I. What is Ecology?
   a. Ecology - the study of interactions among organisms and between organisms and their environment.
   b. Biosphere - contains the portions of air, land, and water on our planet in which life exists.
      i. Hydrosphere - water has the greatest quantity of life!
      ii. Lithosphere - rocky crust
      iii. Atmosphere - contains nitrogen, oxygen, and carbon dioxide

II. Levels of Organization
   a. From single individual to most complex:
      i. Individual
      ii. Species - group of organisms that can breed and produce fertile offspring together.
      iii. Population - all members of the same species that inhabit a particular area
      iv. Community - all the populations found in a particular area
      v. Ecosystem - a community and its physical environment, including biotic and abiotic components.
         1. Biotic factors - living things. In an ecosystem, all the organisms that interact or could potentially interact.
         2. Abiotic factors - nonliving or physical things; precipitations, humidity, etc...
      vi. Biome - all the communities on earth whose members exist in air and water, and on land.
   b. Biodiversity - the variety of life on earth.

III. Energy Flow
   a. Producers - use the suns energy to make their own food or rely on energy captured from inorganic compounds.
      i. Autotroph - organisms that make their own food
      ii. Producers get their food two ways:
         1. Sunlight by photosynthesis
         2. No sunlight, use energy released from the breaking of chemical bonds called chemosynthesis
   b. Consumers
      i. Heterotroph - relies on other organisms for their energy and food supply.
      ii. There are 4 different types:
         1. Herbivores - eat plants
         2. Carnivores - eat animals
         3. Omnivores - eat both plants and animals
         4. Detritivores - feed on dead matter
            a. Saprophyte - bacteria or fungus that lives on dead matter
   c. Feeding Relationships - energy flows in one direction through an ecosystem, from the sun or inorganic compounds to autotrophs and then to heterotrophs.
      i. Food Chains - a series of steps in which organisms transfer energy by eating and being eaten Figure 3-7 page 69
      ii. Food Webs - links all food chains in an ecosystem together Figure 3-8 page 71
      iii. Trophic Levels - Each step in a food chain or web is a trophic level.
         1. 1st level - producers
         2. 2nd level - primary consumer
         3. 3rd level - secondary consumer
         4. 4th level - tertiary consumer
   d. Ecological Pyramids is a diagram that shows the relative amounts of energy or matter contained within each trophic level. Figure 3-9 page 72
      i. Energy Pyramid - shows relative amounts of energy available at each trophic level. Organisms use about 10% of this energy for life processes. There are three reasons discussed below.
      ii. Biomass Pyramid - total amount of living tissue within the trophic levels is shown.
         1. Biomass - refers to the combined weight of all the organisms in the trophic level.
      iii. Pyramid of Numbers - based on numbers of individual organisms.
      iv. Energy Flow in Ecosystems Three things can happen to the energy taken in by the organisms in a trophic level:
         1. It can be passed on to the next trophic level in the food chain when the organism is eaten.
         2. It can become stored in detritus. This energy is passed on to decomposers when the detritus decays.
3. It can be converted to heat energy by inefficient chemical reactions, radiated by warm bodies, or in friction due to movement. The heat energy is lost to the surroundings, and cannot be regained by living organisms.

Eventually, all the energy that enters the ecosystem will be converted to heat, which is lost to space.

IV. What Shapes an Ecosystem?
   a. Biotic and Abiotic Factors
   b. The Niche
      i. Niche- the full range of physical and biological conditions in which an organism lives and the way in which the organism uses its resources. The role of an organism in its environment. Such as: what it eats, how/when reproduces, climate to survive, etc...
   c. Community Interactions
      i. Competition- Organisms attempting to use the same resource (nutrient, water, light, space, or food) in the same place at the same time results in a winner and loser.
         1. Competitive Exclusion Principle- no two species can occupy the same niche in the same habitat at the same time
      ii. Predation- one organism captures and feeds on another organism
         1. Anti-predation Defenses (coevolution- evolving together)
            a. Concealment/Camouflage- blend in with environment
            b. Fright- physical/behavioral characteristics to intimidate predators
            c. Warning Coloration- bright colors to indicate that the prey is poisonous
            d. Spines
            e. Mimicry- one species resembles another that possesses an anti-predator defense.
               i. Batesian- When a prey mimics another species that has a successful defense, like warning coloration, but does not have the actual defense itself.
               ii. Müllerian- Mimics that share the same defense. Both have it.
      iii. Symbiosis- “living together”
         1. Mutualism- (+,+ ) Both species benefit
         2. Commensalism- (+,0) One organism benefits and the other is neither helped or harmed
         3. Parasitism- (+,-) One organism benefits at the others expense
d. Ecological Succession- Change in an ecosystem due to a natural or human made disturbance. It is a series of predictable changes that occurs. *Figure 4-7 page 94*

![Figure 4-7](image)

i. Primary Succession- on land where there is no soil; cooled lava, or exposure of new rock.
   1. Pioneer Species- first organisms to inhabit this area; usually lichen. Help to form fertile soil.
ii. Secondary Succession- when a disturbance changes the existing community, but does not remove the soil.

V. Cycles of Matter
   a. Biogeochemical cycles- connect biological, geological, and chemical aspects of the biosphere.
   b. Water cycle
   c. Nutrient cycles
      i. Carbon
      ii. Nitrogen
   d. Nutrient Limitation
      i. Primary Productivity- the rate at which producers create organic matter. This is the original amount of energy/nutrients available in an ecosystem.
      ii. Limiting Nutrient- a nutrient that is scarce or slow to cycle that is essential to the organisms in an ecosystem.

VI. Growth Curves
   a. Exponential Growth- when individuals in a population reproduce at a constant rate. Found under ideal conditions.
   b. Logistic Growth- curve when a populations’ growth stops or slows following a period of exponential growth.
   i. The horizontal line in a logistic growth curve is called carrying capacity. Carrying capacity represents the largest number of individuals that a given environment can support.

VII. Populations- they are a community characterized by a particular density, distribution, and growth rate.
   a. Population density- the number of individuals in a given area.
      i. Population distribution- pattern of dispersal within the area. Organisms are found: uniform, random, or in clumped distributions.
   b. Population Growth
      i. What affects a population’s size:
         1. Abiotic factors
            a. Seasons

![Exponential and Logistic Growth Curves](image)

![Population Density Distribution](image)
2. **Food Supply**

   ![Graph showing the impact of deer introduction on vegetation and population growth over time.]

3. **Interspecific Competition** (between different species)

   ![Graphs comparing population growth of two species, *P. aurulia* and *P. caudatum*, grown separately and together.]

4. **Intraspecific Competition** (between same species)

   ![Graph showing oscillations in population size over time.]

   **Explanation:**

   - Less interspecific competition: population increases,
   - More intraspecific competition: population decreases,
   - Population increases,
   - Predators decreases,
   - Prey increases,
   - Predators increases,
   - Prey decreases

5. **Predation**

   ![Graph showing oscillations in prey and predator populations.]

6. **Parasitism and Disease**

   ![Graph showing oscillations in host and parasite populations.]

   **Explanation:**

   - Host increases,
   - Parasite increases,
   - Host decreases,
   - Parasite decreases

**c. Growth Curves:**

i. **Exponential Growth** - occurs when individuals in a population reproduce at a constant rate. Under ideal conditions with unlimited resources, a population will grow exponentially. **Figure 5-3 page 121**

ii. **Logistic Curve** - As resources become less available the growth of a population slows or stops. **Figure 5-4 page 122**

**d. Survivorship Curves:**

![Graph showing survivorship curves for different types of organisms.](https://example.com/survivorship_curves.png)
VIII. Human Population Growth
   a. More Developed vs. Less-Developed Countries

   The world's population is aging and, in developed countries, the size of the elderly population has already surpassed that of the 12-24 age group.

   ![Population Graph]

   b. Age Distributions Figure 5-13 page 131

IX. Human Impact on the Ecosystem
   a. Eutrophication
   b. Biological Magnification
   c. CO₂ increases has led to Greenhouse Effect (global warming)
   d. Ozone Depletion Caused by (CFC's)