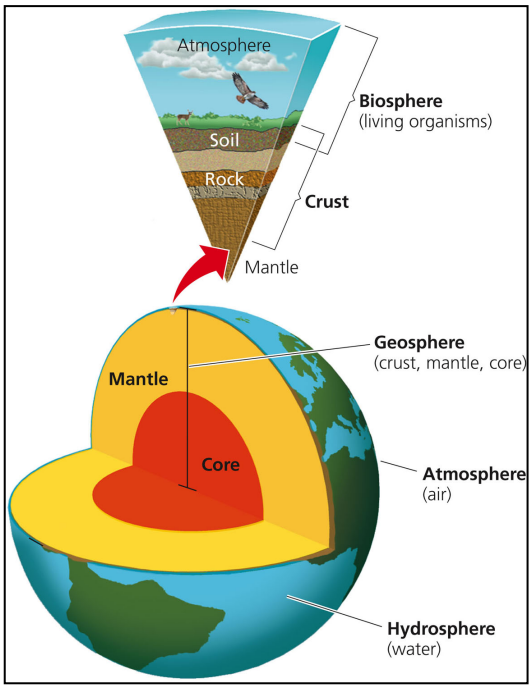
# Chapter 3- Ecosystems: What Are They and How Do They Work? (Part 1)

## The Four Earth Systems

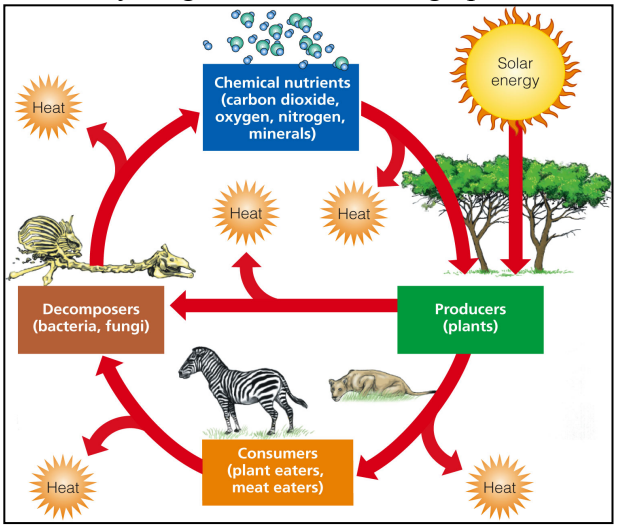
- **Atmosphere**
  - **Troposphere**
    - where weather happens
  - **Stratosphere**
    - contains ozone layer
- **Hydrosphere**
- **Geosphere**
- **Biosphere**

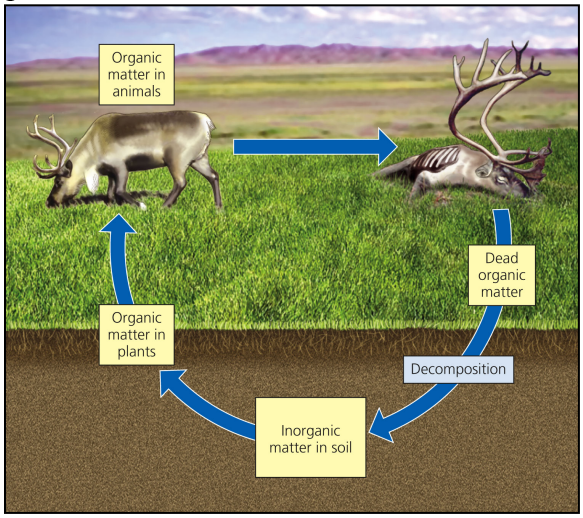



## Sun, Earth, Life, and Climate

### Factors Sustain Life on Earth

- One-way flow of high-quality energy:
  - Sun → plants → living things → environment as heat → radiation to space
- Cycling of nutrients through parts of the biosphere

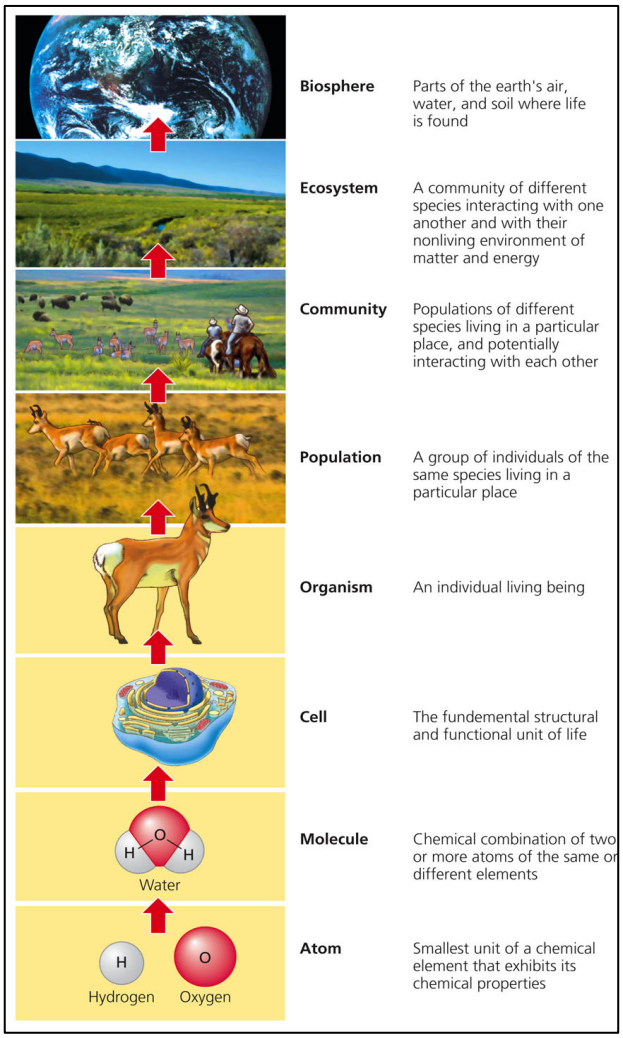


***Ecologists Study Interactions in Nature***

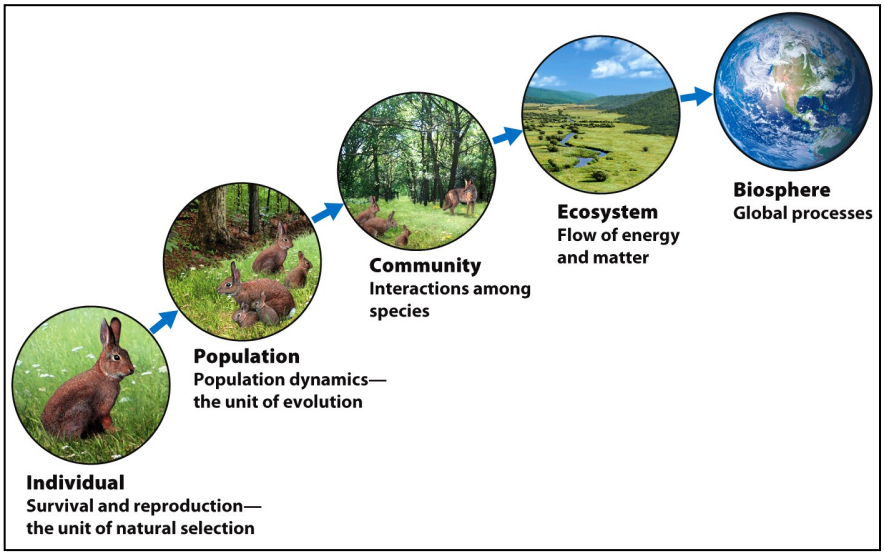
**Ecology:** how organisms interact with each other and their nonliving environment.

- Organisms
- Populations
- Communities
- Ecosystems
- Biosphere



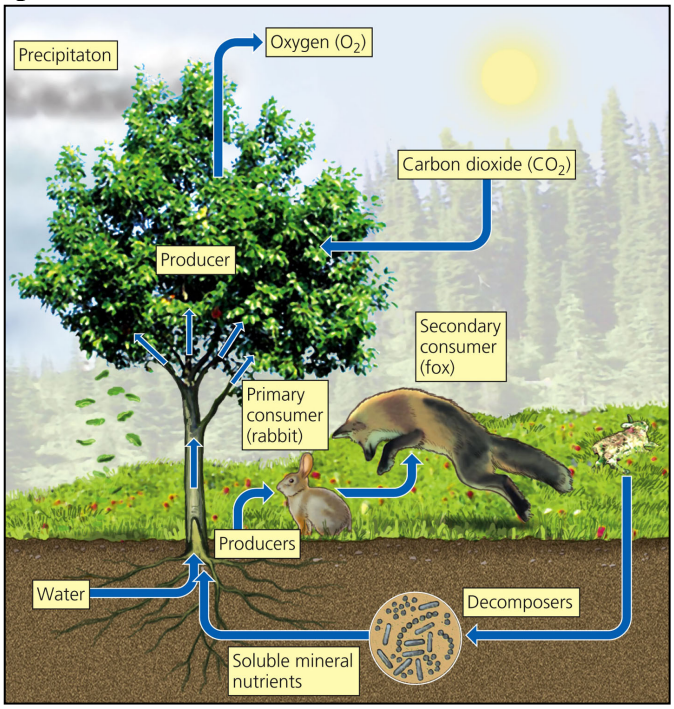

**<u>Levels of Organization</u>**

**Organism→Species→Population→Community→Ecosystem→Biosphere**

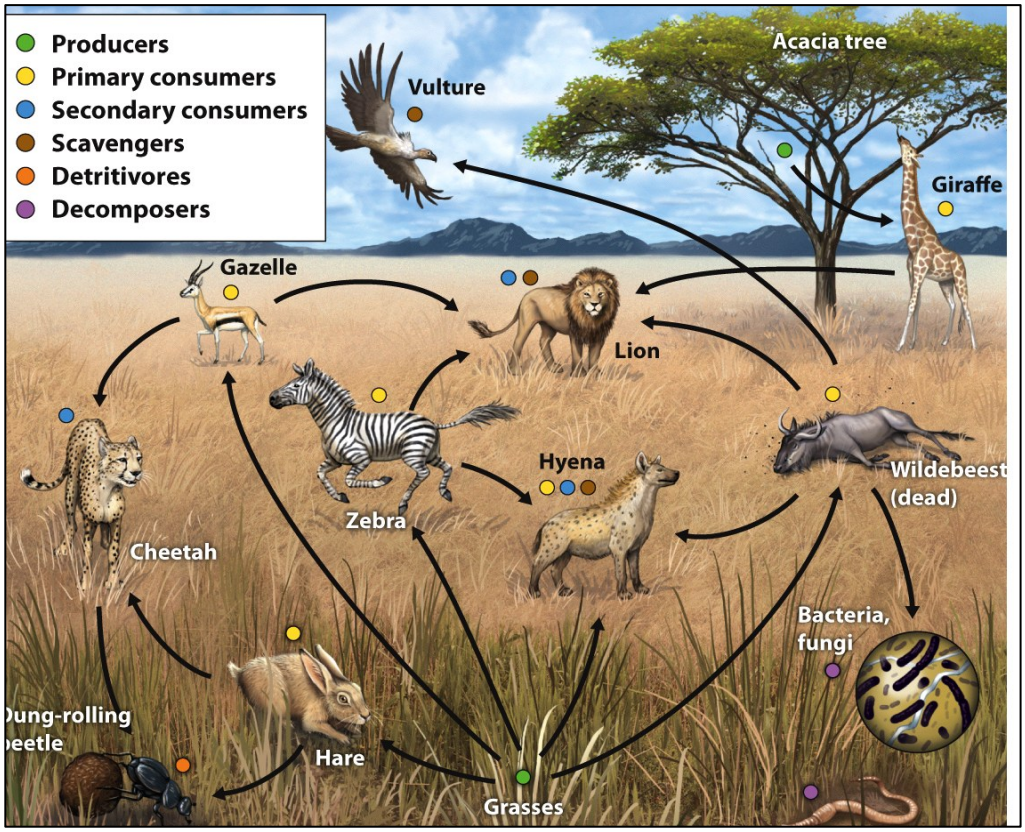


## Ecosystems Have Living & Nonliving Components

- **Abiotic**
  - **Water**
  - **Air**
  - **Nutrients**
  - **Rocks**
  - **Heat**
  - **Solar energy**
- **Biotic**
  - **Living and once living**

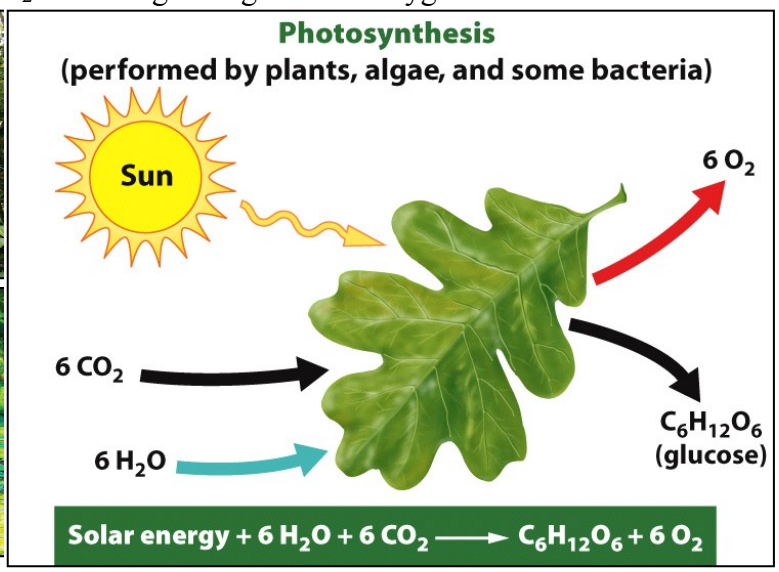



## Producers & Consumers: The Living Components of Ecosystems



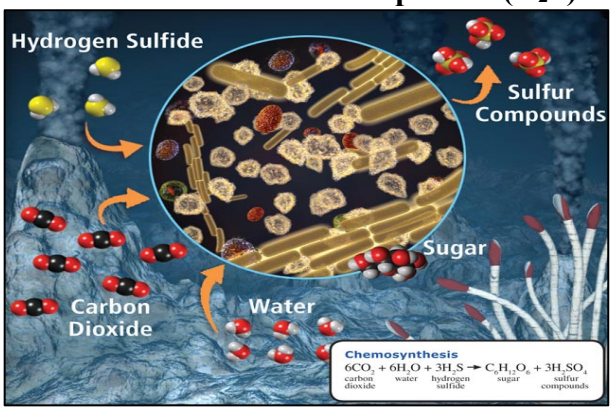
**Producers, autotrophs**

- Photosynthesis: $CO_2 + H_2O$ + sunlight → glucose + oxygen




**Producers, autotrophs**

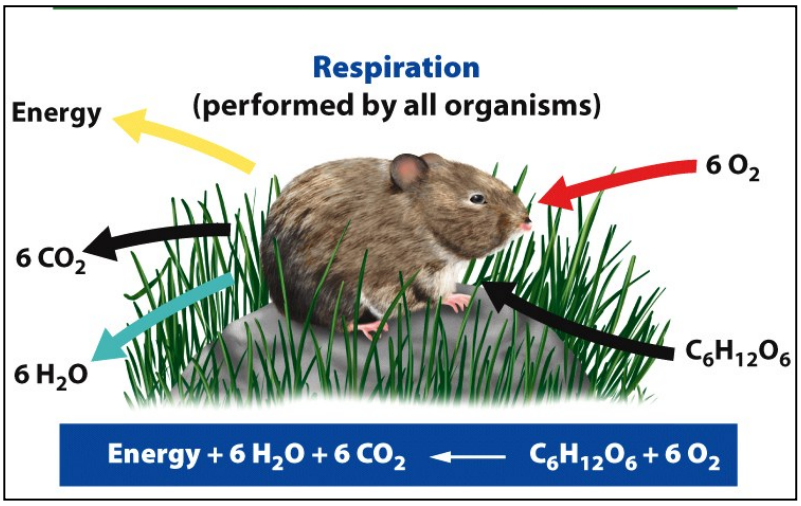
- **Chemosynthesis: chemosynthetic microbes grow on and below the seafloor and even within other animals at the vents**
  - **The microbes break down sulfide compounds ($H_2S$)**



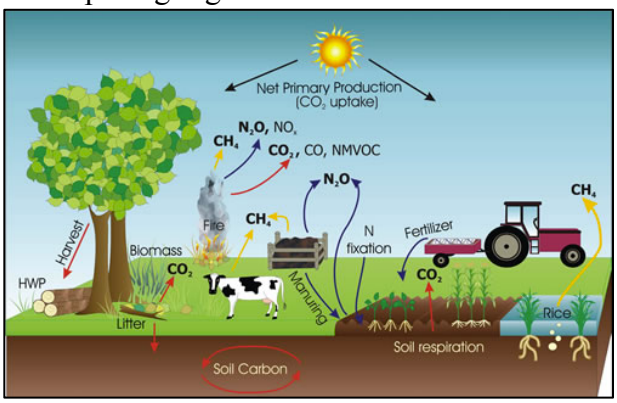

- **Consumers, heterotrophs**
  - Primary consumers = herbivores
  - Secondary consumers
  - Tertiary consumers
  - Carnivores, Omnivores

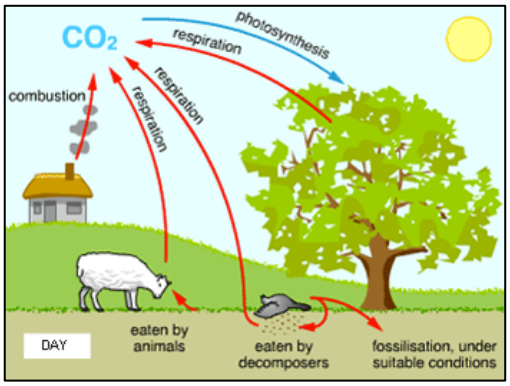
**Aerobic respiration**

- **Using oxygen to turn glucose back to carbon dioxide and water**

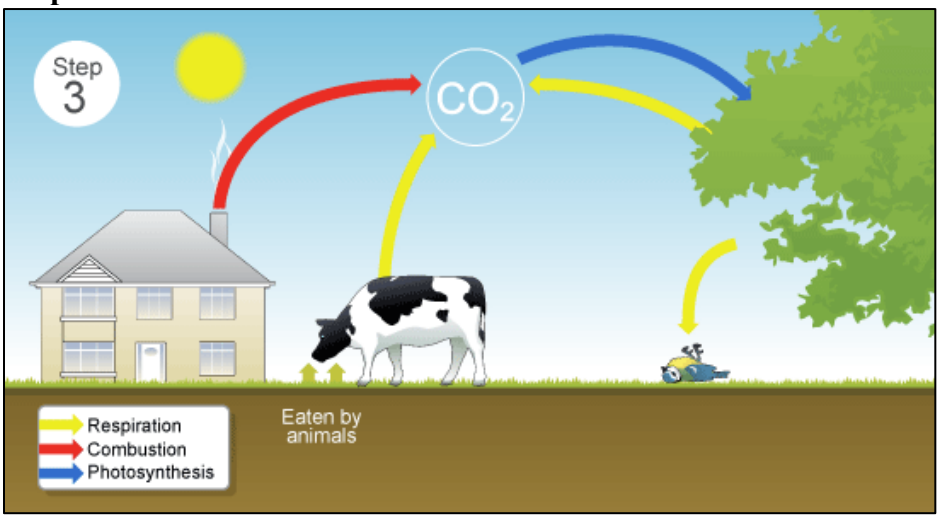



**Aerobic decomposition** is the most common decomposition process in nature. Aerobic microorganisms, such as bacteria & fungus, utilize considerable amounts of oxygen in decomposing organic matter.



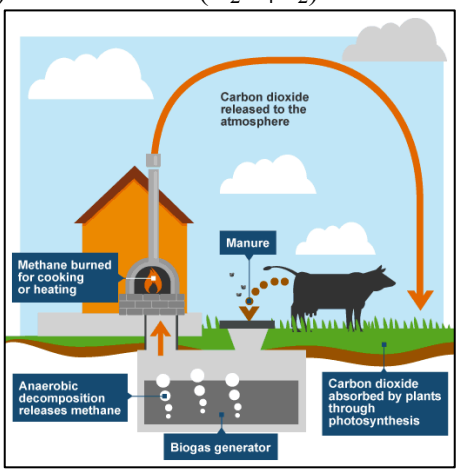




**Aerobic decomposition**



**Anaerobic respiration: fermentation and decomposition**

- Breakdown of glucose/cellulose in absence of oxygen often by bacteria and fungus.
- Products are **methane** ($CH_4$), **ethyl alcohol** ( $C_2H_6O$) & **acetic acid** ($C_2H_4O_2$)



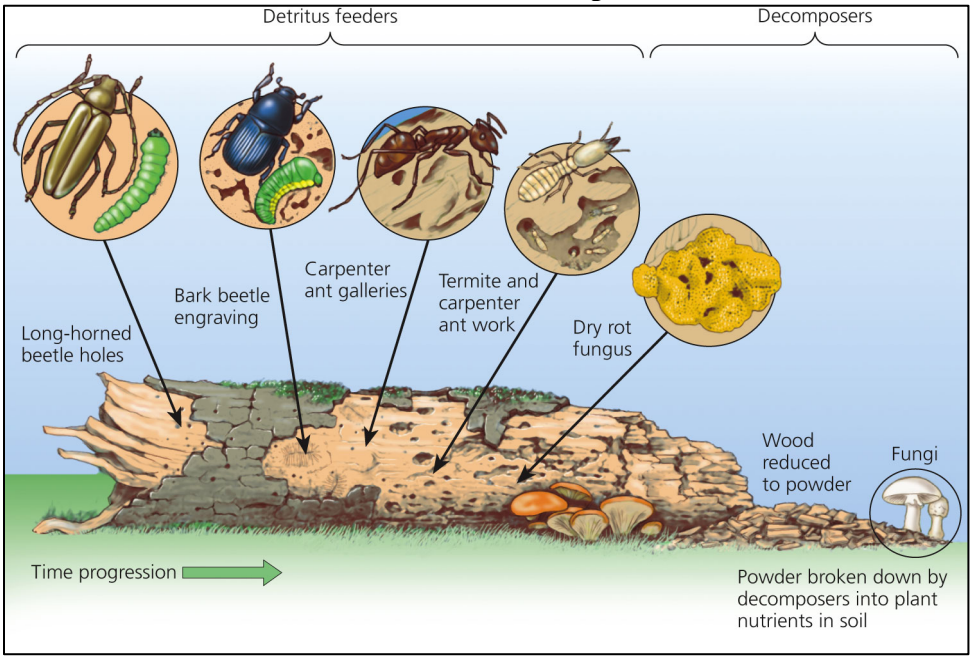

**Decomposers**

- Consumers that release nutrients
- Bacteria
- Fungi

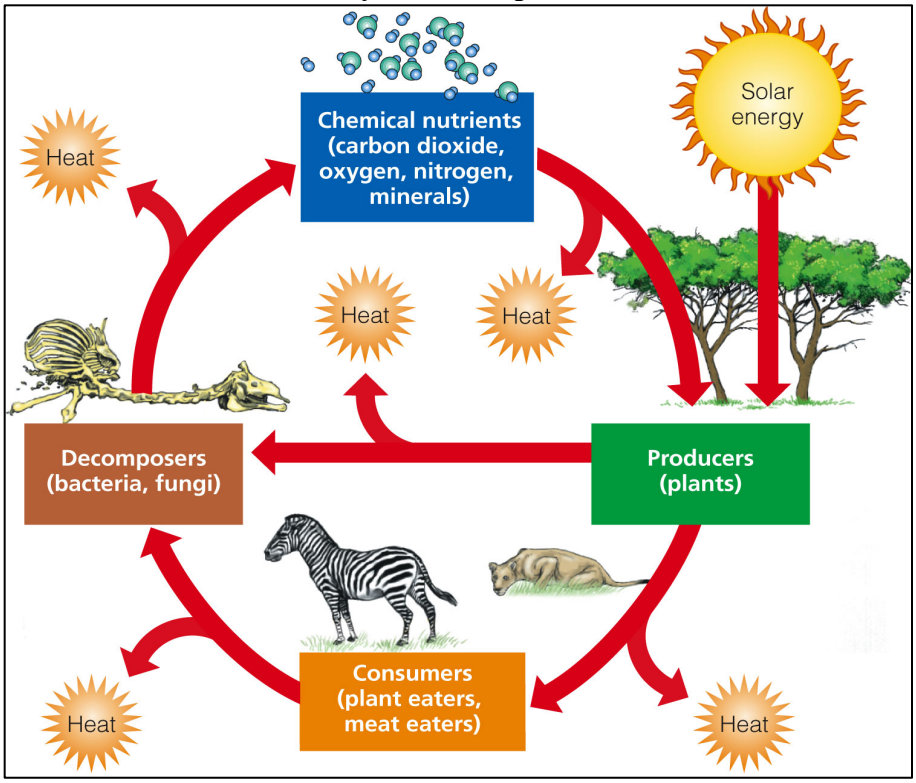
**Detritivores**

- Feed on dead bodies of other organisms
- Earthworms
- Vultures

## Detritivores & Decomposers



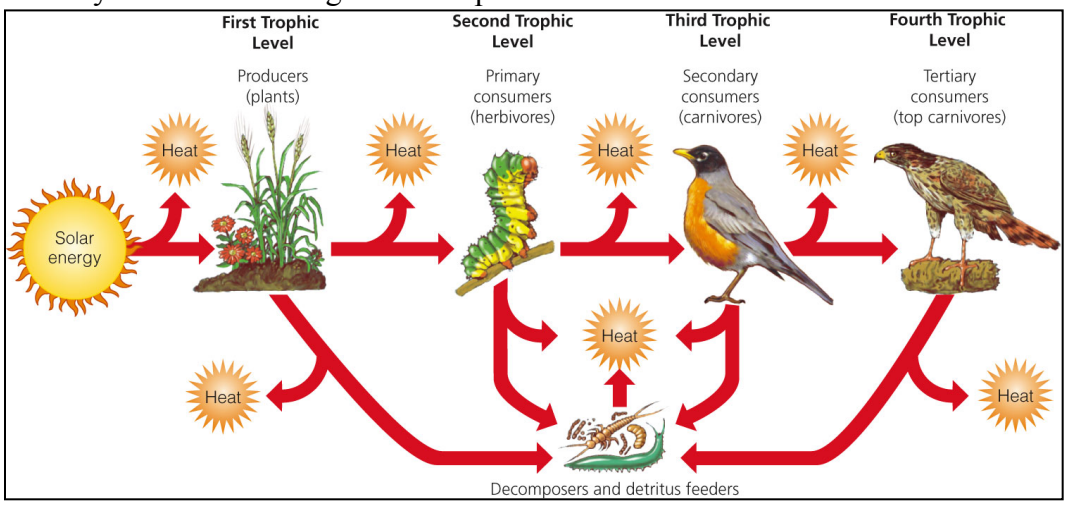

## Ecosystem Components



**Energy Flows Through Ecosystems in Food Chains and Food Webs**

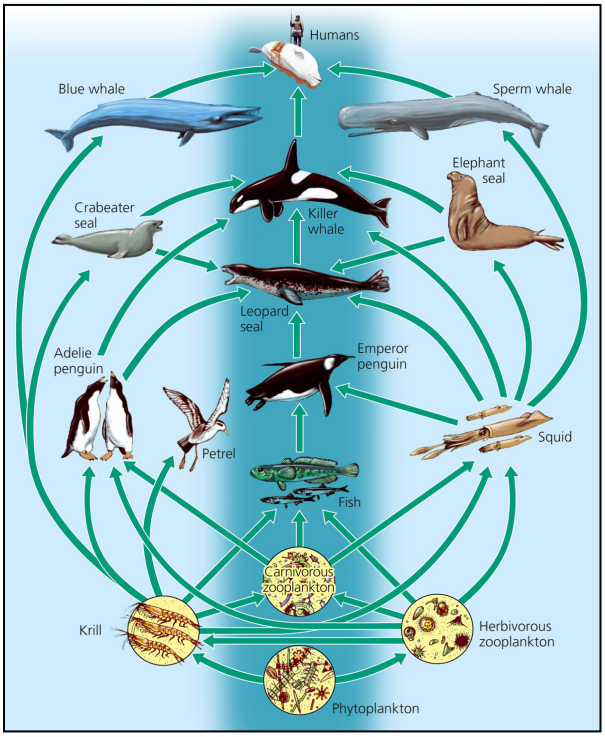
**Food chain**

- Movement of energy and nutrients from one trophic level to the next
- Photosynthesis → feeding → decomposition

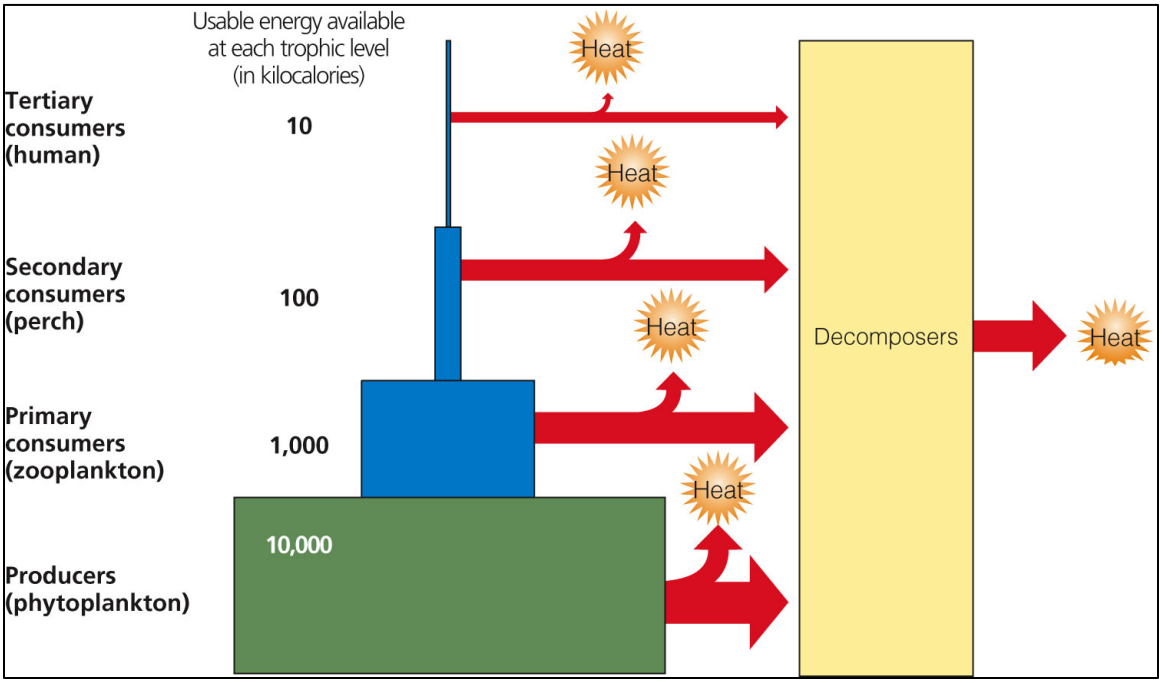



**Food web**

- **Network of interconnected food chains**



**Usable Energy Decreases with Each Link in a Food Chain or Web**
**Pyramid of energy flow** → 90% of energy lost with each transfer
Less chemical energy for higher trophic levels

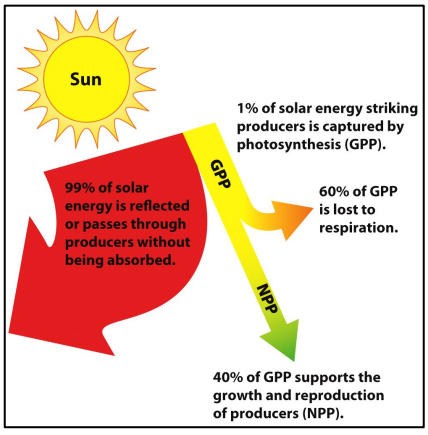



**Some Ecosystems Produce Plant Matter Faster Than Others Do**
**Biomass**

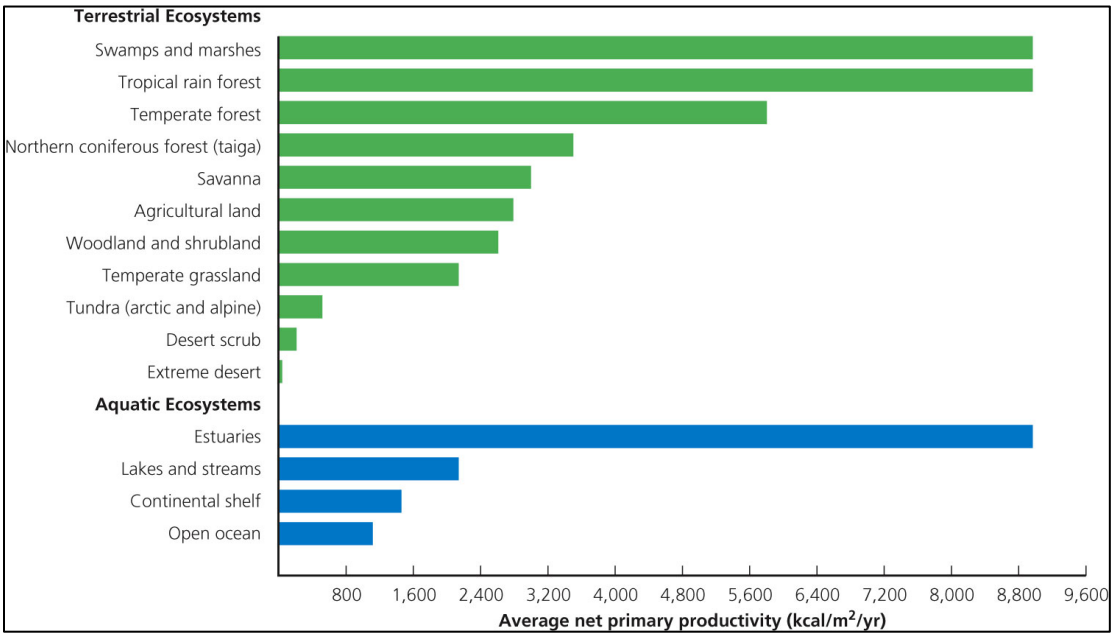
- Dry weight of all organic matter of a given trophic level in a food chain or food web
- Decreases at each higher trophic level due to heat loss

**Gross primary productivity (GPP)**
Rate at which an ecosystem's producers convert solar energy to chemical energy and biomass
→ Kcal/$m^2$/year

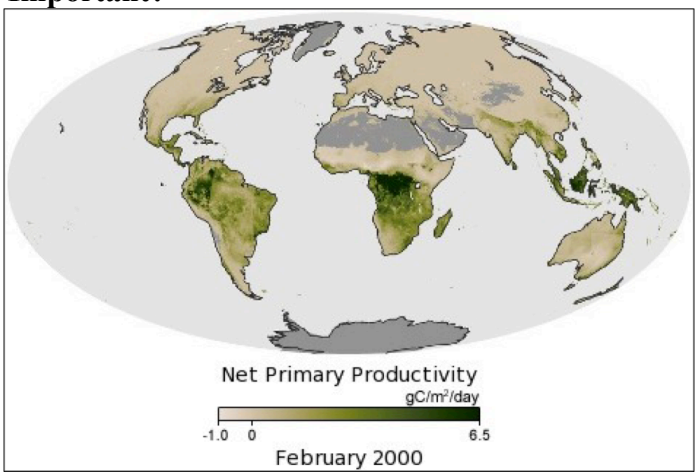
**Net primary productivity (NPP)**
Rate at which an ecosystem's producers convert solar energy to chemical energy, *minus* the rate at which producers use energy for aerobic respiration
-Ecosystems and life zones differ in their NPP



## Average Net primary productivity (NPP) of Various Ecosystems




## Why Productivity is Important?




**Example**

The amount of sunlight that reaches a lake determines how much algae (phytoplankton) can live in the marine ecosystem.

Amount of Algae determine the number of zooplankton the marine ecosystem can support.

Size of zooplankton population determines size of fish population.