Ecological Succession

- **<u>Succession</u>- changes which increase the community complexity over time**
- **<u>Primary succession</u>- succession which takes place when bare, lifeless substrate becomes available for colonization (VERY slow)**
  - **retreating glaciers**
  - **emerging islands**
  - **formation of new lake**

Ecological Succession

- **<u>Secondary Succession</u>- re-colonization following disturbance (much faster than primary succession)**
  - **fire, floods, bulldozers, etc**

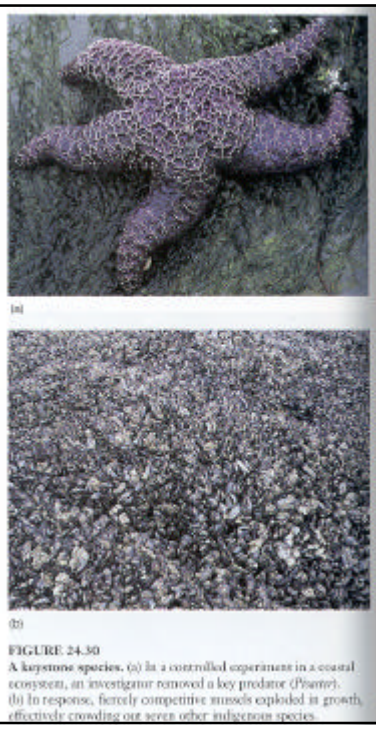
<u>Secondary Succession</u>

Ecological Succession

- **<u>What makes succession happen?</u>**
  - **Tolerance**
    - **only species which can tolerate full range of conditions survive**
    - **early succession- *r*-selected species dominate because they have broader "tolerance ranges"**
  - **Facilitation- species present change the environment and make it more hospitable for others**
  - **Inhibition- species present change the environment and make it <u>less</u> suitable for themselves**

Keystone Species

- In many communities one or a few species appear to be very important in maintaining the community structure… these are called "Keystone" species.



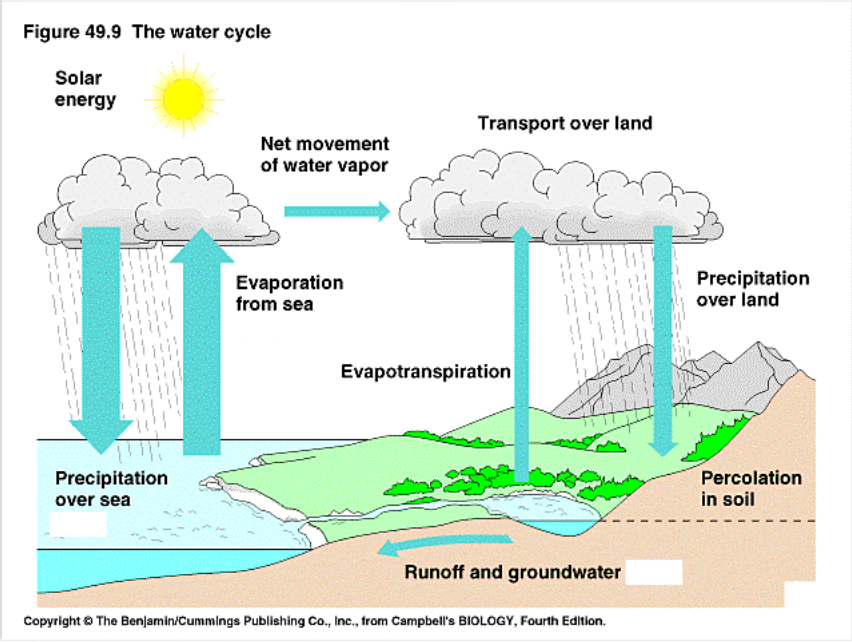
(a)

(b)

FIGURE 24.30
A keystone species. (a) In a controlled experiment in a coastal ecosystem, an investigator removed a key predator (*Pisaster*). (b) In response, fiercely competitive mussels exploded in growth, effectively crowding out seven other indigenous species.

Material Cycling

- **Energy flows / matter cycles**
  - **note: true at STP...**
- **Since there is a finite amount of each element on earth today, essential elements (and compounds) must be recycled over and over.**
- **Examples-**
  - **water**
  - **carbon**
  - **nutrients (nitrogen, phosphorus, iron, etc)**



Material Cycling

- **Carbon Cycle**

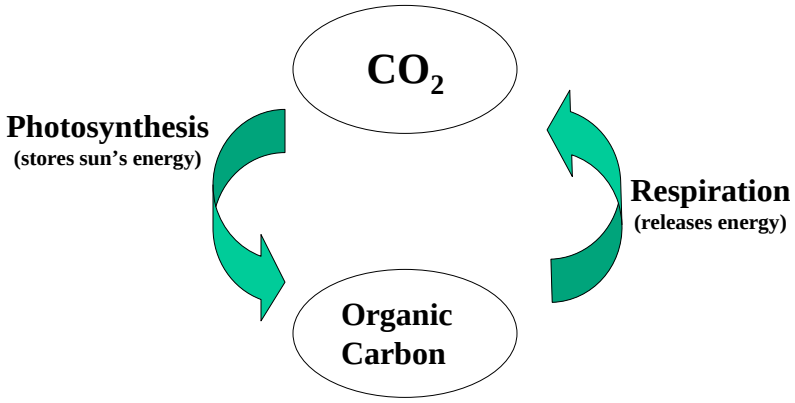
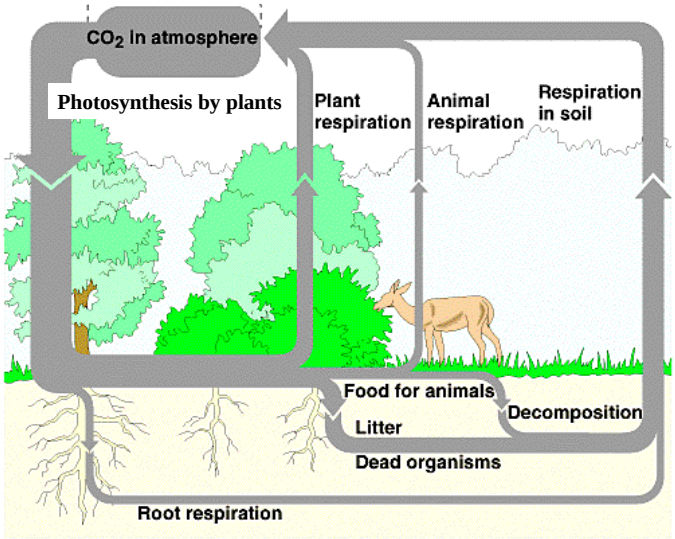


Figure 49.10 The carbon cycle



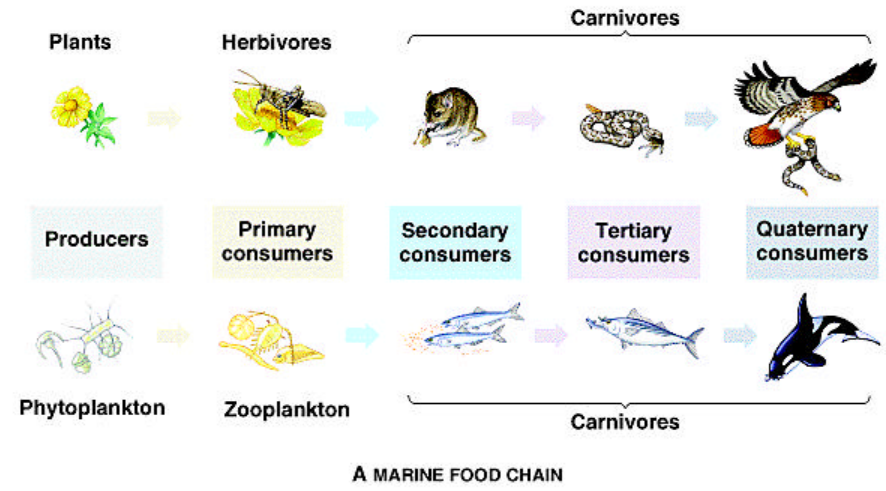
Material Cycles

- Phosphorus Cycle
  - source of P = weathering of rocks
  - major reservoir = soil
  - becomes "biologically active" via plant uptake
- Nitrogen Cycle
  - major reservoir = atmosphere (78% N!)
  - becomes biologically active via microbial "nitrogen fixation" (recall bacteria and protist lectures!)

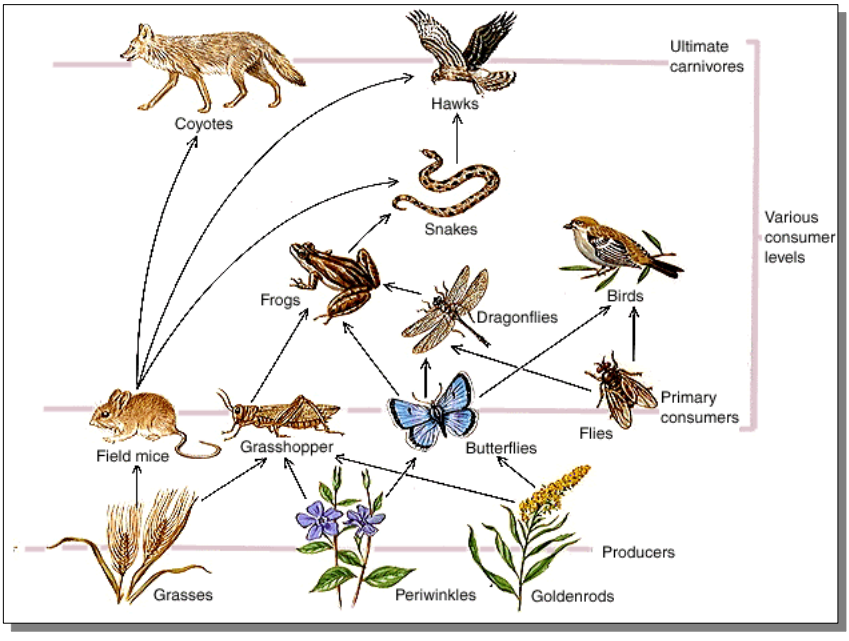
Ecosystem Trophic Structure

- **Community composed of various "trophic levels"**
  - **autotrophs**
    - **(primary producers- make their own organic carbon)**
  - **heterotrophs (consumers- eat other organisms)**
    - **Primary consumer**
      - **herbivores, eat autotrophs**
    - **Higher level consumers**
      - **carnivores & parasites which feed on lower trophic levels**
    - **Detritivores**
      - **live on dead material, many bacteria & fungi**
- **Community is structured by who eats whom**
  - **food chain & food webs**

Figure 49.1 Examples of terrestrial and marine food chains



A Food Web



Energy flow in the ecosystem

- **Primary Productivity**
  - **Rate of organic material produced from solar energy in an area**
  - **only about 1% of solar energy converted to organic material!**
  - **Rate of primary productivity controlled by moisture and temperature**
- **Secondary Productivity**
  - **Rate of production by heterotrophs**
  - **Also not very efficient process!**

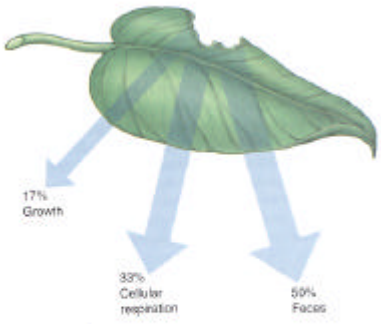
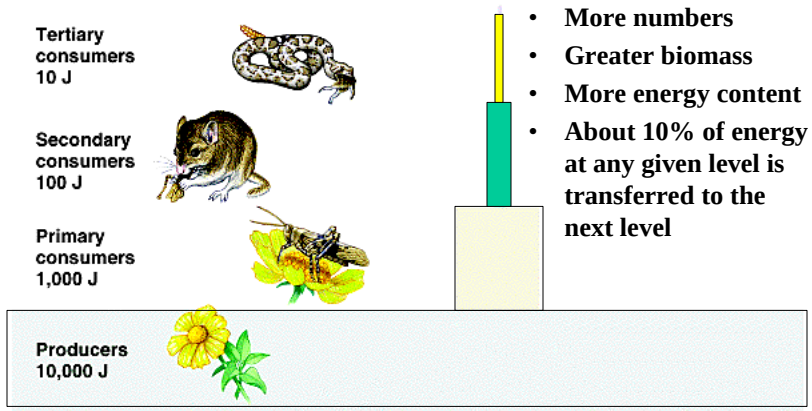


FIGURE 25.10
How heterotrophs utilize food energy. A heterotroph assimilates only a fraction of the energy it consumes. For example, if a "bite" comprises 500 Joules of energy (one Joule = 0.239 calories), about 50%, 250 J, is lost in feces, about 33%, 165 J, is used to fuel cellular respiration, and about 17%, 85 J, is converted into insect biomass. Only this 85 J is available to the next trophic level.

- **Herbivores lose about 50% via feces**
- **Another 30-40% lost to respiration (maintenance)**
- **< 20 % of what is eaten gets converted to biomass!**
- **However, many plants are never consumed by next an herbivore**
- **Overall, the ecological efficiency only about 10%**

Figure 49.5 An idealized pyramid of net productivity



Energy at each trophic level from 1,000,000 J of sunlight during a given time interval

Lower levels of the food chain generally have

- **More numbers**
- **Greater biomass**
- **More energy content**
- **About 10% of energy at any given level is transferred to the next level**