

Chapter 3 The Biosphere

3-1 What is Ecology

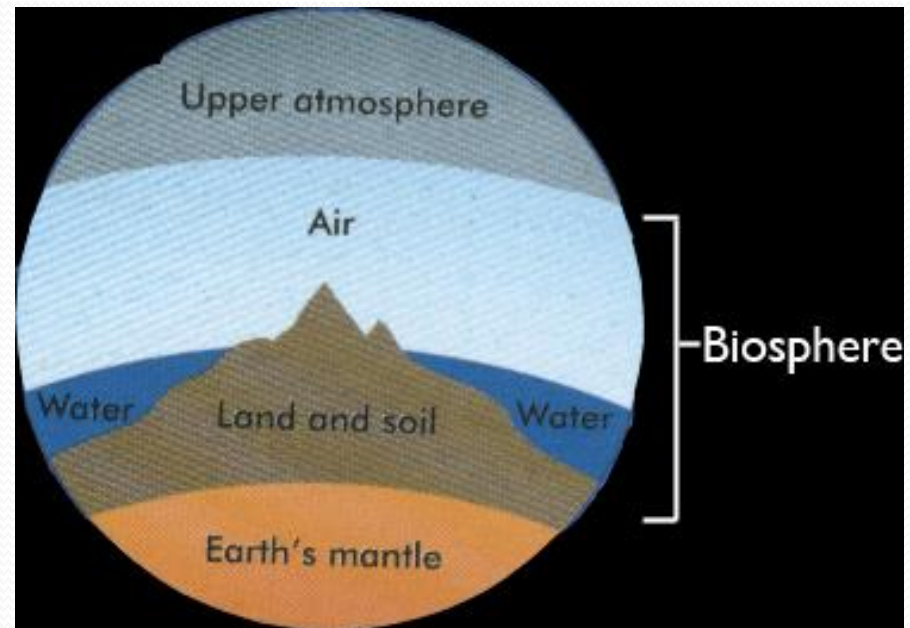
- Ecology is the scientific study of interaction between organisms and between organisms and their environment

3-1 What is Ecology



3-1 What is Ecology

- A biosphere contains the portions of the planet in which life exists; includes land, water and air; Extends 8km above the earth's surface to 11 km below the surface of the ocean



Biosphere 2

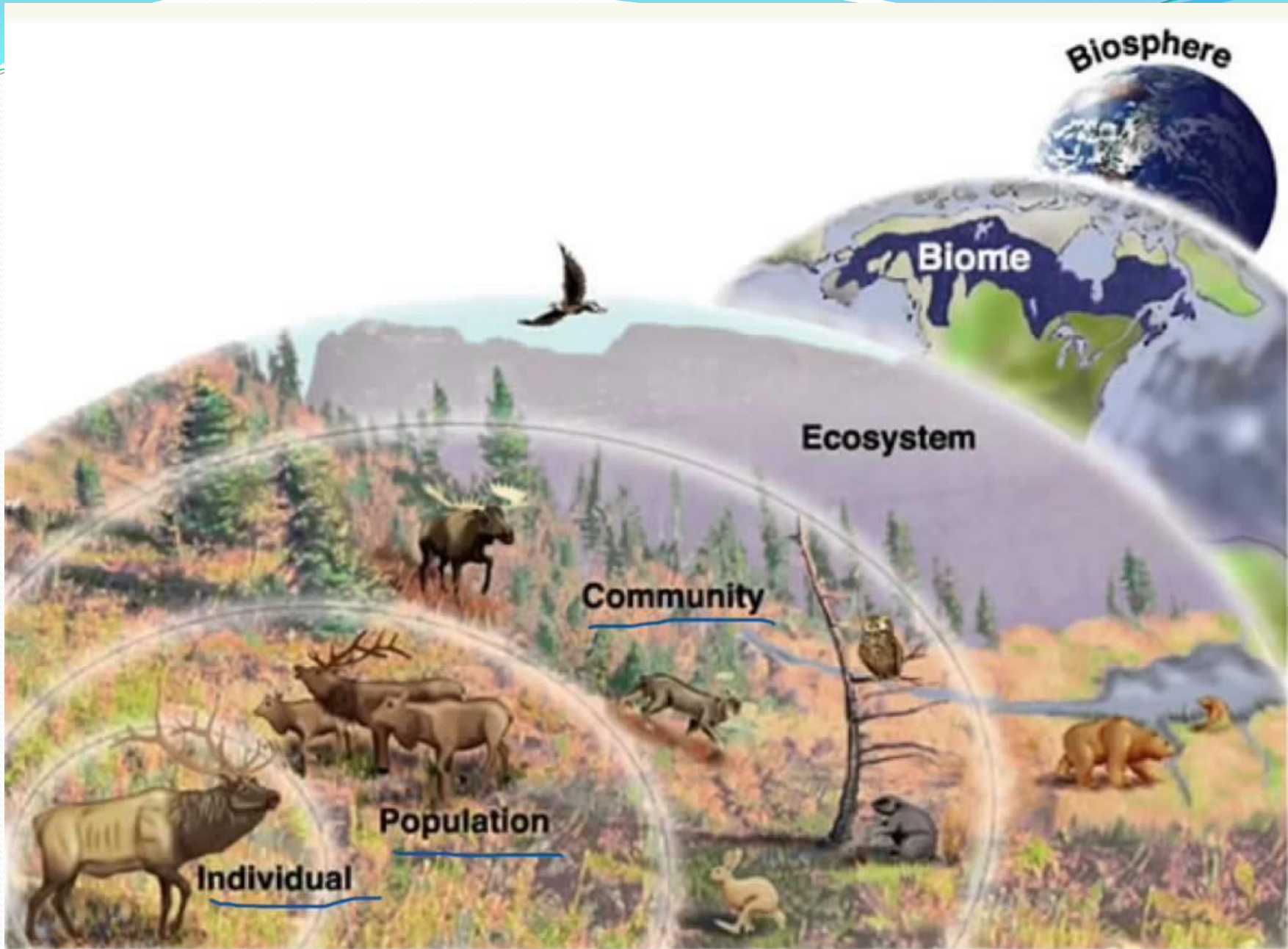


3-1 What is Ecology

- Levels of organization of the biosphere
 - Species-group of organisms that can interbreed because they are so similar to each other
 - Populations-a group of individuals that belong to the same species and live in the same area
 - Communities-a collection of different populations that live together in a defined area
 - Ecosystem-a collection of organisms that live in a particular place together with the non-living environment
 - Biome-a group of ecosystems that have the same climate and similar dominant communities

3-1 What is Ecology

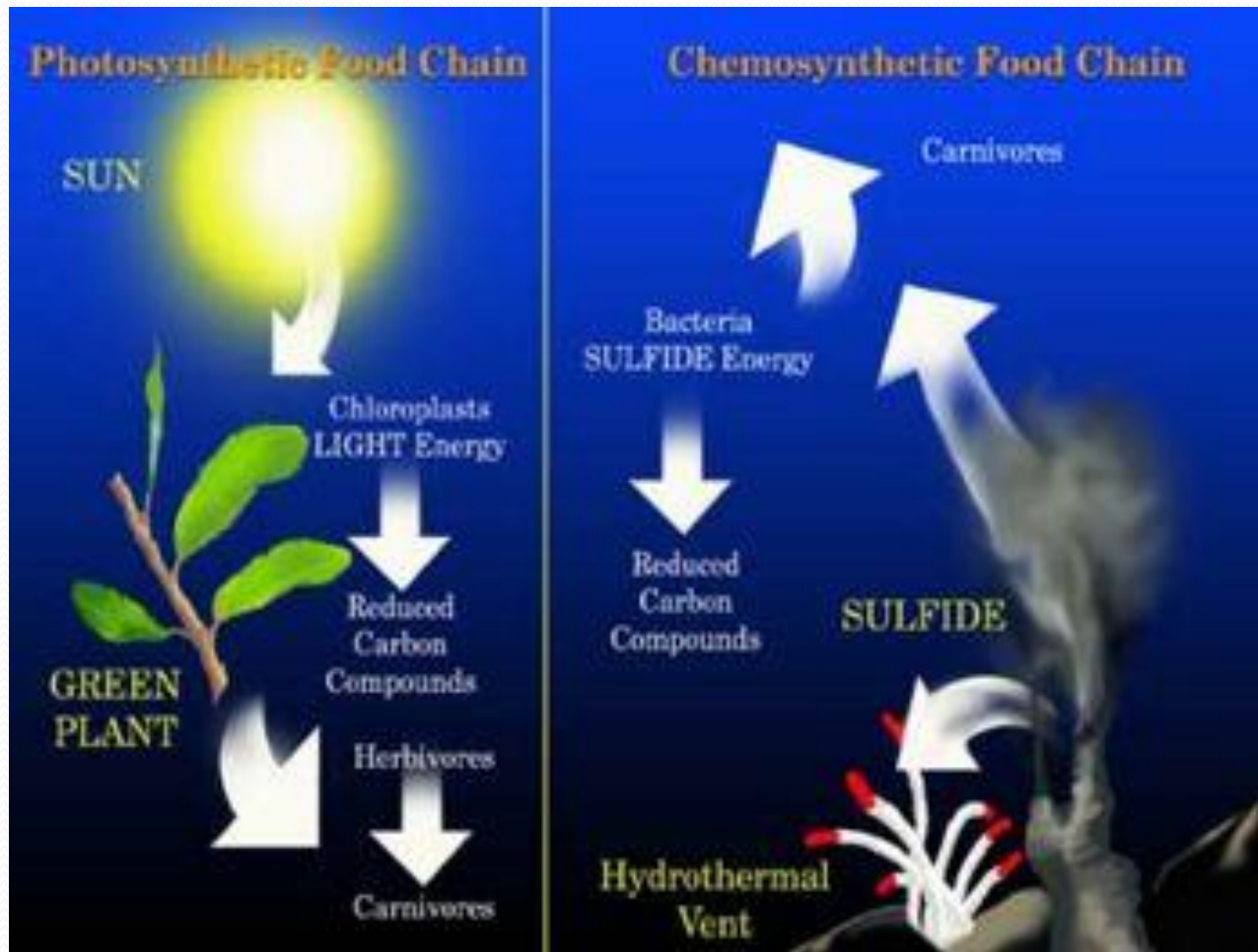
- Ecological methods
- Three approaches:
 - Observing
 - For example, what species live here, how many individuals are there.
 - May be a first step in designing an experiment
 - Experimenting
 - Used to test hypotheses
 - Ecologists may set up an artificial environment in a lab or in a natural ecosystem
 - Modeling
 - Events that occur over a long period of time (a pond turning into a meadow) are difficult to study.
 - Ecologists make models to study things like global warming effects on ecosystems.
 - Many are based on mathematical formulas based on data collected through observation and experimentation



3-2 Energy Flow

- **Producers**
- Sunlight is the main energy source for life on Earth
- Plants, algae and certain bacteria can capture energy from the sun or chemical and are called producers
- In a few ecosystems, some types of organisms rely on stored energy in organic chemical compounds
 - Chemosynthesis-use chemical compounds to produce carbohydrates

3-2 Energy Flow

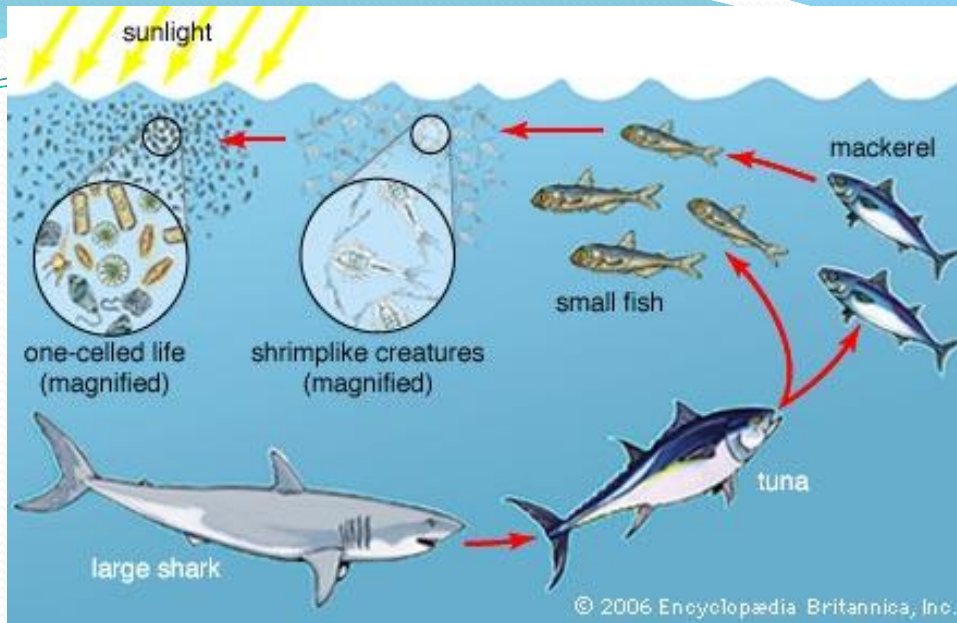


3-2 Energy Flow

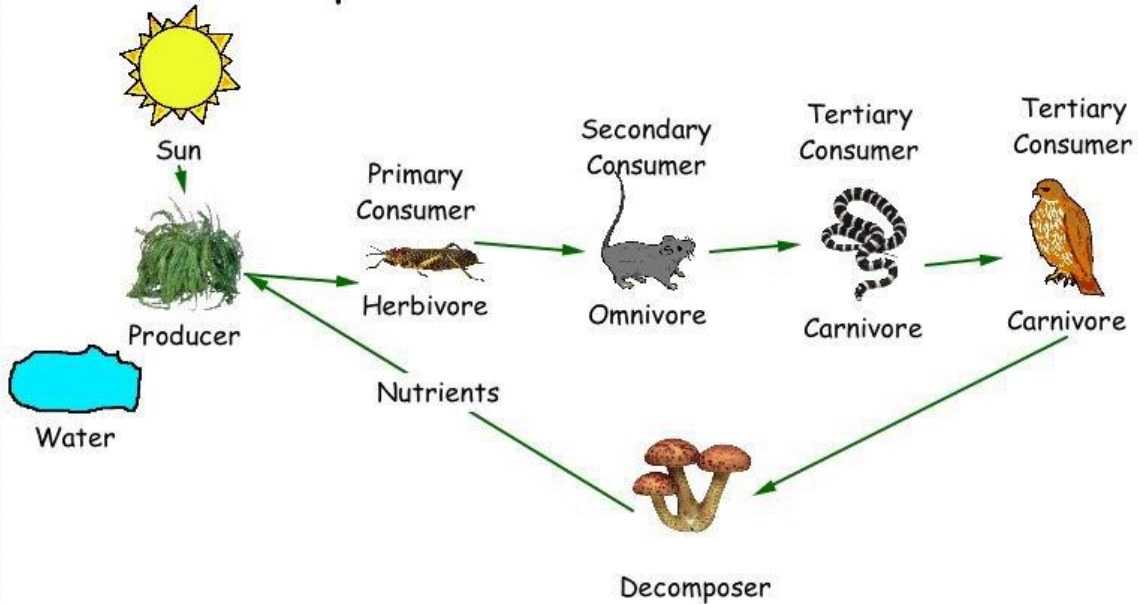
- **Consumers** cannot obtain energy directly from their environment and must consume other organisms for energy
 - Called heterotrophs or consumers
 - Herbivores-eat plants; cows, caterpillars, deer
 - Carnivores-eat animals; humans, dogs, snakes, owls
 - Detritivores-get energy from dead and decaying matter; worms, snails, crabs
 - Decomposers-break down organic matter; bacteria and fungi

3-2 Energy Flow

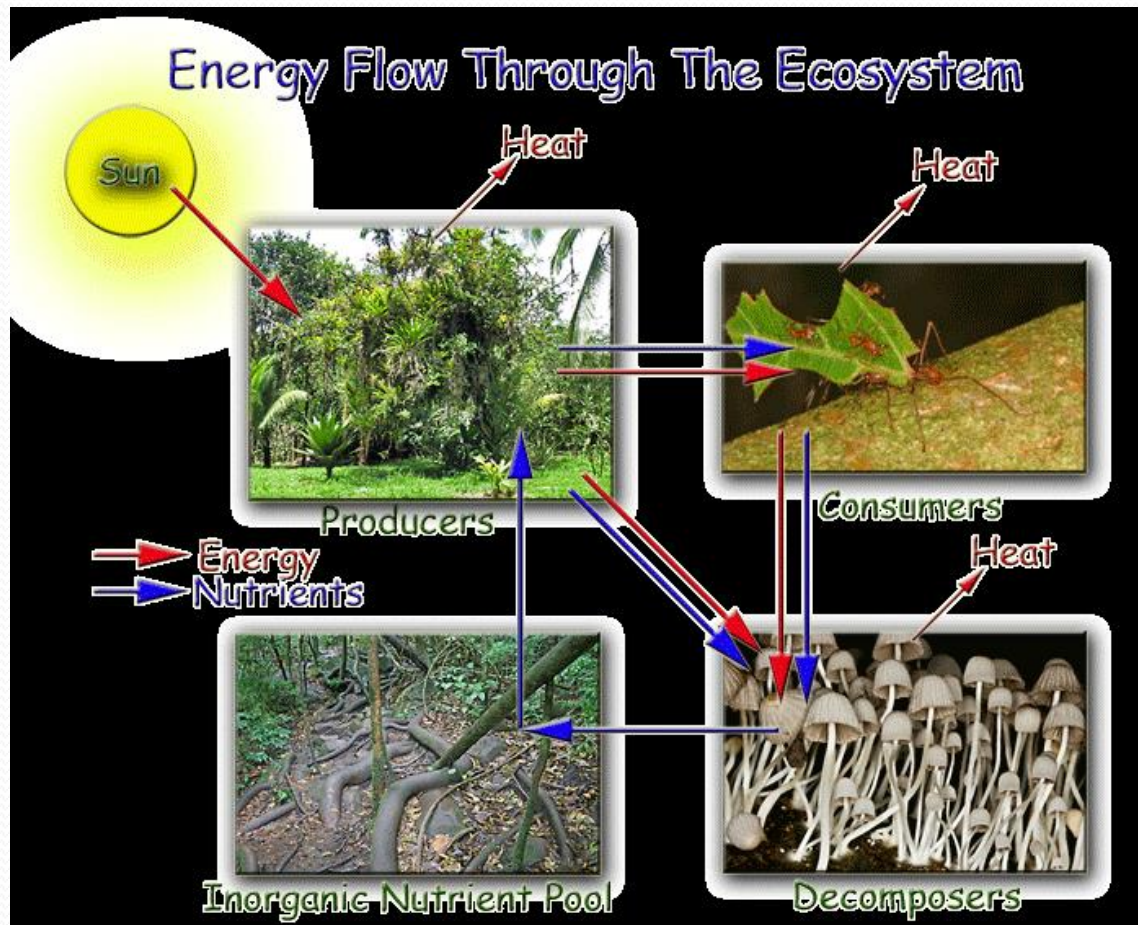
- Feeding relationships-Energy flows in an ecosystem in one direction from the sun or inorganic compounds to autotrophs (producers) and then to various heterotrophs (consumers)
- Energy stored in producers is passed through the ecosystem along a food chain, a series of steps in which organisms transfer energy by eating and being eaten



Temperate Deciduous Forest Food Chain

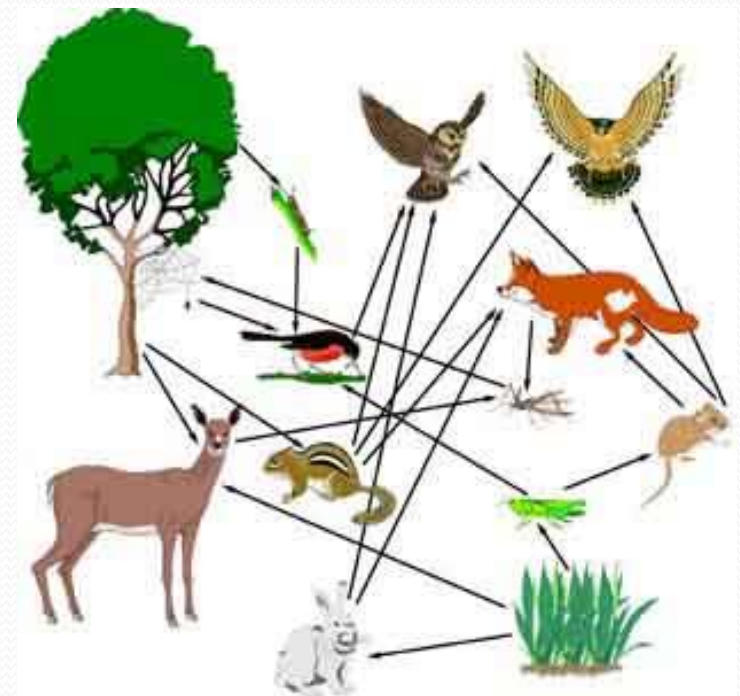


Energy Flow



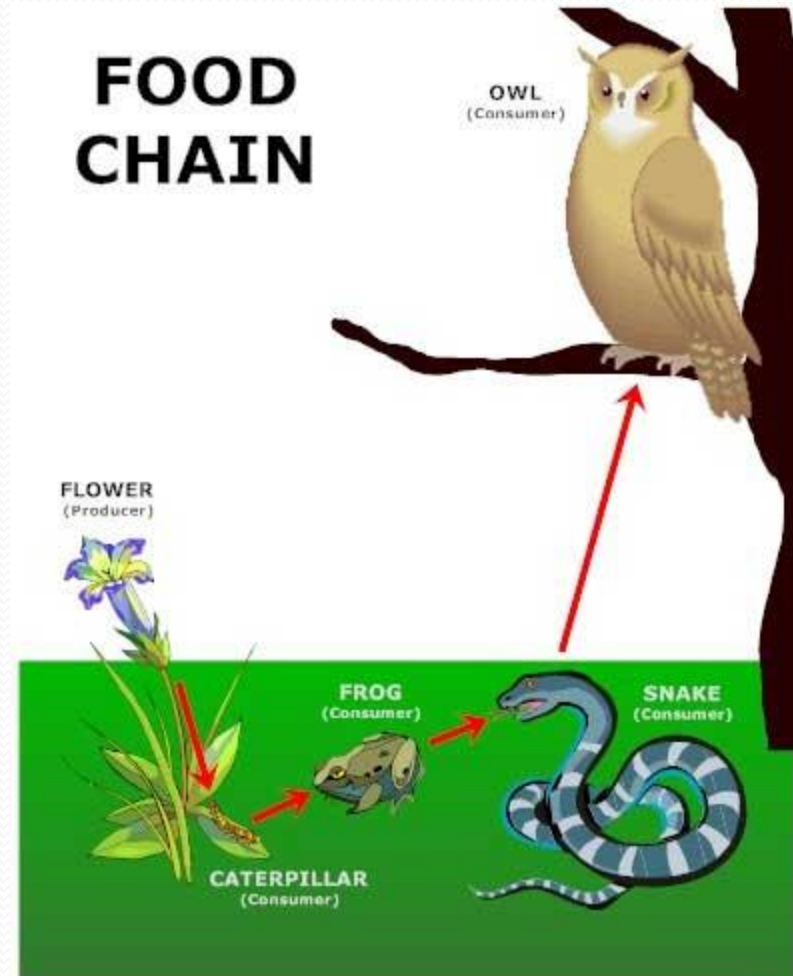
3-2 Energy Flow

- Food webs-more complex than a food chain
- Feeding relationships among the various organisms in an ecosystem form a network



3-2 Energy Flow

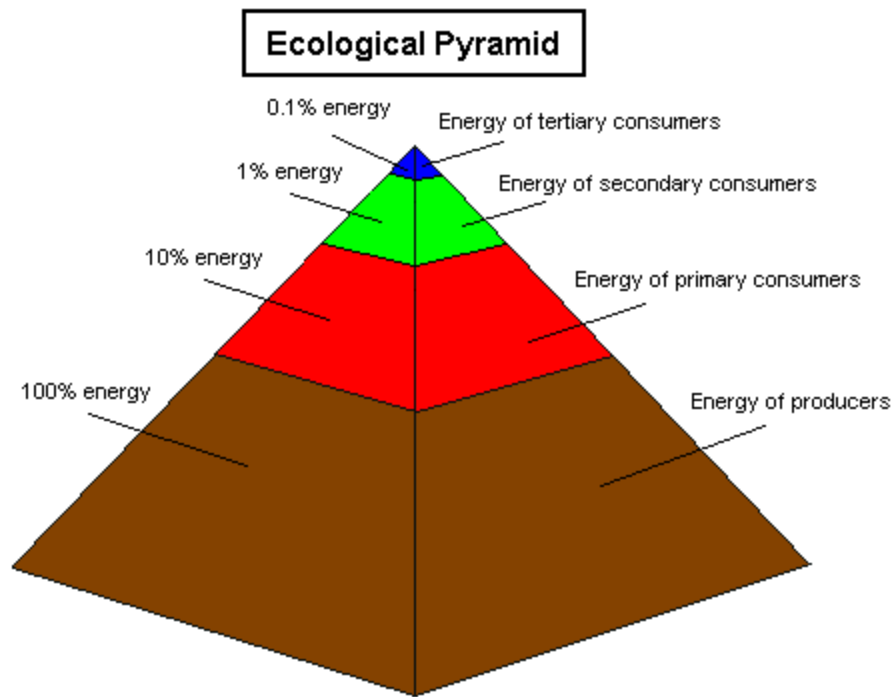
- Trophic Levels-Each step in the food chain
- Producers are the first level
- Consumers are at the 2nd, 3rd and higher levels



3-2 Energy Flow

- **Ecological pyramids represent the amount of energy in an ecosystem**
- Three types of pyramids
- **Energy**-only 10% of the energy at one trophic level is transferred to the next trophic level; much is used or released into the environment as heat
- **Biomass**-usually expressed in terms of grams of organic material per unit area; represents the amount of potential food available at each trophic level
- **Pyramid of numbers**-Based on the number of individual organisms at each trophic level

Ecological Pyramid



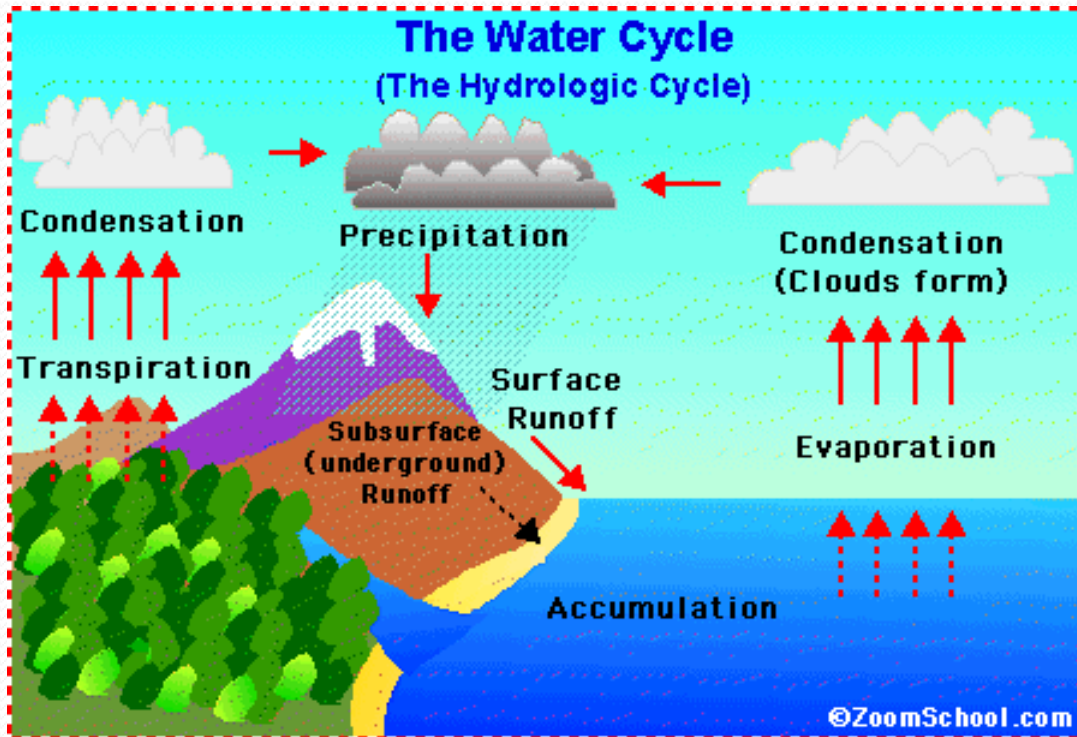
3-3 Cycles of Matter

- Recycling in the Biosphere
 - Energy is recycled within and between ecosystems
 - Elements, chemical compounds and other forms of matter are passed from one organism to another and from one biosphere to another through biogeochemical cycles (biological, geological and chemical)

3-3 Cycles of Matter

- The water cycle
 - Water moves between the ocean, the atmosphere and land
 - When water changes from liquid to vapor, it is called evaporation. Water evaporates from the land and waterways to the atmosphere
 - Water also enters the atmosphere by transpiration by plants
 - Water gets back to land and waterways by precipitation (rain or snow), where the water vapor becomes liquid water again

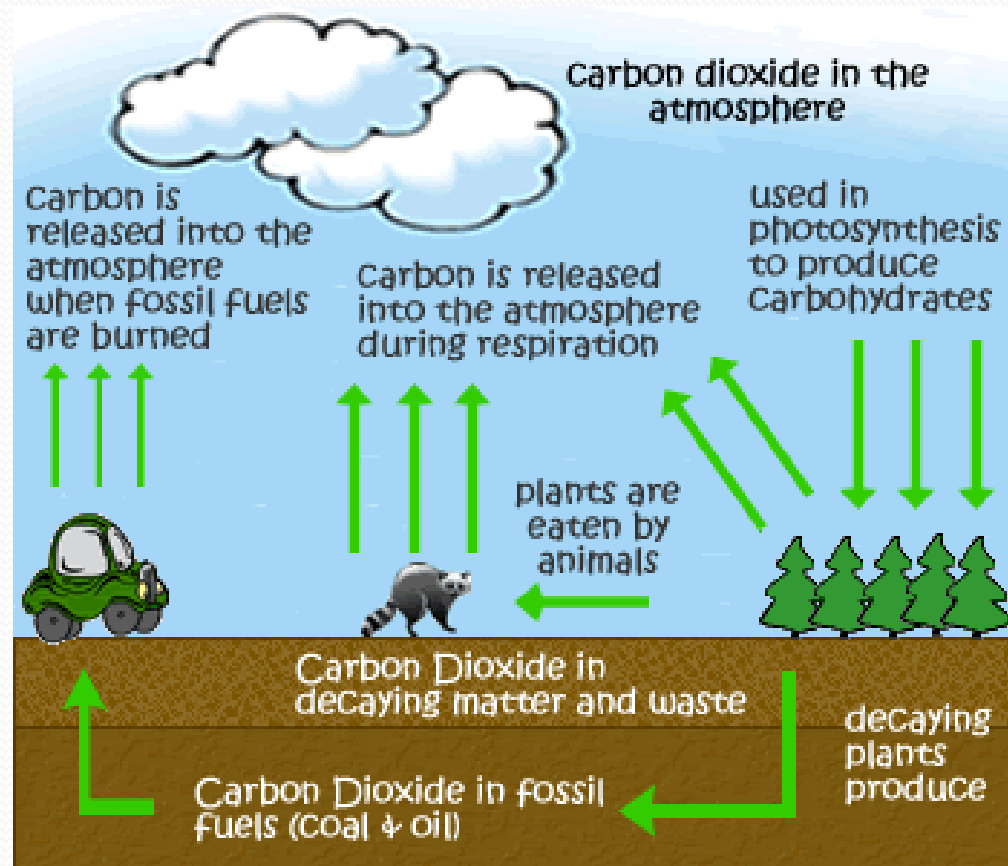
Water Cycle



3-3 Cycles of Matter

- Nutrient cycles
- Nutrients are required for life functions. They are passed between organisms and the environment in biogeochemical cycles.
- Carbon is the element that life is based on.
 - It is captured in the form of CO_2 from the atmosphere by plants in photosynthesis
 - It is eaten by animals during feeding
 - It goes to the soil as organisms decompose
 - It becomes trees and oil and coal and is released by burning or is released in volcanic eruptions

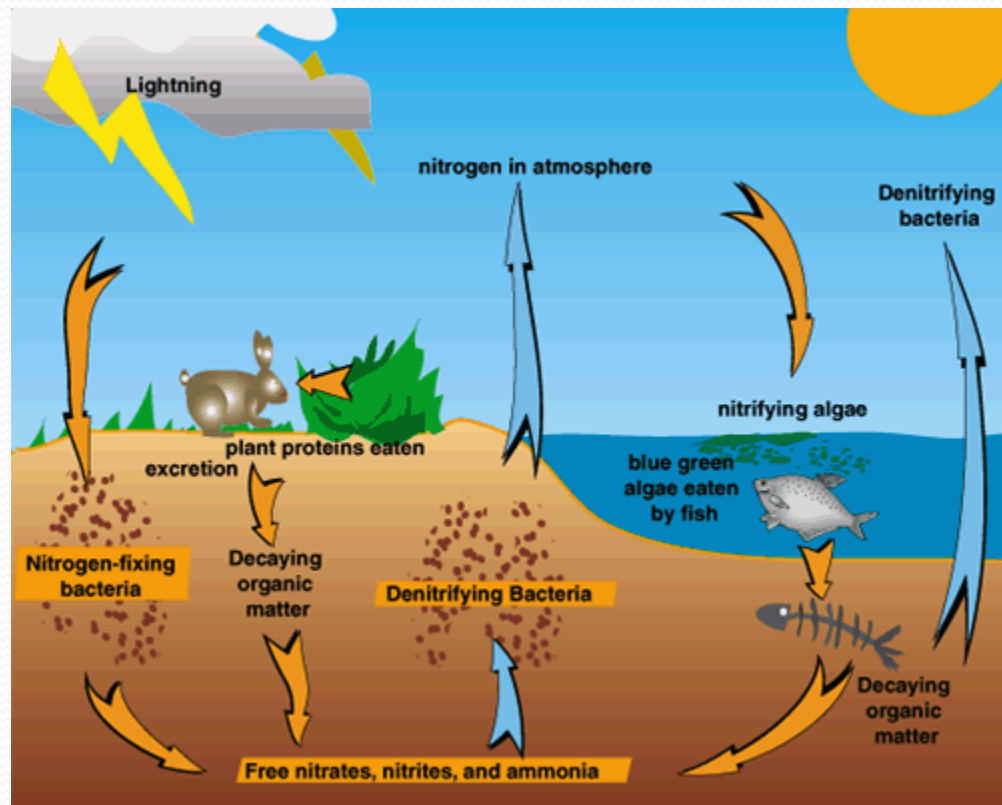
Carbon Cycle



3-3 Cycles of Matter

- Nitrogen cycle
- Nitrogen required to make amino acids and DNA
- Makes up 78% of the atmosphere
- Found in waste of animals-ammonia (NH_3) and nitrates and nitrites(NO_3^- , NO_2^-)
- N_2 in the atmosphere can't be used directly by most organisms, needs to be "fixed"
- Some soil bacteria fix nitrogen (N_2) and turn it into usable forms-Nitrogen fixation
- Nitrogen is returned to the soil by denitrification (decomposition) of living things, and the N_2 is released into the atmosphere again

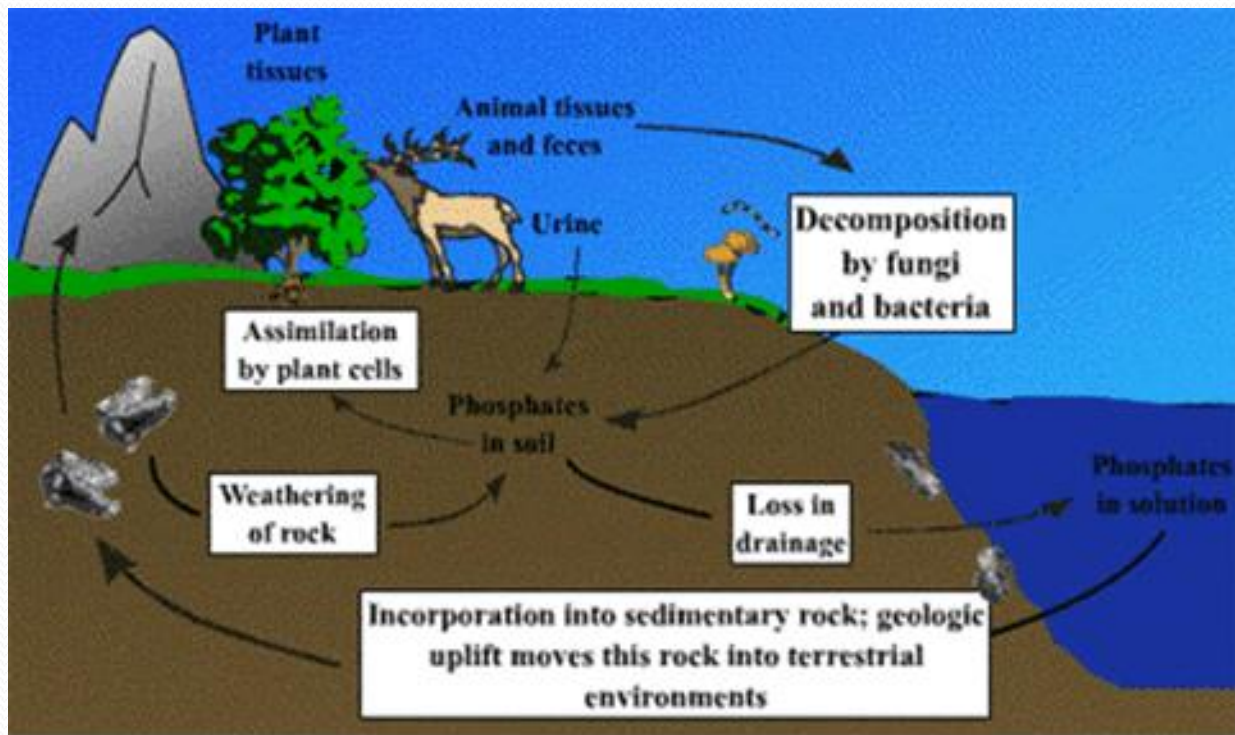
Nitrogen Cycle



3-3 Cycles of Matter

- Phosphorus cycle
- P is part of DNA, RNA and most proteins
- Not common in the biosphere
- Does not enter the atmosphere, but remains in the soil and rocks in the form of inorganic phosphate
- Gets washed into water from the rocks and soil by precipitation where it is used by marine organisms
- Some cycles between the soil and land plants and animals

Phosphorus Cycle



3-3 Cycles of Matter

- **Nutrient Limitation**
- Primary productivity is the rate at which organic matter is created by the producers
- Controlled by available nutrients
- When an ecosystem is limited by the availability of a single nutrient, it is called a limiting nutrient
- This why farmers use fertilizers
- Oceans are nutrient poor; often N_2 is the limiting nutrient

3-3 Cycles of Matter

- When an ecosystem receives an excess of a nutrient, can lead to uncontrolled growth
- Example-When phosphates or nitrates from the soil of detergents run into a lake, it causes an algae bloom.
- This can upset the balance in the ecosystem. The algae grows so fast that it takes O₂ away from the other organisms that live in the water, like fish, leading to a decline in the populations of other organisms

3-3 Cycles of Matter-Algae Bloom

