Middle School Phenomenon Model Course 1 - Bundle 1
Natural Resources

This is the first bundle of the Middle School Phenomenon Model Course 1. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 1 Question: This bundle is assembled to address the questions of "How important are our natural resources?"

Summary

The bundle organizes performance expectations around helping students understand how resource availability is partially the result of geoscience processes. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The concept that resources are distributed unevenly around the planet as a result of past geologic processes (ESS3.A as in MS-ESS3-1) connects to the idea that maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart (ESS2.B as in MS-ESS2-3).

The idea of geologic processes also connects to the ideas that tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches (ESS1.C as in MS-ESS2-3) and that water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations (ESS2.C as in MS-ESS2-2). These concepts connect to the idea that the planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future (ESS2.A as in MS-ESS2-2).

The distribution of resources also connects to the idea that organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Growth of organisms and population increases are limited by access to resources (LS2.A as in MS-LS2-1). This concept also connects to the idea that humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes (ESS3.A as in MS-ESS3-1).

The idea that population increases are limited by access to resources also connects to the concept that predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared (LS2.A as in MS-LS2-2).

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of analyzing and interpreting data (MS-LS2-1, MS-ESS2-3, and MS-ESS3-1) and constructing explanations and designing solutions (MS-LS2-2 and MS-ESS2-2). Many other practice elements can be used in instruction.

Bundle Crosscutting Concepts Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (MS-LS2-2 and MS-ESS2-3), Cause and Effect (MS-LS2-1 and MS-ESS3-1), and Scale, Proportion, and Quantity (MS-ESS2-2). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations MS-ESS2-2 is partially assessable	MS-LS2-1. **Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.] MS-LS2-2. **Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.] MS-ESS2-2. **Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.** [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.] MS-ESS2-3. **Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.** [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [*Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.*] MS-ESS3-1. **Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]
Example Phenomena	The coastlines of South America and Africa appear as though they could fit together. The native Inuit people of the Arctic live on a high-meat diet while other cultures eat little to no meat. Nearly identical fossils, rock strata, and geologic formations occur in widely separated portions of the globe.
Suggested Practices Building to the PEs	**Asking Questions** ● Ask questions that require sufficient and appropriate empirical evidence to answer. Students could *ask questions that require sufficient and appropriate empirical evidence to answer* **about the distribution of resources around the planet**. MS-ESS3-1

Suggested Practices Building to the PEs (Continued)	**Developing and Using Models** ● Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed. Students could *modify a model based on evidence* [about] **organisms' dependence on their environmental interactions both with other living things and with nonliving factors** *to match what happens if a variable or component of a system is changed*. MS-LS2-1 **Planning and Carrying Out Investigations** ● Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. Students could *plan an investigation* [to identify] **organisms' dependence on environmental interactions both with other living things and with nonliving factors**. MS-LS2-1 **Analyzing and Interpreting Data** ● Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. Students could *use graphical displays* (i.e., **maps of ancient land and water patterns**) *of large data sets* [of] **rocks and fossils** *to identify temporal and spatial relationships* [such as] **how Earth's plates have moved great distances, collided, and spread apart**. MS-ESS2-3 **Using Math and Computational Thinking** ● Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. Students could *apply mathematical concepts to answer scientific questions* [about the] **generation of new ocean sea floor at ridges** and the **movement of Earth's plates.** MS-ESS2-3 **Constructing Explanations** ● Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. Students could *construct an explanation that includes qualitative relationships between variables to describe* **how Earth's plates have moved great distances, collided, and spread apart**. MS-ESS2-3 **Engaging in Argument from Evidence** ● Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support of refute an explanation or a model for a phenomenon. Students could *present an oral argument supported by empirical evidence and scientific reasoning to support a model* [of] **organisms' dependence on their environmental interactions both with other living things and with nonliving factors.** MS-LS2-1

Suggested Practices Building to the PEs (Continued)	**Obtaining, Evaluating, and Communicating Information** ● Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural world. Students could *critically read scientific texts adapted for classroom use to obtain scientific information to describe patterns in* **weathering and erosion**. MS-ESS2-2
Suggested Crosscutting Concepts Building to the PEs	**Patterns** ● Graphs, charts, and images can be used to identify patterns in data. Students could use *images to identify patterns in data* [about] **water's movements, weathering, and erosion**. MS-ESS2-2 **Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. Students could use *cause and effect relationships to predict* **competitive, predatory, and mutually beneficial interactions** [of organisms] *in natural systems.* MS-LS2-2 **Scale, Proportion, and Quantity** ● Phenomena that can be observed at one scale may not be observable at another scale. Students could identify *phenomena* [related to] **weathering and erosion** *that can be observed at one scale* [but are] *not observable at another scale.* MS-ESS2-2
Additional Connections to Nature of Science **Additional Connections to Nature of Science (Continued)**	**Scientific Investigations Use a Variety of Methods** ● Science investigations are guided by a set of values to ensure accuracy of measurements, observations, and objectivity of findings. Students could report on their efforts *to ensure accuracy of measurements, observations, and objectivity of findings* [when they conduct] *investigations* [regarding] **organisms dependence on environmental interactions both with other living things and with nonliving factors**. MS-LS2-1 **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. Students could [identify how their conclusions about the effects of] **water's movements on the land's surface features and underground formations** [are based on the] *assumption that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.* MS-ESS2-2

MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to provide evidence for phenomena.

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
- Growth of organisms and population increases are limited by access to resources.

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Observable features of the student performance by the end of the course:			
1	Organizing data		
	a	Students organize the given data (e.g., using tables, graphs, and charts) to allow for analysis and interpretation of relationships between resource availability and organisms in an ecosystem, including:	
		i.	Populations (e.g., sizes, reproduction rates, growth information) of organisms as a function of resource availability.
		ii.	Growth of individual organisms as a function of resource availability.
2	Identifying relationships		
	a	Students analyze the organized data to determine the relationships between the size of a population, the growth and survival of individual organisms, and resource availability.	
	b	Students determine whether the relationships provide evidence of a causal link between these factors.	
3	Interpreting data		
	a	Students analyze and interpret the organized data to make predictions based on evidence of causal relationships between resource availability, organisms, and organism populations. Students make relevant predictions, including:	
		i.	Changes in the amount and availability of a given resource (e.g., less food) may result in changes in the population of an organism (e.g., less food results in fewer organisms).
		ii.	Changes in the amount or availability of a resource (e.g., more food) may result in changes in the growth of individual organisms (e.g., more food results in faster growth).
		iii.	Resource availability drives competition among organisms, both within a population as well as between populations.
		iv.	Resource availability may have effects on a population's rate of reproduction.

MS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena.

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.

Crosscutting Concepts

Patterns

- Patterns can be used to identify cause and effect relationships.

Observable features of the student performance by the end of the course:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that similar patterns of interactions occur between organisms and their environment, regardless of the ecosystem or the species involved.	
	b	Students use evidence and reasoning to construct an explanation for the given phenomenon.	
2	Evidence		
	a	Students identify and describe* the evidence (e.g., from students' own investigations, observations, reading material, archived data) necessary for constructing the explanation, including evidence that:	
		i.	Competitive relationships occur when organisms within an ecosystem compete for shared resources (e.g., data about the change in population of a given species when a competing species is introduced).
		ii.	Predatory interactions occur between organisms within an ecosystem.
		iii.	Mutually beneficial interactions occur between organisms within an ecosystem. Organisms involved in these mutually beneficial interactions can become so dependent upon one another that they cannot survive alone.
		iv.	Resource availability, or lack thereof, can affect interactions between organisms (e.g., organisms in a resource-limited environment may have a competitive relationship, while those same organisms may not be in competition in a resource-rich environment).
		v.	Competitive, predatory, and mutually beneficial interactions occur across multiple, different, ecosystems
	b	Students use multiple valid and reliable sources for the evidence.	
3	Reasoning		
	a	Students identify and describe* quantitative or qualitative patterns of interactions among organisms that can be used to identify causal relationships within ecosystems, related to the given phenomenon.	

	b	Students describe* that regardless of the ecosystem or species involved, the patterns of interactions (competitive, mutually beneficial, predator/prey) are similar.
	c	Students use reasoning to connect the evidence and support an explanation. In their reasoning, students use patterns in the evidence to predict common interactions among organisms in ecosystems as they relate to the phenomenon, (e.g., given specific organisms in a given environment with specified resource availability, which organisms in the system will exhibit competitive interactions). Students predict the following types of interactions:
		i. Predatory interactions.
		ii. Competitive interactions.
		iii. Mutually beneficial interactions.

MS-ESS2-2 Earth's Systems

Students who demonstrate understanding can:

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.	**ESS2.A: Earth's Materials and Systems** • The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **ESS2.C: The Roles of Water in Earth's Surface Processes** • Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.	**Scale Proportion and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Observable features of the student performance by the end of the course:		
1	Articulating the explanation of phenomena	
	a	Students articulate a statement that relates a given phenomenon to a scientific idea, including that geoscience processes have changed the Earth's surface at varying time and spatial scales.
	b	Students use evidence and reasoning to construct an explanation for the given phenomenon, which involves changes at Earth's surface.
2	Evidence	
	a	Students identify and describe* the evidence necessary for constructing an explanation, including:
		i. The slow and large-scale motion of the Earth's plates and the results of that motion.
		ii. Surface weathering, erosion, movement, and the deposition of sediment ranging from large to microscopic scales (e.g., sediment consisting of boulders and microscopic grains of sand, raindrops dissolving microscopic amounts of minerals).
		iii. Rapid catastrophic events (e.g., earthquakes, volcanoes, meteor impacts).
	b	Students identify the corresponding timescales for each identified geoscience process.
	c	Students use multiple valid and reliable sources, which may include students' own investigations, evidence from data, and observations from conceptual models used to represent changes that occur on very large or small spatial and/or temporal scales (e.g., stream tables to illustrate erosion and deposition, maps and models to show the motion of tectonic plates).
	Reasoning	

3	a	Students use reasoning, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to connect the evidence and support an explanation for how geoscience processes have changed the Earth's surface at a variety of temporal and spatial scales. Students describe* the following chain of reasoning for their explanation:	
		i.	The motion of the Earth's plates produces changes on a planetary scale over a range of time periods from millions to billions of years. Evidence for the motion of plates can explain large-scale features of the Earth's surface (e.g., mountains, distribution of continents) and how they change.
		ii.	Surface processes such as erosion, movement, weathering, and the deposition of sediment can modify surface features, such as mountains, or create new features, such as canyons. These processes can occur at spatial scales ranging from large to microscopic over time periods ranging from years to hundreds of millions of years.
		iii.	Catastrophic changes can modify or create surface features over a very short period of time compared to other geoscience processes, and the results of those catastrophic changes are subject to further changes over time by processes that act on longer time scales (e.g., erosion of a meteor crater).
		iv.	A given surface feature is the result of a broad range of geoscience processes occurring at different temporal and spatial scales.
		v.	Surface features will continue to change in the future as geoscience processes continue to occur.

MS-ESS2-3 Earth's Systems

Students who demonstrate understanding can:

MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [*Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to provide evidence for phenomena.

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Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

- Science findings are frequently revised and/or reinterpreted based on new evidence.

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. *(HS.ESS1.C GBE),(secondary)*

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.

Crosscutting Concepts

Patterns

- Patterns in rates of change and other numerical relationships can provide information about natural systems.

Observable features of the student performance by the end of the course:			
1	Organizing data		
	a	Students organize given data that represent the distribution and ages of fossils and rocks, continental shapes, seafloor structures, and/or age of oceanic crust.	
	b	Students describe* what each dataset represents.	
	c	Students organize the given data in a way that facilitates analysis and interpretation.	
2	Identifying relationships		
	a	Students analyze the data to identify relationships (including relationships that can be used to infer numerical rates of change, such as patterns of age of seafloor) in the datasets about Earth features.	
3	Interpreting data		
	a	Students use the analyzed data to provide evidence for past plate motion. Students describe*:	
		i.	Regions of different continents that share similar fossils and similar rocks suggest that, in the geologic past, those sections of continent were once attached and have since separated.
		ii.	The shapes of continents, which roughly fit together (like pieces in a jigsaw puzzle) suggest that those land masses were once joined and have since separated.
		iii.	The separation of continents by the sequential formation of new seafloor at the center of the ocean is inferred by age patterns in oceanic crust that increase in age from the center of the ocean to the edges of the ocean.
		iv.	The distribution of seafloor structures (e.g., volcanic ridges at the centers of oceans, trenches at the edges of continents) combined with the patterns of ages of rocks of the seafloor (youngest ages at the ridge, oldest ages at the trenches) supports the interpretation that new crust forms at the ridges and then moves away from the ridges as new crust continues to form and that the oldest crust is being destroyed at seafloor trenches.

MS-ESS3-1 Earth and Human Activity

Students who demonstrate understanding can:

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**ESS3.A: Natural Resources** • Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. - - - - - - - - - - - - - - - - ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.

Observable features of the student performance by the end of the course:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement relating a given phenomenon to scientific ideas, including that past and current geoscience processes have caused the uneven distribution of the Earth's resources, including:	
		i.	That the uneven distributions of the Earth's mineral, energy, and groundwater resources are the results of past and current geologic processes.
		ii.	That resources are typically limited and nonrenewable due to factors such as the long amounts of time required for some resources to form or the environment in which resources were created forming once or only rarely in the Earth's history.
	b	Students use evidence and reasoning to construct a scientific explanation of the phenomenon.	
2	Identifying the scientific evidence to construct the explanation		
	a	Students identify and describe* the evidence necessary for constructing the explanation, including:	
		i.	Type and distribution of an example of each type of Earth resource: mineral, energy, and groundwater.
		ii.	Evidence for the past and current geologic processes (e.g., volcanic activity, sedimentary processes) that have resulted in the formation of each of the given resources.
		iii.	The ways in which the extraction of each type of resource by humans changes how much and where more of that resource can be found.

	b	Students use multiple valid and reliable sources of evidence.
3	Reasoning	
	a	Students use reasoning to connect the evidence and support an explanation. Students describe* a chain of reasoning that includes:
		i. The Earth's resources are formed as a result of past and current geologic processes.
		ii. The environment or conditions that formed the resources are specific to certain areas and/or times on Earth, thus identifying why those resources are found only in those specific places/periods.
		iii. As resources as used, they are depleted from the sources until they can be replenished, mainly through geologic processes.
		iv. Because many resources continue to be formed in the same ways that they were in the past, and because the amount of time required to form most of these resources (e.g., minerals, fossil fuels) is much longer than timescales of human lifetimes, these resources are limited to current and near-future generations. Some resources (e.g., groundwater) can be replenished on human timescales and are limited based on distribution.
		v. The extraction and use of resources by humans decreases the amounts of these resources available in some locations and changes the overall distribution of these resources on Earth.