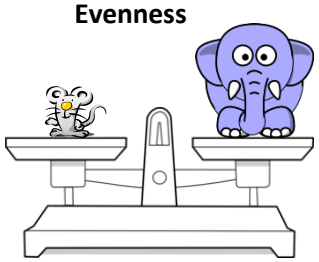
Name _____ Date _____

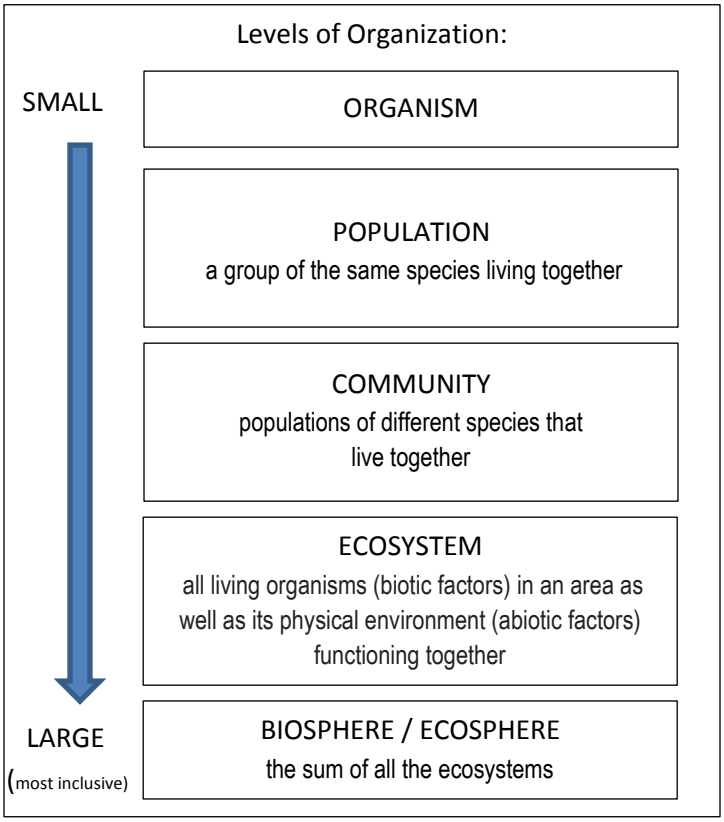
A.P. Environmental Science Mr. Romano

BIODIVERSITY:

Species Dominance **Richness** **&** **Evenness**



Scientists have configured a hierarchy system of ecological organization to better study the relationships of organisms within their environment. Depending on the source you use, there are either 5 or 6 levels: organism, population, community, ecosystem, and biosphere (ecosphere) are the main 5. Sometimes biomes are considered the 6th level placed between ecosystem and biosphere, but some just classify a biome as an ecosystem with a specific climate. Here is a layout of the different levels and their definitions (looks familiar, doesn't it?):



One last subdivision is known as an ecotone. An ecotone is the transitional zone in which one ecosystem merges with an adjacent one where two ecological communities meet and integrate. For instance, Long Island's coastal wetlands are a transitional zone that connects the land environment to the surrounding marine environment. Another example would be how a forest ecosystem blends into the grassland next to it. Because ecotones are influenced by both of the ecosystems that border it, they usually consist of a greater biodiversity than each of those bordering ecosystems. This amplified biodiversity is commonly referred to as the edge effect.

This activity has a specific focus on the biodiversity that exists within an ecological community. Simpson's Diversity Index is a measure often used to quantify the biodiversity of a habitat. It takes into account the number of species present, as well as the abundance of each species in that ecological community.

Biological diversity can be quantified in many different ways. The three main factors taken into account when measuring diversity are dominance, richness, and evenness. Ecological dominance is the degree to which a species is more numerous than its competitors in an ecological community, or makes up more of the biomass. However, diversity depends not only on richness, but also on evenness. Evenness compares the similarity of the population size of each of the species present (basically it is the relative abundance of each species). Some ecological communities have a high degree of evenness, while others have a much lower degree. Obviously, if there is an extreme dominance, a high degree of evenness cannot exist and visa-versa… Species richness is a measure of the number of different kinds of organisms present in a particular area. The more species present in a sample, the 'richer' the ecological community. Bottom line: as species richness and evenness increase, so diversity increases. Simpson's Diversity Index is a measure of diversity which takes into account both richness and evenness.

Example situation:
Two different fields of wildflowers were used in an environmental study of biodiversity. The sample from the first field consisted of 300 daisies, 335 dandelions and 365 buttercups. The sample from the second field was comprised of 20 daisies, 49 dandelions and 931 buttercups. Both samples have the same richness (3 species) and the same total number of individuals (1000). However, the first sample has more evenness than the second. This is because the relative abundance of wildflowers is more evenly distributed between the three species. In the second sample, most of the individuals are buttercups, with only a few daisies and dandelions present. Sample 2 is therefore considered to be less diverse than sample 1 because it has a dominant population of buttercups.

Now, of course there is a more mathematical way to represent richness, evenness, and biodiversity.

In this simulation you will apply the Simpson Index and its formulae:

$D = \sum (n / N)^2$	$D = \frac{\sum n(n-1)}{N(N-1)}$

In addition, you will have to calculate the overall biodiversity of a given region using another formula known as the Shannon Index. $H' = -\sum_{i=1}^{S} p_i \ln p_i$

But don't fret, the numbers usually work out neatly (well …sorta). I hope you are ready to get started …
Can you feel the excitement?

what you look like when you feel the excitement

Well … you are just going to have to wait a little bit longer … Now that you are finished reading the introduction, you should be more prepared for tomorrow's group work. So… give your multi-function calculator a hug goodnight and get some rest. Tomorrow, after a brief review of what you've read over, you will break out into groups, open the google doc titled: Biodiversity: The Instructions, and get busy for the double period.

BIODIVERSITY : The Instructions

Okay … so remember those formulas you were reading about last night? All I have to say now is … PSYCH! (that would be "SIKE!" for those of you with street cred.) While those formulas do exist, they are beyond our pay-grade for now. I really do like you all way too much to get caught up in all of that math mumbo-jumbo. Don't get me wrong; quantifying collected data is a significant part of a scientific study, but our objective does not require us to take that route to gain a basic understanding of the concepts of richness, dominance, evenness, dispersion, and overall biodiversity. Side point: under normal circumstances, we would be conducting this lab using animal crackers instead of clip-art. You see, the symbiotic relationships that exist between different organisms are just another huge part of our study of APES and, in the past, this lab also served as a vehicle by which we could maximize our understanding of human predatory behavior. Sorry… no gum and no crackers this year… what has the world come to?!☹.

PROCEDURE:

Part 1: Group Effort to Crunch the Data

At the end of this Google Doc are ecological communities that require analysis. The clipart animals are moveable to help make it easier when performing your analysis. At the bottom of each page is an area to type in your data to be used later. Once the data collection is completed, you should share the document so that each group member has a copy.

For each of the 6 ecological communities perform the following tasks

a. Record the names of the organisms that are present to determine species richness. If you need a refresher in cute clip-art zoology, extra help is available during office hours. Remember that species richness is expressed as an integer and indicates the number of different species that exist in an ecological community.

b. Count the number of each species and record your findings. You will use this data to determine relative dominance and evenness present in the ecological community. For evenness, we will use qualitative phrases such as a "high degree of evenness" or "low degree of "evenness". For dominance, you can just state "dominance exists" or dominance does not exist" and then state the organism that is the dominant species.

c. As explained in the wildflower example, the overall biodiversity can also be described. Remember that there is an elaborate formula to accomplish this, but we will present a simplified version. Rank the overall biodiversity of each community on a scale of 1-6 (with 1 representing the greatest biodiversity). Obviously, a community that has a greater richness would be more biodiverse, but the amount of evenness is the second factor that helps determine overall biodiversity. If you are still confused, please re-read the wildflower example in the introduction to this activity.

**** I know that you have the tendency to divide the work to be more efficient. If you proceed this way, make sure to check the data counts before you start making your individual data charts ****

Part 2: Individual Data Chart Creation

After all data has been collected, the structure of the lab shifts to individual efforts. You will create a well-organized data chart that includes all of the information you have collected up to this point. We will return to the main room and if you have a question, please direct it toward me. You may put on your headphones and go into your zone, but there should be no sharing of ideas or helping one another. I need to see your ability to organize data as well as your ability to use software to create an organized data chart. I am well aware that many of you have never used software to create a data chart from scratch, so I will provide those individuals with a tutorial in the main room while others that are more experienced get to work.

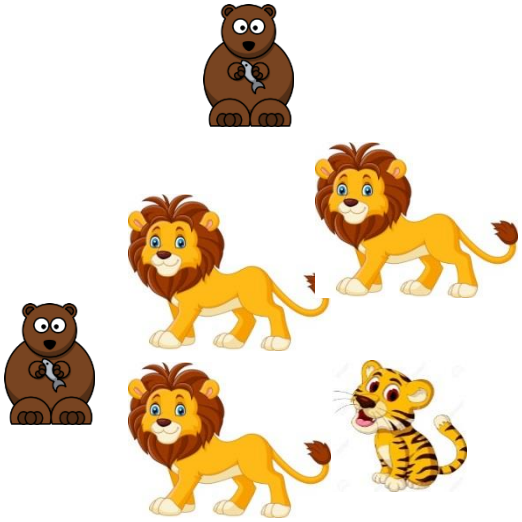
GRADING: 14 point lab * fractions of point may be deducted for minor mistakes **

1. Data Calculations are Correct – 6 points
2. Data Chart correctly formatted with all of the information for each of the 6 ecological communities presented in a clear and logical manner (everything labeled and spell-checked, words not split, attention to cell alignment, one data point per box) – 8 points

Disclaimer 1: Critters are not drawn to scale.

Disclaimer 2: Suspend disbelief! Ignore the scientific inaccuracies of the critters that have been placed together in each community. If you weren't aware, clip-art critters always live harmoniously together in a Google Doc.

COMMUNITY 1:



Community 1 Data

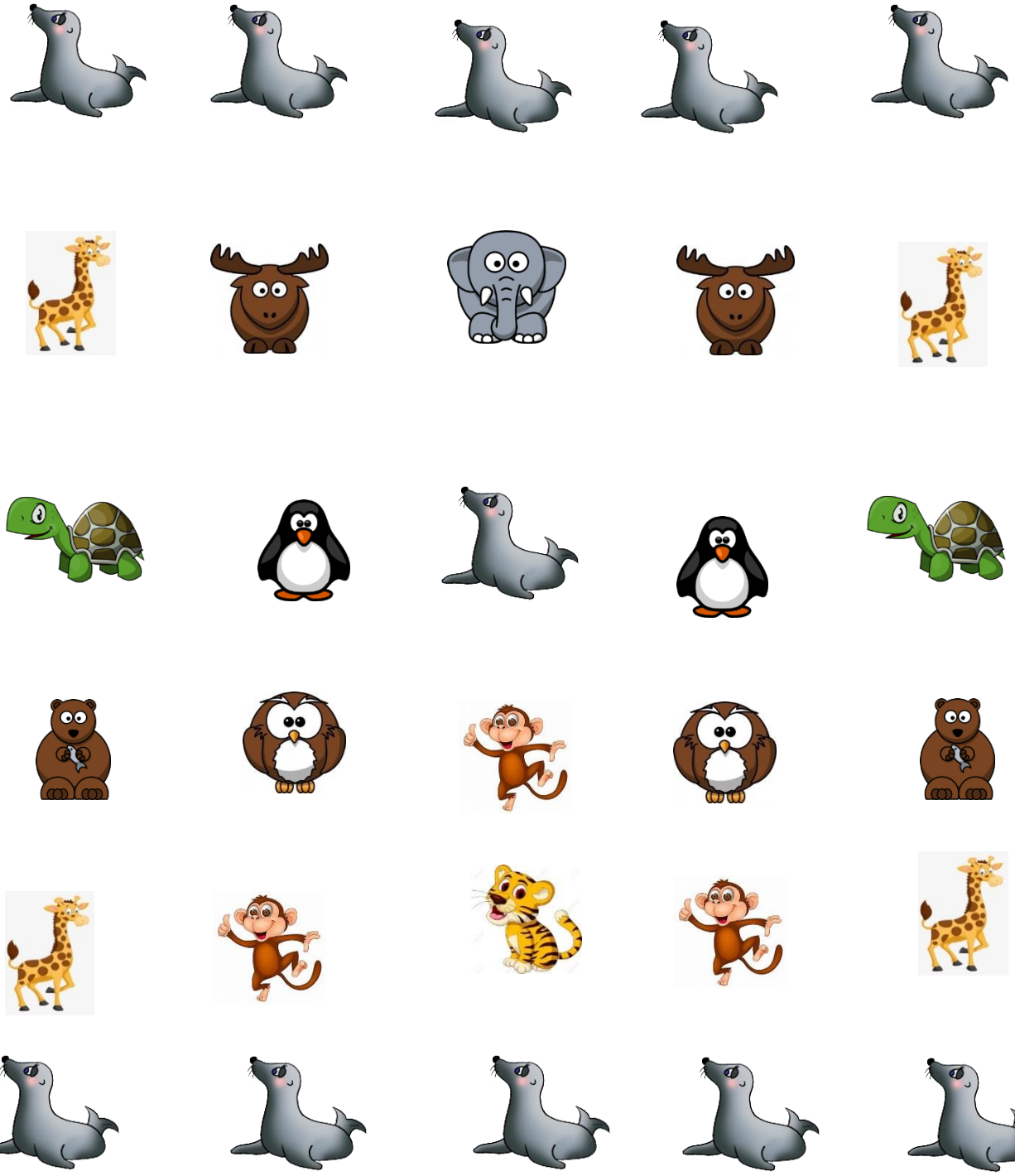
COMMUNITY 2:

Community 2 Data

COMMUNITY 3:

Community 3 Data

COMMUNITY 4:

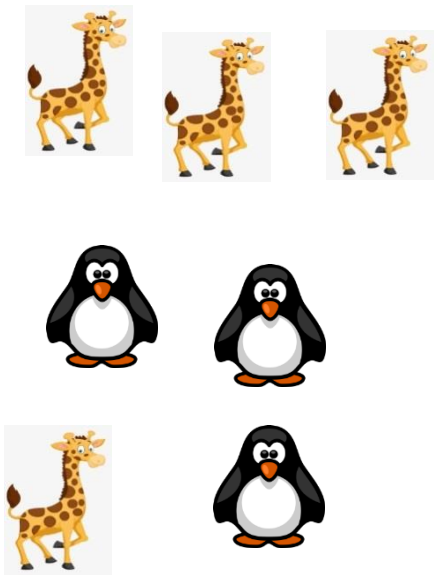


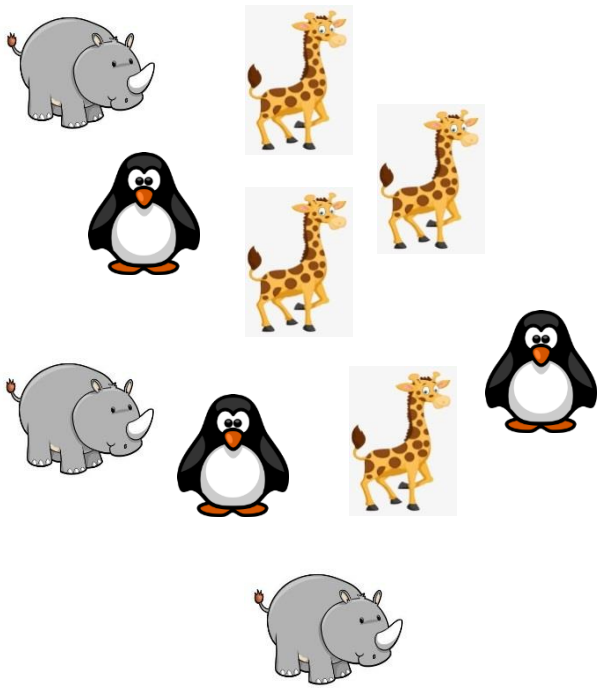
Community 4 Data

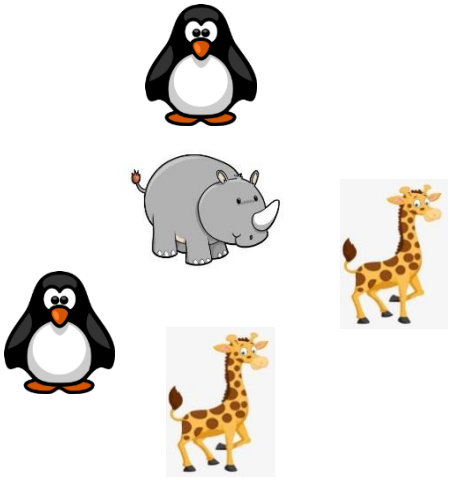
COMMUNITY 5:

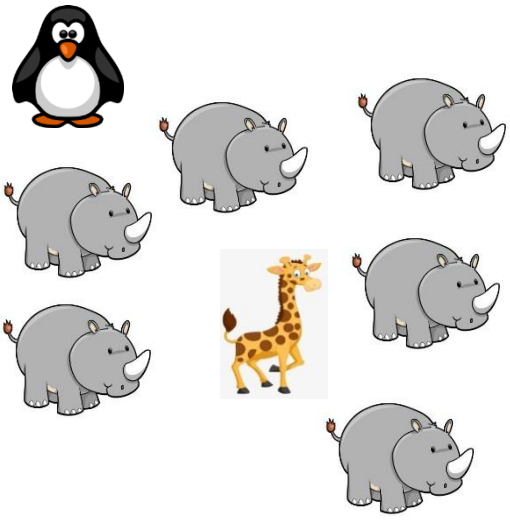
Community 5 Data

COMMUNITY 6:









Community 6 Data