Lesson Title: Water Changes the Land

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Topic: How can water change the shape of the land?

Targeted Grade Level: Grade 2

Time Needed: 2 (40-minute) class periods

Subject Integration: Science, Math, and Art

Justification:

Science- In this lesson, science is integrated in the Engage, Explore, Explain, and Evaluate sections. Students learn about how events on Earth happen quickly and slowly. Furthermore, they get to conduct hands on experiments to understand how those changes affect the land.

Math- In this lesson, math is integrated in the Explore and Explain sections. Students are taught how to measure and use this skill to collect data on their hills, both pre and post erosion. Without this skill, their data would not be as concrete. Finding the difference in height before and after the “rain fall” helps students understand the scientific concept of water altering landforms.

Art- In this lesson, art is integrated in the Elaborate section of the lesson. Students brainstorm with their peers and collectively decide how to build a model for a follow up experiment. They tackle the design as a team, which not only ties in with the visual arts standard, but also allowed them to collaborate thoughtfully as scientists. Students then get to use their artist eye to help design the experiment. The follow up investigation helps students expand on their learning and delve deeper into their understanding of erosion.

Standards:

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

- This standard is addressed in the Engage, Explore, Explain, and Evaluate sections of the lesson below.

02.MD.04. Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.

- This standard is addressed in the Explore and Explain sections of the lesson below.

2.S1.2.1.VACR1.1.2A Brainstorm collaboratively multiple approaches to an art or design problem

- This standard is addressed in the Elaborate section of the lesson below.

NGSS Performance Expectations

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models that represent concrete events or design solutions. • Develop a model to represent patterns in the natural world • Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.	1. Broad importance across multiple science disciplines: • ESS2.A: Earth Materials and Systems: Wind and water can change the shape of the land. • ESS1.C: The History of Planet Earth: Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. 2. Teachable and learnable over multiple grades at increasing levels	1. Stability and Change • Things may change slowly or rapidly. 2. Patterns, similarity, and diversity • Patterns in the natural world can be observed.

	of depth and sophistication • Students can build on prior knowledge to develop models and use experiences to understand this concept more in depth in the future	

Common Core State Standards:

Math: **02.MD.04.** Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.

Other Standards

Visual Arts: **2.S1.2.1.VACR1.1.2A** Brainstorm collaboratively multiple approaches to an art or design problem

Measurable Student Learning Objectives:

Students will be able to analyze their understanding of erosion by constructing an experiment that will allow them to visualize the phenomenon.

Students will be able to compare their data points and evaluate the effects of erosion by measuring their structures throughout the experiment.

Students will be able to draw conclusions about erosion by conducting an investigation and building models to experiment on.

Nature of STEM:

This lesson covers two “nature of” subjects: science and math. One way that this lesson addresses the nature of science is in its inferential, imaginative, and creative nature. Students use their creativity to plan and conduct their experiments. Some imagination is needed on their end; of course, 20 drops of rain would not impact most landforms. However, they need to see how it impacts their sand hill, and they use that information to visualize and infer how that translates to Earth’s terranes.

This lesson also ties into the Principles for School Mathematics. Students are able to use math in this lesson because they have been building on their knowledge and curriculum throughout the school year. Although measurement is a new topic for them, it is adding on to concepts that they have already learned and are familiar with. Students tackle their learning with confidence due to their previous knowledge and mathematical understandings.

Engaging Context/Phenomena: The engaging phenomena for this lesson is a video that shows erosion over time on the Cape Cod coastline. This resource is from the Earth Observatory on NASA’s website. This is an engaging and relevant hook because without even knowing what erosion is, students can see how it impacts the landform and what happens to the coastline as storms reshape the land. This will lead to conversations and predictions about erosion as well as meaningful engagement.

https://earthobservatory.nasa.gov/world-of-change/CapeCod

Data Integration: One piece of NASA data that is integrated in this lesson is the Earth Observatory link used in the engaging context/phenomena. Students will also be using the following NASA link during the Elaborate section of the lesson: https://sealevel.nasa.gov/flooding-days-projection. This link shows students data points and discusses the effects that long term flooding has on land. This will help students understand why erosion is important to learn about, what scientific changes happen on our planet, and will guide them in brainstorming. This data shows students how flooding affects the land, and they will use that information to brainstorm ideas on how to create an experiment that will allow them to observe the effects of flooding.

Student Data Collection- In this lesson, students are collecting and documenting data. In each part of the Explore section, students will be drawing and measuring their sand hills and writing what they notice about them. They will be collecting that data on this sheet: Sand and Water observation sheet.

Differentiation of Instruction: Something that I noticed about this lesson is that there are lots of verbal directions given. This may overwhelm students who struggle to take in information auditorily. An adjustment that can be made is all of the

steps and questions can be pre-written on a piece of paper for each group, as well as displayed somewhere in the classroom (ideally on the whiteboard). This way, students have multiple places where they can find the information and instructions needed to keep them on task. There can also be visual task cards for each part of the experiment for students who need a visual aid with directions.

Real-life Connection: A real life connection to this lesson is that there are occasionally flash floods in our area. There is a patch of land behind the playground that is all grass, and near the road it is slowly beginning to slope. This is a change that has happened over time because of heavy rain and drains that are located right at the property's edge. This is something that the students could observe after the lesson and discuss using their new-found knowledge about how erosion impacts land.

Many students have also visited places that have been impacted by erosion such as: shorelines, camping on cliffsides, and hiking through canyons (such as the Grand Canyon). Students will be able to learn more about the different terrains that they have visited, and will understand how they came to look the way that they do now.

Possible Misconceptions: Some information that students might not know:

- Landforms physical appearance can be changed / altered
- Water flows and takes the shape of its vessel
- Flooding can happen after heavy rain
- Some rivers flow into the ocean

Lesson Procedure: (below)

5E Model	5E Objectives
Engage	**Procedure:** Teacher will begin the lesson by acknowledging students for all of their hard work and for their work so far to learn about the earth's land and water. Teacher will let them know they are moving into a new part of the unit to learn about how the earth's land changes because of water and wind.

	Teacher will share the link (provided under “resources”) and will show the 45 second time lapse video. After showing the video, students will share what they observed and why think the changes occurred. First, students will share their thoughts with a partner before a whole class discussion. This conversation will segue from what students noticed about the phenomena to: How did the water change the land? Teacher will present the following inquiry: Today we are going to be doing an investigation to answer the question, "What does water do to the land (or in this case sand)?" **Modifications:** The changes in the video may be hard for some students to keep in track of if they are visually impaired or have trouble focusing on a screen. Teacher can print out 4-6 different images from the clip and present those to students who struggle with visual focusing. **Standards Addressed: 2-ESS1-1.** Use information from several sources to provide evidence that Earth events can occur quickly or slowly. **Formative/Summative Assessments:** While students are sharing in partnerships, teacher will be conducting informal formative assessments by listening in on conversations and taking notes on which students notice the erosion (anecdotal data). Teacher will also be listening for misconceptions to address both during the partner talk and whole class share. **Resources** https://earthobservatory.nasa.gov/world-of-change/CapeCod
Explore	**Procedure:** **Materials per group:** • Each science team needs 2 cup-fulls of damp sand to make ‘sand hills’) • magnifying glasses--at least one per partner group • 1 small cup of water per group • 1 pipette

	• Goggles (1 per student) • 1 ruler • dishpan --1 per group; this will be used as a workspace • Erosion Water and Sand recording sheet--1 per student Teacher will divide the students into partner groups and assign them each a role – Rainmakers 1-4, Material Collector, Measurer. **The Investigation:** **Part 1:** The material collector come and get a cup of sand, a dishpan, ruler, hand lens, and an Erosion Water and Sand recording sheet. While this is happening, teacher will pass out the goggles. Teacher will demonstrate how to use the sand to make a sand hill after everyone gets on their goggles. During the demonstration, teacher should hit on the following talking points: *For this exploration, Rainmaker 1 gently dumps the cup of sand into the bin. You might have to tap the cup at the bottom to coax the sand out, just like when you are making a sand castle at the beach. You should have a stack of sand, a hill. If your sand falls down, that is okay too. Either way will work for this activity. Then I want you to look carefully at your sand. What could you use to see the sand close up? What could we use to gather quantitative data? How do you think a scientist would record their observations?* Teacher will prompt the children to vocalize the idea that a scientist would record their observations before, during and after the investigation by drawing a diagram and writing their observations in words. They would also measure quantitative data by measuring the castle. They have space to do both of these things on their recording sheet. *Before students go off to work independently, take time to explain the measurement. At this point in the year, we have not taught measurement so this is a good opportunity for a short introduction/mini lesson. Show students how to hold the ruler when measuring an object (0 side down, straight up against object, measuring from top to bottom) Teacher will also have to explain how to read a ruler- students are looking at the line at the top of the structure and reading the [closest] number to that*

	point. After the demonstration and measurement explanation, students will practice reading a ruler with their group by measuring one of their science materials. Once this is done and the teacher sees that each group is able to measure with and read a ruler, students can proceed on completing/building part 1. While they are doing this, the teacher should be walking around to make sure students are making careful observations. *Check to see that they are working on both their drawings and their writing.* After the students have had time to record this information, move on to Part 2. **Part 2:** Teacher will bring the class together and pose the following question, "What does water do to the land when it rains slowly?" Teacher will continue with the explanation below: *Now that we have observed what the sand looks like, it is time for some water to be added to record any changes. Suck up water in the pipette and drop 20 drops of water on your sand. Hold the water up away from the sand when you are dropping it. To be accurate, make sure you count your drops aloud so you are adding the water slowly. After the second person finishes, observe what happened and write it down. Draw a diagram of what you observe. Then repeat the process. Have the last 2 team members drop 20 drops each, observe, measure, and record.* *Teacher note- Adding the drops with the pipette keeps the process of change at a slow and steady pace. Forty drops will create a change that is noticeable, but not too damaging. Do not specify how the drops are added to the sand. Some children purposely add the drops in the exact spot and how others space it out. Either way is fine and this will create a talking point later on in our discussions.* As the children are working, walk around and stop and ask them to make an evidence-based account of their observations and what they noticed. We want to see that they are making the connection that the water is moving the sand in some way. At this point, do not give them too much information or guide them since we want them to discover the basic idea of erosion on their own. Some questions to facilitate the discussion.

	· Did it change or did it stay the same? · What changed in your sand castle? · How did it change? · What change did you see? · So what do you think caused that? · How does that happen in real life? · Does wind always change the same place in something in the environment? · Does water always change a place in the same way? **PART 3:** Teacher will have the students come together and will pose the following question, "What does water do to the land when it rains quickly?" Have the material collector come and get a second cup of sand. As the sand collectors take the second cup of sand back to their stations and then rejoin the discussion, teacher will demonstrate and explain the following: *Now that we have observed what the land looks like after it rained slowly, it is time to repeat the procedure for what will happen to the land when water comes down quickly, like in a downpour. We will follow the same procedures.* *First, measure your second sand tower and make a prediction about what will happen and record.* *Next, Rainmaker 1 and 2 will fill the pipette and quickly squeeze the water on the sand. Hold the water up away from the sand when you are dropping it. Observe what is happening and write it down. Draw a diagram of what you observe.* *Repeat. Rainmaker 3 and 4 drop a pipette full of water on the hill quickly, observe and record.* *In your group, discuss what happened to each sand hill and then compare the results of both so everyone is prepared to share results with the class. What were the observable effects on the sand hill of water that came down slowly and water that came down quickly? How were the results alike? How were they different?* **Make sure that after you finish adding rain, you measure both sand hills and take note of changes*

	in their heights. If you record a change in height, how can you figure out the difference between the before and after heights? Work with your group to make an equation to get the answer. **Modifications:** There are a lot of directions in each of the three parts. Students who struggle with auditory learning/processing may struggle with retaining the given directions. In order to help with this, the teacher can have slips of paper for each part with the written directions on how to complete the task with reminders on what students should be doing. This can also be written on the board after each part is explained so that students are given a visual reinforcement before going back to their stations. **Standards Addressed:** **2-ESS1-1.** Use information from several sources to provide evidence that Earth events can occur quickly or slowly. **02.MD.04.** Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit. **Formative/Summative Assessments:** Teacher will be collecting formative data at the end of the Explore section by collecting each student's observation sheet. Not only should this show their data to illustrate the differences between fast and slow changes, but there should also be a section in which students showed their measurements and calculations to determine the differences between the two hill heights. **Resources** Sand and Water observation sheet Materials for experiment: cup (to measure sand), cup of water, sand, magnifying glass, pipette, goggles, ruler, dishpan
Explain	**Procedure:** **Concepts Explained and Vocabulary Defined:** Call the children to the meeting area to share their findings. By having the students share their

	observations and discuss the results of the investigation, students can make the connection to the concept that earth events can occur quickly or slowly. Point out the pattern that all groups had similar erosion results in their investigations and discuss why that happened and why there may be different results. Also make sure to talk about how students measured their hills and what equations they used to calculate the differences in their heights. Each group should share what they measured each hill to be and what the difference was between the fast and slow erosion. Point out that students should be stating a claim and giving evidence (data from your observation). Give them sentence strips with frames to get them started. Scientific Question: What you WANT to know. "What does water do to the land (or in this case sand)?" Claim: What you THINK. The water changed both sand hills. The slow drops changed the sand more than dropping it quickly, all at once. Evidence: WHY you think that. I think this because the sand hill was shorter after dropping all the water slowly. **Modifications:** The claim/evidence strips have been highlighted above. They should be highlighted when given to students so that they are not overwhelmed with the information and can see the information in different categories. To take this one step further, the teacher can cut the each of the colored strips into three sections and have students put them together like a puzzle for more hands on/kinesthetic learners. **Standards Addressed:** **2-ESS1-1.** Use information from several sources to provide evidence that Earth events can occur quickly or slowly. **02.MD.04.** Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit. **Formative/Summative Assessments:** Teacher will be collecting formative assessment data

	(anecdotal data) by listening to student conversations as they share their findings and use their claim/evidence vocabulary. Teacher should be taking notes on what students are saying and who is exhibiting an understanding/learning of the concepts explored. **Resources**: Claim and evidence strips
Elaborate	**Procedure: Applications and Extensions:** Students will get into groups and explore the following link: https://sealevel.nasa.gov/flooding-days-projection. Students will look at the data to understand how floods are affecting the land. With their groups, they will brainstorm how they would construct an experiment to show the effects of long-term flooding. This discussion and brainstorming will fuel students' learning and creativity for the next part of the lesson. Teacher will pose the following to the students: To elaborate on the ideas you learned in the last two periods, today you will be taking the ideas about erosion that you just learned and will apply them to a new and similar situation. You just explored a link that showed you the effects of flooding on the land. Do you think that we can use some materials to create an experiment that will show us how flooding affects the land? *How can you use the following materials (a plastic tub, a cool-whip sized container, sand, and water) to investigate what happens to a larger landform when it is impacted by greater amounts of water?* Students should start to brainstorm with their group about how they can use these materials to make a giant sand mound. They can draw their ideas out on a piece of paper and label the different materials. They can then share their ideas and guide the teacher on how they think the experiment should be conducted. Although the teacher is using the brainstorming as an outline, try to follow the prompts below: *Whole class guiding questions: Instead of making a sand hill from a cup, we are going to be investigating what happens to larger landforms using a greater amount of water. I am going to be slowly dumping this entire container of water on the sand. What are your predictions? What do you think will happen? Why do you think this way?*

	Teacher will gently pour the water over the sand mound. Watch as the water starts to carve through the sand. *Try to keep the area where you pour the water in a sort of line, so it simulates a river being formed.* *What do you see happening? What do you think this is like in nature? Think about the water and landforms that we have learned about. Does this remind you of any of them? (Looks similar to river being carved in land.)* **Modifications:** Some students may be left out of conversations or not engaged in the discussions. In order to ensure that everyone is contributing, students can have a pencil and paper (or whiteboard and marker) to draw their design ideas. This way, even if they can't share vocally, everyone can hold up their designs and be part of the brainstorming process. **Standards Addressed:** **2.S1.2.1.VACR1.1.2A** Brainstorm collaboratively multiple approaches to an art or design problem **Formative/Summative Assessments:** Teacher will be collecting formative assessment data (anecdotal data) by listening to student conversations as they brainstorm their design ideas. Teacher should be taking notes on what students are saying and who is exhibiting an understanding/learning of the concepts explored. **Resources:** Materials for experiment (tub, container, sand, water)
Evaluate	**Procedure:** To wrap-up the lesson, review and discuss what students have observed and learned. *Create an anchor chart and hang it in the classroom to remind students of their new learning. Ask the following questions: • What is erosion? • How did our investigation show erosion?

	• What happened to the sand when water was dropped on it? • Do you think erosion is a slow or a quick change? Do you think it can be both? Explain your reasoning. Teacher should then let students know what we will be doing next so they can see how their note taking was an important part of the process: *The notes that you have taken today are an important part of the scientific process. Scientists gather notes and make observations so they can analyze and interpret their meaning. This helps them to understand our natural world.* **Modifications:** Some students may struggle with retaining concepts learned. For those students, they can write the definitions of erosion on a post it or draw a picture of what erosion looks like to them. This can then be placed in their science notebooks so that they can look back and have a quick reminder of their learning. **Standards Addressed:** **2-ESS1-1.** Use information from several sources to provide evidence that Earth events can occur quickly or slowly. **Formative/Summative Assessments:** Teacher will be collecting formative assessment data (anecdotal data) by listening to student conversations as they answer the questions for the class anchor chart. Teacher should be taking notes on what students are saying and who is exhibiting an understanding/learning of the concepts explored. **Resources:** Anchor chart paper, marker

Teacher Background: Teachers should understand the concept of erosion- both what it is and how it affects land. *Erosion* by Koontz is mostly is devoted to water erosion and is written for children, but would be a good resource for educators as well to see how to present the topic to children.