Science TEKS Review Work Group D Draft Recommendations

Draft Recommendations
Texas Essential Knowledge and Skills (TEKS) Science, Other High School Courses

The document reflects draft recommendations to the science Texas Essential Knowledge and Skills (TEKS) that have been recommended by the State Board of Education's TEKS review work group for Aquatic Science, Astronomy, Environmental Systems, and a new high school science course, Specialized Topics in Science. 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*). The TEKS for the proposed new Specialized Topics in Science course are shown in black underline (new course). 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.

CCRS: refers to the College and Career Readiness Standards

Framework: refers to *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*

SCIENCE, OTHER HIGH SCHOOL COURSES

Science TEKS Review Work Group D Draft Recommendations

§112.32. Aquatic Science, Beginning with School Year 2010-2011		
TEKS with edits		Work Group Comments/Rationale
(c)	**Knowledge and skills.**	
(1)	**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 explain phenomena, or design solutions using appropriate tools and models. The student is expected to:** ~~**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 separate Scientific and Engineering Practices Work Group developed recommendations for revisions to the current process skills for K-12, which have been incorporated into the Work Group C recommendations chart.
(A)	ask questions and define problems based on observations or information from text, phenomena, models, or investigations; ~~demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms; and~~	
(B)	apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems; ~~demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.~~	
(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 Global Positioning System (GPS), Geographic Information System (GIS), weather balloons, buoys, water testing kits, meter sticks, metric rulers, pipettes, graduated cylinders, standard laboratory glassware, balances, timing devices, pH meters or probes, various data collecting probes, thermometers, calculators, computers, internet access, turbidity testing devices, hand magnifiers, work and disposable gloves, compasses, first aid kits, field guides, water quality test kits or probes, 30-meter tape measures, tarps, ripple tanks, trowels, screens, buckets, sediment samples equipment, cameras, flow meters, cast nets, kick nets, seines, computer models, spectrophotometers, stereomicroscopes, compound microscopes, clinometers, and field journals, various prepared slides, hand lenses, hot plates, Petri dishes, sampling nets, waders, leveling grade rods (Jason sticks), protractors, inclination and height distance calculators, samples of biological specimens or structures, core sampling equipment, fish tanks and associated supplies, hydrometers, and dichotomous keys.	Work Group D added appropriate scientific tools for this course.

(E)	collect quantitative data using the International System of Units (SI) and qualitative data as evidence;	
(F)	organize quantitative and qualitative data using probeware, spreadsheets, lab notebooks or journals, models, diagrams, graphs paper, computers or cellphone applications	Work Group D added appropriate organizers for this course.
(G)	develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	
(H)	distinguish among scientific hypotheses, theories, and laws.	
(2)	**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:** ~~**Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:**~~	
(A)	identify advantages and limitations of models such as their size, scale, properties, and materials; ~~know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;~~	
(B)	analyze data by identifying significant statistical features, patterns, sources of error, and limitations; ~~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)	use mathematical calculations to assess quantitative relationships in data; and ~~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)	evaluate experimental and engineering designs. ~~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 and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:** ~~**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)	develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories; ~~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 explanations and solutions individually and collaboratively in a variety of settings and formats; and ~~communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;~~	
(C)	engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence. ~~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)	**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 connections between grade-level appropriate science concepts and science, technology, engineering, and mathematics (STEM) careers.	
(5)	**Science concepts. The student understands how the properties of water build the foundation of aquatic ecosystems. The student is expected to:**	Rationale: New knowledge and skills statement and associated student expectations were added to emphasize the importance of water's unique properties. Knowledge and skill statement and associated student expectations were added to the beginning of the content standards because they are foundational for all understanding that flows from them.
(A)	describe how the shape and polarity of the water molecule make it a "universal solvent" in aquatic systems;	
(B)	identify how aquatic ecosystems are affected by water's properties of adhesion, cohesion, surface tension, heat capacity, and thermal conductivity; and	
(C)	explain how the density of water is critical for organisms in cold environments.	
(6) ~~(4)~~	**Science concepts. Students know that aquatic environments are the product of *interactions* among Earth systems ~~*interactions.*~~ The student is expected to:**	Rationale: Language change to improve clarity of the KS.
(A)	identify key features and characteristics of atmospheric, geological, hydrological, and biological systems as they relate to aquatic environments;	
(B)	describe the interrelatedness of atmospheric, geological, hydrological, and biological systems in aquatic ecosystems including positive and negative feedback loops; and ~~apply systems thinking to the examination of aquatic environments, including positive and negative feedback cycles; and~~	Rationale: New standard crafted to clarify and incorporate systems thinking into the curriculum, and the verb was changed to improve the balance of higher order thinking overall.

(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, and buoys, etc. to model interactions that affect aquatic ecosystems.	Rationale: The word "global" was deleted to provide greater latitude for data selection. Language was added to focus expectation on modeling to improve connections to science and engineering practices.
(7) ~~(11)~~	**Science concepts. The student knows about the interdependence and interactions that occur in aquatic environments. The student is expected to:**	Rationale: Knowledge and skills statement and associated student expectations were moved here from 11 because they are more closely related in content to knowledge and skills statement 6.
(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) ~~(C)~~	*identify biological, chemical, geological, and physical components of an aquatic life zone as they relate to the organisms in it;*	Rationale: Student expectation 10.C moved to knowledge and skills statement 7 because it better aligns with the content in knowledge and skills statement 7.
(C)	identify variables that affect the solubility of carbon dioxide and oxygen in water;	Rationale: New student expectation was added to include relevant content previously not addressed in the standards.
(D) ~~(B)~~	evaluate ~~the~~ factors affecting aquatic population cycles such as lunar cycles, temperature variations, hours of daylight, predator-prey relationships; and	Rationale: Language was changed to make more open to topics that impact aquatic population cycles and to clarify for newer teachers
(E) ~~(D)~~	*identify the interdependence of organisms in an aquatic environment such as in a pond, river, lake, ocean, or aquifer and the biosphere.*	Rationale: Student expectation moved from existing knowledge and skills statement 5 for improved instructional alignment to interdependence in new knowledge and skills statement 7.
(8) ~~(5)~~	**Science concepts. The student conducts short-term and long-term studies on local aquatic environments. Local natural environments are to be preferred over artificial or virtual environments. The student is expected to:**	Rationale: The words "Short term" were added to extend opportunities for small scale environmental changes that occur such as nitrates in a fish tank.
(A)	evaluate data over a period of time from an established aquatic environment documenting seasonal changes and the behavior of organisms;	

(B)	collect and analyze ~~baseline~~ ~~quantitative~~ ~~*data*~~, ~~including~~ pH, salinity, temperature, mineral content, nitrogen compounds, dissolved oxygen, and turbidity *data* periodically starting with *baseline* measurements; and ~~from an aquatic environment;~~	Rationale: Language was changed to include baseline data for comparison as well as to better align with the new wording the knowledge and skills statement.
(C)	use data from short- or long-term studies to analyze interrelationships among producers, consumers, and decomposers in ~~a local~~ aquatic ecosystems. ~~ecosystem~~	Rationale: Language was added to tie back to the knowledge and skills statement, and the word "local" was deleted to make instructional opportunities more viable throughout Texas.
~~*(D)*~~	~~*identify the interdependence of organisms in an aquatic environment such as in a pond, river, lake, ocean, or aquifer and the biosphere.*~~	Rationale: Student expectation 8.D moved to knowledge and skills statement 7 for improved instructional alignment.
(9) ~~(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; and~~.~~	
(C)	explain how tidal cycles influence intertidal ecology.	Rationale: New student expectation created to include information pertaining to tides.
(10) ~~(7)~~	**Science concepts. The student knows the origin and potential uses of freshwater ~~in a watershed.~~ The student is expected to:**	Rationale: Knowledge and skills statement changed to reflect broader understanding of fresh water sources and usage in the student expectations.
(A)	identify sources ~~and determine the amounts~~ of water in a watershed, including rainfall, groundwater, and surface water;	Rationale: Language deleted to improve clarity of the expectation and to eliminate redundancy.
(B)	identify factors that contribute to how water flows through a watershed; ~~and~~	
(C)	analyze water quantity and quality in a local watershed or aquifer; and	Rationale: Language added to emphasize aquifers as a significant source of fresh water and examine it as a resource.

(D)	describe human uses of freshwater and how human freshwater use competes with that of other organisms.	Rationale: New student expectation created to link the "use" from the knowledge and skills statement into a relevant student expectation. While this new student expectation does address human interactions, the workgroup felt it was best to keep here because it addresses "uses" of water as stated in the knowledge and skills statement. The new standard also emphasizes humans as an organism that competes with other organisms in the environment as well.
(11) ~~(8)~~	**Science concepts. The student knows that geological phenomena and fluid dynamics affect aquatic systems. The student is expected to:**	
(A)	examine ~~demonstrate~~ basic principles of fluid dynamics, including hydrostatic pressure, density, salinity, and buoyancy;	Rationale: Verb was changed to "examine" to provide greater flexibility in approaches in teaching the standard for the inclusion of lab equipment, or examining of data, or potential labs to provide instruction.
(B)	identify interrelationships between ocean currents, climates, and geologic features such as continental margins, active and passive margins, abyssal planes, island atolls, peninsulas, barrier islands, and hydrothermal vents;	Rationale: Language was added to make explicit which features to be included as geological features in instruction.
(C)	~~describe and~~ explain how fluid dynamics causes ~~in an~~ upwelling and lake turnover; and	Rationale: Language was changed to help make instruction more explicit.
(D)	describe how erosion and deposition in river systems lead to formation of geologic features.	Rationale: New student expectation created to address specific geological features pertaining to river systems as it was not implicit in any of the student expectations as written.
(12) ~~(9)~~	**Science concepts: The student understands the types of aquatic ecosystems. ~~The student knows the types and components of aquatic ecosystems.~~ The student is expected to:**	Rationale: Previous knowledge and skills statement was divided into two separate knowledge and skills statements to clarify and simplify for instruction.
(A)	differentiate among freshwater, brackish, and saltwater ecosystems; and	
(B)	identify the major properties and components of different marine and freshwater life zones. ~~; and~~	Rationale: The word "and" was deleted in keeping with document style for the last standard in a knowledge and skills statement.

(C)	*~~identify biological, chemical, geological, and physical components of an aquatic life zone as they relate to the organisms in it.~~*	Rationale: Student expectation 10.C moved here to knowledge and skills statement 12 for improved instructional alignment
(13) ~~(10)~~	**Science concepts. The student knows environmental adaptations of aquatic organisms. The student is expected to:**	
(A)	compare different traits in ~~classify different~~ aquatic organisms using tools such as dichotomous keys;	Rationale: Wording changed to align more closely with the knowledge and skills statement and to build up to student expectation (B).
(B)	compare and describe how adaptations allow an organism to exist within an aquatic environment; and	
(C)	compare ~~differences in~~ adaptations of freshwater ~~aquatic organisms to~~ ~~fresh water~~ and marine organisms ~~environments~~.	Rationale: Language was changed to clarify the student expectation.
(14) ~~(12)~~	**Science concepts. The student understands how human activities impact aquatic environments. The student is expected to:**	
(A) ~~(B)~~	analyze the cumulative impact of human population growth on an aquatic system; and	Rationale: Original positions of student expectations A and B were reversed to facilitate instructional alignment.
(B) ~~(A)~~	predict effects of chemical, organic, physical, and thermal changes from humans on the living and nonliving components of an aquatic ecosystem.~~;~~	
(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; ~~an~~	
(E)	describe ~~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; and~~.~~	Rationale: Group changed the verb to make content in the standard more assessable.
(F)	analyze the purpose and effectiveness of human efforts to restore aquatic ecosystems affected by human activities.	Rationale: New student expectation F created to help incorporate engineering practices with respect to content of the knowledge and skills statement and human activity, and to demonstrate the reciprocity of the environment to show positive effects of human activity to help remediate environmental damage in aquatic ecosystems.

Science TEKS Review Work Group D Draft Recommendations

§112.33. Astronomy, Beginning with School Year 2010-2011 (One Credit).		
	TEKS with edits	Work Group Comments/Rationale
(c)	**Knowledge and skills.**	
(1)	**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 explain phenomena, or design solutions using appropriate tools and models. The student is expected to:** ~~**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 separate Scientific and Engineering Practices Work Group developed recommendations for revisions to the current process skills for K-12, which have been incorporated into the Work Group D recommendations chart.
(A)	ask questions and define problems based on observations or information from text, phenomena, models, or investigations; ~~demonstrate safe practices during laboratory and field investigations; and~~	
(B)	apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems; ~~demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.~~	
(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 gnomons; sundials; Planisphere; star charts; globe of the Earth; diffraction gratings; spectroscopes; color filters; lenses of multiple focal lengths; concave, plane, and convex mirrors; binoculars; telescopes; celestial sphere; online astronomical databases; and online access to observatories;	Work Group D added appropriate scientific tools for this course.
(E)	collect quantitative data using the International System of Units (SI) and qualitative data as evidence;	
(F)	organize quantitative and qualitative data using graphs, charts, spreadsheets, and computer software;	Work Group D added appropriate organizers for this course.
(G)	develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	
(H)	distinguish among scientific hypotheses, theories, and laws.	

(2)	**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:** ~~**Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:**~~	
(A)	identify advantages and limitations of models such as their size, scale, properties, and materials; ~~know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;~~	
(B)	analyze data by identifying significant statistical features, patterns, sources of error, and limitations; ~~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)	use mathematical calculations to assess quantitative relationships in data; and ~~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)	evaluate experimental and engineering designs. ~~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 and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:** ~~**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)	develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories; ~~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 explanations and solutions individually and collaboratively in a variety of settings and formats; and ~~communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;~~	
(C)	engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence. ~~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)	**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.	

(5) ~~(4)~~	**Science concepts. The student understands how ~~recognizes the importance and uses of~~ astronomy influenced and advanced ~~in~~ civilizations. The student is expected to:**	CCRS - IX.C.1. Describe the structure and motions of the solar system and its components & 2. Possess a scientific understanding of the formation of the solar system. CCRS - IV.C.1 - Understand the historical development of major theories in science Framework – Earth and Space Science (ESS) 1.b Rationale: verb changed to make the SE measurable and specific; broadened to include both uses and influences of astronomy
(A)	evaluate and communicate how ancient civilizations developed models of the Universe using astronomical structures, instruments, and tools, including the astrolabe, gnomons, and charts, and how those models influenced society, time keeping, and navigation ~~research and describe the use of astronomy in ancient civilizations such as the Egyptians, Mayans, Aztecs, Europeans, and the native Americans~~;	Rationale: removed names of specific civilizations to allow inclusion of globally representative societies; specified what was meant by "use of astronomy;" increased the rigor of the verbs.
(B)	research and evaluate ~~describe~~ the contributions of scientists as astronomy progressed from a geocentric model to a heliocentric model ~~to our changing understanding of astronomy~~, including Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo, and Newton~~, Einstein, and Hubble, and the contribution of women astronomers, including Maria Mitchell and Henrietta Swan Leavitt~~;	CCRS - IV.C.2. Rationale: Increased the rigor by changing the verb; better aligned the SE to the KS; defined the time period, adjusted the list of scientists, and edited to have students follow the path of knowledge & thought that led to our current understanding of astronomy.
(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.~~	Rationale: concepts moved to proposed 11.B. (asteroids) and 12.D. (the Sun's effects)

Science TEKS Review Work Group D Draft Recommendations

(6) ~~(5)~~	**Science concepts. The student conducts and explains astronomical observations made from the point of reference of Earth ~~develops a familiarity with the sky~~. The student is expected to:**	Framework: Physical Sciences (PS) 2.C – stability/instability in systems; ESS1.A Rationale: Reworded to be more precise & measurable and increased the rigor
(A)	observe, ~~and~~ record, and analyze the apparent movement of the Sun, moon, and stars to predict sunrise, sunset, moonrise, and moonset ~~and Moon during the day~~;	CCRS - I.A.4. Rationale: combined (A) & (B) and increased the rigor by having students use their data to predict motion;
(B)	observe ~~and record~~ the ~~apparent~~ movement of ~~the Moon,~~ planets throughout the year and measure their positions changing relative to the constellations~~, and stars in the nighttime sky~~; and	CCRS - IX.D. Rationale: new SE for the remaining portion of 5.B. (planets and stars); focuses on a common misconception about the relative movement of planets
(C)	~~recognize and~~ identify constellations such as Ursa Major, Ursa Minor, Orion, Cassiopeia, and constellations along the ecliptic and describe their importance ~~of the zodiac~~.	Rationale: rewritten to avoid the term "zodiac" and direct reference to astrology and use the scientific term; increased the rigor and depth of the SE; connects to importance of astronomy to civilizations (proposed 5.A.).
(7) ~~(6)~~	**Science concepts. The student knows our relative place in the Milky Way ~~space~~. The student is expected to:**	Framework: ESS1.A Rationale: narrowed to the solar system to focus this KS; adding the term "relative" addresses the misconceptions around size, distance, and motion; relative place in the universe is covered in proposed KS 14.
(B) ~~(A)~~	model ~~compare and contrast~~ the scale, size, and distance of the Sun, Earth, and moon ~~Moon~~ system and identify the limitations of physical models ~~through the use of data and modeling~~;	CCRS - VI.C. estimate actual sizes of objects based on scale drawings Rationale: verbs changed to increase rigor and clarity, to connect to the Framework (scale & proportion, systems & system models) and SEP 2.A.; discussion of limitations addresses student misconceptions of scale

Science TEKS Review Work Group D Draft Recommendations

(C) ~~(B)~~	model ~~compare and contrast~~ the scale, sizes, and distances of ~~objects in the solar system such as~~ the Sun and the planets in our solar system and identify the limitations of physical models ~~through the use of data and modeling~~; and	Rationale: reworded to parallel (B); increased rigor; Framework & SEP connections; discussion of limitations addresses student misconceptions of scale; B-D increases the size & complexity of the systems at different scales
(D) ~~(C)~~	model ~~examine~~ the scale, size, and location ~~and distance,~~ of our solar system within the ~~stars,~~ Milky Way.~~, and other galaxies through the use of data and modeling;~~	Rationale: reworded to parallel (B); increased rigor; Framework & SEP connections; discussion of limitations addresses student misconceptions of scale; B-D increases the size & complexity of the systems at different scales
~~(D)~~	~~relate apparent versus absolute magnitude to the *distances* of celestial objects; and~~	Rationale: content was moved to proposed 13.H.; distances and absolute magnitude are less relevant within the Milky Way
(A) ~~(E)~~	demonstrate the use of units of measurement in astronomy, including Astronomical Units and light years;~~.~~	Rationale: moved to be first in this KS because it describes the way this section is measured; allows all units to be discussed at once or in the context they apply
(8) ~~(7)~~	**Science concepts. The student observes and models ~~knows~~ the interactions within ~~role of the Moon in~~ the Sun, Earth, and Moon system. The student is expected to:**	CCRS - IX.B.1. understand interactions among the sun-Earth-moon Framework: ESS1.B Rationale: brings this KS closer to the Framework; removed the term "role" because it does not make sense in this context; increased the rigor and made it more easily measurable; more inclusive
~~(A)~~	~~observe and record data about lunar phases and use that information to model the Sun, Earth, and Moon system;~~	Rationale: (A) became part of the KS

Science TEKS Review Work Group D Draft Recommendations

(A) ~~(B)~~	model how the orbit and relative position of the moon cause lunar phases and predict the timing of moonrise and moonset during each phase ~~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~~;	Framework: ESS1.B CCRS - V.E.1. use models to make predictions Rationale: increased the rigor beyond the middle school standard; incorporated SEP 3.A. & 1.G.; added prediction of moonrise and moonset to address misconception that the moon is always and only visible at night
(B) ~~(C)~~	model how the orbit and relative position of the moon cause ~~identify and differentiate the causes of~~ lunar and solar eclipses~~, including differentiating between lunar phases and eclipses~~; and	CCRS - V.E.1. use models to make predictions Rationale: increased the rigor by changing the verb to "model," and make parallel to A; directly addresses misconceptions about eclipses
(C) ~~(D)~~	examine and investigate the dynamics of tides using the Sun, Earth, moon model. ~~identify the effects of the Moon on tides.~~	Framework: ESS1.B Rationale: increased rigor beyond MS-level; addresses the effects of both moon & sun on tides
(9) ~~(8)~~	**Science concepts. The student models the cause of planetary ~~knows the reasons for the~~ seasons. The student is expected to:**	Framework: ESS1.B CCRS - V.E.1. models & prediction Rationale: made the KS more inclusive of other planets & more rigorous; incorporates other planets
(A)	examine the relationship of a planet's axial tilt to its potential seasons; ~~recognize that seasons are caused by the tilt of Earth's axis~~;	Rationale: Changed verb to increase rigor and make measurable; broadened to include other potential planetary tilts
(B)	predict ~~explain~~ how changing latitudinal position affects the length day and night throughout a planet's orbital ~~the~~ year;	Rationale: increased rigor and made measurable; broadened to include other planets
(C)	investigate the relationship between a planet's axial tilt, angle of incidence of sunlight, and concentration of solar energy ~~recognize that the angle of incidence of sunlight determines the concentration of solar energy received on Earth at a particular location~~; and	Rationale: increased rigor; made measurable; broadened to include other potential planetary tilts

(D)	explain the significance of Earth's solstices and equinoxes ~~examine the relationship of the seasons to equinoxes, solstices, the tropics, and the equator~~.	Rationale: simplified and clarified the intention and increased the rigor; removed "tropics" and "equator" because those concepts are embedded within the concepts of the solstices & equinoxes
(10)	**Science concepts. The student knows how astronomical tools collect and record information about celestial objects. The student is expected to:**	Framework: PS4.C CCRS - I.D.3. use a wide variety of apparatuses Rationale: New KS created; content moved forward in the course and is now obviously a larger portion of the curriculum than was previously reflected in the TEKS; better coordinates with Framework; incorporates SEPs 2.D. & 4.C.
(A)	investigate the use of black body radiation curves and emission, absorption, and continuous spectra in the identification and classification of celestial objects;	Framework: PS4.A, PS4.B, PS4.C Rationale: describes the underlying physics of how we learn about stars and galaxies
(B)	calculate the relative light-gathering power of different-sized telescopes to compare telescopes for different applications;	Rationale: brings in grade-level math and has students apply the math; adds depth to the KS
(C)	*analyze the importance and limitations of optical, infrared, and radio telescopes, gravitational wave detectors, and other ground-based technology ~~in astronomical studies~~;*	Rationale: moved and edited from 14.C. to group related content; increased the depth by including limitations; specified types of technology
(D)	*analyze ~~recognize~~ the importance and limitations of space telescopes in ~~to~~ the collection of astronomical data across the electromagnetic spectrum; and*	Rationale: moved and edited from 14.D. to group related content; increased the rigor by changing the verb; increased the depth by including limitations

Science TEKS Review Work Group D Draft Recommendations

(11) ~~(9)~~	**Science concepts. The student uses models to explain the formation, development, organization, and significance of solar system bodies ~~knows that planets of different size, composition, and surface features orbit around the Sun.~~ The student is expected to:**	Framework: ESS1.B CCRS - IX.C.2.a. Rationale: increased the rigor and depth beyond the elementary school standard (3.8.D.) by broadening to include formation, development, and organization and changing the verb to “model”
(D) ~~(A)~~	compare ~~and contrast~~ the factors essential to life on Earth, such as temperature, water, mass, ~~and~~ gases, and magnetic field to conditions on other planets and satellites;	Rationale: removed “contrast” because it is redundant; added “magnetic field” because it is essential to life and “satellites” because current science is exploring the possibility of life on satellites (ex. moons of Jupiter)
(C) ~~(B)~~	compare the planets in terms of orbit, size, composition, rotation, atmosphere, natural satellites, magnetic fields, and geological activity;	Framework: PS3.A Rationale: added magnetic fields to increase the depth and relate the SE to factors essential to life (D).
(A) ~~(C)~~	relate ~~the role of~~ Newton's law of universal gravitation and Kepler’s laws of planetary motion to the formation and motion of the planets ~~around the Sun and to the motion of natural~~ and ~~artificial~~ their satellites ~~around the planets; and~~	Framework: ESS.1.B CCRS - IX.C.2.a. Rationale: refined the wording to be more explicit and expanded the SE to describe the formation of the solar system; increased in depth beyond the middle school standard (proposed 6.11.B);

Science TEKS Review Work Group D Draft Recommendations

(B) ~~(D)~~	explore and communicate the origins and significance of planets, planetary rings, satellites, ~~small solar system bodies, including~~ asteroids, comets, Oort cloud, and Kuiper belt objects;~~.~~	CCRS - IX.B.2. understand the development of current scientific theories for the origin of Earth & moon CCRS - IX.C.1. Describe the structure and motions of the solar system and its components. 2. Possess a scientific understanding of the formation of the solar system. CCRS - IV.C.1. Understand the historical development of major theories in science Rationale: expanded to include all solar system bodies; reorganized for better flow
(12) ~~(10)~~	**Science concepts. The student knows that our sun serves as a model for stellar activity ~~the role of the Sun as the star in our solar system~~. The student is expected to:**	Framework: PS3.A, PS3.D, ESS1.A CCRS - IX.C.1. describe the major components of the solar system Rationale: revised to better fit the content of the SEs and flow of the course and connect to later KSs & SEs
(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;	Framework: PS1.C relationship between energy and forces CCRS - VII.K.1.e. compare and contrast the nuclear processes of fission and fusion
(C)	describe the eleven-year solar cycle, and the significance of sunspots; and	
(D)	analyze the origins and effects of space weather, including the solar wind, ~~solar magnetic storm activity, including~~ coronal mass ejections, prominences, flares, and sunspots.	Framework: ESS2.D Weather and Climate Rationale: revised to provide clarity and specificity; incorporated the concepts from 4.D. about the Sun's effect on human activities
(13) ~~(11)~~	**Science concepts. The student understands ~~knows~~ the characteristics and life cycle of stars. The student is expected to:**	Framework: ESS1.A Rationale: verb changed to be measurable
(A)	identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition;	

(B)	describe and communicate ~~characterize~~ star formation ~~in stellar nurseries~~ from nebulae ~~giant molecular clouds,~~ to protostars~~,~~ to the development of main sequence stars;	CCRS - D.1.b. life cycle of stars Rationale: unclear as written; revised to use measurable verbs & scientific terms
(C)	evaluate the relationship between mass and fusion on stellar evolution ~~the dying process and properties of stars~~;	CCRS - D.1.b. life cycle of stars Rationale: expanded to include the entire life cycle of stars
~~(D)~~	~~differentiate among the end states of stars, including white dwarfs, neutron stars, and black holes;~~	Rationale: duplicative, already part of (E)
(D) ~~(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;	Rationale: mass determines gravity, deleted the redundancy
(E) ~~(F)~~	relate the use of spectroscopy in obtaining physical data on celestial objects such as temperature, chemical composition, and relative motion; ~~and~~	Framework: PS4.A, PS4.B, PS4.C
(F) ~~(G)~~	use the Hertzsprung-Russell diagram to classify stars and plot and examine the life cycle of stars from birth to death;~~.~~	CCRS - D.1.b. life cycle of stars (H-R diagram) Rationale: edited to increase rigor from middle school; includes classification be sure that the simplest use of the HR diagram isn't the only use taught
(G)	illustrate how astronomers use geometric parallax to determine stellar distances and intrinsic luminosities; and	Rationale: new SE provides the necessary foundation to understanding distances and brightness
(H)	describe how stellar *distances* are determined by comparing apparent brightness and intrinsic luminosity when using spectroscopic parallax and the Leavitt relation for variable stars.	Rationale: moved the concept from 6.D., removed magnitude (the math involved in logarithmic relationships is too high), and more clearly defined the content using synonyms of the original

(14) ~~(12)~~	**Science concepts. The student knows the structure of the Universe and our relative place in it ~~the variety and properties of galaxies~~. The student is expected to:**	CCRS - D.1.a. Describe current scientific theories and evidence for the origin of the universe (the Big Bang) and formation of galaxies (Red Shift observations) Framework: ESS1.A Rationale: edited to fit the organization and theme of the course (our place in…); expanded to include more than just galaxies; reflects current research and conceptual model of the universe
~~(A)~~	~~describe characteristics of galaxies;~~	Rationale: very low rigor; is already part of proposed (B)
(A) ~~(B)~~	illustrate ~~recognize~~ the ~~type,~~ structure~~,~~ and components of our Milky Way galaxy and the location and movement of our solar system within it; ~~and~~	Framework: ESS2.B Rationale: verb rigor increased; reflects current research and conceptual model of the universe
(B) ~~(C)~~	compare ~~and contrast the different types of galaxies, including~~ spiral, elliptical, irregular, ~~and~~ dwarf, and active galaxies;~~.~~	Framework: ESS1.A (galaxy & its stars) CCRS - IX.D.2.a. Rationale: removed "contrast" as redundant; edited to remove the "including" because all common types are now listed
(C)	develop and use models to explain how galactic evolution occurs through mergers and collisions;	CCRS - IX.D.1.a. Formation of galaxies Rationale: new SE written; this course was previously missing the concept of the formation & evolution of galaxies, which is a huge topic in current astronomy.
(D)	describe the Local Group and its relation to larger-scale structures in the universe; and	Framework: ESS1.A, ESS2.B Rationale: new SE written; this course was previously missing the concept of astronomical structure beyond the Milky Way

(E)	evaluate the indirect evidence for the existence of dark matter.	Rationale: new SE written; moved dark matter from 13.C. to this KS because the rotational motion of galaxies provides evidence for the existence of dark matter
(15) ~~(13)~~	**Science concepts. The student knows the scientific theories of cosmology. The student is expected to:**	CCRS - IX.D.1. Understand the scientific theories for the formation of the universe. Framework: ESS1.a
(A)	~~research and~~ describe and evaluate the historical development of evidence supporting the Big Bang Theory~~, including red shift, cosmic microwave background radiation, and other supporting evidence~~;	Rationale: increased rigor beyond the middle school TEKS; clearer description of the concept
(B)	evaluate the limits of observational astronomy methods used to formulate the distance ladder;	Framework: PS4.C - Information Technologies and Instrumentation Rationale: new observational astronomy SE that ties together evidence mentioned in other SEs and increases the distance ladder
(C)	evaluate the indirect evidence for the existence of dark energy;	Rationale: new SE written; dark energy was moved from 13.C. because it is important to understand why we think that dark energy exists
(D) ~~(B)~~	~~research and~~ describe the current scientific understanding ~~theories~~ of the evolution of the universe, including estimates for the age of the universe; and	CCRS - IX.D.1.b. Rationale: verb edited because the student must research in order to describe, redundant; not all scientific understandings are scientific theories and not all current theories are scientific; allows for increased depth in the concept by discussing multiple possibilities
(E) ~~(C)~~	~~research and~~ describe the current scientific hypotheses about ~~of~~ the fate of the universe, including open and closed universes ~~and the role of dark matter and dark energy~~.	Rationale: verb edited because the student must research in order to describe; dark matter and dark energy were moved into their own SEs to allow for greater depth to the concepts; because astronomy is rapidly evolving, “the current” was added to allow for future hypotheses to be discussed

(16) ~~(14)~~	**Science concepts. The student understands ~~recognizes~~ the benefits and challenges of expanding our knowledge of the Universe ~~space exploration to the study of the universe~~. The student is expected to:**	Framework: PS4.C information technologies and instrumentation. Rationale: verb changed to be measurable; expanded, removing the limits implied by the term “space exploration” to include technology such as telescopes and probes, models, and conceptual understandings.
(A)	describe and communicate the historical development ~~identify and explain the contributions~~ of human space flight and its ~~future plans and~~ challenges;	Rationale: unclear as written, rephrased; verbs changed to be more rigorous and measurable
(B)	describe and communicate the uses and challenges of ~~recognize the advancement of knowledge in astronomy through~~ robotic space flight;	Rationale: unclear as written, rephrased; increased the rigor; allows for a discussion of the use of space flight for applications outside of astronomy
(C)	evaluate the evidence of the existence of habitable zones and potentially habitable planetary bodies in extrasolar planetary systems;	Rationale: new content, current and constantly changing research in astronomy
~~*(C)*~~	~~*analyze the importance of ground-based technology in astronomical studies;*~~	Rationale: Moved to be proposed 10.C.
~~*(D)*~~	~~*recognize the importance of space telescopes to the collection of astronomical data across the electromagnetic spectrum; and*~~	Rationale: Moved to be proposed 10.D.
(D)	evaluate the impact on astronomy from light pollution, radio interference, and space debris;	Framework: ESS3.B, ESS3.C, PS4.C Rationale: new SE written; these are ongoing problems not currently represented in the TEKS
(E)	examine current ~~demonstrate an awareness of new~~ developments and discoveries in astronomy; ~~.~~	Rationale: increased rigor, rephrased to indicate that the field is rapidly evolving
(F)	explore careers that involve astronomy, space exploration, and the technologies developed through them.	Rationale: new SE written; paralleled other science courses; includes applications outside of astronomy of technologies developed for or within astronomy

Science TEKS Review Work Group D Draft Recommendations

§112.37. Environmental Systems, Adopted 2021 ~~Beginning with School Year 2010-2011~~ (One Credit).		
	TEKS with edits	Work Group Comments/Rationale
(c)	**Knowledge and skills.**	
(1)	**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 explain phenomena, or design solutions using appropriate tools and models. The student is expected to:** ~~**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 separate Scientific and Engineering Practices Work Group developed recommendations for revisions to the current process skills for K-12, which have been incorporated into the Work Group D recommendations chart.
(A)	ask questions and define problems based on observations or information from text, phenomena, models, or investigations; ~~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)	apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems; ~~demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.~~	
(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 meter sticks, metric rulers, pipettes, graduated cylinders, standard laboratory glassware, balances, timing devices, pH meters or probes, various data collecting 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, 30 meter tape measures, tarps, shovels, trowels, screens, buckets, and rock and mineral samples equipment, air quality testing devices, cameras, flow meters, Global Positioning System (GPS) units, Geographic Information System (GIS) software, computer models, densiometers, spectrophotometers, stereomicroscopes, compound microscopes, clinometers, and field journals, various prepared slides, hand lenses, hot plates, Petri dishes, sampling nets, waders, leveling grade rods (Jason sticks), protractors, inclination and height distance calculators, samples of biological specimens or structures, core sampling equipment, kick nets, and dichotomous keys.	Work Group D added appropriate scientific tools for this course.

(E)	collect quantitative data using the International System of Units (SI) and qualitative data as evidence;	
(F)	organize quantitative and qualitative data using probeware, spreadsheets, lab notebooks or journals, models, diagrams, graphs paper, computers or cellphone applications,	Work Group D added appropriate organizers for this course.
(G)	develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	
(H)	distinguish among scientific hypotheses, theories, and laws.	
(2)	**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:** ~~**Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:**~~	
(A)	identify advantages and limitations of models such as their size, scale, properties, and materials; ~~know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;~~	
(B)	analyze data by identifying significant statistical features, patterns, sources of error, and limitations; ~~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)	use mathematical calculations to assess quantitative relationships in data; and ~~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)	evaluate experimental and engineering designs. ~~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 and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:** **~~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)	develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories; ~~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 explanations and solutions individually and collaboratively in a variety of settings and formats; and ~~communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;~~	

(C)	engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence. ~~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)	**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 connections between grade-level appropriate science concepts and science, technology, engineering, and mathematics (STEM) careers.	
(5) ~~(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;~~	Rationale: Student expectation was eliminated because dichotomous keys are listed as tools.
(A) ~~(B)~~	identify native plants and animals within a local ecosystem and compare their roles to those of plants and animals in other biomes, including aquatic, grassland, forest, desert, and tundra. ~~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;~~	Rationale: Language was changed to clarify the expectation to make more measurable and specific.
(B) ~~(C)~~	use models to explain the cycling of water, phosphorus, carbon, silicon, and nitrogen through ecosystems including sinks and human interactions that alter these cycles ~~diagram abiotic cycles, including the rock, hydrologic, phosphorus, carbon, and nitrogen cycles;~~	Rationale: Language was changed to include modeling as a way to incorporate the new science and engineering practices into the standard and to make explicit components to be included as well as to increase rigor to distinguish from TEKS in other courses (middle school).

(C) ~~(D)~~	~~make observations and compile data about fluctuations in abiotic cycles and~~ evaluate the effects of fluctuations in abiotic factors on local ecosystems and local biomes;	Rationale: Language deleted because it was incorporated into the changes made for 5C.
(D) ~~(E)~~	measure the concentration of ~~solute, solvent, and solubility of~~ dissolved substances such as dissolved oxygen, chlorides, and nitrates and describe their impacts on an ecosystem;	Rationale: Wording was simplified for clarity.
(E) ~~(F)~~	use models to predict how the introduction ~~or removal~~ of an invasive species may alter the food chain and affect existing populations in an ecosystem;	Rationale: Because species removal is not practical in real world examples, modeling was added as a verb to increase opportunities to incorporate science and engineering practices into the standard.
(F) ~~(G)~~	use models to predict how species extinction may alter the food chain and affect existing populations in an ecosystem; and	Rationale: Modeling was added as a verb to increase opportunities to incorporate science and engineering practices into the standard.
(G) ~~(H)~~	research and explain the causes of species diversity and predict changes that may occur in an ecosystem if species and genetic diversity are ~~is~~ increased or decreased.. ~~reduced~~	Rationale: Verb was changed from "is" to "are" to correct subject/verb agreement, also "reduced" was changed to "decreased" to contrast better with "increased."
(6) ~~(5)~~	**Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:**	
(A)	compare and contrast land use and management methods and how they affect land attributes such as fertility, productivity, economic value, and ecological stability; ~~summarize methods of land use and management and describe its effects on land fertility;~~	Rationale: Standard was revised to incorporate broader context of land use decisions as well as changing the verb to "compare and contrast" to increase rigor and depth of knowledge explored.
(B)	relate how water sources, management, and conservation affect water uses and quality; ~~identify source, use, quality, management, and conservation of water;~~	Rationale: Standard was reworded to better relate management and conservation practices to water use and quality.
(C)	document the use and conservation of both renewable and non-renewable resources as they pertain to sustainability;	
(D)	identify how changes in limiting resources such as water, food, and energy affect local ecosystems; ~~identify renewable and non-renewable resources that must come from outside an ecosystem such as food, water, lumber, and energy;~~	Rationale: Standard revised to improve clarity and better align to the knowledge and skills statement as previous language was unclear.

(E)	analyze and evaluate the economic significance and interdependence of resources within the local environmental system; and	Rationale: The word "local" was added to the standard to better align to the knowledge and skills statement and keep separate from current KS 10: "Science concepts. The student knows the impact of human activities on the environment. The student is expected to".
(F)	evaluate the impact of waste management methods such as reduction, reuse, recycling, upcycling, and composting on resource availability in the local environment.	Rationale: The language "in the local environment" was added to better align to the knowledge and skills statement. Also upcycling was added to the list of such as examples to include current terminology used in environmental community.
(7) ~~(6)~~	**Science concepts. The student knows the sources and flow of energy through an environmental system. The student is expected to:**	
(A)	describe the interactions between ~~define and identify~~ the components of the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere ~~and the interactions among them~~;	Rationale: Standard revised to emphasize the interactions to better align with the knowledge and skills statement, and to reduce redundancy with middle school content.
(B)	relate biogeochemical cycles to the flow of energy in ecosystems, including energy sinks such as oil, natural gas, and coal deposits;. ~~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~~	Rationale: Standard was revised to algin better with the knowledge and skills statement, and to incorporate a better understanding of how energy sinks are involved in the flow of energy in environmental systems.
(C)	explain the flow of heat energy in an ecosystem, including conduction, convection, and radiation; and	Rationale: The word "heat" was added to better align with the processes of conduction, convection and radiation which only apply to heat energy. The word "and" was added to the end of the standard to keep consistent with document style for the penultimate standard within a knowledge and skills statement.

(D)	identify and describe how energy is used, transformed, and conserved as it flows through ecosystems. ~~investigate and explain the effects of energy transformations in terms of the laws of thermodynamics within an ecosystem~~;	Rationale: New student expectation created to combine both D and E to make expectations more aligned to the knowledge and skills statement, as well to make understanding of the laws of thermodynamics more accessible and relevant to topics related to the first and second laws of thermodynamics. While language pertaining specifically to the laws of thermodynamics was removed, the relevant content of the first and second law are still conserved in C and D.
(E)	~~investigate and identify energy interactions in an ecosystem.~~	
(8) ~~(7)~~	**Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to:**	
(A)	compare exponential and logistical population growth using graphical representations; ~~relate carrying capacity to population dynamics;~~	Rationale: Standard revised to make more explicit inclusion of graphical methods used to demonstrate changes in carrying capacity.
(B)	identify factors that may alter carrying capacity such as disease, natural disaster, available food water and livable space, habitat fragmentation, and periodic changes in weather;	Rationale: New standard created to emphasize factors that impact carrying capacity.
(C) ~~(B)~~	calculate changes in population size in ecosystems; and ~~birth rates, and exponential growth of populations;~~	Rationale: Standard revised to make clear and improve alignment with the knowledge and skills statement.
~~(C)~~	~~analyze and predict the effects of non-renewable resource depletion; and~~	Rationale: Standard removed because it is covered in new 6E that compares cost benefit analysis of renewable and non-renewable resources.
(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.	

Science TEKS Review Work Group D Draft Recommendations

(9) ~~(8)~~	**Science concepts. The student knows that environments change naturally. The student is expected to:**	
(A)	analyze and describe how ~~the effects on areas impacted by~~ natural events such as tectonic movement, volcanic events, fires, tornadoes, hurricanes, flooding, *and* tsunamis, ~~*and*~~ affect natural populations ~~population growth~~	Rationale: Standard reworded to improve clarity and flow of language.
(B)	explain how regional changes in the environment may have ~~a~~ global effects;	Rationale: Standard reworded to broaden opportunities to explore multiple global effects of regional environmental changes.
(C)	examine how natural processes such as succession and feedback loops can restore habitats and ecosystems;	Rationale: Standard reworded to improve accuracy.
(D)	describe how temperature inversions have short term and long term effects ~~impact weather conditions~~, including El Niño and La Niña oscillations, ice cap and glacial melting,and changes in ocean surface temperatures; and	Rationale: Standard was revised in order to consolidate what temperature inversions do and emphasize that they have long and short-term effects.
(E)	analyze the impact of natural ~~temperature inversions on~~ global climate change ~~warming~~, on ice caps and glaciers ~~glacial melting~~, ~~and changes in~~ ocean currents, and surface temperatures.	Rationale: Standard was revised to remove inaccurate wording pertaining to the impacts of temperature inversions on global warming and to center the standard on natural global climate changes in contrast to human caused climate change.

Science TEKS Review Work Group D Draft Recommendations

(10) ~~(9)~~	**Science Concepts. The student knows how humans impact environmental systems through emissions and pollutants. The student is expected to:** ~~**Science concepts. The student knows the impact of human activities on the environment. The student is expected to:**~~	Rationale: Old knowledge and skills statement 10 was eliminated and replaced with new knowledge and skills statements to better organize the student expectations into relevant topics to facilitate instruction. This is the first of 4 new knowledge and skills statements created to improve organizational structure and alignment of relevant concepts.
(A)	identify sources of emissions in ~~causes of~~ air, soil, and water ~~pollution~~, including point and nonpoint sources;	Rationale: The word "pollution" was omitted from the standard because not all substances that are emitted in the environment are not necessarily always considered pollutants, for example, ozone, and water vapor, carbon dioxide.
(B)	distinguish how an emission becomes a pollutant based on its concentration, toxicity, reactivity, and location within the environment;	Rationale: New standard created to emphasize the difference between pollutants and emissions and their impacts and as well as to include the concept of reactivity and for students to be able to consider when a substance becomes a pollutant.
(C) ~~(B)~~	investigate the effects ~~types~~ of pollutants ~~air, soil, and water pollution~~ such as chlorofluorocarbons, greenhouse gasses ~~carbon dioxide~~, ~~pH~~, pesticide runoff, thermal ~~variations~~, metallic ions, heavy metals, light, noise, aerosols, and nuclear waste;	Rationale: Standard reworded to better clarify substances that can be considered pollutants and to include an understanding of their effects on the environment.
(D) ~~(C)~~	evaluate indicators of air, soil and water quality against regulatory standards to determine the health of an ecosystem; and ~~examine the concentrations of air, soil, and water pollutants using appropriate units;~~	Rationale: Standard revised to include non-pollutant indicators of environmental health such as pH, thermal variations, bioindicators.
(E) ~~(D)~~	distinguish between the causes and effects of global warming and ozone depletion including the causes, the chemicals involved, the atmospheric layer, the environmental effects, the human health effects, and the relevant wavelengths on the electromagnetic spectrum (IR and UV). ~~describe the effect of pollution on global warming, glacial and ice cap melting, greenhouse effect, ozone layer, and aquatic viability;~~	Rationale: Standard was reworded to avoid student confusion between ozone depletion and global warming.

Science TEKS Review Work Group D Draft Recommendations

(11)	**Science concepts. The student understands how individual and collective actions impact environmental systems. The student is expected to:**	Rationale: KS statement is the second of new KS statements organized from the old KS 10.
(A) ~~(E)~~	evaluate the negative effects ~~effect~~ of human activities *on the environment* ~~*including habitat restoration projects, species preservation efforts, nature conservancy groups*~~ including overhunting, overfishing, ecotourism, all terrain vehicles, and ~~small~~ personal watercraft; ~~*on the environment*~~;	Rationale: The original SE was split into two separate expectations to improve opportunities for student assessment.
(B)	evaluate the positive effects of human activities on the environment, *including habitat restoration projects, species preservation efforts, nature conservancy groups, game and wildlife management,* and ecotourism; and	
(C)	*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.*	Rationale: Standard was moved from KS 12 J for improved alignment.
(12)	**Science Concepts. The student understands how ethics and economic priorities influence environmental decisions. The student is expected to:**	Rationale: KS12 is the third of new knowledge and skills statements organized from original KS 10.
(A) ~~(F)~~	evaluate cost-benefit trade-offs of commercial activities such as municipal development, farming, deforestation, over-harvesting, ~~and~~ mining, and oil and gas production;	Rationale: added language to include oil and gas production to make distinct from mining and to ensure its inclusion in instruction.
(B)	evaluate the economic impacts of individual actions on the environment such as overbuilding, habitat destruction, poaching, and improper waste disposal;	Rationale: New standard created to emphasize the effects of non-commercial actions by individuals on the economy
(C) ~~(G)~~	analyze how ethical beliefs can be used to influence scientific and engineering practices such as methods for increasing food production~~;~~, increasing energy production, and increasing the extraction of minerals	Rationale: language included to expand science and engineering practices within the standards and to provide additional concepts to be considered surrounding ethical practices.
~~(H)~~	~~analyze and evaluate different views on the existence of global warming;~~	Rationale: Standard removed because it is subsumed in newly worded standard 10D.
(D) ~~(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; and	Rationale: The word "and" added to be consistent with document style for penultimate standard within a knowledge and skills statement group.

(E)	argue from evidence whether or not a healthy economy and a healthy environment are mutually exclusive.	Rationale: New standard created to encourage critical thinking centered the economics of maintaining environmental health and support science and engineering practices.
~~(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;~~	Rationale: Standard moved to newly created knowledge and skills statement 11 C for improved alignment.
(13)	**Science Concepts. The student knows how legislation mediates human impacts on the environment. The student is expected to:**	Rationale: Fourth of new knowledge and skills statements organized from old KS 10
(A) ~~(K)~~	describe ~~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	Rationale: Verb changed in standard to describe in order to provide balance to the rigor of instruction of the standards as a whole. Local was deleted because there are few local regulations that are applicable to discuss.
(B) ~~(L)~~	evaluate the goals and effectiveness of past and present international agreements ~~analyze past and present international treaties and protocols~~ such as the environmental Antarctic Treaty System, Montreal Protocol, and Kyoto Protocol, and the Paris Climate Accord.	Rationale: Language was added to include the Paris Climate Accord, and also, the verbs were changed in the standard to provide balance and rigor in instruction.

§112.xx Specialized Topics in Science (One credit)

TEKS with edits		Work Group Comments/Rationale
(a)	**General Requirements.** Students shall be awarded one credit for successful completion of this course. Students may repeat this course with different course content for up to three credits. Recommended prerequisite: one credit of high school science.	The title "Specialized Topics in Science" was selected to distinguish this course from "Scientific Research and Design." The work group discussed the title "Independent Study in Science" but selected a title that reflects the true goal of the course and does not indicate a course that is solely student driven. One credit for this course was chosen as current graduation requirements for science are based on whole credit requirements and currently, there are no .5 credit science courses. One credit does not prohibit a district from designing a course that would teach all the TEKS in one semester and awarding full credit. The workgroup recommends that this course count towards the third credit of science as defined in TAC §74.12(b)(3)(B) or additional credits in science as defined in §74.13(e)(6). The workgroup also recommends implementation and inclusion in graduation requirements at the earliest date possible because this course fills a demonstrated need for both districts and students. Allowing up to three credits provides students the opportunity to develop greater understanding of science content in multiple disciplines or areas of science, or to dive deeper into the same area over multiple iterations of the course. The "recommended prerequisite" allows all students to enroll in the course, expanding access to science course offerings.

(b)	**Introduction.**	
(1)	Specialized Topics in Science is intended to diversify programs of science study and give students the opportunity to study scientific topics in greater detail and with deeper understanding rather than provide remediation.	The work group discussed how this new course could provide students more flexibility for deeper learning of a particular subject or topic. Science is the only core content area without an independent study or special topics course. To meet the needs of Texas students and to fill a gap in science course offerings, this course provides flexibility for deeper learning or investigation in a particular subject or topic, either independently or as a whole class. This course may be used to develop dual credit courses not otherwise aligned with existing TEKS-based science courses, offers options to award credit to entering out of state students, and provides a pathway to include emergent technologies and discoveries in a program of study. Community based programs, internships, or other opportunities may also use this course to award credit. The work group wanted to clarify that this course is intended to provide opportunities for students to study topics not covered in other science courses or to go into greater detail and depth than other courses allow. The course should not be used to provide credit for remediation in another science course.

(2)	In this course, students are given the opportunity to develop greater understanding of science content beyond what is taught in other TEKS-based science courses while utilizing science and engineering practices. Students will understand the value and role of curiosity in any discipline of science. The specialized topic of study may originate from local or global phenomena, student interest, or teacher specialties. The emphasis of study may vary, such as theoretical science, citizen science, science investigations, science careers, specialized disciplines of science, designing innovations, the ethics of science, or history of science.	
(3)	By the end of Grade 12, students are expected to gain sufficient knowledge of the scientific and engineering practices across the disciplines of science to make informed decisions using critical thinking and scientific problem solving.	
(c)	**Knowledge and skills.**	Rationale: The newly adopted Science and Engineering Practices developed for Biology, IPC, Chemistry and Physics were customized as the foundation for the unique nature of this course. "As appropriate to the specialized topic of study" or "as related to the specialized topic of study" was added to the majority of these student expectations to ensure the course content goes beyond the topics, concepts, breadth, or depth of study specified in other TEKS-based science courses. The group changed "and" to "or" in some student expectations for this course because the items may not be applicable to all topics of study or course content.
(1)	**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 explain phenomena, or design solutions using appropriate tools and models. The student is expected to:**	
(A)	ask questions and define problems related to specialized topics of study based on observations or information from text, phenomena, models, or investigations;	

(B)	apply science practices related to specialized topics of study to plan and conduct investigations or use engineering practices to design solutions to problems;	Rationale: The three types of investigations were omitted to allow for flexibility within the specialized topics of study. Not every topic may require all three types of investigations. Not every topic will have an engineering component.
(C)	use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;	
(D)	use tools appropriate to the specialized topic of study;	Rationale: Due to the nature of this course, topics will vary. The workgroup recommends that the instructor develop a list of science tools appropriate to the course topic(s).
(E)	collect quantitative data using the International System of Units (SI) or qualitative data as evidence as appropriate to the specialized topic of study;	
(F)	organize quantitative or qualitative data using representations appropriate to the specialized topic of study such as scatter plots, line graphs, bar graphs, charts, data tables, diagrams, scientific drawings, and student-prepared models;	
(G)	develop and use models to represent phenomena, systems, processes, or solutions to problems as appropriate to the specialized topic of study; and	Rationale: The workgroup excluded the term "engineering" from this statement because the selected specialized topic(s) may not include an engineering approach to solving a problem.
(H)	distinguish among scientific hypotheses, theories, and laws as appropriate to the specialized topic of study.	
(2)	**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 as appropriate to the specialized topic of study;	
(B)	analyze data appropriate to the specialized topic of study by identifying significant statistical features, patterns, sources of error, and limitations;	
(C)	use mathematical calculations to assess quantitative relationships in data as appropriate to the specialized topic of study; and	

(D)	evaluate experimental or engineering designs as appropriate to the specialized topic of study.	
(3)	**Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, or proposed solutions. The student is expected to:**	
(A)	develop explanations or propose solutions supported by data and models and consistent with scientific ideas, principles, and theories as appropriate to the specialized topic of study;	
(B)	communicate explanations or solutions individually and collaboratively in a variety of settings and formats as appropriate to the specialized topic of study; and	
(C)	engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence as appropriate to the specialized topic of study.	
(4)	**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 or observational testing as appropriate to the specialized topic of study, 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 appropriate to the specialized topic of study; 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), fields in order to investigate STEM careers as appropriate to the specialized topic of study.	