NGSS OVERVIEW

EARTH'S RESOURCES

Performance Expectation MS-ESS1-4: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

Performance Expectation 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.

Performance Expectation MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
1. **Investigation: Observing Earth's Resources** This activity establishes the basis for investigating the distribution and formation of natural resources on Earth. Students are introduced to the concept of natural resources as they examine resource samples from Earth's land, water, and biosphere. They identify the resources as renewable or nonrenewable. In discussing the relative values of resources, students take part in the crosscutting concept that science can provide knowledge but does not direct the actions that people take.	MS-ESS3.A	Constructing Explanations and Designing Solutions Asking Questions and Defining Problems	Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World Connections to Nature of Science: Science Addresses Questions about the Natural and Material World	ELA/Literacy: RST.6-8.3
2. **Reading: World Resource Consumption** This reading examines the consumption and global distribution of natural resources in the context of human population growth. The focus of the reading is on the use of a mineral (copper), an energy source (petroleum), and freshwater. Graphs showing consumption of resources over time and maps of their uneven distribution highlight how these resources are limited.	MS-ESS3.A MS-ESS3.C	Constructing Explanations and Designing Solutions Engaging in Argument from Evidence	Cause and Effect Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World Connections to Nature of Science: Science Addresses Questions about the Natural and Material World	Mathematics: 7.RP.A.2 ELA/Literacy: RST.6-8.1 RST.6-8.7 WHST.6-8.1 WHST.6-8.9

EARTH'S RESOURCES (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
3. **Laboratory: Properties of Natural Resources** The idea that resources such as minerals are limited and not renewable is developed through an investigation of the properties of minerals. Students use mineral properties to identify an unknown mineral, and discuss how the properties of a particular mineral make it useful to people.	MS-ESS3.A	Constructing Explanations and Designing Solutions	Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World Connections to Nature of Science: Science Addresses Questions about the Natural and Material World	ELA/Literacy: RST.6-8.3
4. **Talking it Over: Per Capita Consumption** Students identify patterns in mineral, energy, and groundwater resource-consumption data over time. Population data are used to calculate per capita consumption, and students examine images from each country to determine the possible negative impacts of resource use on the environment. They construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.	MS-ESS3.C	Engaging in Argument from Evidence	Cause and Effect Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World Connections to Nature of Science: Science Addresses Questions about the Natural and Material World	Mathematics: 6.SP.B.5 ELA/Literacy: RST.6-8.1 WHST. 6-8.1 WHST.6-8.9
5. **Modeling: Finding Resource Deposits** Students model how natural resources are discovered using remote sensing techniques. These techniques extend the ability to measure, explore, and identify structures underground. Students analyze the data they collect, which provide evidence that resources are distributed unevenly on Earth. They are introduced to the idea that the distribution of resources is a result of past geological processes.	MS-ESS3.A	Designing and Using Models Analyzing and Interpreting Data	Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: RST.6-8.3

EARTH'S RESOURCES (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
6. **Laboratory: Extracting Resources** The extraction and processing of ores helps meet global demand for natural resources while at the same time resulting in short- and long-term consequences for the environment. The crosscutting concept of systems and system models is introduced through a copper extraction model. Students extract copper from malachite using acid, and examine the wastes produced by this process. They apply what they have learned to a question that is informed by science but requires individual decision-making about the trade-offs involved.	MS-ESS3.C	Designing and Using Models Engaging in Argument from Evidence	Cause and Effect Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World Connections to Nature of Science: Science Addresses Questions about the Natural and Material World Systems and System Models	ELA/Literacy: RST.6-8.3 WHST.6-8.1
7. **Reading: Geological Processes** Students read about the geological processes that result in the formation and distribution of mineral, energy, and groundwater resources on earth. They practice constructing a scientific explanation based on evidence. The crosscutting concept of stability and change is introduced in the context of geological processes. This activity provides an opportunity to assess Performance Expectations MS-ESS3-1.	MS-ESS3.A	Constructing Explanations and Designing Solutions	Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World Connections to Nature of Science: Science Addresses Questions about the Natural and Material World Stability and Change	ELA/Literacy: RST.6-8.1 WHST.6-8.1 WHST.6-8.9

EARTH'S RESOURCES (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
8. **Laboratory: Groundwater Formation** Students use earth materials to explore the phenomena of groundwater movement and the formation of aquifers. This contributes to their understanding of the uneven distribution of Earth's resources. The activity reinforces the crosscutting concept that humans depend on groundwater resources, and extracting groundwater has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.	MS-ESS3.A	Designing and Using Models Analyzing and Interpreting Data	Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World Structure and Function Systems and System Models	ELA/Literacy: RST.6-8.3
9. **Modeling: Modeling Rock Layers** Rock strata provide a way to understand Earth's history. Students use a model of the formation of rock layers to begin to investigate the history of Earth. The crosscutting concept of systems and system models as well as scale, proportion, and quality are developed. Understanding resource formation as a process that happens over extremely long periods of time is the focus of the next few activities.	MS-ESS1.C	Constructing Explanations and Designing Solutions Designing and Using Models	Scale, Proportion, and Quantity Systems and System Models Stability and Change	ELA/Literacy: RST.6-8.3 WHST.6-8.1
10. **Investigation: Earth's History** Students continue a series of activities focusing on how evidence from rock strata has been used to organize Earth's 4.6-billion-year history. They investigate geological time by first ordering their own history over time. They then order events in Earth's history into one of four time periods before examining the work of modern geologists. The crosscutting concept of scale, proportion, and quality is further developed with the introduction of the geologic time scale.	MS-ESS1.C	Constructing Explanations and Designing Solutions Planning and Carrying Out Investigations	Scale, Proportion, and Quantity	ELA/Literacy: RST.6-8.3
11. **Investigation: Fossils Through Time** The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Students analyze data from the rock strata and the fossil record and construct a relative time scale of Earth's 4.6-billion-year history.	MS-ESS1.C	Constructing Explanations and Designing Solutions Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Patterns Scale, Proportion, and Quantity Stability and Change	ELA/Literacy: RST.6-8.3 WHST.6-8.1 WHST.6-8.9

EARTH'S RESOURCES (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
12. **Investigation: Reading Rock Strata** Students construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year history. They correlate layers in stratigraphic columns from different hypothetical locations and use the fossil evidence to determine relative time periods. The crosscutting concepts of patterns, scale, and stability and change are reinforced. The crosscutting concepts of patterns, scale, and stability and change are reinforced. This activity provides an opportunity to assess Performance Expectation MS-ESS1-4.	MS-ESS1.C	Constructing Explanations and Designing Solutions	Patterns Scale, Proportion, and Quantity Stability and Change	ELA/Literacy: RST.6-8.3 WHST.6-8.1 WHST.6-8.9
13. **Reading: Impact on Earth Systems** Students read about everyday examples that show the cause-and-effect relationship between the increases in human population and per capita consumption of natural resources. They construct an argument about how removing natural resources such as water, food, minerals, and energy negatively impacts Earth's systems. They consider the short- and long-term consequences, positive as well as negative, for the health of people and the natural environment that results from withdrawing natural resources from the earth. This activity provides an opportunity to assess Performance Expectation MS-ESS3-4.	MS-ESS3.C	Engaging in Argument from Evidence	Cause and Effect Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World Connections to Nature of Science: Science Addresses Questions about the Natural and Material World	ELA/Literacy: RST.6-8.1 WHST.6-8.1 WHST.6-8.9
14. **Talking It Over: The Rockford Range Decision** Students use geological processes to explain the distribution of resources in a land area. They look at the cause and effect of human activity on Earth's nonrenewable resources. They make decisions about the short- and long-term consequences, positive as well as negative, for those in a given community faced with a need for resources. This activity provides an opportunity to assess Performance Expectation MS-ESS3-1.	MS-ESS3.A	Constructing Explanations and Designing Solutions Engaging in Argument from Evidence	Cause and Effect Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: RST.6-8.1 WHST.6-8.2 WHST.6-8.9

EARTH'S RESOURCES

Unit Issue: How the use of natural resources by humans can affect the availability of these resources and how these resources vary in their distribution around the world.

Anchoring Phenomenon: Humans affect the availability of natural resources, such as metals, fossil fuels, and freshwater. Examples explored include human use of oil, gas, mineral, and fresh water resources to meet human needs. Students generate and answer questions such as: How are natural resources formed and used? Why do some places have more of certain natural resources than others? How important are natural resources to people?

Investigative Phenomena	Driving Questions	Guiding Questions	Activities	PE	Storyline
The availability and use of natural resources (eg., copper, oil, freshwater) varies around the world.	What are natural resources? Where and how are natural resources found and used?	What are natural resources? (Activity 1)	1, 2, 3, 4, 5	MS-ESS3-1, MS- ESS3-4	Nonrenewable resources are found on Earth, and people value some of these resources more than others.
		How has an increase in human population affected resource consumption? (Activity 2)			The consumption of natural resources has changed over time due in part to changes in human population.
		What makes one mineral resource different from another? (Activity 3)			The characteristics and properties of natural resources vary.
		How are natural resources used globally? (Activity 4)			Per capita consumption varies country by country.
		How are underground deposits of natural resources located? (Activity 5)			Energy resources are distributed unevenly in particular geographic areas.
Geologists use what they know about geological features to predict where they can find resources.	What role have geoscience processes played in the formation of natural resources?	How are resources extracted from the earth? (Activity 6)	6, 7, 8	MS- ESS3-1	Natural resources must be extracted from the earth, and such extractions have environmental impacts.
		How are natural resources formed? (Activity 7)			Resources such as petroleum and metal ores form by different processes (including volcanic activity and weathering) over long periods of time.
		How does groundwater form, and how is it extracted? (Activity 8)			Groundwater is distributed unevenly on Earth's surface and affects the formation of natural resources.

PHENOMENA, DRIVING QUESTIONS AND SEPUP STORYLINE

EARTH'S RESOURCES (continued)

Investigative Phenomena	Driving Questions	Guiding Questions	Activities	PE	Storyline
Natural resources have formed over Earth's 4.6-billion-year history.	How do you use evidence to determine when major events in Earth's history have occurred?	Which rock layers are the oldest? (Activity 9) When did particular events in Earth's history occur? (Activity 10)	9, 10, 11, 12	MS-ESS1-4	Deposition and compaction are processes that help form sedimentary rock.
		How long have organisms been living on Earth? (Activity 11)			Fossils provide evidence of organisms that lived in the past.
		How are rock strata and fossils used to sequence Earth's history? (Activity 12)			Rock strata and fossils are used to establish the sequence of events in Earth's history.
Human decisions will affect the future availability of natural resources.	What decisions do people make that affect natural resource consumption?	How is a growing human population and increasing resource consumption impacting the earth? (Activity 13)	13, 14	MS- ESS3-1, MS- ESS3-4	The growing human population is increasingly using Earth's natural resources.
		What action should be taken to meet the needs of a growing population? (Activity 14)			Natural resources are distributed unevenly, and people make decisions about their extraction.

NGSS CORRELATIONS

EARTH'S RESOURCES

Crosscutting Concepts		Activity number
Cause and Effect	Cause and effect relationships may be used to predict phenomena in natural or designed systems.	2, 4, 6, 13, 14
Patterns	Patterns can be used to identify cause and effect relationships.	4, 11, 12
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.	9, 10, 11, 12
Stability and Change	Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.	7, 8, 9, 11, 12
Structure and Function	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.	8
Systems and System Models	Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.	6, 9
	Models are limited in that they only represent certain aspects of the system under study.	8, 9
Asking Questions and Defining Problems	Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.	1
Engaging in Argument from Evidence	Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.	14
Connections to Engineering, Technology, and Applications of Science	Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.	5
	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.	1, 2, 3, 4, 5, 6, 7, 8, 13, 14
Connections to the Nature of Science	Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.	1, 2, 3, 4, 6, 7, 13
Science and Engineering Practices		**Activity number**
Analyzing and Interpreting Data	Analyze and interpret data to provide evidence for phenomena.	5, 8
Constructing Explanations and Designing Solutions	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.	1, 2, 3, 7, 9, 11, 12, 14
	Apply scientific ideas to construct an explanation for real world phenomena, examples, or events.	10

Science and Engineering Practices		Activity number
Developing and Using Models	Develop a model to predict and/or describe phenomena.	5, 6, 8, 9
Engaging in Argument from Evidence	Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	2, 4, 6, 13
Obtaining, Evaluating, and Communicating Information	Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings.	2
Planning and Carrying Out Investigations	Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.	10
Connections to the Nature of Science	Scientific knowledge is based on logical and conceptual connections between evidence and explanations.	11
Performance Expectations		**Activity number**
Earth's Place in the Universe (ESS1)	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. (MS-ESS1-4)	12
Earth and Human Activity (ESS3)	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. (MS-ESS3-1)	14
	Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. (MS-ESS3-4)	13
Disciplinary Core Ideas		**Activity number**
The History of Planet Earth (ESS1.C)	The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.	9, 10, 11, 12
Natural Resources (ESS3.A)	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.	1, 2, 3, 5, 7, 8, 14
Human Impacts on Earth Systems (ESS3.C)	Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	2, 4, 6, 13

COMMON CORE STATE STANDARDS: CONNECTIONS AND CORRELATIONS

EARTH'S RESOURCES

Making Connections in ELA

As with all SEPUP instructional materials, this unit introduces multiple opportunities for students to engage in a range of ELA practices and skills that are important grade-specific goals of the common core state standards and are also essential to the sensemaking students are doing throughout the unit. Specifically, throughout the unit, students are tasked with following procedural information (RST.6-8.3) to plan and carry out a series of hands-on investigations and experiments to support sensemaking of phenomena about natural resources, their properties, their formation, and their distribution. In addition, students engage with a series of readings in activities 2, 7 and 13 to obtain information (RST.6-8.1), to reflect on their ongoing sensemaking, and to construct an evidence-based argument about the effects of human consumption on Earth systems (WHST.6-8.9). Students engage in writing throughout the unit as they engage in argument from evidence (WHST.6-8.1) with a culminating activity where they write a proposal for which resource to mine to meet the needs of a growing fictional community (WHST.6-8.2). Specific literacy strategies are embedded throughout the unit to support student development of these ELA skills and practices. In addition, Appendix E: Literacy Strategies in the Student Book contains optional resources to support reading, writing and oral communication.

Common Core State Standards – English Language Arts		Activity number
Reading in Science and Technical Subjects (RST)	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (RST.6-8.1)	2, 4, 7, 13, 14
	Follow precisely a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks. (RST.6-8.3)	1, 3, 5, 6, 8, 9, 10, 11
Writing in History/ Social Studies, Science, and Technological Subjects (WHST)	Write arguments focused on discipline-specific content. (WHST.6-8.1)	2, 4, 6, 7, 9, 11, 12, 13
	Write informative/explanatory texts to examine and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (WHST.6-8.2)	14
	Draw evidence from informational texts to support analysis, reflection, and research. (WHST.6-8.9)	2, 4, 7, 11, 12, 13, 14

Making Connections in Mathematics

This unit introduces opportunities for students to engage in two key mathematics practices and skills that are important grade-specific goals of the common core state standards and are also essential to the sensemaking students are doing throughout the unit. In activity 2 of this unit, students make sense of the relationship between human population growth and consumption of natural resources over time (7.RP.A.2). They are asked to graphically represent their thinking about the relationship between resource consumption and population growth over time. Student Sheet 2.1 provides scaffolding for students to engage in this mathematical practice. In activity 4, students are provided with visual information and data for eight different countries. Students use this information to calculate per capita consumption of key natural resources for the countries and compare how countries rank on total consumption vs. per capita consumption (6.SP.B.5). A series of student sheets (Student Sheets 4.1 - 4.3) offer scaffolding for summarizing numerical data and Visual Aid 4.1 is provided for students who need additional support with data interpretation.

Common Core State Standards – Mathematics		Activity number
Ratios and Proportional Reasoning (RP)	Recognize and represent proportional relationships between quantities. (7.RP.A.2)	2
Statistics and Probability (SP)	Summarize numerical data sets in relation to their context. (6.SP.B.5)	4