Chapter 12 & 13

Interactions of life
The Nonliving Environment

BIOSPHERE

- Biosphere - the part of the Earth that supports life. This includes the top portion of Earth's crust, all the waters that cover Earth's surface, and the atmosphere that surrounds Earth.
- Environments found in the biosphere:
  - Deserts receive little rain
  - Tropical rain forest receive plenty of rain & warm weather.
  - Coral reefs form in warm, shallow ocean waters.
  - Arctic regions near the north pole are covered with ice and snow.
- Earth is the 3rd planet from the Sun and the amount of energy Earth receives from the Sun helps make the temperature just right for life.

ECOSYSTEMS

- An ecosystem consists of all the organisms living in an area and the nonliving features of their environment. Example: prairie
  - Biotic factors - grass bison, cowbirds, insects
  - Abiotic factors - water, temperature, sunlight, soil, air
- Biotic factors are the features of the environment that are alive or were once alive. (Ex. grass, birds, insects, etc.)
- Abiotic factors are the nonliving, physical features of the environment. (Ex. air, water, sunlight, soil, temperature, and climate)
- Ecology - the study of interactions that occur among organisms & their environment. Ecologists are scientists who study these interactions.

BIOTIC FACTORS

- Biotic means “living” - all biotic factors are living or were once living.
- Relationships among living things are an important part of every ecosystem. How organisms interact with each other and their environment determines their survival.

POPULATIONS

- A population is made up of all the organisms in an ecosystem that belong to the same species.
- A community refers to all the populations in an ecosystem. Ex. Prairie has several populations - bison, grasshopper, cowbirds, etc.

Organisms & their Environment

- The place in which an organism lives is called an organism's habitat. Ex. Woodpeckers live in a forest ecosystem & trees are their habitat.
  - An organism's habitat provides the kinds of food and shelter, the temperature, and the amount of moisture the organism needs to survive.
- A niche refers to how an organism survives, how it obtains food and shelter, how it finds a mate and cares for its young, and how it avoids danger. Special adaptations that improve the survival of an organisms are often part of their niche. Ex. milkweed

- Organisms can share the same habitat, but NOT the same niche.

Habitat -vs Niche

- Why can organisms share the same habitat, but not the same niche??
  - To share the same niche creates competition and eventually one species will be successful over the other. Example: Termites, ants, millipedes, centipedes, spiders, and worms may all live on the same decaying log (habitat), but they do not compete with each other because each one has different requirements for their survival (niche).

Factors that affect Populations

- Competition - occurs when two or more organisms seek the same resource at the same time.
- Population Density - size of population that occupies a specific area.
  - Limiting factors
  - Carrying capacity
  - Biotic potential
- Birth Rate/ Death Rate

Competition

- Competition occurs when two or more organisms seek the same resource at the same time.
- Organisms compete for food, living space, mates, and other resources.
- Competition limits population size. - If resources are limited, the growth of the population slows down. When resources are plentiful, the population may grow or increase.

Population Size

- Scientists often measure the size of a population to determine if a population is healthy and growing.
- Population Density - size of population that occupies a specific area.

How do you measure a population?

- Trap-mark-release - ecologists trap the organism, mark the organism, and release back into the environment unharmed. Some will have marks and some will not. By comparing the number marked and unmarked, ecologists can estimate the population size.
- Sample Counts - used if you want to estimate the number of organisms found in a large area. You count the number of organisms found in one acre and multiply that by the total number of acres. Ex. Looking at 100 acres -- count in 1 acre X 100 = approximate #
- Carrying Capacity - largest number of individuals of one species that an ecosystem can support over time. If a population begins to exceed the carrying capacity of the environment, some individuals will not have enough resources to survive -- die or move elsewhere
- Biotic Potential - highest rate of reproduction under ideal conditions. Larger the number of offspring produced, the higher the biotic potential of the species.

Changes in Populations

- Changes in the population size are affected by many factors.
  - Birthrates and death rates
  - Moving around from place to place
  - Exponential growth - larger the population becomes the faster it grows

ABIOTIC FACTORS

- Abiotic factors are the nonliving factors of the environment that many living things need to survive.
  - Air - invisible and plentiful
  - Water
  - Soil
  - Sunlight
  - Temperature
  - Climate

AIR

- The air that surrounds the Earth is called the atmosphere. 78% nitrogen, 21% oxygen, .94% argon, .03% carbon dioxide and trace amounts of other gases
- Carbon dioxide is required for photosynthesis.
- Oxygen is required for respiration to take place.
- Nitrogen is an element that is important to all living things. It is a necessary ingredient in all proteins.

Water

- Water is essential to life on Earth. It is the major ingredient of the cells which make up all living things.
- Most organisms are 50% to 95% water.
- Respiration, digestion, photosynthesis and many other important life processes can only occur in the presence of water.

Soil

- Soil is a mixture of mineral and rock particles, the remains of dead organisms, water, and air.
- Top most layer of the Earth's crust that supports plant growth.
- Soil is considered an abiotic factor, but it does contain the decaying remains of once living organisms.
- The decaying matter is called humus.
- Type of soil in an area influences what type of plant life will grow there. Amount of sand, clay, & humusin the soil.

Sunlight

- Sunlight is the energy source for almost all life on Earth.
- During photosynthesis, producers convert light energy into chemical energy that is used by most living things. This chemical energy is in the form of glucose (sugar) - consumers eat producers or other consumers and this energy is passed on to them for their use.

Temperature

- Temperature is an important abiotic factor.
- Temperature is determined by the amount of sunlight a region receives and the land's latitude and elevation.
- Most organisms can only survive if their body temperature stays within the range of 0˚ to 50˚.
  - Latitude affects temperature. Latitudes closer to equator have warmer temperatures and latitudes farther from the equator have colder temperatures.
  - Elevation or distance above sea level, affects the temperature. At higher elevations the atmosphere is thinner and it is colder. Lower elevations the atmosphere is thicker and it is warmer. It occurs this way due to the fact that the Earth's atmosphere acts as insulation that traps the Sun's heat.

Climate

- Climate refers to an area's average weather conditions over time. For the majority of living things, temperature and precipitation are the two most important components of climate.
  - Wind is the air currents in a region which are determined by heat energy from the Sun.
  - The Rain Shadow Effect occurs when the presence of mountains affect rainfall patterns. As air nears the top of a mountain, it cools. When air cools, the moisture it contains falls in the form of rain or snow. By the time the cool air passes over the mountain, it has lost most of its moisture. The other side of the mountain will not receive as much moisture. Lush and green on one side, desert-like on the other side.

CYCLES OF MATTER

- Matter is anything that has mass and takes up space. Materials cycle through the environment and are reused by different organisms.
  - Water Cycle - describes how water moves from the surface of Earth to the atmosphere and back to the surface again.
  - Nitrogen Cycle - nitrogen is the most plentiful gas in the atmosphere, but most organisms cannot use nitrogen directly (in its purest form) it must be combined with other elements to form a compound.
  - Carbon Cycle - carbon is the element found in all living things. Describes how carbon molecules move between the living and nonliving world.

Water Cycle

- Water cycle is a model that describes how water moves from the surface of Earth to the atmosphere and back to the surface again.
  - Evaporation - takes place when liquid water changes into water vapor, which is a gas, and enters the atmosphere.
  - Transpiration is when water returns to the atmosphere from plant leaves.
  - Water also returns to the atmosphere when animals exhale.
  - Condensation is the process of changing water vapor (gas) to a liquid.
  - Precipitation - when water vapor cools enough to change back to a liquid, condenses on particles of dust in the air, and falls to the ground in the form of rain or other precipitation.
- Water use can reduce the amount of water i the water cycle. This can limit the amount of water available to plants and animals.

Nitrogen Cycle

- Nitrogen is a necessary ingredient in all proteins. Proteins are involved in most reactions that take place in your body.
- Nitrogen is the most plentiful gas in the atmosphere, but most organisms cannot use it in its pure form (element) it must be combined with other elements (compound).
- Nitrogen fixation is the process in which nitrogen is combined with other elements to form compounds that are usable by living things.
- Human activities can affect the part of the nitrogen cycle that takes place in the soil. When we harvest crops, we take away from the environment. Crops that are left to decay in the field, return nitrogen rich compounds to the soil. Fertilizers are used to replace nitrogen removed from the soil. Compost and animal manure can also be used. Another way to return nitrogen to the soil is to plant nitrogen-fixing crops, such as peas, clover, and soybeans. These plants have roots with swollen nodules that contain nitrogen-fixing bacteria. These bacteria supply nitrogen compounds to the plant and add nitrogen compounds to the soil.

Carbon Cycle

- Carbon is the element found in all living things.
- Begins when carbon dioxide is removed from the environment during photosynthesis.

$$\underset{\text{carbon dioxide}}{6CO_2} + \underset{\text{water}}{6H_2O} + \text{light energy} \xrightarrow{\text{chlorophyll}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{oxygen}}{6O_2}$$

- Human activities also release carbon dioxide into the atmosphere. Burning fossil fuels like gasoline, coal, and heating oil made up of the once living things, release carbon dioxide back into the atmosphere.

Relationships Among Organisms

- Many organisms live together and share resources - not all relationships involve food.
- Symbiosis is any close relationship between species.
  - Mutualism is a symbiotic relationship in which both species benefit. Ex. Lichens = alga or cyanobacteria that live within the tissues of a fungus.
  - Commensalism is a symbiotic relationship in which one organism benefits and the other is not affected. Ex. Clown fish and sea anemone - fish is protected by stinging cells of the anemone, but the anemone is not helped or hurt.
  - Parasitism is a symbiotic relationship in which one organism benefits but the other is harmed (host). Ex. Roundworm obtains nutrients & harms its host.

Relationships Among Organisms

- Predator-prey relationship demonstrates which organism hunt others and which ones are hunted. Predators limit the size of prey populations. As a result, food and other resources are less likely to become scarce, and competition between species is reduced.
  - Predators are consumers that capture and eat other consumers.
  - Prey are the organisms that are captured by the predator.
- Cooperation occurs when individual organisms work together in ways that improve survival. Cooperative actions improve survival and are part of a species niche. Ex. A white-tailed deer will alert the other deer to the presence of predators in the area.

Obtaining Energy

- Living things require a constant supply of energy to carry out all of life's processes.
- Most living things rely on the Sun either directly or indirectly for energy.
  - **Photosynthesis** converts light energy into chemical energy that may be used by all living things.

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- **Producers** are organisms that use an outside source like the Sun to make energy - rich molecules (glucose).
- In order to perform photosynthesis a cell must contain chlorophyll - green pigment that is able to trap the Sun's light energy.
- Some organisms are able to make energy-rich molecules without chlorophyll or energy from the Sun - **chemosynthesis**. Use inorganic molecules in the water to create their energy source.

Living Things & Energy

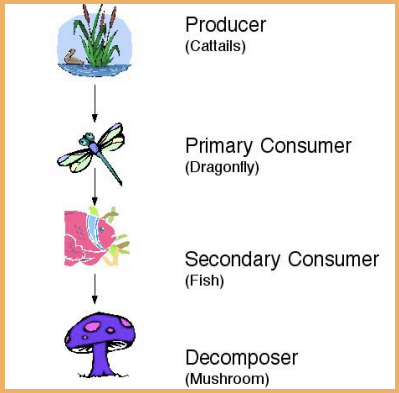
- All the energy in the universe is stored in chemical bonds, when bonds are broken energy is released.
- **Consumers** are organisms that cannot make their own energy-rich molecules (food) and rely on other organisms for their food.
  - **Herbivores** - consumers that eat plants. Ex. rabbits, deer
  - **Carnivores** - consumers that eat other animals. Ex. frogs, lion
  - **Omnivores** - consumers that eat both plants and animals. Ex. humans, pigs
  - **Decomposers** help recycle once-living matter by breaking it down into simple, energy-rich substances. These substances may be used as food for decomposers, be absorbed by plant roots, or be consumed by other organisms.

Energy Transfer Among Organisms

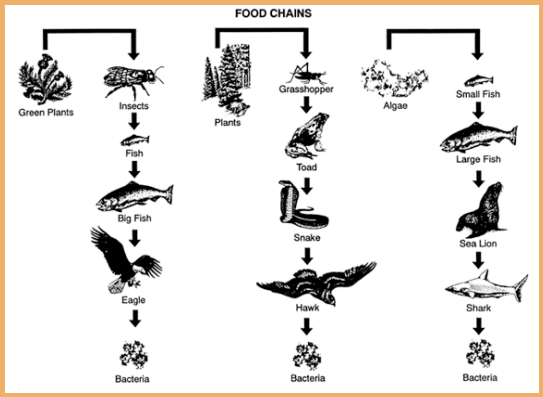
- Energy can be converted from one form to another. It can also be transferred from one organism to another. This occurs throughout nature when one organism becomes food for another organism. Ex. Consumers cannot make their own food, so they obtain energy by eating producers or other consumers.
- All living things are made up of matter (anything that has mass and takes up space). Matter can be recycled over and over, but this requires energy. Energy is not recycled, but converted from one form to another. This conversion of energy is important to all living things on Earth.
- **Food Chain** is a way of showing how matter and energy pass from one organism to another.
  1. Producers - plants, algae & other organisms capable or photosynthesis or chemosynthesis - are always the 1st step in a food chain.
  2. Herbivores - animals that consume producers - are always the 2nd step in food chains.
  3. Carnivores & Omnivores - animals that eat other consumers - 3rd and higher steps in food chains.

Food Chain

Pond Food Chain



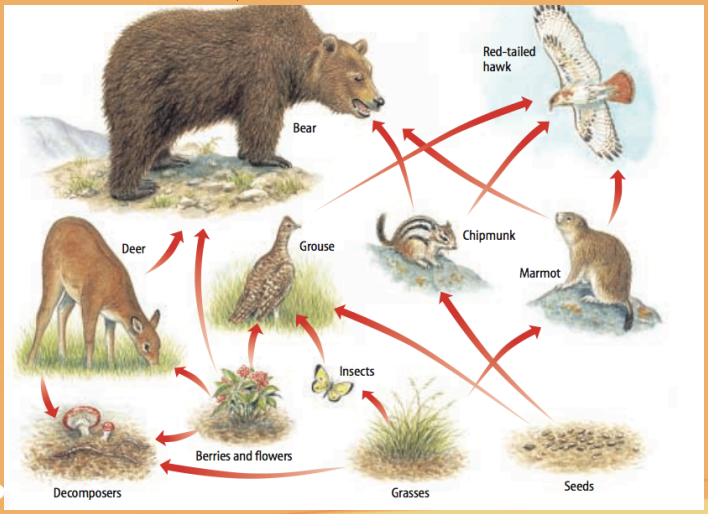
Food Chain


FOOD CHAINS
Green Plants
Insects
Fish
Big Fish
Eagle
Bacteria
Plants
Grasshopper
Toad
Snake
Hawk
Bacteria
Algae
Small Fish
Large Fish
Sea Lion
Shark
Bacteria

Food Web

- A **food web** is a model that shows all the possible feeding relationships (food chains) among the organisms in a community. A food web is made up of many different food chains.

Food Web


Red-tailed hawk
Bear
Deer
Grouse
Chipmunk
Marmot
Insects
Berries and flowers
Decomposers
Grasses
Seeds

Energy Pyramids

- Food chains usually have at least 3 links, but rarely more than 5. This limit exist because the amount of available energy is reduced as you move from one level to the next in a food chain. Each organism in a food chain uses some of the energy it obtains to sustain itself; therefore, not all the energy is available to the organism that consumes that one.
- An energy pyramid shows the amount of energy available at each feeding level in an ecosystem.
  - 1st level = producers & is the largest level - contains the most energy.
  - As you move up the pyramid, each level becomes smaller. Only about 10% of the energy available at each feeding level of an energy pyramid is transferred to the next higher level.

Energy Pyramids