



Earth’s Processes

Fourth Grade

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Standards

NVACS – Science Standards

* 4-ESS-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
* 4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
* 4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Engineering:

* 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
* 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
* 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

ELA:

* 4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
* W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.
* 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
* W.4.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
* RI.4.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
* RI.4.7: Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
* SL.4.2: Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
* SL.4.5: Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

Materials

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** | **Qty.** |  | **Item** | **Qty.** |
| Computer | 1 |  | BrainPOP/ BrainPOP jr. Logins | |
| Individual white boards | Class set (30) |  | White board markers | Class set (30) |
| Pencils | Class set (30) |  | Science notebooks | Class set (30) |
| Crayons | Class set (30) |  | Dental floss | 6 boxes |
| Sandwich bags | 1 box |  | Food coloring (red, green, orange, brown, yellow, blue) | 3 boxes |
| Flour | 5 lbs. |  | Salt | 4 containers |
| Cream of tartar | 5 containers |  | Vegetable oil | 3 bottles |
| Large pot | 1 |  | Access to stove | 1 |
| Play-Doh (red, green, orange, brown, yellow, blue) | 5 containers of each |  | Paper cups | Class set (30) |
| Popsicle sticks | 2 containers |  | Shells | Class set (30) |
| Newspaper | 4 |  | Spoons | Class set (30) |
| Pictures of fossils | 1 set |  | Gummy bears | 5 bags |
| Fruit straws | 5 packages |  | Wheat bread | 1 loaf |
| White bread | 1 loaf |  | Books (access) | 10 |
| Paper towels | 5 rolls |  | Large blue construction paper (12” by 18”) | 1 ream |
| Continent printouts | Class set (30) |  | Glue | Class set (30) |
| Scissors | Class set (30) |  | Landform flipbook template | Class set (30) |
| Stapler (teacher access) | 1 |  | Staples (teacher access) | 1 box |
| Paper | 1 ream |  | Chocolate chip cookies | 5 packages |
| Soak-resistant paper plates | 3 packages |  | Q-tips | 1 package |
| Toothpicks | 1 package |  | Timer | 1 |
| Goggles | Class set (30) |  | Pie pans | Class set (30) |
| Plastic cups | Class set (30) |  | Plastic spoons | Class set (30) |
| Dry measuring cups | 6 |  | Rulers | Class set (30) |
| Permanent markers | Class set (30) |  | Shells | Class set (30) |
| Gravel | 5 lbs. |  | Dirt | 5 lbs. |
| Trays | 6 |  | Spray bottles | 6 |
| Shoe boxes | Class set (30) |  | Straws | Class set (30) |
| Hair dryer (access) | 1 |  | Soil | 5 lb. bag |
| Funnels | Class set (30) |  | Clear plastic bottles | 2 class sets (60) |
| Trays | 6 |  | Vinegar | 3 bottles |
| Dish soap | 3 bottles |  | Baking soda | 5 boxes |
| Strips of cloth | 2 class sets (60) |  | Plastic toy houses | 50 |
| Plastic tablecloths | 6 |  | Dead leaves or rocks | 5 lbs. |
| 2 liter bottles | 3 |  | Plants | 6 |
| A knife (access for teacher) | 1 |  | Pitcher | 1 |
| Long, shallow, clear Tupperware | 6 |  | Sand | 5 lbs. |
| Aquarium gravel | 5 lbs. |  | Popsicle sticks | 1 large box |
| Buckets | 6 |  | Thick rubber bands | 1 bag |
| Tennis balls | 16 |  | Large binder clips | 16 |
| Paint stirrer | 8 |  | Masking tape | 3 rolls |
| Coffee stirrers | 5 boxes |  | Modeling clay | 5 lbs. |
| Marshmallows | 5 bags |  | Manila file folders | 16 |

Books with myON links (if available)

Soil, Silt, and Sand: Layers of the Underground by Jody Sullivan Rake,<https://www.myon.com/reader/index.html?a=us_sss_f15>

Rock On! Fossils by Chris Oxlade, <https://www.myon.com/reader/index.html?a=ro_fossi_s16>

Fossils (Let’s Rock) by Richard Spilsbury,<https://www.myon.com/reader/index.html?a=lrck_fssls_s11>

Continents: What You Need to Know by Jill Sherman,<https://www.myon.com/reader/index.html?a=ff_cntns_f17>

U.S. Landforms: What You Need to Know by Linda Crotta Brennan,<https://www.myon.com/reader/index.html?a=ff_uslnd_f17>

Erosion: Changing Earth’s Surface by Robin Koontz,<https://www.myon.com/reader/index.html?a=as_erosi_f06>

Landform Adventures: Canyon Hunters by Anita Ganeri,<https://www.myon.com/reader/index.html?a=lfadv_canyonhu_f11>

Glaciers by Mari Schuh,<https://www.myon.com/reader/index.html?a=nw_glacier_f10>

Rock on! Soil by Chris Oxlade,<https://www.myon.com/reader/index.html?a=ro_soil_s16>

Volcano! by Renee Gray-Wilburn <https://www.myon.com/reader/index.html?a=btr_volcano_f13>

Earthquakes! by Renee Gray-Wilburn,<https://www.myon.com/reader/index.html?a=fgwe_earth_s12>

The World’s Most Amazing Dams by Ann Weil,<https://www.myon.com/reader/index.html?a=ltten_dams_f11>

Can we Protect People from Natural Disasters? By Catherine Chambers,<https://www.myon.com/reader/index.html?a=ed_natds_s15>

Children’s True Stories: Surviving Earthquakes by Michael Burgan,<https://www.myon.com/reader/index.html?a=chtrst_surear_f11>

Children’s True Stories: Surviving Floods by Elizabeth Raum,<https://www.myon.com/reader/index.html?a=chtrst_surfld_f11>

Children’s True Stories: Surviving Hurricanes by Elizabeth Raum,<https://www.myon.com/reader/index.html?a=chtrst_surhur_f11>

Children’s True Stories: Surviving Tornadoes by Elizabeth Raum,<https://www.myon.com/reader/index.html?a=chtrst_surtor_f11>

Children’s True Stories: Surviving Tsunamis by Kevin Cunningham,<https://www.myon.com/reader/index.html?a=chtrst_surtsu_f11>

Vocabulary

|  |  |
| --- | --- |
| **Word** | **Definition** |
| Accumulation | Oceans and other bodies of water collect the water that has fallen |
| Active volcano | A volcano that erupts regularly |
| Archaeologist | A scientist who studies people of the past, what they were like, and how they lived |
| Ash | Very small fragments of lava or rock blasted into the air by volcanic explosions |
| Biologist | A scientist who studies living things |
| Canyon | A deep, steep-walled, V-shaped valley cut by a river through resistant rock |
| Cartographer | A person who makes maps |
| Cave | A natural underground chamber or series of chambers open to the surface |
| Coastal Plain | A flat, low-lying land adjacent to a sea coast |
| Condensation | When water vapor in the air turns from a gas back into a liquid and leaves the atmosphere |
| Continental Drift | The very slow movement of continents on the surface of the Earth |
| Creek | A natural stream of water normally smaller than and often tributary to a river |
| Crust | The outermost layer of the planet |
| Cycle | A set of events or actions that happen again and again in the same order |
| Delta | A piece of land in the shape of a triangle or fan made by deposits of mud and sand at the mouth of a river |
| Density | How close the molecules of a substance are, or how much mass a substance has in a given space |
| Deposition | The dropping off or depositing of eroded rock |
| Dormant volcano | A volcano that has not erupted for many years, although there is still some activity deep inside |
| Earthquake | Shaking, rolling, or sudden shock of the Earth’s surface; the Earth’s natural means of releasing stress |
| Erosion | The action or process of wearing away by the action of water, wind, or glacial ice |
| Evaporation | When a liquid turns into a gas or vapor |
| Extinct Volcano | A volcano that is no longer active |
| Fold Mountains | Mountains that are formed when two plates run into each other or collide; the force causes the Earth’s crust to crumple and fold |
| Geography | The science that deals with Earth’s surface |
| Geographers | Scientists who study geography; including the Earth’s physical features such as mountains, deserts, rivers, lakes, and oceans |
| Geologist | Scientists that study the Earth and what it is made of |
| Geosphere | The solid earth |
| Glacier | A huge mass of ice slowly floating over a land mass, formed from compacted snow |
| Groundwater | Water that collects or flows beneath the Earth’s surface, filling in the porous spaces in soil, sediment, and rocks |
| Hydrologist | Scientists who study the properties, distribution, and circulation of water on and below Earth’s surface and in the atmosphere |
| Inland Plain | Plains found away from the coast |
| Islands | Any land area surrounded entirely by water |
| Lake | Large bodies of water surrounded by land and not part of an ocean |
| Landform | Any natural foundation of rock and dirt found on Earth |
| Lava | Liquid rock that flows outside of a volcano; it glows red hot to white hot as it flows |
| Levee | A bank built along a river to prevent flooding |
| Limnology | The scientific study of bodies of fresh water, such as lakes |
| Magma | Liquid rock inside a volcano |
| Marine Biologist | A scientist who studies things that live in the ocean: from small organisms such as plankton through very large such as whales |
| Mountain | A natural elevation of Earth’s surface rising abruptly from the surrounding level |
| Ocean | A huge body of salt water covering nearly 71% of Earth’s surface |
| Ocean Current | A vast river within the ocean, flowing from one place to another |
| Oceanographers | Scientists who study the ocean |
| Paleontologist | Scientists that study the remains of ancient organisms or living things |
| Peninsula | Land that extends beyond the mainland and has water on three sides |
| Plain | A large area of flat land without trees |
| Precipitation | The liquid and solid water particles that fall from clouds and reach the ground |
| Reservoir | A usually artificial lake used to store a large supply of water for use in people’s homes, businesses, etc. |
| River | A flowing, moving stream of water, usually feeding into an ocean, lake, pond, or even another river |
| Salinity | The salt content of a body of water |
| Sand Dunes | A pile or mound of sand created by the wind and deposition of sand that was eroded from another location |
| Sediment | Material (as stones or sand) deposited by water, wind, or glaciers |
| Sedimentary rock | Formed when sand, mud, and pebbles get laid down in layers; over time, they are turned into rock |
| Slope | An elevated geological formation |
| Source | The origins of a tributary; the place where the water begins its journey towards the ocean or sea, usually on high ground |
| Spelunker | A person who makes a hobby of exploring or studying caves |
| Speleologist | A scientist who studies or explores caves |
| Stalactite | A deposit of calcium carbonate resembling an icicle hanging from the roof or sides of a cavern or cave |
| Stalagmite | The act or result of dripping; a deposit of calcium carbonate like an inverted stalactite formed on the floor of the cave by a drip of water |
| Stream | A small, flowing body of water such as a brook or a creek |
| Topographic map | A type of map which describes the physical features of an area of land |
| Topography | The physical features of an area or land |
| Tributary | A stream or river that flows into and joins a main river |
| Valley | A long depression or ditch in Earth’s surface, usually between ranges of hills or mountains, formed by rivers that erode soil and rocks |
| Volcano | A mountain that opens downward to a pool of molten rock below the surface of the Earth; when pressure builds up, eruptions occur |
| Water Vapor | Water in the form of vapor, or a gas |
| Waterfall | A place in a river where water spills suddenly downward |
| Watershed | Any area of land that water flows across or through, trickling down and flowing toward a common body of water |
| Weathering | The process where rocks are worn away or broken down into smaller pieces by wind, water, or plants |
| Wind | Air in motion; produced by the uneven heating of the Earth’s surface by the sun |
| Windbreak | Something that serves as a shelter from the wind, usually designed to provide shelter from the wind and to protect soil from erosion |

Lesson 1: How is the Earth structured?

|  |  |
| --- | --- |
| **Learning Target**  **Objective**  **Standard** | The Earth is made up of many different layers.  Students will be able to identify and describe the layers of the Earth.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, crayons, dental floss, sandwich bags, food coloring (red, green, orange, brown, yellow, blue), flour, salt, cream of tartar, vegetable oil, water, large pot, stove  (optional: store-bought playdoh: red, green, orange, brown, yellow, blue) |
| **Books** | Soil, Silt, and Sand: Layers of the Underground by Jody Sullivan Rake |
| **Vocabulary** | Core: The inner part of the Earth that is made of iron  Mantle: The layer of super-hot rock that surrounds Earth’s core  Crust: The thin outer layer of Earth’s surface:  Outer Core: The layer in the Earth which is about 3000 miles beneath the surface, made up of super-heated liquid molten lava made of mostly iron and nickel  Inner Core: The next layer of the Earth about 3900 miles beneath the surface, which is thought to be a solid ball of mostly iron and nickel  Continental Crust: The layer of rocks which form the continents  Atmosphere: The layer of gas that surrounds Earth  Mineral: A material found in nature that is not an animal or a plant  Iron: A very hard metal  Magnetic field:  An area that is magnetic, or has the power to attract and hold other objects |
| **Procedures** | **ENGAGE**  Ask the students: What do we know about the Earth? What have we learned about the structure of the Earth? What about underneath the surface? Give students time to brainstorm different ideas about the Earth and its structure; including different landforms and bodies of water. As a class, make a KWL chart for what they want to know about the Earth.  Book: Soil, Silt, and Sand: Layers of the Underground by Jody Sullivan Rake, or use the myON link: <https://www.myon.com/reader/index.html?a=us_sss_f15>  **EXPLORE**  Video: “Structure of the Earth/The Dr. Bionics Show/Educational Videos for Kids” (3:12): <https://www.youtube.com/watch?v=eXiVGEEPQ6c>  The Earth has many different layers. Explain that each of the colors of playdoh will represent a different layer of the Earth.  Red represents the solid inner core, which is almost as hot as the sun  Orange represents the liquid outer core that spins and creates the Earth’s magnetic field  Yellow represents the mantle, which is the thickest layer made of very hot rocks  Brown represents the Earth’s crust made of rocks  Blue represents the ocean  Green represents the continents (the land we walk on)  Teacher’s note: Playdoh can be made or bought for this activity  Playdough to Plato: Layers of the Earth: <https://www.playdoughtoplato.com/layers-of-the-earth/>    Homemade playdoh: 3 cups of flour, ½ cup of salt, 6 tbsp. cream of tartar, 3 tbsp. vegetable oil, 3 cups of water  Mix all ingredients into a pot until all of the lumps are gone. Move the pot to the stove and cook over low heat, stirring often. The dough should start to thicken in a few minutes. Turn off the heat once the mixture starts pulling away from the sides. Give the dough a few minutes to cool off so it can be kneaded and dyed. Divide the cooked playdough into six parts: two small (golf ball sized), two medium, and two large balls. Drop several drops of food coloring into each ball. The two small balls should be red and green; the medium balls should be orange and brown; and the large ones should be yellow and blue.  Optional: Divide the store-bought playdoh into similar sections: the two small balls should be red and green; the medium balls should be orange and brown; and the large ones should be yellow and blue.  Students should reunite with their partners from the discussion in order to complete the model of the Earth. As they build their model, explain the different layers. They should each receive the different sized balls of playdoh. Students should start by rolling the small red dough into a ball. Flatten the medium sized orange dough and place it around the red ball, pinching the sides closed and removing any extra dough in the process. Flatten the yellow ball and wrap it around the orange ball. Then, flatten the brown ball and place it over the yellow ball. Finally, flatten the blue ball and cover the model. Use the green ball to form the continents.  Teacher’s note: The continents can be formed beforehand.  Using dental floss, have the students cut the planet in half. Teacher assistance may be necessary. Have students draw and color a picture of the model in their science notebooks and label each of the layers.    **EXPLAIN**  Video: “Could I Dig a Hole Through the Earth?” (4:21): <https://www.youtube.com/watch?v=oEW_Qwj6ZCE>  The crust is the thin outer layer of the Earth where people live. Although it is the thinnest, the crust varies from around 3 miles to 30 miles thick. The crust is thinner in the ocean floor to thicker on land, which is called the continental crust. The next layer of the Earth is called the mantle. The mantle is much thicker than the crust, at almost 1865 miles. It is made up of slightly different rocks with more magnesium and iron.  The tectonic plates are a combination of the crust and the outer mantle. These plates move very slowly, around a couple of inches a year. The Earth’s outer core is made up of iron and nickel and is very hot at about 4400 to 5000+ degrees Celsius. It is so hot that the iron and nickel metals are liquid. The outer core is very important to the Earth because they create the magnetic field. The magnetic field the outer core creates goes out into space and makes a protective barrier around the Earth that shields it from the sun’s damaging solar wind.  The Earth’s inner core is made up of iron and nickel, just like the outer core. However, the inner core is different. The inner core is so deep within the Earth that it’s under immense pressure. Because of the pressure, even though it is so hot, it is solid. At over 5000 degrees Celsius, it is about as hot as the surface the sun. |
| **Enrichment** | **EXTEND**  Ask the students: How do you think the layers of the Earth affect life? Do you think they are related? Discuss the idea of a magnetic field from the iron within the Earth keeping the atmosphere in place. |
| **Closure** | **ELABORATE**  The Earth’s crust is made up of layers as well. Intrusive rocks are cooled rock that have risen close to the Earth’s surface. The deep-sea floor is the Earth’s surface beneath the seas and oceans. Sedimentary rocks are the rocks formed over long periods from broken rocks, chemical sediment, and debris. The basaltic layer is basalt rock which forms the deep-sea floor. Metamorphic rocks are rocks that have been exposed to lots of high pressure and very hot temperatures. Igneous rocks are formed from magma (liquid rock) that has cooled and hardened inside the Earth. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ models and labels for understanding. |

Differentiated Instruction

|  |  |  |
| --- | --- | --- |
| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different layers of the Earth, including the models created by the students. Show the student different pictures of the layers to check for understanding. | Review the different layers of the Earth, including the models created by the students. Ask the student: Why do you think no one has been able to drill to the center of the Earth? | Review the different layers of the Earth, including the models created by the students. Ask the student: What would happen if people were able to drill to the center of the Earth? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different layers described in the lesson, and/or have the student describe the different layers of the Earth using the models created by the class.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different items with layers, such as the models they made in class. Give them a chance to explore the different layers for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you summarize the layers of the Earth? How could the age of the planet be determined by looking at the layers? | | |
| **Interactive Technology** | | |
| App: Design Your Own Space Planet: construct, Build, Create World  Interactives: Dynamic Earth: Earth’s Structure: <https://www.learner.org/interactives/dynamicearth/structure/>  Game: Harcourt School Publishers: Earth’s Layers: <http://www.harcourtschool.com/activity/science_up_close/606/deploy/interface.html>  Game: e-Learning for Kids: Layers of the Earth and Plate Tectonics: <http://www.e-learningforkids.org/science/lesson/layers-of-the-earth-and-plate-tectonics/> | | |

Lesson 2: What are fossils?

|  |  |
| --- | --- |
| **Learning Target**  **Objective**  **Standard** | The Earth is made up of many different layers.  Students will be able to identify and describe the layers of the Earth.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, paper cups, popsicle sticks, shells, newspaper, water, spoons, pictures of fossils |
| **Books** | Rock On! Fossils by Chris Oxlade |
| **Vocabulary** | Fossil: The remains of plants and animals that lived long ago, usually forming from the hard parts – such as shells or bones – of living things  Body Fossil: The preserved remains of a plant or animal’s body  Trace Fossil: The preserved remains of the activity of an animal, such as trackways, footprints, egg shells, and nests  Resin: A yellowish or brownish substance obtained from the sap of some trees |
| **Procedures** | **ENGAGE**  Ask the students: What do we know about fossils? How to they form? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm about what they know about fossils and how they are formed. As a class, create a circle map to document facts about fossils.  Book: Rock On! Fossils by Chris Oxlade, or use the myON link: <https://www.myon.com/reader/index.html?a=ro_fossi_s16>  **EXPLORE**  Video: “WHAT’S A FOSSIL?” (2:34): <https://www.youtube.com/watch?v=3rkGu0BItKM>  Video: “Make a Fossil: a fun, at-home science experiment” (2:27): <https://www.youtube.com/watch?v=E5YHZ4RGraI>  Have students return to their partners to make fossils. Each student will need: one paper cup, one shell, a popsicle stick, newspaper, and a cup of water. The teacher should provide the Plaster of Paris.  The recommendation for Plaster of Paris to work is a 2 to 1 ratio: 2 parts plaster to 1-part water. The teacher should scoop 2 tablespoons of Plaster of Paris into a paper cup. The student should then add 1 tablespoon of water and stir until it reaches the correct consistency. (The instructions should be on the container of Plaster of Paris.) Have the student set the shell with the grooves face down in the Plaster of Paris. Leave the edges out so the shell can be removed once the Plaster of Paris has hardened, which should take about 30 minutes.  Once the Plaster of Paris has hardened, the student can tear away the paper cup above the mold to be able to remove their shell. The students may need assistance removing the shell from the Plaster of Paris. Once the shell has been removed, they can see the “fossil” that has been left behind.  Have students draw a picture and label the parts of their fossil in their science notebook.  **EXPLAIN**  Fossils are the preserved remains of plants or animals. For remains to be considered fossils, they need to be over 10,000 years old. There are two main types of fossils: body fossils and traced fossils. Body fossils are the preserved remains of a plant or animal’s body. Trace fossils are the remains of an activity of an animal, such as preserved trackways, footprints, egg shells, and nests.  When an animal or plant dies, it may fall into mud or soft sand and make an impression or mark in the dirt. The body is then covered by another layer of mud or sand. Over time, the body falls apart and is dissolved. The mud or sand can harden into rock preserving the impression of the body, leaving an animal or plant shaped hole in the rock. This hole is called a mold fossil. If the mold becomes filled over time with other minerals, the rock is called a cast fossil.  Optional Video: “Bill Nye the Science Guy S04E19 Fossils” (25:43): <https://www.youtube.com/watch?v=oTqWjPWeyN4> |
| **Enrichment** | **EXTEND**  Ask the students: As you hear about the two different types of fossils, what kind of a fossil was made with the shell and Plaster of Paris? What characteristics tell you this is the case? |
| **Closure** | **ELABORATE**  Another type of fossil is a resin fossil. Resin is sometimes called amber. Plants, mostly trees, secrete sticky stuff called resin. Sometimes insects, other small animals, or bits of plants get stuck in the sticky resin. The resin hardens over time and is preserved in a rock, making a fossil. |
| **Assessment** | **EVALUATE**  Formative: Check on drawings and labels in their science notebooks for understanding. |

Differentiated Instruction

|  |  |  |
| --- | --- | --- |
| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different types of fossils, including those preserved by resin. Show the student different pictures of fossils and check for understanding. | Review the different types of fossils, including those preserved by resin. Ask the student: What type of fossils do you think are the most common? Why? | Review the different types of fossils, including those preserved by resin. Ask the student: How do you think fossils get buried over time? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different fossils as described in the lesson, and/or have the student describe the different fossils using the models created by the class.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different models of fossils, including the models they made in class. Give them a chance to explore the different fossils for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about fossils and how they compare to geography and history? Do you think fossils are still being created today? Why or why not? | | |
| **Interactive Technology** | | |
| App: Expeditions: Fossils  App: 3D Fossil  App: Triceratops: Dinosaur Fossils Robot Age  Idaho Public Television: Fossils: Games: <http://idahoptv.org/sciencetrek/topics/fossils/games.cfm>  e-learning for kids: Science – Exploring Fossils and Fossil Records: <http://www.e-learningforkids.org/science/lesson/exploring-fossils-and-fossil-records/> | | |

Lesson 3: How are fossils buried in layers under the ground?

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| **Learning Target**  **Objective**  **Standard** | Fossils are often thousands to millions of years old and buried under layers in the Earth.  Students will be able to describe how fossils are buried under the ground.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, pictures of fossils, gummy bears, fruit straws, wheat bread, white bread, books, paper towels |
| **Books** | Let’s Rock: Fossils by Richard Spilsbury |
| **Vocabulary** | Fossil: The remains of plants and animals that lived long ago, usually forming from the hard parts – such as shells or bones – of living things  Sediment: Materials (as stones or sand) carried onto land or into water by water, wind, or a glacier  Sedimentary Rock: Rocks formed when sand, mud, and pebbles get laid down in layers; over time, these layers are squashed under more and more layers, eventually turned into rock  Igneous Rock: Rock formed when magma cools and solidifies |
| **Procedures** | **ENGAGE**  Ask the students: How do you think fossils are formed? Why do you think they aren’t on the surface anymore, and how did they get buried under the surface? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm about what they know about fossils and how they are related to the landscape and rock formation. As a class, add to the previous lesson’s circle map to document facts about fossils.  Book: Let’s Rock: Fossils by Richard Spilsbury, or use the myON link: <https://www.myon.com/reader/index.html?a=lrck_fssls_s11>  **EXPLORE**  Video: “Fossil Science Experiment for kids! #1” (7:01): <https://www.youtube.com/watch?v=q0-HfSlK1Gw>  Have students return to their partners to show how layers of sediment make fossils. Each pair of students needs 16 gummy bears, 4 candy straws, 3 pieces of white bread, 2 pieces of wheat bread, plastic cling wrap, paper towels, and three heavy books.  Have students place a piece of the white bread down on a paper towel. Place four gummy bears and a candy straw on the piece of bread. Next, place a piece of wheat bread on top of the gummy bears and candy straw. Put another four gummy bears and candy straws on the wheat bread. Place a piece of white bread on top of the bears and straws. Repeat this process until finishing with the final piece of white bread. The pieces of bread represent the sediment created from erosion.  Wrap the layers of bread in plastic wrap. Set three heavy books on the top of the layers. The heavy books represent the pressure that builds up as the sediment builds up over time. Leave the books on the bread layers for 24 hours. Have the students draw a picture of the gummy bears on the bread in their science notebook, complete with labels.  After 24 hours, remove the plastic wrap from the bread. Carefully take apart the layers and see what the gummy bears have done to the bread. Students should notice the indentations the gummy bears and straws have made in the bread, much like animals do to sedimentary rock as years go by.  Have students draw a picture and label the parts of the fossil indentation in their science notebook.  **EXPLAIN**  Fossils start to form when an animal or plant dies. The soft parts will begin to rot away, and after some time, only the skeleton will be left. For a fossil to form properly, the remains of the plant or animal must be buried quickly. The remains can be buried in lots of different things including mud, sand, silt, and even ash from a volcano. These things are called sediment.  Over millions of years, the deeply buried fossil will start to rise to the Earth’s surface. The fossil will rise to the surface because of things like earthquakes and other things that can cause rocks deep in the Earth to move. Eventually, once the fossil comes to the surface, the rock surrounding it will start to wear away and the fossil can be seen.  Video: “Exploring Fossil Records, How Fossils Are Formed, Interesting & Educational Videos for Kids” (14:48): <https://www.youtube.com/watch?v=sPFiwW8J3sY> |
| **Enrichment** | **EXTEND**  Ask the students: What types of sediment do you think might cover up a fossil so it is not seen right away? If you did the experiment again, and used more layers, would it have the same effect since the pressure wouldn’t change? What could you use to simulate an earthquake? |
| **Closure** | **ELABORATE**  Rock fossils form in sedimentary rock. Sedimentary rock forms from layers of sediment, such as sand or mud. Sometimes, the sediment builds up around animal and plant remains, which can leave fossils in the rock. If sedimentary rocks are changed by heat or pressure, their fossils can be destroyed. Igneous rocks never contain fossils. The heat of the molten rock – from which igneous rock cools – destroys any traces of plants or animals. |
| **Assessment** | **EVALUATE**  Formative: Check on drawings and labels in the students’ science notebooks for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review how fossils are buried under the ground, including the different types of rocks. Show the student different pictures of fossils and check for understanding. | Review how fossils are buried under the ground, including the different types of rocks. Ask the student: If an animal died today, would it turn into a fossil in 10 years? How long would it take, or would it happen at all? Why? | Review how fossils are buried under the ground, including the different types of rocks. Ask the student: Do all animals turn into fossils? Why or why not? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different fossils as described in the lesson, and/or have the student describe the different fossils using the models created by the class.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different models of fossils, including the ones demonstrated in class. Give them a chance to explore the different fossils for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would scientists estimate how old fossils are? Do you think they can tell just by looking at them? Why or why not? | | |
| **Interactive Technology** | | |
| App: Yaratilis Muzesi: Fossils  App: Dino Park 2  App: Dino Quest  Game: Sheppard Software: DinoMIght: Fossils: <http://www.sheppardsoftware.com/scienceforkids/dinosaurs/fossil_study.htm>  Game: PBS Kids: Dinosaur Train: Fossils: <http://www.sheppardsoftware.com/scienceforkids/dinosaurs/fossil_study.htmv> | | |

Lesson 4: How can maps be used to learn about the Earth’s features?

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| **Learning Target**  **Objective**  **Standard** | The Earth has different features, such as land and water.  Students will be able to identify the different features of Earth using maps and a globe.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, large blue construction paper (12” x 18”), continent printouts, crayons, glue, scissors |
| **Books** | Continents: What You Need to Know by Jill Sherman |
| **Vocabulary** | Cartographer: A person who makes maps  Continental drift: The very slow movement of the continents on the surface of the Earth |
| **Procedures** | **ENGAGE**  Ask the students: Where do we all live? What do you think makes Earth different from other planets? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm what is different about the Earth than other planets; including different landforms and bodies of water. As a class, make a circle map about the different types of landforms they have seen.  Book: Continents: What You Need to Know by Jill Sherman, or use the myON link: <https://www.myon.com/reader/index.html?a=ff_cntns_f17>  **EXPLORE**  Video: “7 Continents Song/Seven Continents Song” (3:11): <https://www.youtube.com/watch?v=7yXDYvWSswI>  The students will have a chance to become cartographers. A cartographer is a person who studies and makes maps. Cartography combines science, art, and technology. Today, they will be making a very basic world map before they learn about the different types of landforms and bodies of water.  Give each student a large blue piece of construction paper, printouts of each continent (with labels,) crayons, scissors, and glue.  Continent printout: <http://alittlepinchofperfect.com/world-map-geography-activities-for-kids/>  Have the students color the continents and labels different colors. The labels should match the color of the continent. Students should cut out the different continents. Discuss how the continents were all one big continent called Pangaea before millions of years passed by. Ask students to see if they can figure out how the continents used to fit together using their cut out shapes.  Video: “Continental Drift 101/National Geographic” (1:21): <https://www.youtube.com/watch?v=Wq9kLzm36h0>  Once they have seen how Pangaea used to look, have the students rearrange the continents to match the major continent. Then, have the students arrange the continents to their modern day locations, including labeling the continents and the oceans.  Have the students draw the continents in their science notebooks, complete with labels.  Video: “Space Shuttle – Beauty of the Earth (HD)” (7:29): <https://www.youtube.com/watch?v=vZ50yRcvqjs>  **EXPLAIN**  Video: “Plate Tectonics - Heat Moves Matter” (6:05): <https://www.youtube.com/watch?v=SiUtml2qZkU>  Continental drift was a theory proposed in 1912 by Alfred Wegener which described the movement of continents. Continents have been drifting for hundreds of millions of years. The Earth is made of rock. But inside the Earth, the temperatures are so hot that the rock is melted. The outermost rigid layer of the Earth is called the crust, which people stand and live on. This layer is hard and cool compared to the Earth’s interior. The crust is made up of many sections called tectonic plates. The continents are located on these plates, which are always moving around. These plates only move about an inch per year.  Video: “Pangaea Animation: (0:29): <https://vimeo.com/14258924> |
| **Enrichment** | **EXTEND**  Ask the students: If the continents are moving an inch or so apart every year, what will the Earth look like in 10 years? 100 years? 10,000 years? Is there a chance the continents will get back to being all in one place?  Video: “Bill Nye Plate Tectonics, Volcanoes and Earthquakes” (7:18): <https://www.youtube.com/watch?v=1PVMs2NSdmc> |
| **Closure** | **ELABORATE**  While the theory of plate tectonics wasn’t always popular, the theory has been supported by finding the same rocks and fossils in western Europe and eastern North America. There are also similar fossils on the western coast of Africa and eastern South America. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ maps and their labels of the continents, including describing continental drift. Check for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different continents, including discussing Pangaea and how the changes with plate tectonics caused the separation into multiple continents. Show the student different pictures of the continents and review the different names. | Review the different continents, including discussing Pangaea and how the changes with plate tectonics caused the separation into multiple continents. Discuss how slowly the continents drift and fit back together. Ask the student: How do you think the continents drifted? What did it look like? | Review the different continents, including discussing Pangaea and how the changes with plate tectonics caused the separation into multiple continents. Ask the student: What would happen if the continents didn’t drift, or drifted slower than they do now? How would that affect the weather? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different continents described in the lesson, and/or have the student describe the different types of landforms and water forms from the bubble map.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different items with continents, such as a globe or a map. Give them a chance to explore the different continents for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 3)** | | |
| Ask students: Can you elaborate how plate tectonics work? How would this effect life on the rest of the planet? Would the weather and climate stay the same? Why or why not? | | |
| **Interactive Technology** | | |
| App: Geography Master: Education  App: Planet Geo – Fun Games of World Geography: Planet Factory Interactive  Game: Sheppard Software: All About World Geography: <http://www.sheppardsoftware.com/World_Continents.htm>  Game: World Geography Games: <http://world-geography-games.com/> | | |

Lesson 5: What are different types of landforms?

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| **Learning Target**  **Objective**  **Standard** | Compare the different types of landforms found on the Earth.  Students will be able to identify the different types of landforms found on the Earth.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, crayons, landform flipbook template, scissors, glue, stapler, staples, paper |
| **Books** | U.S. Landforms: What You Need to Know by Linda Crotta Brennan |
| **Vocabulary** | Volcano: A mountain that opens downward to a pool of molten rock below the surface of the Earth; when pressure builds up, eruptions occur  Glacier: A huge mass of ice slowly floating over a land mass, formed from compacted snow  Coastal Plain: A large area of low, flat land near the ocean that was once covered by water  Plate: A large sheet of rock that is a piece of the Earth’s crust  Plateau: An area of high, flat land  Canyon: A deep, steep-walled, V-shaped valley cut by a river through resistant rock  Waterfall: A place where the river water falls from a high place to a lower place  Peninsula: Land that extends beyond the mainland and has water on three sides  Geosphere: The solid Earth  Weathering: The process where rocks are worn away or broken down into smaller pieces by wind, water, or plants  Erosion: The action or process of wearing away by the action of water, wind, or glacial ice |
| **Procedures** | **ENGAGE**  Ask the students: What is a landform? What types of landforms do you see where you live? What types of landforms have you seen in other places? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm different landforms and bodies of water. As a class, add on to the circle map from the previous lesson about the different types of landforms they have seen.  Book: U.S. Landforms: What You Need to Know by Linda Crotta Brennan, or use the myON link: https://www.myon.com/reader/index.html?a=ff\_uslnd\_f17  **EXPLORE**  Ginger Snaps: Landform Flipbook: <http://gingersnapstreatsforteachers.blogspot.com/2012/09/landform-flipbook.html>  The students will have a chance to make a flip book based on some of the different landforms. Each student will need the landform template found here:  Landform template: <https://drive.google.com/file/d/1UyQixe7WQJtxHdi1OHi2VguBrFeLRS-n/view>  Each student will need: pieces of the template, crayons, scissors, and glue. The teacher can use a stapler and staples to put the book together.  Have the students color and label the different landforms. In order to make it more challenging for fourth grade, have the students also write a fact about each of the landforms and how it is formed. Students can refer to different websites to find a fact about each of the landforms.  Geology for Kids: Landforms: <https://kidsgeo.com/geology-for-kids/landforms/>  Kiddle: Landform facts: <https://kids.kiddle.co/Landform>  National Geographic: Landforms: <https://www.nationalgeographic.org/topics/landforms/>  Students can work with their original partners for this activity. Make sure to staple the landforms on the left side to make it a true flip book. The layers should go in this order, from top to bottom: Island, ocean, plains, valley/mountain, canyon, and volcano.  Video: “Landforms, Hey!: Crash Course Kids #17.1” (3:57): <https://www.youtube.com/watch?v=FN6QX43QB4g>  **EXPLAIN**  Landforms are all around us and are natural features of Earth’s surface. Mountains are steep, tall, and sometimes have pointy tops. Mountains are all over the United States. A lake is a large body of water surrounded by land on all sides. A hill is a raised area or mound of land. A valley is a low area surrounded by high land. It is described as either being a U shape or a V shape. A glacier is a large mass of ice that moves across land.  Video: “Landforms” (7:32): <https://www.youtube.com/watch?v=hh3vZc03f1s> |
| **Enrichment** | **EXTEND**  Ask the students: How long does it take for a landform to take shape? Why can’t we see the changes in a landform on a daily basis? Because we can’t see it, does it still mean it is happening?  Optional Video: “Bill Nye the Science Guy S03E04 Rocks & Soil” (25:44): <https://www.youtube.com/watch?v=XIebFtd-t8Y> |
| **Closure** | **ELABORATE**  To determine whether something is a landform, there are three questions to be asked: Has it been there for hundreds, thousands, or millions of years? Was it made naturally? Is it a feature of the solid surface of the Earth? |
| **Assessment** | **EVALUATE**  Formative: Check on students’ landform flip books, as well as their facts written about each landform. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different types of landforms, including the facts the students found about them. Show the student different pictures of landforms and review the different names. | Review the different types of landforms, including the facts the students found about them. Ask the student: What landforms do you see every day, and how do you think the climate would be different if the landforms were different? | Review the different types of landforms, including the facts the students found about them. Ask the student: Why do you think there are so many different landforms in different areas, and how do they affect how people live? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different landforms described in the lesson, and/or have the student describe the different types of landforms and water forms from the bubble map. The student can also draw pictures of their landform.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different items with landforms, such as a topography map or a globe. Give them a chance to explore the different continents for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you apply what you learned about landforms to develop your own topography map? Why would it be important for people to know the topography of the land? | | |
| **Interactive Technology** | | |
| App: GeoGuide Val d’Herenes  Game: Mr. Nussbaum: Interactive Continents for Kids: <https://www.mrnussbaum.com/continents/>  Game: Mr. Polum’s Landform Game: <https://matchthememory.com/mrpolum> | | |

Lesson 6: How are different landforms created? (erosion and weathering)

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| **Learning Target**  **Objective**  **Standard** | Compare how different types of landforms found on the Earth are formed.  Students will be able to identify the different types of landforms found on the Earth.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, chocolate chip cookies, soak-resistant paper plates, cup of water, Q-tips, toothpicks, timer, goggles |
| **Books** | Erosion: Changing Earth’s Surface by Robin Koontz |
| **Vocabulary** | Weathering: The process where rocks are worn away or broken down into smaller pieces by wind, water, or plants  Erosion: The action or process of wearing away by the action of water, wind, or glacial ice |
| **Procedures** | **ENGAGE**  Ask the students: How do you think landforms change? How do the different characteristics of landforms show how they were formed? Do you think landforms change quickly? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm how landforms change over time. As a class, add on to the circle map to include how the different landforms are formed and change over time.  Book: Erosion: Changing Earth’s Surface by Robin Koontz, or use the myON link: <https://www.myon.com/reader/index.html?a=as_erosi_f06>  **EXPLORE**  BL: Chocolate Cookie Erosion: [https://betterlesson.com/lesson/644812/chocolate-cookie-erosion#](https://betterlesson.com/lesson/644812/chocolate-cookie-erosion)  The students will have a chance to see different types of weathering and erosion. Weathering is the breaking down of materials, but erosion is the breaking down and movement of the materials.  Students should return to their partners. Each small group needs: three soak-resistant paper plates, three chocolate chip cookies, four Q-tips, four toothpicks, cup of water, goggles, and a timer.  Students place the first cookie on the first plate, then try to break up the cookie with the Q-tip. They should take about a minute to do so. Students then record their observations in their science notebook.  Students place the second cookie on the second plate and put on their goggles. They use their toothpicks to erode the cookie. The toothpicks don’t make much of a dent in the cookie, but pieces do come off when the toothpicks are used. Students then record their observations in their science notebook.  Students place the third cookie on the third plate. One of the students should have the timer ready. Students pour water onto the plate and time it for one minute. They then lift the cookie gently to see if anything has changed. Students record their observations after one minute, and then after five minutes. Finally, students should determine which form of erosion was most efficient.  **EXPLAIN**  Video: “Weathering and Erosion: Crash Course Kids #10.2” (4:05): <https://www.youtube.com/watch?v=R-Iak3Wvh9c>  Discuss the different forms of erosion, and which one of the processes made the cookie break down faster. Water is the most powerful force in the erosion process. Wind is more like the Q-tip, and human activity is like the toothpick.  Weathering is the process where rock is dissolved, worn away, or broken down into smaller and smaller pieces. There are mechanical, chemical, and organic weather processes. Organic weathering happens when plants break up rocks with their growing roots, or plant acids help dissolve rock. Mechanical weathering physically breaks up rock. One example is called frost action or frost shattering. Water gets into cracks and joints in bedrock. When the water freezes, it expands and cracks are opened a little wider. Over time, pieces of rock can split off a rock face, and big boulders are broken into smaller rocks and gravel. Chemical weathering decomposes or decays rocks and minerals. An example of chemical weathering is water dissolving limestone.  Once the rock has been weakened and broken up by weathering, it is ready for erosion. Erosion happens when rocks and sediments are picked up and moved to another place by ice, water, wind, or gravity. When ice melts, or wind and water slow down, they can’t carry as much sediment. The sediment is dropped, or deposited, in landforms.  Depending on the type of force, erosion can happen quickly, or takes thousands of years. The three main forces are water, wind, and ice. |
| **Enrichment** | **EXTEND**  Human activity has increased the rate of erosion in many areas. This happens through ranching, cutting down forests, and the building of roads and cities. Human activity has caused about one million acres of topsoil to erode each year. How do you think humans can limit the amount of erosion they cause?  Optional Video: “Bill Nye the Science Guy S05E14 Erosion” (25:45): <https://www.youtube.com/watch?v=0e3D2RB-bqI> |
| **Closure** | **ELABORATE**  Fossils in sedimentary rock are often uncovered by erosion. The word “erosion” comes from the Latin word “erosionem,” which means “a gnawing away.” Scientists estimate that the Colorado River has been eroding the Grand Canyon for millions of years. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ experiments and their understanding of erosion. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review how erosion changes different landforms, including the difference between weathering and erosion. Show the student different pictures of forms of erosion to check for understanding. | Review how erosion changes different landforms, including the difference between weathering and erosion. Ask the student: Do you think erosion will continue to shape landforms? Why or why not? | Review how erosion changes different landforms, including the difference between weathering and erosion. Ask the student: Do you think erosion is an important part of the changing landscape? Why or why not? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different landforms described in the lesson, as well as how erosion has impacted them, and/or have the student describe the different types of landforms and forms of erosion.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different items with landforms, such as a topography map or a globe, and describe how erosion has shaped them. Give them a chance to explore the different forms of erosion for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you apply what you learned about erosion to plan where you want to live? Why would it be important to know how erosion affects different areas? | | |
| **Interactive Technology** | | |
| Game: Interactive Sites for Education: Erosion and Weathering: <http://interactivesites.weebly.com/erosion-and-weathering.html>  Game: Legends of Learning: Weathering and Erosion Science: <https://www.legendsoflearning.com/learning-objectives/weathering-and-erosion/> | | |

Lesson 7: How long does it take for Earth’s landforms to change naturally?

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| **Learning Target**  **Objective**  **Standard** | Slow natural processes of the Earth shape and change Earth’s landforms.  Students will use their personal timeline and age to understand how old the Earth is, and that the Earth’s natural processes can be slow.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks |
| **Books** | Landform Adventures: Canyon Hunters by Anita Ganeri |
| **Vocabulary** | Weathering: The process where rocks are worn away or broken down into smaller pieces by wind, water, or plants  Erosion: The action or process of wearing away by the action of water, wind, or glacial ice |
| **Procedures** | **ENGAGE**  Ask the students: How long do you think it takes for a landform to change? Erosion can be seen in a short time, but how long does something like the Grand Canyon take to form? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm how long it takes a landform to change. As a class, add on to the circle map to include how long erosion takes.  Video: “Four ways to understand the Earth’s age - Joshua M. Sneideman” (3:44): <https://www.youtube.com/watch?v=tkxWmh-tFGs>  **EXPLORE**  Google Earth Engine: Timelapse: <https://earthengine.google.com/timelapse/?location=aral-sea>  Timelapse is a global, zoomable video that lets you see how the Earth has changed over the past 32 years. It is made from photographs from 1984 to 2016. As a class, explore the different parts of the Earth, specifically Las Vegas (looking at the lake in particular) and the Columbia Glacier. Give students time to explore the website and make observations, as well as writing down what they see in their science notebooks.  Video: “The Grand Canyon!” (4:18): <https://www.youtube.com/watch?v=oZZEJMtLOKU>  **EXPLAIN**  Erosion is the general term that means the wearing down of landforms, including the toughest, tallest mountains. Weathering is the breakdown of land into smaller pieces, and erosion is the movement of the pieces removed by weathering. Weathering is caused by wind, water, heat and cold; while erosion happens via wind, water, and gravity. Weathering and erosion typically happen over hundreds, thousands, or even millions of years. Boulders become sand, and mountains are reduced to smaller hills. The pieces move downhill, creating new landforms. It’s a never-ending process.  Erosion is a part of nature, but people can make erosion happen more quickly. Man-made structures such as housing developments, industry, oil drilling operations, dams, levees, floodgates, canals, and attempts to artificially build up land to house more people have all cause the natural coastlines, riverbanks, wetlands, and barrier islands to erode. All of these landforms normally help slow down flood peaks and sustain stream flows during droughts. Wetlands and barrier islands can even decelerate a storm surge from a hurricane.  The Grand Canyon is 277 miles long, and 18 miles wide at its widest point. At its narrowest point, it stretches 4 miles across. The Grand Canyon is around 6000 feet deep. The different types of rock visible in the Grand Canyon show erosion over time, as well as making it an important site for geological research. The rock found at the bottom of the Grand Canyon is around 2 billion years old, while the rock found on the upper rim is around 230 million years old. The Grand Canyon became a national park in 1919.  Book: Landform Adventures: Canyon Hunters by Anita Ganeri, or use the myON link: <https://www.myon.com/reader/index.html?a=lfadv_canyonhu_f11> |
| **Enrichment** | **EXTEND**  Several other national parks are the result of thousands or millions of years of erosion. What are some of the other landmarks or national parks can the students think of that were created through erosion?  AccuWeather: Ten Spectacular Landmarks Forged by Nature: <https://www.accuweather.com/en/weather-news/landmarks-forged-by-nature/28993150> |
| **Closure** | **ELABORATE**  One of the challenges for engineers is to accommodate what they are building and creating for eventual erosion. While erosion generally takes thousands to millions of years to take place, they must keep in mind severe weather speeding up the process such as flooding or tornadoes, as well as studying whether a certain area will be more susceptible to these types of changes and erosion increases. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ observations in their science notebooks and their understanding of erosion. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review how erosion changes landforms over long periods of time. Show the student different pictures of forms of erosion to check for understanding. | Review how erosion changes landforms over long periods of time. Ask the student: Why do you think man made erosion changes landscapes faster than natural erosion? | Review how erosion changes landforms over long periods of time. Ask the student: Based on the timeline given, which “months” do you think the Grand Canyon was formed in? Why? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different landforms described in the lesson, as well as how erosion has impacted them, and/or have the student describe the different types of landforms and forms of erosion.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different items with landforms, such as a topography map or a globe, and describe how erosion has shaped them. Give them a chance to explore the different forms of erosion for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: Can you explain how the Colorado River affected the area around the Grand Canyon (aside from the canyon itself?) How can scientists use the Grand Canyon to study the Earth’s layers? | | |
| **Interactive Technology** | | |
| App: Chimani – National Park Guides  App: Grand Canyon National Park Field Guide  App: Parks Explorer VR: Grand Canyon  App: Expeditions: Grand Canyon  Game: National Geographic Kids: Grand Canyon National Park: <https://kids.nationalgeographic.com/explore/nature/grand-canyon/#GrandCanyonsquirrel.jpg>  Game: National Park Service: Grand Canyon: <https://www.nps.gov/grca/learn/kidsyouth/index.htm3> | | |

Lesson 8: How can landforms on the Earth be changed? (water)

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| **Learning Target**  **Objective**  **Standard** | Landforms can be altered by water over time.  Students will be able to identify the ways that water can affect the Earth’s surface.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, pie pans, sand, plastic cups, plastic spoons, blue food coloring, water, dry measuring cup, ruler, permanent markers, shells |
| **Books** | Erosion: Changing Earth’s Surface by Robin Koontz |
| **Vocabulary** | Erosion: The action or process of wearing away by the action of water, wind, or glacial ice  Weathering: The process where rocks are worn away or broken down into smaller pieces by wind, water, or plants  Deposition: The dropping off or depositing of eroded rock  Coastal Erosion: The wearing away of material from a coastal profile |
| **Procedures** | **ENGAGE**  Ask the students: What causes erosion? Review how the continents can change, as well as the different types of erosion (water, wind, vegetation, and ice.) Review how the continents can be changed by erosion. Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to discuss what they know about erosion, as well as brainstorming another form of erosion.  Book: Erosion: Changing Earth’s Surface by Robin Koontz, or use the myON link: <https://www.myon.com/reader/index.html?a=as_erosi_f06>  **EXPLORE**  Tina’s dynamic homeschool plus: Erosion Hands-on Easy Homeschool Science Activity:  <http://www.tinasdynamichomeschoolplus.com/2016/02/05/erosion-hands-on-easy-homeschool-science-activity/#_a5y_p=4986287>  Have students return to their partners. Each group will need: one foil pie pan, sand, plastic cup, water, plastic spoon, blue dye, dry measuring cup ruler, and a permanent marker.  Pour two cups of sand in one end of the pan. Mix some blue food coloring inside a cup of water. Mark one inch on the side of the pie pan to indicate where the water level should be. Slowly pour the water up to the line on the side as not to disturb the sand. Using the shells, mark the level where the water hits on the shore in the sand. Have students draw a picture and label what the sand and water look like in their science notebook.  Using the plastic spoon, make waves in the water. Make the waves for about one minute. Have students make observations about the movement of the sand and the water by drawing another picture in their science notebook. What happened to the sand? What about the water?  **EXPLAIN**  Video: “Moving Water Shapes the Land” (2:57): <https://www.youtube.com/watch?v=n0n3vEul0Hc>  Water is the main cause of erosion on Earth. Although water may not seem powerful at first, it is one of the most powerful forces on the planet. Some of the ways that water causes erosion include:  Rainfall: Rainfall can cause erosion both when the rain hits the surface of the Earth and when raindrops accumulate and flow like small streams  Rivers: Rivers can create a significant amount of erosion over time, breaking up particles along the river bottom and carrying them downstream. One example of river erosion is the Grand Canyon, formed by the Colorado River.  Waves: Ocean waves can cause the coastline to erode. The shear energy and force of the waves causes pieces of rock and coastline to break off, changing the coastline over time.  Floods: Large floods can cause erosion to happen very quickly, acting like powerful rivers. |
| **Enrichment** | **EXTEND**  Students can try the experiment again with stronger waves, or waves that are calmer. Ask the students: Do they think it will have the same result? What if all the water is splashed higher, or the water level is lower? |
| **Closure** | **ELABORATE**  Coastal erosion is the wearing way of a material from a coastal profile, including the removal of beach, sand dunes, or sediment by wave action, tidal currents, wave currents, drainage, or high winds. Waves, generated by storms, can cause coastal erosion, which may take the form of long-term losses of sediment and rocks, or merely the temporary redistribution of coastal sediments. |
| **Assessment** | **EVALUATE**  Formative: Check science notebooks for the experiment results, as well as how students defined erosion by the water. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review erosion by the water, including how soil and sand are carried to different locations. Check for understanding by checking the student’s science notebook and model. | Review erosion by the water, including how soil and sand are carried to different locations. Ask the student: How long do you think it takes for the water to completely change the surface of the Earth? Why? | Review erosion by the water, including how soil and sand are carried to different locations. People can make erosion by water happen faster. Ask the student: How do you think people cause erosion? Is it a good thing or not? Why? |
| **ELL Strategies** | | |
| *Visual Aids:* Review erosion by water as described in the lesson, as well the short and long-term effects of water on the Earth’s surface. Show pictures of landforms affected by the water.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to examine how water affects landforms. Students can also explore the fast and slower changes by water erosion and weathering.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about water erosion on the shore compared to water erosion by a river or stream? Does the effect happen faster with one or the other? Why? | | |
| **Interactive Technology** | | |
| App: Muddy Water Watch: Shiny Creek  Game: Kids Geology: Water Erosion: <https://kidsgeo.com/geology-for-kids/water-erosion/> | | |

Lesson 9: How can landforms on the Earth be changed? (ice)

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| **Learning Target**  **Objective**  **Standard** | Landforms can be altered by ice over time.  Students will be able to identify the ways that ice can affect the Earth’s surface.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer; white boards; white board markers; pencils; science notebooks, paper cups, gravel, dirt, water, clay or Play-Doh, paper towels, tray, spray bottles |
| **Books** | Glaciers by Mari Schuh |
| **Vocabulary** | Erosion: The action or process of wearing away by the action of water, wind, or glacial ice Glacier: A huge mass of ice slowly floating over a land mass, formed from compacted snow  Sediment: Material (as stones or sand) deposited by water, wind, or glaciers |
| **Procedures** | **ENGAGE**  Ask the students: What causes erosion? Review erosion by water, and explain there are other forms of erosion as well. Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to review water erosion, as well as brainstorming another form of erosion.    Book: Glaciers by Mari Schuh, or use the myON link: <https://www.myon.com/reader/index.html?a=nw_glacier_f10>  **EXPLORE**  Tales of Frogs & Cupcakes: Ice Erosion: <http://frogsandcupcakes.blogspot.com/2012/02/ice-erosion.html>  Teacher prep: Overnight, freeze paper cups of water with gravel and dirt in them to make “glaciers.” Students will return to their partners to conduct the experiment. Each group will need: a mini glacier, Play-Doh, their science notebooks, pencils, a tray, a spray bottle, and paper towels.  Have each group take some Play-Doh - a ball that is 2-3 inches and diameter. Flatten the clay onto the surface of the tray. Press an ice cube against the flattened clay and move it back and forth several times. Students should record their observations. What happens to the clay when the ice cube is rubbed on it? Students should record their results in their science notebook.    Fill the spray bottle with warm water and have the students take turns spraying the mini glacier with it. Have the student spray the water in one spot. What happens? Have the students record their observations in their science notebook.  Video: “Melting Glacier – Ice Breaking off” (3:05): <https://www.youtube.com/watch?v=q2ARiPPtvWo>  **EXPLAIN**  Video: “Glacial Movement and Erosion” (3:43): <https://www.neok12.com/video/Glaciers/zX575a5d675a5d5758714273.htm>  Glaciers are large, slow-moving rivers of ice, rock, and sediment that move under the influence of gravity. They are formed by accumulation and compaction of falling snow. Glaciers grow and shrink in response to climate, and cover about 10% of the Earth’s land area. Glaciers are the largest reservoir of fresh water on Earth, and directly influence the sea level variation.  Ice erosion is caused by movement of ice, typically as glaciers. Glaciers can scrape and break up rock, and then transport it. Ice wedging is the weathering process where water is trapped in tiny rock cracks freezes and expands, causing the breakup of the rock. This can lead to gravity erosion on steep slopes. |
| **Enrichment** | **EXTEND**  Students can try the experiment again with the ice cube moving at different speeds. Does it make a difference to move the ice faster or slower? What about if it didn’t move at all? Have students make the ice move in different ways, recording their results. |
| **Closure** | **ELABORATE**  Water erosion doesn’t only affect rocks: it can also affect ice as well, as demonstrated in the experiment. Any rainwater that falls that is warmer than the temperature of the glacier has the potential to melt the ice on the glacier and turn it into streams and rivers, or raise the ocean level over time. |
| **Assessment** | **EVALUATE**  Formative: Check science notebooks for the experiment results, as well as how students defined erosion by ice. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review erosion by the ice, including how soil and sand are carried to different locations. Check for understanding by checking the student’s science notebook and model. | Review erosion by the ice, including how soil and sand are carried to different locations. Ask the student: How long do you think it takes for the ice to change the surface of the Earth? Why? | Review erosion by the ice, including how soil and sand are carried to different locations. Ask the student: How do you think ice changes the land over time? Is it a good thing or not? Why? |
| **ELL Strategies** | | |
| *Visual Aids:* Review erosion by ice as described in the lesson, as well the short and long-term effects of ice moving on the Earth’s surface. Show pictures of landforms affected by the ice. See: Glaciers Change the Land: <https://www.ducksters.com/science/earth_science/glaciers.php>  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to examine how ice affects landforms. Students can also explore the fast and slower changes by ice erosion and weathering.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about how fast ice erosion works as compared to water erosion? Why do you think water erosion is a stronger form? | | |
| **Interactive Technology** | | |
| App: Glacier-National-Park  Game: NeoK12: Glaciers: <https://www.neok12.com/Glaciers.htm> | | |

Lesson 10: How can landforms on the Earth be changed? (wind)

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| **Learning Target**  **Objective**  **Standard** | Landforms can be altered by wind over time.  Students will be able to identify the ways that wind can affect the Earth’s surface.  4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, shoe box, dirt, straws, hair dryer |
| **Books** | Erosion: Changing Earth’s Surface by Robin Koontz |
| **Vocabulary** | Erosion: The action or process of wearing away by the action of water, wind, or glacial ice  Weathering: The process where rocks are worn away or broken down into smaller pieces by wind, water, or plants  Deposition: The dropping off or depositing of eroded rock  Wind: Air in motion; produced by the uneven heating of the Earth’s surface by the sun  Creep Erosion: Larger particles of soil rolling or sliding along the ground’s surface  Suspension Erosion: Small particles are lifted up and sit suspended in the air, like when dust floats in the air; the wind comes and carries these particles long distances, sometimes up to hundreds of miles  Saltation Erosion: Wind causing particles (usually dirt) to bounce along the surface of the ground; most soil moved by wind is through this method |
| **Procedures** | **ENGAGE**  Ask the students: What causes erosion? Is there only one answer to this? How do you think different weather causes erosion? Review erosion by water and wind. Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm about an additional form of erosion.  Book: Erosion: Changing Earth’s Surface by Robin Koontz, or use the myON link: <https://www.myon.com/reader/index.html?a=as_erosi_f06>  **EXPLORE**  Video: “Wind erosion experiment” (1:35): <https://www.youtube.com/watch?v=k3yQGOHSd4M>  Give students a chance to review the vocabulary regarding erosion. Students will continue to work with their partners. Each group needs: their science notebooks, a shoe box, dirt, straws, and a hair dryer. (The hair dryer can be shared with multiple groups.) Students will be examining how the wind can affect the dirt.  Have students spread out the bag of dirt along the bottom of the shoebox. Students should then make predictions as to how they think the wind will affect the sand. Have students draw a picture of the dirt before they start the experiment in their science notebooks.  Very carefully, have the students use one straw to blow a stream of air onto the dirt. One straw represents a very light breeze. Have the students record the results in their notebook. Have students repeat the process with two straws, representing a stronger wind, and recording the results in their science notebook. Finally, have students use the hair dryer along the surface of the dirt and record the results in their science notebook, comparing the results of the different strengths of wind.  **EXPLAIN**  Video: “Wind Erosion (English version)” (3:03): <https://www.youtube.com/watch?v=PQmon7Rj6ns>  Wind erosion is the movement of rock and/or sediment by the wind. Wind erosion breaks up the land and carries the debris to other places. Windbreaks are often planted by farmers to reduce wind erosion. This includes the planting of trees, shrubs, or other vegetation; usually perpendicular or nearly so to the wind direction. Wind erosion is one of the weakest types of erosion.  There are different types of wind erosion. Creep involves larger particles of soil rolling or sliding along the ground's surface. Saltation is when the wind causes particles (usually dirt) to bounce along the surface of the ground. Most soil is moved by wind through this method.  Suspension occurs when the smallest particles are lifted up and sit suspended in the air, like when dust floats in the air. The wind comes and carries these particles long distances. |
| **Enrichment** | **EXTEND**  Students can try the experiment again using sand instead of dirt. Ask the students: Do they think it will have the same result? What about if there are larger straws used? What about other sources of wind, such as a fan? |
| **Closure** | **ELABORATE**  Although wind is a less powerful force of erosion than moving water, it can still shape landforms, especially in dry regions and in areas that have few or no plants to hold soil in place. Wind can build up dunes, deposit layers of dust, or make a land surface as hard as pavement. |
| **Assessment** | **EVALUATE**  Formative: c |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review erosion by the wind, including what happens when the wind blows on the sand or dirt. Check for understanding by checking the student’s science notebook and model. | Review erosion by the wind, including what happens when the wind blows on the sand or dirt. Ask the student: How long do you think it takes for the wind to completely change the surface of the Earth? Why? | Review erosion by the wind, including what happens when the wind blows on the sand or dirt. Ask the student: Is there a way to make erosion by the wind happen faster, or not happen at all? How would you make this happen? |
| **ELL Strategies** | | |
| *Visual Aids:* Review erosion by wind as described in the lesson, as well the short and long term effects of wind on the Earth’s surface. Show pictures of landforms affected by the wind.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to examine how wind affects landforms. Students can also explore the fast and slower changes by wind erosion and weathering.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about wind erosion compared to the erosion of canyons and other forms you learned about in the previous lesson? Which do you think takes longer? Why? | | |
| **Interactive Technology** | | |
| App: Windy.com  App: Wind Sounds – Wind Music, Relaxing  Game: Shape it Up: Erosion Activity: <http://sciencenetlinks.com/interactives/shapeitup.html>  Game: Legends of Learning: “Art of Destruction”: <https://games.legendsoflearning.com/games/WyJnYW1lcyIsMTM0MF0>= | | |

Lesson 11: What are the components of soil?

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| **Learning Target**  **Objective**  **Standard** | Soil has many components, formed through weathering and erosion.  Students will be able to identify and describe the components of soil; which includes sand, clay, humus, and rocks.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, soil, water, funnel, clear plastic bottles, tray |
| **Books** | Rock on! Soil by Chris Oxlade |
| **Vocabulary** | Soil: The loose upper layer of the Earth’s surface where plants grow, consisting of a mix of organic material and broken bits of rocks and minerals  Topsoil: The rich upper layer of soil in which plants have most of their roots  Subsoil: The weathered material that underlies the surface of the soil; layer under the topsoil  Bedrock: The solid rock that lies under the surface of the ground  Humus: A brown or black material in soil that is formed when plants and animals decay  Organic Matter: Matter that has come from a recently living organism |
| **Procedures** | **ENGAGE**  Ask the students: When a landform changes, what is affected before anything else? Which material was used in the different erosion experiments? Students should come up with “soil,” but what is soil made from? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm the different components in soil, and how erosion affects them.  Book: Rock on! Soil by Chris Oxlade, or use the myON link: <https://www.myon.com/reader/index.html?a=ro_soil_s16>  **EXPLORE**  Video: “What the Dirt on...Dirt?” (3:43): <https://www.youtube.com/watch?v=if29mjcd5bc>  Video: “The Soil Profile - Kids Science Experiments” (3:06): <https://www.youtube.com/watch?v=VeuQeAxJIjs>  Have students return to their pairs. Each group will need: soil, an old tray, a small magnifying glass, a plastic water bottle with a lid, and some water.  Have students collect a handful of soil out on the tray and look at it closely with the magnifying glass. Have students record anything they see in the soil, such as rock, plants, or possibly worms or insects.  Fill a clear plastic water bottle about ¾ full with water. Using a funnel, take a handful of soil and put it in the bottle. Put the lid on tightly and shake the bottle to mix the water and the soil. Place the bottle where it won’t be disturbed to the next day. Have students record what they see.  The next day, have students look at the bottle again. They should see layers from the soil at this point. The bottom layer will be gravel, followed by sand, finer silt, and clay. Above the clay will be the water, which may be discolored from the minerals in the soil. Floating at the top will be the humus. Have students draw a picture and label what they see in their science notebook.  **EXPLAIN**  Soil is a complex mix of minerals, water, air, organic matter, and countless organisms that are the decaying remains of once-living things. Dirt is different than soil: it is soil that has lost the characteristics that give it the ability to support life. Soil serves as media for growth of all kinds of plants. Soil also provides a habitat for animals that account for most of the living things on Earth.  Soil is formed over a long period of time by a number of factors. It can take up to 1000 years for just an inch of soil to form. Soil is partly composed of little bits of rock eroded over thousands of years from underlying bedrock. As erosion breaks down rocks, also called weathering, the rocks turn into soil. Erosion is also the wearing away of topsoil. Topsoil is the top layer of soil, which contains the most organic, nutrient-rich materials, and is the layer needed for crops. |
| **Enrichment** | **EXTEND**  How do different forms of erosion affect soil? Compare and contrast the different types of erosion discussed and how they affect soil and landforms (wind, ice, water.)  Video: “Science - Soil Erosion and Conservation - English” (6:22): <https://www.youtube.com/watch?v=QHyK2M8yiQE> |
| **Closure** | **ELABORATE**  Where there is bare land with water runoff, plants can be planted to hold the soil and keep it from being washed away. To stop erosion, people plant trees to hold the soil together. Grasses, shrubs, and trees planted along waterways will stop water from eroding the banks. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ observations of soil in their science notebooks and their understanding of erosion. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review how erosion changes soil over long periods of time. Show the student different pictures of forms of erosion to check for understanding. | Review how erosion changes soil over long periods of time. Ask the student: Why do you think man made erosion changes landscapes faster than natural erosion? | Review how erosion changes soil over long periods of time. Ask the student: Why is soil so important to preserve from erosion? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different layers of soil described in the lesson, as well as how erosion has impacted them, and/or have the student describe the different layers of soil and forms of erosion.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle soil, including examining the experiment and how the soil has separated. Give them a chance to explore the different forms of erosion for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: Can you explain how soil is affected by erosion before anything else? Why do you think it is important to prevent erosion from taking away all of the topsoil? | | |
| **Interactive Technology** | | |
| App: Virtual Reality: Soil Profile  App: SoilInfo: ISRIC – World Soil Information  App: Soil Explorer: Purdue University  Game: Soil 4 Kids: <https://www.soils4kids.org/> | | |

Lesson 12: How do volcanoes occur and affect landforms on Earth?

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| **Learning Target**  **Objective**  **Standard** | Fast processes such as volcanoes can cause dramatic changes in the Earth’s landforms.  Students will be able to explain how a volcano occurs and changes landforms.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, Play-Doh, empty plastic bottle, vinegar, dish soap, red food coloring, baking soda, funnel, tray, bowls, spoons |
| **Books** | Volcanoes! by Renee Gray Wilburn |
| **Vocabulary** | Volcano: A mountain that opens downward to a pool of molten rock below the surface of the Earth; when pressure builds up, eruptions occur  Erupt: A sudden explosion that sends out rocks, ash, and lava  Plate: A huge piece of rock that helps make up the Earth’s crust  Magma: Liquid rock inside a volcano  Lava: Liquid rock that flows outside of a volcano; it glows red hot to white hot as it flows  Active volcano: A volcano that erupts regularly  Dormant volcano: A volcano that has not erupted for many years, although there is still some activity deep inside  Extinct volcano: A volcano that is no longer active  Ash: Very small fragments of lava or rock blasted into the air by volcanic explosions |
| **Procedures** | **ENGAGE**  Ask the students: What is a volcano? Are there any types of volcanoes that you know? Have you ever visited somewhere with a volcano? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm about volcanoes, and the different possibilities of how they were formed, including their effect on the Earth.  Book: Volcanoes! by Renee Gray Wilburn, or use the myON link: <https://www.myon.com/reader/index.html?a=btr_volcano_f13>    **EXPLORE**  Creekside Learning: Easy Science Experiments for kids: How to Make a Volcano Erupt: <https://creeksidelearning.com/easy-science-experiments-for-kids-how-to-make-a-volcano-erupt/>  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to form groups of 2-6 depending on the class size. Each group will need: their science notebooks, ½ cup of vinegar, 2 tbsp. liquid dish soap, red food coloring, ½ cup baking soda, bowls, empty plastic bottle, a funnel, and a tray.  Using the Play-Doh, form a “volcano” over the top of the empty plastic bottle in a mountain shape, making sure not to cover the top of the bottle. Place the funnel inside of the plastic bottle. In one bowl, put ½ cup of baking soda. In the second bowl, combine ½ cup of vinegar, 2 tbsp. of liquid dish soap, and red food coloring  Carefully dump the baking soda through the funnel into the plastic bottle. Next, dump the vinegar mixture and quickly remove the funnel. The explosion will empty the bottle if the experiment needs to be done again. Have students record the results.  **EXPLAIN**  Video: “Volcano Facts for Kids!” (10:34): <https://www.youtube.com/watch?v=x-6bGUffwtA>  The baking soda and vinegar volcano erupts because of an acid-base reaction. When the vinegar hits the baking soda, the carbon dioxide that is given off is a gas. Carbon dioxide is responsible for the fizzing and bubbling during the eruption. The gas builds up enough pressure to force the liquid out of the top of the bottle. The bubbles of soap help carry the mixture down over the sides of the volcano.  Volcanoes are formed when magma from within the Earth’s upper mantle makes its way to the surface. At the surface, it erupts to form lava flows and ash deposits. Over time as the volcano continues to erupt, it will get bigger and bigger.  The Earth’s crust is made up of huge slabs called plates, which fit together like a puzzle. When these plates move, the friction causes volcanic eruptions near the edges of the plates. These changes affect the Earth the same way that erosion does, but in a much quicker fashion. Volcanoes will be warm at the top and make mud and ash slides. Huge rocks can shoot out and make craters like meteorites. The lava can burn the land and spread a hard layer of ash for miles.  Video: “All About Volcanoes: How They Form, Eruptions & More!” (3:04): <https://www.youtube.com/watch?v=K7Oq9_DU1Mc> |
| **Enrichment** | **EXTEND**  Ask the students: What would happen if volcanoes didn’t erupt? How do you think the Earth would react? |
| **Closure** | **ELABORATE**  In early May 2018, hundreds of small earthquakes were detected in Hawaii on the volcano Kilauea’s East zone, leading officials to issue evacuation warnings. On May 3, the volcano erupted after a 5.0 earthquake earlier in the day. By May 31, 87 homes had been destroyed, and cause additional evacuation orders. |
| **Assessment** | **EVALUATE**  Formative: Check science notebooks for understanding of volcanoes, as well as how volcanoes erupt. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review volcanoes and how they are formed, including how volcanoes get bigger the more often they erupt. Check for understanding. | Review volcanoes and how they are formed, including how volcanoes get bigger the more often they erupt. Ask the student: Are volcanoes related to earthquakes? Why or why not? | Review volcanoes and how they are formed, including how volcanoes get bigger the more often they erupt. Ask the student: Why do you think it’s difficult to predict when volcanoes will erupt? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of a volcano as described in the lesson, and/or have the student describe how a volcano is formed and gets bigger.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to examine a volcano and how it forms, and/or look at pictures of volcanoes.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you apply what you learned to develop a volcano safety kit? Is there a way to stay safe from volcanoes? | | |
| **Interactive Technology** | | |
| App: Volcanoes: Map, Alerts & Ash: The best volcano app!  App: Volcano Updates: Foxy Rocket  App: Volcano 360: Sergey Rumyantsev  Game: Scholastic: Magic School Bus – Blows Its Top: <https://www.scholastic.com/magicschoolbus/games/volcano/index.htm> | | |

Lesson 13: How do earthquakes occur and affect landforms on Earth?

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| **Learning Target**  **Objective**  **Standard** | Fast processes such as earthquakes can cause dramatic changes in the Earth’s landforms.  Students will be able to explain how an earthquake occurs and changes landforms.  4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, strips of cloth, soil, plastic toy houses, plastic tablecloths |
| **Books** | Earthquakes! by Renee Gray-Wilburn |
| **Vocabulary** | Earthquake: Shaking, rolling, or sudden shock of the Earth’s surface  Plate: A huge piece of rock that helps make up the Earth’s crust  Fault: A crack in the Earth’s crust resulting from the displacement of one side with respect to another  Epicenter: The part of the Earth’s surface directly above the focus of an earthquake  Aftershock: A smaller earthquake that occurs after a larger one  Seismic Waves: A wave that travels through the Earth, often the result of an earthquake  Richter Scale: A scale measuring the magnitude of an earthquake, resulting in a number 0 to 10, as measured on a seismograph  Seismograph: A machine that records the shaking of an earthquake  Tsunami: A large ocean wave usually caused by an underwater earthquake or volcanic explosion |
| **Procedures** | **ENGAGE**  Ask the students: What is an earthquake? Have you ever been in an earthquake, or know anyone who has been in an earthquake? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm about earthquakes, the different possibilities of how they happen, including their effect on the Earth.  Book: Earthquakes! by Renee Gray-Wilburn, or use the myON link: <https://www.myon.com/reader/index.html?a=fgwe_earth_s12>  **EXPLORE**  The Owl Teacher: Earthquake Experiments: <https://www.theowlteacher.com/earthquake-experiments/>  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to form groups of 2-6 depending on the class size. Each group will need: their science notebooks, two strips of cloth (representing two different plates in the Earth,) soil, plastic houses, and a plastic tablecloth.  Spread the plastic tablecloth down on the table. Lay out the two strips of cloth next to each other. The strips of cloth represent two different plates. The space between represents a fault line. Cover the middle of the strips with the soil. Then, place a few plastic houses on the soil. Have students draw and label a picture of the setup in their science notebook.  One student should be on one end of one cloth, and the other student on the opposite end of the other cloth. Have the two students pull the cloth in opposite direction. When it is pulled, the students can see the “fault line” right away. The destruction (the upside down houses) is very obvious. Have students experiment with pulling slow or fast and noticing the destruction. Students should make notes in their science notebooks.  **EXPLAIN**  Video: “What Causes Earthquakes” (4:49): <https://www.youtube.com/watch?v=FIgksa3x11w>  Earthquakes are the shaking, rolling, or sudden shock of the Earth’s surface. They are the Earth’s natural means of releasing pressure. More than a million earthquakes rattle the world each year. Earthquakes can be felt over large areas, although they usually last less than one minute.  There are about twenty plates along the surface of the Earth that move continuously and slowly past each other. When the plates squeeze or stretch, huge rocks form at their edges, and the rocks shift with great force, causing an earthquake. As the plates move, they put forces on themselves and each other. When the force is large enough, the crust is forced to break. When the break occurs, the stress is released as energy, which moves through the Earth in the form of waves. A fault is an area of stress in the Earth where the broken rocks slide past each other, causing a crack in the Earth’s surface.  Earthquakes change the Earth’s surface faster than erosion, happening in a matter of minutes rather than a matter of years. In addition to ground movements, other surface effects include changes in the flow of groundwater, landslides, and mudflows. Earthquakes can do significant damage to buildings, bridges, pipelines, railways, embankments, dams, and other structures. Underwater earthquakes can cause giant waves called tsunamis.  Video: “Earthquake Facts for Kids!” (10:27): <https://www.youtube.com/watch?v=QNbjqWE7Yhc> |
| **Enrichment** | **EXTEND**  Ask the students: What would happen if earthquakes didn’t take place? How do you think the Earth would react? |
| **Closure** | **ELABORATE**  Unfortunately, scientists cannot yet predict earthquakes. The best they can do is point out where fault lines are so people know where earthquakes are likely to occur. The largest earthquake ever recorded was in Chile in 1960. It measured a 9.6 on the Richter Scale. |
| **Assessment** | **EVALUATE**  Formative: Check science notebooks for understanding of earthquakes, as well as how earthquakes erupt. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review earthquakes and how they occur, including how the movement of the plates in the Earth make them happen. Check for understanding. | Review earthquakes and how they occur, including how the movement of the plates in the Earth make them happen. Ask the student: Are volcanoes related to earthquakes? Why or why not? | Review earthquakes and how they occur, including how the movement of the plates in the Earth make them happen. Ask the student: Why do you think it’s difficult to predict when earthquakes will happen? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the results of an earthquake as described in the lesson, and/or have the student describe how an earthquake affects the Earth.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to examine an earthquake and its effects, as well as looking at videos or pictures of earthquakes.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you apply what you learned to develop an earthquake safety kit? Is there a way to stay safe from earthquakes? | | |
| **Interactive Technology** | | |
| App: Quakefeed Earthquake Alerts  App: Earthquake Safety Tips: Babybus  App: Earthquake Simulator 2D  App: Expeditions: Earthquakes  Game: USGS: Earthquakes for Kids: <https://earthquake.usgs.gov/learn/kids/>  Game: BrainPOP: Earthquake Game: <https://www.brainpop.com/games/earthquakegame/> | | |

Lesson 14: How can erosion be slowed down by plants?

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| **Learning Target**  **Objective**  **Standard** | Erosion can be slowed down by plants.  Students will be able to identify the ways that plants can affect erosion.  4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, soil, dead leaves (if possible - or rocks,) 2 liter bottles, plants, a knife, bowls, a pitcher, a measuring cup, water |
| **Books** | Erosion: Changing Earth’s Surface by Robin Koontz |
| **Vocabulary** | Erosion: The action or process of wearing away by the action of water, wind, or glacial ice  Weathering: The process where rocks are worn away or broken down into smaller pieces by wind, water, or plants  Deposition: The dropping off or depositing of eroded rock |
| **Procedures** | **ENGAGE**  Review the different types of erosion with the class. Ask the students: What causes erosion? Do you think erosion can be stopped? What about slowed down? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm about the different types of erosion, as well as thinking of solutions to slow erosion down.  Book: Erosion: Changing Earth’s Surface by Robin Koontz, or use the myON link: <https://www.myon.com/reader/index.html?a=as_erosi_f06>  **EXPLORE**  Video: “Erosion and Soil” (7:35): <https://www.youtube.com/watch?v=im4HVXMGI68>  This experiment can be done with an entire class. As a class, set up three different types of “land.” You will need: soil, dead leaves (if possible - or rocks,) 2 liter bottles, plants, a knife, bowls, a pitcher, a measuring cup, and water.  Cut one side off of the three 2 liter bottles (see video.) Fill each one with the same amount of soil. In one, plant small plants in the soil. In the second, put large rocks or dead leaves. In the third, leave the soil alone. Place each of the bottles on the edge of a table or ledge. Underneath where the bottles would pour out, place a bowl.  Ask the students: Which landscape will allow the sediment to erode the most? Give students a chance to make a prediction in their science notebook.  Pour 1-2 cups of water into the bottle with the soil. Ask students to make observations about how much sediment fell into the bowl and record it in their science notebooks. Repeat the process with the bottles with the dead leaves (or rocks,) and the plants. Have students record their observations with each of the 2 liter bottles filling with water. Ask students to compare and contrast the different results of the experiment, and make predictions as to why this is happening.  **EXPLAIN**  The bottle with the plants had the cleanest amount of water. This is because the roots of the plants grew into the soil, and almost like little fingers, the roots are holding the soil together. When it rains, the roots hold the soil together. The roots of the plants also help hold the water in. Roots go deep into the ground and make sure the soil stays in place. They get the nutrients from the soil, but also keep erosion from washing away the soil.  When a raindrop hits soil that is not protected by a cover of vegetation and where there are no roots to bind the soil, it has the impact of a bullet. Soil particles are loosened, washed down the slope of the land and either end up in the valley or are washed away out to sea by streams and rivers. Erosion removes the topsoil first. Once this nutrient-rich layer is gone, few plants will grow in the soil again. Without soil and plants the land becomes desert like and unable to support life.  One way to help combat soil erosion uses plants, which have extensive root systems that can help to "grab onto" soil and keep it clumped together. You might have seen this when you pulled a plant such as a weed or vegetable out of the ground and a clump of soil clung to its roots. Plants also help absorb some of the water in the soil. These effects make it harder for water to wash the soil away. Plants also help reduce erosion in other ways, such as breaking the wind that might blow dry topsoil away. |
| **Enrichment** | **EXTEND**  Students can try the experiment again, but use different fillers on top of the soil to see if it makes a difference (gravel, leaves, etc.) What about wind? Would the plants help with wind erosion as well? |
| **Closure** | **ELABORATE**  Soil erosion is partially caused by rain runoff washing away the soil. “Runoff” refers to the water that flows over the soil’s surface. It occurs when the soil is saturated or unable to absorb more water. Plants also help reduce erosion in other ways, such as breaking the wind that might blow dry topsoil away. |
| **Assessment** | **EVALUATE**  Formative: Check science notebooks for the experiment results, as well as how students defined how plants prevent erosion. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review erosion by the wind and water, including how plants protect soil from each type. Check for understanding by checking the student’s science notebook and model. | Review erosion by the wind and water, including how plants protect soil from each type. Ask the student: How long do you think it takes for the wind and water to completely change the surface of the Earth with plants? Why? | Review erosion by the wind and water, including how plants protect soil from each type. Ask the student: Would plants be able to prevent ice erosion from occurring? Why or why not? |
| **ELL Strategies** | | |
| *Visual Aids:* Review erosion by wind as described in the lesson, as well the short and long term effects of water and wind on plants on the Earth’s surface. Show pictures of how plants prevent erosion.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to examine how plants slow down erosion. Students can also explore the fast and slower changes by wind erosion and weathering.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about the effect of erosion on plants as compared to on plain soil? How would erosion change with different types of plants? | | |
| **Interactive Technology** | | |
| Interactive: Dengarden: Best Plants and Erosion Controls: <https://dengarden.com/landscaping/Good-Plants-and-Erosion-Controls-for-Slopes> | | |

Lesson 15: How can erosion be slowed down by people?

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| **Learning Target**  **Objective**  **Standard** | Erosion can be slowed down by people.  Students will be able to identify the ways that people can slow down erosion.  4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, long, shallow, clear Tupperware containers; sand; small rocks (aquarium gravel,) popsicle sticks, buckets full of water |
| **Books** | The World’s Most Amazing Dams by Ann Weil |
| **Vocabulary** | Erosion: The action or process of wearing away by the action of water, wind, or glacial ice  Dam: A barrier preventing the flow of water or of loose solid materials (such as soil or snow)  Hydroelectric Power: Electricity generated by the force of falling water |
| **Procedures** | **ENGAGE**  Review the different types of erosion with the class. Review how plans can stop soil erosion. Ask the students: Besides planting trees and other plants, how do you think humans can slow down or stop erosion? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to get into partners to brainstorm about the different types of erosion, as well as thinking of solutions to slow erosion down.  Book: The World’s Most Amazing Dams by Ann Weil, or use the myON link: <https://www.myon.com/reader/index.html?a=ltten_dams_f11>  **EXPLORE**  Zoom Activities: Build a Dam: <http://pbskids.org/zoom/activities/sci/buildadam.html>  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to form groups of 2-6 depending on the class size. Each group will need: a long, shallow, clear Tupperware container; sand; small rocks (aquarium gravel,) popsicle sticks, and a bucket full of water.  Fill the Tupperware container ⅔ of the way full of sand. Dig a path of a river in the sand. Remind students that this represents erosion in the sand.  This experiment can be done with an entire class. As a class, set up three different types of “land.” You will need: soil, dead leaves (if possible - or rocks,) 2 liter bottles, plants, a knife, bowls, a pitcher, a measuring cup, and water. Choose a spot somewhere along the river to build the dam.  Using popsicle sticks and small rocks, construct a dam that will only let a little bit of the water come through. Keep in mind that the deeper the water, the greater the water pressure. So, the bottom of the dam will need to support more pressure than the top of the dam. One example might be to build the dam in a triangular shape with the bottom being wider and able to support more pressure. Students should draw a picture and label their dam in their science notebook.  Test the dam by pouring water from a bucket down the river path. How did the dam work? Have students record their results in their science notebook.  **EXPLAIN**  Video: “Prevention of soil erosion” (1:23): <https://www.youtube.com/watch?v=Lyad6qVg6N0>  The strongest type of erosion happens from the water. A dam is a large wall or barrier that obstructs or stops the flow of water, forming a reservoir or a lake. A dam is usually built in conjunction with a hydroelectric power station to provide electricity. The type of dam built in any given situation depends on factors such as the intended purpose, environmental considerations, available finances, and the location. Beavers create their own dams from sticks and mud as protection from predators, and also to help provide easy access to food.  When the Hoover Dam was completed, it was both the world’s largest concrete structure and largest hydroelectric power station. The Hoover Dam is made up of enough concrete to make a two lane highway from New York to San Francisco (about 4,000 miles.)  Video: “Hoover Dam Explained for Children” (4:27): <https://www.youtube.com/watch?v=ac0leEzhwUM> |
| **Enrichment** | **EXTEND**  Students can try the experiment again, but use different materials found around the classroom to make their dam stronger. Ask the students: What materials would you want in addition to what is provided to make your dam stronger? |
| **Closure** | **ELABORATE**  Dams supply about a sixth of the world’s electricity and they significantly reduce the risk of floods and droughts. They also make water easier to access, especially in desert like areas, where water is in low supply. |
| **Assessment** | **EVALUATE**  Formative: Check science notebooks for the experiment results, as well as how students defined how dams can prevent erosion. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review erosion by the water and how dams can affect the landscape and are created. Check for understanding by checking the student’s science notebook and model. | Review erosion by the water and how dams can affect the landscape and are created. Ask the student: How do you think dam locations are determined, and what do you think is taken into consideration for different locations? | Review erosion by the water and how dams can affect the landscape and are created. Ask the student: How do different areas benefit from hydroelectricity? Is this a sustainable form of electricity? Why or why not? |
| **ELL Strategies** | | |
| *Visual Aids:* Review erosion by water as described in the lesson, as well as how a dam affects this type of erosion. Show different pictures of dams around the world.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to examine how dams affect erosion, including different dams around the world. Students can also explore the different dams around the classroom and how they were built.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about the different dams created around the classroom? What do they have in common, and what makes them effective? | | |
| **Interactive Technology** | | |
| Interactive: Teaching Kids the Importance of Preventing Soil Erosion: <http://community.today.com/parentingteam/post/teaching-kids-the-importance-of-preventing-soil-erosion>  Dams: Games: http://idahoptv.org/sciencetrek/topics/dams/games.cfm | | |

**Earth Science Unit Assessment**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What are the layers of the Earth?

2. What is a fossil?

3. Describe how Pangea turned into the continents as we currently see them.

4. What are five different types of landforms?

5. Describe the difference between erosion and weathering.

6. Describe the difference between water, air, and wind erosion.

7. List three types of soil.

8. How do earthquakes and volcanoes affect the landforms?

9. How can erosion be slowed down by plants?

10. How can humans react to changes made by the Earth’s processes?

Student Research Project: How can people be prepared for natural disasters?

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| **Learning Target**  **Objective**  **Standard** | Even though natural disasters often cannot be predicted, people can do different things to prepare for each one.  Students will be able to identify ways to prepare for a natural disaster.  4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.  W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.  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  W.4.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.  RI.4.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.  RI.4.7: Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.  SL.4.2: Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.  SL.4.5: Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. |
| **Materials** | Computer, white boards, white board markers, science journals, pencils, crayons, access to the Internet for students |
| **Books** | Can we Protect People from Natural Disasters? by Catherine Chambers  Children’s True Stories: Surviving Earthquakes by Michael Burgan  Children’s True Stories: Surviving Floods by Elizabeth Raum  Children’s True Stories: Surviving Hurricanes by Elizabeth Raum  Children’s True Stories: Surviving Tornadoes by Elizabeth Raum  Children’s True Stories: Surviving Tsunamis by Kevin Cunningham |
| **Vocabulary** | Earthquake: Rumbling, shaking or rolling of the Earth’s surface; happening when two plates in the Earth slip past or break apart from each other  Flood: A large amount of water covering an area of land that is usually dry  Hurricane: A large rotating storm with high wind speeds that form over warm waters in tropical areas  Tornado: A violent rotating column of air extending from a thunderstorm to the ground  Tsunami: A large ocean wave usually caused by an underwater earthquake or volcanic explosion |
| **Procedures** | **ENGAGE**  Ask the students: What are the different natural disasters that could happen on the Earth? Using a circle map, brainstorm the different ideas the students have about what makes a natural disaster. Go over a few similarities and differences between the different types.  Ask the students: How would you prepare for these different natural disasters? Even though natural disasters can’t always be predicted, are there ways to try and stay safe? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm about the different ways to prepare for a natural disaster.  Video: “Big Idea 8: Natural Hazards Affect Humans” (4:26): <https://www.youtube.com/watch?v=n73qtEojP_Y>  Video: “Kids can help Prepare for Natural Disasters” (1:48): <https://www.youtube.com/watch?v=uUvkZ_bW60w>  **EXPLORE**  Give the students an opportunity to choose which natural disaster they would like to study. Topics may include, but are not limited to: earthquakes, floods, hurricanes, tornadoes, and tsunamis. Several students will need to study each topic due to the class size.  Introduce the different websites and books the students will be able to use to write their research.  Can we Protect People from Natural Disasters? by Catherine Chambers, or use the myON link: <https://www.myon.com/reader/index.html?a=ed_natds_s15>  Children’s True Stories: Surviving Earthquakes by Michael Burgan, or use the myON link:<https://www.myon.com/reader/index.html?a=chtrst_surear_f11>    Children’s True Stories: Surviving Floods by Elizabeth Raum, or use the myON link: <https://www.myon.com/reader/index.html?a=chtrst_surfld_f11>  Children’s True Stories: Surviving Hurricanes by Elizabeth Raum, or use the myON link: <https://www.myon.com/reader/index.html?a=chtrst_surhur_f11>  Children’s True Stories: Surviving Tornadoes by Elizabeth Raum, or use the myON link: <https://www.myon.com/reader/index.html?a=chtrst_surtor_f11>  Children’s True Stories: Surviving Tsunamis by Kevin Cunningham, or use the myON link: <https://www.myon.com/reader/index.html?a=chtrst_surtsu_f11>  Natural Disasters for Kids: <https://www.ready.gov/kids>  FEMA: Disaster Fact Sheets for Kids: <https://www.fema.gov/media-library/assets/documents/34288>  Once the students have chosen a topic, they will conduct research on the topic. Students can work in pairs or independently depending on the teacher’s discretion. Students should take notes regarding the natural disaster they chose, and include the following information:   * The name of the natural disaster * How the natural disaster is formed or happens * Is it able to be predicted? Why or why not? * What type of warning systems are in place for the natural disaster? * What should people do to prepare before the natural disaster strikes? * What happens before, during, and after a natural disaster that can be harmful? * What are some solutions to reduce the impact on humans?   Based on their research, the paper should be 2-4 pages long, with more than one source used and listed. Students may use an outline to take notes on their object.  The students will also be asked to give a presentation to the class. They may want to practice this several times. They must be able to describe the natural disaster and the solutions to protect humans to the class, including the researched components. They should also have a visual component: a picture or chart based on their research.  Students may need several days to complete the research activity.  **EXPLAIN**  A natural disaster is a major event caused by the natural processes of the Earth. A natural disaster can cause loss of life or property damage, and leaves some economic damage after it has been completed. Disasters occur when hazards meet vulnerability. If a strong earthquake happens in uninhabited areas, it is usually not seen as a disaster.  Some kinds of disasters are more common in some places than others. Cities near fault lines, for example, are at more danger from earthquakes, while homes in river valleys may be in more danger of flooding. There isn’t any way to avoid natural disasters, but knowing what kinds of disasters are most likely where people live and learning what to do if a disaster happens can help people stay safe. |
| **Enrichment** | **EXTEND**  Have the students create a poster at home of the natural disaster they studied. The poster should be an accurate representation of the natural disaster. It should be easy to see from a distance and easy to present. The poster should be able to be identified without using much prior knowledge about it. The student should have a picture of the natural disaster, some interesting facts, and the name of the disaster. The poster should be the student’s original work. |
| **Closure** | **ELABORATE**  Studying what to do in a natural disaster is incredibly important. Choosing a place to meet near your home is also important should the family become separated. Memorizing important phone numbers, taking a basic first aid class, and making a 72-hour survival kit can also be important during a natural disaster. These kits should contain all the essential things to survive for up to three days. |
| **Assessment** | **EVALUATE**  Summative: See rubric |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Discuss the different types of natural disasters. Student may require assistance in writing or drawing and can be paired up with a student at a higher level. | Discuss the different types of natural disasters. Student may be able to work more independently with teacher support. | Discuss the different types of natural disasters. Student may be able to work completely independently, as well as being paired with a student of a lower ability level. |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different vocabulary words described in the lesson, and/or have the student discuss different types of natural disasters, and why they should be studied.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to explore different natural disasters. Repeat going over the different objects until they can be repeated and explained.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How could you sort the different types of natural disasters? Are some natural disasters more severe than others? Why or why not? | | |
| **Interactive Technology** | | |
| App: Disaster Detector: Smithsonian Institution  Game: NeoK12: Natural Disasters: <https://www.neok12.com/Natural-Disasters.htm> | | |

Fourth Grade Writing Rubric

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| **Standard** | **Exceeds Expectations - 3** | **Meets Expectations - 2** | **Below Expectations - 1** |
| 4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. | Student wrote many details about the impact to natural disasters on humans and how to prevent them. | Student wrote some details about the impact to natural disasters on humans and how to prevent them. | Student wrote few to no details about the impact to natural disasters on humans and how to prevent them. |
| W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.  W.4.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. | Student participated fully in research. | Student somewhat participated in research. | Student did not participate in class research. |
| 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 | Student used at least 2 sources to find information about their natural disaster. | Student used one source to find information about their natural disaster. | Student did not use sources to find out information about their natural disaster. |
| RI.4.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. | Student used two sources to connect information about their natural disaster. | Student used one source to locate information about their natural disaster, or did not make a connection. | Student did not use sources or make a connection for information about their natural disaster. |
| RI.4.7: Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, timelines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. | Student found many similarities in at least two sources regarding information and pictures/diagrams about their topic. | Student found some similarities in at least two sources regarding information and pictures about their topic. | Student did not find similarities regarding information and pictures about their topic. |
| SL.4.2: Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. | Student is able to recall at least three details and present them orally regarding their topic. | Student is able to recall one to two details and present them orally regarding their topic. | Student is not able to recall details or present them orally regarding their topic. |
| SL.4.5: Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. | Student was able to clearly add to their drawing or object to express the facts learned. | Student was somewhat able to add to their drawing or object to express the facts learned. | Student was unable to add to their drawing or object to express the facts learned. |

STEM/Engineering Unit Project

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| **Learning Target**  **Objective**  **Standards** | Engineering design is a process used to solve real world problems. Students will use the five-step engineering design process to solve a problem.  Students will brainstorm, design, and build a structure that will be able to survive an earthquake.  4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.  3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.  3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of a problem.  3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. |
| **Materials** | Computer, BrainPop login, science notebooks, pencils, sturdy cardboard, thick rubber bands, tennis balls, large binder clips, paint stirrer, masking tape, rulers, coffee stirrers, ¼ pound modeling clay (or marshmallows,) manila file folders, glue |
| **Books** |  |
| **Vocabulary** | Earthquake: Shaking, rolling, or sudden shock of the Earth’s surface; the Earth’s natural means of releasing stress |
| **Design Process** | **ASK**  Identify the problem. Identify the constraints  **IMAGINE** Identify some possible solutions  **PLAN** Draw a plan and identify the materials  **CREATE** Use the plan and create. Test it!  **IMPROVE** Modify your design to make it better. Test it out! |
| **Procedures** | **ASK**  Review earthquakes with your students. Ask students: How do you think an earthquake can damage a building? Tell students: You are going to design, build, and test a structure that can withstand an earthquake. Have students brainstorm materials they could possibly need, and how it might work or be built. As a class, take a look at some different videos showing buildings made to withstand earthquakes.  Video: “World’s Largest Earthquake Test” (2:26): <https://www.youtube.com/watch?v=hSwjkG3nv1c>  Video: “Earthquake Protector: Shake Table Crash Testing” (0:42):  <https://www.youtube.com/watch?v=kzVvd4Dk6sw>  Video: “Making Buildings Better Withstand Earthquakes - Science Nation” (4:54): <https://www.youtube.com/watch?v=c25HuZeQsyo>  **IMAGINE**  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) in groups of 3-5 (depending on class size.) Students should explore the given materials: for the shake table: sturdy cardboard, thick rubber bands, tennis balls, large binder clips, paint stirrer, masking tape, and a ruler. For the structure: 20-30 coffee stirrers, ¼ pound modeling clay (or marshmallows,) manila file folder, and a ruler.  **PLAN**  Have students draw a picture of what they want to build. Have the students label the parts of the building, including what materials should be on each portion. Ask students to think about how they can use the coffee stirrers and clay or marshmallows to build a structure that won’t collapse when shaken. The building should be at least 6 inches tall.  **CREATE**  PBS Kids Design Squad: Build Seismic Shake-up: <http://pbskids.org/designsquad/build/seismic-shake-up/>  Students should use the drawings to make a replica of their structure. Explain to students that scientists often make mistakes, and it is only in these mistakes that we can learn and grow. They can use any materials that they would like. To add another challenge, prices can be added to the materials, and a budget given. Have students participate in Carousel Feedback (<https://www.kaganonline.com/>) to give others ideas of what can be changed before the structures are tested.  To test the building, each student will make a shake table. They will need: 2 pieces of sturdy cardboard (about 8 ½” by 11”,) 2 thick rubber bands, 2 tennis balls, 2 large binder clips, a paint stirrer, masking tape, and a ruler. Wrap the rubber bands around the width of both pieces of cardboard. Space them about 4 inches apart. Slide the two tennis balls in between the pieces of cardboard, and position them underneath each rubber band. Tape the paint stirrer under the top piece of cardboard like a handle. Hold the bottom of the shake table with one hand. With the other hand, pull the handle, and let it go.  Using the coffee stirrers, glue and modeling clay or marshmallows, build a structure. Attach the base directly to the manila folder and build up from there. Students should draw a picture of their finished structure in comparison to their original plan.  To test the building, attach the file folder with the building on it to the top of the shake table with the binder clips. Use one hand to hold the bottom of the shake table against a surface, pull the handle with the other, and let go to create an earthquake. Record the results. What happened? What did testing tell them about the building? How safe would they feel if they were inside during an earthquake?  **IMPROVE**  Once the buildings have been tested, some of them may end up breaking. Students may make modifications based on feedback from peers, or feedback from the teacher. Materials can be added or taken away. Ask the students: If you had different materials, what else would you add? How would you make it better?  If the building falls over, the base may be too small. Make it wider and sturdier. If the building collapses, add some triangle shapes. Triangles are stronger than squares or rectangles because all three sides of the triangles carry some of the load. If the building wobbles, make sure all parts are securely fastened together or add cross-braces for more stability. |
| **Enrichment** | Discuss other materials that could be used to make buildings, such as wood or bricks, as in the videos they saw. Ask the students: Could the materials in class be supersized to make a full-sized building? Why or why not? |
| **Closure** | Discuss how knowing the properties of materials assisted in the students creating the buildings. What additional buildings would they want to use? What materials would they not want to use? |
| **Assessment** | Students should be graded based on the rubric. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| As the students are working, some may need help with construction and/or evaluating whether the designs were successful or not. Students can be paired based on ability. | Students should be able to create a building either independently or with a partner. Students may need prompting to identify and adjust for any problems with the building. | Students should be able to successfully create a building, and identify any problems it had, as well as identifying a solution to the problem. They should also be able to assist students who are struggling. |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different types of earthquake-proof buildings, as well as exploring the different buildings made during the lesson.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to test out the different buildings and how they work. Describe the differences between them, and what makes each one effective.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 3)** | | |
| Ask students: How would you test a building like this if it was full sized? Would stirrers work, or would you need something stronger? Would you test a model or a full sized version first? Why? | | |
| **Interactive Technology** | | |
| App: My Earthquake Alerts & Feed; US & Worldwide Earthquake  Interactive: USGS: Simulations for Earthquake Terms and Concepts: <https://earthquake.usgs.gov/learn/animations/> | | |

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|  | Unsatisfactory Effort (0 points) | Effort Needs Improvement (1 point) | Satisfactory Effort (2 points) | Outstanding Effort (3 points) |
| I contributed to the team work. |  |  |  |  |
| I exhibited scientific thinking. |  |  |  |  |
| I maintained a positive attitude. |  |  |  |  |
| I completed the building task. |  |  |  |  |
| I reflected on my work. |  |  |  |  |

Grading Myself

Grading My Team

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory Effort (0 points) | Effort Needs Improvement (1 point) | Satisfactory Effort (2 points) | Outstanding Effort (3 points) |
| My team worked well together. |  |  |  |  |
| My team displayed problem-solving skills. |  |  |  |  |
| My team had a positive attitude. |  |  |  |  |
| My team completed the building task. |  |  |  |  |
| My team discussed and reflected on our work. |  |  |  |  |

Graded by my Teacher

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory Effort (0 points) | Effort Needs Improvement (1 point) | Satisfactory Effort (2 points) | Outstanding Effort (3 points) |
| Student cooperated with team. |  |  |  |  |
| Student exhibited scientific thinking. |  |  |  |  |
| Student maintained a positive attitude. |  |  |  |  |
| Team completed the building task. |  |  |  |  |
| Student reflected on work. |  |  |  |  |

<http://www.morethanaworksheet.com/wp-content/uploads/2015/07/STEM-Rubric.pdf>

Websites/Videos

Mirriam-Webster Word Central: <http://www.wordcentral.com/>

Kagan: <https://www.kaganonline.com/>

Ducksters: Composition of the Earth: <https://www.ducksters.com/science/composition_of_the_earth.php>

National Geographic Kids: Structure of the Earth!: <https://www.natgeokids.com/uk/discover/geography/physical-geography/structure-of-the-earth/>

Kids Dinosaur: What are fossils?: <https://kidsdinos.com/what-are-fossils/>

Eagleford Texas: A Kid’s Guide to Fossil Formation: <http://eaglefordtexas.com/kids-guide-fossil-formation-eaglefordtexas-com/>

One kids: Weathering and erosion: <http://www.onegeology.org/extra/kids/earthprocesses/weathering.html>

Kids Discover: Erosion! The Ever-changing Earth: <https://www.kidsdiscover.com/teacherresources/erosion-ever-changing-earth/>

Ducksters: Earth Science for Kids: Erosion: <https://www.ducksters.com/science/earth_science/erosion.php>

Soil 4 Kids: <https://www.soils4kids.org/>

Weather WizKids: Earthquakes: <http://www.weatherwizkids.com/weather-earthquake.htm>

“Structure of the Earth/The Dr. Bionics Show/Educational Videos for Kids” (3:12): <https://www.youtube.com/watch?v=eXiVGEEPQ6c>

Playdough to Plato: Layers of the Earth:<https://www.playdoughtoplato.com/layers-of-the-earth/>

“Could I Dig a Hole Through the Earth?” (4:21): <https://www.youtube.com/watch?v=oEW_Qwj6ZCE>

“WHAT’S A FOSSIL?” (2:34):<https://www.youtube.com/watch?v=3rkGu0BItKM>

“Make a Fossil: a fun, at-home science experiment” (2:27): <https://www.youtube.com/watch?v=E5YHZ4RGraI>

“Bill Nye the Science Guy S04E19 Fossils” (25:43):<https://www.youtube.com/watch?v=oTqWjPWeyN4>

“Fossil Science Experiment for kids! #1” (7:01): <https://www.youtube.com/watch?v=q0-HfSlK1Gw>

“Exploring Fossil Records, How Fossils Are Formed, Interesting & Educational Videos for Kids” (14:48): <https://www.youtube.com/watch?v=sPFiwW8J3sY>

“7 Continents Song/Seven Continents Song” (3:11): <https://www.youtube.com/watch?v=7yXDYvWSswI>

Continent printout: <http://alittlepinchofperfect.com/world-map-geography-activities-for-kids/>

“Continental Drift 101/National Geographic” (1:21): <https://www.youtube.com/watch?v=Wq9kLzm36h0>

“Space Shuttle – Beauty of the Earth (HD)” (7:29): <https://www.youtube.com/watch?v=vZ50yRcvqjs>

“Plate Tectonics - Heat Moves Matter” (6:05):<https://www.youtube.com/watch?v=SiUtml2qZkU>

“Pangaea Animation: (0:29):<https://vimeo.com/14258924>

“Bill Nye Plate Tectonics, Volcanoes and Earthquakes” (7:18): <https://www.youtube.com/watch?v=1PVMs2NSdmc>

Sheppard Software: All About World Geography:<http://www.sheppardsoftware.com/World_Continents.htm>

World Geography Games:<http://world-geography-games.com/>

Ginger Snaps: Landform Flipbook: <http://gingersnapstreatsforteachers.blogspot.com/2012/09/landform-flipbook.html>

Landform template: <https://drive.google.com/file/d/1UyQixe7WQJtxHdi1OHi2VguBrFeLRS-n/view>

Geology for Kids: Landforms: <https://kidsgeo.com/geology-for-kids/landforms/>

Kiddle: Landform facts: <https://kids.kiddle.co/Landform>

National Geographic: Landforms: <https://www.nationalgeographic.org/topics/landforms/>

“Landforms, Hey!: Crash Course Kids #17.1” (3:57):<https://www.youtube.com/watch?v=FN6QX43QB4g>

“Landforms” (7:32): <https://www.youtube.com/watch?v=hh3vZc03f1s>

“Bill Nye the Science Guy S03E04 Rocks & Soil” (25:44): <https://www.youtube.com/watch?v=XIebFtd-t8Y>

BL: Chocolate Cookie Erosion: [https://betterlesson.com/lesson/644812/chocolate-cookie-erosion#](https://betterlesson.com/lesson/644812/chocolate-cookie-erosion)

“Weathering and Erosion: Crash Course Kids #10.2” (4:05):<https://www.youtube.com/watch?v=R-Iak3Wvh9c>

“Bill Nye the Science Guy S05E14 Erosion” (25:45): <https://www.youtube.com/watch?v=0e3D2RB-bqI>

“Four ways to understand the Earth’s age - Joshua M. Sneideman” (3:44):<https://www.youtube.com/watch?v=tkxWmh-tFGs>

Google Earth Engine: Timelapse:<https://earthengine.google.com/timelapse/?location=aral-sea>

“The Grand Canyon!” (4:18):<https://www.youtube.com/watch?v=oZZEJMtLOKU>

AccuWeather: Ten Spectacular Landmarks Forged by Nature:<https://www.accuweather.com/en/weather-news/landmarks-forged-by-nature/28993150>

Tina’s dynamic homeschool plus: Erosion Hands-on Easy Homeschool Science Activity:

<http://www.tinasdynamichomeschoolplus.com/2016/02/05/erosion-hands-on-easy-homeschool-science-activity/#_a5y_p=4986287>

“Moving Water Shapes the Land” (2:57):<https://www.youtube.com/watch?v=n0n3vEul0Hc>

Tales of Frogs & Cupcakes: Ice Erosion:<http://frogsandcupcakes.blogspot.com/2012/02/ice-erosion.html>

“Melting Glacier – Ice Breaking off” (3:05):<https://www.youtube.com/watch?v=q2ARiPPtvWo>

“Glacial Movement and Erosion” (3:43):<https://www.neok12.com/video/Glaciers/zX575a5d675a5d5758714273.htm>

Glaciers Change the Land:<https://www.ducksters.com/science/earth_science/glaciers.php>

“Wind erosion experiment” (1:35):<https://www.youtube.com/watch?v=k3yQGOHSd4M>

“Wind Erosion (English version)”  
(3:03):<https://www.youtube.com/watch?v=PQmon7Rj6ns>

Legends of Learning: “Art of  
Destruction”:<https://games.legendsoflearning.com/games/WyJnYW1lcyIsMTM0MF0>=  
“What the Dirt on...Dirt?” (3:43):<https://www.youtube.com/watch?v=if29mjcd5bc>

“The Soil Profile - Kids Science Experiments”  
(3:06):<https://www.youtube.com/watch?v=VeuQeAxJIjs>

“Science - Soil Erosion and  
Conservation - English” (6:22):<https://www.youtube.com/watch?v=QHyK2M8yiQE>

Soil 4 Kids:<https://www.soils4kids.org/>

Creekside Learning: Easy Science  
Experiments for kids: How to Make a Volcano Erupt:<https://creeksidelearning.com/easy-science-experiments-for-kids-how-to-make-a-volcano-erupt/>

“Volcano Facts for Kids!” (10:34): <https://www.youtube.com/watch?v=x-6bGUffwtA>

“All About Volcanoes: How They Form, Eruptions & More!” (3:04): <https://www.youtube.com/watch?v=K7Oq9_DU1Mc>

Scholastic: Magic School Bus – Blows Its Top:<https://www.scholastic.com/magicschoolbus/games/volcano/index.htm>

The Owl Teacher: Earthquake Experiments:<https://www.theowlteacher.com/earthquake-experiments/>

“What Causes Earthquakes” (4:49):<https://www.youtube.com/watch?v=FIgksa3x11w>

“Earthquake Facts for Kids!” (10:27):<https://www.youtube.com/watch?v=QNbjqWE7Yhc>

“Erosion and Soil” (7:35):<https://www.youtube.com/watch?v=im4HVXMGI68>

Zoom Activities: Build a Dam:<http://pbskids.org/zoom/activities/sci/buildadam.html>

“Prevention of soil erosion” (1:23):<https://www.youtube.com/watch?v=Lyad6qVg6N0>

“Hoover Dam Explained for Children” (4:27):<https://www.youtube.com/watch?v=ac0leEzhwUM>

Fourth grade: QUIZIZZ:<https://quizizz.com/admin/quiz/583b5375534ea7f63a563e34/landforms-4th-grade>

“Big Idea 8: Natural Hazards Affect Humans” (4:26):<https://www.youtube.com/watch?v=n73qtEojP_Y>

“Kids can help Prepare for Natural Disasters” (1:48):<https://www.youtube.com/watch?v=uUvkZ_bW60w>

FEMA: Disaster Fact Sheets for Kids:<https://www.fema.gov/media-library/assets/documents/34288>

“World’s Largest Earthquake Test” (2:26):<https://www.youtube.com/watch?v=hSwjkG3nv1c>

“Earthquake Protector: Shake Table Crash Testing” (0:42): <https://www.youtube.com/watch?v=kzVvd4Dk6sw>

“Making Buildings Better Withstand Earthquakes - Science Nation” (4:54):<https://www.youtube.com/watch?v=c25HuZeQsyo>

PBS Kids Design Squad: Build Seismic Shake-up:<http://pbskids.org/designsquad/build/seismic-shake-up/>

<http://www.morethanaworksheet.com/wp-content/uploads/2015/07/STEM-Rubric.pdf>

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Software Applications (Apps)

Water Cycle VR – Victory Enterprises

Design Your Own Space Planet: construct, Build, Create World

Expeditions: Fossils

3D Fossil

Triceratops: Dinosaur Fossils Robot Age

Yaratilis Muzesi: Fossils

Dino Park 2

Dino Quest

Geography Master: Education

Planet Geo – Fun Games of World Geography: Planet Factory Interactive

GeoGuide Val d’Herenes

Chimani – National Park Guides

Grand Canyon National Park Field Guide

Parks Explorer VR: Grand Canyon

Expeditions: Grand Canyon

Muddy Water Watch: Shiny Creek

Glacier-National-Park

Windy.com

Wind Sounds – Wind Music, Relaxing

Virtual Reality: Soil Profile

SoilInfo: ISRIC – World Soil Information

Soil Explorer: Purdue University

Volcanoes: Map, Alerts & Ash: The best volcano app!

Volcano Updates: Foxy Rocket

Volcano 360: Sergey Rumyantsev

Quakefeed Earthquake Alerts

Earthquake Safety Tips: Babybus

Earthquake Simulator 2D

Expeditions: Earthquakes

Disaster Detector: Smithsonian Institution

My Earthquake Alerts & Feed; US & Worldwide Earthquake