

Part 1 - Ecosystems

Based on Mader, Sylvia S. 1993. *Biology* - 4th Ed. WCB
and Levine, J.S. and K.R. Miller. *Biology: Discovering Life* D.C. Heath
and Cox, G.W. 1997. *Conservation Biology* - 2nd ed. WCB

Reading: Chapters 3,4,6 in Levine & Miller + pages 168-170.

I. Ecosystems - Chapter 3

- A. All of the living organisms and the physical environment at a given place at a given time**
- B. Biological Diversity**
 - 1. **Ecosystem diversity** - all of the different types of ecosystems in an area
 - 2. **Species diversity** - number of species in an area
 - 3. **Genetic diversity** - variability within a species
- C. Components**
 - 1. **Non-living (abiotic) environment**
 - a) Oxygen
 - b) Sunlight
 - c) Temperature
(1) Fig. 3.5
 - d) Soil
 - e) Water
 - f) Dissolved salts
 - g) Salinity
 - h) Metabolic wastes
 - i) Nutrients
 - 2. **Living (biotic) community**
- D. Biosphere**
 - 1. **a thin shell of air, land and water around the Earth supporting life.**

E. Biomes - a major biotic community having well-recognized life forms and a typical climax species

1. Terrestrial ecosystems

a) Divided into biomes

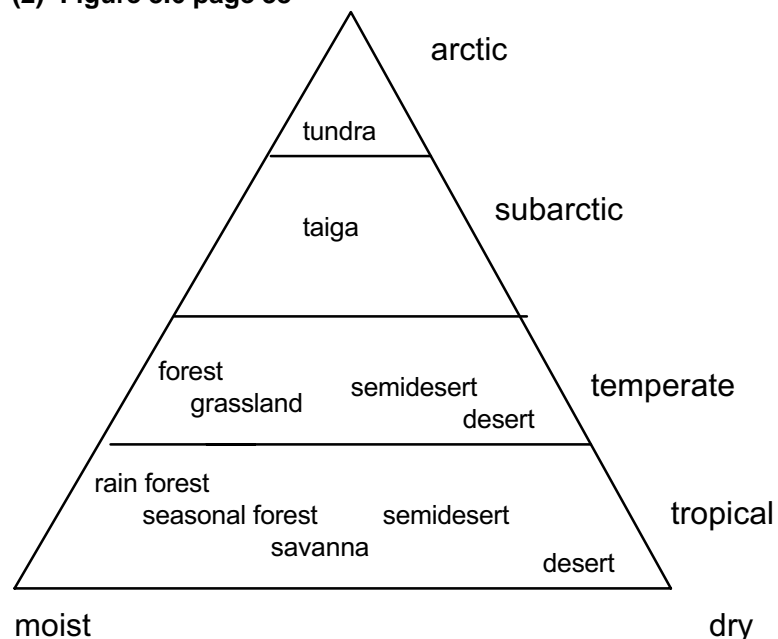
(1) **Biomes distinguished by a distinctive assemblage of plant species**

(a) (Plants are long-lived and don't hide, making them convenient)

b) Climate and soil - effects on biomes

(1) **Biomes largely determined by combination of temperature and rainfall**

(2) **Figure 3.6 page 38**



c) Video: 19267

d) Figure 3.7 page 39

e) Figures 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.15, 3.16,

f) Overhead - distribution Figure 3.18, Figure 3.35

2. Productivity of biomes

Video: 19223

- a) Estuaries and tropical rain forest
- b) Temperate forest
- c) Agricultural land
- d) Temperate grassland
- e) Lakes and streams
- f) Coastal zone
- g) Tundra
- h) Open ocean
- i) Desert

II. Energy and Nutrients in the Ecosystem (Chapter 4)

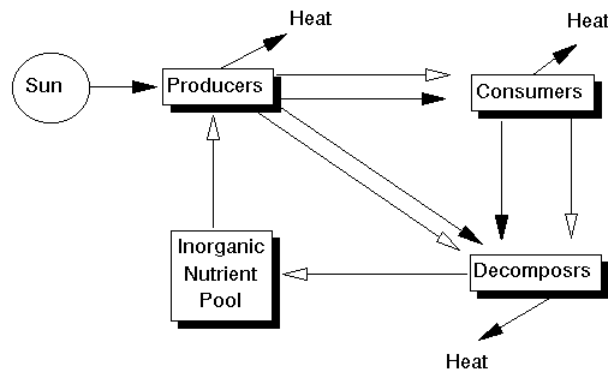
A. Energy flows through organisms

1. Organisms can take one of two roles:

- a) Producers: convert energy into food
 - (1) Usually sunlight into carbon bonds
 - (2) Also known as *autotrophs*
- b) Consumers: use food produced by autotrophs
 - (1) Also known as *heterotrophs*
 - (2) 4 types:
 - (a) Herbivores (primary consumers) - plants
 - (b) Carnivores (secondary or 3⁰) - animals
 - (c) Omnivores - plants or animals
 - (d) Decomposers - decaying material (detritus)

2. Flow through the ecosystem:

- a) Video: 19224



- b) Energy does not cycle - is lost as heat!!!
- c) Video: 19228

B. Food chains and webs

- 1. Food chain:**
 - a) Path of food from a given final consumer back to producer.
- 2. Food web:**
 - a) The real-world picture of interlocked food chains in an ecosystem.
- 3. Figure 4.13, 4.14, 4.15**
- 4. Video: 19225 (forest) 19226 (pond)**
- 5. Trophic levels:**
 - a) Individual links in the food chain
- 6. Detritus vs. grazing food chains**
 - a) Most are detritus based

C. Pyramids:

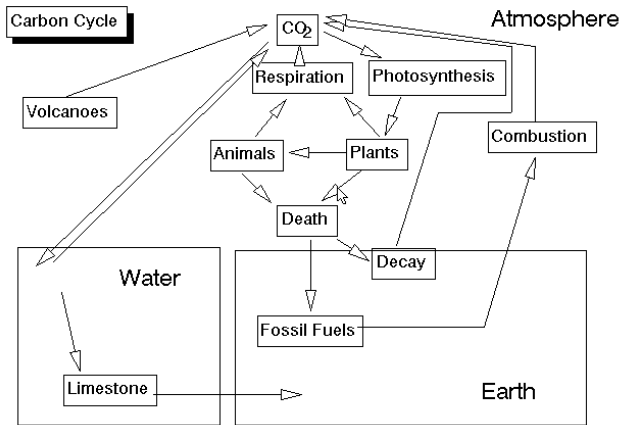
- 1. Trophic levels decrease in size as they move away from producers.**
 - a) Why:
 - (1) Not everything at the lower level gets eaten
 - (2) Not everything at the lower level gets digested
 - (3) Each level loses energy as heat
- 2. Usually only 10% can be passed on to next generation**
 - a) 100 k plants --> 10 k of humans
 - b) 10 k of cows --> 1 k of humans
- 3. Video: 19227, 19228**
- 4. Figure 4.16**

D. Human vs. natural food chains:

- 1. Natural chains more complicated**
 - a) More stable
 - b) Allow for shifting food sources from one to another
- 2. Human chains rely on monoculture**
 - a) Highly susceptible to disease
 - b) Rely on inputs of fertilizers, fossil fuels, pesticides
- 3. Video: 19230, 19231**

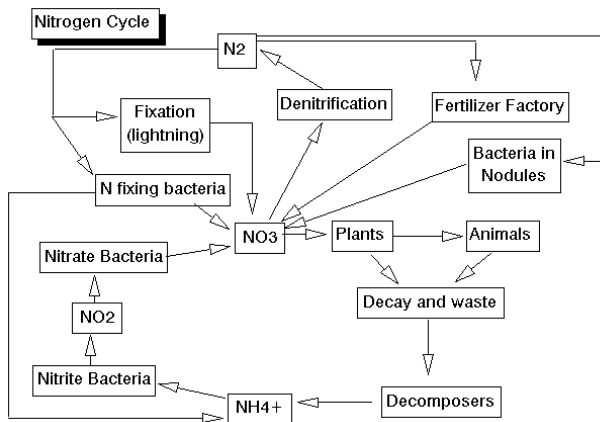
E. Chemical cycles:

1. While energy does not cycle, chemicals do
2. Biogeochemical cycles
 - a) Reservoir, exchange pools, biotic community
 - b) Video: 19232
3. Hydrological cycle Figure 4.17
4. Carbon Cycle Figure 4.18



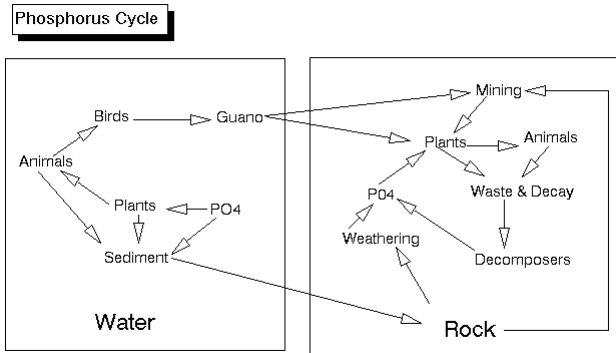
a) Video: 19233, 19234, 19235

5. Nitrogen Cycle - Figure 4.20, 4.21



a) Video: 19236, 19237, 19238, 19239, 19240

6. Phosphorous Cycle



a) Video: 19241

III. Community Ecology (Chapter 6)

A. Niche

1. Functional relationship of an organism to its physical and biological environment
2. Includes 3 sets of parameters:
 - a) Range of physical factors for survival and reproduction: temperature, humidity, pH, soil, sunlight, etc.
 - b) Biological factors: predators, prey, parasites, competitors, etc.
 - c) Behavior: seasonality, diurnal patterns, movement, social organization, etc.

B. Competition

1. Whenever two niches overlap, competition ensues
2. Two main types:
 - a) Intraspecific
 - (1) Within the species - niche overlap near 100%
 - (2) Strongest type of competition
 - (3) Includes competition for mates
 - b) Interspecific
 - (1) Between species
3. Competition strongest at high population densities
4. Competitive exclusion:
 - a) Two species competing for the same limiting resource in an area cannot coexist
 - b) Two species cannot share the same niche

C. Predation:

1. **Predators can control prey populations and vice-versa**
2. **Prey populations can also oscillate on their own**
3. **Hare and lynx example (Figure 6.10)**
 - a) It was thought that hare and lynx populations oscillated together
 - b) New evidence shows that hare populations oscillate on their own, perhaps due to overgrazing
 - c) Lynx populations follow hare populations but do not cause the oscillations, although they may affect them

D. Keystone species: species that are critical to their ecosystems

1. **Keystone predators may control key competitors at lower levels in the food chain, thus allowing other species to thrive.**
2. **Keystone mutualists may provide needed resources for a wide host of organisms (example: fruit trees provide food and shelter)**
3. **Keystone competitors, if removed, allow one competitor to dominate, reducing diversity**

E. Symbioses: Organisms living in close approximation; often one cannot live without the other.

1. **Three types:**
 - a) Parasitism: parasite benefits, host is hurt
(1) **Example: human and tapeworm**
 - b) Commensalism: one species benefits, the other is neither hurt nor helped.
(1) **Example: a few orchids growing epiphytically on a tree**
 - c) Mutualism: both species benefit
(1) **Example: corals and zooxanthellae**

F. Summary: Interactions between organisms:

Type of Interaction	Effect of Interaction On:	
	Species 1	Species 2
Competition	(-)	(-)
Predation	Predator (+)	Prey (-)
Parasitism	Parasite (+)	Host (-)
Herbivory	Herbivore (+)	Plant (-)
Detritivory	Detritivore (+)	Detritus (0)
Commensalism	(+)	(0)
Mutualism	(+)	(+)

Table 1. Types of species interactions

G. Succession

1. Gradual change in a community over time
2. Succession proceeds in a predictable fashion given local climactic and geological conditions
3. Figure 6.13
4. Climax community is the end result of succession
 - a) Biomes are characterized by climax communities
5. Pioneer community is the first step:
 - a) If pioneer community settles in newly formed habitat - primary succession
 - b) If pioneer community settles in disturbed (fire, construction, agriculture) area - secondary succession
6. In succession, each community changes the ecosystem to favor the succeeding community
7. Climax communities are relatively stable; the dominant species there tend to replace themselves.

H. Island communities

1. Larger islands have more species than smaller ones
 - a) More space = larger populations = less chance of extinction due to random events
 - b) More species = more niches available to be filled by yet more species
 - (1) Example: each bird species may harbor its own parasites; the parasites, in turn, may have specific parasites of their own
2. Close islands have more species than far ones
 - a) The closer an island is to a source of species (i.e. the mainland) the more species it will have
3. Island communities are a function of size and distance
4. The number of species on an island remains constant while the actual species become extinct and are replaced by other species. This is known as equilibrium.