

Purpose

To demonstrate how several factors affect the rate of erosion.

Process Skills

Observe, Measure, Collect data, Interpret data, Form a hypothesis, Make a model, Identify and control variables, Draw conclusions

Background

Earth's surface changes as water and wind wear away rock and carry away sediment. This process is called **erosion**.

The amount of erosion depends on the amount of water and speed of the wind moving over the surface in a particular place. The presence of plants as well as how loosely or tightly the soil particles are packed will also affect erosion rates. Other factors that affect erosion include the shape and slope of the land.

Time – 1–1½ hours

Grouping – Pairs, small groups, or class

Materials

- data sheet
- rectangular foil pan
- sand
- ruler
- 500-mL graduated cylinder
- water
- coffee filters
- paper towels
- several thick books

Procedure

Hypothesis: Read all of the procedures. On your data sheet, record a hypothesis for the situation you think will create the most erosion. Explain why you think this will be so.

1. Place the pan on a flat table. Pour in enough dry sand to cover the entire bottom of the pan to about 2 cm (1 in) deep. (The bigger the pan, the more sand you will need.) Make the surface of the sand as flat as you can with your hands or other tools (see Figure A).

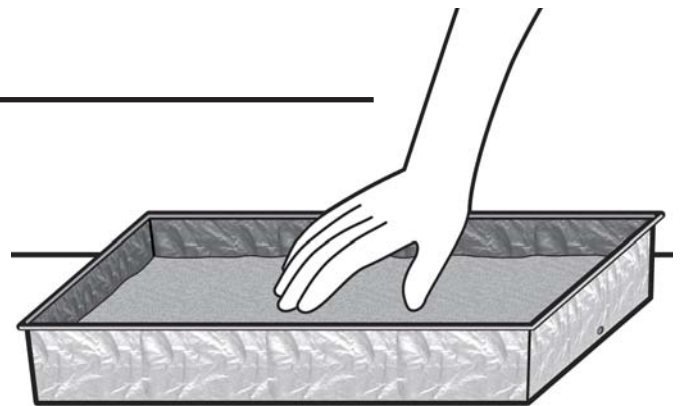


Figure A

2. Fill a graduated cylinder with 100 mL (about ½ cup) of water. Pour the water in—not too fast, not too slow—at the middle of one of the short ends (see Figure B). After pouring, wait for the water to stop moving.

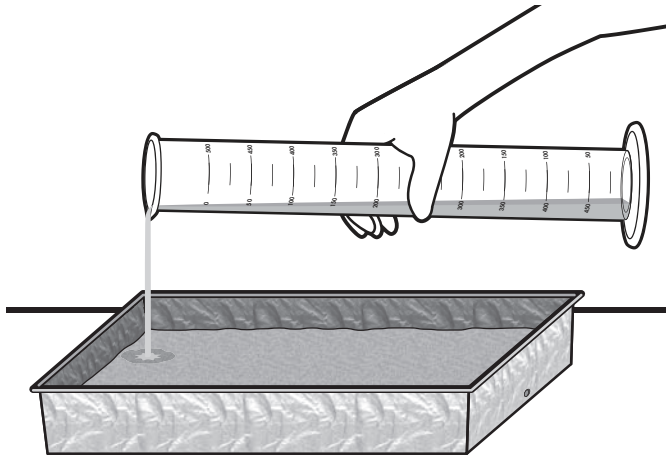
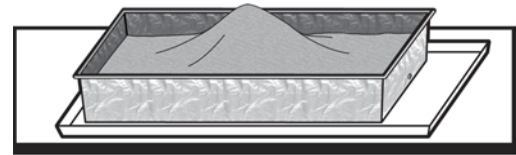


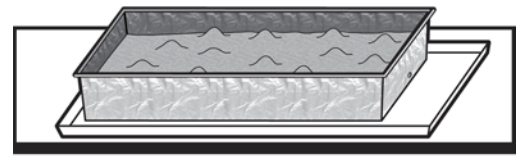
Figure B

3. Observe what happens as the water erodes the sand. On your data sheet, describe the erosion. Then sketch the surface of the sand to show the erosion.
4. Prepare wet sand. Mix the sand with water, and then drain the excess water outside or over a sink. You can use a coffee filter in a cup to catch any sand carried by the water. Use paper towels to dry any spills. Make the surface of the sand as flat as you can with your hands or other tools. Repeat steps 2 and 3 with the wet, level sand.
5. Now test each remaining situation on the data sheet, following steps 2 and 3 each time. After each test, drain the excess water. Read these tips before trying the tests:

- For the landform tests, use your hands or other tools to create small hills as described.

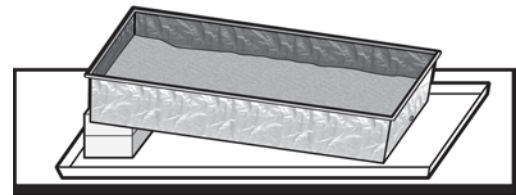


Landform test 1

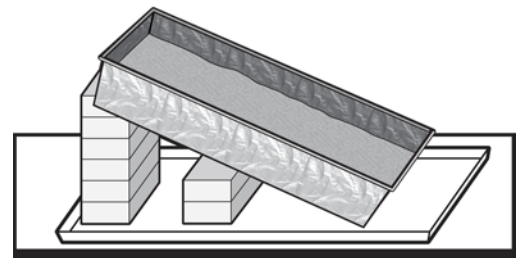


Landform test 2

- For the slope tests, raise the end of the pan where the water is poured, and then place books under that end to hold it up at the right height. (Do not wet the books.)

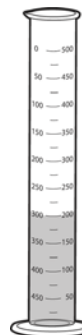


Slope test 1

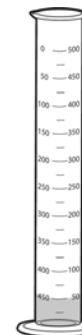


Slope test 2

- For the flow volume tests, pour more (200 mL) or less (50 mL) water than in step 2.



Flow test 1



Flow test 2

Name _____ Date _____

Hypothesis: Which situation below will cause the most erosion, and why do you think so?

Collect Data

Situation	Description of erosion	Sketch of erosion
dry, level sand		
wet, level sand		
Landform test #1: one large hill in center		
Landform test #2: many small hills spread out around the land		
Slope test #1: raised 5 cm (2 in)		
Slope test #2: raised 15 cm (6 in)		
Flow volume test #1: 200 mL		
Flow volume test #2: 50 mL		

Name _____ Date _____

Analyze Data

1. How did the erosion differ in wet sand compared to dry sand, and why do you think this was so?
2. How did different kinds of hills affect erosion, and why do you think this was so?
3. How did the steepness of the slope affect erosion, and why do you think this was so?
4. How did the volume of the flowing water affect erosion, and why do you think this was so?
5. What kind of place on Earth would probably have *a lot* of erosion if it rained? Describe it, taking into account the results of your tests.

Draw Conclusions

1. Review some of the important factors about land that can lead to more erosion.
2. If you were building a home on a piece of land, what land conditions would you want in order to limit erosion?

TEACHING TIPS

These process activities will help students understand what landforms are, how they form, and how different forces shape them over time. Students will learn about Earth's structure, including the core, mantle, and crust. These activities will also address the three major categories of rocks—igneous, sedimentary, and metamorphic—and help students discover how one rock type may change into another.

SET-UP AND PROCEDURES

- Aim for consistent pouring techniques and conditions in the pan or tray.
- The first trial is in dry sand, but all others are in damp sand. If you want students to try the tests in dry sand, you will need to dry it between uses or provide much more sand.
- Reinforce the importance of only changing one variable at a time. (For example, if the height and flow volume are increased together, students cannot isolate which had the bigger impact on erosion.)

MATERIALS

- Adding a drain hole at the base of the outflow side can help the model work better. Carefully use a drill to make a small hole in the base of one end of the pan.
- Disposable aluminum or plastic pans are easiest to drill through. See Figure A in the student activity.
- Any container that can accurately measure water volume may be used. (If ounces are used, require responses in ounces on data sheets.)
- While sand will work, other materials may yield better results, including diatomaceous earth.

SAFETY

Do not allow students to drink the water.

EXTENSIONS AND VARIATIONS

- *Field Trip:* Take a field trip to a local nature area to observe examples of erosion; have students record notes, measurements, and sketches.
- *Research:* Use online resources to view satellite images of erosion.
- *Inquiry Science:* Have students build a dam in their pan and observe its impact on erosion.
- *Inquiry Science:* Encourage students to create new variables to test. Then invite them to perform the tests, record data, and share their results with the class.
- *Variation:* Add mock trees and houses to help make the erosion tests feel more relevant to students' lives.
- *Variation:* Add pools of red food dye at different points in the flow to represent pollution. How do their original positions affect the spread?

ANSWER KEY

Accept any reasonable hypothesis, descriptions, and sketches. Possible results are provided. Students may use separate paper or science journal to provide more space for sketches.

EXPERIMENT	Changing Landforms — Erosion	
Name _____ Date _____		
Hypothesis: Which situation below will cause the most erosion, and why do you think so?		
Collect Data		
Situation	Description of erosion	Sketch of erosion
dry, level sand	<i>The water moved downhill and spread out a little toward the bottom.</i>	
wet, level sand	<i>The water moved downhill faster and spread out more than on the dry sand.</i>	
Landform test #1: one large hill in center	<i>The water divided around the hill and didn't spread out as much.</i>	
Landform test #2: many small hills spread out around the land	<i>The water snaked between and around the hills.</i>	
Slope test #1: raised 5 cm (2 in)	<i>The water moved downhill quickly and didn't spread out very much. It made a narrow path.</i>	
Slope test #2: raised 15 cm (6 in)	<i>The water moved even faster and didn't spread out much. The sides of the path were sharper.</i>	
Flow volume test #1: 200 mL	<i>The water spread out more and made a deeper trough than in any other test.</i>	
Flow volume test #2: 50 mL	<i>The water didn't spread out very much, and it hardly dented the sand at all.</i>	

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ANSWER KEY AND EXPLANATIONS

Analyze Data

1. How did the erosion differ in wet sand compared to dry sand, and why do you think this was so?

In dry sand, the erosion will generally expand from where the water was poured. In wet sand, the erosion is likely to be more widespread. When the sand is wet, the spaces between particles are already filled, so additional water has to flow elsewhere rather than straight down.

2. How did different kinds of hills affect erosion, and why do you think this was so?

The large hill may block the water and erode at the base. Areas between hills will generally experience more erosion because the same amount of water is forced through a narrower area.

3. How did the steepness of the slope affect erosion, and why do you think this was so?

The erosion will generally be deeper and narrower on sloped soil because the water moves faster and has less time to spread out before it reaches the far end of the pan.

4. How did the volume of the flowing water affect erosion, and why do you think this was so?

Increasing the water flow should increase the erosion because the increased numbers of moving water molecules have energy as they flow, and they can therefore move more sand particles.

5. What kind of place on Earth would probably have a lot of erosion if it rained? Describe it, taking into account the results of your tests.

A place with optimal conditions for erosion would likely have wet, loosely packed soil; a lot of rain and wind; and be located in a valley or canyon. An example might be a steep hillside in a rainforest canyon.

Draw Conclusions

1. Review some of the important factors about land that can lead to more erosion.

Important factors include: whether or not the ground is already wet, the amount of rain and wind that affect the area, the slope, and whether or not the water is forced into a narrow area. Other factors not addressed in this activity include: soil compaction, plate tectonics, the presence of plants, freezing, and human activity.

2. If you were building a home on a piece of land, what land conditions would you want in order to limit erosion?

Students should cite conditions opposite to those that can lead to increased erosion. Erosion may be limited best in dry, hard-packed soil; areas with low rainfall; and fairly flat land.