

Teacher Guide and Student Journal

Sample Activity and Planning Pages

Processes That Shape Earth

4ENG



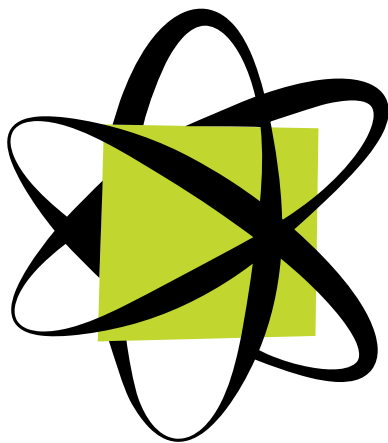
S E C O N D E D I T I O N

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

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

Processes That Shape Earth 4ENG

A fourth-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

Processes That Shape Earth

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PLANNING

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas	Activity
<p>ESS1.C: The History of Planet Earth</p> <ul style="list-style-type: none"> Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. 	3
<p>4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.</p>	3
<p>ESS2.A: Earth Materials and Systems</p> <ul style="list-style-type: none"> Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break down rocks, soils, and sediments into smaller particles and move them around. 	1,2,3
<p>4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering on the rate of erosion by water, ice, wind, or vegetation.</p>	1,2
<p>ESS2.B: Plate Tectonics and Large-Scale System Interactions</p> <ul style="list-style-type: none"> The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along boundaries between continents and oceans. Major mountain chains form inside continents or near the edges. Maps can help locate the different land and water features and other areas of Earth. 	4
<p>4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.</p>	4
<p>ESS2.E: Biogeology</p> <ul style="list-style-type: none"> Living things affect the physical characteristics of their regions. 	1,2
<p>4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.</p>	1,2

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas	Activity
<p>ESS3.B: Natural Hazards</p> <ul style="list-style-type: none"> A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. 	4,5
4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	5
<p>ETS1.B: Designing Solutions to Engineering Problems</p> <ul style="list-style-type: none"> Testing a solution involves investigating how well it performs under a range of likely conditions. 	5
4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	5
<p>ESS3.A: Natural Resources</p> <ul style="list-style-type: none"> Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. 	6,7
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	6,7

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Activity
<p>Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> • Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2) 	1,2,3,7
<p>4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</p>	1,2
<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"> • Analyze and interpret data to make sense of phenomena using logical reasoning. 	2,3,4,6
<p>4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth’s features.</p>	4
<p>Constructing Explanation and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> • Identify the evidence that supports particular points in an explanation. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. 	1,2,3,5,7
<p>4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.</p>	3
<p>4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.</p>	5

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Activity
<p>Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> • Obtain and combine information from books and other reliable media to explain phenomena. 	<p>2,3,4,6,7</p>
<p>4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.</p>	<p>6,7</p>

PLANNING

NEXT GENERATION SCIENCE STANDARDS

Crosscutting Concepts	Activity
Cause and Effect <ul style="list-style-type: none">• Cause-and-effect relationships are routinely identified, tested, and used to explain change.	1,2,5,6,7
4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering on the rate of erosion by water, ice, wind, or vegetation.	1,2
4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	5
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	6,7
Patterns <ul style="list-style-type: none">• Patterns can be used as evidence to support an explanation.	1,3,4
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	3
4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.	4
Connections to Engineering, Technology, and Applications of Science	
Interdependence of Science, Engineering, and Technology <ul style="list-style-type: none">• Knowledge of relevant scientific concepts and research findings is important in engineering.	6,7
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	6,7

NEXT GENERATION SCIENCE STANDARDS

Connections to Engineering, Technology, and Applications of Science	
Influence of Engineering, Technology, and Science on Society and the Natural World <ul style="list-style-type: none"> Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. Over time, people’s needs and wants change, as do their demands for new and improved technologies. 	6,7
4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	5
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	6,7
Connections to Nature of Science	
Scientific Knowledge Assumes an Order and Consistency in Natural Systems <ul style="list-style-type: none"> Science assumes consistent patterns in natural systems. 	1,2,3
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	3

PLANNING

COMMON CORE STATE STANDARDS - READING

Reading Standards for Informational Text—Grade 4	Activity
Key Ideas and Details	
RI.4.1: Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.	2,3,4,6,7
RI.4.2: Determine the main idea of a text and explain how it is supported by key details; summarize the text.	3,4,6,7
RI.4.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.	3,4,6,7
Craft and Structure	
RI.4.4: Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.	2,3,4,7
RI.4.5: Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	4,7
RI.4.6: Compare and contrast a firsthand and secondhand account of the same event or topic; describe the differences in focus and the information provided.	4,7
Integration of Knowledge and Ideas	
RI.4.7: Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.	3,4,6
RI.4.8: Explain how an author uses reasons and evidence to support particular points in a text.	4,7
RI.4.9: Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.	
Range of Reading and Level of Text Complexity	
RI.4.10: By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.	2,3,4,6,7

COMMON CORE STATE STANDARDS - WRITING

Writing Standards–Grade 4	Activity
Text Types and Purposes	
<p>W.4.1: 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 grouped to support the writer’s purpose. b. Provide reasons that are supported by facts and details. c. Link opinion and reasons using words and phrases (e.g., for instance, in order to, in addition). d. Provide a concluding statement or section related to the opinion presented. 	2,6
<p>W.4.2: 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 and group related information in paragraphs and sections; 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 categories of information using words and phrases (e.g., another, for example, also, because). 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
<p>W.4.3: 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 dialogue and description to develop experiences and events or show the responses of characters to situations. c. Use a variety of transitional words and phrases 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. 	

PLANNING

COMMON CORE STATE STANDARDS - WRITING

Writing Standards–Grade 4	Activity
Production and Distribution of Writing	
W.4.4: 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.)	2,3,4,6
W.4.5: With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.	
W.4.6: 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 one page in a single sitting.	
Research to Build and Present Knowledge	
W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.	2,3,4,5,6
W.4.8: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.	2,3,4,6,7
<p>W.4.9: Draw evidence from literary or informational texts to support analysis, reflection, and research.</p> <p>Apply grade 4 reading standards to literature (e.g., “Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text [e.g., a character’s thoughts, words, or actions].”).</p> <p>Apply grade 4 reading standards to information texts (e.g., “Explain how an author uses reasons and evidence to support particular points in a text.”).</p>	2,3,4,6
Range of Writing	
W.4.10: 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.	2,3,4,6,7

COMMON CORE STATE STANDARDS - LANGUAGE

Language Standards—Grade 4	Activity
Conventions of Standard English	
<p>L.4.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.</p> <ul style="list-style-type: none"> a. Use relative pronouns (who, whose, whom, which, that) and relative adverbs (where, when, why). b. Form and use the progressive (e.g., I was walking; I am walking; I will be walking) verb tenses. c. Use modal auxiliaries (e.g., can, may, must) to convey various conditions. d. Order adjectives within sentences according to conventional patterns (e.g., a small red bag rather than a red small bag). e. Form and use prepositional phrases. f. Produce complete sentences, recognizing and correcting inappropriate fragments and run-ons.* g. Correctly use frequently confused words (e.g., to, too, two; there, their).* 	
<p>L.4.2: Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling in writing.</p> <ul style="list-style-type: none"> a. Use correct capitalization. b. Use commas and quotation marks to mark direct speech and quotations from a text. c. Use a comma before a coordinating conjunction in a compound sentence. d. Spell grade-appropriate words correctly, consulting references as needed. 	
Knowledge of Language	
<p>L.4.3: Use knowledge of language and its conventions when writing, speaking, reading, or listening.</p> <ul style="list-style-type: none"> a. Choose words and phrases to convey ideas precisely.* b. Choose punctuation for effect.* c. Differentiate between contexts that call for formal English (e.g., presenting ideas) and situations where informal discourse is appropriate (e.g., small-group discussion). 	

COMMON CORE STATE STANDARDS - LANGUAGE

Language Standards—Grade 4	Activity
Vocabulary Acquisition Use	
<p>L.4.4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 4 reading and content, choosing flexibly from a range of strategies.</p> <ul style="list-style-type: none"> a. Use context (e.g., definitions, examples, or restatements in text) as a clue to the meaning of a word or phrase. b. Use common, grade-appropriate Greek and Latin affixes and roots as clues to the meaning of a word (e.g., telegraph, photograph, autograph). c. Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation and determine or clarify the precise meaning of key words and phrases. 	
<p>L.4.5: Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.</p> <ul style="list-style-type: none"> a. Explain the meaning of simple similes and metaphors (e.g., as pretty as a picture) in context. b. Recognize and explain the meaning of common idioms, adages, and proverbs. c. Demonstrate understanding of words by relating them to their opposites (antonyms) and to words with similar but not identical meanings (synonyms). 	
<p>L.4.6: Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal precise actions, emotions, or states of being (e.g., quizzed, whined, stammered) and that are basic to a particular topic (e.g., <i>wildlife</i>, <i>conservation</i>, and <i>endangered</i> when discussing animal preservation).</p>	

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 4	Activities
Mathematical Practices	
1. Make sense of problems and persevere in solving them.	
2. Reason abstractly and quantitatively.	
3. Construct viable arguments and critique the reasoning of others.	
4. Model with mathematics	
5. Use appropriate tools strategically.	
6. Attend to precision.	
7. Look for and make use of structure.	
8. Look for and express regularity in repeated reasoning.	
4.OA Operations and Algebraic Thinking	
<p>Use the four operations with whole numbers to solve problems.</p> <p>1. Interpret multiplication equations as a comparison, e.g., interpret $35=5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.</p> <p>3. Solve multi-step word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.</p>	
<p>Generate and analyze patterns.</p> <p>9. Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.</p>	

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 4	Activities
4.NBT Number and Operations in Base Ten	
<p>Generalize place value understanding for multi-digit whole numbers.</p> <ol style="list-style-type: none"> 1. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. 2. Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using $>$, $=$, and $<$ symbols to record the results of comparisons. 3. Use place value understanding to round multi-digit whole numbers to any place. 	
<p>Use place value understanding and properties of operations to perform multi-digit arithmetic.</p> <ol style="list-style-type: none"> 4. Fluently add and subtract multi-digit whole numbers using the standard algorithm. 5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. 	
4.MD Measurement and Data	
<p>Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.</p> <ol style="list-style-type: none"> 1. Know relative sizes of measurement units within one system of units, including km, m, cm; kg, g; lb, oz; l, ml; and hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. 2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems that require expressing measurements given in a larger unit in terms of the smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature measurement. 	

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 4	Activities
Represent and interpret data. 4. Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Solve problems involving addition and subtraction of fractions by using information presented in line plots.	4
4.G Geometry	
Draw and identify lines and angles, and classify shapes by properties of their lines and angles. 1. Draw points, lines, line segments, rays, angles (right, obtuse, acute), and perpendicular and parallel lines. Identify these in two-dimensional figures.	

PLANNING

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
1 Weathering and Erosion Detectives	Preparation: 20 min. Activity: 2 classes Lesson 1A: 50–55 min. Lesson 1B: 50–55 min.	Make observations to determine different kinds of weathering and erosion. Obtain data about changes in the surface of the land to explain how different kinds of erosion change the land.	Video of a landslide and how it changes the shape of the land. Changes in the land on the schoolyard.	<ul style="list-style-type: none"> • make observations to determine different kinds of weathering and erosion. • compare pictures of weathering and erosion to their schoolyard observations. • develop definitions of the terms weathering and erosion.
2 Different Forms of Erosion	Preparation: 25 min. Activity: 5 classes Lesson 2A: 55–60 min., 2 classes Lesson 2B: 55–60 min., 2 classes Lesson 2C: 55–60 min., 2 classes	Use and develop models to determine the effect of different types of erosion.	Pictures of changes in the shape of the land.	<ul style="list-style-type: none"> • make observations and models at different weathering and erosion stations. • compare the effects of different types of erosion. • investigate the effects of thawing and freezing on rocks. • investigate the effects of a weak acid and water on rocks and minerals. • read informational text about chemicals and chemical weathering.
3 Fossils and Rock Layers	Preparation: 20 min. Activity: 9 classes Lesson 3A: 50–55 min., 2 classes Lesson 3B: 50–55 min., 2 classes Lesson 3C: 50–55 min., 2 classes Lesson 3D: 50–55 min., 3 classes	Use rock layers and fossils to provide evidence of changes in the land over a long period of time. Develop a model that demonstrates how rock layers and fossils found in layers provide evidence of the history of Earth.	Video: First Time Seen in 200 Million Years Pictures of the layers in the sides of the Grand Canyon.	<ul style="list-style-type: none"> • raise questions about fossils and what information they give scientists. • make observations of specimens for evidence of ancient life forms. • read informational text about the Grand Canyon and fossils.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	Assessment
<ul style="list-style-type: none"> determine the different forces that cause weathering and erosion. determine the cause-and-effect relationship between the forces of weathering and erosion and changes in the land. 	<p>Planning and Carrying Out Investigations</p> <p>Asking Questions and Defining Problems</p> <p>Constructing Explanations and Designing Solutions</p> <p>Cause and Effect</p> <p>Patterns</p>	<p>Formative Assessment</p> <p>Activity Page</p> <p>Science Talk</p>
<ul style="list-style-type: none"> determine the effects of ice wedging. develop a model that demonstrates how temperature change causes ice wedging and breaks apart rocks. develop an investigation to determine the effects of weak acids and water on rocks and minerals. analyze data from their investigation. 	<p>Asking Questions and Defining Problems</p> <p>Planning and Carrying Out Investigations</p> <p>Analyzing and Interpreting Data</p> <p>Obtaining, Evaluating, and Communicating Information</p> <p>Developing and Using Models</p> <p>Cause and Effect</p>	<p>Formative Assessment</p> <p>Activity Page, class chart</p> <p>Summative Assessment</p> <p>Activity Pages</p> <p>Journal Entries</p> <p>Science Talk</p> <p>Investigations</p>
<ul style="list-style-type: none"> determine if a rock is a fossil. compare fossils with modern life forms. develop a model that explains how rock layers and fossils found in the layers give evidence of the history of Earth. obtain information from text about fossils and rock layers. 	<p>Obtaining, Evaluating, and Communicating Information</p> <p>Planning and Carrying Out Investigations</p> <p>Constructing Explanations and Designing Solutions</p> <p>Analyzing and Interpreting Data</p> <p>Patterns</p>	<p>Formative Assessment</p> <p>Activity Page</p> <p>Journal Entry</p> <p>Summative Assessment</p> <p>Activity Pages</p> <p>Journal Entry</p> <p>Rock layer models and presentations</p> <p>Science Talk</p>

PLANNING

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
<p>4</p> <p>Earthquakes, Volcanoes, and Tsunamis</p>	<p>Preparation: 15 min.</p> <p>Activity 4: 8 classes</p> <p>Lesson 4A: 50–55 min., 2 classes</p> <p>Lesson 4B: 50–55 min., 3 classes</p> <p>Lesson 4C: 50–55 min., 3 classes</p>	<p>Use real data to establish the locations where most earthquakes take place.</p> <p>Use maps to locate mountains, volcanoes, and where earthquakes occur.</p>	<p>Video of an earthquake.</p>	<ul style="list-style-type: none"> • raise questions about earthquakes. • use data from USGS to locate earthquakes on a map. • read informational text about earthquakes, volcanoes, and tsunamis
<p>5</p> <p>Reduce the Impact of Natural Hazards</p>	<p>Preparation: 10 min.</p> <p>Activity: 4-6 classes</p> <p>Lesson 5A: 50–55 min., 2 -3 classes</p> <p>Lesson 5B: 50–55 min., 2-3 classes</p>	<p>Develop a solution that will help reduce the impact of a natural hazard.</p>	<p>Engineering Design challenge: Reduce the effect of a natural hazard.</p>	<ul style="list-style-type: none"> • use the Engineering Design Process to develop a plan or structure that reduces the impact of a natural hazard.
<p>6</p> <p>Natural Resources</p>	<p>Preparation: 15 min.</p> <p>Activity: 6 classes</p> <p>Lesson 6A: 50–55 min., 2 classes</p> <p>Lesson 6B: 50–55 min., 2 classes</p> <p>Lesson 6C: 50–55 min., 2 classes</p>	<p>Obtain information to find out how humans use natural resources and the effect of the use of resources on the land.</p> <p>Determine how humans can reduce the impact of the use of resources on the environment.</p>	<p>Read the book <i>Weslandia</i>.</p>	<ul style="list-style-type: none"> • read a book about a boy who developed his own civilization and used a plant for his natural resources. • make observations of different materials to determine what resource they are made from. • use a graphic to learn about the different steps in making glass, paper, and plastics.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	Assessment
<ul style="list-style-type: none"> analyze and interpret data about the location of earthquakes to find patterns. obtain and evaluate information gathered from text to determine the cause-and-effect relationship between shifting plates and earthquakes, volcanoes, and tsunamis. develop a model to explain how the shifting tectonic plates cause earthquakes. 	<p>Obtaining, Evaluating, and Communicating Information Analyzing and Interpreting Data Developing and Using Models Patterns</p>	<p>Formative Assessment What We Think chart Summative Assessment Handout: <i>Mapping Earthquakes</i> Earthquake models and presentations Models Journal Entries Science Talk</p>
<ul style="list-style-type: none"> work as a team of engineers to develop a plan or structure that reduces the impact of a natural hazard. 	<p>Constructing Explanations and Designing Solutions Developing and Using Models Cause and Effect</p>	<p>Formative Assessment Activity Page Charts Science Talk Summative Assessment Engineering solutions and presentation</p>
<ul style="list-style-type: none"> obtain information from text in a story that relates to human use of natural resources. classify resources as renewable and nonrenewable. obtain information from graphics to explain how glass, plastics, and paper are manufactured. classify material as natural or manufactured. 	<p>Constructing Explanations and Designing Solutions Analyzing and Interpreting Data Cause and Effect</p>	<p>Formative Assessment Respond to Text Handout: <i>Wesley's Resources</i> Activity Page Journal Entry Science Talk Summative Assessment Science Talk Classification of materials Journal Entry</p>

PLANNING

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
<p>7</p> <p>Humans Change the Shape of the Land</p>	<p>Preparation: 15 minutes</p> <p>Activity: 6 classes</p> <p>Lesson 7A: 50–55 min.</p> <p>2 classes</p> <p>Lesson 7B: 50–55 min.</p> <p>2 classes</p> <p>Lesson 7C: 50–55 min.</p> <p>2 classes</p>	<p>Obtain information to find out how humans extract or mine natural resources and the effect of the extraction or mining on the land.</p> <p>Determine how humans can reduce the impact of the extraction or mining of resources on the environment.</p>	<p>Video of mountaintop mining.</p> <p>Read the book <i>Oil Spill</i>.</p>	<ul style="list-style-type: none"> • read articles about oil, coal, and gas as natural resources for energy. • read about an oil spill and how environmentalists cleaned it up and the impact on the environment. • work in teams to clean up a model of an oil spill.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	Assessment
<ul style="list-style-type: none"> • obtain information to determine how the use of fossil fuels changes the land and affects the environment. • use information from text to develop and carry out a plan to clean up an oil spill using a model. • use materials available to clean an oil spill. • determine how each individual, family, and community can reduce the effect of the use of natural resources on the environment. 	<p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> <p>Developing and Using Models</p> <p>Obtaining, Evaluating, and Communicating Information</p> <p>Cause and Effect</p>	<p>Summative Assessment</p> <p>Science Talk</p> <p>Journal Entry/Respond to Text</p> <p>Student Presentations</p> <p>Journal Entry</p>

Fourth grade teachers,

In 2018, the Michigan Department of Education adopted K-12 Computer Science Standards. (<https://bit.ly/3368nV2>) This unit, *Processes That Shape the Earth*, 4ENG 2nd Edition, is complete with the integration of upper elementary (grades 3-5) Computer Science Standards (CSS) and computational thinking into lessons 1A-2C. The students become engaged with the program ArcGIS StoryMaps, which provides the opportunity for the integration of Computer Science Standards, technology and developing Story Maps as they figure out the cause and effect of the Oso, Washington landslide. They compare their findings to changes that occur on the schoolyard. Students use digital mapping tools to figure out the changes in the surface of the land.

Students engage in the following Computer Science Standards:

LEVEL 1B: UPPER ELEMENTARY (GRADES 3-5)

DATA AND ANALYSIS

1B-DA-06 Organize and present collected data visually to highlight relationships and support a claim.

1B-DA-07 Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.

ALGORITHMS AND PROGRAMMING

1B-AP-08 Compare and refine multiple algorithms for the same task and determine which is the most appropriate.

1B-AP-09 Create programs that use variables to store and modify data.

1B-AP-16 Take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development.

IMPACTS OF COMPUTING

1B-IC-18 Discuss computing technologies that have changed the world, and express how those technologies influence, and are influenced by, cultural practices.

Included in the Technology Section of the Teacher Guide are the CSS integrated lessons with written instructions and facilitation/questioning techniques for developing explanations using the computer program. Also included, are online tutorials, instructions for becoming an ArcGIS association, and example StoryMaps for students to use for brainstorming to create their own.

We hope you and your students have the opportunity to take learning to a new level using ArcGIS Story maps within their science learning experience. If you have questions, please contact Cereal City Science.

Cereal City Science
Outreach Staff
269-213-3908 or 269-213-3905

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 *Processes That Shape Earth* unit. This unit is geared for fourth-grade students and focuses on the following big ideas:



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- Obtain information through research, models, and investigations to discover how local, regional, and global patterns of rock formations reveal changes over time due to earth forces.
- Generate and evaluate a plan to reduce the impact of natural hazards (e.g., earthquakes, tsunamis, and volcanic eruptions).
- Research topographical maps to analyze how plate tectonics and large-scale interactions are evident, based on their geographical location.
- Investigate how living things affect the physical characteristics of their regions.
- Use research to understand how water, ice, wind, living organisms, and gravity break rocks, soil, and sediments into smaller particles and then move them around.
- Determine how the use of fossil fuels affects the shape of the land and environment.

Fourth-grade students are also encouraged to think and act like scientists and engineers and continue to develop observation and communication skills in science. Your student will be engaged in exploring the effects of weathering, erosion, earthquakes, tsunamis, and volcanic eruptions. He or she will develop models of rock layers and fossils that demonstrate how scientists use patterns to determine the history of Earth. The unit includes students exploring and designing solutions to reduce the impact of geological events and solutions to the effect of the use of fossil fuels on the land.

In this unit, the activities are geared to build on students' inherent knowledge and provide experiences in which they can use and apply their knowledge in a wider range of tasks. Students will be given the opportunity to examine, measure, reflect upon, describe, and discuss how geological events change the land. Suggestions for activities to do at home are included with this letter. These activities will reinforce the concepts taught during this unit instruction.

May you enjoy quality time with your child while discussing the concepts involved with the *Processes that Shape Earth* 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. Start a rock or fossil collection with your student. Search for rocks with interesting markings and possible imprints.
2. Visit a museum with a dinosaur/fossil exhibit.
3. Keep a record of earthquakes around the world using Internet data. Chart earthquakes on a world map using the United States Geological Society website.
4. Take your child to a glass manufacturing plant or a paper manufacturing plant. Help them interview the plant managers to see the process involved in making the products and to learn what kind of natural materials are involved in the production.
5. Take your child to a mine to help him/her learn how ores are taken from the earth. Discuss with your child the natural resources needed for the mining process and the transportation of the ore to a place where metals are removed from it.
6. Set up a plan in your home to make an effort to reduce, reuse, and recycle materials. Choose packaging of material that is environmentally friendlier. Make a list with your child of ways the family can save natural resources.
7. Take your child to the library to find books about weathering and erosion, volcanoes, glaciers, landslides, earthquakes, fossils, natural resources, and fossil fuels. Sample book titles:

The Street Beneath My Feet by Charlotte Guillain and Yuval Zommer

Volcanoes by Anne Schreiber

Earthquakes by Seymore Simon

Volcanoes by Seymore Simon

Fossil by Bill Thompson

Rocks, Fossils, and Arrowheads by Laura Evert

Curious About Fossils by Kate Waters

Buried Sunlight: How Fossil Fuels Have Changed the Earth by Molly Bang and Penny Chisholm

The Story of Fossil Fuels by William B. Rice

ACTIVITY 1

WEATHERING AND EROSION DETECTIVES

Teacher Background Information

Weathering is the process of wearing away at different materials and the surface of Earth in different ways. Erosion is the movement of earth materials from one area to another. Erosion usually follows or is connected to the effect of weathering. Student engagement into how the surface of the earth changes begins with making observations and looking for evidence of weathering and erosion. The first lesson is to elicit current thinking and prior knowledge from previous units of study and experiences.

Considerations for Students With Special Needs

Students are asked to write responses to explain their thinking. Students with special needs may benefit from dictating their answers or discussing their ideas and/or using a word processor.

Students are engaged in developing models to explain their thinking. Some students may benefit from orally explaining their thinking first and then, with guidance, developing the drawings for a model.

Engage the Learner

This initial phase of learning activates students' prior knowledge of and preconceptions about processes that shape the earth. Students begin to make connections between what they have learned in previous units of study, their observations, and what causes changes to the land.

LESSON 1A: WEATHERING AND EROSION DETECTIVES

Advance Preparation

Make a What We Think chart. Find an area to post the chart, as it will be added to and revised as student thinking changes and shifts.

What We Think	Questions We Have	What We Did	What We Figured Out	How Does that Help Us to Figure Out the Phenomenon?

Do an Internet search for a video of a landslide or erosion due to water and wind. Examples:

Search PBS LearningMedia using the term "erosion." Or search using: Killer Landslides/StudyingOso

ESTIMATED TIME

Lesson 1A: 50–55 minutes,
2 classes

Lesson 1B: 50–55 minutes,
2 classes

LESSON LEVEL LEARNING GOALS

Make observations to determine different kinds of weathering and erosion.

Obtain data about changes in the surface of the land to explain how different kinds of erosion change the land.

MATERIALS NEEDED

For each student:

student pages

For each group of 4:

Weathering and Erosion Card Set (example of wind, water, chemical, glaciers, ice, and vegetation erosion)

Michigan Weathering and Erosion Card

Grand Canyon picture

Teacher provides:

chart paper or white boards
markers

ESS2.A: EARTH MATERIALS AND SYSTEMS

- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break down rocks, soils, and sediments into smaller particles and move them around.

LESSON 1A

TEACHING TIP

As you facilitate the group observations, carry a clipboard for taking notes on their ideas. The notes can be referred to during the whole-class sharing of ideas.

Do not introduce the terms weathering and erosion at this time. If students use the terms in their explanations without prompting, ask them to explain what they mean by weathering and erosion. Make a note of their initial explanations.

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.

- 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.
- **Develop and/or use models to describe and/or predict phenomena.**

Search YouTube using the phrase “weathering and erosion for kids.”

The class will be going outdoors in Lesson 1B. Encourage students to dress appropriately for an outdoor exploration.

Procedure

Engage the learner.

As a class, engage in a review of students’ ideas about weathering and erosion, and how they change the surface of Earth. **Project the video of a landslide. Ask the class to discuss what has happened in the picture to change the shape of the land and what caused it to happen.**

Record their initial ideas on the What We Think chart.

Ask the students to work independently at first and develop an initial model of their initial ideas of before, during, and after the landslide that explains the cause of the landslide? Ask: What caused the motion?

Develop a before, during, and after model of the cause of the landslide. What do you think caused the motion?

Allow sufficient time for students to develop their initial models and then divide the class into groups of four, distribute chart paper or white boards and markers. Invite students to collaborate and share their ideas to come up with a group model.

Facilitate the group model development by circulating among the students. Listen for initial ideas that relate to the force of moving water, gravity, and moving soil from one place to another. Check for the use of the vocabulary words *erosion* and *weathering*. Ask students for ideas of how they could find out how the surface of Earth changes because of landslides and other events. Remind students that all ideas are valid and appreciated. Let them know that there will be opportunities for the groups to come back together and add to and revise their models as the unit progresses.

Science Talk

Take this opportunity to have the groups share their models with the class. Ask students to bring their models and form a circle and make observations of their ideas. Ask:

- What are the common components you recognize in all or most of the models?
- What makes you think that it is important for explaining the cause of the landslide?
- Who can add to _____’s idea?

- Do the rest of you agree? Why or why not?
- I see that on this model the group added _____. Can someone explain that part of your model?
- Did anyone else have a similar idea?
- What questions do you have about the models and the cause of landslides?

After the whole class has had the opportunity to share their group models of their initial thinking, record any questions that students generated from their model development and record them on the What We Think chart.

Engage the students in small-group observations of different examples of changes in the shape of the land. Inform the students that they are to become changes in the land detectives and look for evidence of changes in the land in the pictures.

Divide the class into groups of four students. Distribute one *Weathering and Erosion Card Set* and one *Michigan Weathering and Erosion Card* to each group. As students discuss their ideas with one another, encourage them to write and draw their ideas in their Student Journals.

Write what you observe in each picture in the Weathering and Erosion Card Sets. Write how you think the object in the picture represents weathering and/or erosion.

1. (wind)
2. (water)
3. (chemical)
4. (gravity)
5. (ice)
6. (living organisms)

Facilitate the group observations of the cards by circulating among the students and listening to their ideas. To help students elaborate on their explanations and rely on their previous experiences, ask:

- Can someone explain what you have discussed so far?
- What evidence do you have from the picture that makes you think that?
- How do you know?
- What do you mean when you say...?
- How might you find out or confirm your ideas?
- Does that make sense? What do you already know about how weathering and erosion change the land that makes you think that?

CAUSE AND EFFECT

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

SCIENCE TALK

Science Talk is a discussion between students that is an essential part of making meaning from observations and the processing of information. Actively engage your students in collaboration about ideas in a clear, concise form in a nonthreatening environment. Remind students that all ideas are valid and appreciated. Conduct the Science Talk in a circle where students can see one another and no one has his or her back to another student. Science Talk is conducted among students, and the role of the teacher is to facilitate and record ideas that may lead to further discussion. (See Science Talk in the appendix, p. 134).

LESSON 1A

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- **Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).**
- **Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.**
- **Identify the evidence that supports particular points in an explanation.**
- ~~Apply scientific ideas to solve design problems.~~
- ~~Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.~~

- Can someone draw or explain what causes changes to the land to occur? What is the effect of wind and water on the land?

After the groups have discussed the pictures on the *Weathering and Erosion* cards, distribute a picture of the Grand Canyon to each group and ask them to discuss their ideas of what caused the Grand Canyon to look like that.

Science Talk

Allow sufficient time for students to make observations, discuss, and record ideas in the Student Journal. Project or display each card and conduct a whole-class sharing of ideas. Refer to your notes during facilitation of the group discussions to get the class discussion started. Example:

- Mary, I heard you say _____ about _____. Can you explain to the class what you observed that made you think that?
- Did anyone else have a similar or different idea?
- Who can add to _____'s idea?
- What about the picture of the Grand Canyon? How is that related to the other pictures?
- Who can share some of their group's ideas about how it was formed and came to look like that.
- Who can add to _____'s ideas?
- What ideas can we add to the What We Think chart?

Record key ideas, questions, and patterns that may emerge from the discussion. After all students have had the opportunity to engage in conversation about at least one of the pictures, return to the What We Think chart and ask students if they have any further ideas to contribute or adjustments to make to the chart. Allow sufficient time for students to make adjustments and additions to their entries in the Student Journal and initial models.

Write the terms *weathering* and *erosion* on the board or chart paper. As a class, establish a definition for the terms. Only after the class is satisfied with their definition, have them write the meaning of the term in the Key Terms in the Student Journal.

Assessment: Formative

Use the Activity Page and Science Talk to assess the students' beginning ability to make connections to the cause-and-effect relationship between different weathering forces and changes to the land.

Use the Activity Page and Science Talk to assess the students' prior knowledge about weathering and erosion and the forces that change the shape of the land.

CAUSE AND EFFECT

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

PLANNING

LESSON 1B: WEATHERING AND EROSION DETECTIVES

Teacher Background Information

Student engagement and exploration into how the surface of the earth changes continues with a schoolyard exploration. Students make observations of areas on the schoolyard that have eroded or changed due to moving water, thawing and freezing water, wind, and plants. The surface of the land is constantly changing. Changes are caused by forces that move the land and earth, and by chemical changes in the material. The changes can occur quickly and over long periods of time.

Advance Preparation

Conduct a survey of your schoolyard and make note of areas that have been weathered and eroded due to exposure to wind, rain or water movement, thawing and freezing, and plant growth. Check for areas where plant roots have caused cracks in sidewalks and parking lots, where the thawing and freezing of water has caused cracks and holes, where rain or moving water has caused erosion and changes in the soil, and where wind has changed the shape of the land by moving soils from one area to another.

Procedure

Explore the concept.

Review the students' initial ideas of how the surface of the land changes and their observations from the *Weathering and Erosion Card Set* and *Michigan Weathering and Erosion Card*. Ask students if they think they might find similar changes to the land in the schoolyard. Discuss how the examples on the cards are one way that wind, water, ice, chemicals, and plants might change the land. Discuss opportunities for changes that may occur on the sidewalks, driveway, and parking lot.

Inform the class that they are going outdoors to make observations of the schoolyard for evidence of erosion. Discuss ideas for areas on the schoolyard to investigate.

Set boundaries and guidelines for the schoolyard observations. Review the purpose of the outdoor investigation. Ask students to predict what they might observe on the schoolyard that provides evidence of changes and reshaping of the land.

Read the Student Journal prompt and have students explain the purpose of the investigation in their own words.

Your class is investigating changes in the shape of the land in your schoolyard.

1. *Draw and label a model of one of the changes in the shape of the land in the schoolyard that you observed.*

MATERIALS NEEDED**For each student:**

student pages

For each team of 2:

hand lens

For each group of 4:

Weathering and Erosion Card Set (example of wind, water, chemical, gravity, ice, and vegetation erosion)
Michigan Weathering and Erosion Card

Teacher provides:

chart paper

markers

digital camera (optional)

TEACHING TIP

If your students have access to devices with cameras, take this opportunity to use technology in their recording of examples of weathering and erosion on the schoolyard.

ESS2.A: EARTH MATERIALS AND SYSTEMS

- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break down rocks, soils, and sediments into smaller particles and move them around.

ESS2.E: BIOGEOLOGY

- Living things affect the physical characteristics of their regions.

LESSON 1B

PLANNING AND CARRYING OUT INVESTIGATIONS

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Evaluate appropriate methods and/or tools for collecting data.
- **Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.**
- ~~Make predictions about what would happen if a variable changes.~~
- ~~Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.~~

CAUSE AND EFFECT

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

PATTERNS

Patterns can be used as evidence to support an explanation.

2. *Draw and write what you think caused the change in the land.*

3. *What picture from the Weathering and Erosion Card set or the Michigan Weather and Erosion card is your schoolyard observation most similar to? What makes you think that?*

Have students take their Student Journals and pencils outdoors with them to develop models of their findings.

Divide the class into teams of two and allow sufficient time for students to complete their outdoor explorations. Facilitate the team exploration by circulating among the students and observing their explorations. To check progress and help the teams make connections between the landforms in the pictures and their schoolyard observations, ask:

- Can someone explain what you have observed so far?
- What evidence do you have that there was a change in the shape of the land in this area?
- What do you think was the cause of the change? Was it rapid change or did the change happen slowly? What makes you think that?
- What effect does that have on the shape of the land?
- How does your observation relate to the pictures in the *Weathering and Erosion Card Sets*?

Allow sufficient time for students to make observations and complete their models of their findings.

Explain the concept and define the terms.

Conduct a whole-class sharing of their models. Ask teams to describe their observations and why they think their findings provided evidence of a change in the shape of the land. Ask what they think caused the change.

Use the document camera and invite students to project their models and writings, and to explain their ideas.

Encourage students to challenge one another in their thinking. Ask:

- What do you think about what _____ said?
- Do the rest of you agree? Why or why not?
- Does anyone have the same or similar observation but a different way to explain it?
- Can you explain why your answer makes sense? What evidence do you have?

- Do you think the change occurred quickly or over a long period of time? How might you find out?
- What questions do you have about the observations on the schoolyard?

Take this opportunity to record student questions about the changes that they observed. Look for questions that might include:

- What caused the change?
- How long did it take for the change to occur?
- What can we do to prevent or slow the change?
- What will the area look like in a week? Month? Year?

Science Talk

Elaborate on the concept.

Have students return to their groups of four from Lesson 1A and redistribute the *Weathering Card Sets* and *Michigan Weathering and Erosion Cards* to each group. Ask students to take some time to compare their drawings of change on the schoolyard with the pictures. Discuss how the changes in the land on the schoolyard are on a smaller scale than the examples of weathering and erosion on the cards.

Facilitate the small-group discussion by circulating among the students and listening to their ideas. To help them make connections between the pictures and the schoolyard investigation, ask:

- How does your observation of _____ on the schoolyard relate to one or any of the pictures?
- What do you think caused the change? What evidence do you have that makes you think that?
- Can you think of another example of the change you observed?
- Were you surprised by the number of changes you observed on the schoolyard?
- Would it be beneficial to make a list of the different causes of changes you observed?
- How does what we observed on the schoolyard relate to changes that occur across the world?

Evaluate the students' understanding of the concept.

Listen for ideas that relate to what causes the change in the land on the schoolyard, sidewalks, driveways, and parking lots. Encourage students to think about the amount of force it might take to make the change.

TEACHING TIP

If your classroom is equipped with a digital camera, take photos of the students' findings. Be sure to place a ruler or other object next to the weathered and eroded example. To extend their exploration, take another photo of the same area one week later. Have students compare the photos and look for changes over time.

ASKING QUESTIONS AND DEFINING PROBLEMS

Asking questions and defining problems in grades 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions about what would happen if a variable is changed.
- Identify scientific (testable) and non-scientific (non-testable) questions.
- **Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.**
- Use prior knowledge to describe problems that can be solved.
- ~~Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.~~

LESSON 1B

CAUSE AND EFFECT

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

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- **Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).**
- **Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.**
- **Identify the evidence that supports particular points in an explanation.**
- ~~Apply scientific ideas to solve design problems.~~
- ~~Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.~~

Revisit the What We Think chart and make additions and revisions as student ideas change. Make additions to the What We Did and What We Figured Out columns. Ask students if any questions were answered and if they have made progress in figuring out the landslide and changes on the *Weathering and Erosion Card Set* and *Michigan Weathering and Erosion Card*.

Allow time for students to revisit their initial models of changes on the school yard and make revisions and adjustments based on the information shared in the Science Talk.

Assessment: Formative

Use the Activity Page and Science Talk to assess the students' beginning ability to make connections to the cause-and-effect relationship between the forces and changes to the land.

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

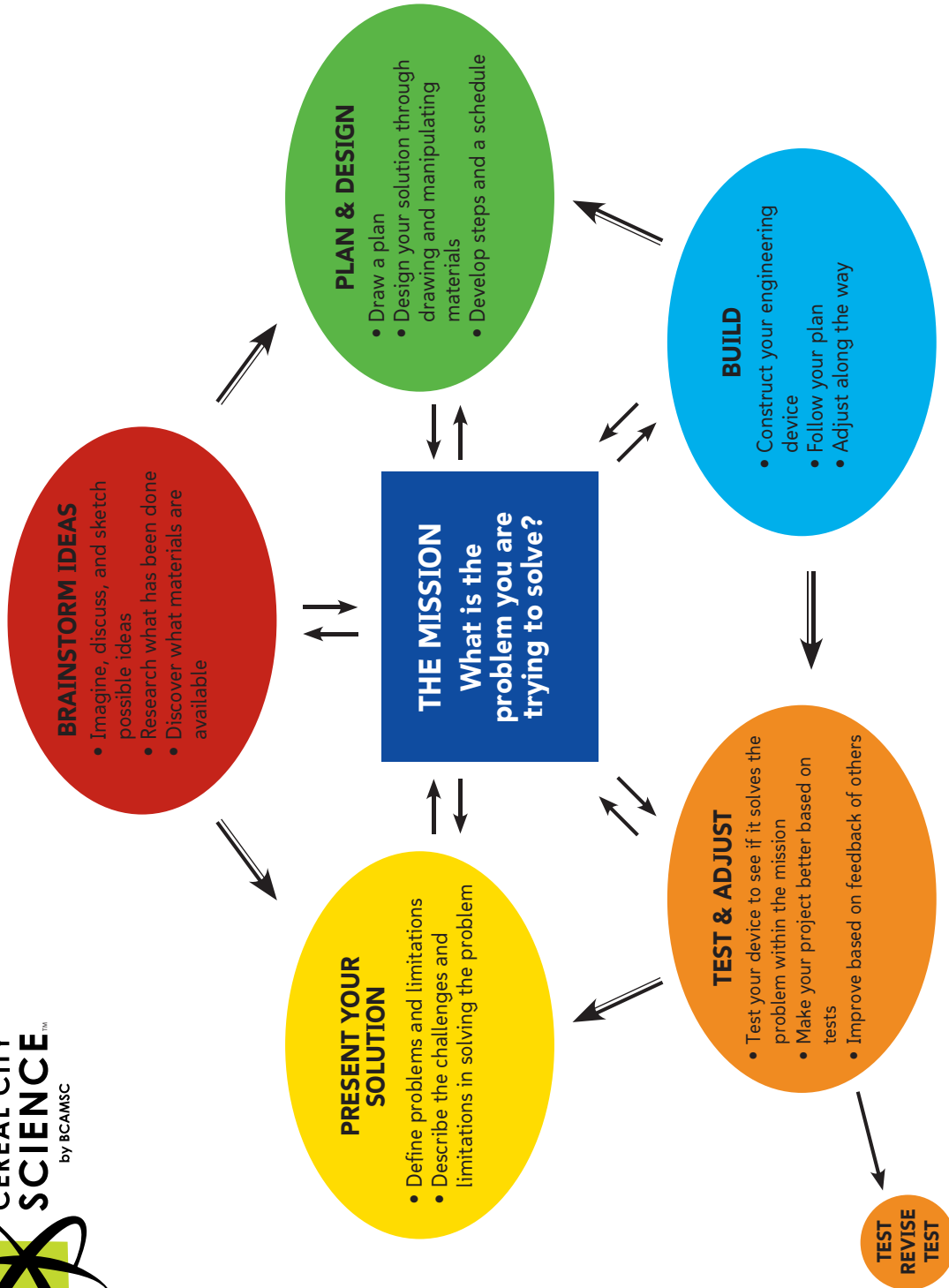
- Test your device to see if it solves the problem within the mission and limitations.
- Make your project better based on tests: Test → Revise → Test.
- Improve based on feedback of others.

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

Processes That Shape Earth 4ENG



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

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

Name: _____

Name: _____

Date: _____

.....
Develop a before, during, and after model of the cause of the landslide.

<p>Before:</p>
<p>During:</p>
<p>After:</p>

Name: _____

Date: _____

.....
Write what you observe in each picture in the *Weathering and Erosion Card Set*.
Write how you think the object in the picture represents weathering and/or
erosion.

1.

2.

3.

1A JOURNAL
**Weathering and Erosion
Detectives**

Name: _____

Date: _____



4.

5.

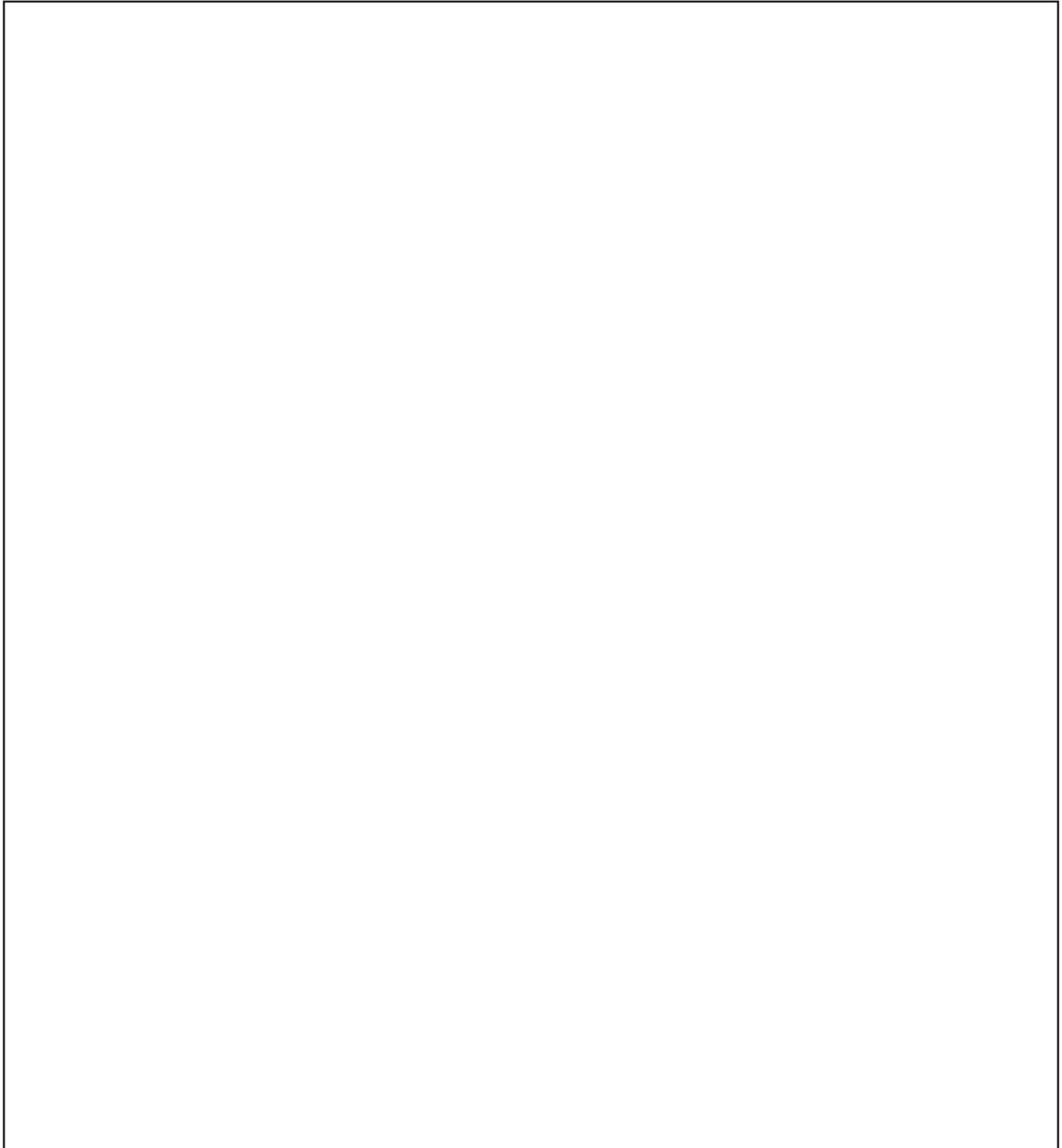
6.

Name: _____

Date: _____

.....
Your class is investigating changes in the shape of the land in your schoolyard.

1. Draw and label a model of one of the changes in the shape of the land in the schoolyard that you observed.



1B JOURNAL
**Weathering and Erosion
Detectives**

Name: _____

Date: _____

.....

2. Draw and write what you think caused the change in the land.



3. What picture from the *Weathering Card Set* is your schoolyard observation most similar to? What makes you think that?
