Career and Technical Education TEKS Review Draft Recommendations

Texas Essential Knowledge and Skills (TEKS) for Career and Technical Education (CTE) Draft Recommendations

CTE Courses that Satisfy Science Graduation Requirements Work Group

Courses:

Principles of Technology

Scientific Research and Design

The document reflects revisions to the career and technical education (CTE) Texas Essential Knowledge and Skills (TEKS) that have been recommended by the State Board of Education's TEKS review work groups for two courses that can satisfy a graduation requirement in science: **Principles of Technology and Scientific Research and Design.**

Proposed additions are shown in green font with underline (additions). Proposed deletions are shown in red font with strikethroughs (~~deletions~~). Text proposed to be moved from its current student expectation is shown in purple italicized font with strikethrough (*~~moved text~~*) and is shown in the proposed new location in purple italicized font with underlines (*new text location*). Numbering for the knowledge and skills statements in the document will be finalized when the proposal is prepared to file with the *Texas Register*.

Comments in the right-hand column provide explanations for the proposed changes. The following notations may be used as part of the explanations.

Abbreviation	**Description**
CCRS	refers to the College and Career Readiness Standards
Cross	refers to the cross disciplinary standards for the CCRS
ELA	refers to English language arts
Gap Analysis	refers to gap analysis report on essential knowledge and skills aligned to in-demand high-wage occupations
KS	refers to knowledge and skills statement
SE	refers to student expectation
IPC	refers to Integrated Physics and Chemistry

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§127.745. Applied Physics and Engineering ~~Principles of Technology~~ (One Credit), Adopted 2024 ~~2015~~.		
	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 10-12. Prerequisites: one credit of ~~high school science~~ Algebra I and two credits of high school science. Students must meet the 40% laboratory and fieldwork requirement. This course satisfies a high school science graduation requirement. Students shall be awarded one credit for successful completion of this course.	Change of course title to reflect alignment to physics and engineering and avoid confusion with technology = IT and reflects the higher rigor than a principles course. Prerequisites: two course option, move out of level one for program of study refresh. Added two credits of high school science so students have flexibility. Quite a bit of math in the course so leaving Algebra I was a prereq is necessary. In order to meet the CCRS students need to meet the foundation requirements for Physics.
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.	
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	Outcome based on Program of Study Refresh may or may not require this to be edited.
(3)	In Principles of Engineering and Applied Physics, ~~Principles of Technology,~~ students will conduct laboratory and field investigations, use scientific and engineering practices 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.	To incorporate engineering practices

(4)	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.	
(5)	Scientific hypotheses and theories. Students are expected to know that:	
(A)	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; and	
(B)	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.	
(6)	Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.	
(A)	Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.	
(B)	Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.	

(7)	Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. 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).	
(8)	Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. 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, while models allow for boundary specification and provide tools for understanding the ideas presented. 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.	
~~(4)~~	~~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 currently scientifically testable by empirical science.~~	
~~(5)~~	~~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.~~	
~~(6)~~	~~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).~~	
~~(7)~~	~~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.~~	

(9) (8)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations, and other leadership or extracurricular organizations,. or practical, hands-on activities or experiences through which a learner interacts with industry professionals in a workplace, which may be an in-person, virtual, or simulated setting. Learners prepare for employment or advancement along a career pathway by completing purposeful tasks that develop academic, technical, and employability skills.	Includes the Tri-Agency Continuum of Work-Based Learning
(10) (9)	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)	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	
(A)	demonstrate knowledge of how to dress appropriately, speak politely, and conduct oneself in a manner appropriate for the profession;	
(B)	show the ability to cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome;	CCRS Cross Disp IE.2
(C)	present written and oral communication in a clear, concise, and effective manner;	CCRS ELA, IA.3, IA.5, 3A.4, 3.A4 CCRS Cross Disp IIB.1
(D)	demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and	
(E)	demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed.	
(2)	Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	
(A)	ask questions and define problems based on observations or information from text, phenomena, models, or investigations;	CCRS ELA IIA.1, IIA.2
(B)	apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;	

(C)	use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;	
(D)	use appropriate tools such as ammeters, balances, ballistic carts or equivalent, batteries, calipers, Celsius thermometers, consumable chemicals, collision apparatus, computers and modeling software, constant velocity cars, data acquisition probes and software, discharge tubes with power supply (H, He, Ne, Ar), dynamics and force demonstration equipment, electroscopes, electrostatic generators, electrostatic kits, friction blocks, graphing technology, hand-held visual spectroscopes, hot plates, iron filings, laser pointers, light bulbs, macrometers, magnets, magnetic compasses, mass sets, metric rulers, meter sticks, models and diagrams, motion detectors, multimeters, optics bench, optics kit, optic lenses, pendulums, photogates, plane mirrors, polarized film, prisms, protractors, resistors, ripple tank with wave generators, rope or string, scientific calculators, simple machines, slinky springs, springs, spring scales, standard laboratory glassware, stopwatches, switches, tuning forks, timing devices, trajectory apparatus, voltmeters, wave motion ropes, wires, or other equipment and materials that will produce the same results.	Align to Physics and Integrated Chemistry and Physics TEKS (c)(1)(D)
(E)	collect quantitative data using the International System of Units (SI) and qualitative data as evidence;	CCRS Math IVA.1
(F)	organize quantitative and qualitative data using notebooks or engineering journals, bar charts, line graphs, scatter plots, data tables, equations, conceptual mathematical relationships, labeled drawings and diagrams, graphic organizers such as Venn diagrams.	Align to Physics and Integrated Chemistry and Physics TEKS (c)(1)(F) Matches course Maybe come back to conceptual mathematical relationships
(G)	develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	
(H)	distinguish between ~~among~~ scientific hypotheses, theories, and laws.	Added "between" to match the language in other courses for this SE
(3)	Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:	
(A)	identify advantages and limitations of models such as their size, scale, properties, and materials;	
(B)	analyze data by identifying significant statistical features, patterns, sources of error, and limitations;	CCRS Math IC.1, VIB.3, VIB.4, VIIIA.1

(C)	use mathematical calculations to assess quantitative relationships in data; and	CCRS Math IID.1, IID.2
(D)	evaluate experimental and engineering designs.	
(4)	Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	
(A)	develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;	
(B)	communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	CCRS IA.1, IA.3, IA.5, IIIA.3
(C)	engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.	
(5)	Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:	
(A)	analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;	CCRS ELA, IA.3
(B)	relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and	
(C)	research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.	CCRS ELA IIA.1, IIA.4 CCRS Math XB.3
~~(2)~~	~~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.~~	
~~(3)~~	~~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)(4) 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 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 multimeters (current, voltage, resistance), balances, batteries, dynamics demonstration equipment, collision apparatus, lab masses, magnets, plane mirrors, convex lenses, stopwatches, trajectory apparatus, graph paper, magnetic compasses, protractors, metric rulers, spring scales, thermometers, and slinky springs;~~	
~~(G)~~	~~use a wide variety of additional course equipment as appropriate such as ripple tank with wave generator, wave motion rope, tuning forks, hand-held visual spectroscopes, discharge tubes with power supply (H, He, Ne, Ar), electromagnetic spectrum charts, laser pointers, micrometer, caliper, computer, data acquisition probes, scientific calculators, graphing technology, electrostatic kits, electroscope, inclined plane, optics bench, optics kit, polarized film, prisms, pulley with table clamp, motion detectors, photogates, friction blocks, ballistic carts or equivalent, resonance tube, stroboscope, resistors, copper wire, switches, iron filings, and/or other equipment and materials that will produce the same results;~~	
~~(H)~~	~~make measurements and record data with accuracy and precision using scientific notation and International System (SI) units;~~	
~~(I)~~	~~organize, evaluate, and make inferences from data, including the use of tables, charts, and graphs;~~	

~~(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; and~~	
~~(K)~~	~~express relationships among physical variables quantitatively, including the use of graphs, charts, and equations.~~	
~~(4)~~	~~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)~~	~~analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, 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)~~	~~explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society;~~	
~~(D)~~	~~research and describe the connections between physics and future careers; and~~	
~~(E)~~	~~express, manipulate, and interpret relationships symbolically to make predictions and solve problems mathematically.~~	
(6)	The student thinks critically and creatively to devise a system or process in applying fundamental engineering designs needed for a project to meet desired needs and specifications within constraints. The student is expected to:	Insert Applied Engineering TEKS 6, took concepts from secondary course and college expectations to make sure the design process, evaluative efforts and customer focus was added.
(A)	apply the design process to multiple solutions or prototypes through the development and initial planning, executing, monitoring and controlling, and evaluating, improving upon and closing a project;	
(B)	use problem-solving techniques to develop technological solutions;	CCRS Math VIIIC.1, VIIIC.2
(C)	create, conduct, and communicate the findings of a customer needs assessment in writing and through collaborative conversation; and	CCRS ELA IA.2, IA.3, IA.5, IIIA.2, IIIIA.1,IIIIA.2,
(D)	assess the risks or trade-offs and benefits of a design solution, such as accessibility, aesthetics, codes, cost, functionality, ethical considerations, or sustainability.	
(7) ~~(5)~~	The student uses the scientific and engineering practices ~~process~~ to investigate physical concepts and phenomena. The student is expected to:	Engineering practices brings in concept of applying physics

(A)	develop and test ~~demonstrate an understanding that~~ scientific and engineering hypotheses ~~are tentative and testable statements~~ that must be capable of being supported by observational evidence;	Included engineering and better verb choice
(B)	compare ~~demonstrate an understanding that~~ scientific theories and apply them appropriately ~~are~~ based on physical phenomena~~,~~ such as wave behavior and heat transfer. ~~and are capable of being tested by multiple independent researchers;~~	Better verb usage,
(C)	design procedures to conduct an investigation ~~design and implement investigative procedures;~~	Better verb choice
~~(D)~~	~~demonstrate the appropriate use and care of laboratory equipment;~~	This SE is covered in 2.C.
(D) ~~(E)~~	perform ~~demonstrate~~ accurate measurements ~~*techniques*~~ using precision instruments and proper *techniques;*	
~~(F)~~	~~record data using scientific notation and International System (SI) of units;~~	This SE is covered in 2.E.
(E) ~~(G)~~	identify and quantify causes and effects of uncertainties in measured data;	
(F) ~~(H)~~	analyze and interpret ~~organize and evaluate~~ data~~, including the use of~~ using equations, tables, charts, and graphs to reveal potential patterns, trends, and sources of error;	Organize was deleted since included in SE 2.F. Added interpret to allow students to find potential patterns, trends, and sources of error.
(G) ~~(I)~~	communicate conclusions supported through various methods such as laboratory reports, labeled drawings, graphic organizers, journals, summaries, oral reports, or technology-based reports~~; and~~	CCRS ELA IA.5
~~(J)~~	~~record, express, and manipulate data using graphs, charts, and equations.~~	Covered in other SE 2.F
(8) ~~(6)~~	The student demonstrates appropriate safety techniques in the field and laboratory environments. The student is expected to:	
~~(A)~~	~~master relevant safety procedures;~~	Redundant with Science and Engineering safety KSs and SEs
(A) ~~(B)~~	~~comply~~ locate and use ~~with~~ safety guidelines as described in various manuals, instructions, and regulations;	Strong verb usage
(B) ~~(C)~~	identify, ~~and~~ classify, and properly dispose of hazardous materials and wastes; and	rephrased parts of 6C to be in 6B
(C) ~~(D)~~	evaluate factors such as cost, recyclability and disposal when mak~~e~~ing ~~prudent~~ choices in the conservation and use of resources ~~and the appropriate disposal of hazardous materials and wastes.~~	Listed examples of conservation and what students should do i.e. evaluate the use

(9) (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:;	CCRS Math IID.1, VIB.2, VIC.2
(B) (i)	define scalar and vector quantities using and describing one-dimensional equations and graphical vector addition for displacement, distance, speed, velocity, average velocity, frames of reference, acceleration, and average acceleration;	Post-secondary instructors want to see entry level students have more knowledge on these topics CCRS Math IIIC.1, IVC.3, IXC.1, IXC.2
(C) (ii)	generate and interpret relevant equations using graphs and charts for two-dimensional motion, including:	One-dimensional and two-dimensional motion are best covered separately
(D)	explain and apply concepts of using and describing two-dimensional equations for using projectile and circular motion with vectors; and	CCRS Math IID.1, VIB.2, VIC.2
(E) (iii)	using and describing vector forces and resolution; and	Covered in 7(A)(i) and 7(A)(ii). Resolution is a topic to cover in another course
(B)	describe and calculate the effects of forces on objects, including law of inertia and impulse and conservation of momentum, using methods, including free-body force diagrams.	
(F)	explain and apply the concepts of equilibrium and inertia as represented by Newton's first law of motion using relevant real-world examples such as rockets, satellites, and automobile safety devices;	From Physics 5.E.
(G)	conduct investigations that include calculations to observe the effect of forces on objects, including tension, friction, normal, gravity, centripetal, and applied forces, using free body diagrams and the relationship between force and acceleration as represented by Newton's second law of motion;	From Physics 5.F. Reinforces the hands-on nature of this course. Reword indicate the role calculations play in standard CCRS Math IID.1, VIB.2, VIC.2
(H)	conduct or design investigations such as those that involve rockets, tug-of-war, or balloon cars to illustrate and analyze the simultaneous forces between two objects as represented in Newton's third law of motion using free body diagrams;	From Physics 5.G. Reinforces the hands-on nature of this course.
(I)	design a model such as one that involves planetary motion to determine how the magnitude of force between two objects depends on their masses and the distance between their centers, and predict the effects on objects in linear and orbiting systems using Newton's law of universal gravitation.	From Physics 5.H. Reinforces the hands-on nature of this course.

(J)	apply engineering practices to conservation of momentum and impulse concepts to design, evaluate, and refine a device to minimize the net force on objects during collisions such as those that occur during vehicular accidents, sports activities, or the dropping of personal electronic devices; and	From IPC 5.C. Reinforces hands-on nature of this course.
(K)	*describe and calculate the mechanical energy of, the power generated within, the impulse applied to, and the momentum of a physical system.* ~~*; and*~~	Moved from 9.C.
(10) ~~(8)~~	The student describes the nature of forces in the physical world. The student is expected to:	
~~(A)~~	~~describe the concepts of gravitational, electromagnetic, weak nuclear, and strong nuclear forces;~~	No longer in Physics TEKS
~~(B)~~	~~describe and calculate the magnitude of gravitational forces between two objects;~~	Covered in 7.J.
(A) ~~(C)~~	predict how the magnitude of the electric force between two objects depends on their charges and the distance between their centers using Coulomb's law; ~~describe and calculate the magnitude of electric forces;~~	Brought in from Physics TEKS 6.A
(E) ~~(D)~~	build models such as generators, motors, and transformers that show how electric, magnetic, and electromagnetic forces and fields work in everyday life. ~~describe the nature and identify everyday examples of magnetic forces and fields~~;	Brought in from Physics TEKS 6.B
~~(E)~~	~~describe the nature and identify everyday examples of electromagnetic forces and fields;~~	Covered in 8.D
(B) ~~(F)~~	test a variety of ~~characterize~~ materials to determine conductive or insulative properties ~~as conductors or insulators~~ based on their electric properties; ~~and~~	Brings in engineering practice
(C) ~~(G)~~	use engineering principles to design, evaluate, and refine series and parallel circuits using schematics, digital resources, and materials such as switches, wires, resistors, lightbulbs, batteries, multimeters, voltmeters, and ammeters; ~~design and construct both series and parallel circuits and calculate current, potential difference, resistance, and power of various circuits~~	From Physics TEKS 6.C. and brings in engineering practice
(D)	construct both series and parallel circuits and use Ohm's Law to calculate current, potential difference, resistance, and power of various real-world circuits such as models of in-home wiring, automobile wiring, and simple electrical devices; and	Combines Physics and IPC TEKS and real-world and hands on

(11) ~~(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 using examples; and	
~~(C)~~	~~*describe and calculate the mechanical energy of, the power generated within, the impulse applied to, and the momentum of a physical system; and*~~	Moved to 7.L
(C) ~~(D)~~	describe and apply the laws of conservation of energy to a physical system ~~and conservation of momentum~~.	Momentum is covered in 7.K
(12) ~~(10)~~	The student analyzes the concept of thermal energy. The student is expected to~~:~~ ~~explain technological examples such as solar and wind energy that illustrate the four laws of thermodynamics and the processes of thermal energy transfer.~~	Expand thermal energy since it is important in real-world engineering applications
(A)	explain the laws of thermodynamics and how they relate to systems such as engines, heat pumps, refrigeration, solar, and heating and air conditioning;	
(B)	investigate and demonstrate the movement of thermal energy through various states of matter by convection, conduction, and radiation through environmental and man-made systems; and	From IPC TEKS 6.D
(C)	apply engineering principles to design, construct, and test a device or system that either minimizes or maximizes thermal energy consumption and perform a cost-benefit analysis such as comparing materials, energy sources that are renewable and nonrenewable.	Brings in engineering application
(13) ~~(11)~~	The student analyzes the properties of wave motion and optics. The student is expected to:	
(A)	examine and describe oscillatory motion using pendulums and wave propagation in various types of media;	
(B)	investigate and analyze characteristics of waves, including period, velocity, frequency, amplitude, and wavelength;	
(C)	investigate and calculate the relationship between wave speed, 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 and explain behaviors of waves, including reflection, refraction, diffraction, interference, resonance, polarization, and the Doppler effect; and	
(F)	describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens.	
~~(12)~~	~~The student analyzes the concepts of atomic, nuclear, and quantum phenomena. The student is expected to:~~	Covered in Chemistry and IPC TEKS
~~(A)~~	~~describe the photoelectric effect and the dual nature of light;~~	
~~(B)~~	~~compare and explain emission spectra produced by various atoms;~~	
~~(C)~~	~~calculate and describe the applications of mass-energy equivalence;~~	
~~(D)~~	~~describe the process of radioactive decay given an isotope and half-life;~~	
~~(E)~~	~~describe the role of mass-energy equivalence for areas such as nuclear stability, fission, and fusion; and~~	
~~(F)~~	~~explore technology applications of atomic, nuclear, and quantum phenomena using the standard model such as nuclear stability, fission, and fusion, nanotechnology, radiation therapy, diagnostic imaging, semiconductors, superconductors, solar cells, and nuclear power.~~	

§127.758. Scientific Research and Design (One Credit), Adopted 2024 2015.

TEKS with edits		Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Biology, Chemistry, Integrated Physics and Chemistry (IPC), or Physics. Students must meet the 40% laboratory and fieldwork requirement. This course satisfies a high school science graduation requirement. Students shall be awarded one credit for successful completion of this course. Students may take this course with different course content for a maximum of three credits.	Prereq in math discussion: Algebra I plus one additional math, does the course require a higher level of math.
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.	
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	This course is in several programs of study. May need to remove or rethink Career Cluster
(3)	Scientific Research and Design is a broad-based course designed to allow districts and schools ~~considerable~~ flexibility to develop local curriculum to supplement a~~ny~~ program of study or coherent sequence. The course has the components of any rigorous scientific or career and technical education (CTE) ~~engineering~~ program of study from the problem identification, investigation design, data collection, data analysis, formulation, and presentation of the conclusions. All of these components are integrated with the career and technical education emphasis of helping students gain entry-level employment in high-skill, high-wage jobs and/or continue their education.	Wanted to include more than just one program of study
(4)	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.	
(5)	Scientific hypotheses and theories. Students are expected to know that:	
(A)	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; and	

(B)	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.	
(6)	Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.	CCRS Science IB.1
(A)	Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.	
(B)	Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.	
(7)	Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. 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).	
(8)	Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. 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, while models allow for boundary specification and provide tools for understanding the ideas presented. 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.	
~~(4)~~	~~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.~~	

~~(5)~~	~~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.~~	
~~(6)~~	~~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).~~	
~~(7)~~	~~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.~~	
(9) ~~(8)~~	Students are encouraged to participate in extended learning experiences such as career and technical student organizations, ~~and~~ other leadership or extracurricular organizations, or practical, hands-on activities or experiences through which a learner interacts with industry professionals in a workplace, which may be an in-person, virtual, or simulated setting. Learners prepare for employment or advancement along a career pathway by completing purposeful tasks that develop academic, technical, and employability skills.	
(10) ~~(9)~~	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)	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	
(A)	demonstrate knowledge of how to dress appropriately, speak politely, and conduct oneself in a manner appropriate for the profession;	
(B)	show the ability to cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome;	CCRS Math 2B.1
(C)	present written and oral communication in a clear, concise, and effective manner;	
(D)	demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and	
(E)	demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed.	

(2)	Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	
(A)	ask questions and define problems based on observations or information from text, phenomena, models, or investigations;	
(B)	apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;	
(C)	use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;	
(D)	use appropriate tools such as measurement and data collection tools, software, sensors, probes, microscopes, cameras, glassware etc.;	Somewhat vague…b/c of all POS.
(E)	collect quantitative data using the International System of Units (SI) and qualitative data as evidence;	
(F)	organize quantitative and qualitative data using notebooks, journals, graphs, charts, tables, spreadsheets, and drawings and models;	Listed general ways to organize since it is in several programs of study
(G)	develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	
(H)	distinguish among scientific hypotheses, theories, and laws.	
(3)	Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:	
(A)	identify advantages and limitations of models such as their size, scale, properties, and materials;	
(B)	analyze data by identifying significant statistical features, patterns, sources of error, and limitations;	
(C)	use mathematical calculations to assess quantitative relationships in data; and	
(D)	evaluate experimental and engineering designs.	

(4)	Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	
(A)	develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;	
(B)	communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	
(C)	engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.	
(5)	Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:	
(A)	analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;	
(B)	relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and	
(C)	research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.	
~~(2)~~	~~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.~~	
~~(3)~~	~~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)(4) 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 descriptive, comparative, and experimental 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 methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.	
(4)	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;	
(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)~~	~~evaluate models according to their limitations in representing biological objects or events;~~	
~~(F)~~	~~research and describe the connections between science and future careers; and~~	
~~(G)~~	~~express and interpret relationships symbolically to make predictions and solve problems mathematically, including problems requiring proportional reasoning and graphical vector addition.~~	
(6)	The student develops a proposal that centers around a scientific or engineering topic, problem, or area of interest within a specific Program of Study. The student is expected to:	
(A)	brainstorm on current and past events to establish a rationale and preliminary set of ideas for research question or questions;	Research methodology, literature review, develops a thesis, methodology (research questions)
(B)	perform a literature review and evaluate several examples related to the project;	
(C)	interact and collaborate with professionals in the field of study, such as scientific researchers and other industry professionals;	
(D)	distinguish between descriptive, comparative, or experimental research design methodologies;	
(E)	develop a research question or questions that is testable and measurable;	
(F)	justify in writing the significance and feasibility of the project;	
(G)	generate a materials list and propose a cost analysis; and	
(H)	use American Psychological Association (APA) style throughout the documentation.	
(7) ~~(5)~~	The student formulates hypotheses to guide experimentation and data collection independently or in a team. The student is expected to:	
(A)	perform background research with respect to ~~an~~ the selected investigative problem; and	
(B)	examine hypotheses generated to guide a research process by evaluating the merits and feasibility of the hypotheses.	
~~(6)~~	~~The student analyzes published research. The student is expected to:~~	
~~(A)~~	~~identify the scientific methodology used by a researcher; such as comparative,~~	

~~(B)~~(C)	identify within the project the ~~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.~~	
(8) ~~(7)~~	The student develops, ~~and~~ implements, and collects data for their investigative designs. The student is expected to:	
(A)	identify the control, independent variable and dependent variable within the research and justify the purpose of each;	CCRS Science IB.1
(B)	write the procedure of the experimental design with a schematic of the lab, materials, set up, and safety protocols;	CCRS Science IB.1
~~(A)~~	~~interact and collaborate with scientific researchers or other professionals in the field of study members of the scientific community to complete a research project;~~	CTE language Animal Science Applied Agricultural Engineering Bio-Medical Science Engineering Environmental and Natural Resources Food Science and Technology Plant Science Renewable Energy Aviation (Flight) Drone (Unmanned Flight) Geospatial Engineering and Land Surveying
~~(B)~~	~~identify and manipulate relevant variables within research situations;~~	These were combined above in the beginning SEs of 7
~~(C)~~	~~use a control in an experimental process; and~~	
~~(D)~~	~~design procedures to test hypotheses.~~	
(C)	conduct the experiment with the independent and dependent variables in place; and	CCRS Science IB.1
(D)	*record observations as they occur within an investigation* including, qualitative and quantitative observations, such as photographic evidence, logs, and tables and charts;	Moved from original 8B to 7D but numbering had to change. CCRS Science IB.1 CCRS Science IA.4
(E)	*acquire, ~~manipulate, and analyze~~ data using appropriate equipment and technology, following the rules of significant digits;*	Manipulate and analyze stay in original 8C CCRS Science IB.1

(9) ~~(8)~~	The student ~~collects,~~ organizes~~,~~ and evaluates qualitative and quantitative data obtained through experimentation. The student is expected to:	
~~(A)~~	~~differentiate between qualitative and quantitative data;~~	
(A) ~~(B)~~	~~*record observations as they occur within an investigation*~~	
(B) ~~(C)~~	~~*acquire,*~~ manipulate, and analyze data using appropriate equipment and technology, following the rules of significant digits;	Moved acquire from original 8C to a new section….which is??? CCRS Science IB.1 CCRS Science IA.4
(C)	*construct data tables to organize information collected in an experiment;*	
(D)	identify sources of random error and systematic error and differentiate between both types of error;	
(E)	report error of a set of measured data in various formats, including standard deviation and percent error;	
~~(F)~~	~~*construct data tables to organize information collected in an experiment; and*~~	Moved from original 8F to earlier in the SEs
(F) ~~(G)~~	evaluate data using statistical methods to recognize patterns, trends, and proportional relationships.	CCRS SCIENCE IA.4
(10) ~~(9)~~	The student knows how to synthesize valid conclusions from qualitative and quantitative data. The student is expected to:	
(A)	~~synthesize and~~ justify conclusions supported by research data;	
(B)	consider and ~~communicate~~ summarize alternative explanations for observations and results; and	
(C)	identify limitations within the research process and provide recommendations for additional research.	
(11) ~~(10)~~	The student communicates conclusions clearly and concisely to an audience of professionals. The student is expected to:	
(A)	construct charts, tables, and graphs using technology in order to facilitate data analysis and to communicate experimental results clearly and effectively, including oral presentation of original findings of a research project, to an audience of peers and professionals; ~~and~~	
(B)	suggest alternative explanations from observations or trends evident within the data or from prompts provided by a review panel; ~~.~~	

(C)	develop a professional portfolio of work that includes artifacts, such as, the proposal, written procedures, methodology, iterations, interviews and check ins with professionals, changes within the experiment, photographic evidence;	CCRS Science IB.1
(D)	develop a plan of action on how to present to a targeted audience;	
(E)	practice a professional presentation with peers and other educators using a rubric to measure content, skill, and performance	
(F)	review artifacts used in the communication of the presentation for errors, grammar professional standards, and citations.	