UNIT 5: ECOLOGY
Chapter 13: The Principles of Ecology
I. Ecologists Study Relationships (13.1)
   A. Ecologists study environments at different levels of organization
      1. **Ecology** - study of the interactions among living things and their surrounding. Name comes from Greek work “oikos” - meaning “house”.

   2. **Levels of organization** - biologist study nature on different levels, from a local to global scale
      a. **Organism** - an individual living thing.

   b. **Population** - group of the same species that lives in one area
   c. **Community** - group of different species that live together in one area
   d. **Ecosystem** - includes all organisms as well as the climate, soil, water, rocks, and other non-living things in a given area.
e. **Biome** - major regional or global community of organisms characterized by climate conditions and plant communities that thrive there.

B. Ecological research methods include observations, experimentation, and modeling

1. **Observation** - the act of carefully watching something over time.
   a. May be **long** term or **short** term studies
   b. **Surveys** are used to monitor and observe populations

2. **Experimentation** - may perform experiments in the lab or in the field
   a. **Lab experiments** give researcher more control, but artificial setting does not reflect complex interactions that occur in nature.
   b. **Field experiments** gives more accurate picture but is more difficult because of numerous factors at work in nature.

**II. Biotic and Abiotic Factors (13.2)**

A. An ecosystem includes both biotic and abiotic factors

1. **Biotic** - includes living things
2. **Abiotic** - includes nonliving things such as moisture, temperature, wind, sunlight, and soil

**c. Modeling** - use of computer or mathematical models to describe and model nature based on real data.

1). Can see how one variable affects another
2). Can create **virtual ecosystem**
B. Changing one factor in an ecosystem can affect many other factors

1. **Biodiversity** - the assortment, or variety, of living things in an ecosystem
   a. amount depends on many factors
   b. **tropical rainforests** have large biodiversity

2. **Keystone species** - a species that has an unusually large effect on its ecosystem
   a. loss of this species may cause *ripple effect* felt across entire ecosystem

b. Example - **beaver** changes habitat for many other species by creating ponds

III. Energy in Ecosystems (13.3)

A. Producers provide energy for other organisms in an ecosystem

1. **Producer (autotroph)** - get their energy from nonliving resources (make their own food)

2. **Consumer (heterotroph)** - get their energy by eating other living things such as plants and animals

B. Almost all producers obtain energy from **sunlight**

1. Most producers on Earth use **sunlight** as energy source using **photosynthesis**.
2. **photosynthesis** converts light energy (**sunlight**) into chemical energy (**carbohydrates**).
C. **Chemosynthesis** - organisms make carbohydrates using **chemicals** instead of sunlight

1. Found in **deep-sea thermal vents** and sulfur-rich marsh flats and hydrothermal pools
2. Can be basis for thriving ecosystems

IV. Food Chains and Food Webs (13.4)

A. **Food chain** - sequence that links species by their feeding relationships.
   1. Only follows connections between one producer and **single chain** of consumers
   2. Simplest way to look at energy flow in an ecosystem

B. **Types of consumers**
   1. **Herbivores** - eat only plants
   2. **Carnivores** - eat only animals
   3. **Omnivores** - eat both plant and animals
   4. **Detritivores** - organisms that eat detritus (dead organic matter)
   5. **Decomposers** - break down organic matter into simpler compounds

   a. **Fungi** and **bacteria**
   b. Important to stability of ecosystem by returning **nutrients** back into the environment

6. Organism may focus on single organism to feed (specialist), or have varying diet (generalist)
C. **Trophic levels** - level in a food chain

1. **Producers** - always first level
2. **Primary consumers** - next level (herbivore)
3. **Secondary consumer** - eat herbivores (carnivore)
4. **Tertiary consumer** - carnivores that eat secondary consumers.

D. **A food web** shows a complex network of feeding relationships

1. **Food web** - organism may have multiple feeding relationships.
2. Stability of food web depends on presence of **producers** (forms base of food web)

V. **Cycling of Matter (13.5)**

A. **Hydrologic cycle** (water cycle) - circular pathway of water on Earth

1. Flows from atmosphere to the surface, below ground and back and involves humans and other organisms.

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B. Elements essential for life also cycle through ecosystems

1. **Biogeochemical cycles** - movement of a particular chemical through biological and geological parts of an ecosystem
   
   a. **Oxygen cycle** - cycle of photosynthesis and cellular respiration

b. **Carbon cycle** - flow of carbon through environment

1. **Carbon** essential for organic compounds (carbohydrates, proteins, fats, etc.)

2. Simplest transfer occurs between plants and animals (photosynthesis and cellular respiration)
c. **Nitrogen cycle** - conversion of nitrogen gas in atmosphere into compounds that living things can utilize

1. **Nitrogen fixation** - converting gaseous nitrogen into ammonia (NH₃) (used by certain bacteria)
2. **Denitrifying bacteria** - convert nitrogen compounds back to nitrogen gas

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**d. Phosphorus cycle** - returns phosphorus to environment (phosphorus is limiting factor for plant growth)

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**VI. Pyramid Models (13.6)**

A. An energy pyramid shows the distribution of energy among trophic levels
   1. Ecosystems get energy from **sunlight**
   2. Some energy is **lost** along the way as heat

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B. Loss of available energy
   1. Energy used for many purposes such as **movement** and **growth**.
   2. Your body very **inefficient** at converting food into useful energy
   3. Unused material excreted as **waste**

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4. **Biomass** - measure of total dry mass of organisms in given area
   a. When consumer eats producer great deal of energy lost in process as **heat** and **waste**
   b. Only 10% of energy is transferred at each trophic level
C. **Energy Pyramid** - diagram that compares energy used by each trophic level
   1. Base made up of producers
   2. Energy lost to each succeeding trophic level

D. Other pyramid models illustrate an ecosystem's biomass and distribution of organisms
   1. **Biomass pyramid** - diagram comparing biomass of different trophic levels within an ecosystem
   2. **Pyramid of Numbers** - shows the numbers of individual organisms

3. Both types of pyramids may occur in an inverted, or upside down, formation (e.g., pyramid of numbers based on single tree)

**Review Quiz**

Chapter 13

**The Principles of Ecology**

The branch of biology dealing with interactions among organisms and between organisms and their environment is called
a. economy.
b. modeling.
c. recycling.
d. ecology.

The part of Earth in which all living things exist is called the
a. biome.
b. community.
c. ecosystem.
d. biosphere.
All of the members of a particular species that live in one area are called a(an)

a. biome.
b. population.
c. community.
d. ecosystem.

Green plants are

a. producers.
b. consumers.
c. herbivores.
d. omnivores.

What is the original source of almost all the energy in most ecosystems?

a. carbohydrates
b. sunlight
c. water
d. carbon

The algae at the beginning of the food chain in Figure 3-1 are

a. consumers.
b. decomposers.
c. producers.
d. heterotrophs.

An organism that produces its own food supply from inorganic compounds is called a(an)

a. heterotroph.
b. consumer.
c. detritivore.
d. autotroph.

Which of the following organisms does NOT require sunlight to live?

a. chemosynthetic bacteria
b. algae
c. trees
d. photosynthetic bacteria
An organism that cannot make its own food is called a(an)

a. heterotroph.
b. chemotroph.
c. autotroph.
d. producer.

In which way are green plants in a sunny mountain meadow and sulfur bacteria in a deep-sea volcanic vent alike?

a. They both use photosynthesis to make their own food.
b. They both produce carbohydrates and oxygen.
c. They both use chemosynthesis to produce their own food.
d. They both produce carbon and hydrogen.

Organisms that break down and feed on wastes and dead organisms are called

a. decomposers.
b. omnivores.
c. autotrophs.
d. producers.

What is an organism that feeds only on plants called?

a. carnivore
b. herbivore
c. omnivore
d. detritivore

All the interconnected feeding relationships in an ecosystem make up a food

a. interaction.
b. chain.
c. network.
d. web.

The total amount of tissue of all the organisms in a food chain is called the

a. organic mass.
b. trophic mass.
c. energy mass.
d. biomass.
What is an ecological model of the relationships that form a network of complex interactions among organisms in a community from producers to decomposers?

a. food web
b. an ecosystem
c. food chain
d. a population

What animals eat both producers and consumers?

a. herbivores
b. omnivores
c. chemotrophs
d. autotrophs

What is the term for each step in the transfer of energy and matter within a biological community?

a. energy path
b. food web
c. trophic level
d. food pyramid

A bird stalks, kills, and then eats an insect. Based on its behavior, which ecological terms describe the bird?

a. herbivore, decomposer
b. producer, heterotroph
c. carnivore, consumer
d. autotroph, herbivore

A snake that eats a frog that has eaten an insect that fed on a plant is a

a. first-level producer.
b. first-level consumer.
c. second-level producer.
d. third-level consumer.

Only 10 percent of the energy stored in an organism can be passed on to the next trophic level. Of the remaining energy, some is used for the organism’s life processes, and the rest is

a. used in reproduction.
b. stored as body tissue.
c. stored as fat.
d. eliminated as heat.
Which type of pyramid shows the amount of living tissue at each trophic level in an ecosystem?

a. a numbers pyramid  
b. an energy pyramid  
c. a biomass pyramid  
d. a food pyramid  

The repeated movement of water between Earth's surface and the atmosphere is called

a. the water cycle.  
b. the condensation cycle.  
c. precipitation.  
d. evaporation.  

Which of the following is NOT recycled in the biosphere?

a. water  
b. nitrogen  
c. carbon  
d. energy  

What is the process by which organisms convert nitrogen gas in the air to ammonia?

a. nitrogen fixation  
b. excretion  
c. decomposition  
d. denitrification  

How is carbon stored in the biosphere?

a. in the atmosphere as carbon dioxide  
b. underground as fossil fuels and calcium carbonate rock  
c. in the oceans as dissolved carbon dioxide  
d. all of the above  

Nitrogen fixation is carried out primarily by

a. humans.  
b. plants.  
c. bacteria.  
d. ammonia.
Which of the following has a direct role in the nitrogen cycle?

a. bacteria
b. legumes
c. decomposers
d. all of the above

Biogeochemical cycling ensures that
a. human activity will have no effect on them.
b. cells well not become limited in any one nutrient.
c. nutrients will not become scarce in any part of the biosphere.
d. many nutrients will not reach toxic concentrations in the biosphere.

The event that can occur after a lake receives a large input of a limiting nutrient is
a. an algal bloom.
b. algae begin to die and decomposers take over.
c. nitrogen compounds are recycled.
d. the concentration of oxygen drops below the necessary level.

Which is most likely to be a limiting nutrient in a freshwater pond?

a. phosphorus
b. nitrogen
c. carbon
d. potassium

If a nutrient is in such short supply in an ecosystem that it affects an animal's growth, the
a. animal becomes a decomposer.
b. substance is a limiting nutrient.
c. nutrient leaves the food chain.
d. ecosystem will not survive.

Levels of Organization

Objective: Students will design poster showing the different examples of the six levels of organization

Time: 30 minutes

Procedure:
1. Form groups of 4 students per group
2. Obtain poster board or newsprint to draw poster. You may use markers, crayons, or colored pencils to design your poster
3. Study Figure #21 (page 64) showing 6 levels of organization in the biosphere
4. The teacher will give each group a different biome to focus on.
5. Design and draw an illustration showing different examples of Levels of Organization
6. Display posters and present to class