

Overview of ecosystems and ecosystem functioning

- **Biosphere = total of all earth's ecosystems**
- **Ecosystem = all the individuals of all the species that live in a particular area, interacting with the physical (abiotic) environment**

Examples of ecosystems



Marine ecosystems

- **Coastal zone**
- **Open sea (pelagic zone)**
- **Seafloor (benthic zone)**
- **Tropical reefs**

Freshwater ecosystems

- Lakes/ponds
- Rivers/streams



Terrestrial ecosystems

- The major terrestrial ecosystems are called **Biomes** = large complexes of communities characterized by a distinctive vegetation type and climate
- Biomes are distributed in broad patterns across Earth
- Many natural biomes have been broken up by human activity

- Tundra
- Boreal forest (taiga)
- Temperate deciduous forest
- Temperate grassland (prairie, pampas)
- Desert
- Chaparral (dry shrubland)
- Tropical savanna
- Tropical forest

Ecosystem structure and dynamics

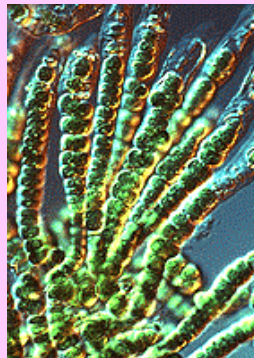
Ecosystems are characterized by patterns of energy flow and nutrient cycling

Overview: energy flow

- One-way passage of energy through the components of the ecosystem, usually starting with photosynthesis by autotrophs and proceeding through heterotrophs.
- Every use of chemical energy by an organism involves loss of heat to the surroundings

The Participants

- Primary producers: convert solar energy to chemical energy (sunlight + inorganic CO₂ to organic glucose).
- Photoautotrophs: Plants, algae, some photosynthetic prokaryotes

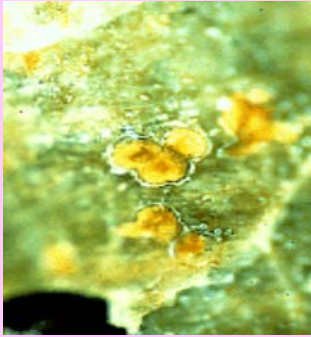


The Participants



- **Consumers = feed on other organisms.**
- **Primary consumers (herbivores that consume the producers; for example, grasshoppers)**
- **Secondary consumers (such as a mouse eating an herbivorous insect)**
- **Tertiary (a snake eating a mouse)**
- **Quaternary consumers (carnivores that consume the next lower consumer level; for instance, a hawk).**

The Participants

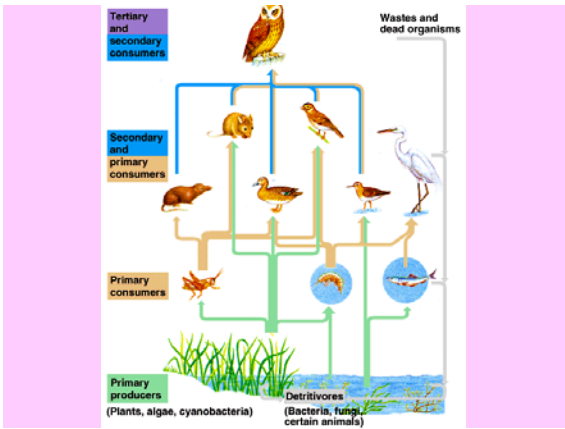


- **Decomposers: derive energy by breaking down the remains and wastes of other organisms.**
- **Fungi and bacteria, but also small animals and heterotrophic protists.**

Trophic structure: hierarchy of energy transfers

- **Food chain: a pathway which describes energy flow from species to species**
- **Food Web: trophic relationships among interconnecting food chains. Shows the pattern of energy flow from one trophic level to the next.**





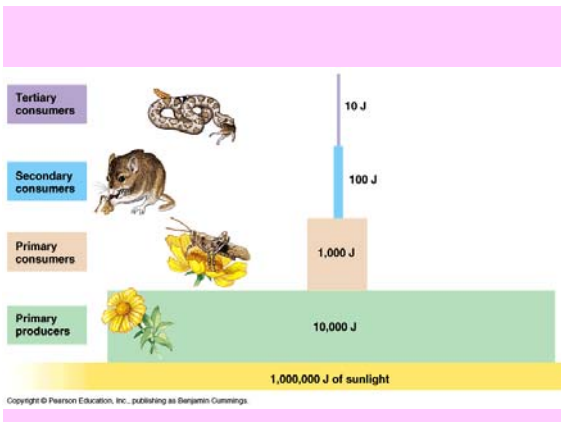
Energy Flow

- **Primary Production** = rate at which primary producers secure energy (i.e. rate at which light energy is converted to chemical energy).
- **Primary production** represents the total "energy budget" available for an ecosystem.
- **Gross primary production (GPP)** = total rate of photosynthesis for an ecosystem for a given time interval ; total energy trapped and accumulated by photosynthetic plants.
- **Net primary production (NPP)** = rate of energy storage in excess of respiration = (total energy trapped minus energy used by the plants themselves for their own metabolism.)
- **NPP = GPP – Respiration** (used by plant for metabolism)

NPP Varies in different ecosystems in (gr/m²/yr):

- Tropical Rainforest - 2,200
- Temperate Forest - 1,200
- Temperate Grassland - 600
- Tundra - 140
- Desert - 90
- Coral Reefs - 2,500
- Estuaries - 1,500
- Open Ocean - 125

- Energy pyramids; pyramid models of biomass, numbers, and energy. Represents trophic structure of an ecosystem, shows energy losses at each transfer between successive trophic levels.
- Ecological Efficiency: as a general rule only about 10% of the energy is passed on to the next highest trophic level; rest is lost as heat.



- **Biological Magnification - the tendency of persistent toxic materials to increase in concentration in progressively higher levels of the food chain.**

