Earth Systems Science

Subject: Science

Grade: 11

Num Expectations: 62

Num Breakouts: 320

(a) Introduction.

(1) Earth Systems Science. The Earth Systems Science course is designed to build on students' prior scientific and academic knowledge and skills to develop their understanding of Earth's systems. These systems (the atmosphere, hydrosphere, geosphere, and biosphere) interact through time to produce the Earth's landscapes, climate, and resources. Students explore the geologic history of individual dynamic systems through the flow of energy and matter, their current states, and how these systems affect and are affected by human use.

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

(3) Scientific hypotheses and theories. Students are expected to know that:

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

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

(4) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(5) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(6) Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested, while models allow for boundary specification and provide tools for understanding the ideas presented. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(7) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and Skills Statements

(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 based on observations or information from text, phenomena, models, or investigations;

Breakouts

(i) ask questions based on observations or information from text, phenomena, models, or investigations

(ii) define problems based on observations or information from text, phenomena, models, or investigations

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

Breakouts

(i) apply scientific practices to plan descriptive investigations

(ii) apply scientific practices to plan comparative investigations

(iii) apply scientific practices to plan experimental investigations

(iv) apply scientific practices to conduct descriptive investigations

(v) apply scientific practices to conduct comparative investigations

(vi) apply scientific practices to conduct experimental investigations

(vii) use engineering practices to design solutions to problems

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

Breakouts

(i) use appropriate safety equipment during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(ii) use appropriate safety equipment during classroom investigations as outlined in Texas Education Agency-approved safety standards

(iii) use appropriate safety equipment during field investigations as outlined in Texas Education Agency-approved safety standards

(iv) use appropriate safety practices during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(v) use appropriate safety practices during classroom investigations as outlined in Texas Education Agency-approved safety standards

(vi) use appropriate safety practices during field investigations as outlined in Texas Education Agency-approved safety standards

(D) use appropriate tools such as a drawing compass, magnetic compass, bar magnets, topographical and geological maps, satellite imagery and other remote sensing data, Geographic Information Systems (GIS), Global Positioning System (GPS), hand lenses, and fossil and rock sample kits;

Breakouts

(i) use appropriate tools

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

Breakouts

(i) collect quantitative data using the International System of Units (SI)

(ii) collect qualitative data as evidence

(F) organize quantitative and qualitative data using scatter plots, line graphs, bar graphs, charts, data tables, digital tools, diagrams, scientific drawings, and student-prepared models;

Breakouts

(i) organize quantitative data using scatter plots

(ii) organize quantitative data using line graphs

(iii) organize quantitative data using bar graphs

(iv) organize quantitative data using charts

(v) organize quantitative data using data tables

(vi) organize quantitative data using digital tools

(vii) organize quantitative data using diagrams

(viii) organize quantitative data using scientific drawings

(ix) organize quantitative data using student-prepared models

(x) organize qualitative data using scatter plots

(xi) organize qualitative data using line graphs

(xii) organize qualitative data using bar graphs

(xiii) organize qualitative data using charts

(xiv) organize qualitative data using data tables

(xv) organize qualitative data using digital tools

(xvi) organize qualitative data using diagrams

(xvii) organize qualitative data using scientific drawings

(xviii) organize qualitative data using student-prepared models

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

Breakouts

(i) develop models to represent phenomena, systems, processes, or solutions to engineering problems

(ii) use models to represent phenomena, systems, processes, or solutions to engineering problems

(H) distinguish between scientific hypotheses, theories, and laws.

Breakouts

(i) distinguish between 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:

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

Breakouts

(i) identify advantages of models

(ii) identify limitations of models

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

Breakouts

(i) analyze data by identifying significant statistical features

(ii) analyze data by identifying patterns

(iii) analyze data by identifying sources of error

(iv) analyze data by identifying limitations

(C) use mathematical calculations to assess quantitative relationships in data;

and Breakouts

(i) use mathematical calculations to assess quantitative relationships in data

(D) evaluate experimental and engineering designs.

Breakouts

(i) evaluate experimental designs

(ii) evaluate engineering designs

(3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models consistent with scientific ideas, principles, and theories;

Breakouts

(i) develop explanations supported by data consistent with scientific ideas

(ii) develop explanations supported by data consistent with scientific principles

(iii) develop explanations supported by data consistent with scientific theories

(iv) develop explanations supported by models consistent with scientific ideas

(v) develop explanations supported by models consistent with scientific principles

(vi) develop explanations supported by models consistent with scientific theories

(vii) propose solutions supported by data consistent with scientific ideas

(viii) propose solutions supported by data consistent with scientific principles

(ix) propose solutions supported by data consistent with scientific theories

(x) propose solutions supported by models consistent with scientific ideas

(xi) propose solutions supported by models consistent with scientific principles

(xii) propose solutions supported by models consistent with scientific theories

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

Breakouts

(i) communicate explanations individually in a variety of settings

(ii) communicate explanations individually in a variety of formats

(iii) communicate explanations collaboratively in a variety of settings

(iv) communicate explanations collaboratively in a variety of formats

(v) communicate solutions individually in a variety of settings

(vi) communicate solutions individually in a variety of formats

(vii) communicate solutions collaboratively in a variety of settings

(viii) communicate solutions collaboratively in a variety of formats

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

Breakouts

(i) engage respectfully in scientific argumentation using applied scientific explanations

(ii) engage respectfully in scientific argumentation using empirical evidence

(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;

Breakouts

(i) analyze scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(ii) analyze scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(iii) analyze scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(iv) analyze scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(v) evaluate scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(vi) evaluate scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(vii) evaluate scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(viii) evaluate scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(ix) critique scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(x) critique scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(xi) critique scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(xii) critique scientific explanations and solutions by using 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

Breakouts

(i) relate the impact of past research on scientific thought, including research methodology

(ii) relate the impact of past research on scientific thought, including cost-benefit analysis

(iii) relate the impact of past research on scientific thought, including contributions of diverse scientists as related to the content

(iv) relate the impact of past research on society, including research methodology

(v) relate the impact of past research on society, including cost-benefit analysis

(vi) relate the impact of past research on society, including contributions of diverse scientists as related to the content

(vii) relate the impact of current research on scientific thought, including research methodology

(viii) relate the impact of current research on scientific thought, including cost-benefit analysis

(ix) relate the impact of current research on scientific thought, including contributions of diverse scientists as related to the content

(x) relate the impact of current research on society, including research methodology

(xi) relate the impact of current research on society, including cost-benefit analysis

(xii) relate the impact of current research on society, including contributions of diverse scientists as related to the content

(C) research and explore resources such as museums, planetariums, observatories, 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.

Breakouts

(i) research STEM careers

(ii) explore resources in order to investigate STEM careers

(5) Science concepts. The student understands the formation of the Earth and how objects in the solar system affect Earth's systems. The student is expected to:

(A) analyze how gravitational condensation of solar nebular gas and dust can lead to the accretion of planetesimals and protoplanets;

Breakouts

(i) analyze how gravitational condensation of solar nebular gas can lead to the accretion of planetesimals

(ii) analyze how gravitational condensation of solar nebular dust can lead to the accretion of planetesimals

(iii) analyze how gravitational condensation of solar nebular gas can lead to the accretion of protoplanets

(iv) analyze how gravitational condensation of solar nebular dust can lead to the accretion of protoplanets

(B) identify comets, asteroids, meteoroids, and planets in the solar system and describe how they affect the Earth and Earth's systems; and

Breakouts

(i) identify comets in the solar system

(ii) identify asteroids in the solar system

(iii) identify meteoroids in the solar system

(iv) identify planets in the solar system

(v) describe how [comets] affect the Earth

(vi) describe how [asteroids] affect the Earth

(vii) describe how [meteoroids] affect the Earth

(viii) describe how [planets] affect the Earth

(ix) describe how [comets] affect Earth's systems

(x) describe how [asteroids] affect Earth's systems

(xi) describe how [meteoroids] affect Earth's systems

(xii) describe how [planets] affect Earth's systems

(C) explore the historical and current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal.

Breakouts

(i) explore the historical hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal

(ii) explore the current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal

(6) Science concepts. The student knows the evidence for the formation and composition of Earth's atmosphere, hydrosphere, biosphere, and geosphere. The student is expected to:

(A) describe how impact accretion, gravitational compression, radioactive decay, and cooling differentiated proto-Earth into layers;

Breakouts

(i) describe how impact accretion differentiated proto-Earth into layers

(ii) describe how gravitational compression differentiated proto-Earth into layers

(iii) describe how radioactive decay differentiated proto-Earth into layers

(iv) describe how cooling differentiated proto-Earth into layers

(B) evaluate the roles of volcanic outgassing and water-bearing comets in developing Earth's atmosphere and hydrosphere;

Breakouts

(i) evaluate the roles of volcanic outgassing in developing Earth's atmosphere

(ii) evaluate the roles of volcanic outgassing in developing Earth's hydrosphere

(iii) evaluate the roles of water-bearing comets in developing Earth's atmosphere

(iv) evaluate the roles of water-bearing comets in developing Earth's hydrosphere

(C) evaluate the evidence for changes to the chemical composition of Earth's atmosphere prior to the introduction of oxygen;

Breakouts

(i) evaluate the evidence for changes to the chemical composition of Earth's atmosphere prior to the introduction of oxygen

(D) evaluate scientific hypotheses for the origin of life through abiotic chemical processes; and

Breakouts

(i) evaluate scientific hypotheses for the origin of life through abiotic chemical processes

(E) describe how the production of oxygen by photosynthesis affected the development of the atmosphere, hydrosphere, geosphere, and biosphere.

Breakouts

(i) describe how the production of oxygen by photosynthesis affected the development of the atmosphere

(ii) describe how the production of oxygen by photosynthesis affected the development of the hydrosphere

(iii) describe how the production of oxygen by photosynthesis affected the development of the geosphere

(iv) describe how the production of oxygen by photosynthesis affected the development of the biosphere

(7) Science concepts. The student knows that rocks and fossils provide evidence for geologic chronology, biological evolution, and environmental changes. The student is expected to:

(A) describe the development of multiple radiometric dating methods and analyze their precision, reliability, and limitations in calculating the ages of igneous rocks from Earth, the Moon, and meteorites;

Breakouts

(i) describe the development of multiple radiometric dating methods

(ii) analyze [multiple radiometric dating methods'] precision in calculating the ages of igneous rocks from Earth

(iii) analyze [multiple radiometric dating methods'] precision in calculating the ages of igneous rocks from the Moon

(iv) analyze [multiple radiometric dating methods'] precision in calculating the ages of meteorites

(v) analyze [multiple radiometric dating methods'] reliability in calculating the ages of igneous rocks from Earth

(vi) analyze [multiple radiometric dating methods'] reliability in calculating the ages of igneous rocks from the Moon

(vii) analyze [multiple radiometric dating methods'] reliability in calculating the ages of meteorites

(viii) analyze [multiple radiometric dating methods'] limitations in calculating the ages of igneous rocks from Earth

(ix) analyze [multiple radiometric dating methods'] limitations in calculating the ages of igneous rocks from the Moon

(x) analyze [multiple radiometric dating methods'] limitations in calculating the ages of meteorites

(B) apply relative dating methods, principles of stratigraphy, and index fossils to determine the chronological order of rock layers;

Breakouts

(i) apply relative dating methods to determine the chronological order of rock layers

(ii) apply principles of stratigraphy to determine the chronological order of rock layers

(iii) apply index fossils to determine the chronological order of rock layers

(C) construct a model of the geological time scale using relative and absolute dating methods to represent Earth's approximate 4.6-billion-year history;

Breakouts

(i) construct a model of the geological time scale using relative and absolute dating methods to represent Earth's approximate 4.6-billion-year history

(D) explain how sedimentation, fossilization, and speciation affect the degree of completeness of the fossil record;

Breakouts

(i) explain how sedimentation affect[s] the degree of completeness of the fossil record

(ii) explain how fossilization affect[s] the degree of completeness of the fossil record

(iii) explain how speciation affect[s] the degree of completeness of the fossil record

(E) 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

Breakouts

(i) describe how evidence of biozones reveal[s] information about the environment at the time those rocks were deposited

(ii) describe how evidence of biozones reveal[s] information about the dynamic nature of the Earth

(iii) describe how faunal succession in rock layers reveal[s] information about the environment at the time those rocks were deposited

(iv) describe how faunal succession in rock layers reveal[s] information about the dynamic nature of the Earth

(F) analyze data from rock and fossil succession to evaluate the evidence for and significance of mass extinctions, major climatic changes, and tectonic events.

Breakouts

(i) analyze data from rock succession to evaluate the evidence for mass extinctions

(ii) analyze data from rock succession to evaluate the evidence for major climatic changes

(iii) analyze data from rock succession to evaluate the evidence for and significance of tectonic events

(iv) analyze data from rock succession to evaluate the significance of mass extinctions

(v) analyze data from rock succession to evaluate the significance of major climatic changes

(vi) analyze data from rock succession to evaluate the significance of tectonic events

(vii) analyze data from fossil succession to evaluate the evidence for mass extinctions

(viii) analyze data from fossil succession to evaluate the evidence for major climatic changes

(ix) analyze data from fossil succession to evaluate the evidence for tectonic events

(x) analyze data from fossil succession to evaluate the significance of mass extinctions

(xi) analyze data from fossil succession to evaluate the significance of major climatic changes

(xii) analyze data from fossil succession to evaluate the significance of tectonic events

(8) Science concepts. The student knows how the Earth's interior dynamics and energy flow drive geological processes on Earth's surface. The student is expected to:

(A) evaluate heat transfer through Earth's systems by convection and conduction and include its role in plate tectonics and volcanism;

Breakouts

(i) evaluate heat transfer through Earth's systems by convection

(ii) evaluate heat transfer through Earth's systems by conduction

(iii) include [heat transfer's] role in plate tectonics

(iv) include [heat transfer's] role in volcanism

(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;

Breakouts

(i) develop a model of the physical composition of Earth's layers using evidence from Earth's magnetic field

(ii) develop a model of the physical composition of Earth's layers using evidence from the composition of meteorites

(iii) develop a model of the physical composition of Earth's layers using evidence from seismic waves

(iv) develop a model of the mechanical composition of Earth's layers using evidence from Earth's magnetic field

(v) develop a model of the mechanical composition of Earth's layers using evidence from the composition of meteorites

(vi) develop a model of the mechanical composition of Earth's layers using evidence from seismic waves

(vii) develop a model of the chemical composition of Earth's layers using evidence from Earth's magnetic field

(viii) develop a model of the chemical composition of Earth's layers using evidence from the composition of meteorites

(ix) develop a model of the chemical composition of Earth's layers using evidence from seismic waves

(C) investigate how new conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics;

Breakouts

(i) investigate how new conceptual interpretations of data led to the current theory of plate tectonics

(ii) investigate how innovative geophysical technologies led to the current theory of plate tectonics

(D) 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;

Breakouts

(i) describe how heat affect[s] density within Earth's interior

(ii) describe how rock composition affect[s] density within Earth's interior

(iii) describe how density influences the development of Earth's tectonic plates

(iv) describe how density influences the motion of Earth's tectonic plates

(E) explain how plate tectonics accounts for geologic processes, including sea floor spreading and subduction, and features, including ocean ridges, rift valleys, earthquakes, volcanoes, mountain ranges, hot spots, and hydrothermal vents;

Breakouts

(i) explain how plate tectonics accounts for geologic processes, including sea floor spreading

(ii) explain how plate tectonics accounts for geologic processes, including subduction

(iii) explain how plate tectonics accounts for features, including ocean ridges

(iv) explain how plate tectonics accounts for features, including rift valleys

(v) explain how plate tectonics accounts for features, including earthquakes

(vi) explain how plate tectonics accounts for features, including volcanoes

(vii) explain how plate tectonics accounts for features, including mountain ranges

(viii) explain how plate tectonics accounts for features, including hot spots

(ix) explain how plate tectonics accounts for features, including hydrothermal vents

(F) calculate the motion history of tectonic plates using equations relating rate, time, and distance to predict future motions, locations, and resulting geologic features;

Breakouts

(i) calculate the motion history of tectonic plates using equations relating rate, time, and distance to predict future motions

(ii) calculate the motion history of tectonic plates using equations relating rate, time, and distance to predict future locations

(iii) calculate the motion history of tectonic plates using equations relating rate, time, and distance to predict resulting geologic features

(G) distinguish the location, type, and relative motion of convergent, divergent, and transform plate boundaries using evidence from the distribution of earthquakes and volcanoes; and

Breakouts

(i) distinguish the location of convergent plate boundaries using evidence from the distribution of earthquakes

(ii) distinguish the location of divergent plate boundaries using evidence from the distribution of earthquakes

(iii) distinguish the location of transform plate boundaries using evidence from the distribution of earthquakes

(iv) distinguish the location of convergent plate boundaries using evidence from the distribution of volcanoes

(v) distinguish the location of divergent plate boundaries using evidence from the distribution of volcanoes

(vi) distinguish the location of transform plate boundaries using evidence from the distribution of volcanoes

(vii) distinguish the type of convergent plate boundaries using evidence from the distribution of earthquakes

(viii) distinguish the type of divergent plate boundaries using evidence from the distribution of earthquakes

(ix) distinguish the type of transform plate boundaries using evidence from the distribution of earthquakes

(x) distinguish the type of convergent plate boundaries using evidence from the distribution of volcanoes

(xi) distinguish the type of divergent plate boundaries using evidence from the distribution of volcanoes

(xii) distinguish the type of transform plate boundaries using evidence from the distribution of volcanoes

(xiii) distinguish the relative motion of convergent plate boundaries using evidence from the distribution of earthquakes

(xiv) distinguish the relative motion of divergent plate boundaries using evidence from the distribution of earthquakes

(xv) distinguish the relative motion of transform plate boundaries using evidence from the distribution of earthquakes

(xvi) distinguish the relative motion of convergent plate boundaries using evidence from the distribution of volcanoes

(xvii) distinguish the relative motion of divergent plate boundaries using evidence from the distribution of volcanoes

(xviii) distinguish the relative motion of transform plate boundaries using evidence from the distribution of volcanoes

(H) 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.

Breakouts

(i) evaluate the role of plate tectonics with respect to long-term global changes in Earth's subsystems

(9) Science concepts. The student knows that the lithosphere continuously changes as a result of dynamic and complex interactions among Earth's systems. The student is expected to:

(A) interpret Earth surface features using a variety of methods such as satellite imagery, aerial photography, and topographic and geologic maps using appropriate technologies;

Breakouts

(i) interpret Earth surface features using a variety of methods

(B) investigate and model how surface water and ground water change the lithosphere through chemical and physical weathering and how they serve as valuable natural resources;

Breakouts

(i) investigate how surface water change[s] the lithosphere through chemical weathering

(ii) investigate how surface water change[s] the lithosphere through physical weathering

(iii) investigate how ground water change[s] the lithosphere through chemical weathering

(iv) investigate how ground water change[s] the lithosphere through physical weathering

(v) model how surface water change[s] the lithosphere through chemical weathering

(vi) model how surface water change[s] the lithosphere through physical weathering

(vii) model how and ground water change[s] the lithosphere through chemical weathering

(viii) model how ground water change[s] the lithosphere through physical weathering

(ix) investigate how [surface water] serve[s] as [a] valuable natural resource

(x) investigate how [ground water] serve[s] as [a] valuable natural resource

(C) model the processes of mass wasting, erosion, and deposition by water, wind, ice, glaciation, gravity, and volcanism in constantly reshaping Earth's surface; and

Breakouts

(i) model the processes of erosion by water in constantly reshaping Earth's surface

(ii) model the processes of deposition by water in constantly reshaping Earth's surface

(iii) model the processes of erosion by wind in constantly reshaping Earth's surface

(iv) model the processes of deposition by wind in constantly reshaping Earth's surface

(v) model the processes of erosion by ice in constantly reshaping Earth's surface

(vi) model the processes of deposition by ice in constantly reshaping Earth's surface

(vii) model the processes of erosion by glaciation in constantly reshaping Earth's surface

(viii) model the processes of deposition by glaciation in constantly reshaping Earth's surface

(ix) model the processes of mass wasting by gravity in constantly reshaping Earth's surface

(x) model the processes of erosion by volcanism in constantly reshaping the Earth's surface

(xi) model the processes of deposition by volcanism in constantly reshaping the Earth's surface

(D) evaluate how weather and human activity affect the location, quality, and supply of available freshwater resources.

Breakouts

(i) evaluate how weather affect[s] the location of available freshwater resources

(ii) evaluate how weather affect[s] the quality of available freshwater resources

(iii) evaluate how weather affect[s] the supply of available freshwater resources

(iv) evaluate how human activity affect[s] the location of available freshwater resources

(v) evaluate how human activity affect[s] the quality of available freshwater resources

(vi) evaluate how human activity affect[s] the supply of available freshwater resources

(10) Science concepts. The student knows how the physical and chemical properties of the ocean affect its structure and flow of energy. The student is expected to:

(A) describe how the composition and structure of the oceans leads to thermohaline circulation and its periodicity;

Breakouts

(i) describe how the composition of the oceans leads to thermohaline circulation

(ii) describe how the structure of the oceans leads to thermohaline circulation

(iii) describe how the composition of the oceans leads to thermohaline periodicity

(iv) describe how the structure of the oceans leads to thermohaline periodicity

(B) model and explain 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; and

Breakouts

(i) model how changes to the composition of deep oceans affect thermohaline circulation using data on energy flow

(ii) model how changes to the composition of deep oceans affect thermohaline circulation using data on ocean basin structure

(iii) model how changes to the composition of deep oceans affect thermohaline circulation using data on changes in polar ice caps and glaciers

(iv) model how changes to the structure of deep oceans affect thermohaline circulation using data on energy flow

(v) model how changes to the structure of deep oceans affect thermohaline circulation using data on ocean basin structure

(vi) model how changes to the structure of deep oceans affect thermohaline circulation using data on changes in polar ice caps and glaciers

(vii) model how changes to the circulation of deep oceans affect thermohaline circulation using data on energy flow

(viii) model how changes to the circulation of deep oceans affect thermohaline circulation using data on ocean basin structure

(ix) model how changes to the circulation of deep oceans affect thermohaline circulation using data on changes in polar ice caps and glaciers

(x) explain how changes to the composition of deep oceans affect thermohaline circulation using data on energy flow

(xi) explain how changes to the composition of deep oceans affect thermohaline circulation using data on ocean basin structure

(xii) explain how changes to the composition of deep oceans affect thermohaline circulation using data on changes in polar ice caps and glaciers

(xiii) explain how changes to the structure of deep oceans affect thermohaline circulation using data on energy flow

(xiv) explain how changes to the structure of deep oceans affect thermohaline circulation using data on ocean basin structure

(xv) explain how changes to the structure of deep oceans affect thermohaline circulation using data on changes in polar ice caps and glaciers

(xvi) explain how changes to the circulation of deep oceans affect thermohaline circulation using data on energy flow

(xvii) explain how changes to the circulation of deep oceans affect thermohaline circulation using data on ocean basin structure

(xviii) explain how changes to the circulation of deep oceans affect thermohaline circulation using data on changes in polar ice caps and glaciers

(C) 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.

Breakouts

(i) analyze how global surface ocean circulation is the result of wind

(ii) analyze how global surface ocean circulation is the result of tides

(iii) analyze how global surface ocean circulation is the result of the Coriolis effect

(iv) analyze how global surface ocean circulation is the result of water density differences

(v) analyze how global surface ocean circulation is the result of the shape of the ocean basins

(11) Science concepts. The student knows that dynamic and complex interactions among Earth's systems produce climate and weather. The student is expected to:

(A) analyze how energy transfer through Milankovitch cycles, albedo, and differences in atmospheric and surface absorption are mechanisms of climate;

Breakouts

(i) analyze how energy transfer through Milankovitch cycles [is a] mechanism of climate

(ii) analyze how albedo [is a] mechanism of climate

(iii) analyze how differences in atmospheric absorption are mechanisms of climate

(iv) analyze how differences in surface absorption are mechanisms of climate

(B) 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 and Ferrel cells, and other atmospheric phenomena;

Breakouts

(i) describe how Earth's atmosphere is chemically stratified

(ii) describe how Earth's atmosphere is thermally stratified

(iii) describe how solar radiation interacts with the layers to cause the ozone layer

(iv) describe how solar radiation interacts with the layers to cause the jet stream

(v) describe how solar radiation interacts with the layers to cause Hadley and Ferrel cells

(vi) describe how solar radiation interacts with the layers to cause other atmospheric phenomena

(C) model how greenhouse gases trap thermal energy near Earth's surface;

Breakouts

(i) model how greenhouse gases trap thermal energy near Earth's surface

(D) evaluate how the combination of multiple feedback loops alter global climate;

Breakouts

(i) evaluate how the combination of multiple feedback loops alter global climate

(E) investigate and analyze evidence for climate changes over Earth's history using paleoclimate data, historical records, and measured greenhouse gas levels;

Breakouts

(i) investigate climate changes over Earth's history using paleoclimate data

(ii) investigate climate changes over Earth's history using historical records

(iii) investigate climate changes over Earth's history using measured greenhouse gas levels

(iv) analyze evidence for climate changes over Earth's history using paleoclimate data

(v) analyze evidence for climate changes over Earth's history using historical records

(vi) analyze evidence for climate changes over Earth's history using measured greenhouse gas levels

(F) explain how the transfer of thermal energy among the hydrosphere, lithosphere, and atmosphere influences weather; and

Breakouts

(i) explain how the transfer of thermal energy among the hydrosphere, lithosphere, and atmosphere influences weather

(G) describe how changing surface-ocean conditions, including El Niño-Southern Oscillation, affect global weather and climate patterns.

Breakouts

(i) describe how changing surface-ocean conditions, including El Niño-Southern Oscillation, affect global weather patterns

(ii) describe how changing surface-ocean conditions, including El Niño-Southern Oscillation, affect global climate patterns

(12) Science concepts. The student understands how Earth's systems affect and are affected by human activities, including resource use and management. The student is expected to:

(A) evaluate the impact on humans of natural changes in Earth's systems such as earthquakes, tsunamis, and volcanic eruptions;

Breakouts

(i) evaluate the impact on humans of natural changes in Earth's systems

(B) analyze the impact on humans of naturally occurring extreme weather events such as flooding, hurricanes, tornadoes, and thunderstorms;

Breakouts

(i) analyze the impact on humans of naturally occurring extreme weather events

(C) analyze the natural and anthropogenic factors that affect the severity and frequency of extreme weather events and the hazards associated with these events;

Breakouts

(i) analyze the natural factors that affect the severity of extreme weather events

(ii) analyze the natural factors that affect the frequency of extreme weather events

(iii) analyze the anthropogenic factors that affect the severity of extreme weather events

(iv) analyze the anthropogenic factors that affect the frequency of extreme weather events

(v) analyze the hazards associated with [extreme weather] events

(D) analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on evaporation, sea level, algal growth, coral bleaching, and biodiversity;

Breakouts

(i) analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on evaporation

(ii) analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on sea level

(iii) analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on algal growth

(iv) analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on coral bleaching

(v) analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on biodiversity

(E) predict how human use of Texas's naturally occurring resources such as fossil fuels, minerals, soil, solar energy, and wind energy directly and indirectly changes the cycling of matter and energy through Earth's systems; and

Breakouts

(i) predict how human use of Texas's naturally occurring resources directly changes the cycling of matter through Earth's systems

(ii) predict how human use of Texas's naturally occurring resources indirectly changes the cycling of matter through Earth's systems

(iii) predict how human use of Texas's naturally occurring resources directly changes the cycling of energy through Earth's systems

(iv) predict how human use of Texas's naturally occurring resources indirectly changes the cycling of energy through Earth's systems

(F) 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 over Earth's history.

Breakouts

(i) explain the cycling of carbon through different forms among Earth's systems

(ii) explain how biological processes have caused major changes to the carbon cycle in those systems over Earth's history

(13) Science concepts. The student explores global policies and careers related to the life cycles of Earth's resources. The student is expected to:

(A) analyze the policies related to resources from discovery to disposal, including economics, health, technological advances, resource type, concentration and location, waste disposal and recycling, mitigation efforts, and environmental impacts; and

Breakouts

(i) analyze the policies related to resources from discovery to disposal, including economics

(ii) analyze the policies related to resources from discovery to disposal, including health

(iii) analyze the policies related to resources from discovery to disposal, including technological advances

(iv) analyze the policies related to resources from discovery to disposal, including resource type

(v) analyze the policies related to resources from discovery to disposal, including concentration and location

(vi) analyze the policies related to resources from discovery to disposal, including waste disposal and recycling

(vii) analyze the policies related to resources from discovery to disposal, including mitigation efforts

(viii) analyze the policies related to resources from discovery to disposal, including environmental impacts

(B) explore global and Texas-based careers that involve the exploration, extraction, production, use, disposal, regulation, and protection of Earth's resources.

Breakouts

(i) explore global and Texas-based careers that involve the exploration of Earth's resources

(ii) explore global and Texas-based careers that involve the extraction of Earth's resources

(iii) explore global and Texas-based careers that involve the production of Earth's resources

(iv) explore global and Texas-based careers that involve the use of Earth's resources

(v) explore global and Texas-based careers that involve the disposal of Earth's resources

(vi) explore global and Texas-based careers that involve the regulation of Earth's resources

(vii) explore global and Texas-based careers that involve the protection of Earth's resources