

LAND EROSION

Running Off With Soil

TEACHER



Activity Overview

Tropical forests have the highest yearly rainfall of any place on Earth. When it rains for long periods of time and the soil cannot absorb more water, the water runs off downhill into streams, rivers, lakes, and oceans carrying soil particles with it. The process by which material such as soil is worn away by water is known as erosion. Plants play a major role in reducing erosion by anchoring soil particles in place. When the land is cleared of plant life, erosion becomes an ecological problem. This is true in any environment, but especially in tropical forests.

In this activity, students will examine the relationship between rainfall and runoff on Barro Colorado Island (BCI) over a period of one year. Table 1 shows monthly total values for rainfall and runoff in one year. They will examine the data and use the TI-73 Explorer™ to graph and analyze the values.

Conclusion: Students will observe that as rainfall increases, runoff increases. As rainfall decreases, runoff decreases.

Table 1

Data source: 2002 Meteorological and Hydrological Summary for Barro Colorado Island – Smithsonian Tropical Research Institute.

Month	Rainfall (mm)	Runoff (mm equivalents)
1	159	114.7
2	10.2	7.6
3	46.6	4.8
4	141.1	1.6
5	215.3	7.8
6	228.1	15.4
7	396.8	104.1
8	396.8	146.8
9	172	58.9
10	157.4	40.8
11	324.4	153.4
12	53	16.7

Note: The months are represented by numbers in order to easily graph the values (1=January, 12=December).

Activity at a Glance

Grade: 4-9
Subject: Science
Category: Earth Science
Topic: Erosion, Deposition, Weather, Climate

Time Required

- One 45-minute period

Level of Complexity

- Low

Materials*

- T-73 Explorer™



TI-73 Explorer™

* This activity has been written for the TI-73 Explorer™ but you can easily substitute the TI-83 or TI-83 Plus.



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Concept Background

- Scientists measure runoff in mm equivalents, which means equivalents of precipitation in mm. This way runoff can be more conveniently compared to the amount of rainfall. At BCI, they determine runoff at a catchment area by measuring the water level using water level recorders and flow meters. They convert their data into runoff in m^3 , and then divide by the total surface area of the catchment area to convert to mm equivalents.
- Between 1950 and 1990, the population of people in the Panama Canal area increased from 22,000 to 113,000. Forests were cleared to make room for homes, farms, and cattle pastures. In those 40 years, a third of the watershed's forests were cleared.
- As trees were cut down, soil washed away more easily. Deforestation of the Panama Canal watershed has resulted in serious soil erosion, filling Lake Alajuela with sediment and making hilly areas more susceptible to dangerous landslides.
- The Panama Canal Commission first used the non-native grass *Saccharum spontaneum* in the 1960s to combat soil erosion in the watershed. The non-native invasive species quickly spread, threatening native vegetation.
- Decisions people make today will affect the watershed 20 to 30 years from now. Indigenous peoples, farmers, and ranchers are finding a variety of ways to meet their economic needs while still sustaining their precious natural resources.

Preparation and Classroom Management Tips

- To answer questions 11 and 12, the students will need to know the average monthly rainfall and the total rainfall in their local area for a one-year period. This information is available through the local weather bureau. Comparing the local area rainfall data with the tropical forest data will help students to better appreciate the amount of rainfall a tropical forest receives during a one-year period.
- Before going over Question 10, explain that the term *mean* is the same as the term *average*. Explain how to find the *mean* of a set of numbers.
- For grades 4 and 5, consider only going over questions 1 – 9 in Data Analysis.
- This activity works well with students working in groups, or as a demonstration.
- Encourage students to answer the questions in Data Analysis in their journals.
- Create your own student questions for use on your students' TI graphing devices using the Texas Instruments StudyCard applications. For more information, go to <http://education.ti.com/us/product/apps/studycards/scresources.html>.

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National Education Standards

Science Standard E: Science and Technology

Students should develop abilities of technological design and understandings about science and technology.

Science Standard F: Science in Personal and Social Perspectives

Students should develop an understanding of personal health, populations, resources and environments, natural hazards, risks and benefits, and science and technology in society.

Math Standard: Connections

Students should develop an understanding of how mathematical ideas interconnect and be able to apply mathematics in contexts outside of mathematics.

Geography Standards 14–16:

Environment and Society

Students should learn how human actions modify the physical environment, how physical systems affect human systems, and the changes that occur in the meaning, use, distribution, and importance of resources.

English Language Arts Standard 8

Students use informational resources to gather, synthesize, and communicate information.

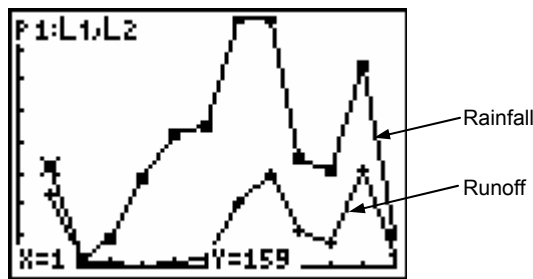


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Data Analysis

Month	Rainfall (mm)	Runoff (mm equivalents)
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- 1 Q. Which month(s) had the highest rainfall during the year?
A. *July and August had the highest rainfall during the year.*
- 2 Q. Which month(s) had the highest runoff during the year?
A. *November had the highest runoff during the year.*
- 3 Q. Which month(s) had the lowest rainfall during the year?
A. *February had the lowest rainfall during the year.*
- 4 Q. Which month(s) had the lowest runoff during the year?
A. *April had the lowest runoff during the year.*
- 5 Q. Which season, winter, spring, summer, or fall, was the rainiest? Explain.
A. *Summer was the rainiest season. During the summer months, the total rainfall was the highest of the year.*

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Vocabulary

Alien invasive species A non-native species that competes with and displaces native species.

Biodiversity A measure of the number and variety of species within a region.

Erosion The natural process by which wind, water, or weathering wears material away from the earth's surface.

Hectare A measure of area. One hectare is equivalent to 2.47 acres. There are 100 hectares in a square kilometer.

Lock A section of waterway, closed off with gates, in which a vessel can be raised or lowered. This involves raising or lowering the water level within the lock.

Native Originally living or growing in an area.

Runoff Water from rain, snow, and melting ice that flows on the Earth's surface into nearby streams, lakes, wetlands, and artificial reservoirs.

Sediments Sand, fine soil, or mud particles often deposited on lake or river bottoms.

Stakeholder A person, or a group of people, with a particular interest, or "stake," in a process or outcome.

Sustainable use The consumption of a natural resource at a rate that does not exceed the ecosystem's ability to regenerate that resource.

Watershed An area of land that delivers runoff water, sediment, and dissolved substances to surface water bodies, such as rivers or lakes. Every watershed consists of boundaries, a basin, and a collection area.



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- 6** Q. Which season, winter, spring, summer, or fall, was the driest? Explain.
- A. *Winter was the driest season. During the winter months, the total rainfall was the lowest of the year.*
- 7** Q. As the amount of rainfall increases within the sample year, does the amount of runoff increase or decrease?
- A. *Overall, the graph shows that as rainfall increases, runoff increases, too. Students should notice though that during March and April as rainfall increased, runoff decreased slightly.*
- 8** Q. As the amount of rainfall decreases within the sample year, does the amount of runoff increase or decrease?
- A. *The graph shows that as rainfall decreases, runoff decreases too.*
- 9** Q. By observing your graph, during which months would you expect erosion to be the highest? Explain.
- A. *The graph shows that the runoff in August and November was very high. The higher the runoff, the more likely it is that material such as soil is worn away by water, causing severe erosion problems.*
- 10** Q. During which months was rainfall above average?
- A. *Rainfall was above average in May, June, July, August, and November. Note: According to the data, the average rainfall at BCI in a year was 191.73 mm.*
- 11** Q. Your teacher will provide the average rainfall in your area. How does the average rainfall at BCI compare with the average rainfall in your area?
- A. *Answers will vary.*
- 12** Q. Your teacher will provide the total rainfall in your area. How does the total rainfall at BCI compare with the total rainfall in your area?
- A. *Answers will vary. Note: According to the data, the total rainfall at BCI in a year was 2300.7 mm.*
- 13** Q. During which months was runoff above average?
- A. *Runoff was above average in January, July, August, September, and November. Note: According to the data, the average runoff at BCI in a year was 56.1 mm equivalents.*



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- 14** Q. Based on your data and information provided in the research article, how might rainfall and runoff data help scientists reduce the amount of erosion that occurs in an ecosystem?
- A. *Data about rainfall and runoff provide scientists a good understanding of when it is more likely to have erosion problems, and how big these problems can be. In areas where the threat of erosion is high, such as at BCI, scientists can take actions that will minimize erosion, such as stop deforestation.*

