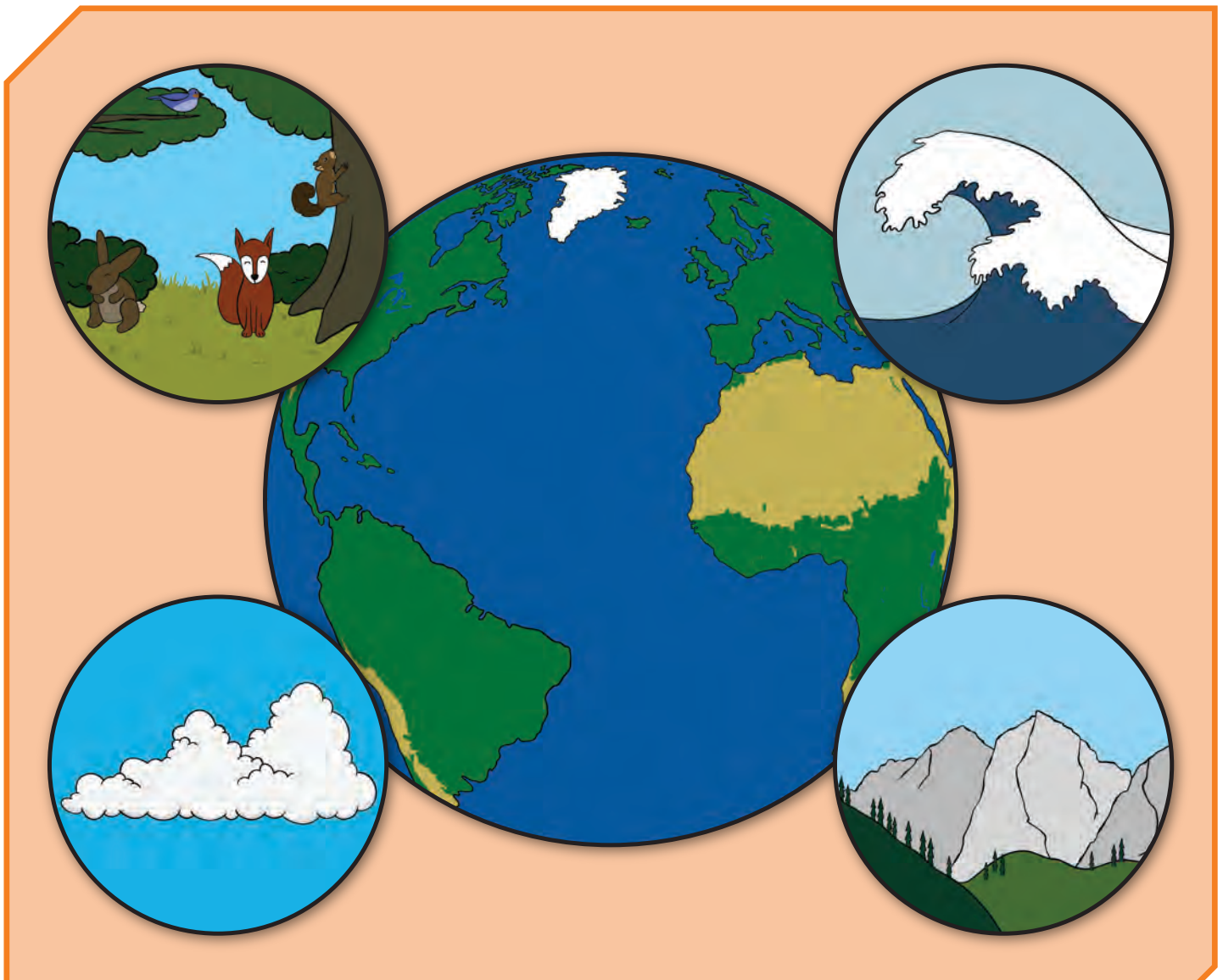


Teacher Guide and Student Journal

Sample Activity and Planning Pages

Earth and Space Systems

5ENG



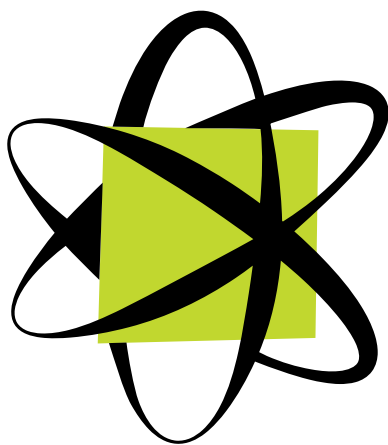
S E C O N D E D I T I O N

A fifth grade unit supporting Next Generation Science Standards
and Michigan Science Standards

S E C O N D E D I T I O N

Earth and Space Systems 5ENG

A fifth-grade unit supporting **Next Generation Science Standards** and the **Michigan Science Standards** developed and written by the Battle Creek Area Mathematics and Science Center for



**CEREAL CITY
SCIENCE™**

by BCAMSC

Earth and Space Systems

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PLANNING

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas	Activity
<p>5-ESS2.A: Earth Materials and Systems</p> <ul style="list-style-type: none"> Earth’s major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth’s surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. 	1,2,3,4,5,6
<p>5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.</p>	1,2,3,4,5,6
<p>5-ESS2.C: The Roles of Water in Earth’s Surface Processes</p> <ul style="list-style-type: none"> Nearly all of Earth’s available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. 	3
<p>5-ESS2-2: Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.</p>	3
<p>5-ESS3.C: Human Impacts on Earth Systems</p> <ul style="list-style-type: none"> Human activities in agriculture, industry, and everyday life have had major effects on land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth’s resources and environments. 	1,2,3,4,5,6
<p>5-ESS3-1: Obtain and combine information about the ways individual communities use science ideas to protect Earth’s resources and the environment.</p>	1,2,3,4,5,6
<p>5-PS2.B: Types of Interactions</p> <ul style="list-style-type: none"> The gravitational force of Earth acting on an object near Earth’s surface pulls that object toward the planet’s center. 	2,3,4,5
<p>5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.</p>	2,3,4,5
<p>5-ESS1.A: The Universe and Its Stars</p> <ul style="list-style-type: none"> The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. 	7

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas	Activity
5-ESS1-1: Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.	7
5-ESS1.B: Earth and the Solar System <ul style="list-style-type: none">The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.	7

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Activity
<p>Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> • Develop a model using an example to describe a scientific principle. 	1,2,3,4,5,6,7
<p>5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.</p>	6
<p>Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.</p> <ul style="list-style-type: none"> • Describe and graph quantities such as area and volume to address scientific questions. 	3
<p>5-ESS2-2: Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.</p>	3
<p>Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. 	1,2,3,4,6
<p>5-ESS3-1: Obtain and combine information about the ways individual communities use science ideas to protect Earth’s resources and the environment.</p>	1,6
<p>Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> • Represent data in graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. 	3,6,7

PLANNING

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Activity
5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	7
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world. <ul style="list-style-type: none">• Support an argument with evidence, data, or a model.	1,2,3,4,5,6,7
5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.	2,3,4,5
5-ESS1-1: Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.	7

NEXT GENERATION SCIENCE STANDARDS

Crosscutting Concepts	Activity
Scale, Proportion, and Quantity <ul style="list-style-type: none"> Standard units are measured and describe physical quantities such as weight and volume. Natural objects exist from the very small to the immensely large. 	3,4,7
5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	6
5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	7
Systems and System Models <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions. 	1,2,3,4,5,6
5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	6
Patterns <ul style="list-style-type: none"> Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena. 	5,6
5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	7
Cause and Effect <ul style="list-style-type: none"> Cause-and-effect relationships are routinely identified and used to explain change. 	5,6
5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.	7
CONNECTIONS TO NATURE OF SCIENCE Science Addresses Questions about the Natural and Material World <ul style="list-style-type: none"> Science findings are limited to questions that can be answered with empirical evidence. 	1,2,3,4,5,6
5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	6

PLANNING

COMMON CORE STATE STANDARDS - READING

Reading Standards for Informational Text—Grade 5	Activity
Key Ideas and Details	
RI.5.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from text.	1,2,3,6,7
RI.5.2: Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.	1,2,3,6,7
RI.5.3: Explain relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in a text.	3,6,7
Craft and Structure	
RI.5.4: Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.	1,2,3,6,7
RI.5.5: Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts.	3,6,7
RI.5.6: Analyze multiple accounts of the same event or topic, noting important similarities and differences in the points of view they represent.	
Integration of Knowledge and Ideas	
RI.5.7: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.	
RI.5.8: Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).	1,3,6,7
RI.5.9: Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.	
Range of Reading and Level of Text Complexity	
RI.5.10: By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 4–5 text complexity band independently and proficiently.	1,3,6,7

COMMON CORE STATE STANDARDS - WRITING

Writing Standards–Grade 5	Activity
Text Types and Purposes	
<p>W.5.1: Write opinion pieces on topics or texts, supporting a point of view with reasons and information.</p> <ul style="list-style-type: none"> a. Introduce a topic or text clearly, state an opinion, and create an organizational structure in which related ideas are logically grouped to support the writer’s purpose. b. Provide logically ordered reasons that are supported by facts and details. c. Link opinion and reasons using words, phrases, and clauses (e.g., consequently, specifically). d. Provide a concluding statement or section related to the opinion presented. 	1,2,3,6
<p>W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <ul style="list-style-type: none"> a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension. b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic. c. Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially). d. Use precise language and domain-specific vocabulary to inform about or explain the topic. e. Provide a concluding statement or section related to the information or explanation presented. 	2,3,4,6,7
<p>W.5.3: Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.</p> <ul style="list-style-type: none"> a. Orient the reader by establishing a situation and introducing a narrator and/or characters; organize an event sequence that unfolds naturally. b. Use narrative techniques, such as dialogue, description, and pacing, to develop experiences and events or show the responses of characters to situations. c. Use a variety of transitional words, phrases, and clauses to manage the sequence of events. d. Use concrete words and phrases and sensory details to convey experiences and events precisely. e. Provide a conclusion that follows from the narrated experiences or events. 	

COMMON CORE STATE STANDARDS - WRITING

Writing Standards–Grade 5	
Production and Distribution of Writing	
W.5.4: Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3.)	1,2,3,4,6,7
W.5.5: With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.	4,6
W.5.6: With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of two pages in a single sitting.	4,6
Research to Build and Present Knowledge	
W.5.7: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.	3,4,6,7
W.5.8: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.	2,3,4,6,7
W.5.9: Draw evidence from literary or informational texts to support analysis, reflection, and research. a. Apply grade-5 reading standards to literature (e.g., “Compare and contrast two or more characters, settings, or events in a story or a drama, drawing on specific details in the text [e.g., How characters interact]”). b. Apply grade-5 reading standards to information texts (e.g., “Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point[s]”).	3,4,6,7
Range of Writing	
W.5.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.	2,4,6,7

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 5	Activities
Mathematical Practices	
1. Make sense of problems and persevere in solving them.	1,2,3,4,5,6
2. Reason abstractly and quantitatively.	1,2,3,4,5,6
3. Construct viable arguments and critique the reasoning of others.	1,2,3,4,5,6
4. Model with mathematics	1,2,3,4,5,6
5. Use appropriate tools strategically.	3,6
6. Attend to precision.	1,2,3,4,5,6
7. Look for and make use of structure.	1,2,3,4,5,6
8. Look for and express regularity in repeated reasoning.	1,2,3,4,5,6
5.NBT Number and Operations in Base Ten	
3. Read, write, and compare decimals to thousandths. <ul style="list-style-type: none"> a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., $347.392 = 3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (1/10) + 9 \times (1/100) + 2 \times (1/1000)$. b. Compare two decimals to thousandths based on meanings of the digits in each place, using $>$, $=$, and $<$ symbols to record the results of comparisons. 	3
5.MD Measurement and Data	
Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.	
3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement. <ul style="list-style-type: none"> a. A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. 	3

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 5	Activities
5.MD Measurement and Data	
Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.	
<p>5. Relate volume to the operations of multiplication and addition and solve real-world and mathematical problems involving volume.</p> <p>a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes (e.g., to represent the associative property of multiplication).</p> <p>b. Apply the formulas $V=l \times w \times h$ and $V=b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole- number edge lengths in the context of solving real world and mathematical problems.</p> <p>c. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.</p>	3

PLANNING

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
1 Preserving Resources and Protecting the Environment	Preparation: 30 minutes Activity 1: Lesson 1A: 50–55 min. 2 classes Lesson 1B: 50–55 min. 2 classes Lesson 1C: 50–55 min.	Obtain, evaluate, and communicate information to explain how human activities impact Earth’s resources and environment. Brainstorm what components make up Earth’s systems.	Plastic island in the ocean. Plastic throwaways make up a large percentage of trash and litter.	<ul style="list-style-type: none"> Analyze the results of a schoolyard cleanup and a plastic waste video. Determine the amount of plastic used on a daily basis. Analyze articles about different organizations that are taking steps to preserve resources and the environment. Brainstorm the components that make up Earth’s systems.
2 The Atmosphere	Preparation: 30 minutes Activity 2: Lesson 2A: 55–60 min. Lesson 2B: 55–60 min. Lesson 2C: 55–60 min.	Use models to explain how wind occurs and clouds form. An increase or decrease in the O ₂ level in the atmosphere causes change for living and nonliving things.	Plastic island in the ocean. Plastic throwaways make up a large percentage of trash and litter.	<ul style="list-style-type: none"> Obtain information that explains the distribution of gases in the atmosphere. Build and observe models that explain how wind occurs. Use a model to explain how clouds are made.
3 The Hydrosphere	Preparation: 30 minutes Activity 3: Lesson 3A: 55–60 min. Lesson 3B: 55–60 min. plus data collection Lesson 3C: 55–60 min. 3 classes Lesson 3D: 55–60 min. 4 classes Lesson 3E: 55–60 min. 3 classes	Use models to explain: that only a the tiny fraction of water on Earth is fresh water. how ocean currents form. how watersheds form. how moving water across the surface of Earth causes change.	Plastic island in the ocean. Plastic throwaways make up a large percentage of trash and litter.	<ul style="list-style-type: none"> Use text to relate the amount of fresh water and available drinking water to the importance of water conservation. Use a model that explains the distribution of water on Earth. Determine how ocean currents form and affect surrounding land. Use a model to determine how moving water changes the shape of the land. Determine how the atmosphere and hydrosphere interact, causing erosion of the geosphere.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	Assessment
<ul style="list-style-type: none"> • Relate their findings from the cleanup, video, and reading to explain how human activities impact Earth’s resources and the environment. • Obtain information from videos, explorations, and articles to explain human impact and design a solution. • Analyze a model that explains the four systems. 	<p>Obtaining, Evaluating, and Communicating Information Developing and Using Models Cause and Effect System and System Models</p>	<p>Formative Assessment Science Talk Journal Entries/Respond to Text Activity Pages</p>
<ul style="list-style-type: none"> • Determine that when the balance of gases is changed, life on Earth changes. • Analyze models to explain how the wind occurs. • Make the connection between air movement, temperature, and gravity. • Relate the problem of throwaway plastics to the atmosphere. 	<p>Obtaining, Evaluating, and Communicating Information Developing and Using Models Cause and Effect System and System Models</p>	<p>Formative Assessment Science Talk Journal Entries Activity Pages</p>
<ul style="list-style-type: none"> • Develop a model to explain how the wind affects the motion of the ocean. • Use a mathematical model to demonstrate how only a tiny fraction of Earth’s water is fresh water and usable by living things. • Collect data to determine the average amount of water used by individuals and the class. • Develop a model that will determine the effects of a hard rainstorm on a future development on a hillside. • Use a model to explain how watersheds form. • Obtain and use information to describe their local watershed. 	<p>Developing and Using Models Using Mathematics and Computational Thinking Analyzing and Interpreting Data Planning and Carrying Out Investigations Systems and System Models Science Addresses Questions About the Natural and Material World Scale, Proportion, and Quantity</p>	<p>Formative Assessment Science Talk Activity Pages</p> <p>Summative Assessment Science Talk Journal Entry</p>

PLANNING

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
4 The Geosphere	Preparation: 15 minutes Activity 4: Lesson 4A: 55–60 min. 3–4 classes Lesson 4B: 55–60 min. 2 classes	Use research to gain information and develop a model of a landform. Use text to determine what is beneath the surface of Earth.	Plastic island in the ocean. Plastic throwaways make up a large percentage of trash and litter.	<ul style="list-style-type: none"> • Research and present information on a landform. • Use text to determine what is beneath the surface of Earth.
5 The Biosphere	Preparation: 15 minutes Activity 5: Lesson 5A: 55–60 min. 2 classes Lesson 5B: 55–60 min.	Develop models to support the claim that Earth’s systems interact and are dependent on each other.	Plastic island in the ocean. Plastic throwaways make up a large percentage of trash and litter.	<ul style="list-style-type: none"> • Conduct an exploration in the field to observe specimens from the biosphere. • Connect their specimens to the atmosphere, hydrosphere, and geosphere.
6 When Components and Systems Change	Preparation: 15 minutes Activity 6: Lesson 6A: 55–60 min. 2 classes Lesson 6B: 55–60 min. 3 classes Lesson 6C: 55–60 min. 2–3 classes	Develop and implement a fifth-grade program to help preserve and protect Earth’s resources and environments.	Plastic island in the ocean. Plastic throwaways make up a large percentage of trash and litter. Plastic throwaways as an environmental problem.	<ul style="list-style-type: none"> • Use information from previous lessons to make lists of the components of the biosphere, atmosphere, hydrosphere, and geosphere. • Use the lists of components to create a concept map and demonstrate how one change causes changes throughout Earth’s systems. • Revisit articles about environmental programs from the beginning of the unit. • Develop a fifth-grade program to help preserve and protect Earth’s resources and environments.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	Assessment
<ul style="list-style-type: none"> • Develop an informative advertisement about a landform. • Obtain, evaluate, and communicate information about a landform. • Determine how the atmosphere and hydrosphere interact to shape the landform. 	<p>Obtaining, Evaluating, and Communicating Information Developing and Using Models Systems and System Models</p>	<p>Formative Assessment Science Talk Activity Pages</p> <p>Summative Assessment Science Talk Journal Entries</p>
<ul style="list-style-type: none"> • Develop a concept map to explain the connections between their biosphere specimens and the geosphere, hydrosphere, and atmosphere. • Use patterns in their findings to support a claim that Earth's systems are interconnected and dependent on one another. 	<p>Developing and Using Models Constructing Explanations and Designing Solutions Systems and System Models Patterns</p>	<p>Formative Assessment Activity Page Group facilitation</p> <p>Summative Assessment Journal Entry Activity Pages</p>
<ul style="list-style-type: none"> • Develop a model to explain how change in one system has an effect on the other systems. • Apply new knowledge about Earth's systems to the articles about environmental programs from the beginning of the unit. • Determine how to evaluate human activity in relation to its effect on the environment. • Use information and understanding about the connectivity between Earth's systems to develop a program to preserve and protect Earth's resources and environments. 	<p>Developing and Using Models Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information Cause and Effect Systems and System Models</p>	<p>Formative Assessment Class Concept Map Student Plan</p> <p>Summative Assessment Science Talk Journal Entries Activity Pages</p>

PLANNING

UNIT AT A GLANCE

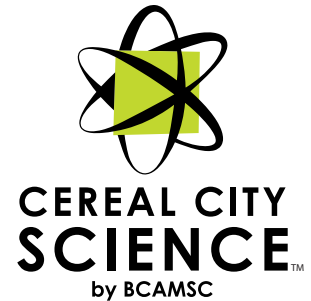
Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
<p>7</p> <p>Earth and Beyond</p>	<p>Preparation: 15 minutes</p> <p>Activity 7: Lesson 7A: 45–50 min. 2 classes Lesson 7B: 55–60 min. 2 classes Lesson 7C: 55–60 min. 2 classes Lesson 7D: 55–60 min. Lesson 7E: 55–60 min.</p>	<p>Collect and graph data to show patterns that demonstrate how we get day and night, the different position of the sun and moon in the sky, and different lengths and positions of shadows throughout the day.</p>	<p>Arctic Lights, Arctic Nights: Light in Alaska and how it changes from month to month.</p>	<ul style="list-style-type: none"> • Raise questions about the changes in the amount of light in Alaska and the Arctic. • Develop and use models to explain the uneven lighting and heating of Earth. • Collect and analyze data to show patterns that give evidence as to why we get day and night, seasons, changes in the shape and location of shadows throughout the day and year, and the different locations of the sun and moon at different times of the day and year.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	Assessment
<ul style="list-style-type: none"> • Use information from text to raise questions and gain information. • Demonstrate day and night, seasons, and changes in the position of sun and moon in the sky using models. • Analyze data to find patterns that provide evidence for the reason for day and night, the seasons, changes in the shape and location of shadows throughout the day and year, and the different locations of the sun and moon at different times of the day. 	<p>Developing and Using Models Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information Systems and System Models Patterns Cause and Effect</p>	<p>Formative Assessment Lesson 7A: Journal Entry Science Talk</p> <p>Summative Assessment Lessons 7B and 7C: Activity Pages Journal Entries Science Talk</p>

Dear Parent,

Your child is beginning a unit developed by the Battle Creek Area Mathematics and Science Center. This unit was designed to promote science and engineering literacy and integrate reading and writing skills into high-interest science content. During the next twelve weeks, your child will be actively involved with the *Earth and Space Systems* unit. The key concepts the unit explores include:



1. Earth is made up of four major systems, the atmosphere, the hydrosphere, the geosphere, and the biosphere.
2. Earth's systems interact in many ways to affect Earth's surface materials and processes.
3. The majority of Earth's water is in the ocean, and only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
4. Human activities have had major effects on land, vegetation, streams, oceans, air, and even outer space. Some communities and individuals are doing things to help protect and preserve Earth's resources and environments.
5. The orbit of Earth around the sun and Earth's rotation on its axis cause observable patterns that give evidence for how we get day and night, seasons, and uneven lighting and heating of the surface.

Earth and Space Systems uses the growing problem of plastic disposables to introduce the atmosphere, hydrosphere, geosphere, and biosphere as Earth's systems. Students explore each system and develop a model to describe the ways systems interact and the effect of change (natural or through human activity) on one or more of the systems. Students develop an understanding that all living things are dependent on the balance between and interaction among the systems. An in-depth exploration into the hydrosphere provides an understanding of the distribution of water on Earth and the very small amount available for use by living things. With their new understanding of Earth's systems and interaction among the systems, students return to the problem of plastic disposables and describe the effect of producing, using, and disposing of plastic bags. Students develop a plan for fifth-graders to preserve and protect Earth's resources and environments.

The effect of gravity within the atmosphere, geosphere, hydrosphere, and biosphere is a common phenomenon throughout the exploration of Earth's systems. After students give evidence of how, on Earth, gravity pulls objects down, they explore the objects in the sky to develop an understanding of the moon, sun, and stars, and the patterns of their changes. They collect data and use patterns to provide an explanation for changes in length of shadows, day and night, moon phases, and seasonal changes in the appearance of some stars in the night sky.

May you enjoy quality time with your child while discussing the concepts involved with the *Earth and Space Systems* unit. Let us know if we may be of assistance.

The Outreach Staff
Battle Creek Area Mathematics and Science Center
(269) 213-3907 or (269) 213-3908

ACTIVITIES TO DO AT HOME

1. Keep a log of the sunrise time, sunset time, and high and low temperatures for several weeks. Discuss the data and relate the length of day and temperature to the season.
2. Start a Moon Watch Journal with your child. Make nightly moon observations and record them in a journal. If it is cloudy and the moon is not visible, check online or in the newspaper and record the phase in the journal.
3. Share stories about the moon that you heard in your childhood with your child. Go to the library and look for books about legends of the moon and folklore that surrounds the moon.
4. Have your child ask their grandparents about the first mission to the moon.
5. Look for current events in newspapers and magazines that relate to space exploration, the International Space Station, satellites, and probes. Start a space scrapbook as a historical timeline of the space explorations.
6. Go to the library and check out books on constellations. Set aside some clear nights to stargaze with your child, identify the constellations, and discuss their apparent movement across the sky. Make a Tube Constellation Viewer with your child. You will need:
 - 1 thick cardboard tube
 - small, different-sized nails
 - 1 flashlight with batteries
 - black construction paper
 - black paint

Using small nails of different sizes, punch out the pattern of a constellation on black construction paper. Place the construction paper over one end of the tube. Paint the inside of the tube black. Insert the flashlight into the other end of the tube, turn off the lights, close the curtains, and project the constellation onto a dark surface. Learn as many constellations as possible, make multiple constellation cards, and share them with the family. Tip: A Pringles can works well for the cardboard tube.
7. Keep a log of the daily water uses in your household. Have your student make a plan to conserve water.
8. Visit nearby bodies of water and identify the watershed in your area. Determine if the body of water is part of the storm drain system.
9. Go on a family hike and identify the different landforms that make up the terrain. Discuss how the rainfall and wind have an effect on the shape of the area.
10. Go to the library and check out books that give information on Earth, the oceans, lakes and rivers, recycling and conservation, protecting the environment, and the sun, the moon, and the stars.

ACTIVITY 1

PRESERVING RESOURCES AND PROTECTING THE ENVIRONMENT

Teacher Background Information

The initial activity for the unit is meant to give the students a common experience with the effect of humans on the environment and programs and initiatives that humans have created to help protect the environment and Earth's resources. Students are encouraged to brainstorm and share ideas regarding the initiatives people are taking to protect and preserve the environment and natural resources. Students are introduced to the concept of Earth's systems (atmosphere, hydrosphere, geosphere, and biosphere) and how they interact to provide the conditions for life to exist on Earth.

Plastic has become a major concern for the environment. Plastics are involved in the majority of human activities and have had major effects on land, bodies of water, the air, and plants and animals.

Engage the Learner

The initial activities for this unit are intended to engage students in thinking about how human activities have major effects on the environment and the real-world projects that humans have created to preserve Earth's resources and environment. The lesson activates prior knowledge regarding Earth's resources and human impact on Earth's systems. Prior to learning about how the geosphere, atmosphere, biosphere, and hydrosphere are interrelated to make up the systems that drive the processes on Earth, students establish what they need to know regarding Earth's systems to better understand how and why it is necessary for humans to protect the environment with a focus on plastic waste.

LESSON 1A: WHO MADE THIS MESS?

Advance Preparation

Conduct an Internet search for a video about plastic and how it is affecting the environment. Be sure to preview examples before showing to the class. Examples:

The Plastic Planet: <https://www.youtube.com/watch?v=73sGgmZoMBQ>

Water bottles around Earth: https://www.youtube.com/watch?v=asCNsl-q_KQ

<https://www.youtube.com/watch?v=yV2EK2bMgwk&t=196s>

<http://www.savesfbay.org/bay-vs-bag>

ESTIMATED TIME

Lesson 1A: 50–55 minutes,
2 classes

Lesson 1B: 50–55 minutes,
2 classes

Lesson 1C: 50–55 minutes

LESSON LEVEL LEARNING GOALS

Obtain, evaluate, and communicate information to explain how human activities impact Earth's resources and environment.

Brainstorm what components make up Earth's systems.

MATERIALS NEEDED

For each student:

student pages
disposable gloves

For each group of 4:

chart paper
markers

Teacher provides:

articles
chart paper
markers
tarp or banner paper
boxes for cleanup

5-ESS3.C: HUMAN IMPACTS ON EARTH SYSTEMS

- Human activities in agriculture, industry, and everyday life have had major effects on land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.

LESSON 1A

OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Read and comprehend grade appropriate complex texts and/or other **reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.**
- Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.
- ~~Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices.~~
- **Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.**
- Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Plastic Pollution Coalition (2016): <https://www.youtube.com/user/PlasticPollution>

Make arrangements for a schoolyard or neighborhood park cleanup. Conduct a survey of your schoolyard or neighborhood park and determine an area where litter and trash collects for students to clean up.

Collect six to eight cardboard boxes for collecting trash. You will need a tarp, old sheet, or banner paper for sorting the trash after the cleanup.

Prepare a What We Think About the Effect Humans Have on the Environment and Resources chart.

What We Think About the Effects of Humans on the Environment and Resources				
What We Think	Questions We Have	What We Did	What We Figured Out	How Does That Help Us to Solve the Challenge?

Procedure

Engage the learner.

Organize an outdoor cleanup on the schoolyard or at a nearby park. Have students pick up trash around the schoolyard and building. Divide the class into groups of four or five students and distribute one cardboard box to each group and one pair of gloves to each student. When the class has completed the schoolyard cleanup, spread out a cloth or tarp and have students empty their boxes and sort the trash by material (paper, plastic, metal, wood, mixed).

As a class, determine the type of material that is discarded the most and rank from most to least. Have students make a list of the plastic items they have already used and tossed today or in the past couple of days. Discuss which material is the most harmful to the environment and why they think that.

Show the video of plastic waste (see Advance Preparation).

Science Talk

Ask the class to sit in a circle and discuss their ideas about the content of the video and their findings from the schoolyard or park clean up. Allow sufficient time for students to discuss their reaction to the video about plastic waste or throwaways and how it relates to their findings from their schoolyard cleanup. Listen for ideas that compare the amount of plastic they found and what is happening to discarded plastic worldwide. Ask:

LESSON 1A

- Who would like to start us off and share their initial reaction to the video?
- What caused this to happen?
- Can someone expand on that idea?
- What ideas do you have about the effect of plastics being discarded or tossed?

Ask what students already think about the science that people need to know in order to take steps to protect resources and the environment, especially the plastic waste.

Ask the class to describe some other ways that humans affect the environment. Record students' initial thinking on the What We Think chart. Check for ideas that may relate to air, water, and land pollution, litter, climate change, oil spills, development and building, habitat destruction, resource use, and fuel consumption. If students do not readily provide ideas of their own, ask the class:

Have you ever:

- been to the beach or gone to a park and discovered litter in the area?
- hiked along a pond or stream and picked up trash along the way?
- heard or read a news report about an oil spill?
- watched a new shopping mall or housing development being built?
- heard or read a news report about deforestation or cutting down trees?
- read or heard about any endangered or extinct species?
- read or heard about invasive species?

What do all of these have in common? What does the term *Earth's resources* mean? What resources have you used today? (Look for responses that include water, fuel, electricity, food, wood, oil, etc.)

Inform the class that as the unit progresses they will continue to add to and revise their ideas on the chart.

After the class has completed their brainstorming, continue the discussion by asking: What are some of the steps you have heard that people are taking to protect the environment? (Record student ideas. Save their ideas for reference throughout the unit.)

Read the Journal Entry as a class.

CAUSE AND EFFECT

- Cause-and-effect relationships are routinely identified and used to explain change.

TEACHING TIP

Science Talk is a conversation among students that allows them to have the opportunity to orally express their ideas and listen to the ideas of others. Allow sufficient time for each student to express ideas and opinions. Encourage "student-led" conversation in the classroom.

TEACHING TIP

If you are unable to conduct a schoolyard cleanup, save the trash in your classroom over several days and have students sort their daily "throwaways" by material. Ask another classroom to donate a few days of trash to your pile if necessary.

TEACHING TIP

SAFETY: Caution students against picking up glass and other sharp objects. If they discover broken glass in the schoolyard, alert the custodian and have the glass safely removed from the area.

LESSON 1A

TEACHING TIP

Throughout the activities in the Teacher Guide, you will notice that specific student instructions from the Student Journal pages are given first and italicized. Additional information for the teacher follows the italicized instructions in plain print.

EXTENSION/HOMEWORK

Have students do some research in bodies of water in your area and organize a river or pond cleanup in your community. Have students analyze the amount of waste they collected based on the makeup of the material.

Pre-Writing Strategy: Science Talk

Divide the class into groups of four students. Allow sufficient time for each student to share ideas and experiences that will help them to write their response. Facilitate the Science Talk by circulating among the groups and listening to their ideas. To help students elaborate on their explanations, ask:

- Can someone explain what you have discussed so far about the amount of plastic and the video we watched?
- Why do you think that?
- How do you know?
- What do you mean when you say...?
- Tell me more about...
- What information do you need to confirm your ideas?

Journal Entry

Your class has taken a peek into the effect of plastic throwaways on the environment.

- *Discuss with your group your reaction to the amount of plastic thrown away in your schoolyard cleanup and the video on plastic waste that was shown in your class.*
 - *Discuss what information you need to learn to make an informed decision about the effects of the use of plastic throwaways on the land, bodies of water, air, and plant and animal life.*
1. *Make a list of the plastic that you used today. Write ideas for other material or items you could have used or substituted.*
 2. *Write your ideas for reducing the effects of plastic on the environment.*
 3. *Write what you need to know about Earth's resources and environments that will help humans to take steps to help protect them.*

Assessment: Formative

Use the What We Think chart, Science Talk, and Journal Entry to assess the students' initial ideas about the effects of humans on resources and the environment.

Use the Science Talk and Journal Entry to assess the students' initial ideas about the need for understanding of Earth's processes to design solutions to the problem of human impact.

LESSON 1B: WHO'S CLEANING UP THIS MESS?

Advance Preparation

Research articles about environmental programs or use the listed websites to prepare a packet of articles for the class. **(One article will be necessary for each group of four students to read, discuss, and present to the class.)**

Possible Resources:

<http://kids.nationalgeographic.com/kids/stories/spacescience/water-bottle-pollution/>

<http://www.groundwater.org>

<http://www.ngwa.org>

<http://www.bluemounds.org/mission.html>

<http://aqua.org/care/a-blue-view-archive/13-07-30-stormwater>

<http://www.bluewaterbaltimore.org>

<http://www.savesfbay.org/plastic-bags-are-history-san-francisco>

<http://www.savesfbay.org/community-based-restoration>

<http://www.healthylakes.org/successes/restoration-success-stories/river-restoration-in-minnesota-repairs-stream-banks-reduces-sediment-load/>

<http://www.healthylakes.org/successes/restoration-success-stories/reducing-stormwater-impacts-in-lake-michigan-watershed-improves-water-quality/>

Procedure

Explore the concept.

Review the What We Think chart and students' initial ideas from the previous lesson. Ask students if they have any new ideas to add to the chart.

Divide the class into groups of four students and distribute one environmental program article to each group. Set a purpose for reading the articles. Inform the class that each group is going to read an article about how some people, around the world, are taking steps to preserve Earth's resources and environment. Each group will be asked to describe their program to the rest of the class. Encourage students to think about the science knowledge that the program developers needed to have to make the program a long-term success. Review the Respond to Text in the Student Journal prior to reading the articles.

MATERIALS NEEDED

For each student:

student pages

For each group of 4:

chart paper
markers

Teacher provides:

environmental program
articles
chart paper
markers
Post It Notes

5-ESS3.C: HUMAN IMPACTS ON EARTH SYSTEMS

- Human activities in agriculture, industry, and everyday life have had major effects on land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.

READING

Key Ideas and Details

RI.5.2: Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

Craft and Structure

RI.5.4: Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

Integration of Knowledge and Ideas

RI.5.8: Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).

LESSON 1B

OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Read and comprehend grade appropriate complex texts and/or other **reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.**
- Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.
- ~~Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices.~~
- **Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.**
- Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

TEACHING TIP

Note: Do not introduce the terms *geosphere*, *hydrosphere*, *atmosphere*, and *biosphere* at this time.

Allow sufficient time for each group to read and discuss their article. Have the groups use the Main Idea and Supporting Details chart in the Student Journal to record their ideas from the reading. Distribute chart paper and markers for students to use when presenting their articles.

1. Write the main idea and supporting details from the environment article on the chart below:

<i>Main Idea—Problem</i>	
<i>Supporting Details:</i>	<i>Supporting Details:</i>

Facilitate the reading and discussion by circulating among the groups and listening to their ideas. To check student progress and their ability to summarize and obtain information from the text, ask:

- Can someone summarize the environmental project you read about?
- What details are important in the reading to support the main idea? How are they related?
- What is the expected outcome of the project?
- What does the article say about the negative impact on the environment? How does the project decrease that impact?
- What scientific information did the developers of the program need to understand before they could implement their plan?
- What science background was necessary to identify the problem in your article?
- Tell me more about...
- What ideas does the article give you about things that a fifth-grade student might do? How would that help?

Explain the concept and define the terms.

After the groups have completed the reading and had the opportunity to discuss and record their ideas, invite each group to present the main ideas and important details to the rest of the class. Encourage the students to ask questions and exchange ideas regarding the differences and similarities between the different programs described in the article. At the conclusion of the presentations, post the charts and ask students to look for a pattern in the information from the environmental articles. Discuss the cause-and-effect relationship between the problem and the steps the community is taking to solve the problem.

Ask three to four students to share their opinions regarding the need to have specific scientific knowledge to develop a plan. Engage students in argumentation using evidence from the reading over their differences in what and why scientists need to understand how Earth provides the components necessary to support life and preserve its resources.

Science Talk

Elaborate on the concept.

As a class, discuss ideas about any new information students need to know to understand an environmental problem and the program from their reading. Have the class generate a list of what they need to investigate in order to identify a problem in their own community and develop a plan to help solve the problem. Encourage the class to break down their thinking into four main groups:

- Soil and land conservation and protection
- Water conservation and clean/up
- Air pollution
- Plant and animal protection and conservation

Ask groups to revisit their articles and discuss where the environmental impact was the greatest, on land, in water, in the air, or plant and animal life. Distribute Post-It Notes to each group. Ask the groups to generate as many questions they can think of about plastics, the effect of plastic waste, and what is the greatest impact. Ask students to write one question per Post-It Note and to generate at least three questions.

After the groups have had the opportunity to generate at least three questions about the effect of human activity and especially plastics on the environment, ask one group to share an initial question. Post the question on the What We Think chart in the Questions We Have column.

Ask the rest of the class if another group had a similar question and post that question on the chart. Continue the posting of questions by similarities until all questions have been shared and valued.

Take this opportunity to categorize their questions and have students think of headings for the groupings of questions.

Example categories:

- Effect on land
- Effect on air
- Effect on water

5-ESS3.C: HUMAN IMPACTS ON EARTH SYSTEMS

- Human activities in agriculture, industry, and everyday life have had major effects on land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.

CAUSE AND EFFECT

- Cause-and-effect relationships are routinely identified and used to explain change.

TEACHING TIP

The use of the What We Think chart throughout the unit enables the students and teacher to see a record of the conceptual shifts and new ideas that build, shift, and change as the unit progresses. It is essential for students to recognize their new ideas and shifts in thinking to help them apply new knowledge and continue to build knowledge.

TEACHING TIP

Note: Save the student-created material from their presentations. They will revisit the article at the end of the unit and apply their new knowledge.

Keep a record of student groups as they will return to their original groups in Lesson 6B.

LESSON 1B

WRITING

Text and Type Purposes

W.5.1: Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Productions and Distribution of Writing

W.5.4: Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1-3.)

Research to Build and Present Knowledge

W.5.7: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

W.5.8: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

W.5.9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

Range of Writing

W.5.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

- Effect on living things
- Recycle questions
- Clean up questions

Students will revisit their questions throughout the unit to find out what questions have been answered as they engage in investigations and research.

Review their initial ideas regarding the land, water, air, and living things that make up Earth and the information necessary to understand how they all work together to support life on Earth.

Evaluate the students' understanding of the concept.

Journal Entry (Respond to Text)

2. *Write the main idea and supporting details from the environment article on the chart below:*

Main Idea—Problem	
Supporting Details:	Supporting Details:

3. *Write why you think scientists and engineers need to have scientific knowledge about Earth's air, land, water, and living things before they can develop a plan to preserve Earth's resources and protect the ecosystem. Include some ideas of what scientists need to know and tell why you think that information is important.*

Assessment

Use the Activity Page/Respond to Text to evaluate the students' ability to obtain, evaluate, and present information about a variety of programs that preserve Earth's resources and protect the environment.

LESSON 1C: EARTH IS MADE UP OF FOUR SYSTEMS: GEOSPHERE, HYDROSPHERE, ATMOSPHERE, AND BIOSPHERE

Teacher Background Information

Students spend considerable time exploring their initial ideas regarding Earth's systems and then take a greater in-depth look into each system. The exploration phase includes multiple lessons that will help students to understand the components of each system and how each system is connected to others.

Earth's systems are the atmosphere, geosphere, hydrosphere, and biosphere. It is the interaction of the components of each system that makes it possible for life to exist on Earth.

In this part of the Engage the Learner, students begin to explore their preconceptions about Earth's systems. They will begin to develop an understanding of the spheres (geosphere, atmosphere, hydrosphere, biosphere) that make up Earth and how they interact to make life possible on Earth. Students continue to evaluate new knowledge that is helpful in understanding how different groups are helping to protect and preserve Earth's environment and resources.

Engage the Learner (cont.)

This activity continues to engage students in thinking about real-world projects that humans have created to preserve Earth's resources and environment. The lesson activates prior knowledge regarding Earth's systems. Prior to learning about how the geosphere, atmosphere, biosphere, and hydrosphere are interrelated to make up the systems that drive processes on Earth, students establish what they need to know about Earth's systems to better understand how and why it is necessary for humans to protect the environment.

Advance Preparation

You will need eight small plants or plant parts to represent living things (biosphere). Place one plant or plant part in a 9 oz. plastic cup.

Prepare four 9-oz. clear plastic cups, one containing $\frac{1}{4}$ cup water, one with $\frac{1}{4}$ cup soil, one with only air, and one containing a plant or plant part (from above), for each group of four students. (Each cup represents a system: hydrosphere, geosphere, atmosphere, and biosphere.) Note: At the end of the lesson, be sure to reserve the sand for following activities.

Make a class chart with four columns to represent land, water, air, and living organisms. The examples in italics demonstrate ideas that students may suggest from their observations of the card sets. Do not write the ideas on the chart prior to the activity.

MATERIALS NEEDED

For each student:

student pages

For each group:

Earth Systems Card Set

9 oz. cup, $\frac{1}{4}$ c. water

9 oz. cup, $\frac{1}{4}$ c. soil

9 oz. cup, empty (air)

9 oz. cup, plant or plant part

index cards, 3x5, white

For the class:

measuring cup

2 cups soil

picture: *Earth from Space*

Teacher provides:

chart paper

markers

Post-it notes

plants or plant parts

water

ESS2.A: EARTH MATERIALS AND SYSTEMS

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with landforms to determine patterns of weather.

LESSON 1C

OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Read and comprehend grade appropriate complex texts and/or other **reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.**
- Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.
- ~~Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices.~~
- **Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.**
- Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

TEACHING TIP

Note: Do not introduce the terms *geosphere*, *hydrosphere*, *atmosphere*, and *biosphere* at this time. Allow students to apply their own terms to the picture cards and introduce the terms when they have recognized the four basic systems.

Example:

Earth's Systems and Components

Land	Water	Air	Living Organisms
mountains prairies hills valleys plains rocks soil	rivers lakes streams oceans ponds groundwater	sky air wind clouds fog smog pollution	plants animals

Procedure

Elaborate on the concept.

Review the class list of ideas for any new information students need to know to understand the environmental problem and the program from the reading. Add any new ideas that students may have thought of since the previous lesson. Inform the class that they are going to work in groups and use their observations and exchange of ideas to determine what systems make up Earth and how they interact with one another.

Display the picture *Earth from Space*. Ask students what they see in the picture. Ask: What do you think Earth is made of? Record their initial ideas on the What We Think chart. Check for responses that include land and water. Tell the students that the first astronauts who orbited Earth and were able to view it from space named the planet “The Blue Marble.” Discuss ideas of why Earth, as viewed from space, made the astronauts name it “The Blue Marble.”

Divide the class into groups of four students. Distribute the *Earth Systems Card Set* and index cards to each group. Ask the groups to make observations of the pictures on each card. Ask the groups to:

- Talk about the different components within each system (land, air, water, and living things) on each card.
- Discuss how the components in each picture might be connected, and finally discuss how the different pictures may be connected.
- Use the index cards and card set to develop a model that explains the connectivity between the different pictures.

Facilitate the group activity by circulating among the students and listening to their ideas and discussion. To help students elaborate on their ideas, ask:

- Can someone explain what you have discussed so far?
- What do you see in the picture that makes you classify it as _____ or connect it to _____?
- How do you know? What can you write on the index card that explains that connectivity?
- How does your idea relate to what you know about _____ (earth materials, the air, water on Earth, land formations, the balance in an ecosystem)?
- Tell me more about the _____ card. How are the components in the card connected or how do they interact? Do any of the cards just have one component or just one thing on them?
- Can someone give me an example of how two or three cards are related? What makes you think that?

To elicit further thinking about the cards and the relationship between the components on the cards, distribute a cup of water, cup of soil, cup of air, and a cup with a plant or plant part. Ask the groups to relate the elements on the cards to the material in the cups. Ask:

- Which cup do you think best represents which card?
- Can you find one card and one cup that are not connected to another card or cup?
- What does that suggest to you?

Give the groups sufficient time to discuss the cards and material in the cups. If students comment that one of the cups is empty, ask them if it is really empty. Elicit ideas that lead them to recognize that the cup is full of air. Ask students what surrounds the cup and what fills the room. Ask if they think what fills the room also fills the cup.

Display the class Earth's Systems and Components chart (see Advance Preparation). Ask the students to reorganize their card sets with the cards that most represent land, water, air, and living organisms. Have each group discuss their stacks of cards and write a list of the components they observe. Discuss limitations in using the cards and cups as models of the interaction between the systems.

SYSTEMS AND SYSTEM MODELS

- A system can be described in terms of its components and their interactions.

TEACHING TIP

To make the chart activity more interactive, have students write their components for each card on Post-It Notes and place their notes on the class chart. When ideas are duplicates, have the students stick the notes on top of one another.

WRITING

Craft and Structure

RI.5.4: Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

TEACHING TIP

The term *interact* may be unfamiliar to students. Discuss the meaning of the term and have students use the term in different scenarios, such as, how classmates interact with each other, how neighbors interact, how government branches interact, how architects, engineers, and builders interact, and how different departments in a grocery store or hardware store interact.

LESSON 1C

SYSTEMS AND SYSTEM MODELS

- A system can be described in terms of its components and their interactions.

ESS2.A: EARTH MATERIALS AND SYSTEMS

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

CAUSE AND EFFECT

- Cause-and-effect relationships are routinely identified and used to explain change.

Science Talk

Evaluate the students' understanding of the concept.

Only after the class has completed the chart and organized their thinking about Earth's systems into four main parts, introduce the terms *geosphere*, *hydrosphere*, *atmosphere*, and *biosphere*.

At this point, students have created their own ideas of Earth's systems and can attach the appropriate terms to each system. As a class, have the students define the terms using what they have discussed and the chart. Discuss the meaning of the prefixes *geo-*, *hydro-*, *bio-*, and *atmo-*. Only after the class is satisfied with their definitions, have them write their definitions in the Student Journal.

Have the students form a circle and ask the groups to share their ideas and high points in their discussion. Have students justify their categorizing and thinking. Refer to suggestions from groups that may lead to deeper or further discussion or argumentation.

Check for patterns in their thinking that relate to land, water, air, and living organisms and how they contribute to life on Earth and how they interact with one another.

Conduct a student led brainstorming session. To collectively make sense of their ideas and Earth's systems and how they interact, ask:

- Can someone explain how Earth's systems are related or interact? How do the components of the geosphere and hydrosphere interact?
- Do rocks or soil interact with water? Tell me more about _____.
- What do you think about what _____ said?
- Do the rest of you agree? Why or why not?
- Can someone give another example of how two or more of the systems interact?
- Do you understand what _____ is saying?
- Can someone explain why the examples make sense?
- What do we need to learn about each system?
- Which card(s) was the most difficult to classify and integrate into the model?
- If you were an environmental scientist or engineer, why would it be important to understand Earth's systems and how they interact?

Record student questions and ideas about what they need to learn and add any new ideas to their list to the What We Think chart from Lesson 1A. Continue to refer to their ideas of what they need to know as the lessons develop.

Revisit the environmental problem of plastic waste from the previous activity. Ask students to identify Earth systems that are affected by the plastic production and disposal issue. Ask:

- Is the use of plastic only an issue for its effect on Earth’s water? Land? Air? Plants and animals? What makes you think that?
- How might understanding how Earth’s systems work together help to develop a plan to solve the plastic problem? Tell me more about _____.
- Does someone have a similar idea but a different way to explain it?
- Do the rest of you agree or disagree? Why or why not?
- Can you explain why your answer makes sense?

Explain to the class that, in the following activities, they will be exploring each of the systems in depth to learn more about the components of each system and how they interact with one another to support life on Earth.

Have students complete the Journal Entry.

Journal Entry

1. Write what Earth system each cup represents. Describe the components that make up the system. Use the class chart as a reference for your response.

Cup of water:

Cup of soil:

Cup of air:

Cup with plant:

2. Choose two of the four systems and develop a model to explain one way they interact.

Assessment: Formative

Use the Journal Entry to assess the students’ initial understanding of Earth’s systems and their components.

EXTENSION/HOMEWORK

Have students develop a model using clay or salt dough that demonstrates the four Earth systems.

DEVELOPING AND USING MODELS

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising models and using models to represent events and design solutions.

- Identify limitations of models.
- Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- Develop and/or use models to describe and/or predict phenomena.
- **Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.**
- **Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.**

ENGINEERING DESIGN PROCESS

The Engineering Design Process provides students with a series of steps to guide them as they solve problems and design and test products, models, and solutions. The process is cyclical, yet not necessarily in an order. Students are encouraged to evaluate as they progress through the process, revisit the mission often, and revise thinking and their plan multiple times as the process unfolds.

Engineers do not always follow the Engineering Design Process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change the design. Engineers must always keep in mind the mission or problem they are trying to solve and the limitations (cost, time, material, etc.) that are part of the solution to the problem. Two key elements in working as an engineer are teamwork and design-test-and-redesign.

Mission

- Defines the problem and what the engineers are trying to design or build.
- Describes the limitations within which the engineers must solve the problem.

Brainstorm Ideas

- Imagine, discuss, and sketch possible solutions.
- Conduct research into what has already been done.
- Discover what materials are available, time frame, and other limitations.

Plan and Design

- Draw and write a plan.
- Design your solution through drawing and manipulating materials.
- Develop a plan or steps and a schedule.

Build

- Construct your engineering device or project.
- Follow your plan.
- Adjust and test along the way.

Test and Adjust

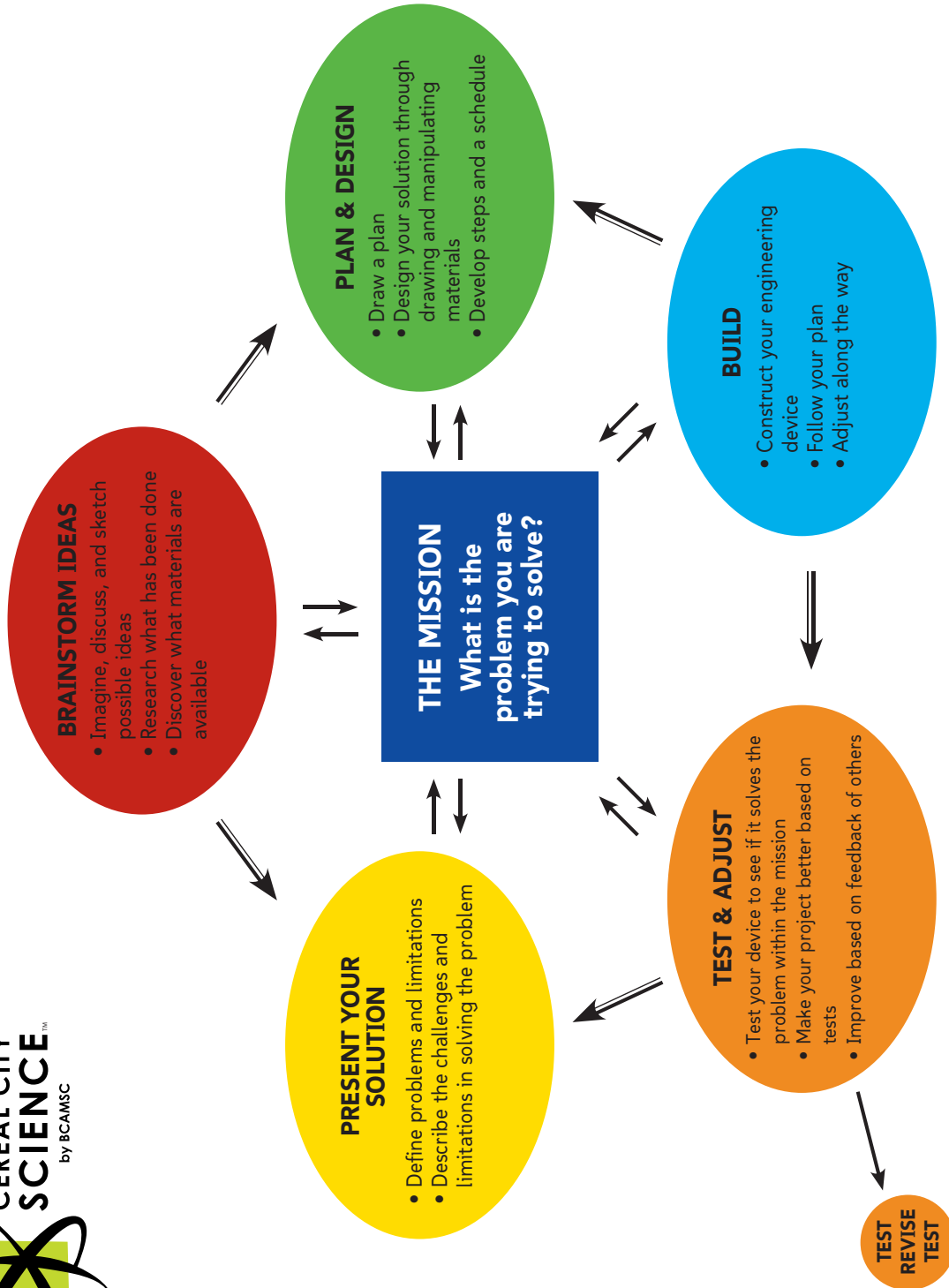
- Test your device to see if it solves the problem within the mission and limitations.
- Make your project better based on tests: Test → Revise → Test.
- Improve based on feedback of others.

Present Your Solution

- Demonstrate how your solution solves the problem.
- Define problems and limitations.
- Describe the challenges and limitations in solving the problem.
- Describe additional revisions that could improve the device or project.

ENGINEERING DESIGN PROCESS

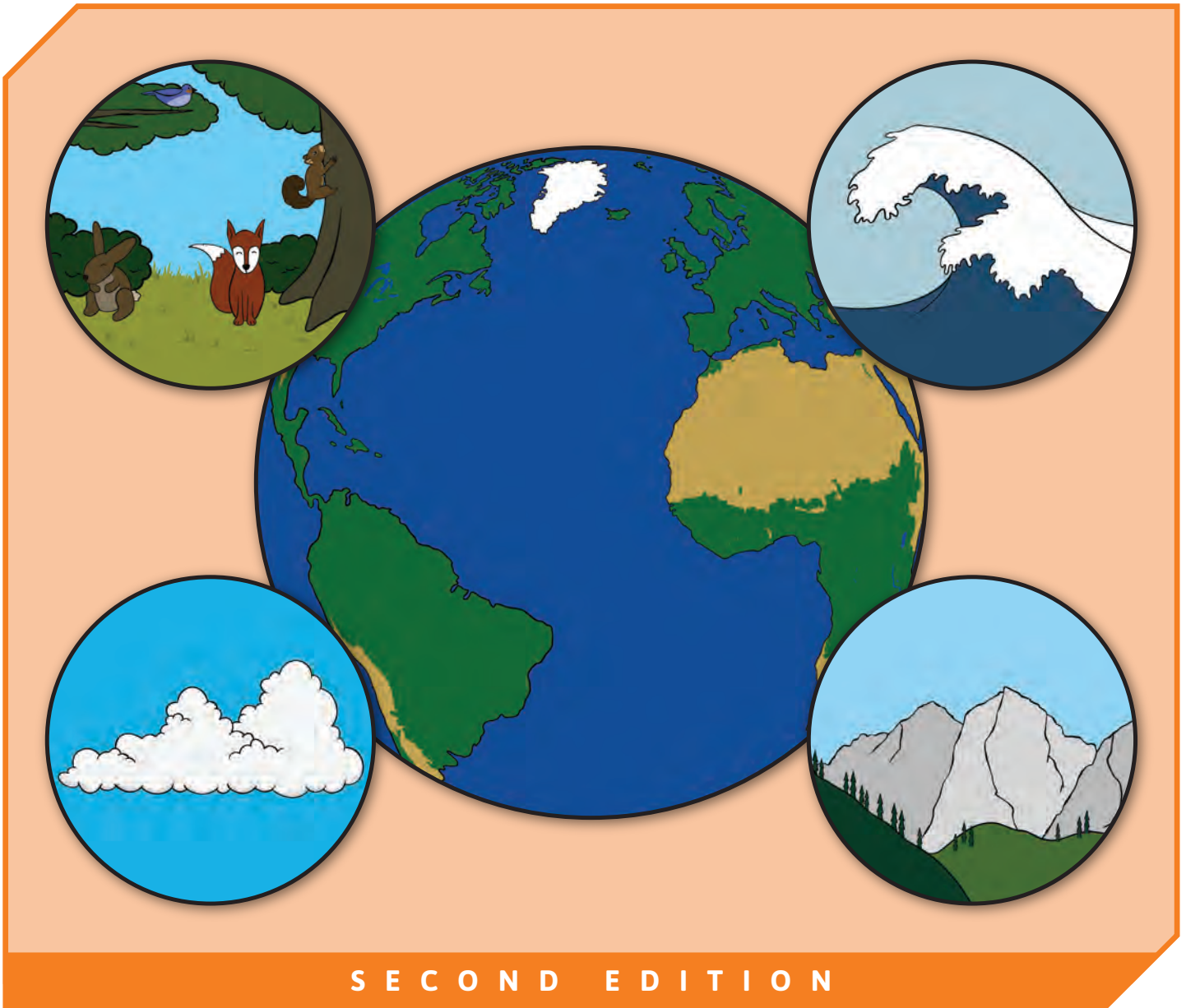
ENGINEERING DESIGN PROCESS



by Battle Creek Area Mathematics and Science Center
Cereal City Science
Adopted from the Carnegie Mellon Robotics Academy

Earth and Space Systems

5ENG



S E C O N D E D I T I O N

A fifth grade unit supporting Next Generation Science Standards
and Michigan Science Standards

Name: _____

Name: _____

Date: _____

.....

Your class has taken a peek into the effect of plastic throwaways on the environment.

- Discuss with your group your reaction to the amount of plastic thrown away in your schoolyard cleanup and the video on plastic waste that was shown in your class.
 - Discuss what information you need to learn to make an informed decision about the effects of the use of plastic throwaways on the land, bodies of water, air, and plant and animal life.
1. Make a list of the plastic that you used today. Write ideas for other material or items you could have used or substituted.

2. Write your ideas for reducing the effects of plastic on the environment.

3. Write what you need to know about Earth’s resources and environments that will help humans to take steps to help protect them.

1B R E S P O N D T O
T E X T
Who's Cleaning Up This Mess?

Name: _____

Date: _____

.....

1. Write the main idea and supporting details from the environment article on the chart below:

Main Idea – Problem	
Supporting Details:	Supporting Details:

2. Write why you think scientists and engineers need to have scientific knowledge about Earth's air, land, water and living things before they can develop a plan to preserve Earth's resources and protect the ecosystem. Include some ideas of what scientists need to know and tell why you think that information is important.

Name: _____

Date: _____

.....

1. Write what Earth system each cup represents. Describe the components that make up the system. Use the class chart as a reference for your response.

Cup of water:

Cup of soil:

Cup of air:

Cup with plant:

2. Choose two of the four systems and develop a model to explain one way they interact.

K E Y T E R M S

Name: _____

Date: _____

.....

Multiple horizontal lines for writing.