ACTIVITIES

The following activities will help your students understand concepts and issues relating to forests, as well as increase your students' awareness about their roles in local and global forest conservation issues. The heading for each activity is organized in the following manner:

Title of the Activity **Grade Level**; **Subject Code(s)** (Component #)

Background information for teachers

Materials needed for the activity

Instructions for conducting the activity

We have suggested appropriate grade levels for each activity, but we encourage you to adapt activities for the level of your class. The subject codes list the different core subjects covered by the activity. These codes are based on core subjects outlined in Washington's Essential Academic Learning Requirements (EALRs). If an activity addresses a specific component or components under one of the Essential Learnings, the component number(s) will be listed in parentheses following the subject code. For example, if an activity targets the third component under Essential Learning 2 in the core subject of mathematics, "**M** (2.3)" would be listed. *Refer to your copy of the Washington State Essential Academic Learning Requirements for listings of the Essential Learnings and components. The EALRs can be accessed at www.k12.wa.us/CurriculumInstruct/default.aspx.* EALR subject codes are as follows:

A = arts, crafts, drama, dance, music
C = communication
G = social studies - geography
M = math
R = reading
S = science
W = writing

We have included three activities, "Forest Comparisons" (page 117), "Drawing Forests" (page 119), and "Food Web Game" (page 156), that can be used as pre- and post-assessment activities. These assessments will assist you in measuring student learning resulting from the information and activities in this packet that you have shared with your students. If you wish to share with us the results of the pre- and post-assessment activities, we welcome the feedback. Please send examples of student work to: Teacher Training, Woodland Park Zoo, 601 N. 59th St., Seattle, WA 98103.

Tropical Rain Forest Activities – Table of Contents

**Suggested assessment activity*

Table of Contents *continued*

Zoo-Based Activities

**Suggested assessment activity*

Tropical Rain Forest Poems and Songs **Grades K – 3**; **A** (1.2), **C** (1.1)

The following selected poems and songs can be used to inspire your students and help them to learn about the climatic characteristics of rain forests and rain forest plants and animals. You can read or sing them aloud to your students, or the class can read or sing them aloud together.

Jungle Rain

Drip, drop, pour, and patter ..... snap fingers in rhythm
Plip, plop, spit, and spatter
Drizzle, drazzle, drain
Jungle rain

Slip, slop, ripple, run..... rub hands together in rhythm, getting faster
Trickle down, fall upon
Leaf and limb and flower
Jungle shower

Crash, smash, lightning flash
Raindrops splash, creatures dash.....pat knees in rhythm, getting even faster
Sticky, steamy, warm
Jungle storm

Rivers run, full and flowing.....rub hands together in rhythm, getting slower
Plants are lush, green, and growing
Clouds begin to fizzle
Jungle drizzle

Sun comes out, shines and gleams .....all groups say rhythms, slow down and finally stop
Scattered drops and rising steam
Are all that now remain
Of jungle rain

Reprinted with permission of National Wildlife Federation from the *Rain Forests: Tropical Treasures* issue of *NatureScope*

Day and Night in the Jungle

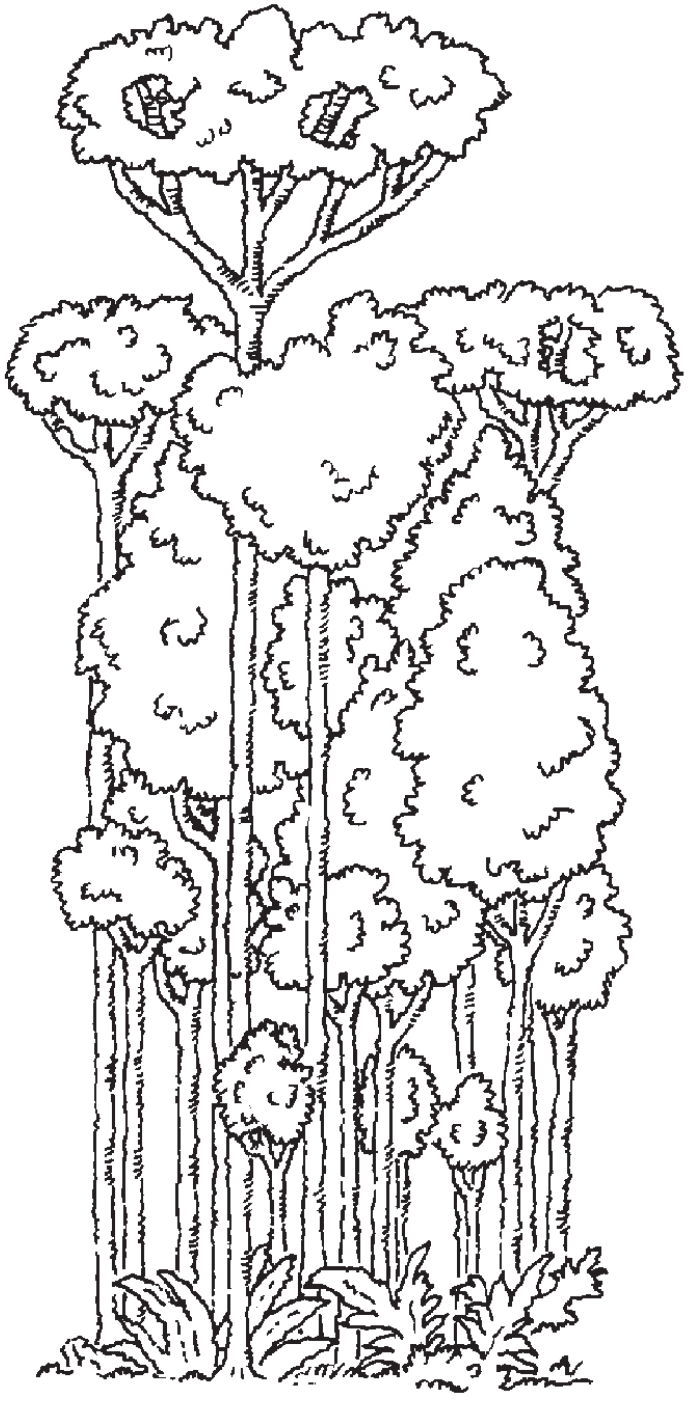
In the daytime
Monkeys swing
Sloths cling
Songbirds sing.

Orchids bloom
Insects zoom
Parrots chatter
Raindrops patter

Snakes slide
Lizards glide
And nighttime creatures
Sleep and hide.

In the nighttime
Big cats growl
Owls holler,
hoot, and howl.
Spiders crawl
Night birds call
Insects click
Crickets "crick"

Bats beep
Frogs leap
And daytime creatures
Hide and sleep.



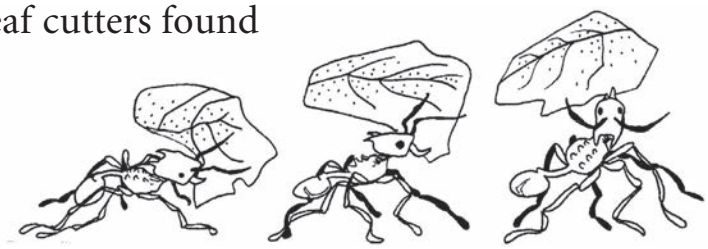
The Leaf-Cutter Ants' Parade

(Sing to the tune of "When Johnny Comes Marching Home")

The ants go marching back and forth
Hooray, hooray!
The ants go marching south and north
Hooray, hooray!
The ants go marching east and west
Looking for leaves to take back to their nest
And they all go marching—
The leaf cutters ant's parade

The ants go marching day and night
Hooray, hooray!
The ants go marching, what a sight
Hooray, hooray!
They munch and they crunch and they bite and they tear
Cutting up leaves that they find here and there
And they all go marching—
The leaf cutter ants' parade.

The gardens are growing underground
Hooray, hooray!
The gardens are growing underground
Hooray, hooray!
The gardens are growing underground
All over the leaves that the leaf cutters found
And they all go marching—
The leaf cutter ants' parade.



Beautiful Bromeliads and Poison Dart Frogs **Grades K – 3**; **A** (1.2)

Tropical rain forests are often full of bromeliads ("bro-MEAL-ee-ads")— a type of plant that grows on the trunks and branches of trees. Some of the bigger bromeliads are lush, leafy, mini-habitats that make perfect high-rise homes for poison dart frogs, insects, snakes and other animals. Your students can make their own bromeliads and poison dart frogs out of construction paper and toilet paper rolls.

Materials

- Copies of "Beautiful Bromeliad Pattern" and "Poison Dart Frogs" student activity sheet *(one per student, included with this activity)*
- Pictures of bromeliads and poison dart frogs
- Toilet paper rolls *(one per person)*
- Green and blue construction paper
- Pencils
- Scissors
- Clear tape
- Crayons or markers
- Glue *(optional)*
- Coloring materials *(crayons, markers, colored pencils)*
- Magnet tape *(optional)*
- Thin cardboard *(optional)*

Instructions

1. Show your students some pictures of bromeliads and poison dart frogs. Then pass out copies of the patterns on the following pages.
2. Read the "Instructions for making a bromeliad" aloud to your students and/or demonstrate each step as your students follow along. Students can also use the poison dart frog patterns to make kitchen magnets using thin cardboard for backing and magnet tape available from craft stores. Note: The blue poison dart frog is a brilliant blue in color—darker blue along the legs. The green and black poison dart frog is a bright green with solid black patches. The bicolored poison dart frog is golden in color with green legs.
3. Ask students why the frogs have such bright colors. *(The bright colors are a warning to potential predators that the frog's skin is poisonous and not something that they would want to eat.)*

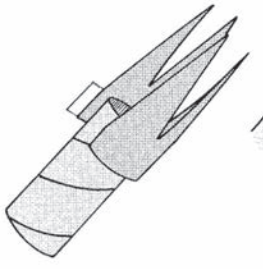


Diagram 1
Wrap top leaves around roll.

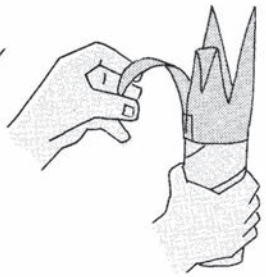


Diagram 2
Curl leaves back.

Diagram 3
Position second set of leaves so that it falls between the first set.

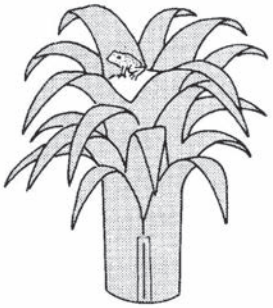


Diagram 4
Tape or glue frog to a leaf.

1. Cut out the pattern marked "top leaves." Trace around the pattern onto green construction paper, then cut out the traced pattern.
2. Cut out the pattern marked "bottom leaves." Trace around the pattern onto green construction paper three times, then cut out all three traced patterns. Put these patterns aside for now.
3. Wrap the first leaf pattern you cut out (from step 1) around the top of the toilet paper roll so that most of the construction paper extends beyond the end of the roll. See diagram 1.
4. Tape the two ends of the construction paper together, and then tape the construction paper to the toilet paper roll.
5. Curl back each leaf by curling it around your fingers and holding it in place for a few seconds. See diagram 2.
6. Wrap one of the leaf patterns from step 2 around the toilet paper roll so that it overlaps the bottom of the first set of leaves. Tape the two ends of this set of leaves together — but before you tape it in place on the toilet paper roll, shift it around so that each leaf will fall more or less between two "top" leaves. See diagram 3. Then curl the leaves as you did in step 5.
7. Wrap the remaining two leaf patterns around the toilet paper roll one at a time, making sure each leaf falls between leaves already taped in place. Curl the leaves. The last leaf pattern should cover the rest of the toilet paper roll. Trim any excess construction paper that's protruding from the bottom of the roll.
8. Cut out the pattern marked "water." Trace around the pattern on a blue piece of construction paper and cut it out. Gently push it into the top of the bromeliad until it fits snugly onto the top of the toilet paper roll. (Note: To fit well, the water pattern should be slightly wider than the toilet paper roll. If the pattern we've provided isn't the right size, make your own circle of water by tracing around your toilet paper roll. Be sure to trace so that the circle is slightly larger around than the roll.)
9. If you want, you can color the tips of your bromeliads leaves. Some bromeliad leaf tips are red, orange, or pink. Then curl the leaves as you did in step 5.

Beautiful Bromeliad Pattern

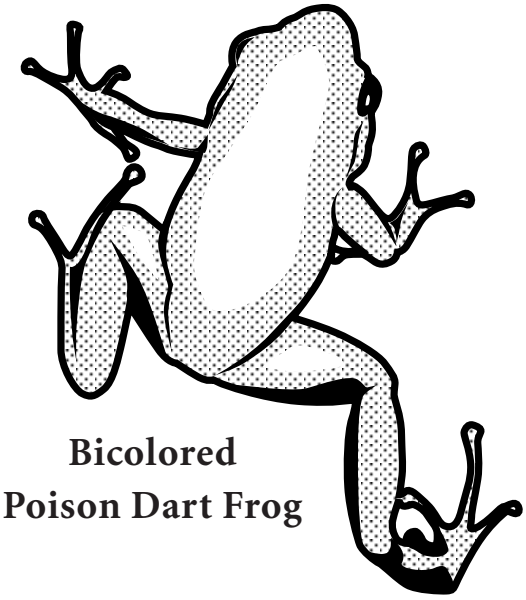
WATER

BOTTOM LEAVES

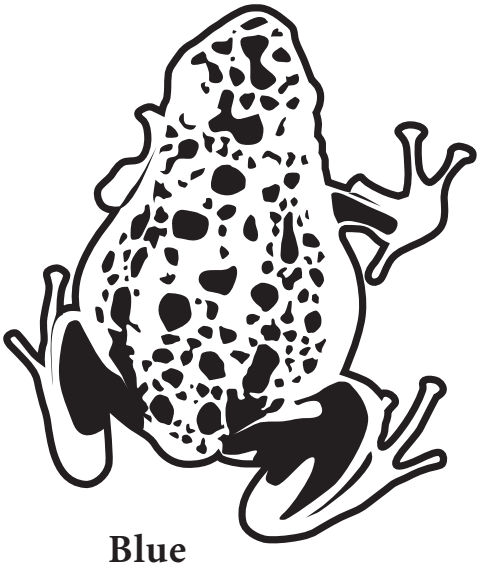
TOP LEAVES

Poison Dart Frogs

* Color the poison dart frogs below.
* Cut them out and place them in the bromeliad you have made.
* What colors should you use to color them?
  Hint: *Look at their names—the bicolored poision dart frog is a golden color with green legs.*



Bicolored
Poison Dart Frog



Blue
Poison Dart Frog

Green & Black
Poison Dart Frog

Inside a Bromeliad Grades K – 6; A

Use the accompanying bromeliad diagram on the student activity sheet to encourage students to observe carefully to see if they can find those animals listed. Using the color key below, the sheet can also be used to understand camouflage and warning coloration (e.g. the bright colors of the poison dart frog warns predators of its poisonous nature).

Materials

- Live bromeliad houseplants or bromeliads made in the "Beautiful Bromeliads" activity *(optional — please make sure that the houseplants you buy are not taken from the wild)*
- "Inside A Bromeliad" student activity sheet *(one per student)*
- Coloring supplies *(pencils, crayons, markers, etc.)*
- Resource materials for student research or teacher background information *(library books, photographs, videotapes—see "References and Resources")*

Instructions

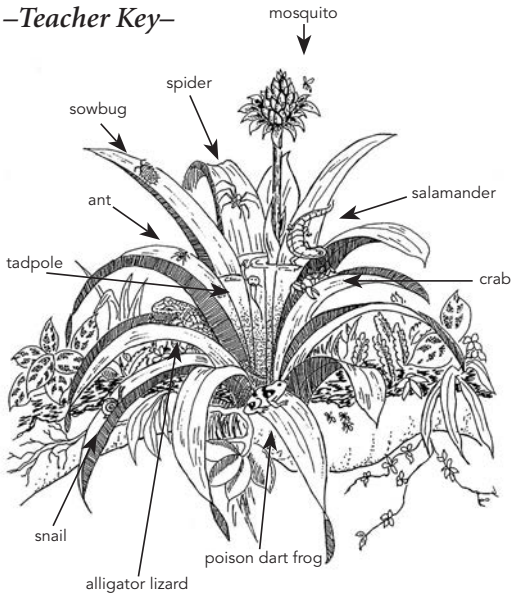
1. Read aloud the following background information on bromeliads to your students. You may need to adapt the information depending on the level of your students.
2. Using the Student Activity Sheet, ask students to search for the animals listed below the illustration and to circle the animal when they find it.
3. Students can then color in the illustration.

In the canopy of neotropical rain forests is a large family of plants called bromeliads. The most familiar form of this plant family to Americans is its domesticated relative, the pineapple. As scientists research the tropical rain forest canopy, they are discovering a complex and diverse habitat centered around bromeliad plants. Due to their shape and growth patterns (swirls of spear-like leaves that grow to create a cup-like depression in the center of the plant), bromeliads collect the rainwater that falls regularly on the canopy. This water is a source of life for a large variety of insects, frogs, ants, worms, minute crabs, spiders, salamanders and lizards, and, of course, a source of food for those animals that visit the bromeliad for a meal—the mouse opossum, birds, such as the white-billed trogon or golden tanager, and tree snakes.

*** Extension for grades 4 – 6**

4. After finding all the animals and coloring the illustration, have each student pick an animal in the bromeliad to study further.
5. After finding more information about the selected animal, from books or through the Internet, have each student present his or her information to the rest of the class orally or write a short story about his or her animal.

–Teacher Key–



Inside a Bromeliad

* Can you find the animals listed at the bottom of the page in the bromeliad?
* Circle the animal when you find it.
* When you have found all the animals, color in this picture of life in a bromeliad.

poison dart frog	spider	mosquito	sowbug	salamander
tadpole	crab	ant	snail	alligator lizard

Leaf Patterns Grades K – 5; **A** (1.2), **S** (1.1)

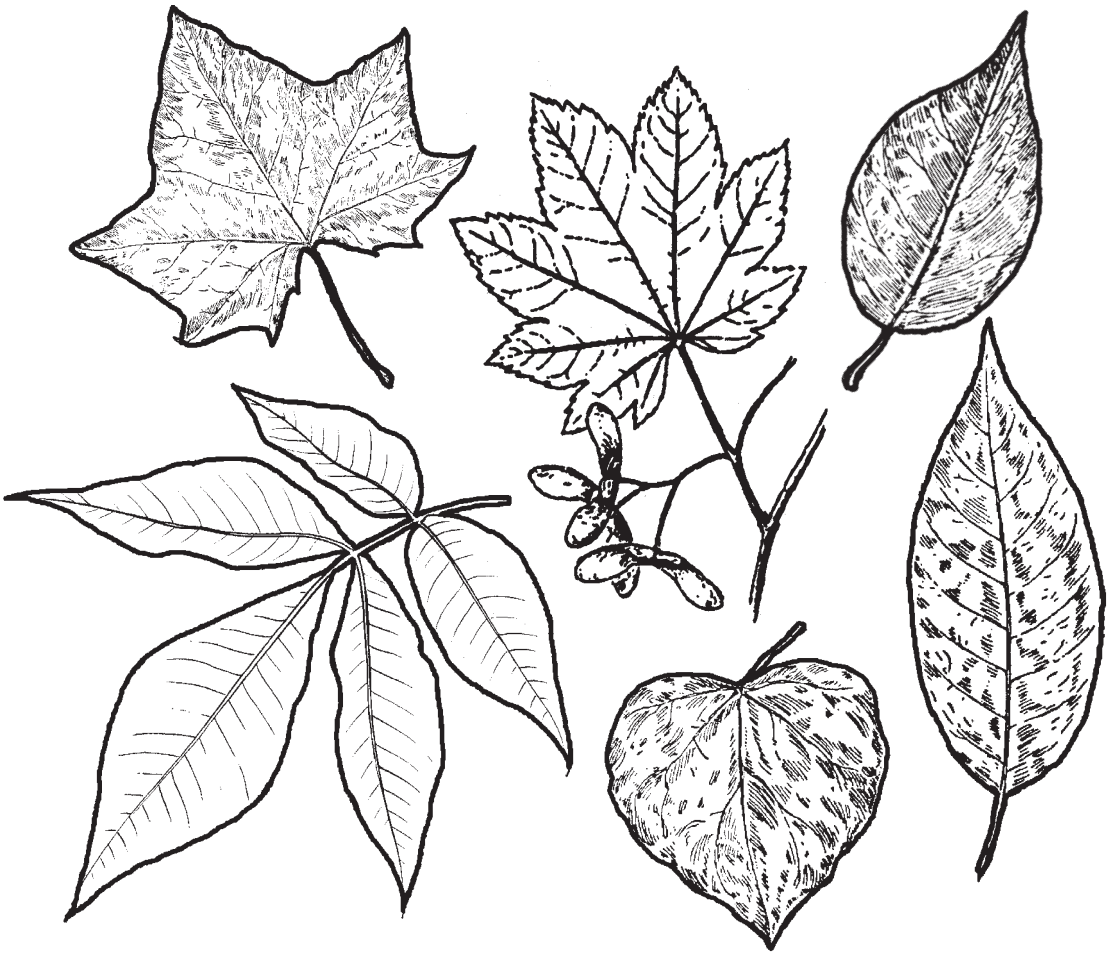
This art activity can help your students to hone their observation skills of patterns in nature. Recognizing patterns prepares students for categorizing objects and living things, an important science skill, which the subsequent activity, "Leaf Sorting," helps students to improve.

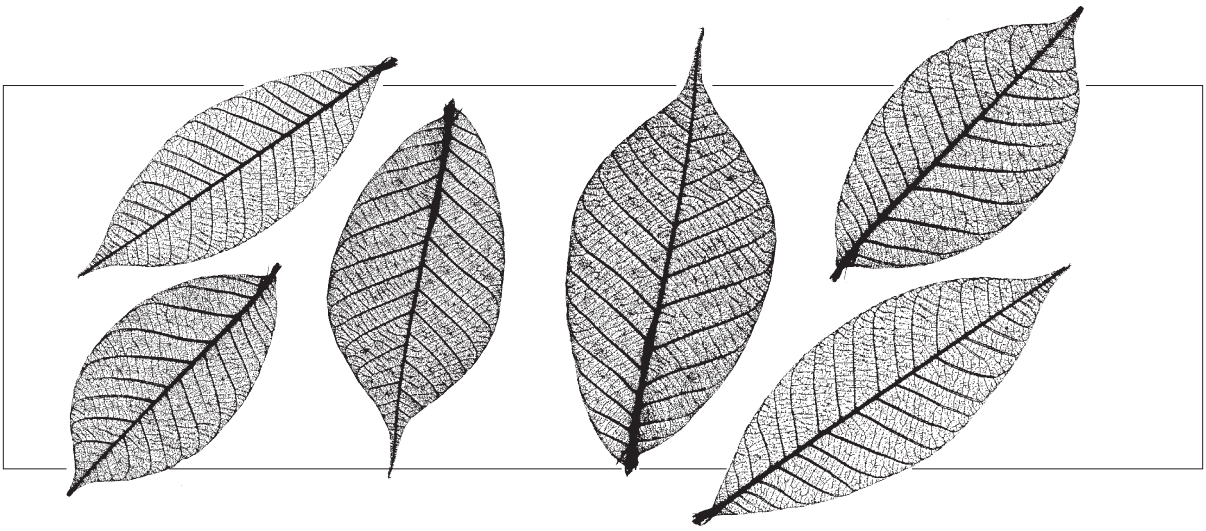
Materials

- Fallen leaves of different sizes and shapes
- Crayons
- Blank white paper

Instructions

1. Have your students collect a variety of fallen leaves of different shapes, sizes and textures.
2. In the classroom, use blank paper and crayons or colored pencils to outline, trace, draw, or do rubbings of the leaves.
3. As a class, have your students discuss the patterns they notice in their leaves, such as the leaf edges (smooth or toothed?), vein patterns, shape (round or narrow?), etc.





Leaf Sorting **Grades K – 5**; **S** (1.1)

An important skill for scientists, as outlined in Washington's Essential Academic Learning Requirements (EALRs), is to "understand how properties are used to identify, describe and categorize substances, materials, and objects" and "how characteristics are used to categorize life in systems." There are many ways to categorize objects, depending on which characteristics you focus on to determine similarities and differences. In this activity, students will enhance their categorizing skills using a variety of tree leaves.

Materials

- A wide variety of tree leaves gathered from a forested area *(gathered by the teacher or by students)*
- Butcher paper or whiteboard

Instructions

1. Spread out the tree leaves on a table or on the floor in your classroom and have your students gather around so they can all see the leaves.
2. Now ask your students to choose one characteristic by which to sort the leaves. Write down "Leaves" at the top of a piece of butcher paper or on the board. Below this write the categories the students choose (e.g. using the characteristic of color, the categories might be "green leaves," "yellow leaves" and "brown leaves").
3. Divide the leaves into piles based on this characteristic. Now look at one pile of leaves, for example the "green leaves" pile. Ask the students to come up with another characteristic by which to divide the leaves in this pile and choose categories according to this characteristic (e.g. size; "big leaves," "small leaves" and "medium-sized leaves"). Write these categories below the "green leaves" category and divide the leaves into piles based on shared characteristics.
4. If possible, continue dividing the leaves into smaller and more specific categories until each pile has one or just a few leaves. Repeat this activity using different general characteristics to start off with (e.g. round leaves, narrow leaves, oval leaves).

Mapping Temperate and Tropical Forests Grades 2 – 3; G (1.1)

There are many diverse forest types in the world. The main factor that determines what type of forest will grow in any one region is climate, primarily the amount of precipitation and annual temperature range. Climate is influenced by many factors, including latitude, altitude, and location in relationship to mountains or the ocean. This activity will introduce your students to the two main types of forests—temperate and tropical—and their respective locations on the earth.

Materials

- World maps and/or globes
- "Map of Temperate and Tropical Forests" worksheet *(one for each student)*
- Crayons or colored markers
- Rulers

Instructions

1. Discuss temperate and tropical forests with your students and show their respective locations on a map or globe. Explain to the class that forests in the Pacific Northwest are called temperate forests. Talk about what the word temperate means (moderate climate) and how that relates to our weather (warm, but not too hot; cool, but not too cold). Explain that temperate forests have moderate climate because they're located between the equator (where it's hot) and the North or South Poles (where it's cold). Point out that in other parts of the world, the climate is different, and so are the forests. Talk about how tropical forests are found near the equator and are consequently always warm.
2. Using maps and globes as resources, have students complete the "Map of Temperate and Tropical Forests" worksheet by:
   - Labeling the names of all the continents to help them put the different forests in a larger geographical context.
   - Coloring in the keys and corresponding areas of both forests.
   - Labeling the equator.
   - Marking their home state (or country) with a star.
   - Labeling the oceans.
   - Creating a legend denoting north, south, east and west.
3. Have your students choose a country that they'd like to visit that contains tropical forests. Have them mark that country with a star. What do they hope to see when they get there? Which animals? Which plants? Who will be traveling the farthest?

Mapping Temperate and Tropical Forests **Grades 4 – 8**; **G** (1.1)

There are many diverse forest types in the world. The main factor that determines what type of forest will grow in any one region is climate, primarily the amount of precipitation and annual temperature range. Climate is influenced by many factors, including latitude, altitude, and location in relationship to mountains or the ocean. This activity will introduce your students to the two main types of forests—temperate and tropical—and their respective locations on the earth.

Materials

- World maps and/or globes
- "Map of Temperate and Tropical Forests" worksheet *(made into an overhead)*
- "World Map" worksheet *(one for each student)*
- Overhead projector
- Colored markers, colored pencils or crayons

Instructions

1. Discuss temperate and tropical forests with your students. Ask them where each of the forests are found on a map or globe. What type of forest is found in the Pacific Northwest? (temperate forest). Talk about what the word temperate means (moderate climate) and how that relates to our weather (warm, but not too hot; cool, but not too cold). Explain that temperate forests have moderate climate because they're located between the equator and the North or South Poles. Ask what latitude and longitude lines are (an imaginary grid system on a map used to define the exact location of a given area; "latitude lines" run parallel with the equator, while "longitude lines" run between the north and south poles and are measured from the prime meridian). Ask about what the weather is like in tropical forests (always warm) and why (tropical forests are found near the equator).
2. Put the overhead of "Map of Temperate and Tropical Forests" worksheet on the overhead projector and pass out one "World Map" worksheet to each student. Have your students draw the locations of temperate and tropical forests onto their maps. Then, they can complete their maps by:
   - Labeling the names of all the continents and oceans.
   - Creating a key and coloring in the corresponding areas of both forests.
   - Creating a legend denoting north, south, east and west.
   - Labeling the equator.
3. Have your students choose a country that they'd like to visit that contains tropical forests. Have them mark that country with a star. What do they hope to see when they get there? What animals? What plants? Who will be traveling the farthest?

Mapping Temperate and Tropical Forests **Grades 9 – 12**; **G** (1.1)

There are many diverse forest types in the world. The main factor that determines what type of forest will grow in any one region is climate, primarily the amount of precipitation and annual temperature range. Climate is influenced by many factors, including latitude, altitude, and location in relationship to mountains or the ocean. This activity will introduce your students to the two main types of forests—temperate and tropical—and their respective locations on the earth.

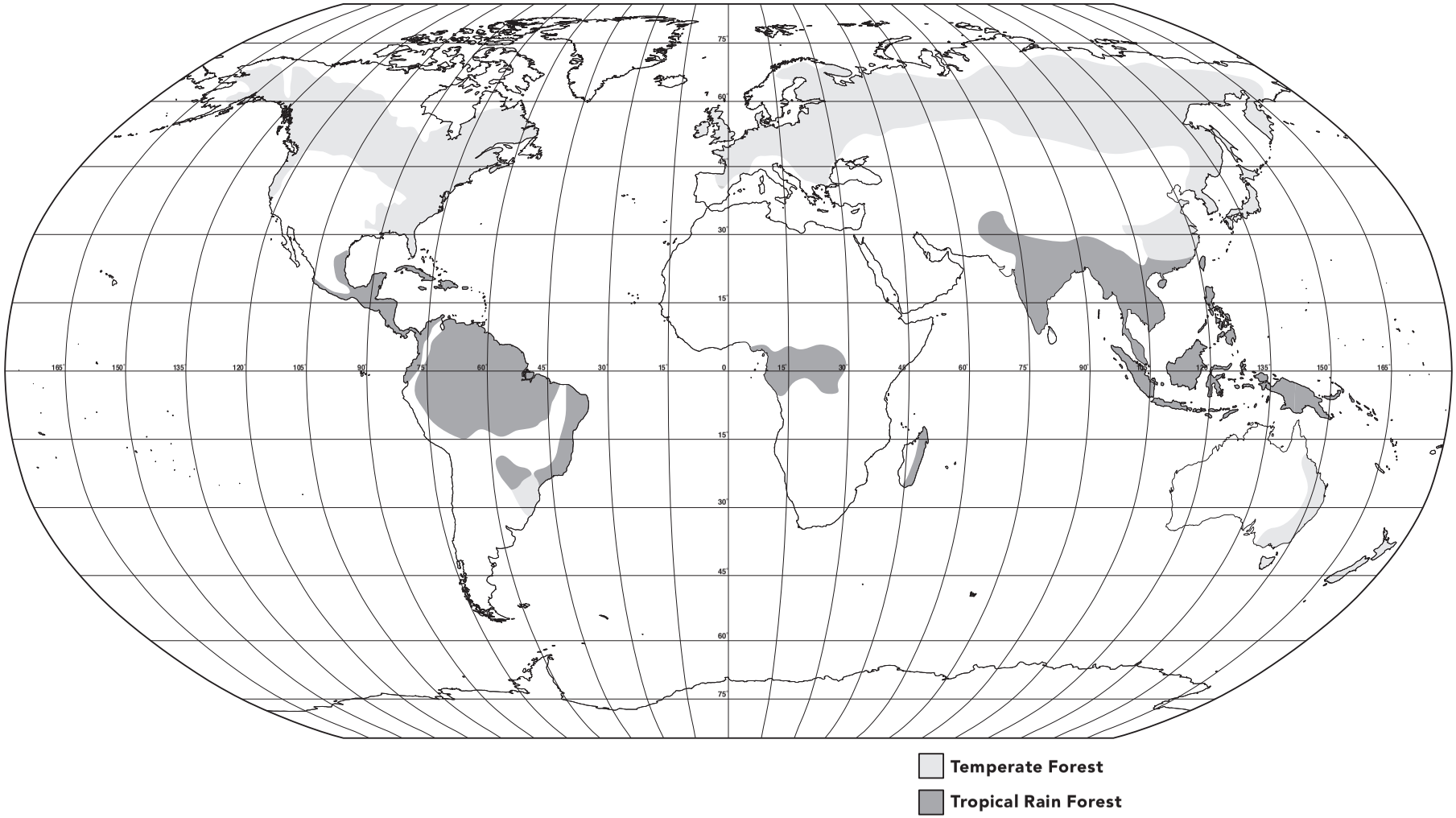
Materials

- World maps and/or globes
- "Map of Temperate and Tropical Forests" worksheet *(made into an overhead)*
- "Blank World Map" worksheet *(one for each student)*
- Overhead projector
- Colored markers, colored pencils or crayons

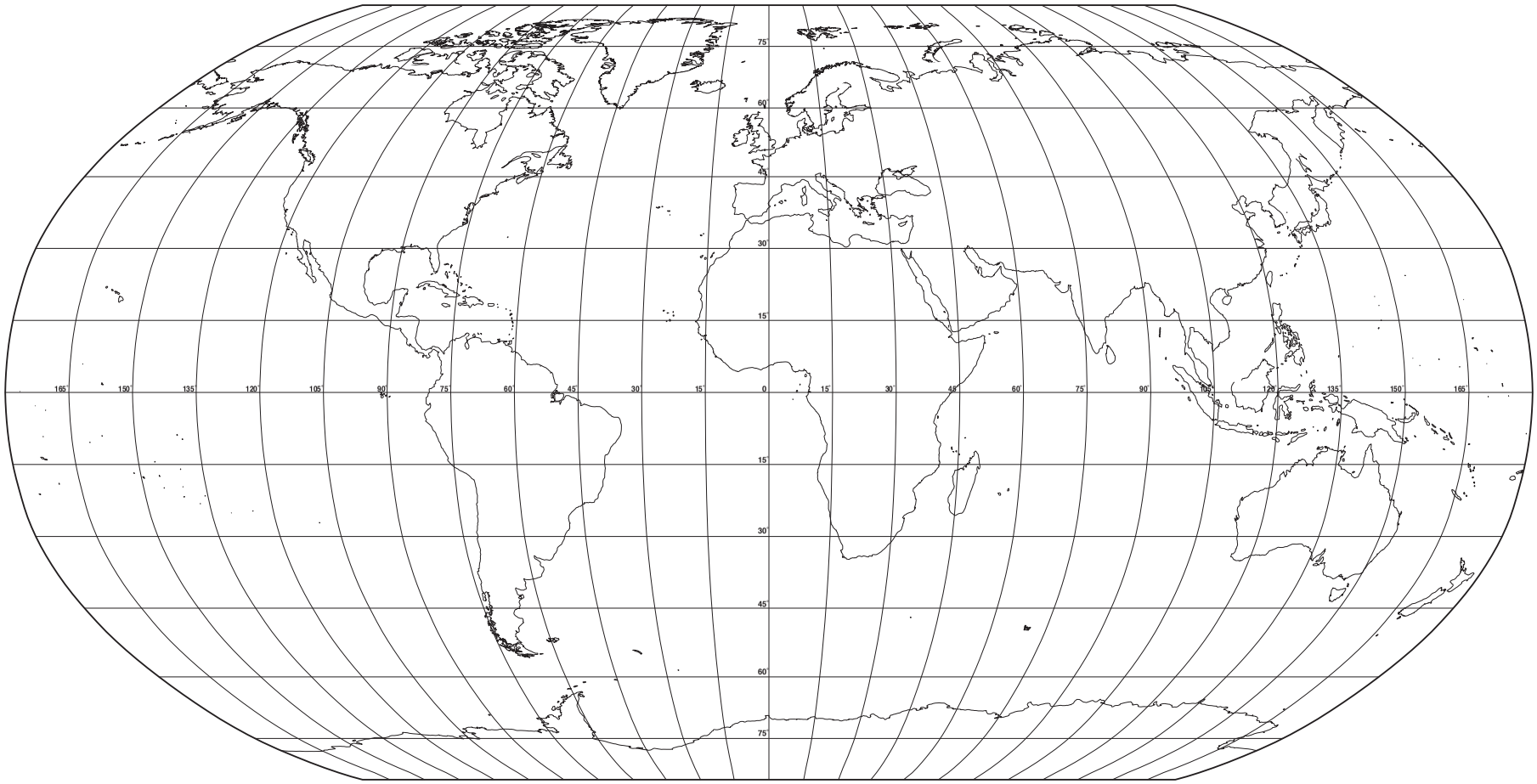
Instructions

1. Discuss temperate and tropical forests with your students. Ask them where each of the forests are found on a map or globe. What type of forest is found in the Pacific Northwest? (temperate forest). Ask what the word temperate means (moderate climate) and how that relates to our weather (warm, but not too hot; cool, but not too cold). Ask what latitude and longitude lines are (an imaginary grid system on a map used to define the exact location of a given area; "latitude lines" run parallel with the equator, while "longitude lines" run between the north and south poles and are measured from the prime meridian). Explain that temperate forests can be found between latitudes 23.5° and 66.5° north of the equator and between latitudes 23.5° and 66.5° south of the equator. Ask about what the weather is like in tropical forests (always warm) and why (tropical forests are found between latitudes 23.5° north and 23.5° south of the equator).
2. Put the overhead of "Map of Temperate and Tropical Forests" worksheet on the overhead projector and pass out one "Blank World Map" worksheet to each student. Have your students draw the continents as well as the locations of the temperate and tropical forests onto their maps, using the latitude and longitude lines as reference guides. Then, they can complete their maps by:
   - Labeling the names of all the continents and oceans.
   - Creating a key and coloring in the corresponding areas of both forests.
   - Creating a legend denoting north, south, east and west.
3. Assign each student a different country that contains tropical forests. Have them find the capital of the country on a map and mark it with a star.
4. Have each student research the flora and fauna of their country and present this information to the class. The students' research could also cover, if time allows, demographics, cultural and geologic history and information about conservation issues in their country.

Map of Temperate and Tropical Forests



World Map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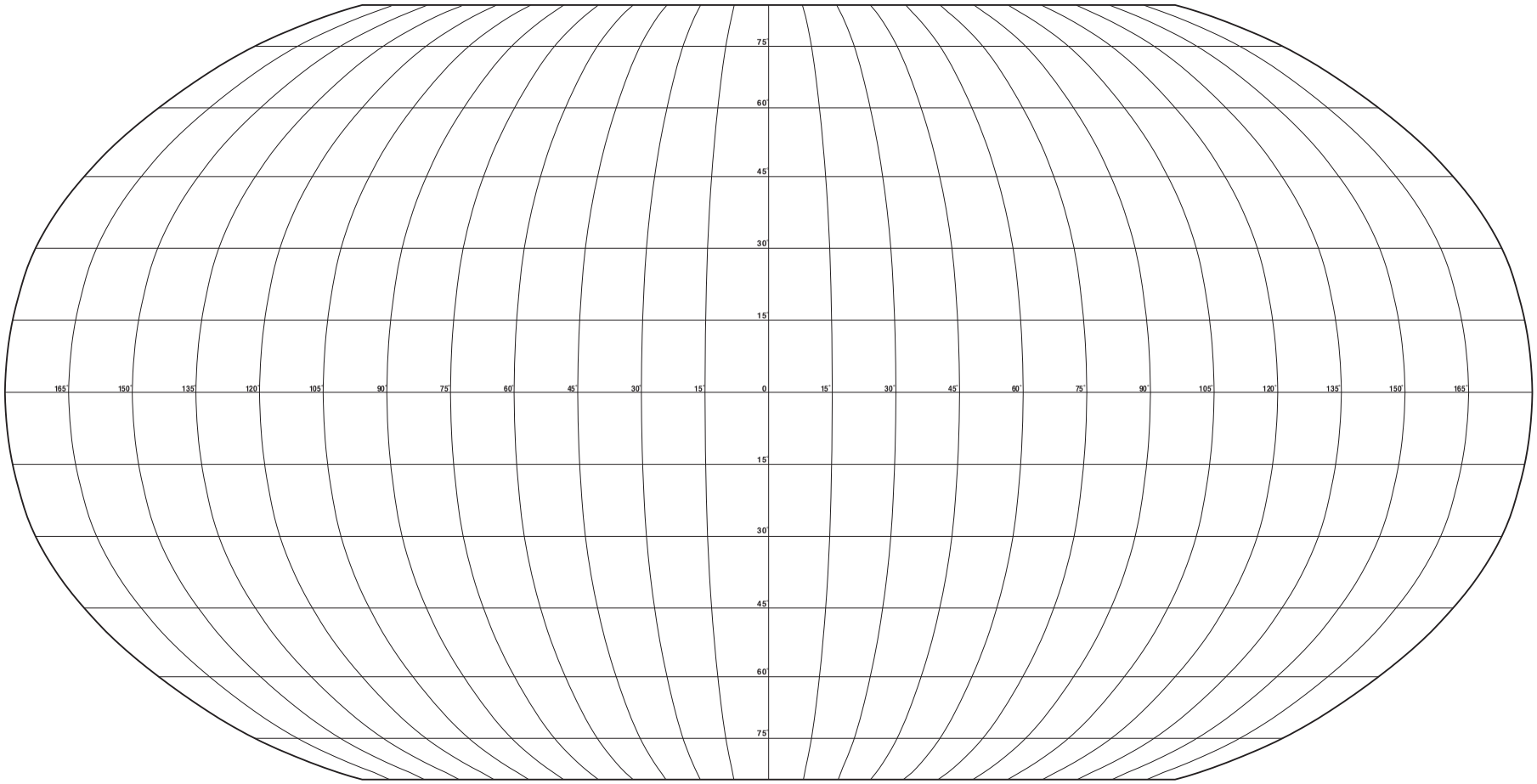
Blank World Map



Forest Climatographs Grades K – 3; **M** (1.4), **S** (1.3), **G** (2.1)

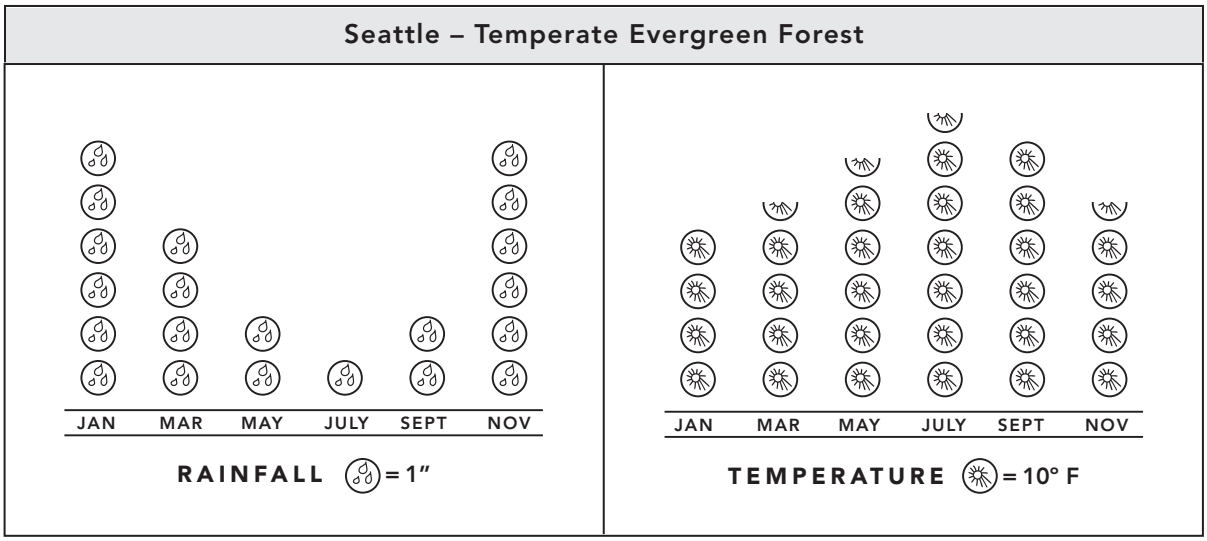
Location on the globe plays a significant role in temperature, precipitation and other climatic occurrences in forest habitats. Other factors such as altitude or location in relationship to mountains or to the ocean will also affect temperature and/or precipitation. This activity offers students the opportunity to explore annual patterns of temperature and precipitation in different types of forests around the world. After gaining an understanding of climate patterns, students will have a background for studying the characteristics and adaptations of plants and animals of different biomes.

Materials

- Computers or other resources with world temperature and precipitation data and/or maps
- World map or globe
- Construction paper

Instructions

1. Find data for your students on the monthly average temperature and precipitation for two or more cities in or near different forest types (e.g. temperate evergreen forest, temperate deciduous forest, tropical rain forest, etc.) Climate data is available at www.worldclimate.com. *See list of cities in or near forests on page 105.*
2. Point out to your students the locations of the cities on a map or globe. Help your students to make pictographs illustrating the monthly average temperature and precipitation for each city. Students can use raindrops to represent inches of rainfall and suns to represent degrees. *See example below.*



Forest Climatographs **Grades 4 – 12**; **M** (1.4), **S** (1.3), **G** (2.1)

Location on the globe plays a significant role in temperature, precipitation and other climatic occurrences in forest habitats. Other factors such as altitude or location in relationship to mountains or to the ocean will also affect temperature and/or precipitation. This activity offers students the opportunity to explore annual patterns of temperature and precipitation in different types of forests around the world. After gaining an understanding of climate patterns, students will have a background for studying the characteristics and adaptations of plants and animals of different biomes.

Materials

- Graph paper
- Colored pencils or pens
- Almanacs, newspapers, computers or other resources with world temperature and precipitation data
- World map or globe

Instructions

1. Focusing on latitude (distance from the equator) and seasonal variations throughout the year, discuss as a class how location on the earth affects the temperature and/or precipitation.
2. Have each student (or group of students) select three cities in or near forested areas. Each city should be in or near a different type of forest (e.g. tropical, temperate evergreen, temperate deciduous). *See list of cities in or near forests on next page.*
3. Have students find the locations of their cities on a map or globe and record the latitude and longitude and/or the continent or region in which their cities are located.
4. Students should then make predictions on how the temperatures and annual precipitation in each of their cities might compare or contrast to their other cities. (Which locations will be hotter? Colder? Receive more or less precipitation per year?) How do they predict temperatures and precipitation will compare through different months of the year? (For example, will one location be warm in January while another is cold?)
5. Using an almanac, Web site or other resource, students should gather data on average monthly temperatures and precipitation for each city. *(World climate data can be found on the Web at www.worldclimate.com)*
6. Then have each student (or group) graph the monthly temperatures and precipitation for each of their cities. A climatograph is a combination of a bar graph and a line graph—the bar graph shows the monthly average temperature and the line graph shows the monthly average rainfall (the x-axis shows the months of the year, the left hand y-axis is degrees and the right-hand y-axis is millimeters). *See examples included with this activity.*
7. Students should then make observations of their graphs, comparing and contrasting climatographs from different forest regions. Were their predictions accurate? Why might the graphs be different from what they predicted. What are the reasons for the patterns they see in their graphs? Have students works together to generate answers.
8. Discuss the results of the students' findings as a class.

Boreal forest
Fort Providence, Northwest Territories, Canada
Olekminsk, Russia

Temperate evergreen forest
Seattle, Washington, USA
Lugano, Switzerland

Temperate rain forest
Forks, Washington, USA
Puerto Montt, Chile

Temperate deciduous forest
Knoxville, Tennessee, USA
Harbin, China

Schlerophyll forest
Perth, Western Australia
Thessaloniki, Greece

Subtropical evergreen forest
Ganzhou, China
Brooksville, Florida, USA

Tropical deciduous forest
Majunga, Madagascar
Hyderabad, India

Tropical rain forest
Manaus, Brazil
Kisangani, Dem. Republic of the Congo

Climate data for these cities can be found at www.worldclimate.com

Temperate evergreen forest

Seattle, Washington

Located at *about* 47.60°N 122.33°W. Height *about* 6m / 9 feet above sea level.

AVERAGE TEMPERATURE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
°C	4.1	5.9	7.2	9.5	12.9	15.7	18.1	18.1	15.6	11.3	7.1	4.7	10.85
°F	39.4	42.6	45.0	49.1	55.2	60.3	64.6	64.6	60.1	52.3	44.8	40.5	51.54

Source: derived from GHCN2 Beta. 558 months between 1948 and 1994

AVERAGE RAINFALL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mm	140.7	106.7	93.8	64.1	42.0	38.1	19.6	27.1	47.2	89.2	149.2	149.1	966.8
inches	5.5	4.2	3.7	2.5	1.7	1.5	0.8	1.1	1.9	3.5	5.9	5.9	38.2

Source: derived from NCDC Cooperative Stations. 51 complete years between 1944 and 1995

Tropical rain forest

Kisangani, Democratic Republic of the Congo

Located at *about* 0.52°N 25.10°E. Height *about* 415m / 1361 feet above sea level.

AVERAGE TEMPERATURE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
°C	24.8	25.1	25.2	24.9	24.9	24.3	23.7	23.6	24.1	24.5	24.4	24.5	24.5
°F	76.6	77.2	77.4	76.8	76.8	75.7	74.7	74.5	75.4	76.1	75.9	76.1	76.1

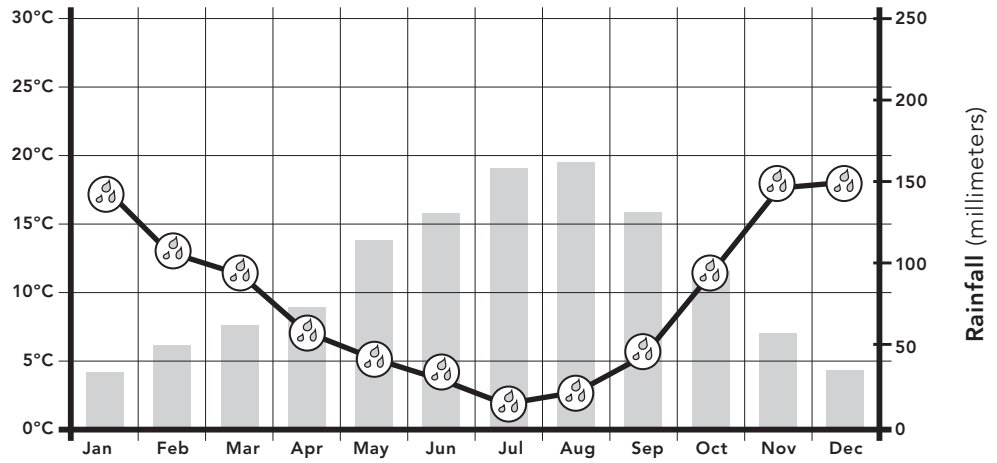
Source: derived from GHCN1. 171 months between 1951 and 1988

AVERAGE RAINFALL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mm	96.7	107.2	172.2	190.4	161.8	127.9	114.0	178.2	164.2	233.0	206.6	105.2	1857.4
inches	3.8	4.2	6.8	7.5	6.4	5.0	4.5	7.0	6.5	9.2	8.1	4.1	73.10

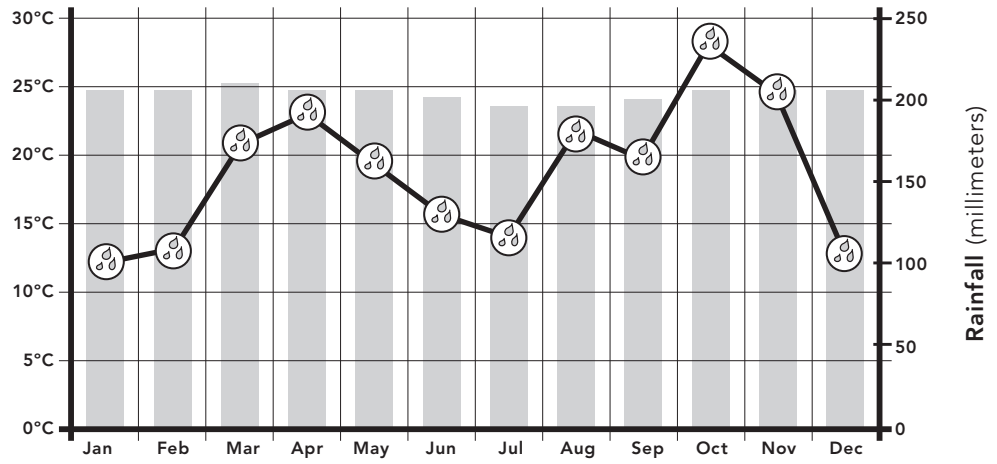
Source: derived from NCDC Cooperative Stations. 51 complete years between 1944 and 1995

TEMPERATE EVERGREEN FOREST CLIMATOGRAPH — Seattle, Washington



	Temperature
	Rainfall

TROPICAL RAIN FOREST CLIMATOGRAPH — Kisangani, Congo



Estimating Canopy Cover Using a Densiometer **Grades 6 – 12**; **M** (1.2,1.4)

Scientists often calculate the percent canopy cover of trees in an area in order to determine whether the area can be defined as a forest (many scientists consider any area with greater than 10 percent canopy cover to be a forest). The percent canopy cover refers to the percentage of horizontal area covered by tree foliage. There are several different means scientists use to determine this percentage. A tool often used to measure canopy cover is a densiometer. In this activity, students will make a simple densiometer consisting of a small, open tube with crosshairs that meet in the center of one end of the tube. Students will use their densiometers to measure canopy cover in a local forested area.

Materials

- Toilet paper tubes (one per student)
- String
- 25 ft. tape measure
- Clear tape
- Metal nut or washer (one per student)
- Bright ribbon
- Clipboards
- Blank paper
- Pencils

Making a Densiometer

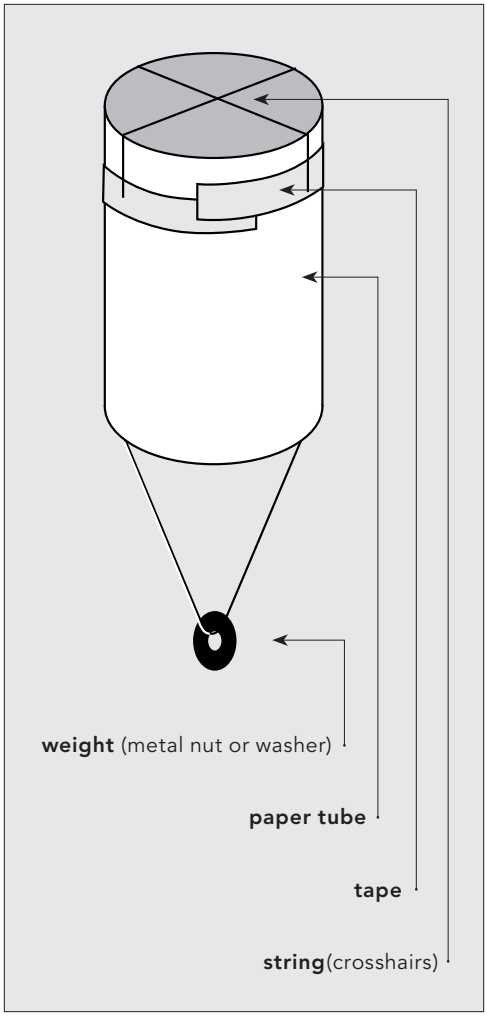
1. Cut two short lengths of string (approximately 3.2 inches [8 cm] long each). Tape one piece of string across the diameter of one end of the tube. Tape the other piece of string across the same end of the tube, perpendicular to the first. These two pieces of string form the crosshair.
2. Cut a third piece of string (approximately 7.2 inches [18 cm]). Thread the metal nut or washer onto this piece of string. Tape this piece of string across the bottom of the other end of the tube so that the washer hangs loosely down under the middle of the tube when the tube is held vertically.

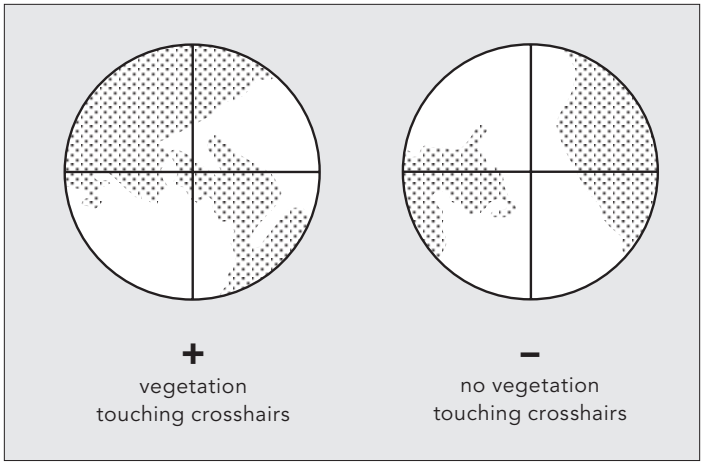
Instructions

1. Use the densiometers in an outdoor, wooded area. Students will work in pairs, with one person acting as the observer and one person acting as the recorder. The recorder should have a clipboard, blank paper and a pencil.
2. Designate several 12-foot (30 m) transects (straight lines) in the wooded area by tying bright ribbon onto branches at the beginning and end of each transect. Each pair of students will walk one or more 12-foot (30 m) transects.
3. Have pairs of students pace the transects, counting paces as they go. The recorder should write down the pace numbers (1, 2, 3, etc.)
4. After every other pace, the observer looks up through the densiometer, making sure that the metal nut is hanging directly below the intersection of the crosshairs (this ensures that the densiometer is held vertically).

5. If the observer sees vegetation (including twigs, leaves, or branches) that appears to be touching the intersection of the crosshairs, the recorder writes down a "+" next to that pace number. If the observer sees no vegetation that appears to be touching the intersection of the crosshairs, the recorder writes down a "-" next to that pace number. (See example below.)
6. Students can walk additional transects if time allows.
7. To calculate the percent canopy cover, students should first add up all the plus signs and minus signs. Next, divide the number of plus signs by the total number of plus and minus signs. Multiply by 100 to convert this fraction to a percentage.
8. If more than one pair of students walked each transect, average the percentages for each transect to obtain an estimated percent canopy cover for that transect.
9. Average the percent canopy cover from all transects to find an estimate of the percent canopy cover for the study area.

Recording Densiometer Observations





Investigate an Acre **Grades 6 – 12**; **M** (1.2, 1.3)

Through the process of measuring out an acre, students will gain a better grasp of the size of an acre, helping them to interpret statistics relating to biodiversity in forests and rates of deforestation.

Materials

- Tape measures or lengths of rope to use for measuring (two to four 50 foot tapes/segments)
- Compasses (four)
- Paper and/or flip chart

Instructions

1. Find a large area outside, such as a playfield. Allow the students to decide as a class how to use the tape measures or lengths of rope to measure out an acre. If you choose, students can use compasses to help them line up the corners of the acre.

   One acre = 43,560 square feet = approximately 209 x 209 feet

2. Have your students imagine that the acre is an acre of tropical or temperate forest. What would they expect to find in that acre (types of plants, types of animals, people)? Brainstorm or research back in the classroom or library, and make a list or word web.

3. If you took a walk through a hectare of that forest, how many different species of trees would you expect to find?

   One acre = 0.4 hectare (one hectare = 2.47 acre)

   One hectare of Malaysian rainforest can contain 180 species of trees, while a hectare of temperate forest may contain only 10 species of trees. Source: World Wildlife Fund www.panda.org/about_wwf/what_we_do/forests/index.cfm

4. In small groups back in the classroom, students can create posters illustrating food chains or webs in temperate and tropical forests, using ideas from the list or word web of plants and animals.

Extension

Lead your students in a discussion about how humans depend on forests (you may choose to have your students complete the "Is This a Forest Product?" activity on page 158 in this packet). Discuss with your students the idea of sustainable use, defined by the World Conservation Union as "using renewable natural resources in such a way that does not threaten a species by over-use, yet it will optimize benefits to both the environment and human needs." (World Conservation Union, www.iucn.org/themes/sustainableuse/faq.htm) Students can then use the following rates of deforestation in temperate and tropical forests to calculate how many acres of each type of forest are logged per day, month or year. Do students feel that these rates are sustainable? Why or why not? If necessary, have your students research to find further information about sustainable use of forests and statistics about logging rates and extent of forested areas in the world.

One acre of Canadian wilderness is logged every 13 seconds.
Source: World Wildlife Fund – Canada, November 30, 1999. www.wwfcanada.org

Approximately one acre of tropical rain forest is logged every second.
Source: Food and Agriculture Organization of the United Nations. State of the World's Forests 2001 Rome: FAO, 2001.

Extension for Forest Conservation

If you and your students would like to help conserve an area of forest or to help Woodland Park Zoo care for forest animals at the zoo, work together as a class to determine some ways to raise money to support these conservation efforts. Here is information about a few organizations that support purchasing acreage in specific forest areas and about Woodland Park Zoo's Wild Parent Program:

Adopt An Acre® Program of the Nature Conservancy

"Adopt an Acre® provides critical funds for rainforest acquisition and protection. This support enables the Conservancy and its partners to achieve their mission of protecting biological diversity. Every year, Adopt an Acre® chooses two to three imperiled sites that are in critical need of protection.

Adopt an Acre® works with other like-minded conservation organizations to raise funds for the protection of additional Adopt an Acre® sites. Since its beginning, the Adopt an Acre® program has protected more than 600,000 acres of rainforests in Latin America and the Caribbean! Once you adopt your acre(s), you'll receive an honorary certificate from The Nature Conservancy specifying the location of your adopted acreage. Although you won't personally own the land you've adopted, you will directly provide for its protection. Your commitment represents a critical investment in the health of the global environment.

By adopting one or a dozen acres you are helping to protect these Last Great Places for generations to come."

Adopt an Acre®
The Nature Conservancy
4245 North Fairfax Drive, Suite 100
Arlington, Virginia 22203-1606
phone 800.84.ADOPT
www.nature.org/joinanddonate/adoptanacre/

Woodland Park Zoo's Wild Parent Program

Cost: five levels of adoption

First level includes:
- Official Wild Parent Adoption Certificate
- Wild Parent window static cling
- Biography information about your animal species
- Invitation for two to the annual Zoo Parent family reunion

Wild Parent Animal Adoption
Woodland Park Zoo
601 North 59th Street
Seattle, Washington 98103
phone 206-615-1024
email membership@zoo.org
www.wpzs–ecommerce.org/adoptions.htm

Protect-an-Acre Program of the Rainforest Action Network

Cost: donations of any amount are accepted
Checks should be made payable to:
Rainforest Action Network-PAA

"Rainforest Action Network established the Protect-an-Acre (PAA) program in 1993 as a tool to protect the world's rainforest and the rights of their inhabitants by providing financial aid to traditionally under-funded organizations and communities in rainforest regions. PAA projects prioritize gaining legal recognition of indigenous territories (a process called 'demarcation'), the development of locally-based alternative economic initiatives, community organization, and resistance to destructive practices such as logging, fossil fuel development, and large-scale infrastructure projects in the rainforests."

Membership Department
Rainforest Action Network
221 Pine Street, #500
San Francisco, California 94104
tel 415.398.4404
phone 415.398.2732
email rainforest@ran.org
www.ran.org/give/paa/

Biodiversity Beads **Grades 5 – 12**; **M** (1.1)

Tropical rain forests host a higher diversity of species than do temperate forests, or, in other words, tropical rain forests have higher biodiversity than do temperate forests. This activity will help students to visualize biodiversity using beads and can be a springboard for further discussion about biodiversity conservation issues.

Materials

- 20 pieces of white paper with one-inch square grids, master included in this packet
- 10 sets of the following:
  - Small plastic container (such as yogurt cups with lids)
  - 25 brown beads
  - 25 white beads
- 10 sets of the following:
  - Small plastic container (such as yogurt cups with lids)
  - 5 beads each of 10 different colors

Instructions

1. Divide your students into 10 groups of two to three students each.
2. Give each group one set of brown/white beads and one set of the multi-colored beads and two sheets of paper (with one-inch square grids). Instruct each group to spread one set of beads on one grid paper and the other set on the other.
3. As a class, discuss the meaning of biodiversity (the diversity of species in an area, the diversity of genes within a species and/or the diversity of habitats on the planet).
4. Explain to your class that the two sets of beads represent the diversity of species in forests — the brown/white beads represent a temperate forest and the multi-colored beads represent a tropical forest. If each color represents a different tree species, what observations can your students make about the relative biodiversity in temperate and tropical forests?
5. On a separate piece of paper, have each group make a list of which colors of beads are on each paper grid and how many beads there are of each color. Then have each group record the number of squares on each paper grid that contain more than one bead of the same color.
6. Next, have each group clear all the beads from one half of each paper grid. Each group should record which colors of beads remain on the grid and how many of each color. Are there any colors of beads (i.e. tree species) that no longer remain on the paper grids (i.e. in the forests)?
7. Once again, have each group clear the beads from half of the remaining squares on each paper grid (so that beads remain on one quarter of the paper grid). Each group should record which colors of beads remain on the grid and how many of each color. Are there any colors of beads (i.e. tree species) that no longer remain on the paper grids (i.e. in the forests)?

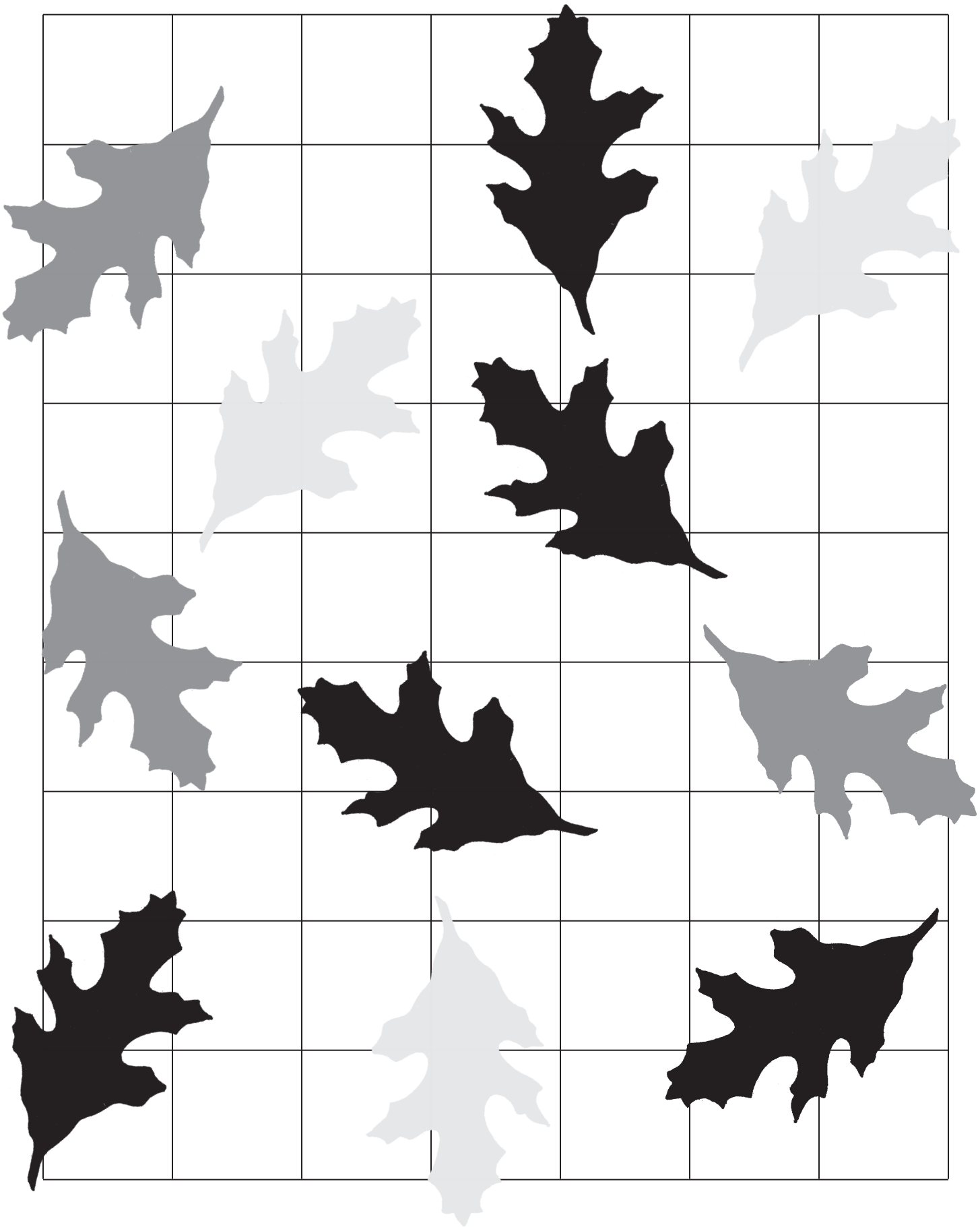
8. Based on their observations of this representation of biodiversity in forests, have your students discuss their understanding of biodiversity in temperate and tropical forests. What does it mean to say that in tropical forests common species are rare and rare species are common"? (Most species have relatively few individuals and therefore cannot be considered common. However, there are so many different species of organisms, that it's common to find a rare species.) Just thinking in terms of species diversity, how could the impacts of logging or forest fires in tropical forests compare to the impacts in temperate forests? (There is a higher chance that species could be eradicated from a tropical forest ecosystem because of the relative rarity of each species.)

Extension

The wrap-up discussion following this activity could lead into some higher-level discussion or writing on biodiversity and conservation. Have your students discuss, research and/or write essays about the following questions concerning habitat conservation:

* If tropical forests host a higher diversity of species than temperate forests, should they be a greater conservation priority? (In the development of the Global Biodiversity Strategy, The World Resources Institute was guided by ten principles for conserving biodiversity, one of which states that, "priorities for biodiversity conservation differ when viewed from global perspectives; all are legitimate, and should be taken into account. All countries and communities have a vested interest in conserving their biodiversity; the focus should not be exclusively on a few species-rich ecosystems or countries" www.wri.igc.org/biodiv/b07-gbs.html.)
* Are there factors apart from biodiversity that should be considered, such as water and nutrient cycles or local socio-economic factors, when assessing the need for conservation in certain habitats?
* What further questions would need to be answered in order to make decisions about conservation priorities? What kind of research would need to be conducted in order to answer these questions?

Biodiversity Beads



Forest Comparisons Grades 2 – 12; S (1.1)

As they learn about forests, students can organize their thoughts about the similarities and differences between temperate and tropical rain forest characteristics by creating a Venn diagram. This activity can be used as an assessment by having students complete Venn diagrams before and after they have studied forests.

Materials

- Paper
- Pencil
- Yarn (optional)
- Pictures and/or videos of temperate and tropical rain forests

Instructions

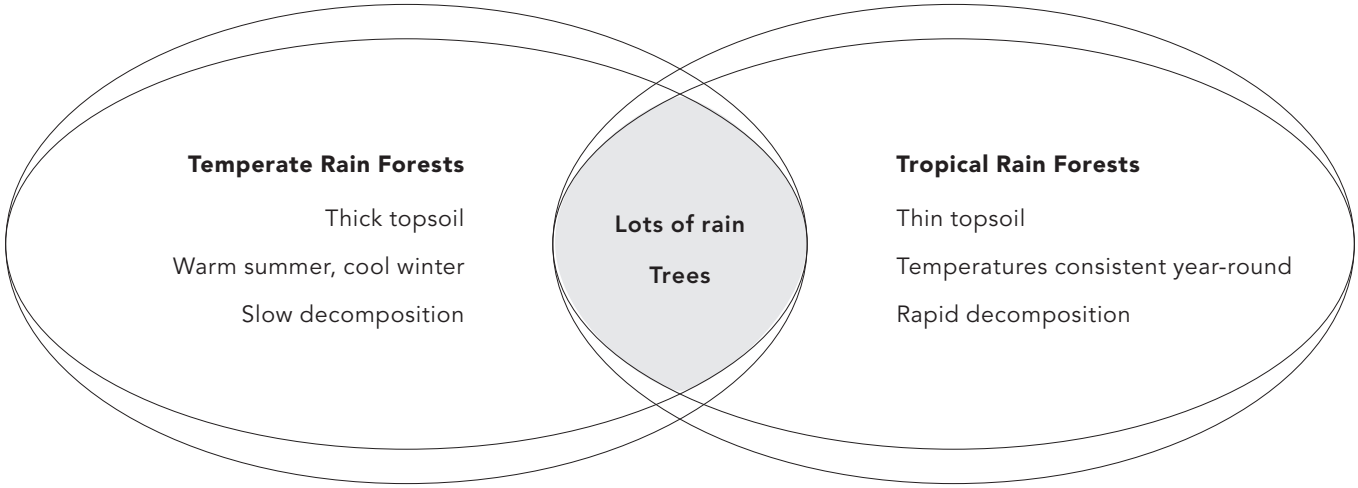
1. Have students complete the following activity individually, in small groups, or as a class. If necessary, show pictures and/or videos of temperate and tropical rain forests.
2. Draw a Venn diagram on the board (to complete as a class) or have each student draw one on a piece of paper to complete individually. *See example on next page.* Inside the left-hand circle write "TEMPERATE RAIN FORESTS." Inside the right-hand circle write "TROPICAL RAIN FORESTS." The area where the circles overlap represents the "common ground" of both types of forests.
3. As a class or individually, make a list of characteristics of rain forests. Depending on the age of your students, the list may include information about vegetation, climate, ecological cycles, animal life, etc. Some of the characteristics will be common to both temperate and tropical rain forests and some will differentiate the forests. *(See background information in this packet for information about forests and the chart on the next page for a summary of characteristics that differ between temperate and tropical forests.)*
4. If the characteristic applies only to tropical rain forests, copy the word in the tropical rain forest area of the diagram. If the characteristic applies only to temperate rain forests, copy the word in the temperate rain forest area of the diagram. If the characteristic applies to both temperate and tropical rain forests, copy the word in the overlapping area of the circles. *Note: As an alternative to writing in the diagram, you can lay two circles on the floor with yarn (making sure the circles overlap) and students can draw or cut pictures out of magazines to illustrate the different characteristics and place them in the correct part of the circles.
5. In a follow-up discussion, ask your students to explain which characteristics temperate and tropical rain forests have in common. Which characteristics set temperate and tropical rain forests apart from one another?

Prior to studying temperate and tropical rain forests, have your students fill out the Venn diagrams based on their current knowledge of forests. Have each student write their name and the number "one" on their initial Venn diagram. After they have studied forests, have each student complete another Venn diagram and write their name and the number "two" on it. Make sure to collect and save all student work for comparison.

Note: *We encourage you to submit your students' work (both the "pre" and "post" Venn diagrams) to Woodland Park Zoo to share their progress with our Education department. Please send drawings to:*

Teacher Training
Woodland Park Zoo
601 North 59th Street
Seattle, Washington 98103

Temperate Rain Forests	Tropical Rain Forests
Slow decomposition	Rapid decomposition
Thick layer (one foot) of leaf litter	Thin layer (one inch) of leaf litter
Thick layer (seven feet) of topsoil	Thin layer (two to three inches of topsoil)
Temperatures range widely	Temperatures fairly constant
Three layers of vegetation	Four layers of vegetation
Trees mostly wind-pollinated	Trees mostly pollinated by animals
Average biodiversity	High biodiversity



Drawing Forests Grades K-5; **A** (3.2), **S** (1.1)

This drawing activity will provide you with an understanding of your students' current knowledge of tropical rain forest layers. In order to encourage their creativity and expression, remind your students that this exercise is not a test but a way of seeing what they already know and what they have not yet learned about forests. You can also use this activity to compare your students' knowledge of tropical rain forests with that of temperate rain forests. Once you and your students have studied forests, you can repeat this activity to assess their learning. Make sure to collect and save all student work to use for comparison.

Materials

- Letter or legal paper
- Crayons, colored pencils or other drawing materials

Instructions

1. Prior to studying forests, give your students a blank piece of letter or legal-sized paper. Ask your students to draw a tropical rain forest. Have them write their names and a number "one" on their paper. There is no right or wrong way to do this activity and it may help your students to relax if you tell them to just draw what comes to mind when they think of a tropical rain forest.
2. If you choose, have your students draw a temperate rain forest on another piece of paper.

Assessment

Repeat this activity once your class has studied temperate and/or tropical rain forests. Have each student label their second drawings with their name and a number "two." Compare the before and after drawings for each student, looking for characteristics of forests (such as layers) and interactions between plants and animals that you have presented in your teaching.

Note: *We encourage you to submit your students' work (both the "pre" and "post" Venn diagrams) to Woodland Park Zoo to share their progress with our Education department. Please send drawings to:*

Teacher Training
Woodland Park Zoo
601 North 59th Street
Seattle, Washington 98103

Becoming the Forest Layers Grades K-5; **A** (3.2), **S** (1.1)

To help students understand characteristics of forest layers, as well as the similarities and differences between temperate and tropical forests, students will act out the different parts of the forest, including layers, plants and animals.

Materials

- Chairs
- Blankets
- Artificial temperate or tropical plants (optional)

Instructions

1. After discussing temperate and tropical forests with your students, pick a forest for you and your students to act out. Talk about the characteristics of that forest with your students. What kinds of animals live there? Where in the forest do these animals live? What do they eat? What happens to dead plants and animals?
2. In a large open space, create that forest using students to act out the different parts of the forest. Assign different forest roles *(see "Forest Layer in Inhabitants" chart, on the following page)* to each student or have your students select their roles out of a hat. The number of roles will depend on your class size.
3. As appropriate, encourage students to move and make the sounds their character would. Introduce different weather patterns into the forest (sunshine, rain, thunder, lightning) and have students react as their character would.
4. Students playing a part of the forest floor (soil and leaf litter in the tropical rain forest; a nurse log in the temperate forest) can lie on blankets on the ground. Students playing small trees or shrubs in the understory can sit or kneel on the ground. Students playing trees in the canopy can stand on the ground, holding their arms out to act as branches. In the tropical forest, some students can hold hands to make vines that connect the layers of the forest as well as the trees in the canopy. Students playing the emergent trees in the tropical forest can stand on chairs. Have your students brainstorm different plant and animal relationships that will allow them to rotate characters.
5. Students who are in the roles of animals can act out predator/prey relationships, which will allow students to rotate through different roles. For example, in the tropical rain forest, the student who is a jaguar can creep up slowly and quietly to where a young tapir (another student) is foraging for food. To make a "kill," the jaguar can touch the tapir gently on the shoulder. Once the tapir has been "eaten" by the jaguar, it decomposes and that student can become soil. The student that was the jaguar can become the tapir, and a student that doesn't have a role yet can become the jaguar.
6. Students who are in the roles of soil and plants can rotate through different layers of the forest, signifying the different stages of plant growth. The student who is soil can become an understory seedling, the understory seedling can become a canopy tree, the canopy tree can become the emergent tree, the emergent tree can topple in a windstorm and become soil.

7. This activity can be played multiple times and can incorporate different art and music projects. Students can make animal masks or artificial plants (see the "Beautiful Bromeliads and Poison Dart Frogs" activity in this packet) to decorate the layers of the forest. They can make wind sounds by blowing air into empty plastic bottles (and if you pierce holes in the bottles, you can change the pitch of the sounds). They can make the sound of rain by slapping their hands and snapping their fingers.

Forest Layer Inhabitants

TEMPERATE RAIN FORESTS

Forest Floor
- nurse log
- cougar
- deer
- rabbit
- banana slug

Understory
- shrub or small tree
- honeybee
- butterfly
- robin with chicks

Canopy
- tall tree
- bald eagle
- bat
- crow

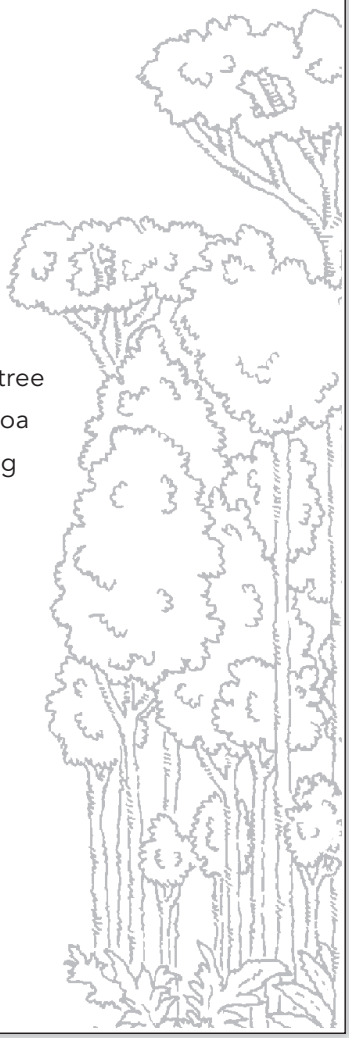
TROPICAL RAIN FORESTS

Forest Floor
- soil
- leafcutter ant
- tapir
- jaguar
- cockroach

Understory
- shrub or small tree
- emerald tree boa
- poison dart frog
- bromeliad

Canopy
- tall tree
- monkey
- sloth
- fruit bat
- harpy eagle

Emergent
- tallest tree
- toucan



Forest Layer Presentations **Grades 6 – 12**; **S** (1.1, 1.3), **R** (1.5), **C** (1.2, 2.1-2.5, 3.2)

To help students understand characteristics of forest layers, as well as the similarities and differences between temperate and tropical forest layers, students will research a forest layer and present their information to the rest of the class.

Materials

- Resources for research
  (books, articles, Internet access and background information provided in this packet)
- Transparencies of "Layers of the Tropical Rain Forest" and "Layers of the Temperate Forest"
  (see master copies on the following pages)

Instructions

1. Divide your students into seven groups. You may wish to ask each group to assign roles within their group such as: coordinator, researcher, writer, presenter, illustrator, etc. Assign each group one of the following: temperate rain forest floor, temperate rain forest understory, temperate rain forest canopy, tropical rain forest floor, tropical rain forest understory, tropical rain forest canopy, tropical rain forest emergent layer.

2. Explain that each group will be responsible for giving a short presentation (approximately five minutes) to the rest of the class on their forest layer using an overhead transparency. Provide each group with time, either in school or at home, to research the physical and biological characteristics of their forest layer. You may choose to photocopy background information from this packet to hand out to your students. Students should include as much of the following information about their forest layer as possible:

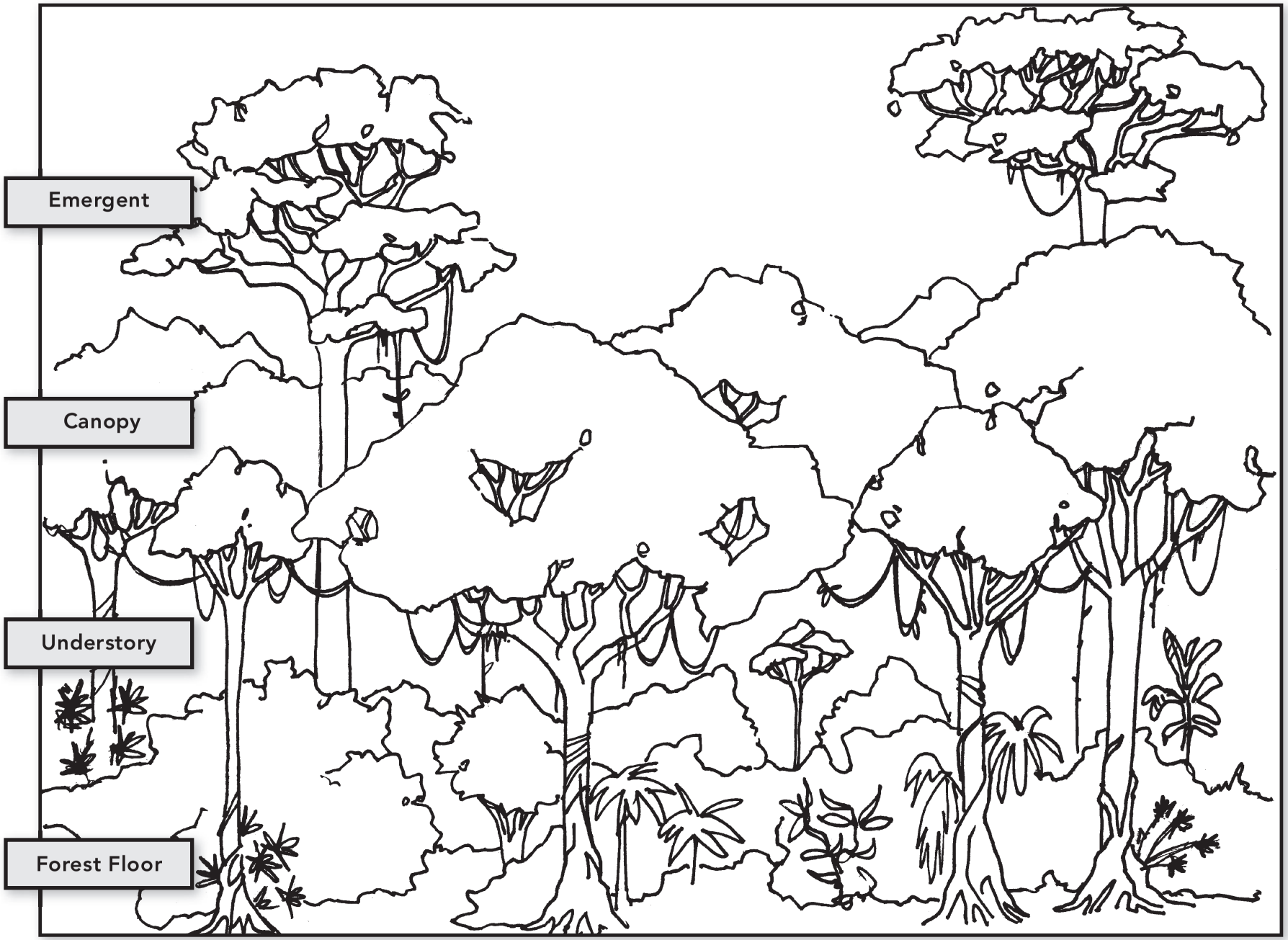
   – Average temperature
   – Amount of sunlight
   – Soil characteristics (especially for forest floor layers, although soil affects all layers)
   – Other climatic conditions (such as humidity and wind)
   – Typical vegetation, including average height of vegetation, number of species, etc.
   – Animals that reside in or visit the layer and how they use the layer
   – Important animal/plant interrelationships in the layer

3. Begin the presentations with the tropical rain forest floor and alternate tropical and temperate forest layers, so that the last presentation is the tropical rain forest emergent layer. This will allow students to make comparisons of each layer between the types of forests. When the groups give their presentations, they should display the transparency of their layer. Groups may choose to develop other visual aids such as posters, slide shows or PowerPoint® presentations.

4. Students should take notes on each groups' presentation for use in a follow-up discussion. Instead of or prior to a follow-up discussion, you may choose to use an assessment tool to determine what information students gained from sharing their forest layers presentations. The "Forest Comparisons" activity (page 117 in this activities section) can be used as an assessment tool. Rather than comparing temperate and tropical rain forests as a whole, students can make Venn diagrams that illustrate the similarities and differences between each layer that the forests share in common (forest floor, understory and canopy).

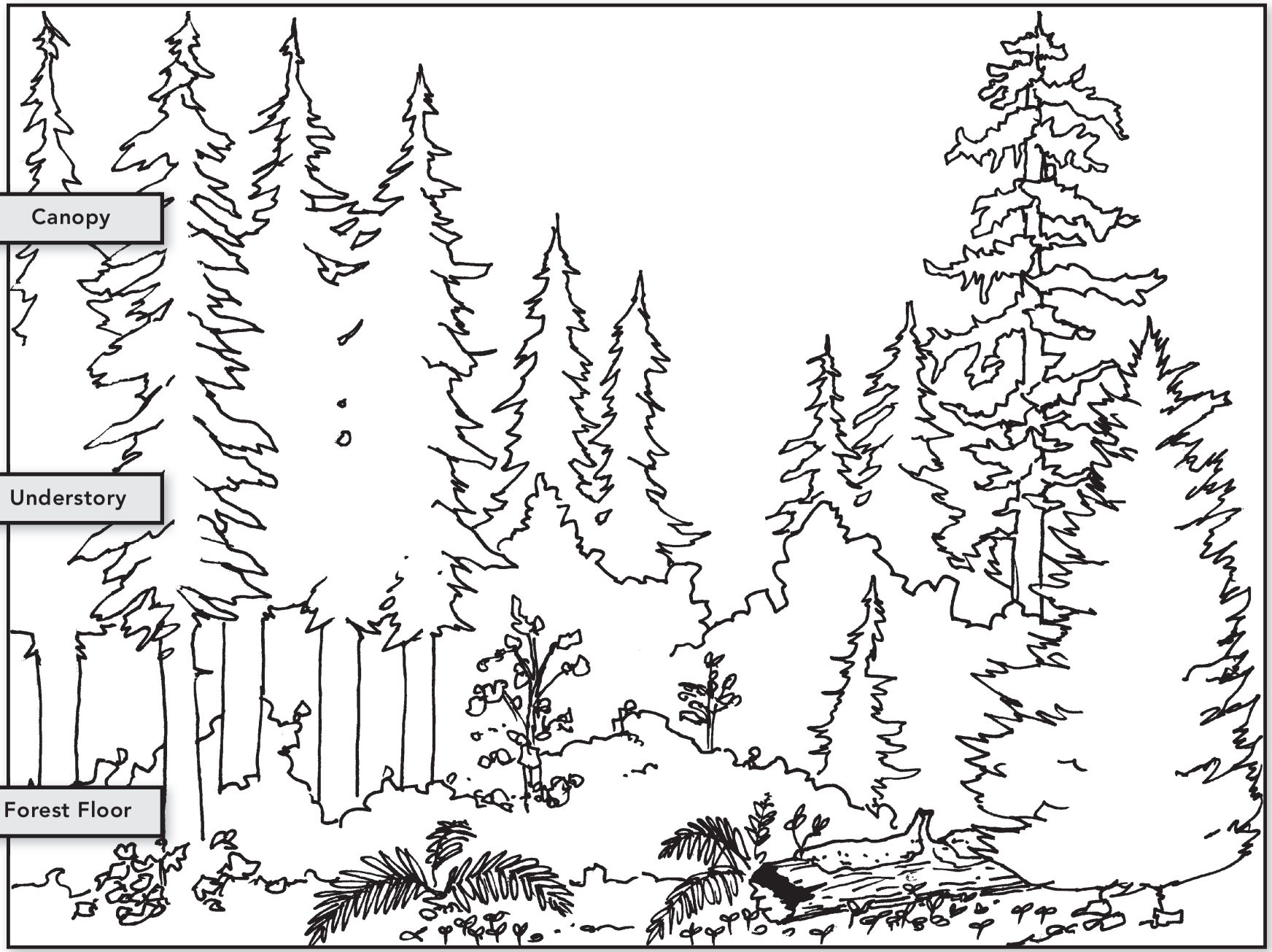
Layers of the Tropical Rain Forest

Name_____



Layers of the Temperate Forest

Name_____



Decomposition Scavenger Hunt Grades K – 3; **S** (1.3)

In this activity, students will use their observation and description skills to learn more about decomposition in forest habitats. We encourage you to take your students outside to explore your schoolyard or local natural area. Woodland Park Zoo's Habitat Discovery Loop in the Temperate Forest is a good outdoor location for completing the following observations and "hunting" activities.

Materials

- Paper
- Crayons
- Clipboards
- Magnifying glasses

Instructions

1. Using ideas from the Student Activity Sheet for grades 4 – 8 (page 130) provided in this packet, adapt a decomposition scavenger hunt for younger students. You may choose to read the tasks aloud one at a time for your students to complete, regrouping after each session to share observations orally. Students can draw and/or write down a few words describing their observations during each task of the scavenger hunt.

Decomposition Scavenger Hunt Grades 4 – 8; **S** (1.3), **W** (2.2, 2.3), **G** (1.1)

Materials

- Copies of "Decomposition Scavenger Hunt" student activity sheet provided in this packet (one per group of five or fewer students)
- Paper
- Pencils
- Clipboards
- Field guides
- Magnifying glasses
- Binoculars (optional)

Instructions

1. Divide students into small groups of five or fewer. Have your students complete the following scavenger hunt using their best observation skills and all their senses. Students can record their observations.
2. After completing the scavenger hunt, have each group draw a map of the area they explored. Include any prominent features and some (or all) of the locations where they found scavenger hunt answers. Also have them include directional information, such as a compass rose, landmarks and distances.
3. Following the scavenger hunt, each group can write a walking tour of the area to highlight the places where they hunted and found special features of the habitat. This tour could be shared with another group of students on a return trip to the location. If different classes go to different locations, they could trade walking tours and then visit each other's locations.

Decomposition Scavenger Hunt

1) Find and describe one of each of the following. Something that is: **smooth, rough, wet, young, old, rotten, smelly.**

2) Describe anything you can find that was once living but is now in the process of decomposing:

   – leaves
   – sticks or branches
   – fallen logs
   – fallen fruits
   – small animals *(such as insects)*

3) Find and compare fallen leaves from different types of trees or shrubs. Do some leaves look more decomposed than others? Describe the appearance and feel of different decomposing leaves.

4) Look for decomposers or signs of decomposers: **worms, beetles and other insects, slugs, fungi.** Describe any decomposers you can find.

5) Find and describe two different types of soils. Are they wet or dry? Light-colored or dark-colored? Hard or soft? Coarse or fine? Gritty or smooth?

Interconnected Niches **Grades 2 – 6**; **C** (3.2), **S** (1.3)

Every living and non-living component of an ecological community plays many important roles within that community. Collectively, the roles played by a species—such as what individuals of a species eat, how they obtain food, and how they avoid predators—are referred to as the species' ecological niche. For example, the niche of pileated woodpeckers living in the temperate rain forest includes eating carpenter ants and other insects, excavating cavity nests in snags and protecting their young from snakes and hawks by sheltering them inside their cavity nests. In this activity, students will be introduced to the concept of a niche by thinking about their roles in their community.
Note: *This activity makes an excellent icebreaker for the beginning of the school year.*

Materials

- Overhead projector or chalkboard
- Copies of "About Me" worksheet provided in this packet (one per student)
- Copies of "My Roles, Your Roles" worksheet provided in this packet (one for every two students)

Intructions

1. As an introduction to the concept of niches, discuss with your students the roles people play in their community. Using yourself or another person as an example, make a list on the overhead projector or chalkboard of some of the roles you play in your community. This list could contain items such as: teacher, mother/father, soccer coach, reader, basketball player, cook, hiker, grocery shopper, car washer, etc.
2. Explain to your students that people's roles in their communities are similar to the roles that species play in their ecological communities, also known as their niche. Discuss how people's roles or activities play a part in defining who they are as people. Each person is unique and the combination of our activities, roles and habits makes us who we are. Additionally, discuss which other factors might help define you as a person. Are you a morning person or a night person, a city dweller or a country dweller, a health food enthusiast or a junk food eater?
3. Point out to your students that many of the roles people have involve forests. You can ask students if they go camping, hiking or picnicking in forested areas or use the forest in other ways. Also, have them think of the products they use in their daily lives: paper? chocolate? wood? bananas? Keep a tally of their responses on the board to see how many of your students' niches extend into the forest.
4. In class or as homework, have the students fill out the "About Me" worksheet.
5. When completed, point out to the students that even though some things about us are the same, each of us has a different set of characteristics that define us. Break the students up into pairs. Each pair should fill out the Venn diagram on the "My Roles, Your Roles" worksheet using the information from the "About Me" worksheet to compare the niches they fill.
6. Then have each pair of students choose a common animal of the temperate rain forest (or of the tropical rain forest, if students are familiar with animals of tropical rain forests), such as a raccoon or robin, and work together to describe the niche of the animal, including what it eats and how it obtains food, what preys on it, and how the animal avoids predators.
7. Wrap up the activity with a class discussion about niches. Have each pair of students share information about what they discovered while filling out the "My Roles, Your Roles" worksheet and information about their forest animal and its niche.

About Me...

Name_____

Things I do: *(chores, school, hobbies)*

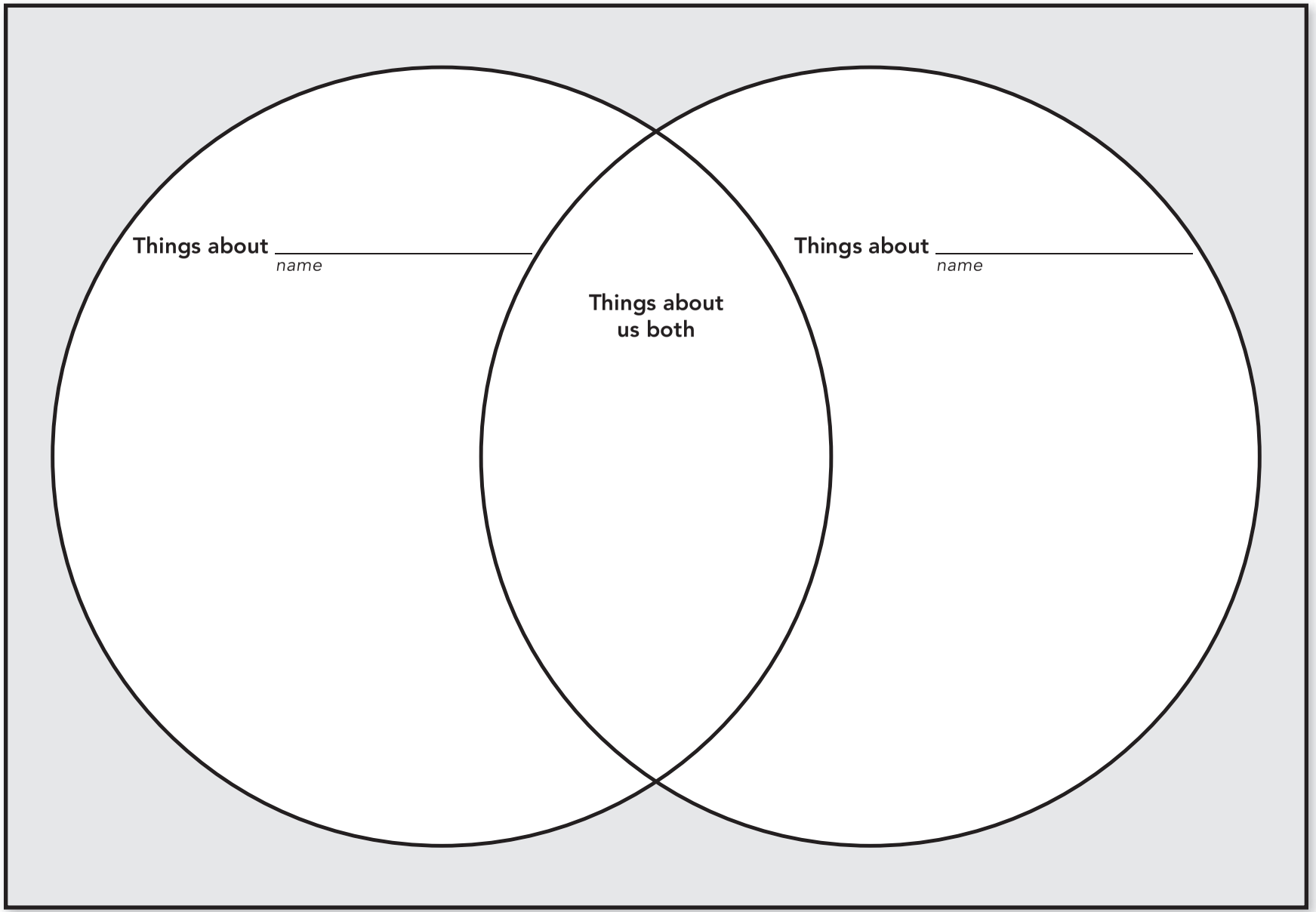
Where I live: *(city, country, house, apartment, condo)*

What I like to eat:

Other interesting information about me:

My Roles, Your Roles

Name_____



Interconnected Niches **Grades 7 – 12**; **C** (3.2), **S** (1.3)

Every living and non-living component of an ecological community plays many important roles within that community. Collectively, the roles played by a species; such as what individuals of a species eat, how they obtain food, and how they avoid predators; are referred to as the species' ecological niche. For example, the niche of pileated woodpeckers living in the temperate rain forest includes eating carpenter ants and other insects, excavating cavity nests in snags and protecting their young from snakes and hawks by sheltering them inside their cavity nests. In this activity, students will be introduced to the concept of a niche by thinking about their roles in their community.
Note: *This activity makes an excellent icebreaker for the beginning of the school year.*

Materials

- Overhead projector or chalkboard
- Notebook paper

Intructions

1. As an introduction to the concept of niches, discuss with your students the roles people play in their community. Using yourself or another person as an example, make a list on the overhead projector or chalkboard of some of the roles you play in your community. This list could contain items such as: teacher, mother/father, soccer coach, reader, basketball player, cook, hiker, grocery shopper, car washer, etc.
2. Explain to your students that people's roles in their communities are similar to the roles that species play in their ecological communities, also known as their niche. Give a few examples, or have students think of examples, of common forest animals and their niches. Then, discuss how people's roles or activities play a part in defining who they are as people. Each person is unique and the combination of our activities, roles and habits makes us who we are. Additionally, discuss which other factors might help define you as a person. Are you a morning person or a night person, a city dweller or a country dweller, a health food enthusiast or a junk food eater?
3. Point out to your students that many of the roles people have involve forests. You can ask students if they go camping, hiking or picnicking in forested areas or use the forest in other ways. Also, have them think of the products they use in their daily lives: paper? chocolate? wood? bananas? Keep a tally of their responses on the board to see how many of your students' niches extend into the forest.
4. Discuss the fact that as they get older, they're going to be adding more and more roles to their niche in the community and the world: summer jobs, college, careers, homeowner, spouse, parent, etc. Discuss how different roles have effects on their social community and their ecological community.
5. In class or as homework, have your students write down their current roles in their community. Also, have them include a section on desired future roles in their social and ecological communities.
6. When completed, point out to the students that even though some things about us are the same, each of us has a different set of characteristics that define us. Break the students up into small groups of three to six students each. In their groups, have your students discuss their current and future roles in their community. Do any of the students share current or future roles? Which roles set the students apart from one another? How can two people with two different roles relate, interact, and work together to accomplish goals?
7. As a whole class, discuss with your students the impact their roles have on their surroundings. What effect do these roles have in their social community? On their ecological community? On forests? On resources? Are there ways to minimize negative impacts? How can they increase positive impacts?

Habitat for Rent **Grades 2 – 4**; **A**, **C** (1.2), **W** (1.1, 1.2), **S** (1.3)

All plants and animals have five basic needs that must be fulfilled by their habitat: air, food, water, shelter and space. In this activity, students will learn about these concepts by hearing and writing classified ads designed to find suitable habitat that meets all of the animal's or plant's basic needs.

Materials

- "Habitat for Rent" ads
- Pens or pencils
- Colored markers or crayons
- Paper

Instructions

1. Familiarize your students with the concept of habitat and basics needs. What is a habitat? (a plant or animal's home, where it meets its basic needs for survival) What are a plant or animal's basic needs? (air, food, water, shelter and space) Do humans have the same basic needs? (yes!) When a human needs to meet one of his or her basic needs, such as shelter, what might he/she do? (buy or rent a house or apartment) How does a person find out about a house for sale or an apartment for rent? (the classified ads in a newspaper) Let's pretend that animals also use the classified ads when looking for a good habitat.
2. Have your students get out paper and a pen or pencil. Read each of the following "Habitat for Rent" ads to your class, instructing them to listen carefully to figure out what animals might want to "move into" each space. Have your students write down their guesses. They can also draw each animal in its habitat. Then, discuss their guesses as a class.
3. Have your students write one of their own ads with a particular animal of temperate or tropical forests in mind. They can then read their ads aloud and have the rest of the class guess what their animal is.

Habitat for Rent **Grades 5 – 12**; **C** (1.2), **W** (1.1, 1.2), **S** (1.3)

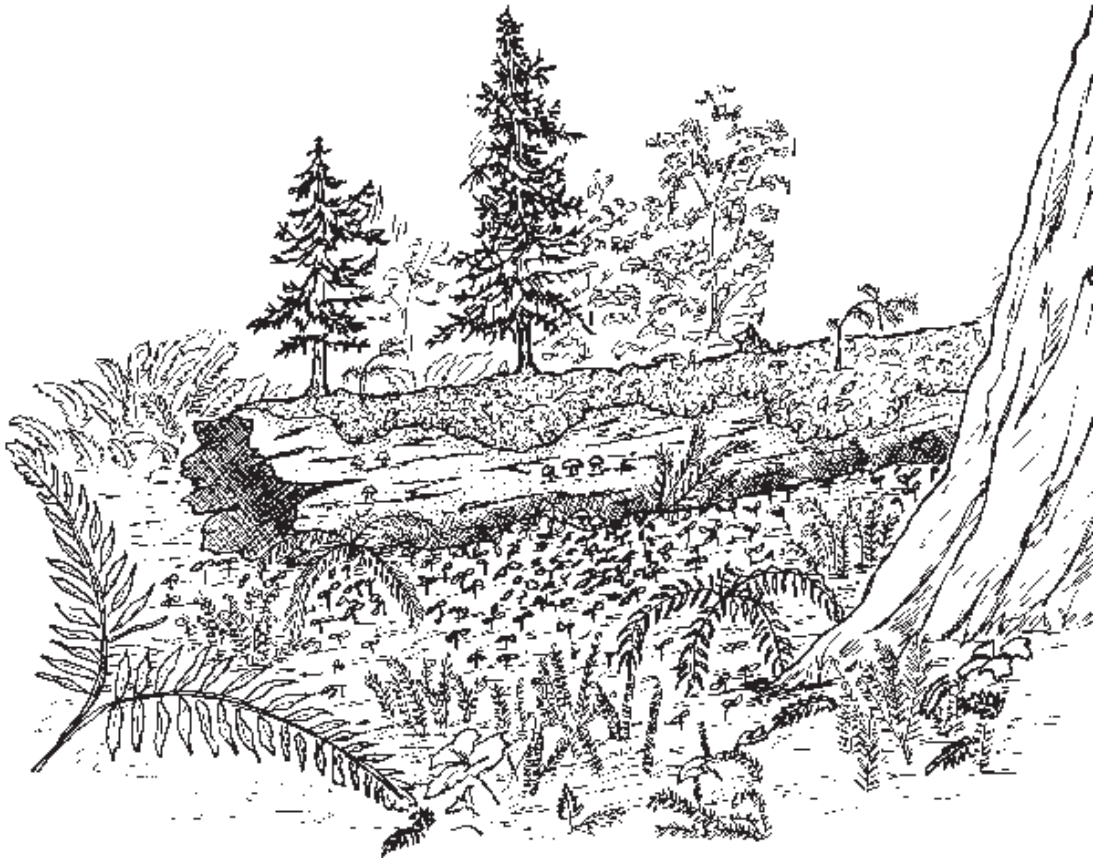
All plants and animals have five basic needs that must be fulfilled by their habitat: air, food, water, shelter and space. In this activity, students will learn about these concepts by hearing and writing classified ads designed to find suitable habitat that meets all of the animal's or plant's basic needs.

Materials

- "Habitat for Rent" ads
- Pens or pencils
- Colored markers or crayons
- Paper

Instructions

1. Quiz your students on what a habitat is (a plant or animal's home, where it meets its basic needs for survival) and what basic needs are (air, food, water, shelter and space). Do humans have basic needs too? Talk about how humans meet their basic needs (going to the grocery store for food, getting water from the faucet, buying or renting a house or apartment). Talk about finding a house to buy or an apartment to rent in the classified section of the newspaper and how you're going to play a game in which animals find their habitat in the same way.
2. Read one of the "Habitat for Rent" ads (or write your own to read) as an example of what you want your students to write. Have each student write a classified ad for a particular animal (they can choose a temperate or tropical forest animal or you can assign animals). Make sure that each student has a different animal and that they keep the animal they're writing about a secret.
3. Divide your class into groups of six to eight students. Have each student read their ad aloud to the rest of their group. While that student is reading, the other students should write down their guess as to what animal might seek out that habitat. When that student is finished reading and everyone has written down their guess, have them go around the group sharing their answers. Each student who guesses correctly gets one point. If no one was able to guess which animal would seek out that habitat, the reader must bring their ad to the teacher. Help the writer to choose a few more identifying details to share with their group to help them to guess the animal. The game continues until each ad has been read. The students with the most points in each of the groups are the winners. If desired, you could hold a championship round with each of these winners to determine who can best match an animal with its habitat.



"Habitat for Rent" Ads

1) **Available Immediately:** A second-story nest in a snag in the canopy of the temperate forest. A perfect spot to raise your young out of sight of predators, like eagles and owls. Good food sources nearby, especially large numbers of ants and other insects to feed on. If you are diurnal (active during the day) and are willing to share this great space with a nocturnal roommate who is away at night, then this is the perfect place for you. *(A bird)*

2) **Available Immediately:** A lovely damp nurse log on the forest floor of the temperate forest. You must be willing to share space with many other animals including insects, amphibians and small mammals. There is moss and shelf fungus that live on the outside and dark damp hallways on the inside. Natural wood walls and floors, of course. Excellent for hiding yourself and your young from predators. Lots of food sources around, from the fungus, leaf litter and bugs right outside your door to the wood walls of your own house. This place has it all! *(An insect, slug or salamander)*

3) **Available Immediately:** A treetop penthouse in the emergent layer of the tropical rain forest. A perfect lookout for spotting your next meal or the closest predator. Lots of space and sunlight with easy access to all those "hard to reach" pieces of fruit in the forest. Must be ready to move at a moment's notice back to the canopy layer in case a predator tries to "move in." *(A bird, bat or monkey)*

Food Chains Grades K – 3; **S** (1.3), **A** (1.2)

Animals and plants rely on each other and their non-living environment for many different things. One common and simple way of demonstrating the interdependence of living and non-living things is a food chain, which shows the flow of energy from one organism to the next. In this activity, students will create their own food chains that show this link.

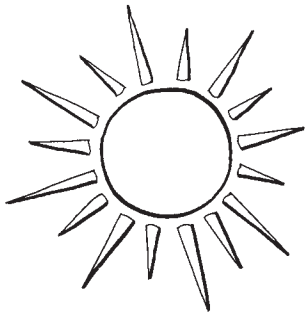
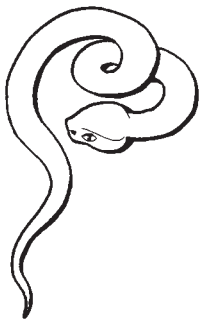
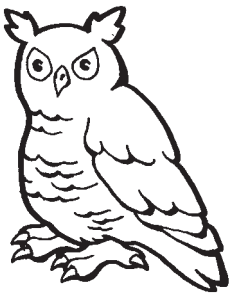
Materials

- Overhead projector or chalkboard
- One "Food Chain Worksheet" for each student
- Crayons or markers
- Scissors
- Tape

Instructions

1. Discuss with your students the idea that food chains are one way to show interdependence, or how plants and animals are linked in nature. Using the chalkboard or overhead projector, have your class construct a simple food chain that might occur in the forests you're studying.
   For example: **Sun > Blackberry Bush > Bird > Hawk**
   A blackberry bush gets energy from the sun, which it uses to grow and produce fruit.
   A bird eats some of the berries.
   Eventually, a hawk might eat the bird.
2. Hand out one "Food Chain Worksheet" to each student. Have your students color each of the links in their chain and cut them apart. Then have each student form a chain by taping the ends of the first link together to form a circle, then feeding the next link through the first and taping its ends together to form a circle. Repeat until all the links are hooked together to form a chain.
3. For grades 2 – 3: Ask your students if they think that the food chain stops with the top predator. How might the energy from a top predator be passed back into the system if that animal is never preyed upon by another animal? (The food chain continues with that animal's death and decomposition, which fertilizes the soil and starts the cycle all over again.) Explain that every plant and animal that avoids being eaten eventually dies and nourishes the soil for further growth. Nourishing the soil is one role that animals and plants may play.

Food Chain Worksheet

A	Energy comes from the sun.		A
B	A plant uses the sun's energy to make food.		B
C	A mouse eats the plant.		C
D	A snake eats the mouse.		D
E	An owl eats the snake.		E

Food Webs **Grades 4 – 6**; **S** (1.3), **A** (1.2)

Animals and plants rely on each other and the non-living components of their ecosystem for many different things. One common and simple way of demonstrating the interdependence of living and non-living things is a food chain, which shows the flow of energy from producer (plants) to primary consumer (herbivores) to secondary consumer (predator) and finally to top consumer (predator that's not eaten by anything else). A food chain is a very simplified way of showing the energy relationships between organisms. In a natural community, many food chains are linked together into a food web. In this activity, students will make food chains that can be connected together to form food webs.

Materials

- Tropical and temperate forest food chain and food web illustrations (included in this packet)
- Overhead projector or chalkboard
- Paper
- Crayons or markers
- Scissors
- Tape or staplers

Instructions

1. Depending on what type of forest your class is studying, write the names of different plants and animals up on the chalkboard or on an overhead, allowing for plenty of space between names. You can use the "Temperate Forest Food Web" or the "Tropical Forest Food Web" (pages 150 and 154) provided in this packet as a source for plant and animal names, as well as their interconnections.

2. Discuss with your students the idea that food chains are one way to show interdependence, or how plants and animals are linked in nature. An example in the temperate forest might be:

   Sun > Blackberry Bush > Bird > Hawk
   A blackberry bush gets energy from the sun, which it uses to grow and produce fruit.
   A bird eats some of the berries.
   Eventually, a hawk might eat the bird.

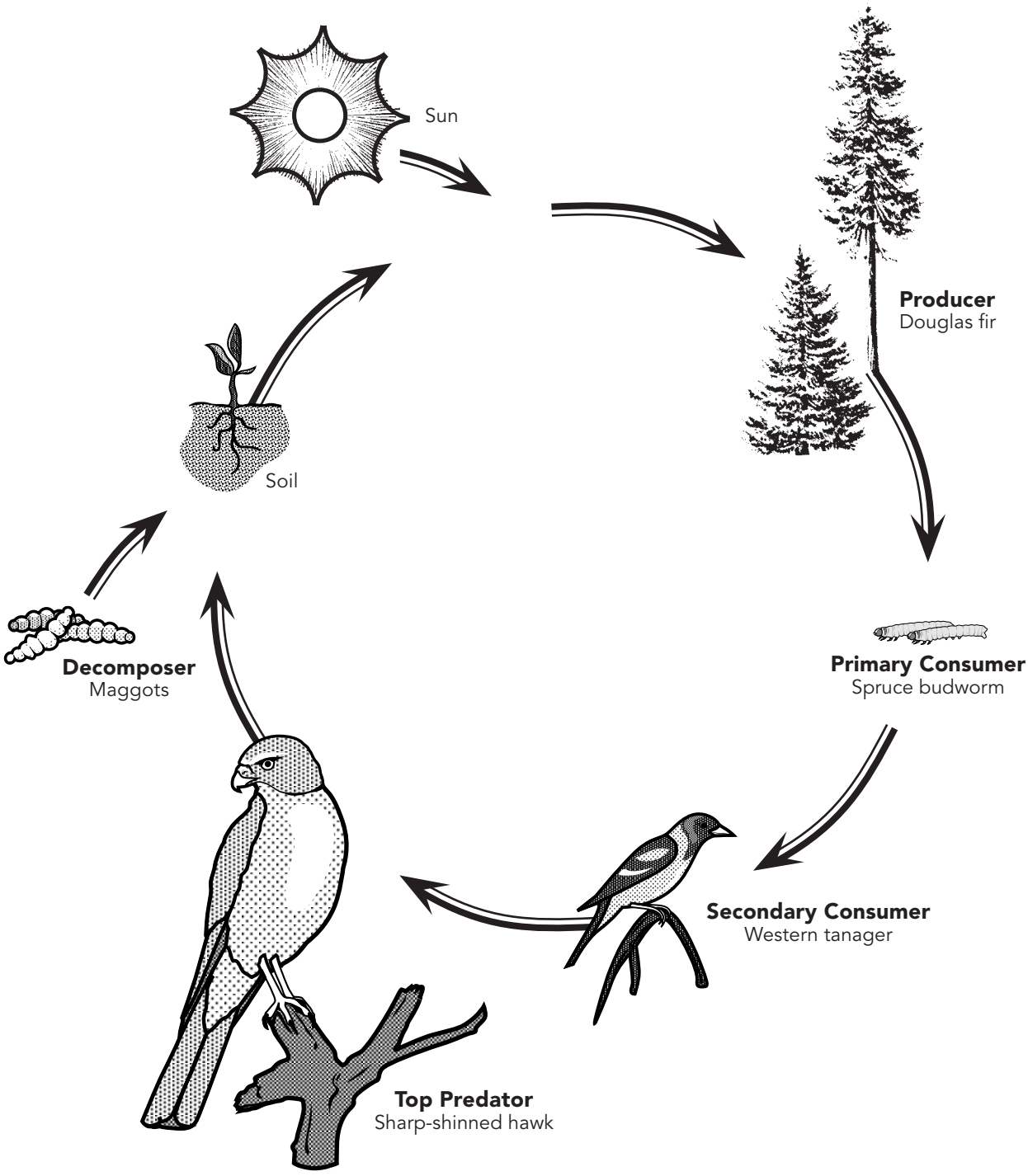
3. Explain that food chains are cycles. The chain does not really stop with the top predator. It continues with that animal's death and decomposition, which fertilizes the soil and starts the cycle all over again. Explain that every plant and animal that avoids being eaten eventually dies and nourishes the soil for further growth. Nourishing the soil is one role that animals and plants may play *(see the illustrated "Temperate Forest Food Chain" and "Tropical Rain Forest Food Chain" on the following pages)*.

4. Show the chalkboard or overhead with the names of forest animals and plants. Ask your students to think of food chains among those plants and animals. Make sure they include producers, primary consumers, secondary consumers and top consumers in each chain. When a student suggests a correct chain, draw arrows connecting the plants and animals. You can make the arrows point in the direction that energy flows through the ecosystem, e.g. from plant to animal. Have them continue to suggest food chains until most of the plants and animals eat or are eaten by a number of different animals. Then, have each student choose three or four plants and animals that are interconnected to make into a paper food chain. Have them cut paper to form links and illustrate a different plant or animal on each link. Then have each student form a chain by taping the ends of the first link together to form a circle, then feeding the next link through the first and taping its ends together to form a circle. Repeat until all the links are hooked together to form a chain.

5. When each student is done with their chains, the chains can be stapled together to form a web. To do this, push back the tables and chairs in your classroom. Have one student lay his or her food chain in the middle of room while saying what plants and animals are involved in the interconnection. Any student who has one of those plants or animals in his or her food chain should lay their food chain on the floor and staple or tape any two plants or animals that are the same together. Have this continue until every student has stapled his or her food chain to another food chain. Then, you can hang your food web on the wall or from the ceiling.
6. Talk about how each plant or animal depends on other plants and animals for survival. Point to one loop that is connected to a lot of different loops. Have your students imagine what would happen if they tried to remove that loop. How many other loops (representing plants and animals) would be affected?
7. Then have them think about the forest you've been studying. When one species is disrupted, all the other species that are connected to that species are also affected. Explain that some of these effects will be direct, such as a predator losing its primary prey species, but that other effects may be less direct and less obvious. For example, the loss of an insect species may not seem significant, but that insect may be responsible for pollinating certain flower species. These flowers would then not produce fruit, thus depriving certain herbivores of a food source, which could decrease the population of those herbivores. This decrease could then cause a food shortage for predators that eat those herbivores.

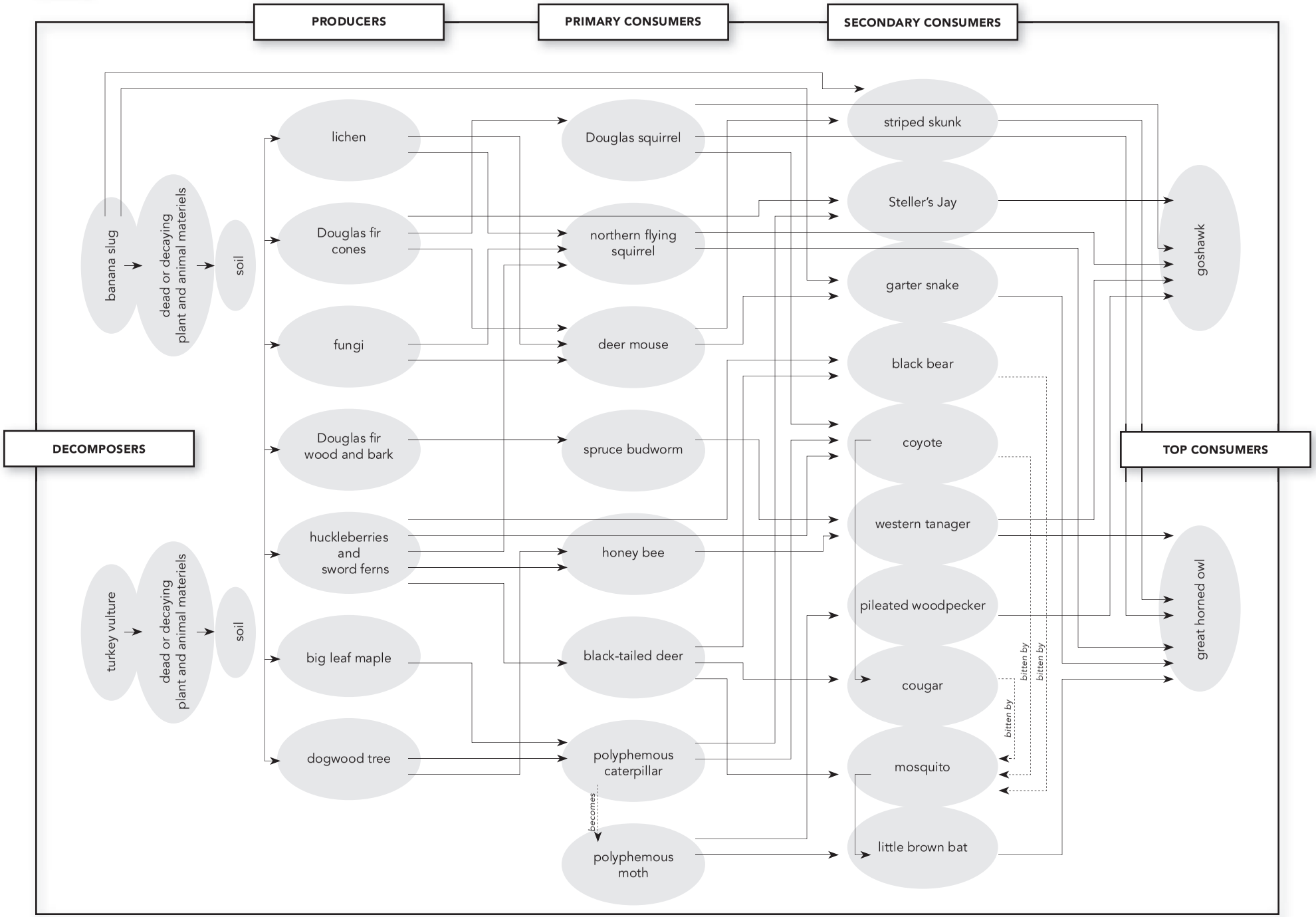
Temperate Forest Food Chain

A food chain is a very simplified way of showing the energy relationships between organisms. In a natural community many food chains are linked together into a **food web**. A simple food chain for a western Washington forest might look like this:



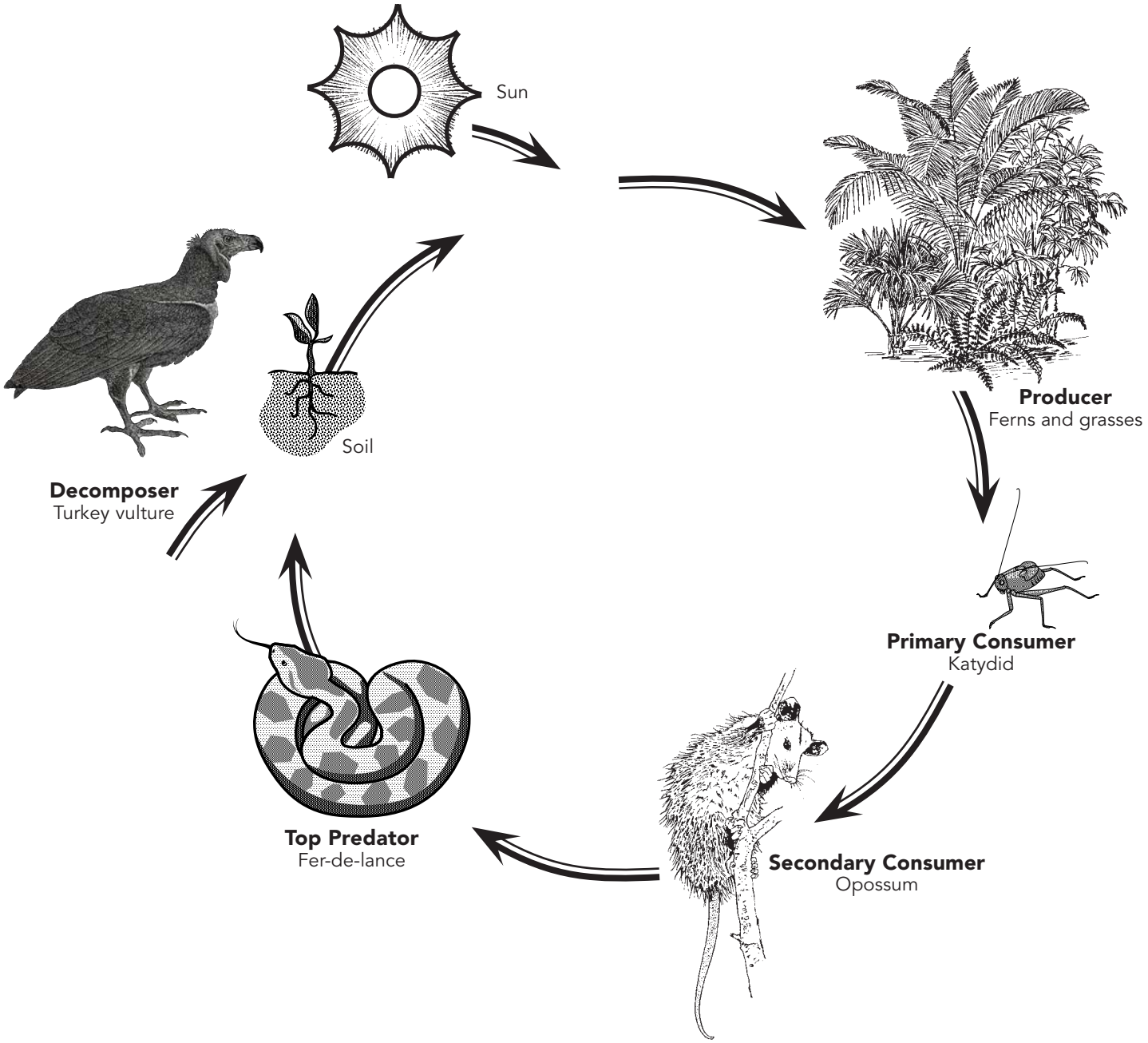
Temperate Forest Food Web

An example of a more complex food web for a temperate forest of western Washington:



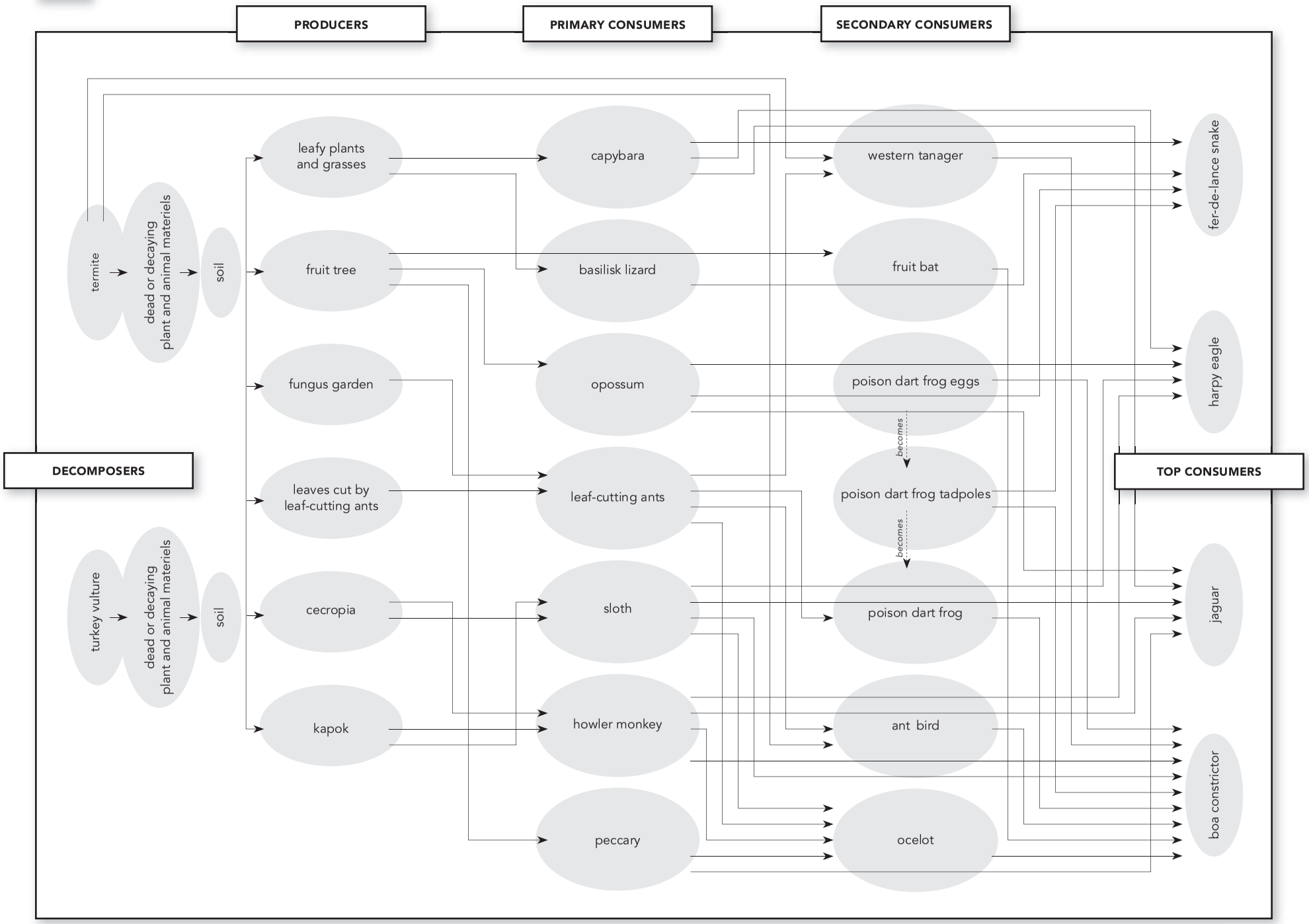
Tropical Rain Forest Food Chain

A food chain is a very simplified way of showing the energy relationships between organisms. In a natural community many food chains are linked together into a **food web**. A simple food chain for a tropical rain forest might look like this:



Tropical Rain Forest Food Web

An example of a more complex food web for a ttropical rain forest of Costa Rica:



Food Web Game Grades 2 – 8; S (1.3)

In this activity, students will become different parts of the forest, physically connected by a string. They will learn about the interconnections of the plants and animals of the forest and how disturbing one part will affect other parts down the line. This activity can be used as an assessment by having students play the game and then write food web stories both before and after they have studied forests.

Materials

- 30 3" x 5" Cards
- Ball of thick string or twine

Instructions

1. Preparation: depending on what forest your class is studying, write the names of different ecosystem components (plants, animals, sun water, soil, air, dead and decaying plant and animal matter) on the 3"x 5" cards. You can use the "Temperate Forest Food Web" or the "Tropical Forest Food Web" (pages 150 and 154) provided in this packet as a source for plant and animal names, as well as their interconnections.
2. Explain to the class that most members of an ecosystem eat and are eaten by many other members, not just one. For example, birds eat many types of fruits and insects and may be eaten by several different animals. Every plant and animal is therefore part of many food chains all linked together to form a web. Emphasize that what affects one strand in the web may also have an effect on others.
3. Hand out a card to each student. Have your students sit in a circle with their card in front of them, face out so everyone can read it. Ask the students to imagine the forest they've been studying. Explain that that forest gets its energy from the sun. Hand the end of the ball of string to the student with the sun card. This student should hold onto the end of the string. Ask your students to raise their hands if they think they represent parts of the forest that rely on the sun for energy (i.e. plants). While unraveling the ball of string, walk over to a student that correctly raises his or her hand and give that student the ball of string to hold. Now ask for an animal that depends on this plant for food or shelter. As you pass on the ball of string, each student should keep holding on to their section of the string. Continue to ask questions and pass the remainder of the ball of string around until all the students are holding at least one section of the string. A web should form as string is passed back and forth from student to student.
4. Now, stop and explain to the class that factors that affect one member of the community will be felt by other members as well. Have the students imagine that a tree is cut down. Instruct a student with a tree card to tug on his or her string. Have any students who feel the tug raise their hand. Now these students can tug on their string. All students who felt the tug should raise their hand. Make up other scenarios (disease, introduced species) that would affect the forest and repeat. Explain how both natural and man-made disruptions to the forest create consequences throughout that community.

Assessment for grades 2-3

After playing the food web game, work together as a class to write a food web story. You may choose to write down the story as your students dictate it or tape record your students telling the story. These stories can be used as a class assessment tool if you write down or record the stories students tell before and after studying the forest. Have your students sit in a circle on the floor. Have one student start a sentence about a part of the forest you're studying. For example, "One day a banana slug was eating dead leaves on the forest floor." Then, have the next student continue that story with another sentence. "Then, it was eaten by a garter snake that was slithering in the bushes." Have the story continue around the circle until every student has contributed. When you compare stories written before and after studying the forest, look for sentences containing false or implausible information (i.e. relationships that wouldn't happen or animals that would not be found in that type of forest) in the first stories and see if information is more accurate in the second stories.

Assessment for grades 4-8

After playing the food web game, have your students write their own food web stories set in the forest that your class is studying. These stories can be used as an assessment tool if students write stories both before and after studying the forest. Have them think about plants' and animals' basic needs (food, water, air, shelter, space) so that they can include in their story how the plants and animals get these basic needs met. Make sure they also include sun, water, air and other non-living components of ecosystems in their stories. When you compare stories written before and after studying the forest, look for sentences containing false or implausible information (i.e. relationships that wouldn't happen or animals that would not be found in that type of forest) in the first stories and see if information is more accurate in the second stories.

Note: *We encourage you to submit your students' work (both the before and after stories) to Woodland Park Zoo to share their progress with our Education department. Please send drawings to:*

Teacher Training
Woodland Park Zoo
601 North 59th Street
Seattle, Washington 98103

Is This a Forest Product? Grades: 2-12; S (1.3), G (3.1, 3.2)

In this activity, students will learn that plants and animals aren't the only living things to benefit from forests. Humans get many important products from forests, including food, wood and medicine.

Materials

- ✔ "Checklist of Forest Products" worksheet (following page)

Instructions

1. Review with your students why forests are important for wildlife and for people (see "Importance of Forests" background information in this packet). One of the things that temperate and tropical forests have in common is that people obtain a variety of products from them.
2. Ask your students to name things that are made from wood or wood pulp. Now ask them to name foods that come from or originate from the forest. Point out that many products that do not seem like forest products really are, such as photographic film, oils, adhesives and medications.
3. Give your students five minutes to search your classroom for forest products. Have each student stand by his or her forest product while you go around the room discussing what they've found. If you want a more lasting reminder of all the different forests products there are in the classroom, you can have students place a label with "Forest Product" written on it on their found object after you've confirmed that it is a forest product.
4. Pass out a copy of the "Checklist of Forest Products" worksheet to each student. For homework, have the students work with their parents to check off as many items as they can find at home. Have each student bring in one interesting forest product they found at home to add to the class forest product collection.

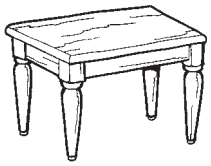
Extension for grades 6-12

Have each student (or small groups of students) choose a forest product from the checklist and research the product's "life cycle." Where is the product grown and harvested? How and where is it processed? How does the product reach the local store shelves? Have each student or group of students develop a presentation or poster about their product's life cycle to share with the class.

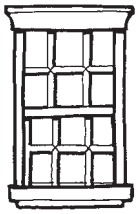
Checklist of forest products

Find as many of these forest products from home as you can:

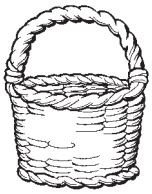
WOOD PRODUCTS



- ☐ table
- ☐ chair
- ☐ cabinet
- ☐ door
- ☐ door frame
- ☐ window sill
- ☐ garden furniture
- ☐ other furniture
- ☐ cutting board
- ☐ tool handle
- ☐ salad bowl
- ☐ wooden toy
- ☐ chop stick
- ☐ wood floor
- ☐ roof shingle

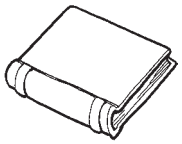


OTHER PRODUCTS

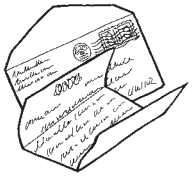


- ☐ bamboo or rattan basket
- ☐ rayon clothing
- ☐ burlap
- ☐ latex rubber glove
- ☐ photographic film
- ☐ latex golf ball cover
- ☐ string or rope made of jute or raffia
- ☐ lotion or soap with coconut, eucalyptus, patchouli or camphor oil
- ☐ rattan or wicker furniture
- ☐ tung oil or wood varnish
- ☐ Ping-Pong ball
- ☐ cellophane wrap

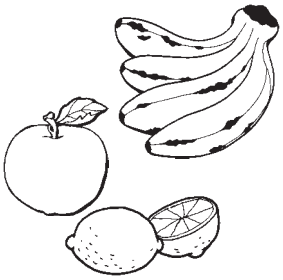
PAPER PRODUCTS



- ☐ books
- ☐ notebook paper
- ☐ paper towel
- ☐ disposable diaper
- ☐ tissue
- ☐ cardboard box
- ☐ poster
- ☐ calendar
- ☐ envelope
- ☐ magazine
- ☐ napkin
- ☐ paper plate
- ☐ toilet paper
- ☐ wrapping paper
- ☐ drawing or writing paper



FRUITS



- ☐ avocado
- ☐ banana
- ☐ coconut
- ☐ grapefruit
- ☐ guava
- ☐ lemon
- ☐ lime
- ☐ mango
- ☐ orange
- ☐ papaya
- ☐ passion fruit
- ☐ apple

SPICES

- ☐ allspice
- ☐ black pepper
- ☐ cayenne
- ☐ chili powder
- ☐ cinnamon
- ☐ cloves
- ☐ ginger
- ☐ nutmeg
- ☐ paprika
- ☐ vanilla
- ☐ tamarind (in sauces)

VEGETABLES, NUTS AND OTHER FOODS

- ☐ Brazil nut
- ☐ walnut
- ☐ hazelnut
- ☐ cane sugar
- ☐ cashew nut
- ☐ chocolate (cacao bean)
- ☐ coffee
- ☐ macadamia nut
- ☐ pepper
- ☐ soft drink (cola nut)
- ☐ tea
- ☐ bamboo shoot
- ☐ chestnut
- ☐ tapioca

What Happened to My Habitat? Grades 5 – 12; S (1.3)

One of the major problems facing many animal species presently is the loss of habitat. Forest habitats can be fragmented, or broken into small pieces, when roads are constructed or when surrounding areas are logged and/or developed. This can affect animals' abilities to fulfill their basic needs (food, air, water, shelter, space), find mates and raise young. In addition, isolated populations of animals may face genetic problems due to inbreeding and/or decimation due to disease, which can spread quickly through populations in restricted areas. Natural disasters can also have major impact on small populations located in isolated areas.

Materials

- Three long lengths of twine or string (30 to 45 feet [9 to 14 m] long)
- Six shorter lengths of twine or string (6 to 10 feet [2 to 3 m] long)
- Paper squares (enough for one per student, can be made from scrap paper)
  - Divide the cards into four equal piles
  - Label the cards in each pile with one of the following group names: "female jaguar," "male jaguar," "peccary" [prey], and "water" *(If your class is not divisible by four, make extra prey and water cards)*

Instructions

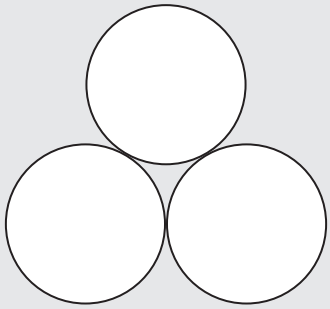
1. Find a large area (field or multi-purpose room) and set out the long lengths of twine to create three large circles that all touch but do not overlap each other (see diagram on the following page). Divide the class into three equal groups and have each group stand in one of the circles.
2. Mix up the paper squares and randomly pass them out, one per student. Ask the students to read to themselves what is written on the back of their paper square.
3. Explain to the students that their task will be to form "survival groups." In order to be a complete "survival group" the students must form groups that include one female jaguar, one male jaguar, and at least one peccary and one water. (There can be more than one peccary and water in each group.)
4. Give the students thirty seconds to wander among the circles and find "survival groups" by standing next to other students. The students may not even need to leave their circles in order to find the other students they need to make a "survival group." (To avoid any conflicts, make it clear to the students that once a person is standing next to other students in their "survival group" they cannot move or be taken away from that group.)
5. Record the number of jaguars (both male and female) that did not form a complete "survival group." Collect the paper squares from all of the students and mix them thoroughly. Run two more trials in this manner, recording the number of jaguars that did not form complete "survival groups" each time.
6. Introduce the concept of habitat fragmentation and describe or have the students think of different human activities that may make habitat undesirable for jaguar. Now tighten each of the circles by several feet and explain that the habitat now in between the circles has been developed or destroyed. Jaguars can neither live in nor move through the destroyed habitat areas.
7. Ask the students what problems the jaguars may face in their shrinking habitat that is now isolated from other populations of jaguars. Can they reach other jaguars (potential mates) from other areas? Can they reach the water or favorite prey species found in another area?

8. Distribute the cards from the pile to the students in the circles. Give the students thirty seconds to try to form "survival groups". Remind them that they cannot move out of their own circle. Record the number of jaguars that did not form complete "survival groups". Run two more trials in this manner, recording the number of jaguars that did not survive each time.

9. Individually or as a class, calculate the average number of jaguars that did not survive the first three trials and the average number of jaguars that did not survive the three trials that were run after the habitat was fragmented. As a class, discuss the results. Ask the students to brainstorm what could have been done to address the problems that occurred when their habitat was destroyed and fragmented. (Students might think of different ways of allowing travel between circles of intact habitat. Corridors could be illustrated by laying down short lengths of twine between the circles and allowing individual jaguars to move through the corridors from one piece of habitat to another. Your class could run three more trials of the game with the corridors in place, allowing jaguars to move between circles.)

10. With older students, you may get into the topic of genetic diversity and how corridors would allow genetic "mixing," which ensures a wide variety of genes within each population. Students can brainstorm reasons that this genetic mixing is important. Note: Through Species Survival Plans (SSPs) conducted between North American zoos and aquariums, conservation scientists attempt to facilitate optimal genetic mixing within populations of captive animals that are essentially isolated from one another. When wild populations of animals are isolated from one another, there are limited opportunities for genetic mixing. Do your students think humans should get involved in this situation? How could humans be involved?

Initial set-up for "What Happened to My Habitat" with three large circles



Extension

After completing the above activity, have your students research different species that have been affected by habitat loss or fragmentation. Topics to be covered could include what kinds of human or activities or natural occurrences caused the habitat destruction, how has the animal's population changed with increases in human activity, what efforts are being made to stop or reverse the problem, and what would their suggestions to address the problem be? The last question could include creating a budget to implement a conservation program for the animal.

Design a Plant **Grades 6 – 12**; **S** (1.3), **A** (3.2)

Students will use their knowledge of plant adaptations and tropical rain forest climatic characteristics to design their own tropical rain forest plant.

Materials

- Copies of "Design a Plant" student activity sheet provided in this packet (one per student or small group)
- Research materials on tropical rain forests and plant adaptations

Instructions

1. Working individually or in small groups, have your students design a plant that is adapted to survive in a tropical rain forest, using the "Design a Plant" student activity sheet included in this packet. Students should spend some time researching tropical plant adaptations and include at least four ways that their plant survives in conditions of high temperature and humidity amid multitudes of plant eaters and decomposers.

2. Researchers in tropical rain forests have noted the following plant survival strategies. Most of these may be seen in Woodland Park Zoo's Tropical Rain Forest exhibit. You can provide this information for your students if they need some initial ideas before researching further:

   - Buttresses: flange-like root growth on the trunk or base of tall trees that help stabilize and support the shallow root system.
   - Prop roots: long, above-ground roots that radiate from the trunks of smaller trees and act as stabilizers.
   - Drip tips: tips of leaves that come to a long or very pronounced tip and are thought to help shed moisture that would encourage fungal and bacterial growth on the leaf surface.
   - Hard, waxy leaves: bromeliads exhibit this strategy. Bromeliads are a type of epiphyte that has hard, waxy leaves that form a cup at the base. Bromeliads often grow on the trunks and branches of trees, robbing the host plant of sunlight but serving as microhabitats and water sources for insects and other animals.
   - Poisonous leaves or bark: the taste or smell of chemicals deters those who would eat them.
   - Smooth bark: a feature that deters climbing plants as well as epiphytes from gaining a hold.
   - Hard bark: deters boring and chewing (e.g. mahogany tree)
   - Crown shyness: a characteristic of canopy plants to maintain a distance, sometimes up to three feet, between the outer edges of the crown of each plant. This is believed to deter the spread of fungi, bacteria and climbing plants and also reduces the possibility of one tree taking down another in a storm blow down.
   - Grow on another plant rather than anchor roots in soil: Epiphytes exhibit this strategy. Many epiphytes are able to take moisture directly from the air. Large epiphytes may become heavy enough to cause a branch to break and fall to the forest floor. Some epiphytes are initially rooted in the soil as shrubs but eventually grow up as vines using tree trunks as support. Lianas, or woody vines, exhibit this strategy. Some researchers estimate that lianas may make up 40 percent of the canopy cover in some areas.

Extension

Have your students create their plant in three dimensions using crepe paper, papier mâché, modeling clay, fabric or other material. A collage, poster, fabric hanging or wall design may be created from the paper plant designs.

Design a Plant Student Activity Sheet

How do plants survive in a warm and humid environment that not only encourages plant growth but also favors the growth of a multitude of animals and other growing things that are ready to use and consume these plants?

1) Read *Conditions in a Tropical Rain Forest* below and think about how a plant could survive under these conditions.

2) Design a plant of your own that you believe would be able to survive in the tropical rain forest. Draw and color the plant on a separate piece of paper.

3) As you design your plant, answer the questions on the back of this page.

4) Label and explain briefly how your plant avoids the problems listed in *Conditions in a Tropical Rain Forest*.

Conditions in a Tropical Rain Forest

* Green plants use sunlight to make their own food in a process called photosynthesis. In photosynthesis, the leaves of the plant extract carbon dioxide (CO_2) from the air while the root system draws up water (H_2O). When six atoms of carbon are formed in a chain, a molecule of glucose is formed ($C_6H_{12}O_6$). Glucose, a sugar, is food or energy that the plant needs in order to grow. Excess oxygen is returned to the atmosphere in the chemical process.
* A lot of rain falls in the tropical forest, at least 80 inches (2,000 mm) per year and, in some areas, up to 300 or more inches (7,500 mm) a year. Moisture combined with high temperatures creates high humidity, a condition that favors the growth of fungi and mold, as well as fast plant growth.
* The nutrient layer of tropical forest soils is shallow. Most of the forest's nutrients are quickly decomposed or used up by the living plants and animals.
* Plant roots in tropical rain forests are usually very shallow.
* Trees and lianas that reach the canopy are often 65 feet (19.5 m) or more in height. Emergents, tree giants that emerge above the canopy, are subject to strong winds, searing heat and buffeting rains.
* On the forest floor light is very low, humidity is very high and temperature is more constant than in the canopy.
* Millions of insects and other animals that use plants as shelter and cover also eat plant leaves or bark.

Design a Plant Student Activity Sheet page 2

As you design your plant, answer the following questions:

1) In what level of the forest does your plant grow? _____

2) Does your plant need a lot or a little sunlight to survive? How does it get this sunlight? _____

3) How does your plant obtain water? _____

4) Does your plant use any strategy to collect or to shed water? _____

5) How does your plant gain the nutrients it needs to grow? _____

6) Does your plant carry on photosynthesis? _____

7) What does your plant do to protect itself from insects and other animals? _____

8) Does your plant need to have a strategy to keep from blowing over in high wind? _____

Tropical Rain Forest Animal Research/Folder **Grades 4 – 9**; **R** (1.5) **W** (1.1–1.3, 2.2) **S** (1.1, 1.3) **G** (1.1)

Through research, students will learn how a rain forest animal is adapted to survive in its tropical rain forest habitat.

Materials

- "Tropical Rain Forest Animal Research" student worksheet on page 170 (one copy per student)
- Folder (one per student)
- Paper
- Research materials including world map of tropical rain forests *(provided in this packet)*
- Woodland Park Zoo Animal and Plant Fact Sheets *(provided in this packet)*

Instructions

Have your students:

- Choose an animal that lives in a tropical rain forest.
- Design a cover for a folder in which students will keep and present their research.
- Include in the folder the map and research work sheet provided.
- Write a story, poem, play, cartoon, comic strip, newscast or other literary form using the rain forest animal as the focus.
- Design a t-shirt, button, or bumper sticker that conveys a message about the animal. Students may do this as a design on paper, or may create their messages on the actual medium.

Tropical Rain Forest Animal Research Student Worksheet

List the following information for your animal:

1) Common name of animal: _____

_____

_____

2) Scientific classification:

Kingdom: _____

Phylum: _____

Class: _____

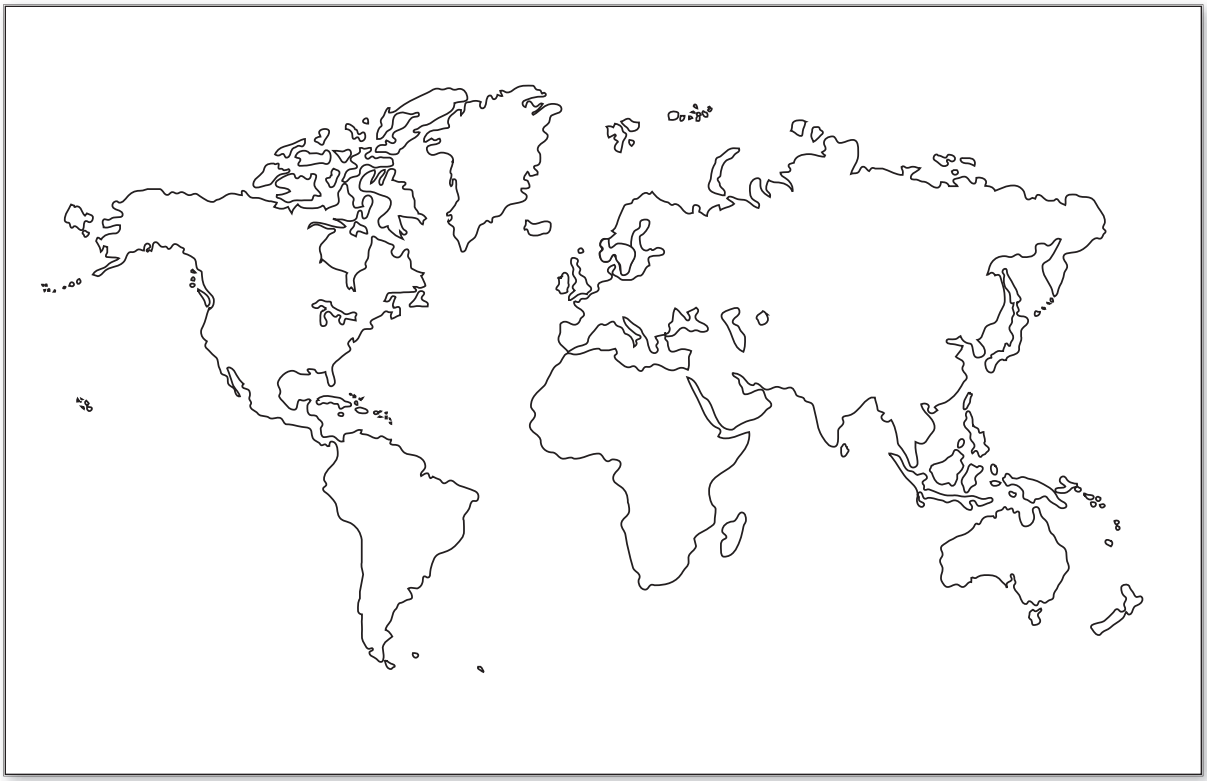
Order: _____

Family: _____

Genus: _____

Species: _____

Note: *In the scientific community, an animal is referred to most often by its genus (capitalized) and species (not capitalized) names, i.e. Equus caballus: horse. Each species of animal has its own unique name when this system is used. Scientific names are italicized (or underlined).*



3) On the map indicate clearly the geographic range of your animal. If you know, you may use colors to indicate present and former range.

4) Find out and list what your animal eats.

5) What is its strategy for obtaining food? (e.g. wait and ambush, stalking, running, cooperative hunting, grazing, etc.)

6) Describe the ways in which your animal is adapted or suited to live in its habitat? (e.g. teeth, muscle structure, bone structure, feet, skin covering, ears, nose, etc.)

7) On a separate paper or papers draw your animal showing: outside covering and coloration, digestive system, muscle structure, and/or bone structure.

8) What do you think is the future of your animal in the wild? Why?

9) Is your animal part of a special program in zoos? (Many captive breeding programs for endangered species are part of a cooperative program called a Species Survival Plan).

10) What would you say is the best plan to assure that your animal will have a place in the wild in the future? Detail or list the steps in your plan.

Primates of Tropical Forest Grades 2 – 5; S (1.1)

Using the worksheet provided, students can compare and contrast apes and monkeys though their observations at the zoo. Black and white colobus belong to the Old World (Africa and Asia) monkey family. Monkeys are divided into Old World and New World varieties. Old World monkeys have nostrils that are narrow and close together, hard sitting pads (ischial callosities) on the lower side of their buttocks, and a unique digestive system that enables them to digest cellulose in the foliage they eat. Colobus live in the tropical rain forests of sub-Saharan Africa, from Nigeria in the west across to Ethiopia and as far south as Tanzania. Colobus have slender bodies with long arms and legs. They have long, silky fur which is black and white around the face with long white hairs on the flanks and tail. The tail ends in a long tuft.

Western lowland gorillas are one of three subspecies of gorilla belonging to the great ape (Pongidae) family of primates. Lowland gorillas are found in the lowland forests of equatorial Africa. Their range is restricted to the extent of humid, lowland forests that readily provide their vegetarian diet, avoiding grasslands and open woodlands. Gorillas are the largest primates. Their bodies are thick and covered with short, dense black hair. The saddle area of the male's back begins to turn silver at about 10 years old and is fully silvered by about 12 years old, hence the name silverback. The silverback is a sign of adulthood rather than old age.

Materials

- "Primates of the Tropical Forest" student activity sheet (one copy per group of students)
- Pencils
- Clipboards or stiff cardboard

Instructions

1. The activity sheet is designed for students to use on their visit to the zoo's Tropical Rain Forest exhibit. Review the activity sheet in class prior to the visit so that students will be familiar with concepts addressed on the sheets.
2. At the zoo, have each group of students and their chaperone work together to fill out the activity sheet while observing the gorillas and the colobus monkeys.
3. Back in the classroom, review the similarities and differences between monkeys and apes.

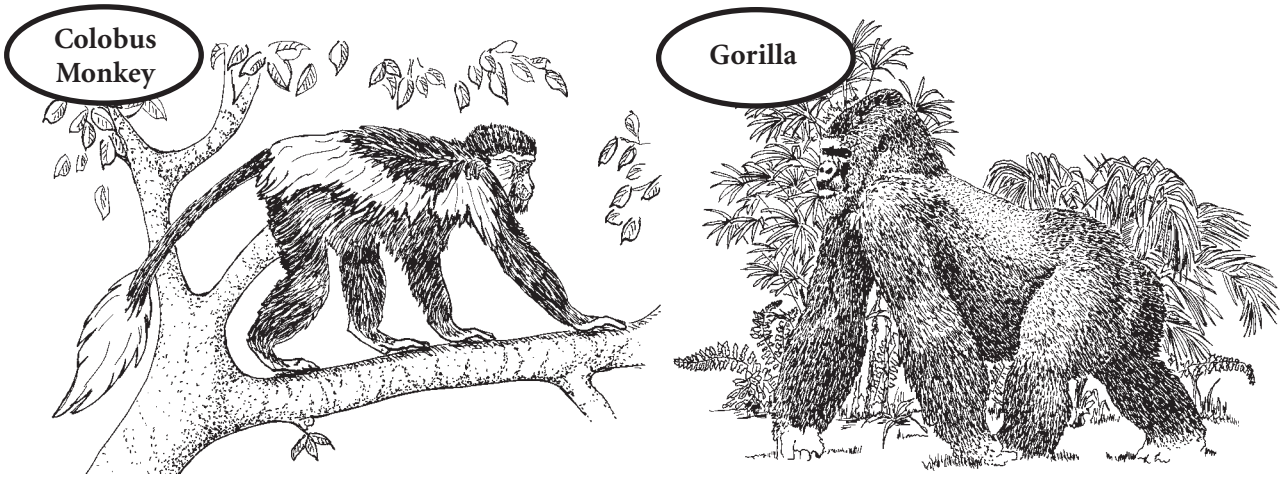
–Teacher Key–

MONKEYS	APES
tail	no tail
walk on flat palms and feet	walk on knuckles
may walk over the tops of branches	may swing hand-over-hand underneath branches (brachiate)
legs and arms about same length	longer arms than legs

Primates of the Tropical Forest Student Worksheet

The black and white colobus and the gorilla are both primates that live in tropical forests of Africa. The colobus is a monkey. The gorilla is an ape.

Using this activity sheet as a guide, observe the colobus and the gorilla in their exhibits at the zoo. Compare and contrast their differences by listing your observations in the blanks below.



_____ Who has a tail? _____

_____ How do they walk? _____

_____ Do they move in other ways? _____

_____ Compare their legs and arms _____

Prosimians, Monkeys and Apes Grades 6 – 12; S (1.1)

Through research in the classroom and at the zoo, students will learn the differences between prosimians, monkeys and apes. Woodland Park Zoo's primates in the Tropical Rain Forest exhibit are:

Prosimians: red ruffed lemur
Monkeys: DeBrazza's guenon, black and white colobus, Goeldi's monkeys, golden lion tamarins
Apes: lowland gorilla

Materials

- "Prosimians, Monkeys and Apes: A Close Look at Primates of the Rain Forest" student activity sheet (one per student)
- Pencils
- Resource materials including Animal Fact Sheets (included in this packet)

Instructions

1. The activity sheet is designed for students to use on their visit to the zoo's Tropical Rain Forest exhibit. Prior to your zoo visit, review the characteristics of different categories of primates (the Animal Fact Sheets in this packet can be used as resource sheets). At the zoo, have students fill out the activity sheet based on their observations of lemurs, black and white colobus monkeys and gorillas.
2. Some of the following similarities and differences may be recorded by students:

Characteristics of prosimians:
- Long snout, good sense of smell
- Tail
- Groom with teeth and grooming claw
- Scent marking behavior
- Moist, naked nose and vibrissae (whiskers)
- 1-3 pairs of mammary glands on female
- Social
- Limited expression (upper lip tethered to upper gum)
- Pseudo-opposable thumb/prehensile hands and feet

Characteristics of apes:
- Broad chest
- No tail
- Knuckle walk
- Upright posture
- Longer arms than legs

Characteristics of monkeys:
- Short snout
- Tail
- Groom with fingers
- Walk on flat palms and feet
- Lots of facial expression
- Narrow chest
- 1 pair of mammary glands on female
- Social
- Legs and arms about same length

Prosimians, Monkeys and Apes:
A Close Look at Primates of the Rain Forest Student Worksheet

Instructions: Through research and observations, determine similarities and differences between prosimians, monkeys and apes. The zoo's Tropical Rain Forest bioclimatic zone exhibits primates from the rain forests of Central and South America, Africa and Madagascar.

On your zoo visit, carefully observe the red ruffed lemurs, black and white colobus monkeys and lowland gorillas and then record your observations on this sheet.

Characteristics of Prosimians (red ruffed lemurs)

Characteristics of Monkeys (black and white colobus)

Characteristics of Apes (lowland gorillas)

Where in the Tropical Rain Forest? **Grades 2 – 5**; **S** (1.3), **R** (1.5)

Through observations at the zoo, students will gain an understanding of how different bird species use different layers of the tropical rain forest.

Materials

- Copies of "Where in the Tropical Rain Forest?" student activity sheet (one per group of students)
- Pencils

Instructions

1. The activity sheet is designed for students to use on their visit to the zoo's Tropical Rain Forest exhibit. Review the activity sheet in class prior to the visit so that students will be familiar with concepts addressed on the sheets.
2. At the zoo, have each group of students and their chaperone work together to fill out the activity sheet while observing bird species in the Tropical Rain Forest exhibit.
3. For each bird, fill in the name of the bird, the level of the forest the bird inhabits and a few pieces of information about the bird's diet.

Where in the Tropical Rain Forest? Student Worksheet

Use your observation skills to discover how birds are adapted to their environment by observing different bird species in Woodland Park Zoo's Tropical Rain Forest exhibit. Read the interpretive signs, observe birds from different layers of the rain forest and complete this activity sheet.

Bird Species Name	Layer of Rain Forest	Beak/Diet

Birds of the Tropical Rain Forest **Grades 5-12**; **S** (1.1), **R** (1.5)

Through research in the classroom and at the zoo, students will improve their observation skills and gain an understanding of nesting and feeding strategies of rain forest birds.

Materials

- Copies of "Birds of the Tropical Rain Forest" student activity sheet (one per student)
- Research materials including Animal Fact Sheets (included in this packet) and/or access to the Internet
- Pencils

Instructions

1. Prior to their zoo visit, have your students research specific animals using the Animal Fact Sheets (also available online at www.zoo.org) to acquaint themselves with the birds in Woodland Park Zoo's Tropical Rain Forest exhibit.

2. The activity sheet is designed for students to use on their visit to the zoo's Tropical Rain Forest exhibit. Review the activity sheet in class prior to the visit so that students will be familiar with concepts addressed on the sheets.

Birds of the Tropical Rain Forest Student Worksheet

Use your observation skills to discover how birds are adapted to their environment by observing four different bird species in Woodland Park Zoo's Tropical Rain Forest exhibit. Read the interpretive signs, observe birds from different layers of the rain forest and complete this activity sheet.

Bird Species Name	Number of Animals	Layer of Rain Forest	Coloration	Nest Description	Beak/Diet