Science TEKS Review Work Group D Working Document

Texas Essential Knowledge and Skills (TEKS) Science, Earth and Space Science
Working Document

The document reflects preliminary 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 the Earth and Space Science course. Recommendations include a new course title: Earth Systems Science. The work group will convene to finish their draft recommendations, which will be posted after the work group finalizes the draft.

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.

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*

§112.36. Earth Systems Science, Adopted 2021 ~~Earth and Space 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 conducts laboratory and field investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. The student is expected to:**~~	A 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;~~	
(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; and~~	
(C)	use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards; ~~use the school's technology and information systems in a wise and ethical manner.~~	
(D)	use appropriate tools such as;	Work Group D will reconvene to add 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	Work Group D will reconvene to add 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.	

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(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)~~	~~demonstrate the use of course equipment, techniques, and procedures, including computers and web-based computer applications;~~	
~~(F)~~	~~use a wide variety of additional course apparatuses, equipment, techniques, and procedures as appropriate such as satellite imagery and other remote sensing data, Geographic Information Systems (GIS), Global Positioning System (GPS), scientific probes, microscopes, telescopes, modern video and image libraries, weather stations, fossil and rock kits, bar magnets, coiled springs, wave simulators, tectonic plate models, and planetary globes;~~	
~~(G)~~	~~organize, analyze, evaluate, make inferences, and predict trends from data;~~	
~~(H)~~	~~use mathematical procedures such as algebra, statistics, scientific notation, and significant figures to analyze data using the International System (SI) units; and~~	
~~(I)~~	~~communicate valid conclusions supported by data using several formats such as technical reports, lab reports, labeled drawings, graphic organizers, journals, presentations, and technical posters.~~	

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(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 public policy;~~	
~~(E)~~	~~explore careers and collaboration among scientists in Earth and space sciences; and~~	
~~(F)~~	~~learn and understand the contributions of scientists to the historical development of Earth and space sciences.~~	
(4)	**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.	

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(5)~~(4)~~	~~**Earth in space and time. The student knows how Earth-based and space-based astronomical observations reveal differing theories about the structure, scale, composition, origin, and history of the universe. The student is expected to:**~~	Rationale: most of the space science was removed to avoid excess duplication of proposed Astronomy TEKS and to allow for a greater focus on Earth Systems Sciences; the space content that remains is directly associated with Earth & Earth's systems
(A)	~~evaluate the evidence concerning the Big Bang model such as red shift and cosmic microwave background radiation and current theories of the evolution of the universe, including estimates for the age of the universe;~~	
(B)	~~explain how the Sun and other stars transform matter into energy through nuclear fusion; and~~	
(C)	~~investigate the process by which a supernova can lead to the formation of successive generation stars and planets.~~	
(6)~~(5)~~	**Earth in space and time. The student understands the solar nebular accretionary disk model. The student is expected to**:	CCRS - IX.D.1.a CCRS - IX.B.2.a This KS has not yet been finalized
(A)	analyze how gravitational condensation of solar nebular gas and dust can lead to the accretion of planetesimals and protoplanets;	
~~*(B)*~~	~~*investigate thermal energy sources, including kinetic heat of impact accretion, gravitational compression, and radioactive decay, which are thought to allow protoplanet differentiation into layers;*~~	Rationale: Concepts moved to KS 7, related to how Earth and its systems formed
(C)	contrast the characteristics of comets, asteroids, and meteoroids and their positions in the solar system, including the orbital regions of the terrestrial planets, the asteroid belt, gas giants, Kuiper Belt, and Oort Cloud;	To do: Keep the inventory of the solar system, reword to remove "contrast the characteristics"
(D)	explore the historical and current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal;	
~~(E)~~	~~compare terrestrial planets to gas-giant planets in the solar system, including structure, composition, size, density, orbit, surface features, tectonic activity, temperature, and suitability for life; and~~	Rationale: astronomy removed unless it directly relates to Earth's Systems
(F)	compare extra-solar planets with planets in our solar system and describe how such planets are detected.	Likely to go away – not relevant to Earth's Systems

(7)~~(6)~~	**~~Earth in space and time.~~ The student knows the evidence for the formation and composition of~~ how~~ Earth's atmospheres, hydrosphere, biosphere, and geosphere ~~formed and changed through time~~. The student is expected to:**	Framework: Earth and Space Science (ESS) 2.A Rationale: deleted the strands to make the course contiguous and not in discrete compartments or sections; emphasizes the interrelatedness of Earth's systems
(A)	describe how impact accretion, gravitational compression, radioactive decay, and cooling differentiated proto-Earth into layers;	CCRS - X.A.2 Rationale: combined concepts from 6.B. and 7.D. to describe the creation of the geosphere
(C) ~~(A)~~	evaluate the evidence for ~~analyze the~~ changes to the chemical composition of Earth's atmosphere prior to the introduction of oxygen~~ that could have occurred through time from the original hydrogen-helium atmosphere, the carbon dioxide-water vapor-methane atmosphere, and the current nitrogen-oxygen atmosphere~~;	CCRS - X.A.3 Rationale: edited to put boundaries on the time scale for this SE and to differentiate it from D & E
(B)	evaluate the roles of volcanic outgassing and ~~impact of~~ water-bearing comets in developing Earth's atmosphere and hydrosphere;	CCRS - X.A.4 Rationale: edited for clarity and flow
(E) ~~(C)~~	describe ~~investigate~~ how the production~~ formation~~ of~~ atmospheric~~ oxygen by photosynthesis affected ~~and the ozone layer impacted~~ the ~~formation of~~ development of the atmosphere, hydrosphere, geosphere, and biosphere.	Rationale: changed the verb to "describe" because there are no classroom-level investigations to do for this SE; specified how the oxygen was produced; and included the effects on all Earth's systems
~~(D)~~	~~evaluate the evidence that Earth's *cooling* led to tectonic activity, resulting in continents and ocean basins.~~	Rationale: plate tectonics covered in KS 9; incorporate the cooling into 7.A.
(D)*(13.F)*	evaluate ~~discuss~~ *scientific hypotheses for the origin of life* through ~~by~~ *abiotic chemical processes* ~~in an aqueous environment through complex geochemical cycles given the complexity of living systems.~~; and	CCRS - X.A.6 Rationale: Content moved from 13.F. and edited for clarity and simplicity; verb changed to increase rigor
(8) ~~(7)~~	**~~Earth in space and time.~~ The student knows that ~~scientific dating methods of~~ *rocks and fossils* *~~fossils and rocks~~* *provide evidence for* geologic chronology, *biological evolution*, and environmental changes~~ sequences are used to construct a chronology of Earth's history expressed in the geologic time scale~~. The student is expected to:**	Rationale: merged KS 7 & 8 to incorporate both rocks and fossils in developing absolute and relative geologic time scales and describing biological evolution and environmental changes over time
(B) ~~(A)~~	apply ~~evaluate~~ relative dating methods, principles of stratigraphy, and ~~using original horizontality, rock superposition, lateral continuity, cross-cutting relationships, unconformities,~~ index fossils~~, and biozones based on fossil succession~~ to determine the chronological order of rock layers; and	Rationale: unclear as written and unnecessarily wordy; as proposed, introduces geological logic; builds on (A) and leads to (C)-(F)

(A) ~~(B)~~	~~calculate the ages of igneous rocks from Earth and the Moon and meteorites using radiometric dating methods; and~~ analyze the strengths and limitations of multiple radiometric dating methods and use them to calculate the ages of igneous rocks from Earth, the Moon, and meteorites;	Framework: ESS1.C Rationale: increased rigor and focuses on an understanding of how and why specific dating methods are used
(C)	~~understand how multiple dating methods are used to construct the geologic time scale, which represents Earth's approximate 4.6-billion-year history.~~ construct a model of the geological time scale using relative and absolute dating methods to represent Earth's approximate 4.6-billion-year history;	Rationale: changed the verb to be assessable/ measurable and incorporate the SEPs; specified which dating methods to use, which follow from (A)&(B)
~~(8)~~	~~**Earth in space and time. The student knows that fossils** ***provide evidence for*** **geological and** ***biological evolution*****. Students are expected to:**~~	Rationale: merged KS 7 & 8 to incorporate both rocks and fossils in developing absolute and relative geologic time scales and describing biological evolution and environmental changes over time
(E) ~~(A)~~	describe how evidence of biozones and faunal succession in rock layers reveal information about the environment at the time those rocks were deposited and the dynamic nature of the Earth; and ~~analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;~~	Framework: Life Science (LS) 4.B & ESS2.B Rationale: original was unclear and wordy; rewritten to focus on evidence of environmental changes and systemic effects
(D) ~~(B)~~	explain how sedimentation, fossilization, and speciation affect the degree of completeness of the fossil record; ~~and~~	Framework: LS4.A
(F) ~~(C)~~	analyze data from rock and fossil succession to evaluate the evidence for and significance of mass extinctions, major climatic changes, and tectonic events. ~~evaluate the significance of the terminal Permian and Cretaceous mass extinction events, including adaptive radiations of organisms after the events.~~	Framework: LS2.C Rationale: rewritten to include the systemic nature of major events in Earth's history
(9)	~~**Solid Earth.**~~ **The student knows how the Earth's interior dynamics and energy flow drive geological processes on Earth's surface** ~~**is differentiated chemically, physically, and thermally.**~~ **The student is expected to:**	Rationale: Combined KS 9 & 10 to be about energy flow (heat), the motions caused, & how that relates to Earth's systems
(A)	evaluate heat transfer through Earth's ~~sub~~systems by ~~radiation,~~ convection, and conduction and include its role in plate tectonics, volcanism, ~~ocean circulation, weather, and climate~~;	Framework: ESS2.B Rationale: removed radiation, ocean circulation, weather, and climate to focus on the interior dynamics of Earth

(B)	develop a model of the physical, mechanical, and chemical composition of Earth's layers using evidence from Earth's magnetic field, the composition of meteorites, and seismic waves. ~~examine the chemical, physical, and thermal structure of Earth's crust, mantle, and core, including the lithosphere and asthenosphere;~~	Rationale: combined (B)-(D) to reduce time to teach and consolidate related content
~~(C)~~	~~explain how scientists use geophysical methods such as seismic wave analysis, gravity, and magnetism to interpret Earth's structure; and~~	Rationale: combined (B)-(D) to reduce time to teach and consolidate related content
~~(D)~~	~~describe the formation and structure of Earth's magnetic field, including its interaction with charged solar particles to form the Van Allen belts and auroras.~~	Rationale: combined (B)-(D) to reduce time to teach and consolidate related content
~~(10)~~	~~Solid Earth. The student knows that plate tectonics is the global mechanism for major geologic processes and that heat transfer, governed by the principles of thermodynamics, is the driving force. The student is expected to:~~	Rationale: Combined KS 9 & 10 to be about energy flow (heat), the motions caused, & how that relates to Earth's systems
(A)	investigate how new conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics;	To do: complete editing and re-lettering of original KS 10 to merge with KS 9
(B)	describe how heat and rock composition affect density within Earth's interior and how density influences the development and motion of Earth's tectonic plates;	
(C)	explain how plate tectonics accounts for geologic processes and features, including sea floor spreading, ocean ridges and rift valleys, subduction zones, earthquakes, volcanoes, mountain ranges, hot spots, and hydrothermal vents;	
(D)	calculate the motion history of tectonic plates using equations relating rate, time, and distance to predict future motions, locations, and resulting geologic features;	
(E)	distinguish the location, type, and relative motion of convergent, divergent, and transform plate boundaries using evidence from the distribution of earthquakes and volcanoes; and	
(F)	evaluate the role of plate tectonics with respect to long-term global changes in Earth's subsystems such as continental buildup, glaciation, sea level fluctuations, mass extinctions, and climate change.	
(10) ~~(11)~~	**~~Solid Earth.~~ The student knows that the ~~geosphere~~ lithosphere continuously changes as a result of ~~over a range of time scales involving~~ dynamic and complex interactions among Earth's ~~sub~~systems. The student is expected to:**	Framework: ESS2.C Rationale:
(C) ~~(A)~~	model the processes of mass wasting, ~~compare the roles of~~ erosion, and deposition by ~~through the actions of~~ water, wind, ice, glaciation, gravity, and volcanism ~~igneous activity by lava~~ in constantly reshaping Earth's surface; and	Rationale: edited to include glaciation as separate from the expansion of ice; specified all volcanism instead of just lava; and increased the rigor by changing the verb to "model"

(B)	investigate and model how both surface and ground water change the lithosphere through chemical and physical weathering and how they serve as valuable natural resources; ~~explain how plate tectonics accounts for geologic surface processes and features, including folds, faults, sedimentary basin formation, mountain building, and continental accretion;~~	Framework: ESS2.A Rationale: concepts moved to KS 9, fits with plate tectonics; new SE on weathering to cover content not explicitly included previously and to align with the KS
(D) ~~(C)~~	evaluate how weather and human activity affect the location, quality, and supply of available freshwater resources. ~~analyze changes in continental plate configurations such as Pangaea and their impact on the biosphere, atmosphere, and hydrosphere through time;~~	Framework: ESS3.C Rationale: concepts in original SE moved into effects of plate tectonics (10.D); new SE written on impact of humans, modified from (E).
(A) ~~(D)~~	interpret Earth surface features using a variety of methods such as satellite imagery, aerial photography, and topographic and geologic maps using appropriate technologies; and	Rationale: moved the tools and methods used to study this topic to be the first SE in this KS
~~(E)~~	evaluate the impact of changes in Earth's subsystems on humans such as earthquakes, tsunamis, volcanic eruptions, hurricanes, flooding, and storm surges and the impact of humans on Earth's subsystems such as population growth, fossil fuel burning, and use of fresh water.	Framework: ESS3.B Rationale: effects on humans moved to effects on the biosphere in proposed KS 13
~~(12)~~	~~**Solid Earth. The student knows that Earth contains energy, water, mineral, and rock resources and that use of these resources impacts Earth's subsystems. The student is expected to:**~~	Framework: ESS3.A Rationale: merged KS 15 & KS 12 to have one KS (proposed 13) that focused on resources
~~(A)~~	~~evaluate how the use of energy, water, mineral, and rock resources affects Earth's subsystems;~~	Rationale: content now covered in proposed 13.D.
~~(B)~~	~~describe the formation of fossil fuels, including petroleum and coal;~~	Rationale: This content is covered in 4th grade science; removed to streamline; fossil fuels are discussed in proposed 13.C.
~~(C)~~	~~discriminate between renewable and nonrenewable resources based upon rate of formation and use;~~	Rationale: This content is covered in 4th grade science; content is subsumed in proposed 13.D; removed to streamline.
~~(D)~~	~~*analyze the economics of resources from discovery to disposal, including technological advances, resource type, concentration and location, waste disposal and recycling, and environmental costs*~~; ~~*and*~~	
~~(E)~~	~~*explore careers that involve the exploration, extraction, production, use, and disposal of Earth's resources.*~~	

(11) ~~(13)~~	**~~Fluid Earth.~~ The student knows how the physical and chemical properties of the ocean affect its structure and flow of energy. ~~that the fluid Earth is composed of the hydrosphere, cryosphere, and atmosphere subsystems that interact on various time scales with the biosphere and geosphere.~~ The student is expected to:**	Framework: ESS2.C, ESS2.D, & LS2.B Rationale: the content of the "fluid Earth" section is divided into two parts and reframed within the context of the system interactions involved - 13-15 reworked into 2 KSs: 11. Ocean structure & energy flow, 12. Weather & climate
(A)	describe how the composition and structure of the oceans leads to thermohaline circulation and its periodicity;	Framework: PS1.A Rationale: new SE; necessary content was not previously part of the course; provides foundational understanding for later analysis
(B)	model and communicate how changes to the composition, structure, and circulation of deep oceans affect thermohaline circulation using data on energy flow, ocean basin structure, and *changes in polar ice caps and glaciers*;	CCRS - VIII.A.4.a and b & IX.A.1.c Rationale: modeled after 13.A., increased the clarity and specificity of the SE and increased the rigor from "quantify" to "model."
~~(A)~~	~~quantify the components and fluxes within the hydrosphere such as *changes in polar ice caps and glaciers*, salt water incursions, and groundwater levels in response to precipitation events or excessive pumping~~;	Rationale: unclear as written; concepts were incorporated into proposed 11.B.
(C) ~~(B)~~	analyze how global surface ocean circulation is the result of wind, tides, the Coriolis effect, water density differences, and the shape of the ocean basins;	CCRS - IX.A.2.e & IX.A.1. Rationale: all of these things affect the surface, not all of them affect the deep ocean; deep ocean is covered in proposed (B)
~~(B)~~	~~investigate evidence such as ice cores, glacial striations, and fossils for climate variability and its use in developing computer models to explain present and predict future climates;~~	Rationale: Concepts moved to KS 12 with climate & weather
~~(C)~~	~~analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature trends over the past 150 years;~~	Rationale: Concepts moved to KS 12 with climate & weather
~~(D)~~	~~discuss mechanisms and causes such as selective absorbers, major volcanic eruptions, solar luminance, giant meteorite impacts, and human activities that result in significant changes in Earth's climate;~~	Rationale: Concepts moved to KS 12 with climate & weather
~~(E)~~	~~investigate the causes and history of eustatic sea-level changes that result in transgressive and regressive sedimentary sequences; and~~	Rationale: Unclear as written; concepts were incorporated in proposed 8.D. & E.
~~(F)~~	~~*discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.*~~	Rationale: Concepts moved to KS 7

(12) ~~(14)~~	**~~Fluid Earth.~~ The student knows that dynamic and complex interactions among Earth's systems produce climate and weather. ~~Earth's global ocean stores solar energy and is a major driving force for weather and climate through complex atmospheric interactions.~~ The student is expected to:**	Framework: ESS2.E & ESS3.C Rationale:
(A)	describe how Earth's atmosphere is chemically and thermally stratified and how solar radiation interacts with the layers to cause the ozone layer, the jet stream, Hadley & Ferrel cells, and other atmospheric phenomena;	CCRS - IX.A.2.e Rationale:
(C) ~~(A)~~	analyze how energy transfer through Milankovitch cycles, ~~the uneven distribution of solar energy on Earth's surface, including differences in atmospheric transparency, surface~~ albedo, ~~Earth's tilt, duration of insolation,~~ and differences in atmospheric and surface absorption ~~of energy~~ are mechanisms of climate;	CCRS - IX.F.2.a & IX.F.2.b Rationale: condensed the components of Milankovitch cycles into that term, and specified that these processes create climate
(B)	model ~~investigate~~ how the atmosphere is heated from Earth's surface due to absorption of solar energy, which is re-radiated as thermal energy and trapped by greenhouse gasses ~~selective absorbers~~; ~~and~~	Rationale: specified which components of the atmosphere trap thermal energy. Changed the verb to "model" because students would not necessarily be performing a lab investigation in this SE.
(E)	evaluate how the combination of multiple feedback loops cause global climate;	Rationale:
(D)	investigate and analyze evidence for historical and short-term climate changes using paleoclimate data, physical historical records, and greenhouse gas levels from the past two centuries;	Rationale: merged (13.B & C) to streamline the content, specify the depth to which this content should be taught, and clarify that climate change is not unique to the last 150 years to avoid creating a misconception
~~(13.C)~~	~~analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature trends over the past 150 years;~~	Rationale: merged (13.B & C) to streamline the content, specify the depth to which this content should be taught, and clarify that climate change is not unique to the last 150 years to avoid creating a misconception
~~(13.D)~~	~~discuss mechanisms and causes such as selective absorbers, major volcanic eruptions, solar luminance, giant meteorite impacts, and human activities that result in significant changes in Earth's climate;~~	Rationale: this list of mechanisms/causes is mixed in duration & affects. The mechanisms and causes were divided up into other SEs in this and other KSs.
(F) ~~(C)~~	explain how the transfer of thermal energy among ~~transfers between~~ the hydrosphere, lithosphere, ~~ocean~~ and atmosphere ~~drives surface currents, thermohaline currents, and evaporation that~~ influences weather and climate; and	CCRS - VII.H1.b Rationale: broadened to align with the systems approach, including the lithosphere and weather

(G) (15.A)	describe how changing surface-ocean conditions, including El Niño-Southern Oscillation, affect global weather and climate patterns;.	CCRS - X.A.6.a and X.B.1.a Rationale: moved from 15.A. to fit with weather & climate
(13) (15)	**Fluid Earth. The student understands how Earth's systems affect and are affected by human activities, resource use, and management. The student knows that interactions among Earth's five subsystems influence climate and resource availability, which affect Earth's habitability. The student is expected to:**	Framework: ESS3.B, ESS3.A CCRS - IX.F.2.a Rationale: merged KS 15 & KS 12 into one KS focused on resources
(A)	describe how changing surface-ocean conditions, including El Niño-Southern Oscillation, affect global weather and climate patterns;	Rationale: moved to proposed KS 12 with weather & climate
(B)	investigate evidence such as ice cores, glacial striations, and fossils for climate variability and its use in developing computer models to explain present and predict future climates;	Rationale: merged concepts with 13.C and placed in proposed KS 12 on weather & climate
(C)	quantify the dynamics of surface and groundwater movement such as recharge, discharge, evapotranspiration, storage, residence time, and sustainability;	Rationale: content in this SE is split between resources (proposed KS 13) & groundwater (proposed 10.D)
(A) (11.E)	evaluate the impact on humans of natural changes in Earth's subsystems on humans such as earthquakes, tsunamis, and volcanic eruptions, hurricanes, flooding, and storm surges and the impact of humans on Earth's subsystems such as population growth, fossil fuel burning, and use of fresh water.;	Rationale: separated geologic and weather-related hazards & separated human impact on Earth systems from system impact on humans; allows teachers to teach this SE with the plate tectonics section if desired
(B)	analyze the natural and anthropogenic contributions to extreme weather events and the hazards associated with these events;	CCRS - X.E.5 Rationale: new SE includes the weather and human impacts from 11.E; includes the more recent scientific consensus that human activity influences extreme weather
(C) (D)	explain the cycling of carbon through different forms among Earth's systems and how biological processes have caused major changes to the carbon cycle in those systems; explain the global carbon cycle, including how carbon exists in different forms within the five subsystems and how these forms affect life; and	CCRS - IX.A.1.d, IX.A.2.d, & X.A.6.a Rationale: better aligned the SE to the KS and switched the affects from "on" life to "by" life; the carbon cycle unites all of Earth's systems.
(E)	analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on evaporation, sea level, algal growth, coral bleaching, hurricane intensity, and biodiversity.	Rationale: combined 12.A. & 15.E into proposed 13.D.

(D) (12.A)		predict how human use of naturally occurring resources directly and indirectly changes the cycling of matter and energy through Earth's systems; evaluate how the use of energy, water, mineral, and rock resources affects Earth's subsystems;	CCRS - X.E.4.d & X.E.5.a Rationale: combined 12.A. & 15.E into proposed 13.D.
(E) (12.D)		*analyze the economics* and policies related to of *resources from discovery to disposal, including technological advances, resource type, concentration and location, waste disposal and recycling, and environmental* impacts costs; *and*	CCRS - X.D.1, X.D.2, & X.E.4 Rationale: moved from 12.D, expanded to include "policies" related to resources and all impacts, not just costs ($).
(F) (12.E)		*explore careers that involve the exploration, extraction, production, use,* and *disposal,* regulation, and protection *of Earth's resources.*	CCRS - X.D.2. Rationale: moved from 12.E and included more careers outside of science, engineering, or direct resource use