

BIOLOGY

SHORT STUDY NOTES

**ECOLOGY
AND
ENVIRONMENT**

CLASS 12

BY LEARNINGMANTRAS.COM

Ecology and Environment

Ecology

- Ecology is the study of relationships between living organisms (plants, animals, bacteria, humans) and the environment.
- According to Odum, who is known as the Father of modern ecology, “Ecology is the study of structure and function of ecosystems”.
- Reiter used the word ‘Ecology’ in the year 1865.
- Ernst Hackel explained it more profoundly in the year 1869.
- Ramdeo Misra is known as the Father of ecology in India.
- Its major components are individual or organisms, species, population, community, ecosystem and biosphere.
- All of the components are interrelated and can be determined on the basis of composition and distribution of a variety of resources like heat, sunlight, nutrients and water.

Environment

- Environment is the totality of the surroundings that we live in.
- It is the combination of physical and biological components such as animals, plants, air, water, sunlight; we can study the effect of all organisms and the effects of their way of living on the environment.
- Climate and weather changes take place due to different impacts on the environment and hence can alter the natural cycles.

Organisms and environment

- Organisms and environment are interrelated and interdependent.
- Any change in the environment affects the living organisms and vice-versa.

Ecosystem

- The term ‘ecosystem’ was proposed by a British ecologist **G. Tansley (1935)**. It represents the basic fundamental, functional unit of ecology which comprises the biotic community together with its abiotic (non-living) environment.
- Ecosystem is the functional unit of nature where living organisms interact with each other and with their
- Ecosystems can be recognized as self-regulating and self-sustaining units of landscapes that may be terrestrial or Forests, grasslands and deserts are examples of terrestrial ecosystems. The aquatic ecosystems can be either fresh water (ponds, lakes, streams) or salt water (marine estuaries) type.
- Ecosystems may be natural (forest, sea), if developed under natural conditions or artificial (garden, aquarium, agriculture) if created by man.

- Ecosystem is normally an open system because there is a continuous and variable entry and loss of energy and Ecosystem is known by different terms i.e., biogeocoenosis or geo biocoenosis or microcosm or ecosom or biosystem, etc. the whole earth can be called biosphere or ecosphere.
- Ecosystem is composed of a variety of abiotic (non-living) and biotic (living organisms) components that function in an interrelated fashion.

Kinds of Ecosystem

- **Natural Ecosystem:** The ecosystem which is completely dependent on solar radiation e.g. forests, oceans, grasslands, lakes, rivers and deserts.
- **Man-made Ecosystem:** The ecosystem which is dependent on solar energy, e.g. agricultural fields and aquaculture ponds. Such ecosystems are also dependent on fossil fuels, e.g. urban and industrial ecosystems.

Types of Ecosystem

- **Terrestrial Ecosystem**

Grassland Ecosystem

- A grassland ecosystem is the collection of plants, animals and microorganisms that live within an environment where grasses are the primary form of vegetation.
- Grasslands cover around 40 percent of the earth's surface, and they exist in both temperate and tropical regions, generally within the dry interior areas of land masses.
- The amount of rainfall in grassland ecosystems is too little to support many large plants, though some trees do occur.
- In tropical grassland ecosystems, the heavy precipitation of the rainy season follows months of dry heat.
- Temperate grasslands alternate periods of abundance with periods of dormancy when the temperatures are too cold for growth.
- Some grassland ecosystems, such as the savanna or the prairie, produce tall grasses.
- Others, such as the windy steppes, grow very short grasses often less than an inch high.

Forest Ecosystems

- Forest ecosystem is the scientific study of the interrelated patterns, processes, flora, fauna and ecosystems in forests.
- The management of forests is known as forestry, silviculture, and forest management.
- A forest ecosystem is a natural woodland unit consisting of all plants, animals and microorganisms (Biotic components) in that area functioning together with all of the non-living physical (abiotic) factors of the environment.
- Forests accumulate large amounts of standing biomass, and many are capable of accumulating it at high rates, i.e. they are highly productive.
- Since trees can grow larger than other plant life-forms, there is the potential for a wide variety of forest structures (or physiognomies).

- The infinite number of possible spatial arrangements of trees of varying size and species makes for a highly intricate and diverse micro-environment in which environmental variables such as solar radiation, temperature, relative humidity, and wind speed can vary considerably over large and small distances.
- **Aquatic Ecosystem**

An aquatic ecosystem is an ecosystem in a body of water. Communities of organisms that are dependent on each other and on their environment live in aquatic ecosystems.

- **Freshwater Ecosystem:** These cover only a small portion of the earth which is nearly 0.8 percent. Freshwater means lakes, ponds, rivers and streams, wetlands, swamp, bog, and temporary pools.
- **Lotic Ecosystems:** These mainly refer to the rapidly flowing waters that move in a unidirectional way including the rivers and streams. Furthermore, these environments have numerous species such as beetles, mayflies, stoneflies and several species of fishes including trout, eel, minnow, etc.
- **Lentic Ecosystems:** They include all standing water habitats. Moreover, lakes and ponds are the primary examples of the Lentic Ecosystem. Also, these ecosystems contain algae, crabs, shrimps, and amphibians such as frogs and salamanders.
- **Wetlands:** Wetlands are marshy areas and are sometimes covered in water which has a wide variety of plants and animals. Swamps, marshes, bogs, black spruce, and water lilies are the main examples in the plant species. The animal life of this ecosystem consists of dragonflies, damselflies, and various birds and fishes.
- **Marine Aquatic Ecosystem:** The marine ecosystem covers the largest surface on the earth. Two-thirds of the earth is covered by water which constitutes oceans, seas, intertidal zone, reefs, seabed, etc. Form of each life is unique and native to its habitat.
- **Ocean Ecosystems:** Our earth has five major oceans. Moreover, these oceans are like a home to more than five lakhs aquatic species. Some species of this ecosystem include shellfish, Shark, Tube Worms, Crab Small, and large ocean fishes.
- **Coastal Systems:** These are the open systems of land and water, joined together to form the coastal ecosystems. A wide variety of species of aquatic plants and algae live at the bottom of it. The diverse fauna consists of crabs, fish, insects, lobsters, snails, shrimp, etc.

Branches of Ecology

- **Autecology:** It deals with an organism or species, its adaptations and interaction with its environment
- **Synecology:** It deals with the study of different species living in a community and its relation with the surrounding. It is further divided into aquatic and terrestrial ecology.
- **Modern Branches of Ecology:**
 - **Applied Ecology:** It deals with the study of conservations and getting economic benefits of organisms, e.g. wild-life management, agronomy, etc.
 - **Genecology:** It is the study of genetic composition and variation present in communities compared to the environment and population distribution and origin of new species, ecads, ecotypes, etc.
 - **System Ecology:** It is the most modern branch of ecology, which takes advantage of applied mathematics, computer science and advanced statistical techniques to understand the structure and function of an ecosystem.

Ecological succession

Ecological succession is the successive development of different biotic communities at the same site. The communities develop one after another till the development of a community which is near equilibrium with the environmental conditions. This is called the climax community. Climax community is the stable perpetuating and final biotic community that develops at the end of biotic succession. It has maximum diversity & niche specialization. The first biotic community which invades a base area is called pioneer community. It is characterized by high growth rate and short life span. The transitional communities which develop during the ecological succession or in between the pioneer and climax community are called serial communities.

- **Characteristics of Ecological succession**

- Formation of soil, increase in thickness and differentiation of soil.
- Increase in humus content of soil.
- Increase in biomass.
- From small lived plants to long lived plants.
- From unstable biotic community to stable biotic
- From lesser species diversity to higher species diversity.
- Increased niche specialization.
- Development of stratification.
- Succession occurs in both animal and plant communities side by side.
- From simple food chains to complex food chains and formation of food webs.
- From aquatic or arid environments to mesic environments.

Abiotic Factors

- **Temperature:**

- It is the most important environmental ecological factor.
- It ranges from a subzero level in polar areas to $>50^{\circ}\text{C}$ in tropical deserts. In thermal springs and deep-sea hydrothermal vents, the temperature even exceeds 100°C .
- Temperature affects the kinetics of enzymes and alters metabolic and physiological functions of organisms.
 - Eurythermal: organisms, that can tolerate a wide range of temperatures
 - Stenothermal: organisms, that can tolerate a narrow range of temperatures

- **Water:**

- Life originated in water and organisms cannot sustain without water.
- Organisms need special adaptations to live in water.
- Various factors like pH, chemical composition govern the quality of the water, which is an important factor for organisms inhabiting the area.
- The salinity of water varies in different water resources, e.g. it is 5 (measured as salt concentration in part per thousand) in rivers, lakes, 30-35 in the ocean and >100 in hypersaline lagoons.
 - Euryhaline: organisms that can tolerate a wide range of salinities.
 - Stenohaline: organisms that can tolerate a narrow range of salinities.

- **Light:**
 - Sunlight is the source of energy that flows in an ecosystem. Producers convert light energy to chemical energy in the process of photosynthesis.
 - The spectral quality of light is also an important factor, e.g. UV component is harmful to many organisms. Many plants require critical daylight for flowering, the process is known as photoperiodism.
- **Soil:**
 - Different places have different qualities of the soil.
 - They differ due to climatic conditions, weathering process and soil development.

Biological Interactions

In ecology, a biological interaction is the effect that a pair of organisms living together in a community have on each other. They can be either of the same species (intraspecific interactions), or of different species (interspecific interactions).

Below are a few important interactions present in the system:

- **Commensalism:** Commensalism benefits one organism and the other organism is neither benefited nor harmed. It occurs when one organism takes benefits by interacting with another organism by which the host organism is not affected. A good example is a remora living with a manatee. Remoras feed on the manatee's faeces. The manatee is not affected by this interaction, as the remora does not deplete the manatee's resources.
- **Amensalism:** Amensalism (a term introduced by Haskell) is an interaction where an organism inflicts harm to another organism without any costs or benefits received by itself. Amensalism describes the adverse effect that one organism has on another organism. This is a unidirectional process based on the release of a specific compound by one organism that has a negative effect on another. A classic example of amensalism is the microbial production of antibiotics that can inhibit or kill other, susceptible microorganisms.
- **Mutualism:** Mutualism is an interaction between two or more species, where species derive a mutual benefit, for example an increased carrying capacity. Similar interactions within a species are known as co-operation. Mutualism may be classified in terms of the closeness of association, the closest being symbiosis, which is often confused with mutualism. One or both species involved in the interaction may be obligate, meaning they cannot survive in the short or long term without the other species.
- **Competition:** When two species competing for the same resources and fitness of one species is affected by the presence of another species
- **Predation:** In predation, one organism, the predator, kills and eats another organism, its prey.
- **Parasitism:** Parasitism is a relationship between species, where one organism, the parasite, lives on or in another organism, the host, causing it some harm, and is adapted structurally to this way of life. The parasite either feeds on the host, or, in the case of intestinal parasites, consumes some of its food.

Difference Between Ecology and Environment

Ecology	Environment
<ul style="list-style-type: none">• The study of how organisms interact with their surroundings is called ecology. It is a group of living beings that is separate.	<ul style="list-style-type: none">• The interaction of physical, chemical, and biological components is referred to as the environment.
<ul style="list-style-type: none">• It is the relationship between organisms and their surroundings.	<ul style="list-style-type: none">• It is the set of circumstances that surround a living thing.
<ul style="list-style-type: none">• It is a broad range that encompasses a variety of smaller habitats.	<ul style="list-style-type: none">• The environment can be both huge and tiny.
<ul style="list-style-type: none">• Its goal is to gain a better understanding of life processes, adaptations, distribution, and biodiversity.	<ul style="list-style-type: none">• Its goal is to investigate the internal and external factors that have an impact on the environment.
<ul style="list-style-type: none">• Population size, dispersion of organisms, diversity, and competition among them are all ecological factors.	<ul style="list-style-type: none">• Pollution, global warming, deforestation, and other more significant challenges are among the environmental causes.
<ul style="list-style-type: none">• Ecology is the study of various ecosystems and how creatures rely on one another to thrive.	<ul style="list-style-type: none">• Temperature, water, light, air, soil, and nutrients are all environmental elements.
<ul style="list-style-type: none">• Eco refers to something beneficial to the environment and does not hurt any particular species or substance.	<ul style="list-style-type: none">• It's the space in which living organisms live, whether made up of biotic or chemical elements.

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