Ecology

The study of the relationships between living organisms and their environment

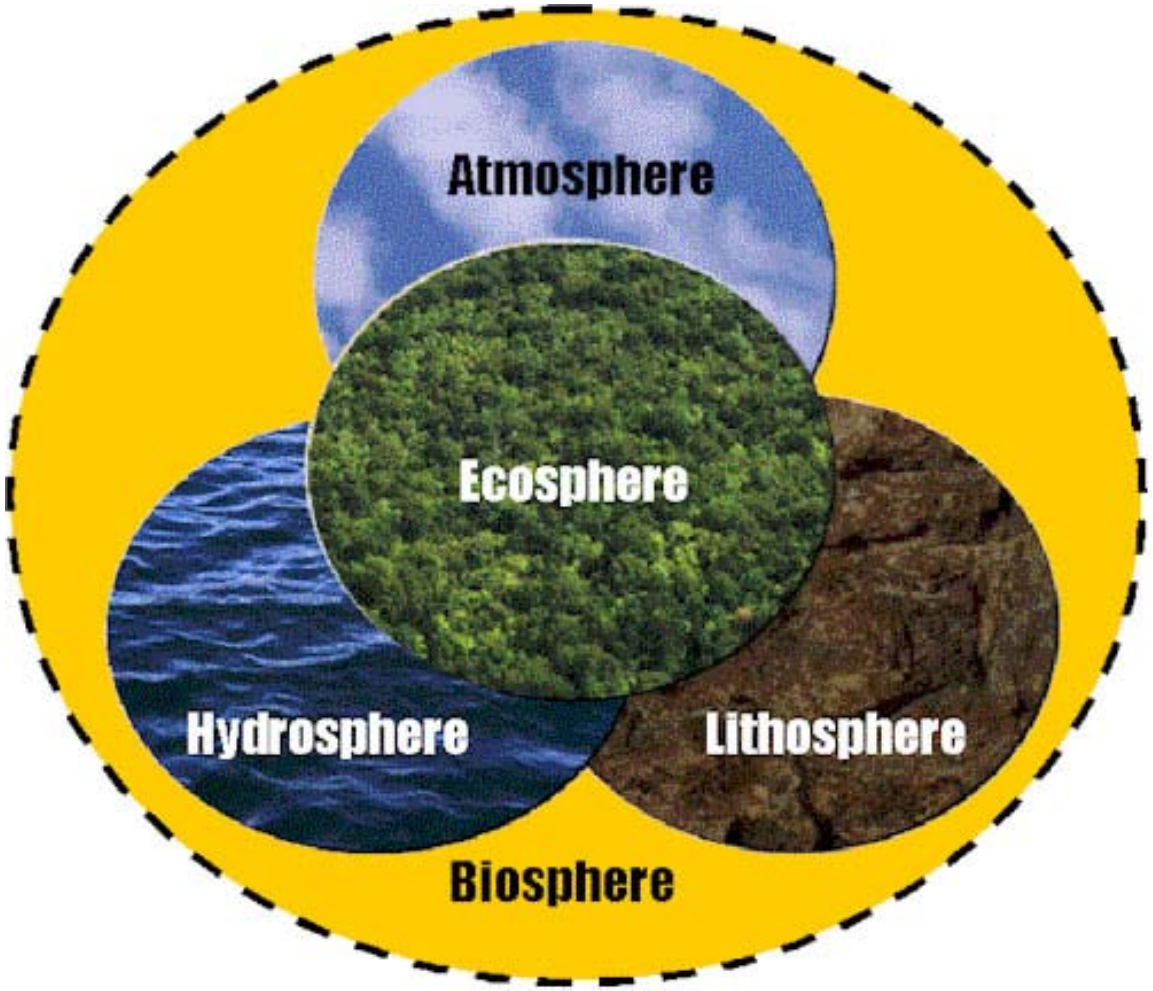
Biosphere: Levels of Organization

- The organization of the **biosphere** from the most specific to the broadest level:

  Organism ⟶ Population ⟶ Community ⟶ Ecosystem ⟶ Biome ⟶ Biosphere

- **Biosphere** = any part of the Earth where organisms live, broadest level of ecological study, includes all of Earth's ecosystems
- The biosphere includes the lithosphere, hydrosphere, and atmosphere

Biosphere


Atmosphere
Ecosphere
Hydrosphere
Lithosphere
Biosphere

Biome

- **Biome** = a geographic region that has separate but similar ecosystems characterized by a distinct climate
- Climate of a location determines which types of organisms are able to live there
- The major **biomes** on Earth include: tropical rainforest, temperate rainforest, desert, grassland, deciduous forest, coniferous forest, tundra, estuary, savanna, and taiga.

Ecosystem

- **Ecosystem** = the biotic, or living, community and its abiotic, or nonliving, environment
- Ecosystems vary greatly in size and conditions
- The plants and animals of an ecosystem are determined by the abiotic factors

Example of an Ecosystem

- All the living and nonliving factors inside a pond:
  - The water in the pond
  - The algae and plants that grow in the water
  - The animals and bacteria that live in the water
  - The dirt and rocks on the bottom
  - The sunlight on the water

Biotic vs. Abiotic Factors

- **Biotic** Factors:
  - Living organisms and factors from formerly living organisms
  - Include interactions between members of the same species and different species
- **Abiotic** Factors:
  - Any nonliving geological, geographical and climatological factors
  - Examples: water, air, soil, light, temperature, and natural disasters

★ **Both abiotic and biotic factors can limit or enhance a population's success in a particular environment.**

Community

- **Community** = all of the populations that live and interact in the same area
- Makes up an ecosystem's living, or biotic, portion
- At the community level, interactions between organisms can be observed
  - Predator/prey
  - Consumer/producer
  - Competition and cooperation

Population

- **Population** = a group of individuals of the same species living in the same area at the same time
- Can be defined at different levels of size
  - A local population could occupy a very small habitat, such as a puddle
  - A population could also include every member of a species of monkey that occupies a large island

Changes in Ecosystems

- The survival of organisms depends greatly on physical factors in their environment
- Any changes to the biotic or abiotic factors can impact an ecosystem
- Even minor changes can have a large impact
- Changes in the environment have ongoing effects

Energy Flow in Ecosystems

- Energy flows from the sun through ecosystems from one organism to another
- The sun's energy cycles through ecosystems from producers to consumers and back into the nutrient pool through decomposers
- Trophic levels describe the feeding levels of organisms: producers, primary/secondary/tertiary consumers, and decomposers

Producers

- Organisms able to make their own food from inorganic compounds using photosynthesis
- Plants, protista (algae), and some bacteria
- At the bottom of all food pyramids, all other organisms depend on producers for energy

Consumers

- Consumers get energy by feeding on producers or other consumers
- Classification depends on location within the food chain:
  - Primary = animals that eat producers (herbivores), ex. deer
  - Secondary = animals that eat primary consumers (carnivores) or primary consumers and producers (omnivores), ex. wolves
  - Tertiary = eat secondary consumers, can still be carnivores or omnivores

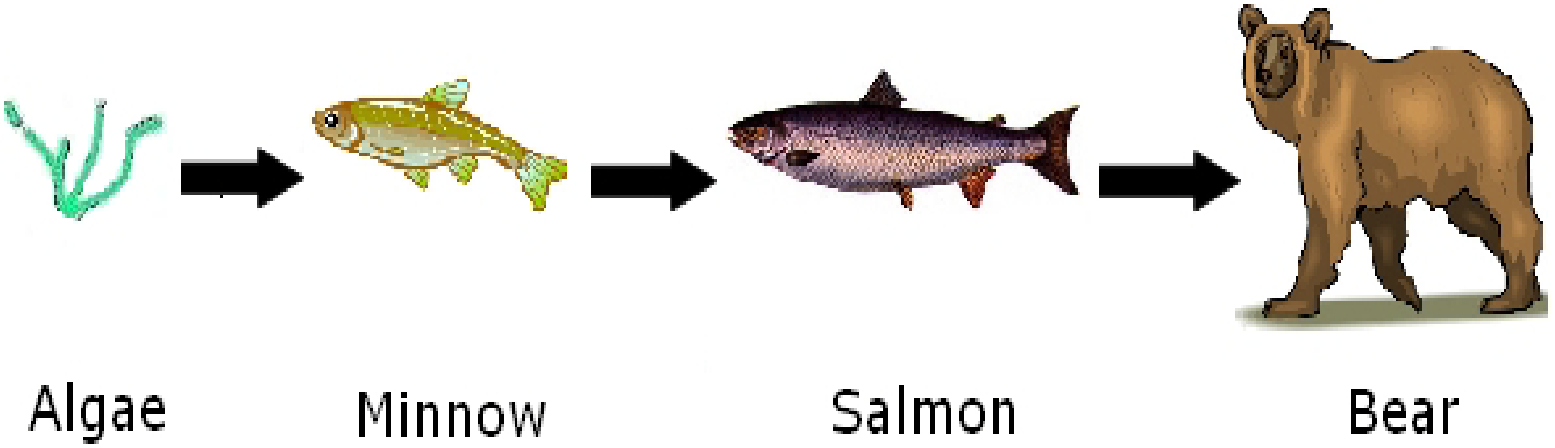
Decomposers

- Organisms that consume dead organisms, releasing nutrients back into the soil, water, and atmosphere
- Crucial to ecosystems, playing important roles in the carbon, nitrogen, phosphorus, and oxygen cycles; ex. fungi

Food Chains

- Describe the energy flow between species within an ecosystem
- Producers use energy from the sun to make food and therefore start the chain
- The arrows represent the direction of energy flow, pointing from the organism being consumed to the organism receiving the energy

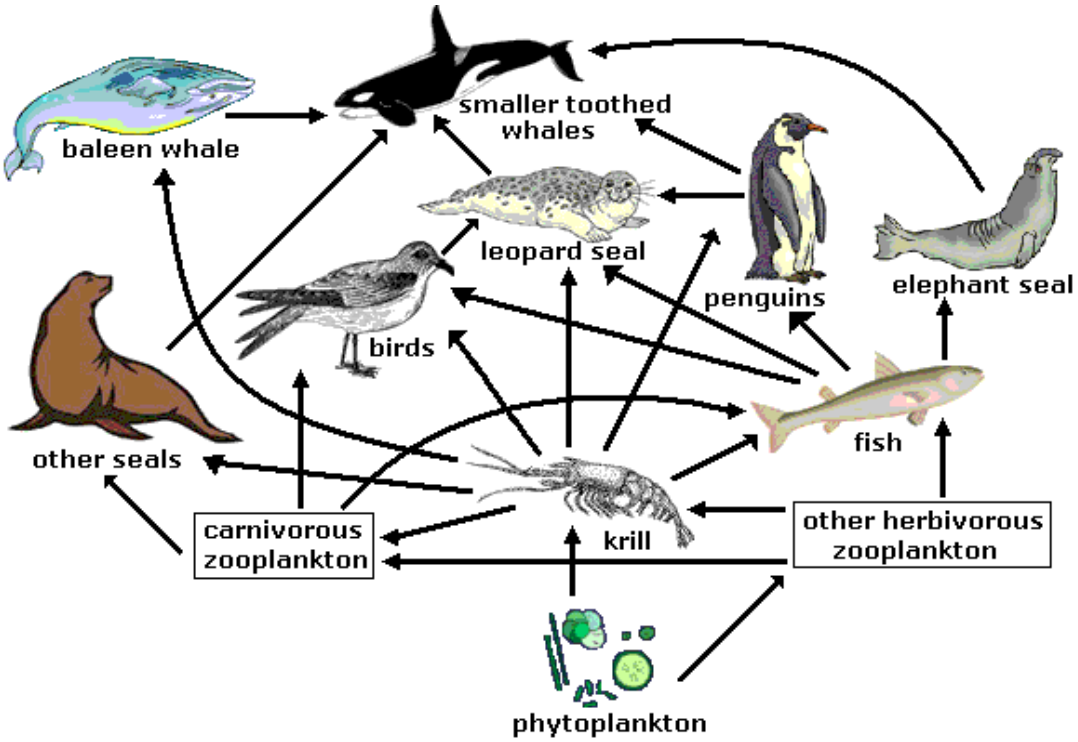
Sample Food Chain



Decomposers may feed on organisms at any stage of the food chain.
Decomposers recycle nutrients back into the ecosystem.

Food Webs

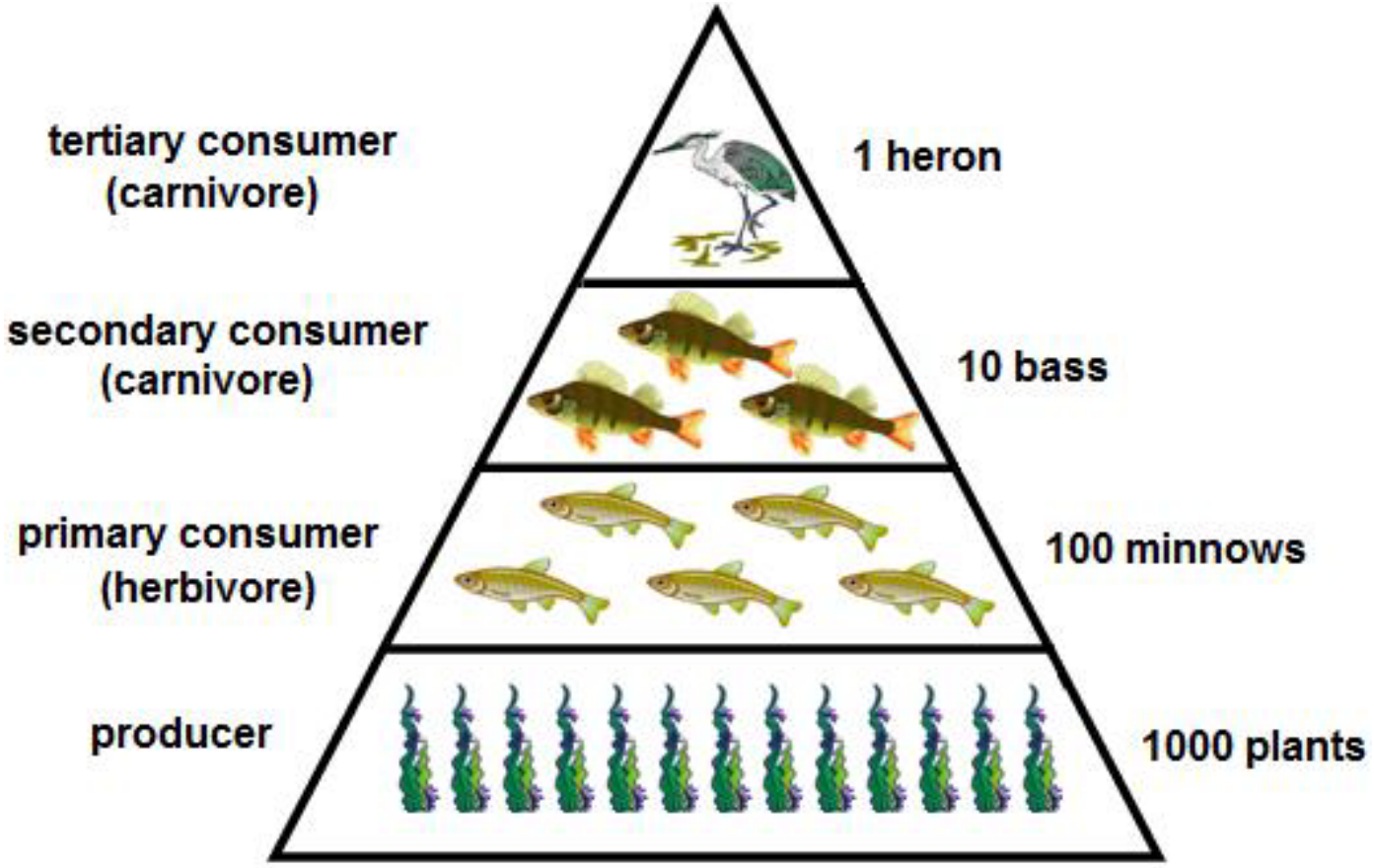
- Group of interconnected food chains
- Organisms within a food web can belong to more than one trophic level, or feeding level.



Energy Pyramid

- A diagram that shows the relative amounts of energy located within each trophic level
- Most of the energy in an energy pyramid is used or lost as heat energy as it moves up the pyramid, therefore each level in an energy pyramid has less energy available to it than the level below (only about 10% of the energy produced at each level is available to the one above it)
- Producers are the foundation of all pyramids

Sample Energy Pyramid



Symbiosis

- An interaction between individuals of different biological species
- One of the organisms receive a benefit from the interaction, the other can either receive a benefit, be harmed, or not be affected in any way
- Three main kinds of symbiotic relationships: ***commensalism, mutualism, and parasitism***

Symbiosis Chart

Interaction	Species A	Species B
Commensalism	Receives benefit	Not affected
Mutualism	Receives benefit	Receives benefit
Parasitism	Receives benefit	Harmed

Symbiosis

- Commensalism: One organism benefits and the other is neither helped nor harmed in a commensalistic relationship.
- Mutualism: Both organisms benefit in a mutualistic relationship. Ex. flowers and pollinators
- Parasitism: One organism benefits and the other is harmed in a parasitic relationship. Ex. mosquitoes

Other Relationships

- Predator/Prey: predator hunts, kills, and eats prey
- Competition: two organisms compete for the same resources, ex. food, water, shelter, space
- Cooperation: an interaction where organisms work together, ex. wolf packs

Carrying Capacity

- For living things to grow they must have the proper amounts of temperature range, minerals, soil, air, space, food or sunlight
- The **carrying capacity**, or the actual number of living things that an ecosystem can support, is limited by the available energy, water, air, space, food, and minerals
- Populations will grow exponentially until they reach the carrying capacity at which point they will level off

Population Growth

- Population Size = the number of individuals within a given population
- Population Density = the number of organisms in the population divided by a regular unit of area or volume
- Affected by birth/death rate, immigration/emigration, and limiting factors which are physical, biological or chemical factors that can affect the growth or diversity of organisms within an ecosystem
- Affected by natural causes, diseases, changes in climate, the introduction of non-native species, and human activity

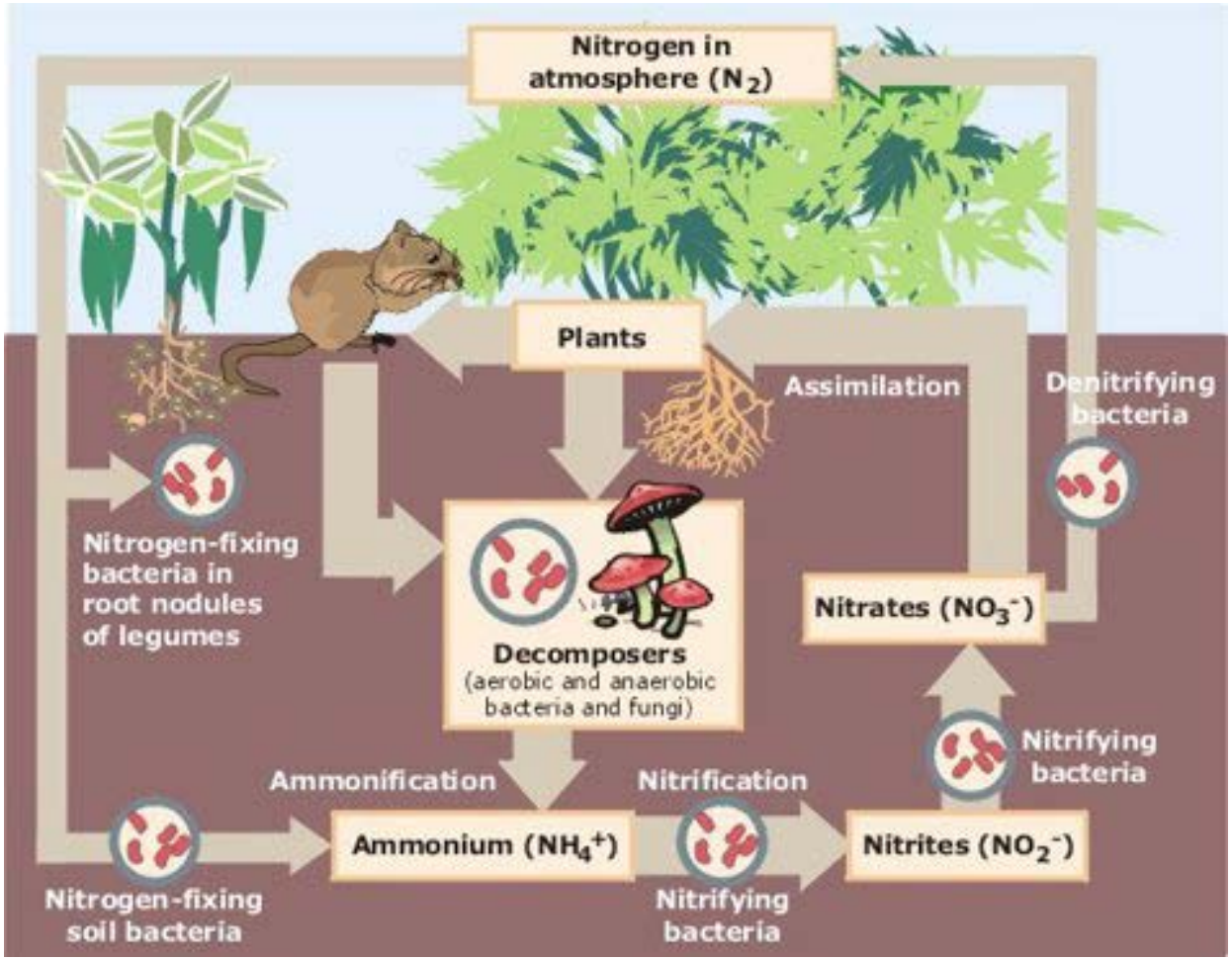
Biogeochemical Cycles

- Predictable pathways followed by chemical elements or molecules as the elements or molecules travel through the living and nonliving parts of an ecosystem
- Move among the Earth's biosphere, atmosphere, lithosphere, and hydrosphere
- For example: the carbon-oxygen cycle through photosynthesis and cellular respiration

Nitrogen Cycle

- Nitrogen is an essential component of amino acids (proteins) and nucleic acids (DNA and RNA); all organisms require nitrogen to survive
- A few microscopic organisms and natural processes, such as lightening, that can convert unusable nitrogen in the atmosphere to usable forms of nitrogen

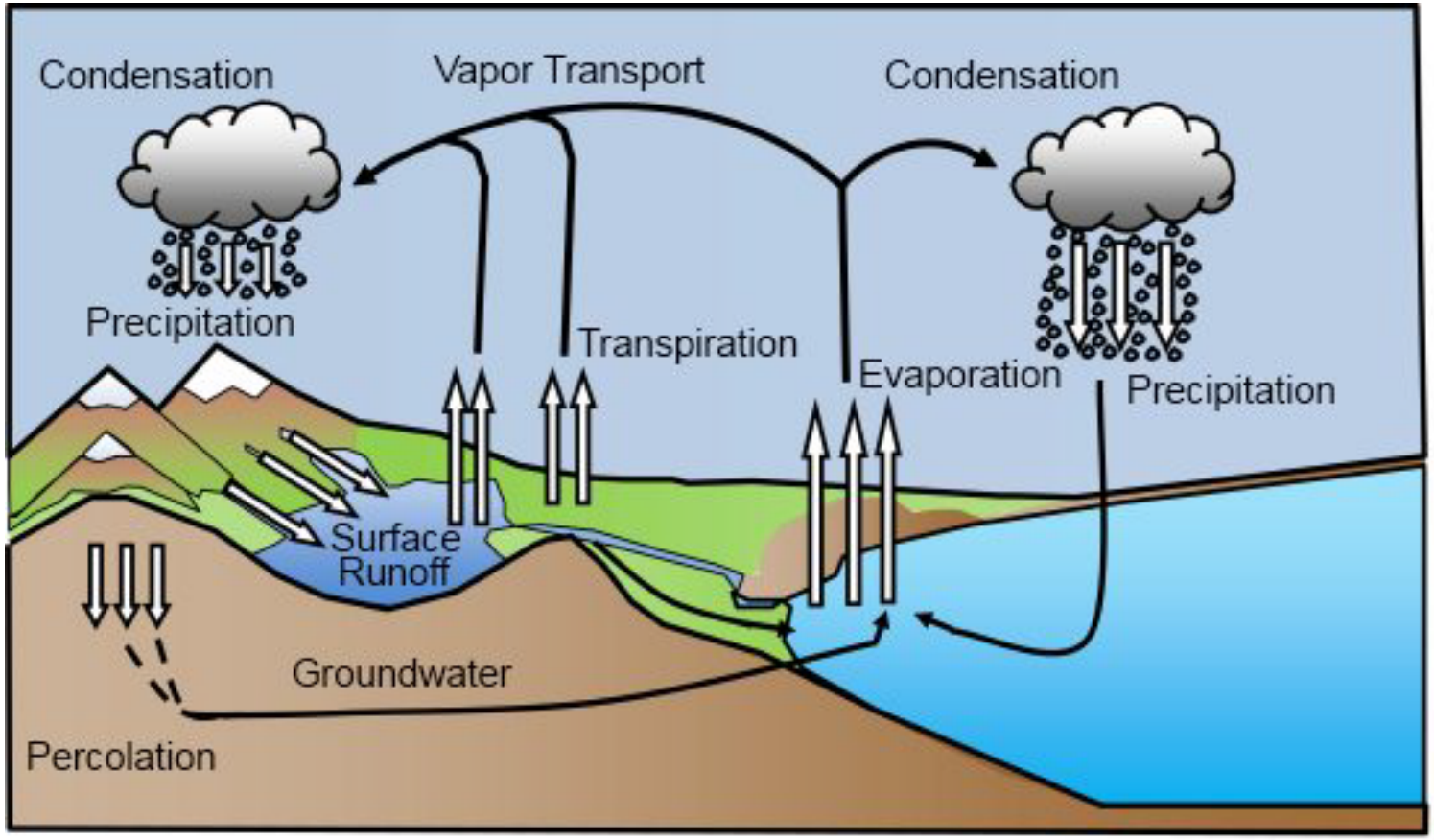
Nitrogen Cycle



Water Cycle

- Much more water stored in the cycle than moving in the cycle
- Water may be stored for a short time as water vapor in the atmosphere, for days or weeks in a lake, or for thousands of years in a polar ice cap
- Sun drives the cycle

Water Cycle


Condensation
Vapor Transport
Condensation
Precipitation
Transpiration
Evaporation
Precipitation
Surface Runoff
Groundwater
Percolation

Natural Environmental Impacts

- Volcanoes: release of greenhouse gases can increase global temperature, or release of particles into the atmosphere can cause a drop in global temperatures
- Fire: fires can be beneficial through clearing out areas for new plants to grow, or they can be harmful to animals through decreasing food sources and increasing erosion
- Plants: multiple benefits to the Earth, including preventing erosion and improving air/soil quality

Human Impacts

- Human activities can change the balance in Earth's processes; careless human activity can also alter or destroy habitats and damage ecosystems
- Humans hurt the Earth through pollution, resource use, and introduction of invasive species
- Humans can also help the Earth through conservation and preservation