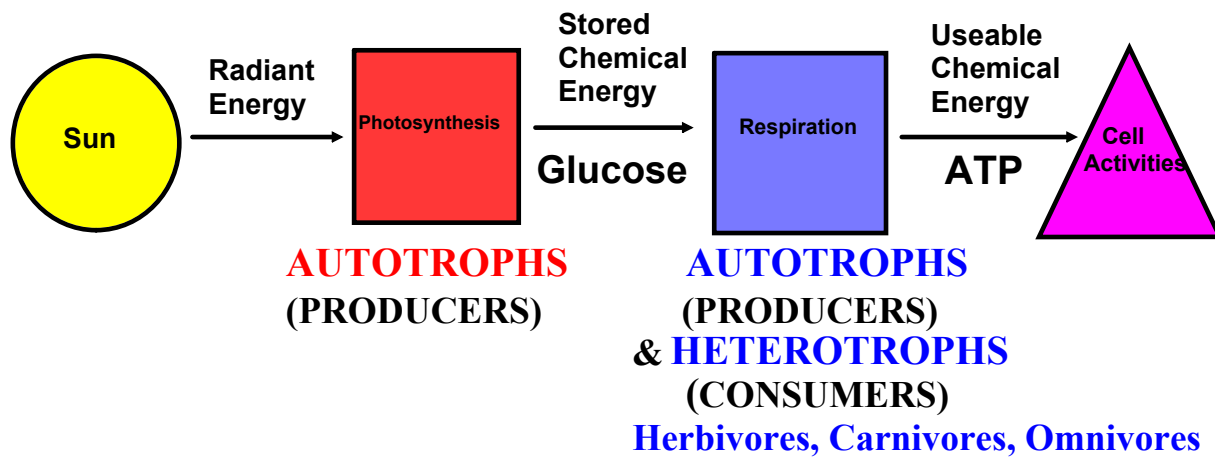


FLOW OF ENERGY



Chapter 13: Principles of Ecology

I. Sharing the World

- Studying nature
 - List ways one can study or observe nature: *ID* plants and animals, keep records of *rainfall and temperature*, where things *grow*, who *eats* them, time of year for mating



II. What is Ecology?

- **Ecology** = the study of interactions that take place between organisms and their environment.
 - Ecological research combines information and techniques from scientific fields, including **mathematics, chemistry, physics, geology**, etc.



III. The Biosphere

= **the portion of Earth that supplies living things.**

- It extends from high in the atmosphere to the bottom of the oceans.
- Living things are affected by both living and nonliving.



A. The nonliving environment or Abiotic factors include *air currents, temperature, moisture, light, soil content, pH*, etc.

B. The living environment or Biotic factors include organisms depending on others *directly or indirectly* for food, *shelter, reproduction*, or *protection*.



IV. Levels of Organization

A. Interactions within populations

1. **Population** = a group of organisms, all of the same specie, which interbreed and live in the same area.
2. Members of the same population may compete with each other for *food, water, mates*, or other resources.
3. **Competition** increases when resources are in short supply.
4. Some species have *adaptations* that reduce competition.

B. Interactions within communities

1. **Biological community** = interacting populations in a certain area.
2. There are ecological levels of organization:
 - a. **Organism**
 - b. **Population**
 - c. **Biological community**
 - d. **Ecosystem**
 - e. **Biome**
 - f. **Biosphere**

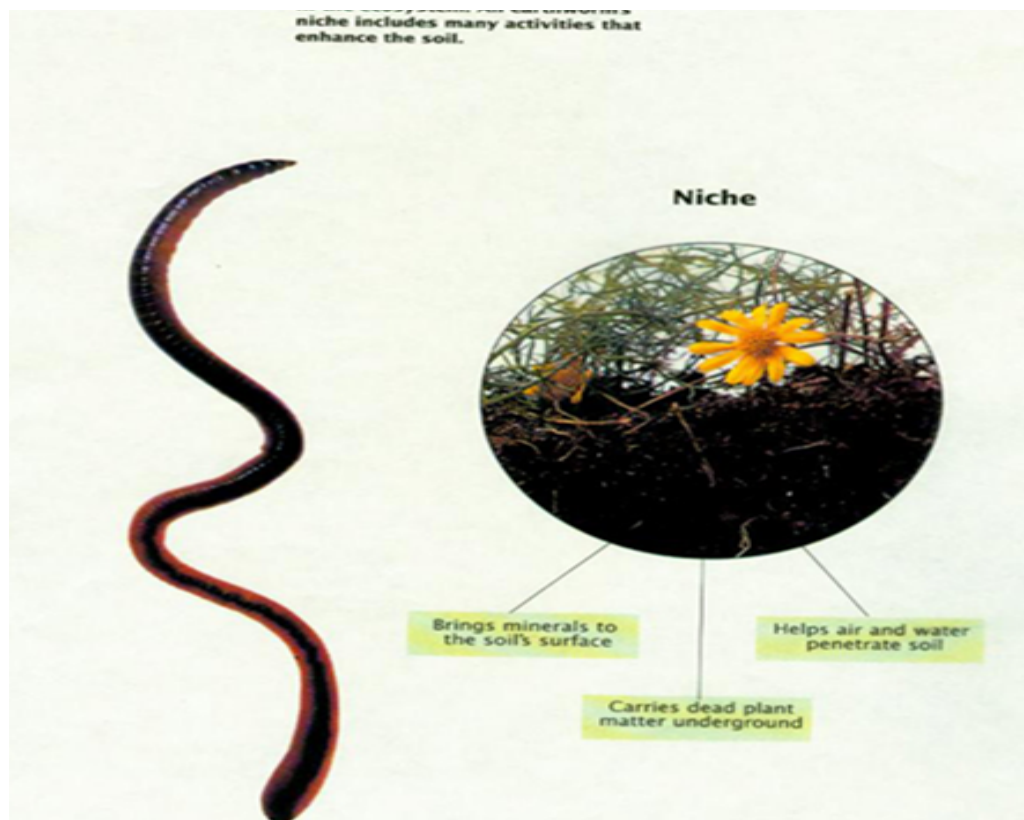
C. Biotic and Abiotic factors form ecosystems

- **Ecosystem** = interacting populations in a biological community along with its abiotic factors.



III. Organisms in Ecosystems


- **Habitat** = *the place where an organism lives out its life.*
- **Niche** = all the *strategies and adaptations* a species uses in its environment - *how it meets* specific needs for food and shelter, *how and where* it survives, and *where and when* it reproduces.
- No two species can occupy the same niche for very long, one will have *to move or it will become extinct.*



HOLT
BIOSOURCES
TEACHING TRANSPARENCIES

Effect of Competition on an Organism's Niche

87



a The barnacle *Chthamalus stellatus* can live in both shallow and deep water on a rocky coast. These areas are its fundamental niche.

b The barnacle *Balanus balanoides* prefers to live in deep water, which is its fundamental niche.

c When the two barnacles live together, *Chthamalus* is restricted to shallow water, its realized niche. What is the realized niche of *Balanus*?

IV. Symbiosis

= The close or permanent association between organisms of different species (*meaning living together*).

- There are three kinds of symbiosis: mutualism, commensalism, and parasitism.

A. Mutualism

= relationship in which both species *benefit*.

Ex: Ants and acacia trees



B. Commensalism

= relationship in which one species *benefits* and the other species is *neither harmed nor benefited*.

Ex: Spanish moss growing on a tree



C. Parasitism

= relationship in which a member of one species *benefits at the expense of* another species (the host). Ex: Ticks



I. How organisms Obtain Energy

A. The Producers

1. ***Autotrophs*** = An organism that uses light (radiant) energy stored in chemical compounds to make energy-rich compound.
EX: ***glucose***
2. The ultimate energy source for autotrophs is the ***sun***.
EX: trees, grasses, shrubs, algae, etc.

B. The Consumers

1. ***Heterotroph*** = An organism that can't make its food and feeds on other organisms. EX: consumers.
2. Some feed on autotrophs and some feed on other heterotrophs.
3. Herbivore - ***plant eaters***
Carnivore - ***animal eaters***
Omnivore - ***plant and animal eater***

4. ***Detritivores*** -obtain nutrients by consuming ***detritus*** (decomposing plant and animal parts as well as feces)

Ex: Scavengers, like buzzards & earthworms

Term interchanges (but shouldn't), with

Decomposers = organisms that ***break down*** dead decaying plants and animals.

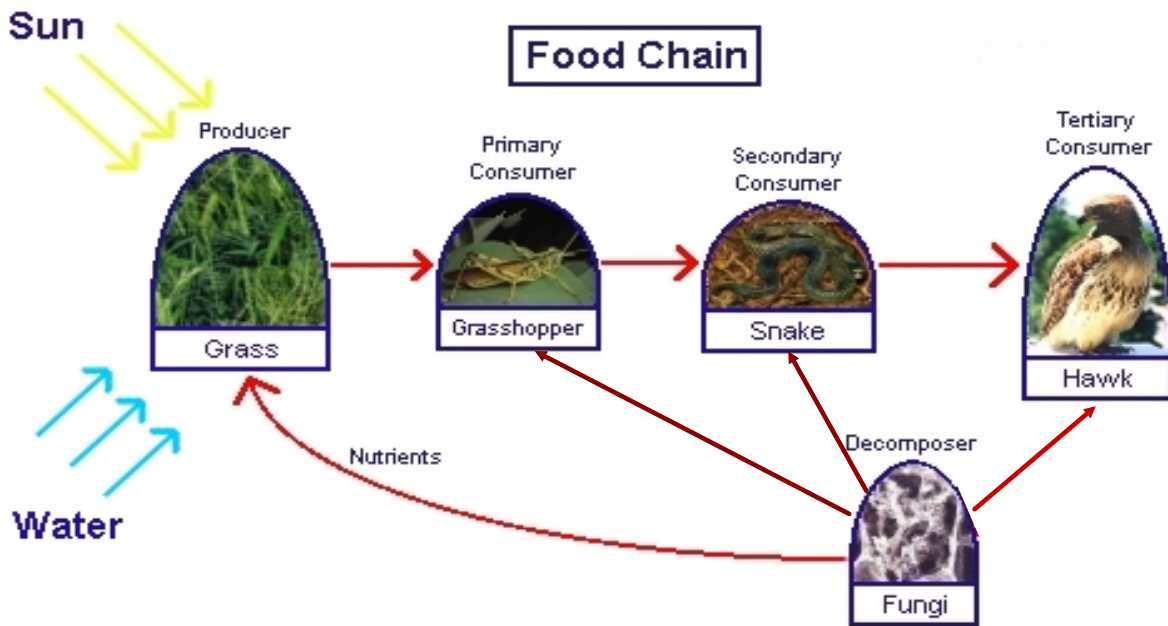
EX: some bacteria, some protists, and most fungi

II. Flow of Matter and Energy

- Matter, in the form of carbon, nitrogen, and other elements, flows through the levels of an ecosystem from ***producers*** to ***consumers***. In doing so, the ***matter is cycled***.

A. Food Chains: Pathways for matter and energy.

1. ***Food chain*** = a simple model that shows how matter and energy move through an ecosystem.
2. EX: berries → mice → black bear
3. The amount of energy remaining in the final transfer is only a portion of what was available at the first transfer. Most energy is given off as ***heat energy***.

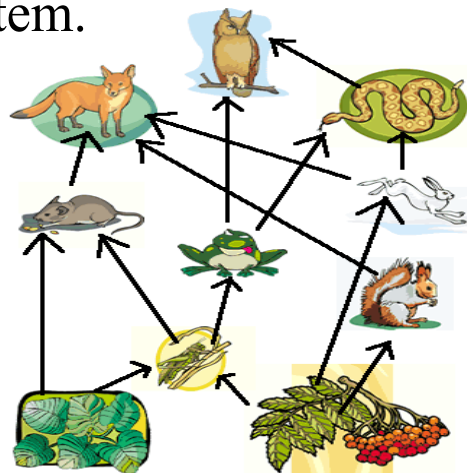


B. Trophic levels represent links in the chain

Trophic level = an organism that represents a feeding step in the movement of energy and materials through an ecosystem.

C. Food Webs

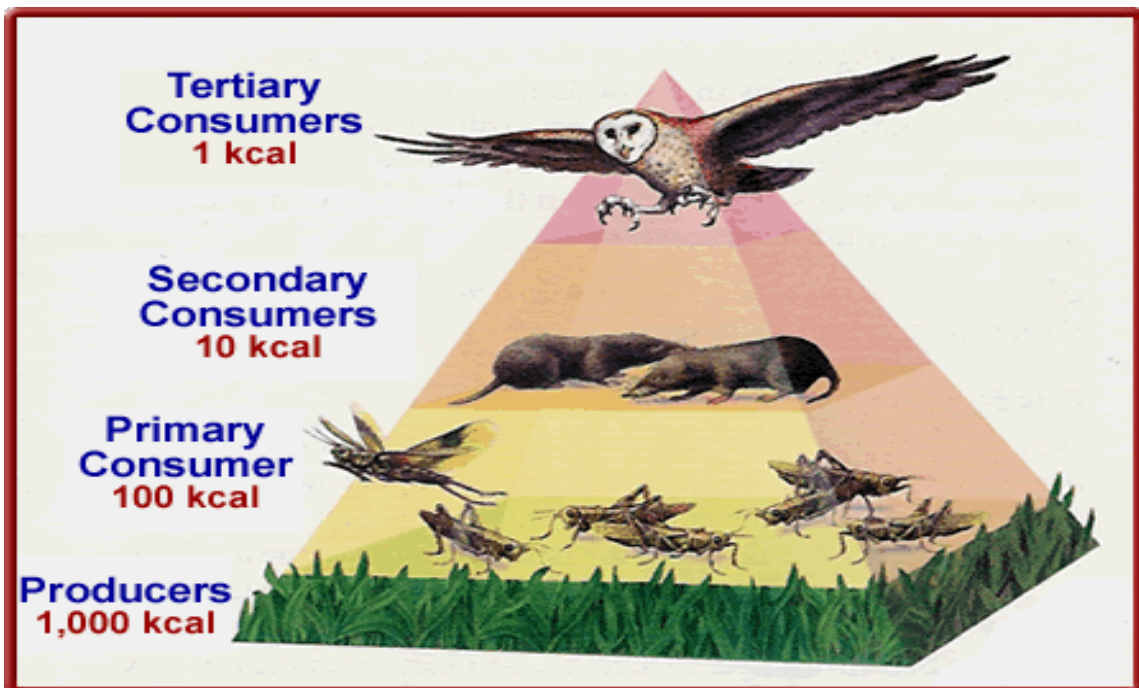
= a model that shows all the possible **feeding relationships** at each trophic level in a community.



D. Energy and trophic levels: Ecological pyramids

1. **Ecological pyramids** = a model that shows how energy flows through an ecosystem.
2. Only **10%** of the energy present at each level is transferred to the next higher trophic level.

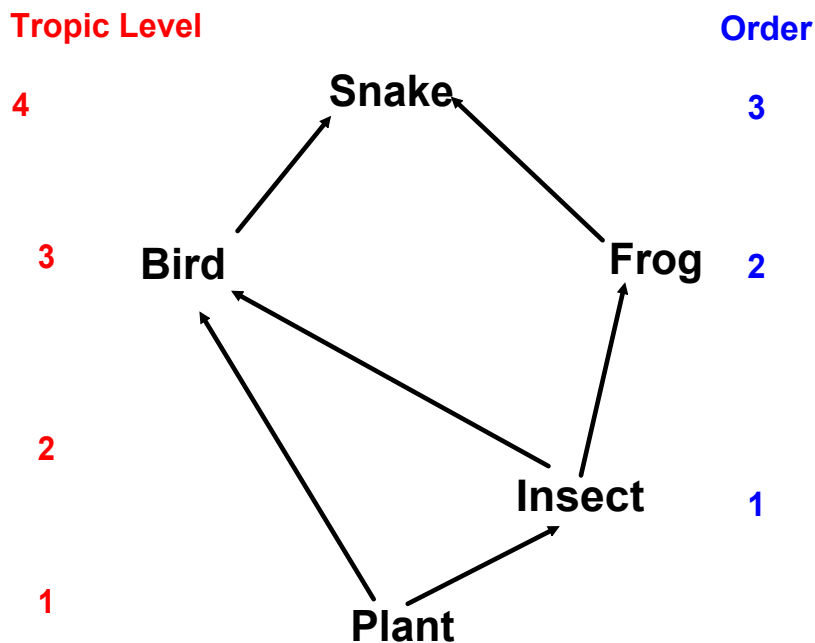
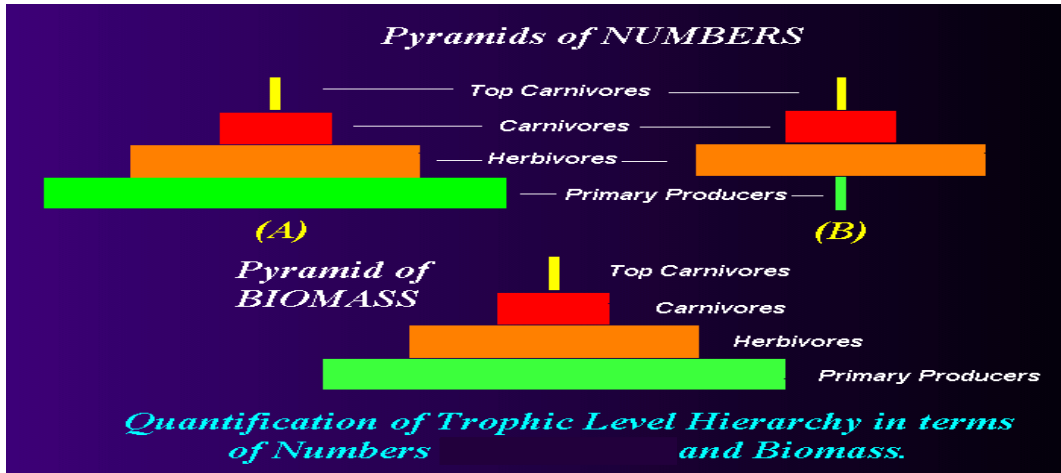
The rest is given off as **heat** or used by the organism itself for **metabolic use** (building body tissue, enzymes, etc).



3. **Biomass** = the total weight of living matter at each trophic level.

ADD TO NOTES:

4. **Number pyramid-** (can also be inverted, i.e. a tree)

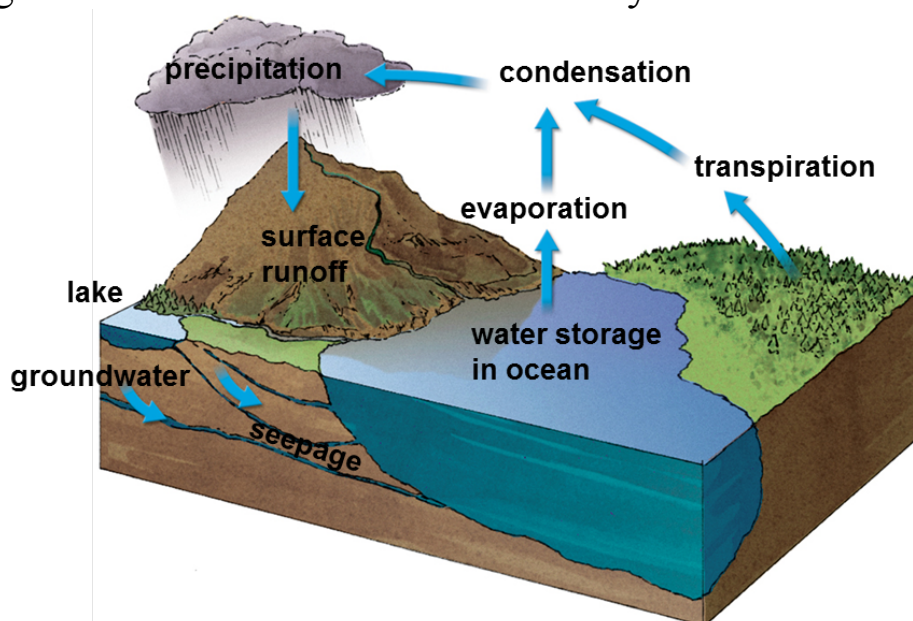


Section 13.5 Cycles in Nature

- Matter, in the form of *nutrients*, moves through, or is part of, all organisms at each trophic level.
- Matter, as well as energy, is *cycled* and is not *replenished*. (Cannot be created or destroyed, just recycled in different forms.)

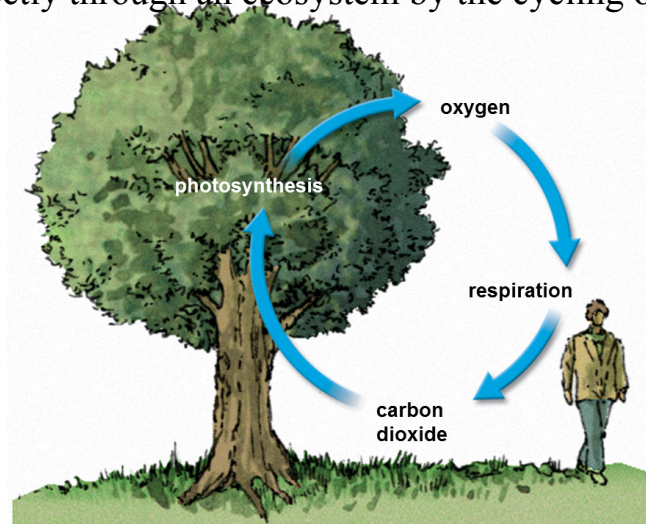
A. The water cycle

- The *hydrologic*, or water, cycle is the circular pathway of water on Earth.
- Organisms all have bodies made mostly of water.



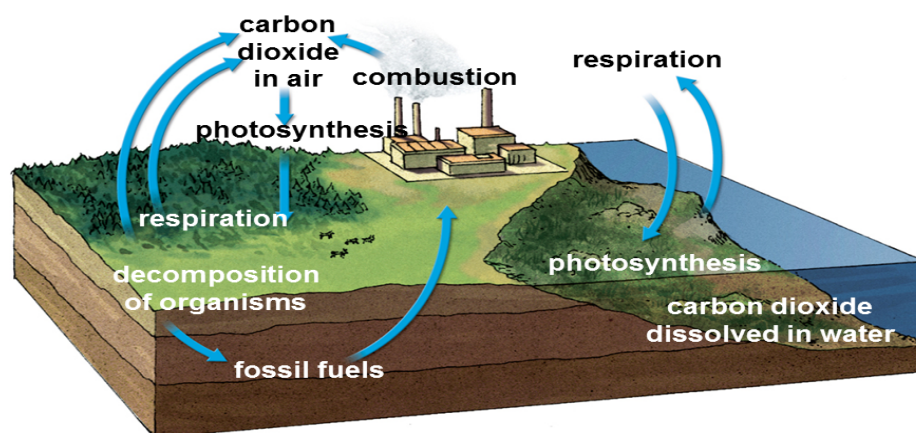
Elements essential for life also cycle through ecosystems.

- A **biogeochemical** cycle is the movement of a **particular chemical** through the biological and geological parts of an ecosystem.
- The main processes involved in the oxygen cycle are **photosynthesis and respiration**.
- **Oxygen** cycles indirectly through an ecosystem by the cycling of other nutrients.



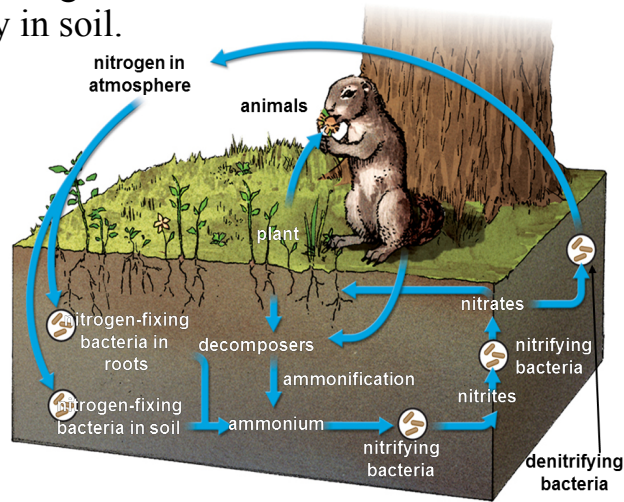
B. The carbon cycle - Carbon is the building block of life.

- The **carbon** cycle moves carbon from the atmosphere, through the food web, and back to the atmosphere.
 - > Carbon is emitted during the **burning of fossil fuels**.
 - > Some carbon is stored for long periods of time in areas called **carbon sinks**.

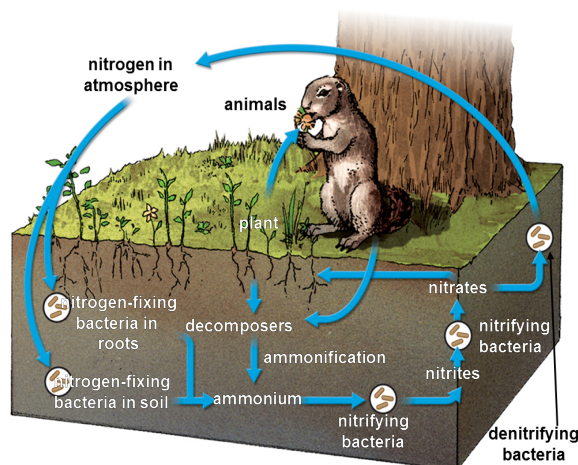


C. The nitrogen cycle - The nitrogen cycle mostly takes place underground.

- > Some bacteria convert gaseous nitrogen into ammonia through a process called **nitrogen fixation**.
- > Some nitrogen-fixing bacteria live in nodules on the **roots** of plants; others live freely in soil.

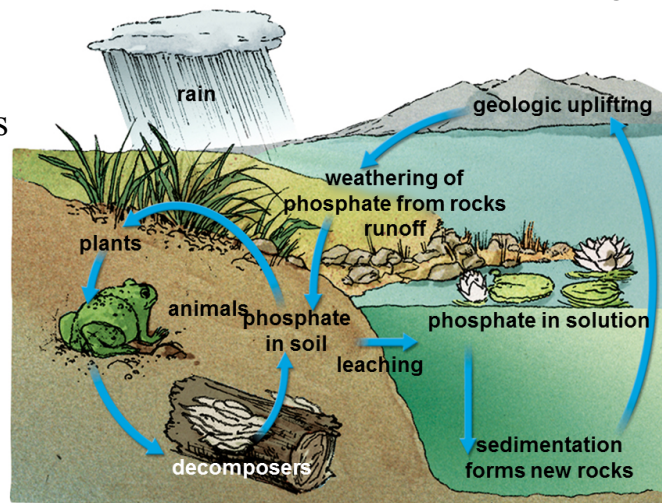


- > **Ammonia** released into the soil is transformed into ammonium.
- > Nitrifying bacteria change the ammonium into **nitrate**.
- > Nitrogen moves through the food web and returns to the soil during **decomposition**.



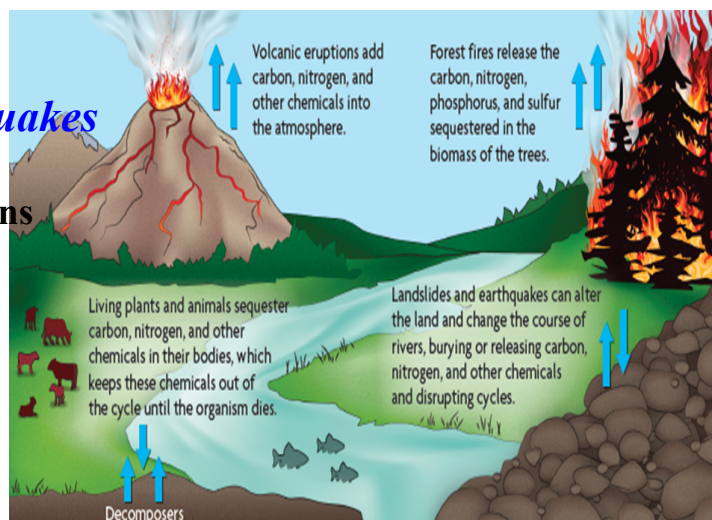
D. The phosphorous cycle - The phosphorus cycle takes place at and below ground level.

- > Phosphate is released by the *weathering of rocks*.
- > Phosphorus moves through the food web and returns to the soil during *decomposition*.
- Phosphorus *leaches* into groundwater from the soil and is locked in sediments.
- Both *mining and agriculture* add phosphorus into the environment.

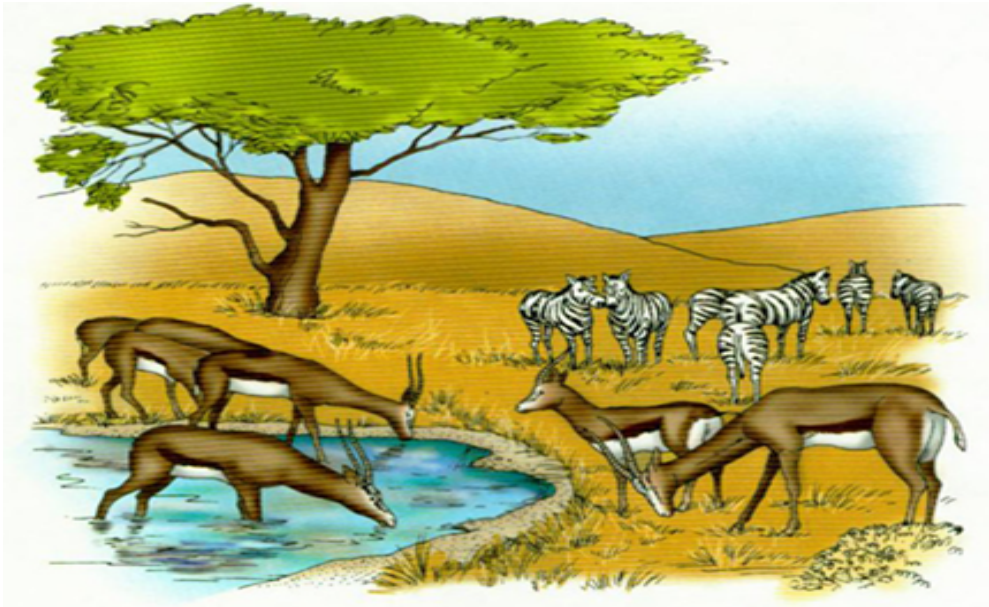


E. Natural and human activities can disrupt biogeochemical cycles and ecosystems.

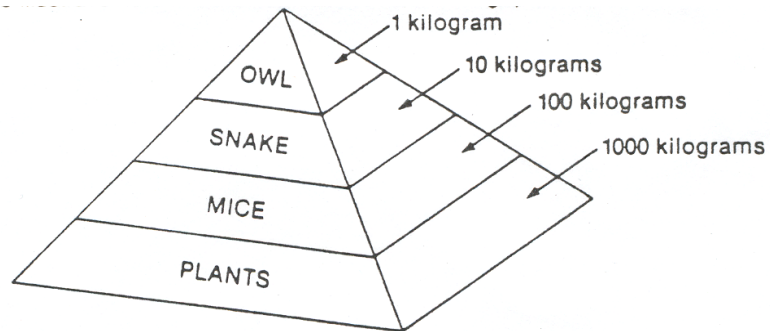
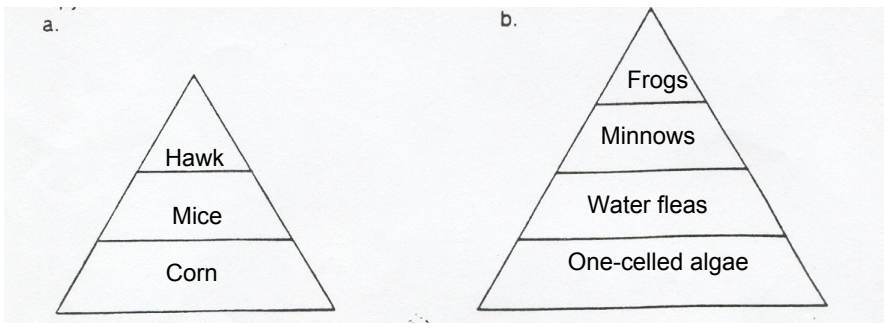
- **Natural disruptions**
 - > *volcanic eruptions*
 - > *forest fires*
 - > *landslides and earthquakes*
 - > *living organisms*
- **Disruptions caused by humans**
 - > *poor farming practices*
 - > *burning fossil fuels*

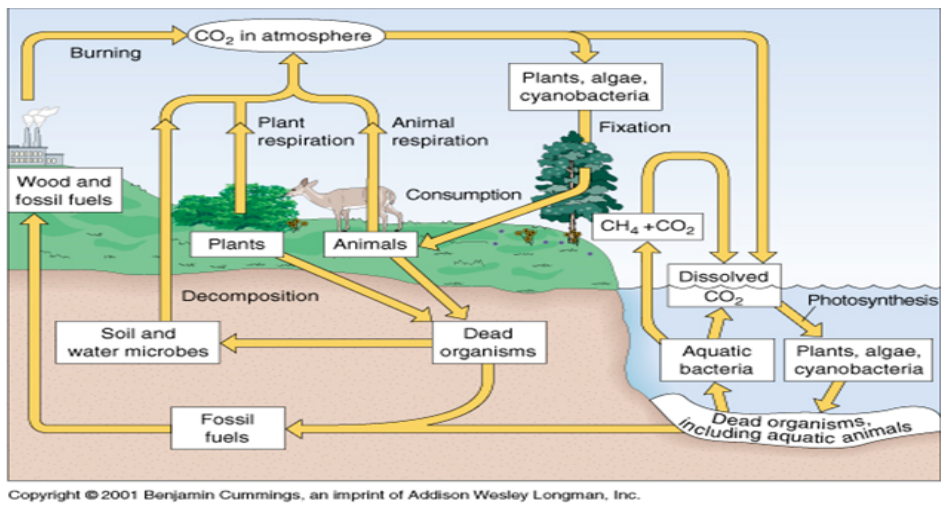
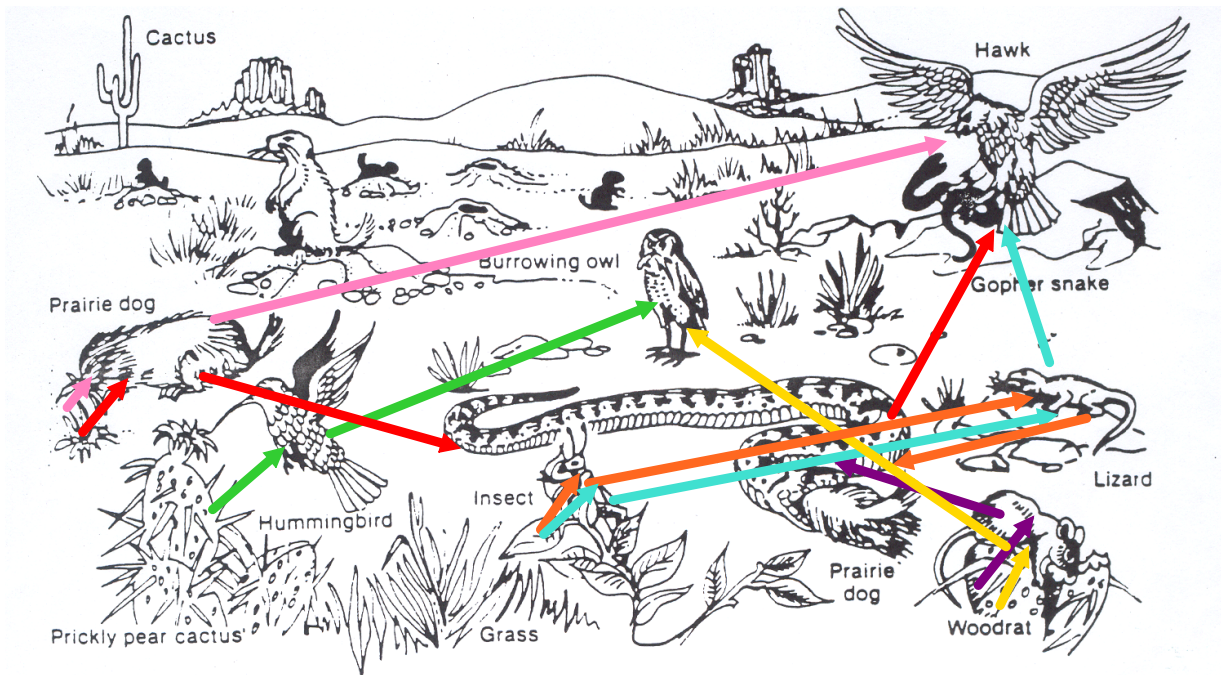


STOP



- 1 How do these organisms interact with one another and with the nonliving parts of the environment?
- 2 What might happen if the zebras were removed?





Copyright © 2001 Benjamin Cummings, an imprint of Addison Wesley Longman, Inc.

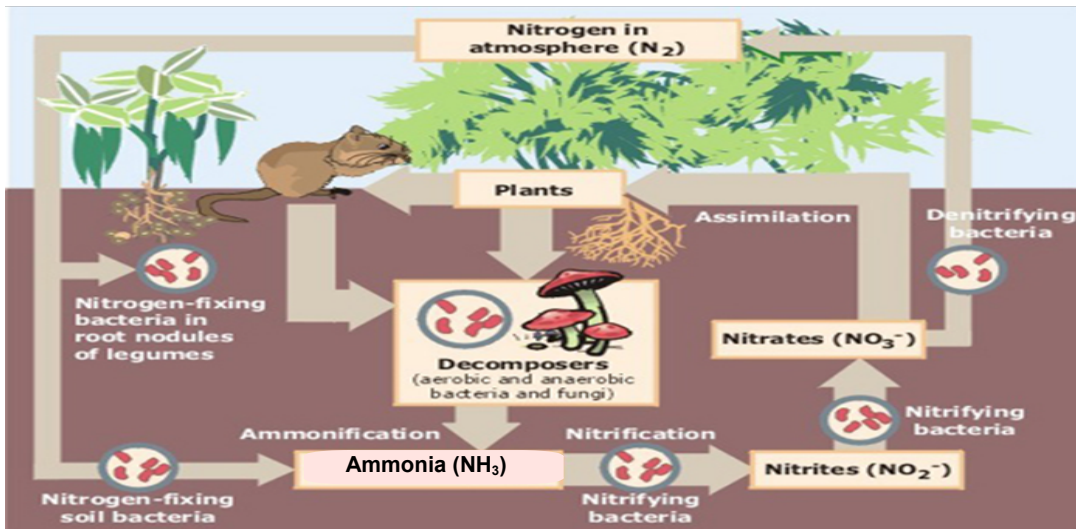
1. What are three ways in which carbon dioxide enters the atmosphere?

Burning, respiration, soil (through decay of organisms).

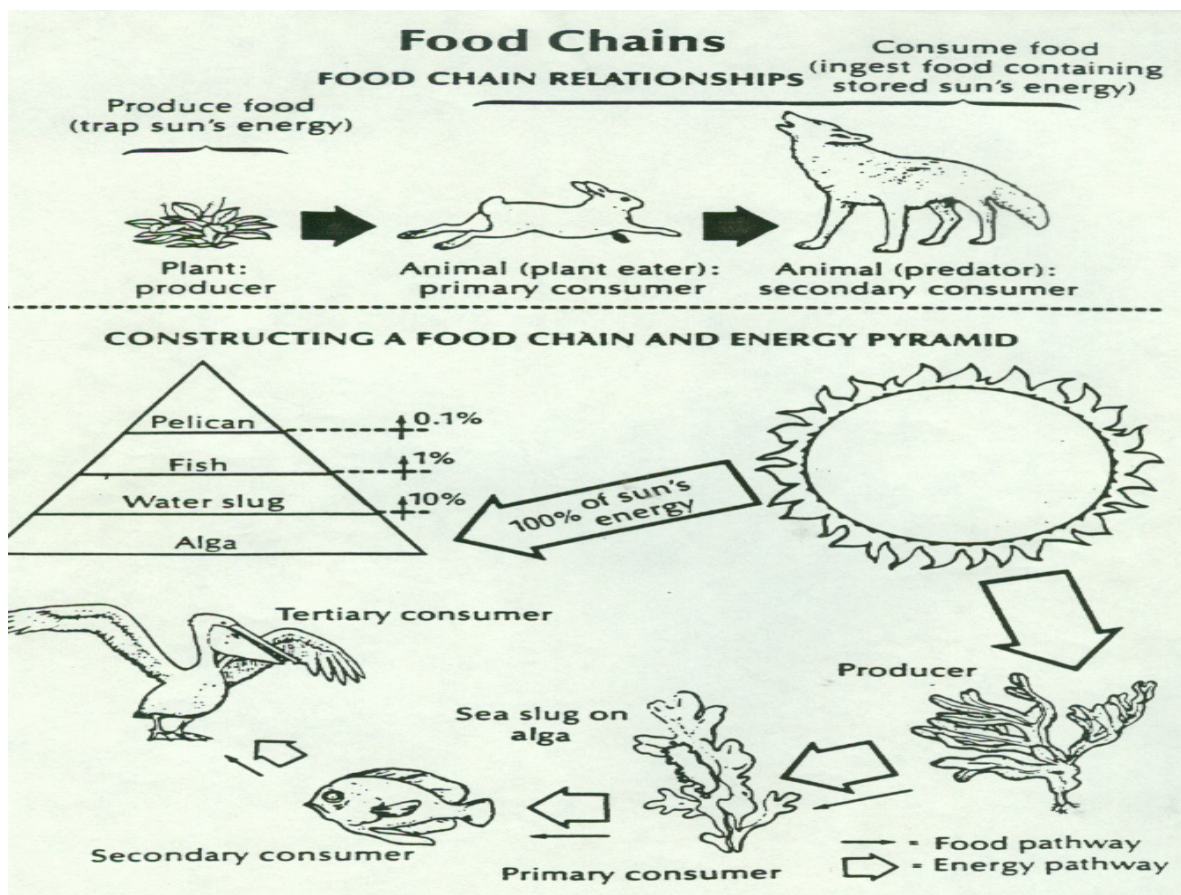
2. How is carbon dioxide removed from the atmosphere?

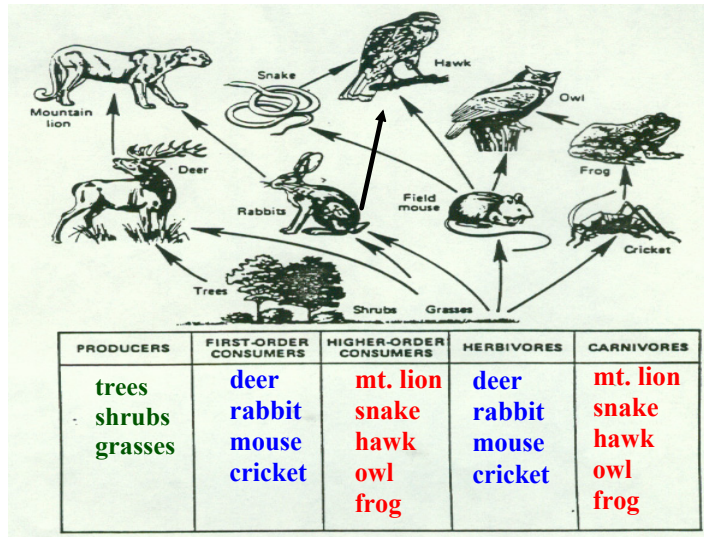
Plants, algae (photosynthesis & dissolved CO₂ from ocean)

3. In what process do plants use carbon dioxide to make carbohydrates? **Photosynthesis**



- How is nitrogen used in plants and animals?
In DNA & proteins
- What are four forms of nitrogen found in the biosphere and where are they found?
N₂ in atmosphere, NO₃⁻, NO₂⁻, NH₃⁺ (in soil)
- What kind of bacteria lives in the soil?
Nitrogen-fixing & nitrification
- What is nitrogen fixation?
By bacteria it is converting N₂ → NH₃⁺ (nitrogen in atmosphere to ammonia by bacteria)
- What is denitrification?
Conversion of nitrates (NO₃⁻) & nitrites (NO₂⁻) to atmospheric N₂ gas





Food Webs

Use the food web below to answer questions 1-5.

- When the hawk is the third-order consumer, the number of second-order consumers is _____.
- The food chain that includes insect-eating birds is _____.
- The animal that consumes the largest number of different types of first-order and second-order consumers is the _____.
- All the animals that are herbivores are _____ consumers.
- If there were no snakes in this food web, the squirrels and rabbits could still be eaten by the _____.