Essential Knowledge

APES 1st semester

Chapter 1:

* Ecological Footprints compare resource demands and waste production for an individual or society.
* Sustainability refers to humans living on Earth and their use of resources without depletion of the resources for future generations. Environmental indicators that can guide humans to sustainability include biological diversity, food production, average global surface temperatures and CO2 concentrations, human population, and resource depletion.
* Sustainable yield is the amount of a renewable resource that can be taken without reducing the available supply.

Chapter 2 and 3:

* Convergent boundaries can result in the creation of mountains, island arcs, earthquakes, and volcanoes.
* Divergent boundaries can result in seafloor spreading, rift valleys, volcanoes, and earthquakes.
* Transform boundaries can result in earthquakes.
* Maps that show the global distribution of plate boundaries can be used to determine the location of volcanoes, island arcs, earthquakes, hot spots, and faults.
* An earthquake occurs when stress overcomes a locked fault, releasing stored energy.
* Organisms adapt to their environment over time, both in short- and long-term scales, via incremental changes at the genetic level.
* Environmental changes, either sudden or gradual, may threaten a species survival, requiring individuals to alter behaviors, move, or perish.
* Specialist species tend to be advantaged in habitats that remain constant, while generalist species tend to be advantaged in habitats that are changing.
* K-selected species tend to be large, have few offspring per reproduction event, live in stable environments, expend significant energy for each offspring, mature after many years of extended youth and parental care, have long life spans/life expectancy, and reproduce more than once in their lifetime. Competition for resources in K-selected species habitats is usually high.
* r-selected species tend to be small, have many offspring, expend or invest minimal energy for each offspring, mature early, have short life spans, and may reproduce only once in their lifetime. Competition for resources in r-selected species habitats is low.
* Biotic potential refers to the maximum reproductive rate of a population in ideal conditions.
* Many species have reproductive strategies that are not uniquely r-selected or K-selected, or they change in different conditions at different times.
* K-selected species are typically more adversely affected by invasive species than r-selected species, which are minimally affected by invasive species. Most invasive species are r-selected.
* A survivorship curve is a line that displays the relative survival rates of a cohort – a group of individuals of the same age- in a population, from birth to the maximum age reached by any one cohort member. There are Type I, Type II, and Type III curve.
* Survivorship curves differ for K-selected and r-selected species, with K-selected species typically following a Type I or Type II curve and r-selected species following a Type III curve.
* When a population exceeds its carrying capacity (K) overshoot occurs. There are environmental impacts of population overshoot, including resource depletion.
* A major ecological effect of population overshoot is dieback of the population (often severe to catastrophic) because the lack of available resources leads to famine, disease, and/or conflict.
* Population growth is limited by environmental factors, especially by the available resources and space.
* Resource availability and the total resource base are limited and finite over all scales of time.
* When the resources needed by a population for growth are abundant, population growth usually accelerates.
* When the resource base of a population shrinks, the increased potential for unequal distribution of resources will ultimately result in increased mortality, decreased fertility (fecundity), or both, resulting in population growth declining to, or below, carrying capacity.

Chapter 4:

* In a predator-prey relationship, the predator is an organism that eats another organism (the prey).
* Symbiosis is a close and long-term interaction between two species in an ecosystem. Types of symbiosis include mutualism, commensalism, and parasitism.
* Competition can occur within or between species in an ecosystem where there are limited resources. Resources partitioning-using the resources in different ways, places, or at different times – can reduce the negative impact of competition on survival.
* The 10% rule approximates that in the transfer of energy from one trophic level to the next, only about 10% of the energy is passed on.
* The loss of energy that occurs when energy moves from lower to higher trophic levels can be explained through the laws of thermodynamics.
* A food web is a model of an interlocking pattern of food chains that depicts the flow of energy and nutrients in two or more food chains.
* Positive and negative feedback loops can each play a role in food webs. When one species is removed from or added to a specific food web, the rest of the food web can be affected.
* There are two main types of ecological succession: primary and secondary.
* A keystone species in an ecosystem is a species whose activities have a particularly significant role in determining community structure, often a top predator or ecosystem engineer.
* An indicator species is a plant or animal that, by its presence, abundance, scarcity, or chemical composition, demonstrates that some distinctive aspect of the character or quality of an ecosystem is present. Often amphibians or birds.
* Pioneer members of an early successional species commonly move into unoccupied habitat and over time adapt to its particular conditions, which may result in the origin of new species.
* Succession in a disturbed ecosystem will affect the total biomass, species richness, and net productivity over time.
* Biodiversity in an ecosystem includes genetic, species, and habitat diversity.
* The more genetically diverse a population is, the better it can respond to environmental stressors. Additionally, a population bottleneck can lead to a loss of genetic diversity.
* Ecosystems that have a larger number of species are more likely to recover from disruptions.
* Loss of habitat leads to a loss of specialist species, followed by a loss of generalist species. It also leads to reduced numbers of species that have large territorial requirements.
* Species richness refers to the number of different species found in an ecosystem.
* There are 4 categories of ecosystem services: provisioning, regulating, cultural, and supporting.

Chapter 5:

* The carbon cycle, nitrogen cycle, and phosphorous cycle are the movement of atoms and molecules containing the element carbon, nitrogen, or phosphorous between sources and sinks.
* Some of the reservoirs in which carbon compounds occur in the carbon cycle hold those compounds for long periods of time, while some hold them for short periods of time.
* Photosynthesis and Respiration.
* Plant and animal decomposition have led to the storage of carbon over millions of years. The burning of fossil fuels quickly moves that stored carbon into atmospheric carbon, in the form of carbon dioxide.
* Most of the reservoirs in which nitrogen compounds occur in the nitrogen cycle hold those compounds for relatively short periods of time.
* Nitrogen fixation is the process in which atmospheric nitrogen is converted into a form of nitrogen (primarily ammonia) that is available for uptake by plants ant that can be synthesized into plant tissue.
* The atmosphere is the major reservoir of nitrogen.
* Major reservoirs of phosphorous are rock and sediment.
* There is NO atmospheric component in the phosphorus cycle, and the limitations this imposes on the return of phosphorus from the ocean to land make phosphorus naturally scarce in aquatic and many terrestrial ecosystems.
* In undisturbed ecosystems, phosphorus is the limiting factor in biological systems.
* The hydrologic cycle (which is powered by the sun) is the movement of water.
* The oceans are the primary reservoir of water.
* Primary productivity is the rate at which solar energy is converted into organic compounds via photosynthesis.
* GPP is the total rate of photosynthesis in a given are.
* Net Primary productivity (NPP) is the rate of energy storage by photosynthesizers in an area, after subtracting the energy lost to respiration. It is the energy available to consumers.
* Productivity units are units of energy per unit of area per unit of time (Kcal/m2/year).
* Most red light is absorbed in the upper 1m of water and blue light only penetrates deeper than 100m in the clearest water. This affects photosynthesis in aquatic ecosystems, whose photosynthesizers have adapted mechanisms to address the lack of visible light.
* All ecosystems depend on a continuous inflow of high-quality energy in order to maintain their structure and function of transferring matter between the environment and organisms via biogeochemical cycles.
* Biogeochemical cycles are essential for life and each cycle demonstrated the conservation of matter.
* Energy flows from the sun to producers then consumers.
* Anthropogenic activities can disrupt ecosystem services, potentially resulting in economic and ecological consequences.

Chapter 6 and 7:

* The tragedy of the commons suggests that individuals will use shared resources in their own self-interest rather than in keeping with the common good, thereby depleting the resources.
* Solutions to Environmental Problems include Regulation with Enforcement and Cooperation. Privatization works in some situations, but not all.

Chapter 8:

|  |
| --- |
| Factors limiting global human population include the Earth’s carrying capacity and the basic factors that limit human population growth as set forth by Malthusian theory |
| Population growth rates can be interpreted from age structure diagrams by the shape of the structure. |
| A rapidly growing population will, as a rule, have a higher proportion of younger people compared to stable or declining populations. |
| Total fertility rate (TFR) is affected by the age at which females have their first child, educational opportunities for females, access to family planning, and government acts and policies. |
| If fertility rate is at replacement levels, a population is considered relatively stable. |
| Factors associated with infant mortality rates include whether mothers have access to good healthcare and nutrition. Changes in these factors can lead to changes in infant mortality rates over time |
| Population growth can be affected by both density-independent factors, such as major storms, fires, heat waves, or droughts, and density-dependent factors, such as access to clean water and air, food availability, disease transmission, or territory size. |
| The demographic transition refers to the transition from high to lower birth and death rates in a country or region as development occurs and that country moves from a preindustrial to an industrialized economic system. This transition is typically demonstrated through a four-stage demographic transition model (DTM). |
| Characteristics of developing countries include higher infant mortality rates and more children in the workforce than developed countries. |
| Birth rates, infant mortality rates, and overall death rates, access to family planning, access to good nutrition, access to education, and postponement of marriage all affect whether a human population is growing or declining |
| Factors limiting global human population include the Earth’s carrying capacity and the basic factors that limit human population growth as set forth by Malthusian theory |
| Population growth can be affected by both density-independent factors, such as major storms, fires, heat waves, or droughts, and density-dependent factors, such as access to clean water and air, food availability, disease transmission, or territory size. |

Chapter 9 and 10:

|  |
| --- |
| Agricultural practices that cause environmental damage include tiling, slash-and-burn farming, and the use of fertilizers. |
| Soils are formed when parent material is weathered, transported, and deposited. |
| Soils are generally categorized by horizons based on their composition and organic material. |
| Water holding capacity—the total amount of water soil can hold—varies with different soil types. Water retention contributes to land productivity and fertility of soils. |
| The particle size and composition of each soil horizon can affect the porosity, permeability, and fertility of the soil. |
| There are a variety of methods to test the chemical, physical, and biological properties of soil that can aid in a variety of decisions, such as irrigation and fertilizer requirements. |
| A soil texture triangle is a diagram that allows for the identification and comparison of soil types based on their percentage of clay, silt, and sand. |
| Agricultural practices that cause environmental damage include tiling, slash-and-burn farming, and the use of fertilizers. |
| Soils can be eroded by winds or water. Protecting soils can protect water quality as soils effectively filter and clean water that moves through them. |
| Overgrazing occurs when too many animals feed on a particular area of land. Overgrazing causes loss of vegetation, which leads to soil erosion. |
| Overgrazing can cause desertification. Desertification is the degradation of low precipitation regions toward being increasingly arid until they become deserts. |
| The goal of soil conservation is to prevent soil erosion. Different methods of soil conservation include contour plowing, windbreaks, perennial crops, terracing, no-till agriculture, and strip cropping. |
| Strategies to improve soil fertility include crop rotation and the addition of green manure and limestone. |
| Rotational grazing is the regular rotation of livestock between different pastures in orfer to avoid overgrazing in a particular area. |
| Agricultural practices that cause environmental damage include tiling, slash-and-burn farming, and the use of fertilizers. |
| The largest human use of freshwater is for irrigation (70%). |
| Types of irrigation include drip irrigation, flood irrigation, furrow irrigation, and spray irrigation. |
| Waterlogging occurs when too much water is left to sit in the soil, which raises the water table of groundwaterand inhibits plants' ability to absorb oxygen through their roots. |
| Furrow irrigation involves cutting furrows between crop rows and filling them with water. This system is inexpensive, but about 1/3 of the water is lost to evaporation and runoff. |
| Flood irrigation involves flooding an agricultural field with water. This system sees about 20% of the water lost to evaporation and runoff. This can also lead to waterlogging of the soil. |
| Spray irrigation involves pumping groundwater into spray nozzles across an agricultural field. This system is more efficient than flood and furrow irrigation, with only 1/4 or less of the water lost to evaporation or runoff. However, spray systems are more expensive than flood and furrow irrigation, and also requires energy to run. |
| Drip irrigation uses perforated hoses to release small amounts of water to plant roots. This system is the most efficient, with only about 5% of water lost to evaporation and runoff. However, this system is expensive and so is not often used. |
| Salinization occurs when the salts in groundwater remain in the soil after the water evaporates. Over time, salinization can make soil toxic to plants. |
| Aquifers can be severely depleted if overused for agricultural irrigation, as has happened to the Ogallala Aquifer in the central United States. |
| Agricultural practices that cause environmental damage include tiling, slash-and-burn farming, and the use of fertilizers. |
| The Green Revolution started a shift to new agricultural strategies and practices in order to increase food production, with both positive and negative results. Some of these strategies and methods are mechanization, genetically modified organisms (GMOs), fertilization, irrigation, and the use of pesticides. |
| Mechanization of farming can increase profits and efficiency for farms. It can also increase reliance on fossil fuels. |
| Methods of meat production include concentrated animal feeding operations (CAFOs), also called feedlots, and free-range grazing. |
| Meat production is less efficient than agriculture; it takes approximately 20 times more land to produce the same amount of calories from meat as from plants. |
| Concentrated animal feeding operation (CAFOs) are used as a way to quickly get livestock ready for slaughter. They tend to be crowded, and animals are fed grains or feed that are not as suitable as grass. Additionally, feedlots generate a large amount of organic waste, which can contaminate ground and surface water. The use of feedlots are less expensive than other methods, which can keep costs to consumers down. |
| Less consumption of meat could reduce CO2, methane, and N2O emissions; conserve water; reduce the use of antibiotics and growth hormones; and improve topsoil. |
| Aquaculture has expanded because it is highly efficient, requires only small areas of water, and requires little fuel. |
| Aquaculture can contaminate wastewater, and fish that escape may compete or breed with wild fish. The density of fish in aquaculture can lead to increases in disease incidences, which can be transmitted to wild fish. |
| Some organisms have been somewhat or completely domesticated and are now managed for economic returns, such as honeybee colonies and domestic livestock. This domestication can have a negative impact on the biodiversity of that organism. |
| Methods to increase water infiltration include replacing traditional pavement with permeable pavement, planting trees, increased use of public transportation, and building up, not out. |
| One consequence of using common pest-control methods such as pesticides, herbicides, fungicides, rodenticides, and insecticides is that organisms can become resistant to them through artificial selection. Pest control decreases crop damage by pest and increases crop yields. |
| Integrated pest management (IPM) is a combination of methods used to effectively control pest species while minimizing the disruption to the environment. These methods include biological, physical, and limited chemical methods such as biocontrol, intercropping, crop rotation, and natural predators of the pests. |
| The use of integrated pest management (IPM) reduces the risk that pesticides pose to wildlife, water supplies, and human health. |
| Integrated pest management (IPM) minimizes disruptions to the environment and threats to human health but can be complex and expensive. |
| Crops can be genetically engineered to increase their resistance to pests and diseases. However, using genetically engineered crops in planting or other ways can lead to loss of genetic diversity of that particular crop. |

Chapter 11 and 12:

* Biodiversity in an ecosystem includes genetic, species, and habitat diversity.
* The more genetically diverse a population is, the better it can respond to environmental stressors. Additionally, a population bottleneck can lead to a loss of genetic diversity.
* Ecosystems that have a larger number of species are more likely to recover from disruptions.
* Species richness refers to the number of different species found in an ecosystem.
* Loss of habitat leads to a loss of specialist species, followed by a loss of generalist species. It also leads to reduced numbers of species that have large territorial requirements.
* Invasive species are species that can live, and sometimes thrive, outside of their normal habitat. Invasive species can sometimes be beneficial, but they are considered invasive when they threaten native species.
* Invasive species are often generalist, r-selected species and therefore may outcompete native species for resources.
* Invasive species can be controlled through a variety of human interventions.
* Not all species will be in danger of extinction when exposed to the same changes in their ecosystem. Species that are able to adapt to changes in their environment or that are able to move to a new environment are less likely to face extinction.
* HIPPCO (habitat destruction, invasive species, population growth, pollution, climate change, and over exploitation) describes the main factors leading to a decrease in biodiversity.
* Habitat fragmentation occurs when large habitats are broken into smaller, isolated areas. Causes of habitat fragmentation include the construction of roads and pipelines, clearing for agriculture or development, and logging.
* The scale of habitat fragmentation that has an adverse effect on the inhabitants of a given ecosystem will vary from species to species within that ecosystem.
* Global climate change can cause habitat loss via changes in temperature, precipitation, and sea level rise.
* Some organisms have been somewhat or completely domesticated and are now managed for economic returns, such as honeybee colonies and domestic livestock. This domestication can have a negative impact on the biodiversity of that organism.
* Strategies to protect animal populations include criminalizing poaching, protecting animal habitats, and legislation.
* Some ways humans can mitigate the impact of loss of biodiversity include creating protected areas, use of habitat corridors, promoting sustainable land use practices, and restoring lost habitats.
* Clearcutting can be economically advantageous but leads to soil erosion, increased soil and stream temperatures, and flooding.
* Forests contain trees that absorb pollutants and store carbon dioxide. The cutting and burning of trees releases carbon dioxide and contributes to climate change.
* Sustainable yield is the amount of a renewable resource that can be taken without reducing the available supply.
* Some of the methods for mitigating deforestation include reforestation, using and buying wood harvested by ecologically sustainable forestry techniques, and reusing wood.
* Methods to protect forests from pathogens and insects include integrated pest management (IPM) and the removal of affected trees.
* Prescribed burn is a method by which forests are set on fire under controlled conditions in order to reduce the occurance of natural fires.
* Island biogeography is the study of the ecological relationships and distribution of organisms on islands, and of these organisms’ community structures
* Islands have been colonized in the past by new species arriving from elsewhere.
* Many island species have evolved to be specialists versus generalists because of the limited resources, such as food and territory, on most islands. The long-term survival of specialists may be jeopardized if and when invasive species, typically generalists, are introduced and outcompete the specialists.