activity **12**

A World of Difference

Introduction:

Scientists estimate that there may be as many as 30 million species worldwide. Over half make their home in the tropical rainforests of Asia, Africa and Latin America.[1] People depend on tropical rainforest for food, medicines, industrial products, and such "ecological services" as water purification and pollination. Tropical rainforests are shrinking as people use them to meet the needs of our growing population.

Concept:

Biodiversity is important both for maintaining the health of our planet's ecosystems. Tropical rainforests are areas of high biodiversity. Coincidentally, countries with tropical rainforests often have high rates of human population growth. Consequently, tropical rainforests have some of the highest rates of habitat loss.

Objectives:

Students will be able to:

- Compare and contrast the biodiversity of a U.S. temperate forest with a tropical rainforest.
- Use probability to demonstrate the impact of human population growth on the biodiversity of these two ecosystems.
- Hypothesize ways in which people and ecosystems are affected by deforestation, and propose means of addressing these challenges.

Skills:

Observation, counting, data analysis, probability, critical thinking

Method:

Students use exercises in probability to demonstrate the value of biodiversity and the impact human population growth can have on the variety of species in a given ecosystem.

Materials per student group:

Student Worksheet (one for each student)
Student Counting Grid
1 die
1 plastic bag labeled "Temperate Forest," containing
  20 dry black beans = Deer
  40 dry red beans = Oak trees
1 plastic bag labeled "Tropical Rainforest," containing
  20 dry pinto beans = Kapok trees
  20 dry red beans = Mahogany trees
  8 dry black beans = Leaf cutter ants
  5 dry sunflower seeds = Poison arrow frogs
  4 dry black eyed peas = Rosy periwinkle
  2 dry lima beans = Hummingbirds
  1 dry unshelled peanut = Jaguar
  (You may substitute beans as necessary)
Graph paper

Procedure:

1. Divide the class into groups of two, and provide each pair of students with one bag of beans for each forest, a Counting Grid, and two Student Worksheets. Students should use a flat work surface.

2. Have students follow the directions on their worksheets.

Answers to Student Worksheet:

1-2. (*Answers will vary*.)

3. (*For the U.S. forest, there are many of each kind of bean. Every acre has at least one of each bean. In the tropical rainforest, each acre is very different in bean composition — no two acres are alike.)* (Your students may note that the 'deck is stacked' in this activity. There are more beans in the rainforest because in reality, diversity is greater there.)

4. a. (P = *6/6 or 1. All outcomes will impact deer because they are in every acre.)*
b. (P= *6/6 or 1. All outcomes will impact the oak trees.)*

5. See table:

Species	Probability
Pinto beans = Kapok trees	(*6/6 = 1)*
Red beans = Mahogany trees	(*6/6 = 1)*
Black beans = Leaf cutter ants	(*4/6 = 2/3)*
Sunflower seeds = Poison arrow frogs	(*4/6 = 2/3)*
Black eye peas = Rosy periwinkle	(*4/6 = 2/3)*
Lima beans = Hummingbirds	(*1/6)*
Peanut = Jaguar	(*1/6)*

6. a. (P = *0/6 or 0. No species is unique to one acre.)*
b. (P = *2/6 or 1/3. Clearing an acre with the jaguar and/or the hummingbirds will cause an extinction, because each species is unique to those acres.)*

7. a. (P = *5/6*)
b. (P = *5/6*)
c. (*The probabilities stayed the same because each roll is an independent event*.)

8-9. (*Answers will vary.*)

10. (*In the U.S. forest, there was a decline in the abundance of both species, but they were still present in the other acres. In the tropical rainforest, there was significant loss of species. Some species were rare to begin with and their numbers have been further reduced. Other species may have only existed in the acres that were cut.*)

Follow up Activity:

Have students compare their results in Questions 6 and 7 to those of other groups.

Sources: Adapted from "A World of Difference" by Sheila Jones. The Conservation Catalyst, Wake Soil and Water Conservation District, Raleigh, NC. Winter 1993-94. [1] Miller, G. T. 2000. Living in the Environment, Eleventh Edition. New York. Brooks/Cole.[2,3] World Population Data Sheet, 2001. Population Reference Bureau. www.prb.org.

Name_____ Date_____

A World of Difference — Student Worksheet #1

Scientists estimate that there may be as many as 30 million plant and animal species worldwide. Over half of all species make their home in the tropical rainforests of Asia, Africa and Latin America. People depend on tropical rainforest species for food, medicines, industrial products, and such "ecological services" like water purification, and pollination. The rate of deforestation, thus habitat loss, is now greatest in the tropical rainforests.

1. Place beans on your Counting Grid according to the instructions below. Each type of bean represents a species, and each bean is an individual of that species.

Temperate Forest:

Deer (20 black beans): Place at least 1 in each acre, but no more than 5 in any acre.

Oak tree (40 red beans): Place at least 3 in each acre, but no more than 10 in any acre.

Tropical Rainforest:

Kapok tree (20 pinto beans): Place at least 3 in each acre, but no more than 4 in any acre.

Mahogany tree (20 red beans): Place at least 1 in each acre, but no more than 8 in any acre.

Leaf cutter ant colony (8 black beans): Place at least 1, but no more than 3, in any 4 acres. DO NOT place ant colonies in 2 acres.

Poison arrow frog (5 sunflower seeds): Place at least 1, but no more than 2, in any 4 acres. DO NOT place frogs in 2 acres.

Rosy periwinkle (4 black eyed peas): Place 1 in each of four acres. DO NOT place periwinkles in 2 acres.

Hummingbird (2 lima beans): Place 2 in the same acre.

Jaguar (1 peanut): Place 1 in any acre.

2. Once you have placed the beans, fill in the tables below to show the distribution of species in each forest.

Temperate Forest Table						
Species	Acre A	Acre B	Acre C	Acre D	Acre E	Acre F
Deer						
Oak tree						
Total species per acre						

Tropical Rainforest Table						
Species	Acre A	Acre B	Acre C	Acre D	Acre E	Acre F
Kapok tree						
Mahogany tree						
Leaf cutter ant colony						
Poison arrow frog						
Rosy periwinkle						
Hummingbird						
Jaguar						
Total species per acre						

3. How would you contrast the temperate forest biodiversity and the tropical rainforest biodiversity?

4. Look at your forests to find out what happens when an acre of forest is cleared:

a. What is the probability that the deer population will change if you clear one acre in the temperate forest? _____.

b. What is the probability that the oak tree population will change if you clear one acre in the temperate forest? _____.

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A World of Difference — Student Worksheet #2

5. What is the probability that the population of each species in the tropical rainforest will change if you clear an acre there? Fill in the table at right.

Species	Probability
Pinto beans = Kapok trees	
Red beans = Mahogany trees	
Black beans = Leaf cutter ants	
Sunflower seeds = Poison arrow frogs	
Black eyed peas = Rosy periwinkle	
Lima beans = Hummingbirds	
Peanut = Jaguar	

6. a. What is the probability that any species will become **extinct** if you clear one acre in the temperate forest? _____.

b. What is the probability that any species will become **extinct** if you clear one acre in the tropical rainforest? _____.

The United States, which contains temperate forests, has a population growth rate of 0.6% annually.[2] In central Africa, the Democratic Republic of Congo has tropical rainforests, and a growth rate of 3.1 %, approximately five times that of the U.S.[3] When you roll the die, a roll of 1 will represent population growth in the U.S., and one acre of temperate forest cleared to meet the needs of society. Rolls of 2, 3, 4, 5, or 6 will represent population growth in the Congo and therefore one acre of tropical rainforest cleared.

7. a. What is the probability that you will clear an acre of tropical rainforest on your first roll? _____.

b. What is the probability that you will clear an acre of tropical rainforest on your second roll? _____.

c. Does the probability change from one roll to the next? _____. Why or why not? _____.

8. *Now roll the die and take out all the beans in Acre A of the forest indicated by your roll. Record your data in the table below. Continue rolling and clearing acres until one of your forests is gone. Record your data after each roll.*

a. Which forest was eliminated first? _____.

b. How many rolls did it take to eliminate that forest? _____.

Roll Number	Forest (CircleOne)		Area Cleared (A-F)	Number of Temperate Species Remaining	Number of Tropical Species Remaining
1	Temperate	Tropical			
2	Temperate	Tropical			
3	Temperate	Tropical			
4	Temperate	Tropical			
5	Temperate	Tropical			
6	Temperate	Tropical			
7	Temperate	Tropical			
8	Temperate	Tropical			
9	Temperate	Tropical			
10	Temperate	Tropical			
11	Temperate	Tropical			
12	Temperate	Tropical			

9. Draw a pair of line graphs on the same axes to show the fates of the forests. Die rolls can go on the *x*-axis, number of species remaining goes on the *y*-axis.

10. How was biodiversity affected by human activity in the temperate forest? How was it affected in the tropical rainforest?

A World of Difference Counting Grid

Temperate Forest		
A	B	C
D	E	F

Tropical Rainforest		
A	B	C
D	E	F