4th Grade - Grading Period 4 Overview

Ohio's New Learning Standards

- Earth’s surface has specific characteristics and landforms that can be identified. (4.ESS.1)
- The surface of Earth changes due to weathering. (4.ESS.2)
- The surface of Earth changes due to erosion and deposition. (4.ESS.3)

Clear Learning Targets

"I can..."

1. _____explain that 70 percent of the Earth's surface is covered with water and most of which is ocean.
2. _____research and identify landforms and the processes by which they are created.
3. _____design and construct a model of a landform and explain the process by it formed.
4. _____synthesize information related to landforms and their processes and present the findings to others
5. _____Explain the process of weathering in changing the Earth's surface.
6. _____Explain the process of erosion and deposition in changing the Earth's surface. 7. _____Differentiate between weathering, erosion, and deposition.
8. _____Connect concepts of weathering, erosion, and deposition to the real world.
9. _____Design, construct, and evaluate a model using research to prevent river bank erosion.
# 4th Grade - Grading Period 4 Overview

## Essential Vocabulary/Concepts

### 4.ESS.1
- Canyon
- Catastrophic
- Cave
- Delta
- Deposition
- Dune
- Earthquake
- Erosion
- Event
- Flooding
- Floodplain
- Glacial Feature
- Glacial Movement
- Hill
- Island
- Landform
- Mountain/Mountain Range
- Physical Geography Map
- Remote Sensing Data
- Sinkhole
- Spring
- Stream
- Topographic Map
- Valley
- Volcano
- Weathering

### 4.ESS.2
- Ice movement
- Freeze/thaw
- Catastrophic event
- Characteristics
- Exposure
- Weathering factors
- Earthquakes
- Mass wasting
- Earth's surface
- Weathering process
- Pollution
- Flooding
- Volcanic activity
- Glaciers
- Types of rocks
- Weathering rates

### 4.ESS.3
- Sediment
- Deposit
- Gravitational force
- Process
- Transport
- Erosion (as a destructive process)
- Deposition (as a constructive process)
- Weathering
- Gravity
- Catastrophic events
- Mass wasting
- Landforms
- Topographic maps
4th Grade Science Unit:
Landforms

Unit Snapshot

Topic: Landforms
Grade Level: 4
Lesson Duration:
~4 Weeks - 18 Days

Summary
In this unit students will focus on the variety of processes that shape and reshape Earth's surface. More specifically, students should understand that Earth's surface has specific characteristics and landforms that can be identified.

Clear Learning Targets
"I can"... statements
_____ explain that 70 percent of the Earth's surface is covered with water and most of which is ocean.
_____ research and identify landforms and the processes by which they are created.
_____ design and construct a model of a landform and explain the process by which it formed.
_____ synthesize information related to landforms and their processes and present the findings to others.

Activity Highlights and Suggested Timeframe

Days 1-2
Engagement: Day 1: This simple demonstration will model the distribution of water on Earth located in oceans, groundwater, lakes, ice, swamps and rivers. Day 2: To view a Discovery Ed. Video: “Landforms: Number 1” as a means to introduce the concept of landforms. [16 min]
Exploration: Part 1: To explore landforms on a virtual fieldtrip to study different locations. Part 2: By exploring this website, students will show understanding of the history and development of Earth imaging, be able to describe Landsat and its role in modern Earth imaging and use knowledge of Landsat's capabilities to make reasoned inferences about the geographic locations shown in Landsat images.

Days 3-6
Part 3: By exploring this website, students can compare satellite images of various landform features.

Days 7-9
Explanation: Students will be assigned to research one of the 14 landforms using a graphic organizer.

Days 10-13
Elaboration: The objective of this activity is to give students an opportunity to create and construct a model of their assigned landform that demonstrates an understanding of the process or processes from which the landform was created.
Evaluation: Students will present their research and model of their landform to others. Students' knowledge and skills will be assessed through completion student journal assignments, graphic organizers, model construction and presentation of models. Conduct formative and summative assessments of student understanding of landforms. Results from the formative assessments should inform the teacher of instructional planning and decision-making. A teacher-created short-cycle assessment will be administered at the end of the unit to assess all clear learning targets.

Days 14-17
and on-going

Day 18
Extension/Intervention: Based on the results of the short-cycle assessment, facilitate extension and/or intervention activities as listed.
NEW LEARNING STANDARDS:

4.ESS.1 Earth's surface has specific characteristics and landforms that can be identified.

About 70 percent of the Earth's surface is covered with water and most of that is the ocean. Only a small portion of the Earth's water is freshwater, which is found in rivers, lakes and ground water. Earth's surface can change due to erosion and deposition of soil, rock or sediment. Catastrophic events such as flooding, volcanoes and earthquakes can create landforms.

CONTENT ELABORATION:

Grade 4 Concepts

Earth is known as the Blue Planet because about 70 percent of Earth's surface is covered in water. Freshwater is a small percentage of the overall water found on Earth; the majority is oceanic.

There are many different processes that continually build up or tear down the surface of Earth. These processes include erosion, deposition, volcanic activity, earthquakes, glacial movement and weathering.

Beginning to recognize common landforms or features through field investigations, field trips, topographic maps, remote sensing data, aerial photographs, physical geography maps and/or photographs (through books or virtually) are important ways to understand the formation of landforms and features. Common landforms and features include streams, deltas, floodplains, hills, mountains/mountain ranges, valleys, sinkholes, caves, canyons, glacial features, dunes, springs, volcanoes and islands.

Connecting the processes that must occur to the resulting landform, feature or characteristic should be emphasized. This can be demonstrated through experiments, investigations (including virtual experiences) or field observations. Technology can help illustrate specific features that are not found locally or demonstrate change that occurred (e.g., using satellite photos of an erosion event such as flooding).

SCIENTIFIC INQUIRY and APPLICATION PRACTICES:

During the years of grades K-12, all students must use the following scientific inquiry and application practices with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

- Asking questions (for science) and defining problems (for engineering) that guide scientific investigations
- Developing descriptions, models, explanations and predictions.
- Planning and carrying out investigations
- Constructing explanations (for science) and designing solutions (for engineering) that conclude scientific investigations
- Using appropriate mathematics, tools, and techniques to gather data/information, and analyze and interpret data
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating scientific procedures and explanations

*These practices are a combination of ODE Science Inquiry and Application and Frame-work for K-12 Science Education Scientific and Engineering Practices

COMMON CORE STATE STANDARDS for LITERACY in SCIENCE:

*For more information:  [http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf](http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf)

**CCSS.ELA-Literacy.W.4.2:** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**CCSS.ELA-Literacy.W.4.7:** Conduct short research projects that build knowledge through investigation of different aspects of a topic.

**CCSS.ELA-Literacy.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.

**CCSS.ELA-Literacy.SL.4.4:** Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.
STUDENT KNOWLEDGE:

Prior Concepts Related to Landforms
PreK-2: Wind and precipitation can be measured, water can change state, heating and freezing can change the properties of materials, and living things can cause changes on Earth. Grade 3: The composition and characteristics of rocks and soil are studied.

Future Application of Concepts
Grade 5: Earth is a planet in the solar system that has a unique composition. Global seasonal changes are introduced, including monsoons and rainy seasons, which can change erosion and deposition patterns.
Grade 6-8: Changes in the surface of Earth are examined using data from the rock record and through the understanding of plate tectonics and the interior of Earth. Historical studies of erosion and deposition patterns are introduced, in addition to soil conservation, the interaction of Earth's spheres and ocean features specific to erosion and deposition.

MATERIALS:

Engage
• Computer access,
• Calculators
• 5 small, clear plastic cups
• 1 liter bottle
• Food coloring
• Eyedropper
• Science journals
• Student materials for building landforms

Explore
• Computer access to specific internet sites

Explain
• Access to non-fiction books and internet access

Elaborate
• Ask students to bring in and/or provide various materials such as: salt dough (see recipe on student sheets), clay, Styrofoam, construction paper, cardboard, sand, soil, toothpicks, rocks, sand, paint, paint brushes, markers; Pizza boxes will often be donated by calling pizza shops. Medium size boxes make a great bottom for the landform projects.

Evaluate
• Students will need to have their projects and presentation materials

VOCABULARY:

Canyon
Catastrophic
Cave
Delta
Deposition
Dune
Earthquake
Erosion
Event
Flooding
Floodplain
Glacial Feature
Glacial Movement
Hill
Island
Landform
Mountain/Mountain Range
Physical Geography Map
Remote Sensing Data
Sinkhole
Spring
Stream
Topographic Map
Valley
Volcano
Weathering

Safety
• All lab safety rules, procedures, and precautions should be taken into consideration, especially when working with hotplates, candles, or other heat related tools.
• Have fire extinguisher available, and understand how to use it properly.
• Tie loose clothing and hair away from face
• Wear safety glasses/goggles and lab apron if available
**ADVANCED PREPARATION**

- Gather resources for students to use while researching their landforms.
- Reserve access to computers over the course of several days.
- Investigate the websites to be used throughout the lesson.
- Obtain materials to support students in the building/construction of their landform models. Salt dough is an inexpensive way of providing model building.
- Copy the student worksheet pages in packet form.

**Objectives:** As we explore this unit, students will discover the impact that various processes have on the shaping of Earth's crust. Moving water has a dramatic effect of on Earth's surface by carving valleys and canyons as well as creating other landforms. Earth is known as the Blue Planet because 70% of Earth's surface is covered in water. Freshwater is a small percentage of the overall water found on earth and located mostly in rivers, lakes and groundwater. The majority of Earth's water is found in the oceans. **Day 1:** This simple demonstration will model the distribution of water on Earth located in oceans, groundwater, lakes, ice, swamps and rivers. **Day 2:** To view a Discovery ed. Video: "Landforms: Number 1" as a means to introduce the concept of landforms. [16 min]

**What is the teacher doing?**

**Earth's Water (Day 1)**

- Gather the following materials: clear 1 liter bottle filled with water (labeled oceans), 6 small clear plastic cups (labeled ice, groundwater, lakes, swamps and rivers), a graduated cylinder, medicine dropper and blue food coloring.
- As a class, discuss the following questions: Why do you predict Earth is called the Blue Planet? (Mostly covered in water) How much water is there on earth? (70%) Where is all of the water located? (Rivers, lakes, underground and in the ocean)
- On the board, write 2 Liter (1000mL) =100% of the water on earth. Underneath, write ice, groundwater, lakes, swamps, rivers and oceans.
- Display the bottle and the cups for all students to see. The liter bottle should contain 1000 mL of water (1 liter). Add blue food coloring to the water for better visibility.
- Have volunteers use a graduated cylinder or medicine dropper to measure and pour

**What are the students doing?**

**Earth's Water (Day 1)**

1. Students should be actively engaged in the demonstration and taking notes in their science journals.
2. At the conclusion of the demonstration ask questions

**ENGAGE**

*(2-30 minute class periods)*

(What will draw students into the learning? How will you determine what your students already know about the topic? What can be done at this point to identify and address misconceptions? Where can connections be made to the real world?)
the following amounts of water to the appropriate cup and label on the board: ice: 20.6 mL; groundwater: 9.0 mL; lakes: .08 mL; swamps: .01 mL (about 5 drops); and rivers: 0.002 mL (about 1 drop).

• Have students calculate the amount of water left in the bottle to represent the water located in our oceans. Students need to add all of the totals from the cups (29.692 mL) and subtract from 1000. This will tell how much water is remaining in the oceans - 970.3 mL or about 97% of the total water. The 29.692 represents about 3% of the total water on Earth that is fresh water. This 3% is all of the water we have to support life on our planet.

• Visit the following website: [http://ga.water.usgs.gov/edu/earthhowmuch.html](http://ga.water.usgs.gov/edu/earthhowmuch.html) "How much water is there on, in, and above the Earth?" to find out more detailed information about water and its distribution.

Day 2: Video-Landforms: Number One

• Show the Discovery education Video: Landforms: Number One: Take a ride in a "traveling machine" to learn about the form and function of landforms. Appreciate the beauty and utility of the worlds' natural features, and see how communities are made unique by the landforms around them. This video highlights oceans, rivers, streams, mountains, hill, plains, valleys, plateaus, deserts, islands, and more. 16:00 minutes.

1. Students should label the date and video title in their notebook. Students should take notes in their science journals during the video presentation.
**Objectives:**

**Part 1:** To explore landforms on a virtual fieldtrip to study different locations. **Part 2:** By exploring this website, students will show understanding of the history and development of Earth imaging, be able to describe Landsat and its role in modern Earth imaging and use knowledge of Landsat's capabilities to make reasoned inferences about the geographic locations shown in Landsat images. **Part 3:** By exploring this website, students can compare satellite images of various landform features.

**What is the teacher doing?**

**Virtual Field Trips (Days 3-6)**
- Investigate the websites prior to the class.
- If time allows, bookmark the websites.
- Copy the student worksheet pages as a packet.
- Support students in their exploration of the sites.
- Allow students to share their findings.
- Monitor the recording of information in student journals as a formative assessment strategy.

**What are the students doing?**

**Virtual Field Trips (Days 3-6)**

**Part 1: Geology Virtual Field Trips**


1. Go to the website. Explore the links for virtual geology fieldtrips to learn more landforms and the processes that form them.
2. Select two links to study in depth. In your science journal, list the two locations and write 3-5 facts about each trip that you learned during your exploration.

**Part 2: Third from the Sun**


1. Viewing landforms and surface geology from satellite photographs and remote sensing can be a helpful tool in illustrating landforms in different parts of the world and conditions that exist for formation. This lesson, called “Third from the Sun” is designed to be a self-guided lesson for students. Students should record their discoveries in their science journal.

**Part 3: NASA Visible Earth Program**

[http://visibleearth.nasa.gov](http://visibleearth.nasa.gov)

1. This website houses hundreds of satellite photos that can be used to illustrate specific landforms. Comparing the photo to a map can be a good way to learn about recognizable features such as delta systems, mountain ranges, volcanoes and canyons.
2. Once on the site, type a land feature into the search window. Students should record 3-5 discoveries in their science journal.
### Objective:
The objective of this activity is to give students the opportunity to research an assigned landform using a graphic organizer.

#### EXPLAIN

**(3-30 minute sessions with computers or books related to landforms)**

(What products could the students develop and share? How will students share what they have learned? What can be done at this point to identify and address misconceptions?)

#### What is the teacher doing?

**Landform Research (Days 7-9)**

- Be sure the students have the student worksheet packet that contains the directions and graphic organizers for the unit.
- Assign each student one of the 14 listed landforms.
- Students should complete Part 1 of the packet entitled, "Part 1: Researching a Landform Graphic Organizer."

#### What are the students doing?

**Landform Research (Days 7-9)**

1. Be assigned or select one of the 14 landforms to study.
2. Using library books and/or computers, complete, "Part 1: Researching a Landform Graphic Organizer". This graphic organizer will help to gain a deep understanding of the assigned landform.

### Objective:
The objective of this activity is to give students an opportunity to create and construct a model of their assigned landform that demonstrates an understanding of the process or processes from which the landform was created.

#### ELABORATE

**(4-30 minute classes)**

(How will the new knowledge be reinforced, transferred to new and unique situations, or integrated with related concepts?)

#### What is the teacher doing?

**Landform Model (Days 10-13)**

- The time frame of this activity may vary depending upon whether this project is assigned to be completed in school or at home.
- Determine whether students will be working alone or in groups based upon the landforms that were assigned.
- Ask students to bring in and/or provide various materials such as: salt dough (see recipe on student sheets), clay, Styrofoam, construction paper, cardboard, sand, soil, toothpicks, rocks, sand, paint, paint brushes, markers
- Pizza boxes will often be donated by calling pizza shops. Medium size boxes make a great bottom for the landform projects.

#### What are the students doing?

**Landform Model (Days 10-13)**

1. Students should plan and construct a model of their assigned landform alone or with a partner or group following the guidelines on the student worksheets.
2. Students will be graded using a rubric.
**Objective:** The objective of this activity is to give students an opportunity to present their research and model of their landform to others.

<table>
<thead>
<tr>
<th>EVALUATE</th>
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<tr>
<td>(4 - 30 minute sessions)</td>
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<tr>
<td>(What opportunities will students have to express their thinking? When will students reflect on what they have learned? How will you measure learning as it occurs? What evidence of student learning will you be looking for and/or collecting?)</td>
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<table>
<thead>
<tr>
<th>Formative</th>
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<tbody>
<tr>
<td>How will you measure learning as it occurs?</td>
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<tr>
<td>1. Journals should be assessed.</td>
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<tr>
<td>2. On-going teacher observations throughout each step.</td>
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<tr>
<td>3. Landform research and model should be graded using a rubric.</td>
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<table>
<thead>
<tr>
<th>Summative</th>
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<tbody>
<tr>
<td>What evidence of learning will demonstrate to you that a student has met the learning objectives?</td>
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<tr>
<td>Days 14-17</td>
</tr>
<tr>
<td>1. Students will present their landform research projects.</td>
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<tr>
<td>2. Students will complete a graphic organizer with completed information about each of the 14 types of landforms.</td>
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<tr>
<th>EXTENSION</th>
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<tr>
<td>INTERVENTION</td>
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<td>(1 Day or as needed)</td>
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<tr>
<th>EXTENSION</th>
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<tbody>
<tr>
<td>1. Plan, build and use a model (such as a small-scale stream table) that can demonstrate the process that helped form your landform. For example, show how moving water can create a sinkhole, canyon or valley. Answer the following questions: What factors speed (accelerate) the processes? What factors must exist for these landforms to form. Share these findings during your presentation.</td>
</tr>
<tr>
<td>2. <strong>Highly Recommended:</strong> Using LANDSAT data, research and locate your landform somewhere on Earth and print to be shared during your presentation.</td>
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<tr>
<th>INTERVENTION</th>
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<tbody>
<tr>
<td>1. Type is name of the landform into the discovery education search window that the student is studying. Allow the student to watch the video to gain a better understanding of their landform.</td>
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<tr>
<td>2. Struggling students may be paired with another student that is studying the same landform.</td>
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<tr>
<th>COMMON MISCONCEPTIONS</th>
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- Rocks do not change.
- Weathering and erosion are essentially the same thing. The two words can be used interchangeably.
- Erosion happens quickly. Erosion is always bad.
- Volcanoes are randomly located across the earth's surface.
- Volcanoes are found only on land.
- Volcanoes are found only in hot climates. All volcanoes erupt violently.
- Volcanoes only erupt straight up through the top vent. If a volcano doesn't erupt for a hundred years, it's extinct. If a volcano does not produce lava, it is not dangerous.

Strategies to address misconceptions:


Visit this website to understand what misconceptions students have regarding weathering, erosion, volcanoes and earthquakes.
### Differentiation

Lower-Level: Consider giving a struggling student a picture book on their particular landform. Sometimes gathering information from computer websites is overwhelming.

Higher-Level: Ask students with stronger capabilities to do the extension activity or extending the amount of their research.

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at ODE.

### Additional Resources

**Websites:**
- [http://ga.water.usgs.gov/edu/earthhowmuch.html](http://ga.water.usgs.gov/edu/earthhowmuch.html) "How much water is there on, in, and above the Earth?" to find out more detailed information about water and its distribution.
- [http://cse.ssl.berkeley.edu/SegwayEd/lessons/third_from_sun/index.htm](http://cse.ssl.berkeley.edu/SegwayEd/lessons/third_from_sun/index.htm) Viewing landforms and surface geology from satellite photographs and remote sensing can be a helpful tool in illustrating landforms in different parts of the world and conditions that exist for formation.

**Discovery Ed:** [www.Discoveryeducation.com](http://www.Discoveryeducation.com)
- Type "landforms" in the search window. There are many videos on landforms.

**Literature:**
Landforms - Explore Activity

Name: _______________________________________________ Date: _______________

Part 1: Geology Virtual Field Trips at Internet 4 Classrooms

Directions:
3. Go to the website. Explore the links for virtual geology fieldtrips to learn more landforms and the processes that form them.

4. Select two links to study in depth. Add the heading, "Geology Virtual Field Trips" in your science journal. In your science journal, list the two locations and write 3-5 facts about each trip that you learned during your exploration.

Part 2: Third from the Sun
http://cse.ssl.berkeley.edu/SegwayEd/lessons/third_from_sun/index.htm

Viewing landforms and surface geology from satellite photographs and remote sensing can be a helpful tool in illustrating landforms in different parts of the world and conditions that exist for formation. This lesson, called "Third from the Sun" is designed to be a self-guided lesson for students.

Directions:
1. Go to the website. Explore the links to learn more about surface geology and landforms from satellite and remote sensing.

2. Add the heading, "Third from the Sun" in your science journal. Record 3-5 discoveries in your science journal.

Part 3: NASA Visible Earth Program
http://visibleearth.nasa.gov/view.php?id=0

This website houses hundreds of satellite photos that can be used to illustrate specific landforms. Comparing the photo to a map can be a good way to learn about recognizable features such as delta systems, mountain ranges, volcanoes and canyons. Once on the site, type a land feature into the search window.

Directions:
1. Go to the website. Explore the links to learn more about landforms.

2. Add the heading, “NASA Visible Earth Program” to your science journal. Record 3-5 discoveries in your science journal.
Landforms Research Project

Name: _______________________________________________ Date: _______________

Landforms are natural features on Earth's surface formed through processes that continually build up or tear down the surface of the earth. In this unit, landforms will be researched, modeled and presented. Throughout this unit, you should discover the processes that must occur to the resulting landforms and tell whether these processes build or tear down Earth's surface.

Landforms to be studied: streams, deltas, floodplains, hills, mountain/mountain ranges, valleys, sinkholes, caves, canyons, glacial features, dunes, springs, volcanoes and islands.

Processes that help to create the landforms: weathering, erosion, deposition, volcanic activity, earthquakes and glacial movement.

• **Weathering**: Weathering is a process by which rocks and minerals are gradually broken down into smaller and smaller particles
• **Erosion**: the process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves, etc.
• **Deposition**: the process of erosion stops when the transported particles fall and settle (deposits) on a surface.
• **Volcanic activity**: The eruption of a volcano by extreme pressure.
• **Earthquake**: shaking of the ground caused by the sudden breaking and movement of large sections (tectonic plates) of the earth's rocky outermost crust.
• **Glacial movement**: moving glaciers carve the landscape and pick up and deposit large rocks, create lakes and rivers, and flatten mountains.
Landform Project Overview

Adapted from: http://www.teacherspayteachers.com/Product/Landforms-Model-Project-334093

Explain Activity:

Part 1-Research: You will be assigned one of the 14 landforms we will be studying to research and become an expert. Using library books and/or computers, complete Part 1: Researching a Landform Graphic Organizer. This graphic organizer will help you to gain a deep understanding and knowledge of the processes that create your landform.

Elaborate Activity:

Part 2 - Constructing a Model: This is where the fun begins. You must creatively build a model of your landform using the attached guidelines. Your project will be graded using a rubric.

Evaluate Activity:

Part 3 - Presentation: Be prepared to share about your research and your project. Your presentation will be graded using a rubric. Include the following information in your presentation:

• The name and definition of your landform
• 3 characteristics of your landform
• Tell what processes cause your landform to form
• Tell whether these processes build up the Earth's surface and break it down
• Show and tell about your model. What materials did you use? What famous landform did you build it after? Where is your famous landform located?
• Tell any other interesting facts you wish to share
• Be sure to speak loud so everyone can hear
• Practice your presentation


**Extension/Intervention Activity (optional):**

**Part 4** - Plan, build and use a model (such as a small-scale stream table) that can demonstrate the process that helped form your landform. For example, show how moving water can create a sinkhole, canyon or valley. Answer the following questions: What factors speed (accelerate) the processes? What factors must exist for these landforms to form. Share these findings during your presentation.

3. Using LANDSAT data, research and locate your landform somewhere on Earth and print to be shared during your presentation.
# Landforms - Explain Activity

Name: _______________________________________

__ Date: ______________

## Part 1: Researching a Landform - Graphic Organizer

<table>
<thead>
<tr>
<th>Type of Landform</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

| What are some characteristics of your landform? | 1. |
|                                                | 2 |
|                                                | 3 |

<table>
<thead>
<tr>
<th>Check the processes that are involved in forming your landform?</th>
<th>□ weathering</th>
<th>□ erosion</th>
<th>□ deposition</th>
<th>□ volcanic activity</th>
<th>□ earthquakes</th>
<th>□ glacial movement</th>
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</thead>
</table>

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<tr>
<th>Of the processes checked above, tell whether each tears down the Earth's surface or builds up the Earth's surface.</th>
<th></th>
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</thead>
</table>

<p>| Name 2 of Famous Landforms of your type and their location. | 1. |
|                                                             | 2 |</p>
<table>
<thead>
<tr>
<th>Other Interesting facts about your landform.</th>
<th>1.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
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<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Draw a sketch of your landform.</td>
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</tbody>
</table>
Landforms - Elaborate Activity

Name: ___________________________________________ Date: ______________

Part 2: Making a Model

For your landform project you are going to build a scale model of your assigned landform using various materials. You will be presenting your landform research and model to the class. The internet has many project ideas on building landform models. Type: "Landform model project ideas" in your search window. You can view videos, pictures and websites containing ideas. Have fun and be creative!

Directions:

1. Select a specific famous landform (ex: The Grand Canyon in Arizona or the Mississippi Delta in the state of Mississippi).

2. Select materials to build a model of the famous landform you selected. Possible Materials: salt dough, clay, Styrofoam, construction paper, cardboard, sand, soil, toothpicks, rocks, sand, paint, paint brushes and markers. A pizza box or shoe box make an excellent bottom for building a landform model while the flap can lift to add pictures or other project information.

3. Your landform model must include: the name and type of your landform, the location of the famous landform you are modeling and be an accurate model of your landform. You may include other landforms in your model as well as other creative items such as plants and animals that might be represented the area of your landform.

Salt dough recipe: Is a mixture of flour, salt and water that combine to make a play-doh type of mixture that hardens when left out or baked. Once dry, the dough can be painted. The recipe: 2 cups white flour, 1 cup salt, 1 luke-warm cup water; mix flour and salt and then add water. Knead the mixture together. Store unused dough in a sealed plastic bag in the refrigerator. Let it warm to room temperature before using. Create your landform and allow it to dry.

Special note: You can use toothpicks to label parts of your landform but they should be placed into the dough before the dough dries.
<table>
<thead>
<tr>
<th>LANDFORM</th>
<th>DEFINITION</th>
<th>PICTURE</th>
<th>PROCESSES</th>
<th>DOES THE PROCESS BUILD UP OR TEAR DOWN THE EARTH'S SURFACE?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream</td>
<td></td>
<td><img src="image" alt="Stream Image" /></td>
<td>Weathering, Erosion and Deposition</td>
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<tr>
<td>Delta</td>
<td></td>
<td><img src="image" alt="Delta Image" /></td>
<td>Deposition</td>
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<tr>
<td>Flood Plain</td>
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<td><img src="image" alt="Flood Plain Image" /></td>
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<tr>
<td>Hill</td>
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<td><img src="image" alt="Hill" /></td>
<td>Glacial Movement, volcanic activity, earthquakes, erosion and deposition</td>
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<tr>
<td>Mountain/Mountain Ranges</td>
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<td><img src="image" alt="Mountain" /></td>
<td>Volcanic activity, earthquakes and deposition</td>
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<tr>
<td>Valley</td>
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<td><img src="image" alt="Valley" /></td>
<td>Weathering and Erosion and deposition</td>
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<tr>
<td>Sinkhole</td>
<td>Weathering and Erosion</td>
<td><img src="sinkhole_image.jpg" alt="Sinkhole Image" /></td>
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<tr>
<td>Cave</td>
<td>Weathering and Erosion</td>
<td><img src="cave_image.jpg" alt="Cave Image" /></td>
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</tr>
<tr>
<td>Canyon</td>
<td>Weathering, erosion and glacial movements</td>
<td><img src="canyon_image.jpg" alt="Canyon Image" /></td>
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</tr>
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<tr>
<td>Glacial Features</td>
<td></td>
<td><img src="image" alt="Glacial Features" /></td>
<td>Glacial Movement, erosion and deposition</td>
<td></td>
</tr>
<tr>
<td>Dune</td>
<td></td>
<td><img src="image" alt="Dune" /></td>
<td>Erosion and Deposition</td>
<td></td>
</tr>
<tr>
<td>Spring</td>
<td></td>
<td><img src="image" alt="Spring" /></td>
<td>Weathering and Erosion</td>
<td></td>
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<tr>
<td>Volcano</td>
<td></td>
<td><img src="image1.png" alt="Volcano Image" /></td>
<td>Volcanic Activity</td>
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<tr>
<td>Island</td>
<td></td>
<td><img src="image2.png" alt="Island Image" /></td>
<td>Volcanic Activity</td>
<td></td>
</tr>
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<td>LANDFORM</td>
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</tr>
<tr>
<td>Stream</td>
<td>A small running body of water flowing on earth. Streams are different from rivers because rivers are larger, deeper and longer than streams.</td>
<td><img src="johnharveyphoto.com" alt="Stream Picture" /></td>
<td>Weathering, Erosion and Deposition</td>
<td>Sediment is carried by the water so this tears down. Sediment is later deposited so this process builds up. Weathering occurs as the rocks are broken down by the moving water.</td>
</tr>
<tr>
<td>Delta</td>
<td><strong>River deltas</strong> are land areas that are formed at the mouth or end of a river as the minerals and soil the river carries are deposited. Deltas are very rich in nutrients. Some of the best farmland on Earth can be found in river deltas.</td>
<td><img src="earthobservatory.nasa.gov" alt="Delta Picture" /></td>
<td>Deposition</td>
<td>The dropping off of minerals and soil builds up the earth's surface.</td>
</tr>
<tr>
<td>Flood Plain</td>
<td>Floodplains are the areas along streams or rivers that are likely to experience repeated flooding.</td>
<td><img src="news.landishomes.wp.mennonite.net" alt="Flood Plain Picture" /></td>
<td>Erosion and Deposition</td>
<td>The flooding causes erosion which tears down the earth's surface. The sediment is deposited which builds the earth's surface.</td>
</tr>
</tbody>
</table>

Answer Key
<table>
<thead>
<tr>
<th>Hill</th>
<th>Mountain/Mountain Ranges</th>
<th>Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>A naturally raised area of land, not as high as a mountain. Can be formed by build-up of rock debris or sand by glaciers and wind; by faults that move upward; deep erosion areas; erosion and deposition and from volcano deposits.</td>
<td>Landforms that rise well above the land are higher and steeper than hills; Most are formed from movements in the earth's crust. There are four types: folded (squeezed rock layers); dome (rock layers forced up by lava); block (breaks or faults in Earth's crust) and volcanic mountains (from lava, ash and cinders poured out from inside the Earth).</td>
<td>A low area of land between hills or mountains, typically with a river or stream flowing through it.</td>
</tr>
<tr>
<td>Glacial Movement, volcanic activity, earthquakes, erosion and deposition</td>
<td>Volcanic activity, earthquakes and deposition</td>
<td>Weathering and Erosion and deposition</td>
</tr>
<tr>
<td>Both. The actual formation of the hill builds the earth's surface but in some of the processes, other areas of the earth's surface are torn down to create a hill.</td>
<td>The actual building of a mountain is a building up process.</td>
<td>Any time there is moving water, weathering, erosion take place which tear down the earth's surface. This moving sediment must be deposited which builds up areas of the earth's surface.</td>
</tr>
<tr>
<td><strong>Sinkhole</strong></td>
<td>A hole that suddenly opens up in the ground. Erosion and underground water cause natural sinkholes. Man-made sinkholes can be caused by drilling, heavy traffic, construction, broken pipes or mining.</td>
<td>Weathering and Erosion</td>
</tr>
<tr>
<td><strong>Cave</strong></td>
<td>A cave is an underground cavity that is formed by rock that has been dissolved by water. Most caves are formed in limestone but can be formed in sandstone, granite, ice, basalt, marble and dolomite.</td>
<td>Weathering and Erosion</td>
</tr>
<tr>
<td><strong>Canyon</strong></td>
<td>Canyons form through erosion or sometimes through movement of the earth's plates. Canyons start out as a riverbed and cuts more deeply over centuries of time. It is a steep gorge with high sides and deepened by wind and water erosion.</td>
<td>Weathering, erosion and glacial movements</td>
</tr>
<tr>
<td>Glacial Features</td>
<td></td>
<td>Glacial Movement, Erosion and Deposition</td>
</tr>
<tr>
<td>------------------</td>
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<td>----------------------------------------</td>
</tr>
<tr>
<td>Glaciers are not landforms but the movement of glaciers creates landforms called glaciation. As glaciers move, they carve out landforms and deposit materials creating new landforms. There are many different types of glacial features.</td>
<td><img src="nasa.gov" alt="Image" /></td>
<td>As glaciers move, the forces create landforms that both build and tear down Earth's surface.</td>
</tr>
</tbody>
</table>
| **Dune** | A mound or ridge of sand or other loose sediment formed by the wind, especially on the sea coast or in a desert: "a sand dune". | ![Image](geography.howstuffworks.com) | **Erosion and Deposition**  
The formation of a dune is a building process as moving sand is deposited. |
| **Spring** | A place on the earth's surface where water naturally emerges. Spring water moves downhill through soil or cracks until it is forced out of the ground by natural pressure. | ![Image](mycustom120.com) | **Weathering and Erosion**  
Moving water causes weathering and erosion which are processes that tear down the earth's surface. |
| **Volcano** | A mountain that opens downward into a molten rock below the Earth's crust. When pressure builds up, an eruption takes place. A volcano can cause tsunamis, flash floods, earthquakes, mudflows and rock falls. | **Volcanic Activity, deposition,** | Volcanoes can build up the land as the lava deposits and hardens. |
|**Island** | A piece of land surrounded by water. Islands can form in several ways, including rising water level, growth of coral and from volcanoes. | **Volcanic Activity, deposition** | The hardening of volcanic lava builds the earth's surface. The Hawaiian islands are formed from volcanoes. |
### Exploring Landforms Project Rubric

<table>
<thead>
<tr>
<th>Area Assessed</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part 1: Researching A Landform</strong></td>
<td>The graphic organizer contains clear, concise, and accurate information about the landform assigned. Includes geological process of formation, famous examples, and the interesting facts of process of landform. There are only one or two spelling, grammar, and punctuation mistakes.</td>
<td>The graphic organizer contains some clear, concise, and accurate information about the landform assigned. Includes some information about the geological process of formation, famous examples, and interesting facts of landform.</td>
<td>The graphic organizer contains little clear, concise, and accurate information about the landform assigned. Includes little information about the geological process of formation, famous examples, and interesting facts of landform.</td>
<td>The graphic organizer contains very little to no clear, concise, and accurate information about the landform assigned. Includes very little to no information about geological formation, famous examples, and interesting facts of landform.</td>
</tr>
<tr>
<td><strong>Part 2: Making A Model</strong></td>
<td>The landform model is a very realistic portrayal of the landform assigned. All objects on model are built to scale. Design is creative and well-built. Student went above and beyond when designing the model.</td>
<td>The landform model is a realistic portrayal of the landform assigned. Most objects on model are built to scale. Student put effort into the design.</td>
<td>The Model somewhat represents landform assigned. Some objects on model are built to scale. Some effort was put into the design of the model.</td>
<td>The model does not represent landform assigned. The model is not built to scale. Little to no effort put into the design of landform.</td>
</tr>
<tr>
<td><strong>Part 3: Landform Presentation</strong></td>
<td>The student used eye contact and a clear speaking voice when presenting landform project. Student had a strong understanding of how the landform was formed.</td>
<td>The student used some eye contact and a clear speaking voice when presenting landform project. Student had a good understanding of how the landform was formed.</td>
<td>The student used little eye contact and a somewhat clear speaking voice when presenting landform project. Student had little understanding of how the landform was formed.</td>
<td>The student used very little to no eye contact and an unclear speaking voice when presenting landform project. Student did not have an understanding of how the landform was formed.</td>
</tr>
</tbody>
</table>
4th Grade Science Unit: Erosion and Weathering

Topic: Earth’s Surface

Grade Level: 4
Lesson Duration: 5 Weeks - 25 Days

Lesson Summary:
The students will be able to explain how the Earth's surface changes due to weathering, erosion, and deposition after viewing multiple pictures and videos and participating in a virtual simulation as well as hands on experiments. Students will design, construct, and evaluate a model of erosion prevention.

Clear Learning Targets

"I can”… statements

_____ Explain the process of weathering in changing the Earth's surface.
_____ Explain the process of erosion and deposition in changing the Earth's surface.
_____ Differentiate between weathering, erosion, and deposition.
_____ Connect concepts of weathering, erosion, and deposition to the real world.
_____ Design, construct, and evaluate a model using research to prevent river bank erosion.

Activity Highlights and Suggested Timeframe

Day 1: Engagement: Observe and respond to pictures

Days 2-5: Exploration: Hands on models of weathering, erosion, and earthquake

Days 6-11: Explanation: Discovery Ed video; Science text chapter
ODNR video of Ohio geology

Days 11-22: Elaboration: Discovery Ed simulation of erosion
Students design, construct, and evaluate a model using research to prevent river bank erosion.

Days 23 and on-going: Evaluation: Conduct formative and summative assessments of student understanding of weathering, erosion, and deposition. Results from the formative assessments should inform the teacher of instructional planning and decision-making. A teacher-created short-cycle assessment will be administered at the end of the unit to assess all clear learning targets.

Day 24: Extension/Intervention: Based on the results of the short-cycle assessment, facilitate extension and/or intervention activities as listed.
LESSON PLANS

OHIO'S NEW LEARNING STANDARDS:

4.ESS.2 The surface of Earth changes due to weathering.
Rocks change shape, size and/or form due to water or ice movement, freeze and thaw, wind, plant growth, gases in the air, pollution and catastrophic events such as earthquakes, mass wasting, flooding and volcanic activity.

Note: The ice movement (above) refers to large bodies of ice, such as glaciers that can break large rocks into small ones.

4.ESS.3 The surface of Earth changes due to erosion and deposition.
Water, wind and ice physically remove and carry (erosion) rock, soil and sediment and deposit the material in a new location. Gravitational force affects movements of water, rock and soil.

CONTENT ELABORATION:

4.ESS.2
Different types of rock weather at different rates due to specific characteristics of the rock and the exposure to weathering factors (e.g., freezing/thawing, wind, water). Weathering is defined as a group of processes that change rock at or near Earth's surface. Some weathering processes take a long time to occur, while some weathering processes occur quickly.

The weathering process must be observed in nature, through classroom experimentation or virtually. Seeing tree roots fracturing bedrock or the effect of years of precipitation on a marble statue can illustrate ways that rocks change shape over time. Investigations can include classroom simulations, laboratory testing and field observations.

4.ESS.3
Erosion is a process that transports rock, soil or sediment to a different location. Weathering is the breakdown of large rock into smaller pieces of rock. Erosion is what carries the weathered material to a new location. Gravity plays an important role in understanding erosion, especially catastrophic events like mass wasting (e.g., mudslides, avalanches, landslides) or flooding.

Erosion is a "destructive" process and deposition is a "constructive" process. Erosion and deposition directly contribute to landforms and features formation that are included in grade 4. Topographic maps and aerial photographs can be used to locate erosional and depositional areas in Ohio. Surficial geology maps also can illustrate the patterns of glacial erosion and deposition that have occurred. Field trips and field investigations (may be virtual) are recommended as erosional and depositional features that can be seen locally or within the state can help to connect the concept of erosion and deposition to the real world.

SCIENTIFIC INQUIRY and APPLICATION PRACTICES:

During the years of grades K-12, all students must use the following scientific inquiry and application practices with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

- Asking questions (for science) and defining problems (for engineering) that guide scientific investigations
- Developing descriptions, models, explanations and predictions.
- Planning and carrying out investigations
- Constructing explanations (for science) and designing solutions (for engineering) that conclude scientific investigations
- Using appropriate mathematics, tools, and techniques to gather data/information, and analyze and interpret data
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating scientific procedures and explanations

*These practices are a combination of ODE Science Inquiry and Application and Frame-work for K-12 Science Education Scientific and Engineering Practices
COMMON CORE STATE STANDARDS for LITERACY in SCIENCE:
*For more information: [http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf](http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf)

- **CCSS.ELA-Literacy.W.4.2**: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

- **CCSS.ELA-Literacy.W.4.7**: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

- **CCSS.ELA-Literacy.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.

- **CCSS.ELA-Literacy.SL.4.4**: Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

**STUDENT KNOWLEDGE:**

Prior Concepts Related to Weathering

**4.ESS.2**

PreK-2: Wind is moving air, water and wind have measurable properties, water changes state, properties of materials change when exposed to various conditions (e.g., heating, freezing) and living organisms interact with their environment.

**Grade 3**: Rocks and soil have unique characteristics. Soil contains pieces of rock.

Prior Concepts Related to Erosion and Deposition

**4.ESS.3**

PreK-2: Wind is moving air, water and wind have measurable properties, water changes state, forces change the motion of an object and some forces act without touching (e.g., gravitational forces).

**Grade 3**: Soil and rock have unique characteristics. Soil and rock are nonliving resources that can be conserved.

Future Application of Concepts Related to Weathering

**4.ESS.2**

**Grade 5**: Earth is a planet in the solar system that has a unique composition, global seasonal changes and patterns are introduced, including temperature fluctuations/ranges, monsoons and/or rainy seasons which can impact the weathering of Earth's surface.

**Grades 6-8**: The relationship between the characteristics of rocks and the environment in which they form is explored as well as how rocks break down (weather) and are transported (erosion), water flows through rock and soil at different rates, and the causes of changes on Earth's surface.

Future Application of Concepts Related to Erosion and Deposition

**4.ESS.3**

**Grade 5**: Earth is a planet in the solar system that has a unique composition, global seasonal changes are introduced, including monsoons and rainy seasons, which can change erosion and deposition patterns.

**Grades 6-8**: Historical studies of erosional and depositional patterns are introduced, in addition to soil conservation, the interaction of Earth's spheres, ocean features specific to erosion and deposition, and plate tectonics.
### MATERIALS:

**Engage:**
- Pictures included in lesson
- Projector
- Graphic organizers

**Explore:**
- Goggles
- Lab aprons (if you have them)
- Lab record sheets
- The following are all per group
  - *chalk 2 pieces (dustless, can be broken in half)
  - cups or containers 2
  - Vinegar - ¼ cup
  - Water - ¼ cup
  - *containers with lids 2 of the same for each group
  - sugar cubes Ten
  - Gravel (Aquarium rock) amount about = to sugar
  - *tubs or aluminum pans 2
  - dry sand about a quart size container full
  - water in a pourable container about 1 cup
  - *2 index cards
  - Clay (modeling clay) about golf ball size
  - denotes a separate lab

**Explain:**
- 4th grade text books
- Projector
- Graphic organizers and movie note copies
- Discovery Ed Video
- YouTube

**Elaborate:**
- Goggles
- Lab aprons (if you have them)
- Computer lab or laptop cart
- Information sheets
- Lab sheets
- Aluminum pans
- Sand
- Soil
- Water
- Water bottle
- Supplies such as the following will be used as erosion control. Consider also allowing students to add to supplies with their own ideas and resources.
  - Gravel *
  - Rocks *
  - Straw
  - Pipe cleaners
  - Craft sticks *
  - Paperclips

**Evaluate:**
- Teacher created assessments
- Extension/Intervention:
  - Paper
  - Projector
  - Computer access

### VOCABULARY:

4.ESS.2
- Ice movement
- Freeze/thaw
- Catastrophic event
- Characteristics
- Exposure
- Weathering factors
- Earthquakes
- Mass wasting
- Earth's surface
- Weathering process
- Pollution
- Flooding
- Volcanic activity
- Glaciers
- Types of rocks
- Weathering rates

4.ESS.3
- Sediment
- Deposit
- Gravitational force
- Process
- Transport
- Erosion (as a destructive process)
- Deposition (as a constructive process)
- Weathering
- Gravity
- Catastrophic events
- Mass wasting
- Landforms
- Topographic maps
| SAFETY | • All lab safety rules, procedures, and precautions should be taken into consideration.  
• Tie loose clothing and hair away from face  
• Wear safety glasses/goggles and lab apron if available  
• Remind students not to eat/put anything in their mouths during the lab |
| ADVANCED PREPARATION | • Gather resources and supplies for lab activities  
• Reserve access to computers over the course of 4 days.  
• Investigate the websites to be used throughout the lesson. Copy the student worksheet pages.  
• Become familiar with lab procedures. |
| **Objectives:** Students will begin to think about the different land formations they see and consider how the land came to be that way. | What is the teacher doing?  
**Day 1: What happened to the land?**  
• Showing pictures of different land forms to students using projector.  
• Passing out graphic organizer.  
• Encouraging students to describe what they observe and think of causes.  
• *Not telling students what caused these land formations yet.*  
What are the students doing?  
**Day 1: What happened to the land?**  
1. Students are observing the pictures.  
2. Sharing descriptions and ideas.  
3. Drawing quick sketches and writing descriptions and ideas of how land was formed. |
| **Objectives:** Students will follow directions to complete 4 models of weathering, erosion, and earthquakes to begin to understand the processes that change the earth’s surface. Students will compare what they are observing in their labs to what might happen in the real world. | What is the teacher doing?  
**Day 2: Land Chang Lab 1**  
• Explain that chalk is made from a type of rock so it is a good representation for rock on earth.  
• Explain your procedures for the lab and monitor students as they gather supplies and complete lab.  
• Guide students in discussion about the results of their lab.  
What are the students doing?  
**Day 2: Land Chang Lab 1**  
1. Listen to teachers instructions.  
2. Gather supplies for lab.  
3. Follow directions for lab.  
4. Complete the lab sheet.  
5. Share answers with class. |
Day 3: Land Chang Lab 2

- Explain that the sugar and gravel represent two types of rock. Tell students it is important that they treat the two containers the same way except one gets only sugar and the other gets sugar and gravel.

- Explain your procedures for the lab and monitor students as they gather supplies and complete lab.

- Guide students in discussion about the results of their lab.

Day 4: Land Chang Lab 3

- Remind students to wear their goggles and to not get sand in their eyes, mouths, or hair.

- Explain your procedures for the lab and monitor students as they gather supplies and complete lab.

- Guide students in discussion about the results of their lab.

Day 5: Land Chang Lab 4

- Demonstrate for students how to put the clay over the two index cards and to move the cards by using fingers of each hand on top of clay on either card. Move the cards and see what happens to the clay.

- Explain your procedures for the lab and monitor students as they gather supplies and complete lab.

- Guide students in discussion about the results of their lab.
### Explain

(6-30 minute classes with books or movies related to landforms)

**Objective:** Students will be able to explain the processes of weathering, erosion, deposition.

**What is the teacher doing?**

**Day 6: Erosion and weathering movie**
- Pass out movie notes papers to students.
- Show the discovery Ed Movie about weathering and erosion.
- Link for the movie
- Review answers with students.

**What are the students doing?**

**Day 6: Erosion and weathering movie**
1. Read over paper before movie starts to know what to look for.
2. Watch movie
3. Complete notes while watching the movie.
4. Review notes to make sure answers are complete and correct.

**Days 7-10: Science text,**
- Have students preview reading by looking at pictures and predicting what they will read about.
- Assign reading.
- Encourage students to make connections to the engage and explore activities they did earlier.
- Pass out graphic organizers.
- Monitor student progress.

**Day 11: Ohio geology movie**
- Pass out papers
- Show movie
- Point out important parts of movie about erosion, deposition, glaciers,
- Lead discussion of what was learned or answers to questions on note sheet.

**What is the teacher doing?**

**Day 11: Ohio geology movie**
1. Read over paper before movie starts to know what to look for.
2. Watch movie
3. Complete notes while watching the movie.

**What are the students doing?**

**Day 12: Virtual Experiment**
- Pay attention to introduction
- Work with partner to plan lab.

**Day 13: Virtual Experiment**
- Monitor student progress as they conduct the level 1
- Work with partner to conduct lab
- Record results /analyze results.

### Elaborate

(12-30 minute classes)

**Objective:** The students will conduct a virtual experiment to learn about ways to slow down erosion. Students will also design, construct, and evaluate a model of a device to slow down riverbank erosion.

**What is the teacher doing?**

**Day 12: Virtual Experiment**
- Pass out lab papers
- Introduce the lab

**Day 13: Virtual Experiment**
- Monitor student progress as they conduct the level 1

**What are the students doing?**

**Day 12: Virtual Experiment**
1. Pay attention to introduction
2. Work with partner to plan lab.

**Day 13: Virtual Experiment**
3. Work with partner to conduct lab
4. Record results /analyze results.
Day 14: Virtual Experiment
• Monitor student progress as they complete level 2

Day 15: Virtual Experiment
• Lead discussion of results and encourage students to complete labs and analyze results.

Day 16-22: The Muck Stops Here
• The time frame of this activity may vary

Objective: The objective of the assessments is to focus on and assess student knowledge and growth to gain evidence of student learning or progress throughout the unit, and to become aware of students misconceptions related to erosion and weathering.

How will you measure learning as it occurs?
Formative
Day 23 and ongoing

• Consider developing a teacher-created formative assessment.
  1. Graphic organizers
  2. Movie notes
  3. Lab observations
  4. Lab planning sheets
  5. Lab analysis

What evidence of learning will demonstrate to you that a student has met the learning objectives?
Summative
Day 23 and ongoing

1. Consider having students write an informative essay explaining the processes of weathering and erosion.

2. Teacher-created short cycle assessment will assess all clear learning targets.

EXTENSION
Students could create an superhero to battle erosion. Use this website to help:

INTERVENTION
1. Students could watch a movie [Link] that explains the difference between weathering and erosion with cartoon super heroes.

2. Discovery Ed model of changing land forms game [Link]

Weathering is the same as erosion.
sometimes non-weathered) pieces away from the source. rock or soil into smaller pieces, but the weathered pieces remain in place.
Erosion is related to the movement of weathered (and - Reality:
Weathering is related to the breaking down and loosening of
Erosion is the process by which weathered particles are deposited into a new location.
- Reality: Erosion is the movement or transport of particles, but it does not involve the settling and accumulation of particles in a new location. The process by which particles accumulate in a new location is called deposition. Deposition is responsible for creating sand dunes and some mountains.
<table>
<thead>
<tr>
<th>Strategies to address misconceptions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visit this website to understand what misconceptions students have regarding weathering, erosion, volcanoes and earthquakes.</td>
</tr>
<tr>
<td>Funded by the National Science Foundation, <em>Beyond Penguins and Polar Bears</em> is an online magazine for K-5 teachers. For a list of common misconceptions about glacial movement, weathering and erosion, as well as ways to address them, visit <a href="http://beyondpenguins.nsdl.org/issue/column.php?date=August2009&amp;departmentid=professional&amp;columnid=professional!misconceptions">http://beyondpenguins.nsdl.org/issue/column.php?date=August2009&amp;departmentid=professional&amp;columnid=professional!misconceptions</a>.</td>
</tr>
</tbody>
</table>

**DIFFERENTIATION**

<table>
<thead>
<tr>
<th>Lower-level: Consider pairing students for reading, writing, and or hands on activities. Provide flash cards for new vocabulary words for extra practice. Higher-Level: Ask students with stronger capabilities to do the extension activity or extending the amount of their research.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at ODE.</td>
</tr>
</tbody>
</table>

**ADDITIONAL RESOURCES**

<table>
<thead>
<tr>
<th>Textbook:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Science: MacMillan 2010</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Websites:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Dirtmeister’s site: <a href="http://teacher.scholastic.com/dirt/erosion/">http://teacher.scholastic.com/dirt/erosion/</a> info on erosion</td>
</tr>
<tr>
<td>• <a href="http://teacher.scholastic.com/dirt/erosion/lab.htm">http://teacher.scholastic.com/dirt/erosion/lab.htm</a> erosion tray experiment</td>
</tr>
<tr>
<td>• <a href="http://teacher.scholastic.com/dirtrep/erosion/invest.htm">http://teacher.scholastic.com/dirtrep/erosion/invest.htm</a> science reporters</td>
</tr>
<tr>
<td>• Geology for Kids <a href="http://www.kidsgeo.com/geology-for-kids/0001-the-lithosphere.php">http://www.kidsgeo.com/geology-for-kids/0001-the-lithosphere.php</a> Chapter 1,2,4,5 general info on topic</td>
</tr>
<tr>
<td>• Geology for Kids <a href="http://www.kidsgeo.com/geology-for-kids/0081-erosion-experiment.php">http://www.kidsgeo.com/geology-for-kids/0081-erosion-experiment.php</a> mountain erosion experiment (may need to be modified)</td>
</tr>
<tr>
<td>• USGS School Yard Geology <a href="http://education.usgs.gov/lessons/schoolyard/RockSedimentary.html">http://education.usgs.gov/lessons/schoolyard/RockSedimentary.html</a> great activity and background information/ connection to data collection and mapping</td>
</tr>
</tbody>
</table>
• http://geomaps.wr.usgs.gov/parks/misc/gweaero.html general info about the difference between erosion and weathering
• review game zone http://reviewgamezone.com/game.php?id=261 games with weathering and erosion questions
• National Park Service http://www.webrangers.us/activities/rockpark/?id=22 rock around the park activity
• Shape it up http://sciencentutils.com/interactives/shapetup.html activity where students match time and weathering agent of two images wind, volcanoes, water and glaciers
• BBC Bite Size http://www.bbc.co.uk/bitesize/ks2/science/materials/rocks_soils/play/ rocks and soils
• National Geographic photo gallery http://science.nationalgeographic.com/science/photos/weathering-erosion-gallery/ examples of weathering, erosion and deposition
• What's the difference between weathering and erosion? http://www.nature.nps.gov/geology/usgsnps/misc/gweaero.html
• Understanding Ohio's glacial history and the different glacial periods will help middle school students prepare for understanding the geologic history of Ohio. This website includes a discussion of specific resultant landforms that can be seen today. Showing photographs of the landforms and connecting them to maps, drawings or historical stories connects to the real world. Taking a field trip to view a landform in person can be a culminating experience http://www.ohiohistorycentral.org/w/Shaping_the_Land?rec=1288
• http://www.dnr.state.oh.us/Portals/10/pdf/OH_SurfaceRocks_Sediments.pdf

Discovery Ed: www.discoveryeducation.com
•discoveryeducation
http://www.discoveryeducation.com/videos/dsc/externalApplications/virtual_l abs-es/Erosion/index.html virtual lab compare plant, bare soil and trenches with different amount of H2O and slope; great for discussion on experimental design, keeping variable constant, data collection, creating conclusions and giving suggestions franklin county soil and water soil presentations and stream table.
• http://app.discoveryeducation.com/player/?assetGuid=1b53a34d-14c6-465f-a35b-05ab8ed82b5b&fromMyDe=0&isPrinterFriendly=0&provider=&isLessonFromHealth=0&productcode=US&isAssigned=false&includeHeader=YES&homeworkGuid videos about types of weathering and erosion
• http://school.discoveryeducation.com/schooladventures/soil/soil_safari.html Soil safari Student learn about soil properties
• http://app.discoveryeducation.com/player/?assetGuid=befc301d-3e16-4f6e-ae82-0ad27ef7134&fromMyDe=0&isPrinterFriendly=0&provider=&isLessonFromHealth=0&productcode=DSCE&isAssigned=false&includeHeader=YES&homeworkGuid erosion video
Literature:

• Gifford, Clive. *Weathering and Erosion*; Smart Apple Media A+ (2006); ISBN-10: 1583407316
• Koonz, Robin. *Erosion: Changing Earth's Surface (Amazing Science (Picture Window));* Picture Window Books (September 1, 2006); ISBN-10: 1404822011

Movies/Videos:

• Super hero movie of weathering and erosion
• Land surface changes fast- [http://k12videos.mit.edu/content/fast-and-slow-changes-to-earths-surface](http://k12videos.mit.edu/content/fast-and-slow-changes-to-earths-surface)
• Bill Nye video- fun- informative, but only refers to erosion even though it explains weathering also. Wonderful visuals and models
Engage-Erosion- Teacher page

Show students images of erosion. The images are from Discovery Education.

http://app.discoveryeducation.com/search?Ntt=erosion&N=4294939057

There are others to choose from if you would like.

Choose a few images to show and have students verbally describe how the land is formed. Ask them how they think the land got like that. Allow them to be creative in their answers. The idea is to get them thinking.

Pick 3 more of the pictures for the students to respond to on their own. Have them draw a quick picture of what they see and ask them to write what they think caused the land to be formed like that. Have students share their answers. Ask students if they can think of places around their neighborhood that show similar land formations. Have them respond in writing.

Come back to these pictures during the explain part and let students know the force that acted on them. You can post copies of pictures around the room to refer to during the lesson.

<table>
<thead>
<tr>
<th>Image 1</th>
<th>Image 2</th>
<th>Image 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="Gully created by flowing water" /></td>
<td><img src="image2.jpg" alt="Earthquake" /></td>
<td><img src="image3.jpg" alt="Soil under fence weathered and eroded away by water and gravity" /></td>
</tr>
<tr>
<td><img src="image4.jpg" alt="Eroded soil carried by wind." /></td>
<td><img src="image5.jpg" alt="Beach house- land has eroded away by water moving along the river." /></td>
<td><img src="image6.jpg" alt="This is the repeated deposits of ash from a nearby volcano." /></td>
</tr>
<tr>
<td><img src="image7.jpg" alt="Grooves created by glacier with rocks on the bottom wearing away the rock." /></td>
<td><img src="image8.jpg" alt="Groove created by glacier with deposits of rock and soil from glacier." /></td>
<td><img src="image9.jpg" alt="This land was first made by deposits of lava from a volcano, but then worn away by wind and water." /></td>
</tr>
</tbody>
</table>
Engage-Erosion

Name ____________________________________________ Date __________

What happened to the land?

Look at the pictures and think about how the land became like that. Draw a picture of the land or write a description and write your ideas about how the land became that way.

<table>
<thead>
<tr>
<th>Picture/description</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Write about a similar example of land erosion that you have noticed around your neighborhood.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Explore-Erosion lab teacher page

Students will complete several labs that are models to represent different types of weathering, erosion, or earthquake. Divide students into groups of 3 or 4. Spend one day on each lab. Have students share their observations and ideas about what it means in nature. Make adjustments as needed to deal with supply issues.

<table>
<thead>
<tr>
<th>Chemical weathering model</th>
<th>Physical weathering model</th>
<th>Wind/water erosion model</th>
<th>Earthquake model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two pieces of chalk</td>
<td>2 like containers with lids</td>
<td>2 tubs or aluminum pans</td>
<td>2 index cards</td>
</tr>
<tr>
<td>Two cups Vinegar</td>
<td>Ten sugar cubes Gravel.</td>
<td>Ten sugar cubes</td>
<td>Clay</td>
</tr>
<tr>
<td>Water</td>
<td>(Aquarium rock)</td>
<td>(Aquarium rock)</td>
<td>/per group</td>
</tr>
<tr>
<td>/per group</td>
<td>/per group</td>
<td>/per group</td>
<td></td>
</tr>
<tr>
<td>Goggles for each student</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Place piece of chalk in each cup. In one cup add ¼ cup of vinegar. To the other cup add ¼ cup of water.

Observe the differences, record.

Place 5 sugar cubes in each container. Add gravel to one container. Attach lids. Shake both containers same degree of harshness, speed, and time.

Observe the differences, record.

1. Wear goggles!
2. Place one tub inside other at a 90° angle so it makes an "L"
3. Dump container of sand in middle of inside tub.
4. Blow on pile of sand towards the upright tub so it catches any moving sand.
5. Record results.
6. Pile sand back up. Slowly pour water on top of sand. Record results.
7. Repeat 6, but pour water quickly. Record results.

You will be using similar materials later in the lesson. Decide how you will want students to clean up.

1. place index cards side by side on table.
2. Flatten clay and lay it over both index cards.
3. Press fingers onto outer edges of clay on each card. This will hold the clay(land) in place on its card (plate) beneath.
4. Holding the clay in place, move cards away from each other. Observe and record what happens to the clay. (land)
5. Repeat steps 1-4 Move cards toward each other. Observe and record.
6. Repeat steps 1-4 Slide cards back and forth along each other. Observe and record.
Expected results and possible answer to questions.

<table>
<thead>
<tr>
<th>Chemical weathering</th>
<th>Physical weathering</th>
<th>Wind/water erosion</th>
<th>Earthquake</th>
</tr>
</thead>
<tbody>
<tr>
<td>The vinegar will wear the chalk down faster. This will be most obvious if the children hold the chalk end to end so they can see the diameter of the chalk in vinegar is smaller. Students may realize that the acid rain will wear down rock. Students haven't had the explain part yet so allow students to be creative in their explanations or ideas of how this applies to nature.</td>
<td>The sugar cubes with the rocks should break down into smaller pieces faster than the sugar cubes by themselves. Students may think that different rocks break down faster than others or that rocks in wind or water may break down rock faster than wind or water alone.</td>
<td>Students should record that the sand will be carried to another place by the &quot;wind&quot; and by the moving water. They may notice that the faster moving water carries the most sand. They may also notice that the sand is deposited in another place.</td>
<td>1. The clay should be torn apart. 2. The clay should rise up in the middle. 3. The clay should be somewhat distorted depending on how much the cards were slid. Students might think that this could cause holes or valleys or hills or mountains.</td>
</tr>
</tbody>
</table>

Remember, students have still not done the research. They haven't read the chapter, you have not defined the vocabulary. They are not yet expected to know all the answers or correct terms. "They are discovering" the processes.
### Explore-Land Change Lab 1

**Name** ________________________  **Date** ______________

<table>
<thead>
<tr>
<th><strong>Materials</strong></th>
<th><strong>Directions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Two pieces of chalk</td>
<td>Gather all materials.</td>
</tr>
<tr>
<td>Two cups</td>
<td>Place a piece of chalk in each cup.</td>
</tr>
<tr>
<td>¼ cup Vinegar</td>
<td>In one cup add the vinegar.</td>
</tr>
<tr>
<td>¼ cup Water</td>
<td>To the other cup add the water.</td>
</tr>
<tr>
<td>Goggles</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Draw a picture of the chalk in the vinegar.</strong></th>
<th><strong>Describe what happened to the chalk in the vinegar.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Draw a picture of the chalk in the water.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Describe what happened to the chalk in the water.</strong></td>
</tr>
</tbody>
</table>

Describe the differences between the two pieces of chalk.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

If the vinegar represents acid rain, predict what the rain would do to rocks?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Explore - Land Change Lab 2

Name ________________________________________________ Date ______________

Materials
- 2 like containers with lids
- Ten sugar cubes
- Gravel or small rocks (Aquarium rock can be used instead of gravel.)

Directions
- Place 5 sugar cubes in each container.
- Add gravel to one container.
- Attach lids.
- Shake both containers in the same way for the same amount of time.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Directions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 like containers with lids</td>
<td>Place 5 sugar cubes in each container.</td>
</tr>
<tr>
<td>Ten sugar cubes</td>
<td>Add gravel to one container.</td>
</tr>
<tr>
<td>Gravel or small rocks (Aquarium</td>
<td>Attach lids.</td>
</tr>
<tr>
<td>rock can be used instead of</td>
<td>Shake both containers in the same way for the</td>
</tr>
<tr>
<td>gravel.)</td>
<td>same amount of time.</td>
</tr>
</tbody>
</table>

Draw a picture of the sugar cubes that were by themselves after you shook them up.

Describe the differences between what happened to the sugar cubes with the rocks and the sugar cubes without the rocks.

____________________________________________________________
____________________________________________________________
____________________________________________________________

Did the rocks change at all? Explain.

____________________________________________________________
____________________________________________________________

If the sugar cubes represent a type of rock, what does this teach you about different rocks?

____________________________________________________________
____________________________________________________________
Explore - Land Change Lab 3

Name __________________________________________ Date ______________

Materials
2 tubs or aluminum pans
2 separate cups water
Quart size container full of dry sand
Goggles

Directions

1. Wear goggles!
2. Place one tub inside other at a 90° angle so it makes an "L"
3. Dump container of sand in middle of inside tub.
4. Blow on pile of sand towards the upright tub so it catches any moving sand.
5. Observe and record results.

Directions

1. Wear goggles!
2. If your tub has a hole, use other tub to catch water.
3. Pile sand back up.
4. Slowly pour 1 cup of water on top of sand.
5. Observe and record.

Directions

1. Wear goggles!
2. If your tub has a hole, use other tub to catch water.
3. Pile sand back up. (leave water in tub for now.)
4. Quickly pour one cup of water on top of sand.
5. Observe and record.

Follow your teacher's directions to clean up.

How can you compare this model to what happens in nature?

_________________________________________________________________

_________________________________________________________________
### Materials
- 2 index cards
- Clay

### Directions

<table>
<thead>
<tr>
<th></th>
<th>Record your observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Place index cards side by side on table.</td>
<td></td>
</tr>
<tr>
<td>2. Flatten clay and lay it over both index cards.</td>
<td></td>
</tr>
<tr>
<td>3. Press fingers onto outer edges of each card (on top of the clay) holding clay in place.</td>
<td></td>
</tr>
<tr>
<td>4. While pressing clay slide cards back and forth along each other.</td>
<td></td>
</tr>
<tr>
<td>5. Observe and record what happens to the clay.</td>
<td></td>
</tr>
</tbody>
</table>

### Record your observations

1. Place index cards side by side on table.
2. Flatten clay and lay it over both index cards.
3. Press fingers onto other edges of each card (on top of the clay) holding clay in place.
4. While pressing clay, move cards away from each other.
5. Observe and record what happens to the clay.

Large plates move under the Earth's surface and cause big changes to the Earth. How can you compare this model to what happens in nature?
Explain-Erosion Movie Note Guide

Name ___________________________________________ Date ____________

1. Weathering is... ____________________________________________
   ___________________________________________________________________

2. Weathering is caused by... ________________________________________
   ___________________________________________________________________

3. Erosion is... ________________________________________
   ___________________________________________________________________

4. Erosion is caused by... ________________________________________
   ___________________________________________________________________

5. Mass wasting is... ________________________________________
   ___________________________________________________________________

6. Land changes by weathering and erosion are usually slow. What are examples of
   things that cause very fast land changes? ___________________________________________________________________
   ___________________________________________________________________

7. Is erosion a good thing or a bad thing? Explain your opinion.
   ___________________________________________________________________
   ___________________________________________________________________
The movie is from Discovery Ed.

Pass out the guide sheet for students to take notes as they watch the movie. Watch the movie. The teacher guide and black line masters may be helpful in adding to your understanding or providing alternative work. Click on the links to access movie, teacher guide, and black line masters. After the movie review the answers and make sure students have correct definitions.

Answers to the exit ticket.

1. Weathering is the breaking down of rock.
2. It can be caused by physical or chemical forces. Physical examples would be water, wind, freezing and thawing of ice, plants, and burrowing animals. Chemical examples would be acid rain, oxidation of iron into rust, lichen releasing acid onto rocks and carbonic acid from water and carbon dioxide. (Answers will vary in complexity, but must include the breaking down of rock.)
3. Erosion is the carrying away of rock. (moving rock to another place)
4. It is caused by water, glaciers, and wind. Students might also write about landslides, or human development.
5. Mass wasting is the moving of a lot of rock, soil, or sand down a hill. It is caused mostly by gravity, but can be encouraged or triggered by weathering or water. Mass wasting includes things like rock slides, landslides, and mud slides.
6. Fast land changes include things like volcanoes, tornados, hurricanes, earthquakes, landslides or other forms of mass wasting.
7. Answers will vary, but may include ideas such as this: good - breaking down the rock is part of making soil so that we can grow plants. Good- it makes beautiful canyons and sand for beaches. Bad- it wears away ground where houses are built or trees are growing.
As you have your students complete these reading assignments, use whatever strategies you have been practicing during reading lessons. Feel free to revise the graphic organizers/assessment to suit your needs. **This information will be important for students for the next unit on landforms.**

First two days:
Have students read the text book and complete the reading guide sheet. 4th grade Science text book: Chapter 2/Lesson 1-page 72-76

Second two days:
Have students read the text book and complete the reading guide sheet. 4th grade Science text book

Students can also read about glacial grooves and Shore line Erosion.

Students who finish early can revisit pictures from engage activity and identify with accurate terms what caused the land formations. They can also do an internet search for information about the glacial grooves or Lake Erie erosion.
Read page 72-76 and complete the Venn Diagrams:

- Mountain
- Valley
- Delta
- Hill
- Canyon
- Dune/Hill
Read page 80-86 in the 4th grade *Science* text book and complete the cause and effect chart.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two land plates pushing together</td>
<td>Mountains are formed</td>
</tr>
<tr>
<td>Earthquakes</td>
<td>Large cracks in the earth's surface.</td>
</tr>
<tr>
<td>Water flows through rivers</td>
<td>Cuts into soil and rocks and Creates valleys</td>
</tr>
<tr>
<td>Wind blowing sand</td>
<td>Makes pits in rocks and deposits sand to make dunes in other places</td>
</tr>
</tbody>
</table>
Read page 80-86 in the 4th grade *Science* text book and complete the cause and effect chart.

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<td>Makes pits in rocks and deposits sand to make dunes in other places</td>
</tr>
</tbody>
</table>
Show this video to your students. **Ohio geology video**  [http://www.youtube.com/watch?v=RhvEPGO-yQY](http://www.youtube.com/watch?v=RhvEPGO-yQY)

You may want to watch the video yourself first. The narrator talks pretty fast and without a break. All by itself as a learning tool it may be beyond the ability of most 4th graders, but it has beautiful images of Ohio that some of our students may recognize or become excited to visit. It provides multiple examples of how glaciers and the fact that much of Ohio was covered with by a sea many years ago affected the landscape Ohio has today. This movie will help all of these ideas sink in and become real to students. It also provides examples of erosion and some rocks wearing away faster than others. This movie will help students connect the ideas of this unit with the upcoming unit about landforms as well as previous life science units about changing ecosystems and fossils.

Show it and ask students to take notes or show you in some other way that they are connecting what they are seeing to what they are learning.

Use the worksheet supplied or consider another way to check for student understanding. One example might be to have students make cards that they can hold up as they watch the movie to represent glaciers, erosion, deposits, mass wasting, etc… to explain what forces caused the land formation.

**Answers to questions:**

How was the Black Hand sandstone formed? The Black Hand sandstone was created by sediment *deposited* from rivers that flowed into the great sea covering most of Ohio and settled to the bottom over millions of years.

How are things such as outcroppings and arches or rock bridges made? The water *eroding* the rock was able to erode the softer rock faster which made such things as the outcroppings and rock bridges.

What are some examples of land formations created with the help of glaciers? *Glaciers* helped form prairies, bogs, marshes, Cedar Bog, eskers, kettles, Lake Erie.

Why are so many of Ohio fossils of marine life? Many of Ohio's fossils are of marine life because most of Ohio was once under a giant sea and fossils are often formed in the sediment that is *deposited* into and then settles on the bottom of a body of water.
1. How was the Black Hand sandstone formed?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

2. How are things such as outcroppings and arches or rock bridges made?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

3. What are some examples of land formations created with the help of glaciers?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

4. Why are so many of Ohio fossils of marine life?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
Reserve computer lab or laptop cart for your students for four days.

Use this lab simulation from Discovery ED. [Link] Make sure you preview the lab first so that you are familiar with how it will work for your students.

4 days have been set aside for this virtual lab. This is to allow time to introduce the lab, conduct level 1 and discuss the results then conduct level 2 and discuss the results. You will need to decide how you want to do this based on the abilities of your students.

The directions are a lot easier to understand if you are looking at the virtual lab on the website.

Have students work with a partner so they can support each other in their work.

**Read the directions to the students. The computer reader does not operate normally.**

You may want to demonstrate to students how to fill in the lab sheets and conduct the lab before allowing them to work on their own. Or you may want to do level one step by step together.

Level one is set up to be strongly guided so that students can complete level two with more independence. Some of the questions they will answer in level 2 are filled in for them in lesson 1 so they can see what kind of answer is expected.

The variables that you can change in level 1 experiment include the following:

* soil treatment - which is digging trenches or planting plants,
* the amount of water flow - of course in real life one does not get to choose the amount of rain that falls.
* Incline - it would be hard work to change the incline of a hill side in real life, but it could be done.

For this part, the variable is chosen. For each trial of the test, the variable will change. The group needs to decide how the other possible variables will stay the same (or controlled) for all 3 trials of the test.

**EXAMPLE of how level 1 plan sheet will be answered.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st variable: soil treatment</td>
<td>the water will be <strong>LOW</strong> the incline will be <strong>STEEP</strong></td>
</tr>
<tr>
<td>2nd variable: water</td>
<td>the soil treatment will be <strong>PLANTS</strong> the incline will be <strong>LOW</strong></td>
</tr>
<tr>
<td>3rd variable: incline</td>
<td>the soil treatment will be <strong>PLANTS</strong> the water will be <strong>MEDIUM</strong></td>
</tr>
</tbody>
</table>

Think of the **test** as going through all three possibilities of one variable while keeping the other variables the same. The **trial** is each time you click on "**go**" after setting up one set of variables.
After students plan the variables they will use for the experiment, allow them to begin the experiment. Notice that all students will not be doing the exact same tests because they will be choosing different variables.

Charts with results are included at the end of the lab. Students should have the same results, but the charts will likely be in a different order since different variable will have been chosen.

On the virtual lab website, make sure that students notice the hill side and the table for the experiment and how they change depending on the variables chosen.

**The charts with results are included at the end of the lesson.**

**The least amount of soil will erode when:**

- The soil is treated with plants
- The water flow is low. The incline is low.
- The soil is a silt and sand mixture.

The most amount of soil will erode when:

- The soil is not treated at all. The water flow is high. The incline is steep. The soil is sand.

Students observations about trends and recommendations to slow down erosion will vary based on the variables that they chose, but they should find and recommend the variables that lead to the least amount of erosion.

Answers for level 2 will vary, but should resemble the answers from level 1 worksheets.
All that rain we had this summer has washed a lot of the hillside at the local park down into the stream. It left behind a big hole. We don't want to lose the rest of the hillside and we need to figure out what to use to fill in the hole. We are going to do a bunch of virtual experiments to help solve this problem. In Level 1, you will conduct a few tests to figure out which combinations of situations will lead to the least erosion. In Level 2, you will conduct a few tests to figure out which type of soil will fill the hole and allow the least amount of erosion.

Go to the [website](http://www.unitedstreaming.com/videos/dsc/externalApplications/virtual_labs-es/Erosion/index.html) and read the introduction and directions. Plan your experiment below.

**Topic of the Lab:** Decreasing soil erosion

**Testable question:** How much soil will erode if I change the conditions?

Variables (Things that can change.)

- Soil treatment
- Water flow
- Incline

**Fill in the blanks.**

1\textsuperscript{st} Variable: soil treatment the water will be _________ the incline will be __________

2\textsuperscript{nd} variable: water the soil treatment will be _________ the incline will be ________

3\textsuperscript{rd} variable: incline the soil treatment will be _________ the water will be __________

These will be fair tests, because I will only be changing one variable at a time so if the results are different I can conclude that the difference is due to the variable that was changed.

**Hypothesis:** (What I think will happen.) (circle one and cross out the other two.)

*If I dig trenches / plant plants / do nothing_______ to change the soil condition then less soil will be eroded.*

Here Today, Gone Tomorrow Virtual Lab level 1

Now that you have planned your experiment, you are ready to begin.
Use the variables you chose on your planning sheet and make your changes to the lab on the website by clicking on the arrows. Remember to also set the 2 variables that you will not be changing by clicking on the arrows and choosing the correct variable. Record the variables on the chart for each trial before you run the test.

Click on go. Record the results. Run another trial by changing the next variable.

<table>
<thead>
<tr>
<th>Test</th>
<th>Soil Treatment (nothing plants, trenches)</th>
<th>Amount of Water (low, medium, high)</th>
<th>Incline (low, medium, high)</th>
<th>Containers of Eroded Soil (L) Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Should be the same for the next 3 trials.</td>
<td>Should be the same for the next 3 trials.</td>
<td></td>
</tr>
<tr>
<td>2</td>
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<td></td>
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<tr>
<td>3</td>
<td></td>
<td>Should be the same for the next 3 trials.</td>
<td>Should be the same for the next 3 trials.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Should be the same for the next 3 trials.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>Should be the same for the next 3 trials.</td>
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<tr>
<td>6</td>
<td>Should be the same for the next 3 trials.</td>
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<tr>
<td>7</td>
<td>Should be the same for the next 3 trials.</td>
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<tr>
<td>8</td>
<td>Should be the same for the next 3 trials.</td>
<td></td>
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</tr>
<tr>
<td>9</td>
<td>Should be the same for the next 3 trials.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analyzing Your Data

Which situation had the least soil lost?
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

Which situation had the most soil lost?
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

What else did you notice about the variables and erosion?
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

Based on your research, what do you recommend the park to do to slow down erosion?
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

Lesson based on: Discovery Education Science Connection © 2007 Discovery Communications, LLC
Here Today, Gone Tomorrow Virtual Lab Level 2

Name ____________________________ Date ______________

Topic of the Lab:
________________________________________________________

Variables (What conditions can I change in this lab?):
________________________________________________________
________________________________________________________

Testable question:
_____________________________________________________________________________
_____________________________________________________________________________

List the variable you will change as well as the situation for the variables that will not change in the trials.

1st variable:

2nd variable:

3rd variable:

4th variable:

This a fair test because
__________________________________________________________________________
__________________________________________________________________________

Hypothesis (What I think will happen based on choices of variables.)
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
Here Today, Gone Tomorrow Virtual Lab level 2

<table>
<thead>
<tr>
<th>Test</th>
<th>Soil Treatment</th>
<th>Amount of Water</th>
<th>Incline</th>
<th>Soil Type</th>
<th>Containers of Eroded Soil (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(nothing plants, trenches)</td>
<td>(low, medium, high)</td>
<td>(low, medium, high)</td>
<td>(sand, silt, sand/ silt mix)</td>
<td></td>
</tr>
</tbody>
</table>

Remember, only one variable should change for the next 3 trials.

1

2

3

Remember, only one variable should change for the next 3 trials.

4

5

6

Remember, only one variable should change for the next 3 trials.

7

8

9

Remember, only one variable should change for the next 3 trials.

10

11

12
Analyzing Your Data

Which situation had the least soil lost?

_____________________________________________________________________________

_____________________________________________________________________________

Which situation had the most soil lost?

_____________________________________________________________________________

_____________________________________________________________________________

What else did you notice about the variables and erosion?

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

Based on your research, what type of soil do you recommend the park use to slow down erosion?

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

Lesson based on: Discovery Education Science Connection © 2007 Discovery Communications, LLC
These are all the possible answers however student’s data tables may look different depending on the questions they ask.

**Lesson 1**

<table>
<thead>
<tr>
<th>Test</th>
<th>Soil Treatment</th>
<th>Amount of Water</th>
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<th>Containers of Eroded Soil</th>
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</thead>
<tbody>
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<td>low</td>
<td>4L2</td>
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<tr>
<td></td>
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<td>medium</td>
<td>5L3</td>
</tr>
<tr>
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<td>steep</td>
<td>6L</td>
</tr>
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<td>6L</td>
</tr>
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LESSON 2

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<th>Containers of Eroded Soil</th>
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Erosion and Weathering Background Information

**Weathering** - is the breakdown of large rock into smaller pieces of rock. It is a group of processes that change rock at or near Earth’s surface.

- Rocks change shape, size and/or form due to water or ice movement, freeze or thaw, wind, plant growth, gases in the air, pollution and catastrophic events such as earthquakes, mass wasting, flooding and volcanic activity.
- Different types of rock weather at different rates due to the specific characteristics of the rock.
- Some rocks break down over a long period of time and some break down quickly.
- Exposure to weathering factors (e.g., freezing/thawing, wind, water) affects the breaking down of rocks.
- Weathering is a "destructive" (tearing down) process.

**Erosion** - a process that transports rocks, soil or sediment to a different location. Erosion is what carries the weathered material to a new location.

- Water, wind and ice physically remove and carry (erosion) rock, soil and sediment and deposit the material in a new location.
- Erosion is a "destructive" (tearing down) process.
- Erosion directly contributes to landforms and landform features formations.
Erosion and Weathering Background Information

**Deposition** - Broken down rock, soil and sediment that is moved by wind, water and ice and dropped (deposited) in a new location.

- Deposition is a “constructive” (building up) process
- Deposition directly contributes to landforms and landform features formation

**Gravity** - Gravity affects movement of water, rock and soil. **Mass wasting** - a catastrophic event of downhill movement of soil and rock fragments due to gravity. This includes mudslide, avalanche and landslides.
Erosion and Weathering Background Information

Shaping the Land
During the past two million years, glaciers have shaped and reshaped the surface of Ohio several times. These continental masses of ice affected as much as two-thirds of the state. Moving from the north and northwest, glaciers have scraped and flattened the landscape. Often more than a mile thick, they smoothed existing hills and filled valleys with enormous amounts of rocks, gravel, and smaller particles.

Through these actions, glaciers have had a very important impact on the agriculture of Ohio. Their activity has been felt in two noticeable ways: shaping the ground upon which people work and build, and forming the soils that cover that ground.

The Glaciers

Continental glaciers are masses of ice, formed from compacted snow, that move across a land surface. One of the most dramatic remains of glaciers in Ohio can be seen at the Glacial Grooves State Memorial on Kelleys Island in Lake Erie. Rocks and gravel embedded in the glacial ice ground away rock leaving scratches and grooves in the bedrock.

Ohio's Terrain

The part of Ohio that was covered by glaciers includes about two-thirds of the northern and western parts of the state. Most of southeastern Ohio was not covered by glaciers. In glaciated Ohio, the surface of the land usually is fairly level or gently rolling. On the other hand, steep ridges, hills and shaded valleys, characterize unglaciated Ohio. One author has estimated that a 200-acre farm in unglaciated Ohio may have as little as 12 acres of land that a tractor can plow and work.

Information from: [http://www.ohiohistorycentral.org/w/Shaping_the_Land?rec=1288](http://www.ohiohistorycentral.org/w/Shaping_the_Land?rec=1288)
The Muck Stops Here! - Elaboration Activity

Imagine spending your whole life planning, working and finally buying your dream home along a river bank. You enjoy the sights, sounds and large amounts of wildlife as you relax in your backyard. Lately, there have been many strong storms and flooding in your area. The water rushes ferociously down the river. You observe the water which has risen and is quite muddy in appearance. You begin to think about your understanding of erosion and weathering and worry about the fact that land in your back yard is disappearing. Below is a picture of your back yard. What will you do to protect your dream home?

You decide that knowledge is power! You realize that you must investigate methods that others have used to stop this erosion from occurring and save your backyard and your house. In your research you come across pictures of houses that could be yours one day if the erosion continues and become even more determined to do something to stop this.
The Muck Stops Here! - Elaboration Activity
You are excited to find out that there are successful before and after examples of land that has been saved by erosion control methods.

http://www.hamiltoncountyexpress.com/News/02282013_CaveBanks

britishamericanauto.com

cooswatershed.org

mda.state.mn.us
The Muck Stops Here! - Elaboration Activity

Realizing there is hope, you decide to learn about the different erosion control methods. Streams change as they mature. And streams, like the plants and animals that live near them, must adjust to the changes in the landscape around them. Many landowners lose valuable streamside property to erosion. Fortunately there are many ways to solve streambank erosion problems. The following are just some of the ways of preventing erosion along a streambank.

**Tree Revetment:** Trees are laid horizontally along the toe of the bank, tops pointing downstream and are secured to the bank and to each other with duck bills and wire cable. They slow the flow of the water and catch sediment and the bank as it falls in. Bushes and trees are also planted to help stabilize the area.

![Tree Revetment](image1.jpg)

**Gabion baskets** are placed on the outside of the river bend to prevent river bank erosion during floods. Gabion baskets are wire mesh containers made from double twisted, hexagonal woven wire mesh. Once assembled, the baskets are filled on site with durable stone in order to create flexible, permeable, monolithic structures.

![Gabion baskets](image2.jpg)

**Erosion control fabric** will prevent sediment runoff and provide streambank erosion control. During a revegetation project of an eroded streambank, the commercially-available fabrics will allow vegetation to grown into the fabric and seed to be placed underneath the fabric.

![Erosion control fabric](image3.jpg)

**Biologs** are made from natural material rolled into structures resembling tree trunks or logs. Biologs can contribute to the protection of the streambank toe or grade by trapping sediment and erosive currents and providing riparian vegetation that may be planted into biolog.

![Biologs](image4.jpg)
The Muck Stops Here! - Elaboration Activity

**Live staking** is used to reestablish streambank vegetation and help stabilize selected slope areas. This form of soil bioengineering involves the planting of live cuttings from shrubs or trees along the streambank and is also known as woody cuttings, posts, poles or stubs. As cuttings develop, they protect streambanks from erosion.

[Link to Streambank Stabilization Management Measures](http://www.srnr.arizona.edu/nemo/BMPdocs/StreambankStabilizationManagementMeasures.pdf)

**Riprap** consists of a layer of angular stone designed to protect and stabilize areas subject to erosion, slopes subject to seepage, or areas with poor soil structure. Riprap is used on streambanks where stream velocities are too great to successfully establish vegetative cover, on channel bottoms and slopes, stormwater structure inlets and outlets, slope drains, and shorelines. Stones should be of sufficient size to resist washing downstream. Larger rock should be placed at the bank bottom below the baseflow elevation.

[Link to Streambank Stabilization Management Measures](http://www.srnr.arizona.edu/nemo/BMPdocs/StreambankStabilizationManagementMeasures.pdf)

**A sediment barrier** consists of a permeable barrier designed to stop the sheet flow of stormwater runoff from disturbed soil along a slope. This barrier contributes to settling some suspended solids from the detained water above the structure while allowing slow passage of the water through a filtering material. Typical sediment barriers used for streambank protection are silt fences, brush, hay, straw bales, filter berm, and dikes.

[Link to Streambank Stabilization Management Measures](http://www.srnr.arizona.edu/nemo/BMPdocs/StreambankStabilizationManagementMeasures.pdf)

**Vegetation** is probably the most commonly used tool for streambank protection. Vegetation has the advantage of being self-propagating and self-repairing. Emergent vegetation provides two levels of protection. First, the root system helps to hold the bank soil together and increase overall bank stability by forming an interweaving network. Second, the stalks, stems, branches and foliage provide resistance to streamflow. Vegetative cover above the waterline protects the banks from rainfall, runoff, and trampling forces.

[Link to Streambank Stabilization Management Measures](http://www.srnr.arizona.edu/nemo/BMPdocs/StreambankStabilizationManagementMeasures.pdf)
The Muck Stops Here! - Elaboration Activity

Now that you have some knowledge and understanding of options to slow the erosion of your land, it is decision-making time. Based upon the information, your team will be designing and constructing a model of two of the specific sediment-control measures. You will evaluate and test the two using different types of materials and present your findings to the class.

1. What factors do you think go into making a decision about which sediment-control method to use?

2. Narrow your decision down to two sediment control measures that you will design, test and compare. Which two measures will you test?
   a. 
   b. 

3. Sediment Control Measure a: What materials will your team use to simulate this model?

4. Sediment Control Measure b: What materials will your team use to simulate this model?

It's testing time. Your team will have two foil pans.