

**Module 03:** Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc. (05 hrs)

### **Short Answer Questions:**

#### **1. What is the concept of Ecology?**

**Ecology:** the study of **how living things interact** with their physical environment (basic definition)

The scientific study of the **processes influencing the distribution** and **abundance of organisms**, the interactions among organisms and the interactions between organisms, and the **transformation and flux of energy and matter**. - **Ernst Haeckel (1866)**

Ecology: is the study and **distribution of organisms** which reinforces the focus on organisms as the core of ecology. - **Andrewartha and Birch (1954)**

#### **2. Define the food chain and food web.**

**Food Chain:** a **single pathway** of **feeding relationships** among **organisms** that involve the **transfer of energy**.

It is of 2 types

- a. **Grazing food chain**
- b. **Detritus food chain**

The main difference between these kinds of food chains is that the **grazing food chain** begins from the **green plants**, which are the principal producers, whereas the **detritus food chain** starts from the **dead organic matter** or decomposed material, which is usually within the soil. The **energy** to the **grazing food chain** comes in **sunlight** as the autotrophs (green plants) prepare their food (photosynthesis) amid the existence of the sunlight. while the energy for the **detritus** food chain is taken in the detritus or the **decomposed materials**.

**Food Web:** Interrelated food chains in a community

#### **3. What is an ecological pyramid? Discuss different types of ecological pyramids.**

Ecological pyramids are a graphical presentation of relationships between **numbers, biomass**, and **energy content** of the primary producers, consumers of first and second orders, and so on to top carnivores in the ecosystem.

Three types are

- a. **Pyramid of Numbers**

A pyramid of numbers indicates the **number of individuals** in each trophic level. Since the size of individuals may vary widely and may not indicate the productivity of that individual, pyramids of numbers **say little or nothing** about the amount of energy moving through the ecosystem.

- b. **Pyramid of Biomass**

If the **biomass** produced by a trophic level is summed **over a year** (or the appropriate **complete cycle period**), then the pyramid of **total biomass produced** must resemble the **pyramid of energy flow**, since biomass can be equated to energy.

c. **Pyramid of Energy**

A pyramid of energy depicts the **energy flow**, or **productivity**, of each trophic level. Due to the **Laws of Thermodynamics**, each **higher level** must be **smaller than lower levels**, due to the loss of some energy as heat (via **respiration**) within each level.



(Yeh diagram teeno mai same hi hai)

#### 4. What is the concept of limiting factors? Define it.

A limiting factor is **anything** that makes it **more difficult** for a **species** to **live, grow, or reproduce** in its environment. It **determines** the **types of organisms** that **exist** in that environment.

Organisms with similar needs may **compete** with each other for **resources** like:

- |          |            |
|----------|------------|
| 1. Food  | 4. Air     |
| 2. Space | 5. Shelter |
| 3. Water |            |

Thus, these **resources** may become a **limiting factor**.

#### 5. What is meant by habitat? What are its types? Elaborate.

(not enough content in ppt putting from Google)

A place where an organism **lives out its life**. It is an **organism's home**, its address.

The five major habitats are – **forests, grasslands, deserts, mountains, polar regions, and aquatic habitats**. Oceans and freshwater together form the **aquatic habitat**.

#### 6. Explain the ecosystem

The ecosystem is the **geographical area** that includes all of the **organisms** & the **non-living environment**. **Community members** in the ecosystem **must interact** to maintain a **balance**.

An ecosystem is self-sustaining if:

- A constant source of energy is supplied.
- Living things use this energy and convert it into organic molecules
- Cycling of materials between organisms and their environment

## 7. Distinguish between the food chain and the food web with examples.

Food Chain	Food Web
In a food chain, there is a straight line from producers to first consumers to second consumers to third consumers	In a food web, each organism eats and is eaten by 2 or more organisms. So, everything is connected by a web.
An organism at higher level of food chain eats a specific organism at the lower level	An organism at higher level of food web can eat more than one organism from the lower level
Food chain is a simplified version of food web	Food web is what happens in reality. A food web contains many food chains.
Single food chains are unstable in an ecosystem	Food webs are stable in an ecosystem

## 8. Distinguish between the Grazing food chain and the Detritus food chain

The main difference between these kinds of food chains is that the grazing food chain begins from the green plants, which are the principal producers, whereas the detritus food chain starts from the dead organic matter or decomposed material, which is usually within the soil. The energy to the grazing food chain comes in sunlight as the autotrophs (green plants) prepare their food (photosynthesis) amid the existence of the sunlight. while the energy for the detritus food chain is taken in the detritus or the decomposed materials.

## Long Answers Questions:

### 9. What is the concept of carrying capacity? Define it

The carrying capacity of an ecosystem is the size of the population that can be supported indefinitely upon the available resources and services of that ecosystem.

It is a term that is used to represent the maximum percentage of the population or a particular species which can be supported by an environment or habitat over a specified period of time without destroying the available resources. The population of an organism can increase in different patterns. If a population increases in a geometric progression, i.e. exponentially (2, 4, 8, 16...), then it is referred to as Malthusian law of population.

Figure 3.22 represents the exponential growth of a population:

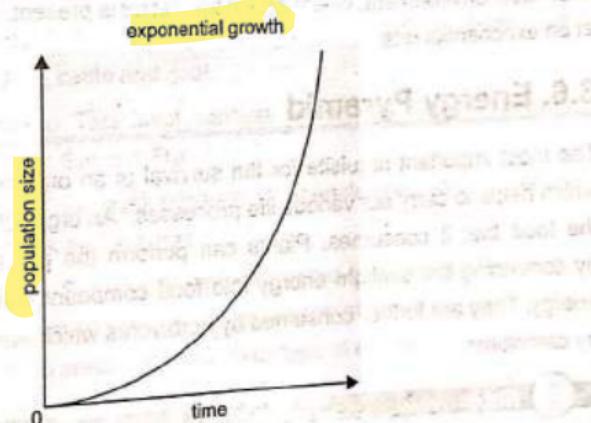


Figure 3.22: Exponential Growth of Population  
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If a population increases in a realistic manner, then it can be represented by a logistic curve which is referred to as Verhulst's law. The population is represented at the vertical axis and the time is represented at the horizontal axis. The maximum population 'K' is determined by the carrying capacity of an area.

Figure 3.23 represents the logistic growth of a population:

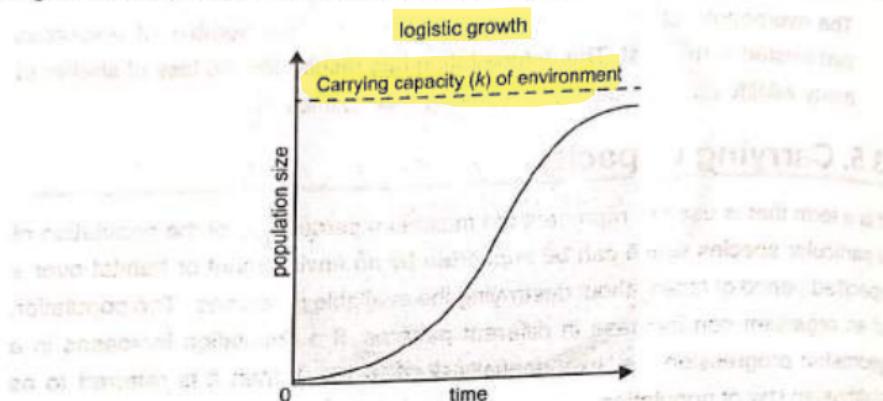


Figure 3.23: Logistic Growth of Population

In an ideal environment, where no limiting factor is present, a population increases at an exponential rate.

**10. Define ecosystem. Classify different types of Ecosystems. What are the biotic and abiotic components of an ecosystem?**

The ecosystem is the geographical area that includes all of the organisms & the non-living environment. Community members in the ecosystem must interact to maintain a balance.

**An ecosystem is self-sustaining if:**

- a. A constant source of energy is supplied.
- b. Living things use this energy and convert it into organic molecules
- c. Cycling of materials between organisms and their environment

**Types of Ecosystems are:**

1. Freshwater Ecosystems  
Includes Pond Ecosystem, River Ecosystem
2. Terrestrial Ecosystems  
Includes Rainforests, Tundra, Deserts, Forests Grasslands
3. Ocean Ecosystem  
Includes Shallow water, Deepwater Warm water, Cold water
4. Artificial Ecosystems

**Biotic Factors and Abiotic Factors:**

**1. Biotic Factors**

These are the living factors that affect the ability of organisms to survive and reproduce.

Examples: other organisms, such as a predator, food source

**2. Abiotic Factors**

These are the nonliving factors that affect the ability of organisms to survive and reproduce.

Examples:

1. intensity of light
2. range of temperatures
3. the amount of moisture
4. soil or rock type
5. availability of inorganic substances
6. supply of gases such as oxygen, carbon dioxide, and nitrogen
7. pH

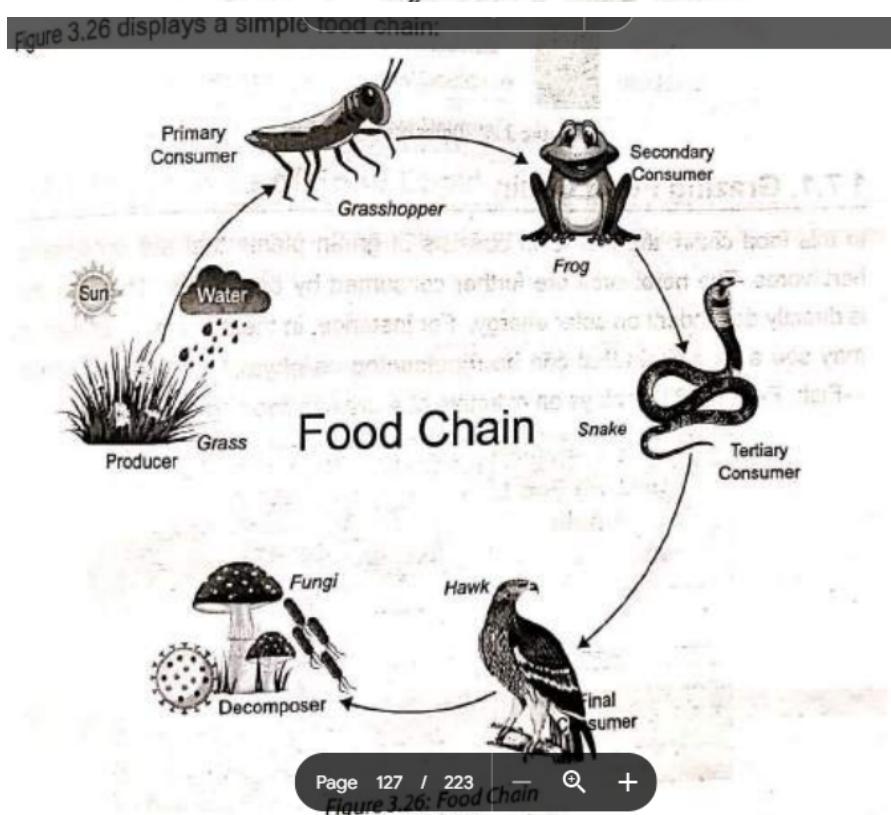
## 11. Explain the food chain with examples.

### 3.7. Food Chain

A food chain is a linear sequence of organisms, that begins with producers and ends at decomposers. It occurs mostly in a single path. As you have already learnt the 10% rule, where 10% of the energy is lost at each trophic level and the remaining amount is passed to the next trophic level. This limits the size of a food chain, i.e. up to 4 or 5 trophic levels. Some of the points related to a food chain are as follows:

- A stronger organism attacks a weaker organism.
- The number of individuals per trophic level decreases.
- A typical food chain can support only four or five trophic levels.

Figure 3.26 displays a simple food chain:



Plants are known as the producers that use the sunlight and produce food in the form of glucose. They are then consumed by primary consumers such as a grasshopper. Then, the grasshopper is eaten by a snake which is a secondary carnivore. The snake is further consumed by a hawk, which is a tertiary carnivore. When the hawk dies, a fungus decomposes its body and nutrients are again transferred back to the soil. A food chain is of two types, as shown in Figure 3.27:

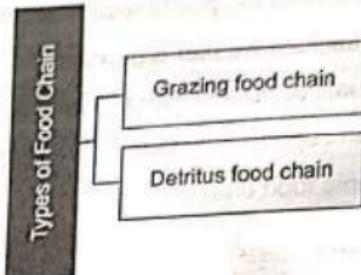


Figure 3.27: Types of Food Chain

### 1.7.1. Grazing Food Chain

In this food chain, the first level consists of green plants that are consumed by herbivores. The herbivores are further consumed by carnivores. This food chain is directly dependent on solar energy. For instance, in the marine ecosystem, you may see a food chain that can be represented as phytoplankton → zooplankton → Fish. Figure 3.28 displays an example of a grazing food chain:

### 1.7.2. Detritus Food Chain

In this type of food chain, the first trophic level consists of dead organic matter that is consumed by microorganisms. The second level comprises detritivores that feed on detritus. The detritus is further consumed by predators. This kind of food chain is less dependent on solar energy. This food chain is found in the temperate forest comprising decomposing litter. Figure 3.29 displays an example of a detritus food chain:

### **1.7.3. Importance of Food Chain**

A food chain helps to maintain the balance in an ecosystem. Some of its advantages are shown in Figure 3.30:

- It helps to understand the feeding relationship amongst different organisms in an ecosystem.
- It helps to understand the energy flow and nutrient recycling in an ecosystem.
- It helps to understand various problems of biomagnifications.

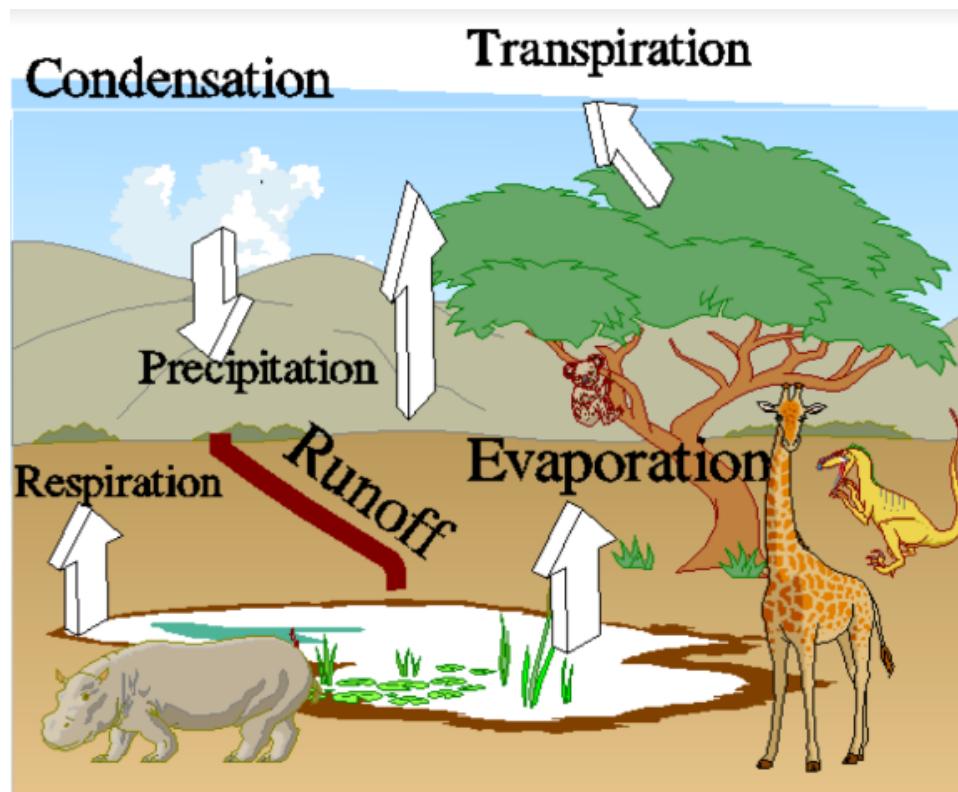
Figure 3.30: Advantages of Food Chain

**12. What do you understand about the biogeochemical cycle? Explain with a neat sketch any one of the following:**

- a. Hydrologic cycle/ water cycle

Water Cycle: involves the processes of

- a. Photosynthesis
- b. Transpiration
- c. Evaporation and condensation
- d. Respiration
- e. Excretion



### b. Nitrogen cycle:

Nitrogen comprises 78% of air and hence it is the key nutrient of an ecosystem and a food chain. It is impossible for plants to absorb nitrogen directly, as it is a non-reactive element. The rhizobium bacteria which are present in the roots of leguminous plants such as pulse and gram. These bacteria convert nitrogen into nitrates so that it can be absorbed by the roots of a plant. Plants use nitrogen to make a protein that is required for the formation of tissues and cells.

Nitrogen is introduced into the soil via bacteria or lightning. Plants use nitrogen in the form of nitrates and make protein by absorbing nitrates from the soil. They are

eaten by herbivores and hence nitrogen is used by them to make cells and tissues, as nitrogen forms the main component of protein which is a building block of the body. When animals urinate or die, urea or their carcass is broken into simpler components by decomposers. This process reintroduces nitrogen into the soil but in the form of ammonia. The nitrates can be transformed into nitrogen with the help of denitrifying bacteria so that nitrogen can be released back to the atmosphere.

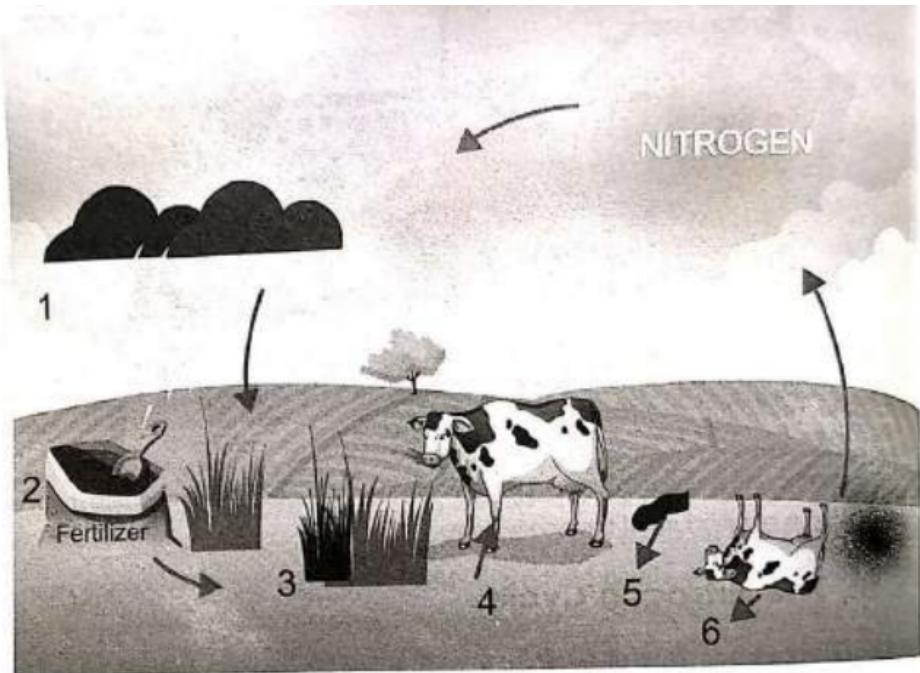
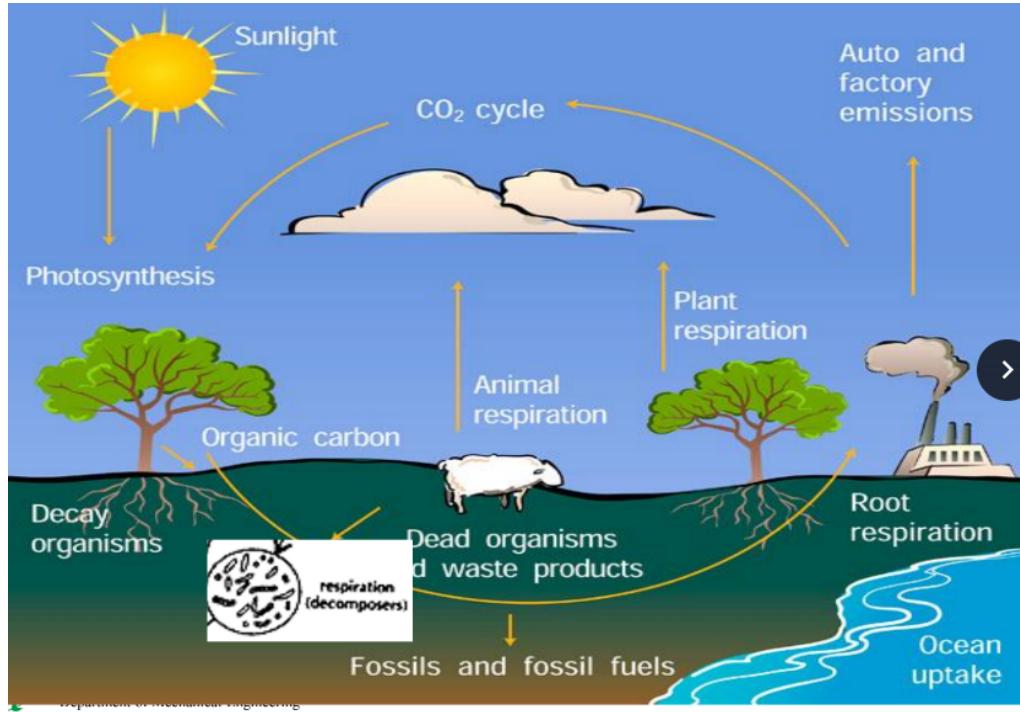


Figure 3.34: The Nitrogen Cycle

### c. Oxygen cycle

Carbon-Oxygen Cycle: involves the processes of

- a. Respiration
- b. Photosynthesis



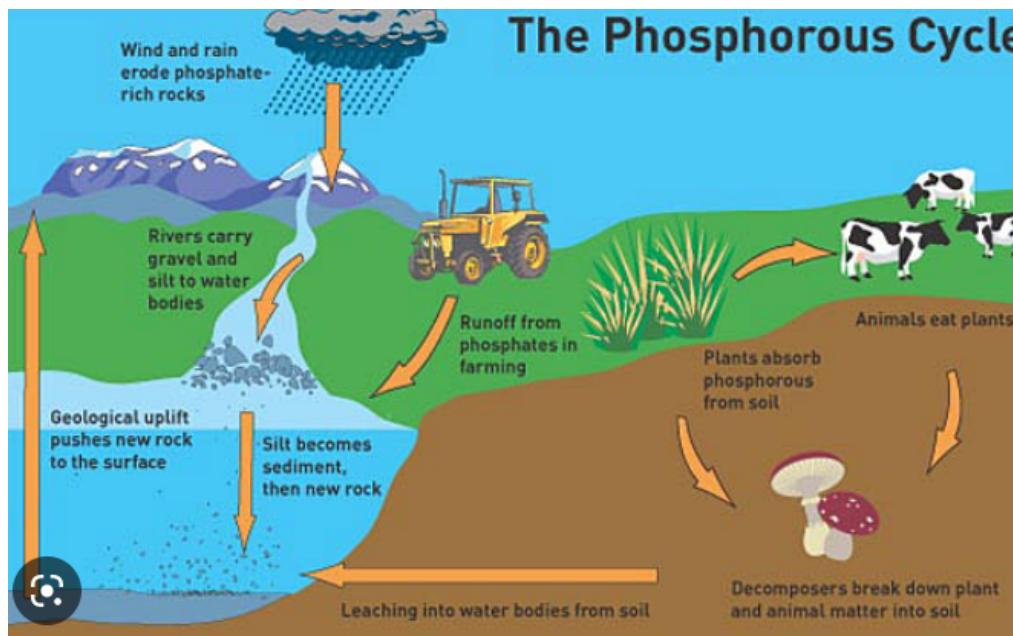
### d. Phosphorus cycle (not in ppt and book online content)

The phosphorus cycle begins with the weathering of rocks, which releases inorganic phosphate into the soil. Plants take up inorganic phosphate through their roots and use it to build organic molecules, such as nucleic acids and phospholipids. Animals obtain phosphorus by consuming plants or other animals that have consumed plants.

Phosphorus is returned to the soil and waterways through the excretion and decomposition of plant and animal matter. Some phosphorus can also be leached from the soil into waterways through erosion and runoff.

Phosphorus can become limiting in aquatic ecosystems, where excess phosphorus can lead to eutrophication, or the growth of algal blooms, which can lead to oxygen depletion and harm to other organisms in the ecosystem.

Human activities, such as the use of fertilizers and the discharge of sewage and industrial waste, can also impact the phosphorus cycle by altering the distribution of phosphorus in ecosystems and contributing to eutrophication.



### 13. Explain the following:

Ecological pyramids are a graphical presentation of relationships between numbers, biomass, and energy content of the primary producers, consumers of first and second orders, and so on to top carnivores in the ecosystem.

#### a. Pyramid of number

A pyramid of numbers indicates the number of individuals in each trophic level. Since the size of individuals may vary widely and may not indicate the productivity of that individual, pyramids of numbers say little or nothing about the amount of energy moving through the ecosystem.



# of carnivores  
# of herbivores  
# of producers

#### b. Pyramid of biomass

If the biomass produced by a trophic level is summed over a year (or the appropriate complete cycle period), then the pyramid of total biomass produced must resemble the pyramid of energy flow, since biomass can be equated to energy.

**Yearly biomass production  
(or energy flow) of:**



**carnivores**  
**herbivores**  
**producers**

c. **Pyramid of energy**

A pyramid of energy depicts the energy flow, or productivity, of each trophic level. Due to the Laws of Thermodynamics, each higher level must be smaller than lower levels, due to the loss of some energy as heat (via respiration) within each level.

**Energy flow in :**



**carnivores**  
**herbivores**  
**producers**

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**MODULE 4:** Scope of Environment Management, Role and Functions of Government as a Planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility (10 Hrs)

**Short Answer Questions:**

**1. Define Environment Management.**

## **1.2. Environmental Management**

Environmental management ensures the proper management of livelihood in different sectors of life. Environmental management consists of organizing different environmental initiatives to address various ecological issues that are affecting the globe. Environmental management deals with trying to prevent ecological disaster as well as aiding in environmental crises and trying to find appropriate solutions.

Environmental management is defined as a system that incorporates processes for summarizing, monitoring, reporting, developing, and executing environmental policies. The aim of encouraging an environmental management system is to ensure the healthy state of our planet for future generations. It also works towards preserving all forms of life.

In business, environmental management is defined as a corporate strategy that monitors, develops, and implements the environmental policies of an organization. It is a systematic approach that is gaining due prominence as consumers are looking for products and services that are eco-friendly and eco-aware.

**2. What is the scope of Environment Management?**

- To identify the environmental problem and to find its solution.
- To restrict & regulate the exploitation & utilization of natural resources.
- To regenerate degraded environment & to renew natural resources(renewable)
- To control environmental pollution & gradation.
- To reduce the impacts of extreme events & natural disasters.
- To make optimum utilization of natural resources.
- To assess the impacts of proposed projects & activities on the environment.
- Population increase and health services.
- Treatment of pollutants (air, water & solid) generated from various sources.
- Pollution level in air, water & soil.
- Development of non-polluting renewable energy sources like wind, solar, biomass, etc.
- Solid waste utilization through recycling.
- Biodiversity conservation
- Environmental awareness in society.

### **Long Answers Questions:**

- 3. What is meant by Environmental Quality Management? Explain**

## **4.4. Environmental Quality Management**

To live a healthy and happy life "quality environment" plays a prominent role. Various components of an environment, i.e. atmosphere, lithosphere, hydrosphere, and biosphere are interlinked with each other. The environmental quality can be affected by extreme changes in environmental components. The term "environmental quality" refers to the overall quality of the environment. It mainly covers four broad areas, namely public health and safety, shelter, efficiency and maximising people's comfort. In the public health and safety, the major concern is laid on the prevention of soil, air and water pollution along with the prevention of

diseases and minimisation of the rate of accidents. Shelter focuses on providing quality commercial, residential and industrial infrastructure. An efficiency stresses on maximising human movements and activities. The comfort of people can be increased by offering various intangible amenities such as aesthetic beauty and privacy to them.

It is necessary to identify and completely remove various pollutants that are creating environmental pollution. Environmental pollution is one of the growing concerns that have negatively affected our natural resources such as air, soil, and water, which is the foremost requirement for the existence of life on earth.

Let's discuss some of the common types of pollution that are faced globally.

#### **4. What is Corporate Environmental Responsibility? Explain it.**

### **Corporate Environmental Responsibility**

Corporate Environmental Responsibility concerns the environmental aspects of Corporate Social Responsibility (CSR).

It is commonly defined as is the way in which organizations can incorporate environmental issues into their operations in order to eliminate waste and emissions, maximize the efficiency and productivity of its resources and minimize practices that badly affect the country's natural resources.

It takes all its meaning in the current context (global warming, destruction of biodiversity, etc.) and becomes a pillar of development for some organizations that voluntarily engage.

Corporate Environmental Responsibility is about managing the use of natural resources in the most effective and efficient manner in order to reduce environmental impacts and financial costs.

#### **4.5. Corporate Environmental Responsibilities**

Corporate Environment Responsibilities (CER) is the subfield of corporate social responsibilities (CSR). CSR comprises activities, norms, and policy strategies that help to establish a relationship between an organisation and society. It focusses on an interaction that occurs between either internal and external business associates, or providers and employees, or both. Irrespective of the goods and services produced the major concern is laid on proper utilisation of natural resources and to maintain a balance between environment and business. On the other hand, CER is the commitment that is made by an organisation to preserve and nourish the environment by implementing policies, strategies and practices that majorly focus on environmental conservation and preservation along with the economic growth of an organisation in a sustainable manner. It mainly focuses on the following sustainable developmental goals, i.e. 3Ps which are planet, people and profit.

The Indian government has laid certain regulations for promoting CER and protecting environmental balance. AS per the companies Act, 2013, it has become mandatory by the Indian government that around 2% of the overall profit earned will be spent on CSR activities which are as follows:

- Promoting education
- Improving maternal health along with reducing the child mortality rate
- Eliminating poverty and hunger
- Focusing on environmental sustainability
- Promoting gender equality
- Promoting projects related to social businesses
- Contributing a certain amount to Prime Minister's National Relief Fund or any such related fund that is set up by the State or the Central government
- Proper handling of diseases such as AIDS and malaria
- Providing vocational skills to raise the level of employment

#### **CER: Areas of Focus**

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• Waste Management</li><li>• Travel and Transportation</li><li>• Sustainable Procurement</li><li>• Sustainable Events</li><li>• Environmental Management Systems</li><li>• Use of genetic material &amp; technology transfer.</li><li>• Use and handling of genetically modified organisms.</li></ul> | <ul style="list-style-type: none"><li>• Greenhouse gas emissions and global warming.</li><li>• Soil &amp; water contamination.</li><li>• Treatment and reduction of wastewater.</li><li>• Eco-efficiency.</li><li>• Recycling and reuse of materials</li><li>• Protection of forest resources.</li><li>• Energy Efficiency and Saving</li></ul> |
|---|---|

#### **5. Discuss the role and functions of the Government as a planning and regulatory agency.**

Government agencies have generally adopted three major functions. These are:

- Policy formulation
- Policy implementation
- Policy enforcement

##### **1. Policy formulation:**

This function involves

- research into environmental standards,
- setting environmental goals and
- integrating environmental protection into development, including regional development, and planning.

## **2. Policy implementation:**

This function involves

- direct responsibility for environmental monitoring, and
- execution of environmental rehabilitation or protection, including the use of environmental impact assessment (EIA).

## **3. Policy Enforcement:**

- This function has a watchdog or regulatory role for monitoring the breach of environmental regulations and then taking action to get the offender penalized.
- A high-level agency will be required to enforce these regulations amidst a tangle of other political priorities.
- In most countries, these central economic planning organizations and sector development agencies generally do not have environmental units of their own; nor do they consider the protection of the environment as part of their function
- In addition, the centralized environmental bodies, at the inception of development planning or natural resource management, consult these organizations only intermittently when decisions are made regarding the design of the projects.

So there is a lack of integration of economic and environmental policies.

## **6. Discuss the role of the Central Pollution Control Board (CPCB) in pollution monitoring.**

- Advise the Central Government on any matter concerning the prevention and control of water and air pollution and improvement of the quality of air.
- Plan and cause to be executed a nationwide program for the prevention, control, or abatement of water and air pollution;
- Coordinate the activities of the State Board and resolve disputes among them;
- Provide technical assistance and guidance to the State Boards, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control, or abatement;
- Plan and organize training of persons engaged in the program on the prevention, control, or abatement of water and air pollution;
- Organize through mass media, a comprehensive mass awareness program on the prevention, control, or abatement of water and air pollution;
- Collect, compile, and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control, or abatement;
- Prepare manuals, codes, and guidelines relating to the treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks, and ducts;
- Disseminate information in respect of matters relating to water and air pollution and their prevention and control;

- Lay down, modify, or annul, in consultation with the State Governments concerned, the standards for stream or well, and lay down standards for the quality of air; and
- Perform such other functions as may be prescribed by the Government of India.

## 7. Discuss the role of Regulatory Agencies and Pollution Control Boards in obtaining Environmental Clearance for a Project.

Regulatory agencies and pollution control boards play a crucial role in obtaining environmental clearance for a project. The environmental clearance process involves assessing the potential environmental impact of a proposed project and determining whether the project meets the necessary environmental standards and regulations.

The role of regulatory agencies and pollution control boards can be broken down into several key tasks, including:

**Reviewing project proposals:** Regulatory agencies and pollution control boards review project proposals to determine the potential environmental impact of the proposed project. This review includes an assessment of the potential impact on air, water, and soil quality, as well as on local flora and fauna.

**Conducting site visits:** In some cases, regulatory agencies and pollution control boards may conduct site visits to assess the potential environmental impact of a proposed project. During these visits, they may inspect the site, collect data, and assess the potential impact on the local environment.

**Consulting with experts:** Regulatory agencies and pollution control boards may consult with environmental experts, such as ecologists, hydrologists, and geologists, to assess the potential impact of a proposed project.

**Issuing environmental clearances:** Based on their review, regulatory agencies and pollution control boards issue environmental clearances to projects that meet the necessary environmental standards and regulations. These clearances may include conditions that the project must meet to ensure compliance with environmental regulations.

**Monitoring compliance:** Once a project has been granted environmental clearance, regulatory agencies, and pollution control boards may monitor the project to ensure that it is meeting the necessary environmental standards and regulations. This may include site visits, data collection, and other forms of monitoring.

Overall, the role of regulatory agencies and pollution control boards is critical in ensuring that proposed projects are environmentally responsible and comply with applicable regulations. By assessing the potential environmental impact of proposed projects, issuing environmental clearances, and monitoring compliance, these agencies play an important role in protecting the environment and promoting sustainable development.