

### Species Diversity Lab

The diversity of species present in an ecosystem can be used as one gauge of the health of an ecosystem. Species richness is a measure of the number of different species present in an ecosystem, while species evenness measures the relative abundance of the various populations present in an ecosystem. In an ecological survey designed to measure species diversity, a wildlife biologist might determine the number of individuals of each species present in an area, then calculate a "diversity index" for the area. Comparison of the diversity index with that of other areas provides insights into the species diversity and the health of the ecosystem.

In this activity your "ecosystem" will be the school parking lot, and the "species" will be the different car models and colors. As a class, we will be comparing the species diversity of the *student* and *staff* parking lots. The diversity index we will use is the Shannon Diversity Index. After determining the number of each species (car), in each parking lot, the Shannon Diversity Index will be calculated separately for the student lot and the staff lot. A rich ecosystem with high species diversity has a large value for the Shannon Diversity Index (H'), while an ecosystem with little diversity has a low H'.

$$p_i = \frac{n_i}{N}$$

(equation 1)

$$H' = - \sum_{i=1}^S p_i (\ln (p_i))$$

(equation 2)

- $n_i$  = number of individuals of species "*i*"
- $N$  = total number of individuals of all species
- $p_i$  = relative abundance of species "*i*" (see equation 1)
- $S$  = total number of species
- $H'$  = The Shannon Diversity Index (see equation 2)

**Materials**

- 2 parking lots full of cars

**Procedure**

1. Prepare a data table or use provided handout for data acquisition. There must be enough space for at least 20 "species".
2. Visit the school's parking lot and collect data as directed in class (your teacher will give you specific guidelines as to what constitutes a "species" of car.

**Sample Data Table**

Leave space to write in either <car model or color> and <student or staff>. This will be determined on the day the lab is performed.

**Sample Table 1: Data collected for <car model or color> in the <student or staff> parking lot**

Species	i	n <sub>i</sub>	p <sub>i</sub>	ln (p <sub>i</sub> )	p <sub>i</sub> (ln (p <sub>i</sub> ))
	1				
	2				
	3				
	4				
	5				
	•				
	•				
	•				
	•				
	•				
	•				
	•				
	•				
	•				
	•				
totals	—				

**Prelab Questions**—Write out and answer the following questions

1. Use the data table below and calculate the Shannon Diversity Index of a hypothetical tidepool.

Species	$i$	$n_i$	$p_i$	$\ln(p_i)$	$p_i (\ln(p_i))$
Sea Anemone ( <i>Anthopleura sp.</i> )	1	22			
Bat star ( <i>Patiria sp.</i> )	2	13			
Lobster ( <i>Panulirus sp.</i> )	3	7			
Sea hare ( <i>Aplysia sp.</i> )	4	16			
<b>TOTAL →</b>					

2. Identify which parking lot you expect to be the most diverse, and defend your choice.
3. Describe the physical location of the parking lot you are sampling

**Data Analysis**

1. Determine the value for the Shannon Diversity Index for the data collected by your group. Show all of your work (each person needs a calculation sheet which you will be handing in with your Post Lab questions).
2. Tabulate the values calculated by **your group** and the **other groups** in class for the Shannon Diversity Index.
3. How consistent is the Shannon value for each group for the student and staff parking lots?

**Postlab Questions**—Write out and answer the following questions

1. Identify the parking lot that was the most diverse. **Based on your observations during the lab**, explain why your prediction in question #2 of the prelab was supported or not supported.
2. List the single most abundant species in each set of data, and write a plausible explanation to explain why these are the most abundant species.
3. Determine the maximum and minimum values for the Shannon Diversity Index for the parking lots sampled.
4. If you conducted this lab in a shopping mall parking lot, predict whether the Shannon Diversity Index would be high or low, and how it would compare to the school parking lots.
5. If you conducted this lab at a new car dealership, predict whether the Shannon Diversity Index would be high or low, and how it would compare to the school parking lots.
6. If you conducted this lab in another part of San Diego, say El Cajon, how similar or different do you think the results may have been? Why?
7. If you conducted this experiment in a different country, do you think the results would be similar or different? Why?
8. The importance of biodiversity has been correlated to ecosystem resilience and stability. According to your results, which parking lot demonstrates the higher degree of ecological stability?
9. List and elaborate on any sources of error that may have affected you lab results.
10. List a few other applications for which the Shannon Diversity value would be beneficial for someone to know.