



Dry Forest

Concepts

Rainfall and vegetative growth patterns.

Duration

1 hour

Source Material

Project Wild

Vocabulary

precipitation
annual precipitation
vegetative composition
latitude
proximity
rain shadow
topography

Lesson 7: Rainfall Mapping

Summary

Students will work with state highway and vegetative maps to determine relationships among rainfall, vegetation, and animal habitats.

Objectives

- Students will correlate rainfall data with vegetative communities.
- Student will correlate vegetative communities with animal life.
- Students will recognize interrelationships among living and nonliving elements of the environment.
- Students will suggest ways that environments affect life forms that occupy them.

Materials

Activity 1: Mapping Activity (materials are per group)

KWL worksheet (one per student)

Student Instructions worksheet

Island Map

Hawaii Island Annual Rainfall Data sheet

Four different colored pencils or crayons

Hawaii Island Vegetation Map and *Vegetation Zones* (1 overhead/elmo version for entire class)

Making Connections

This activity provides the students with more information as to why the dry forest receives low amounts of precipitation. Students will make a connection to the mountains and their home environments, and expand this new understanding to the rest of the island, as well as other islands.

Teacher Prep for Activity

Make copies of all the appropriate worksheets for each student. Be sure you have a good understanding of rain shadows and topography by reading the background information.

Background

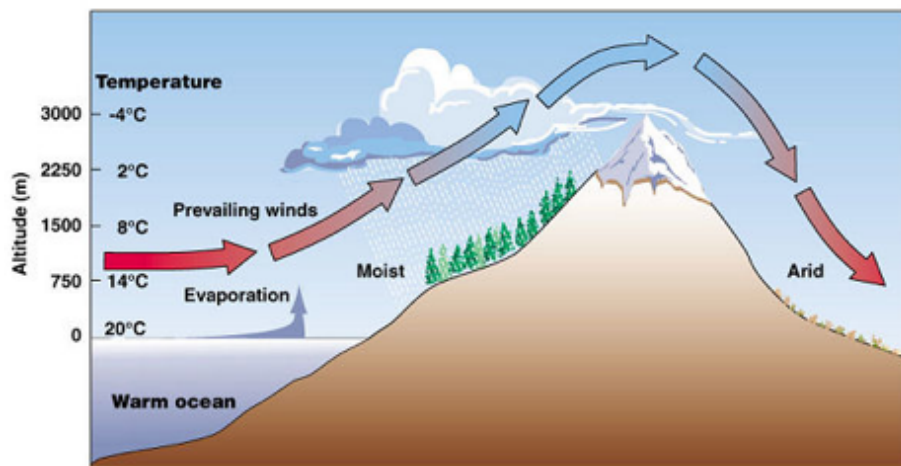
Many natural factors affect wildlife survival and cause populations to fluctuate. Each year, 1 or 2 more inches of rain may allow a forest to grow instead of grassland, thus creating habitat for forest wildlife. Rainfall is just one form of **precipitation**. Other types include snow, sleet, and hail. The types and distributions of **annual precipitation** can influence which plants will survive in an area.



Many plants would benefit more from a series of small rain showers than from a single thundershower that drops 5 inches of rain in less than an hour. Although precipitation has significant impact on an area's **vegetative composition**, other factors also influence what grows where. Those factors include elevation, **latitude**, soil condition and type, and the average number of frost-free days.

Food, water, shelter, and space in the appropriate arrangement are all fundamental to wildlife populations and all of these relate to plants in some way. Other influences on plants are the amount of rainfall and temperatures. Rainfall varies by wind direction, elevation, as well as **proximity** to bodies of water. Essentially, specific rainfall amounts create certain types of plant communities (e.g. grasslands, dry forest, or tropical rain forest). Each of these plant communities supports specific types of animals. In Hawaii, areas with 150 inches of rainfall each year are rainforests with closed ohia or koa canopies. Hawaiian Rainforests above certain elevations have native birds including the `i`iwi, `apapane, and elepaio, and native arthropods like the Happy-faced Spider. Lowland areas with less than 20 inches of rain support grasses and sparse introduced trees like kiawe and koa haole. Some remnant dry forest with ilima, pili grass, wiliwili and kauila trees remain in these areas.

A review of the water cycle may be necessary on the board or overhead.



Winds in Hawaii typically come out of the east, making the east side of the island much wetter than the west side because of the formation of a rain shadow (see above). Water evaporates off of the ocean and precipitates out as the air cools and elevation increases. This graphic is included on page 14 as well.

Vocabulary:

Precipitation: moisture that falls from the sky, rain, snow, and hail

Annual precipitation: the amount of precipitation in a year

Vegetative composition: the type of plants in an environment

Latitude: stretch around the globe with the equator, show distance north and south

Proximity: a space relationship, next to, far from



Rain shadow: an effect created by mountains where one side is extremely wet and the other extremely dry

Topography: elevation change, mountains, valleys, hills

Procedure

Activity 1: Rainfall Mapping

1. Pass out a *KWL* worksheet to the students and have them answer the first two questions.
2. Discuss the idea that all things, biotic (living) and abiotic (nonliving), are connected. Note: They should be able to relate nonliving things like water, temperature, and light to plant growth fairly easily. Animals are also affected by these abiotic and biotic conditions. Ask the students if “They notice there are different plants on Kona-side versus on Hilo-side?”
3. Divide the class into groups of two or three. Give each group an *Island Map*, four crayons of different colors, and the *Community Information* sheet.
4. Have students separate the list of communities into four rainfall groups: 0”-30”, 31”-79”, 80”-149”, 150”+.
5. Assign a color for each level of rainfall. Ask the students to first highlight each community on the rainfall data sheet with the correct color for their rainfall level. Then, ask the students to make a large dot in the appropriate color for each community at its location the *Island Map*.
6. Consolidate each color into rainfall patterns. Boundaries of areas should run between dots of different colors, not from dot to dot. This is going to require some judgment calls-the students may rely on what they know about elevation, places they have visited on the island, or what makes the simplest shape. Shapes should be rounded blobs, or roughly concentric bands. Color the maps according to the color-rainfall pairings.
7. Display the *Vegetative Map* and *Vegetative Key* on an overhead or with an elmo. (Both of the maps were obtained from the website: http://www.vterrain.org/Hawaii/Flora/zones_and_rainfall.html.)
8. Ask the students to find similarities in shapes created on their maps and those on vegetative maps. What rainfall level fits what vegetative type? The correlations will not be exact, but they should be graphic. Most of the time, more than one vegetative type will be covered by one rainfall amount. How much rainfall is needed for kiawe and grassland, mamane woodland, or ohia forest, for example? Have the students determine and list rainfall amounts for each vegetative community. Keep in mind that the student map has only 25-30 points of reference, but thousands of data points were used to develop the vegetative map. As a result, the two maps will not be identical, but they should be visibly similar.
9. Pass out the *Rainfall Mapping Activity* worksheet.



10. Discuss local rainfall with the students and have them fill out the worksheet:

Question 1: Where does your rain come from?

Answer: The winds bring moisture off of the ocean to the big island.

Question 2: What influences rainfall patterns in your state?

Answer: Winds, mountains, temperature, and elevation.

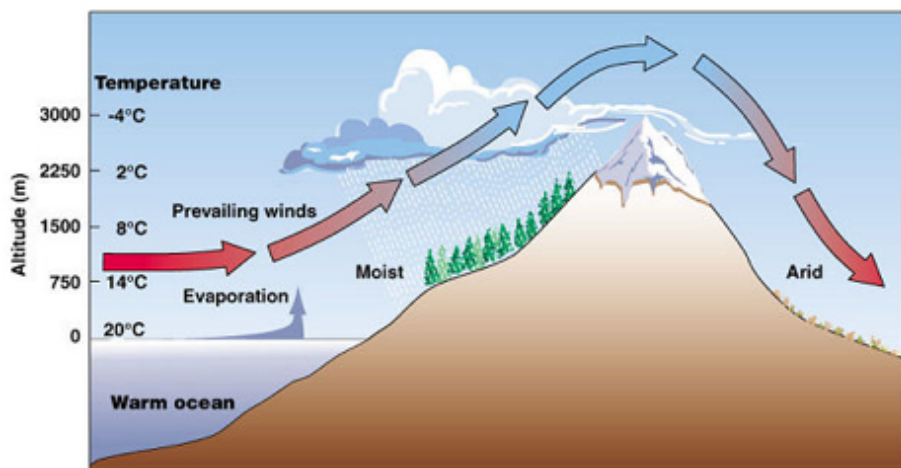
Note: Ask about typically weather around the island. What do you feel at the beach? In the mountains? What's different?

Question 3: Does elevation influence rainfall? Why?

Answer: Higher elevations are cooler, and cool air does not hold as much moisture, so when warm, wet air moves up from the ocean to the mountain, the water is released--it comes out as rain. (This is called orographic lifting.)

Question 4: What is a **rain shadow**?

Answer: A rain shadow is the area on the leeward side of a mountain that doesn't get much rain. Rain shadows are caused by mountains: as moist wind hits the windward side of the mountain, lifts up, and cools, it drops a lot of rain. By the time the wind reaches the leeward side, most of the moisture has already been released, so the leeward side gets far less rain.



Question 5a: Can they see where the topography influences rainfall in the state?

Answer: Mauna Loa and Mauna Kea form a major rain shadow. On other islands, you see the same—the west side is dry, the east side wet and lush, due to Haleakala (Maui) and the Koolau and Waianae Mountains (Oahu).

Question 5b: What direction do the trade winds come from in Hawaii?

Answer: North East.



Question 6: Can they find two cities or towns that are at the same elevation but receive very different amounts of rain? Why is that?

Answer: One example is Hilo and Kona (due to the rain shadow).

Question 7: Would similar influences cause similar patterns all over the world?

Answer: Similar islands with large mountains have the same type of weather patterns and rain shadows are found throughout the world, wherever prevailing winds hit mountains.

11. Have the students finish filling out the *KWL* worksheet and collect it.

Assessments

KWL worksheet

Colored Rainfall Maps

Resources

Project Wild pp. 73-76

Maps from: http://www.vterrain.org/Hawaii/Flora/zones_and_rainfall.html



Hawaii Island Rainfall Project

Student Instructions

Materials:

Four colors of crayons or colored pencils

Island Map

Community Information sheet

Procedure

1. Place each data point into a rainfall category. The rainfall categories are: 0"-30", 31"-79", 80"-149", 150"+.
2. Assign each rainfall category a color. For example, 0"-30" is red.
3. Highlight each community on your *Community Information* Sheet with the right color for its rainfall class.
4. Now you will begin plotting your Rainfall Data onto your Map.
5. Place a large dot of the right color on each community or weather station on the map. You do not need to label your dot.
6. After all the dots are in place, study the map for a few minutes. You are going to draw some shapes on the map that represents areas that have the same amount of rain. Before you begin, try to remember places you have visited around the island and what they looked like. Discuss with your partner or group, which areas are dry and which are wet.
7. Consolidating each color by drawing boundary lines. The boundary lines should run between dots—not connect them.
8. Color the enclosed areas with the correct color.
9. When your map is complete (the whole island should be colored), look at the *Vegetation Map*.
10. Compare the two maps. Can you see any similarities in the shapes? Is there a similar pattern?



Name: _____

Date: _____

Rainfall mapping activity

1. Where does the rain in Hawaii come from?
2. What influences rainfall in Hawaii?
3. Does elevation influence rainfall? Why or why not?
4. What is a rain shadow?
5. Can you see where topography influences rainfall in Hawaii?
6. What direction do the tradewinds come from in Hawaii?

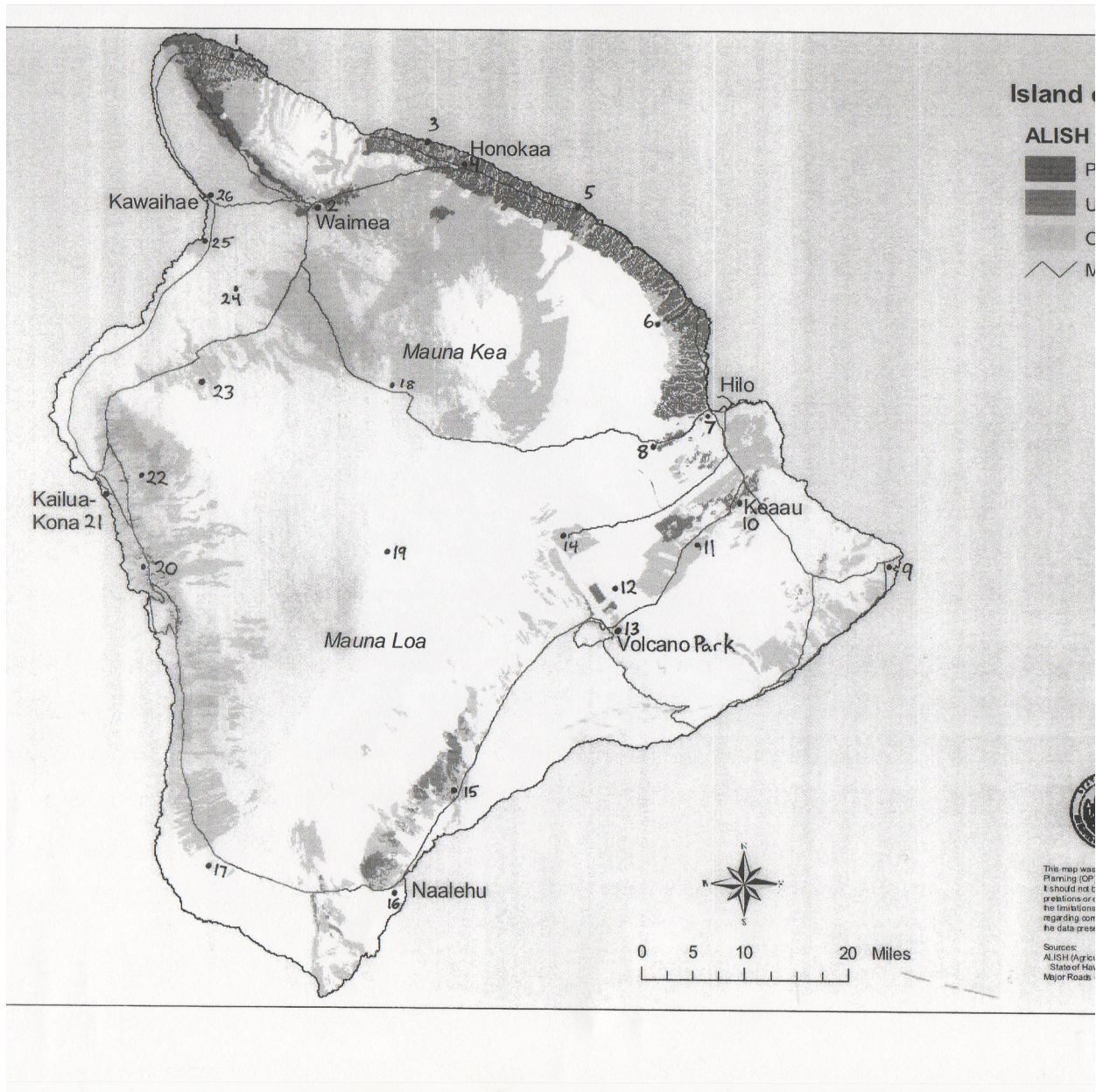


Hawaii Island Annual Rainfall Data

Communities are listed as they appear clockwise around the island

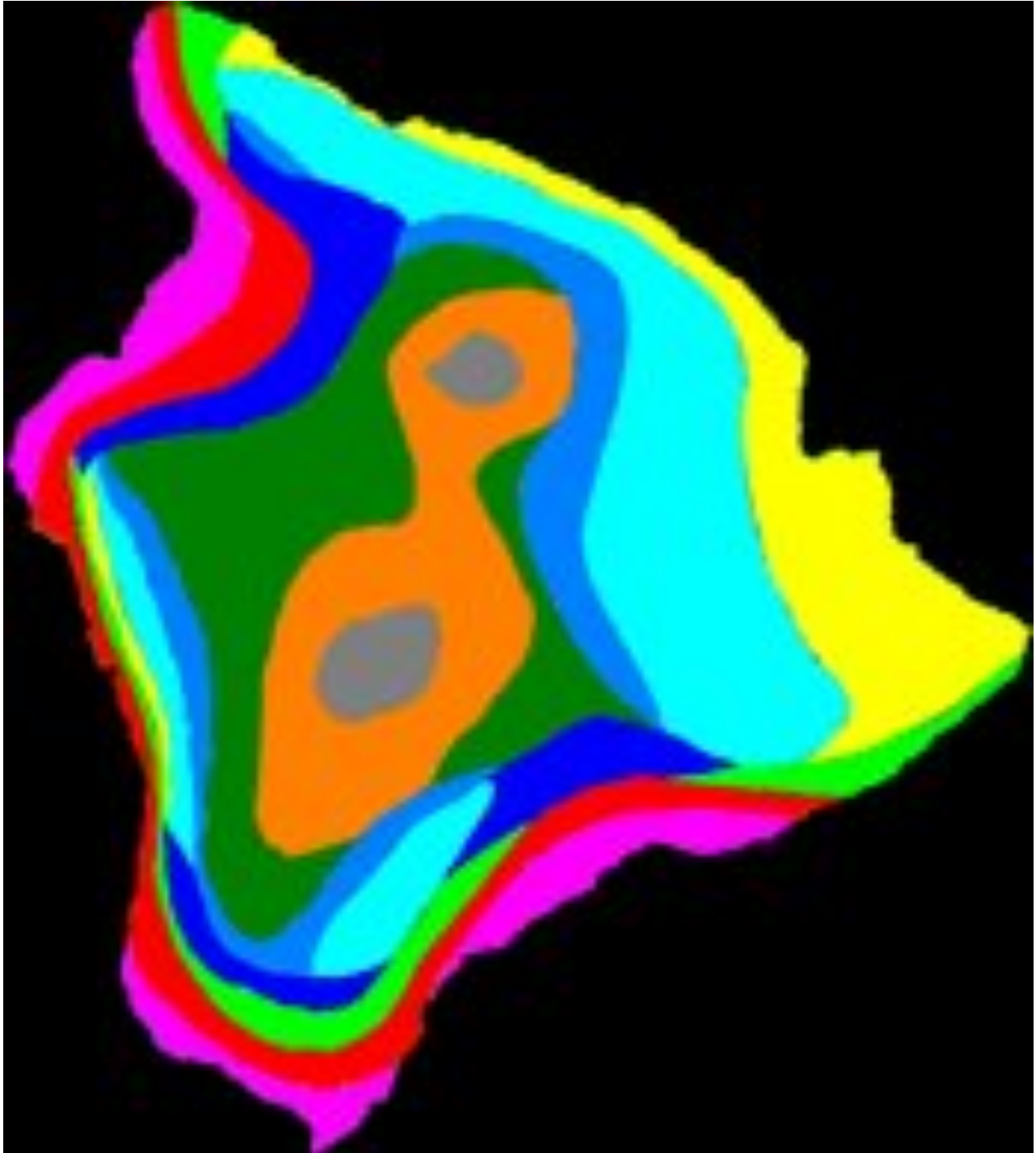
Map Key	Community	Annual Rainfall (inches)
1	Hawi	50
2	Waimea	80
3	Haina	75
4	Honokaa	100
5	Ookala	125
6	Hakalau	300
7	Hilo	150
8	Kaumana	225
9	Kapoho	100
10	Keaau	125
11	Mountain View	175
12	Volcano Village	100
13	Hawaii National Park (Crater)	80
14	Kulani Mauka	50
15	Pahala	40
16	Naalehu	40
17	Manuka	60
18	Pohakuloa	20
19	Mauna Loa Observatory	30
20	Kainaliu	75
21	Kailua-Kona	30
22	Holualoa mauka	75
23	Puu Waawaa	25
24	Waikoloa	20
25	Puako	10
26	Kawaihae	10

Source: Atlas of Hawaii, Second Edition.















Hawaii Island Vegetation Map





Hawaii Island Vegetation Map Legend

VEGETATION ZONES			
ZONE	ALTITUDE	RAINFALL (in./yr.)	CHARACTERISTIC PLANTS (Native Hawaiian species in bold type)
 Kiawe and lowland shrubs	Below 1000	Less than 20	Kiawe, koa haole, finger grass, pili grass
 Lantana-koa haole shrubs	Below 3000	20-40	Lantana, koa haole, klu, panini, Ilima , Natal redtop grass
 Open guava forest with shrubs	Below 2500	40-60	Guava, koa haole, lantana, Spanish clover, Bermuda grass
 Mixed open forest	2500-4000	40-60	Ohia lehua , koa , Spanish clover, Bermuda grass
 Closed guava forest with shrubs	Below 1500	60 or more	Guava, Boston fern, Hilo grass, basket grass, false staghorn fern , kukui, hala
 Closed ohia lehua rainforest	1500-7000	60-400	Ohia lehua , hapuu tree , olapa
 Open koa forest	4000-7000	60 or more	Koa , ohia lehua , rattail grass, hue pueo grass
 Open koa forest with mamane	4000-7000	Less than 50	Koa, mamane, heu pueo grass, pukiawe, aalii
 Open mamane-naio forest with subalpine shrubs	7000-10,000	Less than 50	Mamane , nalo , pukiawe , aalii , ohelo
 Alpine stone desert	Above 10,000	Less than 20	Scattered mosses , silversword , Hawaiian bent grass

Source: After J.C. Ripperton and E.Y. Hosaka (1942); C.H. Lamoureux, Botany Dept., Univ. of Hawaii 1982



Name: _____

Date: _____

Rainfall and Vegetation K-W-L

What do you know about rainfall and vegetation?

What do you want to know about rainfall and vegetation?

What did you learn about rainfall and vegetation?



Rain Shadow Diagram

