SCIENCE

(Biology)

Chapter 13: Our Environment

Our Environment

Everything that surrounds us is environment. It includes both living (biotic) and non-living (abiotic) components.

Interaction between these biotic and abiotic components form an ecosystem.

In an ecosystem living components depend on each other for their food which give rise to food chains and food webs in nature.

Human activities lead to environmental problems such as depletion of ozone layer and production of huge amount of garbage.

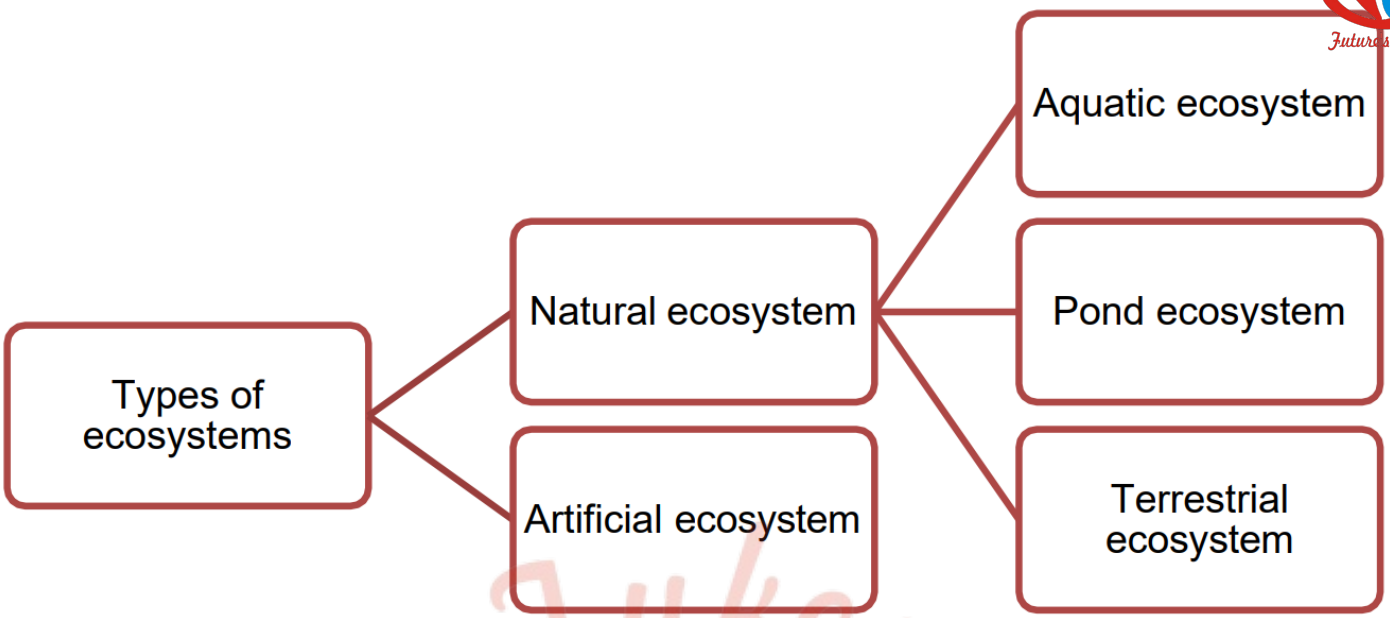
Biodegradable and Non-Biodegradable Wastes

BIODEGRADABLE WASTES	NON-BIODEGRADABLE WASTES
•They can be broken down into non-poisonous substances by the action of microorganisms. •They change their form and structure over time and become harmless. •They do not pollute the environment. •Examples: Spoilt food, vegetable peels, paper, leather etc.	•They cannot be broken down into harmless substances by any biological processes. •They remain unchanged over a long period of time. •They continue to pollute the environment. •Examples: Glass bottles, metal cans, polythene bags, synthetic fibres etc.

Ecosystem

An **ecosystem** is a self-contained area composed of different kinds of organisms which interact with each other as well as with the physical conditions such as sunlight, air, water, soil and climatic factors prevailing in the area.

Types of Ecosystem



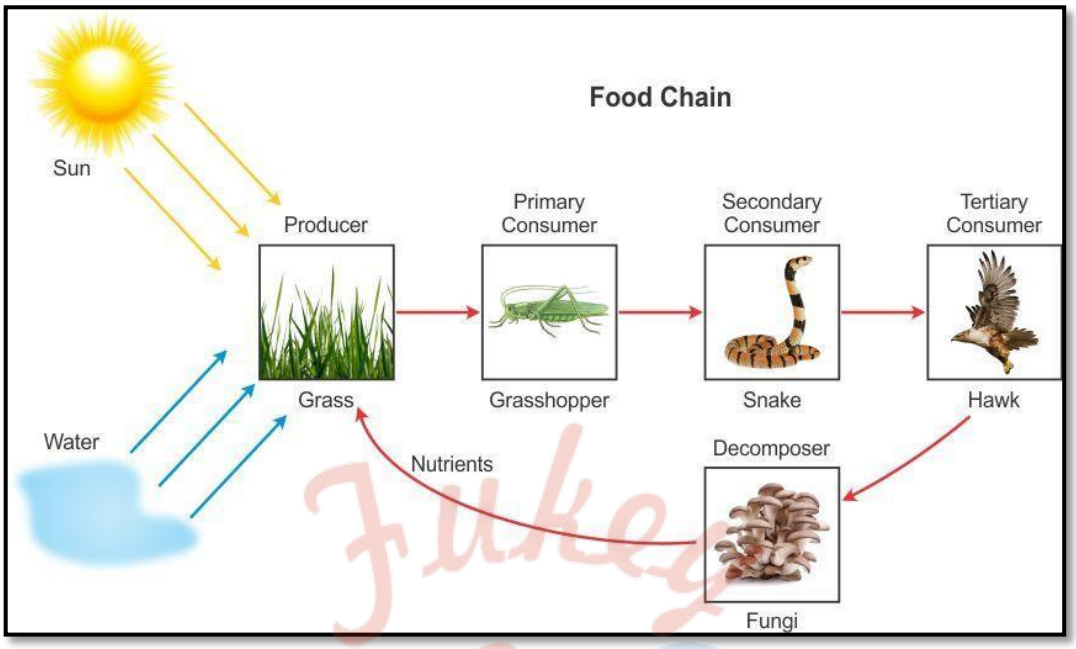
Components of an Ecosystem

An ecosystem consists of two main components: biotic components and abiotic components.

Biotic Components The biotic components are the living components of an ecosystem. They constitute the food-obtaining steps or trophic levels of the ecosystem.	
Trophic level I (Green plants/Autotrophs)	• They produce food through the process of photosynthesis. • These include trees, bushes and grasses.
Trophic level II (Herbivores/ Primary consumers)	• They directly eat plants or their products such as leaves, grains, etc. for food or suck plant sap from their leaves or stems. • These include animals such as deer, rabbits, rats, pigeons, parrots, grasshoppers, bees etc.
Trophic level III (Carnivores/ Secondary consumers)	• They capture their prey and eat it. • These include tigers, wolves, snakes, lizards, certain birds etc.
Trophic level IV (Large carnivores/ Tertiary consumers)	• They capture smaller carnivores and eat them. • These include peacock, eagle etc.
Parasites	• They live inside or on the body surface of another organism, called the host, and obtain their food or nourishment from the host. • Worms which live in the guts of animals and fleas which live on the skin of animals such as dogs are examples of parasites.
Decomposers/ Microconsumers/ Detritivores	• They breakdown the complex organic compounds present in these dead organisms into simpler substances. • These include certain bacteria and fungi, vultures, kites, crows, some insects etc.
Abiotic Components The abiotic components are the non-living components of an ecosystem.	
Sunlight	• The energy obtained from sunlight is essential for the production of food by photosynthesis.
Air	• Oxygen from the air is essential to animals for respiration. • Carbon dioxide is useful to plants for photosynthesis.
Water	• Water is the chief constituent of protoplasm in cells. • It is required for various biochemical reactions which occur in organisms.
Temperature	• Temperature affects the distribution of living organisms in the environment. • It affects the enzymatic activities in organisms.
Soil	• Soil provides the substratum for the growth of plants. • It contains water and mineral nutrients such as sodium and potassium required by plants.

Food Chain

- The sequential process of eating and being eaten is called a **food chain**.
- A food chain represents the unidirectional transfer of energy.



Food chain is a series of organisms in which one organism eats another organism as food.
For example: Grass → Deer → Lion

In a food chain various steps where transfer of energy takes place is called a trophic level.

Energy Flow in a Food Chain

- In a food chain, along with food, transfer of energy also occurs from one trophic level to the other. The flow of energy which occurs along a food chain is called **energy flow**.
- All the energy used by a living organism is obtained from the Sun. Solar energy enters the living components through the autotrophs or green plants. However, only 1% of the total energy is actually captured by green plants.
- The amount of energy gradually declines as one moves up to the next higher trophic level, because at each level, energy is lost in the form of heat.
- The loss of energy in food chains and the transfer of energy from one trophic level to the other can be explained by the **Ten Percent Law** which states that, 'Only 10% of the energy entering a particular trophic level of organisms is available for transfer to the next higher trophic level'.

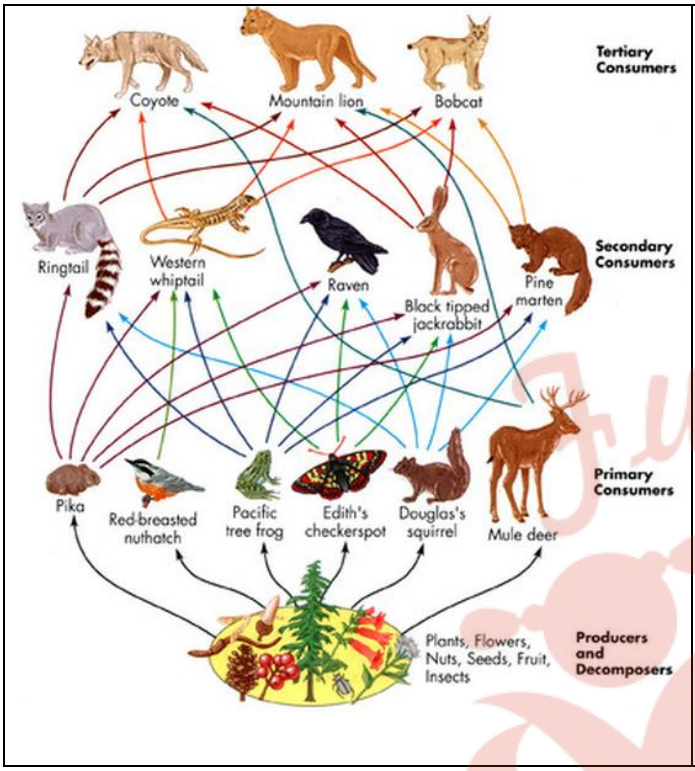
Significance of Food Chain

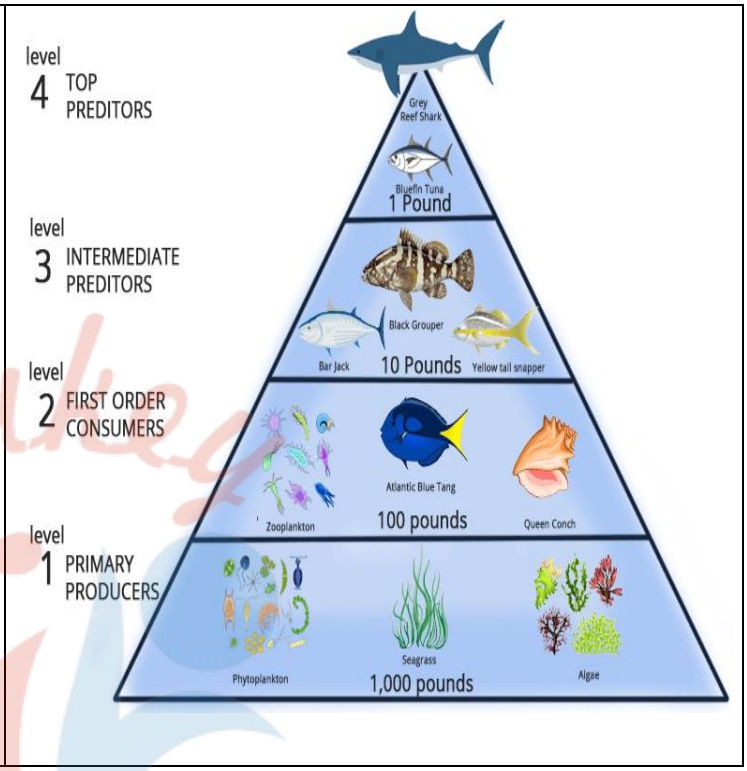
- Food chain maintains a check on the population and a balance in the ecosystem.
- Energy in the form of food is continuously transferred between different food chains. This helps to maintain the equilibrium in an ecosystem.
- Food chains help us to understand the interaction and the interdependence of different organisms in an area.

Food Web

A network of interconnecting food chains in a natural community of different organisms is called a

food web.





Significance of Food Web

- Food webs permit alternative foods.
- They ensure a better chance of survival for an organism if any of its food sources is scarce.

Food Pyramid

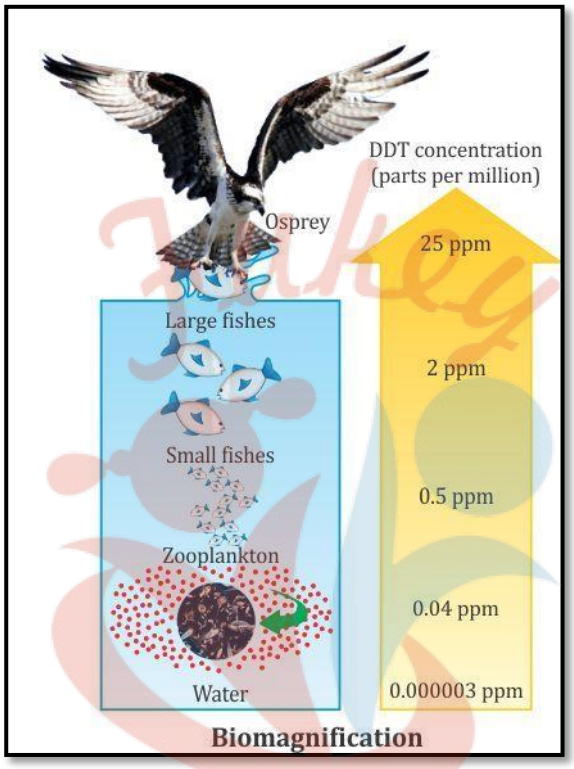
- A graphical representation of various trophic levels of a food chain in an ecosystem is called an ecological pyramid or a **food pyramid**.
- Ecological pyramids are of three types:
    - Pyramid of numbers
    - Pyramid of biomass
    - Pyramid of energy

Significance of Food Pyramid

- The trophic levels in a food chain can be explained by a food pyramid.
- The ecological pyramids help us to understand the structure, functional diversity and energy conversion efficiency of ecosystems.

Biomagnification

- **Biomagnification** or food chain magnification is the phenomenon of increase in the concentration of toxic substances in the bodies of living organisms at each trophic level of a food chain.
- Dichlorodiphenyltrichloroethane (DDT), an organochlorine pesticide, cannot be removed by washing or by other means and tends to accumulate in the environment causing biomagnification.



Environmental Problems

Depletion of the Ozone Layer

About the Ozone Layer
• Ozone is a product of ultraviolet radiations acting on the oxygen molecule and splitting it into free oxygen atoms. These atoms combine with molecular oxygen to form ozone. • The ozone layer extends to about 16–50 km above the Earth's surface.
Reasons for Ozone Depletion
• The drop in ozone levels is due to certain synthetic chemicals such as chlorofluorocarbons (CFCs), which are used as refrigerants and in air conditioners and fire extinguishers.
Effects of Ozone Depletion
• In the absence of the ozone layer, the ultraviolet rays reach the Earth's surface. They are highly harmful to organisms and can even cause skin cancer and other diseases in human beings.
Control Measures for Ozone Depletion
• As per the agreement, The United Nations decided to freeze the production of CFCs at levels which existed in 1986.

Disposal of Wastes

Disposal of waste means to get rid of waste.

Recycling
• Solid wastes such as paper, plastic and metals can be sent to paper mills, plastic processing factories and metal industries respectively. • They can be recycled and used again.
Composting
• Household garbage such as fruit and vegetable peels, egg shells, waste food, tea leaves as well as farmland wastes such as dried leaves, husk and parts of crop plants from fields after harvesting can all be converted into useful compost by rotting. • The use of compost improves the fertility of soil as it provides nutrients to the soil.
Incineration
• Hazardous bio-medical wastes such as discarded medicines, toxic drugs, human anatomical wastes, blood and pus, microbiological and biotechnological wastes are usually disposed of by incineration by burning at very high temperatures. • Electricity can be generated from the heat released during burning.
Landfills
• Large-scale disposal of solid waste can be done by putting it in low areas of the ground and then covering it with Earth.
Sewage Treatment
• Waste water or sewage from houses, offices and hospitals enters a channel of pipelines which finally reach the wastewater treatment plant. • Physical, biological and chemical processes are carried out for the treatment of sewage.

Role of an Individual in Management of Wastes

In order to save our environment and maintain ecological balance in nature, the **3R approach** should be implemented while using resources. The 3R's imply reduce, reuse and recycle.

Reduce

- We have to reduce the excess use of resources, when not required, in order to avoid their wastage.

Reuse

- We have to use the same resources again and again so that the demand for new resources is reduced and it will also conserve the resources.

Recycle

- We have to recycle the used resources rather than throwing them away.

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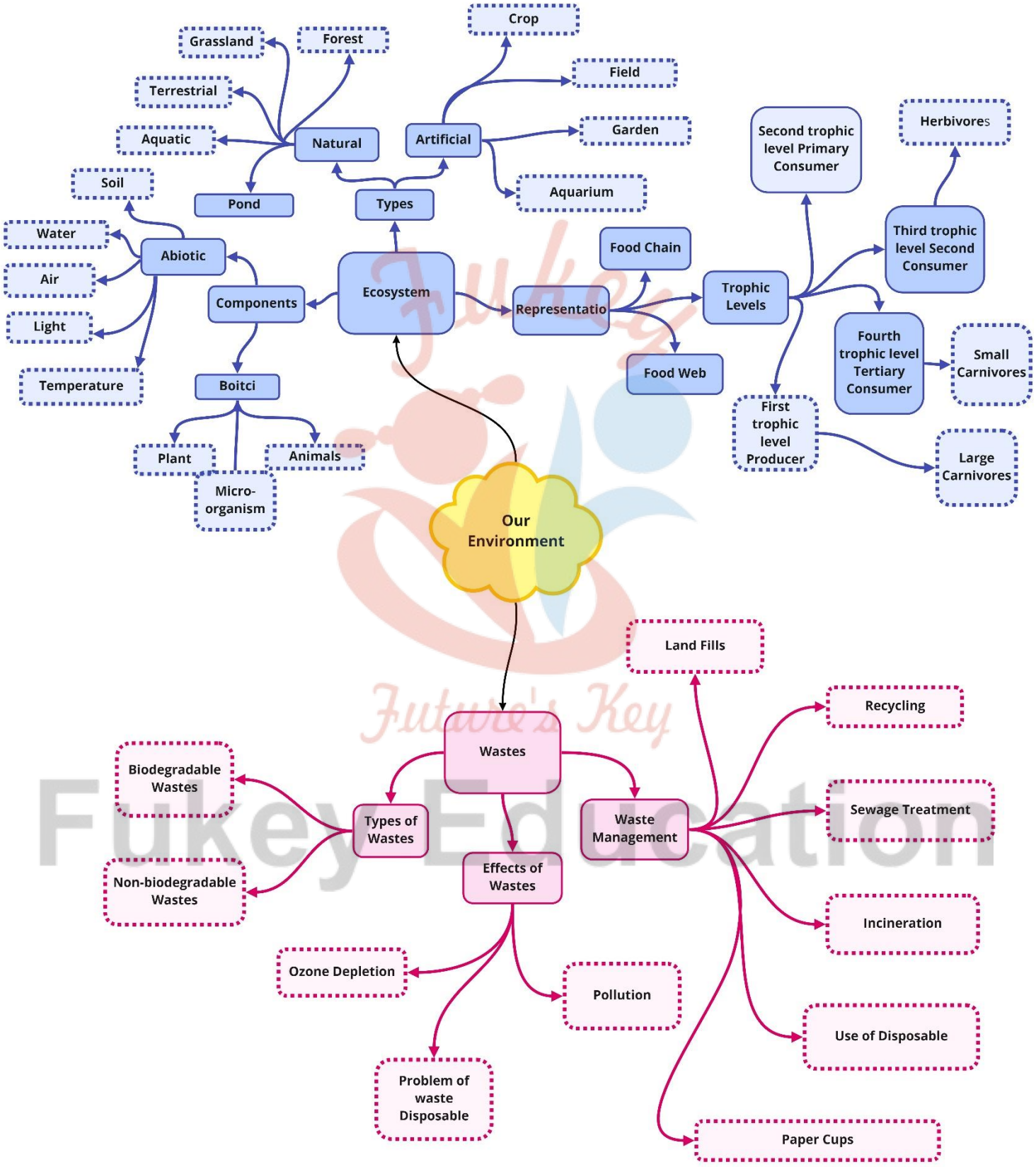


Important Questions

➢ Multiple Choice Questions:

1. The percentage of solar radiation absorbed by all the green plants for the process of photosynthesis is about-

(a) 1%

(b) 8%

(c) 5%

(d) 10%

2. The second trophic level is always of-

(a) herbivores

(b) autotrophs

(c) carnivores

(c) producers

3. The decomposers in an ecosystem-

(a) convert organic material to inorganic forms

(b) convert inorganic material to simpler forms

(c) convert inorganic material into organic compound

(d) do not break down organic compound

4. Which of the following is an abiotic component of an ecosystem?

(a) Humus

(b) Bacteria

(c) Plants

(d) Fungi

5. What will happen if all the deer are killed in the given food chain?

Grass → Deer → Lion

(a) The population of grass decreases.

(b) The population of lions increases.

(c) The population of lions remains unchanged.

(d) The population of lions decreases and grass increases.

6. Which of the following is not a terrestrial ecosystem-

(a) forest

(b) desert

(c) aquarium

(d) grassland

7. In the garden ecosystem, which of the following are producers?

(a) Insects

(b) Snakes

(c) Grasses

(d) Rabbits

8. Which of the following is biodegradable?

(a) Plastic mugs

(b) Leather belts

(c) Silver foil

(d) Iron nails

9. Which of the following is an autotroph?

(a) Lion

(b) Insect

(c) Tree

(d) Mushroom

10. Which of the following is a logical sequence of food chain

(a) producer → consumer → decomposer

(b) producer → decomposer → consumer

(c) consumer → producer → decomposer

(d) decomposer → producer → consumer

➢ Very Short Question:

1. What is environment?

2. Why is ozone layer getting depleted at higher levels of the atmosphere?

3. Name any two abiotic components of an environment.

4. What are two main components of our environment?

5. Which compounds are responsible for the depletion of ozone layer?

6. Why are green plants called producers?

7. The flow of energy in the food chain is unidirectional. Why?

8. Use of paper is more environment friendly than the use of polythene for packaging. Justify.

9. In a food chain comprising frogs, insects, birds and grass, which one of the organisms is likely to have maximum concentration of harmful non-biodegradable chemicals in the body.

10. State one advantage of using disposable paper cups over disposable plastic cups.

➢ Short Questions:

1. Construct an aquatic chain showing four trophic levels.

2. Explain "biological magnification" with the help of an example.

3. A high concentration of harmful chemical is highly injurious, even fatal to higher trophic level organisms. Mention the basis of classifying substances as biodegradable and non-biodegradable. Give two examples of each.

4. What is ozone? How does it protect the organisms on the earth?

5. Observe the food chain:

Plant (1000 kj) → Goat → Lion

(a) If autotrophs occupying the first trophic level are called producers, what are herbivores called as?

(b) How much energy does the lion get in the above food chain?

6. "The maximum concentration of harmful chemicals accumulates in human beings?" State the phenomenon involved and justify this statement.

7. In the food chain Grass → Deer → Lion operating in a forest, what will happen if all the

(a) Lions are removed

(b) Deer are removed.

8. Define

(a) Biomass

(b) Anaerobic degradation.

➢ Long Questions:

1.

(a) What is ozone? How is it formed in the atmosphere? Explain with equation.

(b) How is ozone layer useful?

(c) Name the substances responsible for the depletion of ozone layer.

2.

(a) What are trophic levels in a food chain?

(b) Explain the flow of energy through food chain.

(c) Write a four trophic level food chain and represented in the form of an ecological pyramid.

➢ Assertion Reason Questions:

1. For two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

   a. Both A and R are true, and R is correct explanation of the assertion.

   b. Both A and R are true, but R is not the correct explanation of the assertion.

   c. A is true, but R is false.

   d. A is false, but R is true.

Assertion: Hospital wastes like used syringes, urine bags, etc. can be incinerated.

Reason: Incineration burns the waste at very high temperature and converts it to ashes.

2. For two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

   a. Both A and R are true, and R is correct explanation of the assertion.

   b. Both A and R are true, but R is not the correct explanation of the assertion.

   c. A is true, but R is false.

   d. A is false, but R is true.

Assertion: Food waste can be converted to compost by burying in a pit dug into ground and used as manure.

Reason: Non-biodegradable wastes like fruit and vegetable peels, tea leaves, broken glass jar are ideal for composting.

➢ Case Study Questions:

1. Read the following and answer any four questions from: (i) to (v).

   In any given ecosystem, all living organisms are linked in a systematic chain with respect to their mode of manufacturing food/ feeding habits. This sequential interlinking of organisms involving transfer of food energy from producers through a series of organisms with repeated eating and being eaten is called the food chain. A food chain may have 3-4 trophic levels.

   i. Which of the following statements regarding food chain is incorrect?

      a. It is a single straight pathway through which food energy travels in the ecosystem.

      b. It adds adaptability and competitiveness to the organisms.

      c. Presence of isolated food chains adds to instability of the ecosystem.

      d. Food chain binds up inorganic nutrients of the ecosystem.

   ii. Consider the following food chain.

   Grass → A → Frog → Snake → Eagle.

   Which of the following can be placed at A?

a. Grasshopper.
b. Rabbit.
c. Phytoplankton.
d. Rat.

iii. Select the correct food chain.

a. Aquatic plants → Tadpole → Water beetle → Pike → Perch.
b. Grass → Grasshopper → Snake → Frog → Eagle.
c. Grass → Rabbit → Wild cat → Tiger.
d. Zooplankton → Phytoplankton → Small fish → Fish.

iv. Food chains are sustained by producers and _____.

a. Herbivores.
b. Carnivores.
c. Omnivores.
d. Decomposers.

v. Select the incorrect statement.

a. Food chain may terminate at level of herbivore.
b. Food chain is always straight.
c. Food chain may have 3-5 trophic levels.
d. in a food chain, 80 to 90% of potential energy is lost as heat, at each transfer.

2. Read the following and answer any four questions from: (i) to (v).

An ecosystem may be defined as a structural and functional unit of the biosphere comprising living organisms and their non-living environment which interact by means of food chains and biogeochemical cycles resulting in energy-flow, biotic diversity and material cycling to form a stable, self-supporting system.

i. The two basic processes involved in an ecosystem are:

a. Cycling of materials and food chains.
b. Energy flow and self-sustainability.
c. Carbon cycle and biotic diversity.
d. Cycling of materials and flow of energy.

ii. Which among the following is not an artificial ecosystem?

a. Orchard.
b. Lake.
c. Aquarium.

d. Cropland.

iii. The role of fungi and bacteria in an ecosystem is to:

a. Increase the supply of nutrients.

b. Increase the supply of energy.

c. Release nutrients from dead organic matter.

d. Increase the amount of CO_2 in the atmosphere.

iv. What would one of the likely results if all decomposers in a particular ecosystem were wiped out?

a. The atmospheric reservoir of carbon dioxide would decline.

b. More food would be available for other consumers in the ecosystem.

c. The other organisms in the ecosystem would experience lower death rates.

d. There would be no significant impact, as dead organic matters would spontaneously decompose.

v. Which of the following holds true for an ecosystem?

a. Primary consumers are least dependent upon producers.

b. Primary consumers most of the time-out number producers.

c. Organic substances such as carbon, nitrogen and oxygen constitute the main abiotic components.

d. Permanent ecosystems are self-supporting natural ecosystems that maintain themselves for relatively long duration.

✓ Answer Key-

➢ Multiple Choice Answers:

1. (a) 1%
2. (a) herbivores
3. (a) convert organic material to inorganic forms
4. (a) Humus
5. (d) The population of lions decreases and grass increases.
6. (c) aquarium
7. (c) Grasses
8. (b) Leather belts
9. (c) Tree
10. (a) producer → consumer → decomposer

➢ Very Short Answers:

1. Answer: It is sum total of all external factors, substances, conditions and living beings that surround the organisms and influence the same without becoming their part.
2. Answer: Presence of ozone depleting chemicals like chlorofluorocarbons.
3. Answer:

   (a) Climatic factors (light, temperature, rainfall).

   (b) Edaphic factors (soil and its conditions).
4. Answer:

   (a) Biotic Components, e.g., producers, herbivores, carnivores, decomposers.

   (b) Abiotic Components e.g., climatic factors, edaphic factors, topographic factors, inorganic nutrients and organic substances.
5. Answer: Ozone depleting substances like chlorofluorocarbons, halons, methane, N2O, Chlorine, Carbon tetrachloride.
6. Answer: Green plants are also called producers because only they can synthesize organic food from inorganic raw materials with the help of solar energy in the process of photosynthesis. This food is not only used by green plants but also all other organisms called consumers.
7. Answer: There is dissipation of energy at every step of its transfer and transformation so that energy cannot flow back in the reverse direction. It flows from sun to plants, plants to animals, animals to animals, organic remains to decomposers and dissipation as heat at every stage.
8. Answer: Paper bags are biodegradable while polythene is nonbiodegradable.
9. Answer: Birds, as they form the topmost trophic level where the non-biodegradable chemicals will have maximum biomagnification.
10. Answer: Disposable paper cups are biodegradable while disposable plastic cups are non-biodegradable.

➢ Short Answer:

1. Answer: Phytoplankton → Zooplankton → Small Carnivorous Fish
2. Answer: Biological magnification is increase in the concentration of a chemical per unit weight of the organisms with the successive rise in trophic level. In one study it was found that concentration of harmful chemical like DDT will increase 80,000 times the concentration present in water.

Water	⟶ Plankton	⟶ Fish	⟶ Fish Eating Birds
0·002 ppm	0·05 ppm	2·4 ppm	16·0 ppm

3. Answer: Substances are classified into biodegradable and non-biodegradable on the basis of their disposability or nondisposability by saprophytic organisms.

   Biodegradable. Used tea leaves, waste paper.

Non-biodegradable. DDT, silver/ aluminium foil.

4. Answer: Ozone is triatomic form of oxygen, O3. It forms a protective ozone layer in the stratosphere. Ozone layer absorbs the very harmful component of ultraviolet radiations (100 – 320 nm) and thus protect the organisms on the earth.
5. Answer:

   (a) Primary consumers

   (b) 10 kj (10% law, 1000 → 100 → 10).
6. Answer: Human beings are omnivorous and lie at the tip of almost every food chain. They are also long lived. Harmful chemicals reach in higher concentration through biomagnification and continue to accumulate in their bodies. Therefore, non-biodegradable chemicals occur in maximum concentration in human beings.
7. Answer:

   (a) Removal of Lions. It will cause spurt in population of deer so much so that whole of grass can disappear resulting in conversion of the area into desert and death of the deer as well.

   (b) Removal of Deer Lions will die of starvation.
8. Answer:

   (a) Biomass. It is the amount of living matter, measured as fresh or dry weight.

   (b) Anaerobic Degradation. There is slowing down of rate of decomposition of organic remains which will pile up. Offensive odors may occur due to putrefaction of proteins while fermentation of carbohydrates gives rise to alcohols and organic acids that may kill the microbes. It is, however, useful in production of biogas.

➢ Long Answer:

1. Answer:

   (a) Ozone is triatomic form of oxygen, O_3. Ozone is formed in the upper atmosphere by the action of ultraviolet (UV) radiations over oxygen (O_2)

$$O_2 \xrightarrow{UV} [O] + [O]$$
$$O_2 + [O] \longrightarrow O_3$$

   (b) The important ozone depleting substances or ODS are chlorofluorocarbons (CFC), methane, N_2O, chlorine, halons and carbon tetrachloride.
2. Answer:

   (a) Trophic Levels. They are steps or divisions of food chain which are characterised by particular methods of obtaining food, e.g., producers (T_1), herbivores (T_2), primary carnivores (T_3), etc.

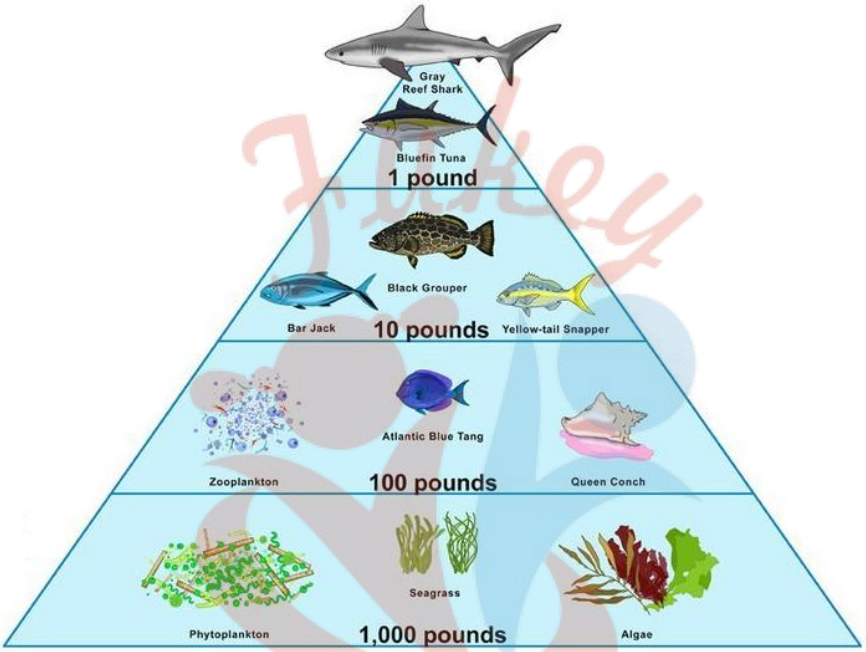
   (b) Flow of Energy Through Food Chain. Energy enters a food chain through producers. Producers or green plants trap solar energy and convert it into chemical energy of food during photosynthesis. From producers energy passes into

herbivores. A lot of energy dissipates during transfer and utilization of food energy by herbivores (10% law). From herbivores the food energy passes into primary carnivores, again with a lot of dissipation. Only about 10% of herbivore energy is passed into body mass of primary carnivores. From primary carnivores, nearly 10% energy passes into secondary carnivores and so on. It is ultimately lost as heat.

Sun		Producers		Herbivores		Primary carnivores		Secondary carnivores
1,00,000 Cal	1% →	1,000 Cal	10% →	100 Cal	10% →	10 Cal	10% →	1 Cal

(c) Aquatic Four Trophic Level Food Chain.

Phytoplankton → Zooplankton → Small Carnivorous Fish → barge Carnivorous Fish.



➢ Assertion Reason Answer:

1. (a) Both A and R are true, and R is correct explanation of the assertion.

Explanation:

Hospital waste contains a lot of germs, so it should not be disposed openly. Burning the waste kills the germs and disposes the waste in proper way.

2. (c) A is true, but R is false.

Explanation:

Biodegradable domestic waste such as leftover food, fruit, and vegetables peels, leaves of potted plants can be converted into compost.

➢ Case Study Answer:

1. i (b) It adds adaptability and competitiveness to the organisms.

Explanation:

Since a food chain is a sequential flow of food energy, it does not add to the adaptability and competitiveness of the organism.

ii. (a) Grasshopper.

Explanation:

In the given food chain, A is a primary consumer that feeds on grass and being eaten by frog. Therefore, among the given organisms, A should be grasshopper.

iii. (c) Grass → Rabbit → Wild cat → Tiger.

iv. (d) Decomposers.

v. (a) Food chain may terminate at level of herbivore.

Explanation:

In a food chain, there is repeated eating in which each group eats the smaller one and is eaten by the larger one.

2. i (d) Cycling of materials and flow of energy.

ii. (b) Lake.

Explanation:

Artificial ecosystems are maintained by man and hence are also termed as man-made, or man engineered ecosystems. In these ecosystems, man maintains/ disturbs the natural balance by the addition of energy and planned manipulations. Common examples of artificial ecosystems are croplands, orchards, gardens, aquarium, etc.

iii. (c) Release nutrients from dead organic matter.

Explanation:

Fungi and bacteria are decomposers which serve to convert carbon locked up in dead organic matter into carbon dioxide, which can then be utilized by plants during photosynthesis. A, B and O are incorrect since decomposers do not increase the amount of nutrients, energy, and carbon dioxide in the ecosystem. They merely allow cycling of nutrients, including carbon, to occur.

iv. (a) The atmospheric reservoir of carbon dioxide would decline.

v. (d) Permanent ecosystems are self-supporting natural ecosystems that maintain themselves for relatively long duration.

Explanation:

Primary or first-order consumers include the animals which eat plants or plant products. They are called herbivores. As the herbivores feed on plants/ plant products and convert them into animal matter, they are often called key industry animals. Inorganic substances, e.g., carbon, nitrogen, oxygen, calcium, phosphorus, etc. and their compounds (water, carbon dioxide, etc.) constitute the main abiotic components. These occur either in the form of compounds dissolved in water, in the soil or in free state in the air.