EARTH SCIENCE - 8TH GRADE

		Verbs / Bloom's Taxonomy Level	Content Vocabulary	*Assess	Skills Needed & Sequencing Of Skills	Resources	Learning Targets I can…	Assessment
STANDARD E1: INQUIRY, REFLECTION, AND SOCIAL IMPLICATIONS								
Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g., hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.								BCS Assessments Teacher Assessments
E1.1 Scientific Inquiry	Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical and explanations result from careful analysis of empirical evidence and the use of logical consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.			*				BCS Assessments Teacher Assessments
E1.1A	Generate new questions that can be investigated in the laboratory or field.	generate-application	0bservation hypothesis test experiment analyze conclusion	*	observe experiments being performed and discuss what was done and why		Students can generate new questions that can be investigated.	BCS Assessments Teacher Assessments
E1.1B	Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.	evaluate-evaluation	variable dependent control independent analysis conclusion data experimental design	*	observe experiments being performed and discuss what was done and why		Students can evaluate the uncertainties or validity of scientific conclusions.	BCS Assessments Teacher Assessments
E1.1C	was done and why	conduct-application	volume interval weight temperature precision	*	observe experiments being performed and discuss what was done and why		Students can conduct scientific investigations using appropriate tools and techniques.	BCS Assessments Teacher Assessments

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E1.1D	Identify patterns in data and relate them to theoretical models.	identify-comprehension relate-application	analyze evaluate data	*	observe experiments being performed and discuss what was done and why		Students can identify patterns in data and relate them to theoretical models.	BCS Assessments Teacher Assessments
E1.1E	Describe a reason for a given conclusion using evidence from an investigation.	Describe-knowledge	evidence conclusion	*	observe experiments being performed and discuss what was done and why		Students can describe a reason for a given conclusion by using evidence.	BCS Assessments Teacher Assessments
E1.1f	Predict what would happen if the variables, methods, or timing of an investigation were changed.	predict-synthesis	predict variables investigation	*	observe experiments being performed and discuss what was done and why		Students can predict what would happen if the variables or methods were changed	BCS Assessments Teacher Assessments
E1.1g	Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.	explain-evaluation critique-evaluation	empirical evidence critique conclusion explanantion	*	observe experiments being performed and discuss what was done and why		Students can explain the reasoning of conclusion based on empirical evidence.	BCS Assessments Teacher Assessments
E1.1h	Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.	design-synthesis conduct-application draw conclusions-analysis	design chart systematic table hypothesis presentation	*	observe experiments being performed and discuss what was done and why formulate hypotheses, predictions, or conclusions based on the results of an experiment		Students can design and test a systematic scientific investigation that tests a hypothesis	BCS Assessments Teacher Assessments
E1.1i	Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.	distinguish-analysis	distinguish consensus emerging	*	observe experiments being performed and discuss what was done and why		Students can distinguish between systematic scientific explanations questions researchers investigate.	BCS Assessments Teacher Assessments
E1.2 Scientific Reflection & Social Implications	The integrity of the scientific process depends on scientists and citizens understanding and respecting the "Nature of Science." Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logic reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.							BCS Assessments Teacher Assessments
E1.2A	Critique whether or not specific questions can be answered through scientific investigations.	critique-evaluation	empirical evidence critigue evidence	*	read descriptions of actual experiments		Students can critique whether or not specific questions can be answered through investigation.	BCS Assessments Teacher Assessments
E1.2B	Identify and critique arguments about personal or societal issues based on scientific evidence.	identify-comprehension critique-evaluation	identify critique societal issue	*	read descriptions of actual experiments		Students can critique and identify arguments based on scientific evidence.	BCS Assessments Teacher Assessments

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E1.2C	Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.	develop-analysis evaluate-evaluation	accessing evaluate accuracy significance	*	read descriptions of actual experiments		Students can develop an understanding of a scientific concept by accessing multiple sources.	BCS Assessments Teacher Assessments
E1.2D	Evaluate scientific explanations in a peer review process or discussion format.	evaluate-evaluation	evaluate peer review	*	read descriptions of actual experiments		Students can evaluate explanations by peer review or discussion.	BCS Assessments Teacher Assessments
E1.2E	Evaluate the future career and occupational prospects of science fields.	evaluate-evaluation	evaluate prospects	*	read descriptions of actual experiments		Students can evaluate future careers in science fields.	BCS Assessments Teacher Assessments
E1.2f	Critique solutions to problems, given criteria and scientific constraints.	critique-evaluation	critique solution criteria constraints	*	read descriptions of actual experiments		Students can critique solutions to problems.	BCS Assessments Teacher Assessments
E1.2g	Identify scientific tradeoffs in design decisions and choose among alternative solutions.	identify-comprehension choose-application	tradeoffs alternative	*	read descriptions of actual experiments		Students can identify scientific trade offs in design decisions	BCS Assessments Teacher Assessments
E1.2h	Describe the distinctions between scientific theories, laws, hypotheses, and observations.	describe-knowledge	distinction theory law hypothesis observation	*	discuss what hypotheses and conclusions are and how they are different from each other		Students can describe the distinctions between theories, laws, and hypotheses	BCS Assessments Teacher Assessments
E1.2i	Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.	explain-evaluation	progression theory current consensus core	*	read descriptions of actual experiments		Students can explain the progression of ideas and explanations that lead theories.	BCS Assessments Teacher Assessments
E1.2j	Apply science principles or scientific data to anticipate effects of technological design decisions.	apply-application	apply principles data anticipate effect technological design decisions	*	read descriptions of actual experiments		Students can apply scientific principles or data to anticipate effects of decisions.	BCS Assessments Teacher Assessments
E1.2k	Analyze how science and society interact from a historical, political, economic, or social perspective.	analyze-analysis	analyze interact perspective	*	read descriptions of actual experiments		Students can analyze how science and society interact from different perspectives.	BCS Assessments Teacher Assessments
STANDARD E2: EARTH SYSTEMS								
Students describe the interactions within and between Earth systems. Students will explain how both fluids (water cycle) and solids (rock cycle) move within Earth systems and how these movements form and change their environment. They will describe the relationship between physical process and human activities and use this understanding to demonstrate an ability to make wise decisions about land use.								BCS Assessments Teacher Assessments

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E2.1 Earth Systems Overview	The Earth is a system consisting of four major interacting components: geosphere (crust, mantle, and core), atmosphere (air), hydrosphere (water), and biosphere (the living part of Earth). Physical, chemical, and biological processes act within and among the four components on a wide range of time scales to continuously change Earth's crust, oceans, atmosphere, and living organisms. Earth elements move within and between the lithosphere, atmosphere, hydrosphere, and biosphere as part of geochemical cycles.		earth system geosphere biosphere atmosphere hydrosphere crust element lithosphere geochemical cycle					BCS Assessments Teacher Assessments
E2.1A	Explain why the Earth is essentially a closed system in terms of matter.	explain-evaluation	closed system matter		Understand basic scientific terminology		Students can explain why the Earth a closed system.	BCS Assessments Teacher Assessments
E2.1B	Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth.	analyze-analysis	analyze interaction system geosphere atmosphere hydrosphere biosphere		Understand basic scientific terminology		Students can analyze the interactions between the major systems of the Earth.	BCS Assessments Teacher Assessments
E2.2 Energy in Earth Systems	Energy in Earth systems can exist in a number of forms (e.g., thermal energy as heat in the Earth, chemical energy stored as fossil fuels, mechanical energy as delivered by tides) and can be transformed from one state to another and move from one reservoir to another. Movement of matter and its component elements, through and between Earth's systems, is driven by Earth's internal (radioactive decay and gravity) and external (Sun as primary) sources of energy. Thermal energy is transferred by radiation, convection, and conduction. Fossil fuels are derived from plants and animals of the past, are nonrenewable, and, therefore, are limited in availability. All sources of energy for human consumption (e.g., solar, wind, nuclear, ethanol, hydrogen, geothermal, hydroelectric) have advantages and disadvantages.		thermal energy chemical energy mechanical energy fossil fuels component reservoir radioactive decay gravity radiation convection conduction nonrenewable consumption					BCS Assessments Teacher Assessments
E2.2A	Describe the Earth's principals sources of internal and external energy	Describe-knowledge	internal energy external energy		Understand basic scientific terminology		The student can describe the Earth's principal sources of heat.	BCS Assessments Teacher Assessments
E2.2B	Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear [U-235]) sources of energy.	identify-comprehension choose-comprehension	biomass renewable nonrenewable fossil fuels		Understand basic scientific terminology		The student can identify differences in the origin and use of renewable and nonrenewable energy.	BCS Assessments Teacher Assessments
E2.2C	Describe natural processes in which heat transfer in the Earth occurs by conduction, convection, and radiation.	Describe-knowledge	heat transfer conduction convection radiation		Understand basic scientific terminology		The student can describe natural processes of heat transfer, on the Earth	BCS Assessments Teacher Assessments

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E2.2D	Identify the main sources of energy to the climate system.	identify-comprehinsion choose-comprehension	climate system		Understand basic scientific terminology		The student can explain the main sources of energy used by climate.	BCS Assessments Teacher Assessments
E2.2e	Explain how energy changes form through Earth systems.	explain-evaluation	earth system		Understand basic scientific terminology		The student can explain how energy changes.	BCS Assessments Teacher Assessments
E2.2f	Explain how elements exist in different compounds and states as they move from one reservoir to another.	explain-evaluation	elements reservoir		Understand basic scientific terminology		The student can explain how elements exist in different compounds and states	BCS Assessments Teacher Assessments
E2.3 Biogeochemical Cycles	The Earth is a system containing essentially a fixed amount of each stable chemical atom or element. Most elements can exist in several different states and chemical forms; they move within and between the geosphere, atmosphere, hydrosphere, and biosphere and have important impacts on human health.		stable element states of matter geosphere biosphere hydrosphere atmosphere					BCS Assessments Teacher Assessments
E2.3A	Explain how carbon exists in different forms such as limestone (rock), carbon dioxide (gas), carbonic acid (water), and animals (life) within Earth systems and how those forms can be beneficial or harmful to humans.	explain-evaluation	carbon dioxide carbonic acid beneficial		Understand basic scientific terminology		The student can explain how carbon exists in different forms and how it is helpful and harmful to humans.	BCS Assessments Teacher Assessments
E2.3b	Explain why small amounts of some chemical forms may be beneficial for life but are poisonous in large quantities (e.g., dead zone in the Gulf of Mexico, Lake Nyos in Africa, fluoride in drinking water).	explain-evaluation	beneficial poisonous chemmical forms		Understand basic scientific terminology		The student can explain why small amounts of some chemicals are beneficial but are poisonous in large quantities.	BCS Assessments Teacher Assessments
E2.3c	Explain how the nitrogen cycle is part of the Earth system.	explain-evaluation	nitrogen cycle		Understand basic scientific terminology		The student can explain the nitrogen cycle	BCS Assessments Teacher Assessments
E2.3d	Explain how carbon moves through the Earth system (including the geosphere) and how it may benefit (e.g., improve soils for agriculture) or harm (e.g., act as a pollutant) society.	explain-evaluation	geosphere pollutant		Understand basic scientific terminology		The student can explain how carbon moves through the Earth's systems and why it is helpful and harmful.	BCS Assessments Teacher Assessments
E2.4 Resources and Human Impacts on Earth systems	The Earth provides resources (including minerals) that are used to sustain human affairs. The supply of nonrenewable natural resources is limited and their extraction and use can release elements and compounds into Earth systems. They affect air and water quality, ecosystems, landscapes, and may have effects on long-term climate. Plans for land use and long-term development must include an understanding of the interactions between Earth systems and human activities.		resources nonrenewable natural resources extraction ecosystems landscape climate interactions Earth systems					BCS Assessments Teacher Assessments
E2.4A	Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits.	describe-knowledge compare-	renewable nonrenewable human consumption environment		Understand basic scientific terminology		The student can explain the costs, benefits, and effects of renewable and nonrenewable energy.	BCS Assessments Teacher Assessments

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E2.4B	Explain how the impact of human activities on the environment (e.g., deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems.	explain-evaluation	deforestation air pollution analysis interactions Earth systems		Understand basic scientific terminology		The student can explain their impact on the 4 systems of of the Earth.	BCS Assessments Teacher Assessments
E2.4c	Explain ozone depletion in the stratosphere and methods to slow human activities to reduce ozone depletion.	explain-evaluation	ozone depletion stratosphere		Understand basic scientific terminology		The student can explain ozone depletion and efforts to reduce its depletion.	BCS Assessments Teacher Assessments
E2.4d	Describe the life cycle of a product, including the resources, production, packaging, transportation, disposal, and pollution.	describe-knowledge	life cycle resources disposal pollution		Understand basic scientific terminology		The student can describe the life cycle of a product.	BCS Assessments Teacher Assessments
STANDARD E3: THE SOLID EARTH								
Students explain how scientists study and model the interior of the Earth and its dynamic nature. They use the theory of plate tectonics, the unifying theory of geology, to explain a wide variety of Earth features and processes and how hazards resulting from these processes impact society.								
E3.p1 Landforms and Soils (prerequisite)	Landforms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruptions, and deposition of sediments transported in rivers, streams, and lakes through watersheds. Destructive forces include weathering and erosion. The weathering of rocks and decomposed organic matter result in the formation of soils. (prerequisite)		landforms constructive force destructive force crustal deformation deposition sediments watershed weathering erosion decomposed organic matter		Understand basic scientific terminology			BCS Assessments Teacher Assessments
E3.p1A	Explain the origin of Michigan landforms. Describe and identify surface features using maps and satellite images. (prerequisite)	explain-comprehension describe-knowledge identify-comprehension	landforms surface feature satellite		Understand basic scientific terminology		The student can explain the origins of Michigan landforms.	BCS Assessments Teacher Assessments
E3.p1B	Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments. (prerequisite)	explain-evaluation	physical weathering chemical weathering erosion sediments		Understand basic scientific terminology		The student can explain physical and chemical weathering.	BCS Assessments Teacher Assessments
SCI.9-12.	Describe how coastal features are formed by wave erosion and deposition. (prerequisite)	describe-knowledge	coastal erosion deposition		Understand basic scientific terminology		The student can explain how coastal features are formed.	BCS Assessments Teacher Assessments

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E3.p2 Rocks and Minerals (prerequisite)	Igneous, metamorphic, and sedimentary rocks are constantly forming and changing through various processes. As they do so, elements move through the geosphere. In addition to other geologic features, rocks and minerals are indicators of geologic and environmental conditions that existed in the past. (prerequisite)							BCS Assessments Teacher Assessments
E3.p2A	Identify common rock-forming minerals (quartz, feldspar, biotite, calcite, hornblende). (prerequisite)	identify-comprehension	rock-forming minerals		Understand basic scientific terminology		The student can identify rock forming minerals.	BCS Assessments Teacher Assessments
E3.p2B	Identify common igneous (granite, basalt, andesite, obsidian, pumice), metamorphic (schist, gneiss, marble, slate, quartzite), and sedimentary (sandstone, limestone, shale, conglomerate) rocks and describe the processes that change one kind of rock to another. (prerequisite)	identify-comprehension describe-knowledge	igneous, meatamorphic, sedimentary rock, processes		Understand basic scientific terminology		The student can identify common igneous, metamorphic, and sedimentary rock and describe the processes that change rock.	BCS Assessments Teacher Assessments
E3.p3 Basic Plate Tectonics (prerequisite)	Early evidence for the movement of continents was based on the similarities of coastlines, geology, faunal distributions, and paleoclimatelogical data across the Atlantic and Indian Oceans. In the 1960s, additional evidence from marine geophysical surveys seismology, volcanology, and paleomagnetism resulted in the development of the theory of plate tectonics. (prerequisite)							BCS Assessments Teacher Assessments
E3.p3A	Describe geologic, paleontologic, and paleoclimatalogic evidence that indicates Africa and South America were once part of a single continent.	describe-knowledge	geologic, paleotongic, paleoclimatalogic		Understand basic scientific terminology		The student can describe evidence for Pangaea.	BCS Assessments Teacher Assessments
E3.p3B	Describe the three types of plate boundaries (divergent, convergent, and transform) and geographic features associated with them (e.g., continental rifts and mid-ocean ridges, volcanic and island arcs, deep-sea trenches, transform faults).	describe-knowledge	plate boundaries, geographic features		Understand basic scientific terminology		The student can describe plate and their geologic features.	BCS Assessments Teacher Assessments
E3.p3C	Describe the three major types of volcanoes (shield volcano, stratovolcano, and cinder cones) and their relationship to the Ring of Fire.	describe-knowledge	Volcanoes, relationship, Ring of Fire		Understand basic scientific terminology		The student can describe the three types of volcanoes and their relationship to the Ring of Fire.	BCS Assessments Teacher Assessments
E3.1 Advanced Rock Cycle	Igneous, metamorphic, and sedimentary rocks are indicators of geologic and environmental conditions and processes that existed in the past. These include cooling and crystallization, weathering and erosion, sedimentation and lithification, and metamorphism. In some way, all of these processes are influenced by plate tectonics, and some are influenced by climate.							BCS Assessments Teacher Assessments

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E3.1A	Discriminate between igneous, metamorphic, and sedimentary rocks and describe the processes that change one kind of rock into another.	discriminate-application describe-knowledge	igneous, meatamorphic, sedimentary rock, processes		Understand basic scientific terminology		The student can describe the processes that change one rock into another.	BCS Assessments Teacher Assessments
E3.1B	Explain the relationship between the rock cycle and plate tectonics theory in regard to the origins of igneous, sedimentary, and metamorphic rocks.	explain-evaluation	plate tectonics, rock cycle, igneous, meatamorphic, sedimentary		Understand basic scientific terminology		The student can explain the relationship between the rock cycle and plate tectonic theory	BCS Assessments Teacher Assessments
E3.1c	Explain how the size and shape of grains in a sedimentary rock indicate the environment of formation (including climate) and deposition.	explain-evaluation	grains, sedimentary rock, environment, deposition		Understand basic scientific terminology		The student can explain the size and shape of grains in sedimentary rock	BCS Assessments Teacher Assessments
E3.1d	Explain how the crystal sizes of igneous rocks indicate the rate of cooling and whether the rock is extrusive or intrusive.	explain-evaluation	crystal, igneous rock, cooling, extrusive, intrusive		Understand basic scientific terminology		The student can explain the crystal sizes of igneous rocks and if the rock is extrusive or intrusive.	BCS Assessments Teacher Assessments
E3.1e	Explain how the texture (foliated, nonfoliated) of metamorphic rock can indicate whether it has experienced regional or contact metamorphism.	explain-evaluation	texture, metamorphic rock, regional metaphorism, contact metamorphism		Understand basic scientific terminology		The student can explain the texture of metamorphic rock.	BCS Assessments Teacher Assessments
E3.2 Interior of the Earth	The Earth can also be subdivided into concentric layers based on their physical characteristics: (lithosphere, asthenosphere, lower mantle, outer core, and inner core). The crust and upper mantle compose the rigid lithosphere (plates) that moves over a "softer" asthenosphere (part of the upper mantle). The magnetic field of the Earth is generated in the outer core. The interior of the Earth cannot be directly sampled and must be modeled using data from seismology.							BCS Assessments Teacher Assessments
E3.2A	Describe the interior of the Earth (in terms of crust, mantle, and inner and outer cores) and where the magnetic field of the Earth is generated.	describe-knowledge	interior of the Earth, magnetic fields		Understand basic scientific terminology		The student can describe the interior of the Earth.	BCS Assessments Teacher Assessments
E3.2B	Explain how scientists infer that the Earth has interior layers with discernable properties using patterns of primary (P) and secondary (S) seismic wave arrivals.	explain-evaluation	interior layers, discernable properties, seismic waves		Understand basic scientific terminology		The student can infer the the properties of the interior of the Earth.	BCS Assessments Teacher Assessments
E3.2C	Describe the differences between oceanic and continental crust (including density, age, composition).	describe-knowledge	oceanic crust, continental crust		Understand basic scientific terminology		The student can describe the difference between continental and oceanic crust	BCS Assessments Teacher Assessments

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E3.2d	Explain the uncertainties associated with models of the interior of the Earth and how these models are validated.	explain-evaluation	interior of earth		Understand basic scientific terminology		The student can explain the uncertainties with models of the Earth's interior.	BCS Assessments Teacher Assessments
E3.3 Plate Tectonics Theory	The Earth's crust and upper mantle make up the lithosphere, which is broken into large mobile pieces called tectonic plates. The plates move at velocities in units of centimeters per year as measured using the global positioning system (GPS). Motion histories are determined with calculations that relate rate, time, and distance of offset geologic features. Oceanic plates are created at mid-ocean ridges by magmatic activity and cooled until they sink back into the Earth at subduction zones. At some localities, plates slide by each other. Mountain belts are formed both by continental collision and as a result of subduction. The outward flow of heat from Earth's interior provides the driving energy for plate tectonics.							BCS Assessments Teacher Assessments
E3.3A	Explain how plate tectonics accounts for the features and processes (sea floor spreading, mid-ocean ridges, subduction zones, earthquakes and volcanoes, mountain ranges) that occur on or near the Earth's surface.	explain-evaluation	sea floor spreading, ridges, subduction, mountain ranges		Understand basic scientific terminology		The student can explain how plate tectonics accounts for the features on or near the Earth's surface.	BCS Assessments Teacher Assessments
E3.3B	Explain why tectonic plates move using the concept of heat flowing through mantle convection, coupled with the cooling and sinking of aging ocean plates that result from their increased density.	explain-evaluation	tectonic plates, mantle convection, cooling, sinking, density		Understand basic scientific terminology		The student can explain why tectonic plates move.	BCS Assessments Teacher Assessments
E3.3C	Describe the motion history of geologic features (e.g., plates, Hawaii) using equations relating rate, time, and distance.	describe-knowledge	geologic features, equations, rate		Understand basic scientific terminology		The student can use rate, time, and distance to describe the motion of geologic features.	BCS Assessments Teacher Assessments
E3.3d	Distinguish plate boundaries by the pattern of depth and magnitude of earthquakes.	distinguish-analysis	plate boudaries, magnitude		Understand basic scientific terminology		The student can distinguish plate boundaries by the pattern of earthquakes.	BCS Assessments Teacher Assessments
E3.r3e	Predict the temperature distribution in the lithosphere as a function of distance from the mid-ocean ridge and how it relates to ocean depth. (recommended)	predict-synthesis	temperature distribution, lithosphere, mid-ocean ridge, ocean depth		Understand basic scientific terminology		The student can predict the temperature distribution in the lithosphere.	BCS Assessments Teacher Assessments
E3.r3f	Describe how the direction and rate of movement for the North American plate has affected the local climate over the last 600 million years. (recommended)	describe-knowledge	North American plate, local climate		Understand basic scientific terminology		The student can describe how the N. American plate has affected local climate.	BCS Assessments Teacher Assessments

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E3.4 Earthquakes and Volcanoes	Plate motions result in potentially catastrophic events (earthquakes, volcanoes, tsunamis, mass wasting) that affect humanity. The intensity of volcanic eruptions is controlled by the chemistry and properties of the magma. Earthquakes are the result of abrupt movements of the Earth. They generate energy in the form of body and surface waves.							BCS Assessments Teacher Assessments
E3.4A	Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries.	locate-comprehension determine-evaluation	plate boudaries, earthquakes, volcanoes		Understand basic scientific terminology		The student can locate and determine types of plate boundaries.	BCS Assessments Teacher Assessments
E3.4B	Describe how the sizes of earthquakes and volcanoes are measured or characterized.	describe-knowledge	earthquakes, volcanoes		Understand basic scientific terminology		The student can describe how the sizes of earthquakes and volcanoes are measured.	BCS Assessments Teacher Assessments
E3.4C	Describe the effects of earthquakes and volcanic eruptions on humans.	describe-knowledge	earthquakes, volcanic eruptions		Understand basic scientific terminology		The student can describe the effects of volcanoes and earthquakes.	BCS Assessments Teacher Assessments
E3.4d	Explain how the chemical composition of magmas relates to plate tectonics and affects the geometry, structure, and explosivity of volcanoes.	explain-evaluation	chemical composition, magma, plate tectonics, geometry, structure, explosivity		Understand basic scientific terminology		The student can explain the chemical makeup of magma and its relationship to explosivity.	BCS Assessments Teacher Assessments
E3.4e	Explain how volcanoes change the atmosphere, hydrosphere, and other Earth systems.	explain-evaluation	volcanoes, atmosphere, hydrosphere		Understand basic scientific terminology		The student can explain how volcanoes affect the spheres.	BCS Assessments Teacher Assessments
E3.4f	Explain why fences are offset after an earthquake, using the elastic rebound theory.	explain-evaluation	earthquake, elastic rebound		Understand basic scientific terminology		The student can use the elastic rebound theory to explain why fences are offset after an earthquake	BCS Assessments Teacher Assessments
STANDARD E4: THE FLUID EARTH								
Students explain how the ocean and atmosphere move and transfer energy around the planet. They also explain how these movements affect climate and weather and how severe weather impacts society. Students explain how long term climatic changes (glaciers) have shaped the Michigan landscape. They also explain features and processes related to surface and ground- water and describe the sustainability of systems in terms of water quality and quantity.								

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E4.p1 Water Cycle (prerequisite)	Water circulates through the crust and atmosphere and in oceans, rivers, glaciers, and ice caps and connects all of the Earth systems. Groundwater is a significant reservoir and source of freshwater on Earth. The recharge and movement of groundwater depends on porosity, permeability, and the shape of the water table. The movement of groundwater occurs over a long period time. Groundwater and surface water are often interconnected. (prerequisite)							BCS Assessments Teacher Assessments
E4.p1A	Describe that the water cycle includes evaporation, transpiration, condensation, precipitation, infiltration, surface runoff, groundwater, and absorption. (prerequisite)	describe-knowledge	evaporation, transpiration, condensation, precipitation, infiltration, groundwater, absorption		Understand basic scientific terminology		The student can describe the water cycle using 6 terms.	BCS Assessments Teacher Assessments
E4.p1B	Analyze the flow of water between the elements of a watershed, including surface features (lakes, streams, rivers, wetlands) and groundwater. (prerequisite)	analyze-analysis	watershed, surface feature, groundwater		Understand basic scientific terminology		The student can analyze the flow of water in a watershed.	BCS Assessments Teacher Assessments
E4.p1C	Describe the river and stream types, features, and process including cycles of flooding, erosion, and deposition as they occur naturally and as they are impacted by land use decisions. (prerequisite)	describe-knowledge	river and stream types, features, processes, flooding, erosion, deposition.		Understand basic scientific terminology		The student can describe river and stream types and features.	BCS Assessments Teacher Assessments
E4.p1D	Explain the types, process, and beneficial functions of wetlands.	explain-evaluation			Understand basic scientific terminology		The student can describe wetlands.	BCS Assessments Teacher Assessments
E4.p2 Water and the Atmosphere (prerequisite)	The atmosphere is divided into layers defined by temperature. Clouds are indicators of weather. (prerequisite)							BCS Assessments Teacher Assessments
E4.p2A	Describe the composition and layers of the atmosphere. (prerequisite)	describe-knowledge	composition, atmosphere		Understand basic scientific terminology		The student can describe the layers of the atmosphere.	BCS Assessments Teacher Assessments
E4.p2B	Describe the difference between weather and climate. (prerequisite)	describe-knowledge	weather, climate		Understand basic scientific terminology		The student can describe the difference between weather and climate.	BCS Assessments Teacher Assessments
E4.p2C	Explain the differences between fog and dew formation and cloud formation. (prerequisite)	explain-evaluation	fog, dew, cloud formation		Understand basic scientific terminology		The student can describe the difference between fog and dew.	BCS Assessments Teacher Assessments
E4.p2D	Describe relative humidity in terms of the moisture content of the air and the moisture capacity of the air and how these depend on the temperature. (prerequisite)	describe-knowledge	relative humidity, moisture content, moisture capacity,temperature		Understand basic scientific terminology		The student can describe relative humidity.	BCS Assessments Teacher Assessments

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E4.p2E	Describe conditions associated with frontal boundaries (cold, warm, stationary, and occluded). (prerequisite)	describe-knowledge	frontal boundaries		Understand basic scientific terminology		The student can describe frontal boundaries.	BCS Assessments Teacher Assessments
E4.p2F	Describe the characteristics and movement across North America of the major air masses and the jet stream. (prerequisite)	describe-knowledge	characteristics, movement, air masses, jet stream		Understand basic scientific terminology		The student can describe the movement of air masses and the jet stream across N. America.	BCS Assessments Teacher Assessments
E4.p2G	Interpret a weather map and describe present weather conditions and predict changes in weather over 24 hours. (prerequisite)	interpret-application predict-synthesis	weather map, weather conditions, predict		Understand basic scientific terminology		The student can interpret a weather map and describe present weather conditions.	BCS Assessments Teacher Assessments
E4.p2H	Explain the primary causes of seasons. (prerequisite)	explain-evaluation	causes, seasons		Understand basic scientific terminology		The student can explain the causes of the season.	BCS Assessments Teacher Assessments
E4.p2I	Identify major global wind belts (trade winds, prevailing westerlies, and polar easterlies) and that their vertical components control the global distribution of rainforests and deserts. (prerequisite)	identify-comprehension	global winds, rainforests, deserts		Understand basic scientific terminology		The student can identify major global wind belts.	BCS Assessments Teacher Assessments
E4.p3 Glaciers (prerequisite)	Glaciers are large bodies of ice that move under the influence of gravity. They form part of both the rock and water cycles. Glaciers and ice sheets have shaped the landscape of the Great Lakes region. Areas that have been occupied by ice sheets are depressed. When the ice sheet is removed, the region rebounds (see also climate change). (prerequisite)						The student can explain the meaning glaciers.	BCS Assessments Teacher Assessments
E4.p3A	Describe how glaciers have affected the Michigan landscape and how the resulting landforms impact our state economy. (prerequisite)	describe-knowledge	glaciers, landforms, impact		Understand basic scientific terminology		The student can describe how glaciers have affected the Michigan landscape.	BCS Assessments Teacher Assessments
E4.p3B	Explain what happens to the lithosphere when an ice sheet is removed. (prerequisite)	explain-evaluation	lithosphere, ice sheet		Understand basic scientific terminology		The student can explain what happens to the lithosphere when an ice sheet is removed	BCS Assessments Teacher Assessments
E4.p3C	Explain the formation of the Great Lakes. (prerequisite)	explain-evaluation	formation		Understand basic scientific terminology		The student can explain the formation of the Great Lakes	BCS Assessments Teacher Assessments
E4.1 Hydrogeology	Fresh water moves over time between the atmosphere, hydrosphere (surface water, wetlands, rivers, and glaciers), and geosphere (groundwater). Water resources are both critical to and greatly impacted by humans. Changes in water systems will impact quality, quantity, and movement of water. Natural surface water processes shape the landscape everywhere and are affected by human land use decisions.		atmosphere, hydrosphere, quality, quantity, natural water, landscape					BCS Assessments Teacher Assessments

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		Verbs / Bloom's Taxonomy Level	Content Vocabulary	*Assess	Skills Needed & Sequencing Of Skills	Resources	Learning Targets I can…	Assessment
E4.1A	Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability).	compare-analysis contrast-analysis	surface water systems, groundwater, reservoirs, dynamics		Understand basic scientific terminology		Students can compare and contrast surface and groundwater systems.	BCS Assessments Teacher Assessments
E4.1B	Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs.	explain-evaluation	aquifers, sustainability, qualitative, recharge, residence time		Understand basic scientific terminology		Students can explain groundwater systems and their effect on aquifers.	BCS Assessments Teacher Assessments
E4.1C	Explain how water quality in both groundwater and surface systems is impacted by land use decisions.	explain-evaluation	groundwater, surface systems		Understand basic scientific terminology		Students can explain how water quality is impacted by land use.	BCS Assessments Teacher Assessments
E4.2 Oceans and Climate	Energy from the sun and the rotation of the Earth control global atmospheric circulation. Oceans redistribute matter and energy around the Earth through currents, waves, and interaction with other Earth systems. Ocean currents are controlled by prevailing winds, changes in water density, ocean topography, and the shape and location of landmasses. Oceans and large lakes (e.g., Great Lakes) have a major effect on climate and weather because they are a source of moisture and a large reservoir of heat. Interactions between oceanic circulation and the atmosphere can affect regional climates throughout the world.							BCS Assessments Teacher Assessments
E4.2A	Describe the major causes for the ocean's surface and deep water currents, including the prevailing winds, the Coriolis effect, unequal heating of the earth, changes in water temperature and salinity in high latitudes, and basin shape.	describe-knowledge	prevailing winds, Coriolis effect, unequal heating, salinity, basin shape		Understand basic scientific terminology		The student can describe the causes for the oceans surface and deep water currents.	BCS Assessments Teacher Assessments
E4.2B	Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climatic zones, and the ocean as a major CO_2 reservoir.	explain-evaluation	heat transfer, thermohaline circulation, boundary currents, climactic zones		Understand basic scientific terminology		The student can describe the ways an ocean influences climate.	BCS Assessments Teacher Assessments
E4.2c	Explain the dynamics (including ocean-atmosphere interactions) of the El Niño-Southern Oscillation (ENSO) and its effect on continental climates.	explain-evaluation	dynamics, El Nino, Southern Oscillation, continental climates		Understand basic scientific terminology		The student can describe how El Nino can effect continental climates.	BCS Assessments Teacher Assessments

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		Verbs / Bloom's Taxonomy Level	Content Vocabulary	*Assess	Skills Needed & Sequencing Of Skills	Resources	Learning Targets I can…	Assessment
E4.2d	Identify factors affecting seawater density and salinity and describe how density affects oceanic layering and currents.	identify-comprehension	seawater density, salinity, density		Understand basic scientific terminology		The student can identify factors affecting seawater density and its effects on currents.	BCS Assessments Teacher Assessments
E4.2e	Explain the differences between maritime and continental climates with regard to oceanic currents.	explain-evaluation	maritime and continental climates		Understand basic scientific terminology		The student can explain maritime and continental climates.	BCS Assessments Teacher Assessments
E4.2f	Explain how the Coriolis effect controls oceanic circulation.	explain-evaluation	Coriolis Effect, oceanic circulation		Understand basic scientific terminology		The student can explain how the Coriolis effect controls circulation.	BCS Assessments Teacher Assessments
E4.r2g	Explain how El Niño affects economies (e.g., in South America). (recommended)	explain-evaluation	El Nino		Understand basic scientific terminology		Students can explain El Nino's affect on the economy.	BCS Assessments Teacher Assessments
E4.3 Severe Weather	Tornadoes, hurricanes, blizzards, and thunderstorms are severe weather phenomena that impact society and ecosystems. Hazards include downbursts (wind shear), strong winds, hail, lightning, heavy rain, and flooding. The movement of air in the atmosphere is due to differences in air density resulting from variations in temperature. Many weather conditions can be explained by fronts that occur when air masses meet.							BCS Assessments Teacher Assessments
E4.3A	Describe the various conditions of formation associated with severe weather (thunderstorms, tornadoes, hurricanes, floods, waves, and drought).	describe-knowledge	drought, severe weather		Understand basic scientific terminology		The student can describe various conditions of formation associated with severe weather.	BCS Assessments Teacher Assessments
E4.3B	Describe the damage resulting from, and the social impact of thunderstorms, tornadoes, hurricanes, and floods.	describe-knowledge	thunderstorms, tornadoes, hurricanes, floods		Understand basic scientific terminology		The student can describe the damage resulting from severe weather.	BCS Assessments Teacher Assessments
E4.3C	Describe severe weather and flood safety and mitigation.	describe-knowledge	flood safety, mitigation		Understand basic scientific terminology		The student can describe severe weather and flood safety	BCS Assessments Teacher Assessments
E4.3D	Describe the seasonal variations in severe weather.	describe-knowledge	seasonal variations		Understand basic scientific terminology		The student can describe seasonal variation in severe weather	BCS Assessments Teacher Assessments
E4.3E	Describe conditions associated with frontal boundaries that result in severe weather (thunderstorms, tornadoes, and hurricanes).	describe-knowledge	frontal boundaries, severe weather		Understand basic scientific terminology		The student can describe conditions associated with frontal boundaries.	BCS Assessments Teacher Assessments
E4.3F	Describe how mountains, frontal wedging (including dry lines), convection, and convergence form clouds and precipitation.	describe-knowledge	frontal wedging, convection, convergence		Understand basic scientific terminology		The student can describe how mountains, convection, and convergence from clouds.	BCS Assessments Teacher Assessments

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		Verbs / Bloom's Taxonomy Level	Content Vocabulary	*Assess	Skills Needed & Sequencing Of Skills	Resources	Learning Targets I can…	Assessment
E4.3g	Explain the process of adiabatic cooling and adiabatic temperature changes to the formation of clouds.	explain-evaluation	adiabatic cooling and heating		Understand basic scientific terminology		The student can explain how cooling and temperature affect cloud formation.	BCS Assessments Teacher Assessments
STANDARD E5: THE EARTH IN SPACE AND TIME								
Students explain theories about how the Earth and universe formed and evolved over a long period of time. Students predict how human activities may influence the climate of the future.								
E5.p1 Sky Observations (prerequisite)	Common sky observations (such as lunar phases) can be explained by the motion of solar system objects in regular and predictable patterns. Our galaxy, observable as the Milky Way, is composed of billions of stars, some of which have planetary systems. Seasons are a result of the tilt of the rotation axis of the Earth. The motions of the moon and sun affect the phases of the moon and ocean tides. (prerequisite)							BCS Assessments Teacher Assessments
E5.p1A	Describe the motions of various celestial bodies and some effects of those motions. (prerequisite)	describe-knowledge	motions, celestial bodies,		Understand basic scientific terminology		Students can describe the motion of various celestial bodies.	BCS Assessments Teacher Assessments
E5.p1B	Explain the primary cause of seasons. (prerequisite)	explain-evaluation	primary, seasons		Understand basic scientific terminology		Students can explain the the cause of the seasons.	BCS Assessments Teacher Assessments
E5.p1C	Explain how a light year can be used as a distance unit. (prerequisite)	explain-evaluation	light year		Understand basic scientific terminology		The student can explain how light-years measure distance.	BCS Assessments Teacher Assessments
E5.p1D	Describe the position and motion of our solar system in our galaxy. (prerequisite)	describe-knowledge	solar system, galaxy		Understand basic scientific terminology		Students can describe position and motion of our solar system.	BCS Assessments Teacher Assessments
E5.1 The Earth in space	Scientific evidence indicates the universe is orderly in structure, finite, and contains all matter and energy. Information from the entire light spectrum tells us about the composition and motion of objects in the universe. Early in the history of the universe, matter clumped together by gravitational attraction to form stars and galaxies. According to the Big Bang theory, the universe has been continually expanding at an increasing rate since its formation about 13.7 billion years ago.							BCS Assessments Teacher Assessments
E5.1A	Describe the position and motion of our solar system in our galaxy and the overall scale, structure, and age of the universe.	describe-knowledge	galaxy, universe		Understand basic scientific terminology		Students can describe the overall scale, structure, and age of the universe.	BCS Assessments Teacher Assessments
E5.1b	Describe how the Big Bang theory accounts for the formation of the universe.	describe-knowledge	Big Bang theory		Understand basic scientific terminology		The student can describe the Big Bang theory and the formation of the universe.	BCS Assessments Teacher Assessments

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E5.1c	Explain how observations of the cosmic microwave background have helped determine the age of the universe.	explain-evaluation	cosmic background radiation		Understand basic scientific terminology		Students can explain microwave background and its use in determining age of the universe.	BCS Assessments Teacher Assessments
E5.1d	Differentiate between the cosmological and Doppler red shift.	differentiate-analysis	cosmological, Red shift		Understand basic scientific terminology		The student can differentiate cosmological and red shift.	BCS Assessments Teacher Assessments
E5.2 The Sun	Stars, including the Sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. Solar energy is responsible for life processes and weather as well as phenomena on Earth. These and other processes in stars have led to the formation of all the other chemical elements.							BCS Assessments Teacher Assessments
E5.2A	Identify patterns in solar activities (sunspot cycle, solar flares, solar wind).	identify-comprehension			Understand basic scientific terminology		Students can identify patterns in solar activities.	BCS Assessments Teacher Assessments
E5.2B	Relate events on the Sun to phenomena such as auroras, disruption of radio and satellite communications, and power grid disturbances.	relate-comprehension	phenomena, auroras, power grids		Understand basic scientific terminology		Students can relate events on the Sun to other phenomena(radio and satellite communication)	BCS Assessments Teacher Assessments
E5.2C	Describe how nuclear fusion produces energy in the Sun.	describe-knowledge	fusion		Understand basic scientific terminology		Students can describe how nuclear fusion produces the Sun's energy.	BCS Assessments Teacher Assessments
E5.2D	Describe how nuclear fusion and other processes in stars have led to the formation of all the other chemical elements.	describe-knowledge	fusion,		Understand basic scientific terminology		Students can describe how nuclear fusion in stars has led to the formation of all elements.	BCS Assessments Teacher Assessments
E5.2x Stellar Evolution	Stars, including the Sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. These and other processes in stars have led to the formation of all the other chemical elements.							BCS Assessments Teacher Assessments
E5.2e	Explain how the Hertzsprung-Russell (H-R) diagram can be used to deduce other parameters (distance).	explain-evaluation	parameters, H-R diagram		Understand basic scientific terminology		Students can explain how HR diagrams can be used to deduce distance.	BCS Assessments Teacher Assessments
E5.2f	Explain how you can infer the temperature, life span, and mass of a star from its color. Use the H-R diagram to explain the life cycles of stars.	explain-evaluation	life span, mass, H-R diagram		Understand basic scientific terminology		Students can explain how you can infer life span, temperature, and mass of a star by its color.	BCS Assessments Teacher Assessments
E5.2g	Explain how the balance between fusion and gravity controls the evolution of a star (equilibrium).	explain-evaluation	fusion, gravity		Understand basic scientific terminology		Students can explain how fusion and gravity control a stars evolution.	BCS Assessments Teacher Assessments
E5.2h	Compare the evolution paths of low-, moderate-, and high-mass stars using the H-R diagram.	compare-analysis	evolution, H-R diagram		Understand basic scientific terminology		Students can explain the growth of low, moderate, and high mass stars	BCS Assessments Teacher Assessments

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E5.3 Earth History and Geologic Time	The solar system formed from a nebular cloud of dust and gas 4.6 Ga (billion years ago). The Earth has changed through time and has been affected by both catastrophic (e.g., earthquakes, meteorite impacts, volcanoes) and gradual geologic events (e.g., plate movements, mountain building) as well as the effects of biological evolution (formation of an oxygen atmosphere). Geologic time can be determined through both relative and absolute dating.							BCS Assessments Teacher Assessments
E5.3A	Explain how the solar system formed from a nebula of dust and gas in a spiral arm of the Milky Way Galaxy about 4.6 Ga (billion years ago).	explain-evaluation	nebula, Milky Way galaxy		Understand basic scientific terminology		Students can explain the formation of our solar system from a nebula of dust and gas.	BCS Assessments Teacher Assessments
E5.3B	Describe the process of radioactive decay and explain how radioactive elements are used to date the rocks that contain them.	describe-knowledge	radioactive decay		Understand basic scientific terminology		The student can describe radioactive decay and how radioactive elements are used to date rocks.	BCS Assessments Teacher Assessments
E5.3C	Relate major events in the history of the Earth to the geologic time scale, including formation of the Earth, formation of an oxygen atmosphere, rise of life, Cretaceous-Tertiary (K-T) and Permian extinctions, and Pleistocene ice age.	relate-	time scale, oxygen atmosphere, K-T, Permian, Pleistocene		Understand basic scientific terminology		The student can relate major events in the history of the Earth to the geologic time scale.	BCS Assessments Teacher Assessments
E5.3D	Describe how index fossils can be used to determine time sequence.	describe-knowledge	time sequence		Understand basic scientific terminology		Students can describe how index fossils are used to determine time sequence	BCS Assessments Teacher Assessments
E5.3x Geologic Dating	Early methods of determining geologic time, such as the use of index fossils and stratigraphic principles, allowed for the relative dating of geological events. However, absolute dating was impossible until the discovery that certain radioactive isotopes in rocks have known decay rates, making it possible to determine how many years ago a given mineral or rock formed. Different kinds of radiometric dating techniques exist. Technique selection depends on the composition of the material to be dated, the age of the material, and the type of geologic event that affected the material.							BCS Assessments Teacher Assessments
E5.3e	Determine the approximate age of a sample, when given the half-life of a radioactive substance (in graph or tabular form) along with the ratio of daughter to parent substances present in the sample.	determine-application	half-life, radioactive, daughter substance, parent substance		Understand basic scientific terminology		Students can determine the approximate age of a sample when given the half life of a substance.	BCS Assessments Teacher Assessments
E5.3f	Explain why C-14 can be used to date a 40,000 year old tree, but U-Pb cannot.	explain-evaluation	C-14, U-Pb		Understand basic scientific terminology		Students can explain why C14 can be used to date a 40,000 year old object but U-Pb can not.	BCS Assessments Teacher Assessments

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E5.3g	Identify a sequence of geologic events using relative-age dating principles.	identify-comprehension	relative age, dating principle		Understand basic scientific terminology		The student can date an object using the relative dating technique	BCS Assessments Teacher Assessments
E5.4 Climate Change	Atmospheric gases trap solar energy that has been reradiated from the Earth's surface (the greenhouse effect). The Earth's climate has changed both gradually and catastrophically over geological and historical time frames due to complex interactions between many natural variables and events. The concentration of greenhouse gases (especially carbon dioxide) has increased due to human industrialization, which has contributed to a rise in average global atmospheric temperatures and changes in the biosphere, atmosphere, and hydrosphere. Climates of the past are researched, usually using indirect indicators, to better understand and predict climate change.							BCS Assessments Teacher Assessments
E5.4A	Explain the natural mechanism of the greenhouse effect, including comparisons of the major greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, and ozone).	explain-evaluation	greenhouse effect, greenhouse gases		Understand basic scientific terminology		The student can explain the greenhouse effect.	BCS Assessments Teacher Assessments
E5.4B	Describe natural mechanisms that could result in significant changes in climate (e.g., major volcanic eruptions, changes in sunlight received by the earth, and meteorite impacts).	describe-knowledge	mechanisms		Understand basic scientific terminology		Students can describe mechanisms that can result in climate change.	BCS Assessments Teacher Assessments
E5.4C	Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature over the past 150 years.	analyze-analysis	emissions, carbon dioxide,		Understand basic scientific terminology		Students can analyze the relationship between emssions of CO2, atmospheric CO2 levels, and temperature.	BCS Assessments Teacher Assessments
E5.4D	Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans (including the results of increased evaporation, shoreline and estuarine impacts, oceanic algae growth, and coral bleaching) and changing climatic zones (including the adaptive capacity of the biosphere).	explain-evaluation	climate change, climactic change		Understand basic scientific terminology		The student can explain the consequences of warmer oceans and changing climactic zones.	BCS Assessments Teacher Assessments
E5.4e	Based on evidence from historical climate research (e.g. fossils, varves, ice core data) and climate change models, explain how the current melting of polar ice caps can impact the climatic system.	explain-evaluation	evidence, climate, polar ice cap, climactic system		Understand basic scientific terminology		Students can explain how the current melting of polar ice caps can impact the climate.	BCS Assessments Teacher Assessments
E5.4f	Describe geologic evidence that implies climates were significantly colder at times in the geologic record (e.g., geomorphology, striations, and fossils).	describe-knowledge	implies, climates		Understand basic scientific terminology		Students can describe geological evidence that implies climates were colder.	BCS Assessments Teacher Assessments

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E5.4g	Compare and contrast the heat-trapping mechanisms of the major greenhouse gases resulting from emissions (carbon dioxide, methane, nitrous oxide, fluorocarbons) as well as their abundance and heat- trapping capacity.	compare-analysis contrast-analysis	compare, contrast, heat trapping, greenhouse gases, emissions, heat trapping		Understand basic scientific terminology		Students can compare and contrast heat trapping devices resulting from emissions.	BCS Assessments Teacher Assessments
E5.r4h	Use oxygen isotope data to estimate paleotemperature. (recommended)	estimate-synthesis	oxygen, isotope, paleotemperature		Understand basic scientific terminology		Students can use oxygen isotopes to estimate paleotemperature.	BCS Assessments Teacher Assessments
E5.r4i	Explain the causes of short-term climate changes such as catastrophic volcanic eruptions and impact of solar system objects. (recommended)	explain-evaluation	climate change, volcanic eruption, solar system		Understand basic scientific terminology		The student can explain the causes of short term climate changes.	BCS Assessments Teacher Assessments
E5.r4j	Predict the global temperature increase by 2100, given data on the annual trends of CO_2 concentration increase. (recommended)	predict-synthesis	predict, data, concentration, global temperature		Understand basic scientific terminology		Students can predict the global temp increase by 2100.	BCS Assessments Teacher Assessments

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