NGSS OVERVIEW

LAND, WATER, AND HUMAN INTERACTIONS

Performance Expectation MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Performance Expectation MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Performance Expectation MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.*

Performance Expectation MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Performance Expectation MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

* *Performance expectations marked with an asterisk integrate traditional science content with engineering through a science and engineering practice or disciplinary core idea.*

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
1. **Investigation: Where Should We Build?** Students are introduced to the human impact on land and water use with a scenario that engages them in the issues in the context of a community's building project. When considering the impact of development, they apply the crosscutting concept of the influence of science, engineering, and technology on the natural world.	MS-ESS3.C	Asking Questions and Defining Problems	Cause and Effect Influence of Science, Engineering, and Technology on Society and the Natural World	
2. **Laboratory: Does It Dissolve?** Students carry out a laboratory experiment that helps them develop a conceptual model for the phenomenon of dissolving salts in water. They apply what they have learned in the investigation to explain how the natural world is affected by the physical properties of water. The movement of dissolved substances into water is related to the crosscutting concept of *energy and matter*.	MS-ESS2.C MS-PS1.A	Constructing Explanations and Designing Solutions Planning and Carrying out Investigations	Energy and Matter	ELA/Literacy: RST.6-8.3
3. **Investigation: Water Quality** Students conduct a data analysis of water-quality indicators that monitor the human impact on waterways. They compare graphical displays of data that show changes to Earth's surface water at varying times in relation to increases in population. The crosscutting concept of *cause and effect* is explored through the introduction of a correlation and a causal relationship.	MS-ESS3.C	Analyzing and Interpreting Data Connections to the Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Cause and Effect Patterns Influence of Science, Engineering, and Technology on Society and the Natural World	Mathematics: 6.SP.B.5 MP.4

LAND, WATER, AND HUMAN INTERACTIONS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
4. **Investigation: Living Indicators** Students identify patterns in data from simulated catches of aquatic invertebrates and construct arguments for possible cause-and-effect relationships to human activities. The crosscutting concept of *cause and effect* is applied to the phenomenon seen in the effect of human activity on the types and number of aquatic invertebrates found over time.	MS-ESS2.A MS-ESS3.C MS-LS2.A MS-LS2.C	Analyzing and Interpreting Data Engaging in Argument from Evidence Connections to the Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Patterns Cause and Effect Scale, Proportion, and Quantity Influence of Science, Engineering, and Technology on Society and the Natural World	Mathematics: 6.SP.B.5 6.RP.A.1 ELA/Literacy: RST.6-8.3
5. **Laboratory: Nutrients as Contaminants** Students use a model to gather evidence about the interaction of soil, water, and fertilizers in a laboratory investigation to understand how human activities have altered the environment. They apply the crosscutting concept of *cause and effect* to human activity and environmental impacts.	MS-ESS3.C MS-ESS2.C	Developing and Using Models Constructing Explanations and Designing Solutions Planning and Carrying Out Investigations	Cause and Effect Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: RST.6-8.3
6. **Reading: Gulf of Mexico Dead Zone** Students read about the phenomenon of dead zones—their formation, causes, and effects on the environment. They apply the crosscutting concept of scale, proportion, and quantity when they draw a model diagram to explain how human impact on natural resources in one place can have large-scale impacts in another, distant part of the ecosystem.	MS-ESS3.C MS-ESS2.A	Developing and Using Models Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information Connections to the Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Cause and Effect Scale, Proportion, and Quantity Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: RST.6-8.1
7. **Modeling: Cutting Canyons and Building Deltas** Students model the phenomenon of sediment movement in a river to provide evidence for how geoscience processes change Earth's surface. They demonstrate how water's movements under the force of gravity contribute to the formation of landforms. Students then apply the scientific and engineering practice of *asking questions and defining problems* as they use criteria and constraints to design a system to hold sediments in place in the stream.	MS-ESS2.A MS-ESS2.C MS-ETS1.A	Asking Questions and Defining Problems Constructing Explanations and Designing Solutions Developing and Using Models	Scale, Proportion, and Quantity Energy and Matter Influence of Science, Engineering, and Technology on Society and the Natural World Stability and Change	ELA/Literacy: RST.6-8.3

LAND, WATER, AND HUMAN INTERACTIONS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
8. **Investigation: Traveling with the Water Cycle** Students model the phenomenon of global water movement as driven by the sun and gravity. Students construct an explanation on the water cycle and the cycling of matter. They consider how the planet's systems interact over various time and spatial scales. They use the crosscutting concept of *scale, proportion, and quantity* to discuss how water movement can be studied using a model of a system too large to observe all at once.	MS-ESS2.A MS-ESS2.C	Developing and Using Models Constructing Explanations and Designing Solutions	Scale, Proportion and Quantity Energy and Matter	ELA/Literacy: WHST.6-8.2
9. **Reading: Human Impact on Earth's Water** Students read about human impacts on Earth's water. Scientific principles are applied to a discussion of methods for monitoring and minimizing human impact on Earth's water. The crosscutting concept of the influence of science, engineering, and technology on society and the natural world is developed, as students consider the health of people and the natural environment. Students are formally assessed on Performance Expectation MS-ESS2-4.	MS-ESS2.C MS-ESS2.A MS-ESS3.C	Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information Developing and Using Models	Energy and Matter Influence of Science, Engineering, and Technology on Society and the Natural World Stability and Change	ELA/Literacy: RST.6-8.1 RST.6-8.9
10. **Investigation: Making Topographic Maps** Students conduct a hands-on investigation to model Earth's landforms using topographic maps. They create a map of a landform and then apply their understanding to interpret other maps. The consider how the maps reflect evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	MS-ESS2.A	Developing and Using Models Planning and Carrying Out Investigations Analyzing and Interpreting Data	Patterns Scale, Proportion, and Quantity	Mathematics: MP.2 MP.4 ELA/Literacy: RST.6-8.3
11. **Investigation: Boomtown's Topography** Students analyze data from topographic maps that display temporal and spatial information about a particular area. They construct explanations based on this evidence for how geoscience processes have changed Earth's surface over time. They consider how water's movements on the land and underground have changed the land's form. The crosscutting concept of *stability and change* is applied to the scenario as students use evidence from the past to make predictions of what future changes are likely in Boomtown.	MS-ESS2.A MS-ESS2.C	Constructing Explanations and Designing Solutions Analyzing and Interpreting Data Connections to the Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Cause and Effect Scale Proportion and Quantity Stability and Change	Mathematics: MP.2 MP.4

LAND, WATER, AND HUMAN INTERACTIONS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
12. **Modeling: Modeling Cliff Erosion** Students apply what they have learned about the phenomena of erosion and deposition to a model of cliff erosion. They use the model to design an erosion-mitigation structure for the cliff using relevant scientific principles that might limit solutions. They use design criteria to develop a solution that is evaluated by others who use a systematic process to determine how well they meet the criteria and constraints of the problem. Students are formally assessed on Performance Expectation MS-ETS1-1.	MS-ESS2.C MS-ETS1.A MS-ETS1.B	Constructing Explanation and Designing Solutions Asking Questions and Defining Problems Developing and Using Models Engaging in Argument from Evidence	Influence of Science, Engineering, and Technology on Society and the Natural World Scale, Proportion, and Quantity Energy and Matter Stability and Change	ELA/Literacy: RST.6-8.3
13. **Reading: Weathering, Erosion, and Deposition** Students read about phenomena related to geologic processes and how they work on Earth's surface over varying time and spatial scales. They investigate how changes in the soil and water change the landscape either by sudden events or by gradual changes that accumulate over time. Students construct an explanation about changes they observe due to erosion and deposition based on information in this and previous hands-on activities. Students use the crosscutting concept of energy and matter is used to examine how the transfer of energy drives the motion and/or cycling of matter in geologic processes.	MS-ESS2.A MS-ESS2.C	Constructing Explanations and Designing Solutions	Energy and Matter Stability and Change Scale, Proportion, and Quantity Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: RST.6-8.9 WHST.6-8.9
14. **Role Play: Building on the Mississippi** Students apply what they have learned about geologic phenomena and the monitoring and mitigation of human impact to the Mississippi River and Delta. They use the crosscutting concepts of *cause and effect* and *stability and change* to investigate how New Orleans has coexisted with the river. The use of unprecedented engineering in this area was driven by the needs of the city and its people. Students are formally assessed on Performance Expectation MS-ESS2-2.	MS-ESS2.A MS-ESS2.C MS-ESS3.C	Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information	Scale, Proportion, and Quantity Energy and Matter Influence of Science, Engineering, and Technology on Society and the Natural World Stability and Change Cause and Effect	ELA/Literacy: RST.6-8.1

LAND, WATER, AND HUMAN INTERACTIONS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
15. **Investigation: Building in Boomtown** Students use criteria and constraints for building and the information provided in the unit to choose a building site. They identify the consequences of their choices on the health of the people and environment. They compare and critique others' choices and determine whether they emphasize similar or different interpretations of evidence.	MS-ESS2.A MS-ESS2.C MS-ESS3.C	Constructing Explanation and Designing Solutions	Influence of Science, Engineering, and Technology Connections to the Nature of Science: Science Is a Way of Knowing Cause and Effect	ELA/Literacy: WHST.6-8.9 WHST.6-8.2
16. **Design: Building Site Plan** In this final activity, students apply scientific principles and knowledge of geologic phenomena to design the school and fields at one of the sites. Students evaluate the solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. Students are formally assessed on Performance Expectations MS-ESS3-3 and MS-ETS1-2.	MS-ESS3.C MS-ESS2.C MS-ETS1.B	Constructing Explanations and Designing Solutions Engaging in Argument from Evidence	Cause and Effect Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: WHST.6-8.2 SL.8.4

NGSS CORRELATIONS

LAND, WATER, AND HUMAN INTERACTIONS

Crosscutting Concepts		Activity Number
Cause and Effect	Cause-and-effect relationships may be used to predict phenomena in natural or designed systems.	6, 11
	Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.	1, 3, 4, 5, 6, 14, 15, 16
Energy and Matter	Within a natural system, the transfer of energy drives the motion and/or cycling of matter.	2, 7, 8, 9, 12, 13, 14
Patterns	Patterns can be used to identify cause-and-effect relationships.	4
	Graphs, charts, and images can be used to identify patterns in data.	3, 10
Stability and Change	Small changes in one part of a system might cause large changes in another part.	9
	Stability might be disturbed either by sudden events or by gradual changes that accumulate over time.	7, 11, 12, 13, 14
Scale, Proportion, and Quantity	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large to observe all at once or too small to see clearly	4, 6, 7, 8, 10, 11, 12, 13, 14
Connections to Engineering, Technology, and Applications of Science	The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time.	5, 7, 12, 13, 14, 16
	Stability might be disturbed either by sudden events or by gradual changes that accumulate over time.	7, 11, 12, 13, 14
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.	1, 3, 4, 6, 9, 12, 15, 16
Connections to the Nature of Science: Science Is a Way of Knowing	Science is a way of knowing by many people, not just scientists.	15

Science and Engineering Practices		Activity Number
Analyzing and Interpreting Data	Analyze and interpret data to provide evidence for phenomena.	4
	Construct and interpret graphical displays of data to identify linear and nonlinear relationships.	3
	Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.	10, 11
	Distinguish between causal and correlational relationships in data	3, 4
Asking Questions and Defining Problems	Define a design problem that can be solved through the development of an object, tool, process, or system and has multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	7, 12
	Ask questions to identify and clarify evidence of an argument.	1
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.	5, 7, 11, 12, 13, 14
	Apply scientific ideas or principles to design an object, tool, process, or system.	7, 12, 15, 16
	Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events.	2, 8, 9, 11
Developing and Using Models	Develop a model to predict and/or describe phenomena.	10
	Develop a model to describe unobservable mechanisms.	6, 8, 9
	Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.	5, 7, 12
Engaging in Argument from Evidence	Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.	4
	Evaluate competing design solutions based on jointly developed and agreed-on design criteria.	12, 16
	Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.	6
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.	6, 9, 14

Science and Engineering Practices		Activity Number
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.	2, 5, 10
Connections to the Nature of Science	Scientific knowledge is based on logical and conceptual connections between evidence and explanations.	3, 4, 6, 11
Disciplinary Core Ideas		**Activity Number**
Defining and Delimiting Engineering Problems (ETS1.A)	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.	7, 12
Developing Possible Solutions (ETS1.B)	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	12, 16
Earth's Materials and Systems (ESS2.A)	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.	4, 6, 7, 8, 9, 10, 11, 13, 14, 15
The Roles of Water in Earth's Surface Processes (ESS2.C)	Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.	2 (12), 5 (21), 7 (37), 8 (43, 46, 47), 9 (50, 54), 14 (88), 15 (96)
	Global movements of water and its changes in form are propelled by sunlight and gravity.	7, 8, 9, 13, 15
	Water's movements—both on the land and underground— cause weathering and erosion, which change the land's surface features and create underground formations.	7, 11, 12, 13, 14, 15, 16
Human Impacts on Earth Systems (ESS3.C)	Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (both negative and positive) for different living things.	1, 3, 4, 5, 6, 9, 14, 15, 16
	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.	1, 3, 5, 6, 9, 14, 15, 16
Structure and Properties of Matter (PS1.A)	Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.	2

Disciplinary Core Ideas		Activity Number
Interdependent Relationships in Ecosystems (LS2.A)	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.	4
Ecosystem Dynamics, Functioning, and Resilience (LS2.C)	Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations.	4
Performance Expectations		**Activity Number**
Earth's Systems (ESS2)	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. (MS-ESS2-2)	14
	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. (MS-ESS2-4)	9
	Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.* (MS- ESS3-3)	16
Engineering Design (ETS1)	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS-ETS1-1)	12
	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)	16

COMMON CORE STATE STANDARDS: CONNECTIONS AND CORRELATIONS

LAND, WATER, AND HUMAN INTERACTIONS

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, students engage in multiple investigations throughout the unit to better understand geoscience processes. These investigations require students to follow multi-step procedures (RST.6-8.3). For example, in activity 2, students carry out a lab experiment that helps them develop a conceptual model of dissolving salts in water (RST.6-8.3). Further along in the unit in activity 5, students engage in another laboratory investigation where they gather evidence about how fertilizers, soil, and water interact (RST.6-8.3). Students learn about dead zones by carefully reading a text in activity 6, drawing evidence from the reading, discussing what they have learned, and applying this content to the next part of the activity (RST.6-8.1). Further along in activity 13, students continue to build on their understanding of geoscience processes, such as erosion and deposition, by reading and summarizing another text, and constructing an explanation based on this reading and the modeling activity they completed previously (RST. 6-8.9; WHST.6-8.9). In activity 15, students read sample reports from geologists, and apply the information they have collected throughout the unit from a variety of sources (texts, hands-on investigations, etc.), to write their own geological report about potential sites for a building (RST.6-8.2; WHST.6-8.2). The unit culminates with activity 16, where students apply their knowledge of the geological phenomenon to design a school at one of the sites. Each group of students presents their designs to the class, and evaluates one another's designs (SL.8.4). 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)	6, 9, 14
	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (RST.6-8.2)	15
	Follow precisely a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks. (RST.6-8.3)	2, 4, 5, 7, 10, 12
	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (RST. 6-8.9)	9, 13
Speaking and Listening (SL)	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound and valid reasoning, and well-chosen details: use appropriate eye contact, adequate volume, and clear pronunciation. (SL.8.4)	16

Common Core State Standards – English Language Arts		Activity Number
Writing in History/ Social Studies, Science, and Technological Subjects (WHST)	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)	8, 15, 16
	Draw evidence from informational texts to support analysis, reflection, and research. (WHST.6-8.9)	13, 15

Making Connections in Mathematics

This unit introduces multiple opportunities for students to engage in math 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 3, students graph data from water quality measurements (dissolved oxygen, turbidity, and dissolved solids), in addition to the population of a town, over time. They analyze and discuss patterns from these graphs, in addition to the idea of correlations and causation in the context of these data (6.SP.B.5; MP.4). In activity 4, students are provided with images of macroinvertebrates that are either pollution tolerant or intolerant (the latter of which is considered 'MSC'). They calculate the ratio (number of MSC organisms/number of total organisms) and percentage of MSC organisms at three different points in time. (6.RP.A.1). Later in the unit, in activity 10, students develop and analyze topographic maps (including distance between lines) to help them understand different landforms (MP.2). For the activities where students create graphical representations of data to find relationships, an optional student sheet entitled "Scatterplot and Line Graphing Checklist" is provided in Appendix C: Science Skills in the Student Book for students who need additional support.

Common Core State Standards – Mathematics		Activity Number
Mathematical Practice (MP)	Reason abstractly and quantitatively. (MP.2)	10, 11
	Model with mathematics. (MP.4)	3, 10, 11
Ratios and Proportional Reasoning (RP)	Understand the concept of a ratio, and use ratio language to describe a ratio between two quantities. (6.RP.A.1)	4
Statistics and Probability (SP)	Summarize numerical data sets in relation to their context. (6.SP.B.5)	3, 4