## Unit #8 – Ecology

Essential Skills

    8-1. *Energy Flow* – Describe how **energy flows** through an **ecosystem** using a four-level **energy pyramid** as a model. (HS-LS2-3 & 4)

    8-2. *Chemical Cycling* – Use a diagram to explain the roles of **photosynthesis** and **cellular respiration** (both **aerobic** and **anaerobic**) in the **cycling of matter** (**carbon**, **water** and **nitrogen**) through an ecosystem. (HS-LS2-3 & 4)

    8-3. *Carrying Capacity* – Identify the **carrying capacity** of an ecosystem based on a graph and describe the **ecological factors** that can affect the carrying capacity of an ecosystem. (HS-LS2-1 & 6)

    8-4. *Biodiversity & Human Impact* – Define the term **biodiversity,** explain **why biodiversity is important** for the health of a species or ecosystem and describe six ways in which **humans impact** the biodiversity of an ecosystem. (HS-LS2-2 & 7)

    8-5. *Ecosystem Interactions & Group Behavior* – Identify the types of **interactions** between organisms in an ecosystem, identify types of animal behavior as **group behavior** or **individual behavior** and explain how the interactions or group behaviors **increase a species' chance of survival**. (HS-LS2-6 & 8)

Study Guide

1. Draw and label an energy pyramid that contains 4 trophic levels. Include the terms <u>producer</u>, <u>primary consumer</u>, <u>secondary consumer</u>, <u>tertiary consumer</u>, <u>decomposer</u>, <u>photosynthesis</u> & <u>respiration</u>.
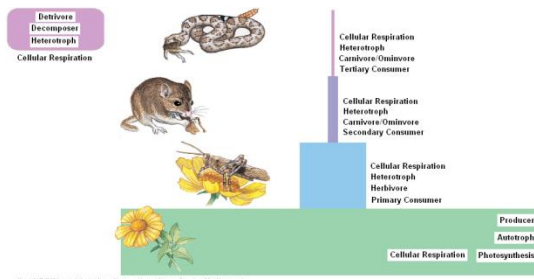
2. Why is the maximum size of any <u>energy pyramid</u> 5 levels? How much energy can be passed from one <u>trophic level</u> to the next? Where does the rest of the energy go?

   The ecological rule of thumb states that only 10% of the energy is passed on to each trophic level. By the 5th level, there would only be 0.001% of the energy from the producers still available. There is just not enough energy to support another trophic level.

3. Explain the relationships between the Hunter, Deer, Wolves and "Mountain" in the reading "Thinking Like a Mountain". What was the result of removing wolves from this environment?

   The hunter is a predator to the deer, in competition and a predator to the wolves. The wolves are predators to the deer. Removing the wolves caused the deer population to rapidly increase and overgraze their ecosystem. Once the plants were gone, the soil was lost due to erosion and plants were unable to grow back. This caused a rapid decline in the deer population.

4. What are the problems associated with exponential growth of a population? Draw an example of this type of graph and label <u>carrying capacity</u>.

   A population growing exponentially can overshoot the carrying capacity for the ecosystem, which will lead to a crash. It is not possible to determine the actual carrying capacity for this population.

Arctic Deer Population Graph
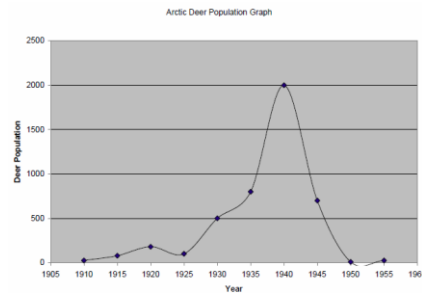
5. Identify 4 factors that could affect the carrying capacity of a population.

   Reduction of resources, introduction of a predator, disease, major environmental change, human activities

6. Describe an actual crash and boom growth pattern and why this is happening.

   Crash and Boom patterns are common in predator/prey situations and also when the limiting resource(s) are available periodically or seasonally. The population will boom (grow) when resources are readily available and crash (decrease rapidly) when resources are scarce.
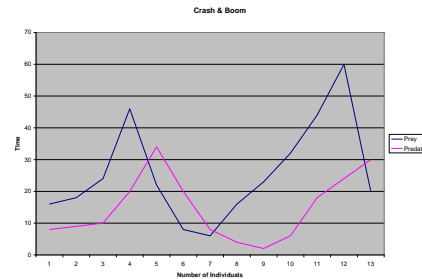
7. Why is it important for an ecologist to study the biotic and abiotic factors in a habitat? Give examples of both types of factors.

   Nutrients, such as carbon, water and nitrogen, cycle between the abiotic (non-living) and biotic (living) factors in a habitat. Examples of abiotic factors include rocks, minerals, water, and the atmosphere. The organisms in the habitat make up the biotic factors (plants, animals, fungi, bacteria, & protists).

8. List the 7 major terrestrial Biomes. How do rainfall, temperature and latitude affect each of the Biomes?

   Tundra, Taiga, Temperate deciduous forest, Tropical rain forest, Grassland, Desert, Savannah

   Warm, wetter biomes are found closer to the equator. Drier, colder climates are found higher in elevation and farther from the equator.

9. What are the major differences between the aquatic ecosystems of Ocean, Estuary and Freshwater?

   Type of water (salt or fresh or a mixture), amount of light, amount of nutrients

10. What is a Biogeochemical Cycle? What is the importance of Nitrogen, Carbon and Water to living things?
    A biogeochemical cycle shows how nutrients (carbon, water, nitrogen, phosphorus, etc.) move between the biotic and abiotic factors of an ecosystem.
    Nitrogen is important in living organisms for the production of amino acids (proteins) and nucleic acids.
    Carbon is important in living organisms for the production carbohydrates and lipids.
    Water is important in living organisms for the maintaining homeostasis in cells.

11. Why is **nitrogen fixation** such an important part of the Nitrogen Cycle? What organisms perform this task? What macromolecules and characteristics of life is Nitrogen a part of.

    Atmospheric **Nitrogen** is made available to living organisms by bacteria in the soil that perform **nitrogen-fixation**.

12. Describe the following terms: <u>Transpiration</u>, <u>Combustion</u>, <u>Precipitation</u>, <u>Respiration</u>, <u>Photosynthesis</u>.

Carbon cycles from the atmosphere (in the form of CO_2) into living things through the process of **photosynthesis**. Carbon is returned to the atmosphere through **cellular respiration** and **combustion** of fossil fuels.
Water in the atmosphere is made available to living organisms through **precipitation**. Water returns to the atmosphere through plants by **transpiration** and off of the surface of bodies of water through **evaporation**.

13. Explain how the following affect the population of a species. <u>Immigration</u>, <u>Emigration</u>, <u>birth rate</u>, <u>death rate</u>.
Immigration and birth rates are a measure of individuals entering a population. Emigration and death rates are a measure of individuals leaving a population. If the number of individuals entering the population is greater than the number of individuals leaving the population, then the population is growing/increasing and vise versa.

14. Describe how the <u>greenhouse effect</u> works and identify two major <u>greenhouse gases</u>.
Greenhouse gases trap heat in the lower atmosphere, which increases the temperature. Examples of GHGs are carbon dioxide and methane.

15. Identify three ways in which human activities are affect the <u>global climate</u>.
Combustion of fossil fuels, agriculture & raising livestock, landfills all increase the amount of greenhouse gases released into the atmosphere.

16. What are the two main types of <u>succession</u>? Describe how each succession takes place.
Ecological succession describes how an ecosystem is re-established after a major catastrophe. Some common causes of ecological succession are volcanoes, glacier movement, forest fires, tsunamis, and urban development.
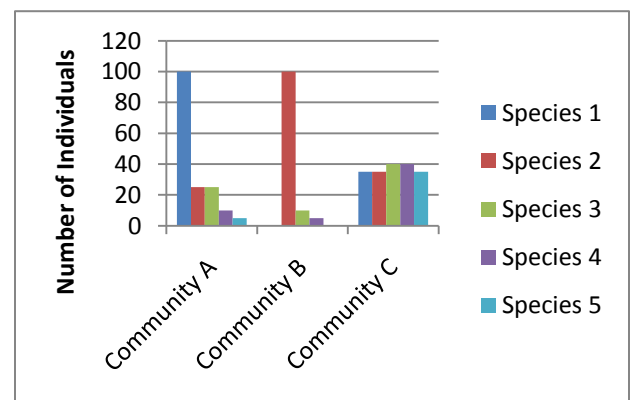The stages of ecological succession are:
1. the establishment of photosynthetic microorganisms that build up soil (in primary succession only)
2. the establishment and growth of lichens & mosses
3. the establishment and growth of small shrubs and trees
4. the establishment and growth of large trees
Primary succession occurs when the soil has been washed away or destroyed where as secondary succession occurs when the soil has not been disturbed, but the producers have all been removed.

17. Define biodiversity and explain why <u>biodiversity</u> is important in an ecological community.
Biodiversity is measured by species richness (how many different species there are) and species abundance (how many individuals of each species there are). Diversity is important to an ecological community because it ensures that the food web remains stable and organisms have multiple sources of food and other resources.

18. Compare the three communities in the chart. Identify which community is more diverse in terms of <u>species richness</u> and <u>species evenness</u>.
Communities A & C have equal specie richness (5 species each), but Community C has higher species evenness (number of individuals of each species). Community C would be considered to have the highest biodiversity. Community B has the lowest biodiversity because it has fewer total species and is not even.

19. List and describe six ways in which <u>humans impact</u> the environment and biodiversity.
Habitat destruction (eliminating or reducing habitats)
Introduction of Invasive species (which out compete, predate upon or bring in disease which eliminate native species)

Pollution (can directly affect the health of the organisms)
Population of Humans (as our population increases, our use of resources and space increases)
Climate change (affects the ability of organisms to survive in current habitats, can reduce the amount of producers and can affect the nutrient cycles)
Overexploitation or overhunting (reducing natural populations to unsustainable sizes, putting them at risk of extinction)

20. Describe each of the 5 major <u>species interactions</u>
    a. <u>Predation</u> – Predator eats prey (+/-)

    b. <u>Parasitism</u> – Parasite feeds on host (+/-)

    c. <u>Competition</u> – Species compete for resources (-/-)

    d. <u>Mutualism</u> – Both species benefit (+/+)

    e. <u>Commensalism</u> – One species benefits, but has no affect on the other species (+/0)

21. Identify the difference between <u>individual</u> and <u>group behavior</u>. Give an example of group behavior and explain how this sort of behavior may benefit the species.
    Individual behavior – the behavior of a single organism
    Group behavior – the collective behavior of a group of organisms
        Examples: Herding, Flocking, Swarming, Schooling, Hunting in packs, etc
    Benefits of group behavior – protection from predators & the environment, better access to mates, defense of a common resource, division of labor