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Student Exploration: Erosion Rates

[Note to teachers and students: This lesson was designed as a follow-up to the Weathering and River Erosion lessons. We recommend doing those activities before trying this one.]

Vocabulary: climate, erosion, precipitation, sandstone, shale, vegetation, valley, weathering

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. **Erosion** is the removal and movement of soil, rocks, and other materials from one place to another on Earth's surface. What are some forces that might cause erosion to occur?

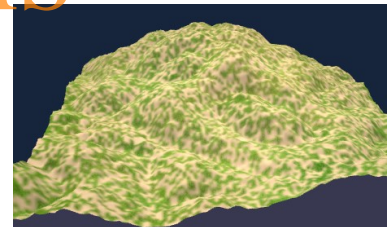
Water, wind, gravity

2. How quickly erosion occurs depends on many factors. In each box of the table below, circle the choice you think would cause erosion to occur *more* quickly.

Hard rocks	Soft rocks	Lots of rain	Little rain
Hot weather	Cold weather	Many plants	Few plants

Gizmo Warm-up

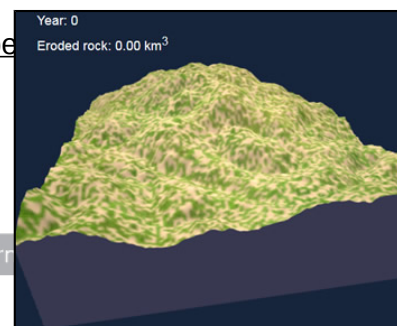
In the *River Erosion* Gizmo, you learned about the ways that rivers erode soil and change landscapes over time. The *Erosion Rates* Gizmo models erosion in a simulated 3D landscape. Using the Gizmo, you will see how quickly erosion happens and observe the long-term effects of erosion on a landscape.

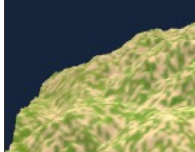


1. Click **Play** (▶). Wait for about 20,000 simulated years, then click **Pause** (⏸). If you want, you can drag the landscape to rotate the view. How much does the landscape change?

Very little

2. Click **Play**, and wait for another 80,000 years or so. Based on what you see, does erosion tend to occur quickly or slowly? Slowly Explain. Erosion occurs pretty slow due to multiple factors including precipitation, temperature, and vegetation cover all not be



Activity A: Effects of climate on erosion rates	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none">• Click Reset (↺). Check that Landscape 1 is shown. (If not, restart the Gizmo.)• Select the Pause every 100,000 years checkbox.	
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Introduction: **Climate** describes the average weather in an area over time. Climate takes into account factors such as temperature and amounts of **precipitation**, or how much it rains and snows. Climate also determines what types of **vegetation**, or plants, live in a region. In this activity, you will see how climate also affects erosion.

Question: How do climate and vegetation affect rates of erosion?

1. **Observe:** The Gizmo shows a simplified model of erosion in a hilly area. Check that the **Precipitation** is 100 cm/yr (39 in/yr), the **Average temperature** is 20 °C (68 °F), and the **Vegetation cover** is 50%. Click **Play**, wait for 100,000 simulated years, and click **Pause**.

The amount of eroded rock is measured in cubic kilometers (km^3). A cubic kilometer is a cube that measures 1 km on each side. How many km^3 of rock were eroded? 1.34 km^3

2. **Predict:** How do you think precipitation, temperature, and vegetation will affect how quickly rocks are eroded? Fill in each blank with “increase” or “decrease.”

As precipitation increases, the rate of erosion will increase.

As temperature increases, the rate of erosion will decrease.

As the amount of vegetation increases, the rate of erosion will increase.

3. **Experiment:** Click **Reset**. Set **Precipitation** to 10 cm/yr.

A. Click **Play** and wait 100,000 years. How much rock was eroded? 0.31 km^3

B. Click **Reset**, and repeat the experiment with the **Precipitation** set to 200 cm/yr. How much erosion occurred this time? 2.26 km^3

C. How does precipitation affect the rate of erosion? The more precipitation per year the more erosion occurs.

D. Why do you think precipitation has this effect? Because water weathers away rocks and land.

(Activity A continued on next page)



Activity A (continued from previous page)

4. Experiment: Click **Reset** and **Return to original settings**. Use the same procedure to see how temperature and vegetation cover affect the rate of erosion. Fill in your findings below:

Erosion with temperature of 5 °C: 0.64 km³ Erosion with temperature of 35 °C: 0.63 km³

Erosion with vegetation of 0%: 1.73 km³ Erosion with vegetation of 100%: 0.70 km³

5. Draw a conclusion: What can you conclude about the effects of temperature and vegetation on erosion rates? Temperature typically has the same after on erosion no matter how high or low the temperature is however vegetation tends to erode more with less vegetation while erosion occurs less with more vegetation.

6. Infer: **Weathering** is the breakdown of rock into soil.

A. How does weathering relate to erosion? The breaking down or dissolving of rocks and minerals on the Earth's surface is known as weathering. After a rock has been broken down, the bits of rock and minerals are carried away by erosion. Weathering and erosion are caused by water, acids, salt, plants, animals, and temperature changes.

B. In general, weathering tends to occur more rapidly in warm climates than in cool climates. How does this trend explain the effect of temperature on erosion rates? Because weathering leads to the development of soil, and the rate of weathering is faster in warmer regions, erosion will occur more quickly as the temperature rises and more soil is generated, as opposed to cooler regions.

7. Explain: Why do you think increasing vegetation slows the rate of erosion? Erosion can be slowed by vegetation. Plant roots cling to soil and rock particles, keeping them from being washed away by rain or wind.

8. Compare: Click **Reset** and **Return to original settings**. Using the Gizmo, create a scenario where the maximum amount of erosion happens in 100,000 years. (Note: Do not change the rock type.) Which Gizmo settings did you choose?

Precipitation: 200 Temperature: 35 Vegetation: 0

How much erosion occurred in 100,000 years? 5.72 km³

Click and drag to rotate the landscape. What changes do you notice? Small pockets of water have now appeared on the surface of the landscape.