

**Question 1:**

Fill in the blanks.

- (a) Plants are called as \_\_\_\_\_ because they fix carbon dioxide.
- (b) In an ecosystem dominated by trees, the pyramid (of numbers) is \_\_\_\_\_ type.
- (c) In aquatic ecosystems, the limiting factor for the productivity is \_\_\_\_\_.
- (d) Common detritivores in our ecosystem are \_\_\_\_\_.
- (e) The major reservoir of carbon on earth is \_\_\_\_\_.

Answer

- (a) Plants are called as autotrophs because they fix carbon dioxide.
- (b) In an ecosystem dominated by trees, the pyramid (of numbers) is of inverted type.
- (c) In aquatic ecosystems, the limiting factor for productivity is light.
- (d) Common detritivores in our ecosystem are earthworms.
- (e) A major reservoir of carbon on Earth is oceans.

**Question 2:**

Which one of the following has the largest population in a food chain?

- (a) Producers
- (b) Primary consumers
- (c) Secondary consumers
- (d) Decomposers

Answer

**(d) Decomposers**

Decomposers include micro-organisms such as bacteria and fungi. They form the largest population in a food chain and obtain nutrients by breaking down the remains of dead plants and animals.

**Question 3:**

The second trophic level in a lake is-

- (a) Phytoplankton



**(b)** Zooplankton

**(c)** Benthos

**(d)** Fishes

Answer

**(b)** Zooplankton

Zooplankton are primary consumers in aquatic food chains that feed upon phytoplankton. Therefore, they are present at the second trophic level in a lake.

**Question 4:**

Secondary producers are

**(a)** Herbivores

**(b)** Producers

**(c)** Carnivores

**(d)** None of the above

Answer

**(d)** None of the above

Plants are the only producers. Thus, they are called primary producers. There are no other producers in a food chain.

**Question 5:**

What is the percentage of photosynthetically active radiation (PAR), in the incident solar radiation.

**(a)** 100%

**(b)** 50 %

**(c)** 1-5%

**(d)** 2-10%

Answer

**(b)** 50%

Out of total incident solar radiation, about fifty percent of it forms photosynthetically active radiation or PAR.

**Question 6:**

Distinguish between



- (a) Grazing food chain and detritus food chain
- (b) Production and decomposition
- (c) Upright and inverted pyramid
- (d) Food chain and Food web
- (e) Litter and detritus
- (f) Primary and secondary productivity

Answer

- (a) Grazing food chain and detritus food chain

	Grazing food chain		Detritus food chain
1.	In this food chain, energy is derived from the Sun.	1.	In this food chain, energy comes from organic matter (or detritus) generated in trophic levels of the grazing food chain.
2.	It begins with producers, present at the first trophic level. The plant biomass is then eaten by herbivores, which in turn are consumed by a variety of carnivores.	2.	It begins with detritus such as dead bodies of animals or fallen leaves, which are then eaten by decomposers or detritivores. These detritivores are in turn consumed by their predators.
3.	This food chain is usually large.	3.	It is usually smaller as compared to the grazing food chain.

- (b) Production and decomposition

	Production		Decomposition
1.	It is the rate of producing organic matter (food) by producers.	2.	It is the process of breaking down of complex organic matter or biomass from the body of dead plants and animals with the help of decomposers into organic raw material such as CO <sub>2</sub> , H <sub>2</sub> O, and other nutrients.



<b>2.</b>	It depends on the photosynthetic capacity of the producers.	<b>2.</b>	It occurs with the help of decomposers.
<b>3</b>	Sunlight is required by plants for primary production.	<b>3.</b>	Sunlight is not required for decomposition by decomposers

**(c) Upright and inverted pyramid**

	<b>Upright pyramid</b>		<b>Inverted pyramid</b>
<b>1.</b>	The pyramid of energy is always upright.	<b>1.</b>	The pyramid of biomass and the pyramid of numbers can be inverted.
<b>2.</b>	In the upright pyramid, the number and biomass of organisms in the producer level of an ecosystem is the highest, which keeps on decreasing at each trophic level in a food chain.	<b>2.</b>	In an inverted pyramid, the number and biomass of organisms in the producer level of an ecosystem is the lowest, which keeps on increasing at each trophic level.

**(d) Food chain and Food web**

	<b>Food chain</b>		<b>Food web</b>
<b>1.</b>	It is a single linear sequence of organisms.	<b>1.</b>	It contains a number of interconnected food chains.
<b>2.</b>	Members present at higher trophic levels feed on single types of organisms.	<b>2.</b>	One organism has alternate food sources.

**(e) Litter and detritus**



	<b>Litter</b>		<b>Detritus</b>
<b>1.</b>	Litter contains all kinds of wastes generated above the ground.	<b>1.</b>	Detritus is composed of the remains of dead plants and animals.
<b>2.</b>	Litter contains both biodegradable and non-biodegradable matter.	<b>2.</b>	Detritus contains only biodegradable matter.

**(f) Primary and secondary productivity**

	<b>Primary productivity</b>		<b>Secondary productivity</b>
<b>1.</b>	It is defined as the amount of organic matter produced by producers per unit area over a period of time.	<b>1.</b>	It is defined as the rate of production of organic matter by consumers over a period of time.

**Question 7:**

Describe the components of an ecosystem.

Answer

An ecosystem is defined as an interacting unit that includes both the biological community as well as the non-living components of an area. The living and the non-living components of an ecosystem interact amongst themselves and function as a unit, which gets evident during the processes of nutrient cycling, energy flow, decomposition, and productivity. There are many ecosystems such as ponds, forests, grasslands, etc.

The two components of an ecosystem are:

**(a) Biotic component:** It is the living component of an ecosystem that includes biotic factors such as producers, consumers, decomposers, etc. Producers include plants and algae. They contain chlorophyll pigment, which helps them carry out the process of photosynthesis in the presence of light. Thus, they are also called converters or transducers. Consumers or heterotrophs are organisms that are directly (primary consumers) or indirectly (secondary and tertiary consumers) dependent on producers for their food.



Decomposers include micro-organisms such as bacteria and fungi. They form the largest population in a food chain and obtain nutrients by breaking down the remains of dead plants and animals.

**(b) Abiotic component:** They are the non-living component of an ecosystem such as light, temperature, water, soil, air, inorganic nutrients, etc.

**Question 8:**

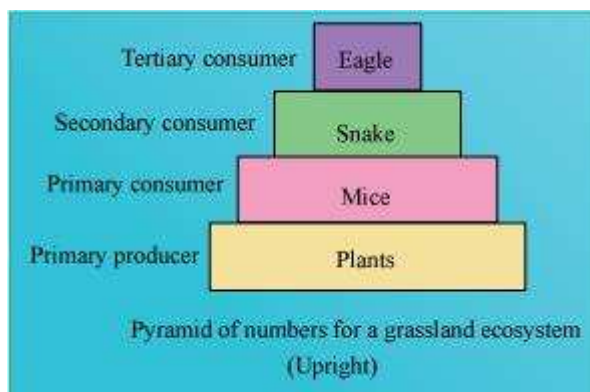
Define ecological pyramids and describe with examples, pyramids of number and biomass.

Answer

An ecological pyramid is a graphical representation of various ecological parameters such as the number of individuals present at each trophic level, the amount of energy, or the biomass present at each trophic level. Ecological pyramids represent producers at the base, while the apex represents the top level consumers present in the ecosystem. There are three types of pyramids:

- (a)** Pyramid of numbers
- (b)** Pyramid of energy
- (c)** Pyramid of biomass

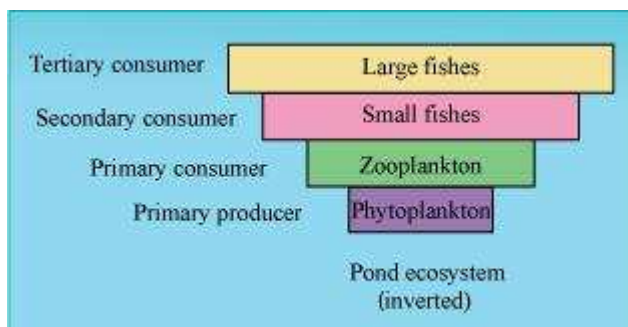
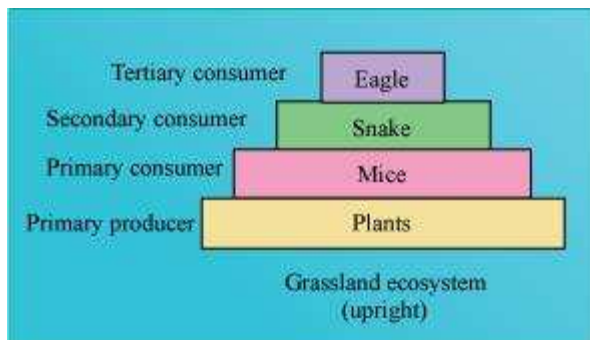
**Pyramid of numbers:** It is a graphical representation of the number of individuals present at each trophic level in a food chain of an ecosystem. The pyramid of numbers can be upright or inverted depending on the number of producers. For example, in a grassland ecosystem, the pyramid of numbers is upright. In this type of a food chain, the number of producers (plants) is followed by the number of herbivores (mice), which in turn is followed by the number of secondary consumers (snakes) and tertiary carnivores (eagles). Hence, the number of individuals at the producer level will be the maximum, while the number of individuals present at top carnivores will be least.



On the other hand, in a parasitic food chain, the pyramid of numbers is inverted. In this type of a food chain, a single tree (producer) provides food to several fruit eating birds, which in turn support several insect species.

### Pyramid of biomass

A pyramid of biomass is a graphical representation of the total amount of living matter present at each trophic level of an ecosystem. It can be upright or inverted. It is upright in grasslands and forest ecosystems as the amount of biomass present at the producer level is higher than at the top carnivore level. The pyramid of biomass is inverted in a pond ecosystem as the biomass of fishes far exceeds the biomass of zooplankton (upon which they feed).



**Question 9:**

What is primary productivity? Give brief description of factors that affect primary productivity.

Answer

It is defined as the amount of organic matter or biomass produced by producers per unit area over a period of time.

Primary productivity of an ecosystem depends on the variety of environmental factors such as light, temperature, water, precipitation, etc. It also depends on the availability of nutrients and the availability of plants to carry out photosynthesis.

**Question 10:**

Define decomposition and describe the processes and products of decomposition.

Answer

Decomposition is the process that involves the breakdown of complex organic matter or biomass from the body of dead plants and animals with the help of decomposers into inorganic raw materials such as carbon dioxide, water, and other nutrients. The various processes involved in decomposition are as follows:

**(1) Fragmentation:** It is the first step in the process of decomposition. It involves the breakdown of detritus into smaller pieces by the action of detritivores such as earthworms.

**(2) Leaching:** It is a process where the water soluble nutrients go down into the soil layers and get locked as unavailable salts.

**(3) Catabolism:** It is a process in which bacteria and fungi degrade detritus through various enzymes into smaller pieces.

**(4) Humification:** The next step is humification which leads to the formation of a dark-coloured colloidal substance called humus, which acts as reservoir of nutrients for plants.

**(5) Mineralization:** The humus is further degraded by the action of microbes, which finally leads to the release of inorganic nutrients into the soil. This process of releasing inorganic nutrients from the humus is known as mineralization.

Decomposition produces a dark coloured, nutrient-rich substance called humus. Humus finally degrades and releases inorganic raw materials such as CO<sub>2</sub>, water, and other nutrient in the soil.

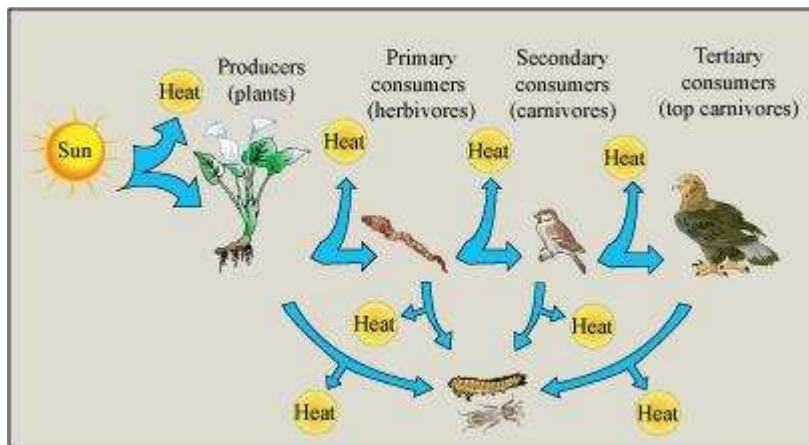


**Question 11:**

Give an account of energy flow in an ecosystem.

Answer

Energy enters an ecosystem from the Sun. Solar radiations pass through the atmosphere and are absorbed by the Earth's surface. These radiations help plants in carrying out the process of photosynthesis. Also, they help maintain the Earth's temperature for the survival of living organisms. Some solar radiations are reflected by the Earth's surface. Only 2-10 percent of solar energy is captured by green plants (producers) during photosynthesis to be converted into food. The rate at which the biomass is produced by plants during photosynthesis is termed as 'gross primary productivity'. When these green plants are consumed by herbivores, only 10% of the stored energy from producers is transferred to herbivores. The remaining 90 % of this energy is used by plants for various processes such as respiration, growth, and reproduction. Similarly, only 10% of the energy of herbivores is transferred to carnivores. This is known as ten percent law of energy flow.

**Question 12:**

Write important features of a sedimentary cycle in an ecosystem.

Answer

Sedimentary cycles have their reservoirs in the Earth's crust or rocks. Nutrient elements are found in the sediments of the Earth. Elements such as sulphur, phosphorus, potassium, and calcium have sedimentary cycles.



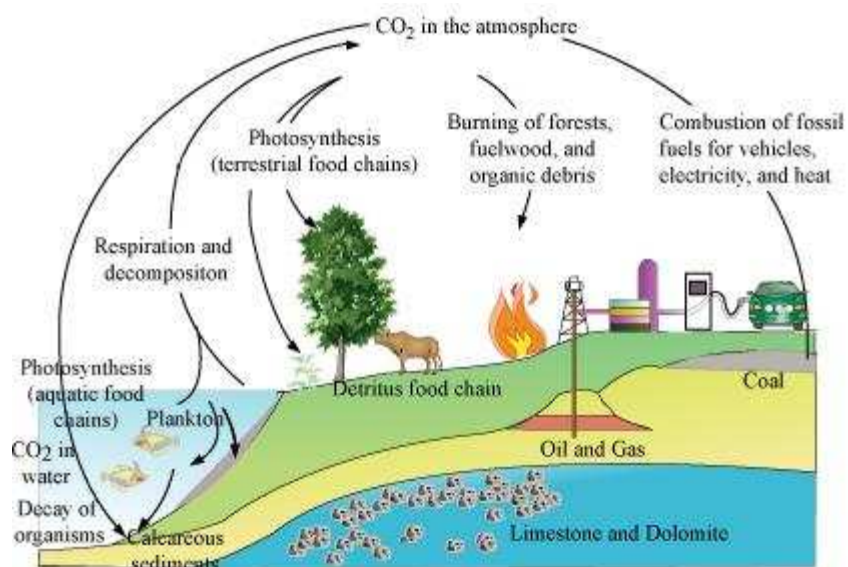
Sedimentary cycles are very slow. They take a long time to complete their circulation and are considered as less perfect cycles. This is because during recycling, nutrient elements may get locked in the reservoir pool, thereby taking a very long time to come out and continue circulation. Thus, it usually goes out of circulation for a long time.

**Question 13:**

Outline salient features of carbon cycling in an ecosystem

Answer

The carbon cycle is an important gaseous cycle which has its reservoir pool in the atmosphere. All living organisms contain carbon as a major body constituent. Carbon is a fundamental element found in all living forms. All biomolecules such as carbohydrates, lipids, and proteins required for life processes are made of carbon. Carbon is incorporated into living forms through a fundamental process called 'photosynthesis'. Photosynthesis uses sunlight and atmospheric carbon dioxide to produce a carbon compound called 'glucose'. This glucose molecule is utilized by other living organisms. Thus, atmospheric carbon is incorporated in living forms. Now, it is necessary to recycle this absorbed carbon dioxide back into the atmosphere to complete the cycle. There are various processes by which carbon is recycled back into the atmosphere in the form of carbon dioxide gas. The process of respiration breaks down glucose molecules to produce carbon dioxide gas. The process of decomposition also releases carbon dioxide from dead bodies of plants and animals into the atmosphere. Combustion of fuels, industrialization, deforestation, volcanic eruptions, and forest fires act as other major sources of carbon dioxide.



## CHAPTER 14

### ECOSYSTEM

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#### POINTS TO REMEMBER

**Ecosystem** : Relationship between living organisms and their abiotic surroundings.

**Stratification** : Vertical distribution of different species occupying different levels in an ecosystem.

**Primary Production** : Amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.

**Gross Primary Productivity** : Rate of production of organic matter during photosynthesis.

**Net Primary Productivity**  $NPP = GPP - R$  : Gross primary productivity minus the respiration losses.

**Secondary Productivity** : Rate of formation of new organic matter by consumers.

**Detritus** : Dead leaves, twigs, animal remains etc. constitute detritus.  
**Detritivore** : Organisms who break down detritus into smaller particles. e.g., earthworm.

**Ecological succession** : The successive and orderly replacement of one community by the other community in an area, over a period of time.

**Ecological Pyramids** : The sequential graphic representation of an ecological parameter (number/ biomass/energy) depicting different trophic levels in a food chain.

**Climax community** : The stable and final biotic community that develops at the end of ecological succession and is in perfect harmony with its physical environment.

**Pioneer species** : The species that invade a bare area at the onset of ecological succession.

**Process of Decomposition** : The decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients. This process is called decomposition. Steps of decomposition are :

- (i) **Fragmentation** : Break down of detritus into smaller particles by detritivores (earthworm).

- (ii) **Leaching** : Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
- (iii) **Catabolism** : Bacterial and fungal enzymes degrade detritus into simple inorganic substances.
- (iv) **Humification** : Accumulation of a dark coloured amorphous substances called humus.
- (v) **Mineralisation** : The humus is further degraded by some microbes and release of inorganic nutrients occur.

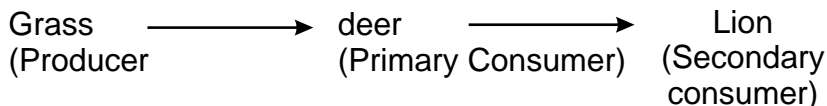
#### **Factors affecting decomposition:**

Decomposition is controlled by:-

- a) **Chemical composition of detritus -**  
The decomposition will slower if detritus is rich in lignin and chitin and will faster if detritus is rich in nitrogen and water soluble substance (sugar).
- d) **Climatic factor.**  
In warm and moist environment , the process of decomposition is inhibited at low temperature and anaerobiosis.

**Energy Flow** : Energy flow is the key function in the ecosystem. The plants (producers) capture only 2 — 10 percent of the photosynthetically active radiation (PAR). Unidirection flow of energy is taken place from the sun to producers and then to consumers. About 10% energy flows from one trophic level to another.

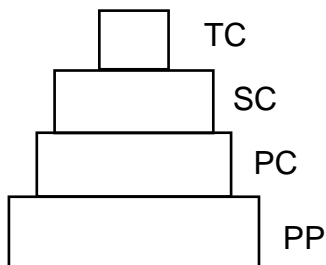
**Grazing Food Chain (GFC)** : It begins with producers.



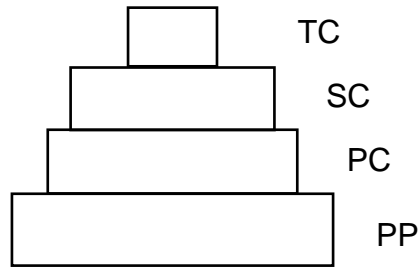
**Detritus Food Chain (DFC)** : (DFC) It begins with dead organic matter. It is made up of decomposers (Fungi, Bacteria). They meet their energy and nutrient requirements by degrading detritus. These are also known as saprotrophs.

#### **Ecological Pyramids**

(i) Pyramid of Numbers : (Grass land Ecosystem)

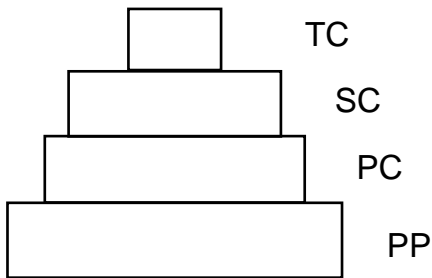


(ii) **Pyramid of Energy** : (Always upright in all Ecosystems)

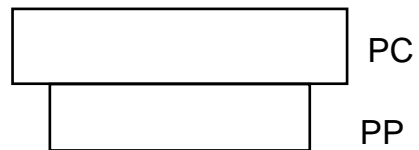


(In Terrestrial Ecosystem)

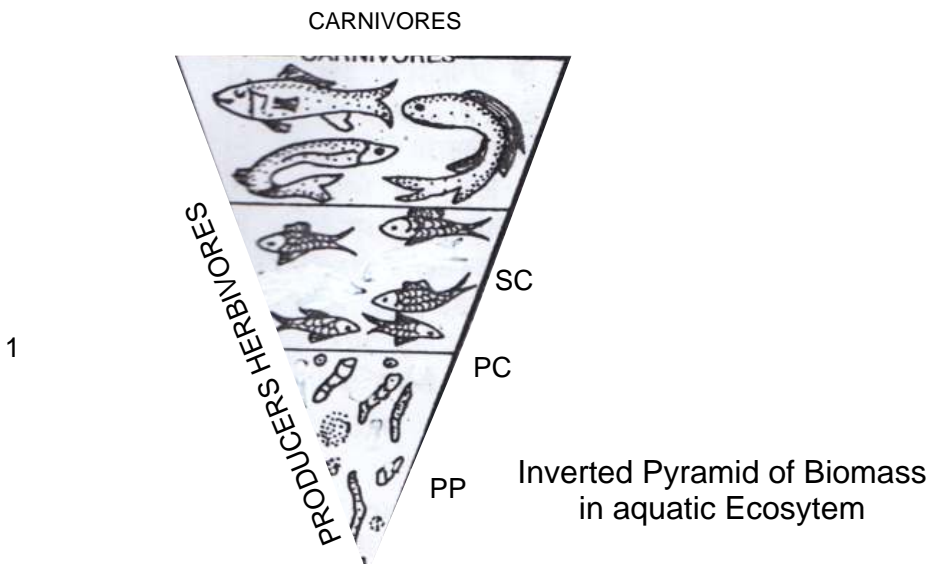
(iii) **Pyramid of Biomass** :



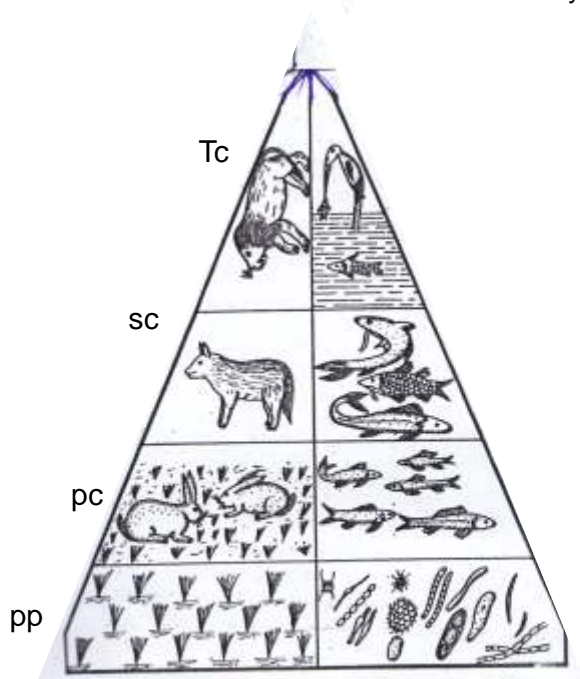
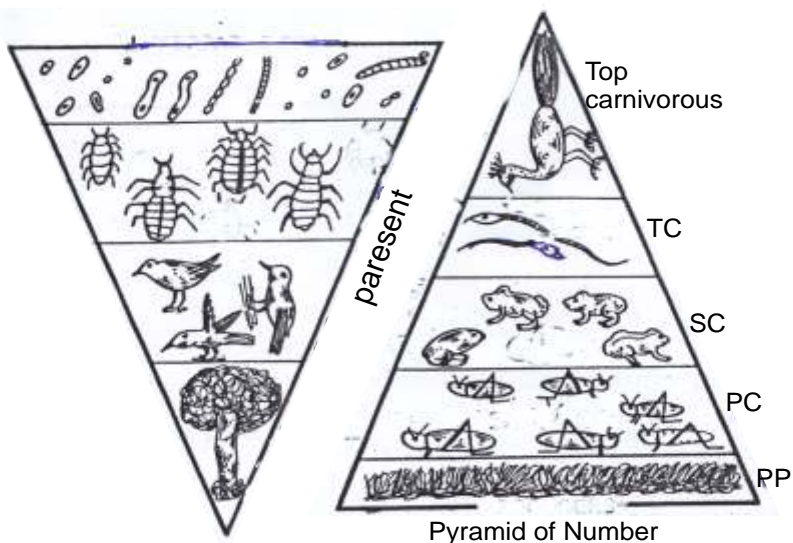
(In Terrestrial Ecosystem)



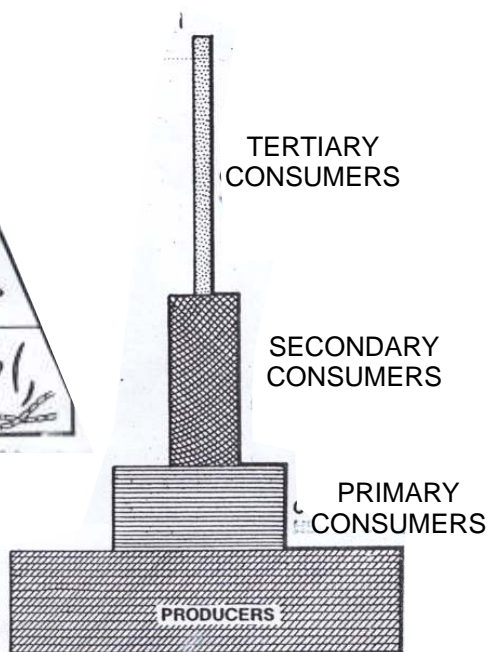
(In Aquatic Ecosystem)



2



Pyramid of  
ENERGY

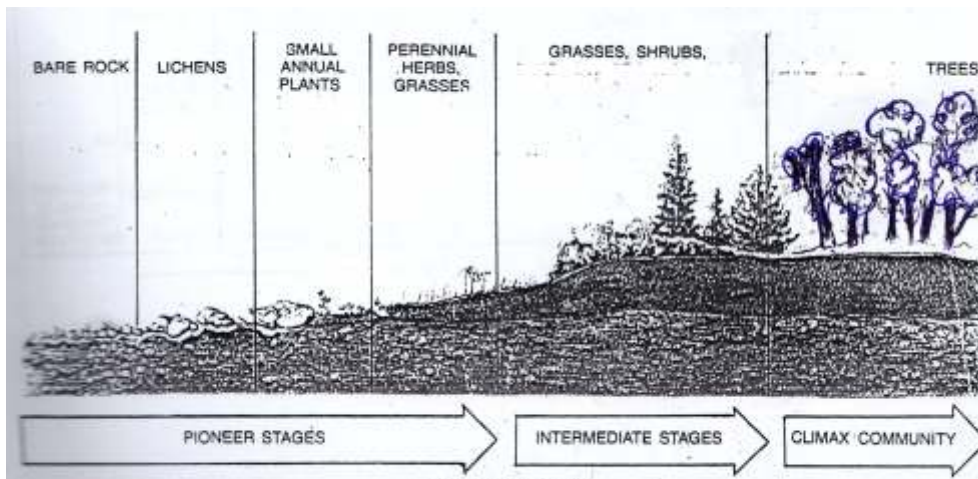




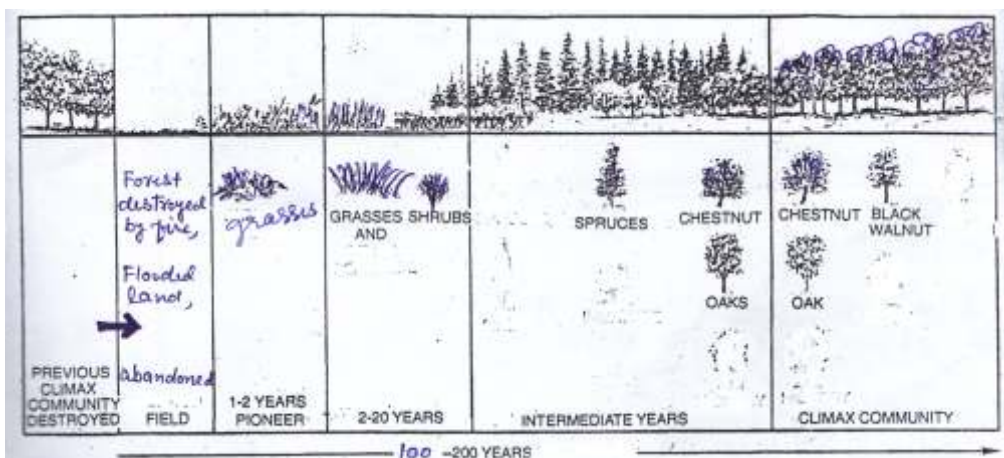
**Ecological Succession :** The gradual and fairly predictable change in the species composition of a given area is called ecological succession. The species that invade a bare area is called pioneer species. The final community is an ecological succession that is in near equilibrium with the environment is called climax community

Secondary Succession begins in the area where natural biotic communities have been destroyed (burned or cut forests, land that have been devastated by flood).

### Succession on a Bare Rock (Xerarch)

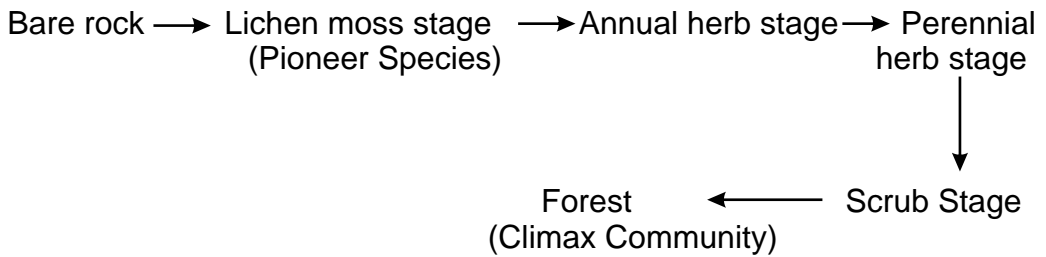


Thousand of Years  
Primary Ecological Succession

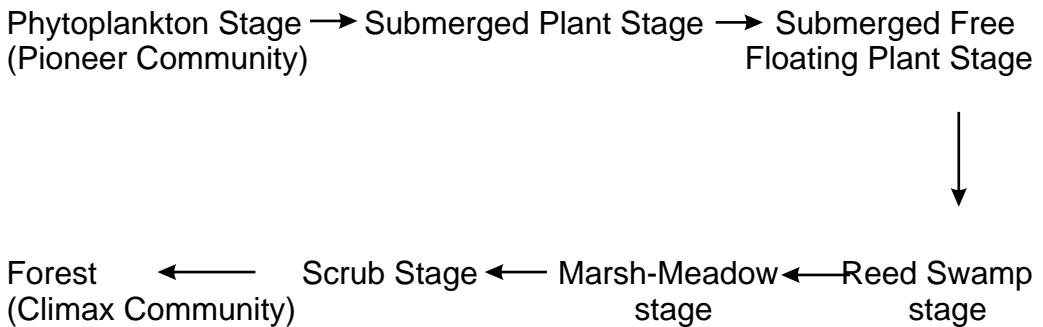


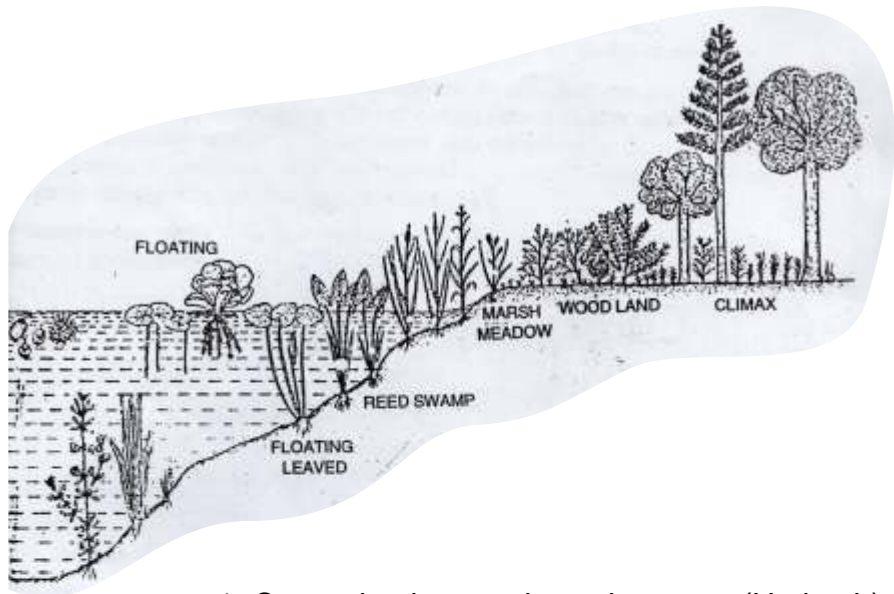
Secondary Ecological Succession



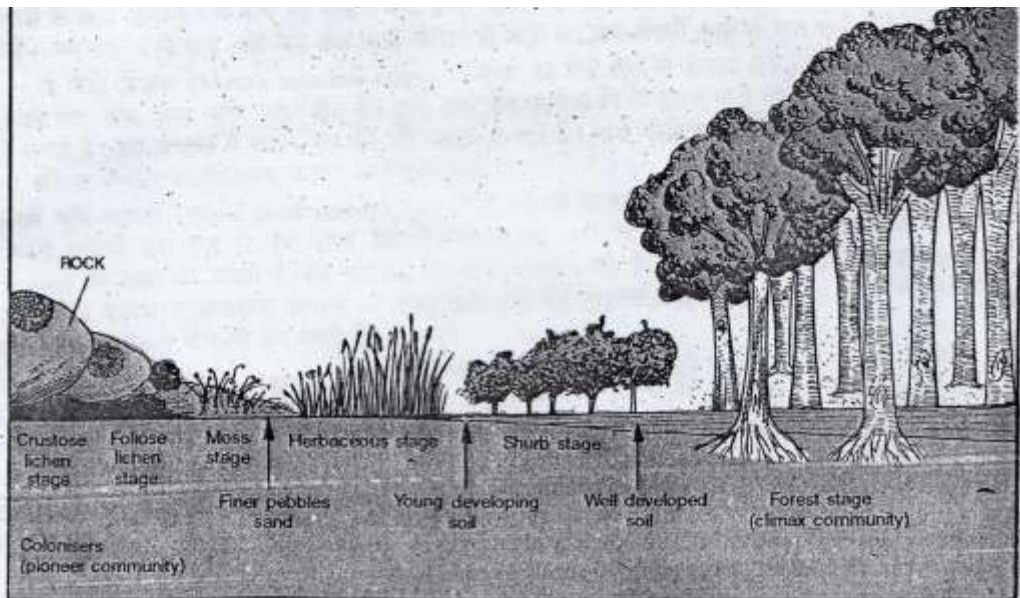


### Succession in Aquatic environment (Hydrach)





1- Secession in aquatic environment (Hydrach)



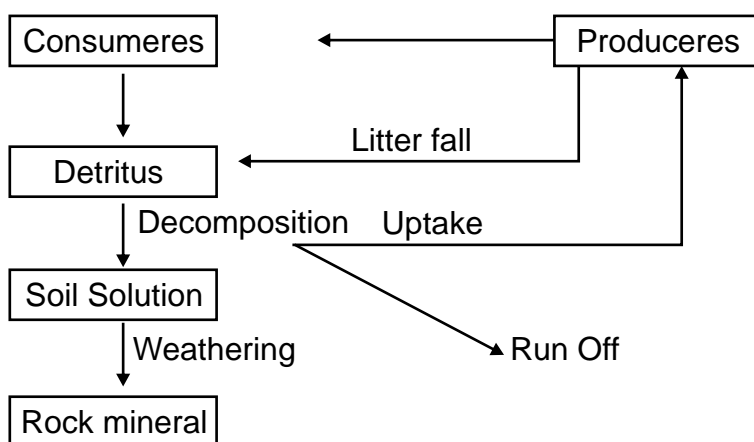
2- Secession on a bare rock (xerach)

**Nutrient Cycling** - Movement of nutrient elements through the various components of an ecosystem also called Biogeochemical cycles.

Nutrient cycle  $\begin{cases} \text{Gaseous} \text{ — Reservoir in atmosphere} \\ \text{Sedimentary} \text{ — Reservoir eg. earth's crust} \end{cases}$

**Carbon cycle** - occurs through atmosphere, ocean, and through living and dead organisms. Considerable amount of carbon returns to atmosphere as  $\text{CO}_2$  through respiratory activities, decomposers also contribute to Carbon di-oxide pool, burning of wood, forest fire and combustion of organic matter, fossil fuels, volcanic activity also release  $\text{CO}_2$  in atmosphere.

**Phosphorous cycle** - Sedimentary cycle Rocks contain phosphorous in the form of phosphates



### Carbon Cycle

1. Amount of atmospheric inputs more in amount
2. Degree of exchanges between high

### Phosphorous Cycle

1. Amount of atmospheric inputs less in amounts
2. Degree of exchange between organism and environment organism and environment negligible.

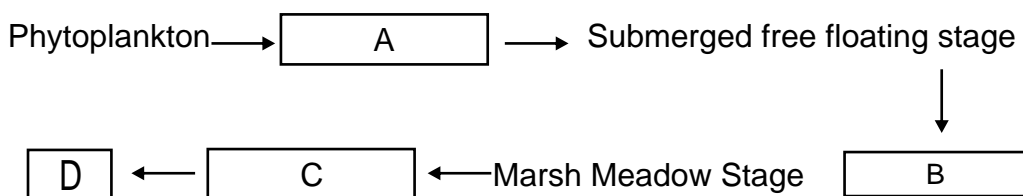
## QUESTIONS

### VSA (1 MARK)

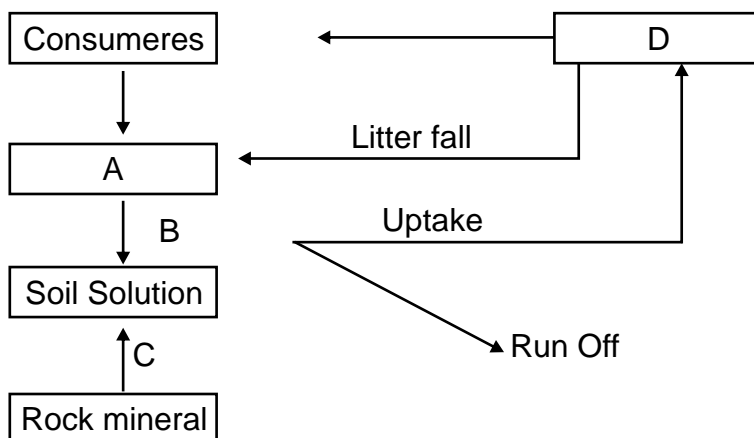
1. Decomposition is faster if detritus is rich in nitrogen and water soluble substance like sugars. When is the decomposition process slower?
2. If we count the number of insects on a tree and number of small birds depending on those insects as also the number of larger birds eating the smaller, what kind of pyramid of number would we get?
3. Differentiate between Sere and Seral communities.
4. Who are generally the pioneer species in a Xerarch succession and in a Hyararch succession?
5. Which metabolic process causes a reduction in the Gross Primary Productivity?
6. What percentage of photosynthetically active radiation is captured by plants?
7. Name the pioners of primary succession in water.

### SA-II (2 MARKS)

8. What is the shape of pyramid of biomass in sea? Why?
9. Give an example of an ecological pyramid which is always upright. Justify your answer.
10. Differentiate between primary succession and secondary succession. Which one occurs faster?
11. Gaseous nutrient cycle and sedimentary nutrient cycles have their reservoir. Name them. Why is a reservoir necessary?
12. Fill up the missing links depicted as A, B, C and D in the given model of primary succession.



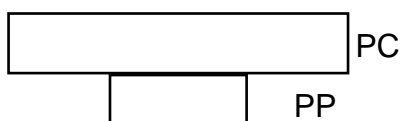
13. In the model of phosphorus cycle given below, what does A, B, C and D refer to?



14. Differentiate between Hydrarch and a Xerarch succession.
15. What is the effect on decomposition rate if :  
 a) Detritus is rich in lignin and chitin  
 b) Detritus is rich is nitrogen and sugars
16. What are the limitations of ecological pyramids?
17. Name any four ecosystem services. Who gave the price tags on nature.s life support services? Which is the most important ecosystem service provider?
18. Study the table given below and fill the blanks from .A. to .F..

S.No	Component of the Ecosystem	Position of the trophic level	Organism present in the Food chain.
1.	E	Fourth trophic level	F
2.	Secondary consumer	D	Bird, fish, wolf.
3.	B	Second trophic level	C
4.	Primary producer	A	Phytoplankton, grass, tree.

19. In the pyramid of biomass drawn below, name the two crops (i) one which is supported (ii) one which supports in which ecosystem is such a pyramid found



### LA (5 MARKS)

20. Detrivores like earthworm are involved in the process of decomposition of dead plants and animals. Describe the different steps involved in the process of decomposition.

### ANSWERS

#### VSA (1 MARK)

1. Its slower if detritus is rich in lignin and chitin.
2. Inverted Pyramid of Number.
3. Sere : Entire sequence of communities that successively change in a given area.

**Seral community** : Individual transitional community.

4. Pioneer species in Hydrarch succession are usually the small phytoplanktons and that in Xerarch succession are usually lichens.
5. Respiration.
6. 2 — 10%
7. Phytoplanktons

#### SA-II (2 MARKS)

8. Inverted, because biomass of fishes far exceeds that of phytoplankton.
9. Pyramid of energy is always upright and can never be inverted, because when energy flows from a trophic level to the next trophic level some energy is always lost as heat at each step.
10. **Primary Succession** : A process that starts where no living organisms are there.

**Secondary succession** : A process that starts in areas which have lost all the living organisms that existed there.

11. Reservoir for Gaseous nutrient cycle : Atmosphere; for sedimentary nutrient cycle : Earth's crust. Reservoir is needed to meet with the deficit which occurs due to imbalance in the rate of influx and efflux.
12. A = Submerged plant stage                      B = Reed Swamp Stage  
C = Scrub stage                                      D = Forest stage
13. A = Detritus    B = Decomposition  
C = Weathering    D = Producers.

14. **Hydrarch Succession** : Starts in water proceeds from hydric (aquatic) to mesic (neither dry nor wet) situations.
- Xerarch succession** : Starts on barren rock Proceeds from Xeric (dry) conditons.
15. a) Decomposition rate is slower  
b) Decomposition rate is faster.
16. (i) Does not take into account same species belonging to two or more trophic levels.  
(ii) Assumes simple food chain, does not accomodate food web.  
(iii) Saprophytes have not been given any place in ecological pyramids.
17. ☐ Forest (ecosystem) purify water and air  
☐ Mitigate Droughts and floods  
☐ Nutrient cycling  
☐ Generate fertile soil  
☐ Provide habitat for wildlife  
☐ Pollinate flower  
☐ Maintain Biodiversity  
☐ Provide aesthetic, cultural & spiritual values  
☐ Robert Constanza gave price tags to ecosystem services.  
☐ Most important ecosystem services provider : Soil formation.
18. A= First trophic level  
B = Primary consumer  
C = Zooplankton, Cow, Grass hopper  
D = Third trophic level  
E = Tertiary consumer  
F = Man, Lion

19. (i) Supported trophic level is founded by zooplanktons  
(ii) Supporting trophic level is formed by phytoplanktons ecosystem It is found in aquatic ecosystem.

**LA (5 Marks)**

20. The dead remains of plants and animals called detritus undergo decomposition and are converted into simpler substances. The steps of this process are :
- (i) **Fragmentation** : Breakdown of detritus into smaller pieces by detritivores like earthworm.
  - (ii) **Leaching** : Water soluble inorganic nutrients go down into soil horizon and get precipitated as unavailable salts.
  - (iii) **Catabolism** : Bacterial and fungal enzymes degrade detritus into simpler inorganic substances.
  - (iv) **Humification** : It leads to accumulation of dark coloured amorphous substance called humus which is highly resistant to microbial action so decomposes at slow rate and is rich in nutrients.
  - (v) **Mineralisation** : Humus is further degraded by some microbes and release of inorganic nutrients occurs.