County Implementation Award Program (CIAP) Math and Science Lesson

Unit Title: Soils, Rocks, and Landforms

Lesson Title: Weathering and Erosion- Sliding Cliffside

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Grade Level: 4th

Time Frame: 30-45 minutes for Introduction/Pre-Lesson and 45-60 minutes for Body of Lesson/Closure.

Targeted Standard(s):

NGSS:

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. *[Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]*

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. *[Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]*

CCSS Math:

4.OA.A.3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

4.MD.A.2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

Short Description of Targeted Phenomenon: Share with students photos or videos
https://www.youtube.com/watch?v=CzrymETf9hY
https://www.youtube.com/watch?v=ZVjr4mii3cE of cliffs eroding.
Unit: *How and why are Earth's landforms constantly changing?*
Lesson: *Why do houses slide down cliffs?*

Three Dimensions of NGSS

Science & Engineering Practice/s (SEP):

- **Planning and Carrying Out Investigations**
  - Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

Crosscutting Concept/s (CCC):

- **Cause and Effect**
  - Cause and effect relationships are routinely identified, tested, and used to explain change.

Disciplinary Core Idea/s (DCI):

- **ESS2.A: Earth Materials and Systems**
  - Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

Language Supports:

- Sentence frames ("Based on _____ I now think _____"; "After my observations I now think _____").
- Dialogue protocol for reading (Ex. "Golden Line") See link: https://education.ucdavis.edu/sites/main/files/file-attachments/dialogue_toolkit_4-6.pdf

Materials Needed:

Teacher:

-*How Were They Created?* Pictures of weathering and erosion (see attached) projected or printed

-Video options (find on YouTube or source of your choice)

- Flyover of the Grand Canyon (drone). National Geographic
- Rapid cliffside beach erosion

-Image 1 (see attached) projected or printed

For each group:

-Airtight Tupperware or jar

-2-3 conglomerate rock or 2 pieces of small sidewalk chalk

-½ cup of sand

-1 copy of worksheet: *Group Work Challenge: Cliffside Slide!*

Objective(s): Students will be able to:

1. Use their evidence to explain the effects of weathering and erosion

2. Make observations and produce data to serve as evidence

3. Make a claim about the best solution to mitigate the effects of erosion based on their evidence.

How Math and Science concepts/skills/practices were integrated in this lesson:

Students are collecting data and analyzing rate of erosion

Possible Challenges /Misconceptions:

Misunderstandings of how landforms are made. Students may not know how to use a ruler or understand scaling. May need to scaffold more depending on students' skill levels.

Formative Assessment: teacher observations, cold calling students, checkpoint after data input of cliffside distances, student drawings.	
Lesson Opening	
Teacher Actions -(T) Show **video 1** of Grand Canyon flyover -(T) *Ask: How was the Grand Canyon formed?* -After time to share out in small group/partners, (T) records ideas on chart paper/white board.	**Student Actions** -(S) discuss ideas in partners/group
Lesson Introduction	
Teacher Actions - (T) shows pictures on *How Were They Created* page provided. - *Ask: Have you seen images like these before? What do you know about these images?* -(T) Explain that all these landforms occur naturally; humans did not create them. *-Ask: How do you think these landforms came to be? What caused them to look like that?* -(T) walks around and encourages students to write ALL predictions down on whiteboards or a sheet of paper (no wrong answers). *optional: cut the cards up and pass out one to each group or discuss one at a time whole group.	**Student Actions** -(S) share out prior knowledge -(S) have quiet think time to themselves to record in their notebooks or whiteboards. After 2-3 minutes of individual think time, collaborate with your group and have one student write down the predictions of the group and be prepared to share out.
Body of Lesson	
Part 1: **Teacher Actions** -(T) show **video 2** of rapid cliff erosion on beach -(T) *Ask: What do you notice? What do you wonder?*	**Student Actions** -(S) record in notebooks their questions -(S) share out
Part 2: **Teacher Actions** -(T) show **Image 1** -(T) *Ask: Why are the rocks different sizes? Why do you think they are piled up? What is happening to the cliffside? etc.* -(T) have each group put chalk or rocks in the jar/tupperware filled with some sand and tell students it represents a large rock. Have a student shake it vigorously for 2 minutes. -(T) *ask, "What did you notice happened to the chalk? How does this relate to what we saw in the cliffside picture? (breaking down big rocks into smaller rocks. eroding cliff…. etc.)*	**Student Actions** -(S) record in notebooks their questions -(S) share out -(S) work in groups

Part 3: **Teacher Actions** -(T) present Cliffside Slide group challenge. -Give (S) 25-35 minutes to complete the challenge depending on the level of your students. -(T) circulates and assists groups	-(S) work in groups to complete the challenge
Lesson Closure	
Teacher Actions -(T) If time permits, ask each group to share out their solutions from step 3	**Student Actions** -(S) share out -(S) comment on each other's solutions
Summative Assessment: Group Work Challenge: Cliffside Slide!	
Other Teaching Resources:	
Lab Safety: N/A	
Extensions (if any): -Pictures of what actual engineers do to prevent erosion -Reading, "Erosion" (see attached) with embedded vocabulary. Dialogue Protocols can be used here.	

Image 1:

Solano County Office of Education

Group Work Challenge: Cliffside Slide!

Problem: Seaside Manor: There are 3 houses built on a beautiful cliff close to the ocean. Despite its great location close to the beach, the residents of those homes are facing a huge problem. The cliffside is quickly eroding over time! Help each of the 3 residents find solutions to their problem and how much time they must figure it out.

Step 1: Use a ruler to measure the distance from the cliffside to each house in August 2017. Then, measure the distance from the cliffside to each house one year later. Now, using the data from erosion over one year, suppose the cliffside erodes at the same rate each year. How much will the cliffside be eroded in three years? Record your data on the chart below.

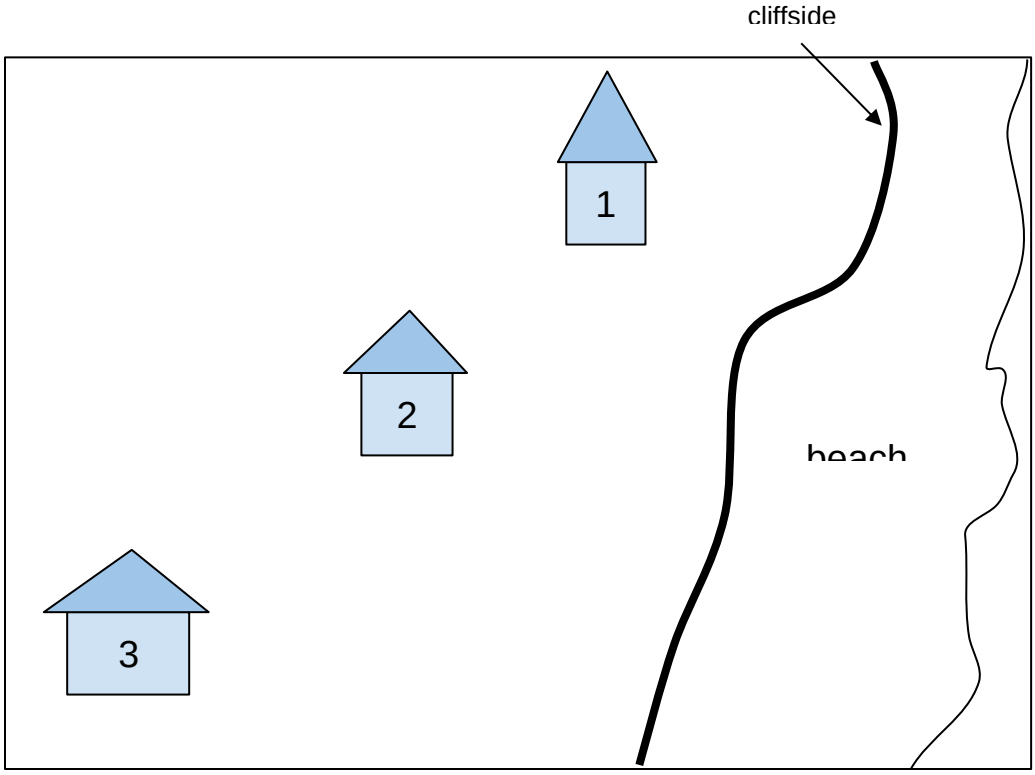
Distance from the cliffside (in feet)	August 2017	August 2018	August 2019	August 2020	August 2021	August 2022	August 2023	August 2024
House 1								
House 2								
House 3								

Step 2: Using the data from your chart, at what year will the cliffside destroy each home and cause the residence to evacuate?

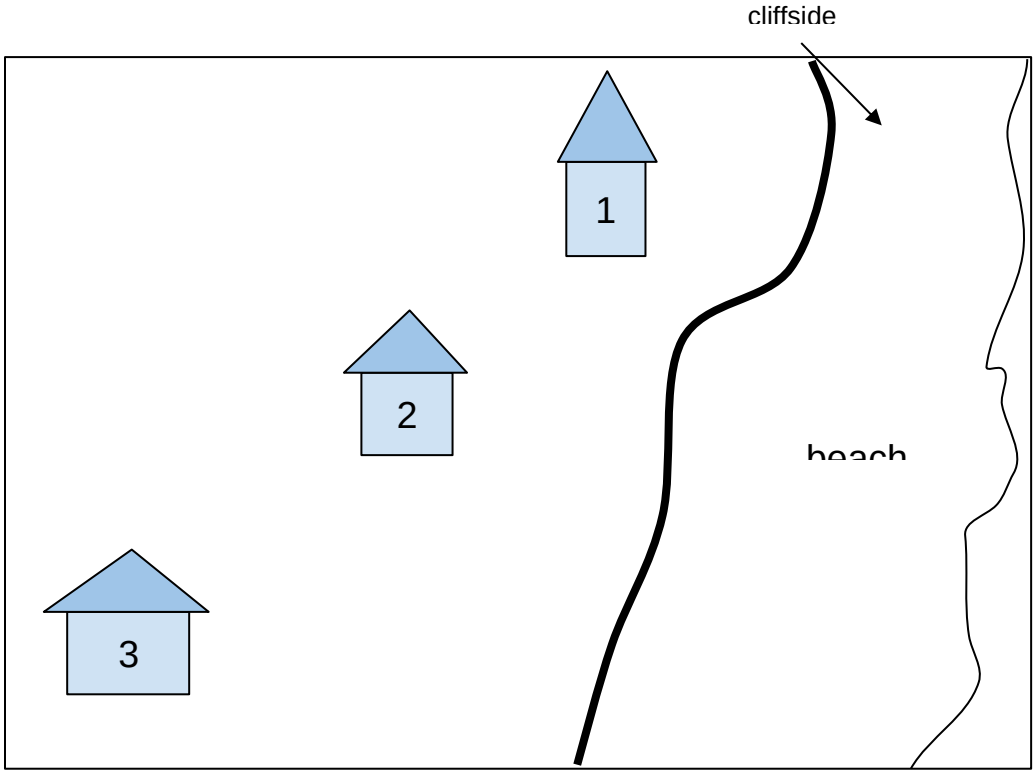
House 1: House 2: House 3:

Step 3: Brainstorm with your group solutions to the problem of the sliding cliffside. What could the residents engineer to save their homes? (No wrong answers!). Use the space below to draw and write your solutions. You MUST work as a group and it is OK to have more than one solution.

August 2017 ***Scale: 1 cm = 10 feet**



August 2018 ***Scale: 1 cm = 10 feet**



How Were They Created?

Make a prediction about how you think each of these landforms were naturally created.

Image 1

Image 2

Image 3

Image 4

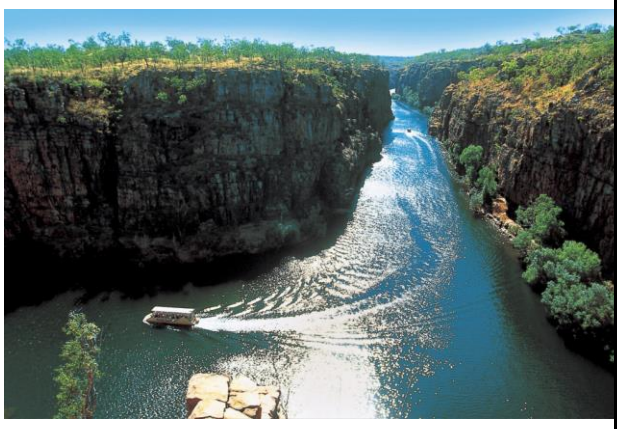


Image 5

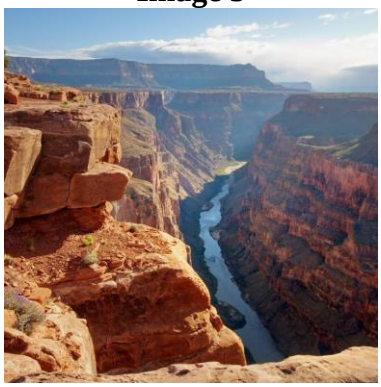


Image 6

ANSWERS: How Were They Created?

For teacher reference

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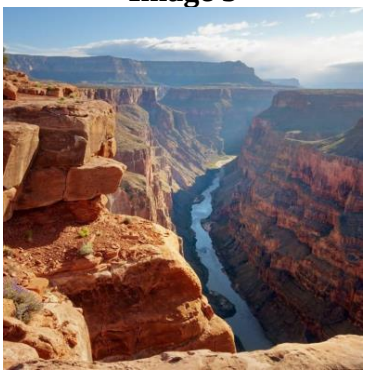
Image 1  **Arch:** formed by chemical/physical weathering that weakens the center of the rock	**Image 2**  **Valley:** formed by water or ice
Image 3  **Hoodoo:** formed when weak rocks erode and leave behind stronger rocks	**Image 4**  **Gorge:** formed by water or ice (steep-sided valley)
Image 5  **Canyon:** a v-shaped gorge formed by water or ice	**Image 6**  **Exfoliation dome:** formed when rocks like granite peel away at the Earth's surface

Erosion

Adopted from Readworks.org

Nature is always changing. Those changes are called natural events. Some natural events happen quickly. Sometimes a fire can start when lightning strikes a tree. But other events occur slowly, such as when as when rocks in a river are worn down over hundreds of years and made smooth, as tiny parts of the rock come off as water washes over it. The same thing can happen when wind hits rocks again and again, slowly tearing off tiny parts from the air washing over them.

Erosion is the name given to that very slow change and can happen from moving air or water. Have you ever seen waves crash against rocks on the shore? The water can wash away small pieces of rock. As more waves hit the rocks, the pieces become even smaller. Eventually, if the process continues, those pieces will add up to sand, but it takes a very long time.

Ice can also cause erosion. Some mountains have solid sheets of ice near the top. During warmer weather, a bit of ice melts. Then the sheet of ice may move slowly down the mountain. As the solid ice moves, it scrapes rocks, breaking off pieces.

Wind also causes erosion. Wind can blow sand and dirt. It can carry the dirt far away. In some places, strong wind will push sand against rocks, and over a long period of time, the wind wears down those rocks.

Water in rivers causes erosion, moving sediment in front and peeling it from the sides, sometimes carving out a canyon, such as the Grand Canyon, but also moving material and depositing it at some further point, like the opening to the ocean.

Over millions of years that water and wind have been affecting the planet, they've carved out the amazing features like canyons, arches and natural bridges that we see. Scientists use our models of how wind and water works to try to make sense of features on other planets, such as Mars.

Erosión

Adoptado desde Readworks.org

La naturaleza siempre está cambiando. Estos cambios se llaman eventos naturales. Algunos eventos naturales ocurren rápidamente. A veces un fuego puede comenzar cuando un rayo golpea un árbol. Pero otros acontecimientos ocurren lentamente, como cuando las rocas de un río se desgastan durante cientos de años y se hacen suaves, ya que pequeñas partes de la roca se desprenden cuando el agua se lava sobre ella. Lo mismo puede suceder cuando el viento golpea las rocas una y otra vez, arrancando lentamente pequeñas partes del aire que se lavan sobre ellas.

La erosión es el nombre dado a ese cambio muy lento y puede ocurrir de mover el aire o el agua. ¿Alguna vez has visto las olas estrellarse contra las rocas en la orilla? El agua puede lavar pequeños pedazos de roca. A medida que más olas golpean las rocas, las piezas se vuelven aún más pequeñas. Eventualmente, si el proceso continúa, esas piezas se sumarán a la arena, pero se necesita mucho tiempo.

El hielo también puede causar erosión. Algunas montañas tienen hojas sólidas de hielo cerca de la parte superior. Durante un tiempo más cálido, un poco de hielo se derrite. Entonces la hoja de hielo puede moverse lentamente por la montaña. A medida que se mueve el hielo sólido, rasca las rocas, rompiendo las piezas.

El viento también causa erosión. El viento puede soplar la arena y la suciedad. Puede llevar la suciedad lejos. En algunos lugares, el viento fuerte empujará la arena contra las rocas, y durante un largo período de tiempo, el viento desgasta esas rocas.

El agua de los ríos provoca erosión, moviendo el sedimento por delante y pelándolo desde los lados, a veces tallando un cañón, como el Gran Cañón, pero también moviendo material y depositándolo en algún punto más, como la apertura al océano.

Durante millones de años que el agua y el viento han estado afectando el planeta, han tallado las características asombrosas como cañones, arcos y puentes naturales que vemos. Los científicos usan nuestros modelos de cómo el viento y el agua funcionan para tratar de dar sentido a las características de otros planetas, como Marte.