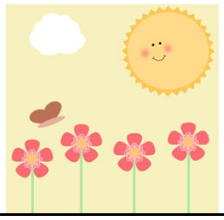
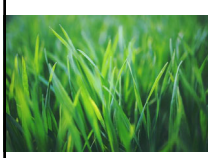
Can We All Just Live at Your Place?

Food Webs and Energy Pyramids

- All living things need energy.
- Plants get their energy from the sun.
- Energy made by plants (through photosynthesis) is transferred to an animal that eats it.



- The organism then transfers the energy to the next organism which eats it, and so on, and so on.
- A food chain shows a **single** pathway for the passing of energy.
  - Arrows represent the direction that energy is transferred.

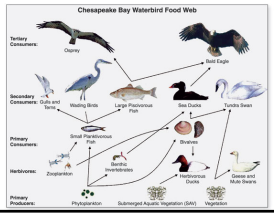


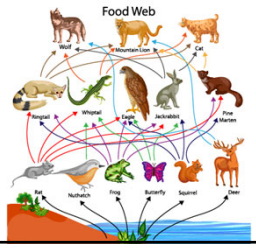
Grass

Rabbit

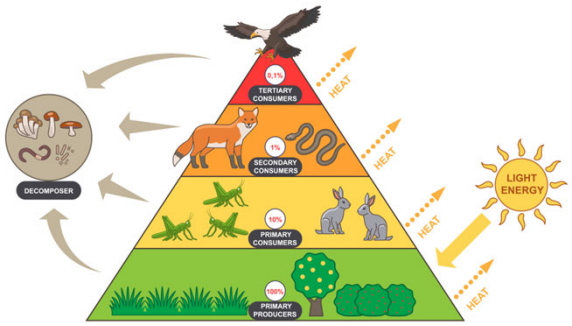
Fox

- Organisms in an ecosystem eat more than one thing.
- A more realistic representation of energy transfer is a food web.
- A food web shows **multiple** food chains.
  - Arrows represent the direction that energy is transferred.





- Another way of representing the energy transfer in an ecosystem is called an energy pyramid.



Trophic Level

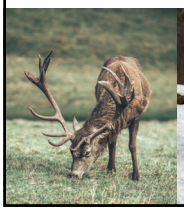
- A **trophic level** is the feeding position in a food chain or energy pyramid that an organism occupies based on what it eats.
- Energy decreases from lower to higher trophic levels.
- **Biomass** (living or organic matter) decreases from lower to higher trophic levels.

Producers

- **Producers** get their energy from the Sun.
- They make their own energy through the process of photosynthesis.
- Producers are also called **autotrophs**, which are organisms that make their own energy.

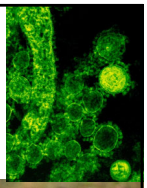
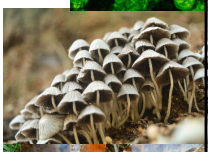
Consumers

- **Consumers** are organisms that are unable to make their own energy.
- They must consume other organisms to get the energy they need to survive.
- Consumers are also called **heterotrophs**.



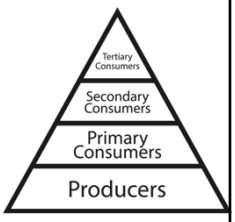
Decomposers

- **Decomposers** are the natural recycler of organic matter in ecosystems.
- They are active at each level of the energy pyramid.
- Decomposers break down dead organisms and return their nutrients back to the environment.

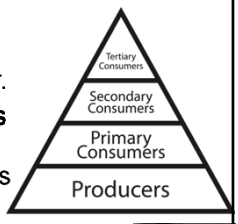

Primary Consumers

- **Primary consumers** are first level consumers that eat producers.
- They are **herbivores** (eat only plants) that cannot make their own energy.
- They consume other organisms, which make them **heterotrophs**.



Secondary and Tertiary Consumers

- **Secondary** and **tertiary consumers** eat primary consumers and each other.
- They are either **carnivores** (eat other animals) or **omnivores** (eat both plants and animals).
- Both secondary and tertiary consumers are **heterotrophs**.



Apex Predators

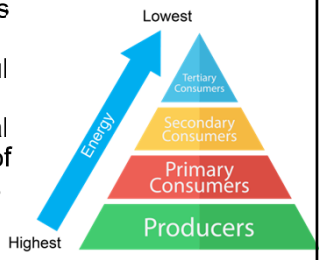
- **Apex predators** are at the top of the food chain (an animal upon which nothing preys).
- They are typically carnivores.
- Apex predators are heterotrophs.

Scavengers

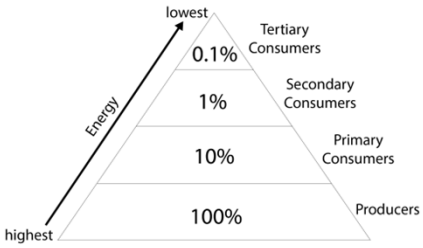
- **Scavengers** consume dead organisms that have died from causes other than predation or have been killed by other predators.
- They are active at each level of the energy pyramid.

Energy Pyramids

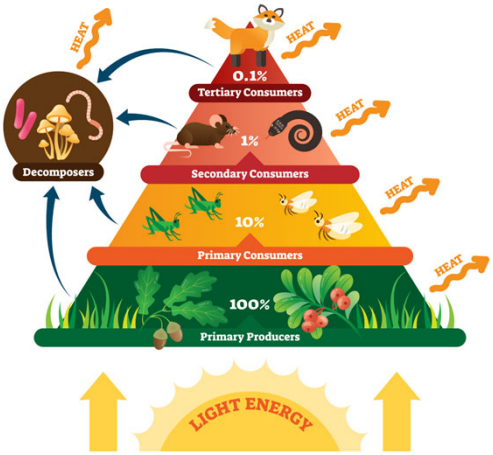
- An energy pyramid's shape shows how the amount of useful energy that enters each level (chemical energy in the form of food) **decreases** as it is used by the organisms in that level.



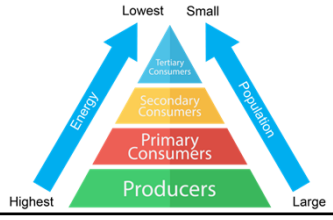
- The amount of energy in every level decreases by about 90% as you go up the pyramid.
- Approximately 10% of the energy is passed onto the next trophic level.



- Energy is used up by the plant or animal's metabolic processes, including growing, reproducing, running, eating, finding mates, escaping danger, and all daily activities.
- Energy is also given off to the environment in the form of heat.



- The consumers at the top of a food chain have much less energy available to support them than those closer to the bottom.
- That is why their numbers are relatively few. Eventually, the amount of useful energy left cannot support another level.



Biodiversity

- Scientists generally accept that the term biodiversity describes the number and kinds of species and their abundance in a given location or on the planet.
- Simplistically, the more biodiversity in an ecosystem, the better its chances to survive changes.

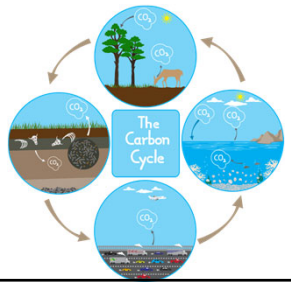
Biogeochemical Cycles

- A biogeochemical cycle is the movement and transformation of chemical elements and compounds between living organisms, the atmosphere, and the Earth's crust.
- Major biogeochemical cycles include the carbon cycle, the nitrogen cycle and the water cycle.

- In each cycle, the chemical element or molecule is transformed and cycled by living organisms and through various geological forms and reservoirs, including the atmosphere, the soil and the oceans.
- It can be thought of as the pathway by which a chemical substance cycles the biotic (living) compartment and the abiotic (non-living) compartments of Earth.

Carbon Cycle

- The carbon cycle is a system that transfers carbon from one part of the environment (reservoir) to another.



Photosynthesis

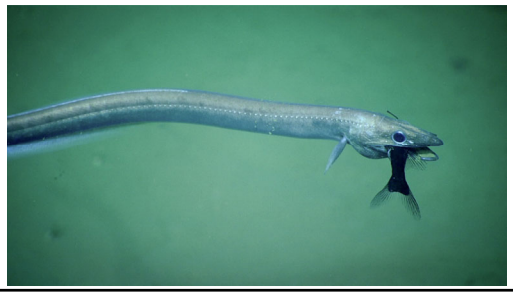
- Photosynthesis occurs in autotrophs (plants).
- This process converts carbon dioxide and water into oxygen and glucose (carbohydrates)
  - $6CO_2 + 6H_2O + \text{energy} \rightarrow 6O_2 + C_6H_{12}O_6$

Cellular Respiration

- Cellular respiration occurs in all living cells.
- This process converts oxygen and glucose (carbohydrates) into carbon dioxide and water.
  - $6O_2 + C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_2O + \text{energy}$

Consumption

- Consumers get the glucose necessary for cellular respiration by ingesting plants and/or animals.



Decomposition

- Carbon enters the soil as dead plant matter.
  - It is broken down by microorganisms during decay.
  - The decay process also releases carbon to the atmosphere through respiration.

- Over long periods of time buried organic matter forms deposits of coal, natural gas and oil (fossil fuels).

Combustion

- The burning of organic material releases carbon dioxide into the atmosphere.

Diffusion

- Carbon dioxide is absorbed and released where the ocean's surface meets the air.

Weathering and Dissolving

- Carbonic acid forms when water (rain) reacts with the carbon dioxide in the atmosphere.
- The weakly acidic rain reacts with minerals on the earth's surface dissolving them.

Precipitation of Minerals

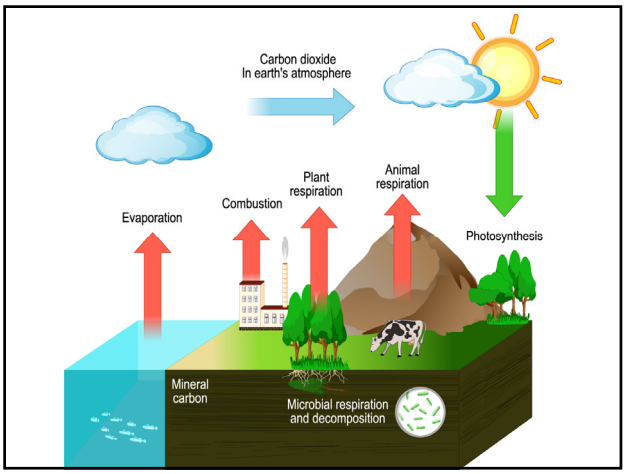
- Dissolved minerals are carried by rivers and streams to the ocean where they precipitate out.
- Marine animal shells settle to the ocean floor when the animal dies and eventually form limestone.

Burial and Subduction

- Carbon bearing sediment is continually being deposited on the sea floor forming new rock.
- Seafloor spreading pushes the seafloor under the continental margins in the process called subduction.

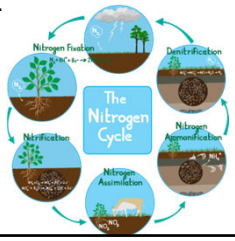
Volcanic Eruptions

- Volcanoes, hot springs, and tectonic uplift all release carbon dioxide back into the atmosphere.



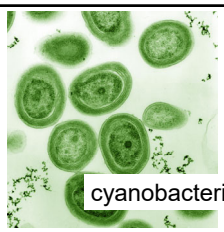
Nitrogen Cycle

- The nitrogen cycle is the process by which nitrogen is converted into various chemical forms as it circulates through the atmosphere, soil, and living organisms.



Nitrogen Fixation

- The atmosphere contains about 78% nitrogen but neither plant nor animal can use this nitrogen directly.
- Nitrogen fixation is a process that takes nitrogen from the atmosphere and converts it into ammonia.
  - This process is performed by various types of bacteria.



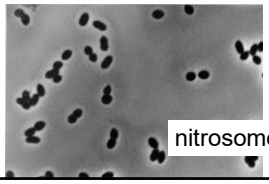
cyanobacteria (blue-green algae)

rhizobia

frankia

Nitrification

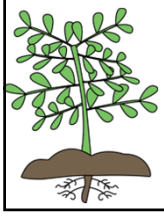
- Not all plants can use ammonia.
- The nitrification process converts ammonia into nitrates and nitrites that the other plants can use.
  - This process is performed by various types of bacteria.



nitrosomonas eutropha

Assimilation

- Plants absorb the ammonia, nitrates, or nitrates through their roots.
- Animals absorb the nitrogen that they need by eating plants (or animals that eat plants).

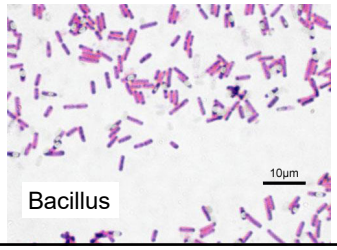


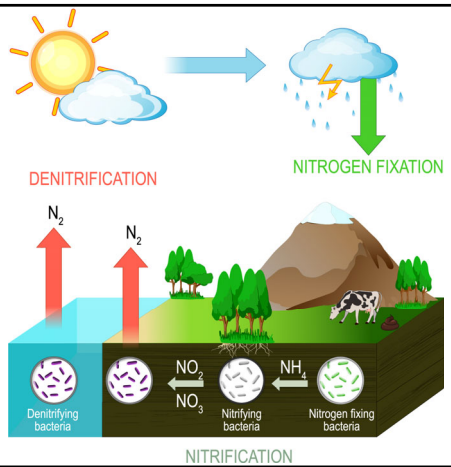
Ammonification

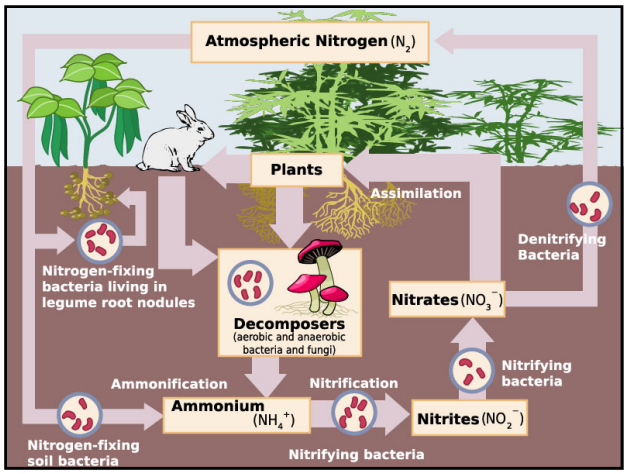
- Decomposers break down the molecules in excretions and dead organisms into ammonia which is stored in the soil.

Denitrification

- Denitrification converts nitrates in the soil to nitrogen gas.
  - This process is performed by various types of bacteria.

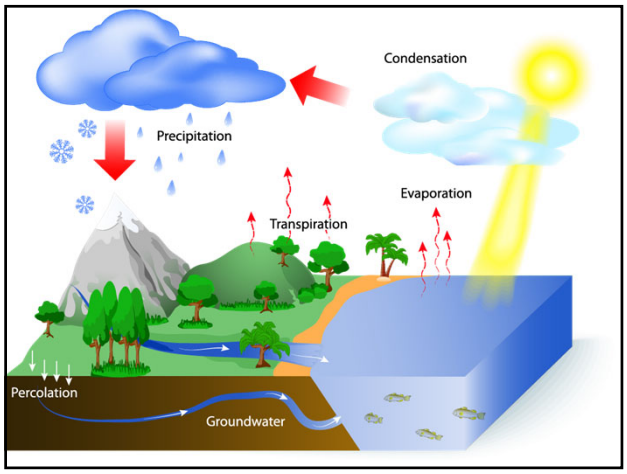






Water Cycle

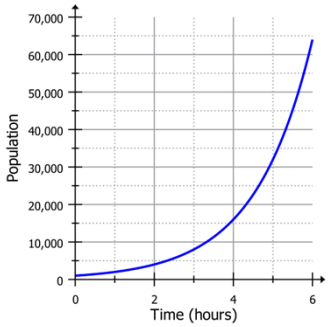
- The water cycle describes the continuous movement of water on, above, and below the Earth's surface.
- It involves processes such as evaporation, condensation, precipitation, and runoff, allowing water to change between liquid, solid, and gas forms.



Population Growth

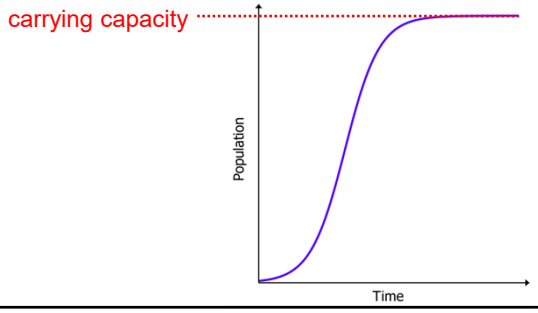
- Thomas Malthus (English) published a book in 1798 stating that populations with unlimited natural resources grow very rapidly, which represents an **exponential growth**, and then population growth decreases as resources become depleted, indicating a **logistic growth**.

- The best example of exponential growth is seen in bacteria grown in the lab with unlimited resources.

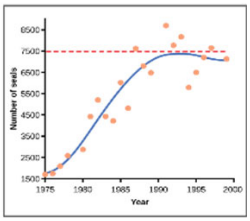


- Exponential growth is possible only when infinite natural resources are available; this is not the case in the real world.
- In the real world, exponential growth cannot continue indefinitely.
- Exponential growth may occur when there are few individuals and plenty of resources, but when the number of individuals gets large enough, resources will be depleted, slowing the growth rate.
- Eventually, the growth rate will plateau or level off.

- This population size, which represents the maximum population size that a particular environment can support, is called the **carrying capacity**.



- In the real world populations fluctuate due to many factors, including adaptation to the environment, weather conditions, and competition between organisms.



- The factors that control (or limit) a population are called limiting factors.
  - Some examples:
    - Resource availability
      - Food, water, shelter
    - Disease
    - Competition
    - Natural disasters
      - Flood, drought, fire
    - Weather