



# *Environmental Studies*



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DEHRADUN, UTTARAKHAND, INDIA



## About the Tutorial

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Environmental studies refer to an extensive and systematic study of nature/environment, its physical, biological, social, and cultural factors, as well as the nature and characteristics of the relationship between man and environment.

Environmental studies help us understand the importance of our environment and teaches us to use natural resources more efficiently and embrace a sustainable way of living. How far man influences nature and to what extent nature delivers its bounties constitute another objective of environmental studies.

This tutorial is concise and takes an authentic approach to provide a vivid account of the natural environment and related issues.

## Audience

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This tutorial is designed keeping in view the prescribed syllabus for Environment and Ecology or Environmental Studies in various colleges and universities. Lucidity in expression and simplicity of language used in this tutorial will acquaint even a youngster with the basic knowledge on Environmental Studies.

## Prerequisites

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The readers of this tutorial should have basic knowledge about the environment and environmental phenomena. Readers should understand their physical surroundings and the changes in climatic condition, seasonal differences, etc.

## Copyright & Disclaimer

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# 1.Environmental Studies– Environment

The word 'environment' is derived from the old French word 'environer' – which means to 'surround, enclose, and encircle'. Environment refers to an aggregate of conditions or surroundings in which living beings such as humans, animals, and plants live or survive and non-living things exist.

All living beings including man and their environment are mutually reactive, affecting each other in a number of ways. It is generally equated with nature wherein physical components of the planet earth such as earth, air, water, etc. support and affect life in the biosphere.



Environment represents the physical components of the earth, wherein man is an important factor affecting the environment.

Environment comprises interacting systems of physical, biological, and cultural elements, which are interlinked individually as well as collectively in various ways.

## Constituents of Environment

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**Physical elements** constitute space, landforms, water-bodies, climate, soils, rocks, and minerals. These elements determine the variable character of human habitat, and also its opportunities and limitations.

**Biological elements** include plants, animals, micro-organisms, and man.

**Cultural elements** include economic, social and political conditions which are largely manmade features.

## Types of Environment

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Since environment is a combination of physical and biological factors, it contains both living or biotic and non-living or abiotic components. On the basis of this basic structure, environment can be divided into physical or abiotic and living or biotic environment.

### Physical or Abiotic Environment

Physical environment is made up of the following states - solid, liquid, and gas. These three elements signify lithosphere, hydrosphere, and atmosphere respectively. On the basis of spatial distribution, smaller units are termed as coastal environment, plateau environment, mountain environment, lake environment, river environment, maritime environment, etc.

### Living or Biotic Environment

Biotic environment consists of plants (flora) and animals (fauna) including human beings as a significant factor. Thus, biotic environment can be of two types such as floral environment and faunal environment.

Apart from the above, there are social, cultural, and psychological environment.

### Social and Cultural Environment

This type of environment includes the varied aspects of socio-cultural interactions along with its outcomes such as beliefs, attitudes, stereotypes etc. The tangible and intangible aspects of environment are included in it.

### Psychological Environment

Psychological environment deals with the perception and experiences related to any environmental setting. Some environment may be stimulating and exciting for us, while others may be dull and boring. Psychological environment is more often used in the organizational context.

## Man-Environment Relationship

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Man and environment relationship is as old as the evolution of mankind. Since the evolution of man, the physical elements of the planet earth, such as terrain, soil, water, climate, flora and fauna formed man's environment. During that time man was a typically a 'physical man' because of his limited wants, requirements, and total dependence on nature.

With the growth in social and economic activities, advancement in technologies, man expanded his own environment through design and skill to have provisions for improved and better food, shelter, access, and comfort or luxuries. Man's ability to survive in a variety of ecosystem and his unique ability to adapt to a great variety of external conditions make man-environment relationship quite a fascinating area of study.

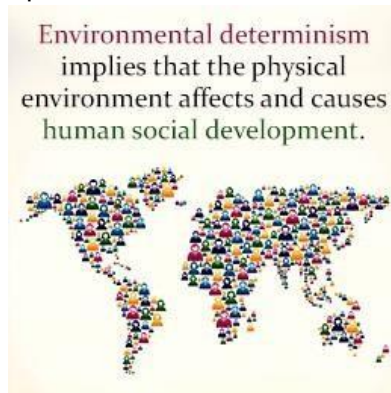
The environment in which man survives and to which he adapts himself and which he influences include physical, socio-cultural, and biological aspects. Man and environment has never been static and a great many factors are responsible for the shifts in man-environment relationship.

## Approaches to Man-Environment Relationship

The man and environment relationship can be studied under the following approaches.

**Determinism** – Friedrich Ratzel, the German geographer, was responsible for the development of the concepts of determinism, which was further expanded by Ellsworth Huntington.

This approach is based on the concept of 'nature controls man' or 'earth made man'. According to this approach, **man is largely influenced by nature**. In fact, the determinism states that man is subordinate to natural environment because all aspects of human life such as physical (health and well-being), social, economic, political, ethical, aesthetic, etc. not only depend on but are dominantly controlled by the physical environment. World famous biologist, Charles Darwin, in 1859 laid the foundation stone of the concept of



environment influences on man and other organism.

**Possibilism** – Lucien Febvre, the French historian, founded the concept of Possibilism. Possibilism approach in the study of man-environment relationship is an offshoot of the criticism of environmental determinism and the impact of science and technology on such a relationship.

Possibilism indicates that **the physical environment is passive and man is the active agent at liberty to choose between wide ranges of environmental possibilities**.

According to it, the pattern of human activity is the result of the initiative and mobility of man operating within the natural framework. Nowadays, the role of natural elements in conditioning, though not controlling human activities, is often lost sight of.



were largely aware of the limitations of freedom of man to dictate terms to environment. It was agreed upon by the possibilists that man lacks the abilities to fully tame the nature and is not always victorious over it. As result of the above, some geographers vouched for 'cooperation with nature' or 'mutual interaction' between man and environment.

**Ecological Approach** – This approach is based upon the basic principle of ecology, which is the study of mutual interaction between organisms and physical environment on the one hand, and the interaction among the organism on the other in a given ecosystem. This approach describes man as an integral part of nature or environment. Man, being most skilled and intelligent, has a unique role to play in maintaining a natural environment as healthy and productive as it should be.

**This approach emphasizes on wise and restrained use of natural resources,** application of appropriate environmental management programs, policies and strategies keeping in view certain basic principles of ecology so that already depleted natural resources are replenished, and health and productivity of the nature is restored.

## What is Environmental Studies?

Environmental studies refer to an extensive and systematic study of nature/environment and of its physical, biological, social, and cultural factors, and the nature and characteristics of relationship between man and environment. How far man influences nature and to what extent nature delivers its bounties constitute another objective of environmental studies.

It is an interdisciplinary study as subjects like ecology, biochemistry, toxicology, geography, geology, meteorology, sociology, etc. are dealt with under environmental studies.

## The Need for Environmental Studies

Nature or environment sustains life. As a conscious and rational being, man needs to know the importance of environment and help keep the environment as healthy and productive as it can be. It is the environment that has made this beautiful world possible for him. Hence, there is an ever demanding need for environmental studies.

The natural environment that mankind had before the onset of industrialization, urbanization, and exponential growth in population was expectedly healthy and resilient. Nature was able to replenish the loss of its resources, which was very limited.

After the onset of modern civilization, the overall health and efficiency of natural environment started deteriorating gradually and went on to such an extent that nature has virtually lost its natural ability to replenish the loss of resources caused by man.

Environmentalists, geographers, and biologists the world over are constantly endeavoring for a sustainable solution to restore a sustainable environment.

There is a need for focus on environmental management, laws governing environment protection, pollution and recycling of non-bio-degradable material, etc. There is also a need for careful and cautious use of natural resources in the present time to establish sustainability in every aspect of nature.

There is a need to clarify modern environmental concepts such as how to conserve biodiversity and maintain an ecological balance.

Environmental studies help us understand the importance of our environment and teaches us to use natural resources more efficiently and embrace a sustainable way of living. It enables us to know the behavior of organisms under natural conditions and the interrelationship between organisms in population and communities.

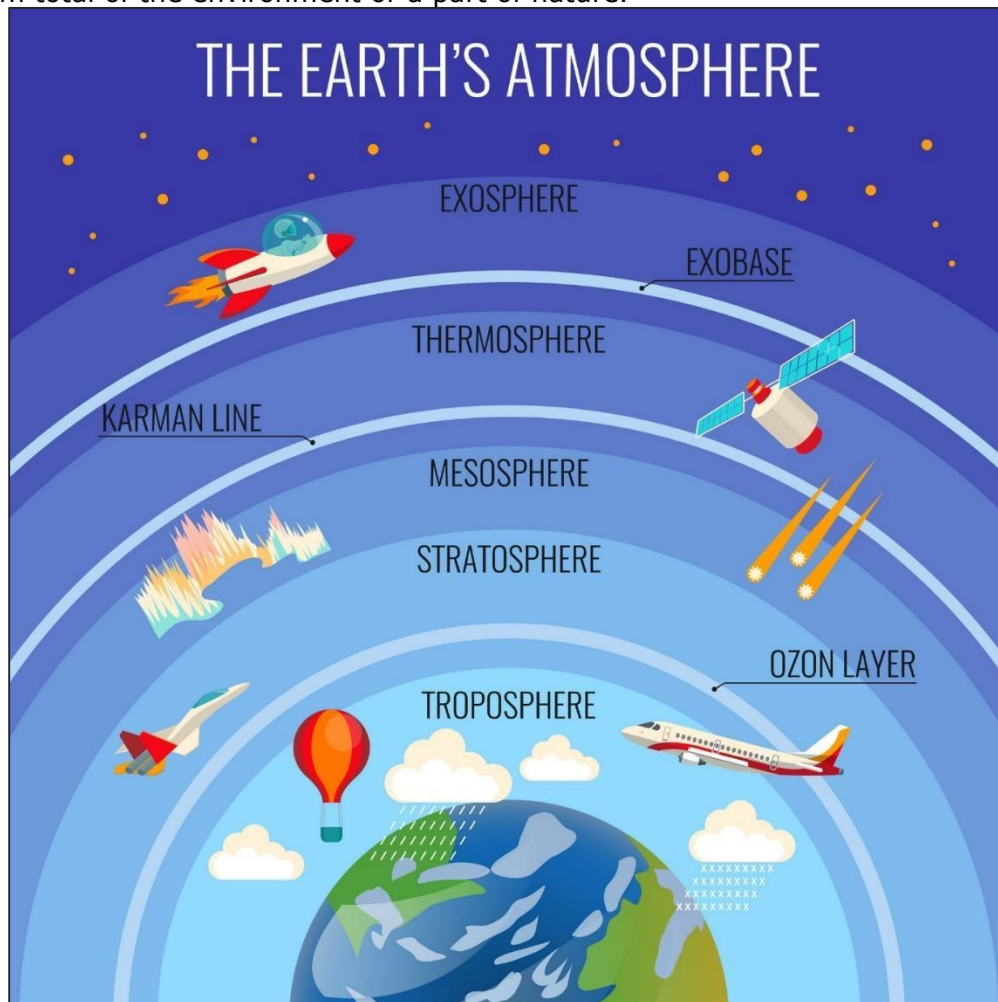
## 2. Environmental Studies Ecosystem

The interaction and interrelationship between the living community (plants, animals, and organisms) in relation to each other and the non-living community (soil, air, and water) is referred to as an **ecosystem**. Thus, an ecosystem is a structural and functional unit of biosphere. It is made up of living and non-living beings and their physical environment.

In other words, a natural ecosystem is defined as a network of interactions among the organisms and between organisms and their environment. Nutrient cycles and energy flows keep these living and non-living components connected in an ecosystem.

### Ecosystem – Scope and Importance

Ecosystem is a part of natural environment consisting of a community of living beings and the physical environment both constantly interchanging materials and energy between them. It is the sum total of the environment or a part of nature.



### 3. Environmental Studies Classification of Ecosystem

The environment consists of four segments as follows:

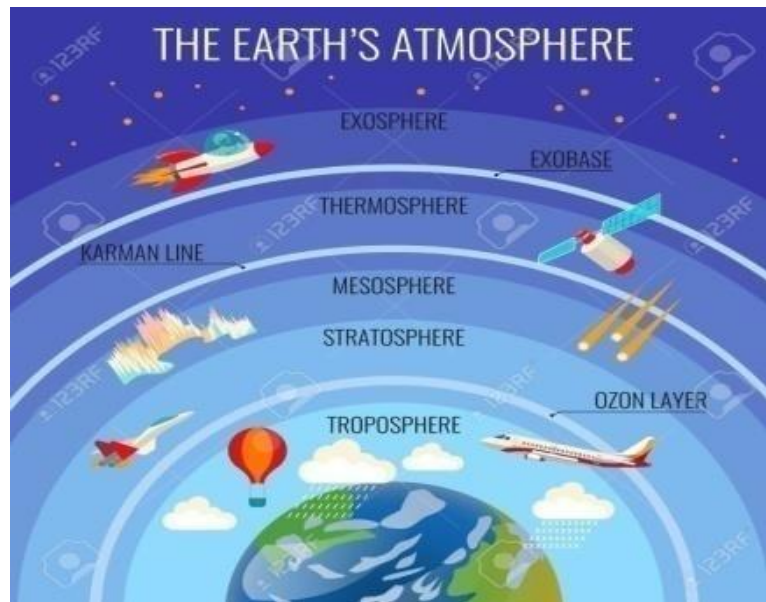
**atmosphere** - The atmosphere refers to the protective blanket of gases, surrounding the earth. It sustains life on the earth. It saves the Earth from the hostile environment of the outer space. The atmosphere composed of nitrogen and oxygen in large quantity along with small percentage of other gases such as argon, carbon dioxide, and trace gases (the gases which makes up less than 1 percent by volume of the atmosphere).

**hydrosphere** - Hydrosphere comprises all water resources such as ocean, seas, lakes, rivers, reservoirs, icecaps, glaciers, and ground water.

**lithosphere** - It is the outer mantle of the solid earth. It contains minerals occurring in the earth's crust and the soil.

**biosphere** - It constitutes the realm of living organisms and their interactions with the environment (atmosphere, hydrosphere, and lithosphere).

The study of ecosystem or environmental studies has been seen to be multidisciplinary in nature, hence, it is considered to be a subject with great scope. It is no more confined only to the issues of sanitation and health; rather, it is now concerned with pollution control, biodiversity conservation, waste management and conservation of natural resources.



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The ecosystems are classified into many types and are classified based on a number of factors. We will discuss major types of ecosystems and will try and understand on what basis these classifications are done. It is also essential to know the different factors which differentiate the ecosystems from one another.

ecosystems can generally be classified into two classes such as natural and artificial. **Artificial ecosystems** are natural regions affected by man's interferences. They are artificial lakes,

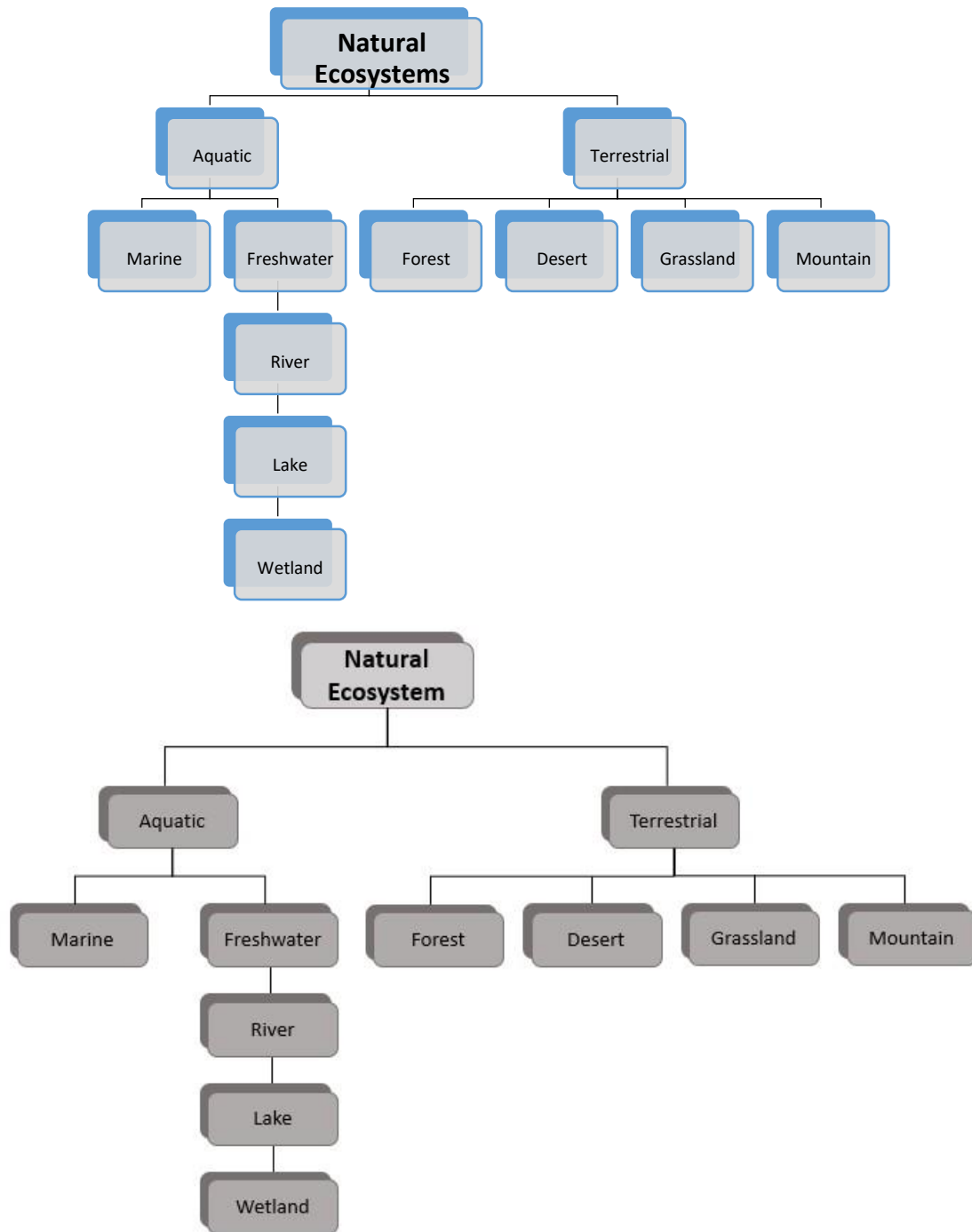


reservoirs, townships, and cities. **Natural ecosystems** are basically classified into two major types. They are aquatic ecosystem and terrestrial ecosystem.

## Types of Natural Ecosystem

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An ecosystem is a self-contained unit of living things and their non-living environment. The following chart shows the types of Natural Ecosystem:



### Biotic (Living Components)

Biotic components in ecosystems include organisms such as plants, animals, and microorganisms. The biotic components of ecosystem comprise:

- Producers or Autotrophs

- Consumers or Heterotrophs
- Decomposers or Detritus

### **Abiotic (Non-living Components)**

Abiotic components consist of climate or factors of climate such as temperature, light, humidity, precipitation, gases, wind, water, soil, salinity, substratum, mineral, topography, and habitat. The flow of energy and the cycling of water and nutrients are critical to each ecosystem on the earth. Non-living components set the stage for ecosystem operation.

## **Aquatic Ecosystem**

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An ecosystem which is located in a body of water is known as an aquatic ecosystem. The nature and characteristics of the communities of living or biotic organisms and non-living or abiotic factors which interact with and interrelate to one another are determined by the aquatic surroundings of their environment they are dependent upon.

Aquatic ecosystem can be broadly classified into Marine Ecosystem and Freshwater Ecosystem.

### **Marine Ecosystem**

These ecosystems are the biggest of all ecosystems as all oceans and their parts are included in them. They contain salt marshes, intertidal zones, estuaries, lagoons, mangroves, coral reefs, the deep sea, and the sea floor.

Marine ecosystem has a unique flora and fauna, and supports a vast kingdom of species. These ecosystems are essential for the overall health of both marine and terrestrial environments.

Salt marshes, seagrass meadows, and mangrove forests are among the most productive ecosystem. Coral reef provides food and shelter to the highest number of marine inhabitants in the world. Marine ecosystem has a large biodiversity.

### **Freshwater Ecosystem**

Freshwater ecosystem includes lakes, rivers, streams, and ponds. Lakes are large bodies of freshwater surrounded by land.

Plants and algae are important to freshwater ecosystem because they provide oxygen through photosynthesis and food for animals in this ecosystem. Estuaries house plant life with the unique adaptation of being able to survive in fresh and salty environments. Mangroves and pickle weed are examples of estuarine plants.

Many animals live in freshwater ecosystem. Freshwater ecosystem is very important for people as they provide them water for drinking, energy and transportation, recreation, etc.

## Terrestrial Ecosystem

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Terrestrial ecosystems are those ecosystems that exist on land. Water may be present in a terrestrial ecosystem but these ecosystems are primarily situated on land. These ecosystems are of different types such as forest ecosystem, desert ecosystem, grassland and mountain ecosystems.

Terrestrial ecosystems are distinguished from aquatic ecosystems by the lower availability of water and the consequent importance of water as a limiting factor. These are characterized by greater temperature fluctuations on both diurnal and seasonal basis, than in aquatic ecosystems in similar climates.

Availability of light is greater in terrestrial ecosystems than in aquatic ecosystems because the atmosphere is more transparent on land than in water. Differences in temperature and light in terrestrial ecosystems reflect a completely different flora and fauna.

## 4. Environmental Studies Function of Ecosystem

The functional attributes of the ecosystem keep the components running together. Ecosystem functions are natural processes or exchange of energy that take place in various plant and animal communities of different biomes of the world.

For instance, green leaves prepare food and roots absorb nutrients from the soil, herbivores feed on the leaves and the roots and in turn serve as food for the carnivores.

Decomposers execute the functions of breaking down complex organic materials into simple inorganic products, which are used by the producers.

Fundamentally, ecosystem functions are exchange of energy and nutrients in the food chain. These exchanges sustain plant and animal life on the planet as well as the decomposition of organic matter and the production of biomass.

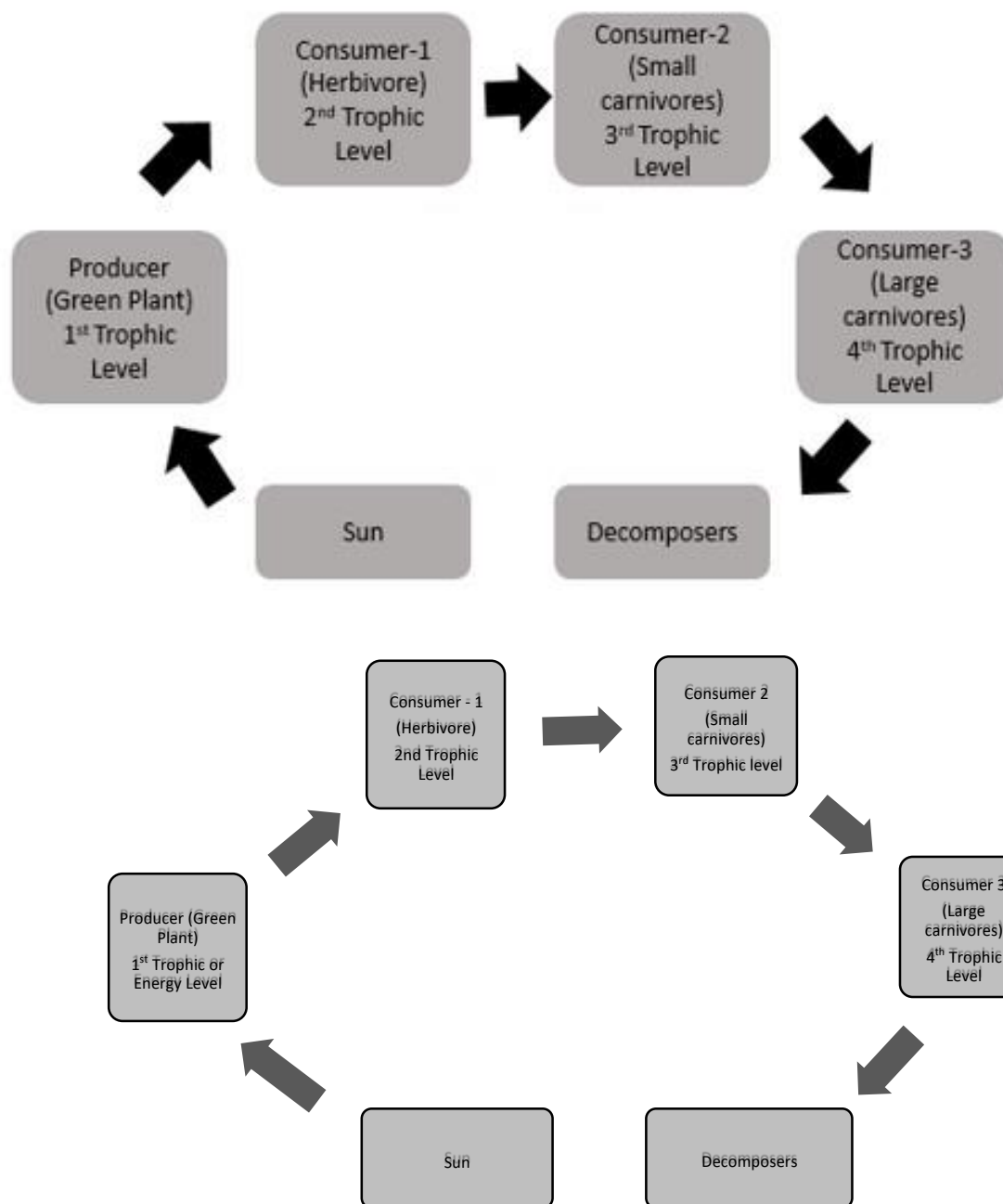
All these functions of the ecosystem take place through delicately balanced and controlled processes.

### Food Chain

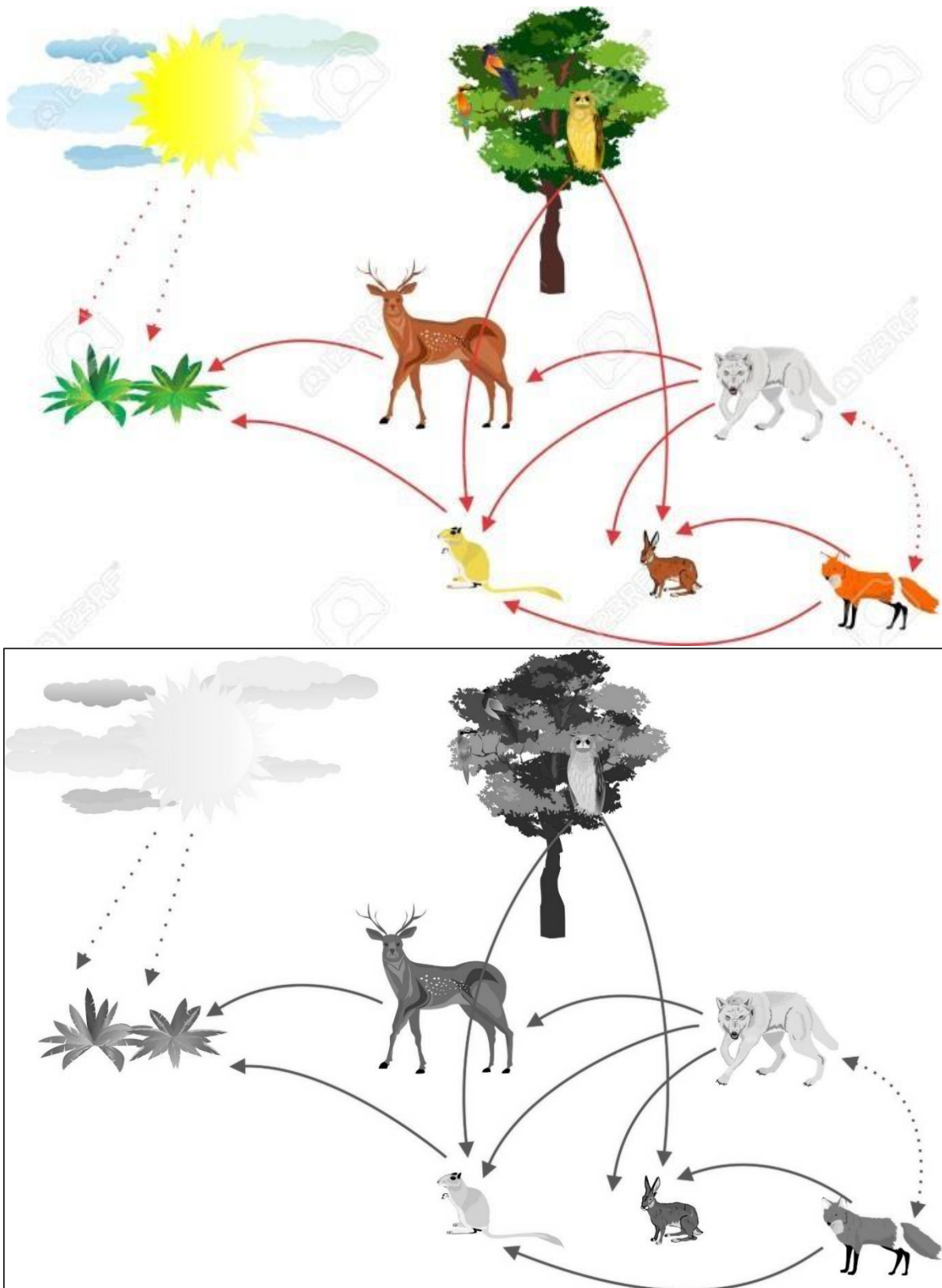
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The order of living organisms in a community in which one organism consumes other and is itself consumed by another organism to transfer energy is called a **food chain**. Food chain is also defined as “a chain of organisms, existing in any natural community, through which energy is transferred”.

of their size and habitat, from the tiniest algae to giant blue whales, need food to survive. Food chain is structured differently for different species in different ecosystems. Each food chain is the vital pathway for energy and nutrients to follow through the ecosystem.



Food chains were first introduced by the African-Arab scientist and philosopher Al-Jahiz in the 9<sup>th</sup> century and later popularized in a book published in 1927 by Charles Elton.



A food chain starts with a producer such as plants. Producers form the basis of the food chains. Then there are consumers of many orders. Consumers are organisms that eat other organisms. All organisms in a food chain, except the first organism, are consumers.

Plants are called producers because they produce their own food through photosynthesis. Animals are called consumers because they depend on plants or other animals for food to get energy they need.

In a certain food chain, each organism gets energy from the one at the level below. In a food chain, there is reliable energy transfer through each stage. All the energy at one stage of the chain is not absorbed by the organism at the next stage.

## Trophic Levels in a Food Chain

Trophic levels are different stages of feeding position in a food chain such as primary producers and consumers of different types.

Organisms in a food chain are categorized under different groups called trophic levels. They are as follows -

**Producers (First Trophic Level)** – Producers otherwise called autotrophs prepare their food by themselves. They form the first level of every food chain. Plants and one-celled organisms, some types of bacteria, algae, etc. come under the category of Autotrophs. Virtually, almost all autotrophs use a process called photosynthesis to prepare food.

**Consumers** - At the second trophic level, there are consumers who depend upon others for food.

- **Primary Consumers (Second Trophic Level)** – Primary consumers eat the producers. They are called herbivores. Deer, turtle, and many types of birds are herbivores.
- **Secondary Consumers (Third Trophic Level)** – Secondary consumers based at the third trophic level eat plants and herbivores. They are both carnivores (meat-eaters) and omnivores (animals that eat both animals and plants). In a desert ecosystem, a secondary consumer may be a snake that eats a mouse. Secondary consumers may eat animals bigger than they are. Some lions, for example, kill and eat buffalo. The buffalo weighs twice as much as the lions do.

**Tertiary Consumers (Fourth Trophic Level)** – Tertiary consumers are animals eating other carnivores. The secretary bird in Africa and the King Cobra specialize in killing and eating snakes but all snakes are carnivores. The leopard seal eats mostly other carnivores - mainly other seals, squids, and penguins, all of which are carnivores.

**Decomposers** which don't always appear in the pictorial presentation of the food chain, play an important part in completing the food chain. These organisms break down dead organic material and wastes. Fungi and bacteria are the key decomposers in many ecosystems; they use the chemical energy in dead matter and wastes to fuel their metabolic processes. Other decomposers are detritivores—detritus eaters or debris eaters.



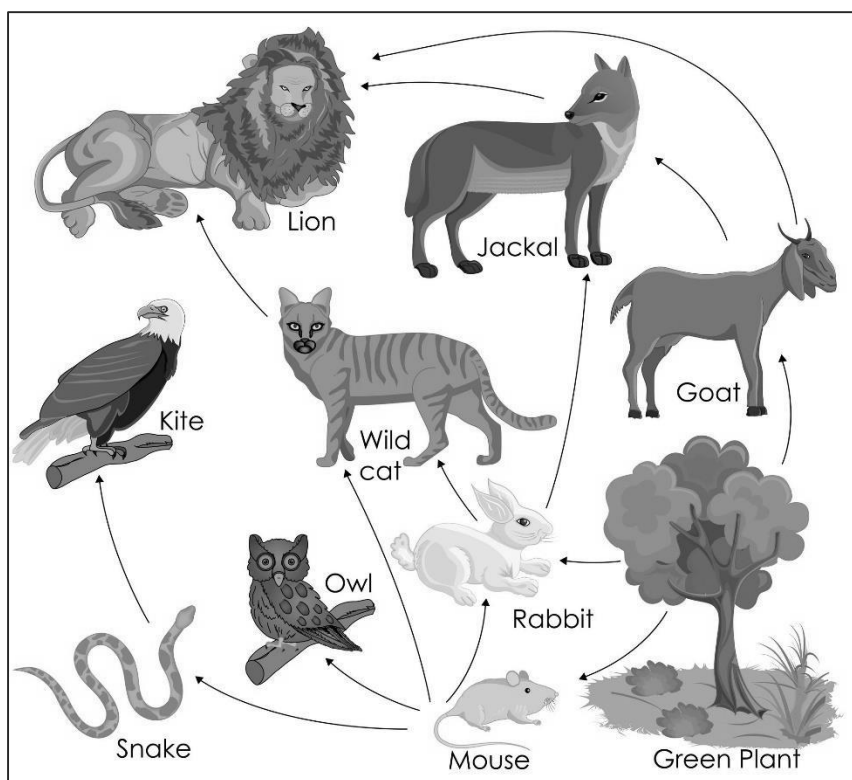
Understanding the food chain helps us know the feeding interrelationship and interaction between an organism and the ecosystem. It also enables us to know the mechanism of energy flow in an ecosystem.

## Food Web

The word 'web' means network. Food web can be defined as 'a network of interconnected food chains so as to form a number of feeding relationships amongst different organism of a biotic community.

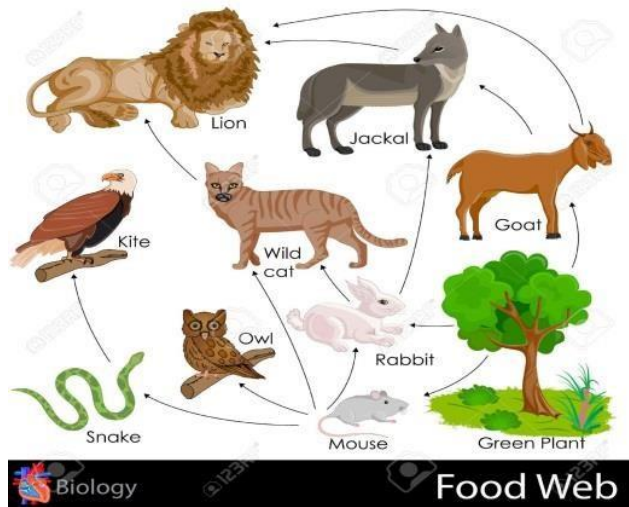
A food chain cannot stand isolated in an ecosystem. The same food resource may be a part of more than one chain. This is possible when the resource is at the lower tropic level.

A food web comprises all the food chains in a single ecosystem. It is essential to know that each living thing in an ecosystem is a part of multiple food chains.



A single food chain is the single possible path that energy and nutrients may make while passing through the ecosystem. All the interconnected and overlapping food chains in an ecosystem make up a food web.

Food webs are significant tools in understanding that plants are the foundation of all ecosystem and food chains, sustaining life by providing nourishment and oxygen needed for survival and reproduction. The food web provides stability to the ecosystem.



The tertiary consumers are eaten by quaternary consumers. For example, a hawk that eats owls. Each food chain ends with a top predator and animal with no natural enemies (such as an alligator, hawk, or polar bear).