

Rain Reasons

National Science Education Standards

- * Standard C: *Life Sciences*— Structure and function in living systems.
- * Standard C: *Life Sciences*— Populations and ecosystems.
- * Standard C: *Life Sciences* — Diversity and adaptations of organisms.
- * Standard F: *Science in Personal and Social Perspectives* — Populations, resources, and environments.



OVERVIEW

Rainfall, sunlight, and temperature are important factors influencing where plants can grow, and, in turn, where animals can live. In this activity, students will design experiments to see how these climatic factors influence the growth and lives of plants. They will use the learned principles to explore how varying climate conditions have resulted in an astounding variety of forest types in Puerto Rico.

OBJECTIVES

Students will:

1. Explore how variations in water, lights and temperature affect plant growth.
2. Describe how precipitation and geography can affect the plant and animal species that are found in a particular region.

SUBJECTS

Science, Math, Social Studies

VOCABULARY

silviculturalist, horticulturalist, botanist

TIME

Preparation: 30-60 minutes

Activity Part A: Two 50-minute periods over several weeks;

Part B: 50 minutes

MATERIALS

Part A: small containers, potting soil, fast-growing seeds (mung bean or radish), water, measuring sticks, graph paper, pencils.

Part B: copies of Student Pages 1 & 2, markers or paper pencils.

BACKGROUND

Puerto Rico is a subtropical island about the size of Delaware. Because of regional variations in elevation, temperature, and, most important, rainfall, Puerto Rico has a tremendous variety of forest types—from dry, open woodland to lush rainforest.

BEFORE THE ACTIVITY

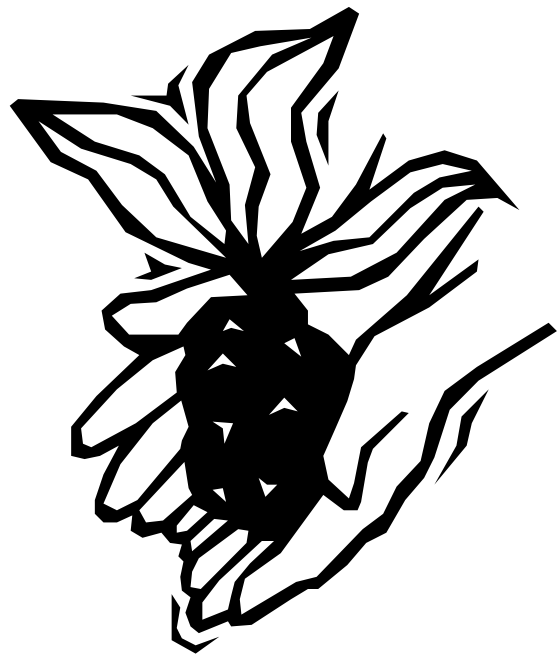
1. Make copies of student pages.
2. Prepare materials for experiments in Part A

ACTIVITY

PART A

EXPERIMENTAL SPROUTS

1. Begin by asking the students what plants need for growth (water, light, nutrients). List their suggestions on the chalkboard.
2. As they consider these requirements, ask students how the climate conditions of rainfall, sunlight, and temperature affect the growth of plants and trees. Divide the group into teams of two, and challenge each team to design an experiment using live plants that will demonstrate how climatic factors influence plant growth. Teams should follow certain guidelines such as 1. testing for one variable at a time (water, sunlight, or temperature); 2. labeling containers clearly; and 3. having a control group.
3. Have teams predict the outcome of their experiments.
4. Tell each team to first grow the sprouts they will use in their experiments. They should use fast-growing seeds in small paper cups or egg cartons filled with potting soil. When the seeds have sprouted, students should record the height and appearance of the plants before beginning their experiments.
5. Have students observe their plants each day, and record any changes, especially size and appearance.
6. After several weeks, have students present the results of their experiments to the rest of the group. Did any team get results it didn't expect? How did team members interpret those results?



ACTIVITY

ISLAND PARADISE

1. Point out the Commonwealth of Puerto Rico on a world map. Have any students or their relatives been there? Identify for students the different forest types they could see on a trip to Puerto Rico. (See Map D on Student Page 1.) Ask students to use experiments they did in Part A as they consider how climatic factors have affected the development of those different forest types. (*For example, more rainfall supports lush forests.*) Would climate also affect where particular animals can live? (*Yes, animals depend on food sources that are specific to certain climate conditions.*) Tell students they will study the relationship between climate and forest types in Puerto Rico.

2. Divide the students into teams of four, and distribute copies of student pages 2-3 to each student. Each person on a team will study the materials to gain information on how one of the following is distributed on the island: 1. rainfall, 2. temperature, 3. elevation, or 4. forest types.

Afterward, have teams work together to answer the questions on Student Page 3. Students should hypothesize about what

types of plants and animals might be found in the different forest types of Puerto Rico. Point out to students that classifying a “forest type region” does not mean that region is presently covered with forest. Much of Puerto Rico’s originally forested areas has been replaced by farmland. But, if this farmland were left alone, it would eventually return to the forest type of that region.



EXTENSIONS

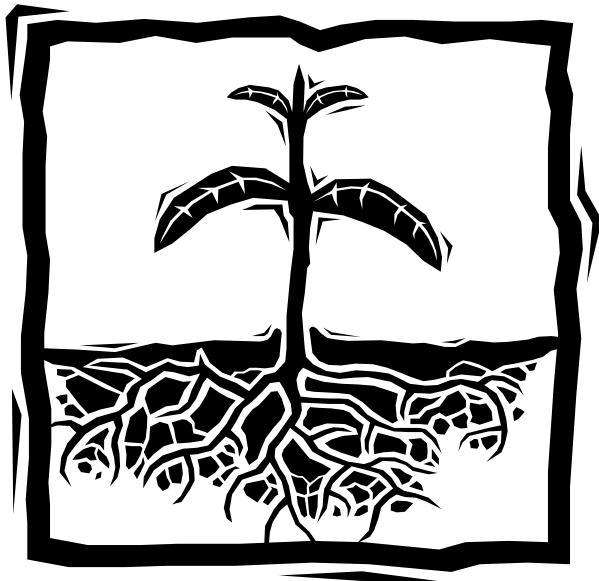
1. Each student should select a common local plant or animal species, then look it up in a field guide that shows the range for that species. Most series of field guides such as *GOLDEN GUIDES*, *THE PETERSON FIELD GUIDE SERIES*, or *AUDUBON SOCIETY FIELD GUIDES* and *NATURE GUIDES* show these ranges. Students should compare the species’ range with a map showing average precipitation for regions of North America. Many encyclopedias have precipitation maps. Students should consider whether the range of their species is limited by precipitation or vegetation type. Then, students should read more about their species to verify their conclusions.

2. Plan a class trip to a nursery, plant shop, or greenhouse. Have students roam about in pairs. They should select a plant that interests them; they should write down its name and carefully read the directions for taking care of it (*usually on a card attached to the plant or stuck in the soil*). Each card will tell what level of temperature, soil moisture, and sunlight the plant requires, and perhaps what continent the plant comes from. Using this information, students should imagine a natural habitat where the plant might be found. Remind students of the relationships they studied between plants and climate factors in Puerto Rico.

3. Ask a local silviculturalist, horticulturalist, or botanist to visit your classroom and bring several plants from distinctly different climate areas. (*These experts may work at universities, greenhouses, arboretums, botanical gardens, plant nurseries, or research institutes.*) Let students guess where plants may be from by recalling characteristics they have learned. The experts can discuss students’ guesses, tell students where the plants occur naturally, and point out each plant’s special adaptations.

ASSESSMENT

Evaluate how well the students used maps to gain information for answering the questions on Student Page 3. Evaluate the students' understanding of what all living things need to survive, and what factors influence where particular plants and animals can live.



CREDIT

This activity is adapted with permission from Project Learning Tree (PLT). PLT is a program of the American Forest Foundation. Go to <http://www.plt.org/> for more information about this award-winning environmental education curriculum.

Answers to Student Page 3

- 1.a) Higher elevations correspond to lower temperatures.
b) Yes, it usually gets colder as you go up a mountain, because the atmosphere is thinner and retains less heat.
- 2.a) Mountainous regions tend to have more rainfall.
b) When warm, moist air reaches a mountain range, it is forced to rise. In doing so, it cools and condenses, losing most of its moisture as precipitation.
- 3.a) Lower temperatures correspond with more rainfall.
b) Lower temperatures cause water vapor to condense and cause rain.
- 4.a) The northeast and west corner.
b) High.
c) e.g., Sierra palm trees, tabanuco tree, Colorado trees, ferns, vines, bromeliads.
d) e.g., Puerto Rican parrot.
e) Rainforest, upper montane rainforest, lower montane rainforest, or lower montane wet forest.
- 5.a) Southern Coast.
b) Higher
c) Dry forest
d) e.g., crazy ants, humming-birds; ucar, gumbo-limbo, aleli
e) e.g., cactus plants have spines; gumbo-limbo trees shed leaves during the dry season.
- 6.a) Foothills.
b) Average.
c) Average.
d) e.g., prickly and royal .palm, bananaquit, gray kingbird.

Forest Types

Dry Forests

Ucar (*OOH-KAR*), gumbo-limbo (*GUHM-boh-lim-bo'h*), aleli (*AH-lay-LEE*), turpentine, and guayacan (*GWEYE-uh-kan*) are some common trees adapted to climate conditions in the dry forests of Puerto Rico. Gumbo-limbo trees, for example, shed their leaves during the dry season and slow their growth at times when little moisture is available.

The trees provide homes for other plants and animals living in the dry forest. For example, mistletoe, a parasitic plant growing right out of tree branches, derives most of its nutrition directly from trees. Many birds, such as hummingbirds and bullfinches, depend on trees in dry forests for building their nests. In turn, the melon cactus depends on the hummingbird to pollinate its brilliant pink flowers and on the bullfinch to eat its pink fruits, thereby dispersing its seeds throughout the forest. Cactus plants (cacti) are adapted to dry conditions since their leaves (spines) have little surface area; for cacti, photosynthesis happens in their stems instead of leaves. (With less surface area, cacti lose less water than leafy trees through transpiration.) The stems (green, fleshy part of the cactus) store water for drier times. Also, the broad, shallow root system of cacti gathers water over a large area.

As one of the dry forest's recyclers, "crazy ants" break down leaves, dead insects, and other debris. These ants, in turn, become food for many different lizards that live there, such as the ameiva (*uh-MAY-vah*), with its long, iridescent tail.

Moist Forests

In Puerto Rico moist forest covers more area than any other forest type, but almost all of it has been cleared at one time or another for growing crops. As a result, grasslands are a dominant feature of this zone today. Trees up to 20 meters (65.6 feet) tall with rounded crowns like the mango are characteristic of areas where deforestation has not occurred. Common trees of the moist forest are prickly and royal palms, white and Spanish cedars, grandleaf sea grapes, and shortleaf figs. In coastal areas, mangroves grow much taller in the moister forests than in the drier forests. Common birds in the moist forest include the bananaquit, the grey kingbird, and the greater Antillean (*an-TILL-ee-uhn*) grackle. Reptiles such as the ground lizard are common there, as well as the Jamaican fruit bat.

Wet Forests

In the wet forests, you are likely to see tabanuco (*TAB-uh-NEW-ko*) or candlewood, trumpet, balsa, and sierra palm trees growing. Those trees support many vines and epiphytes (*EP-uh-fights*) (plants that use other plants for support). One epiphyte, the red-flowered bromeliad (*bro-MEE-lee-ad*), catches water in its tank-shaped leaves, providing a moist home for insects like centipedes. The ground of the wet forest is typically covered with ferns and mosses. In a wet forest, where there is no need to retain water because of the constant rainfall, plants have large, green leaves that transpire a lot of water. In addition, many plants are evergreens, meaning that they retain their leaves and photosynthesize all year long.

Birds of the wet forests include Puerto Rican tanagers (*TAN-ih-juhrs*), hawks, owls, pigeons, quail doves, and the endangered Puerto Rican parrot (a beautiful green, blue, and red bird about one foot or 30.5 cm long). However, fewer birds are in the wet than in the dry forests because large lizard and frog populations in the wet forests compete for the same insect food. Puerto Rico is famous for its coquis (*KO-key*), or tree frogs, most of which live in the wet forests and climb trees for food and shelter.

Rain Forests

Within the wet forest are several types of rainforests, which vary on the basis of elevation. Below 2,000 feet, the lower montane (mountain) rainforest is dominated by the tabanuco tree whose spreading crowns create a semi-dark environment. Tabanuco tree trunks are clear of branches for more than half the tree's height, creating an open midsection in the forest. On the forest floor grow ferns and other lush vegetation. Above 2,000 feet, the lower montane rainforest is dominated by Colorado trees, which are mostly short, gnarled, and twisted. When they grow old, these trees develop cavities that are used by birds, insects, and the Puerto Rican parrot.

The upper montane rainforest is dominated by Sierra palm trees. On the trees and floor of this forest grow ferns, mosses, and the red-flowered bromeliad. With rainfall nearly every day, the rainforest at the highest elevations supports great numbers of vines and bromeliads.





Name _____

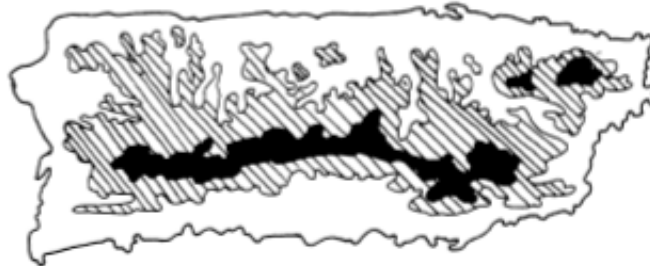
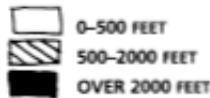
Student Page 2

Rain Reasons Maps of Puerto Rico

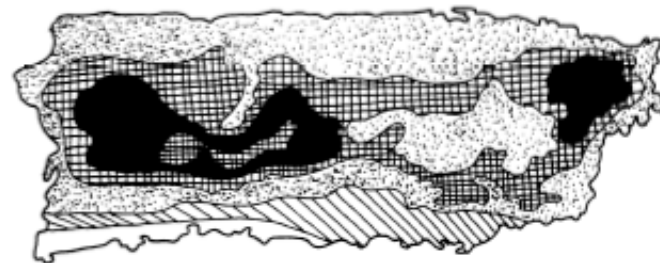
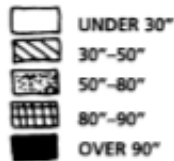
A. TEMPERATURE MAP



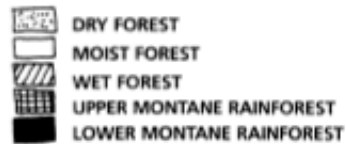
B. TOPOGRAPHY MAP



C. RAINFALL MAP



D. FOREST TYPE MAP



Rain Reasons

America's Rain Forests



Name _____

Student Page 3

Rain Reasons Questions??

2

a Study Maps B and C. What is the relationship between elevation and rainfall in Puerto Rico?

b What makes you say this?

4

a Using Map C, find the region with the most rainfall.

b Are these areas at a high, medium, or low elevation?

c Use the student Page 1 to find out what types of plants grow there.

d What types of animals live in those forests?

e What are these forests called?

6

a On Map D, find the regions that have moist forests. Do these regions occur in the coastal lowlands, foothills, central mountains, or coastal valleys of Puerto Rico? (See Map D).

b How does the amount of rain fall in this region compare to the reef of Puerto Rico?

c How about the temperature?

d What kinds of plants and animals do you think live in this region?

1

a Look at Maps A and B. What is the relationship between elevation and temperature in Puerto Rico?

b Does this relationship occur in other parts of the world?

3

a Look at Maps A and C. What is the relationship between temperature and rainfall in Puerto Rico?

b What might cause this relationship?

5

a Find the region with the least rainfall.

b Is the temperature higher or lower than other regions?

c Look at Map D to find out the name of this type of forest.

d What kind of plants and animals would live in this region?

e How are the animals and plants that live there adapted to this type of forest?

Rain Reasons