Grades 5-8 rather than individual grade levels. In order to follow the grade level format used in Texas, the various national standards are found among Grades 6, 7, and 8. Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include change and constancy, patterns, cycles, systems, models, and scale.

(4) The strands for Grade 7 include:

(A) Scientific investigation and reasoning.

(i) To develop a rich knowledge of science and the natural world, students must become familiar with different modes of scientific inquiry, rules of evidence, ways of formulating questions, ways of proposing explanations, and the diverse ways scientists study the natural world and propose explanations based on evidence derived from their work.

(ii) Scientific investigations are conducted for different reasons. All investigations require a research question, careful observations, data gathering, and analysis of the data to identify the patterns that will explain the findings. Descriptive investigations are used to explore new phenomena such as conducting surveys of organisms or measuring the abiotic components in a given habitat. Descriptive statistics include frequency, range, mean, median, and mode. A hypothesis is not required in a descriptive investigation. On the other hand, when conditions can be controlled in order to focus on a single variable, experimental research design is used to determine causation. Students should experience both types of investigations and understand that different scientific research questions require different research designs.

(iii) Scientific investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations, and the methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. Models have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.

(B) Matter and energy. Matter and energy are conserved throughout living systems. Radiant energy from the Sun drives much of the flow of energy throughout living systems due to the process of photosynthesis in organisms described as producers. Most consumers then depend on producers to meet their energy needs. Decomposers play an important role in recycling matter. Organic compounds are composed of carbon and other elements that are recycled due to chemical changes that rearrange the elements for the particular needs of that living system. Large molecules such as carbohydrates are composed of chains of smaller units such as sugars, similar to a train being composed of multiple box cars. Subsequent grade levels will learn about the differences at the molecular and atomic level.

(C) Force, motion, and energy. Force, motion, and energy are observed in living systems and the environment in several ways. Interactions between muscular and skeletal systems allow the body to apply forces and transform energy both internally and externally. Force and motion can also describe the direction and growth of seedlings, turgor pressure, and geotropism. Catastrophic events of weather systems such as

hurricanes, floods, and tornadoes can shape and restructure the environment through the force and motion evident in them. Weathering, erosion, and deposition occur in environments due to the forces of gravity, wind, ice, and water.

(D) Earth and space. Earth and space phenomena can be observed in a variety of settings. Both natural events and human activities can impact Earth systems. There are characteristics of Earth and relationships to objects in our solar system that allow life to exist.

(E) Organisms and environments.

(i) Students will understand the relationship between living organisms and their environment. Different environments support different living organisms that are adapted to that region of Earth. Organisms are living systems that maintain a steady state with that environment and whose balance may be disrupted by internal and external stimuli. External stimuli include human activity or the environment. Successful organisms can reestablish a balance through different processes such as a feedback mechanism. Ecological succession can be seen on a broad or small scale.

(ii) Students learn that all organisms obtain energy, get rid of wastes, grow, and reproduce. During both sexual and asexual reproduction, traits are passed onto the next generation. These traits are contained in genetic material that is found on genes within a chromosome from the parent. Changes in traits sometimes occur in a population over many generations. One of the ways a change can occur is through the process of natural selection. Students extend their understanding of structures in living systems from a previous focus on external structures to an understanding of internal structures and functions within living things.

(iii) All living organisms are made up of smaller units called cells. All cells use energy, get rid of wastes, and contain genetic material. Students will compare plant and animal cells and understand the internal structures within them that allow them to obtain energy, get rid of wastes, grow, and reproduce in different ways. Cells can organize into tissues, tissues into organs, and organs into organ systems. Students will learn the major functions of human body systems such as the ability of the integumentary system to protect against infection, injury, and ultraviolet (UV) radiation; regulate body temperature; and remove waste.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student, for at least 40% of the instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards; and

(B) practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

(A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;

(B) design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;

(C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;

(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and

(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) use models to represent aspects of the natural world such as human body systems and plant and animal cells;

(C) identify advantages and limitations of models such as size, scale, properties, and materials; and

(D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.

(4) Science investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

(A) use appropriate tools to collect, record, and analyze information, including life science models, hand lens, stereoscopes, microscopes, beakers, Petri dishes, microscope slides, graduated cylinders, test tubes, meter sticks, metric rulers, metric tape measures, timing devices, hot plates, balances, thermometers, calculators, water test kits, computers, temperature and pH probes, collecting nets, insect traps, globes, digital cameras, journals/notebooks, and other equipment as needed to teach the curriculum; and

(B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.

(5) Matter and energy. The student knows that interactions occur between matter and energy. The student is expected to:

(A) recognize that radiant energy from the Sun is transformed into chemical energy through the process of photosynthesis;

(B) demonstrate and explain the cycling of matter within living systems such as in the decay of biomass in a compost bin; and

(C) diagram the flow of energy through living systems, including food chains, food webs, and energy pyramids.

(6) Matter and energy. The student knows that matter has physical and chemical properties and can undergo physical and chemical changes. The student is expected to:

(A) identify that organic compounds contain carbon and other elements such as hydrogen, oxygen, phosphorus, nitrogen, or sulfur;

(B) distinguish between physical and chemical changes in matter in the digestive system; and

(C) recognize how large molecules are broken down into smaller molecules such as carbohydrates can be broken down into sugars.

(7) Force, motion, and energy. The student knows that there is a relationship among force, motion, and energy. The student is expected to:

(A) contrast situations where work is done with different amounts of force to situations where no work is done such as moving a box with a ramp and without a ramp, or standing still;

(B) illustrate the transformation of energy within an organism such as the transfer from chemical energy to heat and thermal energy in digestion; and

(C) demonstrate and illustrate forces that affect motion in everyday life such as emergence of seedlings, turgor pressure, and geotropism.

(8) Earth and space. The student knows that natural events and human activity can impact Earth systems. The student is expected to:

(A) predict and describe how different types of catastrophic events impact ecosystems such as floods, hurricanes, or tornadoes;

(B) analyze the effects of weathering, erosion, and deposition on the environment in ecoregions of Texas; and

(C) model the effects of human activity on groundwater and surface water in a watershed.

(9) Earth and space. The student knows components of our solar system. The student is expected to:

(A) analyze the characteristics of objects in our solar system that allow life to exist such as the proximity of the Sun, presence of water, and composition of the atmosphere; and

(B) identify the accommodations, considering the characteristics of our solar system, that enabled manned space exploration.

(10) Organisms and environments. The student knows that there is a relationship between organisms and the environment. The student is expected to:

(A) observe and describe how different environments, including microhabitats in schoolyards and biomes, support different varieties of organisms;

(B) describe how biodiversity contributes to the sustainability of an ecosystem; and

(C) observe, record, and describe the role of ecological succession such as in a microhabitat of a garden with weeds.

(11) Organisms and environments. The student knows that populations and species demonstrate variation and inherit many of their unique traits through gradual processes over many generations. The student is expected to:

(A) examine organisms or their structures such as insects or leaves and use dichotomous keys for identification;

(B) explain variation within a population or species by comparing external features, behaviors, or physiology of organisms that enhance their survival such as migration, hibernation, or storage of food in a bulb; and

(C) identify some changes in genetic traits that have occurred over several generations through natural selection and selective breeding such as the Galapagos Medium Ground Finch (*Geospiza fortis*) or domestic animals.

(12) Organisms and environments. The student knows that living systems at all levels of organization demonstrate the complementary nature of structure and function. The student is expected to:

(A) investigate and explain how internal structures of organisms have adaptations that allow specific functions such as gills in fish, hollow bones in birds, or xylem in plants;

(B) identify the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine systems;

(C) recognize levels of organization in plants and animals, including cells, tissues, organs, organ systems, and organisms;

(D) differentiate between structure and function in plant and animal cell organelles, including cell membrane, cell wall, nucleus, cytoplasm, mitochondrion, chloroplast, and vacuole;

(E) compare the functions of a cell to the functions of organisms such as waste removal; and

(F) recognize that according to cell theory all organisms are composed of cells and cells carry on similar functions such as extracting energy from food to sustain life.

(13) Organisms and environments. The student knows that a living organism must be able to maintain balance in stable internal conditions in response to external and internal stimuli. The student is expected to:

(A) investigate how organisms respond to external stimuli found in the environment such as phototropism and fight or flight; and

(B) describe and relate responses in organisms that may result from internal stimuli such as wilting in plants and fever or vomiting in animals that allow them to maintain balance.

(14) Organisms and environments. The student knows that reproduction is a characteristic of living organisms and that the instructions for traits are governed in the genetic material. The student is expected to:

(A) define heredity as the passage of genetic instructions from one generation to the next generation;

(B) compare the results of uniform or diverse offspring from sexual reproduction or asexual reproduction; and

(C) recognize that inherited traits of individuals are governed in the genetic material found in the genes within chromosomes in the nucleus.

§112.20. Science, Grade 8, Beginning with School Year 2010-2011.

(a) Introduction.

(1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(2) Scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions become theories. Scientific theories are based on natural and physical phenomena and are capable of being tested by multiple, independent researchers. Students should know that scientific theories, unlike hypotheses, are well-established and highly reliable, but they may still be subject to change as new information and technologies are developed. Students should be able to distinguish between scientific decision-making methods and ethical/social decisions that involve the application of scientific information.

(3) Grade 8 science is interdisciplinary in nature; however, much of the content focus is on earth and space science. National standards in science are organized as multi-grade blocks such as Grades 5-8 rather than individual grade levels. In order to follow the grade level format used in Texas, the various national standards are found among Grades 6, 7, and 8. Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include change and constancy, patterns, cycles, systems, models, and scale.

(4) The strands for Grade 8 include:

(A) Scientific investigation and reasoning.

(i) To develop a rich knowledge of science and the natural world, students must become familiar with different modes of scientific inquiry, rules of evidence, ways of formulating questions, ways of proposing explanations, and the diverse ways scientists study the natural world and propose explanations based on evidence derived from their work.

(ii) Scientific investigations are conducted for different reasons. All investigations require a research question, careful observations, data gathering, and analysis of the data to identify the patterns that will explain the findings. Descriptive investigations are used to explore new phenomena such as conducting surveys of organisms or measuring the abiotic components in a given habitat. Descriptive statistics include frequency, range, mean, median, and mode. A hypothesis is not required in a descriptive investigation. On the other hand, when conditions can be controlled in order to focus on a single variable, experimental research design is used to determine causation. Students should experience both types of investigations and understand that different scientific research questions require different research designs.

(iii) Scientific investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations, and the methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems

work. Models have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.

(B) Matter and energy. Students recognize that matter is composed of atoms. Students examine information on the Periodic Table to recognize that elements are grouped into families. In addition, students understand the basic concept of conservation of mass. Lab activities will allow students to demonstrate evidence of chemical reactions. They will use chemical formulas and balanced equations to show chemical reactions and the formation of new substances.

(C) Force, motion, and energy. Students experiment with the relationship between forces and motion through the study of Newton's three laws. Students learn how these forces relate to geologic processes and astronomical phenomena. In addition, students recognize that these laws are evident in everyday objects and activities. Mathematics is used to calculate speed using distance and time measurements.

(D) Earth and space. Students identify the role of natural events in altering Earth systems. Cycles within Sun, Earth, and Moon systems are studied as students learn about seasons, tides, and lunar phases. Students learn that stars and galaxies are part of the universe and that distances in space are measured by using light waves. In addition, students use data to research scientific theories of the origin of the universe. Students will illustrate how Earth features change over time by plate tectonics. They will interpret land and erosional features on topographic maps. Students learn how interactions in solar, weather, and ocean systems create changes in weather patterns and climate.

(E) Organisms and environments. In studies of living systems, students explore the interdependence between these systems. Interactions between organisms in ecosystems, including producer/consumer, predator/prey, and parasite/host relationships, are investigated in aquatic and terrestrial systems. Students describe how biotic and abiotic factors affect the number of organisms and populations present in an ecosystem. In addition, students explore how organisms and their populations respond to short- and long-term environmental changes, including those caused by human activities.

(b) Knowledge and skills.

(1) Scientific investigation and reasoning. The student, for at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards; and

(B) practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

(A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;

(B) design and implement comparative and experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;

(C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;

(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and

(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) use models to represent aspects of the natural world such as an atom, a molecule, space, or a geologic feature;

(C) identify advantages and limitations of models such as size, scale, properties, and materials; and

(D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.

(4) Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

(A) use appropriate tools to collect, record, and analyze information, including lab journals/notebooks, beakers, meter sticks, graduated cylinders, anemometers, psychrometers, hot plates, test tubes, spring scales, balances, microscopes, thermometers, calculators, computers, spectroscopes, timing devices, and other equipment as needed to teach the curriculum; and

(B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.

(5) Matter and energy. The student knows that matter is composed of atoms and has chemical and physical properties. The student is expected to:

(A) describe the structure of atoms, including the masses, electrical charges, and locations, of protons and neutrons in the nucleus and electrons in the electron cloud;

(B) identify that protons determine an element's identity and valence electrons determine its chemical properties, including reactivity;

(C) interpret the arrangement of the Periodic Table, including groups and periods, to explain how properties are used to classify elements;

(D) recognize that chemical formulas are used to identify substances and determine the number of atoms of each element in chemical formulas containing subscripts;

(E) investigate how evidence of chemical reactions indicate that new substances with different properties are formed; and

(F) recognize whether a chemical equation containing coefficients is balanced or not and how that relates to the law of conservation of mass.

(6) Force, motion, and energy. The student knows that there is a relationship between force, motion, and energy. The student is expected to:

(A) demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion;

(B) differentiate between speed, velocity, and acceleration; and

(C) investigate and describe applications of Newton's law of inertia, law of force and acceleration, and law of action-reaction such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.

(7) Earth and space. The student knows the effects resulting from cyclical movements of the Sun, Earth, and Moon. The student is expected to:

(A) model and illustrate how the tilted Earth rotates on its axis, causing day and night, and revolves around the Sun causing changes in seasons;

(B) demonstrate and predict the sequence of events in the lunar cycle; and

(C) relate the position of the Moon and Sun to their effect on ocean tides.

(8) Earth and space. The student knows characteristics of the universe. The student is expected to:

(A) describe components of the universe, including stars, nebulae, and galaxies, and use models such as the Herztsprung-Russell diagram for classification;

(B) recognize that the Sun is a medium-sized star near the edge of a disc-shaped galaxy of stars and that the Sun is many thousands of times closer to Earth than any other star;

(C) explore how different wavelengths of the electromagnetic spectrum such as light and radio waves are used to gain information about distances and properties of components in the universe;

(D) model and describe how light years are used to measure distances and sizes in the universe; and

(E) research how scientific data are used as evidence to develop scientific theories to describe the origin of the universe.

(9) Earth and space. The student knows that natural events can impact Earth systems. The student is expected to:

(A) describe the historical development of evidence that supports plate tectonic theory;

(B) relate plate tectonics to the formation of crustal features; and

(C) interpret topographic maps and satellite views to identify land and erosional features and predict how these features may be reshaped by weathering.

(10) Earth and space. The student knows that climatic interactions exist among Earth, ocean, and weather systems. The student is expected to:

(A) recognize that the Sun provides the energy that drives convection within the atmosphere and oceans, producing winds and ocean currents;

(B) identify how global patterns of atmospheric movement influence local weather using weather maps that show high and low pressures and fronts; and

(C) identify the role of the oceans in the formation of weather systems such as hurricanes.

(11) Organisms and environments. The student knows that interdependence occurs among living systems and the environment and that human activities can affect these systems. The student is expected to:

(A) describe producer/consumer, predator/prey, and parasite/host relationships as they occur in food webs within marine, freshwater, and terrestrial ecosystems;

(B) investigate how organisms and populations in an ecosystem depend on and may compete for biotic and abiotic factors such as quantity of light, water, range of temperatures, or soil composition;

(C) explore how short- and long-term environmental changes affect organisms and traits in subsequent populations; and

(D) recognize human dependence on ocean systems and explain how human activities such as runoff, artificial reefs, or use of resources have modified these systems.

Subchapter C. High School

§112.32. Aquatic Science, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Required prerequisite: one unit of high school Biology. Suggested prerequisite: Chemistry or concurrent enrollment in Chemistry. This course is recommended for students in Grades 10, 11, or 12.

(b) Introduction.

(1) Aquatic Science. In Aquatic Science, students study the interactions of biotic and abiotic components in aquatic environments, including impacts on aquatic systems. Investigations and field work in this course may emphasize fresh water or marine aspects of aquatic science depending primarily upon the natural resources available for study near the school. Students who successfully complete Aquatic Science will acquire knowledge about a variety of aquatic systems, conduct investigations and observations of aquatic environments, work collaboratively with peers, and develop critical-thinking and problem-solving skills.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting, handling, and maintaining appropriate equipment and technology;

(F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;

(G) demonstrate the use of course apparatuses, equipment, techniques, and procedures;

(H) organize, analyze, evaluate, build models, make inferences, and predict trends from data;

(I) perform calculations using dimensional analysis, significant digits, and scientific notation; and

(J) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research and technology on scientific thought, society, and the environment;

(E) describe the connection between aquatic science and future careers; and

(F) research and describe the history of aquatic science and contributions of scientists.

(4) Science concepts. Students know that aquatic environments are the product of Earth systems interactions. The student is expected to:

(A) identify key features and characteristics of atmospheric, geological, hydrological, and biological systems as they relate to aquatic environments;

(B) apply systems thinking to the examination of aquatic environments, including positive and negative feedback cycles; and

(C) collect and evaluate global environmental data using technology such as maps, visualizations, satellite data, Global Positioning System (GPS), Geographic Information System (GIS), weather balloons, buoys, etc.

(5) Science concepts. The student conducts long-term studies on local aquatic environments. Local natural environments are to be preferred over artificial or virtual environments. The student is expected to:

(A) evaluate data over a period of time from an established aquatic environment documenting seasonal changes and the behavior of organisms;

(B) collect baseline quantitative data, including pH, salinity, temperature, mineral content, nitrogen compounds, and turbidity from an aquatic environment;

(C) analyze interrelationships among producers, consumers, and decomposers in a local aquatic ecosystem; and

(D) identify the interdependence of organisms in an aquatic environment such as in a pond, river, lake, ocean, or aquifer and the biosphere.

(6) Science concepts. The student knows the role of cycles in an aquatic environment. The student is expected to:

(A) identify the role of carbon, nitrogen, water, and nutrient cycles in an aquatic environment, including upwellings and turnovers; and

(B) examine the interrelationships between aquatic systems and climate and weather, including El Niño and La Niña, currents, and hurricanes.

(7) Science concepts. The student knows the origin and use of water in a watershed. The student is expected to:

(A) identify sources and determine the amounts of water in a watershed, including rainfall, groundwater, and surface water;

(B) identify factors that contribute to how water flows through a watershed; and

(C) identify water quantity and quality in a local watershed.

(8) Science concepts. The student knows that geological phenomena and fluid dynamics affect aquatic systems. The student is expected to:

(A) demonstrate basic principles of fluid dynamics, including hydrostatic pressure, density, salinity, and buoyancy;

(B) identify interrelationships between ocean currents, climates, and geologic features; and

(C) describe and explain fluid dynamics in an upwelling and lake turnover.

(9) Science concepts. The student knows the types and components of aquatic ecosystems. The student is expected to:

(A) differentiate among freshwater, brackish, and saltwater ecosystems;

(B) identify the major properties and components of different marine and freshwater life zones; and

(C) identify biological, chemical, geological, and physical components of an aquatic life zone as they relate to the organisms in it.

(10) Science concepts. The student knows environmental adaptations of aquatic organisms. The student is expected to:

(A) classify different aquatic organisms using tools such as dichotomous keys;

(B) compare and describe how adaptations allow an organism to exist within an aquatic environment; and

(C) compare differences in adaptations of aquatic organisms to fresh water and marine environments.

(11) Science concepts. The student knows about the interdependence and interactions that occur in aquatic environments. The student is expected to:

(A) identify how energy flows and matter cycles through both fresh water and salt water aquatic systems, including food webs, chains, and pyramids; and

(B) evaluate the factors affecting aquatic population cycles.

(12) Science concepts. The student understands how human activities impact aquatic environments. The student is expected to:

(A) predict effects of chemical, organic, physical, and thermal changes from humans on the living and nonliving components of an aquatic ecosystem;

(B) analyze the cumulative impact of human population growth on an aquatic system;

(C) investigate the role of humans in unbalanced systems such as invasive species, fish farming, cultural eutrophication, or red tides;

(D) analyze and discuss how human activities such as fishing, transportation, dams, and recreation influence aquatic environments; and

(E) understand the impact of various laws and policies such as The Endangered Species Act, right of capture laws, or Clean Water Act on aquatic systems.

§112.33. Astronomy, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Suggested prerequisite: one unit of high school science. This course is recommended for students in Grade 11 or 12.

(b) Introduction.

(1) Astronomy. In Astronomy, students conduct laboratory and field investigations, use scientific methods, and make informed decisions using critical thinking and scientific problem solving. Students study the following topics: astronomy in civilization, patterns and objects in the sky, our place in space, the moon, reasons for the seasons, planets, the sun, stars, galaxies, cosmology, and space exploration. Students who successfully complete Astronomy will acquire knowledge within a conceptual framework, conduct observations of the sky, work collaboratively, and develop critical-thinking skills.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement investigative procedures, including making observations, asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect data and make measurements with accuracy and precision;

(G) organize, analyze, evaluate, make inferences, and predict trends from data, including making new revised hypotheses when appropriate;

(H) communicate valid conclusions in writing, oral presentations, and through collaborative projects; and

(I) use astronomical technology such as telescopes, binoculars, sextants, computers, and software.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research on scientific thought, society, and the environment; and

(E) describe the connection between astronomy and future careers.

(4) Science concepts. The student recognizes the importance and uses of astronomy in civilization. The student is expected to:

(A) research and describe the use of astronomy in ancient civilizations such as the Egyptians, Mayans, Aztecs, Europeans, and the native Americans;

(B) research and describe the contributions of scientists to our changing understanding of astronomy, including Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo, Newton, Einstein, and Hubble, and the contribution of women astronomers, including Maria Mitchell and Henrietta Swan Leavitt;

(C) describe and explain the historical origins of the perceived patterns of constellations and the role of constellations in ancient and modern navigation; and

(D) explain the contributions of modern astronomy to today's society, including the identification of potential asteroid/comet impact hazards and the Sun's effects on communication, navigation, and high-tech devices.

(5) Science concepts. The student develops a familiarity with the sky. The student is expected to:

(A) observe and record the apparent movement of the Sun and Moon during the day;

(B) observe and record the apparent movement of the Moon, planets, and stars in the nighttime sky; and

(C) recognize and identify constellations such as Ursa Major, Ursa Minor, Orion, Cassiopeia, and constellations of the zodiac.

(6) Science concepts. The student knows our place in space. The student is expected to:

(A) compare and contrast the scale, size, and distance of the Sun, Earth, and Moon system through the use of data and modeling;

(B) compare and contrast the scale, size, and distance of objects in the solar system such as the Sun and planets through the use of data and modeling;

(C) examine the scale, size, and distance of the stars, Milky Way, and other galaxies through the use of data and modeling;

(D) relate apparent versus absolute magnitude to the distances of celestial objects; and

(E) demonstrate the use of units of measurement in astronomy, including Astronomical Units and light years.

(7) Science concepts. The student knows the role of the Moon in the Sun, Earth, and Moon system. The student is expected to:

(A) observe and record data about lunar phases and use that information to model the Sun, Earth, and Moon system;

(B) illustrate the cause of lunar phases by showing positions of the Moon relative to Earth and the Sun for each phase, including new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, third quarter, and waning crescent;

(C) identify and differentiate the causes of lunar and solar eclipses, including differentiating between lunar phases and eclipses; and

(D) identify the effects of the Moon on tides.

(8) Science concepts. The student knows the reasons for the seasons. The student is expected to:

(A) recognize that seasons are caused by the tilt of Earth's axis;

(B) explain how latitudinal position affects the length of day and night throughout the year;

(C) recognize that the angle of incidence of sunlight determines the concentration of solar energy received on Earth at a particular location; and

(D) examine the relationship of the seasons to equinoxes, solstices, the tropics, and the equator.

(9) Science concepts. The student knows that planets of different size, composition, and surface features orbit around the Sun. The student is expected to:

(A) compare and contrast the factors essential to life on Earth such as temperature, water, mass, and gases to conditions on other planets;

(B) compare the planets in terms of orbit, size, composition, rotation, atmosphere, natural satellites, and geological activity;

(C) relate the role of Newton's law of universal gravitation to the motion of the planets around the Sun and to the motion of natural and artificial satellites around the planets; and

(D) explore the origins and significance of small solar system bodies, including asteroids, comets, and Kuiper belt objects.

(10) Science concepts. The student knows the role of the Sun as the star in our solar system. The student is expected to:

(A) identify the approximate mass, size, motion, temperature, structure, and composition of the Sun;

(B) distinguish between nuclear fusion and nuclear fission, and identify the source of energy within the Sun as nuclear fusion of hydrogen to helium;

(C) describe the eleven-year solar cycle and the significance of sunspots; and

(D) analyze solar magnetic storm activity, including coronal mass ejections, prominences, flares, and sunspots.

(11) Science concepts. The student knows the characteristics and life cycle of stars. The student is expected to:

(A) identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition;

(B) characterize star formation in stellar nurseries from giant molecular clouds, to protostars, to the development of main sequence stars;

(C) evaluate the relationship between mass and fusion on the dying process and properties of stars;

(D) differentiate among the end states of stars, including white dwarfs, neutron stars, and black holes;

(E) compare how the mass and gravity of a main sequence star will determine its end state as a white dwarf, neutron star, or black hole;

(F) relate the use of spectroscopy in obtaining physical data on celestial objects such as temperature, chemical composition, and relative motion; and

(G) use the Hertzsprung-Russell diagram to plot and examine the life cycle of stars from birth to death.

(12) Science concepts. The student knows the variety and properties of galaxies. The student is expected to:

(A) describe characteristics of galaxies;

(B) recognize the type, structure, and components of our Milky Way galaxy and location of our solar system within it; and

(C) compare and contrast the different types of galaxies, including spiral, elliptical, irregular, and dwarf.

(13) Science concepts. The student knows the scientific theories of cosmology. The student is expected to:

(A) research and describe the historical development of the Big Bang Theory, including red shift, cosmic microwave background radiation, and other supporting evidence;

(B) research and describe current theories of the evolution of the universe, including estimates for the age of the universe; and

(C) research and describe scientific hypotheses of the fate of the universe, including open and closed universes and the role of dark matter and dark energy.

(14) Science concepts. The student recognizes the benefits and challenges of space exploration to the study of the universe. The student is expected to:

(A) identify and explain the contributions of human space flight and future plans and challenges;

(B) recognize the advancement of knowledge in astronomy through robotic space flight;

(C) analyze the importance of ground-based technology in astronomical studies;

(D) recognize the importance of space telescopes to the collection of astronomical data across the electromagnetic spectrum; and

(E) demonstrate an awareness of new developments and discoveries in astronomy.

§112.34. Biology, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Prerequisites: none. This course is recommended for students in Grade 9, 10, or 11.

(b) Introduction.

(1) Biology. In Biology, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students in Biology study a variety of topics that include: structures and functions of cells and viruses; growth and development of organisms; cells,

tissues, and organs; nucleic acids and genetics; biological evolution; taxonomy; metabolism and energy transfers in living organisms; living systems; homeostasis; and ecosystems and the environment.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of biology and contributions of scientists.

(4) Science concepts. The student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells. The student is expected to:

(A) compare and contrast prokaryotic and eukaryotic cells;

(B) investigate and explain cellular processes, including homeostasis, energy conversions, transport of molecules, and synthesis of new molecules; and

(C) compare the structures of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as human immunodeficiency virus (HIV) and influenza.

(5) Science concepts. The student knows how an organism grows and the importance of cell differentiation. The student is expected to:

(A) describe the stages of the cell cycle, including deoxyribonucleic acid (DNA) replication and mitosis, and the importance of the cell cycle to the growth of organisms;

(B) examine specialized cells, including roots, stems, and leaves of plants; and animal cells such as blood, muscle, and epithelium;

(C) describe the roles of DNA, ribonucleic acid (RNA), and environmental factors in cell differentiation; and

(D) recognize that disruptions of the cell cycle lead to diseases such as cancer.

(6) Science concepts. The student knows the mechanisms of genetics, including the role of nucleic acids and the principles of Mendelian Genetics. The student is expected to:

(A) identify components of DNA, and describe how information for specifying the traits of an organism is carried in the DNA;

(B) recognize that components that make up the genetic code are common to all organisms;

(C) explain the purpose and process of transcription and translation using models of DNA and RNA;

(D) recognize that gene expression is a regulated process;

(E) identify and illustrate changes in DNA and evaluate the significance of these changes;

(F) predict possible outcomes of various genetic combinations such as monohybrid crosses, dihybrid crosses and non-Mendelian inheritance;

(G) recognize the significance of meiosis to sexual reproduction; and

(H) describe how techniques such as DNA fingerprinting, genetic modifications, and chromosomal analysis are used to study the genomes of organisms.

(7) Science concepts. The student knows evolutionary theory is a scientific explanation for the unity and diversity of life. The student is expected to:

(A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;

(B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;

(C) analyze and evaluate how natural selection produces change in populations, not individuals;

(D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;

(E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;

(F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and

(G) analyze and evaluate scientific explanations concerning the complexity of the cell.

(8) Science concepts. The student knows that taxonomy is a branching classification based on the shared characteristics of organisms and can change as new discoveries are made. The student is expected to:

(A) define taxonomy and recognize the importance of a standardized taxonomic system to the scientific community;

(B) categorize organisms using a hierarchical classification system based on similarities and differences shared among groups; and

(C) compare characteristics of taxonomic groups, including archaea, bacteria, protists, fungi, plants, and animals.

(9) Science concepts. The student knows the significance of various molecules involved in metabolic processes and energy conversions that occur in living organisms. The student is expected to:

(A) compare the structures and functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids;

(B) compare the reactants and products of photosynthesis and cellular respiration in terms of energy and matter;

(C) identify and investigate the role of enzymes; and

(D) analyze and evaluate the evidence regarding formation of simple organic molecules and their organization into long complex molecules having information such as the DNA molecule for self-replicating life.

(10) Science concepts. The student knows that biological systems are composed of multiple levels. The student is expected to:

(A) describe the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals;

(B) describe the interactions that occur among systems that perform the functions of transport, reproduction, and response in plants; and

(C) analyze the levels of organization in biological systems and relate the levels to each other and to the whole system.

(11) Science concepts. The student knows that biological systems work to achieve and maintain balance. The student is expected to:

(A) describe the role of internal feedback mechanisms in the maintenance of homeostasis;

(B) investigate and analyze how organisms, populations, and communities respond to external factors;

(C) summarize the role of microorganisms in both maintaining and disrupting the health of both organisms and ecosystems; and

(D) describe how events and processes that occur during ecological succession can change populations and species diversity.

(12) Science concepts. The student knows that interdependence and interactions occur within an environmental system. The student is expected to:

(A) interpret relationships, including predation, parasitism, commensalism, mutualism, and competition among organisms;

(B) compare variations and adaptations of organisms in different ecosystems;

(C) analyze the flow of matter and energy through trophic levels using various models, including food chains, food webs, and ecological pyramids;

(D) recognize that long-term survival of species is dependent on changing resource bases that are limited;

(E) describe the flow of matter through the carbon and nitrogen cycles and explain the consequences of disrupting these cycles; and

(F) describe how environmental change can impact ecosystem stability.

§112.35. Chemistry, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Required prerequisites: one unit of high school science and Algebra I. Suggested prerequisite: completion of or concurrent enrollment in a second year of math. This course is recommended for students in Grade 10, 11, or 12.

(b) Introduction.

(1) Chemistry. In Chemistry, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include characteristics of matter, use of the Periodic Table, development of atomic theory and chemical bonding, chemical stoichiometry, gas laws, solution chemistry, thermochemistry, and nuclear chemistry. Students will investigate how chemistry is an integral part of our daily lives.

(2) Nature of Science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations, including the appropriate use of safety showers, eyewash fountains, safety goggles, and fire extinguishers;

(B) know specific hazards of chemical substances such as flammability, corrosiveness, and radioactivity as summarized on the Material Safety Data Sheets (MSDS); and

(C) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses scientific methods to solve investigative questions. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology, including graphing calculators, computers and probes, sufficient scientific glassware such as beakers, Erlenmeyer flasks, pipettes, graduated cylinders, volumetric flasks, safety goggles, and burettes, electronic balances, and an adequate supply of consumable chemicals;

(F) collect data and make measurements with accuracy and precision;

(G) express and manipulate chemical quantities using scientific conventions and mathematical procedures, including dimensional analysis, scientific notation, and significant figures;

(H) organize, analyze, evaluate, make inferences, and predict trends from data; and

(I) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphs, journals, summaries, oral reports, and technology-based reports.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research on scientific thought, society, and the environment;

(E) describe the connection between chemistry and future careers; and

(F) research and describe the history of chemistry and contributions of scientists.

(4) Science concepts. The student knows the characteristics of matter and can analyze the relationships between chemical and physical changes and properties. The student is expected to:

(A) differentiate between physical and chemical changes and properties;

(B) identify extensive and intensive properties;

(C) compare solids, liquids, and gases in terms of compressibility, structure, shape, and volume; and

(D) classify matter as pure substances or mixtures through investigation of their properties.

(5) Science concepts. The student understands the historical development of the Periodic Table and can apply its predictive power. The student is expected to:

(A) explain the use of chemical and physical properties in the historical development of the Periodic Table;

(B) use the Periodic Table to identify and explain the properties of chemical families, including alkali metals, alkaline earth metals, halogens, noble gases, and transition metals; and

(C) use the Periodic Table to identify and explain periodic trends, including atomic and ionic radii, electronegativity, and ionization energy.

(6) Science concepts. The student knows and understands the historical development of atomic theory. The student is expected to:

(A) understand the experimental design and conclusions used in the development of modern atomic theory, including Dalton's Postulates, Thomson's discovery of electron properties, Rutherford's nuclear atom, and Bohr's nuclear atom;

(B) understand the electromagnetic spectrum and the mathematical relationships between energy, frequency, and wavelength of light;

(C) calculate the wavelength, frequency, and energy of light using Planck's constant and the speed of light;

(D) use isotopic composition to calculate average atomic mass of an element; and

(E) express the arrangement of electrons in atoms through electron configurations and Lewis valence electron dot structures.

(7) Science concepts. The student knows how atoms form ionic, metallic, and covalent bonds. The student is expected to:

(A) name ionic compounds containing main group or transition metals, covalent compounds, acids, and bases, using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules;

(B) write the chemical formulas of common polyatomic ions, ionic compounds containing main group or transition metals, covalent compounds, acids, and bases;

(C) construct electron dot formulas to illustrate ionic and covalent bonds;

(D) describe the nature of metallic bonding and apply the theory to explain metallic properties such as thermal and electrical conductivity, malleability, and ductility; and

(E) predict molecular structure for molecules with linear, trigonal planar, or tetrahedral electron pair geometries using Valence Shell Electron Pair Repulsion (VSEPR) theory.

(8) Science concepts. The student can quantify the changes that occur during chemical reactions. The student is expected to:

(A) define and use the concept of a mole;

(B) use the mole concept to calculate the number of atoms, ions, or molecules in a sample of material;

(C) calculate percent composition and empirical and molecular formulas;

(D) use the law of conservation of mass to write and balance chemical equations; and

(E) perform stoichiometric calculations, including determination of mass relationships between reactants and products, calculation of limiting reagents, and percent yield.

(9) Science concepts. The student understands the principles of ideal gas behavior, kinetic molecular theory, and the conditions that influence the behavior of gases. The student is expected to:

(A) describe and calculate the relations between volume, pressure, number of moles, and temperature for an ideal gas as described by Boyle's law, Charles' law, Avogadro's law, Dalton's law of partial pressure, and the ideal gas law;

(B) perform stoichiometric calculations, including determination of mass and volume relationships between reactants and products for reactions involving gases; and

(C) describe the postulates of kinetic molecular theory.

(10) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to:

(A) describe the unique role of water in chemical and biological systems;

(B) develop and use general rules regarding solubility through investigations with aqueous solutions;

(C) calculate the concentration of solutions in units of molarity;

(D) use molarity to calculate the dilutions of solutions;

(E) distinguish between types of solutions such as electrolytes and nonelectrolytes and unsaturated, saturated, and supersaturated solutions;

(F) investigate factors that influence solubilities and rates of dissolution such as temperature, agitation, and surface area;

(G) define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions and predict products in acid base reactions that form water;

(H) understand and differentiate among acid-base reactions, precipitation reactions, and oxidation-reduction reactions;

(I) define pH and use the hydrogen or hydroxide ion concentrations to calculate the pH of a solution; and

(J) distinguish between degrees of dissociation for strong and weak acids and bases.

(11) Science concepts. The student understands the energy changes that occur in chemical reactions. The student is expected to:

(A) understand energy and its forms, including kinetic, potential, chemical, and thermal energies;

(B) understand the law of conservation of energy and the processes of heat transfer;

(C) use thermochemical equations to calculate energy changes that occur in chemical reactions and classify reactions as exothermic or endothermic;

(D) perform calculations involving heat, mass, temperature change, and specific heat; and

(E) use calorimetry to calculate the heat of a chemical process.

(12) Science concepts. The student understands the basic processes of nuclear chemistry. The student is expected to:

(A) describe the characteristics of alpha, beta, and gamma radiation;

(B) describe radioactive decay process in terms of balanced nuclear equations; and

(C) compare fission and fusion reactions.

§112.36. Earth and Space Science, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Required prerequisites: three units of science, one of which may be taken concurrently, and three units of mathematics, one of which may be taken concurrently. This course is recommended for students in Grade 12 but may be taken by students in Grade 11.

(b) Introduction.

(1) Earth and Space Science (ESS). ESS is a capstone course designed to build on students' prior scientific and academic knowledge and skills to develop understanding of Earth's system in space and time.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) ESS themes. An Earth systems approach to the themes of Earth in space and time, solid Earth, and fluid Earth defined the selection and development of the concepts described in this paragraph.

(A) Earth in space and time. Earth has a long, complex, and dynamic history. Advances in technologies continue to further our understanding of the origin, evolution, and properties of Earth and planetary systems within a chronological framework. The origin and distribution of resources that sustain life on Earth are the result of interactions among Earth's subsystems over billions of years.

(B) Solid Earth. The geosphere is a collection of complex, interacting, dynamic subsystems linking Earth's interior to its surface. The geosphere is composed of materials that move between subsystems at various rates driven by the uneven distribution of thermal energy. These dynamic processes are responsible for the origin and distribution of resources as well as geologic hazards that impact society.

(C) Fluid Earth. The fluid Earth consists of the hydrosphere, cryosphere, and atmosphere subsystems. These subsystems interact with the biosphere and geosphere resulting in complex biogeochemical and geochemical cycles. The global ocean is the thermal energy reservoir for surface processes and, through interactions with the atmosphere, influences climate. Understanding these interactions and cycles over time has implications for life on Earth.

(6) Earth and space science strands. ESS has three strands used throughout each of the three themes: systems, energy, and relevance.

(A) Systems. A system is a collection of interacting physical, chemical, and biological processes that involves the flow of matter and energy on different temporal and spatial scales. Earth's system is composed of interdependent and interacting subsystems of the geosphere, hydrosphere, atmosphere, cryosphere, and biosphere within a larger planetary and stellar system. Change and constancy occur in Earth's system and can be observed, measured as patterns and cycles, and described or presented in models used to predict how Earth's system changes over time.

(B) Energy. The uneven distribution of Earth's internal and external thermal energy is the driving force for complex, dynamic, and continuous interactions and cycles in Earth's subsystems. These interactions are responsible for the movement of matter within and between the subsystems resulting in, for example, plate motions and ocean-atmosphere circulation.

(C) Relevance. The interacting components of Earth's system change by both natural and human-influenced processes. Natural processes include hazards such as flooding, earthquakes, volcanoes, hurricanes, meteorite impacts, and climate change. Some human-influenced processes such as pollution and nonsustainable use of Earth's natural resources may damage Earth's system. Examples include climate change, soil erosion, air and water pollution, and biodiversity loss. The time scale of these changes and their impact on human society must be understood to make wise decisions concerning the use of the land, water, air, and natural resources. Proper stewardship of Earth will prevent unnecessary degradation and destruction of Earth's subsystems and diminish detrimental impacts to individuals and society.

(c) Knowledge and skills.

(1) Scientific processes. The student conducts laboratory and field investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations;

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials; and

(C) use the school's technology and information systems in a wise and ethical manner.

(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) demonstrate the use of course equipment, techniques, and procedures, including computers and web-based computer applications;

(F) use a wide variety of additional course apparatuses, equipment, techniques, and procedures as appropriate such as satellite imagery and other remote sensing data, Geographic Information Systems (GIS), Global Positioning System (GPS), scientific probes, microscopes, telescopes, modern video and image libraries, weather stations, fossil and rock kits, bar magnets, coiled springs, wave simulators, tectonic plate models, and planetary globes;

(G) organize, analyze, evaluate, make inferences, and predict trends from data;

(H) use mathematical procedures such as algebra, statistics, scientific notation, and significant figures to analyze data using the International System (SI) units; and

(I) communicate valid conclusions supported by data using several formats such as technical reports, lab reports, labeled drawings, graphic organizers, journals, presentations, and technical posters.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research on scientific thought, society, and public policy;

(E) explore careers and collaboration among scientists in Earth and space sciences; and

(F) learn and understand the contributions of scientists to the historical development of Earth and space sciences.

(4) Earth in space and time. The student knows how Earth-based and space-based astronomical observations reveal differing theories about the structure, scale, composition, origin, and history of the universe. The student is expected to:

(A) evaluate the evidence concerning the Big Bang model such as red shift and cosmic microwave background radiation and current theories of the evolution of the universe, including estimates for the age of the universe;

(B) explain how the Sun and other stars transform matter into energy through nuclear fusion; and

(C) investigate the process by which a supernova can lead to the formation of successive generation stars and planets.

(5) Earth in space and time. The student understands the solar nebular accretionary disk model. The student is expected to:

(A) analyze how gravitational condensation of solar nebular gas and dust can lead to the accretion of planetesimals and protoplanets;

(B) investigate thermal energy sources, including kinetic heat of impact accretion, gravitational compression, and radioactive decay, which are thought to allow protoplanet differentiation into layers;

(C) contrast the characteristics of comets, asteroids, and meteoroids and their positions in the solar system, including the orbital regions of the terrestrial planets, the asteroid belt, gas giants, Kuiper Belt, and Oort Cloud;

(D) explore the historical and current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal;

(E) compare terrestrial planets to gas-giant planets in the solar system, including structure, composition, size, density, orbit, surface features, tectonic activity, temperature, and suitability for life; and

(F) compare extra-solar planets with planets in our solar system and describe how such planets are detected.

(6) Earth in space and time. The student knows the evidence for how Earth's atmospheres, hydrosphere, and geosphere formed and changed through time. The student is expected to:

(A) analyze the changes of Earth's atmosphere that could have occurred through time from the original hydrogen-helium atmosphere, the carbon dioxide-water vapor-methane atmosphere, and the current nitrogen-oxygen atmosphere;

(B) evaluate the role of volcanic outgassing and impact of water-bearing comets in developing Earth's atmosphere and hydrosphere;

(C) investigate how the formation of atmospheric oxygen and the ozone layer impacted the formation of the geosphere and biosphere; and

(D) evaluate the evidence that Earth's cooling led to tectonic activity, resulting in continents and ocean basins.

(7) Earth in space and time. The student knows that scientific dating methods of fossils and rock sequences are used to construct a chronology of Earth's history expressed in the geologic time scale. The student is expected to:

(A) evaluate relative dating methods using original horizontality, rock superposition, lateral continuity, cross-cutting relationships, unconformities, index fossils, and biozones based on fossil succession to determine chronological order;

(B) calculate the ages of igneous rocks from Earth and the Moon and meteorites using radiometric dating methods; and

(C) understand how multiple dating methods are used to construct the geologic time scale, which represents Earth's approximate 4.6-billion-year history.

(8) Earth in space and time. The student knows that fossils provide evidence for geological and biological evolution. Students are expected to:

(A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;

(B) explain how sedimentation, fossilization, and speciation affect the degree of completeness of the fossil record; and

(C) evaluate the significance of the terminal Permian and Cretaceous mass extinction events, including adaptive radiations of organisms after the events.

(9) Solid Earth. The student knows Earth's interior is differentiated chemically, physically, and thermally. The student is expected to:

(A) evaluate heat transfer through Earth's subsystems by radiation, convection, and conduction and include its role in plate tectonics, volcanism, ocean circulation, weather, and climate;

(B) examine the chemical, physical, and thermal structure of Earth's crust, mantle, and core, including the lithosphere and asthenosphere;

(C) explain how scientists use geophysical methods such as seismic wave analysis, gravity, and magnetism to interpret Earth's structure; and

(D) describe the formation and structure of Earth's magnetic field, including its interaction with charged solar particles to form the Van Allen belts and auroras.

(10) Solid Earth. The student knows that plate tectonics is the global mechanism for major geologic processes and that heat transfer, governed by the principles of thermodynamics, is the driving force. The student is expected to:

(A) investigate how new conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics;

(B) describe how heat and rock composition affect density within Earth's interior and how density influences the development and motion of Earth's tectonic plates;

(C) explain how plate tectonics accounts for geologic processes and features, including sea floor spreading, ocean ridges and rift valleys, subduction zones, earthquakes, volcanoes, mountain ranges, hot spots, and hydrothermal vents;

(D) calculate the motion history of tectonic plates using equations relating rate, time, and distance to predict future motions, locations, and resulting geologic features;

(E) distinguish the location, type, and relative motion of convergent, divergent, and transform plate boundaries using evidence from the distribution of earthquakes and volcanoes; and

(F) evaluate the role of plate tectonics with respect to long-term global changes in Earth's subsystems such as continental buildup, glaciation, sea level fluctuations, mass extinctions, and climate change.

(11) Solid Earth. The student knows that the geosphere continuously changes over a range of time scales involving dynamic and complex interactions among Earth's subsystems. The student is expected to:

(A) compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface;

(B) explain how plate tectonics accounts for geologic surface processes and features, including folds, faults, sedimentary basin formation, mountain building, and continental accretion;

(C) analyze changes in continental plate configurations such as Pangaea and their impact on the biosphere, atmosphere, and hydrosphere through time;

(D) interpret Earth surface features using a variety of methods such as satellite imagery, aerial photography, and topographic and geologic maps using appropriate technologies; and

(E) evaluate the impact of changes in Earth's subsystems on humans such as earthquakes, tsunamis, volcanic eruptions, hurricanes, flooding, and storm surges and the impact of humans on Earth's subsystems such as population growth, fossil fuel burning, and use of fresh water.

(12) Solid Earth. The student knows that Earth contains energy, water, mineral, and rock resources and that use of these resources impacts Earth's subsystems. The student is expected to:

(A) evaluate how the use of energy, water, mineral, and rock resources affects Earth's subsystems;

(B) describe the formation of fossil fuels, including petroleum and coal;

(C) discriminate between renewable and nonrenewable resources based upon rate of formation and use;

(D) analyze the economics of resources from discovery to disposal, including technological advances, resource type, concentration and location, waste disposal and recycling, and environmental costs; and

(E) explore careers that involve the exploration, extraction, production, use, and disposal of Earth's resources.

(13) Fluid Earth. The student knows that the fluid Earth is composed of the hydrosphere, cryosphere, and atmosphere subsystems that interact on various time scales with the biosphere and geosphere. The student is expected to:

(A) quantify the components and fluxes within the hydrosphere such as changes in polar ice caps and glaciers, salt water incursions, and groundwater levels in response to precipitation events or excessive pumping;

(B) analyze how global ocean circulation is the result of wind, tides, the Coriolis effect, water density differences, and the shape of the ocean basins;

(C) analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature trends over the past 150 years;

(D) discuss mechanisms and causes such as selective absorbers, major volcanic eruptions, solar luminance, giant meteorite impacts, and human activities that result in significant changes in Earth's climate;

(E) investigate the causes and history of eustatic sea-level changes that result in transgressive and regressive sedimentary sequences; and

(F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.

(14) Fluid Earth. The student knows that Earth's global ocean stores solar energy and is a major driving force for weather and climate through complex atmospheric interactions. The student is expected to:

(A) analyze the uneven distribution of solar energy on Earth's surface, including differences in atmospheric transparency, surface albedo, Earth's tilt, duration of insolation, and differences in atmospheric and surface absorption of energy;

(B) investigate how the atmosphere is heated from Earth's surface due to absorption of solar energy, which is re-radiated as thermal energy and trapped by selective absorbers; and

(C) explain how thermal energy transfer between the ocean and atmosphere drives surface currents, thermohaline currents, and evaporation that influence climate.

(15) Fluid Earth. The student knows that interactions among Earth's five subsystems influence climate and resource availability, which affect Earth's habitability. The student is expected to:

(A) describe how changing surface-ocean conditions, including El Niño-Southern Oscillation, affect global weather and climate patterns;

(B) investigate evidence such as ice cores, glacial striations, and fossils for climate variability and its use in developing computer models to explain present and predict future climates;

(C) quantify the dynamics of surface and groundwater movement such as recharge, discharge, evapotranspiration, storage, residence time, and sustainability;

(D) explain the global carbon cycle, including how carbon exists in different forms within the five subsystems and how these forms affect life; and

(E) analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on evaporation, sea level, algal growth, coral bleaching, hurricane intensity, and biodiversity.

§112.37. Environmental Systems, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Suggested prerequisite: one unit high school life science and one unit of high school physical science. This course is recommended for students in Grade 11 or 12.

(b) Introduction.

(1) Environmental Systems. In Environmental Systems, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include: biotic and abiotic factors in habitats, ecosystems and biomes, interrelationships among resources and an environmental system, sources and flow of energy through an environmental system, relationship between carrying capacity and changes in populations and ecosystems, and changes in environments.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts hands-on laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations, including appropriate first aid responses to accidents that could occur in the field such as insect stings, animal bites, overheating, sprains, and breaks; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) follow or plan and implement investigative procedures, including making observations, asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;

(G) demonstrate the use of course apparatuses, equipment, techniques, and procedures, including meter sticks, rulers, pipettes, graduated cylinders, triple beam balances, timing devices, pH meters or probes, thermometers, calculators, computers, Internet access, turbidity testing devices, hand magnifiers, work and disposable gloves, compasses, first aid kits, binoculars, field guides, water quality test kits or probes, soil test kits or probes, 100-foot appraiser's tapes, tarps, shovels, trowels, screens, buckets, and rock and mineral samples;

(H) use a wide variety of additional course apparatuses, equipment, techniques, materials, and procedures as appropriate such as air quality testing devices, cameras, flow meters, Global Positioning System (GPS) units, Geographic Information System (GIS) software, computer models, densiometers, clinometers, and field journals;

(I) organize, analyze, evaluate, build models, make inferences, and predict trends from data;

(J) perform calculations using dimensional analysis, significant digits, and scientific notation; and

(K) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research on scientific thought, society, and the environment;

(E) describe the connection between environmental science and future careers; and

(F) research and describe the history of environmental science and contributions of scientists.

(4) Science concepts. The student knows the relationships of biotic and abiotic factors within habitats, ecosystems, and biomes. The student is expected to:

(A) identify native plants and animals using a dichotomous key;

(B) assess the role of native plants and animals within a local ecosystem and compare them to plants and animals in ecosystems within four other biomes;

(C) diagram abiotic cycles, including the rock, hydrologic, carbon, and nitrogen cycles;

(D) make observations and compile data about fluctuations in abiotic cycles and evaluate the effects of abiotic factors on local ecosystems and local biomes;

(E) measure the concentration of solute, solvent, and solubility of dissolved substances such as dissolved oxygen, chlorides, and nitrates and describe their impact on an ecosystem;

(F) predict how the introduction or removal of an invasive species may alter the food chain and affect existing populations in an ecosystem;

(G) predict how species extinction may alter the food chain and affect existing populations in an ecosystem; and

(H) research and explain the causes of species diversity and predict changes that may occur in an ecosystem if species and genetic diversity is increased or reduced.

(5) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:

(A) summarize methods of land use and management and describe its effects on land fertility;

(B) identify source, use, quality, management, and conservation of water;

(C) document the use and conservation of both renewable and non-renewable resources as they pertain to sustainability;

(D) identify renewable and non-renewable resources that must come from outside an ecosystem such as food, water, lumber, and energy;

(E) analyze and evaluate the economic significance and interdependence of resources within the environmental system; and

(F) evaluate the impact of waste management methods such as reduction, reuse, recycling, and composting on resource availability.

(6) Science concepts. The student knows the sources and flow of energy through an environmental system. The student is expected to:

(A) define and identify the components of the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere and the interactions among them;

(B) describe and compare renewable and non-renewable energy derived from natural and alternative sources such as oil, natural gas, coal, nuclear, solar, geothermal, hydroelectric, and wind;

(C) explain the flow of energy in an ecosystem, including conduction, convection, and radiation;

(D) investigate and explain the effects of energy transformations in terms of the laws of thermodynamics within an ecosystem; and

(E) investigate and identify energy interactions in an ecosystem.

(7) Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to:

(A) relate carrying capacity to population dynamics;

(B) calculate birth rates and exponential growth of populations;

(C) analyze and predict the effects of non-renewable resource depletion; and

(D) analyze and make predictions about the impact on populations of geographic locales due to diseases, birth and death rates, urbanization, and natural events such as migration and seasonal changes.

(8) Science concepts. The student knows that environments change naturally. The student is expected to:

(A) analyze and describe the effects on areas impacted by natural events such as tectonic movement, volcanic events, fires, tornadoes, hurricanes, flooding, tsunamis, and population growth;

(B) explain how regional changes in the environment may have a global effect;

(C) examine how natural processes such as succession and feedback loops restore habitats and ecosystems;

(D) describe how temperature inversions impact weather conditions, including El Niño and La Niña oscillations; and

(E) analyze the impact of temperature inversions on global warming, ice cap and glacial melting, and changes in ocean currents and surface temperatures.

(9) Science concepts. The student knows the impact of human activities on the environment. The student is expected to:

(A) identify causes of air, soil, and water pollution, including point and nonpoint sources;

(B) investigate the types of air, soil, and water pollution such as chlorofluorocarbons, carbon dioxide, pH, pesticide runoff, thermal variations, metallic ions, heavy metals, and nuclear waste;

(C) examine the concentrations of air, soil, and water pollutants using appropriate units;

(D) describe the effect of pollution on global warming, glacial and ice cap melting, greenhouse effect, ozone layer, and aquatic viability;

(E) evaluate the effect of human activities, including habitat restoration projects, species preservation efforts, nature conservancy groups, hunting, fishing, ecotourism, all terrain vehicles, and small personal watercraft, on the environment;

(F) evaluate cost-benefit trade-offs of commercial activities such as municipal development, farming, deforestation, over-harvesting, and mining;

(G) analyze how ethical beliefs can be used to influence scientific practices such as methods for increasing food production;

(H) analyze and evaluate different views on the existence of global warming;

(I) discuss the impact of research and technology on social ethics and legal practices in situations such as the design of new buildings, recycling, or emission standards;

(J) research the advantages and disadvantages of "going green" such as organic gardening and farming, natural methods of pest control, hydroponics, xeriscaping, energy-efficient homes and appliances, and hybrid cars;

(K) analyze past and present local, state, and national legislation, including Texas automobile emissions regulations, the National Park Service Act, the Clean Air Act, the Clean Water Act, the Soil and Water Resources Conservation Act, and the Endangered Species Act; and

(L) analyze past and present international treaties and protocols such as the environmental Antarctic Treaty System, Montreal Protocol, and Kyoto Protocol.

§112.38. Integrated Physics and Chemistry, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Prerequisites: none. This course is recommended for students in Grade 9 or 10.

(b) Introduction.

(1) Integrated Physics and Chemistry. In Integrated Physics and Chemistry, students conduct laboratory and field investigations, use scientific methods during investigation, and make informed decisions using critical thinking and scientific problem solving. This course integrates the disciplines of physics and chemistry in the following topics: force, motion, energy, and matter.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models.

Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(C) collect data and make measurements with precision;

(D) organize, analyze, evaluate, make inferences, and predict trends from data; and

(E) communicate valid conclusions.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research on scientific thought, society, and the environment;

(E) describe connections between physics and chemistry and future careers; and

(F) research and describe the history of physics and chemistry and contributions of scientists.

(4) Science concepts. The student knows concepts of force and motion evident in everyday life. The student is expected to:

(A) describe and calculate an object's motion in terms of position, displacement, speed, and acceleration;

(B) measure and graph distance and speed as a function of time using moving toys;

(C) investigate how an object's motion changes only when a net force is applied, including activities and equipment such as toy cars, vehicle restraints, sports activities, and classroom objects;

(D) assess the relationship between force, mass, and acceleration, noting the relationship is independent of the nature of the force, using equipment such as dynamic carts, moving toys, vehicles, and falling objects;

(E) apply the concept of conservation of momentum using action and reaction forces such as students on skateboards;

(F) describe the gravitational attraction between objects of different masses at different distances, including satellites; and

(G) examine electrical force as a universal force between any two charged objects and compare the relative strength of the electrical force and gravitational force.

(5) Science concepts. The student recognizes multiple forms of energy and knows the impact of energy transfer and energy conservation in everyday life. The student is expected to:

(A) recognize and demonstrate that objects and substances in motion have kinetic energy such as vibration of atoms, water flowing down a stream moving pebbles, and bowling balls knocking down pins;

(B) demonstrate common forms of potential energy, including gravitational, elastic, and chemical, such as a ball on an inclined plane, springs, and batteries;

(C) demonstrate that moving electric charges produce magnetic forces and moving magnets produce electric forces;

(D) investigate the law of conservation of energy;

(E) investigate and demonstrate the movement of thermal energy through solids, liquids, and gases by convection, conduction, and radiation such as in weather, living, and mechanical systems;

(F) evaluate the transfer of electrical energy in series and parallel circuits and conductive materials;

(G) explore the characteristics and behaviors of energy transferred by waves, including acoustic, seismic, light, and waves on water as they superpose on one another, bend around corners, reflect off surfaces, are absorbed by materials, and change direction when entering new materials;

(H) analyze energy conversions such as those from radiant, nuclear, and geothermal sources; fossil fuels such as coal, gas, oil; and the movement of water or wind; and

(I) critique the advantages and disadvantages of various energy sources and their impact on society and the environment.

(6) Science concepts. The student knows that relationships exist between the structure and properties of matter. The student is expected to:

(A) examine differences in physical properties of solids, liquids, and gases as explained by the arrangement and motion of atoms, ions, or molecules of the substances and the strength of the forces of attraction between those particles;

(B) relate chemical properties of substances to the arrangement of their atoms or molecules;

(C) analyze physical and chemical properties of elements and compounds such as color, density, viscosity, buoyancy, boiling point, freezing point, conductivity, and reactivity;

(D) relate the physical and chemical behavior of an element, including bonding and classification, to its placement on the Periodic Table; and

(E) relate the structure of water to its function as a solvent and investigate the properties of solutions and factors affecting gas and solid solubility, including nature of solute, temperature, pressure, pH, and concentration.

(7) Science concepts. The student knows that changes in matter affect everyday life. The student is expected to:

(A) investigate changes of state as it relates to the arrangement of particles of matter and energy transfer;

(B) recognize that chemical changes can occur when substances react to form different substances and that these interactions are largely determined by the valence electrons;

(C) demonstrate that mass is conserved when substances undergo chemical change and that the number and kind of atoms are the same in the reactants and products;

(D) analyze energy changes that accompany chemical reactions such as those occurring in heat packs, cold packs, and glow sticks and classify them as exothermic or endothermic reactions;

(E) describe types of nuclear reactions such as fission and fusion and their roles in applications such as medicine and energy production; and

(F) research and describe the environmental and economic impact of the end-products of chemical reactions such as those that may result in acid rain, degradation of water and air quality, and ozone depletion.

§112.39. Physics, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Algebra I is suggested as a prerequisite or co-requisite. This course is recommended for students in Grade 9, 10, 11, or 12.

(b) Introduction.

(1) Physics. In Physics, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include: laws of motion; changes within physical systems and conservation of energy and momentum; forces; thermodynamics; characteristics and behavior of waves; and atomic, nuclear, and quantum physics. Students who successfully complete Physics will acquire factual knowledge within a conceptual framework, practice experimental design and interpretation, work collaboratively with colleagues, and develop critical thinking skills.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student conducts investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses a systematic approach to answer scientific laboratory and field investigative questions. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) design and implement investigative procedures, including making observations, asking well-defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, and evaluating numerical answers for reasonableness;

(F) demonstrate the use of course apparatus, equipment, techniques, and procedures, including multimeters (current, voltage, resistance), triple beam balances, batteries, clamps, dynamics demonstration equipment, collision apparatus, data acquisition probes, discharge tubes with power supply (H, He, Ne, Ar), hand-held visual spectroscopes, hot plates, slotted and hooked lab masses, bar magnets, horseshoe magnets, plane mirrors, convex lenses, pendulum support, power supply, ring clamps, ring stands, stopwatches, trajectory apparatus, tuning forks, carbon paper, graph paper, magnetic compasses, polarized film, prisms, protractors, resistors, friction blocks, mini lamps (bulbs) and sockets, electrostatics kits, 90-degree rod clamps, metric rulers, spring scales, knife blade switches, Celsius thermometers, meter sticks, scientific calculators, graphing technology, computers, cathode ray tubes with horseshoe magnets, ballistic carts or equivalent, resonance tubes, spools of nylon thread or string, containers of iron filings, rolls of white craft paper, copper wire, Periodic Table, electromagnetic spectrum charts, slinky springs, wave motion ropes, and laser pointers;

(G) use a wide variety of additional course apparatus, equipment, techniques, materials, and procedures as appropriate such as ripple tank with wave generator, wave motion rope, micrometer, caliper, radiation monitor, computer, ballistic pendulum, electroscope, inclined plane, optics bench, optics kit, pulley with table clamp, resonance tube, ring stand screen, four inch ring, stroboscope, graduated cylinders, and ticker timer;

(H) make measurements with accuracy and precision and record data using scientific notation and International System (SI) units;

(I) identify and quantify causes and effects of uncertainties in measured data;

(J) organize and evaluate data and make inferences from data, including the use of tables, charts, and graphs;

(K) communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports; and

(L) express and manipulate relationships among physical variables quantitatively, including the use of graphs, charts, and equations.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society;

(E) research and describe the connections between physics and future careers; and

(F) express and interpret relationships symbolically in accordance with accepted theories to make predictions and solve problems mathematically, including problems requiring proportional reasoning and graphical vector addition.

(4) Science concepts. The student knows and applies the laws governing motion in a variety of situations. The student is expected to:

(A) generate and interpret graphs and charts describing different types of motion, including the use of real-time technology such as motion detectors or photogates;

(B) describe and analyze motion in one dimension using equations with the concepts of distance, displacement, speed, average velocity, instantaneous velocity, and acceleration;

(C) analyze and describe accelerated motion in two dimensions using equations, including projectile and circular examples;

(D) calculate the effect of forces on objects, including the law of inertia, the relationship between force and acceleration, and the nature of force pairs between objects;

(E) develop and interpret free-body force diagrams; and

(F) identify and describe motion relative to different frames of reference.

(5) Science concepts. The student knows the nature of forces in the physical world. The student is expected to:

(A) research and describe the historical development of the concepts of gravitational, electromagnetic, weak nuclear, and strong nuclear forces;

(B) describe and calculate how the magnitude of the gravitational force between two objects depends on their masses and the distance between their centers;

(C) describe and calculate how the magnitude of the electrical force between two objects depends on their charges and the distance between them;

(D) identify examples of electric and magnetic forces in everyday life;

(E) characterize materials as conductors or insulators based on their electrical properties;

(F) design, construct, and calculate in terms of current through, potential difference across, resistance of, and power used by electric circuit elements connected in both series and parallel combinations;

(G) investigate and describe the relationship between electric and magnetic fields in applications such as generators, motors, and transformers; and

(H) describe evidence for and effects of the strong and weak nuclear forces in nature.

(6) Science concepts. The student knows that changes occur within a physical system and applies the laws of conservation of energy and momentum. The student is expected to:

(A) investigate and calculate quantities using the work-energy theorem in various situations;

(B) investigate examples of kinetic and potential energy and their transformations;

(C) calculate the mechanical energy of, power generated within, impulse applied to, and momentum of a physical system;

(D) demonstrate and apply the laws of conservation of energy and conservation of momentum in one dimension;

(E) describe how the macroscopic properties of a thermodynamic system such as temperature, specific heat, and pressure are related to the molecular level of matter, including kinetic or potential energy of atoms;

(F) contrast and give examples of different processes of thermal energy transfer, including conduction, convection, and radiation; and

(G) analyze and explain everyday examples that illustrate the laws of thermodynamics, including the law of conservation of energy and the law of entropy.

(7) Science concepts. The student knows the characteristics and behavior of waves. The student is expected to:

(A) examine and describe oscillatory motion and wave propagation in various types of media;

(B) investigate and analyze characteristics of waves, including velocity, frequency, amplitude, and wavelength, and calculate using the relationship between wavespeed, frequency, and wavelength;

(C) compare characteristics and behaviors of transverse waves, including electromagnetic waves and the electromagnetic spectrum, and characteristics and behaviors of longitudinal waves, including sound waves;

(D) investigate behaviors of waves, including reflection, refraction, diffraction, interference, resonance, and the Doppler effect;

(E) describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens; and

(F) describe the role of wave characteristics and behaviors in medical and industrial applications.

(8) Science concepts. The student knows simple examples of atomic, nuclear, and quantum phenomena. The student is expected to:

(A) describe the photoelectric effect and the dual nature of light;

(B) compare and explain the emission spectra produced by various atoms;

(C) describe the significance of mass-energy equivalence and apply it in explanations of phenomena such as nuclear stability, fission, and fusion; and

(D) give examples of applications of atomic and nuclear phenomena such as radiation therapy, diagnostic imaging, and nuclear power and examples of applications of quantum phenomena such as digital cameras.

Subchapter D. Other Science Courses

§112.71. Principles of Technology.

(a) General requirements. This course is recommended for students in Grades 10-12. Prerequisites: one unit of high school science and Algebra I. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Principles of Technology. In Principles of Technology, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Various systems will be described in terms of space, time, energy, and matter. Students will study a variety of topics that include laws of motion, conservation of energy, momentum, electricity, magnetism, thermodynamics, and characteristics and behavior of waves. Students will apply physics concepts and perform laboratory experimentations for at least 40% of instructional time using safe practices.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses a systematic approach to answer scientific laboratory and field investigative questions. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) design and implement investigative procedures, including making observations, asking well-defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, and evaluating numerical answers for reasonableness;

(F) demonstrate the use of course apparatus, equipment, techniques, and procedures, including multimeters (current, voltage, resistance), triple beam balances, batteries, clamps, dynamics demonstration equipment, collision apparatus, data acquisition probes, discharge tubes with power supply (H, He, Ne, Ar), hand-held visual spectroscopes, hot plates, slotted and hooked lab masses, bar magnets, horseshoe magnets, plane mirrors, convex lenses, pendulum support, power supply, ring clamps, ring stands, stopwatches, trajectory apparatus, tuning forks, carbon paper, graph paper, magnetic compasses, polarized film, prisms, protractors, resistors, friction blocks, mini lamps (bulbs) and sockets, electrostatics kits, 90-degree rod clamps, metric rulers, spring scales, knife blade switches, Celsius thermometers, meter sticks, scientific calculators, graphing technology, computers, cathode ray tubes with horseshoe magnets, ballistic carts or equivalent, resonance tubes, spools of nylon thread or string, containers of iron filings, rolls of white craft paper, copper wire, Periodic Table, electromagnetic spectrum charts, slinky springs, wave motion ropes, and laser pointers;

(G) use a wide variety of additional course apparatus, equipment, techniques, materials, and procedures as appropriate such as ripple tank with wave generator, wave motion rope, micrometer, caliper, radiation monitor, computer, ballistic pendulum, electroscope, inclined plane, optics bench, optics kit, pulley with table clamp, resonance tube, ring stand screen, four-inch ring, stroboscope, graduated cylinders, and ticker timer;

(H) make measurements with accuracy and precision and record data using scientific notation and International System (SI) units;

(I) identify and quantify causes and effects of uncertainties in measured data;

(J) organize and evaluate data and make inferences from data, including the use of tables, charts, and graphs;

(K) communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports; and

(L) express and manipulate relationships among physical variables quantitatively, including the use of graphs, charts, and equations.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society;

(E) research and describe the connections between physics and future careers; and

(F) express and interpret relationships symbolically in accordance with accepted theories to make predictions and solve problems mathematically, including problems requiring proportional reasoning and graphical vector addition.

(4) The student uses the scientific process to investigate physical concepts. The student is expected to:

(A) understand that scientific hypotheses are tentative and testable statements that must be capable of being supported by observational evidence;

(B) understand that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers;

(C) design and implement investigative procedures;

(D) demonstrate the appropriate use and care of laboratory equipment;

(E) demonstrate accurate measurement techniques using precision instruments;

(F) record data using scientific notation and International System (SI) of units;

(G) identify and quantify causes and effects of uncertainties in measured data;

(H) organize and evaluate data, including the use of tables, charts, and graphs;

(I) communicate conclusions supported through various methods such as laboratory reports, labeled drawings, graphic organizers, journals, summaries, oral reports, or technology-based reports; and

(J) record, express, and manipulate data using graphs, charts, and equations.

(5) The student demonstrates appropriate safety techniques in the field and laboratory environments. The student is expected to:

(A) master relevant safety procedures;

(B) follow safety guidelines as described in various manuals, instructions, and regulations;

(C) identify and classify hazardous materials and wastes; and

(D) make prudent choices in the conservation and use of resources and the disposal of hazardous materials and wastes appropriately.

(6) The student uses critical-thinking, scientific-reasoning, and problem-solving skills. The student is expected to:
  (A) analyze and evaluate scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing;
  (B) communicate and apply scientific information;
  (C) explain the societal impacts of scientific contributions; and
  (D) research and describe the connections between technologies and future career opportunities.
(7) The student describes and applies the laws governing motion in a variety of situations. The student is expected to:
  (A) generate and interpret relevant equations using graphs and charts for one- and two-dimensional motion, including:
    (i) using and describing one-dimensional equations for displacement, distance, speed, velocity, average velocity, acceleration, and average acceleration;
    (ii) using and describing two-dimensional equations for projectile and circular motion; and
    (iii) using and describing vector forces and resolution;
  (B) describe and calculate the effects of forces on objects, including law of inertia and impulse and conservation of momentum;
  (C) develop and interpret free-body force diagrams; and
  (D) identify and describe motion relative to different frames of reference.
(8) The student describes the nature of forces in the physical world. The student is expected to:
  (A) research and describe the historical development of the concepts of gravitational, electromagnetic, weak nuclear, and strong nuclear forces;
  (B) describe and calculate the magnitude of gravitational forces between two objects;
  (C) describe and calculate the magnitude of electrical forces;
  (D) describe the nature and identify everyday examples of magnetic forces and fields;
  (E) describe the nature and identify everyday examples of electromagnetic forces and fields;
  (F) characterize materials as conductors or insulators based on their electrical properties;
  (G) design and construct both series and parallel circuits and calculate current, potential difference, resistance, and power of various circuits;
  (H) investigate and describe the relationship between electric and magnetic fields in applications such as generators, motors, and transformers; and
  (I) describe technological applications of the strong and weak nuclear forces in nature.
(9) The student describes and applies the laws of the conservation of energy and momentum. The student is expected to:
  (A) describe the transformational process between work, potential energy, and kinetic energy (work-energy theorem);
  (B) use examples to analyze and calculate the relationships among work, kinetic energy, and potential energy;

(C) describe and calculate the mechanical energy of, the power generated within, the impulse applied to, and the momentum of a physical system; and

(D) describe and apply the laws of conservation of energy and conservation of momentum.

(10) The student analyzes the concept of thermal energy. The student is expected to:

(A) describe how the macroscopic properties of a thermodynamic system such as temperature, specific heat, and pressure are related to the molecular level of matter, including kinetic or potential energy of atoms;

(B) contrast and give examples of different processes of thermal energy transfer, including conduction, convection, and radiation; and

(C) analyze and explain technological examples such as solar and wind energy that illustrate the laws of thermodynamics, including the law of conservation of energy and the law of entropy.

(11) The student analyzes the properties of wave motion and optics. The student is expected to:

(A) examine and describe oscillatory motion and wave propagation in various types of media;

(B) investigate and analyze characteristics of waves, including velocity, frequency, amplitude, and wavelength;

(C) investigate and calculate the relationship between wavespeed, frequency, and wavelength;

(D) compare and contrast the characteristics and behaviors of transverse waves, including electromagnetic waves and the electromagnetic spectrum, and longitudinal waves, including sound waves;

(E) investigate behaviors of waves, including reflection, refraction, diffraction, interference, resonance, and the Doppler effect;

(F) describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens; and

(G) describe the role of wave characteristics and behaviors in medical and industrial technology applications.

(12) The student analyzes the concepts of atomic, nuclear, and quantum phenomena. The student is expected to:

(A) describe the photoelectric effect and the dual nature of light;

(B) compare and explain emission spectra produced by various atoms;

(C) describe the significance of mass-energy equivalence and apply it in explanations of phenomena such as nuclear stability, fission, and fusion;

(D) describe the role of mass-energy equivalence for areas such as nuclear stability, fission, and fusion; and

(E) explore technology applications of atomic, nuclear, and quantum phenomena such as nanotechnology, radiation therapy, diagnostic imaging, and nuclear power.

Capítulo 112. Conocimientos y destrezas esenciales en Texas para ciencias

Subcapítulo A. Primaria

§112.11. Ciencias, Kindergarten, empezando el año escolar 2010–2011.

(a) Introducción.

(1) La ciencia, según la define la Academia Nacional de Ciencias, es el "uso de evidencias para elaborar explicaciones comprobables y hacer predicciones de los fenómenos naturales, así como el conocimiento generado a través de este proceso".

(2) En ciencias, matemáticas y tecnología prevalecen ciertos temas recurrentes. Estas ideas trascienden los límites disciplinarios e incluyen patrones, ciclos, sistemas, modelos, así como el cambio y la constancia.

(3) El estudio de las ciencias al nivel de educación primaria incluye la planificación y la implementación en condiciones seguras de investigaciones en el salón de clases y al aire libre usando procesos científicos, incluyendo métodos de investigación, análisis de la información, toma de decisiones informadas y uso de instrumentos para reunir y anotar información considerando al mismo tiempo los principales conceptos y el vocabulario de las ciencias físicas, las ciencias de la Tierra y las ciencias biológicas. Se recomienda que los distritos asignen por lo menos un 80% del tiempo de la instrucción a la realización de investigaciones en el salón de clases y al aire libre.

(4) En Kindergarten, los estudiantes observan y describen la naturaleza usando sus cinco sentidos. Los estudiantes estudian las ciencias por medio de investigaciones para desarrollar y enriquecer su capacidad de comprensión de procesos y conceptos científicos. Los estudiantes desarrollan el vocabulario a través de sus experiencias al investigar las propiedades de objetos comunes, materiales terrestres y organismos.

(A) Un tema central en el estudio de la investigación y el razonamiento científicos; en el de la materia y la energía; en el de la fuerza, el movimiento y la energía; en el de la Tierra y el espacio; y en el de los organismos y el medio ambiente es la participación activa al formular preguntas, comunicar ideas y explorar con instrumentos científicos. La investigación y el razonamiento científicos implican la práctica de procedimientos de seguridad, la formulación de preguntas sobre la naturaleza y la búsqueda de respuestas a esas preguntas a través de observaciones simples e investigaciones descriptivas.

(B) La materia es descrita en términos de sus propiedades físicas, incluyendo tamaño y masa relativos, forma, color y textura. La importancia de la energía luminosa, térmica y del sonido es identificada al relacionarla con la vida diaria de los estudiantes. La ubicación y el movimiento de los objetos también se exploran.

(C) El estado del tiempo se anota y se discute diariamente para que los estudiantes puedan empezar a reconocer sus patrones. Otros patrones pueden observarse en la apariencia de objetos en el cielo.

(D) En las ciencias biológicas, los estudiantes reconocen la interdependencia de los organismos en la naturaleza. Entienden que todos los organismos tienen necesidades básicas que se pueden satisfacer mediante la interacción con seres vivos y objetos

inertes. Los estudiantes investigarán el ciclo de vida de las plantas e identificarán las semejanzas entre los padres y sus descendientes.

(b) Conocimientos y Destrezas.

(1) Investigación y razonamiento científicos. El estudiante realiza investigaciones dentro y fuera del salón de clases siguiendo los procedimientos de seguridad del hogar y de la escuela, y usa prácticas ambientales adecuadas y responsables. Se espera que el estudiante:

(A) identifique y demuestre las prácticas de seguridad como se describen en los Estándares de Seguridad de Texas durante las investigaciones en el salón de clases y al aire libre, incluyendo el uso de lentes de seguridad, lavado de manos y el uso apropiado de materiales;

(B) discuta la importancia de las prácticas de seguridad para protegerse y mantenerse sano a sí mismo y a los demás; y

(C) demuestre cómo usar, conservar y desechar los recursos naturales y materiales, tales como al conservar el agua y reutilizar o reciclar papel, plástico y metal.

(2) Investigación y razonamiento científicos. El estudiante desarrolla habilidades para formular preguntas y buscar respuestas en las investigaciones dentro del salón de clases y al aire libre. Se espera que el estudiante:

(A) haga preguntas acerca de organismos, objetos y eventos observados en la naturaleza;

(B) planifique y realice investigaciones descriptivas simples, tales como la manera en que los objetos se mueven;

(C) reúna información y haga observaciones con equipos simples, tales como lupas, balanzas e instrumentos de medición no usuales;

(D) anote y organice la información y las observaciones usando dibujos, números y palabras; y

(E) comunique sus observaciones con los demás acerca de investigaciones descriptivas simples.

(3) Investigación y razonamiento científicos. El estudiante entiende que la información y el razonamiento crítico se usan en la resolución científica de problemas. Se espera que el estudiante:

(A) identifique y explique un problema, tal como el impacto de arrojar basura en el área de recreo, y proponga una solución con sus propias palabras;

(B) haga predicciones basadas en patrones observables en la naturaleza, tales como la forma de las hojas; y

(C) explore que los científicos investigan diferentes cosas en la naturaleza y usan instrumentos que les ayudan en sus investigaciones.

(4) Investigación y razonamiento científicos. El estudiante usa instrumentos y modelos apropiados para su edad para investigar la naturaleza. Se espera que el estudiante:

(A) reúna información usando instrumentos, incluyendo computadoras, lupas, balanzas, tazas, recipientes, imanes, redes y cuadernos; medidores de tiempo, incluyendo relojes y cronómetros; objetos no usuales para medir, como clips y pinzas de ropa; instrumentos meteorológicos, tales como termómetros y mangas de viento; y materiales que apoyen las observaciones del hábitat de organismos, tales como terrarios y acuarios; y

(B) use los sentidos como un instrumento de observación para identificar propiedades y patrones de organismos, objetos y eventos en el medio ambiente.

(5) Materia y energía. El estudiante entiende que los objetos tienen propiedades y patrones. Se espera que el estudiante:

(A) observe y anote las propiedades de los objetos, incluyendo su masa y tamaño relativos, tales como más grande o más pequeño, más pesado o más liviano, forma, color y textura; y

(B) observe, anote y discuta cómo los materiales pueden cambiar al calentarse o enfriarse.

(6) Fuerza, movimiento y energía. El estudiante entiende que la energía, la fuerza y el movimiento están relacionados y son parte de su vida diaria. Se espera que el estudiante:

(A) use los cinco sentidos para explorar las diferentes formas de energía, tales como la energía luminosa, térmica y del sonido;

(B) examine la interacción entre imanes y distintos materiales;

(C) observe y describa la ubicación de un objeto con relación a otro, tal como arriba, abajo, detrás, enfrente y al lado; y

(D) observe y describa las maneras en que los objetos se pueden mover, tales como en línea recta, en zigzag, hacia arriba y hacia abajo, hacia atrás y hacia adelante, en círculo, rápida y lentamente.

(7) La Tierra y el espacio. El estudiante entiende que en la naturaleza hay materiales terrestres. Se espera que el estudiante:

(A) observe, describa, compare y clasifique las rocas por su tamaño, forma, color y textura;

(B) observe y describa las propiedades físicas de las fuentes naturales de agua, incluyendo color y claridad; y

(C) dé ejemplos de las maneras en que las rocas, el suelo y el agua son útiles.

(8) La Tierra y el espacio. El estudiante entiende que hay patrones reconocibles en la naturaleza y entre los objetos en el cielo. Se espera que el estudiante:

(A) observe y describa los cambios en el estado del tiempo de un día para otro y de una estación del año a otra;

(B) identifique eventos que tienen patrones que se repiten, incluyendo las estaciones del año, el día y la noche; y

(C) observe, describa y dibuje los objetos en el cielo, tales como las nubes, la Luna y las estrellas, incluyendo al Sol.

(9) Organismos y medio ambiente. El estudiante entiende que las plantas y los animales tienen necesidades básicas y que dependen de los seres vivos y los objetos inertes que hay a su alrededor para sobrevivir. Se espera que el estudiante:

(A) pueda diferenciar entre los seres vivos y los objetos inertes basándose en si éstos tienen necesidades básicas y si pueden tener descendientes; y

(B) examine la evidencia de que los organismos vivos tienen necesidades básicas, tales como alimento, agua y refugio para los animales, y agua, aire, nutrientes, luz del sol y espacio para las plantas.

(10) Los organismos y el medio ambiente. El estudiante entiende que los organismos se parecen a sus padres y tienen estructuras y procesos que los ayudan a sobrevivir dentro de su medio ambiente. Se espera que el estudiante:

(A) clasifique plantas y animales en grupos basándose en características físicas, tales como color, tamaño, cubierta del cuerpo o forma de la hoja;

(B) identifique partes de las plantas, tales como raíces, tallo y hojas, y partes de los animales, tales como la cabeza, los ojos y las extremidades;

(C) identifique las maneras en que los brotes de plantas se parecen a sus padres; y

(D) observe los cambios que son parte de un ciclo de vida simple de una planta: semilla, brote, planta, flor y fruto.

§112.12. Ciencias, primer grado, empezando con el año escolar 2010–2011.

(a) Introducción.

(1) La ciencia, según la define la Academia Nacional de Ciencias, es el "uso de evidencias para elaborar explicaciones comprobables y hacer predicciones de los fenómenos naturales, así como el conocimiento generado a través de este proceso".

(2) En ciencias, matemáticas y tecnología prevalecen ciertos temas recurrentes. Estas ideas trascienden los límites disciplinarios e incluyen patrones, ciclos, sistemas, modelos, así como el cambio y la constancia.

(3) El estudio de las ciencias al nivel de educación primaria incluye la planificación y la implementación en condiciones seguras de investigaciones en el salón de clases y al aire libre usando procesos científicos, incluyendo métodos de investigación, análisis de la información, toma de decisiones informadas y uso de instrumentos para reunir y anotar información considerando al mismo tiempo los principales conceptos y el vocabulario de las ciencias físicas, las ciencias de la Tierra y las ciencias biológicas. Se recomienda que los distritos asignen por lo menos un 80% del tiempo de la instrucción a la realización de investigaciones en el salón de clases y al aire libre.

(4) En primer grado, los estudiantes observan y describen la naturaleza usando sus cinco sentidos. Los estudiantes practican la investigación científica para desarrollar y enriquecer su capacidad de comprensión del mundo que los rodea en el contexto de los procesos y conceptos científicos. Los estudiantes desarrollan el vocabulario a través de sus experiencias al investigar las propiedades de objetos comunes, materiales terrestres y organismos.

(A) Un tema central en ciencias en primer grado es la participación activa al hacer preguntas, comunicar ideas y explorar con instrumentos científicos con el fin de explicar conceptos y procesos científicos, como la investigación y el razonamiento científicos; la materia y la energía; la fuerza, el movimiento y la energía; la Tierra y el espacio; y los organismos y el medio ambiente. La investigación y el razonamiento científicos implican la práctica de los procedimientos de seguridad, la formulación de preguntas acerca de la naturaleza y la búsqueda de respuestas a esas preguntas a través de observaciones simples e investigaciones descriptivas.

(B) La materia es descrita en términos de sus propiedades físicas, incluyendo tamaño y masa relativos, forma, color y textura. La importancia de la energía luminosa, térmica y del sonido es identificada al relacionarla con la vida diaria de los estudiantes. La ubicación y el movimiento de los objetos también se exploran.

(C) El estado del tiempo se anota y se discute diariamente para que los estudiantes puedan empezar a reconocer sus patrones. Además, se pueden observar otros patrones en la apariencia de objetos en el cielo.

(D) En las ciencias biológicas, los estudiantes reconocen la interdependencia de los organismos en la naturaleza. Entienden que todos los organismos tienen necesidades básicas que se pueden satisfacer mediante la interacción con seres vivos y objetos inertes. Los estudiantes investigarán el ciclo de vida de los animales e identificarán las semejanzas entre los padres y sus descendientes.

(b) Conocimientos y Destrezas.

(1) Investigación y razonamiento científicos. El estudiante realiza investigaciones dentro y fuera del salón de clases siguiendo los procedimientos de seguridad del hogar y de la escuela, y usa prácticas ambientales adecuadas y responsables. Se espera que el estudiante:

(A) reconozca y demuestre las prácticas de seguridad que se describen en los Estándares de Seguridad de Texas durante las investigaciones en el salón de clases y al aire libre, incluyendo el uso de lentes de seguridad, lavado de manos y el uso apropiado de los materiales;

(B) reconozca la importancia de las prácticas de seguridad para protegerse y mantenerse sano a sí mismo y a los demás; e

(C) identifique y aprenda cómo usar los recursos naturales y materiales, incluyendo la conservación y la reutilización o reciclaje de papel, plástico y metal.

(2) Investigación y razonamiento científicos. El estudiante desarrolla habilidades para formular preguntas y buscar respuestas en las investigaciones dentro del salón de clases y al aire libre. Se espera que el estudiante:

(A) haga preguntas acerca de organismos, objetos y eventos observados en la naturaleza;

(B) planifique y lleve a cabo investigaciones descriptivas simples, tales como la manera en que los objetos se mueven;

(C) reúna información y haga observaciones con equipos simples, tales como lupas, balanzas e instrumentos de medición no usuales;

(D) anote y organice la información usando dibujos, números y palabras; y

(E) comunique observaciones y provea las razones de sus explicaciones usando datos reunidos por estudiantes durante investigaciones descriptivas simples.

(3) Investigación y razonamiento científicos. El estudiante entiende que la información y el razonamiento crítico se usan en la resolución científica de problemas. Se espera que el estudiante:

(A) identifique y explique un problema, tal como encontrar un hogar para una mascota del salón de clases, y proponga una solución con sus propias palabras;

(B) haga predicciones basadas en patrones observables; y

(C) describa qué hacen los científicos.

(4) Investigación y razonamiento científicos. El estudiante usa instrumentos y modelos apropiados para su edad para investigar la naturaleza. Se espera que el estudiante:

(A) reúna, anote y compare información usando instrumentos, incluyendo computadoras, lupas, balanzas, tazas, recipientes, imanes, redes, cuadernos y lentes de seguridad; medidores de tiempo, incluyendo relojes y cronómetros; instrumentos de medición no usuales, como clips y pinzas de ropa; instrumentos meteorológicos, tales como termómetros y mangas de viento; y materiales que apoyen las observaciones del hábitat de los organismos, tales como terrarios y acuarios; y

(B) mida y compare los organismos y los objetos usando unidades no usuales.

(5) Materia y energía. El estudiante entiende que los objetos tienen propiedades y patrones. Se espera que el estudiante:

(A) clasifique los objetos de acuerdo con las propiedades de los materiales con que están hechos, tales como más grande y más pequeño, más pesado y más liviano, forma, color y textura; y

(B) pronostique e identifique cambios en los materiales causados por el calentamiento o enfriamiento, tales como el derretimiento del hielo, el congelamiento del agua y la evaporación del agua.

(6) Fuerza, movimiento y energía. El estudiante entiende que la energía, la fuerza y el movimiento están relacionados y son parte de su vida diaria. Se espera que el estudiante:

(A) identifique y discuta cómo las diferentes formas de energía, tales como la energía luminosa, térmica y del sonido, son importantes en la vida diaria;

(B) pronostique y describa cómo se puede usar un imán para repeler o atraer un objeto;

(C) describa el cambio en la ubicación de un objeto, como cercano a, más cerca de y más lejos de; y

(D) demuestre y anote las maneras en que los objetos se pueden mover, tales como en línea recta, en zigzag, hacia arriba y hacia abajo, hacia atrás y hacia adelante, en círculo, rápida y lentamente.

(7) La Tierra y el espacio. El estudiante entiende que la naturaleza incluye rocas, suelo y agua que se pueden observar en ciclos, patrones y sistemas. Se espera que el estudiante:

(A) observe, compare, describa y clasifique los componentes del suelo por tamaño, textura y color;

(B) identifique y describa una variedad de fuentes naturales de agua, incluyendo arroyos, lagos y océanos; y

(C) reúna evidencia de cómo las rocas, el suelo y el agua ayudan en la fabricación de productos útiles.

(8) La Tierra y el espacio. El estudiante entiende que la naturaleza incluye el aire que nos rodea y los objetos en el cielo. Se espera que el estudiante:

(A) anote información sobre el estado del tiempo, incluyendo la temperatura relativa, como el calor o el frío, despejado o nublado, calmado o con viento y lluvioso o helado;

(B) observe y anote los cambios en la apariencia de objetos que observa en el cielo, tales como las nubes, la Luna y las estrellas, incluyendo al Sol;

(C) identifique las características de las estaciones del año, y del día y la noche; y

(D) demuestre que el aire nos rodea y observe que el viento es aire en movimiento.

(9) Organismos y el medio ambiente. El estudiante entiende que el medio ambiente está formado por las relaciones entre los organismos y los ciclos de vida que ocurren. Se espera que el estudiante:

(A) ordene y clasifique los seres vivos y los objetos inertes basándose principalmente en si tienen o no necesidades básicas y si pueden tener descendencia;

(B) analice y anote los ejemplos de interdependencia encontrados en diferentes situaciones, tales como terrarios y acuarios o entre una mascota y su dueño; y

(C) reúna evidencia de la interdependencia entre los organismos vivos, tales como la transferencia de energía a través de cadenas alimenticias y el uso que hacen los animales de las plantas para obtener refugio.

(10) Organismos y el medio ambiente. El estudiante entiende que los organismos se parecen a sus padres y tienen estructuras y procesos que les ayudan a sobrevivir dentro de su medio ambiente. Se espera que el estudiante:

(A) investigue cómo las características externas de un animal están relacionadas con el lugar donde vive, cómo se mueve y qué come;

(B) identifique y compare las partes de las plantas;

(C) compare las maneras en que los animales jóvenes se parecen a sus padres; y

(D) observe y anote los ciclos de vida de los animales, tales como los de la rana, la gallina y el pez.

§112.13. Ciencias, segundo grado, empezando con el año escolar 2010–2011.

(a) Introducción.

(1) La ciencia, según la define la Academia Nacional de Ciencias, es el "uso de evidencias para elaborar explicaciones comprobables y hacer predicciones de los fenómenos naturales, así como el conocimiento generado a través de este proceso".

(2) En ciencias, matemáticas y tecnología prevalecen ciertos temas recurrentes. Estas ideas trascienden los límites disciplinarios e incluyen patrones, ciclos, sistemas, modelos, así como el cambio y la constancia.

(3) El estudio de las ciencias al nivel de educación primaria incluye la planificación y la implementación en condiciones seguras de investigaciones en el salón de clases y al aire libre usando procesos científicos, incluyendo métodos de investigación, análisis de la información, toma de decisiones informadas y uso de instrumentos para reunir y anotar información considerando al mismo tiempo los principales conceptos y el vocabulario de las ciencias físicas, las ciencias de la Tierra y las ciencias biológicas. Se recomienda que los distritos asignen por lo menos un 60% del tiempo de la instrucción a la realización de investigaciones en el salón de clases y al aire libre.

(4) En segundo grado, la observación y la investigación cuidadosa se usa para aprender acerca de la naturaleza y revelar sus patrones, cambios y ciclos. Los estudiantes deben entender que cierto tipo de preguntas se pueden contestar usando la observación y la investigación, y que la información reunida puede cambiar al realizarse nuevas observaciones. A medida que los estudiantes participan en investigaciones, desarrollan las destrezas necesarias y también desarrollan nuevos conceptos de ciencias.

(A) Dentro del ambiente físico, los estudiantes expanden sus conocimientos en cuanto a las propiedades de los objetos, tales como la forma, masa, temperatura y flexibilidad; luego usan estas propiedades para comparar, clasificar, y después combinar los objetos para hacer algo que antes no podían hacer. Los estudiantes manipulan los objetos para demostrar un cambio en el movimiento y la posición.

(B) Dentro del ambiente natural, los estudiantes observarán las propiedades de los materiales terrestres, así como también los patrones predecibles que ocurren en la Tierra y en el cielo. Los estudiantes entienden que esos patrones se usan para tomar decisiones relacionadas con qué ropa usar, actividades diarias y transporte.

(C) Dentro del ambiente de los seres vivos, los estudiantes exploran patrones, sistemas y ciclos investigando las características de los organismos, los ciclos de vida y las interacciones entre todos los componentes de su hábitat. Los estudiantes examinan cómo los organismos vivos dependen unos de otros y de su medio ambiente.

(b) Conocimientos y Destrezas.

(1) Investigación y razonamiento científicos. El estudiante lleva a cabo investigaciones dentro y fuera del salón de clases siguiendo los procedimientos de seguridad del hogar y de la escuela. Se espera que el estudiante:

(A) identifique y demuestre las prácticas de seguridad que se describen en los Estándares de Seguridad de Texas durante las investigaciones en el salón de clases y al aire libre, incluyendo el uso de lentes de seguridad, lavado de manos y el uso apropiado de materiales;

(B) describa la importancia de las prácticas de seguridad; e

(C) identifique y aprenda cómo usar, conservar y desechar los recursos naturales y materiales, tales como al conservar el agua y reutilizar o reciclar papel, plástico y metal.

(2) Investigación y razonamiento científicos. El estudiante desarrolla las habilidades necesarias para hacer investigaciones científicas dentro y fuera del salón de clases. Se espera que el estudiante:

(A) haga preguntas acerca de organismos, objetos y eventos durante las observaciones y las investigaciones;

(B) planifique y lleve a cabo investigaciones descriptivas, tales como el crecimiento de los organismos;

(C) reúna información obtenida en las observaciones usando equipo simple, como lupas, balanzas, termómetros e instrumentos de medición no usuales;

(D) anote y organice la información usando dibujos, números y palabras;

(E) comunique las observaciones y justifique las explicaciones usando la información reunida por estudiantes durante investigaciones descriptivas simples; y

(F) compare los resultados de las investigaciones con lo que los estudiantes y los científicos saben acerca del mundo.

(3) Investigación y razonamiento científicos. El estudiante entiende que la información y el razonamiento crítico, la resolución científica de problemas y las contribuciones de científicos se usan para la toma de decisiones. Se espera que el estudiante:

(A) identifique y explique un problema con sus propias palabras y proponga una tarea y una solución para el problema, tal como la falta de agua en un hábitat;

(B) haga predicciones basadas en patrones observables; e

(C) identifique que es un científico e investigue qué hacen diferentes científicos.

(4) Investigación y razonamiento científicos. El estudiante usa los instrumentos y modelos apropiados para su edad para investigar la naturaleza. Se espera que el estudiante:

(A) reúna, anote y compare información usando instrumentos, incluyendo computadoras, reglas, lupas, balanzas, vasos de precipitados de plástico, imanes, redes, cuadernos y lentes de seguridad; medidores de tiempo, incluyendo relojes y cronómetros; instrumentos meteorológicos, tales como termómetros, mangas de viento y pluviómetros; y materiales que apoyen las observaciones del hábitat de los organismos, tales como terrarios y acuarios; y

(B) mida y compare organismos y objetos usando unidades no estandarizadas que se aproximan a las unidades métricas.

(5) Materia y energía. El estudiante entiende que la materia tiene propiedades físicas y estas propiedades determinan la forma como se describe, clasifica, cambia y utiliza la materia. Se espera que el estudiante:

(A) clasifique la materia por sus propiedades físicas, incluyendo forma, masa relativa, temperatura relativa, textura, flexibilidad y si el material es sólido o líquido;

(B) compare los cambios en los materiales causados por calentamiento o enfriamiento;

(C) demuestre que hay cosas que pueden hacerse a los materiales que cambian sus propiedades físicas, tales como cortarlos, doblarlos, lijarlos y derretirlos; y

(D) combine materiales para que al juntarlos puedan hacer cosas que no podían hacer por sí mismos, como construir una torre o un puente, y justifique la selección de esos materiales basándose en sus propiedades físicas.

(6) Fuerza, movimiento y energía. El estudiante entiende que las fuerzas causan cambios y que la energía existe en muchas formas. Se espera que el estudiante:

(A) investigue qué efectos tiene sobre un objeto aumentar o disminuir la cantidad de luz, calor y energía del sonido, por ejemplo, cómo el color de un objeto se ve diferente bajo una luz tenue o cómo el calor derrite la mantequilla;

(B) observe e identifique cómo se usan los imanes en la vida diaria;

(C) señale los cambios en la posición de un objeto en un lapso de tiempo, tales como una taza rodando sobre el piso y un carro rodando por una rampa; y

(D) compare los patrones de movimiento de los objetos, tales como deslizarse, rodar y girar.

(7) La Tierra y el espacio. El estudiante entiende que la naturaleza incluye materiales terrestres. Se espera que el estudiante:

(A) observe y describa las rocas por su tamaño, textura y color;

(B) identifique y compare las propiedades de las fuentes naturales de agua dulce y agua salada; y

(C) distinga entre los recursos naturales y los creados por el hombre.

(8) La Tierra y el espacio. El estudiante entiende que hay patrones reconocibles en la naturaleza y entre los objetos en el cielo. Se espera que el estudiante:

(A) mida, anote y haga gráficas sobre la información del estado del tiempo, incluyendo la temperatura, las condiciones del viento, precipitación y nubosidad, para identificar los patrones en esa información;

(B) identifique la importancia de la información sobre el estado del tiempo y la que es de temporada para tomar decisiones relacionadas con qué ropa usar, actividades diarias y el transporte;

(C) explore los procesos en el ciclo del agua, incluyendo la evaporación, condensación y precipitación, y cómo se relacionan con las condiciones meteorológicas; y

(D) observe, describa y anote los patrones de los objetos en el cielo, incluyendo la apariencia de la Luna.

(9) Organismos y medio ambiente. El estudiante entiende que los organismos vivos tienen necesidades básicas que tienen que satisfacer para sobrevivir dentro de su medio ambiente. Se espera que el estudiante:

(A) identifique las necesidades básicas de las plantas y de los animales;

(B) identifique los factores en el medio ambiente, incluyendo la temperatura y la precipitación, que afectan el crecimiento y el comportamiento, tal como la migración, hibernación y el letargo de los seres vivos; y

(C) compare y dé ejemplos de las maneras en que los organismos vivos dependen unos de otros en su medio ambiente, tal como la cadena alimenticia dentro de un jardín, un parque, una playa, un lago o un área de bosque.

(10) Organismos y medio ambiente. El estudiante entiende que los organismos se parecen a sus padres y tienen estructuras y procesos que les ayudan a sobrevivir dentro de su medio ambiente. Se espera que el estudiante:

(A) observe, anote y compare cómo las características físicas y el comportamiento de los animales les ayudan a satisfacer sus necesidades básicas, por ejemplo, cómo las aletas ayudan al pez a moverse y mantener su balance en el agua;

(B) observe, anote y compare cómo las características físicas de las plantas les ayudan a satisfacer sus necesidades básicas, por ejemplo, cómo el tallo conduce agua por toda la planta; e

(C) investigue y anote algunas de las etapas específicas que los insectos experimentan durante su ciclo de vida.

§112.14. Ciencias, tercer grado, empezando con el año escolar 2010–2011.

(a) Introducción.

(1) La ciencia, según la define la Academia Nacional de Ciencias, es el "uso de evidencias para elaborar explicaciones comprobables y hacer predicciones de los fenómenos naturales, así como el conocimiento generado a través de este proceso".

(2) En ciencias, matemáticas y tecnología prevalecen ciertos temas recurrentes. Estas ideas trascienden los límites disciplinarios e incluyen patrones, ciclos, sistemas, modelos, así como el cambio y la constancia.

(3) El estudio de las ciencias al nivel de educación primaria incluye la planificación y la implementación en condiciones seguras de las investigaciones en el salón de clases y al aire libre usando métodos científicos, analizando información, toma de decisiones informadas y uso de instrumentos para reunir y anotar información considerando al mismo tiempo los conceptos principales y el vocabulario de las ciencias físicas, de las ciencias de la Tierra y de las ciencias biológicas. Se recomienda que los distritos asignen por lo menos un 60% del tiempo de la instrucción a la realización de investigaciones en el salón de clases y al aire libre.

(4) En tercer grado, los estudiantes aprenden que el estudio de las ciencias usa instrumentos apropiados y prácticas de seguridad al planificar e implementar investigaciones, al formular y contestar preguntas, al reunir información a través de la observación y medición, y a través del uso de modelos para apoyar las investigaciones científicas acerca de la naturaleza.

(A) Los estudiantes reconocen que existen patrones, relaciones y ciclos en la materia. Los estudiantes investigarán las propiedades físicas de la materia y aprenderán que ocurren cambios. Exploran mezclas e investigan la energía luminosa, del sonido y térmica en la vida diaria. Los estudiantes manipulan objetos al empujarlos y jalarlos para demostrar cambios en el movimiento y la posición.

(B) Los estudiantes investigan cómo la superficie de la Tierra cambia y provee recursos que el hombre usa. Al explorar los objetos en el cielo, los estudiantes describen cómo las relaciones afectan los patrones y los ciclos en la Tierra. Los estudiantes construirán modelos para demostrar las relaciones del sistema entre el Sol, la Tierra y la Luna, y describirán el papel del Sol en el ciclo del agua.

(C) Los estudiantes exploran los patrones, sistemas y ciclos del medio ambiente al investigar las características de los organismos, los ciclos de vida y las interacciones entre todos los componentes del ambiente natural. Los estudiantes examinan cómo el medio ambiente juega un papel clave en la sobrevivencia. Los estudiantes entienden que cuando se producen cambios en el medio ambiente los organismos pueden prosperar, enfermarse o perecer.

(b) Conocimientos y Destrezas.

(1) Investigación y razonamiento científicos. El estudiante lleva a cabo investigaciones dentro y fuera del salón de clases siguiendo los procedimientos de seguridad del hogar y de la escuela, y prácticas ambientales adecuadas. Se espera que el estudiante:

(A) demuestre las prácticas de seguridad que se describen en los Estándares de Seguridad de Texas durante las investigaciones al aire libre y en el salón de clases, incluyendo observar un hábitat en el área de recreo de la escuela;

(B) tome decisiones informadas sobre el uso y conservación de los recursos naturales a través del reciclaje y reutilización de materiales, tales como papel, latas de aluminio y plásticos.

(2) Investigación y razonamiento científicos. El estudiante usa métodos de investigación científica durante investigaciones en el laboratorio y al aire libre. Se espera que el estudiante:

(A) planifique e implemente investigaciones descriptivas, incluyendo formular y contestar preguntas, hacer inferencias, y seleccionar y usar el equipo y la tecnología que se necesite, para resolver un problema específico en la naturaleza;

(B) reúna información al observar y medir usando el sistema métrico, y reconozca la diferencia entre datos observados y datos medidos;

(C) construya mapas, organizadores gráficos, tablas simples, carteles y gráficas de barras usando instrumentos y tecnología actual para organizar, examinar y evaluar los datos medidos;

(D) analice e interprete patrones en la información y elabore explicaciones razonables basadas en las evidencias obtenidas en las investigaciones;

(E) demuestre que repetir las investigaciones puede aumentar la confiabilidad de los resultados; y

(F) comunique conclusiones válidas apoyadas en información escrita, en dibujos y a través de la discusión oral.

(3) Investigación y razonamiento científicos. El estudiante entiende que la información, el razonamiento crítico, la resolución científica de problemas y las contribuciones de los científicos se usan para tomar decisiones. Se espera que el estudiante:

(A) analice, evalúe y critique las explicaciones científicas en todos los campos de las ciencias a través del uso de la evidencia empírica, el razonamiento lógico y las pruebas experimentales y de observación, incluyendo un examen desde todos los

ángulos de la evidencia científica de esas explicaciones científicas, de tal manera que se fomente el razonamiento crítico en el estudiante;

(B) haga inferencias y evalúe la exactitud de la información que aparece en las etiquetas de los productos y materiales promocionales, tales como juguetes y alimentos;

(C) represente la naturaleza usando modelos, tales como los volcanes, el sistema formado por el Sol, la Tierra y la Luna e identifique sus limitaciones, incluyendo el tamaño, las propiedades y los materiales; y

(D) relacione los conceptos de ciencias apropiados al nivel del grado con la historia de las ciencias, las carreras científicas y las contribuciones de científicos.

(4) Investigación y razonamiento científicos. El estudiante entiende cómo usar una variedad de instrumentos y métodos para realizar investigaciones científicas. Se espera que el estudiante:

(A) reúna, anote y analice información usando instrumentos, incluyendo microscopios, cámaras, computadoras, lupas, reglas métricas, termómetros en grados Celsius, mangas de viento, pluviómetros, balanza de platillos, cilindros graduados, vasos de precipitados, básculas, hornillas, metros, brújulas, imanes, redes, cuadernos, grabadoras y modelos del sistema del Sol, la Luna y la Tierra; medidores de tiempo, incluyendo relojes y cronómetros; y materiales que apoyen las observaciones del hábitat de los organismos, tales como terrarios y acuarios; y

(B) use el equipo apropiado de seguridad, incluyendo lentes y guantes de seguridad.

(5) Materia y energía. El estudiante entiende que la materia tiene propiedades físicas que se pueden medir y estas propiedades determinan cómo la materia es clasificada, cambiada y usada. Se espera que el estudiante:

(A) mida, pruebe y anote las propiedades físicas de la materia, incluyendo la temperatura, la masa, el magnetismo y la habilidad para hundirse o flotar;

(B) describa y clasifique ejemplos de materia, tales como sólidos, líquidos y gases, y demuestre que los sólidos tienen una forma definida, y que los líquidos y los gases toman la forma de su recipiente;

(C) pronostique, observe y anote los cambios en el estado de la materia causados por el calentamiento o el enfriamiento; y

(D) explore y reconozca que una mezcla se crea cuando dos materiales son combinados, tales como grava y arena, y clips de metal y de plástico.

(6) Fuerza, movimiento y energía. El estudiante entiende que las fuerzas producen cambios y que la energía existe en muchas formas. Se espera que el estudiante:

(A) explore diferentes formas de energía, incluyendo la energía mecánica, luminosa, del sonido y térmica, en la vida diaria;

(B) demuestre y observe cómo la posición y el movimiento pueden cambiar al empujar y jalar objetos para mostrar el trabajo realizado, tales como los que se ven en columpios, pelotas, poleas y carritos; y

(C) observe fuerzas, tales como el magnetismo y la gravedad, actuando sobre los objetos.

(7) La Tierra y el espacio. El estudiante entiende que la Tierra está formada por recursos naturales y que su superficie cambia constantemente. Se espera que el estudiante:

(A) explore y anote cómo se forman los suelos a través de la degradación de las rocas y la descomposición de restos de plantas y animales;

(B) investigue los cambios rápidos en la superficie de la Tierra, tales como erupciones volcánicas, terremotos y derrumbes de tierra;

(C) identifique y compare los distintos accidentes geográficos, incluyendo montañas, colinas, valles y llanuras; y

(D) explore las características de los recursos naturales que los hacen útiles como productos y materiales, tales como ropa y muebles, y cómo los recursos se pueden conservar.

(8) La Tierra y el espacio. El estudiante entiende que hay patrones reconocibles en la naturaleza y entre los objetos en el cielo. Se espera que el estudiante:

(A) observe, mida, anote y compare los cambios diarios en el estado del tiempo en distintos lugares al mismo tiempo, incluyendo la temperatura del aire, la dirección del viento y la precipitación;

(B) describa y dibuje al Sol como una estrella compuesta por gases que provee energía luminosa y térmica para el ciclo del agua;

(C) construya modelos que demuestren la relación del Sol, la Tierra y la Luna, incluyendo órbitas y posiciones; e

(D) identifique los planetas en nuestro sistema solar y sus posiciones con relación al Sol.

(9) Organismos y medio ambiente. El estudiante entiende que los organismos tienen características que les ayudan a sobrevivir y pueden describir patrones, ciclos, sistemas y relaciones dentro del medio ambiente. Se espera que el estudiante:

(A) observe y describa las características del medio ambiente y cómo éstas sustentan a poblaciones y comunidades dentro de un ecosistema;

(B) identifique y describa el flujo de energía en una cadena alimenticia y pronostique cómo los cambios en la cadena alimenticia, tales como quitar las ranas de un estanque o las abejas de un campo, afectan al ecosistema; y

(C) describa los cambios en el medio ambiente, tales como inundaciones y sequías, donde algunos organismos prosperan y otros perecen o se van a un nuevo lugar.

(10) Organismos y medio ambiente. El estudiante entiende que los organismos pasan por procesos de vida similares y tienen estructuras que les ayudan a sobrevivir en su medio ambiente. Se espera que el estudiante:

(A) examine cómo las estructuras y las funciones de las plantas y animales les permiten sobrevivir en un medio ambiente en particular;

(B) examine que algunas características de los organismos son heredadas, tales como la cantidad de extremidades en un animal o el color de una flor, y reconozca que algunos comportamientos son aprendidos como resultado de vivir en cierto medio ambiente, como cuando un animal usa herramientas para obtener alimento; e

(C) investigue y compare cómo animales y plantas sufren una serie de cambios ordenados en sus diversos ciclos de vida, tales como los de las plantas de tomate, las ranas y los escarabajos.

§112.15. Ciencias, cuarto grado, empezando con el año escolar 2010–2011.

(a) Introducción.

(1) La ciencia, según la define la Academia Nacional de Ciencias, es el "uso de evidencias para elaborar explicaciones comprobables y hacer predicciones de los fenómenos naturales, así como el conocimiento generado a través de este proceso".

(2) En ciencias, matemáticas y tecnología prevalecen ciertos temas recurrentes. Estas ideas trascienden los límites disciplinarios e incluyen patrones, ciclos, sistemas, modelos, así como el cambio y la constancia.

(3) El estudio de las ciencias al nivel de educación primaria incluye la planificación y la implementación en condiciones seguras de investigaciones en el salón de clases y al aire libre usando procesos científicos, incluyendo métodos de investigación, análisis de la información, toma de decisiones informadas y uso de instrumentos para reunir y anotar información considerando al mismo tiempo los principales conceptos y el vocabulario de las ciencias físicas, las ciencias de la Tierra y las ciencias biológicas. Se recomienda que los distritos asignen por lo menos un 50% del tiempo de la instrucción a la realización de investigaciones en el salón de clases y al aire libre.

(4) En cuarto grado, se usan investigaciones para aprender acerca de la naturaleza. Los estudiantes deben entender que ciertos tipos de preguntas pueden ser contestadas mediante las investigaciones y que las conclusiones, los métodos y modelos obtenidos a través de estas investigaciones cambian a medida que se hacen nuevas observaciones. Los modelos de objetos y eventos son herramientas para entender la naturaleza y pueden demostrar cómo funcionan los sistemas. Estos modelos tienen limitaciones y están siendo modificados constantemente gracias a nuevos descubrimientos para reflejar con mayor precisión la naturaleza.

(A) Dentro del medio ambiente natural, los estudiantes entienden que los materiales terrestres tienen propiedades que constantemente están cambiando debido a las fuerzas de la Tierra. Los estudiantes aprenden que la naturaleza está formada por recursos, incluyendo los renovables y los no renovables, y entienden su responsabilidad para conservar nuestros recursos naturales para las futuras generaciones. También explorarán las relaciones entre el Sol, la Tierra y la Luna. Los estudiantes reconocerán que nuestra mayor fuente de energía es el Sol.

(B) Dentro del medio ambiente de los seres vivos, los estudiantes saben y entienden que los organismos vivos dentro de un ecosistema interactúan entre sí y con su medio ambiente. Los estudiantes reconocerán que las plantas y animales tienen necesidades básicas, y que éstas se satisfacen a través del flujo de energía que se conoce como red alimenticia. Los estudiantes explorarán que todos los organismos vivos pasan por un ciclo de vida y cómo las adaptaciones permiten a los organismos sobrevivir en su ecosistema.

(b) Conocimientos y Destrezas.

(1) Investigación y razonamiento científicos. El estudiante lleva a cabo investigaciones dentro y fuera del salón de clases siguiendo procedimientos de seguridad de la escuela y del hogar, y prácticas ambientales adecuadas y éticas. Se espera que el estudiante:

(A) demuestre las prácticas de seguridad y el uso del equipo de seguridad que se describen en los Estándares de Seguridad de Texas durante las clases y las investigaciones al aire libre; y

(B) tome decisiones informadas sobre el uso y la conservación de los recursos naturales a través del reciclaje y reutilización de materiales, tales como papel, aluminio, vidrio, latas y plástico.

(2) Investigación y razonamiento científicos. El estudiante usa el método de investigación científica en el laboratorio y al aire libre. Se espera que el estudiante:

(A) planifique e implemente investigaciones descriptivas, incluyendo formular preguntas bien definidas, hacer inferencias, y seleccionar y usar el equipo o la tecnología apropiados para contestar sus preguntas;

(B) reúna y anote información al observar y medir usando el sistema métrico, y usando palabras descriptivas y números, tales como dibujos rotulados, escritos y mapas conceptuales;

(C) construya tablas simples, carteles, gráficas de barras y mapas usando herramientas y tecnología actual para organizar, examinar y evaluar la información;

(D) analice información e interprete patrones para elaborar explicaciones razonables sobre información que puede ser observada y medida;

(E) repita investigaciones para aumentar la confiabilidad de los resultados; y

(F) comunique resultados válidos, oralmente y por escrito, que estén apoyados en la información.

(3) Investigación y razonamiento científicos. El estudiante usa el razonamiento crítico y la resolución científica de problemas para tomar decisiones informadas. Se espera que el estudiante:

(A) analice, evalúe y critique las explicaciones científicas en todos los campos de las ciencias a través del uso de la evidencia empírica, el razonamiento lógico y las pruebas experimentales y de observación, incluyendo un examen desde todos los ángulos de la evidencia científica de esas explicaciones científicas, de tal manera que se fomente el razonamiento crítico en el estudiante;

(B) haga inferencias y evalúe la exactitud de la información que aparece en las etiquetas y de los productos y materiales promocionales, tales como juguetes, alimentos y crema protectora solar;

(C) represente la naturaleza usando modelos, tales como ríos, modelos de corrientes de agua y fósiles, e identifique sus limitaciones, incluyendo su exactitud y tamaño; y

(D) relacione los conceptos de ciencias apropiados al nivel del grado con la historia de las ciencias, las carreras científicas y las contribuciones de científicos.

(4) Investigación y razonamiento científicos. El estudiante entiende cómo usar una variedad de herramientas, materiales, equipos y modelos para realizar investigaciones científicas. Se espera que el estudiante:

(A) reúna, anote y analice la información usando instrumentos, incluyendo calculadoras, microscopios, cámaras, computadoras, lupas, reglas métricas, termómetros en grados Celsius, espejos, básculas, balanzas de platillos, balanzas de tres brazos, cilindros graduados, vasos de precipitados, hornillas, cintas métricas, brújulas, imanes, redes y cuadernos; medidores de tiempo, incluyendo relojes y cronómetros; y materiales que apoyen las observaciones del hábitat de los organismos, tales como terrarios y acuarios; y

(B) use el equipo apropiado de seguridad, incluyendo lentes y guantes de seguridad.

(5) Materia y energía. El estudiante entiende que la materia tiene propiedades físicas que se pueden medir y estas propiedades determinan cómo la materia es clasificada, cambiada y usada. Se espera que el estudiante:

(A) mida, compare y contraste las propiedades físicas de la materia, incluyendo tamaño, masa, volumen, estados (sólido, líquido y gaseoso), temperatura, magnetismo y la habilidad para hundirse o flotar;

(B) haga predicciones de los cambios causados por el calor o el frío, tales como cuando el hielo se convierte en agua líquida y la condensación que se forma en la parte de afuera de un vaso con agua helada; y

(C) compare y contraste una variedad de mezclas y soluciones, tales como rocas en arena, arena en agua o azúcar en agua.

(6) Fuerza, movimiento y energía. El estudiante entiende que la energía existe en muchas formas y que se puede observar en ciclos, patrones y sistemas. Se espera que el estudiante:

(A) distinga entre las formas de energía, incluyendo la energía del sonido, mecánica, eléctrica, luminosa y térmica;

(B) distinga entre conductores y aislantes;

(C) demuestre que la electricidad viaja en un circuito cerrado creando un circuito eléctrico, y explore un campo electromagnético; y

(D) diseñe un experimento para probar el efecto de la fuerza sobre un objeto, tales como al empujarlo o jalarlo, la fuerza de gravedad, la fricción o el magnetismo.

(7) La Tierra y el espacio. El estudiante entiende que la Tierra está formada por recursos útiles y que su superficie cambia constantemente. Se espera que el estudiante:

(A) examine las propiedades de los suelos, incluyendo color y textura, capacidad de retener agua y capacidad para sustentar el crecimiento de las plantas;

(B) observe e identifique los cambios lentos que ocurren en la superficie de la Tierra causados por la degradación, la erosión y la sedimentación del agua, el viento y el hielo; e

(C) identifique y clasifique los recursos renovables de la Tierra, incluyendo el aire, plantas, agua y animales, así como los recursos no renovables, incluyendo el carbón mineral, petróleo y gas natural, y la importancia de conservarlos.

(8) La Tierra y el espacio. El estudiante entiende que hay patrones reconocibles en la naturaleza y entre el sistema formado por el Sol, la Tierra y la Luna. Se espera que el estudiante:

(A) mida y anote los cambios en el estado del tiempo y haga predicciones usando mapas del estado del tiempo, y símbolos y claves en mapas del estado del tiempo;

(B) describa e ilustre el movimiento continuo del agua en la tierra, en la superficie y por encima de esta, durante el ciclo del agua y explique el papel del Sol como fuente principal de energía en este proceso; y

(C) reúna y analice información para identificar secuencias y prediga los patrones de cambio en las sombras, mareas, estaciones del año y en la apariencia observable de la Luna a través del tiempo.

(9) Organismos y medio ambiente. El estudiante sabe y entiende que los organismos vivos dentro de un ecosistema interactúan entre sí y con su medio ambiente. Se espera que el estudiante:

(A) investigue que la mayoría de los productores necesitan luz solar, agua y dióxido de carbono para producir su alimento, mientras que los consumidores dependen de otros organismos para alimentarse; y

(B) describa el flujo de energía a través de las redes alimenticias, comenzando con el Sol, y pronostique cómo los cambios en el ecosistema afectan la red alimenticia, tales como un incendio en un bosque.

(10) Organismos y medio ambiente. El estudiante entiende que los organismos pasan por procesos de vida similares y tienen estructuras que les ayudan a sobrevivir en su medio ambiente. Se espera que el estudiante:

(A) explore cómo las adaptaciones permiten a los organismos sobrevivir en su medio ambiente, como al comparar los picos de los pájaros y las hojas de las plantas;

(B) demuestre que algunas similitudes entre los padres y sus descendientes son heredadas y que se transmiten de generación en generación, tales como el color de ojos en los seres humanos o la forma de las hojas en las plantas. Otras similitudes son aprendidas, tales como los modales en la mesa, leer un libro y una foca que puede equilibrar una pelota con su nariz;

(C) explore, dibuje y compare los ciclos de vida en los organismos vivos, tales como los de las mariposas, escarabajos, rábanos o frijoles.

§112.16. Ciencias, quinto grado, empezando con el año escolar 2010–2011.

(a) Introducción.

(1) La ciencia, según la define la Academia Nacional de Ciencias, es el "uso de evidencias para elaborar explicaciones comprobables y hacer predicciones de los fenómenos naturales, así como el conocimiento generado a través de este proceso".

(2) En ciencias, matemáticas y tecnología prevalecen ciertos temas recurrentes. Estas ideas trascienden los límites disciplinarios e incluyen patrones, ciclos, sistemas, modelos, así como el cambio y la constancia.

(3) El estudio de las ciencias al nivel de educación primaria incluye la planificación y la implementación en condiciones seguras de investigaciones en el salón de clases y al aire libre usando procesos científicos, incluyendo métodos de investigación, análisis de la información, toma de decisiones informadas y uso de instrumentos para reunir y anotar información considerando al mismo tiempo los principales conceptos y el vocabulario de las ciencias físicas, las ciencias de la Tierra y las ciencias biológicas. Se recomienda que los distritos asignen por lo menos un 50% del tiempo de la instrucción a la realización de investigaciones en el salón de clases y al aire libre.

(4) En quinto grado, se usan investigaciones para aprender acerca de la naturaleza. Los estudiantes deben entender que ciertos tipos de preguntas se pueden contestar mediante investigaciones y que las conclusiones, los métodos y modelos obtenidos a través de estas investigaciones cambian a medida que se hacen nuevas observaciones. Los modelos de objetos y eventos son herramientas para entender la naturaleza y pueden demostrar cómo funcionan los sistemas. Sin embargo, estos modelos tienen limitaciones y están siendo modificados constantemente gracias a nuevos descubrimientos para reflejar con mayor precisión la naturaleza.

(A) Dentro del medio ambiente físico, los estudiantes aprenden acerca de las propiedades físicas de la materia, incluyendo magnetismo, estados físicos de la

materia, densidad relativa, solubilidad en el agua y la capacidad de conducir o aislar la energía eléctrica y térmica. Los estudiantes exploran el uso de la energía luminosa, térmica, eléctrica y del sonido.

(B) Dentro del medio ambiente natural, los estudiantes aprenden cómo ocurren cambios sobre la superficie de la Tierra y qué patrones predecibles se producen en el cielo. Los estudiantes aprenden que la naturaleza está formada por recursos naturales, incluyendo los no renovables, los renovables y las fuentes alternativas de energía.

(C) Dentro del medio ambiente de los seres vivos, los estudiantes aprenden que la estructura y la función de los organismos puede incrementar la capacidad de sobrevivir de los miembros de una especie. Los estudiantes aprenden a diferenciar entre características heredadas y comportamientos aprendidos. Los estudiantes aprenden que los ciclos de vida ocurren en animales y plantas, y que el ciclo del dióxido de carbono-oxígeno ocurre en forma natural para mantener la vida en el medio ambiente.

(b) Conocimientos y Destrezas.

(1) Investigación y razonamiento científicos. El estudiante lleva a cabo investigaciones dentro y fuera del salón de clases siguiendo procedimientos de seguridad aprendidos en la escuela y el hogar, así como prácticas ambientales adecuadas y éticas. Se espera que el estudiante:

(A) demuestre el uso de prácticas de seguridad y el uso del equipo de seguridad que se describen en los Estándares de Seguridad de Texas durante investigaciones en la clase y al aire libre; y

(B) tome decisiones informadas sobre la conservación, el desecho y el reciclaje de materiales.

(2) Investigación y razonamiento científicos. El estudiante usa métodos científicos durante las investigaciones en el laboratorio y al aire libre. Se espera que el estudiante:

(A) describa, planifique e implemente investigaciones experimentales sencillas probando una variable;

(B) formule preguntas bien definidas, formule hipótesis comprobables y seleccione y use apropiadamente el equipo y la tecnología;

(C) reúna información a través de observaciones detalladas y medición precisa;

(D) analice e interprete información para elaborar explicaciones razonables usando evidencia directa (observable) y la indirecta (inferida);

(E) demuestre que repetir investigaciones puede aumentar la confiabilidad de los resultados;

(F) comunique conclusiones válidas en forma escrita y oral; y

(G) construya gráficas simples, tablas y mapas apropiados usando tecnología, incluyendo computadoras para organizar, examinar y evaluar la información.

(3) Investigación y razonamiento científicos. El estudiante usa el razonamiento crítico y la resolución científica de problemas para tomar decisiones informadas. Se espera que el estudiante:

(A) analice, evalúe y critique las explicaciones científicas en todos los campos de las ciencias usando la evidencia empírica, el razonamiento lógico y pruebas experimentales y de observación, incluyendo un examen desde todos los ángulos de la evidencia científica de esas explicaciones científicas, de tal manera que se fomente el razonamiento crítico en el estudiante;

(B) evalúe la exactitud de la información relacionada con materiales de promoción de productos y servicios, tales como las etiquetas de información nutricional;

(C) dibuje o desarrolle un modelo que represente cómo funcionan o cómo son algunas cosas que no se pueden ver, tales como el funcionamiento de una máquina de refrescos; y

(D) relacione los conceptos de ciencias apropiados al nivel del grado con la historia de las ciencias, las carreras científicas y las contribuciones de científicos.

(4) Investigación y razonamiento científicos. El estudiante entiende cómo usar una variedad de instrumentos y métodos para realizar una investigación científica. Se espera que el estudiante:

(A) reúna, anote y analice información usando instrumentos, incluyendo calculadoras, microscopios, cámaras, computadoras, lupas, reglas métricas, termómetros en grados Celsius, prismas, espejos, balanzas de platillos, balanzas de tres brazos, básculas, cilindros graduados, vasos de precipitados, hornillas, metros, imanes, redes, cuadernos; medidores de tiempo, incluyendo relojes y cronómetros; y materiales que apoyen observaciones de los hábitats u organismos, tales como terrarios y acuarios; y

(B) use equipo de seguridad, incluyendo lentes y guantes de seguridad.

(5) Materia y energía. El estudiante entiende que la materia tiene propiedades físicas que se pueden medir y estas propiedades determinan cómo la materia es clasificada, cambiada y usada. Se espera que el estudiante:

(A) clasifique la materia basándose en las propiedades físicas, incluyendo masa, magnetismo, estado físico (sólido, líquido y gaseoso), densidad relativa (capacidad de hundirse y flotar), solubilidad en agua y la capacidad para conducir o aislar la energía térmica o eléctrica;

(B) identifique los puntos de ebullición y de congelamiento/fusión del agua en la escala de grados Celsius o centígrados;

(C) demuestre que las mezclas mantienen propiedades físicas de sus componentes, tales como las limaduras de hierro y la arena; e

(D) identifique los cambios que ocurren en las propiedades físicas de los componentes de las soluciones, tales como al disolver sal en agua o añadir jugo de limón al agua.

(6) Fuerza, movimiento y energía. El estudiante entiende que la energía existe en muchas formas y que se puede observar en ciclos, patrones y sistemas. Se espera que el estudiante:

(A) explore los usos de la energía, incluyendo la energía mecánica, luminosa, térmica, eléctrica y del sonido;

(B) demuestre que el flujo de energía eléctrica en los circuitos requiere un recorrido completo a través del cual la corriente eléctrica puede pasar y producir luz, calor y sonido;

(C) demuestre que la luz viaja en línea recta hasta que choca con un objeto o viaja de un medio a otro y demuestre que la luz puede ser reflejada, como cuando se usan espejos u otras superficies brillantes, y refractada, como cuando se observa la apariencia de un objeto a través del agua; y

(D) diseñe un experimento que pueda probar el efecto de la fuerza sobre un objeto.

(7) La Tierra y el espacio. El estudiante entiende que la superficie de la Tierra cambia constantemente y está formada por recursos útiles. Se espera que el estudiante:

(A) explore los procesos que llevaron a la formación de rocas sedimentarias y combustibles fósiles;

(B) reconozca que los accidentes geográficos, tales como deltas, cañones y dunas de arena, son el resultado de los cambios en la superficie terrestre causados por el viento, el agua y el hielo;

(C) identifique fuentes alternativas de energía, tales como la energía del viento, energía solar, hidroeléctrica, geotérmica y la energía que se obtiene de los biocombustibles; e

(D) identifique fósiles como evidencia de organismos vivos que existieron en el pasado y las características del medio ambiente de esa época usando modelos.

(8) La Tierra y el espacio. El estudiante entiende que hay patrones reconocibles en la naturaleza y en el sistema formado por el Sol, la Tierra y la Luna. Se espera que el estudiante:

(A) distinga entre el estado del tiempo y el clima;

(B) explique cómo el Sol y los océanos interactúan en el ciclo del agua;

(C) demuestre que la Tierra gira sobre su propio eje una vez cada 24 horas causando el ciclo día/noche y el movimiento aparente del Sol en el cielo; e

(D) identifique y compare las características físicas del Sol, la Tierra y la Luna.

(9) Organismos y medio ambiente. El estudiante entiende que hay relaciones, sistemas y ciclos en distintos ambientes. Se espera que el estudiante:

(A) observe la manera en que viven y sobreviven los organismos en su ecosistema al interactuar con otros seres vivos y con objetos inertes;

(B) describa cómo el flujo de energía derivada del Sol es utilizado por los productores para producir su propio alimento, es transferida a través de cadenas y redes alimenticias a los consumidores y descomponedores;

(C) pronostique los efectos de los cambios en los ecosistemas causados por organismos vivos, incluyendo a los seres humanos, tales como el pastoreo excesivo o la construcción de carreteras; e

(D) identifique la importancia del ciclo del dióxido de carbono-oxígeno para la sobrevivencia de plantas y animales.

(10) Organismos y medio ambiente. El estudiante entiende que los organismos pasan por procesos de vida similares y tienen estructuras que les ayudan a sobrevivir en su medio ambiente. Se espera que el estudiante:

(A) compare las estructuras y funciones de las diferentes especies que les ayudan a vivir y sobrevivir, tales como las pezuñas en los animales de las praderas o los pies palmeados de los animales acuáticos;

(B) distinga entre las características heredadas de plantas y animales, tales como las espinas en los cactus o la forma del pico en las aves, y los comportamientos aprendidos, como cuando un animal aprende trucos o un niño aprende a manejar una bicicleta; y

(C) describa las diferencias entre una metamorfosis completa e incompleta de los insectos.

Chapter 130. Texas Essential Knowledge and Skills for Careeer and Technical Education

Subchapter A. Agriculture, Food, and Natural Resources

§130.7. Advanced Animal Science.

(a) General requirements. This course is recommended for students in Grade 12. Recommended prerequisite: a minimum of one credit from the courses in the Agriculture, Food, and Natural Resources cluster. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Advanced Animal Science. To be prepared for careers in the field of animal science, students need to attain academic skills and knowledge, acquire knowledge and skills related to animal systems, and develop knowledge and skills regarding career opportunities, entry requirements, and industry standards. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills in a variety of settings. This course examines the interrelatedness of human, scientific, and technological dimensions of livestock production. Instruction is designed to allow for the application of scientific and technological aspects of animal science through field and laboratory experiences.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment,

but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses scientific methods and equipment during field and laboratory investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools and equipment;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of science and contributions of scientists.

(4) The student evaluates the employability characteristics of an employee. The student is expected to:

(A) identify career development and entrepreneurship opportunities in the field of animal systems;

(B) apply competencies related to resources, information, interpersonal skills, and systems of operation in animal systems;

(C) demonstrate knowledge of personal and occupational safety and health practices in the workplace; and

(D) identify employers' expectations, including appropriate work habits, ethical conduct, legal responsibilities, and good citizenship skills.

(5) The student demonstrates principles relating to the human, scientific, and technological dimensions of scientific animal agriculture and the resources necessary for producing domesticated animals. The student is expected to:

(A) evaluate market classes and grades of livestock;

(B) identify animal products and consumption patterns relative to human diet and health issues; and

(C) describe the growth and development of livestock as a global commodity.

(6) The student applies the principles of reproduction and breeding to livestock improvement. The student is expected to:

(A) describe reproductive cycles and relate them to breeding systems;

(B) explain the embryo transfer process and how it can impact the livestock industries;

(C) recognize the significance of meiosis to sexual reproduction; and

(D) evaluate animal behavior and its relationship to livestock management.

(7) The student applies the principles of molecular genetics and heredity. The student is expected to:

(A) explain Mendel's laws of inheritance by predicting genotypes and phenotypes of offspring using the Punnett square;

(B) explain the inheritance of sex-linked characteristics and provide some examples found in animals;

(C) identify and compare the three parts of nucleic acids;

(D) explain the functions of nucleic acids;

(E) describe how heredity is used in the selection of livestock; and

(F) explain how traits are passed from parent to offspring through genetic transfer and the implications of breeding practices.

(8) The student examines and compares animal anatomy and physiology in livestock species. The student is expected to:

(A) identify and compare the external anatomy of a variety of livestock species;

(B) compare the anatomy and physiology of the skeletal, muscular, reproductive, digestive, circulatory, genito-urinary, respiratory, nervous, and endocrine systems of animals;

(C) describe interactions among various body systems such as circulatory, respiratory, and muscular systems; and

(D) identify and describe the functions of epithelial, connective, and muscular tissue and relate these to animal body systems.

(9) The student determines nutritional requirements of ruminant and non-ruminant animals. The student is expected to:

(A) describe the structures and functions of the digestive system of ruminant and non-ruminant animals, including poultry and cattle;

(B) identify and describe sources of nutrients and classes of feeds and relate to the ruminant and non-ruminant animals;

(C) identify and describe vitamins, minerals, and feed additives and how they relate to the nutritional requirements of ruminant and non-ruminant animals;

(D) formulate rations based on different nutritional requirements;

(E) analyze feeding practices in relation to nutritional requirements of animals; and

(F) analyze feed quality issues and determine their effect on animal health.

(10) The student evaluates animal diseases and parasites. The student is expected to:

(A) identify factors that influence the health of animals such as geographic location, age, genetic composition, and inherited diseases to a particular species;

(B) identify pathogens and describe the effects that diseases have on various body systems;

(C) explain the methods of prevention, control, and treatment for diseases;

(D) describe the process of immunity and disease transmission;

(E) explain how parasites are transmitted and the effect they have on the host;

(F) explain the methods of prevention, control, and treatment of internal and external parasites;

(G) describe the life cycles of various parasites and relate them to animal health issues; and

(H) conduct parasite diagnostic tests.

(11) The student defines how an organism grows and how specialized cells, tissues, and organs develop. The student is expected to:

(A) compare cells from different parts of animals, including epithelia, muscles, and bones, to show specialization of structure and function;

(B) describe and explain cell differentiation in the development of organisms; and

(C) sequence the levels of organization in animals and relate the parts to each other and to the whole.

(12) The student recognizes policies and issues in animal science. The student is expected to:

(A) discuss the impacts of biotechnology on the production of livestock such as cloning, artificial insemination, and freezing of semen and embryos;

(B) analyze the issues surrounding animal welfare and the humane treatment of livestock;

(C) apply principles of nutrition to maximize feed efficiency for livestock; and

(D) design, conduct, and complete research to solve a self-identified problem in scientific animal agriculture.

(13) The student discusses livestock harvesting operations. The student is expected to:

(A) map the stages of animal growth and development as it relates to market readiness;

(B) describe the harvesting process;

(C) describe federal and state meat inspection standards such as safety, hygiene, and quality control; and

(D) identify retail and wholesale cuts of meat and meat by-products and correlate to major muscle groups.

(14) The student explores methods of marketing livestock. The student is expected to:

(A) compare various methods of marketing livestock; and

(B) describe methods of marketing meat and meat products.

(15) The student develops an advanced supervised agriculture experience program as it relates to agriculture, food, and natural resources. The student is expected to:

(A) plan, propose, conduct, and evaluate entrepreneurship; placement; exploratory; research, either experimental or analytical; improvement; supplementary; laboratory-based; or other identified, supervised agricultural experience as an experiential learning activity;

(B) apply proper record-keeping skills as they relate to a supervised experience;

(C) design and use a customized record-keeping system for the individual supervised experience;

(D) participate in youth leadership opportunities to create a well-rounded experience program in agriculture; and

(E) produce a challenging approach for a local program of activities in agriculture.

§130.21. Advanced Plant and Soil Science.

(a) General requirements. This course is recommended for students in Grade 12. Recommended prerequisite: a minimum of one credit from the courses in the Agriculture, Food, and Natural Resources cluster.

(b) Introduction.

(1) Plant and Soil Science provides a way of learning about the natural world. Students should know how plant and soil science has influenced a vast body of knowledge, that there are still applications to be discovered, and that plant and soil science is the basis for many other fields of science.

(2) Investigations, laboratory practices, and field exercises will be used to develop an understanding of current plant and soil science.

(3) This course is designed to prepare students for careers in the food and fiber industry. Students will learn, reinforce, apply, and transfer their knowledge in a scientific setting.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts field experiments, laboratory investigations, or approved supervised experience programs using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

(B) demonstrate an understanding of the use and conservation of resources and proper disposal and recycling of spent resources.

(2) The student analyzes plant and soil science as related to plant and soil relationships affecting the production of food and fiber. The student is expected to:

(A) recognize the importance and interrelationships of soil and plants; and

(B) practice soil and plant evaluation as it applies to agricultural and urban settings.

(3) The student demonstrates the employability characteristics of a successful employee. The student is expected to:

(A) identify career development and entrepreneurship opportunities in the field of plant systems;

(B) apply competencies related to resources, information, interpersonal skills, and systems of operation in plant systems;

(C) demonstrate knowledge of personal and occupational safety practices in the workplace; and

(D) identify employer expectations, appropriate work habits, and good citizenship skills.

(4) The student develops an advanced supervised experience program as it relates to agriculture, food, and natural resources. The student is expected to:

(A) plan, propose, conduct, and evaluate entrepreneurship; placement; exploratory; research, either experimental or analytical; improvement; supplementary; laboratory-based; or other identified, supervised agricultural experience as an experiential learning activity;

(B) apply proper record-keeping skills as they relate to a supervised experience;

(C) design and use a customized record-keeping system for the individual supervised experience;

(D) participate in youth leadership opportunities to create a well-rounded experience program in agriculture; and

(E) produce a challenging approach for a local program of activities in agriculture.

(5) The student develops scenarios for advances in plant and soil science. The student is expected to:

(A) design, conduct, and complete research in a laboratory or field activity to solve problems in plant and soil science;

(B) use charts, tables, and graphs to prepare written summaries of results and data obtained in a laboratory or field activity;

(C) organize, analyze, evaluate, make inferences, and predict trends from resulting data; and

(D) communicate valid outcomes and solutions.

(6) The student explains the relationship of biotic and abiotic factors within habitats and ecosystems. The student is expected to:

(A) identify native plants, assess their role in an ecosystem, and compare them to plants in other ecosystems;

(B) make observations and compile data about fluctuations in abiotic cycles and evaluate their effects on local ecosystems;

(C) evaluate the impact of human activity such as methods of pest control, hydroponics, and sustainable agriculture on ecosystems; and

(D) predict how the introduction, removal, or re-introduction of an organism may affect the food chain and existing populations.

(7) The student analyzes soil science as related to food and fiber production. The student is expected to:

(A) explain soil formation;

(B) evaluate the properties and nature of soils;

(C) recognize the importance of conservation of soil and agencies involved in conservation;

(D) perform soil management practices such as tillage trials and sustainable soil management; and

(E) practice soil evaluations as related to experiential activities such as land judging.

(8) The student describes the relationship between resources within environmental systems. The student is expected to:

(A) summarize methods of land use and management;

(B) identify sources, use, quality, and conservation of water;

(C) explore the use and conservation of renewable and non-renewable resources;

(D) analyze and evaluate the economic significance and interdependence of components of the environment;

(E) evaluate the impact of human activity and technology on soil fertility and productivity;

(F) analyze and describe the effects on environments by events such as fire, hurricanes, deforestation, mining, population growth, and urban development; and

(G) explain how regional changes in the environment may have a global effect.

(9) The student describes the origin and use of water in a watershed. The student is expected to:

(A) identify sources and calculate the amount of water in a watershed, including ground and surface water;

(B) research and identify the type of water used in a watershed;

(C) analyze water quality in a watershed; and

(D) identify and use methods to evaluate water quantity available in a watershed.

(10) The student maps the process of soil formation as influenced by weathering, including erosion processes due to water, wind, and mechanical factors influenced by climate. The student is expected to:

(A) illustrate the role of weathering in soil formations;

(B) distinguish chemical weathering from mechanical weathering; and

(C) identify geological formations that result from differing weathering processes.

(11) The student describes the dynamics of a watershed. The student is expected to:

(A) identify the characteristics of a local watershed such as average annual rainfall, runoff patterns, aquifers, location of water basins, and surface reservoirs; and

(B) analyze the impact of floods, drought, irrigation, urbanization, and industrialization in a watershed.

(12) The student explains how petroleum energy resources affect agriculture. The student is expected to:

(A) research and describe the origin of fossil fuels such as coal, oil, and natural gas;

(B) analyze issues regarding the use of fossil fuels and other non-renewable energy sources or alternative energy sources; and

(C) analyze the significance and economic impact of the use of fossil fuels and alternative energy sources.

(13) The student evaluates components of plant science as it relates to crop production. The student is expected to:

(A) analyze plant physiology, genetics, and reproduction;

(B) recognize characteristics of quality seeds such as mechanical damage, viability, and grade;

(C) identify plant pests and diseases and their causes, prevention, and treatment;

(D) perform plant management practices such as germination tests, plant spacing trials, and fertilizer tests; and

(E) measure trends in crop species and varieties grown locally in Texas and the United States and how this affects agriculture and consumers.

(14) The student identifies how plants grow and how specialized cells, tissues, and organs develop. The student is expected to:

(A) compare cells from different parts of the plant, including roots, stems, and leaves, to show specialization of structures and functions; and

(B) sequence the levels of organization in multicellular organisms that relate the parts to each other and the whole.

(15) The student diagrams the structure and function of nucleic acids in the mechanism of genetics. The student is expected to:

(A) describe components of deoxyribonucleic acid and illustrate how information for specifying the traits of an organism is carried in deoxyribonucleic acid;

(B) identify and illustrate how changes in deoxyribonucleic acid cause phenotypic or genotypic changes;

(C) compare and contrast genetic variations observed in plants and animals; and

(D) compare the processes of mitosis and meiosis and their significance.

(16) The student demonstrates skills related to the human, scientific, and technological dimensions of crop production and the resources necessary for producing domesticated plants. The student is expected to:

(A) describe the growth and development of major crops;

(B) apply principles of genetics and plant breeding;

(C) examine the development of crop varieties through the origin of agriculture; and

(D) design and conduct experiments to support known principles of genetics.

(17) The student explains the chemistry involved in plants at the cellular level. The student is expected to:

(A) compare the structures and functions of different types of organic molecules such as carbohydrates, lipids, proteins, and nucleic acids;

(B) compare the energy flow in photosynthesis to the energy flow in cellular respiration; and

(C) investigate and identify the effect of enzymes on plant cells.

(18) The student identifies the sources and flow of energy through environmental systems. The student is expected to:

(A) summarize forms and sources of energy;

(B) explain the flow of energy in an environment;

(C) investigate and explain the effects of energy transformations in an ecosystem; and

(D) investigate and identify energy interaction in an ecosystem.

Subchapter H. Health Science

§130.206. Anatomy and Physiology.

(a) General requirements. This course is recommended for students in Grades 10-12. Recommended prerequisites: three credits of science. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Anatomy and Physiology. In Anatomy and Physiology, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students in Anatomy and Physiology study a variety of topics, including the structure and function of the human body and the interaction of body systems for maintaining homeostasis.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) The student conducts investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of science and contributions of scientists.

(4) The student evaluates the energy needs of the human body and the processes through which these needs are fulfilled. The student is expected to:

(A) analyze the chemical reactions that provide energy for the body;

(B) evaluate the means, including the structure and function of the digestive system, by which energy is processed and stored within the body;

(C) analyze the effects of energy deficiencies in malabsorption disorders such as diabetes, hypothyroidism, and Crohn's disease; and

(D) analyze the effects of energy excess in disorders such as obesity as it relates to cardiovascular and musculoskeletal systems.

(5) The student differentiates the responses of the human body to internal and external forces. The student is expected to:

(A) explain the coordination of muscles, bones, and joints that allows movement of the body;

(B) investigate and report the uses of various diagnostic and therapeutic technologies;

(C) interpret normal and abnormal contractility conditions such as in edema, glaucoma, aneurysms, and hemorrhage;

(D) analyze and describe the effects of pressure, movement, torque, tension, and elasticity on the human body; and

(E) perform an investigation to determine causes and effects of force variance and communicate findings.

(6) The student examines the body processes that maintain homeostasis. The student is expected to:

(A) investigate and describe the integration of the chemical and physical processes, including equilibrium, temperature, pH balance, chemical reactions, passive transport, active transport, and biofeedback, that contribute to homeostasis; and

(B) determine the consequences of the failure to maintain homeostasis.

(7) The student examines the electrical conduction processes and interactions. The student is expected to:

(A) illustrate conduction systems such as nerve transmission or muscle stimulation;

(B) investigate the therapeutic uses and effects of external sources of electricity on the body system; and

(C) evaluate the application of advanced technologies such as electroencephalogram, electrocardiogram, bionics, transcutaneous electrical nerve stimulation, and cardioversion.

(8) The student explores the body's transport systems. The student is expected to:

(A) analyze the physical, chemical, and biological properties of transport systems, including circulatory, respiratory, and excretory;

(B) determine the factors that alter the normal functions of transport systems; and

(C) contrast the interactions among the transport systems.

(9) The student investigates environmental factors that affect the human body. The student is expected to:

(A) identify the effects of environmental factors such as climate, pollution, radioactivity, chemicals, electromagnetic fields, pathogens, carcinogens, and drugs on body systems; and

(B) explore measures to minimize harmful environmental factors on body systems.

(10) The student investigates structure and function of the human body. The student is expected to:

(A) analyze the relationships between the anatomical structures and physiological functions of systems, including the integumentary, nervous, skeletal, musculoskeletal, cardiovascular, respiratory, gastrointestinal, endocrine, and reproductive;

(B) evaluate the cause and effect of disease, trauma, and congenital defects on the structure and function of cells, tissues, organs, and systems;

(C) research technological advances and limitations in the treatment of system disorders; and

(D) examine characteristics of the aging process on body systems.

(11) The student describes the process of reproduction and growth and development. The student is expected to:

(A) explain embryological development of tissues, organs, and systems;

(B) identify the functions of the male and female reproductive systems; and

(C) summarize the human growth and development cycle.

(12) The student recognizes emerging technological advances in science. The student is expected to:

(A) recognize advances in stem cell research such as cord blood utilization; and

(B) recognize advances in bioengineering and transplant technology.

§130.207. Medical Microbiology.

(a) General requirements. This course is recommended for students in Grades 10-12. Recommended prerequisites: three credits of science. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Medical Microbiology. Students in Medical Microbiology explore the microbial world, studying topics such as pathogenic and non-pathogenic microorganisms, laboratory procedures, identifying microorganisms, drug resistant organisms, and emerging diseases.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically

tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) The student conducts investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of science and contributions of scientists.

(4) The student describes the relationships between microorganisms and health and wellness in the human body. The student is expected to:

(A) research and describe the historical development of microbiology as it relates to health care of an individual;

(B) identify chemical processes of microorganisms;

(C) recognize the factors required for microbial reproduction and growth;

(D) explain pathogenic and non-pathogenic microbes in the human body;

(E) describe the morphology and characteristics of microorganisms using a variety of microbiological techniques;

(F) discuss the results of laboratory procedures that are used to identify microorganisms;

(G) explain how pathogens affect the human body systems; and

(H) research roles, functions, and responsibilities of agencies governing infectious disease control.

(5) The student examines the role of pathogens in infectious diseases. The student is expected to:

(A) outline the infectious process;

(B) classify microorganisms using a dichotomous key;

(C) categorize diseases caused by bacteria, fungi, viruses, protozoa, rickettsias, arthropods, and helminths;

(D) explain the body's immune response and defenses against infection;

(E) evaluate the effects of anti-microbial agents;

(F) examine reemergence of diseases such as malaria, tuberculosis, and polio;

(G) investigate drug-resistant microorganisms, including methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, and superbugs; and

(H) outline the role of the governing agencies in monitoring and establishing guidelines based on the spread of infectious diseases.

§130.208. Pathophysiology.

(a) General requirements. This course is recommended for students in Grades 11-12. Recommended prerequisites: three credits of science. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Pathophysiology. In Pathophysiology, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students in Pathophysiology study disease processes and how humans are affected. Emphasis is placed on prevention and treatment of disease. Students will differentiate between normal and abnormal physiology.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) The student conducts investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of science and contributions of scientists.

(4) The student analyzes the mechanisms of pathology. The student is expected to:

(A) identify biological and chemical processes at the cellular level;

(B) detect changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;

(C) identify factors that contribute to disease such as age, gender, environment, lifestyle, and heredity;

(D) examine the body's compensating mechanisms occurring under various conditions; and

(E) analyze how the body attempts to maintain homeostasis when changes occur.

(5) The student examines the process of pathogenesis. The student is expected to:

(A) identify pathogenic organisms using microbiological techniques;

(B) differentiate the stages of pathogenesis, including incubation period, prodromal period, and exacerbation or remission;

(C) analyze the body's natural defense systems against infection such as barriers, the inflammatory response, and the immune response;

(D) evaluate the effects of chemical agents, environmental pollution, and trauma on the disease process; and

(E) research stages in the progression of disease.

(6) The student examines a variety of human diseases. The student is expected to:

(A) describe on the nature of diseases according to etiology, signs and symptoms, diagnosis, prognosis, and treatment options;

(B) explore advanced technologies for the diagnosis and treatment of disease;

(C) examine reemergence of diseases such as malaria, tuberculosis, and polio;

(D) describe drug-resistant diseases;

(E) differentiate between congenital disorders and childhood diseases; and

(F) investigate ways diseases affect multiple body systems.

(7) The student integrates the effects of disease prevention and control. The student is expected to:

(A) evaluate public health issues related to asepsis, isolation, immunization, and quarantine;

(B) analyze the effects of stress and aging on the body;

(C) evaluate treatment options for diseases;

(D) investigate diseases that threaten world health and propose intervention strategies; and

(E) develop a plan for personal health and wellness.

Subchapter I. Hospitality and Tourism

§130.230. Food Science.

(a) General requirements. This course is recommended for students in Grades 11-12. Prerequisites: three units of science. Recommended prerequisite: Principles of Hospitality and Tourism. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Food Science. In Food Science students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Food Science is the study of the nature of foods, the causes of deterioration, the principles underlying food processing, and the improvement of foods for the consuming public.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Food scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(6) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools and equipment;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of science and contributions of scientists.

(4) The student analyzes the role of acids and bases in the food sciences. The student is expected to:

(A) identify the properties of acids and bases;

(B) describe the pH scale and how it is used;

(C) use various indicators to measure the pH of solutions;

(D) describe the importance of pH in digestion and blood; and

(E) discuss ways pH is related to the properties of food, its safety, and its freshness.

(5) The student applies the principles of food safety and microbiology. The student is expected to:

(A) investigate the properties of microorganisms that cause food spoilage;

(B) explain the difference between food intoxication and food infection;

(C) examine the conditions under which the important pathogens are commonly destroyed, inactivated, or rendered harmless in foods;

(D) discuss the difference between microorganisms that are helpful and those that are harmful; and

(E) analyze sanitary food-handling practices.

(6) The student studies the chemical properties of food. The student is expected to:

(A) discuss elements, compounds, mixtures, and formulas;

(B) explain the Periodic Table of the Elements;

(C) compare elements and compounds;

(D) describe heterogeneous and homogeneous mixtures;

(E) explain the similarities and differences between heterogeneous and homogenous mixtures;

(F) identify chemical examples of pure substances and mixtures;

(G) identify chemical symbols, formulas, and equations and explain how they are used in food science;

(H) analyze the occurrence of specific chemical reactions; and

(I) analyze chemical and physical changes in food.

(7) The student analyzes solutions, colloids, solids, gels, foams, and emulsions. The student is expected to:

(A) identify the solvent and solute in a given solution;

(B) discuss the effect of a solute and its concentration on the boiling and freezing points of a solution;

(C) calculate the concentration of a solution using mass percent;

(D) compare and contrast unsaturated, saturated, and supersaturated solutions;

(E) describe the properties of colloidal dispersions;

(F) explain the three parts of an emulsion and their relationship to each other; and

(G) identify various food emulsions and the types of each emulsion.

(8) The student understands the functions of enzymes. The student is expected to:

(A) describe how enzymes act as catalysts in chemical reactions;

(B) explain the relationship between an enzyme and a substrate;

(C) discuss the enzymes involved in digestion;

(D) identify factors that affect enzyme activity; and

(E) explain how enzyme reactions are involved in food preparation.

(9) The student understands the role of fermentation in food sciences. The student is expected to:

(A) explain anaerobic respiration and how it is involved in metabolism and food science;

(B) list reasons food is fermented;

(C) describe how bacteria is used to ferment food, including how lactic acid bacteria creates sauerkraut from cabbage;

(D) compare fresh-pack pickling and brine pickling; and

(E) describe the process of making vinegar.

(10) The student discusses how leavening agents are used in baking. The student is expected to:

(A) describe the purpose of leavening agents in baked goods;

(B) identify and describe major leavening agents;

(C) explain why baking soda is used with an acid in baked goods;

(D) describe the types of dough and batters used in making quick breads;

(E) analyze the ingredients in baking powder;

(F) discuss how air and steam act as leavening agents; and

(G) identify the purposes of the ingredients used in making yeast breads.

(11) The student understands the purposes of additives in food. The student is expected to:

(A) discuss the use of food additives;

(B) describe properties of a desirable food preservative;

(C) explain why additives used as antioxidants are added to food;

(D) explain the difference between natural and artificial additives;

(E) identify kinds of sweeteners used in food processing;

(F) name nutrients that are used as food additives;

(G) discuss the advantages and disadvantages of using food additives; and

(H) identify agencies involved in regulating food additives.

(12) The student understands the physiology of digestion. The student is expected to:

(A) define mechanical and chemical digestive processes;

(B) explain the difference between mechanical and chemical digestive processes; and

(C) explain absorption as part of the digestive process.

(13) The student understands metabolism. The student is expected to:

(A) analyze components and byproducts of metabolism;

(B) define anabolism and catabolism;

(C) describe conditions needed for metabolism to occur;

(D) explain the process of osmosis and the role it plays in metabolism;

(E) discuss basal metabolism and the factors that affect it;

(F) identify levels of voluntary activity and how these affect the need for kilocalories;

(G) describe metabolic changes and the effect they have on the body during fasting; and

(H) explain why lactic acid builds up in the muscles during exercise and how this can be prevented or treated.

(14) The student explains how food provides energy. The student is expected to:

(A) discuss molecular motion and temperature;

(B) explain heat transfer;

(C) explain latent heat in phase changes;

(D) compare various temperatures on rates of reaction;

(E) analyze how the body uses energy and calories;

(F) describe the relationship of energy to physical and chemical reactions;

(G) analyze relationships between food intake and body weight;

(H) determine energy requirements of individuals using multiple variables such as activity level;

(I) discuss energy imbalances in relationship to weight-related disorders and diseases; and

(J) explain the transfer of energy through a food chain and its relationship to human nutrition.

(15) The student describes the basic nutrients and their specific properties as related to food science. The student is expected to:

(A) identify the recommended daily allowances of the basic nutrients;

(B) list the five main nutrients and food sources of each;

(C) explain the use of the five main nutrients in relation to the Food Guide Pyramid and/or the Dietary Guidelines; and

(D) discuss the importance of fiber in the diet.

(16) The student identifies properties of carbohydrates. The student is expected to:

(A) explain the chemical reaction that occurs when plants produce carbohydrates;

(B) define monosaccharides and disaccharides and name examples of each;

(C) describe the regulation of glucose in the blood and the conditions resulting from low and high glucose levels;

(D) explain sugar hydrolysis and list the products of the hydrolysis of sucrose and lactose;

(E) discuss the process of caramelization;

(F) compare the structures of amylose and amylopectin and how these structures affect cooking properties; and

(G) describe gelatinization, paste, retrogradation, and syneresis.

(17) The student describes the properties of fats and lipids. The student is expected to:

(A) compare the properties of saturated and unsaturated fatty acids;

(B) identify foods containing triglycerides and identify which foods contain saturated and unsaturated fat;

(C) discuss the function of fat in food preparation;

(D) describe ways lipid oxidation can be controlled in food;

(E) describe the functions of fat in the body;

(F) explain the role of fat in maintaining optimum health;

(G) explain the role of cholesterol in maintaining optimum health;

(H) contrast the properties of saturated and unsaturated fats; and

(I) describe the effects of temperature on fats in food preparation.

(18) The student describes the properties of proteins and amino acids. The student is expected to:

(A) name the groups of elements that identify an amino acid;

(B) describe the chemical structure of protein;

(C) explain what happens during the denaturation of protein and how the process occurs;

(D) describe ways in which protein is used in food preparation;

(E) discuss the composition of eggs and their storage requirements;
(F) list factors that affect the stability of an egg foam;
(G) identify the functions of protein in the body; and
(H) compare and contrast complete and incomplete proteins.

(19) The student understands the coagulation and coalescence processes associated with milk protein and cheese. The student is expected to:
(A) list the components of milk and explain how each component is dispersed in the milk;
(B) describe what happens when milk protein is coagulated;
(C) discuss the processing of milk and how it is treated when it is pasteurized, homogenized, and fortified;
(D) compare and contrast skim milk, low-fat milk, whole milk, half-and-half, and various creams;
(E) explain the differences between evaporated milk, condensed milk, and dried milk;
(F) identify factors that affect the ability of cream to form a foam;
(G) explain the changes that occur when milk is heated; and
(H) describe the process of making a fermented or cultured milk product and list examples of these products.

(20) The student analyzes the properties of vitamins and minerals. The student is expected to:
(A) discuss the functions of vitamins and minerals in the body;
(B) describe water- and fat-soluble vitamins and list the main vitamins in each category;
(C) explain why megadoses of fat-soluble vitamins can be toxic;
(D) analyze the food sources for each vitamin and mineral;
(E) analyze deficiency diseases and explain their causes;
(F) explain the difference and list examples of major and trace minerals; and
(G) explain the interrelationships among nutrients.

(21) The student explains the properties of water. The student is expected to:
(A) identify the properties of water that make it a polar molecule;
(B) describe hydrogen bonds and how they differ from covalent bonds;
(C) discuss the differences between hard and soft water;
(D) compare the heat of fusion and the heat of vaporization;
(E) explain the functions of water in food preparation; and
(F) identify the functions of water in the body.

(22) The student analyzes the food irradiation process. The student is expected to:
(A) list the steps in the food irradiation process;
(B) define the units used to measure the amount of radiation used during the irradiation process; and
(C) describe the effects of irradiation on food.

(23) The student discusses United States Department of Agriculture (USDA) packaging guidelines. The student is expected to:
(A) research food packaging guidelines established by the USDA;

(B) explain the rationale and purposes of those guidelines;
(C) describe properties of containers needed for commercial food packaging;
(D) identify factors related to the successful use of controlled-atmosphere packaging; and
(E) describe information required on a food label.

(24) The student analyzes the food dehydration process. The student is expected to:
(A) describe the principles and purposes of dehydration;
(B) describe methods of dehydration and explain their similarities and differences;
(C) explain why food is pretreated before dehydrating;
(D) compare sulfating, sulfuring, and blanching;
(E) describe types of blanching that can be used as pretreatment methods; and
(F) discuss the role of air temperature and movement in successful dehydration.

(25) The student analyzes the food canning process. The student is expected to:
(A) identify safety practices and equipment used in home and commercial canning;
(B) describe hot-pack, cold-pack, and pressure canning;
(C) identify advantages and disadvantages of each canning method;
(D) identify types of food that should be processed by each canning method; and
(E) compare heat transfer by conduction and by convection in canning.

(26) The student analyzes the food freezing process. The student is expected to:
(A) list the steps of the food freezing process;
(B) identify factors needed for successful freezing of food; and
(C) identify advantages and disadvantages of freezing food.

(27) The student understands the importance of developing lifelong skills. The student is expected to:
(A) demonstrate the use of oral and written communication skills such as writing technical reports, letters, and memos; communicating technical information to a nontechnical audience; and making formal and informal presentations;
(B) define a problem, identify potential causes and possible solutions, and make thoughtful recommendations;
(C) apply critical-thinking skills to new situations;
(D) demonstrate the highest standards of professional integrity and ethical values;
(E) work and interact with individuals from diverse cultures;
(F) explain the skills necessary for lifelong learning;
(G) work effectively with others;
(H) provide leadership in a variety of situations;
(I) deal with individual or group conflicts;
(J) research scientific and nonscientific information;
(K) competently use library resources;
(L) manage time effectively;
(M) facilitate group projects;
(N) handle multiple tasks and pressures; and

(O) prepare for a state or national food manager's sanitation certification or alternative credential within the field of food science technology.

Subchapter L. Law, Public Safety, Corrections, and Security

§130.295. Forensic Science.

(a) General requirements. The course is recommended for students in Grades 11-12. Prerequisites: Biology and Chemistry. Recommended prerequisites: Principles of Law, Public Safety, Corrections, and Security and Law Enforcement I. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Forensic Science. Forensic Science is a course that uses a structured and scientific approach to the investigation of crimes of assault, abuse and neglect, domestic violence, accidental death, homicide, and the psychology of criminal behavior. Students will learn terminology and investigative procedures related to crime scene, questioning, interviewing, criminal behavior characteristics, truth detection, and scientific procedures used to solve crimes. Using scientific methods, students will collect and analyze evidence through case studies and simulated crime scenes such as fingerprint analysis, ballistics, and blood spatter analysis. Students will learn the history, legal aspects, and career options for forensic science.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, Petri dishes, lab incubators, meter sticks, and models, diagrams, or samples of biological specimens or structures;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of science and contributions of scientists.

(4) The student explores the history, legal responsibilities, and career options for forensic science. The student is expected to:

(A) distinguish between forensic science and criminalistics in law, public safety, corrections, and security;

(B) identify roles, functions, and responsibilities of forensic science professionals;

(C) summarize the ethical standards required of a forensic science professional;

(D) present career information in written and verbal formats;

(E) recognize the major contributors to the development of forensic science; and

(F) illustrate the history of forensic science.

(5) The student recognizes the procedures of evidence collection while maintaining the integrity of a crime scene. The student is expected to:

(A) analyze the role of scientists such as forensic pathologists and anthropologists as they relate to a homicide investigation;

(B) demonstrate the ability to work as a member of a team;

(C) conduct a systematic search of a simulated crime scene for physical evidence following crime scene protocol;

(D) apply knowledge of the elements of criminal law that guide search and seizure of persons, property, and evidence;

(E) describe the elements of a crime scene sketch such as measurements, compass directions, scale of proportion, legend, key, and title;

(F) develop a crime scene sketch using triangulation, rectangular coordinates, straight-line methods, and use of coordinates on transecting baseline;

(G) outline the chain of custody procedure for evidence discovered in a crime scene;

(H) demonstrate proper techniques for collecting and packaging physical evidence found at a crime scene;

(I) explain the functions of national databases available to forensic scientists; and

(J) collect and preserve physical evidence from a simulated crime scene.

(6) The student analyzes the evidence collected from a crime scene using scientific methods. The student is expected to:

(A) demonstrate conversions of measurements between English and International System (SI) of units;

(B) distinguish between physical and chemical properties of matter using the periodic table;

(C) determine the elements within a compound or mixture;

(D) identify the four types of chemical reactions;

(E) explain properties of refractive index;

(F) explain dispersion of light through a prism;

(G) identify the light sources used in forensic science such as ultraviolet light;

(H) explain the examination of trace evidence using instruments such as a spectrophotometer, stereoscope, electron microscope, and compound microscope;

(I) calculate the direction of a projectile by examining glass fractures; and

(J) compare the composition of glass fragments.

(7) The student recognizes the methods to process and analyze trace evidence commonly found in a crime scene. The student is expected to:

(A) perform continuous and light emissions laboratory procedures to identify trace evidence;

(B) process trace evidence such as soil, grass, glass, blood, fibers, and hair collected in a simulated crime scene;

(C) compare the anatomy of the human hair to animal hair; and

(D) differentiate between natural and manufactured fibers.

(8) The student analyzes fingerprints in forensic science. The student is expected to:

(A) compare the three major fingerprint patterns of arches, loops, and whorls and their respective subclasses;

(B) identify characteristics of fingerprints, including bifurcations, ending ridges, ridge islands, dots, short ridges, and divergence ridges;

(C) distinguish among visible, plastic, and latent fingerprints;

(D) perform laboratory procedures for lifting latent prints on porous and nonporous objects using chemicals such as iodine, ninhydrin, silver nitrate, and cyanoacrylate resin;

(E) perform laboratory procedures for lifting latent prints on nonporous objects using fingerprint powders such as black powder and florescent powders;

(F) explain the Automatic Fingerprint Identification System; and

(G) compare fingerprints collected at a simulated crime scene with the fingerprints of a suspect.

(9) The student analyzes blood spatter at a simulated crime scene. The student is expected to:

(A) analyze blood stain patterns based on source, direction, and angle of trajectory; and

(B) explain the method of chemically isolating an invisible blood stain using reagents such as luminol.

(10) The student explores toxicology laboratory procedures in forensic science. The student is expected to:

(A) explain the absorption, distribution, and elimination of alcohol through the human body;

(B) describe the blood alcohol laboratory procedures as they relate to blood alcohol concentration;

(C) explain the levels of tolerance and impairment due to alcohol consumption; and

(D) explain the precautions necessary in the forensic laboratory for proper preservation of blood samples.

(11) The student explores serology laboratory procedures in forensic science. The student is expected to:

(A) explain forensic laboratory procedures to determine if a stain detected in a crime scene is blood;

(B) identify the red blood cell antigens and antibodies as they relate to human blood types;

(C) determine genotypes and phenotypes in the human red blood cell system using Punnet Squares; and

(D) research methodologies used to collect and analyze other body fluids.

(12) The student analyzes deoxyribonucleic acid laboratory procedures in forensic science. The student is expected to:

(A) diagram the deoxyribonucleic acid molecule, including nitrogen bases, sugars, and phosphate groups;

(B) explain base pairing of adenine, thymine, cytosine, and guanine as they relate to deoxyribonucleic acid fingerprinting;

(C) extract deoxyribonucleic acid from food such as peas and strawberries;

(D) explain the polymerase chain reaction laboratory procedure for forensic deoxyribonucleic acid typing; and

(E) collect and package deoxyribonucleic acid from a simulated crime scene.

(13) The student identifies drugs found at a simulated crime scene. The student is expected to:

(A) classify controlled substances using Food and Drug Administration classification; and

(B) identify controlled substances using laboratory procedures such as color test reactions, microcrystalline procedures, chromatography, and spectrophotometry.

(14) The student evaluates bullet and tool mark impressions in a criminal investigation. The student is expected to:

(A) explain the individual characteristics of tool marks;

(B) recognize characteristics of bullet and cartridge cases;

(C) explain laboratory methodologies used to determine whether an individual has fired a weapon such as identifying gun shot residue; and

(D) recognize the type of information available through the National Integrated Ballistics Information Network.

(15) The student explores principles of anthropology relevant to forensic science. The student is expected to:

(A) identify the major bones of the human skeletal system;

(B) compare composition and structure of human bones with other animals;

(C) describe the techniques used to excavate bones from a crime scene;

(D) determine unique characteristics of the human skeletal system such as gender and age;

(E) explain the role of dental records in identification of remains; and

(F) describe the role of dental matching in forensic science.

(16) The student calculates the time and cause of death in relationship to decomposition of the human body. The student is expected to:

(A) explain the process and timeline of rigor mortis and its role in calculating time of death;

(B) explain post mortem lividity and its importance when processing a crime scene;

(C) determine time of death using entomology; and

(D) determine time and cause of death through case studies.

Subchapter O. Science, Technology, Engineering, and Mathematics

§130.364. Advanced Biotechnology.

(a) General requirements. This course is recommended for students in Grades 11-12. Recommended prerequisites: Biology and Chemistry. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Students enrolled in this course will apply advanced academic knowledge and skills to the emerging fields of biotechnology such as agricultural, medical, regulatory, and forensics. Students will have the opportunity to use sophisticated laboratory equipment, perform statistical analysis, and practice quality-control techniques.

(2) Students will conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students in Advanced Biotechnology study a variety of topics that include structures and functions of cells, nucleic acids, proteins, and genetics.

(3) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(4) Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(5) Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(6) A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms;

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials;

(C) demonstrate appropriate safety procedures, guidelines, and chemical hygiene plan;

(D) maintain required safety training, including location and understanding of interpretation of material safety data sheets;

(E) comply with federal and state safety regulations as specified by Occupational Safety and Health Administration and other regulatory agencies as appropriate;

(F) identify and obey safety symbols and signs;

(G) maintain clean and well organized work areas;

(H) dispose of equipment, glassware, and biologics according to laboratory policies;

(I) recognize common laboratory hazards;

(J) observe procedures for the safe use of instruments, gas cylinders, and chemicals; and

(K) maintain safety and personal protection equipment.

(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(3) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting, handling, and maintaining appropriate equipment and technology;

(F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;

(G) demonstrate the use of course apparatus, equipment, techniques, and procedures;

(H) organize, analyze, evaluate, build models, make inferences, and predict trends from data;

(I) perform calculations using dimensional analysis, significant digits, and scientific notation; and

(J) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing,

including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research and technology on scientific thought, society, and the environment;

(E) describe the connection between biotechnology and future careers; and

(F) research and describe the history of biotechnology and contributions of scientists.

(4) The student explores the emerging field of biotechnology. The student is expected to:

(A) define biotechnology as related to new and emerging occupations;

(B) explore engineering and bioinformatics;

(C) create a timeline of historical biotechnology research and development; and

(D) research career opportunities in fields such as molecular, forensic, medical, regulatory, and agricultural biotechnology.

(5) The student analyzes bacterial, plant, and animal cell structures. The student is expected to:

(A) distinguish among bacterial, plant, and animal cells;

(B) describe the major structures in a bacterial cell and their functions such as pili, capsule, and flagella;

(C) describe the major structures in a plant cell and their functions such as cell wall and chloroplasts;

(D) describe the major structures in an animal cell and their functions such as nucleus, nucleolus, cell membrane, mitochondria, ribosomes, Golgi apparatus, chromatin, cytoplasm, and endoplasmic reticulum; and

(E) identify cells using the microscope.

(6) The student understands the role of genetics in the biotechnology industry. The student is expected to:

(A) explain terms related to molecular biology such as nucleic acids, nitrogen bases, amino acids, transcription, translation, polymerase, and protein synthesis;

(B) describe the structure of a nucleotide;

(C) identify the nitrogen bases of deoxyribonucleic acid and ribonucleic acid;

(D) explain how nucleotides join together to form a double-helical deoxyribonucleic acid molecule;

(E) describe the deoxyribonucleic acid and ribonucleic acid replication process;

(F) illustrate the process of protein synthesis;

(G) define genome and gene expression;

(H) evaluate the significance of ethics and regulations as it relates to gene expression; and

(I) summarize the role of genetics in the biotechnology industry.

(7) The student analyzes the importance of recombinant deoxyribonucleic acid technology and genetic engineering. The student is expected to:

(A) define recombinant deoxyribonucleic acid technology as it relates to the biotechnology industry;

(B) explain how recombinant deoxyribonucleic acid technology is used to clone genes;
(C) explain the role of tissue cultures to genetic modification procedures;
(D) propagate plant cultures;
(E) maintain proper growing conditions for plant tissue cultures;
(F) explain the role of restriction enzymes and plasmid deoxyribonucleic acid;
(G) describe the vectors commonly used, including bacteriophage vectors;
(H) discuss the polymerase chain reaction and its application in recombinant deoxyribonucleic acid technology; and
(I) perform restriction digests.

(8) The student examines federal, state, local, and industry regulations as related to biotechnology. The student is expected to:
(A) discuss the relationship between the local, state, and federal agencies responsible for regulation of the biotechnology industry; and
(B) analyze policies and procedures used in the biotechnology industry such as animal research laboratories.

(9) The student performs standard biotechnology laboratory procedures. The student is expected to:
(A) operate laboratory equipment such as a microscope, thermocycler, hood, pH meter, stirrers, balance, mixers, autoclave, power supply, shakers, dry heat oven, incubators, and Bunsen burners;
(B) practice measuring volumes and weights to industry standards;
(C) analyze data and perform calculations and statistical analysis as it relates to biotechnology laboratory experiments;
(D) demonstrate and show proficiency in titration and pipetting techniques;
(E) identify microorganisms using staining methods such as the Gram stain, methylene-blue stain, and acid-fast staining;
(F) document laboratory results; and
(G) investigate how laboratory techniques vary in different industry sectors.

(10) The student prepares solutions and reagents for the biotechnology laboratory. The student is expected to:
(A) practice aseptic technique;
(B) prepare, dispense, and monitor physical properties of stock reagents, buffers, media, and solutions;
(C) calculate and prepare a dilution series; and
(D) determine acceptability and optimum conditions of reagents for experimentation.

(11) The student performs advanced biotechnology laboratory procedures. The student is expected to:
(A) explain the importance of media components to the outcome of cultures;
(B) isolate, maintain, and store pure cultures;
(C) prepare seed inoculum;
(D) perform plating techniques such as the Kirby-Bauer method;
(E) precipitate and solubilize proteins;

(F) isolate and interpret proteins using electrophoresis; and

(G) perform nucleic acid sequencing procedures.

(12) The student conducts quality-control analysis while performing biotechnology laboratory procedures. The student is expected to:

(A) perform validation testing on laboratory reagents and equipment; and

(B) analyze data and perform calculations and statistical analysis on results of quality-control samples such as trending of data.

(13) The student summarizes biotechnology laboratory procedures and their applications in the biotechnology industry. The student is expected to:

(A) identify the major sectors of the biotechnology industry;

(B) categorize the biotechnology laboratory procedures included in each sector; and

(C) compare the different applications used in biotechnology laboratory procedures of each sector.

§130.372. Scientific Research and Design

(a) General requirements. This course is recommended for students in Grades 11-12. Prerequisite: one unit of high school science. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(2) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(3) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(4) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment,

but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses a systematic approach to answer scientific laboratory and field investigative questions. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(1) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) design and implement investigative procedures, including making observations, asking well-defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, and evaluating numerical answers for reasonableness;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, and meter sticks;

(G) analyze, evaluate, make inferences, and predict trends from data;

(H) identify and quantify causes and effects of uncertainties in measured data;

(I) organize and evaluate data and make inferences from data, including the use of tables, charts, and graphs; and

(J) communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society;

(E) research and describe the connections between science and future careers; and

(F) express and interpret relationships symbolically in accordance with accepted theories to make predictions and solve problems mathematically, including problems requiring proportional reasoning and graphical vector addition.

(4) The student formulates hypotheses to guide experimentation and data collection. The student is expected to:

(A) perform background research with respect to an investigative problem; and

(B) examine hypotheses generated to guide a research process by evaluating the merits and feasibility of the hypotheses.

(5) The student analyzes published research. The student is expected to:

(A) identify the scientific methodology used by a researcher;

(B) examine a prescribed research design and identify dependent and independent variables;

(C) evaluate a prescribed research design to determine the purpose for each of the procedures performed; and

(D) compare the relationship of the hypothesis to the conclusion.

(6) The student develops and implements investigative designs. The student is expected to:

(A) interact and collaborate with scientific researchers and/or other members of the scientific community to complete a research project;

(B) identify and manipulate relevant variables within research situations;

(C) use a control in an experimental process; and

(D) design procedures to test hypotheses.

(7) The student collects, organizes, and evaluates qualitative and quantitative data obtained through experimentation. The student is expected to:

(A) record observations and events as they occur within an investigation;

(B) acquire, manipulate, and analyze data using equipment and technology;

(C) construct data tables to organize information collected in an experiment; and

(D) evaluate data using statistical methods to recognize patterns, trends, and proportional relationships.

(8) The student knows how to synthesize valid conclusions from qualitative and quantitative data. The student is expected to:

(A) synthesize conclusions supported by research data;

(B) consider and communicate alternative explanations for observations and results; and

(C) identify limitations within the research process and provide recommendations for additional research.

(9) The student communicates conclusions clearly and concisely to an audience of professionals. The student is expected to:

(A) construct charts, tables, and graphs in facilitating data analysis and in communicating experimental results clearly and effectively using technology; and

(B) suggest alternative explanations from observations or trends evident within the data or from prompts provided by a review panel.

§130.373. Engineering Design and Problem Solving .

(a) General requirements. This course is recommended for students in Grades 11-12. Prerequisites: Geometry, Algebra II, Chemistry, and Physics.

(b) Introduction.

(1) Engineering design is the creative process of solving problems by identifying needs and then devising solutions. This solution may be a product, technique, structure, process, or many other things depending on the problem. Science aims to understand the natural world, while engineering seeks to shape this world to meet human needs and wants. Engineering design takes into consideration limiting factors or "design under constraint." Various engineering disciplines address a broad spectrum of design problems using specific concepts from the sciences and mathematics to derive a solution. The design process and problem solving are inherent to all engineering disciplines.

(2) Engineering Design and Problem Solving reinforces and integrates skills learned in previous mathematics and science courses. This course emphasizes solving problems, moving from well defined toward more open ended, with real-world application. Students apply critical-thinking skills to justify a solution from multiple design options. Additionally, the course promotes interest in and understanding of career opportunities in engineering.

(3) This course is intended to stimulate students' ingenuity, intellectual talents, and practical skills in devising solutions to engineering design problems. Students use the engineering design process cycle to investigate, design, plan, create, and evaluate solutions. At the same time, this course fosters awareness of the social and ethical implications of technological development.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts engineering field and laboratory activities using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during engineering field and laboratory activities; and

(B) make informed choices in the use and conservation of resources, recycling of materials, and the safe and legal disposal of materials.

(2) The student applies knowledge of science and mathematics and the tools of technology to solve engineering design problems. The student is expected to:

(A) apply scientific processes and concepts outlined in the Texas Essential Knowledge and Skills (TEKS) for Biology, Chemistry, or Physics relevant to engineering design problems;

(B) apply concepts, procedures, and functions outlined in the TEKS for Algebra I, Geometry, and Algebra II relevant to engineering design problems;

(C) select appropriate mathematical models to develop solutions to engineering design problems;

(D) integrate advanced mathematics and science skills as necessary to develop solutions to engineering design problems;

(E) judge the reasonableness of mathematical models and solutions;

(F) investigate and apply relevant chemical, mechanical, biological, electrical, and physical properties of materials to engineering design problems;

(G) identify the inputs, processes, outputs, control, and feedback associated with open and closed systems;

(H) describe the difference between open-loop and closed-loop control systems;

(I) make measurements and specify tolerances with minimum necessary accuracy and precision;

(J) use appropriate measurement systems, including customary and International System (SI) of units; and

(K) use conversions between measurement systems to solve real-world problems.

(3) The student communicates through written documents, presentations, and graphic representations using the tools and techniques of professional engineers. The student is expected to:

(A) communicate visually by sketching and creating technical drawings using established engineering graphic tools, techniques, and standards;

(B) read and comprehend technical documents, including specifications and procedures;

(C) prepare written documents such as memorandums, emails, design proposals, procedural directions, letters, and technical reports using the formatting and terminology conventions of technical documentation;

(D) organize information for visual display and analysis using appropriate formats for various audiences, including, but not limited to, graphs and tables;

(E) evaluate the quality and relevance of sources and cite appropriately; and

(F) defend a design solution in a presentation.

(4) The student recognizes the history, development, and practices of the engineering professions. The student is expected to:

(A) identify and describe career options, working conditions, earnings, and educational requirements of various engineering disciplines such as those listed by the Texas Board of Professional Engineers;

(B) recognize that engineers are guided by established codes emphasizing high ethical standards;

(C) explore the differences, similarities, and interactions among engineers, scientists, and mathematicians;

(D) describe how technology has evolved in the field of engineering and consider how it will continue to be a useful tool in solving engineering problems;

(E) discuss the history and importance of engineering innovation on the United States economy and quality of life; and

(F) describe the importance of patents and the protection of intellectual property rights.

(5) The student creates justifiable solutions to open-ended problems using engineering design practices and processes. The student is expected to:

(A) identify and define an engineering problem;

(B) formulate goals, objectives, and requirements to solve an engineering problem;

(C) determine the design parameters associated with an engineering problem such as materials, personnel, resources, funding, manufacturability, feasibility, and time;

(D) establish and evaluate constraints pertaining to a problem, including, but not limited to, health, safety, social, environmental, ethical, political, regulatory, and legal;

(E) identify or create alternative solutions to a problem using a variety of techniques such as brainstorming, reverse engineering, and researching engineered and natural solutions;

(F) test and evaluate proposed solutions using methods such as models, prototypes, mock-ups, simulations, critical design review, statistical analysis, or experiments;

(G) apply structured techniques to select and justify a preferred solution to a problem such as a decision tree, design matrix, or cost-benefit analysis;

(H) predict performance, failure modes, and reliability of a design solution; and

(I) prepare a project report that clearly documents the designs, decisions, and activities during each phase of the engineering design process.

(6) The student manages an engineering design project. The student is expected to:

(A) participate in the design and implementation of a real or simulated engineering project;

(B) develop a plan and timeline for completion of a project;

(C) work in teams and share responsibilities, acknowledging, encouraging, and valuing contributions of all team members;

(D) compare and contrast the roles of a team leader and other team responsibilities;

(E) identify and manage the resources needed to complete a project;

(F) use a budget to determine effective strategies to meet cost constraints;

(G) create a risk assessment for an engineering design project;

(H) analyze and critique the results of an engineering design project; and

(I) maintain an engineering notebook that chronicles work such as ideas, concepts, inventions, sketches, and experiments.

Chapter 111. Texas Essential Knowledge and Skills for Mathematics

Subchapter A. Elementary

§111.2. Kindergarten, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) For students to become fluent in mathematics, students must develop a robust sense of number. The National Research Council's report, "Adding It Up," defines procedural fluency as "skill in carrying out procedures flexibly, accurately, efficiently, and appropriately." As students develop procedural fluency, they must also realize that true problem solving may take time, effort, and perseverance. Students in Kindergarten are expected to perform their work without the use of calculators.

(4) The primary focal areas in Kindergarten are understanding counting and cardinality, understanding addition as joining and subtraction as separating, and comparing objects by measurable attributes.

(A) Students develop number and operations through several fundamental concepts. Students know number names and the counting sequence. Counting and cardinality lay a solid foundation for number. Students apply the principles of counting to make the connection between numbers and quantities.

(B) Students use meanings of numbers to create strategies for solving problems and responding to practical situations involving addition and subtraction.

(C) Students identify characteristics of objects that can be measured and directly compare objects according to these measurable attributes.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to understand how to represent and compare whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system. The student is expected to:

(A) count forward and backward to at least 20 with and without objects;

(B) read, write, and represent whole numbers from 0 to at least 20 with and without objects or pictures;

(C) count a set of objects up to at least 20 and demonstrate that the last number said tells the number of objects in the set regardless of their arrangement or order;

(D) recognize instantly the quantity of a small group of objects in organized and random arrangements;

(E) generate a set using concrete and pictorial models that represents a number that is more than, less than, and equal to a given number up to 20;

(F) generate a number that is one more than or one less than another number up to at least 20;

(G) compare sets of objects up to at least 20 in each set using comparative language;

(H) use comparative language to describe two numbers up to 20 presented as written numerals; and

(I) compose and decompose numbers up to 10 with objects and pictures.

(3) Number and operations. The student applies mathematical process standards to develop an understanding of addition and subtraction situations in order to solve problems. The student is expected to:

(A) model the action of joining to represent addition and the action of separating to represent subtraction;

(B) solve word problems using objects and drawings to find sums up to 10 and differences within 10; and

(C) explain the strategies used to solve problems involving adding and subtracting within 10 using spoken words, concrete and pictorial models, and number sentences.

(4) Number and operations. The student applies mathematical process standards to identify coins in order to recognize the need for monetary transactions. The student is expected to identify U.S. coins by name, including pennies, nickels, dimes, and quarters.

(5) Algebraic reasoning. The student applies mathematical process standards to identify the pattern in the number word list. The student is expected to recite numbers up to at least 100 by ones and tens beginning with any given number.

(6) Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional shapes and three-dimensional solids to develop generalizations about their properties. The student is expected to:

(A) identify two-dimensional shapes, including circles, triangles, rectangles, and squares as special rectangles;

(B) identify three-dimensional solids, including cylinders, cones, spheres, and cubes, in the real world;

(C) identify two-dimensional components of three-dimensional objects;

(D) identify attributes of two-dimensional shapes using informal and formal geometric language interchangeably;

(E) classify and sort a variety of regular and irregular two- and three-dimensional figures regardless of orientation or size; and

(F) create two-dimensional shapes using a variety of materials and drawings.

(7) Geometry and measurement. The student applies mathematical process standards to directly compare measurable attributes. The student is expected to:

(A) give an example of a measurable attribute of a given object, including length, capacity, and weight; and

(B) compare two objects with a common measurable attribute to see which object has more of/less of the attribute and describe the difference.

(8) Data analysis. The student applies mathematical process standards to collect and organize data to make it useful for interpreting information. The student is expected to:

(A) collect, sort, and organize data into two or three categories;

(B) use data to create real-object and picture graphs; and

(C) draw conclusions from real-object and picture graphs.

(9) Personal financial literacy. The student applies mathematical process standards to manage one's financial resources effectively for lifetime financial security. The student is expected to:

(A) identify ways to earn income;

(B) differentiate between money received as income and money received as gifts;

(C) list simple skills required for jobs; and

(D) distinguish between wants and needs and identify income as a source to meet one's wants and needs.

§111.3. Grade 1, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) For students to become fluent in mathematics, students must develop a robust sense of number. The National Research Council's report, "Adding It Up," defines procedural fluency as "skill in carrying out procedures flexibly, accurately, efficiently, and appropriately." As students develop procedural fluency, they must also realize that true problem solving may take time, effort, and perseverance. Students in Grade 1 are expected to perform their work without the use of calculators.

(4) The primary focal areas in Grade 1 are understanding and applying place value, solving problems involving addition and subtraction, and composing and decomposing two-dimensional shapes and three-dimensional solids.

(A) Students use relationships within the numeration system to understand the sequential order of the counting numbers and their relative magnitude.

(B) Students extend their use of addition and subtraction beyond the actions of joining and separating to include comparing and combining. Students use properties of operations and the relationship between addition and subtraction to solve problems.

By comparing a variety of solution strategies, students use efficient, accurate, and generalizable methods to perform operations.

(C) Students use basic shapes and spatial reasoning to model objects in their environment and construct more complex shapes. Students are able to identify, name, and describe basic two-dimensional shapes and three-dimensional solids.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent and compare whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system related to place value. The student is expected to:

(A) recognize instantly the quantity of structured arrangements;

(B) use concrete and pictorial models to compose and decompose numbers up to 120 in more than one way as so many hundreds, so many tens, and so many ones;

(C) use objects, pictures, and expanded and standard forms to represent numbers up to 120;

(D) generate a number that is greater than or less than a given whole number up to 120;

(E) use place value to compare whole numbers up to 120 using comparative language;

(F) order whole numbers up to 120 using place value and open number lines; and

(G) represent the comparison of two numbers to 100 using the symbols >, <, or =.

(3) Number and operations. The student applies mathematical process standards to develop and use strategies for whole number addition and subtraction computations in order to solve problems. The student is expected to:

(A) use concrete and pictorial models to determine the sum of a multiple of 10 and a one-digit number in problems up to 99;

(B) use objects and pictorial models to solve word problems involving joining, separating, and comparing sets within 20 and unknowns as any one of the terms in the problem such as 2 + 4 = [ ]; 3 + [ ] = 7; and 5 = [ ] - 3;

(C) compose 10 with two or more addends with and without concrete objects;

(D) apply basic fact strategies to add and subtract within 20, including making 10 and decomposing a number leading to a 10;

(E) explain strategies used to solve addition and subtraction problems up to 20 using spoken words, objects, pictorial models, and number sentences; and

(F) generate and solve problem situations when given a number sentence involving addition or subtraction of numbers within 20.

(4) Number and operations. The student applies mathematical process standards to identify coins, their values, and the relationships among them in order to recognize the need for monetary transactions. The student is expected to:

(A) identify U.S. coins, including pennies, nickels, dimes, and quarters, by value and describe the relationships among them;

(B) write a number with the cent symbol to describe the value of a coin; and

(C) use relationships to count by twos, fives, and tens to determine the value of a collection of pennies, nickels, and/or dimes.

(5) Algebraic reasoning. The student applies mathematical process standards to identify and apply number patterns within properties of numbers and operations in order to describe relationships. The student is expected to:

(A) recite numbers forward and backward from any given number between 1 and 120;

(B) skip count by twos, fives, and tens to determine the total number of objects up to 120 in a set;

(C) use relationships to determine the number that is 10 more and 10 less than a given number up to 120;

(D) represent word problems involving addition and subtraction of whole numbers up to 20 using concrete and pictorial models and number sentences;

(E) understand that the equal sign represents a relationship where expressions on each side of the equal sign represent the same value(s);

(F) determine the unknown whole number in an addition or subtraction equation when the unknown may be any one of the three or four terms in the equation; and

(G) apply properties of operations to add and subtract two or three numbers.

(6) Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional shapes and three-dimensional solids to develop generalizations about their properties. The student is expected to:

(A) classify and sort regular and irregular two-dimensional shapes based on attributes using informal geometric language;

(B) distinguish between attributes that define a two-dimensional or three-dimensional figure and attributes that do not define the shape;

(C) create two-dimensional figures, including circles, triangles, rectangles, and squares, as special rectangles, rhombuses, and hexagons;

(D) identify two-dimensional shapes, including circles, triangles, rectangles, and squares, as special rectangles, rhombuses, and hexagons and describe their attributes using formal geometric language;

(E) identify three-dimensional solids, including spheres, cones, cylinders, rectangular prisms (including cubes), and triangular prisms, and describe their attributes using formal geometric language;

(F) compose two-dimensional shapes by joining two, three, or four figures to produce a target shape in more than one way if possible;

(G) partition two-dimensional figures into two and four fair shares or equal parts and describe the parts using words; and

(H) identify examples and non-examples of halves and fourths.

(7) Geometry and measurement. The student applies mathematical process standards to select and use units to describe length and time. The student is expected to:

(A) use measuring tools to measure the length of objects to reinforce the continuous nature of linear measurement;

(B) illustrate that the length of an object is the number of same-size units of length that, when laid end-to-end with no gaps or overlaps, reach from one end of the object to the other;

(C) measure the same object/distance with units of two different lengths and describe how and why the measurements differ;

(D) describe a length to the nearest whole unit using a number and a unit; and

(E) tell time to the hour and half hour using analog and digital clocks.

(8) Data analysis. The student applies mathematical process standards to organize data to make it useful for interpreting information and solving problems. The student is expected to:

(A) collect, sort, and organize data in up to three categories using models/representations such as tally marks or T-charts;

(B) use data to create picture and bar-type graphs; and

(C) draw conclusions and generate and answer questions using information from picture and bar-type graphs.

(9) Personal financial literacy. The student applies mathematical process standards to manage one's financial resources effectively for lifetime financial security. The student is expected to:

(A) define money earned as income;

(B) identify income as a means of obtaining goods and services, oftentimes making choices between wants and needs;

(C) distinguish between spending and saving; and

(D) consider charitable giving.

§111.4. Grade 2, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) For students to become fluent in mathematics, students must develop a robust sense of number. The National Research Council's report, "Adding It Up," defines procedural fluency as "skill in carrying out procedures flexibly, accurately, efficiently, and appropriately." As students develop procedural fluency, they must also realize that true problem solving may take time, effort, and perseverance. Students in Grade 2 are expected to perform their work without the use of calculators.

(4) The primary focal areas in Grade 2 are making comparisons within the base-10 place value system, solving problems with addition and subtraction within 1,000, and building foundations for multiplication.

(A) Students develop an understanding of the base-10 place value system and place value concepts. The students' understanding of base-10 place value includes ideas of counting in units and multiples of thousands, hundreds, tens, and ones and a grasp of number relationships, which students demonstrate in a variety of ways.

(B) Students identify situations in which addition and subtraction are useful to solve problems. Students develop a variety of strategies to use efficient, accurate, and generalizable methods to add and subtract multi-digit whole numbers.

(C) Students use the relationship between skip counting and equal groups of objects to represent the addition or subtraction of equivalent sets, which builds a strong foundation for multiplication and division.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to understand how to represent and compare whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system related to place value. The student is expected to:

(A) use concrete and pictorial models to compose and decompose numbers up to 1,200 in more than one way as a sum of so many thousands, hundreds, tens, and ones;

(B) use standard, word, and expanded forms to represent numbers up to 1,200;

(C) generate a number that is greater than or less than a given whole number up to 1,200;

(D) use place value to compare and order whole numbers up to 1,200 using comparative language, numbers, and symbols (>, <, or =);

(E) locate the position of a given whole number on an open number line; and

(F) name the whole number that corresponds to a specific point on a number line.

(3) Number and operations. The student applies mathematical process standards to recognize and represent fractional units and communicates how they are used to name parts of a whole. The student is expected to:

(A) partition objects into equal parts and name the parts, including halves, fourths, and eighths, using words;

(B) explain that the more fractional parts used to make a whole, the smaller the part; and the fewer the fractional parts, the larger the part;

(C) use concrete models to count fractional parts beyond one whole using words and recognize how many parts it takes to equal one whole; and

(D) identify examples and non-examples of halves, fourths, and eighths.

(4) Number and operations. The student applies mathematical process standards to develop and use strategies and methods for whole number computations in order to solve addition and subtraction problems with efficiency and accuracy. The student is expected to:

(A) recall basic facts to add and subtract within 20 with automaticity;

(B) add up to four two-digit numbers and subtract two-digit numbers using mental strategies and algorithms based on knowledge of place value and properties of operations;

(C) solve one-step and multi-step word problems involving addition and subtraction within 1,000 using a variety of strategies based on place value, including algorithms; and

(D) generate and solve problem situations for a given mathematical number sentence involving addition and subtraction of whole numbers within 1,000.

(5) Number and operations. The student applies mathematical process standards to determine the value of coins in order to solve monetary transactions. The student is expected to:

(A) determine the value of a collection of coins up to one dollar; and

(B) use the cent symbol, dollar sign, and the decimal point to name the value of a collection of coins.

(6) Number and operations. The student applies mathematical process standards to connect repeated addition and subtraction to multiplication and division situations that involve equal groupings and shares. The student is expected to:

(A) model, create, and describe contextual multiplication situations in which equivalent sets of concrete objects are joined; and

(B) model, create, and describe contextual division situations in which a set of concrete objects is separated into equivalent sets.

(7) Algebraic reasoning. The student applies mathematical process standards to identify and apply number patterns within properties of numbers and operations in order to describe relationships. The student is expected to:

(A) determine whether a number up to 40 is even or odd using pairings of objects to represent the number;

(B) use an understanding of place value to determine the number that is 10 or 100 more or less than a given number up to 1,200; and

(C) represent and solve addition and subtraction word problems where unknowns may be any one of the terms in the problem.

(8) Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional shapes and three-dimensional solids to develop generalizations about their properties. The student is expected to:

(A) create two-dimensional shapes based on given attributes, including number of sides and vertices;

(B) classify and sort three-dimensional solids, including spheres, cones, cylinders, rectangular prisms (including cubes as special rectangular prisms), and triangular prisms, based on attributes using formal geometric language;

(C) classify and sort polygons with 12 or fewer sides according to attributes, including identifying the number of sides and number of vertices;

(D) compose two-dimensional shapes and three-dimensional solids with given properties or attributes; and

(E) decompose two-dimensional shapes such as cutting out a square from a rectangle, dividing a shape in half, or partitioning a rectangle into identical triangles and identify the resulting geometric parts.

(9) Geometry and measurement. The student applies mathematical process standards to select and use units to describe length, area, and time. The student is expected to:

(A) find the length of objects using concrete models for standard units of length;

(B) describe the inverse relationship between the size of the unit and the number of units needed to equal the length of an object;

(C) represent whole numbers as distances from any given location on a number line;

(D) determine the length of an object to the nearest marked unit using rulers, yardsticks, meter sticks, or measuring tapes;

(E) determine a solution to a problem involving length, including estimating lengths;

(F) use concrete models of square units to find the area of a rectangle by covering it with no gaps or overlaps, counting to find the total number of square units, and describing the measurement using a number and the unit; and

(G) read and write time to the nearest one-minute increment using analog and digital clocks and distinguish between a.m. and p.m.

(10) Data analysis. The student applies mathematical process standards to organize data to make it useful for interpreting information and solving problems. The student is expected to:

(A) explain that the length of a bar in a bar graph or the number of pictures in a pictograph represents the number of data points for a given category;

(B) organize a collection of data with up to four categories using pictographs and bar graphs with intervals of one or more;

(C) write and solve one-step word problems involving addition or subtraction using data represented within pictographs and bar graphs with intervals of one; and

(D) draw conclusions and make predictions from information in a graph.

(11) Personal financial literacy. The student applies mathematical process standards to manage one's financial resources effectively for lifetime financial security. The student is expected to:

(A) calculate how money saved can accumulate into a larger amount over time;

(B) explain that saving is an alternative to spending;

(C) distinguish between a deposit and a withdrawal;

(D) identify examples of borrowing and distinguish between responsible and irresponsible borrowing;

(E) identify examples of lending and use concepts of benefits and costs to evaluate lending decisions; and

(F) differentiate between producers and consumers and calculate the cost to produce a simple item.

§111.5. Grade 3, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) For students to become fluent in mathematics, students must develop a robust sense of number. The National Research Council's report, "Adding It Up," defines procedural fluency as "skill in carrying out procedures flexibly, accurately, efficiently, and appropriately." As students develop procedural fluency, they must also realize that true problem solving may take time, effort, and perseverance. Students in Grade 3 are expected to perform their work without the use of calculators.

(4) The primary focal areas in Grade 3 are place value, operations of whole numbers, and understanding fractional units. These focal areas are supported throughout the mathematical strands of number and operations, algebraic reasoning, geometry and measurement, and data analysis. In Grades 3-5, the number set is limited to positive rational numbers. In number and operations, students will focus on applying place value, comparing and ordering whole numbers, connecting multiplication and division, and understanding and representing fractions as numbers and equivalent fractions. In algebraic reasoning, students will use multiple representations of problem situations, determine missing values in number sentences, and represent real-world relationships using number pairs in a table and verbal descriptions. In geometry and measurement, students will identify and classify two-dimensional figures according to common attributes, decompose composite figures formed by rectangles to determine area, determine the perimeter of polygons, solve problems involving time, and measure liquid volume (capacity) or weight. In data analysis, students will represent and interpret data.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent and compare whole numbers and understand relationships related to place value. The student is expected to:

(A) compose and decompose numbers up to 100,000 as a sum of so many ten thousands, so many thousands, so many hundreds, so many tens, and so many ones using objects, pictorial models, and numbers, including expanded notation as appropriate;

(B) describe the mathematical relationships found in the base-10 place value system through the hundred thousands place;

(C) represent a number on a number line as being between two consecutive multiples of 10; 100; 1,000; or 10,000 and use words to describe relative size of numbers in order to round whole numbers; and

(D) compare and order whole numbers up to 100,000 and represent comparisons using the symbols >, <, or =.

(3) Number and operations. The student applies mathematical process standards to represent and explain fractional units. The student is expected to:

(A) represent fractions greater than zero and less than or equal to one with denominators of 2, 3, 4, 6, and 8 using concrete objects and pictorial models, including strip diagrams and number lines;

(B) determine the corresponding fraction greater than zero and less than or equal to one with denominators of 2, 3, 4, 6, and 8 given a specified point on a number line;

(C) explain that the unit fraction $1/b$ represents the quantity formed by one part of a whole that has been partitioned into b equal parts where b is a non-zero whole number;

(D) compose and decompose a fraction a/b with a numerator greater than zero and less than or equal to b as a sum of parts $1/b$;

(E) solve problems involving partitioning an object or a set of objects among two or more recipients using pictorial representations of fractions with denominators of 2, 3, 4, 6, and 8;

(F) represent equivalent fractions with denominators of 2, 3, 4, 6, and 8 using a variety of objects and pictorial models, including number lines;

(G) explain that two fractions are equivalent if and only if they are both represented by the same point on the number line or represent the same portion of a same size whole for an area model; and

(H) compare two fractions having the same numerator or denominator in problems by reasoning about their sizes and justifying the conclusion using symbols, words, objects, and pictorial models.

(4) Number and operations. The student applies mathematical process standards to develop and use strategies and methods for whole number computations in order to solve problems with efficiency and accuracy. The student is expected to:

(A) solve with fluency one-step and two-step problems involving addition and subtraction within 1,000 using strategies based on place value, properties of operations, and the relationship between addition and subtraction;

(B) round to the nearest 10 or 100 or use compatible numbers to estimate solutions to addition and subtraction problems;

(C) determine the value of a collection of coins and bills;

(D) determine the total number of objects when equally-sized groups of objects are combined or arranged in arrays up to 10 by 10;

(E) represent multiplication facts by using a variety of approaches such as repeated addition, equal-sized groups, arrays, area models, equal jumps on a number line, and skip counting;

(F) recall facts to multiply up to 10 by 10 with automaticity and recall the corresponding division facts;

(G) use strategies and algorithms, including the standard algorithm, to multiply a two-digit number by a one-digit number. Strategies may include mental math, partial products, and the commutative, associative, and distributive properties;

(H) determine the number of objects in each group when a set of objects is partitioned into equal shares or a set of objects is shared equally;

(I) determine if a number is even or odd using divisibility rules;

(J) determine a quotient using the relationship between multiplication and division; and

(K) solve one-step and two-step problems involving multiplication and division within 100 using strategies based on objects; pictorial models, including arrays, area models, and equal groups; properties of operations; or recall of facts.

(5) Algebraic reasoning. The student applies mathematical process standards to analyze and create patterns and relationships. The student is expected to:

(A) represent one- and two-step problems involving addition and subtraction of whole numbers to 1,000 using pictorial models, number lines, and equations;

(B) represent and solve one- and two-step multiplication and division problems within 100 using arrays, strip diagrams, and equations;

(C) describe a multiplication expression as a comparison such as 3 x 24 represents 3 times as much as 24;

(D) determine the unknown whole number in a multiplication or division equation relating three whole numbers when the unknown is either a missing factor or product; and

(E) represent real-world relationships using number pairs in a table and verbal descriptions.

(6) Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional geometric figures to develop generalizations about their properties. The student is expected to:

(A) classify and sort two- and three-dimensional solids, including cones, cylinders, spheres, triangular and rectangular prisms, and cubes, based on attributes using formal geometric language;

(B) use attributes to recognize rhombuses, parallelograms, trapezoids, rectangles, and squares as examples of quadrilaterals and draw examples of quadrilaterals that do not belong to any of these subcategories;

(C) determine the area of rectangles with whole number side lengths in problems using multiplication related to the number of rows times the number of unit squares in each row;

(D) decompose composite figures formed by rectangles into non-overlapping rectangles to determine the area of the original figure using the additive property of area; and

(E) decompose two congruent two-dimensional figures into parts with equal areas and express the area of each part as a unit fraction of the whole and recognize that equal shares of identical wholes need not have the same shape.

(7) Geometry and measurement. The student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving customary and metric measurement. The student is expected to:

(A) represent fractions of halves, fourths, and eighths as distances from zero on a number line;

(B) determine the perimeter of a polygon or a missing length when given perimeter and remaining side lengths in problems;

(C) determine the solutions to problems involving addition and subtraction of time intervals in minutes using pictorial models or tools such as a 15-minute event plus a 30-minute event equals 45 minutes;

(D) determine when it is appropriate to use measurements of liquid volume (capacity) or weight; and

(E) determine liquid volume (capacity) or weight using appropriate units and tools.

(8) Data analysis. The student applies mathematical process standards to solve problems by collecting, organizing, displaying, and interpreting data. The student is expected to:

(A) summarize a data set with multiple categories using a frequency table, dot plot, pictograph, or bar graph with scaled intervals; and

(B) solve one- and two-step problems using categorical data represented with a frequency table, dot plot, pictograph, or bar graph with scaled intervals.

(9) Personal financial literacy. The student applies mathematical process standards to manage one's financial resources effectively for lifetime financial security. The student is expected to:

(A) explain the connection between human capital/labor and income;

(B) describe the relationship between the availability or scarcity of resources and how that impacts cost;

(C) identify the costs and benefits of planned and unplanned spending decisions;

(D) explain that credit is used when wants or needs exceed the ability to pay and that it is the borrower's responsibility to pay it back to the lender, usually with interest;

(E) list reasons to save and explain the benefit of a savings plan, including for college; and

(F) identify decisions involving income, spending, saving, credit, and charitable giving.

§111.6. Grade 4, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) For students to become fluent in mathematics, students must develop a robust sense of number. The National Research Council's report, "Adding It Up," defines procedural fluency as "skill in carrying out procedures flexibly, accurately, efficiently, and appropriately." As students develop procedural fluency, they must also realize that true problem solving may take time, effort, and perseverance. Students in Grade 4 are expected to perform their work without the use of calculators.

(4) The primary focal areas in Grade 4 are use of operations, fractions, and decimals and describing and analyzing geometry and measurement. These focal areas are supported throughout the mathematical strands of number and operations, algebraic reasoning, geometry and measurement, and data analysis. In Grades 3-5, the number set is limited to positive rational numbers. In number and operations, students will apply place value and represent points on a number line that correspond to a given fraction or terminating decimal. In algebraic reasoning, students will represent and solve multi-step problems involving the four operations with whole numbers with expressions and equations and generate and analyze patterns. In geometry and measurement, students will classify two-dimensional figures, measure angles, and convert units of measure. In data analysis, students will represent and interpret data.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent, compare, and order whole numbers and decimals and understand relationships related to place value. The student is expected to:

(A) interpret the value of each place-value position as 10 times the position to the right and as one-tenth of the value of the place to its left;

(B) represent the value of the digit in whole numbers through 1,000,000,000 and decimals to the hundredths using expanded notation and numerals;

(C) compare and order whole numbers to 1,000,000,000 and represent comparisons using the symbols >, <, or =;

(D) round whole numbers to a given place value through the hundred thousands place;

(E) represent decimals, including tenths and hundredths, using concrete and visual models and money;

(F) compare and order decimals using concrete and visual models to the hundredths;

(G) relate decimals to fractions that name tenths and hundredths; and

(H) determine the corresponding decimal to the tenths or hundredths place of a specified point on a number line.

(3) Number and operations. The student applies mathematical process standards to represent and generate fractions to solve problems. The student is expected to:

(A) represent a fraction a/b as a sum of fractions $1/b$, where a and b are whole numbers and $b > 0$, including when a > b;

(B) decompose a fraction in more than one way into a sum of fractions with the same denominator using concrete and pictorial models and recording results with symbolic representations;

(C) determine if two given fractions are equivalent using a variety of methods;

(D) compare two fractions with different numerators and different denominators and represent the comparison using the symbols >, =, or <;

(E) represent and solve addition and subtraction of fractions with equal denominators using objects and pictorial models that build to the number line and properties of operations;

(F) evaluate the reasonableness of sums and differences of fractions using benchmark fractions 0, 1/4, 1/2, 3/4, and 1, referring to the same whole; and

(G) represent fractions and decimals to the tenths or hundredths as distances from zero on a number line.

(4) Number and operations. The student applies mathematical process standards to develop and use strategies and methods for whole number computations and decimal sums and differences in order to solve problems with efficiency and accuracy. The student is expected to:

(A) add and subtract whole numbers and decimals to the hundredths place using the standard algorithm;

(B) determine products of a number and 10 or 100 using properties of operations and place value understandings;

(C) represent the product of 2 two-digit numbers using arrays, area models, or equations, including perfect squares through 15 by 15;

(D) use strategies and algorithms, including the standard algorithm, to multiply up to a four-digit number by a one-digit number and to multiply a two-digit number by a two-digit number. Strategies may include mental math, partial products, and the commutative, associative, and distributive properties;

(E) represent the quotient of up to a four-digit whole number divided by a one-digit whole number using arrays, area models, or equations;

(F) use strategies and algorithms, including the standard algorithm, to divide up to a four-digit dividend by a one-digit divisor;

(G) round to the nearest 10, 100, or 1,000 or use compatible numbers to estimate solutions involving whole numbers; and

(H) solve with fluency one- and two-step problems involving multiplication and division, including interpreting remainders.

(5) Algebraic reasoning. The student applies mathematical process standards to develop concepts of expressions and equations. The student is expected to:

(A) represent multi-step problems involving the four operations with whole numbers using strip diagrams and equations with a letter standing for the unknown quantity;

(B) represent problems using an input-output table and numerical expressions to generate a number pattern that follows a given rule representing the relationship of the values in the resulting sequence and their position in the sequence;

(C) use models to determine the formulas for the perimeter of a rectangle ($l + w + l + w$ or $2l + 2w$), including the special form for perimeter of a square ($4s$) and the area of a rectangle (l x w); and

(D) solve problems related to perimeter and area of rectangles where dimensions are whole numbers.

(6) Geometry and measurement. The student applies mathematical process standards to analyze geometric attributes in order to develop generalizations about their properties. The student is expected to:

(A) identify points, lines, line segments, rays, angles, and perpendicular and parallel lines;

(B) identify and draw one or more lines of symmetry, if they exist, for a two-dimensional figure;

(C) apply knowledge of right angles to identify acute, right, and obtuse triangles; and

(D) classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines or the presence or absence of angles of a specified size.

(7) Geometry and measurement. The student applies mathematical process standards to solve problems involving angles less than or equal to 180 degrees. The student is expected to:

(A) illustrate the measure of an angle as the part of a circle whose center is at the vertex of the angle that is "cut out" by the rays of the angle. Angle measures are limited to whole numbers;

(B) illustrate degrees as the units used to measure an angle, where 1/360 of any circle is one degree and an angle that "cuts" n/360 out of any circle whose center is at the angle's vertex has a measure of n degrees. Angle measures are limited to whole numbers;

(C) determine the approximate measures of angles in degrees to the nearest whole number using a protractor;

(D) draw an angle with a given measure; and

(E) determine the measure of an unknown angle formed by two non-overlapping adjacent angles given one or both angle measures.

(8) Geometry and measurement. The student applies mathematical process standards to select appropriate customary and metric units, strategies, and tools to solve problems involving measurement. The student is expected to:

(A) identify relative sizes of measurement units within the customary and metric systems;

(B) convert measurements within the same measurement system, customary or metric, from a smaller unit into a larger unit or a larger unit into a smaller unit when given other equivalent measures represented in a table; and

(C) solve problems that deal with measurements of length, intervals of time, liquid volumes, mass, and money using addition, subtraction, multiplication, or division as appropriate.

(9) Data analysis. The student applies mathematical process standards to solve problems by collecting, organizing, displaying, and interpreting data. The student is expected to:

(A) represent data on a frequency table, dot plot, or stem-and-leaf plot marked with whole numbers and fractions; and

(B) solve one- and two-step problems using data in whole number, decimal, and fraction form in a frequency table, dot plot, or stem-and-leaf plot.

(10) Personal financial literacy. The student applies mathematical process standards to manage one's financial resources effectively for lifetime financial security. The student is expected to:

(A) distinguish between fixed and variable expenses;

(B) calculate profit in a given situation;

(C) compare the advantages and disadvantages of various savings options;

(D) describe how to allocate a weekly allowance among spending; saving, including for college; and sharing; and

(E) describe the basic purpose of financial institutions, including keeping money safe, borrowing money, and lending.

§111.7. Grade 5, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) For students to become fluent in mathematics, students must develop a robust sense of number. The National Research Council's report, "Adding It Up," defines procedural fluency as "skill in carrying out procedures flexibly, accurately, efficiently, and appropriately." As students develop procedural fluency, they must also realize that true problem solving may take time, effort, and perseverance. Students in Grade 5 are expected to perform their work without the use of calculators.

(4) The primary focal areas in Grade 5 are solving problems involving all four operations with positive rational numbers, determining and generating formulas and solutions to expressions, and extending measurement to area and volume. These focal areas are supported throughout the mathematical strands of number and operations, algebraic reasoning, geometry and measurement, and data analysis. In Grades 3-5, the number set is limited to positive rational numbers. In number and operations, students will apply place value and identify part-to-whole relationships and equivalence. In algebraic reasoning, students will represent and solve problems with expressions and equations, build foundations of functions through patterning, identify prime and composite numbers, and use the order of operations. In geometry and measurement, students will classify two-dimensional figures, connect geometric attributes to the measures of three-dimensional figures, use units of measure, and represent location using a coordinate plane. In data analysis, students will represent and interpret data.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent, compare, and order positive rational numbers and understand relationships as related to place value. The student is expected to:

(A) represent the value of the digit in decimals through the thousandths using expanded notation and numerals;

(B) compare and order two decimals to thousandths and represent comparisons using the symbols >, <, or =; and

(C) round decimals to tenths or hundredths.

(3) Number and operations. The student applies mathematical process standards to develop and use strategies and methods for positive rational number computations in order to solve problems with efficiency and accuracy. The student is expected to:

(A) estimate to determine solutions to mathematical and real-world problems involving addition, subtraction, multiplication, or division;

(B) multiply with fluency a three-digit number by a two-digit number using the standard algorithm;

(C) solve with proficiency for quotients of up to a four-digit dividend by a two-digit divisor using strategies and the standard algorithm;

(D) represent multiplication of decimals with products to the hundredths using objects and pictorial models, including area models;

(E) solve for products of decimals to the hundredths, including situations involving money, using strategies based on place-value understandings, properties of operations, and the relationship to the multiplication of whole numbers;

(F) represent quotients of decimals to the hundredths, up to four-digit dividends and two-digit whole number divisors, using objects and pictorial models, including area models;

(G) solve for quotients of decimals to the hundredths, up to four-digit dividends and two-digit whole number divisors, using strategies and algorithms, including the standard algorithm;

(H) represent and solve addition and subtraction of fractions with unequal denominators referring to the same whole using objects and pictorial models and properties of operations;

(I) represent and solve multiplication of a whole number and a fraction that refers to the same whole using objects and pictorial models, including area models;

(J) represent division of a unit fraction by a whole number and the division of a whole number by a unit fraction such as $1/3 \div 7$ and $7 \div 1/3$ using objects and pictorial models, including area models;

(K) add and subtract positive rational numbers fluently; and

(L) divide whole numbers by unit fractions and unit fractions by whole numbers.

(4) Algebraic reasoning. The student applies mathematical process standards to develop concepts of expressions and equations. The student is expected to:

(A) identify prime and composite numbers;

(B) represent and solve multi-step problems involving the four operations with whole numbers using equations with a letter standing for the unknown quantity;

(C) generate a numerical pattern when given a rule in the form $y = ax$ or $y = x + a$ and graph;

(D) recognize the difference between additive and multiplicative numerical patterns given in a table or graph;

(E) describe the meaning of parentheses and brackets in a numeric expression;

(F) simplify numerical expressions that do not involve exponents, including up to two levels of grouping;

(G) use concrete objects and pictorial models to develop the formulas for the volume of a rectangular prism, including the special form for a cube ($V = l \times w \times h$, $V = s \times s \times s$, and $V = Bh$); and

(H) represent and solve problems related to perimeter and/or area and related to volume.

(5) Geometry and measurement. The student applies mathematical process standards to classify two-dimensional figures by attributes and properties. The student is expected to classify two-dimensional figures in a hierarchy of sets and subsets using graphic organizers based on their attributes and properties.

(6) Geometry and measurement. The student applies mathematical process standards to understand, recognize, and quantify volume. The student is expected to:

(A) recognize a cube with side length of one unit as a unit cube having one cubic unit of volume and the volume of a three-dimensional figure as the number of unit cubes (*n* cubic units) needed to fill it with no gaps or overlaps if possible; and

(B) determine the volume of a rectangular prism with whole number side lengths in problems related to the number of layers times the number of unit cubes in the area of the base.

(7) Geometry and measurement. The student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving measurement. The student is expected to solve problems by calculating conversions within a measurement system, customary or metric.

(8) Geometry and measurement. The student applies mathematical process standards to identify locations on a coordinate plane. The student is expected to:

(A) describe the key attributes of the coordinate plane, including perpendicular number lines (axes) where the intersection (origin) of the two lines coincides with zero on each number line and the given point (0, 0); the *x*-coordinate, the first number in an ordered pair, indicates movement parallel to the *x*-axis starting at the origin; and the *y*-coordinate, the second number, indicates movement parallel to the *y*-axis starting at the origin;

(B) describe the process for graphing ordered pairs of numbers in the first quadrant of the coordinate plane; and

(C) graph in the first quadrant of the coordinate plane ordered pairs of numbers arising from mathematical and real-world problems, including those generated by number patterns or found in an input-output table.

(9) Data analysis. The student applies mathematical process standards to solve problems by collecting, organizing, displaying, and interpreting data. The student is expected to:

(A) represent categorical data with bar graphs or frequency tables and numerical data, including data sets of measurements in fractions or decimals, with dot plots or stem-and-leaf plots;

(B) represent discrete paired data on a scatterplot; and

(C) solve one- and two-step problems using data from a frequency table, dot plot, bar graph, stem-and-leaf plot, or scatterplot.

(10) Personal financial literacy. The student applies mathematical process standards to manage one's financial resources effectively for lifetime financial security. The student is expected to:

(A) define income tax, payroll tax, sales tax, and property tax;

(B) explain the difference between gross income and net income;

(C) identify the advantages and disadvantages of different methods of payment, including check, credit card, debit card, and electronic payments;

(D) develop a system for keeping and using financial records;

(E) describe actions that might be taken to balance a budget when expenses exceed income; and

(F) balance a simple budget.

Subchapter B. Middle School

§111.26. Grade 6, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) The primary focal areas in Grade 6 are number and operations; proportionality; expressions, equations, and relationships; and measurement and data. Students use concepts, algorithms, and properties of rational numbers to explore mathematical relationships and to describe increasingly complex situations. Students use concepts of proportionality to explore, develop, and communicate mathematical relationships. Students use algebraic thinking to describe how a change in one quantity in a relationship results in a change in the other. Students connect verbal, numeric, graphic, and symbolic representations of relationships, including equations and inequalities. Students use geometric properties and relationships, as well as spatial reasoning, to model and analyze situations and solve problems. Students communicate information about geometric figures or situations by quantifying attributes, generalize procedures from measurement experiences, and use the procedures to solve problems. Students use appropriate statistics, representations of data, and reasoning to draw conclusions, evaluate arguments, and make recommendations. While the use of all types of technology is important, the emphasis on algebra readiness skills necessitates the implementation of graphing technology.

(4) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to:

(A) classify whole numbers, integers, and rational numbers using a visual representation such as a Venn diagram to describe relationships between sets of numbers;

(B) identify a number, its opposite, and its absolute value;

(C) locate, compare, and order integers and rational numbers using a number line;

(D) order a set of rational numbers arising from mathematical and real-world contexts; and

(E) extend representations for division to include fraction notation such as a/b represents the same number as $a \div b$ where $b \neq 0$.

(3) Number and operations. The student applies mathematical process standards to represent addition, subtraction, multiplication, and division while solving problems and justifying solutions. The student is expected to:

(A) recognize that dividing by a rational number and multiplying by its reciprocal result in equivalent values;

(B) determine, with and without computation, whether a quantity is increased or decreased when multiplied by a fraction, including values greater than or less than one;

(C) represent integer operations with concrete models and connect the actions with the models to standardized algorithms;

(D) add, subtract, multiply, and divide integers fluently; and

(E) multiply and divide positive rational numbers fluently.

(4) Proportionality. The student applies mathematical process standards to develop an understanding of proportional relationships in problem situations. The student is expected to:

(A) compare two rules verbally, numerically, graphically, and symbolically in the form of $y = ax$ or $y = x + a$ in order to differentiate between additive and multiplicative relationships;

(B) apply qualitative and quantitative reasoning to solve prediction and comparison of real-world problems involving ratios and rates;

(C) give examples of ratios as multiplicative comparisons of two quantities describing the same attribute;

(D) give examples of rates as the comparison by division of two quantities having different attributes, including rates as quotients;

(E) represent ratios and percents with concrete models, fractions, and decimals;

(F) represent benchmark fractions and percents such as 1%, 10%, 25%, 33 1/3%, and multiples of these values using 10 by 10 grids, strip diagrams, number lines, and numbers;

(G) generate equivalent forms of fractions, decimals, and percents using real-world problems, including problems that involve money; and

(H) convert units within a measurement system, including the use of proportions and unit rates.

(5) Proportionality. The student applies mathematical process standards to solve problems involving proportional relationships. The student is expected to:

(A) represent mathematical and real-world problems involving ratios and rates using scale factors, tables, graphs, and proportions;

(B) solve real-world problems to find the whole given a part and the percent, to find the part given the whole and the percent, and to find the percent given the part and the whole, including the use of concrete and pictorial models; and

(C) use equivalent fractions, decimals, and percents to show equal parts of the same whole.

(6) Expressions, equations, and relationships. The student applies mathematical process standards to use multiple representations to describe algebraic relationships. The student is expected to:

(A) identify independent and dependent quantities from tables and graphs;

(B) write an equation that represents the relationship between independent and dependent quantities from a table; and

(C) represent a given situation using verbal descriptions, tables, graphs, and equations in the form $y = kx$ or $y = x + b$.

(7) Expressions, equations, and relationships. The student applies mathematical process standards to develop concepts of expressions and equations. The student is expected to:

(A) generate equivalent numerical expressions using order of operations, including whole number exponents and prime factorization;

(B) distinguish between expressions and equations verbally, numerically, and algebraically;

(C) determine if two expressions are equivalent using concrete models, pictorial models, and algebraic representations; and

(D) generate equivalent expressions using the properties of operations: inverse, identity, commutative, associative, and distributive properties.

(8) Expressions, equations, and relationships. The student applies mathematical process standards to use geometry to represent relationships and solve problems. The student is expected to:

(A) extend previous knowledge of triangles and their properties to include the sum of angles of a triangle, the relationship between the lengths of sides and measures of angles in a triangle, and determining when three lengths form a triangle;

(B) model area formulas for parallelograms, trapezoids, and triangles by decomposing and rearranging parts of these shapes;

(C) write equations that represent problems related to the area of rectangles, parallelograms, trapezoids, and triangles and volume of right rectangular prisms where dimensions are positive rational numbers; and

(D) determine solutions for problems involving the area of rectangles, parallelograms, trapezoids, and triangles and volume of right rectangular prisms where dimensions are positive rational numbers.

(9) Expressions, equations, and relationships. The student applies mathematical process standards to use equations and inequalities to represent situations. The student is expected to:

(A) write one-variable, one-step equations and inequalities to represent constraints or conditions within problems;

(B) represent solutions for one-variable, one-step equations and inequalities on number lines; and

(C) write corresponding real-world problems given one-variable, one-step equations or inequalities.

(10) Expressions, equations, and relationships. The student applies mathematical process standards to use equations and inequalities to solve problems. The student is expected to:

(A) model and solve one-variable, one-step equations and inequalities that represent problems, including geometric concepts; and

(B) determine if the given value(s) make(s) one-variable, one-step equations or inequalities true.

(11) Measurement and data. The student applies mathematical process standards to use coordinate geometry to identify locations on a plane. The student is expected to graph points in all four quadrants using ordered pairs of rational numbers.

(12) Measurement and data. The student applies mathematical process standards to use numerical or graphical representations to analyze problems. The student is expected to:

(A) represent numeric data graphically, including dot plots, stem-and-leaf plots, histograms, and box plots;

(B) use the graphical representation of numeric data to describe the center, spread, and shape of the data distribution;

(C) summarize numeric data with numerical summaries, including the mean and median (measures of center) and the range and interquartile range (IQR) (measures of spread), and use these summaries to describe the center, spread, and shape of the data distribution; and

(D) summarize categorical data with numerical and graphical summaries, including the mode, the percent of values in each category (relative frequency table), and the percent bar graph, and use these summaries to describe the data distribution.

(13) Measurement and data. The student applies mathematical process standards to use numerical or graphical representations to solve problems. The student is expected to:

(A) interpret numeric data summarized in dot plots, stem-and-leaf plots, histograms, and box plots; and

(B) distinguish between situations that yield data with and without variability.

(14) Personal financial literacy. The student applies mathematical process standards to develop an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

(A) compare the features and costs of a checking account and a debit card offered by different local financial institutions;

(B) distinguish between debit cards and credit cards;

(C) balance a check register that includes deposits, withdrawals, and transfers;

(D) explain why it is important to establish a positive credit history;

(E) describe the information in a credit report and how long it is retained;

(F) describe the value of credit reports to borrowers and to lenders;

(G) explain various methods to pay for college, including through savings, grants, scholarships, student loans, and work-study; and

(H) compare the annual salary of several occupations requiring various levels of post-secondary education or vocational training and calculate the effects of the different annual salaries on lifetime income.

§111.27. Grade 7, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to

connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) The primary focal areas in Grade 7 are number and operations; proportionality; expressions, equations, and relationships; and measurement and data. Students use concepts, algorithms, and properties of rational numbers to explore mathematical relationships and to describe increasingly complex situations. Students use concepts of proportionality to explore, develop, and communicate mathematical relationships, including number, geometry and measurement, and statistics and probability. Students use algebraic thinking to describe how a change in one quantity in a relationship results in a change in the other. Students connect verbal, numeric, graphic, and symbolic representations of relationships, including equations and inequalities. Students use geometric properties and relationships, as well as spatial reasoning, to model and analyze situations and solve problems. Students communicate information about geometric figures or situations by quantifying attributes, generalize procedures from measurement experiences, and use the procedures to solve problems. Students use appropriate statistics, representations of data, and reasoning to draw conclusions, evaluate arguments, and make recommendations. While the use of all types of technology is important, the emphasis on algebra readiness skills necessitates the implementation of graphing technology.

(4) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of rational numbers.

(3) Number and operations. The student applies mathematical process standards to add, subtract, multiply, and divide while solving problems and justifying solutions. The student is expected to:

(A) add, subtract, multiply, and divide rational numbers fluently; and

(B) apply and extend previous understandings of operations to solve problems using addition, subtraction, multiplication, and division of rational numbers.

(4) Proportionality. The student applies mathematical process standards to represent and solve problems involving proportional relationships. The student is expected to:

(A) represent constant rates of change in mathematical and real-world problems given pictorial, tabular, verbal, numeric, graphical, and algebraic representations, including $d = rt$;

(B) calculate unit rates from rates in mathematical and real-world problems;

(C) determine the constant of proportionality ($k = y/x$) within mathematical and real-world problems;

(D) solve problems involving ratios, rates, and percents, including multi-step problems involving percent increase and percent decrease, and financial literacy problems; and

(E) convert between measurement systems, including the use of proportions and the use of unit rates.

(5) Proportionality. The student applies mathematical process standards to use geometry to describe or solve problems involving proportional relationships. The student is expected to:

(A) generalize the critical attributes of similarity, including ratios within and between similar shapes;

(B) describe π as the ratio of the circumference of a circle to its diameter; and

(C) solve mathematical and real-world problems involving similar shape and scale drawings.

(6) Proportionality. The student applies mathematical process standards to use probability and statistics to describe or solve problems involving proportional relationships. The student is expected to:

(A) represent sample spaces for simple and compound events using lists and tree diagrams;

(B) select and use different simulations to represent simple and compound events with and without technology;

(C) make predictions and determine solutions using experimental data for simple and compound events;

(D) make predictions and determine solutions using theoretical probability for simple and compound events;

(E) find the probabilities of a simple event and its complement and describe the relationship between the two;

(F) use data from a random sample to make inferences about a population;

(G) solve problems using data represented in bar graphs, dot plots, and circle graphs, including part-to-whole and part-to-part comparisons and equivalents;

(H) solve problems using qualitative and quantitative predictions and comparisons from simple experiments; and

(I) determine experimental and theoretical probabilities related to simple and compound events using data and sample spaces.

(7) Expressions, equations, and relationships. The student applies mathematical process standards to represent linear relationships using multiple representations. The student is expected to represent linear relationships using verbal descriptions, tables, graphs, and equations that simplify to the form $y = mx + b$.

(8) Expressions, equations, and relationships. The student applies mathematical process standards to develop geometric relationships with volume. The student is expected to:

(A) model the relationship between the volume of a rectangular prism and a rectangular pyramid having both congruent bases and heights and connect that relationship to the formulas;

(B) explain verbally and symbolically the relationship between the volume of a triangular prism and a triangular pyramid having both congruent bases and heights and connect that relationship to the formulas; and

(C) use models to determine the approximate formulas for the circumference and area of a circle and connect the models to the actual formulas.

(9) Expressions, equations, and relationships. The student applies mathematical process standards to solve geometric problems. The student is expected to:

(A) solve problems involving the volume of rectangular prisms, triangular prisms, rectangular pyramids, and triangular pyramids;

(B) determine the circumference and area of circles;

(C) determine the area of composite figures containing combinations of rectangles, squares, parallelograms, trapezoids, triangles, semicircles, and quarter circles; and

(D) solve problems involving the lateral and total surface area of a rectangular prism, rectangular pyramid, triangular prism, and triangular pyramid by determining the area of the shape's net.

(10) Expressions, equations, and relationships. The student applies mathematical process standards to use one-variable equations and inequalities to represent situations. The student is expected to:

(A) write one-variable, two-step equations and inequalities to represent constraints or conditions within problems;

(B) represent solutions for one-variable, two-step equations and inequalities on number lines; and

(C) write a corresponding real-world problem given a one-variable, two-step equation or inequality.

(11) Expressions, equations, and relationships. The student applies mathematical process standards to solve one-variable equations and inequalities. The student is expected to:

(A) model and solve one-variable, two-step equations and inequalities;

(B) determine if the given value(s) make(s) one-variable, two-step equations and inequalities true; and

(C) write and solve equations using geometry concepts, including the sum of the angles in a triangle, and angle relationships.

(12) Measurement and data. The student applies mathematical process standards to use statistical representations to analyze data. The student is expected to:

(A) compare two groups of numeric data using comparative dot plots or box plots by comparing their shapes, centers, and spreads;

(B) use data from a random sample to make inferences about a population; and

(C) compare two populations based on data in random samples from these populations, including informal comparative inferences about differences between the two populations.

(13) Personal financial literacy. The student applies mathematical process standards to develop an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

(A) calculate the sales tax for a given purchase and calculate income tax for earned wages;

(B) identify the components of a personal budget, including income; planned savings for college, retirement, and emergencies; taxes; and fixed and variable expenses, and calculate what percentage each category comprises of the total budget;

(C) create and organize a financial assets and liabilities record and construct a net worth statement;

(D) use a family budget estimator to determine the minimum household budget and average hourly wage needed for a family to meet its basic needs in the student's city or another large city nearby;

(E) calculate and compare simple interest and compound interest earnings; and

(F) analyze and compare monetary incentives, including sales, rebates, and coupons.

§111.28. Grade 8, Adopted 2012.

(a) Introduction.

(1) The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on computational thinking, mathematical fluency, and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

(2) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, algorithms, paper and pencil, and technology and techniques such as mental math, estimation, number sense, and generalization and abstraction to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, computer programs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify

mathematical ideas and arguments using precise mathematical language in written or oral communication.

(3) The primary focal areas in Grade 8 are proportionality; expressions, equations, relationships, and foundations of functions; and measurement and data. Students use concepts, algorithms, and properties of real numbers to explore mathematical relationships and to describe increasingly complex situations. Students use concepts of proportionality to explore, develop, and communicate mathematical relationships. Students use algebraic thinking to describe how a change in one quantity in a relationship results in a change in the other. Students connect verbal, numeric, graphic, and symbolic representations of relationships, including equations and inequalities. Students begin to develop an understanding of functional relationships. Students use geometric properties and relationships, as well as spatial reasoning, to model and analyze situations and solve problems. Students communicate information about geometric figures or situations by quantifying attributes, generalize procedures from measurement experiences, and use the procedures to solve problems. Students use appropriate statistics, representations of data, and reasoning to draw conclusions, evaluate arguments, and make recommendations. While the use of all types of technology is important, the emphasis on algebra readiness skills necessitates the implementation of graphing technology.

(4) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent and use real numbers in a variety of forms. The student is expected to:

(A) extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of real numbers;

(B) approximate the value of an irrational number, including π and square roots of numbers less than 225, and locate that rational number approximation on a number line;

(C) convert between standard decimal notation and scientific notation; and

(D) order a set of real numbers arising from mathematical and real-world contexts.

(3) Proportionality. The student applies mathematical process standards to use proportional relationships to describe dilations. The student is expected to:

(A) generalize that the ratio of corresponding sides of similar shapes are proportional, including a shape and its dilation;

(B) compare and contrast the attributes of a shape and its dilation(s) on a coordinate plane; and

(C) use an algebraic representation to explain the effect of a given positive rational scale factor applied to two-dimensional figures on a coordinate plane with the origin as the center of dilation.

(4) Proportionality. The student applies mathematical process standards to explain proportional and non-proportional relationships involving slope. The student is expected to:

(A) use similar right triangles to develop an understanding that slope, m, given as the rate comparing the change in y-values to the change in x-values, $(y_2 - y_1)/ (x_2 - x_1)$, is the same for any two points (x_1, y_1) and (x_2, y_2) on the same line;

(B) graph proportional relationships, interpreting the unit rate as the slope of the line that models the relationship; and

(C) use data from a table or graph to determine the rate of change or slope and y-intercept in mathematical and real-world problems.

(5) Proportionality. The student applies mathematical process standards to use proportional and non-proportional relationships to develop foundational concepts of functions. The student is expected to:

(A) represent linear proportional situations with tables, graphs, and equations in the form of $y = kx$;

(B) represent linear non-proportional situations with tables, graphs, and equations in the form of $y = mx + b$, where $b \neq 0$;

(C) contrast bivariate sets of data that suggest a linear relationship with bivariate sets of data that do not suggest a linear relationship from a graphical representation;

(D) use a trend line that approximates the linear relationship between bivariate sets of data to make predictions;

(E) solve problems involving direct variation;

(F) distinguish between proportional and non-proportional situations using tables, graphs, and equations in the form $y = kx$ or $y = mx + b$, where $b \neq 0$;

(G) identify functions using sets of ordered pairs, tables, mappings, and graphs;

(H) identify examples of proportional and non-proportional functions that arise from mathematical and real-world problems; and

(I) write an equation in the form $y = mx + b$ to model a linear relationship between two quantities using verbal, numerical, tabular, and graphical representations.

(6) Expressions, equations, and relationships. The student applies mathematical process standards to develop mathematical relationships and make connections to geometric formulas. The student is expected to:

(A) describe the volume formula $V = Bh$ of a cylinder in terms of its base area and its height;

(B) model the relationship between the volume of a cylinder and a cone having both congruent bases and heights and connect that relationship to the formulas; and

(C) use models and diagrams to explain the Pythagorean theorem.

(7) Expressions, equations, and relationships. The student applies mathematical process standards to use geometry to solve problems. The student is expected to:

(A) solve problems involving the volume of cylinders, cones, and spheres;

(B) use previous knowledge of surface area to make connections to the formulas for lateral and total surface area and determine solutions for problems involving rectangular prisms, triangular prisms, and cylinders;

(C) use the Pythagorean Theorem and its converse to solve problems; and

(D) determine the distance between two points on a coordinate plane using the Pythagorean Theorem.

(8) Expressions, equations, and relationships. The student applies mathematical process standards to use one-variable equations or inequalities in problem situations. The student is expected to:

(A) write one-variable equations or inequalities with variables on both sides that represent problems using rational number coefficients and constants;

(B) write a corresponding real-world problem when given a one-variable equation or inequality with variables on both sides of the equal sign using rational number coefficients and constants;

(C) model and solve one-variable equations with variables on both sides of the equal sign that represent mathematical and real-world problems using rational number coefficients and constants; and

(D) use informal arguments to establish facts about the angle sum and exterior angle of triangles, the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.

(9) Expressions, equations, and relationships. The student applies mathematical process standards to use multiple representations to develop foundational concepts of simultaneous linear equations. The student is expected to identify and verify the values of x and y that simultaneously satisfy two linear equations in the form $y = mx + b$ from the intersections of the graphed equations.

(10) Two-dimensional shapes. The student applies mathematical process standards to develop transformational geometry concepts. The student is expected to:

(A) generalize the properties of orientation and congruence of rotations, reflections, translations, and dilations of two-dimensional shapes on a coordinate plane;

(B) differentiate between transformations that preserve congruence and those that do not;

(C) explain the effect of translations, reflections over the x- or y-axis, and rotations limited to 90°, 180°, 270°, and 360° as applied to two-dimensional shapes on a coordinate plane using an algebraic representation; and

(D) model the effect on linear and area measurements of dilated two-dimensional shapes.

(11) Measurement and data. The student applies mathematical process standards to use statistical procedures to describe data. The student is expected to:

(A) construct a scatterplot and describe the observed data to address questions of association such as linear, non-linear, and no association between bivariate data;

(B) determine the mean absolute deviation and use this quantity as a measure of the average distance data are from the mean using a data set of no more than 10 data points; and

(C) simulate generating random samples of the same size from a population with known characteristics to develop the notion of a random sample being representative of the population from which it was selected.

(12) Personal financial literacy. The student applies mathematical process standards to develop an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

(A) solve real-world problems comparing how interest rate and loan length affect the cost of credit;

(B) calculate the total cost of repaying a loan, including credit cards and easy access loans, under various rates of interest and over different periods using an online calculator;

(C) explain how small amounts of money invested regularly, including money saved for college and retirement, grow over time;

(D) calculate and compare simple interest and compound interest earnings;

(E) identify and explain the advantages and disadvantages of different payment methods;

(F) analyze situations to determine if they represent financially responsible decisions and identify the benefits of financial responsibility and the costs of financial irresponsibility; and

(G) estimate the cost of a two-year and four-year college education, including family contribution, and devise a periodic savings plan for accumulating the money needed to contribute to the total cost of attendance for at least the first year of college.

Capítulo 111. Conocimientos y destrezas esenciales en Texas para matemáticas

Subcapítulo A. Primaria

§111.2. Kindergarten, adoptado en el 2012.

(a) Introducción

(1) El deseo de alcanzar una excelencia educativa es la fuerza que impulsa al currículo Conocimientos y Destrezas Esenciales de Texas para matemáticas, el cual está guiado por los estándares de preparación para la universidad o para una carrera técnica o vocacional. A través de la inclusión de la estadística, la probabilidad y las finanzas, y enfocándose al mismo tiempo en el pensamiento computacional, en el dominio matemático y en una sólida comprensión, Texas será el líder en la educación de las matemáticas y preparará a todos sus estudiantes para los retos que enfrentarán en el siglo XXI.

(2) Los estándares de procesos describen los métodos en los cuales se espera que los estudiantes hagan conexiones con el contenido. La ubicación de los estándares de procesos al principio de los conocimientos y destrezas de cada grado y curso es intencional. Los estándares de procesos entrelazan los otros conocimientos y destrezas para que los estudiantes puedan tener éxito al resolver problemas y puedan utilizar las matemáticas eficiente y eficazmente en la vida diaria. Los estándares de procesos están integrados en cada grado y en cada curso. Cuando sea posible, los estudiantes aplicarán las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo. Los estudiantes utilizarán un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución. Los estudiantes seleccionarán herramientas apropiadas, tales como objetos reales, manipulativos, algoritmos, papel y lápiz, además de tecnología y técnicas, tales como el cálculo mental, la estimación, el sentido numérico y la generalización y abstracción, para resolver problemas. Los estudiantes comunicarán eficazmente ideas matemáticas y su razonamiento, además de las implicaciones de éstos utilizando múltiples representaciones, tales como símbolos, diagramas, gráficas, programas de computadora y el lenguaje común. Los estudiantes utilizarán relaciones matemáticas para generar soluciones y hacer conexiones, así como predicciones. Los estudiantes analizarán relaciones matemáticas para conectar y comunicar ideas matemáticas. Los estudiantes mostrarán, explicarán o justificarán ideas y razonamientos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(3) Para que los estudiantes lleguen a dominar las matemáticas, tendrán que desarrollar un sólido sentido numérico. El reporte del National Research Council, "Adding It Up," define el dominio de los procedimientos como "la destreza de poder realizar procedimientos de manera flexible, precisa, eficiente y apropiada". Mientras los estudiantes desarrollan el dominio de los procedimientos, también tienen que reconocer que la verdadera resolución de problemas puede tomar tiempo, esfuerzo y perseverancia. Se espera que los estudiantes en Kindergarten realicen su trabajo sin el uso de calculadoras.

(4) Las áreas principales de enfoque en Kindergarten son la comprensión del conteo y del reconocimiento de los números cardinales; la comprensión de que en la suma se une y en la resta se separa; y la comparación de objetos de acuerdo con sus atributos medibles.

(A) Los estudiantes desarrollan un sentido numérico y las operaciones a través de varios conceptos fundamentales. Los estudiantes saben los nombres de los números y la secuencia en el conteo. El conteo y el reconocimiento de números establecen bases sólidas para el sentido numérico. Los estudiantes aplican los principios de conteo para hacer conexiones entre números y cantidades.

(B) Los estudiantes utilizan el significado de los números para crear estrategias al resolver problemas y al responder a situaciones prácticas que involucran suma y resta.

(C) Los estudiantes identifican las características de los objetos que se pueden medir y comparan directamente los objetos de acuerdo con estos atributos medibles.

(5) Los enunciados que contienen las palabras "incluyendo" o "que incluyan" se refieren a destrezas que deben dominarse, mientras que los que contienen las frases "como", "tal(es) como" o "por ejemplo" se presentan como opciones posibles.

(b) Conocimientos y destrezas

(1) Estándares de procesos matemáticos. El estudiante utiliza procesos matemáticos para adquirir y demostrar comprensión matemática. Se espera que el estudiante:

(A) aplique las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo;

(B) utilice un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución;

(C) seleccione herramientas cuando sean apropiadas, incluyendo objetos reales, manipulativos, papel y lápiz, y tecnología, además de técnicas cuando sean apropiadas, incluyendo el cálculo mental, la estimación y el sentido numérico, para resolver problemas;

(D) comunique ideas matemáticas, su razonamiento y sus implicaciones utilizando múltiples representaciones cuando sean apropiadas, incluyendo símbolos, diagramas, gráficas y el lenguaje común;

(E) genere y utilice representaciones para organizar, anotar y comunicar ideas matemáticas;

(F) analice relaciones matemáticas para conectar y comunicar ideas matemáticas; y

(G) muestre, explique y justifique ideas y argumentos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(2) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para comprender cómo se representan y comparan números enteros, la posición relativa y la magnitud de los números enteros y las relaciones dentro del sistema de numeración. Se espera que el estudiante:

(A) cuente hacia adelante y hacia atrás por lo menos hasta el número 20 con y sin objetos;

(B) lea, escriba y represente números enteros del 0 hasta por lo menos el 20 con y sin objetos o ilustraciones;

(C) cuente un conjunto de por lo menos 20 objetos y demuestre que el último número que cuente indica el número de objetos en el conjunto sin importar cómo están acomodados o el orden;

(D) reconozca inmediatamente la cantidad de un grupo pequeño de objetos acomodados en forma organizada y al azar;

(E) genere un conjunto utilizando modelos concretos y pictóricos que representen un número que es mayor que, menor que e igual a un número dado por lo menos hasta el 20;

(F) genere un número que es uno más o uno menos que otro número por lo menos hasta el 20;

(G) compare conjuntos de por lo menos 20 objetos en cada uno utilizando lenguaje comparativo;

(H) utilice lenguaje comparativo para describir dos números que se presentan como numerales escritos hasta el 20; y

(I) componga y descomponga números hasta el 10 usando objetos e ilustraciones.

(3) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para desarrollar comprensión de situaciones en las que se necesita sumar y restar que le permita resolver problemas. Se espera que el estudiante:

(A) elabore modelos que muestren la acción de juntar para representar la suma y la acción de separar para representar la resta;

(B) resuelva problemas escritos utilizando objetos e ilustraciones para encontrar las sumas hasta el 10 y las diferencias hasta el 10; y

(C) explique las estrategias utilizadas para resolver problemas que involucren sumar y restar hasta el 10 usando lenguaje verbal, modelos concretos y pictóricos, así como oraciones numéricas.

(4) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para identificar monedas y reconocer la necesidad de transacciones monetarias. Se espera que el estudiante identifique monedas estadounidenses por su nombre, incluyendo monedas de un centavo (pennies), cinco centavos (nickels), diez centavos (dimes) y veinticinco centavos (quarters).

(5) Razonamiento algebraico. El estudiante aplica los estándares de procesos matemáticos para identificar el patrón que existe en una lista de números escritos. Se espera que el estudiante cuente en voz alta los números por lo menos hasta el 100 de uno en uno y de diez en diez comenzando con cualquier número dado.

(6) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para analizar los atributos de figuras de dos dimensiones y sólidos de tres dimensiones que le permita hacer generalizaciones acerca de sus propiedades. Se espera que el estudiante:

(A) identifique figuras de dos dimensiones, incluyendo círculos, triángulos, rectángulos y cuadrados, que son considerados rectángulos especiales;

(B) identifique en el mundo real sólidos de tres dimensiones, incluyendo cilindros, conos, esferas y cubos;

(C) identifique componentes de dos dimensiones en objetos de tres dimensiones;

(D) identifique atributos de figuras de dos dimensiones utilizando lenguaje geométrico informal y formal de manera intercambiable;

(E) clasifique y agrupe una variedad de figuras de dos y tres dimensiones regulares e irregulares sin importar la orientación o el tamaño; y

(F) haga figuras de dos dimensiones utilizando una variedad de materiales e ilustraciones.

(7) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para comparar directamente atributos medibles. Se espera que el estudiante:

(A) dé un ejemplo de un atributo medible de un objeto dado, incluyendo longitud, capacidad y peso; y

(B) compare dos objetos con un atributo medible común para ver cuál objeto tiene más del atributo y menos del atributo, y describa la diferencia.

(8) Análisis de datos. El estudiante aplica los estándares de procesos matemáticos para reunir y organizar datos que le permitan utilizarlos al interpretar información. Se espera que el estudiante:

(A) reúna, ordene y organice datos en dos o tres categorías;

(B) utilice datos para crear gráficas con objetos reales y con ilustraciones; y

(C) saque conclusiones de gráficas que usan objetos reales y gráficas que usan ilustraciones.

(9) Comprensión de finanzas personales. El estudiante aplica los estándares de procesos matemáticos para manejar eficazmente sus propios recursos financieros para lograr una seguridad financiera de por vida. Se espera que el estudiante:

(A) identifique formas de obtener ingresos;

(B) diferencie entre dinero recibido como ingreso y dinero recibido como regalo;

(C) haga una lista de las destrezas simples que son necesarias en los trabajos; y

(D) distinga entre lo que se desea y lo que se necesita, e identifique los ingresos como un recurso para obtener lo que se desea y lo que se necesita.

§111.2. Primer grado, adoptado en el 2012.

(a) Introducción

(1) El deseo de alcanzar una excelencia educativa es la fuerza que impulsa al currículo Conocimientos y Destrezas Esenciales de Texas para matemáticas, el cual está guiado por los estándares de preparación para la universidad o para una carrera técnica o vocacional. A través de la inclusión de la estadística, la probabilidad y las finanzas, y enfocándose al mismo tiempo en el pensamiento computacional, en el dominio matemático y en una sólida comprensión, Texas será el líder en la educación de las matemáticas y preparará a todos sus estudiantes para los retos que enfrentarán en el siglo XXI.

(2) Los estándares de procesos describen los métodos en los cuales se espera que los estudiantes hagan conexiones con el contenido. La ubicación de los estándares de procesos al principio de los conocimientos y destrezas de cada grado y curso es intencional. Los estándares de procesos entrelazan los otros conocimientos y destrezas para que los estudiantes puedan tener éxito al resolver problemas y puedan utilizar las matemáticas eficiente y eficazmente en la vida diaria. Los estándares de procesos están integrados en cada grado y en cada curso. Cuando sea posible, los estudiantes aplicarán las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo. Los estudiantes utilizarán un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la

justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución. Los estudiantes seleccionarán herramientas apropiadas, tales como objetos reales, manipulativos, algoritmos, papel y lápiz, además de tecnología y técnicas, tales como el cálculo mental, la estimación, el sentido numérico y la generalización y abstracción, para resolver problemas. Los estudiantes comunicarán eficazmente ideas matemáticas y su razonamiento, además de las implicaciones de éstos utilizando múltiples representaciones, tales como símbolos, diagramas, gráficas, programas de computadora y el lenguaje común. Los estudiantes utilizarán relaciones matemáticas para generar soluciones y hacer conexiones, así como predicciones. Los estudiantes analizarán relaciones matemáticas para conectar y comunicar ideas matemáticas. Los estudiantes mostrarán, explicarán o justificarán ideas y razonamientos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(3) Para que los estudiantes lleguen a dominar las matemáticas, tendrán que desarrollar un sólido sentido numérico. El reporte del National Research Council, "Adding It Up," define el dominio de los procedimientos como "la destreza de poder realizar procedimientos de manera flexible, precisa, eficiente y apropiada". Mientras los estudiantes desarrollan el dominio de los procedimientos, también tienen que reconocer que la verdadera resolución de problemas puede tomar tiempo, esfuerzo y perseverancia. Se espera que los estudiantes en primer grado realicen su trabajo sin el uso de calculadoras.

(4) Las áreas principales de enfoque en primer grado son la comprensión y aplicación del valor de posición, la resolución de problemas que involucren sumar y restar, y la composición y descomposición de figuras de dos dimensiones y de sólidos de tres dimensiones.

(A) Los estudiantes utilizan relaciones del sistema de numeración para comprender el orden secuencial al contar números y su magnitud relativa.

(B) Los estudiantes expanden su uso de la suma y la resta más allá de las acciones de juntar y separar en el que incluyen comparar y combinar. Los estudiantes utilizan las propiedades de las operaciones y la relación entre la suma y la resta para resolver problemas. Al comparar una variedad de estrategias de solución, los estudiantes utilizan métodos eficientes, precisos y generalizables para hacer operaciones.

(C) Los estudiantes utilizan figuras simples y razonamiento espacial para representar objetos que hay en su medio ambiente y construir figuras más complejas. Los estudiantes pueden identificar, nombrar y describir figuras simples de dos dimensiones y figuras sólidas de tres dimensiones.

(5) Los enunciados que contienen las palabras "incluyendo" o "que incluyan" se refieren a destrezas que deben dominarse, mientras que los que contienen las frases "como", "tal(es) como" o "por ejemplo" se presentan como opciones posibles.

(b) Conocimientos y destrezas

(1) Estándares de procesos matemáticos. El estudiante utiliza procesos matemáticos para adquirir y demostrar comprensión matemática. Se espera que el estudiante:

(A) aplique las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo;

(B) utilice un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución;

(C) seleccione herramientas cuando sean apropiadas, incluyendo objetos reales, manipulativos, papel y lápiz, y tecnología, además de técnicas cuando sean apropiadas, incluyendo el cálculo mental, la estimación y el sentido numérico, para resolver problemas;

(D) comunique ideas matemáticas, su razonamiento y sus implicaciones utilizando múltiples representaciones cuando sean apropiadas, incluyendo símbolos, diagramas, gráficas y el lenguaje común;

(E) genere y utilice representaciones para organizar, anotar y comunicar ideas matemáticas;

(F) analice relaciones matemáticas para conectar y comunicar ideas matemáticas; y

(G) muestre, explique y justifique ideas y argumentos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(2) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para representar y comparar números enteros, la posición relativa y la magnitud de los números enteros y las relaciones dentro del sistema de numeración en cuanto al valor de posición. Se espera que el estudiante:

(A) reconozca inmediatamente la cantidad de objetos en arreglos estructurados;

(B) utilice modelos concretos y pictóricos para componer y descomponer números hasta el 120 en más de una forma, como al decir que un número está compuesto de tantas centenas, tantas decenas y tantas unidades;

(C) utilice objetos, ilustraciones y formas estandarizadas y desarrolladas para representar números hasta el 120;

(D) genere un número que es mayor que o menor que un número entero dado hasta el 120;

(E) utilice el valor de posición para comparar números enteros hasta el 120 utilizando lenguaje comparativo;

(F) ordene números enteros hasta el 120 utilizando el valor de posición y las rectas numéricas abiertas; y

(G) represente la comparación de dos números hasta el 100 utilizando los símbolos >, < o =.

(3) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para desarrollar y utilizar estrategias al hacer operaciones de suma y resta con números enteros que le permitan resolver problemas. Se espera que el estudiante:

(A) utilice modelos concretos y pictóricos para determinar la suma de un múltiplo de 10 y un número de un dígito en problemas que van hasta el 99;

(B) utilice objetos y modelos pictóricos para resolver problemas escritos que involucran juntar, separar y comparar conjuntos hasta el 20 y encontrar números desconocidos en cualquiera de los términos de un problema, tales como 2 + 4 = [ ]; 3 + [ ] = 7; y 5 = [ ] – 3;

(C) componga el número 10 utilizando dos o más sumandos con y sin objetos concretos;

(D) aplique estrategias de relaciones básicas al sumar y restar hasta el 20, como al formar el número 10 y al descomponer un número para que forme el 10;

(E) explique las estrategias utilizadas para resolver problemas de suma y resta hasta el 20 usando lenguaje verbal, objetos, modelos pictóricos y oraciones numéricas; y

(F) genere y resuelva problemas de matemáticas en los que se le da una oración numérica que involucra suma o resta de números hasta el 20.

(4) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para identificar monedas, sus valores y las relaciones entre ellas que le permitan reconocer la necesidad de transacciones monetarias. Se espera que el estudiante:

(A) identifique monedas estadounidenses por su valor, incluyendo monedas de un centavo (pennies), cinco centavos (nickels), diez centavos (dimes) y veinticinco centavos (quarters), y describa las relaciones entre ellas;

(B) escriba un número con el símbolo de centavos para describir el valor de una moneda; y

(C) utilice relaciones para contar de dos en dos, de cinco en cinco y de diez en diez para determinar el valor de una colección de monedas de un centavo, cinco centavos y/o diez centavos.

(5) Razonamiento algebraico. El estudiante aplica los estándares de procesos matemáticos para identificar y aplicar patrones numéricos dentro de las propiedades de los números y las operaciones que le permitan describir relaciones. Se espera que el estudiante:

(A) cuente en voz alta los números hacia adelante y hacia atrás a partir de cualquier número dado que esté entre el uno y el 120;

(B) cuente de dos en dos, de cinco en cinco y de diez en diez para determinar el número total de objetos en un conjunto hasta el 120;

(C) utilice relaciones para determinar un número que es 10 más y 10 menos de un número dado hasta el 120;

(D) represente problemas escritos que involucran suma y resta de números enteros hasta el 20 utilizando modelos concretos, pictóricos y oraciones numéricas;

(E) entienda que el símbolo igual representa una relación donde las expresiones que están a cada lado del símbolo representan el mismo valor;

(F) determine el número entero desconocido en una ecuación de suma o resta cuando el número desconocido sea cualquiera de los tres o cuatro términos de la ecuación; y

(G) aplique las propiedades de las operaciones para sumar y restar dos o tres números.

(6) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para analizar los atributos de figuras de dos dimensiones y sólidos de tres dimensiones que le permita hacer generalizaciones acerca de sus propiedades. Se espera que el estudiante:

(A) clasifique y ordene figuras de dos dimensiones regulares e irregulares a partir de sus atributos utilizando lenguaje geométrico informal;

(B) distinga entre los atributos que definen una figura de dos dimensiones o una de tres dimensiones y los atributos que no definen la figura;

(C) haga figuras de dos dimensiones, incluyendo círculos, triángulos, rectángulos y cuadrados, que son considerados rectángulos especiales, así como de rombos y hexágonos;

(D) identifique figuras de dos dimensiones, incluyendo círculos, triángulos, rectángulos y cuadrados, que son considerados rectángulos especiales, así como de rombos y hexágonos, y describa sus atributos utilizando lenguaje geométrico formal;

(E) identifique sólidos de tres dimensiones, incluyendo esferas, conos, cilindros, prismas rectangulares (incluyendo cubos) y prismas triangulares, y describa sus atributos utilizando lenguaje geométrico formal;

(F) componga figuras de dos dimensiones uniendo dos, tres o cuatro figuras para producir la figura deseada en más de una manera si es posible;

(G) separe figuras de dos dimensiones en dos y cuatro partes iguales, y describa las partes utilizando palabras; e

(H) identifique ejemplos y contraejemplos de mitades y cuartos.

(7) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para seleccionar y utilizar unidades que le permitan describir la longitud y el tiempo. Se espera que el estudiante:

(A) utilice herramientas de medición para medir la longitud de objetos que le permita reforzar el carácter continuo de la medición lineal;

(B) muestre que la longitud de un objeto es igual al total de unidades de una misma longitud que, al ponerse de un extremo a otro sin separaciones y sin encimarse, abarcan la longitud del objeto;

(C) mida el mismo objeto o la misma distancia con unidades de dos longitudes distintas y describa cómo y por qué las medidas son diferentes;

(D) describa una longitud a la unidad entera más cercana utilizando un número y una unidad; y

(E) lea la hora y las medias horas utilizando relojes análogos y digitales.

(8) Análisis de datos. El estudiante aplica los estándares de procesos matemáticos para organizar datos que le permitan utilizarlos al interpretar información y resolver problemas. Se espera que el estudiante:

(A) reúna, ordene y organice datos en un máximo de tres categorías utilizando modelos o representaciones, tales como marcas de conteo o tablas T;

(B) utilice datos para crear pictografías y gráficas de barras; y

(C) saque conclusiones, y genere y conteste preguntas utilizando información que aparece en pictografías y gráficas de barras.

(9) Comprensión de finanzas personales. El estudiante aplica los estándares de procesos matemáticos para manejar eficazmente sus propios recursos financieros para lograr una seguridad financiera de por vida. Se espera que el estudiante:

(A) defina el dinero ganado como ingresos;

(B) identifique los ingresos como una manera de obtener bienes y servicios, muchas veces teniendo que elegir entre lo que se desea y lo que se necesita;

(C) distinga entre gastar y ahorrar; y

(D) considere donaciones para obras caritativas.

§111.2. Segundo grado, adoptado en el 2012.

(a) Introducción

(1) El deseo de alcanzar una excelencia educativa es la fuerza que impulsa al currículo Conocimientos y Destrezas Esenciales de Texas para matemáticas, el cual está guiado por los estándares de preparación para la universidad o para una carrera técnica o vocacional. A través de la inclusión de la estadística, la probabilidad y las finanzas, y enfocándose al mismo tiempo en el pensamiento computacional, en el dominio matemático y en una sólida comprensión, Texas será el líder en la educación de las matemáticas y preparará a todos sus estudiantes para los retos que enfrentarán en el siglo XXI.

(2) Los estándares de procesos describen los métodos en los cuales se espera que los estudiantes hagan conexiones con el contenido. La ubicación de los estándares de procesos al principio de los conocimientos y destrezas de cada grado y curso es intencional. Los estándares de procesos entrelazan los otros conocimientos y destrezas para que los estudiantes puedan tener éxito al resolver problemas y puedan utilizar las matemáticas eficiente y eficazmente en la vida diaria. Los estándares de procesos están integrados en cada grado y en cada curso. Cuando sea posible, los estudiantes aplicarán las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo. Los estudiantes utilizarán un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución. Los estudiantes seleccionarán herramientas apropiadas, tales como objetos reales, manipulativos, algoritmos, papel y lápiz, además de tecnología y técnicas, tales como el cálculo mental, la estimación, el sentido numérico y la generalización y abstracción, para resolver problemas. Los estudiantes comunicarán eficazmente ideas matemáticas y su razonamiento, además de las implicaciones de éstos utilizando múltiples representaciones, tales como símbolos, diagramas, gráficas, programas de computadora y el lenguaje común. Los estudiantes utilizarán relaciones matemáticas para generar soluciones y hacer conexiones, así como predicciones. Los estudiantes analizarán relaciones matemáticas para conectar y comunicar ideas matemáticas. Los estudiantes mostrarán, explicarán o justificarán ideas y razonamientos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(3) Para que los estudiantes lleguen a dominar las matemáticas, tendrán que desarrollar un sólido sentido numérico. El reporte del National Research Council, "Adding It Up," define el dominio de los procedimientos como "la destreza de poder realizar procedimientos de manera flexible, precisa, eficiente y apropiada". Mientras los estudiantes desarrollan el dominio de los procedimientos, también tienen que reconocer que la verdadera resolución de problemas puede tomar tiempo, esfuerzo y perseverancia. Se espera que los estudiantes en segundo grado realicen su trabajo sin el uso de calculadoras.

(4) Las áreas principales de enfoque en segundo grado incluyen hacer comparaciones dentro del sistema de numeración de base 10 o sistema decimal, resolver problemas de suma y resta hasta el 1,000, y establecer las bases de la multiplicación.

(A) Los estudiantes desarrollan la comprensión del sistema de numeración de base 10 y los conceptos del valor de posición. La comprensión de los estudiantes del valor de posición en el sistema de base 10 debe incluir ideas del conteo en unidades y múltiplos de millares, centenas, decenas y unidades, y la comprensión de las relaciones entre los números, los cuales los estudiantes demostrarán de varias maneras.

(B) Los estudiantes identifican situaciones en las cuales la suma y la resta son útiles para resolver problemas. Los estudiantes desarrollan una variedad de estrategias para utilizar métodos eficientes, precisos y generalizables que les permitan sumar y restar números enteros de múltiples dígitos.

(C) Los estudiantes utilizan la relación entre el conteo saltándose números y los grupos iguales de objetos para representar la suma y la resta de conjuntos equivalentes, los cuales establecen bases sólidas para la multiplicación y la división.

(5) Los enunciados que contienen las palabras "incluyendo" o "que incluyan" se refieren a destrezas que deben dominarse, mientras que los que contienen las frases "como", "tal(es) como" o "por ejemplo" se presentan como opciones posibles.

(b) Conocimientos y destrezas

(1) Estándares de procesos matemáticos. El estudiante utiliza procesos matemáticos para adquirir y demostrar comprensión matemática. Se espera que el estudiante:

(A) aplique las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo;

(B) utilice un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución;

(C) seleccione herramientas cuando sean apropiadas, incluyendo objetos reales, manipulativos, papel y lápiz, y tecnología, además de técnicas cuando sean apropiadas, incluyendo el cálculo mental, la estimación y el sentido numérico, para resolver problemas;

(D) comunique ideas matemáticas, su razonamiento y sus implicaciones utilizando múltiples representaciones cuando sean apropiadas, incluyendo símbolos, diagramas, gráficas y el lenguaje común;

(E) genere y utilice representaciones para organizar, anotar y comunicar ideas matemáticas;

(F) analice relaciones matemáticas para conectar y comunicar ideas matemáticas; y

(G) muestre, explique y justifique ideas y argumentos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(2) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para comprender cómo representar y comparar números enteros, la posición relativa y la magnitud de los números enteros y las relaciones dentro del sistema de numeración en cuanto al valor de posición. Se espera que el estudiante:

(A) utilice modelos concretos y pictóricos para componer y descomponer números hasta el 1,200 en más de una manera como la suma de tantos millares, tantas centenas, tantas decenas y tantas unidades;

(B) utilice formas escritas, estandarizadas y desarrolladas para representar números hasta el 1,200;

(C) genere un número que es mayor que o menor que un número entero dado hasta el 1,200;

(D) utilice el valor de posición para comparar y ordenar números enteros hasta el 1,200 utilizando lenguaje comparativo, números y símbolos (>, < o =);

(E) localice la posición de un número entero dado en una recta numérica abierta; y

(F) nombre el número entero que corresponde a un punto específico en una recta numérica.

(3) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para reconocer y representar unidades fraccionarias, y comunica cómo éstas se utilizan para nombrar las partes de un entero. Se espera que el estudiante:

(A) separe objetos en partes iguales y nombre las partes, incluyendo mitades, cuartos y octavos;

(B) explique que entre más partes fraccionarias se utilizan para hacer un entero, más pequeñas serán las partes; y entre menos partes fraccionarias se utilizan, más grandes serán las partes;

(C) utilice modelos concretos para contar partes fraccionarias más allá de un entero utilizando palabras y reconozca cuántas partes se necesitan para igualar un entero; e

(D) identifique ejemplos y contraejemplos de mitades, cuartos y octavos.

(4) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para desarrollar y utilizar estrategias y métodos para hacer cálculos con números enteros que le permitan resolver problemas de suma y resta con eficiencia y precisión. Se espera que el estudiante:

(A) recuerde relaciones básicas al sumar y restar hasta el 20 en forma automática;

(B) sume hasta cuatro números de dos dígitos y reste números de dos dígitos utilizando estrategias mentales y algoritmos basados en el conocimiento del valor de posición y en las propiedades de las operaciones;

(C) resuelva problemas escritos de un paso y de múltiples pasos que involucran la suma y la resta hasta el 1,000 utilizando una variedad de estrategias que se basan en el valor de posición, incluyendo algoritmos; y

(D) genere y resuelva problemas de matemáticas en los que se le da una oración numérica que involucra suma y resta de números hasta el 1,000.

(5) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para determinar el valor de las monedas que le permita resolver transacciones monetarias. Se espera que el estudiante:

(A) determine el valor de una colección de monedas hasta un dólar; y

(B) utilice los símbolos para los centavos, los dólares y el punto decimal para nombrar el valor de una colección de monedas.

(6) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para conectar sumas y restas repetidas con situaciones de multiplicación y división que involucran grupos y partes iguales. Se espera que el estudiante:

(A) represente, haga y describa situaciones de multiplicación dentro de un contexto en las cuales se unen conjuntos equivalentes de objetos concretos; y

(B) represente, haga y describa situaciones de división dentro de un contexto en las cuales se separa un conjunto de objetos concretos en conjuntos equivalentes.

(7) Razonamiento algebraico. El estudiante aplica los estándares de procesos matemáticos para identificar y aplicar patrones numéricos dentro de las propiedades de los números y operaciones que le permitan describir relaciones. Se espera que el estudiante:

(A) determine si un número hasta el 40 es par o impar utilizando pares de objetos para representar el número;

(B) utilice la comprensión del valor de posición para determinar si un número es 10 ó 100 más o menos que un número dado hasta el 1,200; y

(C) represente y resuelva problemas escritos de suma y resta en donde cualquiera de los términos en el problema puede ser desconocido.

(8) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para analizar atributos de figuras de dos dimensiones y sólidos de tres dimensiones que le permita desarrollar generalizaciones acerca de sus propiedades. Se espera que el estudiante:

(A) haga figuras de dos dimensiones con base en atributos dados, incluyendo el número de lados y vértices;

(B) clasifique y ordene sólidos de tres dimensiones, incluyendo esferas, conos, cilindros, prismas rectangulares (incluyendo cubos, que son considerados prismas rectangulares especiales) y prismas triangulares, con base en sus atributos utilizando lenguaje geométrico formal;

(C) clasifique y ordene polígonos de 12 lados o menos según sus atributos, incluyendo la identificación del número de lados y el número de vértices que tienen;

(D) componga figuras de dos dimensiones y sólidos de tres dimensiones con propiedades o atributos dados; y

(E) descomponga figuras de dos dimensiones, como al cortar un cuadrado de un rectángulo, al dividir una figura por la mitad o al dividir un rectángulo en triángulos idénticos, e identifique las partes geométricas que resultan.

(9) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para seleccionar y utilizar unidades que le permitan describir la longitud, el área y el tiempo. Se espera que el estudiante:

(A) determine la longitud de objetos utilizando modelos concretos para unidades estandarizadas de longitud;

(B) describa la relación inversa entre el tamaño de la unidad y el número de unidades que se necesitan para igualar la longitud de un objeto;

(C) represente cómo los números enteros pueden representar distancias en cualquier posición dada sobre una recta numérica;

(D) determine la longitud de un objeto a la unidad más cercana marcada utilizando reglas, reglas de una yarda, metros o cintas de medición;

(E) determine la solución de un problema que involucra la longitud, incluyendo la estimación de las longitudes;

(F) utilice modelos concretos de unidades cuadradas para determinar el área de un rectángulo al cubrirlo con estas unidades sin separaciones y sin encimarse, contarlas para encontrar el total de unidades cuadradas y describir esta medición utilizando un número y la unidad; y

(G) lea y escriba la hora al minuto más cercano utilizando relojes análogos y digitales, y distinga entre a. m. y p. m.

(10) Análisis de datos. El estudiante aplica los estándares de procesos matemáticos para organizar datos que le permitan utilizarlos al interpretar información y al resolver problemas. Se espera que el estudiante:

(A) explique que la longitud de una barra en una gráfica de barras o que el número de ilustraciones en una pictografía representan el número de datos de una categoría dada;

(B) organice un conjunto de datos hasta cuatro categorías utilizando pictografías y gráficas de barras con intervalos de uno o más de uno;

(C) escriba y resuelva problemas escritos de un paso que involucran la suma y la resta utilizando datos representados en pictografías y en gráficas de barras con intervalos de uno; y

(D) saque conclusiones y haga predicciones usando la información contenida en una gráfica.

(11) Comprensión de finanzas personales. El estudiante aplica los estándares de procesos matemáticos para manejar eficazmente sus propios recursos financieros para lograr una seguridad financiera de por vida. Se espera que el estudiante:

(A) calcule cómo el dinero ahorrado se puede convertir en una cantidad más grande al pasar el tiempo;

(B) explique que en lugar de gastar se puede ahorrar;

(C) distinga entre el depósito y el retiro de fondos;

(D) identifique ejemplos de préstamos y distinga entre ser responsable e irresponsable al pedir un préstamo;

(E) identifique ejemplos de préstamos y utilice conceptos de beneficios y costos al evaluar decisiones que implican hacer préstamos; y

(F) diferencie entre productores y consumidores, y calcule el costo de producir un artículo sencillo.

§111.2. Tercer grado, adoptado en el 2012.

(a) Introducción

(1) El deseo de alcanzar una excelencia educativa es la fuerza que impulsa al currículo Conocimientos y Destrezas Esenciales de Texas para matemáticas, el cual está guiado por los estándares de preparación para la universidad o para una carrera técnica o vocacional. A través de la inclusión de la estadística, la probabilidad y las finanzas, y enfocándose al mismo tiempo en el pensamiento computacional, en el dominio matemático y en una sólida comprensión, Texas será el líder en la educación de las matemáticas y preparará a todos sus estudiantes para los retos que enfrentarán en el siglo XXI.

(2) Los estándares de procesos describen los métodos en los cuales se espera que los estudiantes hagan conexiones con el contenido. La ubicación de los estándares de procesos al principio de los conocimientos y destrezas de cada grado y curso es intencional. Los estándares de procesos entrelazan los otros conocimientos y destrezas para que los estudiantes puedan tener éxito al resolver problemas y puedan utilizar las matemáticas eficiente y eficazmente en la vida diaria. Los estándares de procesos están integrados en cada grado y en cada curso. Cuando sea posible, los estudiantes aplicarán las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo. Los estudiantes utilizarán un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución. Los estudiantes seleccionarán herramientas apropiadas, tales como objetos reales, manipulativos, algoritmos, papel y lápiz, además de tecnología y técnicas, tales como el cálculo mental, la estimación, el sentido numérico y la generalización y abstracción, para resolver problemas. Los estudiantes comunicarán eficazmente ideas matemáticas y su razonamiento, además de las implicaciones de éstos utilizando múltiples representaciones, tales como símbolos, diagramas, gráficas, programas de computadora y el lenguaje común. Los estudiantes utilizarán relaciones matemáticas para generar soluciones y hacer conexiones, así como predicciones. Los estudiantes analizarán relaciones matemáticas para conectar y comunicar ideas matemáticas. Los estudiantes mostrarán, explicarán o justificarán ideas y razonamientos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(3) Para que los estudiantes lleguen a dominar las matemáticas, tendrán que desarrollar un sólido sentido numérico. El reporte del National Research Council, "Adding It Up," define el dominio de los procedimientos como "la destreza de poder realizar procedimientos de manera flexible, precisa, eficiente y apropiada". Mientras los estudiantes desarrollan el dominio de los procedimientos, también tienen que reconocer que la verdadera resolución de problemas puede tomar tiempo, esfuerzo y perseverancia. Se espera que los estudiantes en tercer grado realicen su trabajo sin el uso de calculadoras.

(4) Las áreas de enfoque principal en tercer grado incluyen valor de posición, operaciones con números enteros y comprensión de unidades fraccionarias. Estas áreas de enfoque están apoyadas en las áreas de las matemáticas de números y operaciones, razonamiento algebraico, geometría y medición, y análisis de datos. En los grados de tercero a quinto, el conjunto de números se limita a números racionales positivos. En números y operaciones, los estudiantes se enfocarán en aplicar el valor de posición, en comparar y ordenar números enteros, conectar la multiplicación y la división, y en comprender y representar fracciones como números y fracciones equivalentes. En razonamiento algebraico, los estudiantes utilizarán múltiples representaciones de problemas de matemáticas, determinarán valores desconocidos en oraciones numéricas y representarán relaciones de la vida diaria utilizando pares de números en una tabla y en descripciones verbales. En geometría y medición, los estudiantes identificarán y clasificarán figuras de dos dimensiones según sus atributos comunes, descompondrán figuras compuestas formadas por rectángulos para determinar el área, determinarán el perímetro de polígonos, resolverán problemas relacionados con el tiempo y medirán el volumen líquido (la capacidad) o peso. En análisis de datos, los estudiantes representarán e interpretarán datos.

(5) Los enunciados que contienen las palabras "incluyendo" o "que incluyan" se refieren a destrezas que deben dominarse, mientras que los que contienen las frases "como", "tal(es) como" o "por ejemplo" se presentan como opciones posibles.

(b) Conocimientos y destrezas

(1) Estándares de procesos matemáticos. El estudiante utiliza procesos matemáticos para adquirir y demostrar comprensión matemática. Se espera que el estudiante:

(A) aplique las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo;

(B) utilice un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución;

(C) seleccione herramientas cuando sean apropiadas, incluyendo objetos reales, manipulativos, papel y lápiz, y tecnología, además de técnicas cuando sean apropiadas, incluyendo el cálculo mental, la estimación y el sentido numérico, para resolver problemas;

(D) comunique ideas matemáticas, su razonamiento y sus implicaciones utilizando múltiples representaciones cuando sean apropiadas, incluyendo símbolos, diagramas, gráficas y el lenguaje común;

(E) genere y utilice representaciones para organizar, anotar y comunicar ideas matemáticas;

(F) analice relaciones matemáticas para conectar y comunicar ideas matemáticas; y

(G) muestre, explique y justifique ideas y argumentos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(2) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para representar y comparar números enteros, así como para comprender las relaciones en cuanto al valor de posición. Se espera que el estudiante:

(A) componga y descomponga números hasta el 100,000 como la suma de tantas decenas de millar, tantos millares, tantas centenas, tantas decenas y tantas unidades utilizando objetos, modelos pictóricos y números, incluyendo la notación desarrollada según sea apropiado;

(B) describa relaciones matemáticas encontradas en el sistema de numeración de base 10 o sistema decimal hasta la posición de las centenas de millar;

(C) represente un número en una recta numérica cuando está entre dos múltiplos consecutivos de 10, 100, 1,000 ó 10,000, y utilice palabras para describir el tamaño relativo de números al redondear números enteros; y

(D) compare y ordene números enteros hasta el 100,000 y represente comparaciones utilizando los símbolos >, < o =.

(3) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para representar y explicar unidades fraccionarias. Se espera que el estudiante:

(A) represente fracciones mayores que cero y menores que o iguales a uno con denominadores de 2, 3, 4, 6 y 8 utilizando objetos concretos y modelos pictóricos, incluyendo diagramas de tiras y rectas numéricas;

(B) determine la fracción correspondiente mayor que cero y menor que o igual a uno con denominadores de 2, 3, 4, 6 y 8 cuando se da un punto específico en una recta numérica;

(C) explique que la unidad fraccionaria 1/b representa la cantidad formada por una parte de un entero que ha sido dividido en b partes iguales donde b es un número entero diferente de cero;

(D) componga y descomponga una fracción a/b con un numerador mayor que cero y menor que o igual a b como la suma de las partes 1/b;

(E) resuelva problemas que involucran la división de un objeto o un conjunto de objetos entre dos o más individuos utilizando ilustraciones de fracciones con denominadores de 2, 3, 4, 6 y 8;

(F) represente fracciones equivalentes con denominadores de 2, 3, 4, 6 y 8 utilizando una variedad de objetos y modelos pictóricos, incluyendo rectas numéricas;

(G) explique que dos fracciones son equivalentes si y sólo si ambas fracciones son representadas por el mismo punto en una recta numérica o representan la misma porción de un entero del mismo tamaño usando un modelo de área; y

(H) compare dos fracciones con el mismo numerador o denominador en problemas al razonar acerca de sus tamaños y al justificar la conclusión por medio de símbolos, palabras, objetos y modelos pictóricos.

(4) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para desarrollar y utilizar estrategias y métodos para hacer cálculos con números enteros que le permitan resolver problemas con eficiencia y precisión. Se espera que el estudiante:

(A) resuelva con facilidad problemas de un paso y de dos pasos utilizando la suma y la resta hasta el 1,000 por medio de estrategias basadas en el valor de posición, en las propiedades de las operaciones y en la relación entre la suma y la resta;

(B) redondee a la decena ó a la centena más cercana, o utilice números compatibles para estimar soluciones de problemas de suma y resta;

(C) determine el valor de una colección de monedas y billetes;

(D) determine el número total de objetos cuando grupos de objetos del mismo tamaño se combinan o se ponen en matrices o arreglos hasta de 10 por 10;

(E) represente las tablas de multiplicación utilizando diferentes métodos, como la suma repetida, grupos del mismo tamaño, matrices o arreglos, modelos de área, saltos iguales en una recta numérica y el conteo saltándose números;

(F) recuerde las tablas de multiplicar hasta 10 por 10 de forma automática y recuerde las relaciones correspondientes en la división;

(G) utilice estrategias y algoritmos, incluyendo el algoritmo normal, para multiplicar un número de dos dígitos por un número de un dígito. Las estrategias pueden incluir el cálculo mental, los productos parciales y las propiedades conmutativa, asociativa y distributiva;

(H) determine el número de objetos en cada grupo cuando un conjunto de objetos se divide en partes iguales o un conjunto de objetos se comparte equitativamente;

(I) determine si un número es par o impar utilizando las reglas de divisibilidad;

(J) determine un cociente utilizando la relación entre la multiplicación y la división; y

(K) resuelva problemas de un paso y de dos pasos que involucran multiplicación y división hasta el 100 utilizando estrategias basadas en objetos, en modelos pictóricos, incluyendo matrices o modelos rectangulares, modelos de área y grupos iguales, en las propiedades de las operaciones o al recordar las tablas de multiplicación.

(5) Razonamiento algebraico. El estudiante aplica los estándares de procesos matemáticos para analizar y crear patrones y relaciones. Se espera que el estudiante:

(A) represente problemas de un paso y de dos pasos que involucran suma y resta de números enteros hasta el 1,000 utilizando modelos pictóricos, rectas numéricas y ecuaciones;

(B) represente y resuelva problemas de un paso y de dos pasos de multiplicación y división hasta el 100 utilizando matrices o arreglos, diagramas de tiras y ecuaciones;

(C) describa una expresión de multiplicación como una comparación, tal como 3 x 24 representa lo mismo que 3 veces 24;

(D) determine el número entero desconocido en una ecuación de multiplicación o división que relaciona tres números enteros cuando el número desconocido es el factor o el producto; y

(E) represente relaciones de la vida diaria utilizando pares de números en una tabla y descripciones verbales.

(6) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para analizar atributos de figuras de dos dimensiones que le permitan desarrollar generalizaciones acerca de sus propiedades. Se espera que el estudiante:

(A) clasifique y ordene figuras de dos dimensiones y sólidos de tres dimensiones, incluyendo conos, cilindros, esferas, prismas rectangulares y prismas triangulares, y cubos basados en sus atributos utilizando lenguaje geométrico formal;

(B) utilice atributos para reconocer rombos, paralelogramos, trapecios, rectángulos y cuadrados como ejemplos de cuadriláteros, y dibuje ejemplos de cuadriláteros que no pertenecen a ninguna de estas subcategorías;

(C) determine el área de rectángulos en problemas en los cuales la longitud de los lados son números enteros utilizando la multiplicación en relación al número de filas por el número de unidades cuadradas en cada fila;

(D) descomponga figuras compuestas formadas por rectángulos en rectángulos que no se enciman para determinar el área de la figura original utilizando la propiedad aditiva del área; y

(E) descomponga dos figuras congruentes de dos dimensiones en partes con áreas iguales y exprese el área de cada parte como una unidad fraccionaria del entero, y reconozca que las porciones iguales de enteros idénticos no tienen que ser de la misma forma.

(7) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para seleccionar unidades apropiadas, estrategias y herramientas que le permitan resolver problemas que involucran medición usando el sistema inglés (usual) y el métrico. Se espera que el estudiante:

(A) represente fracciones de mitades, cuartos y octavos como distancias a partir de cero en una recta numérica;

(B) determine en problemas el perímetro de un polígono o de una longitud desconocida cuando se da el perímetro y las longitudes de los lados restantes;

(C) determine soluciones a problemas que involucran la suma y la resta de intervalos de tiempo en minutos utilizando modelos pictóricos u otras herramientas, tal como al calcular que un evento de 15 minutos más un evento de 30 minutos es igual a 45 minutos;

(D) determine cuándo es apropiado utilizar medición de volumen líquido (capacidad) o de peso; y

(E) determine el volumen líquido (capacidad) o el peso utilizando unidades y herramientas apropiadas.

(8) Análisis de datos. El estudiante aplica los estándares de procesos matemáticos para resolver problemas al recopilar, organizar, presentar e interpretar datos. Se espera que el estudiante:

(A) resuma un conjunto de datos con múltiples categorías utilizando una tabla de frecuencia, un diagrama de puntos, una pictografía o una gráfica de barras con una escala en intervalos; y

(B) resuelva problemas de un paso y de dos pasos utilizando datos categóricos representados en una tabla de frecuencia, un diagrama de puntos, una pictografía o una gráfica de barras con una escala en intervalos.

(9) Comprensión de finanzas personales. El estudiante aplica los estándares de procesos matemáticos para manejar eficazmente sus propios recursos financieros para lograr una seguridad financiera de por vida. Se espera que el estudiante:

(A) explique la conexión entre el capital humano/fuerza laboral y los ingresos;

(B) describa la relación entre disponibilidad o escasez de recursos, y cómo eso impacta los costos;

(C) identifique costos y beneficios sobre los gastos planificados y los no planificados;

(D) explique que el crédito se utiliza cuando lo que se quiere o se necesita sobrepasa la capacidad de pagar, y que es la responsabilidad del deudor pagar lo que se debe al prestamista, casi siempre con intereses;

(E) escriba una lista de las razones para ahorrar y explique los beneficios de un plan de ahorros, incluyendo ahorros para la universidad; e

(F) identifique decisiones que involucran ingresos, gastos, ahorros, crédito y donaciones para obras caritativas.

§111.2. Cuarto grado, adoptado en el 2012.

(a) Introducción

(1) El deseo de alcanzar una excelencia educativa es la fuerza que impulsa al currículo Conocimientos y Destrezas Esenciales de Texas para matemáticas, el cual está guiado por los estándares de preparación para la universidad o para una carrera técnica o vocacional. A través de la inclusión de la estadística, la probabilidad y las finanzas, y enfocándose al mismo tiempo en el pensamiento computacional, en el dominio matemático y en una sólida comprensión, Texas será el líder en la educación de las matemáticas y preparará a todos sus estudiantes para los retos que enfrentarán en el siglo XXI.

(2) Los estándares de procesos describen los métodos en los cuales se espera que los estudiantes hagan conexiones con el contenido. La ubicación de los estándares de procesos al principio de los conocimientos y destrezas de cada grado y curso es intencional. Los estándares de procesos entrelazan los otros conocimientos y destrezas para que los estudiantes puedan tener éxito al resolver problemas y puedan utilizar las matemáticas eficiente y eficazmente en la vida diaria. Los estándares de procesos están integrados en cada grado y en cada curso. Cuando sea posible, los estudiantes aplicarán las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo. Los estudiantes utilizarán un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución. Los estudiantes seleccionarán herramientas apropiadas, tales como objetos reales, manipulativos, algoritmos, papel y lápiz, además de tecnología y técnicas, tales como el cálculo mental, la estimación, el sentido numérico y la generalización y abstracción, para resolver problemas. Los estudiantes comunicarán eficazmente ideas matemáticas y su razonamiento, además de las implicaciones de éstos utilizando múltiples representaciones, tales como símbolos, diagramas, gráficas, programas de computadora y el lenguaje común. Los estudiantes utilizarán relaciones matemáticas para generar soluciones y hacer conexiones, así como predicciones. Los estudiantes analizarán relaciones matemáticas para conectar y comunicar ideas matemáticas. Los estudiantes mostrarán, explicarán o justificarán ideas y razonamientos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(3) Para que los estudiantes lleguen a dominar las matemáticas, tendrán que desarrollar un sólido sentido numérico. El reporte del *National Research Council, "Adding It Up,"* define el dominio de los procedimientos como "la destreza de poder realizar procedimientos de manera flexible, precisa, eficiente y apropiada". Mientras los estudiantes desarrollan el dominio de los procedimientos, también tienen que reconocer que la verdadera resolución

de problemas puede tomar tiempo, esfuerzo y perseverancia. Se espera que los estudiantes en cuarto grado realicen su trabajo sin el uso de calculadoras.

(4) Las áreas de enfoque principal en cuarto grado incluyen operaciones, fracciones y decimales, así como describir y analizar la geometría y la medición. Estas áreas de enfoque están apoyadas en las áreas de las matemáticas de números y operaciones, razonamiento algebraico, geometría y medición, así como en el análisis de datos. En los grados de tercero a quinto, el conjunto de números se limita a números racionales positivos. En números y operaciones, los estudiantes aplicarán el valor de posición y representarán puntos en una recta numérica que corresponden a una fracción dada o a un decimal finito dado. En razonamiento algebraico, los estudiantes representarán y resolverán problemas de múltiples pasos que involucran las cuatro operaciones básicas con números enteros en expresiones y ecuaciones, y generarán y analizarán patrones. En geometría y medición, los estudiantes clasificarán figuras de dos dimensiones, medirán ángulos y convertirán unidades de medición. En análisis de datos, los estudiantes representarán e interpretarán datos.

(5) Los enunciados que contienen las palabras "incluyendo" o "que incluyan" se refieren a destrezas que deben dominarse, mientras que los que contienen las frases "como", "tal(es) como" o "por ejemplo" se presentan como opciones posibles.

(b) Conocimientos y destrezas

(1) Estándares de procesos matemáticos. El estudiante utiliza procesos matemáticos para adquirir y demostrar comprensión matemática. Se espera que el estudiante:

(A) aplique las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo;

(B) utilice un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución;

(C) seleccione herramientas cuando sean apropiadas, incluyendo objetos reales, manipulativos, papel y lápiz, y tecnología, además de técnicas cuando sean apropiadas, incluyendo el cálculo mental, la estimación y el sentido numérico, para resolver problemas;

(D) comunique ideas matemáticas, su razonamiento y sus implicaciones utilizando múltiples representaciones cuando sean apropiadas, incluyendo símbolos, diagramas, gráficas y el lenguaje común;

(E) genere y utilice representaciones para organizar, anotar y comunicar ideas matemáticas;

(F) analice relaciones matemáticas para conectar y comunicar ideas matemáticas; y

(G) muestre, explique y justifique ideas y argumentos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(2) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para representar, comparar y ordenar números enteros y decimales, así como para comprender las relaciones acerca del valor de posición. Se espera que el estudiante:

(A) interprete el valor de cada valor de posición como 10 veces la posición a la derecha y como un décimo la posición del valor a la izquierda;

(B) represente el valor de un dígito en números enteros hasta el 1,000,000,000 y el valor de decimales a los centésimos utilizando la notación desarrollada y numerales;

(C) compare y ordene números enteros hasta el 1,000,000,000 y represente comparaciones utilizando los símbolos >, < o =;

(D) redondee números enteros a un valor de posición dado hasta la posición de las centenas de millar;

(E) represente decimales, incluyendo décimos y centésimos, utilizando modelos concretos y visuales, así como dinero;

(F) compare y ordene decimales utilizando modelos concretos y visuales hasta los centésimos;

(G) relacione los decimales a las fracciones que nombran décimos y centésimos; y

(H) determine el decimal correspondiente al lugar de los décimos o centésimos a partir de un punto específico dado en una recta numérica.

(3) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para representar y generar fracciones que le permitan resolver problemas. Se espera que el estudiante:

(A) represente una fracción a/b como la suma de fracciones $1/b$, donde a y b son números enteros y $b > 0$, incluyendo cuando $a > b$;

(B) descomponga de varias maneras una fracción en una suma de fracciones que tienen el mismo denominador utilizando modelos concretos y pictóricos, y escribiendo los resultados con representaciones simbólicas;

(C) determine si dos fracciones dadas son equivalentes utilizando una variedad de métodos;

(D) compare dos fracciones con diferentes numeradores y diferentes denominadores, y represente la comparación utilizando los símbolos >, = o <;

(E) represente y resuelva la suma y la resta de fracciones con denominadores iguales utilizando objetos y modelos pictóricos que se conectan con la recta numérica, así como las propiedades de las operaciones;

(F) evalúe lo razonable de sumas y diferencias de fracciones utilizando las fracciones de referencia 0, 1/4, 1/2, 3/4 y 1, relacionadas al mismo entero; y

(G) represente fracciones y decimales a los décimos o a los centésimos como distancias a partir de cero en una recta numérica.

(4) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para desarrollar y utilizar estrategias y métodos para hacer cálculos con números enteros, sumas y diferencias de decimales que le permitan resolver problemas con eficiencia y precisión. Se espera que el estudiante:

(A) sume y reste números enteros y decimales hasta la posición de los centésimos utilizando el algoritmo normal;

(B) determine el producto de un número y de 10 ó 100 utilizando la comprensión de las propiedades de las operaciones y del valor de posición;

(C) represente el producto de 2 números de dos dígitos utilizando matrices o arreglos, modelos de área o ecuaciones, incluyendo cuadrados perfectos hasta el 15 por 15;

(D) utilice estrategias y algoritmos, incluyendo el algoritmo normal, para multiplicar hasta un número de cuatro dígitos por un número de un dígito y multiplicar un número de dos dígitos por un número de dos dígitos. Las estrategias pueden incluir el cálculo mental, los productos parciales y las propiedades conmutativa, asociativa y distributiva;

(E) represente el cociente de un número entero de hasta cuatro dígitos dividido por un número entero de un dígito utilizando matrices o arreglos, modelos de área o ecuaciones;

(F) utilice estrategias y algoritmos, incluyendo el algoritmo normal, para dividir un dividendo de hasta cuatro dígitos por un divisor de un dígito;

(G) redondee a la decena, centena o unidad de millar más cercana o utilice números compatibles para estimar soluciones que involucran números enteros; y

(H) resuelva con facilidad problemas de un paso o de dos pasos que involucran multiplicación y división, incluyendo la interpretación de residuos.

(5) Razonamiento algebraico. El estudiante aplica los estándares de procesos matemáticos para desarrollar conceptos de expresiones y ecuaciones. Se espera que el estudiante:

(A) represente problemas de múltiples pasos que involucran las cuatro operaciones básicas con números enteros utilizando diagramas de tiras y ecuaciones que tienen una letra que representa una cantidad desconocida;

(B) represente problemas utilizando una tabla de entrada-salida y expresiones numéricas para generar un patrón numérico que sigue una regla dada, la cual representa la relación de valores en la secuencia resultante y sus posiciones en la secuencia;

(C) utilice modelos para determinar las fórmulas para el perímetro del rectángulo ($l + a + l + a$, *o bien* $2l + 2a$) incluyendo la forma especial para el perímetro de un cuadrado ($4l$) y el área del rectángulo (l x a); y

(D) resuelva problemas relacionados con el perímetro y el área de rectángulos cuyas dimensiones son números enteros.

(6) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para analizar atributos geométricos que le permitan desarrollar generalizaciones de sus propiedades. Se espera que el estudiante:

(A) identifique puntos, líneas, segmentos de recta, rayos, ángulos y líneas perpendiculares y paralelas;

(B) dentifique y dibuje uno o más ejes de simetría, si los hubiera, en una figura de dos dimensiones;

(C) utilice el conocimiento de ángulos rectos para identificar triángulos agudos, rectos y obtusos; y

(D) clasifique figuras de dos dimensiones basadas en la presencia o ausencia de líneas paralelas o perpendiculares, o en la presencia o ausencia de ángulos de un tamaño específico.

(7) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para resolver problemas que involucran ángulos menores que o iguales a 180 grados. Se espera que el estudiante:

(A) muestre la medida de un ángulo como la parte de un círculo cuyo centro está en el vértice del ángulo "cortado" por los rayos del ángulo. Las medidas de los ángulos se limitan a números enteros;

(B) muestre que los grados son las unidades que se utilizan para medir un ángulo, donde 1/360 de cualquier círculo es un grado y que, además, cualquier ángulo que "corta" n/360 en cualquier círculo cuyo centro es el vértice del ángulo tiene una medida de n grados. Las medidas de los ángulos se limitan a números enteros;

(C) determine las medidas aproximadas de ángulos en grados al número entero más cercano utilizando un transportador;

(D) dibuje un ángulo con una medida dada; y

(E) determine la medida de un ángulo desconocido formado por dos ángulos adyacentes que no se enciman y donde se dan una o dos de las medidas de los ángulos.

(8) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para seleccionar apropiadamente unidades del sistema inglés (usuales) y métricas, estrategias y herramientas que le permitan resolver problemas de medición. Se espera que el estudiante:

(A) identifique los tamaños relativos de unidades de medición dentro de los sistemas inglés (usual) y métrico;

(B) convierta mediciones dentro del mismo sistema de medición, inglés (usual) o métrico, de una unidad más pequeña a una unidad más grande o de una unidad más grande a una unidad más pequeña cuando se dan otras medidas equivalentes representadas en una tabla; y

(C) resuelva problemas sobre medidas de longitud, intervalos de tiempo, volumen líquido, masa y dinero utilizando la suma, la resta, la multiplicación o la división según sea apropiado.

(9) Análisis de datos. El estudiante aplica los estándares de procesos matemáticos para resolver problemas recopilando, organizando, presentando e interpretando datos. Se espera que el estudiante:

(A) represente datos en una tabla de frecuencia, un diagrama de puntos, o bien en un diagrama de tallo y hojas que estén marcados con números enteros y fracciones; y

(B) resuelva problemas de un paso y de dos pasos utilizando datos con números enteros, decimales y fracciones en una tabla de frecuencia, un diagrama de puntos, o bien en un diagrama de tallo y hojas.

(10) Comprensión de finanzas personales. El estudiante aplica los estándares de procesos matemáticos para manejar eficazmente sus propios recursos financieros para lograr una seguridad financiera de por vida. Se espera que el estudiante:

(A) distinga entre gastos fijos y variables;

(B) calcule las ganancias en una situación dada;

(C) compare las ventajas y las desventajas de varios planes de ahorro;

(D) describa cómo asignar fondos semanales para gastar, para ahorrar, incluyendo ahorros para la universidad, y para compartir; y

(E) describa el propósito básico de las instituciones financieras, incluyendo el mantenimiento seguro del dinero, así como la solicitud y aprobación de préstamos.

§111.2. Quinto grado, adoptado en el 2012.

(a) Introducción

(1) El deseo de alcanzar una excelencia educativa es la fuerza que impulsa al currículo Conocimientos y Destrezas Esenciales de Texas para matemáticas, el cual está guiado por los estándares de preparación para la universidad o para una carrera técnica o vocacional. A través de la inclusión de la estadística, la probabilidad y las finanzas, y enfocándose al mismo tiempo en el pensamiento computacional, en el dominio matemático y en una

sólida comprensión, Texas será el líder en la educación de las matemáticas y preparará a todos sus estudiantes para los retos que enfrentarán en el siglo XXI.

(2) Los estándares de procesos describen los métodos en los cuales se espera que los estudiantes hagan conexiones con el contenido. La ubicación de los estándares de procesos al principio de los conocimientos y destrezas de cada grado y curso es intencional. Los estándares de procesos entrelazan los otros conocimientos y destrezas para que los estudiantes puedan tener éxito al resolver problemas y puedan utilizar las matemáticas eficiente y eficazmente en la vida diaria. Los estándares de procesos están integrados en cada grado y en cada curso. Cuando sea posible, los estudiantes aplicarán las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo. Los estudiantes utilizarán un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución. Los estudiantes seleccionarán herramientas apropiadas, tales como objetos reales, manipulativos, algoritmos, papel y lápiz, además de tecnología y técnicas, tales como el cálculo mental, la estimación, el sentido numérico y la generalización y abstracción, para resolver problemas. Los estudiantes comunicarán eficazmente ideas matemáticas y su razonamiento, además de las implicaciones de éstos utilizando múltiples representaciones, tales como símbolos, diagramas, gráficas, programas de computadora y el lenguaje común. Los estudiantes utilizarán relaciones matemáticas para generar soluciones y hacer conexiones, así como predicciones. Los estudiantes analizarán relaciones matemáticas para conectar y comunicar ideas matemáticas. Los estudiantes mostrarán, explicarán o justificarán ideas y razonamientos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(3) Para que los estudiantes lleguen a dominar las matemáticas, tendrán que desarrollar un sólido sentido numérico. El reporte del National Research Council, "Adding It Up," define el dominio de los procedimientos como "la destreza de poder realizar procedimientos de manera flexible, precisa, eficiente y apropiada". Mientras los estudiantes desarrollan el dominio de los procedimientos, también tienen que reconocer que la verdadera resolución de problemas puede tomar tiempo, esfuerzo y perseverancia. Se espera que los estudiantes en quinto grado realicen su trabajo sin el uso de calculadoras.

(4) Las áreas de enfoque principal en quinto grado incluyen resolver problemas que involucran las cuatro operaciones básicas con números racionales positivos, determinar y generar fórmulas y soluciones a expresiones, así como extender la medición al área y al volumen. Estas áreas de enfoque están apoyadas en las áreas de las matemáticas de números y operaciones, razonamiento algebraico, geometría y medición, así como en el análisis de datos. En los grados de tercero a quinto, el conjunto de números se limita a números racionales positivos. En números y operaciones, los estudiantes aplicarán el valor de posición e identificarán las relaciones de las partes respecto al entero y su equivalencia. En razonamiento algebraico, los estudiantes representarán y resolverán problemas con expresiones y ecuaciones, establecerán las bases de las funciones utilizando patrones, identificarán números primos y compuestos, y usarán el orden de las operaciones. En geometría y medición, los estudiantes clasificarán figuras de dos dimensiones, conectarán atributos geométricos a las medidas de figuras de tres dimensiones, utilizarán unidades de medición y representarán ubicaciones utilizando un plano de coordenadas. En análisis de datos, los estudiantes representarán e interpretarán datos.

(5) Los enunciados que contienen las palabras "incluyendo" o "que incluyan" se refieren a destrezas que deben dominarse, mientras que los que contienen las frases "como", "tal(es) como" o "por ejemplo" se presentan como opciones posibles.

(b) Conocimientos y destrezas

(1) Estándares de procesos matemáticos. El estudiante utiliza procesos matemáticos para adquirir y demostrar comprensión matemática. Se espera que el estudiante:

(A) aplique las matemáticas a los problemas que surgen en la vida diaria, la sociedad y el trabajo;

(B) utilice un modelo de resolución de problemas que incorpora el análisis de información dada, la formulación de un plan o estrategia, la determinación de una solución, la justificación de la solución y la evaluación del proceso de resolución de problemas, así como lo razonable de la solución;

(C) seleccione herramientas cuando sean apropiadas, incluyendo objetos reales, manipulativos, papel y lápiz, y tecnología, además de técnicas cuando sean apropiadas, incluyendo el cálculo mental, la estimación y el sentido numérico, para resolver problemas;

(D) comunique ideas matemáticas, su razonamiento y sus implicaciones utilizando múltiples representaciones cuando sean apropiadas, incluyendo símbolos, diagramas, gráficas y el lenguaje común;

(E) genere y utilice representaciones para organizar, anotar y comunicar ideas matemáticas;

(F) analice relaciones matemáticas para conectar y comunicar ideas matemáticas; y

(G) muestre, explique y justifique ideas y argumentos matemáticos utilizando lenguaje matemático preciso en forma verbal o escrita.

(2) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para representar, comparar y ordenar números racionales positivos, así como para comprender las relaciones acerca del valor de posición. Se espera que el estudiante:

(A) represente el valor de un dígito en decimales hasta los milésimos utilizando la notación desarrollada y numerales;

(B) compare y ordene dos decimales hasta los milésimos y represente comparaciones utilizando los símbolos >, < o =; y

(C) redondee decimales a los décimos o a los centésimos.

(3) Números y operaciones. El estudiante aplica los estándares de procesos matemáticos para desarrollar y utilizar estrategias y métodos al calcular números racionales positivos que le permitan resolver problemas con eficiencia y precisión. Se espera que el estudiante:

(A) estime para determinar soluciones a problemas matemáticos y a problemas del mundo real que involucran suma, resta, multiplicación y división;

(B) multiplique con facilidad un número de tres dígitos por un número de dos dígitos utilizando el algoritmo normal;

(C) encuentre con habilidad el cociente de un dividendo de hasta cuatro dígitos entre un divisor de dos dígitos utilizando estrategias y el algoritmo normal;

(D) represente la multiplicación de decimales con productos hasta los centésimos utilizando objetos y modelos pictóricos, incluyendo modelos de área;

(E) encuentre productos de decimales hasta los centésimos, incluyendo situaciones que involucran dinero, utilizando estrategias basadas en la comprensión del valor de posición, en las propiedades de las operaciones y en la relación de la multiplicación de números enteros;

(F) represente los cocientes de decimales hasta los centésimos con dividendos de hasta cuatro dígitos y divisores de números enteros de dos dígitos utilizando objetos y modelos pictóricos, incluyendo modelos de área;

(G) encuentre cocientes con decimales hasta los centésimos, con dividendos hasta de cuatro dígitos y con divisores de números enteros de dos dígitos utilizando estrategias y algoritmos, incluyendo el algoritmo normal;

(H) represente y resuelva la suma y la resta de fracciones con denominadores distintos relacionados al mismo entero utilizando objetos y modelos pictóricos, así como las propiedades de las operaciones;

(I) represente y resuelva la multiplicación de un número entero y de una fracción que se relaciona al mismo entero utilizando objetos y modelos pictóricos, incluyendo modelos de área;

(J) represente la división de una fracción unitaria por un número entero y la división de un número entero por una fracción unitaria, tal como $1/3 \div 7$ y $7 \div 1/3$, utilizando objetos y modelos pictóricos, incluyendo modelos de área;

(K) sume y reste números racionales positivos con facilidad; y

(L) divida números enteros entre fracciones unitarias y fracciones unitarias entre números enteros.

(4) Razonamiento algebraico. El estudiante aplica los estándares de procesos matemáticos para desarrollar conceptos de expresiones y ecuaciones. Se espera que el estudiante:

(A) identifique números primos y compuestos;

(B) represente y resuelva problemas de múltiples pasos que involucran las cuatro operaciones básicas con números enteros utilizando ecuaciones que tienen una letra que representa una cantidad desconocida;

(C) genere un patrón numérico cuando se da una regla con la forma $y = ax$, o bien $y = x + a$, y haga una representación gráfica;

(D) reconozca la diferencia entre patrones numéricos de suma y de multiplicación dados en una tabla o una gráfica;

(E) describa el significado de paréntesis y corchetes en una expresión numérica;

(F) simplifique expresiones numéricas que no involucran exponentes, incluyendo hasta dos niveles de agrupación;

(G) utilice objetos concretos y modelos pictóricos para desarrollar las fórmulas para el volumen de un prisma rectangular, incluyendo la fórmula especial para un cubo ($V = l \times a \times h$, $V = l \times l \times l$, o bien $V = Bh$); y

(H) represente y resuelva problemas relacionados con el perímetro y/o el área, así como con el volumen.

(5) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para clasificar figuras de dos dimensiones por atributos y propiedades. Se espera que el estudiante clasifique figuras de dos dimensiones en una jerarquía de conjuntos y subconjuntos utilizando organizadores gráficos basados en sus atributos y propiedades.

(6) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para comprender, reconocer y cuantificar el volumen. Se espera que el estudiante:

(A) reconozca un cubo que tenga lados que midan una unidad de longitud como un cubo unitario que tiene una unidad cúbica de volumen, así como el volumen de una figura de tres dimensiones como el número de cubos unitarios (n unidades cúbicas) que se necesita para llenarla sin tener separaciones o sin que sus lados se encimen, si es posible; y

(B) determine el volumen de un prisma rectangular que tenga las longitudes de los lados en números enteros en problemas relacionados con el número de niveles multiplicado por el número de cubos unitarios en el área de la base.

(7) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para seleccionar unidades, estrategias y herramientas apropiadas que le permitan resolver problemas de medición. Se espera que el estudiante resuelva problemas que implican el cálculo de conversiones dentro de un sistema de medición, el inglés (usual) o el métrico.

(8) Geometría y medición. El estudiante aplica los estándares de procesos matemáticos para identificar ubicaciones en un plano de coordenadas. Se espera que el estudiante:

(A) describa los atributos principales de un plano de coordenadas, incluyendo las rectas numéricas perpendiculares (ejes), donde la intersección (el origen) de dos rectas coincide con cero en cada recta numérica y el punto dado (0, 0); la coordenada-x, el primer número en un par ordenado, indica movimiento paralelo al eje x empezando en el origen; y la coordenada-y, el segundo número, indica movimiento paralelo al eje y empezando en el origen;

(B) describa el proceso para representar en una gráfica pares ordenados de números en el primer cuadrante del plano de coordenadas; y

(C) represente en el primer cuadrante del plano de coordenadas pares ordenados de números que surgen de problemas matemáticos y problemas del mundo real, incluyendo los que se generan de patrones numéricos o los que se encuentran en una tabla de entrada-salida.

(9) Análisis de datos. El estudiante aplica los estándares de procesos matemáticos para resolver problemas recopilando, organizando, presentando e interpretando datos. Se espera que el estudiante:

(A) represente datos categóricos mediante gráficas de barras o tablas de frecuencia, así como datos numéricos, incluyendo conjuntos de datos de medición en fracciones o decimales, con diagramas de puntos o con diagramas de tallo y hojas;

(B) represente en un diagrama de dispersión datos discretos en pares; y

(C) resuelva problemas de un paso y de dos pasos utilizando datos de una tabla de frecuencia, un diagrama de puntos, una gráfica de barras, un diagrama de tallo y hojas o de un diagrama de dispersión.

(10) Comprensión de finanzas personales. El estudiante aplica los estándares de procesos matemáticos para manejar eficazmente sus propios recursos financieros para lograr una seguridad financiera de por vida. Se espera que el estudiante:

(A) defina los impuestos sobre los ingresos, los impuestos a las ventas y los impuestos a las propiedades;

(B) explique la diferencia entre ingresos brutos e ingresos netos;

(C) identifique las ventajas y desventajas de los diferentes métodos de pago, incluyendo el uso de cheques, tarjetas de crédito, tarjetas de débito y los pagos electrónicos;

(D) desarrolle un sistema para llevar y utilizar registros financieros;

(E) describa las acciones que se podrían tomar para balancear un presupuesto cuando los gastos superan los ingresos;

(F) haga el balance de un presupuesto sencillo.

Additional Considerations for Addressing the Mathematics Standards

I. Student mastery of standard algorithms, including addition, subtraction, multiplication, division, is the capstone standard for elementary mathematics.

II. The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards should not be addressed in isolation. Students must have opportunities to develop proficiency in solving mathematical and real world problems. The instructional materials for mathematics in Kindergarten – Grade 8 must integrate the following process standards into the rest of the student expectations for each grade level:

a) apply mathematics to problems arising in everyday life, society, and the workplace;

b) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

c) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

d) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

e) create and use representations to organize, record, and communicate mathematical ideas;

f) analyze mathematical relationships to connect and communicate mathematical ideas; and

g) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

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Chapter 126. Texas Essential Knowledge and Skills for Technology Applications

Subchapter A. Elementary

§126.6. Technology Applications, Kindergarten-Grade 2, Beginning with School Year 2012-2013.

(a) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of the six strands in technology applications, students use creative thinking and innovative processes to construct knowledge and develop products. Students communicate and collaborate both locally and globally to reinforce and promote learning. Research and information fluency includes the acquisition and evaluation of digital content. Students develop critical-thinking, problem-solving, and decision-making skills by collecting, analyzing, and reporting digital information. Students practice digital citizenship by behaving responsibly while using technology tools and resources. Through the study of technology operations and concepts, students learn technology related terms, concepts, and data input strategies.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge and develop digital products. The student is expected to:

(A) apply prior knowledge to develop new ideas, products, and processes;

(B) create original products using a variety of resources;

(C) explore virtual environments, simulations, models, and programming languages to enhance learning;

(D) create and execute steps to accomplish a task; and

(E) evaluate and modify steps to accomplish a task.

(2) Communication and collaboration. The student collaborates and communicates both locally and globally using digital tools and resources to reinforce and promote learning. The student is expected to:

(A) use communication tools that allow for anytime, anywhere access to interact, collaborate, or publish with peers locally and globally;

(B) participate in digital environments to develop cultural understanding by interacting with learners of multiple cultures;

(C) format digital information, including font attributes, color, white space, graphics, and animation, for a defined audience and communication medium; and

(D) select, store, and deliver products using a variety of media, formats, devices, and virtual environments.

(3) Research and information fluency. The student acquires and evaluates digital content. The student is expected to:

(A) use search strategies to access information to guide inquiry;

(B) use research skills to build a knowledge base regarding a topic, task, or assignment; and

(C) evaluate the usefulness of acquired digital content.

(4) Critical thinking, problem solving, and decision making. The student applies critical-thinking skills to solve problems, guide research, and evaluate projects using digital tools and resources. The student is expected to:

(A) identify what is known and unknown and what needs to be known regarding a problem and explain the steps to solve the problem;

(B) evaluate the appropriateness of a digital tool to achieve the desired product;

(C) evaluate products prior to final submission; and

(D) collect, analyze, and represent data using tools such as word processing, spreadsheets, graphic organizers, charts, multimedia, simulations, models, and programming languages.

(5) Digital citizenship. The student practices safe, responsible, legal, and ethical behavior while using digital tools and resources. The student is expected to:

(A) adhere to acceptable use policies reflecting appropriate behavior in a digital environment;

(B) comply with acceptable digital safety rules, fair use guidelines, and copyright laws; and

(C) practice the responsible use of digital information regarding intellectual property, including software, text, images, audio, and video.

(6) Technology operations and concepts. The student demonstrates knowledge and appropriate use of technology systems, concepts, and operations. The student is expected to:

(A) use appropriate terminology regarding basic hardware, software applications, programs, networking, virtual environments, and emerging technologies;

(B) use appropriate digital tools and resources for storage, access, file management, collaboration, and designing solutions to problems;

(C) perform basic software application functions, including opening an application and creating, modifying, printing, and saving files;

(D) use a variety of input, output, and storage devices;

(E) use proper keyboarding techniques such as ergonomically correct hand and body positions appropriate for Kindergarten-Grade 2 learning;

(F) demonstrate keyboarding techniques for operating the alphabetic, numeric, punctuation, and symbol keys appropriate for Kindergarten-Grade 2 learning; and

(G) use the help feature online and in applications.

§126.7. Technology Applications, Grades 3-5, Beginning with School Year 2012-2013.

(a) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of the six strands in technology applications, students use creative thinking and innovative processes to construct knowledge and develop products. Students communicate and collaborate both locally and globally to reinforce and promote learning. Research and information fluency includes the acquisition and evaluation of digital content. Students develop critical-thinking, problem-solving, and decision-making skills by collecting, analyzing, and reporting digital information. Students practice digital citizenship by behaving responsibly while using technology tools and resources. Through the study of technology operations and concepts, students learn technology related terms, concepts, and data input strategies.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and skills.

(1) Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge and develop digital products. The student is expected to:

(A) create original products using a variety of resources;

(B) analyze trends and forecast possibilities, developing steps for the creation of an innovative process or product; and

(C) use virtual environments to explore systems and issues.

(2) Communication and collaboration. The student collaborates and communicates both locally and globally using digital tools and resources to reinforce and promote learning. The student is expected to:

(A) draft, edit, and publish products in different media individually and collaboratively;

(B) use font attributes, color, white space, and graphics to ensure that products are appropriate for multiple communication media, including monitor display, web, and print;

(C) collaborate effectively through personal learning communities and social environments;

(D) select and use appropriate collaboration tools;

(E) evaluate the product for relevance to the assignment or task; and

(F) perform basic software application functions, including opening applications and creating, modifying, printing, and saving files.

(3) Research and information fluency. The student acquires and evaluates digital content. The student is expected to:

(A) use various search strategies such as keyword(s); the Boolean identifiers *and*, *or*, and *not*; and other strategies appropriate to specific search engines;

(B) collect and organize information from a variety of formats, including text, audio, video, and graphics;

(C) validate and evaluate the relevance and appropriateness of information; and

(D) acquire information appropriate to specific tasks.

(4) Critical thinking, problem solving, and decision making. The student researches and evaluates projects using digital tools and resources. The student is expected to:

(A) identify information regarding a problem and explain the steps toward the solution;

(B) collect, analyze, and represent data to solve problems using tools such as word processing, databases, spreadsheets, graphic organizers, charts, multimedia, simulations, models, and programming languages;

(C) evaluate student-created products through self and peer review for relevance to the assignment or task; and

(D) evaluate technology tools applicable for solving problems.

(5) Digital citizenship. The student practices safe, responsible, legal, and ethical behavior while using digital tools and resources. The student is expected to:

(A) adhere to acceptable use policies reflecting positive social behavior in the digital environment;

(B) respect the intellectual property of others;

(C) abide by copyright law and the Fair Use Guidelines for Educational Multimedia;

(D) protect and honor the individual privacy of oneself and others;

(E) follow the rules of digital etiquette;

(F) practice safe, legal, and responsible use of information and technology; and

(G) comply with fair use guidelines and digital safety rules.

(6) Technology operations and concepts. The student demonstrates knowledge and appropriate use of technology systems, concepts, and operations. The student is expected to:

(A) demonstrate an understanding of technology concepts, including terminology for the use of operating systems, network systems, virtual systems, and learning systems appropriate for Grades 3-5 learning;

(B) manipulate files using appropriate naming conventions; file management, including folder structures and tagging; and file conversions;

(C) navigate systems and applications accessing peripherals both locally and remotely;

(D) troubleshoot minor technical problems with hardware and software using available resources such as online help and knowledge bases; and

(E) use proper touch keyboarding techniques and ergonomic strategies such as correct hand and body positions and smooth and rhythmic keystrokes.

Subchapter B. Middle School

§126.14. Technology Applications, Grade 6, Beginning with School Year 2012-2013.

(a) General requirements. Districts have the flexibility of offering technology applications in a variety of settings. Districts are encouraged to offer technology applications in all content areas. This content may also be offered in a specific class while being integrated in all content areas.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of technology applications, students make informed decisions by understanding current and emerging technologies, including technology systems, appropriate digital tools, and personal learning networks. As competent researchers and responsible digital citizens, students use creative and computational thinking to solve problems while developing career and college readiness skills.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge, generate new ideas, and create products. The student is expected to:

(A) identify, create, and use files in various formats such as text, raster and vector graphics, video, and audio files;

(B) create original works as a means of personal or group expression;

(C) explore complex systems or issues using models, simulations, and new technologies to make predictions, modify input, and review results; and

(D) discuss trends and possible outcomes.

(2) Communication and collaboration. The student collaborates and communicates both locally and globally to reinforce and promote learning. The student is expected to:

(A) participate in personal learning networks to collaborate with peers, experts, or others using digital tools such as blogs, wikis, audio/video communication, or other emerging technologies;

(B) communicate effectively with multiple audiences using a variety of media and formats; and

(C) read and discuss examples of technical writing.

(3) Research and information fluency. The student acquires, analyzes, and manages content from digital resources. The student is expected to:

(A) create a research plan to guide inquiry;

(B) discuss and use various search strategies, including keyword(s) and Boolean operators;

(C) select and evaluate various types of digital resources for accuracy and validity; and

(D) process data and communicate results.

(4) Critical thinking, problem solving, and decision making. The student makes informed decisions by applying critical-thinking and problem-solving skills. The student is expected to:

(A) identify and define relevant problems and significant questions for investigation;

(B) plan and manage activities to develop a solution, design a computer program, or complete a project;

(C) collect and analyze data to identify solutions and make informed decisions;

(D) use multiple processes and diverse perspectives to explore alternative solutions;

(E) make informed decisions and support reasoning; and

(F) transfer current knowledge to the learning of newly encountered technologies.

(5) Digital citizenship. The student practices safe, responsible, legal, and ethical behavior while using technology tools and resources. The student is expected to:

(A) understand copyright principles, including current laws, fair use guidelines, creative commons, open source, and public domain;

(B) practice ethical acquisition of information and standard methods for citing sources;

(C) practice safe and appropriate online behavior, personal security guidelines, digital identity, digital etiquette, and acceptable use of technology; and

(D) understand the negative impact of inappropriate technology use, including online bullying and harassment, hacking, intentional virus setting, invasion of privacy, and piracy such as software, music, video, and other media.

(6) Technology operations and concepts. The student demonstrates a thorough understanding of technology concepts, systems, and operations. The student is expected to:

(A) define and use current technology terminology appropriately;

(B) select technology tools based on licensing, application, and support;

(C) identify, understand, and use operating systems;

(D) understand and use software applications, including selecting and using software for a defined task;

(E) identify, understand, and use hardware systems;

(F) understand troubleshooting techniques such as restarting systems, checking power issues, resolving software compatibility, verifying network connectivity, connecting to remote resources, and modifying display properties;

(G) demonstrate effective file management strategies such as file naming conventions, location, backup, hierarchy, folder structure, file conversion, tags, labels, and emerging digital organizational strategies;

(H) discuss how changes in technology throughout history have impacted various areas of study;

(I) discuss the relevance of technology as it applies to college and career readiness, life-long learning, and daily living;

(J) use a variety of local and remote input sources;

(K) use keyboarding techniques and ergonomic strategies while building speed and accuracy;

(L) create and edit files with productivity tools, including:

(i) a word processing document using digital typography standards such as page layout, font formatting, paragraph formatting, and list attributes;

(ii) a spreadsheet workbook using basic computational and graphic components such as basic formulas and functions, data types, and chart generation;

(iii) a database by manipulating components such as entering and searching for relevant data; and

(iv) a digital publication using relevant publication standards;

(M) plan and create non-linear media projects using graphic design principles; and

(N) integrate two or more technology tools to create a new digital product.

§126.15. Technology Applications, Grade 7, Beginning with School Year 2012-2013.

(a) General requirements. Districts have the flexibility of offering technology applications in a variety of settings. Districts are encouraged to offer technology applications in all content areas. This content may also be offered in a specific class while being integrated in all content areas.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of technology applications, students make informed decisions by understanding current and emerging technologies, including technology systems, appropriate digital tools, and personal learning networks. As competent researchers and responsible digital citizens, students use creative and computational thinking to solve problems while developing career and college readiness skills.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge, generate new ideas, and create products. The student is expected to:

(A) identify, create, and use files in various formats such as text, raster and vector graphics, video, and audio files;

(B) create and present original works as a means of personal or group expression;

(C) explore complex systems or issues using models, simulations, and new technologies to make predictions, modify input, and review results; and

(D) discuss trends and make predictions.

(2) Communication and collaboration. The student collaborates and communicates both locally and globally to reinforce and promote learning. The student is expected to:

(A) create personal learning networks to collaborate and publish with peers, experts, or others using digital tools such as blogs, wikis, audio/video communication, or other emerging technologies;

(B) communicate effectively with multiple audiences using a variety of media and formats; and

(C) create products using technical writing strategies.

(3) Research and information fluency. The student acquires, analyzes, and manages content from digital resources. The student is expected to:

(A) create a research plan to guide inquiry;

(B) use and evaluate various search strategies, including keyword(s) and Boolean operators;

(C) select and evaluate various types of digital resources for accuracy and validity; and

(D) process data and communicate results.

(4) Critical thinking, problem solving, and decision making. The student makes informed decisions by applying critical-thinking and problem-solving skills. The student is expected to:

(A) identify and define relevant problems and significant questions for investigation;

(B) plan and manage activities to develop a solution, design a computer program, or complete a project;

(C) collect and analyze data to identify solutions and make informed decisions;

(D) use multiple processes and diverse perspectives to explore alternative solutions;

(E) make informed decisions and support reasoning; and

(F) transfer current knowledge to the learning of newly encountered technologies.

(5) Digital citizenship. The student practices safe, responsible, legal, and ethical behavior while using technology tools and resources. The student is expected to:

(A) understand and practice copyright principles, including current fair use guidelines, creative commons, open source, and public domain;

(B) practice ethical acquisition of information and standard methods for citing sources;

(C) practice and explain safe and appropriate online behavior, personal security guidelines, digital identity, digital etiquette, and acceptable use of technology; and

(D) understand the negative impact of inappropriate technology use, including online bullying and harassment, hacking, intentional virus setting, invasion of privacy, and piracy such as software, music, video, and other media.

(6) Technology operations and concepts. The student demonstrates a thorough understanding of technology concepts, systems, and operations. The student is expected to:

(A) define and use current technology terminology appropriately;

(B) select and apply technology tools based on licensing, application, and support;

(C) identify, understand, and use operating systems;

(D) understand and use software applications, including selecting and using software for a defined task;

(E) identify, understand, and use hardware systems;

(F) understand troubleshooting techniques such as restarting systems, checking power issues, resolving software compatibility, verifying network connectivity, connecting to remote resources, and modifying display properties;

(G) implement effective file management strategies such as file naming conventions, location, backup, hierarchy, folder structure, file conversion, tags, labels, and emerging digital organizational strategies;

(H) explain how changes in technology throughout history have impacted various areas of study;

(I) explain the relevance of technology as it applies to college and career readiness, life-long learning, and daily living;

(J) use a variety of local and remote input sources;

(K) use keyboarding techniques and ergonomic strategies while building speed and accuracy;

(L) create and edit files with productivity tools, including:

(i) a word processing document using digital typography standards such as page layout, font formatting, paragraph formatting, and list attributes;

(ii) a spreadsheet workbook using advanced computational and graphic components such as complex formulas, basic functions, data types, and chart generation;

(iii) a database by manipulating components such as defining fields, entering data, and designing layouts appropriate for reporting; and

(iv) a digital publication using relevant publication standards;

(M) plan and create non-linear media projects using graphic design principles; and

(N) integrate two or more technology tools to create a new digital product.

§126.16. Technology Applications, Grade 8, Beginning with School Year 2012-2013.

(a) General requirements. Districts have the flexibility of offering technology applications in a variety of settings. Districts are encouraged to offer technology applications in all content areas. This content may also be offered in a specific class while being integrated in all content areas.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of technology applications, students make informed decisions by understanding current and emerging technologies, including technology systems, appropriate digital tools, and personal learning networks. As competent researchers and responsible digital citizens, students use creative and computational thinking to solve problems while developing career and college readiness skills.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge, generate new ideas, and create products. The student is expected to:

(A) identify, create, and use files in various formats, including text, raster and vector graphics, video, and audio files;

(B) create, present, and publish original works as a means of personal or group expression;

(C) explore complex systems or issues using models, simulations, and new technologies to develop hypotheses, modify input, and analyze results; and

(D) analyze trends and forecast possibilities.

(2) Communication and collaboration. The student collaborates and communicates both locally and globally to reinforce and promote learning. The student is expected to:

(A) create and manage personal learning networks to collaborate and publish with peers, experts, or others using digital tools such as blogs, wikis, audio/video communication, or other emerging technologies;

(B) communicate effectively with multiple audiences using a variety of media and formats; and

(C) create and publish products using technical writing strategies.

(3) Research and information fluency. The student acquires, analyzes, and manages content from digital resources. The student is expected to:

(A) create a research plan to guide inquiry;

(B) plan, use, and evaluate various search strategies, including keyword(s) and Boolean operators;

(C) select and evaluate various types of digital resources for accuracy and validity; and

(D) process data and communicate results.

(4) Critical thinking, problem solving, and decision making. The student makes informed decisions by applying critical-thinking and problem-solving skills. The student is expected to:

(A) identify and define relevant problems and significant questions for investigation;

(B) plan and manage activities to develop a solution, design a computer program, or complete a project;

(C) collect and analyze data to identify solutions and make informed decisions;

(D) use multiple processes and diverse perspectives to explore alternative solutions;

(E) make informed decisions and support reasoning; and

(F) transfer current knowledge to the learning of newly encountered technologies.

(5) Digital citizenship. The student practices safe, responsible, legal, and ethical behavior while using technology tools and resources. The student is expected to:

(A) understand, explain, and practice copyright principles, including current laws, fair use guidelines, creative commons, open source, and public domain;

(B) practice and explain ethical acquisition of information and standard methods for citing sources;

(C) practice and explain safe and appropriate online behavior, personal security guidelines, digital identity, digital etiquette, and acceptable use of technology; and

(D) understand and explain the negative impact of inappropriate technology use, including online bullying and harassment, hacking, intentional virus setting, invasion of privacy, and piracy such as software, music, video, and other media.

(6) Technology operations and concepts. The student demonstrates a thorough understanding of technology concepts, systems, and operations. The student is expected to:

(A) define and use current technology terminology appropriately;

(B) evaluate and select technology tools based on licensing, application, and support;

(C) identify, understand, and use operating systems;

(D) understand and use software applications, including selecting and using software for a defined task;

(E) identify, understand, and use hardware systems;

(F) apply troubleshooting techniques, including restarting systems, checking power issues, resolving software compatibility, verifying network connectivity, connecting to remote resources, and modifying display properties;

(G) implement effective file management strategies such as file naming conventions, location, backup, hierarchy, folder structure, file conversion, tags, labels, and emerging digital organizational strategies;

(H) evaluate how changes in technology throughout history have impacted various areas of study;

(I) evaluate the relevance of technology as it applies to college and career readiness, life-long learning, and daily living;

(J) use a variety of local and remote input sources;

(K) use keyboarding techniques and ergonomic strategies while building speed and accuracy;

(L) create and edit files with productivity tools, including:

(i) a word processing document using digital typography standards such as page layout, font formatting, paragraph formatting, mail merge, and list attributes;

(ii) a spreadsheet workbook using advanced computational and graphic components such as complex formulas, advanced functions, data types, and chart generation;

(iii) a database by manipulating components, including defining fields, entering data, and designing layouts appropriate for reporting; and

(iv) a digital publication using relevant publication standards and graphic design principles;

(M) plan and create non-linear media projects using graphic design principles; and

(N) integrate two or more technology tools to create a new digital product.

Subchapter C. High School

§126.32. Fundamentals of Computer Science, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one-half to one credit for successful completion of this course. The prerequisite for this course is proficiency in the knowledge and skills relating to Technology Applications, Grades 6-8. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Fundamentals of Computer Science is intended as a first course for those students just beginning the study of computer science. Students will learn about the computing tools that are used every day. Students will foster their creativity and innovation through opportunities to design, implement, and present solutions to real-world problems. Students will collaborate and use computer science concepts to access, analyze, and evaluate information needed to solve problems. Students will learn the problem-solving and reasoning skills that are the foundation of computer science. By using computer science knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will gain an understanding of the principles of computer science through the study of technology operations and concepts.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understanding by extending existing knowledge. The student is expected to:

(A) investigate and explore various career opportunities within the computer science field and report findings through various media;

(B) create and publish interactive stories, games, and animations;

(C) create and publish interactive animations;

(D) create algorithms for the solution of various problems;

(E) create web pages using a mark-up language;

(F) use the Internet to create and publish solutions; and

(G) design creative and effective user interfaces.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:

(A) seek and respond to advice from peers and professionals in evaluating problem solutions;

(B) debug and solve problems using reference materials and effective strategies; and

(C) publish information in a variety of ways such as print, monitor display, web pages, and video.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:

(A) construct appropriate electronic search strategies; and

(B) use a variety of resources, including other subject areas, together with various productivity tools to gather authentic data as a basis for individual and group programming projects.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:

(A) demonstrate the ability to insert applets into web pages;

(B) find, download, and insert scripting code into web pages to enhance interactivity;

(C) understand binary representation of data in computer systems, perform conversions between decimal and binary number systems, and count in binary number systems;

(D) read and define a problem's description, purpose, and goals;

(E) demonstrate coding proficiency in a contemporary programming language by developing solutions that create stories, games, and animations;

(F) choose, identify, and use the appropriate data type to properly represent data in a problem solution;

(G) demonstrate an understanding of and use variables within a programmed story, game, or animation;

(H) demonstrate proficiency in the use of arithmetic operators to create mathematical expressions, including addition, subtraction, multiplication, real division, integer division, and modulus division;

(I) demonstrate an understanding of and use sequence within a programmed story, game, or animation;

(J) demonstrate an understanding of and use conditional statements within a programmed story, game, or animation;

(K) demonstrate an understanding of and use iteration within a programmed story, game, or animation;

(L) create an interactive story, game, or animation;

(M) use random numbers within a programmed story, game, or animation; and

(N) test program solutions by investigating valid and invalid data.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) discuss copyright laws/issues and model ethical acquisition of digital information by citing sources using established methods;

(B) demonstrate proper digital etiquette and knowledge of acceptable use policies when using networks, especially resources on the Internet and on intranets;

(C) investigate measures such as passwords or virus detection/prevention to protect computer systems and databases from unauthorized use and tampering;

(D) understand the safety risks associated with the use of social networking sites;

(E) discuss the impact of computing and computing related advancements on society; and

(F) determine the reliability of information available through electronic media.

(6) Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:

(A) demonstrate knowledge of the basic computer components, including a central processing unit (CPU), storage, and input/output devices;

(B) use operating system tools, including appropriate file management;

(C) demonstrate knowledge and appropriate use of different operating systems;

(D) demonstrate knowledge and understanding of basic network connectivity;

(E) describe, compare, and contrast the differences between an application and an operating system; and

(F) compare, contrast, and appropriately use various input, processing, output, and primary/secondary storage devices.

§126.33. Computer Science I, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one-half to one credit for successful completion of this course. The required prerequisite for this course is Algebra I. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Computer Science I will foster students' creativity and innovation by presenting opportunities to design, implement, and present meaningful programs through a variety of media. Students will collaborate with one another, their instructor, and various electronic communities to solve the problems presented throughout the course. Through data analysis, students will identify task requirements, plan search strategies, and use computer science concepts to access, analyze, and evaluate information needed to solve problems. By using computer science knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will gain an understanding of the principles of computer science through the study of technology operations, systems, and concepts.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understandings by extending existing knowledge. The student is expected to:
   (A) participate with electronic communities as a learner, initiator, contributor, and teacher/mentor;
   (B) extend the learning environment beyond the school walls with digital products created to increase teaching and learning in the other subject areas; and
   (C) participate in relevant, meaningful activities in the larger community and society to create electronic projects.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:
   (A) create and properly display meaningful output;
   (B) create interactive console display interfaces, with appropriate user prompts, to acquire data from a user;
   (C) use Graphical User Interfaces (GUIs) to create interactive interfaces to acquire data from a user and display program results;
   (D) write programs with proper programming style to enhance the readability and functionality of the code by using meaningful descriptive identifiers, internal comments, white space, spacing, indentation, and a standardized program style;
   (E) improve numeric display by optimizing data visualization;
   (F) display simple vector graphics using lines, circles, and rectangles;
   (G) display simple bitmap images; and
   (H) seek and respond to advice from peers and professionals in evaluating quality and accuracy.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:
   (A) use a variety of resources, including foundation and enrichment curricula, to gather authentic data as a basis for individual and group programming projects; and
   (B) use various productivity tools to gather authentic data as a basis for individual and group programming projects.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:
   (A) use program design problem-solving strategies to create program solutions;
   (B) define and specify the purpose and goals of solving a problem;
   (C) identify the subtasks needed to solve a problem;
   (D) identify the data types and objects needed to solve a problem;
   (E) identify reusable components from existing code;
   (F) design a solution to a problem;
   (G) code a solution from a program design;
   (H) identify and debug errors;
   (I) test program solutions with appropriate valid and invalid test data for correctness;
   (J) debug and solve problems using error messages, reference materials, language documentation, and effective strategies;

(K) explore common algorithms, including finding greatest common divisor, finding the biggest number out of three, finding primes, making change, and finding the average;

(L) analyze and modify existing code to improve the underlying algorithm;

(M) create program solutions that exhibit robust behavior by understanding, avoiding, and preventing runtime errors, including division by zero and type mismatch;

(N) select the most appropriate algorithm for a defined problem;

(O) demonstrate proficiency in the use of the arithmetic operators to create mathematical expressions, including addition, subtraction, multiplication, real division, integer division, and modulus division;

(P) create program solutions to problems using available mathematics libraries, including absolute value, round, power, square, and square root;

(Q) develop program solutions that use assignment;

(R) develop sequential algorithms to solve non-branching and non-iterative problems;

(S) develop algorithms to decision-making problems using branching control statements;

(T) develop iterative algorithms and code programs to solve practical problems;

(U) demonstrate proficiency in the use of the relational operators;

(V) demonstrate proficiency in the use of the logical operators; and

(W) generate and use random numbers.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) discuss intellectual property, privacy, sharing of information, copyright laws, and software licensing agreements;

(B) model ethical acquisition and use of digital information;

(C) demonstrate proper digital etiquette, responsible use of software, and knowledge of acceptable use policies;

(D) investigate measures, including passwords and virus detection/prevention, to protect computer systems and databases from unauthorized use and tampering; and

(E) investigate how technology has changed and the social and ethical ramifications of computer usage.

(6) Technology operations, systems, and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:

(A) compare and contrast types of operating systems, software applications, and programming languages;

(B) demonstrate knowledge of major hardware components, including primary and secondary memory, a central processing unit (CPU), and peripherals;

(C) differentiate among current programming languages, discuss the use of those languages in other fields of study, and demonstrate knowledge of specific programming terminology and concepts;

(D) differentiate between a high-level compiled language and an interpreted language;

(E) understand concepts of object-oriented design;

(F) use local and global scope access variable declarations;

(G) encapsulate data and associated subroutines into an abstract data type;

(H) create subroutines that do not return values with and without the use of arguments and parameters;

(I) create subroutines that return typed values with and without the use of arguments and parameters;

(J) understand and identify the data-binding process between arguments and parameters;

(K) compare objects using reference values and a comparison routine;

(L) understand the binary representation of numeric and nonnumeric data in computer systems;

(M) understand the finite limits of numeric data;

(N) perform numerical conversions between the decimal and binary number systems and count in the binary number system;

(O) choose, identify, and use the appropriate data types for integer, real, and Boolean data when writing program solutions;

(P) demonstrate an understanding of the concept of a variable;

(Q) demonstrate an understanding of and use reference variables for objects;

(R) demonstrate an understanding of how to represent and manipulate text data, including concatenation and other string functions;

(S) demonstrate an understanding of the concept of scope;

(T) identify and use the structured data type of one-dimensional arrays to traverse, search, and modify data;

(U) choose, identify, and use the appropriate data type and structure to properly represent the data in a program problem solution; and

(V) compare and contrast strongly typed and un-typed programming languages.

§126.34. Computer Science II, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. The required prerequisites for this course are Algebra I and either Computer Science I or Fundamentals of Computer Science. This course is recommended for students in Grades 11 and 12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Computer Science II will foster students' creativity and innovation by presenting opportunities to design, implement, and present meaningful programs through a variety of media. Students will collaborate with one another, their instructor, and various electronic communities to solve the problems presented throughout the course. Through data analysis, students will identify task requirements, plan search strategies, and use computer

science concepts to access, analyze, and evaluate information needed to solve problems. By using computer science knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will gain an understanding of computer science through the study of technology operations, systems, and concepts.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understandings by extending existing knowledge. The student is expected to:

(A) use program design problem-solving strategies to create program solutions;

(B) demonstrate the ability to read and modify large programs, including the design description and process development;

(C) follow the systematic problem-solving process of identifying the specifications of purpose and goals, the data types and objects needed, and the subtasks to be performed;

(D) compare and contrast design methodologies and implementation techniques such as top-down, bottom-up, and black box;

(E) analyze, modify, and evaluate existing code by performing a case study on a large program, including inheritance and black box programming;

(F) identify the data types and objects needed to solve a problem;

(G) choose, identify, and use the appropriate abstract data type, advanced data structure, and supporting algorithms to properly represent the data in a program problem solution;

(H) use object-oriented programming development methodology, data abstraction, encapsulation with information hiding, and procedural abstraction in program development and testing; and

(I) create, edit, and manipulate bitmap images that are used to enhance user interfaces and program functionality.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:

(A) use the principles of software engineering to work in software design teams, break a problem statement into specific solution requirements, create a program development plan, code part of a solution from a program development plan while a partner codes the remaining part, team test the solution for correctness, and develop presentations to report the solution findings;

(B) create interactive console display interfaces with appropriate user prompts;

(C) create interactive human interfaces to acquire data from a user and display program results using an advanced Graphical User Interface (GUI);

(D) write programs and communicate with proper programming style to enhance the readability and functionality of the code by using meaningful descriptive identifiers, internal comments, white space, indentation, and a standardized program style;

(E) improve data display by optimizing data visualization;

(F) display simple vector graphics to interpret and display program results; and

(G) display simple bitmap images.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:

(A) use local area networks (LANs) and wide area networks (WANs), including the Internet and intranets, in research, file management, and collaboration;

(B) understand programming file structure and file access for required resources;

(C) acquire and process information from text files, including files of known and unknown sizes;

(D) manipulate data structures using string processing;

(E) manipulate data values by casting between data types;

(F) identify and use the structured data type of one-dimensional arrays to traverse, search, modify, insert, and delete data;

(G) identify and use the structured data type of two-dimensional arrays to traverse, search, modify, insert, and delete data; and

(H) identify and use a list object data structure to traverse, search, insert, and delete data.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:

(A) develop sequential algorithms using branching control statements, including nested structures, to create solutions to decision-making problems;

(B) develop choice algorithms using selection control statements based on ordinal values;

(C) demonstrate proficiency in the use of short-circuit evaluation;

(D) demonstrate proficiency in the use of Boolean algebra, including De Morgan's Law;

(E) develop iterative algorithms using nested loops;

(F) identify, trace, and appropriately use recursion in programming solutions, including algebraic computations;

(G) design, construct, evaluate, and compare search algorithms, including linear searching and binary searching;

(H) identify, describe, design, create, evaluate, and compare standard sorting algorithms, including selection sort, bubble sort, insertion sort, and merge sort;

(I) measure time/space efficiency of various sorting algorithms;

(J) compare and contrast search and sort algorithms, including linear, quadratic, and recursive strategies, for time/space efficiency;

(K) analyze algorithms using "big-O" notation for best, average, and worst-case data patterns;

(L) develop algorithms to solve various problems, including factoring, summing a series, finding the roots of a quadratic equation, and generating Fibonacci numbers;

(M) test program solutions by investigating boundary conditions; testing classes, methods, and libraries in isolation; and performing stepwise refinement;

(N) identify and debug compile, syntax, runtime, and logic errors;

(O) compare and contrast algorithm efficiency by using informal runtime comparisons, exact calculation of statement execution counts, and theoretical efficiency values using "big-O" notation, including worst-case, best-case, and average-case time/space analysis;

(P) demonstrate the ability to count, convert, and perform mathematical operations in the binary and hexadecimal number systems;

(Q) demonstrate knowledge of the maximum integer boundary, minimum integer boundary, imprecision of real number representations, and round-off errors;

(R) create program solutions to problems using the mathematics library class;

(S) use random algorithms to create simulations that model the real world;

(T) identify, understand, and create class specifications and relationships among classes, including composition and inheritance relationships;

(U) understand and explain object relationships among defined classes, abstract classes, and interfaces;

(V) create object-oriented definitions using class declarations, variable declarations, constant declarations, method declarations, parameter declarations, and interface declarations;

(W) create robust classes that encapsulate data and the methods that operate on that data and incorporate overloading to enrich the object's behavior;

(X) design and implement a set of interactive classes;

(Y) design, create, and evaluate multiclass programs that use abstract classes and interfaces;

(Z) understand and implement a student-created class hierarchy;

(AA) extend, modify, and improve existing code using inheritance;

(BB) create adaptive behaviors, including overloading, using polymorphism;

(CC) understand and use reference variables for object and string data types;

(DD) understand and implement access scope modifiers;

(EE) understand and demonstrate how to compare objects;

(FF) duplicate objects using the appropriate deep and/or shallow copy;

(GG) define and implement abstract classes and interfaces in program problem solutions;

(HH) apply functional decomposition to a program solution;

(II) create simple and robust objects from class definitions through instantiation;

(JJ) apply class membership of variables, constants, and methods;

(KK) examine and mutate the properties of an object using accessors and modifiers;

(LL) understand and implement a composite class; and

(MM) design and implement an interface.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) model ethical acquisition and use of digital information;

(B) demonstrate proper digital etiquette, responsible use of software, and knowledge of acceptable use policies; and

(C) investigate digital rights management.

(6) Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:

(A) compare and contrast types of operating systems, software applications, hardware platforms, and programming languages;

(B) demonstrate knowledge of major hardware components, including primary and secondary memory, a central processing unit (CPU), and peripherals;

(C) demonstrate knowledge of major networking components, including hosts, servers, switches, and routers;

(D) demonstrate knowledge of computer communication systems, including single-user, peer-to-peer, workgroup, client-server, and networked;

(E) demonstrate knowledge of computer addressing systems, including Internet Protocol (IP) address and Media Access Control (MAC) address; and

(F) differentiate among the categories of programming languages, including machine, assembly, high-level compiled, high-level interpreted, and scripted.

§126.35. Computer Science III, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. The required prerequisite for this course is Computer Science II, Advanced Placement (AP) Computer Science A, or International Baccalaureate (IB) Computer Science. This course is recommended for students in Grades 11 and 12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Computer Science III will foster students' creativity and innovation by presenting opportunities to design, implement, and present meaningful programs through a variety of media. Students will collaborate with one another, their instructor, and various electronic communities to solve the problems presented throughout the course. Through data analysis, students will identify task requirements, plan search strategies, and use computer science concepts to access, analyze, and evaluate information needed to solve problems. By using computer science knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will gain an understanding of advanced computer science data structures through the study of technology operations, systems, and concepts.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understandings by extending existing knowledge. The student is expected to:

(A) apply data abstraction and encapsulation to manage complexity;

(B) implement a student-created class hierarchy;

(C) read and write class specifications using visual organizers, including Unified Modeling Language;

(D) use black box programming methodology;

(E) design, create, and use interfaces to apply protocols;

(F) identify, describe, design, create, evaluate, and compare standard sorting algorithms that perform sorting operations on data structures, including quick sort and heap sort;

(G) select, identify, and use the appropriate abstract data type, advanced data structure, and supporting algorithms to properly represent the data in a program problem solution; and

(H) manage complexity by using a systems approach.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:

(A) use local area networks (LANs) and wide area networks (WANs), including the Internet and intranets, in research, file management, and collaboration;

(B) create interactive human interfaces to acquire data from a user and display program results using an advanced Graphical User Interface (GUI);

(C) write programs and communicate with proper programming style to enhance the readability and functionality of the code by using meaningful descriptive identifiers, internal comments, white space, indentation, and a standardized program style; and

(D) work in software design teams.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:

(A) identify and use the structured data type of arrays of objects to traverse, search, modify, insert, and delete data;

(B) identify and use two-dimensional ragged arrays to traverse, search, modify, insert, and delete data;

(C) identify and use a list object data structure, including vector, to traverse, search, insert, and delete object data;

(D) understand and trace a linked-list data structure;

(E) create program solutions using a linked-list data structure, including unordered single, ordered single, double, and circular linked;

(F) understand composite data structures, including a linked list of linked lists;

(G) understand and create program solutions using stacks, queues, trees, heaps, priority queues, graph theory, and enumerated data types;

(H) understand and create program solutions using sets, including HashSet and TreeSet;

(I) understand and create program solutions using maps, including HashMap and TreeMap; and

(J) write and modify text file data.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:

(A) develop choice algorithms using selection control statements, including break, label, and continue;

(B) demonstrate proficiency in the use of the bitwise operators;

(C) develop iterative algorithms using do-while loops;

(D) demonstrate proficiency in the use of the ternary operator;

(E) create program solutions that use iterators;

(F) identify, trace, and appropriately use recursion;

(G) understand and create program solutions using hashing;

(H) perform pattern recognition using regular expressions;

(I) explore common algorithms, including matrix addition and multiplication, fractals, Towers of Hanoi, and magic square;

(J) create program solutions that exhibit robust behavior by understanding and avoiding runtime errors and handling anticipated errors;

(K) understand object-oriented design concepts of inner classes, outer classes, and anonymous classes;

(L) use object reference scope identifiers, including null, this, and super;

(M) provide object functionality to primitive data types;

(N) write program assumptions in the form of assertions;

(O) write a Boolean expression to test a program assertion; and

(P) construct assertions to make explicit program invariants.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) model ethical acquisition and use of digital information; and

(B) demonstrate proper digital etiquette, responsible use of software, and knowledge of acceptable use policies.

(6) Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:

(A) compare and contrast high-level programming languages;

(B) create a small workgroup network;

(C) create and apply a basic network addressing scheme; and

(D) create discovery programs in a low-level language, high-level language, and scripting language.

§126.36. Digital Forensics, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one-half to one credit for successful completion of this course. The prerequisite for this course is proficiency in the knowledge and skills relating to Technology Applications, Grades 6-8. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Digital Forensics will foster students' creativity and innovation by presenting opportunities to investigate simulations and case studies of crimes, reconstructing computer security incidents, troubleshooting operational problems, and recovering from accidental system damage. Students will collaborate to develop forensic techniques to assist with computer security incident response. Students will learn methods to identify, collect, examine, and analyze data while preserving the integrity of the information and maintaining a strict chain of custody for data. Students will solve problems as they study the application of science to the law. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will gain an understanding of computing and networking systems that transmit or store electronic data.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understanding by extending existing knowledge. The student is expected to:

(A) explain the need for digital forensics, staffing requirements, and team interactions;

(B) develop policies to define staff roles and responsibilities;

(C) develop guidelines, procedures, and recommendations for digital forensics tool use; and

(D) investigate simulations and case studies of crimes to reconstruct computer security incidents.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:

(A) describe the characteristics and behaviors of a given system;

(B) justify and describe the impact of selecting a given system;

(C) apply effective teamwork practices;

(D) collaborate with multiple participants;

(E) document use, functionality, and implementation;

(F) seek and respond to advice from peers and professionals; and

(G) describe considerations required for incident response.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:

(A) identify possible sources of data;

(B) acquire data;

(C) analyze and report data collected;

(D) collect files by copying files from media while maintaining data file integrity;

(E) examine data files by locating files, extracting data, and using a digital forensics toolkit;

(F) examine and analyze operating system data;

(G) collect volatile and non-volatile operating system data;

(H) collect, examine, and analyze application data;

(I) use traffic data sources, including firewalls and routers, packet sniffers and protocol analyzers, intrusion detection systems, remote access, security event management software, and network forensic analysis tools;

(J) describe how a file scan can be accessed and modified;

(K) collect, examine, and analyze data from multiple sources; and

(L) provide examples of how multiple data sources can be used during digital forensics, including investigating worm infections, viruses, and email threats.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:

(A) resolve information conflicts and validate information through data acquisition, research, and comparison; and

(B) examine and analyze network traffic data, including identifying events of interest, examining data sources, and identifying attacks.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) identify and use digital information appropriately;

(B) identify and use appropriate methods for citing sources;

(C) identify and discuss intellectual property laws, issues, and use;

(D) identify intellectual property stakeholders and their needs and perspectives;

(E) identify and describe the kinds of crimes investigated by digital forensics specialists;

(F) identify legal, illegal, ethical, and unethical aspects of information gathering;

(G) compare and contrast legal, illegal, ethical, and unethical information gathering methods and identify possible gray areas;

(H) identify and describe ways in which developing laws and guidelines affect digital forensics practices;

(I) identify and describe legal considerations and technical issues related to collecting network traffic data;

(J) identify and describe ways in which technological changes affect applicable laws; and

(K) identify and describe businesses and government agencies that use digital forensics.

(6) Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:

(A) demonstrate knowledge of and appropriately use operating systems, software applications, and communication and networking components;

(B) compare, contrast, and appropriately use various input, processing, output, and primary and secondary storage devices;

(C) make decisions regarding the selection, acquisition, and use of software, including its quality, appropriateness, effectiveness, and efficiency;

(D) demonstrate knowledge of data formats;

(E) demonstrate knowledge of networks, including the Internet, intranets, and extranets;

(F) compare and contrast non-volatile and volatile data;

(G) describe file basics, including file storage, file systems, and other types of storage media;

(H) describe file modification, including access and creation times;

(I) describe operating systems, including terminology and functions;

(J) describe technical procedures related to collecting operating system data;

(K) describe the significance to digital forensics of the Transmission Control Protocol/Internet Protocol (TCP/IP) model, including application, transport, IP, and hardware layers;

(L) describe the function and use of application components, including configurations settings, authentications, logs, application data, supporting files, and application architecture; and

(M) describe the functions and use of application types, including email, web usage, interactive communications, file sharing, document usage, security applications, and data concealment tools.

§126.37. Discrete Mathematics, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one-half to one credit for successful completion of this course. The required prerequisite for this course is Algebra II. This course is recommended for students in Grades 11 and 12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Discrete Mathematics provides the tools used in most areas of computer science. Exposure to the mathematical concepts and discrete structures presented in this course is essential in order to provide an adequate foundation for further study. Discrete Mathematics is generally listed as a core requirement for Computer Science majors. Course topics are divided into six areas: sets, functions, and relations; basic logic; proof techniques; counting basics; graphs and trees; and discrete probability. Mathematical topics are interwoven with computer science applications to enhance the students' understanding of the introduced mathematics. Students will develop the ability to see computational problems from a mathematical perspective. Introduced to a formal system (propositional

and predicate logic) upon which mathematical reasoning is based, students will acquire the necessary knowledge to read and construct mathematical arguments (proofs), understand mathematical statements (theorems), and use mathematical problem-solving tools and strategies. Students will be introduced to discrete data structures such as sets, discrete functions, and relations and graphs and trees. Students will also be introduced to discrete probability and expectations.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understanding by extending existing knowledge. The student is expected to:

(A) model algorithms and real-world situations using formal tools of symbolic logic;

(B) model computer science problems by using graphs and trees; and

(C) calculate the probabilities of events and expectations of random variables for such problems as games of chance.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:

(A) convert spoken language statements to appropriate statements in propositional logic;

(B) explain basic terminology of sets, functions, and relations;

(C) state the definition of the Master theorem;

(D) use the context of a particular application to interpret the meaning derived when computing the permutations and combinations of a set;

(E) interpret associated operations and terminology in context; and

(F) define and provide examples of logical equivalence, normal forms, validity, and modus ponens/modus tollens.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:

(A) construct truth tables for negation, conjunction, disjunction, implication, biconditional, and bit operators; and

(B) use truth tables to demonstrate propositional relations.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:

(A) analyze practical examples using appropriate models of sets, functions, and relations;

(B) compare and contrast tautology, contradiction, and contingency as related to propositional equivalences;

(C) compare and contrast examples and use of counterexamples, contrapositions, and contradictions;

(D) describe the appropriate use and limitations of predicate logic;

(E) apply formal methods of symbolic propositional and predicate logic;

(F) use formal logic proofs and logical reasoning to solve problems;

(G) outline the basic structure of proofs, including direct, indirect, contradiction, induction, existence, and constructive proofs;

(H) compare and contrast the types of problems best satisfied by direct, indirect, contradiction, induction, existence, and constructive proofs;

(I) relate mathematical induction to recursion and recursively defined structures;

(J) compare and contrast weak, strong, and structural induction, including when each is most appropriately used and examples of each;

(K) compare and contrast dependent and independent events;

(L) use recurrence equations to analyze algorithms and other practical problems;

(M) use counting techniques to analyze algorithms and other practical problems;

(N) apply probability tools to solve problems; and

(O) define, compare, and contrast simple graphs, multigraphs, and directed and undirected graphs using definitions, properties, and examples, including special cases.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) model ethical acquisition and use of digital information;

(B) demonstrate proper digital etiquette, responsible use of software, and knowledge of acceptable use policies; and

(C) investigate how the concepts of discrete mathematics are related to relevant problems and significant questions.

(6) Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:

(A) perform operations associated with sets, functions, and relations;

(B) apply basic counting principles, including cardinality and the pigeonhole principle;

(C) apply appropriate precedence when using logical operators;

(D) use appropriate strategies, including De Morgan's Laws, to identify propositional equivalences;

(E) identify and appropriately use predicates, existential and universal quantifiers, and valid arguments;

(F) identify possible applications of proofs, including evaluating algorithmic complexity;

(G) state and appropriately use the product and sum rules;

(H) compute permutations and combinations of a set;

(I) solve a variety of basic recurrence equations;

(J) apply the binomial theorem to independent events;

(K) apply Bayes' theorem to dependent events;

(L) demonstrate transversal methods for trees and graphs; and

(M) relate graphs and trees to data structures, algorithms, and counting.

§126.38. Game Programming and Design, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one-half to one credit for successful completion of this course. The required prerequisite for this course is Algebra I. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Game Programming and Design will foster student creativity and innovation by presenting students with opportunities to design, implement, and present meaningful programs through a variety of media. Students will collaborate with one another, their instructor, and various electronic communities to solve gaming problems. Through data analysis, students will include the identification of task requirements, plan search strategies, and use programming concepts to access, analyze, and evaluate information needed to design games. By acquiring programming knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will create a computer game that is presented to an evaluation panel.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understanding by extending existing knowledge. The student is expected to:

(A) understand the basic game design elements, including conceptual ideas, storyline, visualization, storyboard, game effects, sound elements, game play, game controls, and player tutorial;

(B) create a design concept document;

(C) create a storyboard;

(D) demonstrate an understanding of the fundamentals of game art, including the look and feel, graphics coordinate system, basics of color, and color palettes;

(E) use bitmap graphics images, including designing, creating, reading, and manipulating images;

(F) create backgrounds, including solid, image, and tiled backgrounds;

(G) write programs creating images using geometric shapes;

(H) create games using sprites by evaluating the role of sprites, creating sprites, and managing sprites;

(I) create programs using sprite sheets;

(J) demonstrate an understanding of image rendering, including transparency, refresh rate, hardware acceleration, and animation;

(K) find, create, and edit game audio sound effects and music; and

(L) implement game sound mechanics, including playing, pausing, and looping.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:

(A) design and implement procedures to set timelines for, track the progress of, and evaluate a game product;

(B) seek and respond to input from peers and professionals in evaluating a game project;

(C) demonstrate knowledge and appropriate use of operating systems, program development tools, and networking resources;

(D) use network resources to acquire, organize, maintain, and evaluate information;

(E) collaborate to research the business of games, including the roles of developer, marketing, publisher, and retail sales; and

(F) demonstrate an understanding of and evaluate online technology, including online interaction and massive multiplayer games.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:

(A) play board games to research and collect game play data;

(B) evaluate, analyze, and document game styles and playability; and

(C) research the dramatic elements in games, including kinds of fun, player types, and nonlinear storytelling.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:

(A) demonstrate an understanding of the game design process, including generating ideas, brainstorming, and paper prototyping;

(B) write programs using variables of different data types;

(C) evaluate game rules and instructions;

(D) demonstrate an understanding of the user experience by comparing rules and game-play patterns;

(E) write game rules and instructions;

(F) develop game software;

(G) write computer game code, resolve game defects, and revise existing game code; and

(H) test a finished game product by implementing sound testing techniques.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) explore intellectual property, privacy, sharing of information, copyright laws, and software licensing agreements;

(B) model ethical acquisition and use of digital information;

(C) demonstrate proper digital etiquette when using networks, responsible use of software, and knowledge of acceptable use policies;

(D) model respect of intellectual property, including manipulating graphics, morphing graphics, editing graphics, and editing sound;

(E) discuss and evaluate the social issues surrounding gaming; and

(F) evaluate the cultural aspects of game design fundamentals, including rationale for games and types of games.

(6) Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to game programming. The student is expected to:

(A) identify basic game components, including the game engine, game play subsystems, data structures, models, and interfaces;

(B) generate random numbers in a program;

(C) create a program implementing conditional statements;

(D) develop an appropriate data model;

(E) demonstrate an understanding of and apply object-oriented game programming;

(F) demonstrate an understanding of game programming essentials, including event-driven programming, communicating with messages, and device management;

(G) demonstrate an understanding of the role of game events, the animation loop, and game timing;

(H) demonstrate an understanding of the role of game engines;

(I) demonstrate an understanding of video display flicker and double buffering;

(J) apply basic game screen design and layout, including visual controls, user interfaces, menus, and options;

(K) use game control design to understand, access, and control input devices, including keyboard, mouse, and joystick;

(L) demonstrate an understanding of and apply game animation, including the principles of animation and frame-based animation;

(M) demonstrate an understanding of decision making and types of decisions;

(N) demonstrate an understanding of game events, including listeners, triggers, and timed events;

(O) demonstrate an understanding of and implement collision detection, including bounding boxes and sprite collisions;

(P) implement a tile-based game, including loading tile maps, drawing tile maps, rendering a tile map, and layering sprites;

(Q) demonstrate an understanding of artificial intelligence and develop and implement artificial intelligence;

(R) demonstrate an understanding of game balance and tuning; and

(S) demonstrate an understanding of player progression, including leveling, linear progression, and maintaining high score data.

§126.39. Mobile Application Development, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one-half to one credit for successful completion of this course. The required prerequisites for this course are proficiency in the knowledge and skills relating to Technology Applications, Grades 6-8, and Algebra I. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Mobile Application Development will foster students' creativity and innovation by presenting opportunities to design, implement, and deliver meaningful projects using mobile computing devices. Students will collaborate with one another, their instructor, and various electronic communities to solve problems presented throughout the course. Through data analysis, students will identify task requirements, plan search strategies, and use software development concepts to access, analyze, and evaluate information needed to program mobile devices. By using software design knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will gain an understanding of the principles of mobile application development through the study of development platforms, programming languages, and software design standards.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understanding by extending existing knowledge. The student is expected to:

(A) create effective user interfaces appropriate for a specified mobile device that is best suited for an identified purpose;

(B) create effective user interfaces for browser-based, native, and hybrid mobile applications;

(C) create mobile application components appropriate for identified needs;

(D) create browser-based applications for mobile devices;

(E) create native applications that can reside on specified mobile devices; and

(F) create mobile applications that combine native and hybrid components.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:

(A) demonstrate an understanding of and discuss how teams function;

(B) use teamwork to solve problems;

(C) describe the development workflow of mobile applications;

(D) use time-management techniques to develop and maintain work schedules, meet deadlines, and establish mobile application project criteria;

(E) describe a problem solution; and

(F) document and share problem solutions through various media.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:

(A) analyze, identify, and describe mobile application project stakeholders and their perspectives;

(B) collect and analyze available data to identify mobile application project requirements;

(C) analyze, identify, and describe input, output, and processing requirements; and

(D) analyze, identify, and define hardware and software specifications.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:

(A) compare and contrast design decisions based on the hardware considerations of a mobile device;

(B) compare and contrast available mobile technologies, including platforms and their operating systems;

(C) compare and contrast available development approaches, including application to specific technologies and platforms;

(D) determine the most appropriate solution for the development of a given mobile application, including browser-based, native, and hybrid approaches;

(E) compare and contrast available programming languages and how their use might be applied to specific technologies and platforms;

(F) identify and justify the selection of an appropriate programming language, including available resources and required interfaces;

(G) select an appropriate program development environment;

(H) identify and use available libraries;

(I) evaluate and justify the selection of appropriate options and components;

(J) compare and contrast available networks and their implications for mobile application development; and

(K) compare and contrast design strategies related to mobile network and device security.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) discuss copyright laws and issues;

(B) model ethical acquisition and use of digital information;

(C) cite sources using established methods;

(D) demonstrate proper digital etiquette and knowledge of acceptable use policies;

(E) investigate mobile device security measures such as passwords, virus detection, and virus prevention;

(F) describe potential risks and benefits associated with the use of a mobile application;

(G) identify current and emerging technologies related to mobile applications; and

(H) evaluate technologies and assess their applicability to current mobile applications.

(6) Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:

(A) demonstrate an understanding of the difference between desktop and mobile applications;

(B) demonstrate an understanding of hardware and software structures and requirements in the design of mobile applications;

(C) recognize multiple platforms and demonstrate an understanding of their associated requirements;

(D) recognize various program development environments;

(E) demonstrate an understanding of event-based programming and its appropriate use;

(F) describe how memory management affects mobile application design;

(G) demonstrate an understanding of how low bandwidth and the mobility of a device affect the design of mobile applications;

(H) identify applications that are best suited for mobile devices;

(I) demonstrate an understanding of the use of libraries when designing mobile applications;

(J) use a simulation tool to emulate a mobile device's functionality; and

(K) use actual mobile devices to test mobile applications.

§126.40. Robotics Programming and Design, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one-half to one credit for successful completion of this course. The prerequisite for this course is proficiency in the knowledge and skills relating to Technology Applications, Grades 6-8. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Robotics Programming and Design will foster students' creativity and innovation by presenting opportunities to design, implement, and present meaningful robotic programs through a variety of media. Students will collaborate with one another, their instructor, and various electronic communities to solve problems in designing and programming robots. Through data analysis, students will identify task requirements, plan search strategies, and use robotic concepts to access, analyze, and evaluate information needed to solve problems. By using robotic knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will gain an understanding of the principles of robotics through the study of physics, robotics, automation, and engineering design concepts.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student develops products and generates new understanding by extending existing knowledge. The student is expected to:

(A) produce a prototype;

(B) present a prototype using a variety of media;

(C) use the design process to construct a robot;

(D) refine the design of a robot;

(E) build robots of simple, moderate, and advanced complexity;

(F) improve a robot design to meet a specified need;

(G) demonstrate an understanding of and create artificial intelligence in a robot; and

(H) create behavior-based control algorithms.

(2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:

(A) demonstrate an understanding of and implement design teams;

(B) use design teams to solve problems;

(C) serve as a team leader and a team member;

(D) describe a problem and identify design specifications;

(E) design a solution to a problem and share a solution through various media;

(F) document prototypes, adjustments, and corrections in the design process;

(G) document a final design and solution; and

(H) present a final design, testing results, and solution.

(3) Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:

(A) test and evaluate a robot design;

(B) implement position tracking to complete assigned robot tasks;

(C) develop solution systems and implement systems analysis;

(D) modify a robot to respond to a change in specifications; and

(E) implement a system to identify and track all components of a robot.

(4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:

(A) develop algorithms to control a robot, including applying instructions, collecting sensor data, and performing simple tasks;

(B) create maneuvering algorithms to physically move the location of a robot;

(C) create algorithms that provide interaction with a robot;

(D) demonstrate an understanding of and use output commands, variables, and sequence programming structure;

(E) demonstrate an understanding of and use jumps, loops, and selection programming structures;

(F) demonstrate an understanding of and use subroutines, accessors, and modifiers; and

(G) apply decision-making strategies when developing solutions.

(5) Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:

(A) discuss intellectual property, privacy, sharing of information, copyright laws, and software licensing agreements;

(B) demonstrate proper digital etiquette, responsible use of software, and knowledge of acceptable use policies; and

(C) explore the effects robots have on changing our culture and society.

(6) Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:

(A) use tools and laboratory equipment safely to construct and repair robots;

(B) identify and describe the steps needed to produce a prototype;

(C) use software applications to simulate robotic behavior, present design concepts, and test solution strategies;

(D) demonstrate the use of computers to manipulate a robot;

(E) demonstrate knowledge of process control design factors;

(F) demonstrate knowledge of different types of sensors used in robotics;

(G) demonstrate knowledge and use of effectors;

(H) implement multiple sensors in a robot;

(I) interpret sensor feedback and calculate threshold values;

(J) demonstrate knowledge of motors, gears, and gear trains used in a robot;

(K) implement infrared range sensing;

(L) apply measurement and geometry to calculate robot navigation;

(M) implement movement control using shaft encoding;

(N) demonstrate robot navigation;

(O) implement path planning using geometry and multiple sensor feedback;

(P) program a robot to perform simple tasks, including following lines, moving objects, and avoiding obstacles;

(Q) demonstrate and implement a robotic task solution using robotic arm construction;

(R) demonstrate knowledge of feedback control loops to provide information;

(S) demonstrate knowledge of torque and power factors used in the operation of a robot servo; and

(T) troubleshoot and maintain robotic systems and subsystems.

§126.41. Digital Design and Media Production, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. The prerequisite for this course is proficiency in the knowledge and skills relating to Technology Applications, Grades 6-8. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Digital Design and Media Production will allow students to demonstrate creative thinking, develop innovative strategies, and use communication tools in order to work effectively with others as well as independently. Students will gather information electronically, which will allow for problem solving and making informed decisions regarding media projects. Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect. Students will demonstrate a thorough understanding of digital design principles that is transferable to other disciplines.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student employs a creative design process to create original projects as they relate to purposes and audiences. The student is expected to:

(A) create designs for defined projects such as graphics, logos, and page layouts;

(B) apply design elements and typography standards; and

(C) use visual composition principles.

(2) Communication and collaboration. The student understands professional digital media communications strategies. The student is expected to:

(A) adapt the language and design of a project for audience, purpose, situation, and intent;

(B) organize oral, written, and graphic information into formal and informal publications;

(C) interpret and communicate information to multiple audiences; and

(D) collaborate to create original projects, including seeking and responding to advice from others such as peers or experts in the creation and evaluation process.

(3) Research and information fluency. The student uses a variety of strategies to plan, obtain, evaluate, and use valid information. The student is expected to:

(A) obtain print and digital information such as graphics, audio, and video from a variety of resources while citing the sources;

(B) evaluate information for accuracy and validity; and

(C) present accurate information using techniques appropriate for the intended audience.

(4) Critical thinking, problem solving, and decision making. The student implements problem-solving methods using critical-thinking skills to plan, implement, manage, and evaluate projects; solve problems; and make informed decisions using appropriate digital tools and resources. The student is expected to:

(A) employ critical-thinking and interpersonal skills to solve problems and make decisions through planning and gathering, interpreting, and evaluating data;

(B) identify and organize the tasks for completion of a project using the most appropriate digital tools;

(C) distinguish design requirements as they relate to the purposes and audiences of a project and apply appropriate design elements;

(D) seek and respond to input from others, including peers, teachers, and outside collaborators;

(E) evaluate a process and project both independently and collaboratively and make suggested revisions; and

(F) transfer critical-thinking, problem-solving, and decision-making processes when using new technologies.

(5) Digital citizenship. The student complies with standard practices and behaviors and upholds legal and ethical responsibilities. The student is expected to:

(A) examine copyright and fair use guidelines with regard to print and digital media;

(B) model ethical and legal acquisition and use of digital resources such as licensing and established methods of citing sources;

(C) demonstrate proper digital etiquette, personal security guidelines, use of network resources, and application of the district's acceptable use policy for technology; and

(D) identify and demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, listening attentively to speakers, willingness to learn new knowledge and skills, and pride in quality work.

(6) Technology operations and concepts. The student uses technology concepts, systems, and operations as appropriate for a project. The student is expected to:

(A) define the purpose of a product and identify the specified audience;

(B) demonstrate appropriate project management to:

(i) create a plan for a media project such as a storyboard, stage development, and identification of equipment and resources; and

(ii) evaluate design, content delivery, purpose, and audience throughout a project's timeline and make suggested revisions until completion of the project;

(C) use hardware, software, and information appropriate to a project and its audience to:

(i) acquire readily available digital information, including text, audio, video, and graphics, citing the sources;

(ii) create digital content through the use of various devices such as video camera, digital camera, scanner, microphone, interactive whiteboard, video capture, and musical instrument;

(iii) collaborate via online tools such as blogs, discussion boards, email, and online learning communities;

(iv) make decisions regarding the selection and use of software, taking into consideration operating system platform, quality, appropriateness, effectiveness, and efficiency;

(v) delineate and make necessary adjustments regarding compatibility issues, including digital file formats and cross-platform connectivity; and

(vi) demonstrate the ability to import and export elements from one program to another;

(D) use digital typography standards such as:

(i) one space after punctuation, the use of em- and en-dashes, and smart quotation marks;

(ii) categories of type, font, size, style, and alignment appropriate for the task;

(iii) type techniques such as drop cap, decorative letters, or embedded text frames as graphic elements;

(iv) leading and kerning, automatic text flow into linked columns, widows and orphans, and text wrap; and

(v) type measurement for inches and picas;

(E) apply design and layout principles and techniques to:

(i) incorporate the principles of design, including balance, contrast, dominant element, white space, consistency, repetition, alignment, and proximity;

(ii) apply the elements of design, including text, graphics, and white space;

(iii) apply color principles appropriate to the product in order to communicate the mood for the specific audience;

(iv) identify the parts of pages, including inside margin, outside margin, and gutter;

(v) create a master template, including page specifications and other repetitive elements; and

(vi) use style sheets, including a variety of type specifications such as typeface, style, size, alignment, indents, and tabs;

(F) demonstrate appropriate use of digital photography and editing to:

(i) use digital photography equipment to capture still-shot images that incorporate various photo composition techniques, including lighting, perspective, candid versus posed, rule of thirds, and filling the frame;

(ii) transfer digital images from equipment to the computer; and

(iii) demonstrate image enhancement techniques such as feathering, layering, color enhancement, and image selection using appropriate digital manipulation software;

(G) demonstrate appropriate use of videography equipment and techniques to:

(i) use digital photography equipment to capture video that incorporates video principles such as lighting, zooming, panning, and stabilization;

(ii) transfer video from equipment to the computer;

(iii) demonstrate videographic enhancement and editing techniques such as transitions, zooming, content editing, and synchronizing audio and video using appropriate digital manipulation software; and

(iv) export video in digital formats to be used in various delivery systems such as podcasting, downloadable media, embedding, and streaming; and

(H) deploy digital media into print, web, and video products to:

(i) produce digital files in various formats such as portable document format (PDF), portable network graphics (PNG), and HyperText Markup Language (HTML);

(ii) publish integrated digital content such as video, audio, text, graphics, and motion graphics following appropriate digital etiquette standards;

(iii) publish and share projects using online methods such as social media and collaborative sites;

(iv) incorporate various digital media into a printed document such as a newsletter, poster, or report;

(v) use printing options such as tiling, color separations, and collation; and

(vi) collect and organize student-created products to build an individual portfolio.

§126.42. Digital Art and Animation, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. The prerequisite for this course is proficiency in the knowledge and skills relating to Technology Applications, Grades 6-8. The recommended prerequisite is Art, Level I. This course is recommended for students in Grades 9-12. This course satisfies the high school fine arts graduation requirement.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of the six strands in technology applications, students will develop college readiness skills applied to technology, including terminology, concepts, and strategies. Students will communicate information in different formats and to diverse audiences using a variety of technologies. Students will learn the efficient acquisition of information using search strategies and using technology to access, analyze, and evaluate the acquired information. Students will learn to make informed decisions about technologies and their applications. By using technology as a tool that supports the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results.

(3) Digital Art and Animation consists of computer images and animations created with digital imaging software. Digital Art and Animation has applications in many careers, including graphic design, advertising, web design, animation, corporate communications, illustration, character development, script writing, storyboarding, directing, producing, inking, project management, editing, and the magazine, television, film, and game industries. Students in this course will produce various real-world projects and animations.

(4) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student demonstrates creative thinking, constructs knowledge, and develops innovative products and processes using technology. The student is expected to:

(A) evaluate, edit, and create scripts for animations;

(B) identify and apply color theories, including harmony rules, tints, shades, gradients, color mixing, new color creation, and the visual impacts of specific color combinations using a digital format;

(C) compare, contrast, and integrate the basic sound editing principles, including mixing and manipulating wave forms, audio tracks, and effects;

(D) compare and contrast the rules of composition such as the rule of thirds or the golden section/rectangle with respect to harmony and balance;

(E) evaluate the fundamental concepts of a digital art and design such as composition, perspective, angles, lighting, repetition, proximity, white space, balance, and contrast;

(F) analyze digital art designs to interpret the point of interest, the prominence of the subject, and visual parallels between the structures of natural and human-made environments;

(G) distinguish among typefaces while recognizing and resolving conflicts that occur through the use of typography as a design element;

(H) use perspective, including backgrounds, light, shades and shadows, hue and saturation, and scale, to capture a focal point and create depth;

(I) use the basic principles of design such as proportion, balance, variety, emphasis, harmony, symmetry, and unity in type, color, size, line thickness, shape, and space;

(J) edit files using appropriate digital editing tools and established design principles such as consistency, repetition, alignment, proximity, white space, image file size, color use, and font size, type, and style; and

(K) identify pictorial qualities in a design such as shape and form, space and depth, or pattern and texture to create visual unity and desired effects in designs.

(2) Communication and collaboration. The student uses digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning experience of others. The student is expected to:

(A) use vocabulary as it relates to digital art, audio, and animation;

(B) demonstrate the use of technology to participate in self-directed and collaborative activities within the global community;

(C) participate in electronic communities;

(D) create technology specifications for tasks and rubrics for the evaluation of products;

(E) design and implement procedures to track trends, set timelines, and evaluate products;

(F) collaborate with peers in delineating technological tasks;

(G) publish and save information in a variety of ways, including print or digital formats;

(H) analyze and evaluate projects for design, content delivery, purpose, and audience; and

(I) critique original digital artwork, portfolios, and products with peers.

(3) Research and information fluency. The student applies digital tools to gather, evaluate, and use information. The student is expected to:

(A) distinguish between and correctly apply process color (RGB and CYMK), spot color, and black or white;

(B) research the history of digital art and animation;

(C) research career choices in digital art and animation;

(D) use the Internet to retrieve information in an electronic format;

(E) demonstrate the appropriate use of digital imaging, video integration, and sound retrieved from an electronic format;

(F) import sounds from a variety of sources; and

(G) create planning designs such as rough sketches, storyboards, and brainstorming materials.

(4) Critical thinking, problem solving, and decision making. The student uses critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. The student is expected to:

(A) distinguish between and use the components of animation software programs such as cast, score, stage, and the animation manipulation interface;

(B) distinguish between and use different animation techniques such as path and cell animation, onion skinning, and tweening;

(C) create three-dimensional effects by layering images such as foreground, middle distance, and background images;

(D) apply a variety of color schemes such as monochromatic, analogous, complementary, primary/secondary triads, cool/warm colors, and split complements to digital designs;

(E) use the basic concepts of color and design theory such as working in a bitmapped and vector mode to create backgrounds, characters, and other cast members as needed for the animation;

(F) use the appropriate scripting language or program code to create an animation;

(G) use a variety of lighting techniques such as shadows and shading to create effects; and

(H) define the design attributes and requirements of products created for a variety of purposes such as posters, billboards, logos, corporate identity, advertisements, book jackets, brochures, and magazines.

(5) Digital citizenship. The student understands human, cultural, and societal issues related to technology and practices legal and ethical behavior. The student is expected to:

(A) discuss copyright laws/issues and use of digital information such as attributing ideas and citing sources using established methods;

(B) define plagiarism and model respect of intellectual property;

(C) demonstrate proper digital etiquette and knowledge of acceptable use policies when using technology; and

(D) evaluate the validity and reliability of sources.

(6) Technology operations and concepts. The student demonstrates a sound understanding of technology concepts, systems, and operations. The student is expected to:

(A) demonstrate knowledge and appropriate use of operating systems, software applications, and communication and networking components;

(B) make decisions regarding the selection and use of software and Internet resources;

(C) make necessary adjustments regarding compatibility issues with digital file formats, importing and exporting data, and cross-platform compatibility; and

(D) read, use, and develop technical documentation.

§126.43. 3-D Modeling and Animation, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. The prerequisite for this course is proficiency in the knowledge and skills relating to Technology Applications, Grades 6-8. The recommended prerequisite is Art, Level I. This course is recommended for students in Grades 9-12. This course satisfies the high school fine arts graduation requirement.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of the six strands in technology applications, students will develop college readiness skills applied to technology, including terminology, concepts, and strategies. Students will learn to make informed decisions about technologies and their applications. Students will learn the efficient acquisition of information using search strategies and the use of technology to access, analyze, and evaluate acquired information. By using technology as a tool that supports the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate results. Students will communicate information in different formats and to diverse audiences using a variety of technologies. Students will analyze and evaluate the results.

(3) 3-D Modeling and Animation consists of computer images created in a virtual three-dimensional (3-D) environment. 3-D Modeling and Animation has applications in many careers, including criminal justice, crime scene, and legal applications; construction and architecture; engineering and design; and the movie and game industries. Students in this course will produce various 3-D models of real-world objects.

(4) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student demonstrates creative thinking, constructs knowledge, and develops innovative products and processes using technology. The student is expected to:

(A) evaluate, edit, and create scripts for animations;

(B) identify and apply color theories, including harmony rules, tints, shades, gradients, color mixing, new color creation, and the visual impacts of specific color combinations using a digital format;

(C) apply texture, transparency, skinning, and contour along a 3-D object surface;

(D) compare, contrast, and integrate the basic sound editing principles, including mixing and manipulating wave forms, audio tracks, and effects;

(E) compare and contrast the rules of composition such as the rule of thirds or the golden section/rectangle with respect to harmony and balance;

(F) evaluate the fundamental concepts of 3-D modeling and design such as composition, perspective, angles, lighting, repetition, proximity, white space, balance, and contrast;

(G) analyze 3-D model objects to interpret the point of interest, the prominence of the subject, and visual parallels between the structures of natural and human-made environments;

(H) distinguish among typefaces while recognizing and resolving conflicts that occur through the use of typography as a design element;

(I) use perspective, including spot and directional light, backgrounds, ambience, shades and shadows, and hue and saturation;

(J) use the basic principles of design such as proportion, balance, variety, emphasis, harmony, symmetry, and unity in type, color, size, line thickness, shape, and space;

(K) edit files using appropriate digital editing tools and established design principles such as consistency, repetition, alignment, proximity, white space, image file size, color use, font size, type, and style; and

(L) identify pictorial qualities in a design such as shape and form, space and depth, or pattern and texture to create visual unity and desired effects in designs.

(2) Communication and collaboration. The student uses digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning experience of others. The student is expected to:

(A) use vocabulary as it relates to digital art, audio, and animation;

(B) demonstrate the use of technology to participate in self-directed and collaborative activities within the global community;

(C) participate in electronic communities;

(D) create technology specifications for tasks and rubrics for the evaluation of products;

(E) design and implement procedures to track trends, set timelines, and evaluate products;

(F) collaborate with peers in delineating technological tasks;

(G) publish and save information in a variety of ways, including print or digital formats;

(H) analyze and evaluate projects for design, content delivery, purpose, and audience; and

(I) critique original 3-D digital artwork, portfolios, and products with peers.

(3) Research and information fluency. The student applies digital tools to gather, evaluate, and use information. The student is expected to:

(A) distinguish among and correctly apply process color (RGB and CYMK), spot color, and black or white;

(B) research the history of 3-D modeling and 3-D animation;

(C) research career choices in 3-D modeling and 3-D animation;

(D) use the Internet to retrieve information in an electronic format;

(E) demonstrate the appropriate use of 3-D objects, digital imaging, video integration, and sound retrieved from an electronic format;

(F) import sounds from a variety of sources; and

(G) create planning designs such as rough sketches, storyboards, and brainstorming materials.

(4) Critical thinking, problem solving, and decision making. The student uses critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. The student is expected to:

(A) distinguish between and use the components of 3-D animation software programs such as cast, score, environment, the X-Y-Z coordinate system, and the animation manipulation interface;

(B) distinguish between and use the different 3-D modeling techniques such as box modeling, transformation, and polygon primitives using extrusion and rotation;

(C) distinguish between and use the different 3-D animation techniques such as path and rendering using dynamics and physics;

(D) apply a variety of color schemes such as monochromatic, analogous, complementary, primary/secondary triads, cool/warm colors, and split complements to digital designs;

(E) use the basic concepts of color and design theory such as working with 3-D models and environments, characters, objects, and other cast members as needed for the animation;

(F) use the appropriate rendering techniques to create an animation;

(G) use a variety of lighting techniques such as shadow, shading, point, spot, directional, and ambient to create effects; and

(H) define the design attributes and requirements of a 3-D animation project.

(5) Digital citizenship. The student understands human, cultural, and societal issues related to technology and practices legal and ethical behavior. The student is expected to:

(A) discuss copyright laws/issues and use of digital information such as attributing ideas and citing sources using established methods;

(B) define plagiarism and model respect of intellectual property;

(C) demonstrate proper digital etiquette and knowledge of acceptable use policies when using technology; and

(D) evaluate the validity and reliability of sources.

(6) Technology operations and concepts. The student demonstrates a sound understanding of technology concepts, systems, and operations. The student is expected to:

(A) demonstrate knowledge and appropriate use of operating systems, software applications, and communication and networking components;

(B) make decisions regarding the selection and use of software and Internet resources;

(C) make necessary adjustments regarding compatibility issues with digital file formats, importing and exporting data, and cross-platform compatibility; and

(D) read, use, and develop technical documentation.

§126.44. Digital Communications in the 21st Century, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. The prerequisite for this course is proficiency in the knowledge and skills relating to Technology Applications, Grades 6-8. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of the six strands in technology applications, students will support and manage the work of individuals and groups to create products to inform and promote their proposed solutions using appropriate communication skills and methods of delivery. Students will learn to make informed decisions using digital tools and appropriate applications. By using online research and information resources such as journals, newspapers, or authoritative databases, students will synthesize knowledge; create solutions; and evaluate the results for authentic, real-world local, state, national, and global issues.

(3) Digital Communications in the 21st Century will prepare students for the societal demands of increased civic literacy, independent working environments, global awareness, and the mastery of a base set of analysis and communication skills. Students will be expected to design and present an effective product based on well-researched issues in order to thoughtfully propose suggested solutions to authoritative stakeholders. The outcome of the process and product approach is to provide students an authentic platform to demonstrate effective application of multimedia tools within the contexts of global communication and collaborative communities and appropriately share their voices to affect change that concerns their future.

(4) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student demonstrates the ability to analyze, evaluate, and adapt during the creative problem-solving process and demonstrates creative thinking in developing solutions to real-world issues using digital tools. The student is expected to:

(A) generate innovative, sustainable solutions for real-world issues such as global warming, immigration, or the global economy using emerging digital tools;

(B) gather and evaluate accurate information for feasibility and practicality as a basis for making communication decisions; and

(C) analyze the ethical and social responsibilities as a project team when communicating with peers, stakeholders, and experts.

(2) Creativity and innovation. The student uses innovative thinking to develop new ideas and processes for solving real-world issues and conveying those ideas to a global audience through a persuasive digital product. The student is expected to:

(A) examine real-world issues relating to current topics such as health care, government, business, or aerospace;

(B) develop innovative solutions to address issues;

(C) create unique methods and products conveying solutions to audiences beyond the classroom such as school officials, non-profit organizations, higher education officials, government, or other stakeholders;

(D) demonstrate the effective use and importance of verbal and nonverbal communication skills when presenting ideas and solutions to diverse audiences; and

(E) use appropriate techniques to manage communication apprehension, build self-confidence, and gain command of information.

(3) Communication and collaboration. The student develops a process to effectively communicate with peers, experts, and other audiences about current issues and solutions to global problems. The student is expected to:

(A) demonstrate innovative uses of a wide range of emerging technologies, including online learning, mobile devices, digital content, and Web 2.0 tools such as podcasting, wikis, and blogs;

(B) participate within appropriate electronic communities as a learner, initiator, and contributor;

(C) extend the learning environment beyond the school walls using appropriate digital tools;

(D) collaborate with a variety of field experts;

(E) prepare for, organize, and participate in an informative or persuasive group discussion with an audience; and

(F) participate appropriately in conversations by making clear requests, giving accurate directions, and asking purposeful questions.

(4) Communication and collaboration. The student uses digital tools to facilitate collaboration and communication in the design, development, and evaluation of products offering solutions to real-world issues. The student is expected to:

(A) design and organize resources to create an effective collaborative working environment that enables a group to investigate a local, state, national, or global issue;

(B) analyze and evaluate effective communication;

(C) demonstrate leadership by managing project activities such as timelines, research, product development, marketing material, and effective communication skills;

(D) demonstrate effective management of diverse peer-group dynamics such as solving problems, managing conflicts, and building consensus; and

(E) evaluate original products for accuracy, validity, and compliance with copyright laws.

(5) Research and information fluency. The student uses a variety of strategies to acquire and evaluate information relating to real-world issues. The student is expected to:

(A) locate authoritative information from primary and secondary sources such as field experts, online full-text databases, or current news databases;

(B) make decisions regarding the selection, acquisition, and use of information gathered, taking into consideration its quality, appropriateness, effectiveness, and level of interest to society; and

(C) demonstrate fluency in the use of a variety of electronic sources such as cloud computing, emerging collaboration technologies, data mining strategies, and mobile or other technologies.

(6) Research and information fluency. The student uses a variety of digital tools to synthesize information related to real-world issues in student-created materials. The student is expected to:

(A) construct real-world informational materials that inform, persuade, or recommend reform of selected issues;

(B) identify and employ a method to evaluate the design, functionality, and accuracy of the student-created materials; and

(C) use effective strategies to organize and outline presentations to support and clarify points.

(7) Critical thinking, problem solving, and decision making. The student uses critical-thinking skills to conduct research, manage products, solve problems, and make informed decisions for real-world local, state, national, and global issues. The student is expected to:

(A) identify and define authentic problems and significant questions for investigation;

(B) design and implement procedures to track trends, set timelines, and review and evaluate progress for project completion;

(C) read and use technical documentation, including appropriate help options, to complete tasks; and

(D) analyze the audience, occasion, and purpose when designing presentations.

(8) Critical thinking, problem solving, and decision making. The student creates a product presenting solutions for real-world local, state, national, and global issues. The student is expected to:

(A) create technology specifications for tasks and rubrics to evaluate products and product quality against established criteria;

(B) resolve information conflicts and validate information by comparing data;

(C) represent diverse perspectives in problem solutions; and

(D) prepare and use visual or auditory aids such as scripts, notes, or digital applications to enhance presentations.

(9) Digital citizenship. The student examines ethical and legal behavior to demonstrate leadership as a digital citizen. The student is expected to:

(A) model safe and ethical use of digital information;

(B) model respect of intellectual property when manipulating, morphing, or editing graphics, video, text, and sound;

(C) use technology applications in a positive manner that supports productivity, collaboration, and continuing education; and

(D) use professional etiquette and protocol in situations such as making introductions, offering and receiving criticism, and communicating with digital tools.

(10) Digital citizenship. The student demonstrates ethical and legal behavior in the creation of student products. The student is expected to:

(A) use collaborative tools and strategies; and

(B) use digital tools to correctly document sources such as in bibliographies or works cited.

(11) Technology operations and concepts. The student makes decisions regarding the selection, acquisition, and use of digital tools in a multimedia classroom/lab, taking into consideration the quality, appropriateness, effectiveness, and efficiency of the tools. The student is expected to:

(A) determine the most appropriate file type based on universally recognized file formats such as portable document format (PDF), text format (TXT), rich text format (RTF), and Joint Photographic Experts Group format (JPEG);

(B) use compression schemes for photo, animation, video, and graphics; and

(C) distinguish among appropriate color, sound, and design principles such as consistency, repetition, alignment, proximity, and ratio of text to white space.

(12) Technology operations and concepts. The student demonstrates knowledge through various cloud and network technologies such as web-based interactive presentations, document sharing, and online scholarly databases. The student is expected to:

(A) use necessary vocabulary related to digital tools;

(B) retrieve and discriminate between authoritative and non-authoritative data sources; and

(C) adopt, adapt, and transfer prior knowledge to multiple situations when retrieving, manipulating, and creating original digital projects.

§126.45. Digital Video and Audio Design, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. This course is recommended for students in Grades 11 and 12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student applies academic knowledge and skills in audio and video projects. The student is expected to:

(A) apply English language arts knowledge and skills by demonstrating the use of appropriate technical concepts;

(B) apply English language arts knowledge and skills by demonstrating the use of vocabulary and correct grammar and punctuation to write and edit documents; and

(C) incorporate knowledge of mathematics by determining a feasible resolution and aspect ratio to keep a file.

(2) Creativity and innovation. The student understands and examines problem-solving methods. The student is expected to employ critical-thinking and interpersonal skills independently and in teams to solve problems.

(3) Creativity and innovation. The student applies information technology applications. The student is expected to:

(A) use personal information management, email, Internet, writing and publishing, presentation, and spreadsheet or database applications for audio or video production projects;

(B) demonstrate an understanding of the impact of participation in videoconferencing and other social network environments; and

(C) demonstrate an understanding of the responsibility of digital publications in social network environments.

(4) Creativity and innovation. The student understands design systems. The student is expected to analyze and summarize the history and evolution of audio and video production fields.

(5) Communication and collaboration. The student understands professional communication strategies. The student is expected to:

(A) adapt language such as structure and style for audience, purpose, situation, and intent;

(B) organize oral and written information;

(C) interpret and communicate information, data, and observations;

(D) present formal and informal presentations;

(E) apply active listening skills;

(F) listen to and speak with diverse individuals;

(G) exhibit public relations skills;

(H) employ leadership skills;

(I) employ collaborative and conflict-management skills;

(J) conduct and participate in meetings; and

(K) employ mentoring skills.

(6) Research and information fluency. The student understands the pre-production process. The student is expected to:

(A) identify critical elements in the pre-production stage, including design procedures, timeline development, technology specifications, scripting techniques, and budgeting procedures;

(B) analyze script and storyboard development processes for a successful production;

(C) identify and participate in the team roles required for completion of a production;

(D) identify equipment, crew, and cast requirements for a scripted production; and

(E) understand the casting or audition process.

(7) Critical thinking, problem solving, and decision making. The student develops employability characteristics. The student is expected to:

(A) identify and participate in training, education, or certification required for employment;

(B) identify and demonstrate positive work behaviors and personal qualities needed to be employable;

(C) demonstrate skills related to seeking and applying for employment;

(D) create a video portfolio to document work experiences, licenses, certifications, and work samples;

(E) demonstrate skills in evaluating and comparing employment opportunities; and

(F) examine employment opportunities in entrepreneurship.

(8) Digital citizenship. The student applies ethical decision making and complies with laws regarding the use of technology in audio and video production. The student is expected to:

(A) exhibit ethical conduct related to interacting with others and provide proper credit for ideas;

(B) discuss and apply copyright laws in relation to fair use and acquisition;

(C) discuss what defines intellectual property and how to show appropriate respect;

(D) analyze the ethical impact of the audio and video production industry on society;

(E) implement personal and workplace safety rules and regulations;

(F) follow emergency procedures; and

(G) examine and summarize safety-related problems that may result from working with electrical circuits.

(9) Technology operations and concepts. The student develops a basic understanding of the history, current practice, future trends, and procedural protocols in the use of audio and video production. The student is expected to:

(A) explain the origin and evolution of audio, video, and film;

(B) describe how changing technology impacts the digital society;

(C) define terminology associated with the industry;

(D) apply knowledge of audio and video script production;

(E) discuss the impact of audio and video selection on human emotion;

(F) demonstrate the use of audio and video for a three-screen environment, including cell phones, television monitors, and computer screens;

(G) demonstrate various videography techniques, including picture composition, video composition, audio composition, editing, and delivery;

(H) understand the differences in linear and nonlinear systems;

(I) demonstrate knowledge of control peripherals for capturing or ingesting media;

(J) demonstrate the skills needed to create special lighting, animation, and voice-over effects with appropriate resources; and

(K) format digital information for effective communication for a defined audience with the use of appropriate camera perspectives, color techniques, and content selection.

(10) Technology operations and concepts. The student understands the post-production process. The student is expected to:

(A) select the appropriate evaluation and delivery formats such as a product evaluation rubric, job performance critique, and client and audience feedback survey; and

(B) deliver the product in a variety of media forms such as social networks, collaborative workspaces, and cloud environments.

§126.46. Web Communications, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one-half credit for successful completion of this course. This course is recommended for students in Grade 9.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts. This is an exploratory course in web communications.

(2) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student demonstrates creative thinking, constructs knowledge, and develops innovative products and processes using technology. The student is expected to:

(A) demonstrate proficiency in the use of local and online collaboration;

(B) create websites using web editors or web authoring programs;

(C) evaluate the accessibility and usability of original websites; and

(D) conceptualize possible technologies based on current technical trends.

(2) Communication and collaboration. The student uses digital technology to work collaboratively toward his or her own learning and the learning of others. The student is expected to:

(A) analyze and implement the proper and acceptable use of digital/virtual communications technologies such as instant messaging (IM), chat, email, and social networking;

(B) define and implement the acquisition, sharing, and use of files taking into consideration primary ownership and copyright;

(C) apply decisions regarding the selection, acquisition, and sharing of uniform resource locators (URLs) used in research, taking into consideration their quality, appropriateness, and effectiveness; and

(D) solve problems using critical-thinking strategies.

(3) Research and information fluency. The student applies digital tools to gather, evaluate, and use information. The student is expected to:

(A) verify the accuracy, validity, and currency of acquired information;

(B) conduct effective searches using Boolean operators;

(C) acquire and use appropriate vocabulary terms;

(D) cite sources appropriately using established methods;

(E) model ethical and legal acquisition of digital information following guidelines in the student code of conduct, including plagiarism and copyright laws;

(F) identify and discuss emerging technologies and their impact;

(G) understand Internet history and structure and how they impact current use; and

(H) demonstrate appropriate use of grammar, spelling, and vocabulary when creating original work.

(4) Critical thinking, problem solving, and decision making. The student uses critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. The student is expected to:

(A) demonstrate the transfer and adaptation of knowledge through the creation of original work;

(B) evaluate and implement security measures such as firewalls and Hypertext Transfer Protocol Secure (HTTPS) to protect original work;

(C) analyze and follow timelines needed to create, edit, and present original work;

(D) verify current licensing issues for software being used for the creation of original work;

(E) identify and evaluate the design and functionality of web pages using rubrics;

(F) optimize web information for fast download such as dial-up and high speed Internet and mobile devices; and

(G) evaluate original work through self-, peer, and professional review of websites.

(5) Digital citizenship. The student understands human, cultural, and societal issues related to technology and practices legal and ethical behavior. The student is expected to:

(A) engage in online activities that follow appropriate behavioral, communication, and privacy guidelines, including ethics, personal security, and verbiage determined by the intended audience;

(B) understand the negative impact of inappropriate technology use, including online bullying and harassment;

(C) implement online security guidelines, including identity protection, limited personal information sharing, and password protection of a secure website; and

(D) advocate and practice safe, legal, and responsible use of information and technology.

(6) Technology operations and concepts. The student demonstrates a sound understanding of technology concepts, systems, and operations. The student is expected to:

(A) demonstrate knowledge of hardware such as scanners, cameras, printers, video cameras, and external hard drives;

(B) identify the parts of a computer and explain their functions;

(C) summarize the need, functionality, and use of servers;

(D) identify the advantages and disadvantages of running a personal web server versus using a web server provider;

(E) differentiate and appropriately use various input, processing, output, and primary/secondary storage devices;

(F) create and implement universally accessible documents;

(G) analyze bandwidth issues as they relate to audience, servers, connectivity, and cost;

(H) establish a folder/directory hierarchy for storage of a web page and its related or linked files;

(I) follow file and folder naming conventions, including spacing, special characters, and capitalization; and

(J) identify basic design principles when creating a website.

§126.47. Web Design, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. This course is recommended for students in Grades 9-12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts. This is an introductory course in web design.

(2) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student demonstrates creative thinking, constructs knowledge, and develops innovative products and processes using technology. The student is expected to:

(A) demonstrate proficiency in local and online collaboration;

(B) create a website using web editors and web authoring programs;

(C) evaluate the accessibility and usability of an original website as it relates to a target audience;

(D) conceptualize new possible technologies based on current technical trends;

(E) analyze the use of virtualization such as virtual classrooms, distance learning, virtual storage, and a virtual operating system;

(F) demonstrate knowledge and appropriate use of operating systems, software applications, and communication and networking components; and

(G) make decisions regarding the selection, acquisition, and use of software, taking into consideration its quality, appropriateness, effectiveness, and efficiency.

(2) Communication and collaboration. The student uses digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning experience of others. The student is expected to:

(A) analyze and implement the proper and acceptable use of digital/virtual communications technologies such as instant messaging (IM), chat, email, and social networking;

(B) define and implement the acquisition, sharing, and use of files, taking into consideration their primary ownership and copyright;

(C) apply decisions regarding the selection, acquisition, and sharing of uniform resource locators (URLs) used in research, taking into consideration their quality, appropriateness, and effectiveness;

(D) solve problems using critical-thinking strategies; and

(E) compare, evaluate, and implement the use of wired versus wireless access.

(3) Research and information fluency. The student applies digital tools to gather, evaluate, and use information. The student is expected to:

(A) verify the accuracy, validity, and currency of acquired information;

(B) conduct effective searches with Boolean operators;

(C) acquire and use appropriate vocabulary terms;

(D) cite sources appropriately using established methods;

(E) model ethical and legal acquisition of digital information following guidelines in the student code of conduct, including plagiarism and copyright laws;

(F) identify and discuss emerging technologies and their impact;

(G) understand Internet history and structure and how they impact current use;

(H) demonstrate appropriate use of grammar, spelling, and vocabulary when creating original work;

(I) acquire, evaluate, and use various web standards such as World Wide Web Consortium (W3C), Ecma International, and Internet Corporation for Assigned Names and Numbers (ICANN) to make informed decisions and implement standards in original work;

(J) understand, analyze, and use interactive websites;

(K) understand, evaluate, and determine the appropriate use of dynamic and static websites;

(L) understand, evaluate, and determine the appropriate use of open/closed source file formats and software;

(M) explain and demonstrate how search engines work such as advanced options, preferences, advertising, and search categories;

(N) evaluate, create, and apply principles of project management, including web storyboards, site maps, job duties, time constraints, group dynamics, communication interaction, and project completion, evaluation, and feedback;

(O) understand the use and application of a virtual private network (VPN);

(P) distinguish among protocols, including Hypertext Transfer Protocol (HTTP) and File Transfer Protocol (FTP);

(Q) summarize the technical needs of a World Wide Web server, including random access memory (RAM), hard disk capacity, central processing unit (CPU) speed, busses, methods of connectivity, and appropriate software;

(R) demonstrate proficiency in the use of a variety of electronic input devices such as keyboard, scanner, voice/sound recorder, mouse, touch screen, or digital video by incorporating such components while publishing web pages;

(S) demonstrate proper digital etiquette and knowledge of acceptable use policies when using networks, especially resources on the Internet and intranets;

(T) demonstrate proficiency in and appropriate use and navigation of local area networks (LANs), wide area networks (WANs), the Internet, and intranets for research and resource sharing;

(U) construct appropriate search strategies in the acquisition of information from the Internet, including keyword searches and searches with Boolean operators; and

(V) acquire information in electronic formats, including text, audio, video, and graphics, citing the source.

(4) Critical thinking, problem solving, and decision making. The student uses critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. The student is expected to:

(A) demonstrate the transfer and adaptation of knowledge through the creation of original work;

(B) evaluate and implement security measures to protect original work such as firewalls and Hypertext Transfer Protocol Secure (HTTPS);

(C) analyze and follow timelines needed to create, edit, and present original work;

(D) verify current licensing issues for software being used for the creation of original work;

(E) identify and evaluate the design and functionality of web pages using rubrics;

(F) optimize web information for fast download such as dial-up and high speed Internet and mobile devices;

(G) evaluate original work through self-, peer, and professional review of websites;

(H) evaluate the types, functions, and target audiences of websites;

(I) read, use, and develop technical documents;

(J) analyze, examine, assess, and decide on servers as they relate to the management of a website;

(K) analyze, examine, assess, and decide on a web host;

(L) analyze, examine, assess, and decide on domain name acquisition and retention;

(M) evaluate the functionality of a website such as color scheme, grammar, technological constraints, age appropriateness, cross-platform usability, and user relevant criteria as it relates to an intended audience;

(N) identify software file formats and their characteristics and appropriate use;

(O) identify and apply search engine optimization (SEO) to ensure optimal website visibility;

(P) investigate and choose electronic security methods for a web server to protect from unauthorized access and negative intentions; and

(Q) draw conclusions from data gathered from electronic and telecommunication resources.

(5) Digital citizenship. The student understands human, cultural, and societal issues related to technology and practices legal and ethical behavior. The student is expected to:

(A) engage in online activities that follow appropriate behavioral, communication, and privacy guidelines, including ethics, personal security, verbiage determined by the intended audience, and ethical use of files and file sharing;

(B) understand the negative impact of inappropriate technology use, including online bullying and harassment;

(C) implement online security guidelines, including identity protection, limited personal information sharing, and password protection of a secure website;

(D) engage in safe, legal, and responsible use of information and technology;

(E) understand and respond to local, state, national, and global issues to ensure appropriate cross-browser and cross-platform usability;

(F) interpret, use, and develop a safe online shared computing environment;

(G) identify legal, ethical, appropriate, and safe website marketing practices;

(H) identify legal, ethical, appropriate, and safe multimedia usage, including video, audio, graphics, animation, and emerging trends;

(I) analyze the impact of the World Wide Web on society through research, interviews, and personal observation; and

(J) participate in relevant and meaningful activities in the larger community and society to create electronic projects.

(6) Technology operations and concepts. The student demonstrates a sound understanding of technology concepts, systems, and operations. The student is expected to:

(A) demonstrate knowledge of hardware, including scanners, cameras, printers, video cameras, and external hard drives;

(B) identify the parts of a computer and explain its functions;

(C) summarize the need for and functionality and use of servers;

(D) identify the advantages and disadvantages of running a personal web server versus using a web server provider;

(E) differentiate and appropriately use various input, processing, output, and primary/secondary storage devices;

(F) create and implement universally accessible documents;

(G) analyze bandwidth issues as related to audience, server, connectivity, and cost;

(H) establish a folder/directory hierarchy for storage of a web page and its related or linked files;

(I) create file and folder naming conventions to follow established guidelines, including spacing, special characters, and capitalization;

(J) identify basic design principles when creating a website, including white space, color theory, background color, shape, line, proximity, unity, balance (ratio of text to white space), alignment, typography, font size, type, style, image file size, repetition, contrast, consistency, and aesthetics;

(K) demonstrate knowledge of the six core domains (gov, net, com, mil, org, edu) and be familiar with new domain implementation;

(L) implement escape codes, HyperText Markup Language (HTML), cascading style sheets (CSS), and javascript through hard coding, web editors, and web authoring programs;

(M) identify and use FTP client software;

(N) implement java applet insertion;

(O) identify and differentiate various network topologies, including physical and logical;

(P) create, evaluate, and use web-based animation;

(Q) create, evaluate, and use video, including editing, compression, exporting, appropriateness, and delivery;

(R) demonstrate the ability to conduct secure communications from a web server to a client; and

(S) use hypertext linking appropriately when creating web pages.

§126.48. Web Game Development, Beginning with School Year 2012-2013.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. The recommended prerequisite for this course is Web Design. This course is recommended for students in Grades 11 and 12.

(b) Introduction.

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student demonstrates creative thinking, constructs knowledge, and develops innovative products and processes using technology. The student is expected to:

(A) research, evaluate, and demonstrate appropriate design of a web-based gaming site;

(B) illustrate ideas for web artwork from direct observations, experiences, and imagination;

(C) create original designs for web applications; and

(D) demonstrate the effective use of art media to create original web designs.

(2) Communication and collaboration. The student uses digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning experience of others. The student is expected to:

(A) understand and evaluate the use and appropriateness of webinars;

(B) examine, discuss, and summarize interactive online learning environments;

(C) distinguish between distance learning, virtual learning, and online learning;

(D) define and evaluate Voice over Internet Protocol (VoIP);

(E) identify and apply end-user, peer, self-, and professional evaluations; and

(F) work collaboratively to create functioning programs and gaming products.

(3) Research and information fluency. The student applies digital tools to gather, evaluate, and use information. The student is expected to:

(A) research, evaluate, and create web forms for database processing;

(B) identify the various programming languages and differentiate among the available web programming languages;

(C) research, evaluate, and summarize content management systems (CMS);

(D) differentiate between Common Gateway Interface (CGI) and computer-generated imagery (CGI);

(E) discuss, analyze, and summarize streaming media/content and game broadcasting;

(F) define and evaluate instant messaging (IM) within a game environment;

(G) analyze and discuss the history of gaming;

(H) discuss, analyze, compare, and contrast game types such as action, action-adventure, adventure, construction and management simulation, life simulation, massively multiplayer online role-playing (MMORPG), music, party, puzzle, role-playing, sports, strategy, trivia, and vehicle simulation;

(I) discuss, analyze, compare, and contrast gaming hardware, including console, personal computer, mobile, and web;

(J) compare and contrast web standards versus browser-specific languages;

(K) research, evaluate, and summarize e-commerce;

(L) investigate career opportunities in programming, gaming, art, design, business, and marketing;

(M) research the characteristics of existing gaming websites to determine local, state, national, and global trends;

(N) compare and contrast historical and contemporary styles of art as applied to website development;

(O) compare and contrast the use of the art elements of color, texture, form, line, space, and value and the art principles of emphasis, pattern, rhythm, balance, proportion, and unity in personal web game artwork and the web game artwork of others, using vocabulary accurately;

(P) describe general characteristics in artwork from a variety of cultures that influence web game design;

(Q) research and evaluate emerging technologies; and

(R) research and evaluate augmented reality (the supplementing of reality with computer-generated imagery) such as heads-up display and virtual digital projectors.

(4) Critical thinking, problem solving, and decision making. The student uses critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. The student is expected to:

(A) select an appropriate web programming language based on given criteria;

(B) develop requirements for a database and determine the appropriate means to insert, delete, and modify records;

(C) develop Structured Query Language (SQL) statements to retrieve, insert, modify, and delete records in a database;

(D) design and create a flow diagram to plan a database, program, and game;

(E) define and identify proper use of gaming graphics, including skins, textures, environment appearance, environment mapping, raster graphics, and vector graphics;

(F) plan an animation that includes the movement of characters, camera movements, camera angles, user point of view, mechanics of motion, backgrounds, settings, ambient objects, and environments;

(G) compare and contrast two-dimensional (2-D) and three-dimensional (3-D) animation;

(H) develop and create a gaming storyboard and script that shows the overall development of a storyline;

(I) identify and implement graphic and game design elements, including color, environment, time to completion, difficulty, story complexity, character development, device control, backstory, delivery, and online player(s);

(J) design and create decision trees for a game's artificial intelligence engine;

(K) compare and contrast available audio formats for optimal delivery;

(L) identify the similarities and differences among platforms, including the application of coding on a personal computer, mobile device, and gaming console;

(M) research and identify existing online game development tools;

(N) evaluate and determine network requirements for the delivery of online games to end users; and

(O) create visual solutions by elaborating on direct observation, experiences, and imagination as they apply to original web design.

(5) Digital citizenship. The student understands human, cultural, and societal issues related to technology and practices legal and ethical behavior. The student is expected to:

(A) explain game ratings and why games fit into certain ratings;

(B) assess games and game ratings in terms of their impact on societal interactions;

(C) model the ethical and legal acquisition of digital information following copyright laws, fair-use guidelines, and the student code of conduct;

(D) define and practice the ethical and legal acquisition, sharing, and use of files taking into consideration their primary ownership and copyright;

(E) examine original web game artwork to comply with appropriate behavioral, communication, and privacy guidelines, including ethics, online bullying and harassment, personal security, appropriate audience language, ethical use of files/file sharing, technical documentation, and online communities;

(F) interpret, evaluate, and justify artistic decisions in the creation of original art for web game design; and

(G) analyze original web game artwork and digital portfolios created by peers and others to form precise conclusions about formal qualities, historical and cultural contexts, intents, and meanings.

(6) Technology operations and concepts. The student demonstrates a sound understanding of technology concepts, systems, and operations. The student is expected to:

(A) create a website that includes:

(i) an interactive database with elements such as SQL statements, Extensible Markup Language (XML), and Open Database Connectivity (ODBC);

(ii) javascript; and

(iii) server-side processing, including Common Gateway Interface (CGI); bitmap and vector graphics; database creation, modification, and deletion; creation and maintenance of user accounts; user authentication; and documentation;

(B) create a fully functional online game that includes:

(i) multiple game levels with increasing difficulty;

(ii) high-score ranking;

(iii) physics, including center of mass, collision detection, lighting, shading, perspective, anatomy, motion blur, lens flare, and reflections;

(iv) art principles, including color theory, texture, balance, lighting, shading, skinning, and drawing;
(v) graphics resolution, including pixel depth and compression;
(vi) database creation, modification, and deletion;
(vii) creation and maintenance of user accounts;
(viii) user authentication;
(ix) artificial intelligence;
(x) game-level saving;
(xi) mathematical functions;
(xii) varying camera angles;
(xiii) VoIP for online web games; and
(xiv) documentation; and

(C) create a digital portfolio.

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English Language Proficiency Standards

§74.4. English Language Proficiency Standards.

(a) Introduction.

(1) The English language proficiency standards in this section outline English language proficiency level descriptors and student expectations for English language learners (ELLs). School districts shall implement this section as an integral part of each subject in the required curriculum. The English language proficiency standards are to be published along with the Texas Essential Knowledge and Skills (TEKS) for each subject in the required curriculum.

(2) In order for ELLs to be successful, they must acquire both social and academic language proficiency in English. Social language proficiency in English consists of the English needed for daily social interactions. Academic language proficiency consists of the English needed to think critically, understand and learn new concepts, process complex academic material, and interact and communicate in English academic settings.

(3) Classroom instruction that effectively integrates second language acquisition with quality content area instruction ensures that ELLs acquire social and academic language proficiency in English, learn the knowledge and skills in the TEKS, and reach their full academic potential.

(4) Effective instruction in second language acquisition involves giving ELLs opportunities to listen, speak, read, and write at their current levels of English development while gradually increasing the linguistic complexity of the English they read and hear, and are expected to speak and write.

(5) The cross-curricular second language acquisition skills in subsection (c) of this section apply to ELLs in Kindergarten-Grade 12.

(6) The English language proficiency levels of beginning, intermediate, advanced, and advanced high are not grade-specific. ELLs may exhibit different proficiency levels within the language domains of listening, speaking, reading, and writing. The proficiency level descriptors outlined in subsection (d) of this section show the progression of second language acquisition from one proficiency level to the next and serve as a road map to help content area teachers instruct ELLs commensurate with students' linguistic needs.

(b) School district responsibilities. In fulfilling the requirements of this section, school districts shall:

(1) identify the student's English language proficiency levels in the domains of listening, speaking, reading, and writing in accordance with the proficiency level descriptors for the beginning, intermediate, advanced, and advanced high levels delineated in subsection (d) of this section;

(2) provide instruction in the knowledge and skills of the foundation and enrichment curriculum in a manner that is linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's levels of English language proficiency to ensure that the student learns the knowledge and skills in the required curriculum;

(3) provide content-based instruction including the cross-curricular second language acquisition essential knowledge and skills in subsection (c) of this section in a manner that is linguistically accommodated to help the student acquire English language proficiency; and

(4) provide intensive and ongoing foundational second language acquisition instruction to ELLs in Grade 3 or higher who are at the beginning or intermediate level of English language proficiency in listening, speaking, reading, and/or writing as determined by the state's English language proficiency assessment system. These ELLs require focused, targeted, and systematic second language acquisition instruction to provide them with the foundation of English language vocabulary, grammar, syntax, and English mechanics necessary to support content-based instruction and accelerated learning of English.

(c) Cross-curricular second language acquisition essential knowledge and skills.

(1) Cross-curricular second language acquisition/learning strategies. The ELL uses language learning strategies to develop an awareness of his or her own learning processes in all content areas. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. The student is expected to:

(A) use prior knowledge and experiences to understand meanings in English;

(B) monitor oral and written language production and employ self-corrective techniques or other resources;

(C) use strategic learning techniques such as concept mapping, drawing, memorizing, comparing, contrasting, and reviewing to acquire basic and grade-level vocabulary;

(D) speak using learning strategies such as requesting assistance, employing non-verbal cues, and using synonyms and circumlocution (conveying ideas by defining or describing when exact English words are not known);

(E) internalize new basic and academic language by using and reusing it in meaningful ways in speaking and writing activities that build concept and language attainment;

(F) use accessible language and learn new and essential language in the process;

(G) demonstrate an increasing ability to distinguish between formal and informal English and an increasing knowledge of when to use each one commensurate with grade-level learning expectations; and

(H) develop and expand repertoire of learning strategies such as reasoning inductively or deductively, looking for patterns in language, and analyzing sayings and expressions commensurate with grade-level learning expectations.

(2) Cross-curricular second language acquisition/listening. The ELL listens to a variety of speakers including teachers, peers, and electronic media to gain an increasing level of comprehension of newly acquired language in all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in listening. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. The student is expected to:

(A) distinguish sounds and intonation patterns of English with increasing ease;

(B) recognize elements of the English sound system in newly acquired vocabulary such as long and short vowels, silent letters, and consonant clusters;

(C) learn new language structures, expressions, and basic and academic vocabulary heard during classroom instruction and interactions;

(D) monitor understanding of spoken language during classroom instruction and interactions and seek clarification as needed;

(E) use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language;

(F) listen to and derive meaning from a variety of media such as audio tape, video, DVD, and CD ROM to build and reinforce concept and language attainment;

(G) understand the general meaning, main points, and important details of spoken language ranging from situations in which topics, language, and contexts are familiar to unfamiliar;

(H) understand implicit ideas and information in increasingly complex spoken language commensurate with grade-level learning expectations; and

(I) demonstrate listening comprehension of increasingly complex spoken English by following directions, retelling or summarizing spoken messages, responding to questions and requests, collaborating with peers, and taking notes commensurate with content and grade-level needs.

(3) Cross-curricular second language acquisition/speaking. The ELL speaks in a variety of modes for a variety of purposes with an awareness of different language registers (formal/informal) using vocabulary with increasing fluency and accuracy in language arts and all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in speaking. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. The student is expected to:

(A) practice producing sounds of newly acquired vocabulary such as long and short vowels, silent letters, and consonant clusters to pronounce English words in a manner that is increasingly comprehensible;

(B) expand and internalize initial English vocabulary by learning and using high-frequency English words necessary for identifying and describing people, places, and objects, by retelling simple stories and basic information represented or supported by pictures, and by learning and using routine language needed for classroom communication;

(C) speak using a variety of grammatical structures, sentence lengths, sentence types, and connecting words with increasing accuracy and ease as more English is acquired;

(D) speak using grade-level content area vocabulary in context to internalize new English words and build academic language proficiency;

(E) share information in cooperative learning interactions;

(F) ask and give information ranging from using a very limited bank of high-frequency, high-need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts, to using abstract and content-based vocabulary during extended speaking assignments;

(G) express opinions, ideas, and feelings ranging from communicating single words and short phrases to participating in extended discussions on a variety of social and grade-appropriate academic topics;

(H) narrate, describe, and explain with increasing specificity and detail as more English is acquired;

(I) adapt spoken language appropriately for formal and informal purposes; and

(J) respond orally to information presented in a wide variety of print, electronic, audio, and visual media to build and reinforce concept and language attainment.

(4) Cross-curricular second language acquisition/reading. The ELL reads a variety of texts for a variety of purposes with an increasing level of comprehension in all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in reading. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. For Kindergarten and Grade 1, certain of these student expectations apply to text read aloud for students not yet at the stage of decoding written text. The student is expected to:

(A) learn relationships between sounds and letters of the English language and decode (sound out) words using a combination of skills such as recognizing sound-letter relationships and identifying cognates, affixes, roots, and base words;

(B) recognize directionality of English reading such as left to right and top to bottom;

(C) develop basic sight vocabulary, derive meaning of environmental print, and comprehend English vocabulary and language structures used routinely in written classroom materials;

(D) use prereading supports such as graphic organizers, illustrations, and pretaught topic-related vocabulary and other prereading activities to enhance comprehension of written text;

(E) read linguistically accommodated content area material with a decreasing need for linguistic accommodations as more English is learned;

(F) use visual and contextual support and support from peers and teachers to read grade-appropriate content area text, enhance and confirm understanding, and develop vocabulary, grasp of language structures, and background knowledge needed to comprehend increasingly challenging language;

(G) demonstrate comprehension of increasingly complex English by participating in shared reading, retelling or summarizing material, responding to questions, and taking notes commensurate with content area and grade level needs;

(H) read silently with increasing ease and comprehension for longer periods;

(I) demonstrate English comprehension and expand reading skills by employing basic reading skills such as demonstrating understanding of supporting ideas and details in text and graphic sources, summarizing text, and distinguishing main ideas from details commensurate with content area needs;

(J) demonstrate English comprehension and expand reading skills by employing inferential skills such as predicting, making connections between ideas, drawing inferences and conclusions from text and graphic sources, and finding supporting text evidence commensurate with content area needs; and

(K) demonstrate English comprehension and expand reading skills by employing analytical skills such as evaluating written information and performing critical analyses commensurate with content area and grade-level needs.

(5) Cross-curricular second language acquisition/writing. The ELL writes in a variety of forms with increasing accuracy to effectively address a specific purpose and audience in all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in writing. In order for the ELL to meet grade-level learning expectations across foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. For Kindergarten and Grade 1, certain of these student expectations do not apply until the student has reached the stage of generating original written text using a standard writing system. The student is expected to:

(A) learn relationships between sounds and letters of the English language to represent sounds when writing in English;

(B) write using newly acquired basic vocabulary and content-based grade-level vocabulary;

(C) spell familiar English words with increasing accuracy, and employ English spelling patterns and rules with increasing accuracy as more English is acquired;

(D) edit writing for standard grammar and usage, including subject-verb agreement, pronoun agreement, and appropriate verb tenses commensurate with grade-level expectations as more English is acquired;

(E) employ increasingly complex grammatical structures in content area writing commensurate with grade-level expectations, such as:

(i) using correct verbs, tenses, and pronouns/antecedents;

(ii) using possessive case (apostrophe *s*) correctly; and

(iii) using negatives and contractions correctly;

(F) write using a variety of grade-appropriate sentence lengths, patterns, and connecting words to combine phrases, clauses, and sentences in increasingly accurate ways as more English is acquired; and

(G) narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs as more English is acquired.

(d) Proficiency level descriptors.

(1) Listening, Kindergarten-Grade 12. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in listening. The following proficiency level descriptors for listening are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction.

(A) Beginning. Beginning ELLs have little or no ability to understand spoken English in academic and social settings. These students:

(i) struggle to understand simple conversations and simple discussions even when the topics are familiar and the speaker uses linguistic supports such as visuals, slower speech and other verbal cues, and gestures;

(ii) struggle to identify and distinguish individual words and phrases during social and instructional interactions that have not been intentionally modified for ELLs; and

(iii) may not seek clarification in English when failing to comprehend the English they hear; frequently remain silent, watching others for cues.

(B) Intermediate. Intermediate ELLs have the ability to understand simple, high-frequency spoken English used in routine academic and social settings. These students:

(i) usually understand simple or routine directions, as well as short, simple conversations and short, simple discussions on familiar topics; when topics are unfamiliar, require extensive linguistic supports and adaptations such as visuals, slower speech and other verbal cues, simplified language, gestures, and preteaching to preview or build topic-related vocabulary;

(ii) often identify and distinguish key words and phrases necessary to understand the general meaning during social and basic instructional interactions that have not been intentionally modified for ELLs; and

(iii) have the ability to seek clarification in English when failing to comprehend the English they hear by requiring/requesting the speaker to repeat, slow down, or rephrase speech.

(C) Advanced. Advanced ELLs have the ability to understand, with second language acquisition support, grade-appropriate spoken English used in academic and social settings. These students:

(i) usually understand longer, more elaborated directions, conversations, and discussions on familiar and some unfamiliar topics, but sometimes need processing time and sometimes depend on visuals, verbal cues, and gestures to support understanding;

(ii) understand most main points, most important details, and some implicit information during social and basic instructional interactions that have not been intentionally modified for ELLs; and

(iii) occasionally require/request the speaker to repeat, slow down, or rephrase to clarify the meaning of the English they hear.

(D) Advanced high. Advanced high ELLs have the ability to understand, with minimal second language acquisition support, grade-appropriate spoken English used in academic and social settings. These students:

(i) understand longer, elaborated directions, conversations, and discussions on familiar and unfamiliar topics with occasional need for processing time and with little dependence on visuals, verbal cues, and gestures; some exceptions when complex academic or highly specialized language is used;

(ii) understand main points, important details, and implicit information at a level nearly comparable to native English-speaking peers during social and instructional interactions; and

(iii) rarely require/request the speaker to repeat, slow down, or rephrase to clarify the meaning of the English they hear.

(2) Speaking, Kindergarten-Grade 12. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in speaking. The following proficiency level descriptors for speaking are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction.

(A) Beginning. Beginning ELLs have little or no ability to speak English in academic and social settings. These students:

(i) mainly speak using single words and short phrases consisting of recently practiced, memorized, or highly familiar material to get immediate needs met; may be hesitant to speak and often give up in their attempts to communicate;

(ii) speak using a very limited bank of high-frequency, high-need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts;

(iii) lack the knowledge of English grammar necessary to connect ideas and speak in sentences; can sometimes produce sentences using recently practiced, memorized, or highly familiar material;

(iv) exhibit second language acquisition errors that may hinder overall communication, particularly when trying to convey information beyond memorized, practiced, or highly familiar material; and

(v) typically use pronunciation that significantly inhibits communication.

(B) Intermediate. Intermediate ELLs have the ability to speak in a simple manner using English commonly heard in routine academic and social settings. These students:

(i) are able to express simple, original messages, speak using sentences, and participate in short conversations and classroom interactions; may hesitate frequently and for long periods to think about how to communicate desired meaning;

(ii) speak simply using basic vocabulary needed in everyday social interactions and routine academic contexts; rarely have vocabulary to speak in detail;

(iii) exhibit an emerging awareness of English grammar and speak using mostly simple sentence structures and simple tenses; are most comfortable speaking in present tense;

(iv) exhibit second language acquisition errors that may hinder overall communication when trying to use complex or less familiar English; and

(v) use pronunciation that can usually be understood by people accustomed to interacting with ELLs.

(C) Advanced. Advanced ELLs have the ability to speak using grade-appropriate English, with second language acquisition support, in academic and social settings. These students:

(i) are able to participate comfortably in most conversations and academic discussions on familiar topics, with some pauses to restate, repeat, or search for words and phrases to clarify meaning;

(ii) discuss familiar academic topics using content-based terms and common abstract vocabulary; can usually speak in some detail on familiar topics;

(iii) have a grasp of basic grammar features, including a basic ability to narrate and describe in present, past, and future tenses; have an emerging ability to use complex sentences and complex grammar features;

(iv) make errors that interfere somewhat with communication when using complex grammar structures, long sentences, and less familiar words and expressions; and

(v) may mispronounce words, but use pronunciation that can usually be understood by people not accustomed to interacting with ELLs.

(D) Advanced high. Advanced high ELLs have the ability to speak using grade-appropriate English, with minimal second language acquisition support, in academic and social settings. These students:

(i) are able to participate in extended discussions on a variety of social and grade-appropriate academic topics with only occasional disruptions, hesitations, or pauses;

(ii) communicate effectively using abstract and content-based vocabulary during classroom instructional tasks, with some exceptions when low-frequency or academically demanding vocabulary is needed; use many of the same idioms and colloquialisms as their native English-speaking peers;

(iii) can use English grammar structures and complex sentences to narrate and describe at a level nearly comparable to native English-speaking peers;

(iv) make few second language acquisition errors that interfere with overall communication; and

(v) may mispronounce words, but rarely use pronunciation that interferes with overall communication.

(3) Reading, Kindergarten-Grade 1. ELLs in Kindergarten and Grade 1 may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in reading. The following proficiency level descriptors for reading are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction and should take into account developmental stages of emergent readers.

(A) Beginning. Beginning ELLs have little or no ability to use the English language to build foundational reading skills. These students:

(i) derive little or no meaning from grade-appropriate stories read aloud in English, unless the stories are:

(I) read in short "chunks;"

(II) controlled to include the little English they know such as language that is high frequency, concrete, and recently practiced; and

(III) accompanied by ample visual supports such as illustrations, gestures, pantomime, and objects and by linguistic supports such as careful enunciation and slower speech;

(ii) begin to recognize and understand environmental print in English such as signs, labeled items, names of peers, and logos; and

(iii) have difficulty decoding most grade-appropriate English text because they:

(I) understand the meaning of very few words in English; and

(II) struggle significantly with sounds in spoken English words and with sound-symbol relationships due to differences between their primary language and English.

(B) Intermediate. Intermediate ELLs have a limited ability to use the English language to build foundational reading skills. These students:

(i) demonstrate limited comprehension (key words and general meaning) of grade-appropriate stories read aloud in English, unless the stories include:

(I) predictable story lines;

(II) highly familiar topics;

(III) primarily high-frequency, concrete vocabulary;

(IV) short, simple sentences; and

(V) visual and linguistic supports;

(ii) regularly recognize and understand common environmental print in English such as signs, labeled items, names of peers, logos; and

(iii) have difficulty decoding grade-appropriate English text because they:

(I) understand the meaning of only those English words they hear frequently; and

(II) struggle with some sounds in English words and some sound-symbol relationships due to differences between their primary language and English.

(C) Advanced. Advanced ELLs have the ability to use the English language, with second language acquisition support, to build foundational reading skills. These students:

(i) demonstrate comprehension of most main points and most supporting ideas in grade-appropriate stories read aloud in English, although they may still depend on visual and linguistic supports to gain or confirm meaning;

(ii) recognize some basic English vocabulary and high-frequency words in isolated print; and

(iii) with second language acquisition support, are able to decode most grade-appropriate English text because they:

(I) understand the meaning of most grade-appropriate English words; and

(II) have little difficulty with English sounds and sound-symbol relationships that result from differences between their primary language and English.

(D) Advanced high. Advanced high ELLs have the ability to use the English language, with minimal second language acquisition support, to build foundational reading skills. These students:

(i) demonstrate, with minimal second language acquisition support and at a level nearly comparable to native English-speaking peers, comprehension of main points and supporting ideas (explicit and implicit) in grade-appropriate stories read aloud in English;

(ii) with some exceptions, recognize sight vocabulary and high-frequency words to a degree nearly comparable to that of native English-speaking peers; and

(iii) with minimal second language acquisition support, have an ability to decode and understand grade-appropriate English text at a level nearly comparable to native English-speaking peers.

(4) Reading, Grades 2-12. ELLs in Grades 2-12 may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in reading. The following proficiency level descriptors for reading are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction.

(A) Beginning. Beginning ELLs have little or no ability to read and understand English used in academic and social contexts. These students:

(i) read and understand the very limited recently practiced, memorized, or highly familiar English they have learned; vocabulary predominantly includes:

(I) environmental print;

(II) some very high-frequency words; and

(III) concrete words that can be represented by pictures;

(ii) read slowly, word by word;

(iii) have a very limited sense of English language structures;

(iv) comprehend predominantly isolated familiar words and phrases; comprehend some sentences in highly routine contexts or recently practiced, highly familiar text;

(v) are highly dependent on visuals and prior knowledge to derive meaning from text in English; and

(vi) are able to apply reading comprehension skills in English only when reading texts written for this level.

(B) Intermediate. Intermediate ELLs have the ability to read and understand simple, high-frequency English used in routine academic and social contexts. These students:

(i) read and understand English vocabulary on a somewhat wider range of topics and with increased depth; vocabulary predominantly includes:

(I) everyday oral language;

(II) literal meanings of common words;

(III) routine academic language and terms; and

(IV) commonly used abstract language such as terms used to describe basic feelings;

(ii) often read slowly and in short phrases; may re-read to clarify meaning;

(iii) have a growing understanding of basic, routinely used English language structures;

(iv) understand simple sentences in short, connected texts, but are dependent on visual cues, topic familiarity, prior knowledge, pretaught topic-related vocabulary, story predictability, and teacher/peer assistance to sustain comprehension;

(v) struggle to independently read and understand grade-level texts; and

(vi) are able to apply basic and some higher-order comprehension skills when reading texts that are linguistically accommodated and/or simplified for this level.

(C) Advanced. Advanced ELLs have the ability to read and understand, with second language acquisition support, grade-appropriate English used in academic and social contexts. These students:

(i) read and understand, with second language acquisition support, a variety of grade-appropriate English vocabulary used in social and academic contexts:

(I) with second language acquisition support, read and understand grade-appropriate concrete and abstract vocabulary, but have difficulty with less commonly encountered words;

(II) demonstrate an emerging ability to understand words and phrases beyond their literal meaning; and

(III) understand multiple meanings of commonly used words;

(ii) read longer phrases and simple sentences from familiar text with appropriate rate and speed;

(iii) are developing skill in using their growing familiarity with English language structures to construct meaning of grade-appropriate text; and

(iv) are able to apply basic and higher-order comprehension skills when reading grade-appropriate text, but are still occasionally dependent on visuals, teacher/peer assistance, and other linguistically accommodated text features to determine or clarify meaning, particularly with unfamiliar topics.

(D) Advanced high. Advanced high ELLs have the ability to read and understand, with minimal second language acquisition support, grade-appropriate English used in academic and social contexts. These students:

(i) read and understand vocabulary at a level nearly comparable to that of their native English-speaking peers, with some exceptions when low-frequency or specialized vocabulary is used;

(ii) generally read grade-appropriate, familiar text with appropriate rate, speed, intonation, and expression;

(iii) are able to, at a level nearly comparable to native English-speaking peers, use their familiarity with English language structures to construct meaning of grade-appropriate text; and

(iv) are able to apply, with minimal second language acquisition support and at a level nearly comparable to native English-speaking peers, basic and higher-order comprehension skills when reading grade-appropriate text.

(5) Writing, Kindergarten-Grade 1. ELLs in Kindergarten and Grade 1 may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in writing. The following proficiency level descriptors for writing are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction and should take into account developmental stages of emergent writers.

(A) Beginning. Beginning ELLs have little or no ability to use the English language to build foundational writing skills. These students:

(i) are unable to use English to explain self-generated writing such as stories they have created or other personal expressions, including emergent forms of writing (pictures, letter-like forms, mock words, scribbling, etc.);

(ii) know too little English to participate meaningfully in grade-appropriate shared writing activities using the English language;

(iii) cannot express themselves meaningfully in self-generated, connected written text in English beyond the level of high-frequency, concrete words, phrases, or short sentences that have been recently practiced and/or memorized; and

(iv) may demonstrate little or no awareness of English print conventions.

(B) Intermediate. Intermediate ELLs have a limited ability to use the English language to build foundational writing skills. These students:

(i) know enough English to explain briefly and simply self-generated writing, including emergent forms of writing, as long as the topic is highly familiar and concrete and requires very high-frequency English;

(ii) can participate meaningfully in grade-appropriate shared writing activities using the English language only when the writing topic is highly familiar and concrete and requires very high-frequency English;

(iii) express themselves meaningfully in self-generated, connected written text in English when their writing is limited to short sentences featuring simple, concrete English used frequently in class; and

(iv) frequently exhibit features of their primary language when writing in English such as primary language words, spelling patterns, word order, and literal translating.

(C) Advanced. Advanced ELLs have the ability to use the English language to build, with second language acquisition support, foundational writing skills. These students:

(i) use predominantly grade-appropriate English to explain, in some detail, most self-generated writing, including emergent forms of writing;

(ii) can participate meaningfully, with second language acquisition support, in most grade-appropriate shared writing activities using the English language;

(iii) although second language acquisition support is needed, have an emerging ability to express themselves in self-generated, connected written text in English in a grade-appropriate manner; and

(iv) occasionally exhibit second language acquisition errors when writing in English.

(D) Advanced high. Advanced high ELLs have the ability to use the English language to build, with minimal second language acquisition support, foundational writing skills. These students:

(i) use English at a level of complexity and detail nearly comparable to that of native English-speaking peers when explaining self-generated writing, including emergent forms of writing;

(ii) can participate meaningfully in most grade-appropriate shared writing activities using the English language; and

(iii) although minimal second language acquisition support may be needed, express themselves in self-generated, connected written text in English in a manner nearly comparable to their native English-speaking peers.

(6) Writing, Grades 2-12. ELLs in Grades 2-12 may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in writing. The following proficiency level descriptors for writing are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction.

(A) Beginning. Beginning ELLs lack the English vocabulary and grasp of English language structures necessary to address grade-appropriate writing tasks meaningfully. These students:

(i) have little or no ability to use the English language to express ideas in writing and engage meaningfully in grade-appropriate writing assignments in content area instruction;

(ii) lack the English necessary to develop or demonstrate elements of grade-appropriate writing such as focus and coherence, conventions, organization, voice, and development of ideas in English; and

(iii) exhibit writing features typical at this level, including:

(I) ability to label, list, and copy;

(II) high-frequency words/phrases and short, simple sentences (or even short paragraphs) based primarily on recently practiced, memorized, or highly familiar material; this type of writing may be quite accurate;

(III) present tense used primarily; and

(IV) frequent primary language features (spelling patterns, word order, literal translations, and words from the student's primary language) and other errors associated with second language acquisition may significantly hinder or prevent understanding, even for individuals accustomed to the writing of ELLs.

(B) Intermediate. Intermediate ELLs have enough English vocabulary and enough grasp of English language structures to address grade-appropriate writing tasks in a limited way. These students:

(i) have a limited ability to use the English language to express ideas in writing and engage meaningfully in grade-appropriate writing assignments in content area instruction;

(ii) are limited in their ability to develop or demonstrate elements of grade-appropriate writing in English; communicate best when topics are highly familiar and concrete, and require simple, high-frequency English; and

(iii) exhibit writing features typical at this level, including:

(I) simple, original messages consisting of short, simple sentences; frequent inaccuracies occur when creating or taking risks beyond familiar English;

(II) high-frequency vocabulary; academic writing often has an oral tone;

(III) loosely connected text with limited use of cohesive devices or repetitive use, which may cause gaps in meaning;

(IV) repetition of ideas due to lack of vocabulary and language structures;

(V) present tense used most accurately; simple future and past tenses, if attempted, are used inconsistently or with frequent inaccuracies;

(VI) undetailed descriptions, explanations, and narrations; difficulty expressing abstract ideas;

(VII) primary language features and errors associated with second language acquisition may be frequent; and

(VIII) some writing may be understood only by individuals accustomed to the writing of ELLs; parts of the writing may be hard to understand even for individuals accustomed to ELL writing.

(C) Advanced. Advanced ELLs have enough English vocabulary and command of English language structures to address grade-appropriate writing tasks, although second language acquisition support is needed. These students:

(i) are able to use the English language, with second language acquisition support, to express ideas in writing and engage meaningfully in grade-appropriate writing assignments in content area instruction;

(ii) know enough English to be able to develop or demonstrate elements of grade-appropriate writing in English, although second language acquisition support is particularly needed when topics are abstract, academically challenging, or unfamiliar; and

(iii) exhibit writing features typical at this level, including:

(I) grasp of basic verbs, tenses, grammar features, and sentence patterns; partial grasp of more complex verbs, tenses, grammar features, and sentence patterns;

(II) emerging grade-appropriate vocabulary; academic writing has a more academic tone;

(III) use of a variety of common cohesive devices, although some redundancy may occur;

(IV) narrations, explanations, and descriptions developed in some detail with emerging clarity; quality or quantity declines when abstract ideas are expressed, academic demands are high, or low-frequency vocabulary is required;

(V) occasional second language acquisition errors; and

(VI) communications are usually understood by individuals not accustomed to the writing of ELLs.

(D) Advanced high. Advanced high ELLs have acquired the English vocabulary and command of English language structures necessary to address grade-appropriate writing tasks with minimal second language acquisition support. These students:

(i) are able to use the English language, with minimal second language acquisition support, to express ideas in writing and engage meaningfully in grade-appropriate writing assignments in content area instruction;

(ii) know enough English to be able to develop or demonstrate, with minimal second language acquisition support, elements of grade-appropriate writing in English; and

(iii) exhibit writing features typical at this level, including:

(I) nearly comparable to writing of native English-speaking peers in clarity and precision with regard to English vocabulary and language structures, with occasional exceptions when writing about academically complex ideas, abstract ideas, or topics requiring low-frequency vocabulary;

(II) occasional difficulty with naturalness of phrasing and expression; and

(III) errors associated with second language acquisition are minor and usually limited to low-frequency words and structures; errors rarely interfere with communication.

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APPENDIX

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Glossary of Terms

For the purpose of Proclamation 2014, the following words and terms will have the following meanings:

Ancillaries Those materials not listed on the publisher's *Statement of Intent to Bid*, but that the publisher plans to provide to districts and open-enrollment charter schools free with each order. Ancillaries are not reviewed by panel members at the state level and are not adopted nor sanctioned by the State Board of Education (SBOE).

Affidavit of Authorship or Contribution A signed and notarized document by which a publisher certifies that each individual whose name is listed on its materials as an author or contributor of content was engaged in the development of the materials. The affidavit also states in general terms the involvement of each author and/or contributor.

Affidavit of Corrections A signed and notarized document by which a publisher certifies that all required corrections of factual errors have been made.

Breakouts The result of parsing the Texas Essential Knowledge and Skills (TEKS) into constituent parts. The breakouts are shown on the Correlations Form and the Evaluation Form.

Citation The identification of one occurrence of a factual error, editorial error, or a specific example of content that covers one of the Texas Essential Knowledge and Skills (TEKS).

Consumable Instructional material that is intended to be written in, depleted, or otherwise consumed during the first year of use.

Correlations Form A document, provided by the TEA, on which publishers of print materials indicate the locations in their materials where the required Texas Essential Knowledge and Skills (TEKS) are addressed. Publishers of electronic materials must include correlations as part of their products.

Depository An entity through which publishers receive and fill orders for instructional materials. Depositories must be EMAT and Electronic Data Interchange (EDI) compliant. Publishers are no longer required to maintain a depository, though the use of a depository is permitted.

Educational Materials System (EMAT) The TEA's statewide electronic instructional materials management system that processes all requisitions for, payments for, and deliveries of, adopted instructional materials. School districts and open-enrollment charter schools also use EMAT to request disbursements from their Instructional Materials Allotments.

Education Service Centers (ESCs) Public entities created by state statute to provide educational support programs and services to local schools and school districts. Each of the 20 ESCs serves districts in a specific geographic area.

Enrichment Subjects Those subjects, other than the foundation subjects, that public schools in Texas must offer to their students. The subjects are: languages other than English, health, physical education, fine arts, career and technical education, technology applications, and religious literature.

Error Form Please see *Identification of Errors and Changes by Publisher Form.*

Evaluation Form (State Review Panel evaluation) A document that the state review panels complete and submit detailing where the instructional material addresses the Texas Essential Knowledge and Skills (TEKS).

Exhibit A Please see *Official Bid Form.*

Extensible Markup Language (XML) A general-purpose specification developed by the World Wide Web Consortium (W3C) for creating custom markup languages whereby the meaning of text can be understood directly from its context within the file. NIMAS is an example of XML.

Form B and Warranty of Publisher A signed statement certifying that the printed books submitted for adoption conform in every respect to the *Manufacturing Standards and Specifications for Textbooks (MSST).*

Form M and Warranty of Publisher A signed statement certifying that the electronic media submitted for adoption conform in every respect to the *Manufacturing Standards and Specifications for Textbooks (MSST).*

Foundation Subjects Those subjects other than the enrichment subjects that public schools in Texas must offer to their students. The subjects are English language arts, mathematics, science, and social studies.

Identification of Errors and Changes by Publisher Form A document with which a publisher provides the list of all corrections necessary to each student and teacher component of an instructional materials submission.

Instructional Materials Allotment (IMA) An annual allocation of money from the Instructional Materials Fund to each school district and open-enrollment charter school. The allotment is based on student enrollment, and the per-student amount is determined by the commissioner of education.

Instructional Materials Fund A reserve of capital comprised of an amount set aside by the State Board of Education from the available school fund and any amounts lawfully paid into the fund from any other source. Money from the instructional materials fund is used to finance the instructional materials allotment.

Instructional Materials Content that conveys the essential knowledge and skills of a subject in the public school curriculum through a medium or a combination of media for conveying information to a student. The term includes a book, supplementary materials, a combination of a book, workbook, and supplementary materials, computer software, magnetic media, DVD, CD-ROM, computer courseware, online services, or an electronic medium or other means of conveying information to the student or otherwise contributing to the learning process through electronic means, including open-source instructional materials.

Instructional Materials and Educational Technology (IMET) The division of the Texas Education Agency (TEA) that coordinates the acquisition of state-approved instructional materials in various media and implements and supports educational technology to prepare Texas public school students and educators for success in the 21st century.

International Standard Book Number (ISBN) A unique number that identifies books and book-like products internationally. Each component listed on a *Statement of Intent to Bid* must have a unique 13-digit ISBN.

Manufacturing Standards and Specifications for Textbooks (MSST) The physical standards of quality and performance for K-12 instructional materials. The MSST is published by the National Association of State Textbook Administrators (NASTA).

National Instructional Materials Accessibility Standard (NIMAS) A technical standard used to produce (XML)-based source files, from which accessible, student-ready alternate-format versions of textbooks and core materials (e.g., Braille, e-text, Digital Talking Book, large print, etc.) can be created and distributed to students with print disabilities.

No-Contact Period The time during which appointed state review panel members are not permitted to have either direct or indirect contact regarding content of instructional materials under evaluation by the panel with any person having an interest in the adoption process. The period begins when the Texas Education Agency (TEA) initially contacts a nominee regarding his or her appointment to review instructional materials and ends after the State Board of Education (SBOE) adopts the instructional materials.

Nonconsumable Components that are considered self-sufficient for the entire period of the adoption.

Official Bid (Exhibit A) The document with which a publisher makes an official offer to provide specific instructional materials to the state of Texas at a fixed price. The form is based on the *Statement of Intent to Bid,* and becomes Exhibit A of the contract.

Proclamation The document issued by the State Board of Education (SBOE) calling for bids for instructional materials in selected subject areas and/or grade levels. The proclamation identifies the subject areas scheduled for review and contains the content requirements Texas Essential Knowledge and Skills (TEKS). Proclamations are named for the year in which the materials are intended to be made available in the classroom.

Questions and Answers Document (Q&A) A proclamation-specific document issued by the State Board of Education (SBOE) that consists of questions presented by publishers and answers provided by the Texas Education Agency (TEA).

Register of Contacts Form The document with which a publisher discloses all contact with members of the State Board of Education (SBOE). The disclosure, which is required by state law, must include the time, date, location and purpose for each communication with a member of the SBOE.

Report of the Commissioner of Education Concerning Required Corrections of Factual Errors A report prepared by the commissioner of education and presented to the State Board of Education (SBOE) listing all factual errors discovered in instructional materials being considered for adoption. This report is a compilation of the errors found by the state review panels, those reported by the publishers (who are required to disclose all known factual errors), and any reported to the Texas Education Agency (TEA) by the general public or third-party organizations.

Schedule of Adoption Procedures The section in the proclamation that lists the specific activities and deadlines related to the review and adoption of instructional materials.

Statement of Intent to Bid The document with which a publisher indicates its intention to participate in an adoption under a specific proclamation. The form requires detailed information about each instructional product to be submitted.

State Review Panel A group of individuals that conducts a full and complete investigation of the instructional materials submitted for adoption to identify the Texas Essential Knowledge and Skills (TEKS) covered and identify factual errors. The panels are composed of university professors, public school teachers, parents, business and industry representatives, and other subject matter experts.

Student Component Any instructional materials that are specifically intended for use by the student. The student components may include print and non-print materials such as student editions, workbooks, and online materials.

Teacher Component Any resources that are specifically intended for use by a teacher. The teacher components may include print and non-print materials such as student editions, workbooks, and online materials.

Texas Essential Knowledge and Skills (TEKS) The state standards for the foundation and enrichment curriculum, adopted by the SBOE, that identify what students should know and be able to do at the end of each grade level or course.

Textbook Please see *Instructional Materials*.

Accessibility Information

I. Electronic Instructional Materials

Publishing companies that offer electronic textbooks (e.g., CD-ROMs, DVDs or Web-based instructional materials) for adoption are required to offer these materials in an accessible format in accordance with the technical standards of the Federal Rehabilitation Act, Section 508. The standards are available at http://www.section508.gov/index.cfm?fuseAction=stdsdoc

Accessibility Information Resources For Publishers Of Electronic Instructional Materials

The following web links, publications and conferences offer essential information for publishers that are planning the development of accessible electronic textbooks.

General

1. Section 508: http://www.section508.gov/

2. Resources from the World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI): http://www.w3.org/WAI/Resources/

3. Guidelines for Describing STEM Images for Use within Digital Talking Books and on Web Sites: http://ncam.wgbh.org/about/news/ncam-publishes-guidelines-for-

4. Conference Proceedings, Annual Conference on "Technology and Persons with Disabilities," California State University, Northridge (CSUN): http://www.csun.edu/cod/conference/index.php

5. Texas Administrative Code, Chapter 206, Subchapter B, Section 206.50, Accessibility and Usability of State Web Sites: http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=1&pt=10&ch=206&rl=50

Resources for Designing Accessible Web Sites

1. Web Content Accessibility Guidelines (WCAG 2.0) – W3C: http://www.w3.org/TR/WCAG20/

2. Accessible Web Authoring Resources and Education (AWARE) Center for the HTML Writers Guild: http://aware.hwg.org/

3. Evaluation, Repair, and Transformation Tools for Web Content Accessibility: http://www.w3.org/WAI/ER/tools/

4. HTML Kit (editor, validator, Word 2000 cleanup): http://www.chami.com/html-kit/

5. IBM Software Accessibility Checklist Checkpoint 2.1, http://www-03.ibm.com/able/guidelines/web/accessweb.html

6. WGBH's National Center for Accessible Media: http://ncam.wgbh.org/

7. Trace Research and Development Center's Developing More Usable Web Sites: http://www.trace.wisc.edu/world/web/

Resources for Closed Captioning and Audio Description

1. Media Access Group at WGBH, The Caption Center: http://www.wgbh.org/caption

2. National Captioning Institute: http://www.ncicap.org

3. VITAC: http://www.vitac.com

4. Media Access Group at WGBH, Descriptive Video Service: http://main.wgbh.org/wgbh/pages/mag/services/description/

5. Metropolitan Washington Ear, Inc.: http://www.washear.org

6. Narrative Television Network: http://www.narrativetv.com

II. Printed Instructional Materials

Electronic Files and Instructional Materials Required For Automated Production Of Braille

Under sections 712(a)(23)(A) and 674(e)(4) of the Individuals with Disabilities Education Act, as amended b the Individuals with Disabilities Improvement Act of 2004, the Secretary of Education establishes the National Instructional Materials Accessibility Standard (NIMAS). Under Section 674(e)(4) of the Act, NIMAS files of printed instructional materials are needed to ensure the timely production of braille versions of the materials.

Every publisher of print materials adopted under Proclamation 2014 must provide electronic files of their adopted programs to facilitate the production of braille versions. The electronic files must conform to the NIMAS, the purpose of which is to help increase the availability and timely delivery of print instructional materials in accessible formats to blind or other persons with print disabilities in elementary and secondary schools. The *NIMAS 1.1 The Technical Standard (Annotated)* can be found at http://aim.cast.org/experience/technologies/spec-v1_1.

New publishers should email nimac@aph.org to request a publisher account. The National Instructional Materials Access Center (NIMAC) will provide instructions regarding how to set up an account, as well as complete documentation regarding submission procedures and how to prepare metadata correctly. A new publisher may be required to provide a sample NIMAS file to the NIMAC for review before they establish an account for the publisher. Specific information and resources for publishers, including a list of frequently asked questions (FAQ), can be found at the NIMAC web site: http://www.nimac.us/publishers.html.

Additionally, publishers of *electronic* instructional materials adopted under Proclamation 2014 are required to offer these programs in an accessible format in accordance with the technical standards of the Federal Rehabilitation Act, Section 508. Additional information is available on the Section 508 website http://www.Section508.gov . Please refer to *Section I. Electronic Instructional Materials*. The portion of specifications entitled "Accessibility Information Resources for Publishers of Electronic Instructional Materials" has been updated to show the latest versions of publications related to the development of accessible electronic instructional materials.

Computer files and printed instructional materials are required for all subjects for automated braille instructional materials produced under Proclamation 2014. However, computer files are not required for Kindergarten instructional materials as the content is too pictorial for producing in a braille format.

Each publisher participating in Proclamation 2014 is required to provide the name, address, telephone number, fax number and e-mail address of the individual responsible for providing the computerized files, normally the instructional materials production manager, by **September 13, 2013**. Communication between the Division of Instructional Materials and Educational Technology and the publisher's representative responsible for providing the computerized files should begin early in the file production process. Publishers will send a small test file and associated print pages to the Division of Instructional Materials and Educational Technology, Attention: Distribution and Accessibility Director by **October 4, 2013**. Early detection of any problems in the test file will allow time for publishers and braille producers to remedy these problems before the final delivery deadline. Also, publishers will be requested to submit three copies of the designated print student materials and one copy of the computerized files to be used in production of Braille versions. **Publishers should provide computerized files of blackline masters or other materials clearly intended for student use even though they are included in the teacher component**. Printed student materials and computer files must be received by the Instructional Materials and Educational Technology Division no later than **December 6, 2013**.

Publishers are required to submit three pint copies and NIMAS files of student components adopted in Proclamation 2014 that incorporate all required corrections. Corrected student components and NIMAS files must be received no later than **May 2, 2014**.

Procedures For Providing Electronic Files And Printed Materials To Braille, Large-Type, and Audio Producers

(1) **September 13, 2013**: Publishers provide to the Instructional Materials and Educational Technology Division the name, address, and telephone number of the production manager of each printed textbook or instructional material being prepared for submission. This information should be sent to Ms. Kelly Griffin, at e-mail address: kelly.griffin@tea.state.tx.us, fax number (512) 463-8278, or regular address: 1701 North Congress Avenue, Room 3-110, Austin, Texas 78701.

(2) **October 4, 2013**: Publishers send a small NIMAS test file and associated print pages to the Instructional Materials and Educational Technology Division, Attention: Distribution and Accessibility Director. In the past, this procedure has proven to be extremely beneficial to publishers and braille producers. It has significantly facilitated communication between publishers and braille producers. After receipt of the NIMAS test files, braille producers designated by the Agency will need at least two weeks to evaluate the files and respond to publisher inquiries about usability.

(3) **Week Following November SBOE Meeting**: Publishers of adopted printed instructional materials are informed of the designated braille producers by Instructional Materials and Educational Technology Division.

(4) **December 6, 2013**:

(a) Publishers must provide three print copies of the adopted student materials, one copy of the digital files and a screen shot from the publisher's copy of the NIMAC Validation Wizard showing that the file has successfully passed validation with "0 errors, 0 warnings" for both the XML file and OPF file to the designated braille producer.

Publishers are not required to provide printed copies or computer files of materials that are designed for use by teachers. If a teacher who is visually impaired requires a braille version during the adoption period, a publisher will be requested to provide the agency with two printed teacher editions, if applicable. **Publishers should provide two print copies and computerized files of blackline masters or other materials clearly intended for student use even though they are included in the teacher component**.

(b) Deliver usable textbook NIMAS files to designated Braille producers in accordance with the enclosed NIMAS standards.

(c) Publishers must provide one print copy of the adopted student materials to the designated large-print producer; publishers must provide one print copy of the adopted student materials to the designated audio producer.

(5) **May 2, 2014**:

(a) Submit three print copies of the corrected student components and corrected NIMAS files to the designated Braille producer.

(b) Publishers must submit corrected NIMAS files to the NIMAC. The Texas Education Agency (TEA) and the NIMAC will coordinate to ensure that the file is uploaded to the NIMAC

NIMAS 1.1 Technical Specifications

The NIMAS 1.1 technical specification can be found at
http://aim.cast.org/experience/technologies/spec-v1_1