

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## AP Environmental Science

### Shannon Diversity Index "Car Species" Diversity Lab

The diversity of species present in an ecosystem can be used as one gauge of the health of an ecosystem. **Species evenness** describes how evenly distributed all the species are in a community while **species richness** describes how many different types of species there are in a community. 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. Diversity Indices are one method used to measure species diversity in nature, and determine the degree of species evenness and species richness in an area. Using these calculations, ecologists can also attempt to assess the impacts of human development or pollution on an ecological community. When pollution is present or a human disturbance has occurred, diversity is typically low.

In this activity your "ecosystem" will be the school parking lot, and the "species" will be the different car makes and models. As a class, we will be comparing the species diversity of the **seniors (A)** and **regular (B)** parking lots. The diversity index we will use is the Shannon Diversity Index. After determining the number of each species (cars), in each parking lot, the Shannon Diversity Index will be calculated separately for the senior lot and the regular lot. We will use Microsoft Excel to compute the Shannon Diversity Index (Part 2 of the lab). The calculations of species diversity, evenness, and richness are the same as for a natural environment.

***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)

Example data set:

"Species" of Cars	"Species" identifier code	Number of "individuals" in Parking lot A			
	I	$n_i$	$p_i$	$\ln(p_i)$	$p_i (\ln(p_i))$
Chrysler Lebaron	1	10	0.17	-1.7719	-0.3012
Dodge Minivan	2	10	0.17	-1.7719	-0.3012
Toyota Corolla	3	10	0.17	-1.7719	-0.3012
Chevy Cavalier	4	10	0.17	-1.7719	-0.3012
Nissan Pickup	5	10	0.17	-1.7719	-0.3012
Ford Taurus	6	10	0.17	-1.7719	-0.3012
<b>TOTAL</b>	<b>S= 6</b>	<b>N = 60</b>	<b>1.00</b>		<b>H' = 1.8074</b>

"Species" of Cars*	"Species" identifier code	Number of "individuals" in Parking lot B			
	i	$n_i$	$p_i$	$\ln(p_i)$	$p_i (\ln(p_i))$
Chrysler Lebaron	1	1	0.02	-3.9120	-0.0782
Dodge Minivan	2	2	0.03	-3.5066	-0.1052
Toyota Corolla	3	25	0.42	-0.8675	-0.3644
Chevy Cavalier	4	32	0.53	-0.6348	-0.3364
Nissan Pickup	5	0	0.00	0	0
Ford Taurus	6	0	0.00	0	0
<b>TOTAL</b>	<b>S= 4</b>	<b>60</b>	<b>1.00</b>		<b>H' = 0.8842</b>

Which parking lot "community" above is most diverse?

**Lot A** ( $S = 6$ ,  $H' = 1.8074$ ). The car "species" are equally represented in this lot. We say that this "community" has a high degree of **evenness**. **Lot B** is less diverse based on our indexes ( $S = 4$ ,  $H' = 0.8842$ ) and has low evenness because the car "species" are unequally represented. Chevy Cavaliers are the most common "species" in Lot B, followed by Toyota Corollas. This lot has a high degree of **dominance** by these two "species." ( $p_3 + p_4 = 0.95$  or 95% of the individuals in this community are Chevy's or Toyota's)

Diversity Measurement	Community A	Community B
Species richness (S)	6 species	4 species
Evenness	High	Low
Dominance	Low	High
Overall diversity	High	Low
Shannon Diversity Index (H')	1.8074	0.8842