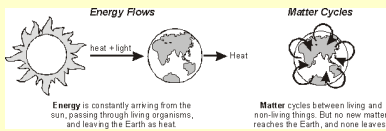


## *Energy and nutrients*

## Ecosystem

Energy *flows* from the sun, through plants, animals, and decomposers, and is lost as heat

Chemicals (nutrients) are *recycled* between air, water, soil, and organisms



## A terrarium ecosystem

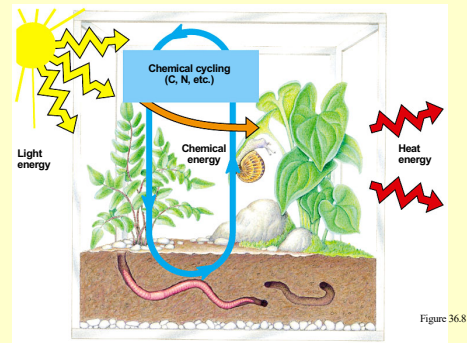


Figure 36.8

Presentation adapted from: Campbell, N., Reece, J., Mitchell, L., Taylor, M., 2003. *Biology: Concepts and Connections*. Powerpoint lectures: Pearson Education, Inc. publishing as Benjamin Cummings.

## *Trophic (food) structure*

A food chain is the stepwise flow of energy and nutrients

- ♦ from plants
- ♦ to herbivores
- ♦ to carnivores

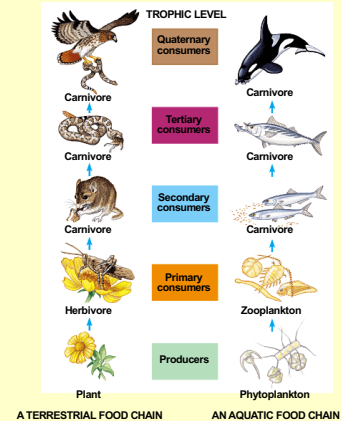


Figure 36.9A

## Decomposition

Detritivores decompose waste matter and recycle nutrients

- Examples: animal scavengers, fungi, and bacteria



Figure 36.9B

Food chains interconnect, forming food webs

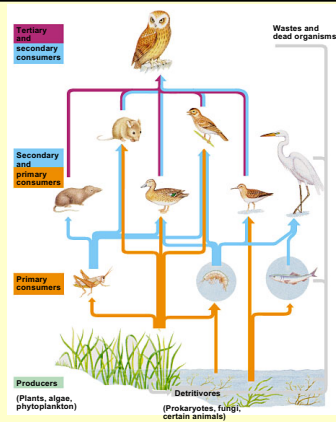


Figure 36.10

Production pyramid: flow of energy from producers to higher trophic levels

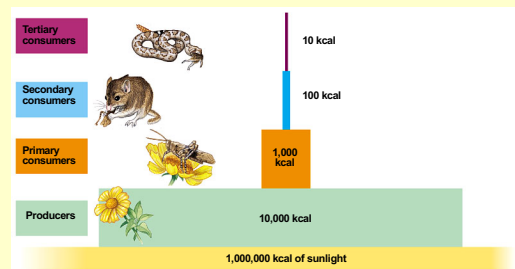


Figure 36.11

Only about 10% of the energy in food is stored at each trophic level and available to the next level

The rest is lost as: feces, growth, cellular respiration, & heat loss

Because the production pyramid tapers so sharply, a field of corn or other plant crops can support many more vegetarians than meat-eaters

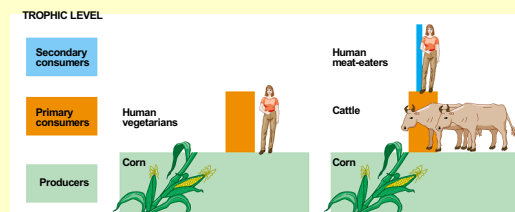


Figure 36.12

*Chemicals are recycled between organic matter and abiotic reservoirs*

Ecosystems require daily infusions of energy

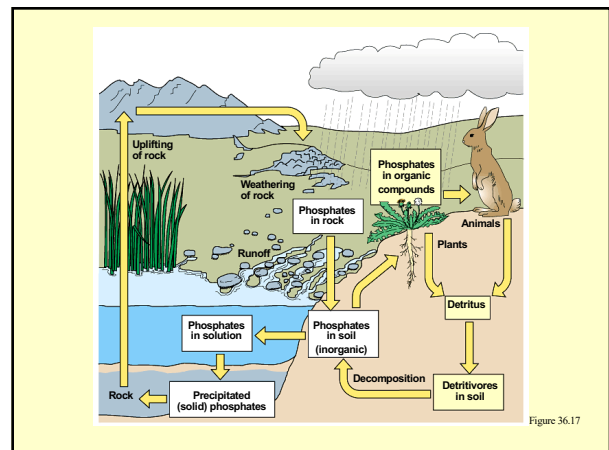
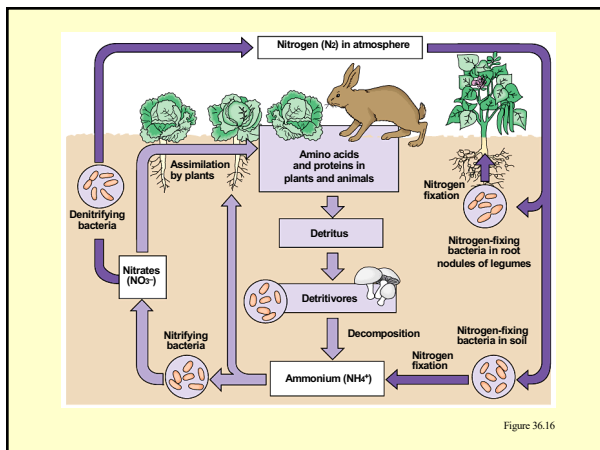
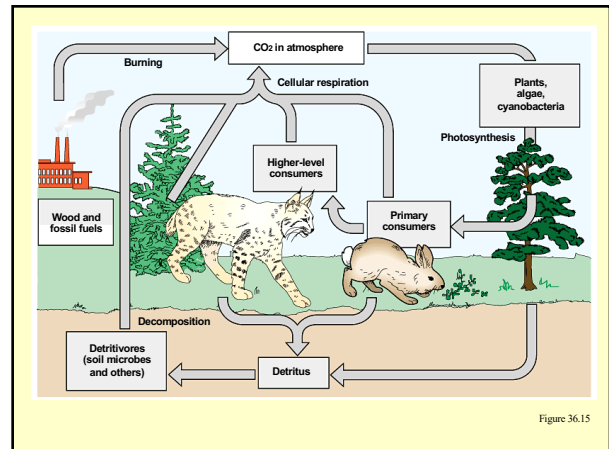
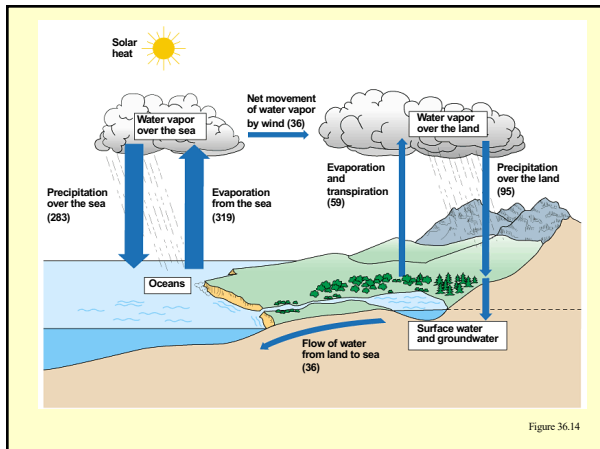
- ♦ The sun supplies the Earth with energy
- ♦ But there are no extraterrestrial sources of water or other chemical nutrients

Nutrients must be recycled between organisms and abiotic reservoirs

- ♦ Abiotic reservoirs are parts of the ecosystem where a chemical accumulates

There are four main abiotic reservoirs

- ♦ Water cycle
- ♦ Carbon cycle
- ♦ Nitrogen cycle
- ♦ Phosphorus cycle



## Nutrient cycling experiment



Dams were built across streams at the bottom of each watershed to monitor water and nutrient losses

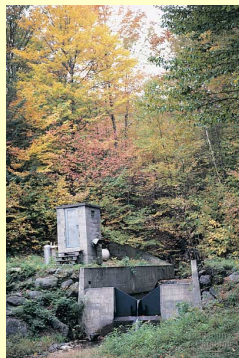


Figure 36.18A

In 1966, one of the valleys was completely logged

- It was then sprayed with herbicides for 3 years to prevent plant regrowth
- All the original plant material was left in place to decompose



Figure 36.18B

Researchers found that the total removal of vegetation can increase the runoff of water and loss of soil nutrients

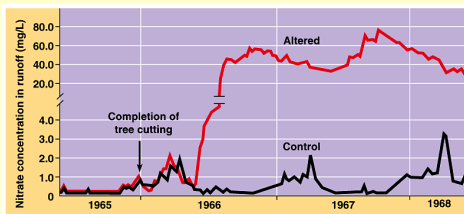


Figure 36.18C

Environmental changes caused by humans can unbalance nutrient cycling over the long term

- Examples
  - a) eutrophication
  - b) acid rain

Algal bloom can cause a pond or lake to lose much of its species diversity

- ♦ Human-caused eutrophication wiped out fisheries in Lake Erie in the 1950s and 1960s



Figure 36.19B

Dr. David Schindler is an ecologist who worked at the Experimental Lakes Project in northern Ontario

- ♦ His experiments on eutrophication led to the ban on phosphates in detergents

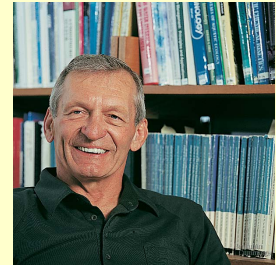


Figure 36.19A

According to Dr. Schindler, there are three serious threats to freshwater ecosystems

- ♦ Acid precipitation
- ♦ Climate warming
- ♦ Changes in land use

*Zoned reserves are an attempt to reverse ecosystem disruption*

The human alteration of ecosystems threatens the existence of thousands of species

- ♦ Zoned reserves
  - a) Undisturbed wildlands surrounded by buffer zones

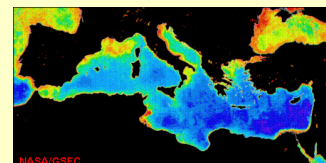
- ♦ Costa Rica has established eight zone reserves

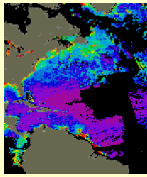
Green:  
reserves

Yellow:  
buffers

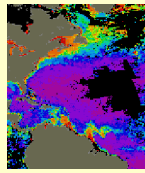


Figure 36.20





Phyoplankton  
: March



Phyoplankton  
: September