Name_____Date_____Hour_____

Virtual Lab Model Ecosystems

How does energy flow through an ecosystem?

An **ecosystem** consists of a community of living organisms interacting with each other and the environment. The source of energy that fuels most ecosystems is the Sun. Plants use the Sun's energy to produce food in a process called photosynthesis. Organisms that use energy from the Sun or energy stored in chemical compounds to produce their own nutrients are called **autotrophs**. They are also called producers because most other organisms depend on autotrophs for nutrients and energy. **Heterotrophic organisms** that cannot make their own food may obtain nutrients by eating other organisms. A heterotroph that feeds only on plants is called an herbivore. Herbivores are also called first order heterotrophs. Carnivores that feed on herbivores are called second order heterotrophs. Carnivores that feed on other carnivores are called third order heterotrophs. A **food chain** is a simple model of how energy and matter move through an ecosystem.

Each level of production and consumption in a food chain is a **trophic level**. The autotrophs form the first trophic level, first order heterotrophs (herbivores) constitute the second trophic level, second order heterotrophs the third trophic level, and third order heterotrophs are layered on top.

In the pyramid of energy, the energy moves in only one direction and decreases at each succeeding trophic level. The total energy transfer from one trophic level to the next is, in general, only about ten percent or less. This is called the energy conversion efficiency. Organisms fail to capture and eat all the food available at the trophic level below them. The food consumers ingest is used to metabolize and build body tissues. Some food is given off as waste. The energy lost at each trophic level enters the environment as heat.

A pyramid of biomass expresses the weight of living material at each trophic level. Biomass is calculated by finding the average weight of each species at that trophic level and multiplying the weight by the estimated number of organisms in each population. In terrestrial ecosystems, biomass decreases as the trophic level increases. In contrast to terrestrial ecosystems, freshwater and marine ecosystems have less primary producer biomass than biomass present at higher trophic levels, leading to an inverted biomass pyramid. This is because algae and phytoplankton have a shorter lifespan, are more edible than terrestrial plants, and are more rapidly grazed. Their biomass does not accumulate.

In this exploration, you will study and analyze five simplified model ecosystems: a deciduous forest, a hot desert, a freshwater lake, grassland, and an Antarctic ocean shore. Many more plant and animal species would be involved in a real-world ecosystem. The field notes for each model ecosystem present a profile of the plant and animal inventory for each ecosystem.

Pre-Lab Questions

1. Give an example of an autotroph. Give an example of a heterotroph.

2. What is a food chain? Give an example of a simple food chain.

3. What is a trophic level?

Procedure

1. Login to your connected account, find the virtual lab for chapter 2 section 1. Open the resource.
2. Make sure the dropdown menu at the top of the resource says Deciduous Forest Ecosystem.
3. Select the icon next to the animals' and plants' names from the Field Notes tablet and drag and drop them to the appropriate trophic level in the ecosystem pyramid.
4. Once you have placed all the organisms into the pyramid click the Check button.
    a. For each accurate placement, the names of the animals are replaced with pictures and the number of each kind of animal is displayed beneath it.
5. Fix any mistakes, and continue to check until you have correctly placed every animal into the pyramid.
6. Click the button that says, “Pyramid of numbers”, and fill in the appropriate row of the data table.
7. Look at the pyramid, list possible food chain that exists the ecosystem.
8. Select the next ecosystem from the dropdown at the top, and repeat steps 3-7, until you have completed the data table for all ecosystems.

Data Table

Ecosystems	Producers	First Order Heterotrophs	Second Order Heterotrophs	Third Order Heterotrophs
Deciduous Forest				
Example Food Chain				
Hot Desert				
Example Food Chain				
Grassland				
Example Food Chain				
Antarctic Ocean Shore				
Example Food Chain				
Fresh Water Lake				
Example Food Chain				

Analysis Questions

1. What happens to the number of organisms as we move up the pyramids in each of the ecosystems? What does this tell you about the available energy from each level?

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2. Which type of organisms are not shown in the pyramids? What job do these organisms perform for the ecosystem? What would happen if these organisms disappeared.

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3. What might happen to the deciduous pyramid if most of the deer were killed due to hunting by people and disease?

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4. What's a herbivore? Choose an ecosystem that we studied, give an example of a 1st order heterotroph (herbivore).

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5. What is a carnivore? Choose an ecosystem that we studied, give an example of a 2nd order heterotroph, and a 3rd order heterotroph that belong in this ecosystem.

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