COLUMBUS STATE COMMUNITY COLLEGE

ESSH 1101 - Introduction to Environmental Science, Safety & Health

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Homework 3 – Ecosystems

Environmental Science, 16th Ed. by Tyler and Spoolman - Sec. 2.4, Chapters 3 & 5

1. Distinguish between a *positive feedback loop* and a *negative feedback loop*. Provide examples of each.

   A **positive feedback loop causes a system to change in the same direction** while a **negative feedback loop cause the system to do the converse and go in the opposite direction**.
   - **An example of a positive feedback loop would be the removal of stabilizing vegetation along the banks of a stream or creek**.
     - Erosion from precipitation will cause additional plant loss as well as nutrient and soil loss. Too much of a positive feedback look will cause an ecological tipping point.
   - **An example of a negative feedback loop would be a thermostat**.
     - By measuring the ambient temperature within the home, the system is programed to initiate the furnace or the air conditioner until the desired temperature is achieved once more.

2. What three interconnected factors sustain life on the Earth?

   The **three interconnected factors that sustain life on Earth** are:
   - One-way flow of high-quality energy from the sun
   - Cycling of nutrients through parts of the biosphere
   - Gravity, which allows Earth to hold onto its atmosphere and enables the movement and cycling of chemicals through the air, water, soil, and organisms

3. Distinguish between the *living* and *nonliving components* in ecosystems. Give two examples of each.

   Living components in an ecosystem (biotic) **are organisms that are classified as either produces or consumers**. **Nonliving components** in an ecosystem (abiotic) **are elements/features** within an ecosystem **that do not produce or consume**.
   - **Examples of living components** in an ecosystem include:
     - **Plants, animals, and microbes**.
   - **Examples of nonliving components** in an ecosystem include:
     - **Water, air, nutrients, rocks, heat, and solar energy**.

4. What is a *trophic level*? Distinguish among *producers, consumers, decomposers* and *detritus feeders*.

   The trophic level, also referred to as the feeding level, **is a level assigned to organisms** (living components) **in an ecosystem based on its source of nutrients**.

   - **Producers are organisms that use the environment around them to collect nutrients and energy**.
     - As an example, in a process called photosynthesis, green plants capture solar energy and combine carbon dioxide with water to form carbohydrates, which they store as energy. The byproduct of this process is oxygen.
   - **Consumers can be herbivores** (primary consumers), **carnivores** (secondary and tertiary consumers), or **omnivores** (primary, secondary, and tertiary consumers) **and are defined by the fact that they cannot produce their own food**.
     - An example would be the zebra eating the grass then the lion eating the zebra
   - **Decomposers are also consumers but they get their nutrients by breaking down** (decomposing) **the wastes or remains of plants or animals**. The process or decomposition returns the nutrients the air, soil, and water (non-living components) for reuse by producers.
     - Most decomposers are bacteria and fungi
   - **Detritus Feeders** (detritivores) **get their nutrients by feeding on the wastes or dead bodies** (detritus) **of other organisms**.
     - Examples would be earthworms, some soil insects, hyenas, and vultures.

5. Explain the role *microbes* play in the cycling of nutrients. In which two soil horizons does decomposition of organic matter mostly happen?

   - Microbes play a vital role to humans as they serve several purposes:
     - Healthy bacteria break down food as it traverses our intestinal tract
     - Microbes in our nose prevent harmful bacteria from reaching our lungs
   - The **role microbes play in the cycling of nutrients** include the following functions:
     - Microbes help purify water by breaking down plant matter and animal waste
     - Bacteria and fungi in the soil decompose organic waste into nutrients
   - The **decomposition of organic matter takes place in the "A" and "O" horizons**.

6. Define and distinguish between a *food chain* and a *food web*.

    - A **food chain is a sequence of organisms with each serving as a source of nutrients or energy for the next level** of organisms.
    - A **complex network of interconnected food chains is called a food web**.
        - In an ecosystem, most consumers feed on more than one type of organism AND most organisms are eaten or decomposed by more than one type of consumer. This is what forms the complex network of interconnected food chains called a food web.

7. Why does the *energy content* decrease at each higher level of a food chain? What happens to the energy lost at each level?

    - **Energy content decreases as it progresses up the food chain due to net primary productivity (NPP)**, which is the rate that an ecosystem's producers convert solar energy to chemical energy minus the rate they use some of the stored chemical energy through aerobic respiration.
    - The **energy lost is through low-quality heat, which is released back into the ecosystem**.

8. Provide at least two examples of how humans often alter the natural hydrologic cycle.

    Humans alter the hydrologic cycle by:
    1. **Withdrawing water from fresh water sources** faster than it can be replenished
    2. **Clear vegetation for agriculture, mining, and roads**, which increases runoff and reduces infiltration for groundwater recharging
    3. **Draining and filling wetlands** which reduces natural flood control abatement

9. What is the percentage of *nitrogen gas* (N_2) in the ambient atmosphere? What organisms are responsible for taking nitrogen from the atmosphere and converting it to a form usable by plants?

    - The **ambient atmosphere contains 78% nitrogen** and 21% oxygen.
    - The **atmospheric nitrogen must be 'converted' by electrical storms and by specialized bacteria in topsoil**.
    - Once converted, producers can then use the nitrogen

10. Define and give an example of *interspecific competition*.

    - **Interspecific competition is when two or species attempt to use the same limited resources** of an ecosystem.
    - An **example of interspecific competition would be the coyote and the wolf**.

11. Define *parasitism, mutualism* and *commensalism*, and given an example of each.

    - **Parasitism occurs when one species lives on or in another** organism
        - An example would be a tapeworm
    - **Mutualism occurs when two species behave in ways that benefit both** by providing each with food, shelter, or some other resource
        - An example would be pollination of flowers by bees
    - **Commensalism is an interaction between one species that has little, if any, beneficial of harmful effect** on another species
        - An example would be birds nesting in trees

12. Distinguish between *primary ecological succession* and *secondary ecological succession* and give an example of each.

    - **Primary ecological succession involves the gradual establishment of communities** of different species
        - An example would be bare being exposed by a retreating glacier
    - **Secondary ecological succession involves a community or ecosystem developing on the site of an existing community** or system
        - An example would be abandoned farmland

13. Define the term *limiting factor* and given an example.

    - **Limiting factors are a set of conditions whereby a certain species can survive**
        - An example would be the water temperature in a stream or creek where trout are present. Too hot or too cold and the fish die.

14. Describe the factors that affect the *carrying capacity* of a habitat or ecosystem.

    Carrying capacity is the combined effect of limiting factors that ultimately determines an ecosystems maximum population for a given species that can be sustain indefinitely.