Earth Science
Chap 10 – Lecture Notes
Ecosystems

I. Section 1 – Living Things & the Environment

A. **Habitats**

1. Organism- a living thing

2. **Habitat** – an environment that provides to an organism the things an organism needs to live, grow and reproduce; including food, water & shelter.

a. One area may contain many different habitats

3. Organisms interact w/ living & nonliving parts of its habitat

B. **Biotic** Factors ("bio" Latin for life)

1. Living parts of the environment an organism interacts with.

a. includes: prey items, vegetation, predators, other animals and plants in the environment.

C. **Abiotic** Factors ("**a**" Latin prefix meaning "without"; "**bio**" Latin for life)

1. Includes things like sunlight, water, Air, Temperature, Soil etc.

D. Levels of Life's Organization

1. **Cell → Tissue → Organ → Organ System → Organism**

2. **Organism → Species → Population → Communities → Ecosystem → Biosphere**

3. **Species** – a group of organisms that physically similar, and can reproduce fertile offspring

a. Labrador Retriever & Dalmatian can reproduce a puppy that can reproduce – both parent dogs are of the same species.

b. Horse and a Donkey can reproduce to make a mule. A mule is sterile and cannot reproduce. Therefore; Horse & donkeys are physically similar but cannot reproduce a fertile offspring so are different species.

4. **Population** – All the members of the same species in a given area

a. The 400 million prairie dogs in a prairie dog "town".

b. All the pigeons in New York City

c. All the trees in a forest: NOT a population because there are different species of trees in the forest.

5. **Community** – All the different populations of organisms that are able to **INTERACT** in a designated area.

6. **Ecosystems** – The community of organisms that live in an area **ALONG** with the abiotic surroundings

7. The study of how living things interact w/ each other & their environment is **Ecology**.

II. Section 2 - Populations

A. **Changes in Population Size** – Population size changes when new members enter or leave the population.

1. **Birth & Death Rates** –

a. Most common way individuals join or leave a population

b. # of births / time. I.e. 300 rabbits per year born to a population.

c. If birth rate > death rate then population is increasing

d. If death rate > birth rate then population is decreasing

2. Immigration & Emigration

a. **Immigration** – individuals of a species moving into a population.

b. **Emigration** – individuals of a species moving out of a population.

B. **Limiting Factors** – an environmental factor that causes a population to stop growing
   1. i.e. food, shelter, water, space, light, weather extremes.
   2. The largest population that an area can support is its **carrying capacity**.
   3. Populations usually stay at or near its carrying capacity due to the **limiting factors.**

III. Section 3 – Energy Flow in Ecosystems

A. Each of the organisms in an ecosystem fills a spot in an energy pyramid as a producer, consumer or decomposer.
   1. **Producers** – Organism that makes its own food – **Photosynthesis** – plants.
   2. **Consumers** – classified by what they eat
      a. **Herbivores** – Primary (first) consumers – Plant eaters
      b. **Carnivores** – animals that eat only other animals
      c. **Omnivores** – Consumers that eat both plants and animals
      d. **Scavengers** – a carnivore that feeds on the bodies of dead organisms.
   3. **Decomposers** – organisms that breakdown wastes and dead tissue returning the nutrients back to the ecosystem.

B. Food Chains & Food Webs
   1. **Food Chain** – a series of events in which one organism eats another to obtain energy.
      a. Food Chains always start w/ a producer – a plant.
      b. **Primary consumer** – animals that eat plants
      c. **Secondary consumers** – animals that eat primary consumers
      d. Top of the food chain – Top predator in the system
      e. Grass → grasshopper → field mouse → snake → hawk
      f. Shows only one path the passing of energy might take – reality this path is very twisted and complex
   2. **Food Web** – many overlapping food chains
      a. Organisms play multiple roles & levels in a web
      b. Many food chains overlap to make up food web
      c. Food webs also overlap
         i. a sea gull is part of a land food web (eats at the dump) then flies out to the ocean and eats from a school of anchovies.

C. **Energy Pyramids** – a diagram that shows the amount of energy transferred from one feeding level to the next.
   1. The most energy is available at the producer level.
   2. **Primary consumer** – eats plants and uses most of the "food" as energy to live, grow and reproduce. When it is eaten by secondary consumer only a small amount of energy from the plant is available to the next level of consumer.
   3. Generally speaking, **10% of the energy** of one level is available to the next level on the pyramid.

IV. Section 4 – Interactions Among Living Things

A. Adapting to the Environment
   1. **Natural Selection** – process where changes that make organisms better suited to their environment become more common in that species.
   2. Results of natural selection are adaptations that allow the organism to live and reproduce successfully.
   3. **Niche** – how an organism "makes a living" in its environment.
      a. **No two different species "occupies" the same niche.**
      b. Includes: type of food it eats, how it gets its food, when it is active, where it lives, how it reproduces, the conditions it requires to live, etc. etc.

4. 3 major types of Interactions between organisms: Competition, Predation & Symbiosis
    a. **Competition** – struggle between organisms to survive as they attempt to use the same limited resources.
    b. **Predation** – Interaction where one organism kills and eats another organism.
        1. Predator – the animal that does the killing
        2. Prey – the animal that gets killed and eaten
        3. Predators can have a major effect on the size of a population
    c. **Symbiosis** – a close relationship between two organisms in which at least ones of the benefits – 3 types: **Mutualism, Commensalism, Parasitism**
        1. **Mutualism** – both benefit
        2. **Commensalism** – one benefit the other neither helped or harmed
        3. **Parasitism** – one benefits, the other harmed
            a. One that benefits – **parasite**
            b. One that is harmed – **host**

V. Section 5 – Cycles of Matter

B. The **Water Cycle** – Evaporation → Condensation → Precipitation

C. **Carbon Cycle** & **Oxygen Cycle** interconnected
    1. Chemicals that contain carbon are called organic those w/out are inorganic
        a. Exception is CO_2 and CO – both gasses
    2. CO_2 taken in from air by plants during photosynthesis → consumers and finally decomposers finally breakdown organics. CO_2 is released back into the air as each of these processes respire, burn fuels, etc.
    3. Oxygen is released into the environment during photosynthesis

D. **Nitrogen Cycle** – nitrogen moves from air to the soil, to plants, to consumers, decomposers and back to the air or soil.
    1. Most plants can't use atmospheric nitrogen
    2. Plants called **legumes** (beans, peas, clover, alfalfa & peanuts) convert atmospheric nitrogen into usable nitrates and nitrites – **Nitrification** – **nitrogen fixation**
        a. Achieved by bacteria living in the **root nodules** of the legumes.

VI. Section 6 – Changes in Communities

E. **Succession** – the series of predictable changes that occur in a community over time.

F. **Primary Succession** – The first organisms to populate an area where **no soil** or organisms currently exist.
    1. newly formed volcanic island exhibits primary succession
    2. 1st species to populate are Pioneer Species – like moss, algae & lichens
    3. These pioneers breakdown the rock, die and decompose to start soil formation
    4. Seeds of land plants land/fall onto new soil & grow.
    5. Certain species populate the community as time progresses.

G. **Secondary Succession** – the series of changes that occur where the ecosystem has been disturbed but where soil and some organisms still exist.
    1. Natural disturbances include fire, flood, hurricanes and tornadoes
    2. Human disturbances include farming, logging, mining,
    3. occurs where ecosystem currently exist
    4. occurs more rapidly than primary succession.

Living Things and the Environment *Section 1 Summary*

A prairie dog is one type of **organism,** or living thing. Different types of organisms live in different types of environments. **An organism obtains food, water, shelter, and other things it needs to live, grow, and reproduce from its environment.** Other living things depend on plants and algae for food. An environment that provides the things the organism needs to live, grow, and reproduce is called its **habitat.**

An organism interacts with both living and nonliving parts of its habitat. The living parts of a habitat are called **biotic factors.** The nonliving parts of a habitat are called **abiotic factors.** Abiotic factors include water, sunlight, oxygen, temperature, and soil. Some organisms make their own food in a process called **photosynthesis.**

A **species** is a group of organisms that are physically similar and can mate with each other and produce offspring that can also mate and reproduce. All the members of one species in a particular area are referred to as a **population.** All the different populations that live together in an area make up a **community.** The community of organisms that live in a particular area, along with their nonliving surroundings, make up an **ecosystem. The smallest level of organization is a single organism, which belongs to a population that includes other members of its species. The population belongs to a community of different species. The community and abiotic factors together form an ecosystem.**

The study of how living things interact with each other and with their environment is called **ecology.** Ecologists are scientists who study ecology. They study how organisms react to changes in their environment.

Populations• *Section 2 Summary*

Ecologists study populations to determine how a population may be changing. This is done by observing population changes over several years.

Populations can change in size when new members join the population or when members leave the population. The main way in which new individuals are added to a population is being born in it. The **birth rate** of a population is the number of births in a population over a certain amount of time. The major way that individuals leave a population is by dying. The **death rate** is the number of deaths in a population over a certain amount of time. If the birth rate is greater than the death rate, the population will generally increase in size. If the death rate is greater than the birth rate, the population size will generally decrease. The size of a population can also change when individuals move into or out of the population. **Immigration** means moving into a population. **Emigration** means leaving a population. Graphs are useful to show changes in the size of a population over time.

A **limiting factor** is an environmental factor that causes a population to stop growing. **Some limiting factors for populations are food and water, space, light, soil composition, and weather conditions.** The largest population that an environment can support is called the **carrying capacity.** A population usually stays near its carrying capacity because of the limiting factors in its habitat.

Energy Flow in Ecosystems■ *Section 3 Summary*

An organism's energy role is determined by how it obtains energy and how it interacts with the other living things in its ecosystem. **Each of the organisms in an ecosystem fills the energy role of producer, consumer, or decomposer.**

Plants, algae, and some bacteria can carry out photosynthesis. In this process, the organism uses the sun's energy to turn water and carbon dioxide into sugar molecules. An organism that can make its own food is a **producer.** Producers are the source of all the food in an ecosystem.

Other organisms cannot make their own food. They depend on producers for food and energy. An organism that obtains energy by feeding on other organisms is a **consumer.** Consumers are classified by what they eat. Consumers that eat only plants are called **herbivores.** Consumers that eat only animals are called **carnivores.** A consumer that eats both plants and animals is called an **omnivore.** A **scavenger** is a carnivore that feeds on the bodies of dead organisms. An organism may play more than one role in an ecosystem.

Organisms that break down wastes and dead organisms and return the raw materials to the environment are called **decomposers.** As decomposers obtain energy for their own needs, they return simple molecules to the environment to be used again by other organisms.

The transfer of energy from organism to organism in an ecosystem can be shown in diagrams called food chains and food webs. A food chain is a series of events in which one organism eats another and obtains energy. The first organism in a food chain is always a producer. The second organism, called a first-level consumer, eats the producer. The next consumer, called a second-level consumer, eats the first-level consumer. A food chain shows just one possible path of energy through an ecosystem.

Most producers and consumers are part of many food chains. A more realistic way to show the flow of energy through an ecosystem is a food web. A **food web** consists of the many overlapping food chains in an ecosystem.

When an organism makes its own food or eats other organisms, it obtains energy. The organism uses some of this energy to move, feed, grow, and reproduce. Only some of the energy will be available to the next organism in the food web. A diagram called an **energy pyramid** shows the amount of energy that moves from one feeding level to another in a food web. **The most energy is available at the producer level of the pyramid. As you move up the pyramid, each level has less energy available than the level below.** In general, only about 10 percent of the chemical energy at one level of a food web is transferred to the next higher level. As a result, there are usually few organisms at the highest level in a food web.

Interactions Among Living Things■ *Section 4 Summary*

Every organism has some unique characteristics that enable it to live in its environment. In response to their environment, species evolve, or change over time. The changes that make organisms better suited to their environment become common in that species by a process called **natural selection.** Individuals whose unique characteristics are best suited for their environment tend to survive and produce offspring. The offspring inherit those characteristics and also live to reproduce. Individuals that are poorly suited to the environment are less likely to survive and reproduce. The poorly suited characteristics may disappear from the population over time. The results of natural selection are **adaptations,** the behaviors and physical characteristics of species that allow them to live successfully in their environment.

Every organism has a variety of adaptations that are suited to its specific living conditions. These adaptations create a unique role for the organism in its ecosystem. An organism's particular role in its habitat, or how it makes its living, is called its **niche.** A niche includes the type of food the organism eats, how it obtains this food, which other organisms use the organism as food, when and how the organism reproduces, and the physical conditions it requires to survive.

Some adaptations involve how organisms interact. **There are three major types of interactions among organisms: competition, predation, and symbiosis. Competition** is the struggle between organisms to survive as they attempt to use the same limited resource. **Predation** is an interaction in

which one organism kills and eats another organism. The organism that does the killing is the **predator.** The organism that is killed is the **prey.** Predators have adaptations that help them catch and kill their prey. Prey organisms have adaptations that help them avoid being caught and eaten. Predation can have a major effect on the size of a population.

Symbiosis is a close relationship between two species that benefits at least one of the species. **The three types of symbiotic relationships are mutualism, commensalism, and parasitism. Mutualism** is a relationship in which both species benefit. **Commensalism** is a relationship in which one species benefits and the other species is neither helped nor harmed. **Parasitism** involves one organism living on or inside another organism and harming it. The organism that benefits is called a **parasite,** and the organism it lives on or in is called a **host.**

Cycles of Matter■ *Section 5 Summary*

Matter is recycled in ecosystems. Matter includes water, oxygen, carbon, nitrogen, and many other substances. The most important cycles of matter are the water cycle, the carbon and oxygen cycles, and the nitrogen cycle.

The water cycle is the continuous process by which water moves from Earth's surface to the atmosphere and back. **The processes of evaporation, condensation, and precipitation make up the water cycle.** Living things also contribute to the water cycle. Plants take up water through their roots and release water vapor through pores in their leaves. Animals drink water. They release water in their waste and water vapor when they exhale.

Carbon is the building block for the matter that makes up the bodies of living things. **In ecosystems, the processes by which carbon and oxygen are recycled are linked. Producers, consumers, and decomposers play roles in recycling carbon and oxygen.** Producers take in carbon dioxide from the atmosphere during photosynthesis. In this process, the producers use carbon from the carbon dioxide to produce other carbon-containing molecules. These molecules include sugars and starches. Consumers obtain energy from these molecules by breaking them down into simpler molecules. The consumers release water and carbon dioxide as waste products of the process. At the same time, producers release oxygen as a result of photosynthesis. Other organisms take in oxygen from the air or water and use it in their life processes.

Like carbon, nitrogen is a necessary building block in the matter that makes up living things. **In the nitrogen cycle, nitrogen moves from the air to the soil, into living things, and back into the air.** Most organisms cannot use nitrogen gas in the air. Nitrogen gas is called "free" nitrogen because it is not combined with other kinds of atoms. Most organisms can use nitrogen only when it has been "fixed," or combined with other elements to form nitrogen-containing compounds. The process of changing nitrogen gas into a usable form of nitrogen is called **nitrogen fixation.** Most nitrogen fixation is performed by certain kinds of bacteria. Some of these bacteria live in bumps called nodules on the roots of certain plants. Once the nitrogen has been fixed, it can be used by organisms to build proteins and other complex substances. Decomposers break down these complex compounds. Decomposition returns simple nitrogen compounds to the soil. Certain types of bacteria break down the nitrogen compounds completely. These bacteria release free nitrogen back into the air, and the cycle starts again.

Changes in Communities■ *Section 6 Summary*

Fires, floods, volcanoes, hurricanes, and other natural disasters can change communities in a short period of time. Even without a disaster, communities change. The series of predictable changes that occur in a community over time is called **succession.**

Primary succession is the series of changes that occur in an area where no soil or organisms exist. The area might be a new island formed by the eruption of an undersea volcano or an area uncovered by a melting sheet of ice. When the land is first exposed, there is no soil. The first species to populate the area are called **pioneer species.** Pioneer species are usually lichens and mosses, which can grow on bare rocks. As they grow, the lichens and mosses help break up the rocks to form soil. When these organisms die, they provide nutrients that enrich the developing soil. Over time, seeds of plants land in the new soil and begin to grow. The specific plants that grow depend on the climate of the area. In time, as the soil grows older and richer, a mature forest may develop.

Secondary succession is the series of changes that occur in an area where the ecosystem has been disturbed, but where soil and organisms still exist. Natural disturbances include fires, hurricanes, and tornadoes. Human activities, such as farming, logging, or mining, also may disturb an ecosystem. **Unlike primary succession, secondary succession occurs in a place where an ecosystem currently exists.** Secondary succession usually occurs more rapidly than primary succession.

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D. Levels of Life's Organization

1. **Cell → Tissue → Organ → Organ System → Organism**

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