Unit 2 Earth Science: Processes that Shape Earth

Content Area: **Science**
Course(s):
Time Period: **Trimester 2**
Length: **10-12 weeks**
Status: **Published**

Summary

Introduction: In this unit of study, students develop understandings of the effects of weathering and the rate of erosion by water, ice, wind, or vegetation. In this unit of study, students apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. Students will also explore the effects of environmental factors such as climate change on the processes that shape the earth.

The crosscutting concepts of patterns, cause and effect, and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, and constructing explanations and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 4-ESS2-2, 4-ESS3-2, 3-5-ETS1-2, and 3-5-ETS1-3.

This unit will be taught utilizing Earth Science: Soil, Rocks and Landforms FOSS program kit.

Revision Date: July 2021

Standards

CS.3-5.8.1.5.AP.4	Break down problems into smaller, manageable sub-problems to facilitate program development.
CS.3-5.8.1.5.AP.6	Develop programs using an iterative process, implement the program design, and test the program to ensure it works as intended.
CS.3-5.8.1.5.DA.1	Collect, organize, and display data in order to highlight relationships or support a claim.
CS.3-5.8.1.5.DA.3	Organize and present collected data visually to communicate insights gained from different views of the data.
CS.3-5.8.2.5.ED.2	Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
CS.3-5.8.2.5.ED.3	Follow step by step directions to assemble a product or solve a problem, using appropriate

	tools to accomplish the task.
LA.W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
LA.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.
LA.W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
LA.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.
LA.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.
LA.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.
LA.SL.4.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.
LA.SL.4.1.C	Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.
LA.SL.4.1.D	Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
MA.4.MD.A.1	Know relative sizes of measurement units within one system of units including km, m, cm, mm; kg, g; lb, oz.; l, ml; 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.
MA.4.MD.A.2	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
MA.4.MD.B.4	Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots.
CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest

	value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
SCI.3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
SCI.3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
SCI.4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
SCI.4-ESS2-2	Analyze and interpret data from maps to describe patterns of Earth's features.
SCI.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.
WRK.K-12.P.3	Consider the environmental, social and economic impacts of decisions.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.
TECH.9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2).
TECH.9.4.5.CT.4	Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).
	Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
	Testing a solution involves investigating how well it performs under a range of likely conditions.
	Cause and effect relationships are routinely identified, tested, and used to explain change.
	Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
	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.
	Analyze and interpret data to make sense of phenomena using logical reasoning.
	Living things affect the physical characteristics of their regions.
	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 rocks, soils, and sediments into smaller particles and move them around.

Essential Questions/Enduring Understandings

Essential Questions:

How does the Earth change over time?

What can land and rock formations tell us about the past?

How can we engineer ways to protect humans from natural Earth?

How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured?

How do weathering and erosion affect the Earth's surface?

How do forces within and outside the earth change its surface?

How can we prevent erosion/weathering?

Why are Earth's landforms where they are?

What patterns can be noticed on Earth's surface?

Enduring Understandings:

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 indicates the order in which rock layers are formed.

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

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 the boundries between continents and ocaens. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.

Living things affect the physical characteristics of their regions.

Energy and fuels that humans use are derived from natural resources and their use affects the environment in multiple ways. Some resources are renewable over time and others are not.

A variety of hazards result from natural processes (ex. earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.

Objectives

Students will know that rainfall helps to shape the land and affects the types of living things found in a region.

Students. will know that water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

Students will know that living things affect the physical characteristics of their regions (weathering or erosion).

Students will know cause and effect relationships are routinely identified, tested, and used to explain change. (Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.)

Students will know how local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes.

Students will know that the presence and location of certain fossil types indicate the order in which rock layers were formed.

Students will know how the earth has changed over time and observe the changes in the nature around them.

Students will know the locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns.

Students will know that most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans.

Students will know that major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.

Students will know when and why natural disasters such as floods, tsunamis and earthquakes occur.

Students will know that 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.

Students will know which natural disasters Cranford, Union County , New Jersey and the US are most prone to.

Students will be skilled at...

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating and communicating information

Learning Plan

Soils, Rocks and Landforms

FOSS Investigation 1-Soils and Weathering

Part 2 Physical Weathering: Students will begin to explore how large masses of rock break into smaller

pieces. They tumble rocks and freeze water to see how these two types of physical weathering can break rocks. At the end of the investigation students should understand that weathering is the process of breaking down rocks into smaller pieces. They should also understand that wind, vegetation, and water (freezing/thawing, running water) cause rock to weather. Students will bee introduced to the terms conglomerate, granite, abrasion, they do not need to be memorized. The focus word they should know is "weathering"

To assess you can use evidence in student notebook for example the response to the freezing investigation, or the suggested question in the FOSS text: How do big rocks break into smaller rocks?

Investigation 1 I-Check question: 2, 3a, 5, and 6

Gizmos that can accompany lesson: Focus more on the physical weathering.

Weathering: Weathering is the breakdown of rock at Earth's surface through physical or chemical means. Students will learn about the different types of mechanical and chemical weathering, then use a simulation to model the effects of weathering on different types of rocks in varying climate conditions.

Rock Cycle: Play the role of a piece of rock moving through the rock cycle. Select a starting location and follow many possible paths throughout the cycle. Learn how rocks are formed, weathered, eroded, and reformed as they move from Earth's surface to locations deep within the crust.

BrainPOP:

Weathering: Where do soil and sand come from? In this BrainPOP movie, Tim and Moby introduce you to the fundamentals of weathering. Discover how rocks break down into soil and how slow, natural forces can actually change the shape of Earth's surface. You'll learn the four causes of mechanical weathering, as well as the difference between mechanical and chemical weathering. You can also find out about some of the cool natural phenomena that chemical weathering can cause — like caves!

FOSS Investigation 2-Landforms

Part 1 Erosion and Deposition: Students use stream tables to observe that water moves earth materials from one location to another. After running a volume of water through a stream table, students shake a vial containing a sample of earth material mixed with water to observe the rate at which different particle sizes of earth material settle out. At the end of the investigation, students should know that wind and water can cause weathered rock to move from place to place (erosion) and settle (deposition). Try to have the students first use their own words to generate observations/ideas, then you can provide the "Landform Vocabulary" sheet to help students describe their observations in the stream table, but they do not need to memorize the definitions. Students do not need to know the rate in which different sediments settle. (Part 1, Step 11-12), so this can be cut out for time (if needed). It would be beneficial for students to do this for the purpose of making claims (inferences) based on evidence.

To assess at the end of this investigation use Investigation 2 I-Check (at the end of the investigation) and/or a Notebook Check, such as looking at the students stream table observations/answers to questions, etc.

Gizmo that can accompany lesson: Students do not have to answer the questions, but can adjust the precipitation, vegetation, and temperature to see how a landscape changes over time.

Erosion Rates: Explore erosion in a simulated 3D environment. Observe how the landscape evolves over time as it is shaped by the forces of flowing water. Vary the initial landscape, rock type, precipitation amount, average temperature, and vegetation and measure how each variable affects the rate of erosion and resulting landscape features.

BrainPOP:

Erosion: Drip, drip, drip. Just a little bit of water can wear down rock if you give it enough time! Let Tim and Moby show you just how that happens in this BrainPOP movie on erosion. They'll introduce you to the types

of forces that can cause erosion; show you the many kinds of features that erosion can form on the landscape; and explain how weathering and sandblasting leave their mark on both natural and man-made monuments. You'll also learn about the important role that plants play in the erosion process and discover how a few waves can reshape an entire continent. Hurry and watch this movie before it washes away!

Part 2 Stream Table Investigations: Students continue to learn how environmental variables can effect erosion and deposition. The investigate the variables of slope and water volume (flood). Then they plan and conduct their own stream table investigations. At the end of the investigation, students should know that the rate of erosion is affected by factors such as the slope of the land, the volume of water, speed of the wind, or amount of vegetation. Students can test different variables and make observations about how they affect the rate of erosion. The focus should not be on knowing how each landform was created, rather that the rate and volume of water flow affects erosion and deposition. This is a great way to have students use their science and engineering practices (Carry out Investigations). Every student does not need to test every one of these factors. You can jigsaw and have the students share their findings.

To assess at the end of this investigation use a Notebook Check for instance the student response to the question posed in the FOSS text: How does slope affect erosion and deposition? and /or the Investigation-2 response sheet No. 13-Notebook Master

Gizmo that can accompany lesson: Looking at the 'camera' view students can see changes to the river bank as they make changes with the flow of water.

River Erosion: Explore how river erosion affects landscapes in the short term and over long periods of time. Describe the features of mountain streams and meandering rivers, and use a floating barrel to estimate current speed. Witness the changes that occur as mountain streams erode downward and meandering rivers erode from side to side.

Part 3 Schoolyard Erosion and Deposition: Students consider. whether erosion and deposition are happening in their own schoolyard. They look for evidence of erosion and for locations where deposition is in evidence. They simulate a rainstorm by pouring water on to various outdoor surfaces. At the end of th investigation, students should know that evidence of weathering and erosion can be seen all around us. Students can make observations about where they can see evidence of changes to earth's surface. This may be a difficult investigation since we are doing it in the winter. Instead, you can emphasize how ice is a factor. Possibly look at potholes, measure them and then again at the end of the winter.

To help students compare multiple solutions to reduce the impacts of natural Earth processes on humans, they can complete the Erosion Challenge (linked in the materials section). You can simplify this design challenge if you don't want to do the budget part, or if you want to modify the materials.

To assess at the end of this investigation use a Notebook Check, look at notes/observations taken during the schoolyard exploration response to the question in the FOSS text: Where are erosion and deposition happening in our schoolyard? Also, the 'Erosion Challenge' if used.

Part 4 Fossil Evidence: Students think about what happens to and in sediments over long periods of time as sediments layer on top of each other. Students watch a video, make models, and read an article to learn about how sedimentation processes can result in fossils. They learn how fossils provide evidence of life and landscapes from the past. Students do not really need to know how fossils are formed.

Students should have the opportunity to interpret and draw conclusions from fossil evidence. It will be beneficial for them to analyze samples of fossils, or pictures of fossils. You can simulate a fossil "dig" by giving images of fossils and saying where they came from. Students can then infer about how Earth has changed over time. (See Sample idea in the Materials Section 'The Great Fossil Find')

To assess at the end of this investigation use a Notebook Check. For interpreting fossil evidence, you can use the 'Great Fossil Find'.

Investigation 2 I-Check Questions: 1, 3, 4, 5, and 6.

BrainPOP:

Fossils: How do we know what dinosaurs looked like? Or our ape-like ancestors? Well, as Tim and Moby will show you in this BrainPOP movie, the answer lies in the fossil record! BrainPOP's dynamic duo will teach you the difference between a body fossil, which you might find in a tar pit, and a trace fossil, which might be as simple as a set of footprints. You'll find out how these amazing relics of the distant past are formed, and why they're so rare. You'll also learn how the forces of time, heat, and pressure can turn trees into coal! And finally, you'll see how careful examination of the fossil record can teach us a great deal about the history of our planet. No time for love, Dr. Jones--click on this movie and learn!

FOSS Investigation 3-Mapping Earth's Surface

Part 1 Making a Topographic Map: Students will build a model mountain of Mount Shasta by stacking and orienting six foam layers. They trace outlines of the six pieces onto paper, creating a topographic map of the mountian. Students should understand that maps can be used to notice patterns of features on Earth's surface. While students do not necessarily need to know how to construct a topographic map, this activity will help them better understand how to read a topographic map.

To assess at the end of this investigation use a Notebook Check.

Gizmo that can accompany lesson: Using the student sheet will help the students create a focus when making the map.

Building Topographic Maps: Build a topographic map by flooding a three dimensional landscape with water and drawing contour lines. Draw a profile of a landscape based on the topographic map.

Part 2 Drawing a Profile: Students use their topographic maps to produce two-dimensional profiles, or cross-sections of their foam mountain. The profile reveals a side view of Mount Shasta, a dormant volcano. Students gather information about volcanoes from a video. Students should understand that maps can be used to notice patterns of features on Earth's surface. These lessons are not specifically indicated in the standards, but might still be beneficial in helping students really see how we can find evidence of change over time. Mount St Helens should provide students with an example of earth's processes at work.

Gizmo that can accompany lesson:

Reading Topographic Maps: Understand how topographic maps work by creating a three-dimensional landscape and observing the corresponding contour lines. See how mountains, depressions, valleys and cliffs are represented on topographic maps. Fill in the landscape with water to demonstrate that contours are lines of constant elevation.

To assess at the end of this investigation use a Notebook Check.

Part 3 Mount St. Helens Case Study: **Optional: If there is time left at the end of unit or year, you can go back to this.** Students compare two topographic maps and have a short debate about whether or not they show the same mountain. After learning that the two topo maps are the same mountain, they draw profiles of Mount St. Helens before and after its devastating eruption in 1980. Students watch a USGS video that explains how scientists were involved in predicting the eruption.

To assess at the end of this investigation use a Notebook Check.

Part 4 Rapid Changes to Earth's Surface: Students think about the processes that cause rapid changes to Earth's surface: landslides, earthquakes, floods, and volcanoes. Students should understand that some changes to Earth happen more quickly than others.

Students should also describe patterns of Earth's features: Use latitude/longitude coordinates to plot volcanoes and earthquakes on earth- Make observations about where they are located (they are located close together, mainly on the borders of continents- You can tell them about tectonic plates, but it is not necessary for them to know about them. There is an activity in the materials section that support this.

To assess you can use I-Check questions. You can also use the 'Erosion challenge' or 'Design Challenge: Earthquake Resistant Building' located in the materials section. This challenge can also be used for science and engineering.

Investigation 3 I-Check Questions: 2a, 2b, 4, 5, 6, and 7

Assessment

Formative: teacher observation, student responses during lessons, exit tickets, science notebook questions/observations,

Summative: investigation response sheets, science notebooks, quizzes, Survey/Posttest Questions: 1, 2, 3, 4,

5, 6, and 12

Benchmark: iChecks ,Science Notebook

Alternative: oral presentation with visual model such as a Google slideshow to demonstrate understanding of concepts, drawing models, FOSS extensions

Materials

Core Book List

FOSS kit- Unit 2: Soils, Rocks, and Landforms

Discovery Education/BrainPOP

Science notebook for assessment and journaling

Gizmos (grades 3-5) See learning plan for which Gizmo supports each investigation/concept.

Brain Pop

Integrated Accommodations and Modifications

https://docs.google.com/spreadsheets/d/1ivmYc4cqSjzCUCsZZkB5876Nnt42FhFxq92_3Tx8TOg/edit?usp=sharing