

UNIT 1

Fundamentals of Ecology

Fundamentals of Ecology

- Ecology is an important branch of the fundamental biological science that explains interdependence and interrelationships between man, animals and plants in a manner to help others to sustain and grow without any difficulties.



What is Ecology?

- Ecology is the scientific study of the interactions between organisms and their environment.
- It is the science that seeks to describe and explain the relationship between living organisms and their environment.

Ecology & Its Origin

- The word “ecology” is derived from the Greek word “Oikos” and “logos”. The former signifies the “Household” and the latter represents “Study”.
- Therefore, it is the study of environmental house that includes all the living and non-living organisms in it. It also encompasses the functional processes to provide sufficient energy for the organisms to sustain and grow in natural environment

Meaning & Definition of Ecology

- It is a century old discipline with the primary focus on the principles, theories, and concepts for dealing with growing environmental problems and finding the sustainable solutions for the preservation of organisms in the planet during the last four decades.

Types of Ecology

- **Behavioral Ecology**

- It is the study of the evolutionary basis for animal behavior due to ecological pressures. It outlines the four causes of behavior that consists of causation, development, function and phylogeny.



Types of Ecology

- **Human Ecology:** It is the study of the human species and its interactions with its surroundings. It recognizes that organisms both change their surroundings and are changed by their surroundings.



Types of Ecology

- **Population Ecology:** A population consists of individuals of the same species and they live, interact and migrate through the same niche and habitat.
- It is the study of the dynamics of species populations and the interactions with the environment.



Principles of Ecology

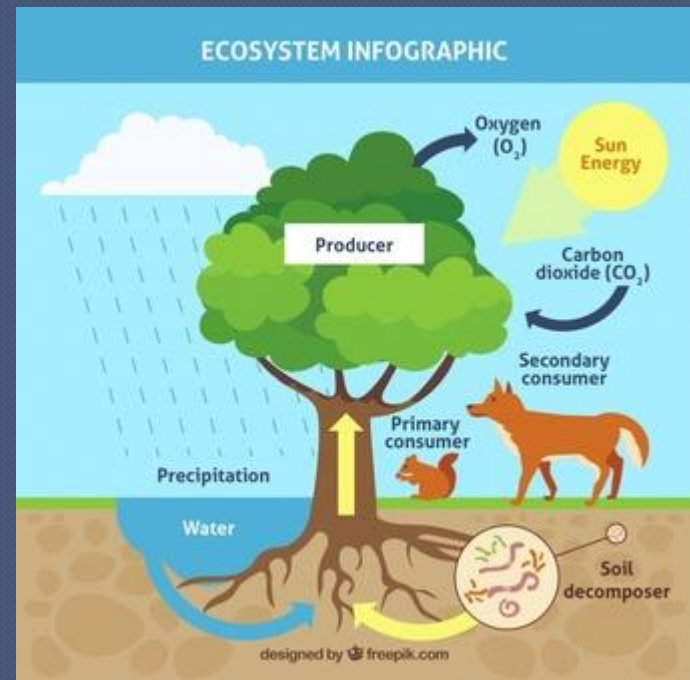
- Adaptations and life processes for organisms to derive energy to survive and grow.
- Abundance of organisms and distribution them across the ecosystem for mutual sharing the energy.
- Abundance and distribution of biodiversity in accordance with the environmental conditions.
- Movement of materials and energy through living communities at various levels.
- Development of ecosystems in a successive way.

Scope of Ecology

- The scope of ecology covers a wide array of interacting levels of organization spanning micro-level or cells to planetary scale or ecosphere phenomena.
- Ecosystems contain populations of individuals that aggregate into distinct ecological communities.
- It can take thousands of years for ecological processes to bring about the final successional stages of a forest.
- Ecology is interdisciplinary in nature and it derives the basic concepts from sociology, anthropology, psychology and health sciences.

Key Terms of Ecology

- **Ecosystem:** Ecosystem is a process of linking the organisms for continuous supply of energy from producers to consumers for sustainable habitations.
- The habitats within biomes form an integrated whole.
- It is dynamically responsive system with a wide array of physical and biological complexes.

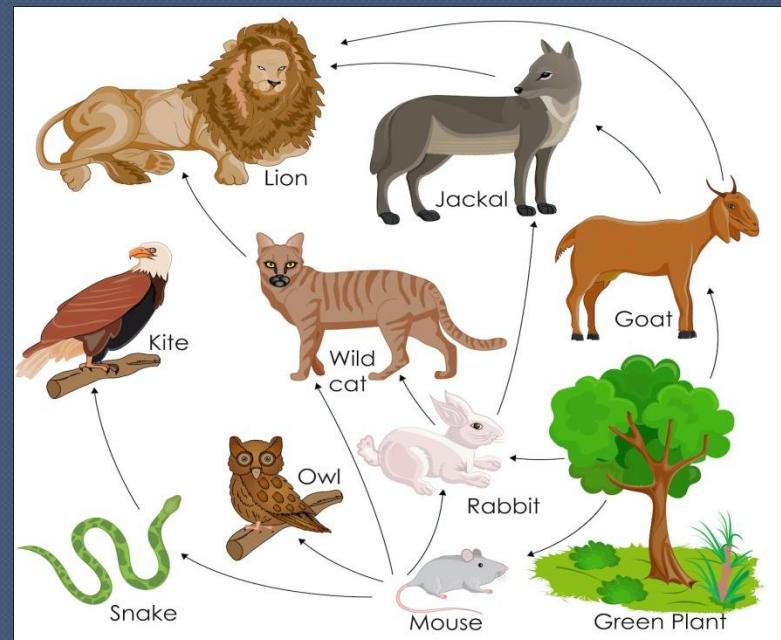


Key Terms of Ecology

- **Ecosystem Engineering:** The niche construction is nothing but a process and concept of ecosystem engineering. Organisms directly or indirectly get adjusted with the resources and share with other species.
- In this process, it causes physical changes in biotic or abiotic materials in an ecosystem.

Key Terms of Ecology

- **Food Web:** Food web is the archetypal ecological network through which all the organisms, both producers and consumers, accumulate the energy for their survival and help others to survive mutually.



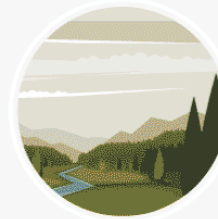
Key Terms of Ecology

- **Biome:** Biomes are the larger units of organization. The categorization of different regions of the earth's ecosystems is done as per the structure and composition of vegetation.

KINDS OF BIOME



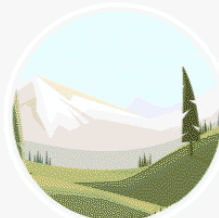
RAIN FOREST



TAIGA



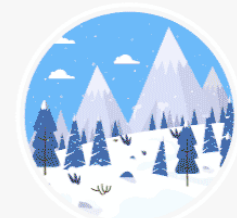
TEMPERATE
DECIDUOUS FOREST



GRASSLANDS



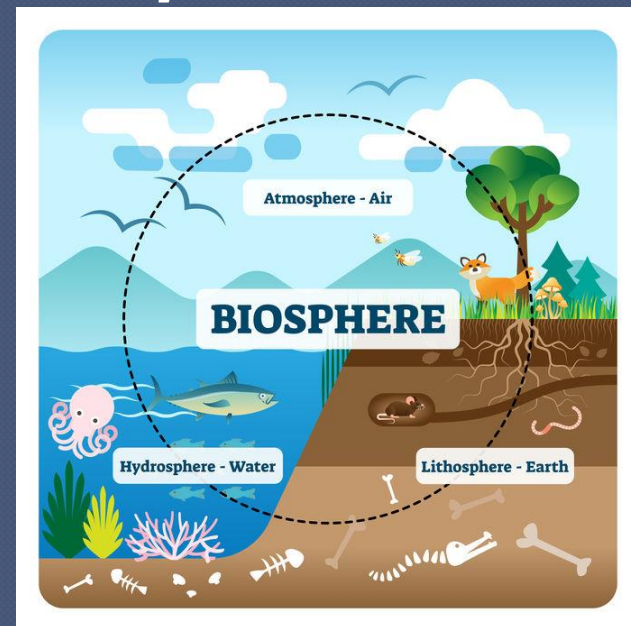
DESERT



TUNDRA

Key Terms of Ecology

- **Biosphere:** The largest scale of ecological organization with the sum of ecosystems on the planet is called as the biosphere.
- Ecological relationships control the flow of energy, nutrients and climate to the planetary scale in a biosphere.



Key Terms of Ecology

- **Biodiversity:** Biodiversity is the variety of life and its processes.
- It includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting.

Key Terms of Ecology

- **Habitat:** The habitat of a species indicates the size and capacity of environment over which a species directly or indirectly depends for receiving energy.
- Further, the habitation region in environmental space represents a biotic or abiotic environmental variable.

Basic Laws of Ecology

- **The First Law of Ecology:** Everything Is Connected to Everything Else. There is one ecosphere for all living organisms and what affects one, affects all. *“When we try to pick out anything by itself, we find it hitched to everything else in the universe.”* John Muir
- **The Second Law of Ecology:** Everything Must go Somewhere. There is no “waste” in nature and there is no “away” to which things can be thrown. Any waste produced in one ecological process is recycled in another. A core principle for the Circular Economy.

Basic Laws of Ecology

- **The Third Law of Ecology:** Nature Knows Best. Humankind has fashioned technology to improve upon nature, but any human change in a natural system is, says Commoner, “likely to be detrimental to that system” And in the context of chemicals of concern we are looking to eradicate from buildings “The absence of a particular substance in nature, is often a sign that it is incompatible with the chemistry of life”
- **The Fourth Law of Ecology:** There Is No Such Thing as a Free Lunch. Exploitation of nature, will always carry an ecological cost and will inevitably involve the conversion of resources from *useful to useless*.

Ecosystem

- Ecosystem is otherwise called as a network of ecological relationship that provides opportunity for organisms to make interactions with one another along with the environment in which they occur.
- It occurs at the level of the individual, the population, the community and the ecosystem.

Ecosystem Management

- Management of ecosystem is a recent phenomenon that focuses on the interventions of scientific knowledge to control, distribute and manage the food chain in an ecosystem.
- An efficient management of ecosystem can be more effective in conserving major ecological services and restoring natural resources.
- The primary objective is to meet the needs of present and future generation. At the same time, processes and functioning of ecosystem should be affected.

Ecosystem Management

- Ecosystem management is focused at the efficient maintenance of natural resources and it can only be possible with responsible use of natural resources.
- The interrelation of socio-cultural, economic and ecological systems is essentially important for ecosystem to function dynamically.
- Adding management with ecosystem does not serve the purpose unless and until the principles are implemented and obeyed by the users of natural resources.

Types of Ecosystem Management

- ◉ Adaptive management
- ◉ Natural resource management
- ◉ Strategic management
- ◉ Command and control management.

Adaptive Management

- This approach generally helps in the prediction of future influences or disturbances to ecosystem.
- Managing the ecological integrity by practicing the ability to accept changes based on new knowledge, experience and insights is the primary objective of this approach.
- It aims to identify uncertainties in the management of an ecosystem and suggest the ways to deal with the uncertainties.
- For example, lack of decision-making skills of custodians of ecosystem or government officials prevent the authorities from making the technique more effective.

Strategic Management

- Formulation of goals and driving to achieve the goals can be possible only when there will be better strategy.
- Strategic management develops different resource management model that can benefit the ecosystem without affecting socio-economic interests of other stakeholders.
- It is a process of implementing policy and programmes of the government

Landscape Level Conservation

- It is a method to meet the wildlife needs at a broader landscape level scale at the time of taking conservation initiatives.
- It is one of the ecosystem management approaches that focuses on the interconnected of ecological systems.
- As such, measuring and weighing the landscape requirements of wildlife while taking the needs of humans into consideration is a complicated and complex process.
- For example, project tiger or elephant is created to provide special attention due to the loss of predator population.

Command & Control Management

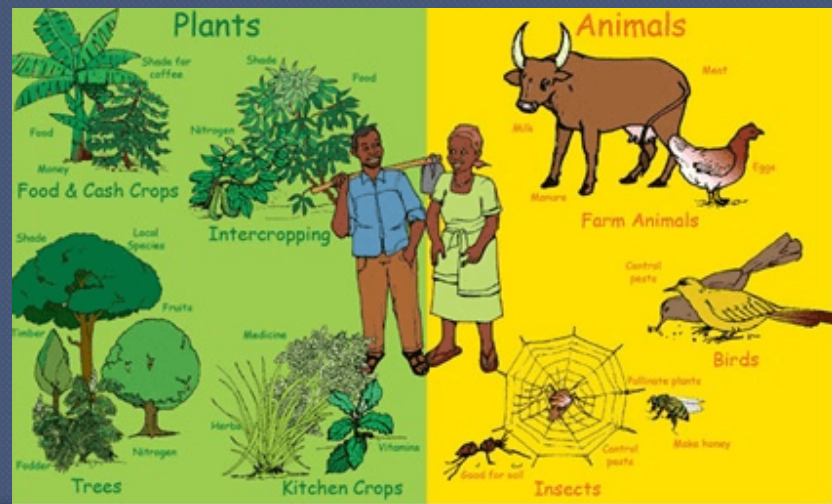
- In order to manage the ecosystem, there needs the command and control as a form of management technique. It is top-down control approach that attempts to control nature, its processes and functioning with an objective of improving product extractions
- It uses a liner problem solving technique to solve the problems with laws, threats, contracts and agreements.
- These controlling devices have so far become very useful for preserving the ecosystem and managing the natural resources

Command & Control Management

- ⦿ These are the following actions of command and control management
- ⦿ Protection of crops for harvesting more products
- ⦿ Use of herbicides and pesticides to protect the crop
- ⦿ Select the predators to create reliable game species
- ⦿ Curb the timber supply by suppressing forest fires

Biodiversity & Conservation

- Biodiversity is the variety of life and its processes. It includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting.



Biodiversity

- The term biodiversity refers to the variety of life on Earth at all its levels, from genes to ecosystems, and the ecological and evolutionary processes that sustain it.
- Biodiversity includes not only species which are rare, threatened, or endangered, but every living thing-even organism, such as microbes, fungi and invertebrates.
- Biodiversity is present at all places. Species and habitats in distant lands play a role in maintaining healthy ecosystems. The need for biodiversity is to satisfy basic needs like food, drinking water, fuel, shelter, and medicine.
- Much of the world's population still uses plants and animals as a primary source of medicine, Ecosystems provide services such as pollination, seed dispersal, climate regulation, water purification, nutrient cycling, and control of agricultural pests.
- Many flowering plants depend on animals for pollination, and 30% of human crops depend on the free services of pollinator

Pollution

- Pollution is nothing but an entry of contaminants into the natural environment.
- It causes adverse change to the environment. These are chemical substances that create pollutions in the noise, heat or light.
- Pollution is a phenomenon of an undesirable change that occurs in the physical, chemical or biological characteristics of air, water and land.



Types of Pollution

Air Pollution

- It is a release of chemicals and particles such as carbon monoxide, sulfur dioxide, chlorofluorocarbons and nitrogen oxides into the atmosphere.
- These contaminants are produced from the various manufacturing industries and motor vehicles.
- Air gets polluted from two important sources such as photochemical ozone and smog

Types of Pollution

Water Pollution

- ⦿ It is a form of pollution that occurs due to the discharge of solid and liquid commercial and industrial waste wastewater from into surface waters.
- ⦿ These industrial and urban wastes are released into river, lakes and seas without making any treatment

Types of Pollution

Noise Pollution

- ⦿ Pollutions due to the blow of horns, running of machines, washing machines, air conditions, trains, aircraft and public address system cause huge noise.
- ⦿ Noise pollution induces hearing loss, high blood pressure, stress, and sleep disturbance.

Types of Pollution

Soil Contamination

- ⦿ Soil gets contaminated when any spills or underground leakage occurs from petroleum products. At the same time, heavy use of fertilizers and pesticides for growing crops also cause damage to the soil.
- ⦿ For example, hydrocarbons, heavy metals, herbicides, pesticides and chlorinated hydrocarbons are some of the forms of soil contaminants

Types of Pollution

Light Pollution

- ⦿ It is one of the forms of pollutions that occur due to the trespass of light, over-illumination and astronomical interference

Radioactive Pollution

- ⦿ This has become a serious form of pollution that occurs from the generation of nuclear power and manufacture of nuclear weapons and deployment.
- ⦿ Chemical and radioactive substances can cause cancer and as well as birth defects.

Types of Pollution

Littering

- It is a form of pollution due to the rapid urbanization and industrialization in the developing countries. Throwing of inappropriate man-made objects onto public and private properties creates the soil, air and water pollution. They are not removed for long time.



Ecological Footprint

What is an ecological footprint?

It is a measure of how much biologically productive land and water an individual, population or activity requires to produce all the resources it consumes, and to absorb the waste it generates.

The Ecological Footprint is usually measured in global hectares (gha)

Carbon

Represents the amount of forest land that could sequester CO₂ emissions from the burning of fossil fuels, excluding the fraction absorbed by the oceans which leads to acidification



Cropland

Represents the amount of cropland used to grow crops for food and fibre for human consumption as well as for animal feed, oil crops and rubber



Grazing land

Represents the amount of grazing land used to raise livestock for meat, dairy, hide and wool products



Forest

Represents the amount of forest required to supply timber products, pulp and fuel wood



Built-up land

Represents the amount of land covered by human infrastructure, including transportation, housing industrial structures and reservoirs for hydropower



Fishing grounds

Calculated from the estimated primary production required to support the fish and seafood caught, based on catch data for marine and freshwater species

Ecological Footprint

- The Ecological Footprint is the only metric that measures how much nature we have and how much nature we use.
- It is a key concept for evaluating the environmental sustainability.
- It is an indicator for ascertaining the capacity to absorb the amount of development.
- The ecological footprint is a technique of measuring the biologically productive land, sea, lake, river, pond, mountain, desert, etc that are in need of producing resources for growth and development of human life.

Ecological Footprint

The Ecological Footprint

MEASURES

how fast we consume resources and generate waste



Energy



Settlement



Timber & Paper



Food & Fiber



Seafood

COMPARED TO
how fast nature can absorb our waste and generate new resources.



Carbon Footprint



Built-up land



Forest



Cropland & Pasture



Fisheries

Ecological Footprint helps

- ◉ **COUNTRIES**

- ◉ Improve sustainability and well-being

- ◉ **LOCAL LEADERS**

- ◉ optimize public project investments

- ◉ **INDIVIDUALS**

- ◉ understand their impact on the planet

- ◉ All these human activities need these resources to consume and create the waste.
- ◉ Thus, ecological footprint is a method of measuring the level of consuming resources and absorbing the waste it generates.
- ◉ It is nothing but a comparison between the human need and the available resources.

Tourism & Environment

- Tourism is a form of development that brings about radical changes in the socio-economic conditions of people in the host destination.
- Development is essentially important for tourism to grow with the purpose of revenue and employment generation



Tourism & Environment

- ⦿ Both natural and man-made environment is essential for tourism development. However, the complex relationship of tourism with the environment needs to be explained with pertinent illustrations.
- ⦿ Tourism needs the quality of environment to be maintained at different levels.
- ⦿ Environment expects from the tourism industry to be more responsible and contribute largely for its maintenance.

Tourism & Environment

- The elements of environment include climate, altitude, temperature, topography, soil, water, etc and these elements make the environment better or worse depending on the awareness of people involved directly and indirectly in the business.

Tourism & Environment

- Many activities of tourism can have adverse environmental effects due to the development of infrastructure. It includes the construction of roads, rail lines, seaports and airports and touristic facilities include resorts, hotels, restaurants, shops, golf courses and marinas.

Positive Impacts

- ◉ The positive aspects of these activities create additional facilities for the local people and stimulate several other forward and backward linkages in the economic activities.
- ◉ In addition, tourism has the potential to create beneficial effects on the environment by contributing to environmental protection and conservation.
- ◉ It is a way to raise awareness of environmental values and it can serve as a tool to finance protection of natural areas and increase their economic importance.

Negative Impacts

- Tourism is otherwise a destroyer or polluter of environment in the form of its carbon emission and creation of waste materials. The negative impacts of tourism development can gradually destroy the environmental resources and its restoration becomes almost impossible. Whether is air or noise or water or visual pollution, each form of pollution has its harmful effects on the ecology and environment.
- **Soil erosion**
- **Increased pollution**
- **Discharges into the sea**
- **Natural habitat loss**
- **Increased pressure on endangered species**
- **Heightened vulnerability to forest fires**