

# Chapter 03

## The Biosphere

### 3.1 What is Ecology?

- Studying Our Living Planet
  - **Biosphere** = All life on Earth and all parts of the Earth in which life exists. Includes all land, all water, and the atmosphere
  - The Science of Ecology
    - **Ecology** = The study of the interactions between organisms and their surroundings
    - **Key** = Ecology is the scientific study of interactions among organisms and between organisms and their physical environment
  - Ecology and Economics
    - Both ecology and economics have the same root word which makes the interactions between each other and surroundings in the transfer of nutrients between individuals
  - Levels of Organization
    - **Individual** = One member of a type of living thing
    - **Species** = A group of similar organisms that can breed and produce offspring
    - **Population** = A group of individuals of the same species that live in the same area
    - **Community** = Assembly of populations that live together in a defined area
    - **Ecosystem** = All the organisms that live in a place as well as their physical environment
    - **Biome** = Group of ecosystems that share similar climates and typical organisms
    - All the biomes, with all organisms, and all environments make up the biosphere
- Biotic and Abiotic Factors
  - Biotic Factors
    - **Key** = The biological influences on organisms are called biotic factors
    - **Biotic Factor** = Any living part of the environment with which an organism may interact
      - Animals, plants, mushrooms, bacteria, etc...
  - Abiotic Factors
    - **Key** = Physical components of an environment are called abiotic factors
    - **Abiotic Factor** = Any nonliving part of the environment
      - Sunlight, heat, precipitation, humidity, wind, water, soil, etc...
  - Biotic and Abiotic Factors Together
    - Both biotic and abiotic factors tend to intermix with one another and it can be difficult to determine if something is just one of the two
      - Muck in a pond contains leaves, mold, and other plant material that serves as food for bacteria, fungi, and many biotic factors that live within it
      - The trees and plants of a forest will affect the humidity of the air within the forest, the amount of oxygen and carbon dioxide, and many other abiotic factors
- Ecological Methods
  - **Key** = Regardless of their tools, modern ecologists use three methods in their work, each of these approaches relies on scientific methodology to guide inquiry
    - Observation – Asking questions and using senses for data
    - Experimentation – Making and testing hypotheses
    - Modeling – Creating mathematical or visual representations of data

### 3.2 Energy, Producers, and Consumers

- Primary Producers
  - **Autotrophs** = Use solar or chemical energy to produce food by assembling inorganic compounds into complex organic molecules
  - **Key** = **Primary Producers** = Autotrophs are also called primary producers because they are the first producers of energy-rich compounds that are later used by other organisms
- Energy From the Sun
  - **Photosynthesis** = The capturing of light energy and using it to power chemical reactions that convert carbon dioxide and water into oxygen and energy-rich carbohydrates

- Life Without Light
  - **Chemosynthesis** = The capturing of chemical energy from inorganic molecules such as hydrogen sulfide to produce carbohydrates
- Consumers
  - **Heterotrophs** = Organisms that must obtain their energy from other organisms
  - **Key** = **Consumers** = Heterotrophs are also called consumers because they must get their energy and nutrients from consuming other organisms
- Types of Consumers
  - **Carnivores** = Kill and eat other animals
    - Snakes, dogs, cats, otters, etc...
  - **Herbivores** = Eat plant leaves, roots, seeds, or fruits
    - Cows, caterpillars, deer, macaws, etc...
  - **Scavengers** = Consume carcasses of other animals that have already died
    - Vultures
  - **Omnivores** = Eat both plants and animals
    - Humans, bears, pigs, coati, etc...
  - **Decomposers** = Chemically break down organic matter
    - Bacterium, fungi, mushrooms, etc...
    - They produce “detritus”, which are small pieces of dead and decaying remains
  - **Detritivores** = Consume detritus particles
    - Mites, snails, shrimp, crabs, etc...
    - Will digest decomposers and detritus that decomposers tend to live in
- Beyond Consumer Categories
  - Having categories is a good place to start, but organisms in nature often do not stay inside of tidy little categories if they need to.
    - Hyenas will scavenge if they have a chance to
    - Aquatic animals will eat a mixture of algae, bits of carcasses, and detritus particles, technically making them fit into 3 different categories

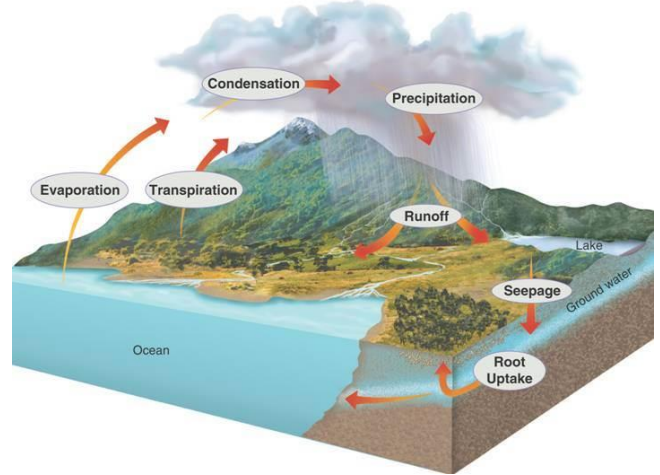
### 3.3 Energy Flow in Ecosystems

- Food Chains and Food Webs
  - **Key** = Energy flows through an ecosystem in a one-way stream, from primary producers to various consumers
- Food Chains
  - **Food Chain** = Series of steps in which organisms transfer energy by eating & being eaten
  - **Phytoplankton** = A mixture of floating algae that are the producers in aquatic systems
- Food Webs
  - **Food Web** = A more realistic look at the energy flow of an ecosystem as the feeding relationships are not linear and therefore create a type of web relationship between organisms
  - Food Chains Within Food Webs
    - Each individual path taken through a food web is a food chain
  - Decomposers and Detritivores in Food Webs
    - Decomposers are the recyclers of a food web because they convert the dead plant and animal material into detritus, which is then the beginning of many of the food chains within a food web
- Food Webs and Disturbance
  - **Zooplankton** = Small animals that swim and eat marine algae
- Trophic Levels and Ecological Pyramids
  - **Trophic Level** = Each step in a food chain or food web
  - **Ecological Pyramids** = 3 pyramids showing relative amounts of things in food chain/web

- Pyramids of Energy
  - **Key** = Pyramids of energy show the relative amount of energy available at each trophic level of a food chain or food web.
- Pyramids of Biomass and Numbers
  - **Biomass** = The total amount of living tissue within a trophic level
  - **Key** = Pyramids of biomass show the relative amount of living organic matter available at each trophic level in an ecosystem
  - **Key** = Pyramids of numbers show the relative number of individual organisms at each trophic level in an ecosystem
    - Sometimes consumers are much smaller than the organisms they feed upon, so the pyramid of numbers can be turned upside down due to size of the organisms

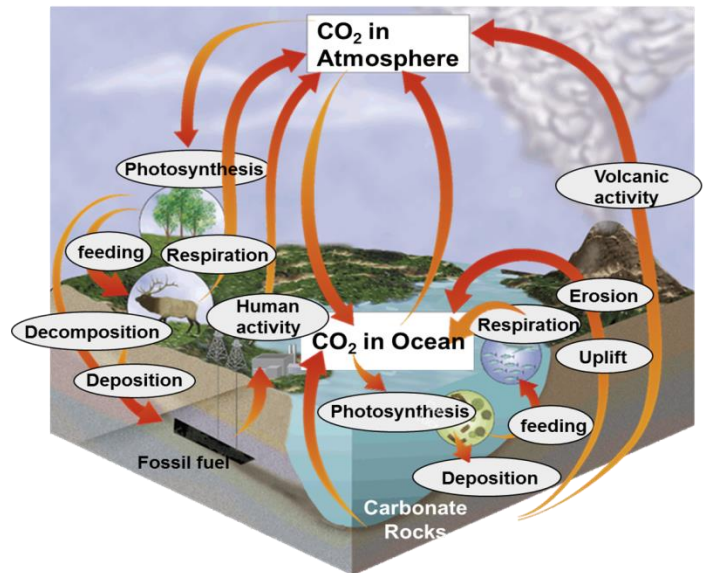
### 3.4 Cycles of Matter

- Recycling in the Biosphere
  - **Key** = Unlike the one-way flow of energy, matter is recycled within/between ecosystems
  - **Biogeochemical Cycles** = Closed loops in which elements pass from one organism to another and among parts of the biosphere.
    - Biological Processes – any processes done by living organisms
    - Geological Processes – any processes done by the earth
    - Chemical and Physical Processes – any chemical or physical processes
    - Human Activity – humans move elements through all of their activities



The Water Cycle

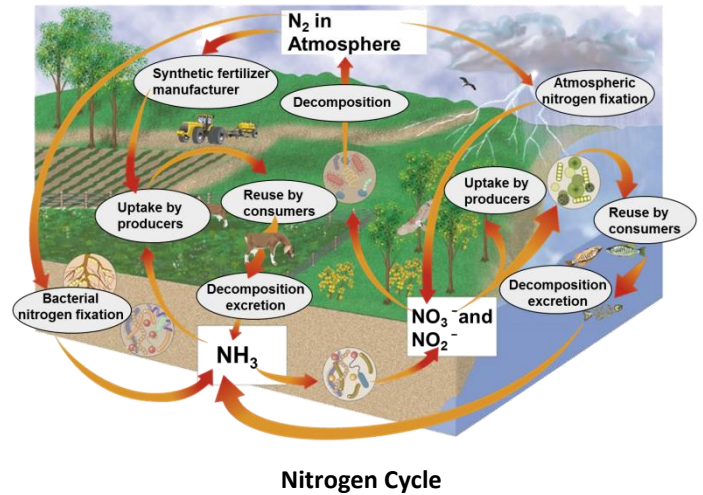
- The Water Cycle
  - **Key** = Water continuously moves between the oceans, the atmosphere, and land – sometimes outside living organisms and sometimes within them
- Nutrient Cycles
  - **Nutrients** = chemical substances that an organism needs to sustain life
  - **Key** = Every organism needs nutrients to build tissues and carry out life functions. Like water, nutrients pass through organisms and the environment through biogeochemical cycles.



The Carbon Cycle

- The Carbon Cycle
  - Carbon moves through the ecosystem in many ways

- The Nitrogen Cycle
  - **Nitrogen Fixation** = process of nitrogen from the atmosphere being converted into nitrogen containing compounds by certain bacteria
  - **Denitrification** = process of nitrogen being released into the atmosphere from nitrogen containing compounds by certain bacteria
- The Phosphorous Cycle
  - Phosphorous is an important chemical for life as it is used in DNA and RNA. It is mostly stored in phosphates



- Nutrient Limitation
  - **Key** = If ample sunlight and water are available, the primary productivity of an ecosystem may be limited by the availability of nutrients
  - **Limiting Nutrient** = Nutrient whose supply limits the productivity of life
- Nutrient Limitation in Soil
  - Fertilizer adds nutrients to the soil to keep growing crops well
- Nutrient Limitation in Aquatic Ecosystems
  - Open oceans are nutrient-poor when compared to most land
  - Usually after a rainstorm bodies of water will get a huge supply of limiting nutrient from the runoff of water carrying those nutrients from the land into the ocean

