Name _____

Date _____ Per. _____

Biodiversity

Background

When people discuss biodiversity, it is often in the context of saving an animal species or in conserving rainforests, tropical reefs, or other biologically diverse habitats. Although many people agree that biodiversity is crucial to a healthy and sustainable ecosystem, the many underlying reasons for its importance are not always readily apparent.

Imagine that you or a loved one is ill, and there is currently no good treatment for the disease. What hope might you have for a cure? Where could doctors start looking for answers? Plants and animals may hold secrets to fighting disease, but researchers question which organisms do, and whether these organisms will still exist when a cure is needed. For example, research on the Madagascar periwinkle led to the development of a drug that has improved the survival rate of individuals with Hodgkin's Lymphoma from 10% in the 1950s to 90% today. It has been used to treat other cancers, as well. The Madagascar periwinkle is now endangered in the wild.

Researchers continue to test compounds and chemicals for potential medicinal applications, but they have extensively studied less than 5% of plant species in the rainforests, among the places on earth with the greatest biodiversity. Obviously, there is still much to be learned, and the potential exists for many lifesaving innovations to be developed by studying the planet's flora and fauna. This is one of many reasons people work for the preservation of the biological diversity across the globe.

Genetic diversity describes the variation in genes within a population of organisms, and also with genetic variation between different populations of organisms. Scientists generally consider genetic variation within a population a good thing. The more variation a population has, the better its chance of adapting to changing environmental conditions, because there are more variations to be selected for and against. When there is little genetic variation, a population will often show lower environmental fitness or an increased susceptibility to disease. Genetic diversity of a population can be measured on the basis of three factors: (1) the number of polymorphic loci (having two or more alleles) found in the genome, (2) the number of alleles (forms of genes) at each locus, and (3) heterozygosity (the number of carrying traits for two different phenotypes).

Species diversity, often referred to as species richness, is another form of biodiversity. Species diversity is based on the number of species found in a part of an ecosystem, in a particular ecosystem, or even within the biosphere. As species are lost, different genes also are lost, thus reducing overall genetic diversity. Furthermore, the species' role in the ecosystem may be removed, ultimately affecting the lives of other organisms and even earth systems, such as nutrient cycling. Species diversity can be measured in several ways. It can be measured based on the number of species within an ecosystem (i.e., species richness) or it can be based on both the number and evenness of those species within the ecosystem. Two indices commonly used to evaluate both richness and evenness are the Simpson index and the Shannon index.

Another type of biodiversity, ecosystem diversity, can refer to the total number of ecosystems found in the biosphere. This is important, because different ecosystems rely upon one another for a variety of resources, and each ecosystem has its own patterns of nutrient and chemical cycling. For example, phytoplankton in marine ecosystems reduce levels of atmospheric carbon dioxide and produce oxygen. This impacts organisms that require oxygen for respiration and affects the cycle of carbon through earth systems. Without the phytoplankton, much of the carbon needed by organisms to survive would remain in an unusable atmospheric form. In addition to impacting the carbon cycle, whole ecosystems help to purify air and water, reduce the severity of droughts and floods, and remove toxic chemicals from the environment all things that can benefit other ecosystems. When ecosystems are threatened, these interactions are also endangered.

In this laboratory activity, you will examine the biodiversity of the layers of a pond by sampling the layers and counting both the number of organisms and the number of species. Upon completing the lab, you will compare the biodiversity of the pond layers using the Simpson index.

Layers of a Pond

Materials: 3 pipettes, microscope, 6 microscope slides, 6 cover slips, pond water samples

Procedure:

1. Label three pipets as "surface," "middle," and "bottom" respectively. Each will be used to sample a different level of the pond.
2. Using the "surface" pipet, take a sample of pond water from the "surface" pond water solution. You should use the pipette to mix up the sample before drawing some of it up into the pipette.
3. Place a drop of the sample water on the center of a slide and place a coverslip on it.
   ★ Each time you prepare a slide, expel any remaining water back into the appropriate sample beaker.
4. Examine the sample under a microscope. It may be easier to focus initially using a lower powered lens and switch to higher magnification to examine details or smaller organisms.
5. Using the dichotomous key provided, identify each type of organism that you can see on the slide. Draw the organisms in your science notebook and identify the steps used in the key to determine the identity of each organism. (Although you will not turn in your sketches, you will need to reference them and the species present to answer the questions that follow.)
6. Make another slide of this level of the pond, using the same procedures used to make your first slide.
7. Observe the slide and identify any organism not identified in the previous slide.
8. Using the same procedures, make two slides from the middle layer sample and two slides from the bottom layer sample of the pond. Be sure to use the correct pipet for each layer.
9. Answer the questions in the *Results & Analysis* section.

Results & Analysis

On a separate sheet of paper, answer the following questions thoroughly using complete sentences. You may complete your work on the computer. Staple your work to the back of this paper.

1. What do you think the term "biodiversity" means?
2. Where have you heard the term biodiversity before, and how was it used? Try to think of instances outside of this class (or even other biology-based classes) if possible.
3. Why do you think people might be concerned about how much biodiversity exists?
4. In the activity, you examined samples for all species present. Were there differences observed in the species variety in each layer observed? List the layers, along with the species identified within those layers.
5. Were there any species present in more than one layer? Identify them and the layers they were present in.
6. Sampling techniques like the one practiced in the activity are often used in surveying biodiversity or populations. What are some limitations to this sampling approach?
7. Which layer of the pond showed the greatest biodiversity in terms of species richness? Which layer had the least biodiversity based on species richness?
8. Why would a metric such as the Shannon index be used in place of any measure that only accounts for species richness?
9. If a new, rare species were added to the pond, how would it affect the Shannon index for biodiversity?
10. Ecosystems, like the pond, typically are more stable when they are biologically diverse. Why do you think this is true?
11. List and explain several ways that human populations can affect biodiversity.