

# Schoolyard Ecology Lab

## Exploring Biodiversity

### Purpose:

To develop an understanding of the Shannon-Wiener diversity index and species richness as tools for quantifying biodiversity and assessing human impacts on the environment.

### Background:

A study of biodiversity requires an understanding of several terms and concepts.

- **Biodiversity** is the population heterogeneity of a community, or the number of species in a given area.
- **Species diversity** is a combination of species richness and species evenness.
  - **Species richness** is the total number of species present in the community.
  - **Species evenness** is the relative distribution of individuals among the species present in a community.
    - Evenness contrasts with **dominance**, and is maximized when all species have the same number of individuals.

Maintaining biodiversity is important for a variety of reasons.

- New medicines have been discovered by screening diverse ecosystems.
- Genetic diversity in crop plants and their wild relatives provides breeders with the "raw material" needed to select for traits in response to new agricultural challenges.
- Diverse communities are generally less susceptible to perturbation than similar but less diverse communities.
- Biodiversity provides an aesthetic value that humans find appealing.

When pollution is present or a human disturbance has occurred in a community, biodiversity is typically lower than in an undisturbed community.

In this activity we will use three indices of diversity to measure the species diversity of the cars in the faculty and student parking lots.

### Indices of Diversity:

#### **Species Richness (R)**

The species richness is based solely on the number of species found in the given area and does not reflect the relative dominance of species. The formula is:

$$R = s$$

Where:

s = the number of species

### ***Shannon-Wiener Index (H)***

This index is determined by both the number of species and the even distribution of individuals among those species (relative dominance). It indicates the degree of uncertainty of predicting the species of a given individual picked at random from the community. In other words, if the diversity is high, you have a poor chance of correctly predicting the species of the next individual picked at random. The formula is:

$$H = - \sum (P_i \ln[P_i])$$

Where:

$$P_i \text{ (relative abundance)} = n_i/N$$

Where:

$n_i$  = number of individuals in species  $i$

$N$  = total number of individuals in all species

$H$  (the uncertainty of predicting the species) will range from 0 for a community with a single species, to over 7 for a very diverse community.

### ***Species Evenness (E)***

Using species richness ( $R$ ) and the Shannon-Wiener index ( $H$ ), you can also compute a measure of evenness. The formula is:

$$E = H/\ln(R)$$

Evenness ( $E$ ) is a measure of how similar the abundance of different species are. When there are similar proportions of all species then evenness is one, but when the abundance are very dissimilar (some rare and some common species) then the value increases.

### **Pre-Lab Questions:**

1. Use all three indices to determine which of the following three communities of 100 individuals is most diverse.
  - Community 1 contains 10 species with 91 individuals in the first species, and one individual in each of the remaining species.
  - Community 2 also contains 10 species, but there are 10 individuals in each species.
  - Community 3 only contains 5 species, with 20 individuals in each species.

**Procedure:**

1. Prior to starting this lab you MUST:

- Read the background material
- Complete the Pre-lab questions
- Prepare a data table that will assist in the data collection process.
  - See below for data collection procedures.

2. Divide into teams of four.

- Two of your team members will be collecting data from the student parking lot "community" and the other two will collect data from the faculty parking lot "community". You decide.
- Hopefully there will not be much immigration or emigration (cars coming and going) during our sampling time. But, if you do notice some, use your best judgment.

3. Collecting data.

- There is not unlimited time for data collection so be efficient.
- Your "species" will be based on the make of the automobile (e.g. Dodge, Honda, Chevy, etc.) and whether it is a "car", "truck", "SUV" or "minivan".
- If you are having difficulty classifying a "species", you must come to a decision as a team. No individuals are to be skipped.

4. Calculating biodiversity.

- Use the formulas provided in the background section to calculate all three indices of diversity for both "communities" (parking lots).
- Remember that a well designed data table can help this process immensely.
- You may do calculations by hand or use a spreadsheet. You decide.
- You must provide an example of each calculation in your lab write-up.
  - For the Shannon-Weiner Index, just show calculations for one "species".
- Complete the table below:

<b>Diversity Measurement</b>	<b>Community A (Student)</b>	<b>Community B (Faculty)</b>
Species richness (R)		
Evenness (E)		
Dominance (high/low)		
Relative diversity (high/low)		
Shannon-Weiner Index (H)		

## Conclusions:

*Individually* summarize your analysis of the data into a clear, concise essay. Make sure you include all of your findings and analysis. The following questions will help guide you:

- Which "community" is most diverse? You must support your conclusion with experimental data.
- If both "communities" were similar in make-up, which one would you conclude has most likely experienced some sort of human disturbance? Explain.
- Did any species dominate in either "community"? If so, explain.
- Were there opportunities for errors in your methods or conclusions? If so, explain in detail.