IDX G9 Biology S
Study Guide Issue Semester 1 Final
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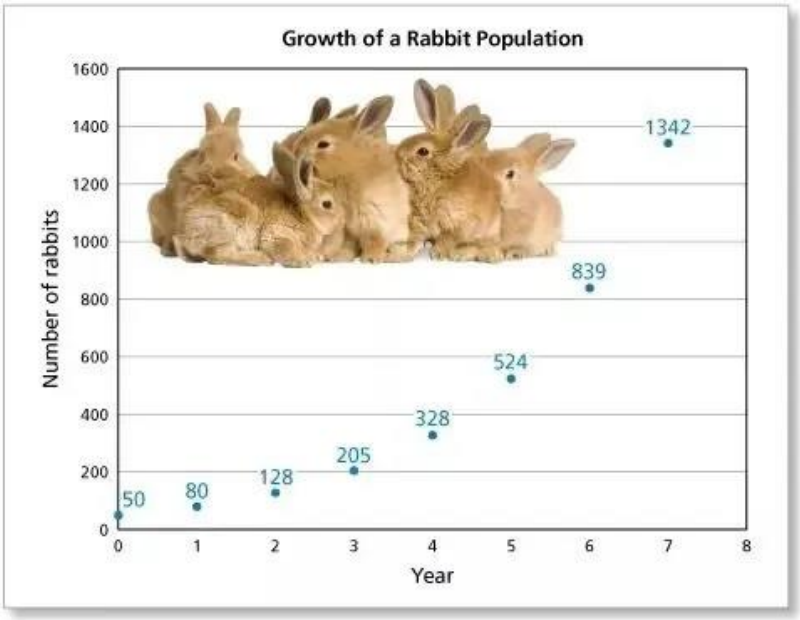
Contents:

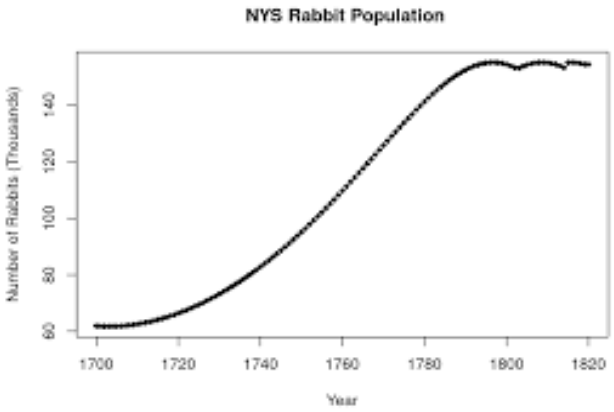
5.1 How Populations Grow

- Characteristics of Populations
    - Geographic Range: The area a population inhabits.
    - Population Density: The number of individuals per unit area (e.g., people per square kilometer).
    - Growth Rate: How quickly a population increases or decreases.
    - Age Structure: The number of males and females of each age in a population.
- Factors Affecting Population Size:
    - Number of Births
    - Number of Deaths
    - Number of individuals that enter or leave (Immigration & Emigration)
    - Formula: Population Change = (Births + Immigration) – (Deaths + Emigration)
- Patterns of Population Growth:
    - Exponential Growth (J-Curve):

- Occurs under ideal conditions with unlimited resources.
- The larger the population gets, the faster it grows.
- Produces a J-shaped curve on a graph.
- Exponential Growth: Under ideal conditions with unlimited resources, a population will grow exponentially. Which means it is almost impossible to happen. (Sometimes happens when invasive species enter a new environment with enough resources and no predators)

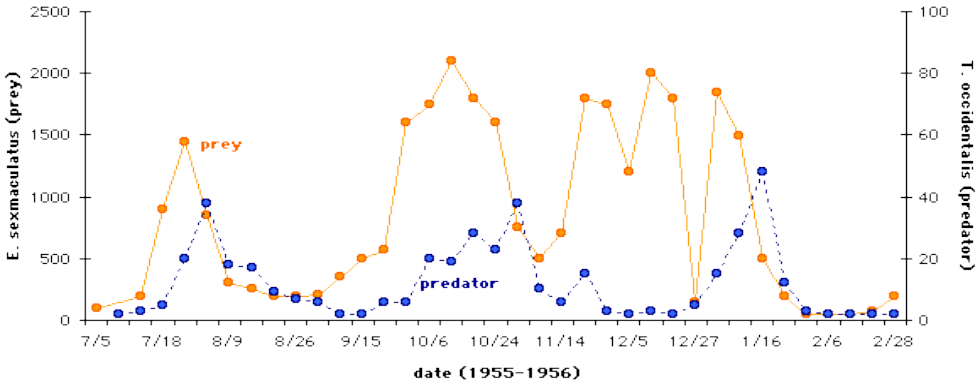


- Logistic Growth (S-Curve):
  - Growth slows or stops as resources become less available.
  - Carrying Capacity (K): The maximum number of individuals of a species that an environment can support.
  - Produces a S-shaped curve (sigmoidal) on a graph, levelling off at the carrying capacity.



5.2 Limits to Growth

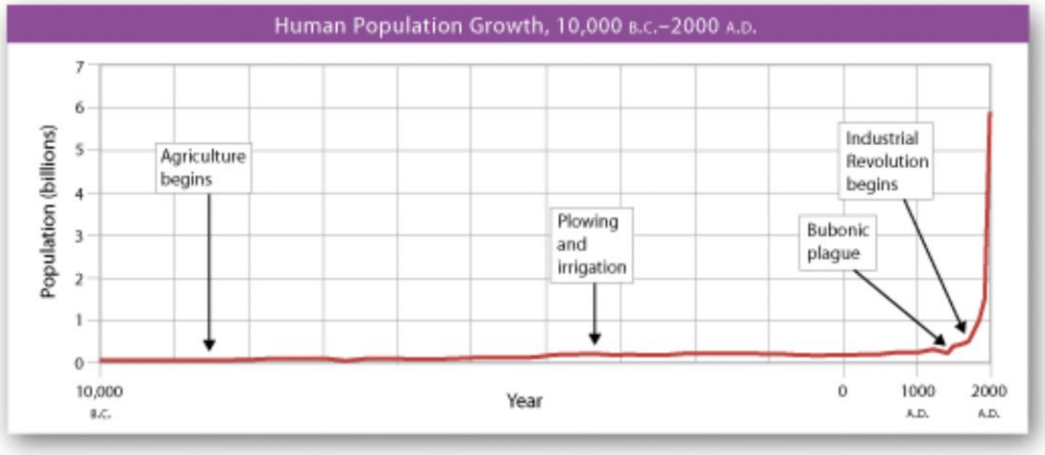
- Limiting factor
    - It is what controls the growth of the population. So, it also determines the carrying capacity of an environment for a species.
    - Density-Dependent Factors:
        - Limiting only when the population density reaches a certain level.
        - Act more strongly as the population increases.
        - Examples: Competition, Predation, Herbivory, Parasitism, Disease, Stress from overcrowding.
            - Competition: it is a density-dependent limiting factor because competition happens when many individuals live in one area and compete for resources.
            - Predation and herbivory: The predator and prey relationship is affected by the number of predators and prey in each environment. When the population of prey drops, the predator species' population drops, but as soon as predators are gone, the prey population will increase again, as will the predator population.
            - Parasitism and diseases:
                - When an individual is infected by a parasite or disease, the disease is spread through the same species by the infected one. Therefore, it is a density-dependent factor that is affected by the number of populations that is available to infect.
            - Stress from overcrowding: Increase of population causes more intense competition for limited resources in the community. The high level of stress can cause emigration and decrease the population.



- Density-Independent Factors:
    - Affect all populations in similar ways, regardless of their size or density.
    - Often abiotic (non-living) factors.
    - Examples: Unusual weather, natural disasters (fires, floods, hurricanes), human activities (damming rivers, clear-cutting).

- Controlling populations:
    - In nature, a combination of density-dependent and density-independent factors act together to regulate population size near the environment's carrying capacity.

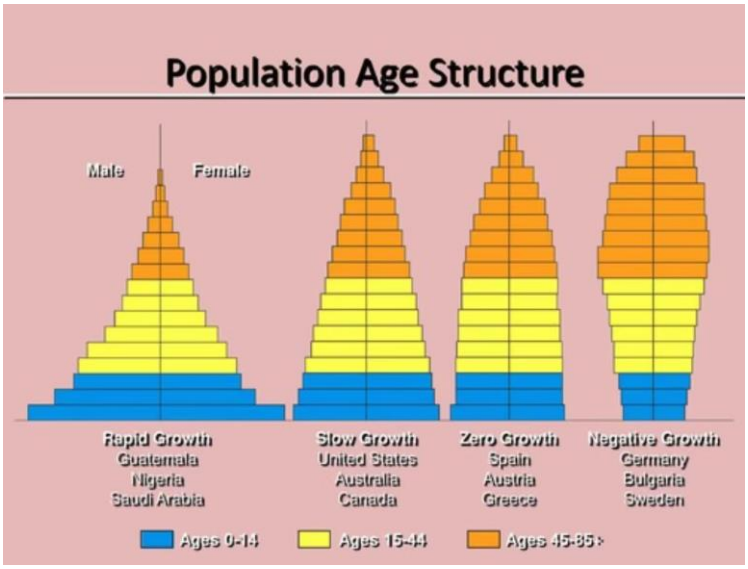
5.3 Human Population Growth



- How does the human population grow
    - Human population changes over time as people are born, move into an area, pass away, or move out. Historically, shifts in how societies live and advances in technology have allowed more people to be supported, leading to periods of rapid increase. The pattern of growth is not uniform everywhere, it differs from place to place and era to era, influenced by social conditions, resource availability, and cultural factors. Ultimately, these ongoing additions and subtractions shape the total number of people in a region or across the world.

- Historical growth patterns
    - For most of human history, populations grew very slowly: high birth rates were balanced by high death rates (due to disease, lack of medicine, poor sanitation, limited food, etc.).

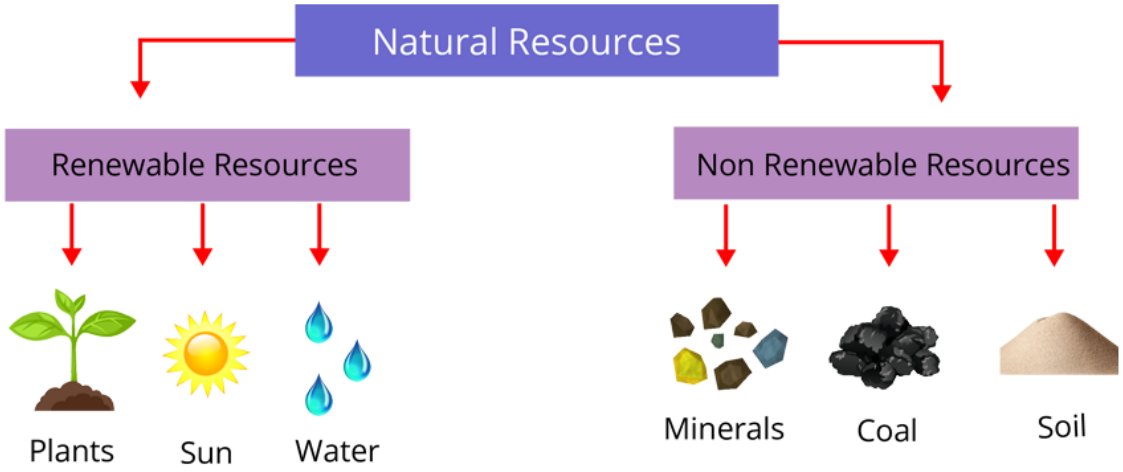
    - As living conditions improved (better sanitation, medicine, food supply, urbanization, technology), death rates dropped, but birth rates remained high, which caused a dramatic, rapid increase in the human population.
    - This period of accelerated growth is similar to "exponential growth" seen in ecology: when conditions are favorable and resources are sufficient, populations can grow fast.
- Demographic Transition — why growth slows down in developed countries
- Demographic transition describes the shift societies go through: from high birth & death rates to low birth & death rates.
    - Stage I — pre-industrial: high birth, high death, slow growth.
    - Stage II — death rate falls (due to better medicine, sanitation), but birthrate stays high for a while → population grows rapidly.
    - Stage III — birthrates decline (often as living standards rise, more access to education, contraception, changed social norms), so growth slows and population stabilizes.
    - Many developed countries have completed the demographic transition; others — especially developing countries — may still be in Stage II or transitioning.
- Age-structure & population growth predictions
    - The age structure (how many people in different age groups) helps predict population growth trends for a country.
    - Countries with many young people (a "youth-heavy" age pyramid) tend to have high growth potential (because many people will reach reproductive age).
    - Countries with more balanced or older age distributions tend to have slower growth or a stable population.
- Why human population growth matters & its implications
    - Human populations, unlike many other species, can actively modify their environment (through technology, agriculture, and urbanization), which can increase the environment's carrying capacity, but also cause environmental stress/damage.
    - Rapid population growth raises concerns about sustainability, resource use (food, water, land), environmental impact (pollution, habitat destruction), and social issues (crowding, inequality, public health).



6.1 A Changing Landscape

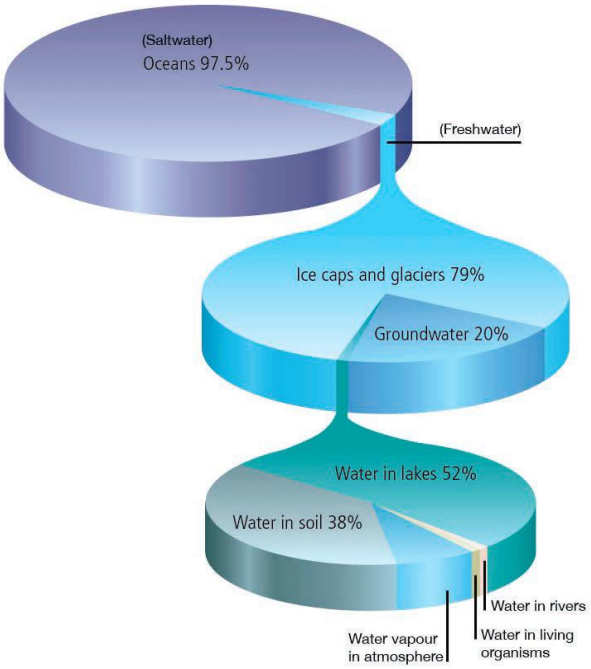
- How does our daily life affect the environment?
    - Humans affect regional and global environments through agriculture, development, and industry in ways that have an impact on the quality of Earth's natural resources, including soil, water, and the atmosphere.
- Agriculture
    - Monoculture is one of the examples of how human impact on environment:
    - Is the practice of clearing large areas of land to plant a single highly productive crop year after year, like the soybeans.
    - The monoculture eventually causes decreased fertility and water retention capacity of soil, ecological imbalances, decrease in biodiversity.
- Development
    - Today, industry and scientific know-how provide us with the conveniences of modern life—from comfortable homes and clothes to electronic devices for work and play.
    - **Sustainable development**: sustainable development provides for human needs while preserving the ecosystems that produce natural resources.
    - Rivers, streams, and lake of healthy ecosystem provide goods and services for free. However, if the ecosystem is polluted, people need to pay for the free service.
    - Ecosystem goods are considered renewable or nonrenewable resources.

- The nonrenewable resources, like coal for example, are formed by buried organic materials and takes millions of years to form. Therefore, to use natural resources to meet our needs without causing long-term environmental harm, sustainable development is considered.

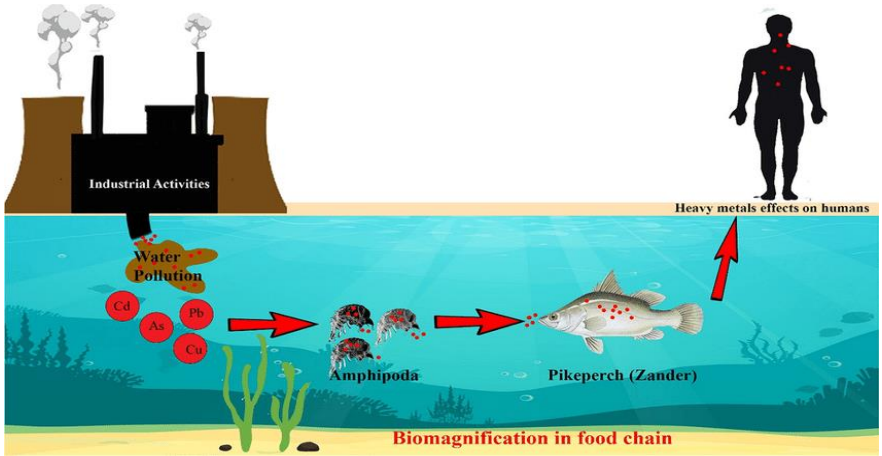


6.2 Using Resources Wisely

- Why is soil important, and how do we protect it?
  - Healthy soil supports both agriculture and forestry.
  - "Topsoil" are nutrient rich soils that absorbs water and rich in organic matter.
  - The topsoil is renewable if soil is healthy, but it is not renewable if soil erosion removes these soils.
- Soil Erosion: Removal of soil by wind or water.
  - The causes of soil erosion are climate change, overgrazing, farming, and seasonal drought.
  - The effect of soil erosion are deforestation and desertification.
  - The solutions for soil erosion are leaving stem of previous year's crop to hold soil in place, planting different crops each year to prevent lack of nutrient in the soil, and changing shape of land prevent water runoffs.
- Fresh water resources:
  - Water is considered renewable, but the source of fresh water that human can use is very limited and consider not renewable because it takes a long period of time to be collected.



- Pollutant is a harmful material that enter biosphere.
- Pollutants that enter water supplies from many scattered sources are called “non-point” sources.
- Example of non-point sources are fertilizer runoff, sewage, and industrial/ agricultural chemicals.
- Through biological magnification, species in higher food chain consumes more concentrated pollutant, in fact human eat those.



Example of industrial chemicals reaching human through biological magnification

- Atmospheric Resources:
  - Common forms of air pollutions are smog, acid rain, greenhouse gases, and particulates.
  - Acid rain falls when chemicals emitted by factories combine, and create a sulfuric, nitric acids. When these acids fall, they release mercury and other toxic elements to the soil.

- Carbon dioxide from burning fossil fuel and methane from raising cattle accumulates around atmosphere, causing global warming.

6.3 Biodiversity

- Biodiversity is the total of all the genetically based variation in all organisms in the biosphere. There are three big types of biodiversity
  - Ecosystem diversity refers to the variety of habitats, communities, and ecological processes in the biosphere.
  - The number of different species in the biosphere, or in a particular area, is called species diversity.
  - Genetic diversity can refer to the sum total of all different forms of genetic information carried by a particular species, or by all organisms on Earth.
- Valuing diversity
  - Biodiversity's benefits to society include contributions to medicine and agriculture, and the provision of ecosystem goods and services.
  - Wild species are original source of many medicines
  - Genetic diversity of a species is using for genetic engineering and breeding for human to produce crops with helpful traits.
  - Keystone species in an environment keeps the ecosystem stable. Healthy ecosystem is important to sustain because it plays a vital role in maintaining air, soil, and water quality.
    - Diversity: how many different species are in a particular area + quantity (ex: 3 types of birds, but 10 A birds, 10 B birds, 10 C birds)
    - Richness: how many different species are in a particular area
- Threats to Biodiversity:
  - Altered habitats isolate species from rest of ecosystem, splits ecosystems into pieces. This process is called habitat fragmentation, and it is caused by human development.
  - Hunt and demand for wildlife products kill many species for their meat, medicinal use, or for sale.
  - Introduced species have no predator in the new environment, becomes invasive and threaten biodiversity.
  - Pollution harms ecosystem as well as the species living inside it.
  - Climate change beyond a species' tolerance may push species to extinction.
- How do we preserve biodiversity?

    - To conserve biodiversity, we must protect individual species, preserve habitats and ecosystems, and make certain that human neighbors of protected areas benefit from participating in conservation efforts.
- Captive breeding program of AZA (The Association of Zoos and Aquariums) is putting their effort to protect individual species.
- To concentrate on specific ecosystem to protect, biologist identified ecological hot spot, the most endangered ecosystems with significant numbers of species.
- Government provides incentives to make local communities to change their habits. Also, by providing carbon credits to limit the amount of carbon emitted by companies.
- Carbon credit helps protect the economy while reducing biodiversity loss due to pollution.