BIODIVERSITY AND ECOSYSTEMS

Biodiversity is critical in any self-sustaining environment. Complex and diverse ecological systems are made up of many organisms and a huge variety of interactions. Simple ecosystems have few organisms, few interactions, and are fragile. All ecosystems, whether diverse or sparse, involve an intimate interaction of living things with their abiotic environment. Variety or diversity in an ecosystem increases the chance of survival in a changing world.

The earth is losing its biodiversity at a worrisome rate. Humans simplify ecosystems for many reasons: to increase the agricultural base, to make way for cities and industrial zones, or for aesthetic reasons, such as making lawns and gardens. This practice has direct effects upon many abiotic factors within an environment. The air temperatures found in cities, for instance, are usually significantly higher than that in surrounding, non-urbanized areas. Such cities are said to produce *heat islands*. An area's biodiversity has profound effects upon the physical and biological makeup of an ecosystem.

MATERIALS

LabPro	meter stick
TI Graphing Calculator	notebook
DataMate	string or twine
Temperature Probe	rubber band
various field sites	

PROCEDURE

1. Choose two sites, one that is fairly diverse with a fair variety of different types of plants. Call this Site A. Find a simple site, such as a grassy lawn. Call this Site B. Two such sites might be similar to those shown here:

Site A   *Site B*

Site A:

2. Using a meter stick, measure out a one-square meter area at Site A. Mark the area with string or twine.

Reference: *Biology with Calculators,* Vernier Software & Technology, 2000.

Identifying organisms

3. Examine this area closely. Discuss how your group will determine answers for the questions below. Record your decisions and rationale for your choices.

   - How will we identify an organism? What is a grass organism? One blade? A group from one set of roots? A patch of grass?
   - How will we count similar organisms? If there are thousands of one type of organism in your area, do you count each one, or find ways of estimating? What ways of estimating are reasonably accurate? Since many animals and birds move in and out of an area, over what time period will you count organisms?
   - How will we identify a plant patch? A patch of one type of plant is an area of similar plants that are physically separate from another area of similar plants. Patches need not be the same size. You will need to distinguish one patch from another.

4. Now, record information about the different living organisms in your area. Include estimates of the following:

   a. The type of organism. The actual name is not important. You might write something like:
      - a maple tree
      - tall (20-30 cm) grass with wide blades
      - cut grass, 3 cm long
      - beetle #1 (0.5 cm long, black)
      - bee #1 (yellow and black stripes about 1 cm long)
      - a fly flew in and out of the area

   b. The approximate number of each type of organism.
   c. The number of plant patches in the 1 m^2 area.

5. Using a soil borer or a trowel, examine a small sample of soil. Record the depth of the humus in your soil in Table 1. Humus is made of decaying organic matter and is usually darker in color than the non-organic soil. Note any animals in your sample.

6. Examine your data from Steps 4 and 5 and record each of the following in Table 1:

   a. The number of different animals in your area.
   b. The number of different plants in your area.
   c. The number of plant patches in your area.

Identifying physical factors

7. Plug the Temperature Probe into Channel 1 of the LabPro. Use the link cable to connect the TI Graphing Calculator to the LabPro. Firmly press in the cable ends.

8. Turn on the calculator, press APPS and select the DATAMATE program. Press CLEAR to reset the program.

9. The calculator screen should display CH 1:TEMP (C). If not, please tell your instructor.

10. Place a meter stick vertically in your area. One end of the stick (reading 0 cm) should be on the soil. If leaf litter exists, move it aside and place the stick on the dirt. The other end (100 cm) should be in the air, so that the stick is as vertical as possible.

11. Place the Temperature Probe at the top of the meter stick (at a height of 100 cm).

12. Allow the temperature readings to stabilize. Record the value displayed on the calculator screen in Table 2.

13. Move the sensor down to 90 cm. When the displayed value has stabilized, record the temperature in Table 2.

14. Continue measuring the temperature at heights of 80, 70, 60, 50, 40, 30, 20, 10, and 0 cm. Record all values in Table 2.

Site B

15. Repeat Steps 2 – 6 to examine Site B.

16. Repeat Steps 10 – 14 to collect temperature readings at Site B.

Name _____
Name _____
Date _____ Period _____

DATA

Table 1		
Count in your area	Site A (diverse)	Site B (sparse)
Number of different animals		
Number of different plants		
Number of plant patches		
Humus depth (cm)		

Table 2										
Height (cm)	100	90	80	70	60	50	40	30	20	10	0
Site A Temperature (°C)										
Site B Temperature (°C)										

Table 3								
Team	# of Animals		# of Plants		# of Patches		Humus depth (cm)	
	Site A	Site B	Site A	Site B	Site A	Site B	Site A	Site B
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Average								

PROCESSING THE DATA

1. For the data from both Sites A and B, graph the temperature (y-axis) versus the height it was measured at (x-axis).

2. Obtain the data found in Table 1 from each team in your class and record their values in Table 3. Calculate the averages for each column and record your results in the last row of Table 3.

QUESTIONS

1. How would you compare Sites A and B? Include a comparison of the biodiversity at each site.

2. Which site supported a *larger* animal population? Which site supported a *more diverse* animal population? Hypothesize why this might be so.

3. Examine your data in Table 3. How does the average number of plants compare to the average number of plant patches?

4. What seems to be a more meaningful indicator of biodiversity—a count of the number of plants, or a count of the number of plant patches? Explain your answer.

5. How would each group's definition of what a plant was affect the results in Table 3 and the answer to Question 4?

6. Compare your graphs of temperature *vs.* height for the two sites. If you performed Extension 1, compare graphs of the measurements for the two sites.

7. Using your answer to Questions 6, summarize how living organisms affect both biotic and abiotic factors in an ecosystem.

8. Which ecosystem, the complex one found in Site A or the simple one found in Site B, requires a greater expenditure of human resources to maintain? Explain your answer.

9. If each ecosystem experienced a fundamental environmental change, which would be more likely to survive? Explain your reasoning.

10. Summarize your conclusions of this field experiment.

EXTENSIONS

1. What other environmental measurements (in addition to temperature) could be taken that would help one understand how abiotic variables are affected by living organisms? Design an experiment to measure these variables.

2. Write an essay that discusses how an animal might perceive a patch size.

3. Make two possible food pyramids from your data, one from Site A and the other from Site B. Discuss how biodiversity affects the two food pyramids.