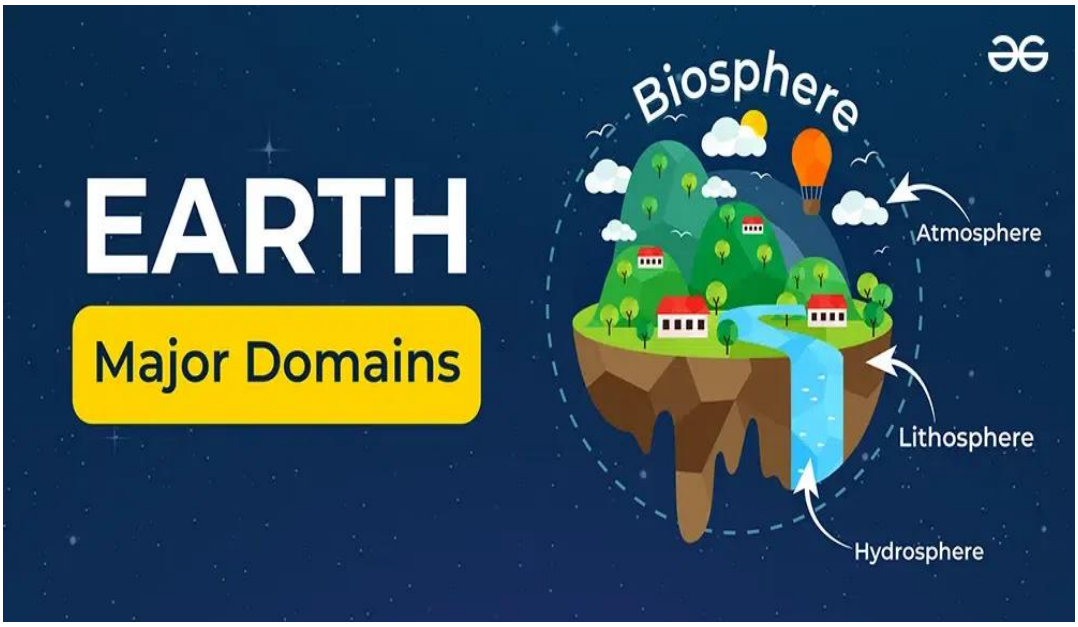
Subject:-environment studies

Meaning:- Environment is everything that is around us. It can be living or nonliving things. It includes physical, chemical, and other natural forces. Living things live in their environment.

Definitions:- Environment can be defined as a sum total of all the living and non-living elements and their effects that influence human life. While all living or biotic elements are animals, plants, forests, fisheries, and birds, non-living or abiotic elements include water, land, sunlight, rocks, and air.

Scope and its components:- The four major components of the environment are lithosphere (rocks), hydrosphere (water), atmosphere (air), and biosphere (life):



Lithosphere

The lithosphere is the solid outer portion of Earth which includes Earth's crust as well as the underlying cool, dense, rigid uppermost portion of the upper mantle. At the center of the Earth is a structure called the Core, which has a diameter of around 7000 km and a radius of 3500 km. Surrounding the core is the

2900 km thick mantle. The lithosphere extends from the surface of Earth to a depth of approximately 100 km. The tectonic plates of Earth make up the majority of the lithosphere.

Hydrosphere

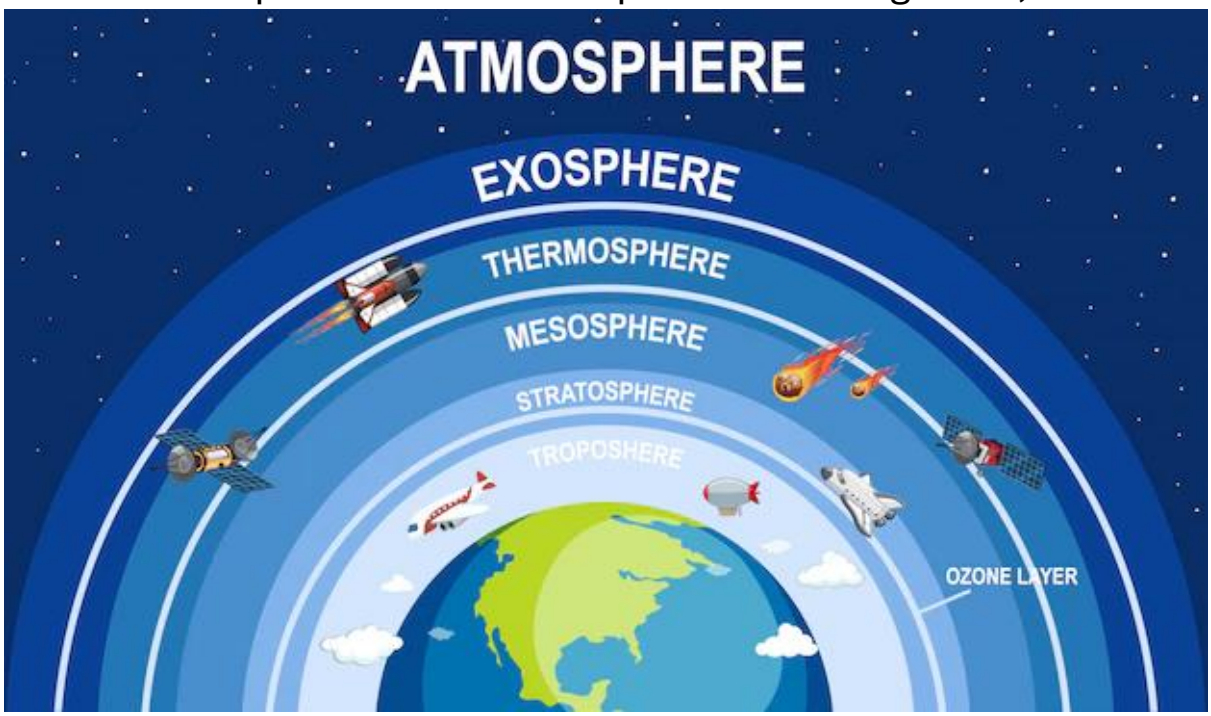
It includes all types of water bodies on Earth, such as freshwater (rivers, lakes, ponds, streams), marine (oceans, seas), and groundwater resources, among others. There are three states of water: gas (water vapour), liquid (water), and solid (ice). It occupies 71% of the planet's surface. The oceans contain 97.5% of all the water on Earth, which is salt water. Freshwater makes up only 2.5% of all water on Earth. Of total, 68.9% is in frozen forms, such as glaciers, while 30.8% is accessible as groundwater. A readily available quantity of 0.3% can be found in lakes, reservoirs, and rivers.

Atmosphere

The earth is enveloped by thick gaseous layers that make up the atmosphere. It stretches up to 300 km. Life is supported by the atmosphere which contains a lot of oxygen. It is composed of gases such as nitrogen (78.08%), oxygen (20.95%), argon (0.93%), carbon dioxide (0.039%), and trace amounts of hydrogen, helium, and noble gases. The troposphere, stratosphere, mesosphere, thermosphere, and exosphere are the layers that rise above the surface of the earth.

- The lowest layer is called the **troposphere**. It rises from ground level to a height of roughly 11 kms above sea level.
- The **stratosphere** is the next layer above. It stretches from the top of the troposphere to about 52 km above the ground. The ozone layer is present in stratosphere. Ozone molecules in this layer absorb ultraviolet light from the sun and convert the UV energy into heat.
- The **mesosphere** is located above the stratosphere. It rises to a height of approximately 85 kms above Earth. The mesosphere is where most meteors burn up.

- The **thermosphere** is the layer of extremely rare air above the mesosphere. The thermosphere absorbs UV and high energy X-rays from the Sun, which can cause it to heat up to thousands or even hundreds of degrees. The top thermosphere can have temperatures as high as 2,000°C.



Biosphere

It includes every area of Earth where life is present. It includes both living things and non-living objects in the environment. There could be ecosystems in the soil, air, water, or on land that sustain life. Geologist Edward Suess first used the word “biosphere” to refer to any area of Earth where life is present. It stretches from the polar ice caps to the equator, with a living form appropriate for the local environment existing in each zone. An ecosystem is a part of the biosphere that influences the state of the planet as a whole.

Compoents of Environment: The term “environment” refers to everything in our immediate surroundings, including both living and nonliving items such as soil, water, animals, and plants that adapt to their surroundings. It is a natural gift that aids in the

feeding of life on Earth. The environment is important to the survival of life on Earth. An ecosystem is a component of the Biosphere that influences the health of the entire planet. It encompasses all living and nonliving organisms in the environment. The components of the environment are primarily divided into two categories:

1. **Biotic environment:** Animals, birds, woods, insects, reptiles, and microorganisms such as algae, bacteria, fungi, and viruses are all included.
2. **Abiotic environment:** It comprises everything that isn't alive, such as air, clouds, dust, land, mountains, rivers, temperature, humidity, water, water vapor, sand, and so on.

Biotic Components

When used together, they are referred to as living creatures. As a result, biotic components might also be defined as all living organisms on the planet. Examples include plants, animals, people, decomposers, yeast, insects, and other species. All of these biotic components work together to create new generations, or to reproduce new organisms, in order to keep the food chain stable. Because biotic variables take the shape of living organisms, their examples must take the form of live organisms as well.

Producer

The organisms that are capable of producing their own food through photosynthesis are called producers. Plants, algae, and microbes are examples. Abiotic variables such as sunlight, humidity, and water provide them with energy. All of these elements are necessary for optimal food synthesis. Chlorophyll is present in the procedure, and they absorb all of the abiotic elements necessary for food synthesis. Producers use a portion of synthesized food solely for their own healthy functioning and growth.

Consumers

Consumers are organisms that consume the products of producers. Consumers are classified into three or more categories.

1. **Primary Consumers:** Primary customers are those who immediately benefit from procedures. For instance, a buffalo, a goat, and so on.
2. **Secondary consumers:** Secondary consumers are those who eat the food of primary consumers. Lions, tigers, and other animals are examples.

Decomposer

Decomposers are living creatures that break down or decompose the dead carcasses of plants and animals. In nature, they are heterotrophic. E.g. Fungi, bacteria, and other microorganisms.

Detritivores

Detritivores are creatures that feed on dead and rotting organisms. After eating, they have the least amount of energy.

Abiotic Components

Abiotic or physical components are the non-living components of the environment. Soil, water, and air on the earth's surface make up the physical environment. Climatic factors such as sunlight, precipitation, temperature, humidity, and wind also belong to the abiotic environment. Abiotic factors play an important role in influencing the species, behavior, and distribution of organisms in ecosystems.

About 70% of the earth's surface is covered with water in the form of oceans, seas, lakes, rivers, and ponds. Water is an important part of the composition of living organisms. About 70% of our body is made up of water.

1. Water is the most abundant natural resource on the earth's surface. It is also the most important need of all living things.
2. The presence of water is necessary for several life processes, such as the germination of seeds, the digestion

and absorption of food, the removal of waste products, the absorption of nutrients, and the circulation of substances in the body requires water as a medium.

3. The amount of water in the habitat affects the types of flora and fauna found in that habitat.
4. For example, there is less vegetation in desert areas where water is scarce.
5. On the other hand, in areas with high rainfall, a wide variety of plants grow thickly, forming tropical rainforests. This provides a very rich environment for animals, with a wide variety of animals thriving.
6. Water can dissolve gases such as oxygen and carbon dioxide. Water also contains dissolved salts and minerals. Both plants and animals can survive in water.

Air:-

Air is a mixture of 21% oxygen, 78% nitrogen, 0.03% carbon dioxide, and 0.3% argon. Air also contains water vapor and dust particles, which protect us from the harmful effects of UV rays.

1. Without air, life as we know it would not be conceivable on Earth. Carbon dioxide is absorbed by plants from the atmosphere and used to produce food. As a by-product of this action, oxygen is emitted.
2. All living things utilize oxygen for respiration. Combustion also makes use of oxygen (burning).
3. Plants once more utilize the carbon dioxide created by respiration, the burning of fossil fuels, and the decomposition of organic materials for photosynthesis.
4. A balance between oxygen and carbon dioxide in the air is maintained through the processes of respiration, combustion, and photosynthesis.
5. Microorganisms in the soil transform atmospheric nitrogen into nitrates. These nitrates are taken up by the plants and used for protein synthesis.

Light:-

The sun is the planet Earth's main and most important source of light energy. The Sun provides heat and light to us.

1. The only living things that can absorb and use solar energy to produce food are green plants. Through the natural food chain, this energy that plants store in the food they produce is transferred to every other living thing.
2. Other ways that light affects plants and animals are likewise numerous. Light affects a wide range of processes, including stomata opening and closing, seed germination, flowering, animal movement, sleeping, and feeding.
3. Some animals' behavior is also influenced by light. The majority of creatures, known as diurnal animals, can endure intense light and are active during the day.
4. Some are referred to as nocturnal animals, such as earthworms and cockroaches because they are active at night and shun the light.

Temperature:-

The temperature on the surface of the Earth varies greatly. Each type of creature can only withstand a certain range of temperatures.

1. Most plants and animals thrive between 20 and 45 degrees Celsius. Living cells are destroyed at extreme temperatures between 50 and 70 degrees Celsius, and they are frozen at extremely low temperatures below Orc. Some bacteria can endure temperatures as low as -240°C and as high as 120°C.
2. Different species have various defenses against temperature variations in their surroundings. For instance, most plants have long roots that extend far into the soil in deserts when it is hot and there is a lack of water to help them absorb moisture. To store water, many cacti have fleshy stems. Cacti's leaves are turned into spines in order to stop transpiration.

Multidisciplinary nature of environmental studies:-

To understand the multidisciplinary nature of environmental studies, we must first comprehend the literal definition of the term multidisciplinary. The phrase is made up of two words: multi and disciplinary. To begin, we define the term disciplinary. Disciplined research in a certain subject is what the term "disciplinary" refers to. Multidisciplinary, on the other hand, refers to the combination of more than one discipline or topic of study. It defines multi-sectoral and multi-dimensional research in a variety of disciplines.

Components of the Multidisciplinary Nature of Environmental Studies:-

Environmental studies are made up of several components. They are as follows:

- **Anthropology**: It is the study of human traits, biological and psychological well-being, communities and cultures, and the growth and evolution of humans. EVS is connected to anthropology since it studies humans and their environments throughout place and time.
- **Biology**: It is a field of science that focuses on the study of living creatures. Their physical structure, chemical processes, molecular interactions, development, and evolution are all included. EVS is connected to biology since it is concerned with the natural environment of living creatures.
- **Chemistry**: It is a field of science that examines chemicals and the components that make up matter. Understanding natural occurrences in EVS necessitates knowledge of chemistry.
- **Computers**: As the world has progressed, computers have become a need for everyone. Computers are used by the Environmental Protection Agency to keep track of pollutants found in soil and water.

- **Geology**: It is the study of physical structures and substances found on Earth, as well as their history and the processes that they go through. EVS is also concerned with the study of the earth and the environment.
- **Economics**: It is a field of study concerned with the production, consumption, and distribution of commodities and services. Various economic strategies have been established to protect the environment from pollution, global warming, and climate change by evaluating and developing answers or cures for environmental concerns.
- **Physics**: It is a field of science that examines energy and matter in space and time, as well as their interactions. Physics is concerned with energy conservation, atmospheric modelling, and many environmental concerns.
- **Sociology**: It is the study of social life, change, social causes, and the social repercussions of human action. It also addresses the connection between contemporary society and the environment.
- **Statistics**: It is the study of quantitative data collection, analysis, interpretation, and presentation. It is also used to evaluate data in order to find trends and recommend the optimal environmental growth.

Concepts of sustainability and sustainable development:-

Sustainability and sustainable development are concepts that aim to balance economic growth, social well-being, and environmental protection to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs.

Sustainability

Sustainability focuses on maintaining and improving the quality of human life while living within the carrying capacity

of supporting ecosystems. It encompasses three main pillars:

1. **Environmental Sustainability**: Involves conserving natural resources, reducing pollution, and protecting ecosystems and biodiversity to maintain the health of the planet.
2. **Economic Sustainability**: Ensures that economic activities are financially viable and benefit society as a whole. This includes creating jobs, fostering innovation, and supporting sustainable business practices.
3. **Social Sustainability**: Aims to improve social equity, justice, and quality of life. This includes addressing issues such as poverty, education, healthcare, and human rights.

Sustainable Development

Sustainable development is a holistic approach to development that seeks to achieve sustainability. The most widely accepted definition comes from the Brundtland Commission's 1987 report, "Our Common Future," which defines sustainable development as:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Key principles of sustainable development include:

1. **Intergenerational Equity**: Ensuring that the actions taken today do not negatively impact the ability of future generations to meet their needs.
2. **Integration of Economic, Social, and Environmental Goals**: Recognizing that these three dimensions are interconnected and must be addressed together for development to be truly sustainable.
3. **Participation and Inclusion**: Involving all stakeholders, including marginalized and vulnerable groups, in decision-making processes to ensure that development benefits everyone.

4. **Precautionary Principle**: Taking preventive action in the face of uncertainty to avoid harm to the environment and human health.
5. **Resource Efficiency**: Using natural resources more efficiently and promoting the use of renewable resources to reduce environmental impact.

Global Initiatives and Frameworks

Several international initiatives and frameworks guide sustainable development efforts:

1. **United Nations Sustainable Development Goals (SDGs)**: A set of 17 global goals adopted in 2015 as part of the 2030 Agenda for Sustainable Development. They address a wide range of issues, including poverty, hunger, health, education, gender equality, clean water, and climate action.
2. **Paris Agreement**: An international treaty adopted in 2015 to combat climate change and limit global warming to well below 2°C above pre-industrial levels.
3. **Circular Economy**: An economic system aimed at minimizing waste and making the most of resources. This involves reusing, repairing, refurbishing, and recycling existing materials and products.

Challenges and Opportunities

Achieving sustainability and sustainable development faces several challenges:

1. **Resource Depletion**: Overexploitation of natural resources, such as fossil fuels, minerals, and forests, threatens the planet's ability to sustain life.
2. **Climate Change**: Rising temperatures, extreme weather events, and sea-level rise pose significant risks to ecosystems, human health, and economies.
3. **Inequality**: Social and economic disparities can hinder progress towards sustainable development by marginalizing certain populations.

Ecology and Ecosystem:-

Ecology is the study of the relationships between living organisms, including humans, and their physical environment; it seeks to understand the vital connections between plants and animals and the world around them. Ecology also provides information about the benefits of ecosystems and how we can use Earth's resources in ways that leave the environment healthy for future generations.

Concept of ecology and ecosystems:-

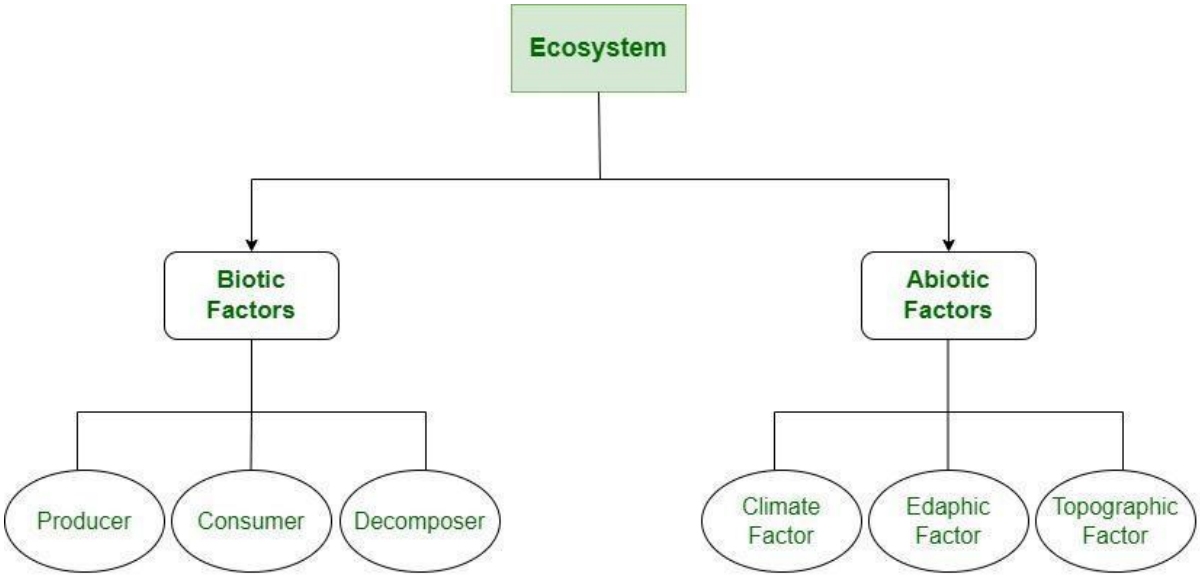
The term Ecology was coined by Earnst Haeckel in 1869. It is derived from the Greek words Oikos- home + logos- study. So ecology deals with the study of organisms in their natural home interacting with their surroundings. The surroundings or environment consists of other living organisms (biotic) and physical (abiotic) components. Modern ecologists believe that an adequate definition of ecology must specify some unit of study and one such basic unit described by Tansley (1935) was ecosystem. An ecosystem is a selfregulating group of biotic communities of species interacting with one another and with their non-living environment exchanging energy and matter. Now ecology is often defined as ‘‘the study of ecosystems’’. The ecosystem is a unit or a system which is composed of a number of sub-units, that are all directly or indirectly linked with each other. They may be freely exchanging energy and matter from outs.

Structure of Ecosystem:-

The structure of an ecosystem is made of two main components: biotic and abiotic components. The biotic component interacts

with the abiotic components to maintain the flow of energy. The energy is distributed in the environment. The ecosystem includes 2 main components for a working ecosystem:

- Biotic Component
- Abiotic Component



Biotic Components

Plants, animals, microorganisms, aquatic plants, and all other living creatures are the biotic components of the ecosystem. These biotic components can be classified into:

- **Producers:** All autotrophs like plants, phytoplankton, etc. that can produce their food using sources like sun, water, carbon dioxide, or any other chemical elements belong to this category.
- **Consumers:** All heterotrophs, primarily animals, that are dependent on the producers or other organisms are called consumers. These consumers are subdivided into the following groups:
    - **Primary consumers:** All herbivores that directly depend on plants, such as cows, goats, rabbits, and sheep, are considered primary consumers.

    - **Secondary consumers:** All that depend on primary consumers for food are considered secondary consumers. The secondary consumer can be omnivores or carnivores.
    - **Tertiary consumers:** All animals that depend on secondary-level organisms for their food are known as tertiary consumers.
    - **Quaternary consumer**: Those animals that depend on the tertiary level organism for their food and are known as the quaternary consumer. This level is present in some food chains only.
- **Decomposers:** All microorganisms, such as bacteria and fungi, that depend on decaying and dead matter for food fall under this category. It contributes to environmental cleanup and ecosystem nutrient recycling. These nutrients support plant development and subsequently ecosystem maintenance.

Abiotic Components

It involves all the non-living things present in the environment. Some of the abiotic components are sun, soil, water, minerals, climate, rocks, temperature, and humidity. These components' functioning together enables the ecosystem's energy and nutrition cycles. The sun's rays are the primary energy source. An ecosystem's temperature changes have an impact on the types of plants that may flourish there. The availability of nutrients and soil nature determines the type and abundance of vegetation in an area. All the abiotic factors are essential factors that determine the number and type of organisms present in a region.

Functions of Ecosystem

Following are some of the functions of the ecosystem;

1. It regulates different life processes.
2. The various components of an ecosystem are designed in a manner to support the life systems.
3. It regulates various types of nutrient cycles.

4. It maintains the balance of energy flow between various levels of the ecosystem.
5. It regulates the cycling of nutrients between abiotic and biotic factors.

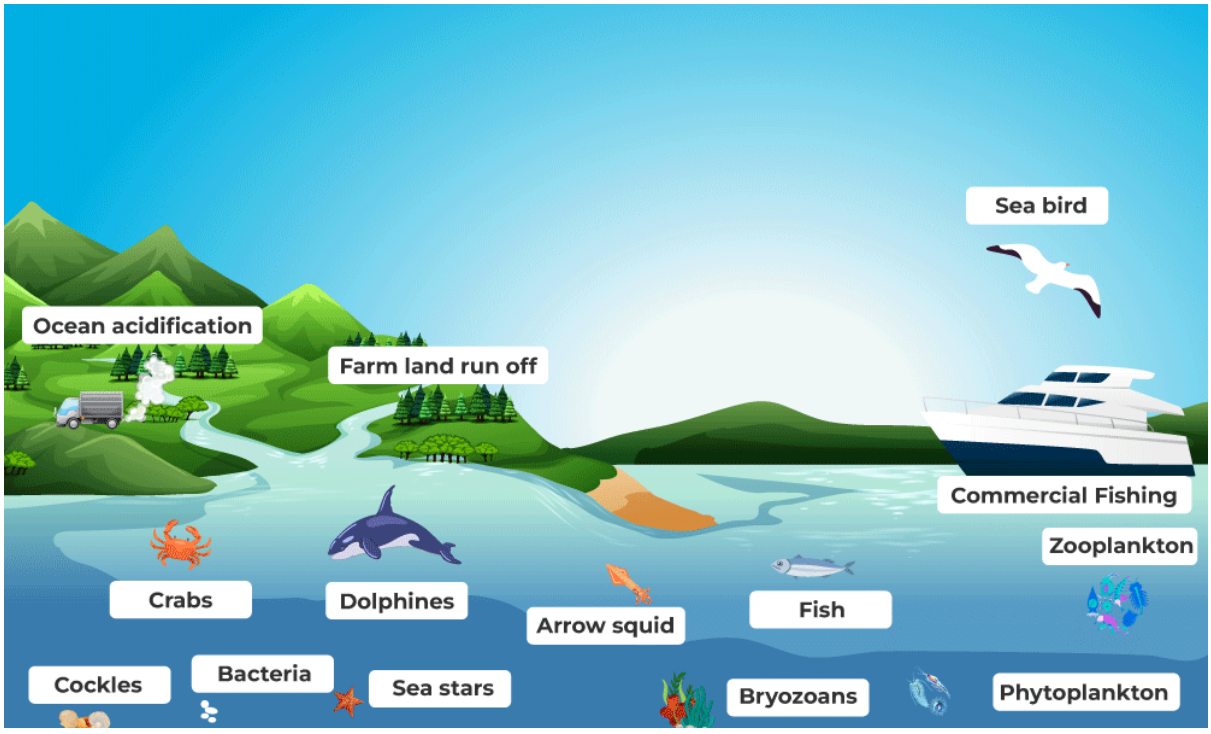
Types of Ecosystem

An ecosystem can be small or large. There are 2 types of ecosystem:

- Aquatic Ecosystem
- Terrestrial Ecosystem

Aquatic Ecosystem

Oceans, rivers, seas, lakes, springs, and other water bodies are aquatic biomes. The bulk of the earth's surface is covered by the water. Two-thirds of the earth's surface is made up of oceans, seas, the intertidal zone, reefs, the seabed, and rock pools. This ecosystem includes plants, fishes, amphibians, coral reefs, huge sea creatures, and insects.



There are 2 types of aquatic ecosystem:

- Freshwater Ecosystem
- Marine Ecosystem

Freshwater Ecosystems

A freshwater ecosystem has low salinity levels, providing a good environment for a variety of plants and animals. The sizes of freshwater resources range from small ponds to very large rivers. Freshwater resources vary from one another in terms of how they travel. While some freshwater bodies are constantly moving, like rivers, others remain still, like ponds.

Freshwater Ecosystem Types: Based on the region, the three main categories of the freshwater environment are the lotic, lentic, and wetland freshwater ecosystems.

- **Lotic:** In a lotic freshwater ecosystem, the water bodies travel in one direction. Numerous rivers and streams start at their sources and meet rivers or oceans at their mouths as they travel toward their destinations.
- **Lentic:** All non-flowing (still) waterways, such as ponds, swamps, bogs, lagoons, and lakes are lentic ecosystems. Due to the saturation of the underlying land, water will temporarily remain on the earth's surface. They are closed structures that keep the water still. Because every lentic system has multiple areas with different biological environments, animals, and plants in that system behave and adapt in different ways.
- **Wetlands:** Wetlands contain water and are home to vascular plants. Wetland environments are more often known as marshes, swamps, and bogs. Because soil and water are so close together, wetlands are highly productive. The plant species found in wetlands are referred to as hydrophytes since they have adapted to the area's moist and humid climate. Wetland ecosystems contain hydrophyte plants such as cattails, pond lilies, and sedges. Various amphibians, reptiles, birds, shrimp, shellfish, and other animal species find refuge in wetlands.

Living creatures that live in Freshwater Ecosystems: Fishes, amphibians, reptiles, mosquitoes, dragonflies, bees, wasps, water spiders, ducks, geese, etc.

Marine Ecosystems

Aquatic environments with high levels of dissolved salt are marine ecosystems. These comprise the deep ocean, the open ocean, and the coastal marine ecosystems. Each of these has unique biological and physical properties. The ecosystem's exposure to the sun, the amount of oxygen and nutrients that are dissolved in the water, the distance from land, the depth, and the temperature are all significant abiotic factors. Marine ecosystems have unique biotic and abiotic characteristics.

Terrestrial Ecosystem

A terrestrial ecosystem refers to an ecosystem of diverse land surfaces. Forests, deserts, grasslands, tundra, and coastal regions are all examples of terrestrial ecosystems. These terrestrial ecosystems are climate-dependent.

1. **Forests:** A type of terrestrial ecosystems that is covered in trees, creating several canopy layers. A variety of animal species live in dense tree covers and tropical rainforests. Forests are home to about 300 million different plant and animal species. A forest is a type of ecosystem that includes tropical rainforests, plantation forests, and temperate deciduous forests.
2. **Grasslands:** It has a dry environment that permits relatively little vegetation. Primarily, different species of grasses, are what define the grassland ecosystem. In this environment, grass and herbs predominate. The ecosystem of grasslands is significant to the animal kingdom.
3. **Tundra:** Tundra has extreme environmental conditions like that of the polar region. The location is typically windy, blanketed in snow, and devoid of trees. Its environment is constantly covered in absolutely frozen dirt. Small ponds are formed when the snow melts. Some lichens can flourish in such ponds.
4. **Deserts:** Deserts are unproductive land surfaces with extreme temperature swings and inadequately maintained species. One of the driest land regions on the globe. A

desert receives an extremely small amount of rainfall. Because of this, there is less vegetation. The desert ecosystem's plants and animals have learned the skill of surviving extreme environments.

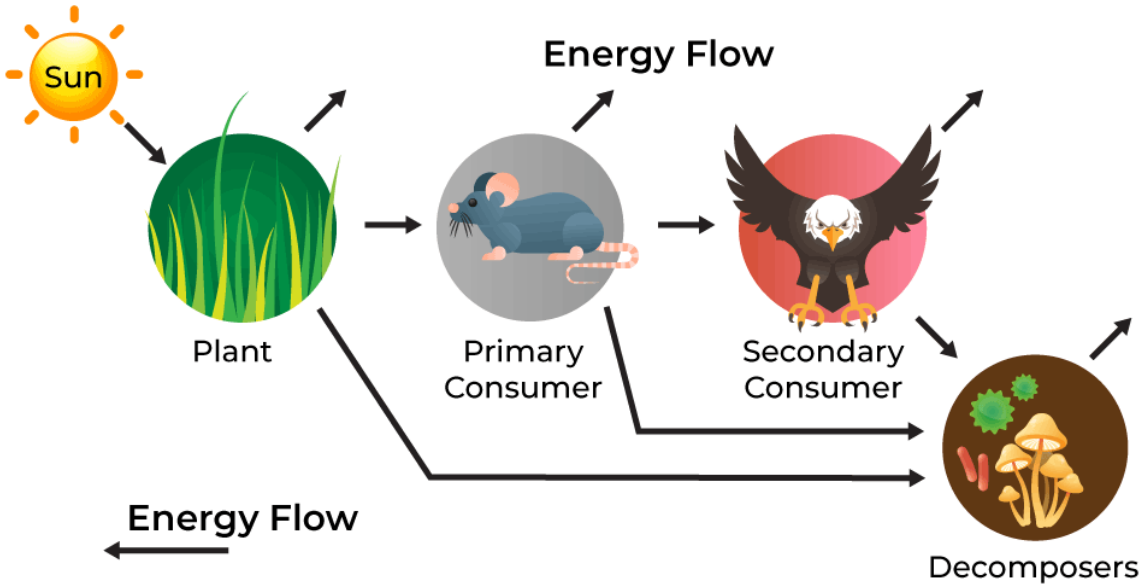
Energy Flow of Ecosystem?

Energy flow in an ecosystem is defined as the movement or transfer of energy from one trophic level to another in an ecosystem. The energy that is passed is in the form of chemical energy.

Energy flow is the phenomenon that is responsible to sustain life on this planet. All the biotic components in this ecosystem need energy for their survival. If the energy flow in an ecosystem is disturbed, then it leads to ecological imbalance. This energy flow occurs on the Earth through the biogeochemical cycle.

Energy Flow of Ecosystem Diagram

The diagram of energy flow of ecosystem is given below:



Laws of Thermodynamics in Ecosystem

The energy flow in an ecosystem is governed by the first two laws of thermodynamics. These two laws are explained as follows;

- **First Law of thermodynamics:** It states that energy can neither be created nor destroyed, but it keeps changing from one form to the other. Similarly in an ecosystem, the main source of energy is the sun, and this energy from the sun is transferred from one level to the other.
- **Second Law of thermodynamics:** It states that when energy transforms from one form to another, some part of it is lost as heat to the surroundings. Thus the energy at one level is never completely transferred to the other.

  What is the Direction of Energy Flow of Energy in an Ecosystem?

  The direction of the energy flow in an ecosystem is unidirectional. It flows from the primary source of energy i.e. the sun's light energy to producers or autotrophs which then transferred to the consumers. The producer uses the solar energy to produce organic food which flows through a series of trophic levels. Each trophic level captures a portion of this energy for its metabolic needs, while the rest is passed to the next level. The flow of energy follows the following pathway;

  Solar Energy –> Producer (autotrophs) –> Consumer (herbivores) –> Consumer (carnivores) –> Consumer (higher levels of carnivores)

  Mechanism of Energy Flow in Ecosystem

  Animals get energy in two forms: radiant energy and fixed energy. Radiant energy comes from electromagnetic waves, like light. Fixed energy is stored in objects and substances as chemical energy.

  Organisms that convert radiant energy to fixed energy are called autotrophs. Heterotrophs get their energy from autotrophs. The sun is the main source of energy in our ecosystem. But less than half of the sun's energy is used by plants for photosynthesis i.e. 50% of this energy is **photosynthetically active radiation (PAR)**.

Plants convert radiant energy to fixed energy and pass it on to other organisms. When the sun shines on plants, they use it along with carbon dioxide and water to make glucose and oxygen. The oxygen goes into the atmosphere and the glucose stays in the plant. When herbivores eat plants, they get energy from the plant. Some of this energy is lost as heat.

When carnivores eat herbivores, there is again a loss of some energy. We call this the 10% law because only 10% of the energy available at one level is transferred to the next level. The flow of energy in an ecosystem is unidirectional, meaning it only goes in one direction. We can't transfer energy to a previous level. To understand this, we need to learn about trophic levels and the food chain.

Trophic Levels

An ecosystem is divided into various levels called trophic levels. Various trophic levels are as follows:

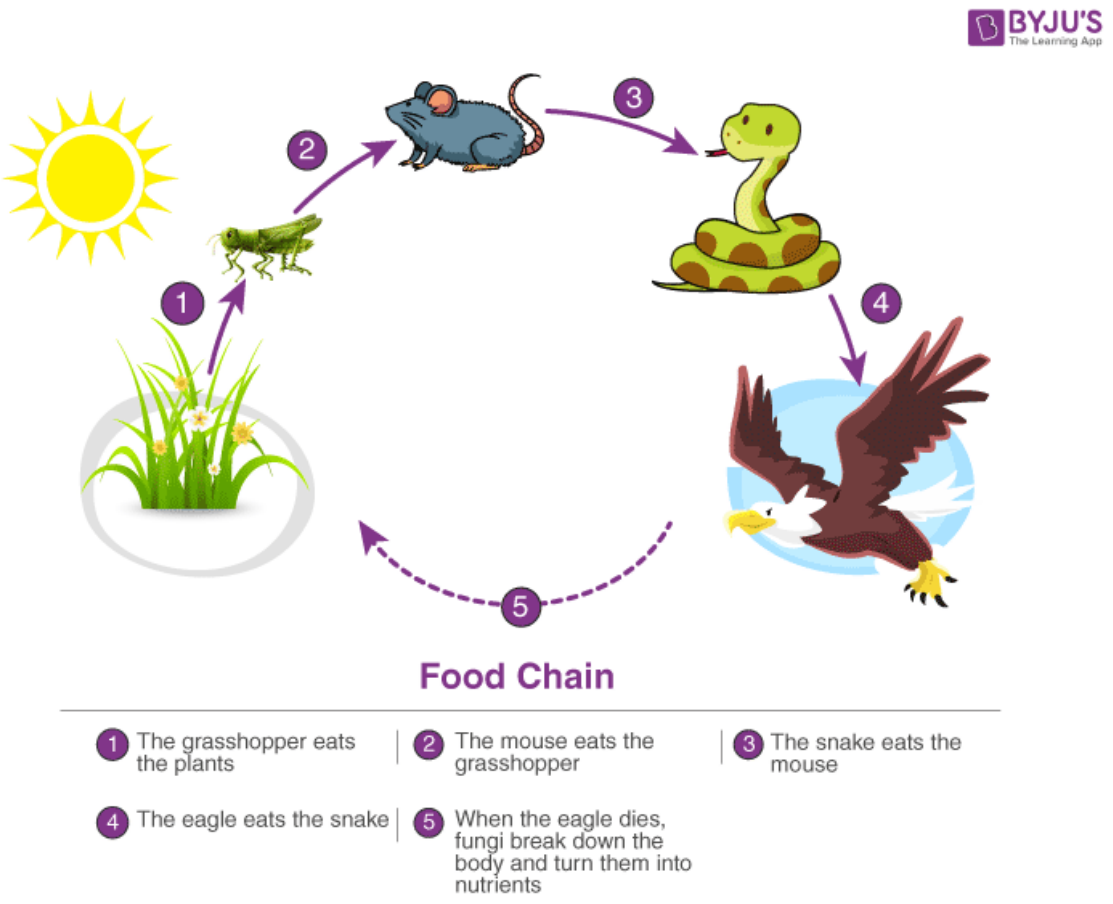
- **First trophic level:** This level is occupied by the **producers** which include the plants.
- **Second trophic level:** It is occupied by the primary consumers that consume plants. For example herbivores such as cows, goats, etc.
- **Third Trophic Level:** This level is occupied by the primary carnivores or secondary consumers such as snakes, frogs, birds, etc.
- **Fourth trophic level:** Large carnivores that are also called tertiary consumers make up this level. Example: Lion, Tiger, Cheetah, etc.

Food chain:-

A food chain explains which organism eats another organism in the environment. The food chain is a linear sequence of organisms where nutrients and energy is transferred from one organism to the other. This occurs when one organism consumes

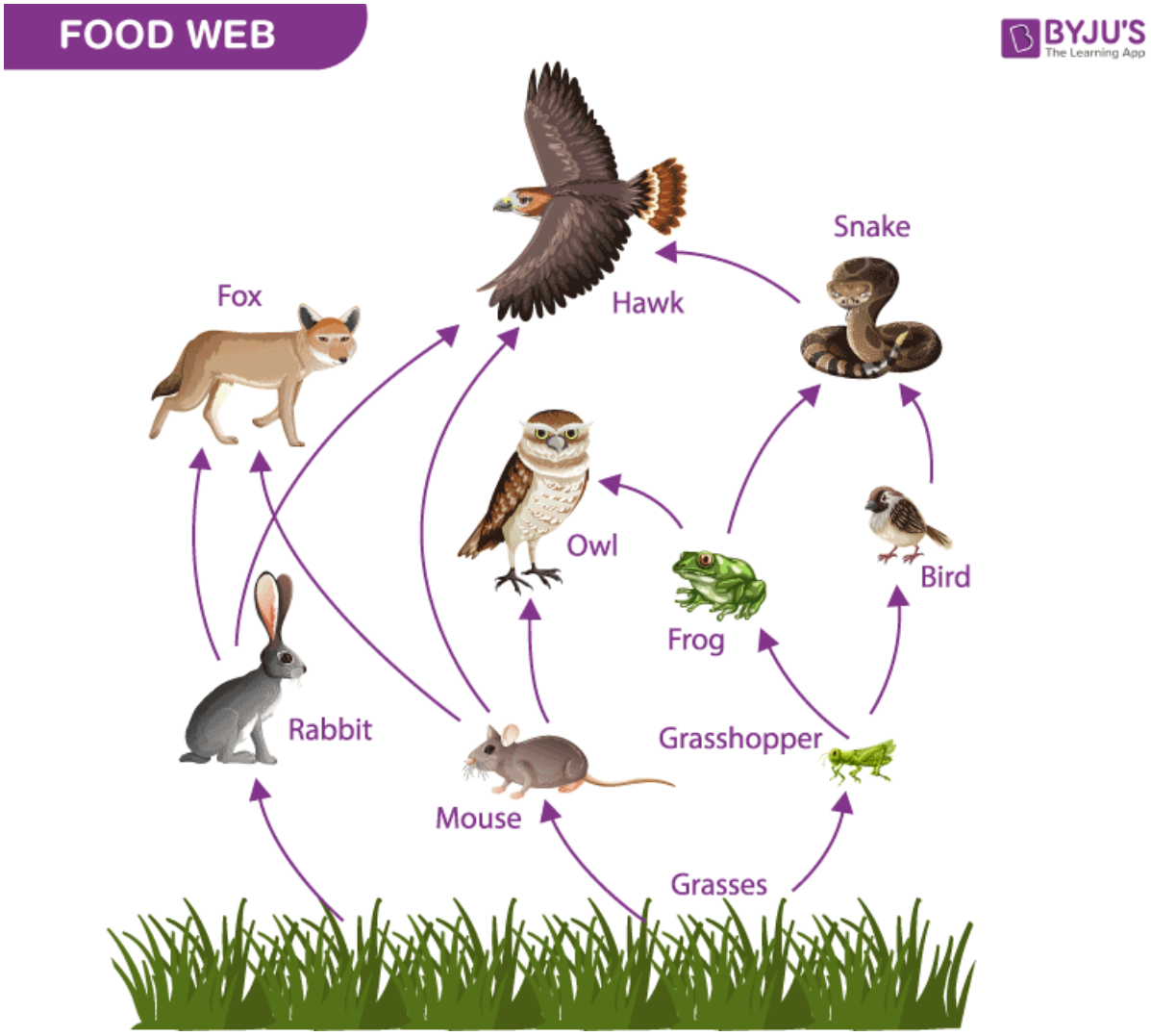
another organism. It begins with the producer organism, follows the chain and ends with the decomposer organism. After understanding the food chain, we realise how one organism is dependent upon another organism for survival.

- **The Sun:** The sun is the initial source of energy, which provides energy for everything on the planet.
- **Producers:** The producers in a food chain include all autotrophs such as phytoplankton, cyanobacteria, algae, and green plants. This is the first stage in a food chain. The producers make up the first level of a food chain. The producers utilise the energy from the sun to make food. Producers are also known as autotrophs as they make their own food. Producers are any plant or other organisms that produce their own nutrients through photosynthesis.
- **Consumers:** Consumers are all organisms that are dependent on plants or other organisms for food. This is the largest part of a food web, as it contains almost all living organisms. It includes herbivores which are animals that eat plants, carnivores which are animals that eat other animals, parasites that live on other organisms by harming them and lastly the scavengers, which are animals that eat dead animals' carcasses.



Food Web:

Several interconnected food chains form a food web. A food web is similar to a food chain but the food web is comparatively larger than a food chain. Occasionally, a single organism is consumed by many predators or it consumes several other organisms. Due to this, many trophic levels get interconnected. The food chain fails to showcase the flow of energy in the right way. But, the food web is able to show the proper representation of energy flow, as it displays the interactions between different organisms.



Types of Food Chain

There are two types of food chains, namely the detritus food chain and the grazing food chain. Let's look at them more closely:

- **Detritus food chain:** The detritus food chain includes different species of organisms and plants like algae, bacteria, fungi, protozoa, mites, insects, worms and so on. The detritus food chain begins with dead organic material. The food energy passes into decomposers and detritivores, which are further eaten by smaller organisms like carnivores. Carnivores, like maggots, become a meal for bigger carnivores like frogs, snakes and so on. Primary consumers like fungi, bacteria, protozoans, and so on are detritivores which feed on detritus.

- **Grazing food chain:** The grazing food chain is a type of food chain that starts with green plants, passes through herbivores and then to carnivores. In a grazing food chain, energy in the lowest trophic level is acquired from photosynthesis.

Basic concept of populations and community ecology:-

Population ecology is a more specific field of study of how and why the populations of those organisms transform over time. As the human population rises in the 21st century, the information gleaned from population ecology can help with planning. It can also help with measures to preserve other species.

Population Ecology :-

*In **population** biology, the term population means a group of individuals of the same species living within a given area*.

Population ecology is the study of how various factors impact population growth, rates of survival and reproduction, and risk of extinction. Population ecology has its most profound historical roots and development in the study of population growth, regulation, dynamics, or demography. The population can be open or closed population.

Closed Population

A closed population is not able to exchange with other people after a while. The population can grow through the birth of new people. This circumstance is usually seen on islands as a population might be laid out during a storm or any other influence but no additional members will be added over time. When a brief period of time is over, a population is bound to be closed. A storm event where more turtles are added during a single year than 100 years is less likely to happen on an island. Animals will not be able to cross the river during a normal year if the river stays at its full level. The population can grow through birth and decline through death, making it easier to project growth rates. The

growth rate is not determined by the number of organisms or the rate of reproduction.

The population will be diminished by the death rate. population growth can be influenced:

- space
- hereditary qualities
- age of individuals
- resources

Open Population

An open population can acquire and lose different populations over time. The population isn't geographically isolated. The longer the period of time, the more probable it is that the population will open. The typical changes in an environmental system are the reason for this.

After some time, we expect that rivers will experience times of dry weather, mountain passes will open and close, and bridges will be destroyed. The capacity of new individuals to join an existing population will be influenced by these things.

Characteristics of Population Ecology

Ecologists use diverse terms while understanding and examining populations of organisms. A population is all of one sort of species living in a particular location. Population size describes the total number of individuals in a habitat. Population density refers to how many individuals live in a specific area.

Population size is represented by the letter **N**, which refers to the total number of individual organisms in a population. The bigger a population is, the greater its generic variation and thus its potential for long-term survival. Increased population size can, however, lead to further issues, such as overuse of resources leading to a population crash.

Population Density refers to the number of individual organisms in a particular area. A low-density region would have more organisms spread out. High-density regions would have more

individuals residing closer together, leading to greater resource competition.

Population Dispersion: Hauls helpful information regarding how species interact with each other. Researchers can discover more about populations by studying how they are distributed or dispersed.

Population distribution describes how individual organisms of a species are spread out, whether they live close or far apart or massed into groups.

- ***Uniform dispersion*** means the organisms that live in a distinct territory. One example would be penguins. Penguins live in parts; within those territories, the birds space themselves reasonably uniformly.
- ***Random dispersion*** means the spread of individual organisms, such as wind-dispersed seeds, which fall randomly after transiting.
- ***Clustered or clumped dispersion*** means a drop of seeds straight to the ground, instead of being carried, to groups of animals living together, such as herds or schools. Schools of the fish show this manner of dispersion.

Community Ecology

Community ecology *also known as synecology examines the interaction between species in a group over a wide range of spatial scales comprising population dynamics, demography, and abundance*.

What is Community Ecology?

The study of interactions between species in groups across a broad variety of temporal and spatial scales, including distribution, population dynamics, structure, abundance, and demography, is known as community ecology, or synecology. Community ecology is mainly concerned with how certain genotypic and phenotypic features affect interactions within populations. Studies of community ecology concentrate on the relationships and rivalry

between organisms that coexist in a certain ecological niche, such as a grassland, lake, or forested area.

Types of Community

There are two main types of community:

Major Community

The smallest self-sustaining, self-regulating ecological unit is called a major community. These communities typically exist in relative isolation from other communities, such as lakes, ponds, forests, or grasslands. A major community is an amalgam of a microbiological community (also known as “microbiocenosis”), a floral community (also known as “phytocenosis”), and a faunal community (also known as “zoonenosis”).

Minor Community

Smaller ecological entities that depend on interactions with other communities for survival, minor communities, also known as merocenoses, are the building blocks of big communities. An example of a minor community is the

collection of organisms, which lives within a piece of deadwood on the forest floor.

Community Structure

The community structure describes the composition of a community by including a number of species and their relative abundances. Different ecological communities can have rather different kinds and numbers of species living there. Communities that are near the equator are generally home to the most notable species, whereas communities that are closest to the poles are usually home to the fewest species.

The Structure of the Trophic Pyramid

The trophic pyramid is a common structure found in all biological groups. Each pyramid comprises four or five layers. Food energy is passed from one food chain to the next. It requires a large number of species at a particular trophic level to support those in the next level since every level of the pyramid loses energy to heat. Autotrophs are the basis species in every biological community; they are organisms that directly obtain heat from the sun through photosynthesis. Heterotrophs are the species that make up the remainder of the pyramid.

Animals can have more than one meal at a time depending on their developmental stage. A normal food chain has four or five links, with autotrophs at the base and carnivores at the top as the top predator. But many organisms eat more than one species.

Food Web

Numerous species feed at different trophic levels, consuming both plants and animals. Because of this, food chains are often linked to form incredibly intricate food webs.

Animals in a society participate in interactions other than mutual consumption, such as competition for resources. Non-trophic relationships between species play an equally

important role in determining the organisation of biological communities as do the trophic level food webs and food chain.

Examples of Community Ecology

Numerous diverse ecological interactions that are always changing are included in community ecology. A forest community is made up of all the trees, the flora, fish in the forest rivers, birds, deer, squirrels, foxes, mushrooms, insects, and other seasonal or local species. A coral reef community is made up of different types of fish, algae, and coral. The biotic community is significantly influenced by dispersion and abundance.

The interactions between different species that affect the health, growth, spread, and richness of the ecological system are referred to as community ecology. At the communal level, species often rely on each other. The majority of biological groups have multiple short food chains.

Characteristics of a Community Ecology

The primary features of community ecology are species diversity, trophic organization, dominance, self-sufficiency, growth shape and structure, and relative abundance. A pond, a forest, and a desert are examples of natural communities. A community's development, organisation, and behaviours are all distinct.

- **Variability in Species**: Every community consists of a variety of organisms, such as bacteria, plants, and animals. They differ from one another in terms of taxonomy. There may be a local or regional diversity of species.
- **Growth Form and Organization:** A community can be examined using primary growth forms, such as trees, shrubs, and herbs. Each growth form found in trees may contain a variety of plant species, including broadleaf trees,

evergreen trees, etc. The structure of a community is influenced by these many growth types.

- **Dominion:** Within a community, species vary in importance. A community's traits are determined by a chosen few species. A few numbers of species regulate and rule over the community.
- **Self-Reliance:** There are many different heterotrophic and autotrophic organisms in every group. Plants that are autotrophic can endure on their own.
- **Relative Abundance:** The idea of relative abundance states that many populations coexist in a community in relative amounts.
- **Trophic Structure:** The trophic organisation of each ecosystem regulates the flow of food and energy from plants to herbivores and then to carnivores.

Importance of Community Ecology

The community ecology is important because:

- It helps in the understanding of community structure and evolution by scientists. It also helps in understanding the causes, effects, and maintenance of species variety.
- The interactions and competition between organisms that coexist in a certain ecological niche are the main focus of community ecology.
- This is particularly important for invasive species, which, if they can fill certain niches held by native species, may be able to establish themselves in particular groups.
- Abiotic variables that affect species interactions or distributions are also taken into consideration in community ecology. For example, the soil pH or the annual temperature.

Ecological Succession:-

Ecological succession is the steady and gradual change in a species of a given area with respect to the changing environment.

It is a predictable change and is an inevitable process of nature as all the biotic components have to keep up with the changes in **our environment.**

The ultimate aim of this process is to reach equilibrium in the ecosystem. The community that achieves this aim is called a climax community. In an attempt to reach this equilibrium, some species increase in number while some others decrease.

Types of Ecological Succession

These are the following types of ecological succession:

Primary Succession

Primary succession is the succession that starts in lifeless areas such as the regions devoid of soil or the areas where the soil is unable to sustain life.

When the planet was first formed there was no soil on earth. The earth was only made up of rocks. These rocks were broken down by microorganisms and eroded to form soil. The soil then becomes the foundation of plant life. These plants help in the survival of different animals and progress from primary succession to the climax community.

If this primary ecosystem is destroyed, secondary succession takes place.

Secondary Succession

Secondary succession occurs when the primary ecosystem gets destroyed. For eg., a climax community gets destroyed by fire. It gets recolonized after the destruction. This is known as secondary ecological succession. Small plants emerge first, followed by larger plants. The tall trees block the sunlight and change the structure of the organisms below the canopy. Finally, the climax community arrives.

Characteristic features of the following :-

1.forest ecosystems:- A forest ecosystem is an ecosystem of forests and resources. Forests are renewable natural resources. Forests are formed by a group of plants that are structurally

defined by their trees, shrubs, herbs, climbers, and ground cover. Soil, animals, insects, microorganisms, and birds are the most important interacting units of a forest ecosystem. In India, the forests occupy about 18-20% of the total land area.

1. **Abiotic Components** of the forest include inorganic and organic components present in the soil along with temperature, rainfall, light, etc.

2. **Biotic Components** are represented by producers, consumers, and decomposers.

2.Grassland ecosystem:-

- Grasslands are one of the intermediate stages in ecological succession and cover a part of the land on all the altitudes and latitudes at which climatic and soil conditions do not allow the growth of trees.
- Grasslands make up almost a quarter of the total land surface. The types of plants that grow here greatly depend on what the climate and soil are like.
- Grasslands cover areas where rainfall is usually low and/or the soil depth and quality is poor.
- The low rainfall prevents the growth of numerous trees and shrubs but is sufficient to support the growth of grass cover during the monsoon.

3.Desert ecosystem:-

Deserts are barren areas of land characterised by extremely high or low temperatures, with low rainfall and scarce or no vegetation.

Deserts are examples of terrestrial ecosystems, which are found throughout the world. Neither all deserts are flat, nor do all deserts have cacti or oases. These are regions with a short rainy season. It is scorching in the daytime, and very cold at night in the desert.

Types of deserts

Deserts are arid regions with especially low or high temperatures and limited vegetation. Based on the climate condition,

deserts are classified into two types –
1.hot deserts
2. cold deserts.

4.aquatic ecosystems:-

The aquatic ecosystem definition states it is a water-based environment, wherein, living organisms interact with both physical and chemical features of the environment. These living creatures whose food, shelter, reproduction, and other essential activities depend on a water-based environment are known as aquatic organisms.

Water plays a significant role in the management of world-scale ecosystem processes in aquatic systems, connecting the atmosphere, lithosphere, and biosphere by transferring material between them and allowing chemical reactions to occur. Water has unique physicochemical features that reflect the water body's quality.

The physicochemical characteristics of an aquatic ecosystem determine how well it functions and how long it can support life forms. In the same way as sediments in terrestrial ecosystems provide substrate, nutrients, and a home for live aquatic resources, sediments in aquatic ecosystems are equivalent to the soil in terrestrial ecosystems. Sediments are significant catalysts in environmental food cycles and the two water quality dynamics.

Water Ecosystem

This particular ecosystem is the largest aquatic ecosystem and covers over 70% of the earth's total surface. This

ecosystem is relatively more concentrated in terms of salinity.

Ocean Ecosystem

Pacific Ocean, Atlantic Ocean, Indian Ocean, Arctic Ocean, and the Southern Ocean are the five major oceans on earth. Notably, the Pacific Ocean is the largest and deepest of these five, while the Atlantic is the second largest in terms of size. Also, the Southern Ocean harbors the largest population of Krill among them. Other than that, the oceans serve as home to aquatic organisms like – turtles, crustaceans, plankton, corals, shellfish, blue whale, sharks, tube worms, reptiles, etc.

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- **Estuaries**

Typically, it is the meeting point of a sea and rivers, which makes the water slightly more saline when compared to freshwater and more diluted when compared to the marine ecosystem. Biologically, estuaries are considered to be productive as they stimulate primary production and trap plant nutrients. Some examples of estuaries include – tidal marshes, river mouth, and coastal bays.

- **Coral Reefs**

These are fondly referred to as the Rain Forest of Oceans as they harbor a wide diversity of aquatic flora and fauna. A coral reef is an aquatic ecosystem made up of corals that form reefs. Coral polyps are held together by calcium carbonate in the formation of reefs. Stony corals, whose polyps cluster in groups, make up the majority of coral reefs.

The animal phylum Cnidaria includes sea anemones and jellyfish, and coral is part of the class Anthozoa. Corals secrete hard carbonate exoskeletons that support and protect them, unlike sea anemones. Warm, shallow, clear, sunny, agitated water is

ideal for most reefs. At the beginning of the Early Ordovician, 485 million years ago, coral reefs displaced the Cambrian's microbial and sponge reefs.

- **Coastal Ecosystem**

Coastal ecosystems are formed when land and water meet. The structure, variety, and energy flow of these ecosystems are all unique. The bottom of the coastal environment is dominated by plants and algae. Insects, snails, fish, crabs, shrimp, lobsters, and other animals make up the fauna. It is one of the major aquatic ecosystems and is quite distinct in terms of structure and diversity. The coastal ecosystem is formed in the union of land and water. Coastal ecosystems harbor a variety of plants and algae and serve as a home to snails, shrimps, crabs, lobsters, and fish.