Environmental Science Lab

BIODIVERSITY ON CAMPUS

OVERVIEW

The ecology of the earth can be studed at various levels: an single organism, a population, a community, an ecosystem, a biome, or the entire biosphere. The variety of living organisms that inhabit any of these environments is a measure of their biodiversity. Biodiversity is frequently used to determine the health of a community or ecosystem. A biodiversity study is often employed by scientists when a location is being considered for development. The simplest way to measure biodiversity is to count the total number of species at a location. This number is a measurement of the species richness. By comparing species richness at two locations, scientists can learn something about biodiversity. However, such a simple survey doesn't give scientists a complete picture of biodiversity in an ecosystem because it does not take into account the importance of the relative abundance of species. One measure of biodiversity that includes relative abundance is the Shannon-Weiner Biodiversity Index. In this lab activity you will make a study of the biodiversity of the insect population at specific locations on your school campus. Insects are very diverse on the earth, and they are fairly easy to capture and identify. For these reasons they make good subjects for biodiversity studies.

1. You will first determine three “natural” areas on your school campus where you want to conduct your biodiversity studies.

2. Next, you will create the two types of biodiversity collection traps. These will be used to collect specimens overnight at the three different locations.

3. During the next class period, you will collect the traps, analyze the biodiversity of the insects found in the traps, and then clean up the lab.

4. Using the Shannon-Wiener index, you will determine which of your three study areas has the greatest biodiversity.

5. Finally, you will make a recommendation as to which study location will be least impacted by further development.

TIME REQUIREMENTS

Part 1: This activity requires a 50-minute class period.

Part 2: This activity requires a 50-minute class period (on the following day).

LAB EQUIPMENT AND MATERIALS

A list of equipment and materials you will need to perform this lab is given below.

Part 1:

Equipment	**Amount Needed**
Beaker (500 mL)	1
Graduated cylinder (500 mL)	1
Stirring rod	1
Materials	**Amount Needed**
Plastic knife	1
Plastic cups	9
Note cards (3" x 5")	9
Tanglefoot® Brand Tree Pest Barrier (6 oz tube)	1
Bent paper clips	9
Plastic bags (gallon size)	3
Table sugar	one-half cup
Distilled water	400 mL

Part 2:

Equipment	**Amount Needed**
Dissecting scope or magnifying glass	1
Insect identification books/keys	1
Petri dish	1
Tweezers	1

LAB PROCEDURE

Hints for a successful lab:

1. Be careful with the Tanglefoot® Brand Tree Pest Barrier. It is an oil-based insect barrier and is extremely sticky. Do not get it on your clothes, hands, desks, etc., as it is difficult to remove.

2. Do not place your traps in areas with high moisture (e.g. an area watered with sprinklers) as this can ruin the set-up.

Part 1:

Scout potential study areas

1. Seek out areas of your campus where development may occur in the future. It can be an empty field near the parking lot or a garden area between the student cafeteria and the athletic field.

2. Select three areas to assess their biodiversity.

Prepare card collection traps

1. Gather the note cards, Tanglefoot® Brand Tree Pest Barrier, plastic knife and paper clips.

2. Fold the paper clips into the shape of a hook and insert them into the top of each note card.

3. Write your name, collection location, and card number (you will have three cards at each location) on the back of the nine note cards and lay them on a piece of paper.

4. Spread the Tanglefoot® Brand Tree Pest Barrier onto the front surface of a note card using the plastic knife. The Tanglefoot® Brand Tree Pest Barrier is extremely sticky and is oil-based so do not get it on your hands, clothes, desks, etc. It is difficult to wash off.

Place the card collection traps

1. Lift the card traps by their hooks and drape them over a pencil or ruler to carry them out to the research areas.

2. Hang the card traps within your chosen locations (three cards per location). Place them where they are likely to attract insects (e.g. trees, bushes, grass, etc.). If hanging the card traps is not an option, then lay them (sticky side up) on the ground within the area.

3. Return to the classroom.

Prepare sugar/water solutions for the cup collection traps

1. Mix one-half cup of sugar and 400 mL distilled water in the 500 mL beaker. Stir well using the stirring rod.

2. Write on the side of your nine plastic cups: “Science Experiment - Do Not Throw Away!”

3. Pour equal amounts of the sugar/water solution into the nine plastic cups. Each cup should be about one-third full.

Place the cup collection traps

1. Place three cup traps at each of the same collection sites as the card traps.

2. Secure the cup traps so they do not tip over. You can wedge them in a bush, place them on the ground, prop them with a rock, etc.

3. Return to the classroom.

Cleanup classroom lab area

1. Properly dispose of the plastic knife in the recycling bin (or trash).

2. Wash the glassware.

3. Return the reusable equipment to your teacher.

Part 2:

Retrieve the collection traps

1. Return to your collection sites with three one-gallon plastic bags on the following school day.

2. Place the plastic cups from each location into the same plastic bag, keeping them separate. If the cups have insects crawling in and around them, be careful not to lose any of the insects during the bagging process. Use a different plastic bag for each location.

3. Take down the cards with the Tanglefoot® Brand Tree Pest Barrier. Do not put them in the bags as they are still quite sticky. Carry them with a pencil or ruler as before.

4. Return to the classroom with your traps.

Identify the insects in each trap

1. Put the plastic bags in a freezer for a few minutes to slow down any active insects.

2. Transfer the insects from one trap to the petri dish with the tweezers for viewing, if necessary. You may be able to view some specimens directly in the plastic bag.

3. Classify each insect species using the provided identification books. If you are unable to identify a species, classify it yourself using descriptive phrases such as “small, green insect with wings” or “black insect with red stripe.” This method gives you a “morphospecies” and is perfectly acceptable in biodiversity studies.

4. Count the number of individuals of each species found in each trap at each location and enter the data onto the Data Worksheet.

5. Return the living insects to outside when you are finished studying them.

Analyze the insect diversity

1. Record the number of individuals (N) of each species for each collection location on your Biodiversity Worksheet.

2. Calculate p_i, the the proportion, or relative abundance, of each individual species to the total for each location. Record the calculations on your Biodiversity Worksheet.

3. Calculate $\ln p_i$, the natural logarithm of p_i. for each value of p_i. Record the calculations on the Biodiversity Worksheet.

4. Calculate $(p_i)(\ln p_i)$ values and record them in the Biodiversity Worksheet.

5. Calculate H’, the Shannon-Wiener Biodiversity Index for each location. It is calculated using the equation: $H' = -[\Sigma(p_i)(\ln p_i)]$. Record the values on the Biodiversity Worksheet.

6. Determine S, the total number of different species found for each location.

7. Calculate H_{max}, the maximum diversity for each location. It is calculated using the equation: $H_{max} = \ln S$. Record the values on the Biodiversity Worksheet.

8. Calculate J, the evenness for each location. It is a measure of the distribution of individuals among species in a community. It is calculated using: $J = H'/H_{max}$. Record the values on the Biodiversity Worksheet.

LAB REPORT / ANALYSIS QUESTIONS

Provide answers to the following questions using complete sentences.

1. What were the H', H_{max}, and J values for each of the three research locations?

2. Which of these three location has the greatest biodiversity?

3. What does evenness, J, measure in a community or ecosystem?

4. Why do ecologists think that biodiversity is an important measure of the well-being of an ecosystem?

5. What are some human-caused activities that are decreasing the global biodiversity?

6. What conservation recommendations would you make to the school administration regarding the development of your research locations? Which should be developed first and which should be developed last?

7. What are some possible sources of error in this experiment?

8. Write a comprehensive summary and conclusion of your results.

END OF LAB

DATA WORKSHEET							
Location 1:							
Species	**Card A (# of Ind)**	**Card B (# of Ind)**	**Card C (# of Ind)**	**Cup A (# of Ind)**	**Cup B (# of Ind)**	**Cup C (# of Ind)**	**Total**
1.							
2.							
3.							
4.							
5.							
6.							

Location 2:							
Species	**Card A (# of Ind)**	**Card B (# of Ind)**	**Card C (# of Ind)**	**Cup A (# of Ind)**	**Cup B (# of Ind)**	**Cup C (# of Ind)**	**Total**
1.							
2.							
3.							
4.							
5.							
6.							

Location 3:							
Species	**Card A (# of Ind)**	**Card B (# of Ind)**	**Card C (# of Ind)**	**Cup A (# of Ind)**	**Cup B (# of Ind)**	**Cup C (# of Ind)**	**Total**
1.							
2.							
3.							
4.							
5.							
6.							

Biodiversity Worksheet

Location ~~1~~ 2

Species	1	2	3	4	5	6	Σ
N							
p_i							
$\ln p_i$							
$(p_i)(\ln p_i)$							

H' Shanon-Weiner Biodiversity	H_{max} Maximum Diversity	J Evenness

Location 1

Species	1	2	3	4	5	6	Σ
N							
p_i							
$\ln p_i$							
$(p_i)(\ln p_i)$							

H' Shanon-Weiner Biodiversity	H_{max} Maximum Diversity	J Evenness

Location ~~1~~ 3

Species	1	2	3	4	5	6	Σ
N							
p_i							
$\ln p_i$							
$(p_i)(\ln p_i)$							

H' Shanon-Weiner Biodiversity	H_{max} Maximum Diversity	J Evenness