Instructional Segment: Earth and Changes Over Time

This segment focuses on Earth's processes associated with Providence Canyon State Park, Georgia and other North American landmarks.

Student Science Performance

Grade: 5th	**Title:**
Topic: Constructive and Destructive Processes	Earth's Processes Discovered through Providence Canyon State Park

Performance Expectation for GSE:

S5E1. Obtain, evaluate, and communicate information to identify surface features on the Earth caused by constructive and/or destructive processes.

a. Construct an argument supported by scientific evidence to identify surface features (examples could include deltas, sand dunes, mountains, volcanoes) as being caused by constructive and/or destructive processes (examples could include deposition, weathering, erosion, and impact of organisms).
b. Develop simple interactive models to collect data that illustrate how changes in surface features are/were caused by constructive and/or destructive processes.
c. Ask questions to obtain information on how technology is used to limit and/or predict the impact of constructive and destructive processes. (Clarification statement: Examples could include seismological studies, flood forecasting (GIS maps), engineering/construction methods and materials, and infrared/satellite imagery.)

Performance Expectations for Instruction:

1. Develop an understanding of how Earth's surface processes change land and features such as mountains, valleys, and islands as well as seafloor features such as trenches, ridges, and seamounts through the mechanisms of erosion, deposition, weathering, faults, and volcanism.
2. Develop an understanding for the natural processes that work together to continually shape the surface of Earth through constructive and destructive forces.
3. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
4. Use data from models developed in the Getting Carried Away labs to construct a reasonable explanation of how weathering and erosion shape the surface of the Earth.
5. Communicate investigations and explanations to peers.
6. Understand that the surface of the Earth changes. Some changes are due to slow processes such as weathering and erosion.
7. Recognize that scientists monitor seismic activity using different methods of technology to help better understand the changes in the Earth's surface.

Additional notes on student supports

Materials:

water, clay, sand, soil, pebbles, large baking pans, grass seeds or grassy plot, straws, sponge for moving water, plastic houses or small wooden blocks to simulate buildings, chalk, vinegar, paper towels, tongs or instrument to lift material out of water, clear plastic bottles with lids, coffee filters, foil, and cups

Engaging Learners	***Phenomenon:*** ***Providence Canyon State Park*** Do not show the entire 14-minute video. Use the segment between 5:00 and 7:30 minutes to show students the creek bed and walls of the canyon. (The world's largest sand castle)

	Obtaining: How do you think Providence Canyon formed? Why do you think it has gotten wider and deeper over time? How long did it take for Providence Canyon to form? *Teacher hint: For background information on how Providence Canyon's formation was due to poor farming practices: Teacher Notes -Providence Canyon's History* ● *Questioning is one of the keys to conducting successful inquiry-based learning activities. A KWL chart can help students raise questions as questions should come from the students whenever possible. Use the Obtaining questions to help guide students through the KWL chart.* ● *An anticipation guide is a series of statements that students must respond to individually after viewing the phenomenon. The teacher's role is to activate thought and background knowledge. Statements can be marked as likely or unlikely that the statement has scientific basis for how Providence Canyon formed:* 1. *Animals dug a hole first, then the hole just got bigger.* 2. *Rain and wind made a hole, then the hole just got bigger.* 3. *There was once a big lake, and suddenly all the water evaporated and left Providence Canyon.* 4. *An earthquake cracked the Earth.* ***Evaluating:*** Students choose an explanation for how Providence Canyon formed by making inferences from the panoramic view. *For the teacher* ● *Encourage students to create a narrative, an illustration with labels, a timeline, or a model to explain their reasoning.* ● *Encourage students to distinguish among facts, reasoned judgment, and speculation in an explanation.* ***Communicating:*** Students share their explanations for the formation of Providence Canyon. *For the teacher* ● *If possible, post or make available students' explanations. These can be referred to when clearing up misconceptions. They can also be used as teaching tools to further develop understanding of Earth's processes.* ● *If possible, keep the KWL chart or the anticipation guide, encouraging students to add to or change their thoughts based on evidence.*
Exploring	***Phenomenon:*** ***Same link to Providence Canyon State Park*** This is the link shown previously and is inserted here for an additional reference. *Teacher hint: Refer to Providence Canyon's history link above for background information on how Providence Canyon's formation was due to poor farming practices:*

	Activities ● Getting Carried Away Labs ○ Slowing the Effects of Rain ○ Beachfront Property ○ Wind Erosion ○ Acid Rain ○ Weather or Not ○ Water and Rocks Have students compare the similarities and differences between the formation of the Grand Canyon and Providence Canyon. *They are both formed by water erosion, but the Grand Canyon was formed by a river. Using a stream table, note how rivers impact Earth and note how deltas are formed.*
	Obtaining: Students gather information about constructive and destructive processes. *For the teacher* ● *Focus on S5E1b during this part of the lesson. Choose the above activities that help students develop models and gather data. Prepare in advance all the materials necessary for the activities you choose to complete with your class. Material list: water, clay, sand, pebbles, large metal baking pans, straws, sponge for moving water, plastic houses or small wooden blocks to simulate buildings, chalk, vinegar, paper towels, tongs or instrument to lift material out of water, clear plastic bottles with lids, coffee filter, foil, and cups.* ● *Provide a chart or wall space for students to post other questions they have and suggestions on how they could find answers: research or investigation.* ● *Use the activities as small group stations or partner labs.* ● *You do not have to use all the activities, but ensure that students are inquiring and learning about several different processes.* ● *Have students complete activities at their own pace. Use formative assessment options as the students are working and interacting.* ● *Students may need to do some additional reading/research on Providence Canyon. http://www.georgiaencyclopedia.org/articles/geography-environment/providence-canyon Based on their experiences (relate back to labs) and their reading have them discuss the formation of Providence Canyon. Compare historical photos. How might it look in the future?* ***Evaluating:*** Students describe the components of constructive and destructive forces. *For the teacher* ● *Ask probing questions as students discover throughout the activities. Probing questions are open ended: How do you know? What is your evidence? What surprised you? What does this remind you of? Can you make any connections?*

	Communicating: Students revise their previous understanding of the formation of Providence Canyon. *For the teacher* ● *Students should revise, redraw, and rewrite their explanations from the Engage section to include their new information.* ● *At this point, teachers can add vocabulary that students have discovered to a word wall, to the KWL chart, or to student's self-collection dictionary.*
Evaluation	***Evaluating and Communicating*** Questions and model to initiate class discussion: Discuss the different kinds of erosion you see in these images of the phenomenon or use the images and questions in this link: Images of Evidence of Erosion Additional questions: ● How do human activities contribute to erosion? ● Is erosion beneficial or harmful? ● What can you infer from the images about the geology of the area? ● What techniques can manage or prevent erosion? ● How are organisms impacted by the changing landscape? Can they adapt or change their behavior? *For the teacher* ● *Focus on S5E1 a and c during this part of the lesson. Students should connect their exploration of constructive and destructive processes to the formation of landforms, the technology used by humans that increase or slow the processes, and the impact that the processes and technology have on organisms. Teachers can offer prompts for writing and discussions such as: There is a mound of dirt in the school yard. How will it change over time? What forces will change it?* ● *All writing prompts and quizzes are an opportunity to enhance learning, adjust thinking, and clear up misconceptions.* ● *Have students brainstorm testable questions and make a quiz using these.*
	Additional Activities for Assessment: ● Go back to the original questions and have students write a micro-theme (mini-essay that limits the space to write by using an index card or a half sheet of paper), A Point of View Guide (students write narrative where the processes become the characters of the narrative), an Unsent Letter (students write to a friend or relative to explain what they have learned about Providence Canyon), or a double entry journal (where the teacher uses vocabulary, questions, or prompts on the left side of a paper and the student responds on the right side). ● Add to the KWL chart ● Have students conduct a webquest to find out more about Providence Canyon. ● Quiz to include questions about the cause and effect of erosion and resulting deposition.

Engaging and Explaining	Ask: Are all mountains and valleys made by erosion and deposition? Challenge them to explain their thinking about other processes that form mountains. Yellowstone National Park contains evidence of many different processes that change the Earth's surface. Erosion and Sedimentation Information Weathering, erosion and deposition are not the only processes that change the landscape in some areas. Introduce the process of volcanoes and earthquakes as constructive and destructive processes. Old Faithful Geyser gives evidence that there is something going on under the surface to heat the water that plumes into the air. This process is called hydrothermal activity. Old Faithful Geyser Yellowstone is also home to earthquakes and evidence of volcanic activity: Volcanic history of Yellowstone Earthquakes in Yellowstone The destructive and constructive processes have changed and are changing the land in Yellowstone National Park. Other changes have happened nearby in the state of Washington. Those mountains were formed by volcanic activity and five of those mountains are still active volcanoes! Phenomenon Resources: Mt. St. Helen's Web page Image of eruption of May 1980: Image of Eruption of May 1980 Ask students to discuss and explain: Why is a volcano considered a constructive force when it causes destruction of houses and other buildings? When is an earthquake or volcano a constructive process, and when is it a destructive process? Can it be both? Have students research other active volcanoes, earthquakes, and how they are monitored. Here are possible website resources: ● Michigan Tech Volcanoes Page ● United States Geologic Survey ● Earthquakes-- Incorporated Research Institutions for Seismology ● Current data on volcanoes in the United States Satellite images of areas before and after events etc. can be found at www.usgs.gov.

Elaborating	Challenge groups of students to develop and design a model showing Earth's processes involving changes in the surface of the Earth. Models are 2 dimensional or 3 dimensional and can include a booklet, a shoebox diorama, a poster, or a newsletter. Have them divide their model into three sections: ● Constructive Force, ● Destructive Force, and ● Both Constructive and Destructive. Share the models with others by displaying them in the hallway, media center or other central location.
	Assessment of Student Learning
	For the teacher *Throughout the lesson, students receive feedback on the adequacy of their explanations and abilities.* *Informal, formative evaluations occur from the initial phase of the instructional sequence. At end of the lesson, information from assessment becomes more formal. In the evaluate phase, the teacher should involve students in experiences that are understandable and consistent with those of prior phases and congruent with the explanations from prior phases.* Note that these descriptions of proficiency are referenced throughout the lesson as benchmarks for formative assessment. Clarify Intended Learning – Students explain the lesson phenomena using a model and written argument. Elicit Evidence – through model and written argument Interpret Evidence – look for evidence of student work below proficiency Act on Evidence – at this point in the lesson, determine how you will address student work that is below proficiency.
SEP, CCC, DCI	**Science Essentials**
Science and Engineering Practices	● Ask questions about the phenomena-- Providence Canyon, Yellowstone, and Mt. St. Helens. ● Develop and use models and simulations to construct explanations about the phenomena. ● Plan and carry out investigations that require identifying what is to be recorded, what are the dependent and independent variables, and how data will be collected in the Wind and Water Labs. ● Analyze data to identify significant patterns from IRIS (www.iris.edu) and USGS web sites that give current information about flooding, earthquakes and volcanoes. ● Construct an explanation to provide an account of features on the Earth's surface ● Engage in argument from evidence to best explain the natural phenomena of Earth's changes.

Crosscutting Concepts	• Observe patterns and look for relationships. • Identify cause and effect relationships associated with constructive and destructive processes. • Recognize scale, proportion and quantity in relation to size, time, and energy. • Define the system of study by setting and identifying the boundaries of each system. • Track the fluxes of energy and matter in and out of the established system. • Identify structure and shape as part of the properties of the system or landform. • Emphasize stability and change in the natural world as critical elements of each system.
Disciplinary Core Ideas	• Earth's processes drive Earth's conditions, overall structure, composition, and change over time. • Earth's processes are continuous and interrelated. • Earth's internal mechanisms play a vital role. • Water plays a vital role in both weathering and erosion. • Human activity and interactions with the planet affect Earth's processes.

Additional Supports for struggling learners:

General supports for the following categories:

Reading:	Writing:	Math:
1. Provide reading support by reading aloud 2. Have the teacher model what they are thinking when reading the text 3. Annotate the text with students so that they may refer to it as they work through the lab	1. The teacher can provide a sentence starter for the students. 2. The teacher can give students an audience to write to (i.e. Write a letter to your sibling explaining this topic). 3. The teacher can provide constructive feedback during the writing process to help students understand the expectations.	1. Calculators should be provided as needed.

Supports for this specific lesson if needed:

Performance expectations for instruction:

1. The teacher should have a clear plan on how to assess student learning. The teacher can provide a rubric to help students self-monitor their learning as they move through the unit.
2. The teacher should provide multiple formats that allow the students to express their knowledge.

Phenomenon:

1. The teacher can provide the KWL chart in advance of showing the video to get students to think about what they already know about constructive and destructive forces.
2. The students can use the KWL chart to record questions as the student comes up with them.
3. The teacher may need to show the video more than once to get students to notice the elements that are most important.
4. When asking students to mark statements as likely or unlikely the statements may need to be read aloud and discussed to avoid creating misconceptions.
5. The teacher should provide multiple formats that allow the students to express their knowledge.
6. When asking students to share with the class it might touch on some students' insecurities. This would be a good time to build in expectations for sharing, respectful class behavior while sharing and a way for students to share without putting themselves in the spotlight for those students that are truly opposed. Pushing a student too far when it comes to sharing in front of the class can cause the student to shut down and not be willing to participate further. This is a gradual building process and students must feel that they can trust their teacher.
7. Also, the teacher should try to tie this to something the students have visually seen, this could be cracks in their driveway or potholes that can be used to engage students. If a student feels like the topic can impact them in life, then they are much more likely to be involved and engaged.

Exploring:

1. Have students create a Venn diagram comparing the Grand Canyon and providence canyon. The teacher can project images on the board of the two canyons to assist students in comparing the canyons.
2. As students do the labs it may be prudent to have them draw images that show the results. This way

they have more than words to refer to later in the lesson.
3. Be intentional in grouping students. You can use strong students to help struggling students navigate the lab and draw conclusions from the labs. However, remember that sometimes struggling students vary from topic to topic, need more assistance than other students can give them and can get overshadowed by their peers.
4. Use formative assessments to ensure that students are progressing as needed. Pull students for small group review/re-teach as needed throughout the lab process.
5. The teacher should provide multiple formats that allow the students to express their knowledge such as writing, drawings or verbally.
6. Students may require additional time for revisions.

Evaluating:

1. Provide questions for class discussion in advance to struggling students. This will allow students with processing issues to feel prepared for the class discussion and make it more likely that they will be willing to participate.
2. The teacher should have a system to allow students to participate in the discussion without any student getting too much or too little "floor" time.
3. Students that struggle with confidence to engage in class discussion will be encouraged by success. Providing answers or encouragement on sticky notes to the students can propel students to feel more confident in participating.
4. The additional activities for assessment may require sentence starters to get students started on the writing assignments or read aloud for quizzes.

Explaining:

1. Use formative assessments to ensure that students are progressing as needed prior to adding in new material. Pull students for small group review/re-teach as needed.
2. Use examples to help students see destructive forces, constructive forces and how an event can be both.

Elaborating:

1. Students may need additional time to construct a model.

Background information:

Providence Canyon is formed from sediments deposited over 50 million years ago when the area was under ancient seas and near coastal beaches. These sediments consist of different colors of sands and clays that are susceptible to groundwater runoff.

In the late 1800s people cleared the land of trees to farm the area. They took no measures to avoid soil erosion, so the small gullies from heavy rains continued to form and get deeper. By the 1850s these trenches were up to three feet deep causing a path for the water to continue to erode the soils during each heavy rain.

A classroom activity to simulate this progression of erosion will help students understand what happened.

How is this different from the formation of the Grand Canyon that was formed by a river? How are the destructive process of erosion and the resulting constructive process of deposition similar?

Sanders, Sigrid. "Providence Canyon." New Georgia Encyclopedia. 10 March 2015. Web. 10 July 2017

For additional reading and for ways to put the science into context with what was going on historically in Georgia, visit the New Georgia Encyclopedia for additional information, https://www.georgiaencyclopedia.org/articles/geography-environment/soil-erosion .

The Georgia Soil and Water Conservation also has relevant information, https://gaswcc.georgia.gov/ .

A copy of the Geologic Guide to Providence Canyon State Park, by Lisa G. Joyce can be found here: https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/GG9a.pdf .

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Slowing the Effects of Rain

Materials Needed

- large pan (like an aluminum baking pan)
- watering can or paper cup with holes at the bottom
- grass growing in soil or sand and soil

Procedure:

1. Put a layer of sand and soil or soil in the bottom of a large pan.
2. A few days before doing the erosion investigation, plant some grass seeds in half the pan of soil or find a place where grass is growing on a slope with bare patches.
3. Sketch what you see.
4. Use your watering can or cup to "rain" on the grass and on the bare soil.
5. Describe in a second sketch or write a paragraph about what happened.
6. When did the water flow more quickly? Was any of the soil washed away?
7. How can you prevent soil loss on a bare patch in your home yard or school yard?
8. How does this activity help you understand the impact of vegetation on a hillside?

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Beach Front Property

Materials Needed

- Plastic tub or metal baking pan
- Sand
- Wooden block or sponge
- Water
- plastic houses or blocks

Procedure

1. Place the plastic houses or blocks on the sand a few inches from the edge of the water.
2. Measure the distance from the houses to the edge of the beach. Measure the area that the sand covers. Draw what the beach looks like once you have set it up, and label it with your measurements.
3. Then draw a profile of the beach and include the measurements. (A profile is how the beach looks when you view it from the side of the container).
4. Place the wooden block or sponge in the container at the opposite end of the sand. Move it back and forth to create ten gentle waves. Make sure you are holding the block parallel to the beach.
5. Measure the area that the sand covers and the distance from the houses to the edge of the water. Draw a picture of the beach and the profile after this step, include the measurements.
6. Now repeat the steps but create ten stronger "storm strength" waves.

What do you understand about moving water as an agent of erosion? How do you know?

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Wind Erosion

Materials per group: container, sand, rocks or gravel, straws, ruler, string, cup

Safety goggles for each student and teacher

Procedure

1. Put on safety goggles.
2. Carefully pour the sand into the pan to form a small hill.
3. Measure the height of the hill and the circumference of the base of the hill (may use a string). Sketch a picture of your hill and include the measurements.
4. Using the straw, blow gently on the hill for 15 to 30 seconds. Make sure you do not blow the sand out of the pan.
5. Measure the height and the circumference. Draw a sketch of your hill after the wind erosion has occurred, include the measurements.
6. Carefully pour the sand back into the cup.
7. Again, pour the sand back onto the pan to form another small hill.
8. Carefully place the rocks and gravel on top of the hill. Measure the height and circumference.
9. Draw a picture of the new hill with the rocks and gravel on top. Be sure to include the measurements.
10. Using the straw, blow gently on the hill for 15 to 30 seconds. Measure and draw a sketch of the hill again. Include measurements.
11. Analyze your sketches using math.

What do you know about wind as an agent of erosion?

What role does the rock play in erosion?

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Acid Rain

Materials:

- **Cup of water**
- **Cup of vinegar**
- **Two pieces of chalk**
- **Tweezers or tongs**
- **Magnifying glass**
- **Paper towel**

Procedure

1. Break one piece of chalk in half.
2. Weigh each piece of chalk.
3. Write the weight of the first chalk and label it sample A.
4. Write the weight of the second chalk and label it sample B.
5. Place chalk sample A in the cup with water.
6. Place chalk sample B in the cup with vinegar.
7. Set your timer for 5 minutes.
8. Record your observations of the pieces of chalk in each of the cups.
9. After the 5 minutes, use the tongs to remove each piece of chalk and place them on a paper towel.
10. Weigh them again. Record your findings.
11. Use the magnifying glass to observe the changes that occurred to each piece of chalk.
12. Analyze your data.

How do chemicals in rain water affect weathering?

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Weather or Not the School Grounds or Playground

The process that breaks down rocks is called weathering. The process that carries away debris is called erosion. Look at these websites to investigate both before you go outside.

http://wiki.kidzsearch.com/wiki/Erosion http://wiki.kidzsearch.com/wiki/Weathering

There are two types of weathering:

1. Physical weathering is when a rock is broken into smaller and smaller pieces. This process could be a result of the following:

a. Alternating water's freezing and thawing action

b. Plant roots wedging the rock apart

c. Burrowing animals moving soil and rocks

d. The breaking up of rock due to human activity

2. Chemical weathering is when the rocks change due to different chemical reactions. This process could be a result of one of the following:

a. When water and iron oxidize and become rust.

b. When a mild acid from rain water deteriorates the rock, paint, or building's surface.

Explore your school's grounds and playground looking for the effects of weathering.

WHAT IS WEATHERED	WHAT TYPE OF WEATHERING
WHAT IS ERODED	HOW WAS IT ERODED

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Water and Rocks 1

1. Fill a large, clear, plastic container with a lid about halfway with equal amounts of sand, soil, small gravel.
2. Fill the jar with water and tighten the lid.
3. Shake the jar for 1 minute.
4. Set the jar on a shelf or table.
5. Observe the jar after 20 minutes.
6. Draw what you see, label the particles.
7. Analyze your findings.

Water and Rocks 2

1. Gather 1 cup of rocks. Place ½ cup of rocks into a plastic bottle with a lid.
2. Place the other ½ cup of rocks onto a paper plate.
3. Fill the bottle halfway with water.
4. Close the lid and shake the bottle for 10 minutes.
5. Pour the water out of the jar and into another container through a coffee filter so that all the debris is caught.
6. Compare the rocks in the coffee filter to those that you placed on the paper plate.
7. Compare and contrast the two piles of rocks.
8. Examine the water. Is it still clear?

CER (Claim, Evidence, Reasoning)

1. Make a claim about how water causes changes in rocks.
2. Support your claim with evidence.
3. Build an argument for your claim through reasoning.

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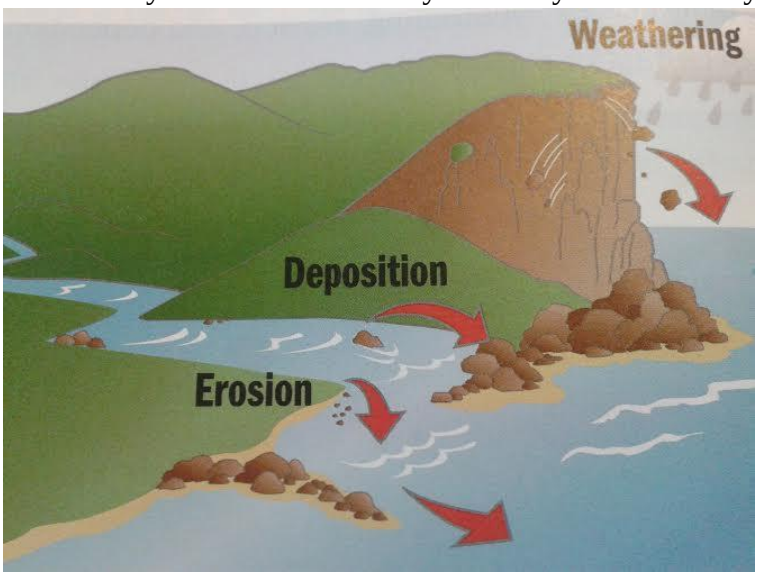
Example Images of Erosion and Deposition for class and small group discussion

Sample Discussion Questions:

- What changes do you see happening in these pictures?
- What is the cause of the change?
- What is the effect of the change?
- Is this a constructive or destructive process or both? Why?
- Can you have one without the other?
- Is there a way to prevent this from happening?
- Do you know of areas in your own yard or school yard where this is a problem? What can you do?



These are after pictures of erosion. Choose one and draw or explain what the land probably looked like before the erosion happened.

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