Eco Systems

Mod - 2

Contents

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession.

Case studies of the following ecosystems:

- a) Forest ecosystem
- b) Grassland ecosystem
- c) Desert ecosystem
- d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Eco System

- An ecosystem is a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life.
- Ecosystems contain biotic or living, parts, as well as abiotic factors, or nonliving parts.
- Biotic factors include plants, animals, and other organisms. Abiotic factors include rocks, temperature, and humidity.
- A change in the temperature of an ecosystem will often affect what plants will grow there, for instance.
- Animals that depend on plants for food and shelter will have to adapt to the changes, move to another ecosystem, or perish.

Eco System

- Ecosystems can be very large or very small. Tide pools, the ponds left by the ocean as the tide goes out, are complete, tiny ecosystems. Tide pools contain seaweed, a kind of algae, which uses photosynthesis to create food.
- Tide pools depend on the changing level of ocean water. Some organisms, such as seaweed, thrive in an aquatic environment, when the tide is in and the pool is full. In this way, the biotic parts of the ecosystem depend on abiotic factors.

- The whole surface of Earth is a series of connected ecosystems. Ecosystems are often connected in a larger biome.
- Biomes are large sections of land, sea, or atmosphere. Forests, ponds, reefs, and tundra are all types of biomes, for example. They're organized very generally, based on the types of plants and animals that live in them.
- Within each forest, each pond, each reef, or each section of tundra, you'll find many different ecosystems.

- The biome of the Sahara Desert, for instance, includes a wide variety of ecosystems.
- The arid climate and hot weather characterize the biome.
- Within the Sahara are oasis ecosystems, which have date palm trees, freshwater, and animals such as crocodiles.
- The Sahara also has dune ecosystems, with the changing landscape determined by the wind.
- Organisms in these ecosystems, such as snakes or scorpions, must be able to survive in sand dunes for long periods of time.
- The Sahara even includes a marine environment, where the Atlantic Ocean creates cool fogs on the Northwest African coast.
- Shrubs and animals that feed on small trees, such as goats, live in this Sahara ecosystem.

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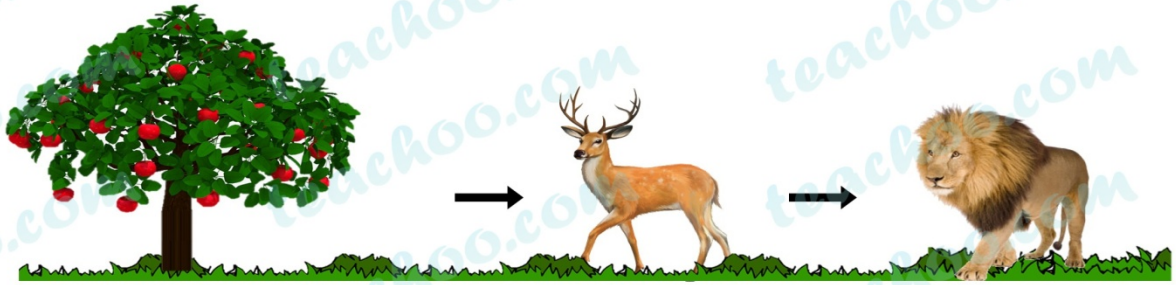
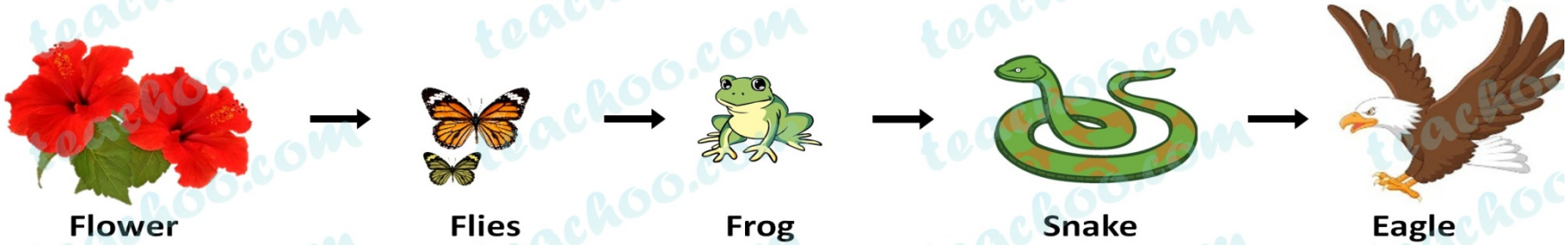
- The secondary and tertiary consumers (carnivores) eat other consumers. For e.g. Tiger, Lion eat deer and other animals for terrestrial ecosystems and fishes for aquatic ecosystems.
- Decomposers are organisms that obtain energy and nutrients from remains of dead producers and consumers.
- Composition of species varies according to the Eco system type.

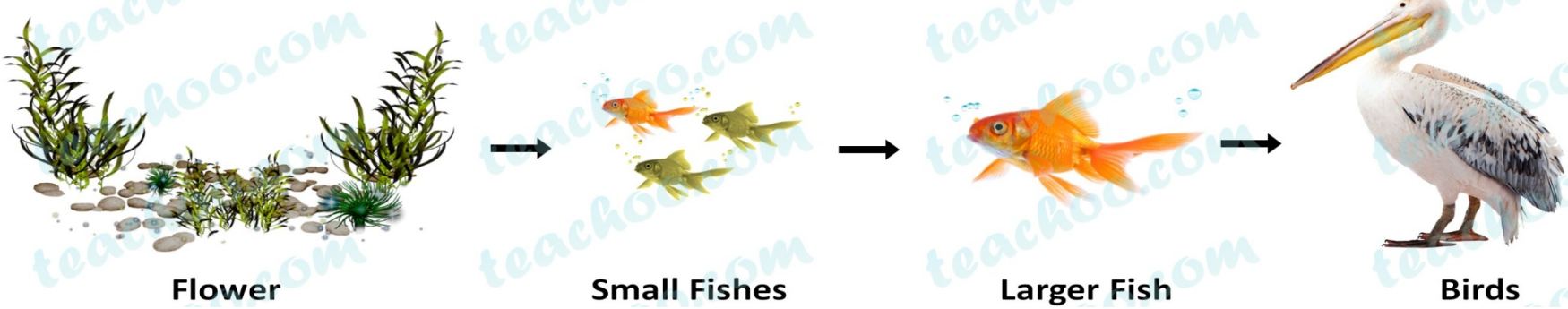
Food chain

- ***Food chain***, in ecology, the sequence of transfers of matter and energy in the form of food from organism to organism.
- Food chains intertwine locally into a food web because most organisms consume more than one type of animal or plant.
- Plants, which convert solar energy to food by photosynthesis, are the primary food source.
- In a predator chain, a plant-eating animal is eaten by a flesh-eating animal.
- In a parasite chain, a smaller organism consumes part of a larger host and may itself be parasitized by even smaller organisms.
- In a saprophytic chain, microorganisms live on dead organic matter.

Food Chains



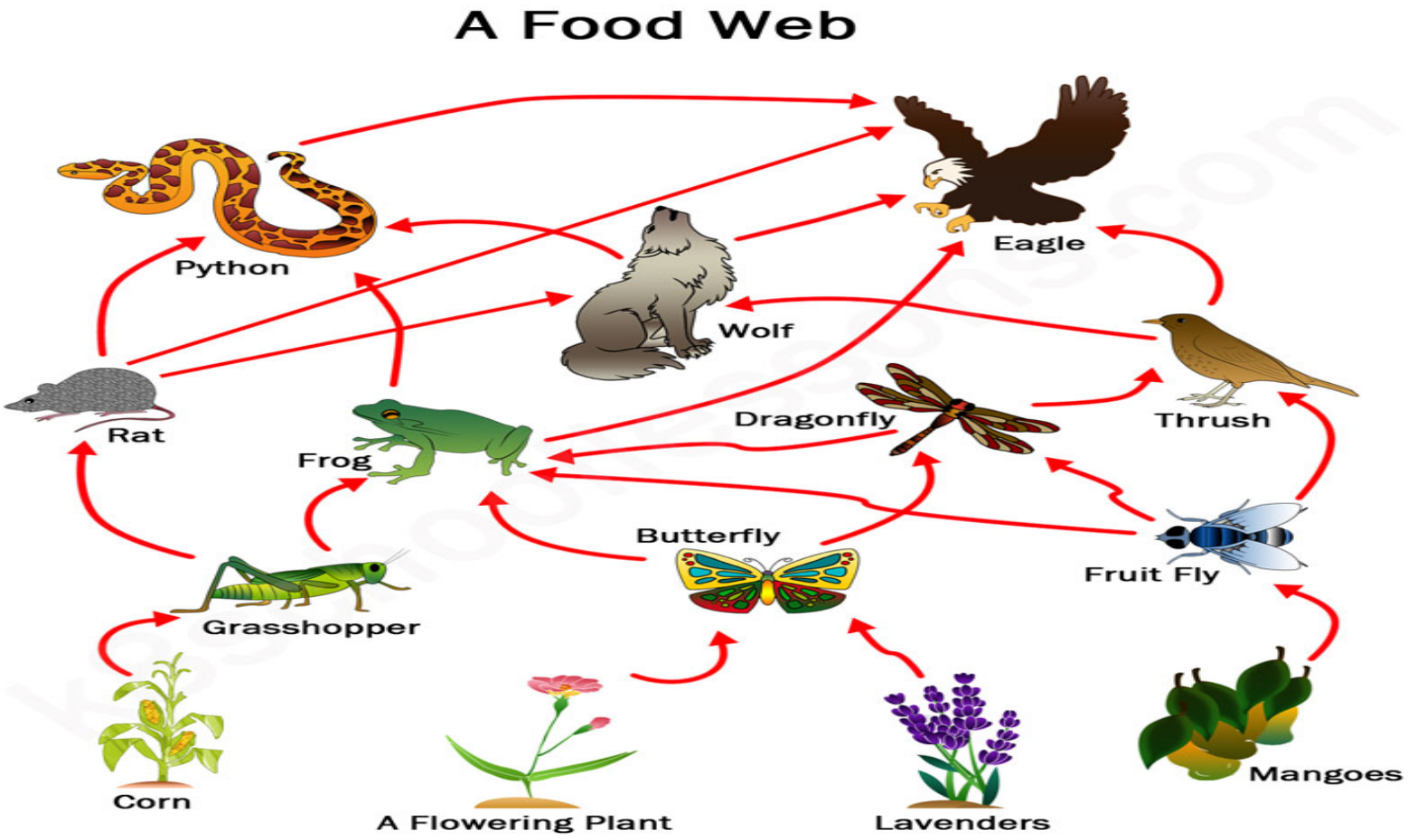




Food web

- A food web consists of all the food chains in an ecosystem.
- Each living thing in an ecosystem is part of multiple food chains. Each food chain is one possible path that energy and nutrients may take as they move through the ecosystem.
- All of the interconnected and overlapping food chains in an ecosystem make up a food web.
- Each organism in an ecosystem occupies a specific trophic level or position in the food chain or web.
- Producers, who make their own food using photosynthesis or chemosynthesis, make up the bottom of the trophic pyramid. Primary consumers, mostly herbivores, exist at the next level, and secondary and tertiary consumers, omnivores and carnivores, follow.

FOOD WEB IN TROPICAL TERRAIN



Abiotic components

- The abiotic components are air, water, salts, light, temperature, nutrients etc. These are basic components in the structure of every ecosystem. In deserts, temperature and light will be in excess, but with scarcity of water.
- All these components are vital and the species composition if affected by these abiotic factors. The amount of these nutrients present in soil is known as standing state.

Tropic relationships

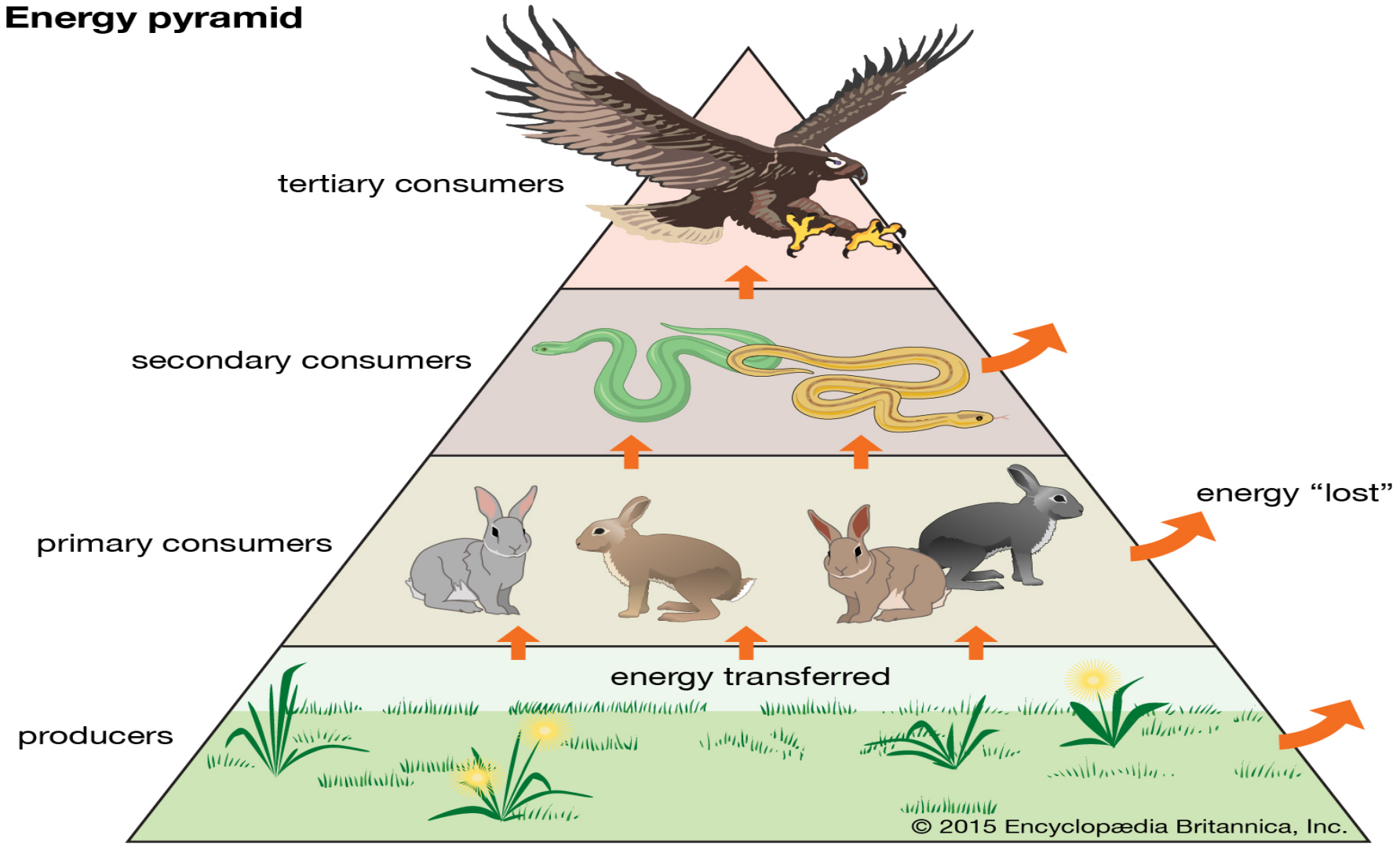
- It’s a relationship of `who eats whom’ in a food chain which forms a food web.!
- A food chain is a linear series of organisms dependent on one another resulting in the transfer of energy. Eg. Sheep eats grass, and sheep eaten by a Lion
- A food web is interconnected set of food chains..! Like mouse in a field may eat different kinds of insects and mouse may be eaten by different carnivorous animals.

CONSUMERS- Types

- Herbivorous- Eat only plants
- Carnivorous – Eat meat- other animals
- Omnivorous- eat both plant & Animals

Food pyramid or Energy pyramid

- An energy pyramid, also known as a trophic or ecological pyramid, is a graphical representation of the energy found within the trophic levels of an ecosystem.
- The bottom and largest level of the pyramid is the producers and contains the largest amount of energy.
- As you move up the pyramid, through the trophic levels to primary, secondary and tertiary consumers, the amount of energy decreases and the levels become smaller.
- While energy can not be created or destroyed is it released as heat within each level.
- Approximately only 10% of energy is passed from one level to the next.



https://www.youtube.com/watch?v=k9-x_YYKaV4

Functions of Eco Systems

1. Energy Flow – Energy flow is an important function that sustains the ecosystem but the energy does not cycle and so needs a constant input. Energy flow is a one-way process in ecosystems. Two types-Single energy flow model & Y shape flow-grazing food chain & detritus chain.
2. Nutrient Cycling- Nutrients move through ecosystems by way of biogeochemical cycles which by name indicate that these cycles include biological, geological and chemical cycles.

Ecological Succession

- Within any community some species may become less abundant over some time interval, or they may even vanish from the ecosystem altogether. Similarly, over some time interval, other species within the community may become more abundant, or new species may even invade into the community from adjacent eco systems. This observed change over a period of time is called ecological succession.

- https://www.youtube.com/watch?v=8ceDE01iWLE

Ecological succession-Process

1 Nudation-It is the development of a bare area without any life form. The bare area may be caused due to landslides, volcanic eruptions, drought, glaciers, frost, overgrazing, outbreak of diseases, agricultural, industrial activities etc

2. Invasion-It is the successful establishment of one or more species on a bare area through dispersal (by wind water birds etc) or migration, followed by ecesis or establishment. As growth and reproduction start, these pioneer species increase

Ecological succession-Process

3.Competition and coactions- As the number of individuals grows there is interspecific (between species) and intraspecific (within species) competition for space water and nutrition. This influence on each other in a number of ways is called coactions.

4. Reaction- the cause of ecosystem change, is the impact that established species have upon their own environments, sometimes subtle and sometimes overt alteration of one's own environment. This modification of environment by established species is called Reaction.

Types of Eco systems

- Forest eco system
- Grassland Eco system
- Desert Eco system
- Aquatic Eco System
- Marine Eco system

Forest Eco System

- Forest Eco system is complex and can be disrupted and harmed if not properly sustained. Its complex-from dry desert shrub land to large temperate rain forests.

  Based on the climate conditions, forests are classified into:
- Tropical rain Forests
- Tropical Deciduous forests
- Tropical scrub forests
- Temperate rain forests
- Temperate deciduous forests
- Evergreen Coniferous forests

Tropical Rain forests

- These are considered the storehouse of biodiversity and found near the equator having high temperature, humidity and rainfall favouring broad leaved evergreen tree growth which forms a dense canopy not allowing sunlight coming in. hence only shade loving small trees exist in these forests.
- Silent valley forest in Kerala is only rain forest In India other examples are Amazon forest in South America, kilum-Ijium forest west Africa.

Other types of forests

- **Tropical Deciduous Forests**-Found a little away from equator, having warm climate, rainfall only during monsoon,(moderate amount of precipitation),), a large part of year remaining dry and so favouring deciduous trees which lose their leaves in autumn.
- **Tropical Shrub Forests**- Found in areas where the dry season is very long favouring small deciduous trees and shrubs. Some areas of Western Ghats in India have shrub forests.
- **Temperate Rain Forests**- Found in temperate areas with adequate rainfall dominated by coniferous trees like pines, firs, redwood and also some evergreen broad leaved trees owing to the plentiful rainfall. Found in United States along the coastline of the Pacific Northwest and in Canada, and Alaska

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- **Temperate Deciduous Forests**- Found in areas with marked seasonality but moderate temperature and abundant rainfallthroughout the year favouring broad leaf deciduous trees like oak(*Quercus*), hickory, poplar etc. Therefore they are more precisely termed as ***temperate broadleaf forest***, and are found in North America, southern South America, Europe, and Asia.
- **Evergreen Coniferous Forests(Boreal Forests)-** Found south of arctic tundra having long cold and dry winters, sunlight being available for a few hours only and summer season being mild and short favouring coniferous trees like fir, cedar, pines, spruce etc. having tiny needle shaped leaves with wax coating to withstand the cold.

Grassland Eco system

- Grasslands are open areas where grasses or grass-like plants are the dominant vegetation and where there are few trees. Grasses came to dominate over other species, such as trees, because they are better able to thrive in hot, dry climates where spring and summer rain is sparse. Shrubs are also an important component of grasslands, and in some areas they are the dominant plants which have long, deep tap roots that search for water well below the surface. The rolling landscape of grasslands includes hills, river valleys, canyons and cliffs.

Types of Grasslands

- Three types of grasslands are found to occur in different climatic region
- **Tropical Grasslands**-In Africa these are known as Savannas, which have tall grasses, scattered shrubs, stunted trees and perennating bulbs, rhizomes, runners etc. Termite mounds are very common. Animal diversity is high including Zebras, giraffes, gazelle, antelope

- **Temperate Grasslands**-In United States and Canada these grasslands are known as prairies, in South America as Pampas, in Africa as Velds and in central Europe and Asia they are known as Steppes. The soils are very fertile and often cleared for agriculture.

- **Polar Grasslands**- These grasslands are found in Arctic Tundra where the climate is too cold and harsh for trees to grow. A thick layer of ice remains frozen under the surface of soil throughout the year. Only in summers when the sun shine round the clock some annual plants grow and even shallow lakes, bogs etc appear which attract migratory birds. Animals include arctic wolf, weasel, arctic fox, reindeer etc.

DESERT ECO SYSTEM

- Deserts are defined as regions wherein the average annual precipitation seldom exceeds more than 10 inches per year, and the amount of water lost to evaporation is much more than the amount of water gained by precipitation. Though a desert may seem like a barren land devoid of forms of life, life does exist in this harsh environment. Numerous plants and animal species have adapted to these seemingly unsuitable conditions.

Desert Animals

- Deserts are home to a number of species of the animal kingdom. Biodiversity of the deserts is as unique as other biomes of the world.
- Plants are the primary producers
- Rodents, insects and reptiles which feed on these plants are the primary consumers.
- Secondary consumers- comprise larger reptiles and insects which feed on primary consumers.
- Apex predators in the form of birds and mammals. Most prominent members of the desert animals list include the Gila monster, chuckawallas, desert tortoise, rattlesnakes, hawks, ostriches, bobcat, kangaroo rats, mountain lions, etc. Most of these desert animals are nocturnal, i.e. active during the night, and spend the entire day burrowing.

Desert -Plants

- Desert vegetation is only thought about as cactus. However, within cactus, there are different types which grow in different deserts of the world. These plants have modified themselves to sustain in the desert environment. Some plants store water in the specialized tissues, while others have small leaves with hair like structures which reduce the evaporation of moisture.
- In North American deserts, barrel cactus is the most abundantly found cacti species, while other species include crimson hedgehog cactus, pancake prickly pear cactus, saguaro cactus, etc. Other cactus plants such as brittle bush, saltbush, creosote bush, desert ironwood, gravillias, Joshua tree, Mojave aster, Soaptree yucca, hanging chain cholla, etc., are also quite common in deserts.

Aquatic Eco systems

- Aquatic systems are those that contain plants and animals that predominantly depend on a significant amount of water to be present for at least part of the year. They are either freshwater or marine.
- **Pond Ecosystem**- Ponds are often shallow water bodies and seasonal. Like in a forest, the top, middle, and bottom of a pond can be vastly different from each other, and even the layers in between.
- Under different temperature or light conditions the water in a pond can vary greatly in oxygen, clarity, and other factors that effect where plants and animals might live.

Pond Eco system…..

- **Diversity** - A pond is not just a small lake with frogs and fishes, rather there are thousands of different species of plants, algae, insects fishes and animals living together in a natural pond. The more diverse a pond is (more species that it has) the stronger and healthier it is.
- **Micro-organisms** - Some of the most important plants and animals in a pond are micro organisms and while a few may cause disease, almost all are very beneficial and important to a pond ecosystem. While bigger animals may fly, walk, or swim away to other ponds, micro-organisms are always present in large numbers.
- **Macro-organisms -** Larger plants and animals that are easy to see on a pond are called “macro-organisms (macro=large). They are the plants and animals that we often notice first, and can more easily spread from pond to pond, for example water birds.

Lake Eco System

- These are usually big water bodies having shallow water zone called littoral zone, open water zone where effective penetration of sunlight takes place called limnetic zone and a deep bottom area where light penetration is negligible called profundal zone.
- Organisms- Several types of organisms occur like planktons(that float on water surface), nektons(that swim like fishes), Neustons (rest ir swim on surface, like water insects, Benthos(attached to bottom like snails), Periphytons(clinging to other plants and surfaces like crustacians)

- Dal lake of Srinagar, Naini lake of Nainital , Loktak lake in Manipur are some famous lakes of the country.

Streams & rivers

- **Streams and Rivers-** Streams are shallow flowing water and rivers are large streams flowing through plains and falling into the sea.
- Stream organisms have to face extremes of temperature and current but constant movement and shallow water provides abundant oxygen.
- Large rivers are relatively deep and wide and rich in organic matter but also contain a lot of inorganic sediment produced by erosion and runoff into the upland waters.
- Fish species such as sturgeon and catfish, which feed on sediments, are more common here than predatory fish.

Marine Ecosystem

- These are among the largest of Earth's aquatic ecosystems. They include oceans, salt marsh and estuaries and lagoons, mangroves and coral reefs, the deep sea and the sea floor.
- Marine waters cover two-thirds of the surface of the Earth. Such places are considered ecosystems because the plant life supports the animal life and vice-versa.

Estuaries

- **Estuary** is a partly enclosed coastal body of water with one or more rivers or streams flowing into it, and with a free connection to the open sea.
- Estuaries form a transition zone between river environments and ocean environments and are subject to both marine influences, such as tides, waves, and the influx of saline water.
- Plants which cope up with saline water will grow well, short trees and plants.

Estuarine Food web

An Estuarine food web contains the following elements:

- **Phytoplankton**. These microscopic organisms manufacture food by photosynthesis and absorb nutrients such as phosphorus and nitrogen from the water.
- **Detritus** (dead organic matter).
- **Microscopic animals** known as zooplankton eat some of the phytoplankton. The remainder of the phytoplankton becomes detritus, when it dies.
- Larger estuary animals such as filter-feeding worms, shellfish and hungry young fish feed on the zooplankton and detritus. There are many migratory species of fishes like eels and salmons in which half of the life is spent in fresh water and half in salty water.

Bio- Diversity Types

- Genetic diversity is all the different genes contained in all the living species including individual plants, animals, fungi, and microorganisms.

- Species diversity is all the different species, as well as the differences within and between different species. Roughly 1.4 million species are known to science, but because many species are undescribed, an estimated 10-30 million species likely exist at present.

- Ecosystem diversity is all the different habitats, biological com-munities and ecological processes, as well as variation within individual ecosystems.

Biodiversity Loss Concerns

- Biodiversity found on Earth today is the result of 3.5 billion years of evolution. In the geological history there has been not only evolution but also diversification and extinctions. Extinction is a natural event which from a geological perspective can be said to be routine. Most species that lived have gone extinct. The average rate over the past 200 million years (my) is 1-2 species per year, and 3-4 families per my. The average duration of a species is 2-10 million years (based on last 200 million years). There have also been occasional episodes of mass extinction, when many taxa representing a wide array of life forms have gone extinct in the same blink of geological time.

Reasons for bio-diversity loss

- Habitat loss and destruction: This is one of the greatest threats to biodiversity. Habitat loss is directly linked to human induced pressures on land.
- Alterations in ecosystem composition: Variety of species and their interactions with their ecosystems is critical for not only saving the species, but also for their successful future evolution. In the event of alterations, either within species groups, or within the environment, entire ecosystems can begin to change. Alterations to ecosystems are a critical factor contributing to species and habitat loss.
- Invasive alien species: The introduction of exotic species that replace local and native species is cited as the second largest cause of biodiversity loss. Alien invasive species replace, and often result in the extinction of native species.

Loss of bio-diversity….

- Over-exploitation: Over-hunting, over-fishing or over-collecting of a species can quickly lead to its decline. Changing consumption pat-terns of humans is often cited as the key reason for this unsustainable.
- Pollution and contamination: Biological systems respond slowly to changes in their surrounding environment and so pollution and con-tamination cause irreversible damage to species and varieties as spe-cies cannot immediately adapt. High level of DDT in birds affects their ability to reproduce as it leads to thinning of egg shells.
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- Global climate change: Both climate variability and climate change cause biodiversity loss. Species and populations may be lost per-manently, if they are not provided with enough time to adapt to chang-ing climatic conditions.

SOLUTIONS

- Conservation of wildlife
- In Situ Conservation Methods:
- In-situ conservation, is the conservation of species in their natural habitats and is considered the most appropriate way of conserving biodiversity. It involves conserving the areas where populations of species exist naturally and is an underlying condition for the conservation of biodiversity

Conservation methods

- Biosphere reserves- These conserve some representative ecosystems as a whole. In India there are 17 biosphere reserves. e.g. Nanda Devi (U.P) and Manas (Assam).
- National Park- It is an area dedicated for the conservation of wildlife along with its environment. It is also open to tourists. Within a Biosphere reserve there may be one or more national parks. e.g. Nilgiri Biosphere Reserve (covering areas of Karnataka, Kerala and Tamil Nadu) has two National Parks viz. Bandipur and Nagarhole National Park. Recently (Feb 2011) a deer was photographed in Nagarhole eating a plastic cover. It reflects the negligent attitudes of tourists and officials alike and is a big blot on conservation efforts. There are 99 National Parks in the country and each National Park usually aims at conservation of some particular species of wildlife along with others. For example, Elephant in Bandipur (Karnataka), Tiger in Kanha (M.P.) etc.