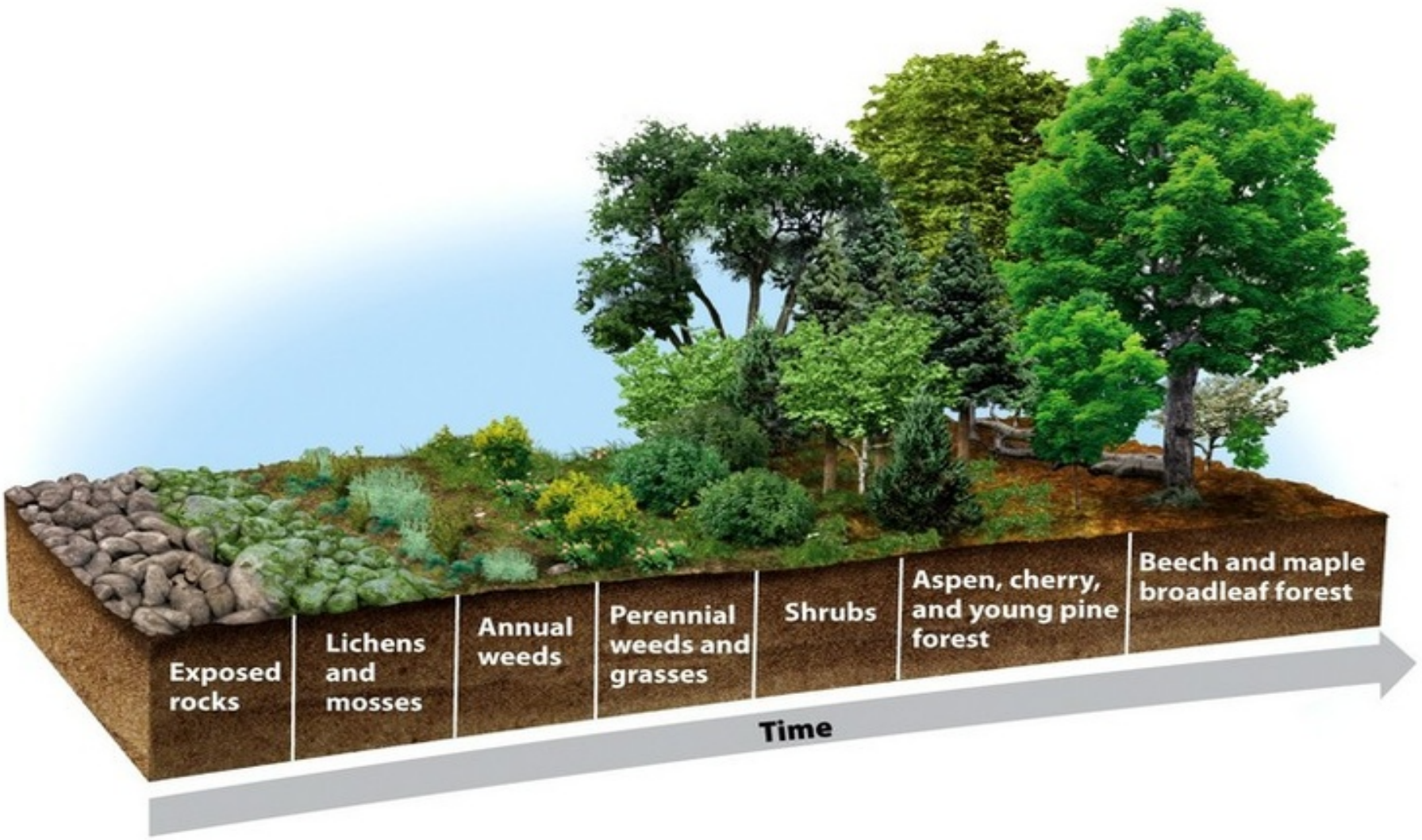


Ecological Succession

- The process by which communities of plant and animal species in an area are **replaced or changed** into another over a period of time is known as **ecological succession**.
- Succession is a universal process of **directional change in vegetation**, on an ecological time scale.
- Succession occurs due to large scale changes or destruction (natural or manmade).
- The process involves a progressive series of changes with one community replacing another until a **stable, mature, climax community** develops.



- The first plant to colonize an area is called the **pioneer community**.
- The final stage of succession is called the **climax community**.
- **A climax community is stable, mature, more complex and long-lasting.**
- The stage leading to the climax community is called **successional stages or seres**.
- Each transitional community that is formed and replaced during succession is called a **stage in succession or a seral community**.
- Succession is characterized by the following: **increased productivity, the shift of nutrients from the reservoirs, increased diversity of organisms, and a gradual increase in the complexity of food webs.**



A volcanic crater in the Galapagos Islands. GETTY IMAGES/MINT IMAGES RM

Q. Lichens, which are capable of initiating ecological succession even on a bare rock, are actually a symbiotic association of

- a) algae and bacteria
- b) algae and fungi
- c) bacteria and fungi
- d) fungi and mosses

Q. In the grasslands, trees do not replace the grasses as a part of an ecological succession because of

- a) insects and fungi
- b) limited sunlight and paucity of nutrients
- c) water limits and fire
- d) None of the above

Succession in water bodies

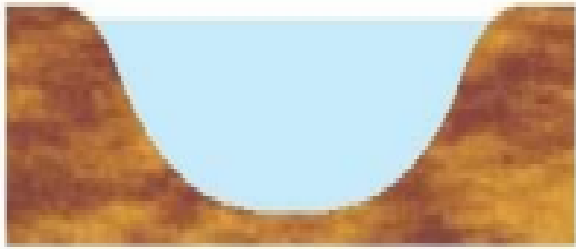


Diagram 1: Initial water body formation.

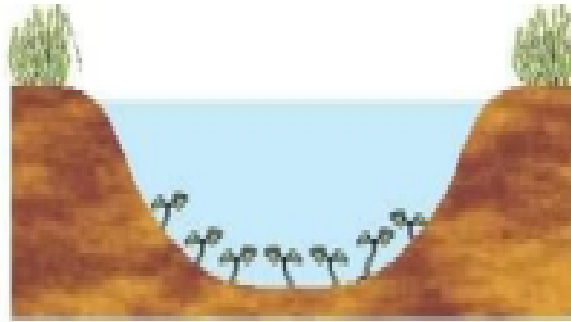


Diagram 2: Emergence of aquatic plants.

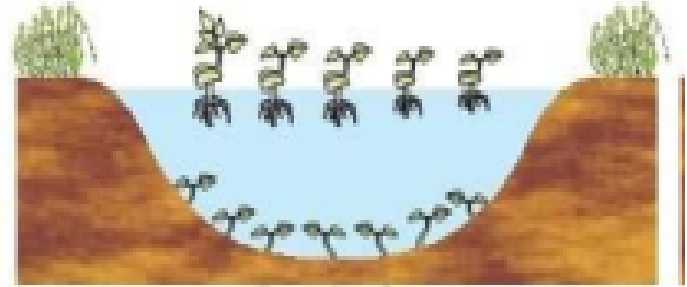


Diagram 3: Growth of aquatic plants.



Diagram 4: Emergence of tall reeds.

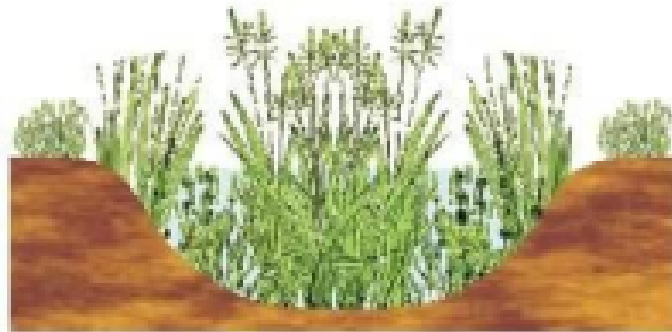


Diagram 5: Growth of tall reeds.

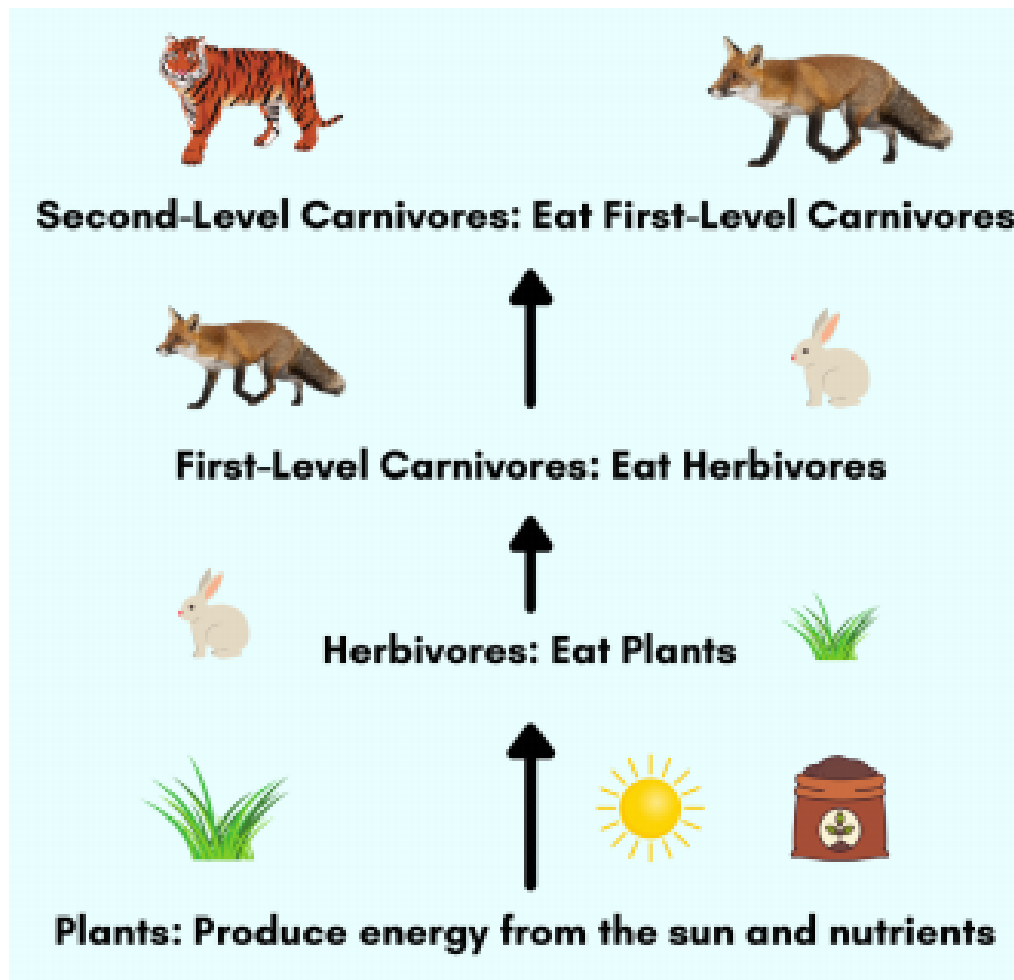


Diagram 6: Emergence of trees.

- Succession that occurs on land (dry areas) where moisture content is low for e.g. on a bare rock is known as **xerarch**.
- Succession that takes place in a water body, like ponds or lake is called **hydrarch**.
- Both hydrarch and xerarch successions lead to medium water conditions (**mesic**) – neither too dry (xeric) nor too wet (hydric).

Energy Flow Through an Ecosystem – Trophic Levels

- A trophic level (trophe = Nourishment) is the **representation of energy flow in an ecosystem.**



Trophic Levels	
Autotrophs	Green plants (Producers)
Heterotrophs	Herbivore (Primary consumers)
Heterotrophs	Carnivores (Secondary consumers)
Heterotrophs	Carnivore (Tertiary consumers)
Heterotrophs	Top carnivores (Quaternary consumers)

- Energy flows through the trophic levels from producers to subsequent trophic levels is **unidirectional**.
- Energy level **decreases** from the first trophic level upwards **due to loss of energy in the form of heat** at each trophic level.
- This energy loss at each trophic level is quite significant. Hence there are usually not more than four-five trophic levels (beyond this the energy available is negligible to support an organism).
- The trophic level interaction involves three concepts, namely:
 - 1) **Food Chain**
 - 2) **Food Web**
 - 3) **Ecological Pyramids**

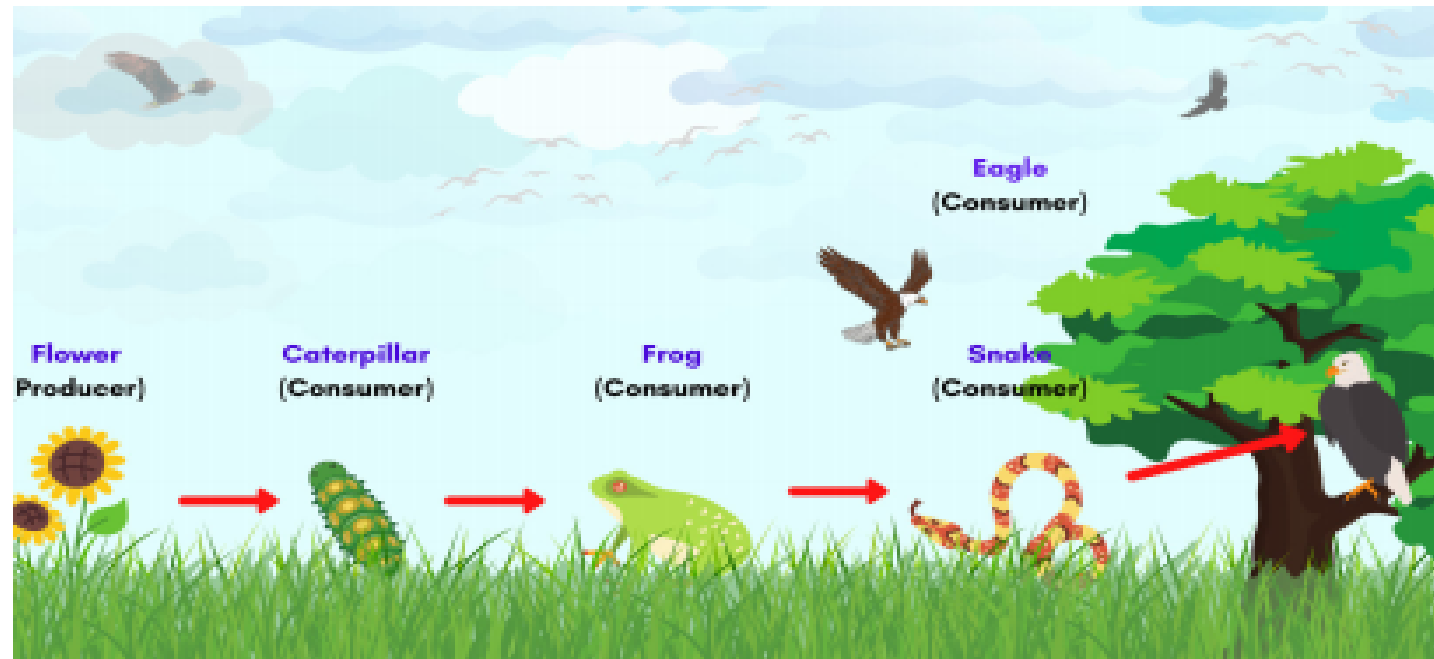
Food Chain

- Transfer of food energy from green plants (producers) through a series of organisms with repeated eating and being eaten link is called a food chain. E.g., Grasses → Grasshopper → Frog → Snake → Hawk/Eagle.
- Each step in the food chain is called **trophic level**.
- A food chain starts with producers and ends with top carnivores.

- The **trophic level of an organism** is the position it occupies in a food chain.
- Types of Food Chains: 1) **Grazing food chain** and 2) **Detritus food chain**

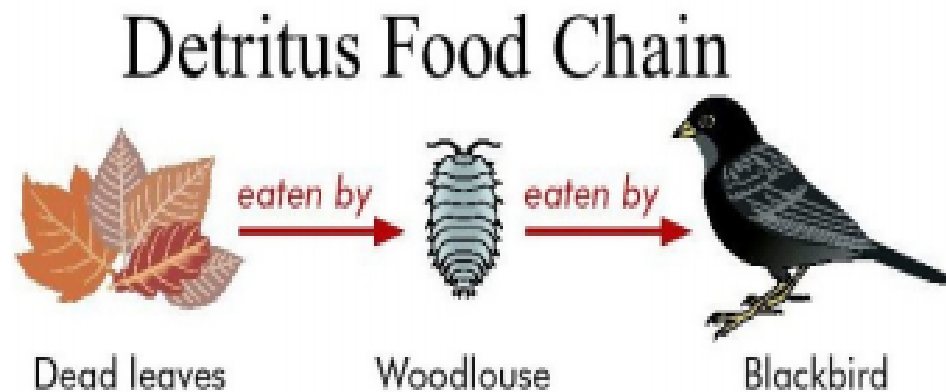
Grazing Food Chain

- The consumers which start the food chain, utilising the **plant or plant part as their food**, constitute the grazing food chain.
- For example, in a terrestrial ecosystem, the grass is eaten by a caterpillar, which is eaten by lizard and lizard is eaten by a snake.
- In Aquatic ecosystem **phytoplankton** (primary producers) are eaten by zooplanktons which are eaten by fishes and fishes are eaten by pelicans.



Detritus food chain

- This type of food chain **starts from organic matter** of dead and decaying animals and plant bodies from the grazing food chain.
- Dead organic matter or detritus feeding organisms are called **detrivores or decomposers**. The detrivores are eaten by predators.
- In an **aquatic ecosystem, the grazing food chain is the major conduit for energy flow**.
- As against this, in a **terrestrial ecosystem, a much larger fraction of energy flows through the detritus food chain than** through the grazing food chain.



Q. With reference to the food chains in ecosystems, which of the following kinds of organism is/are known as decomposer organism/organisms?

- 1) Virus
- 2) Fungi
- 3) Bacteria

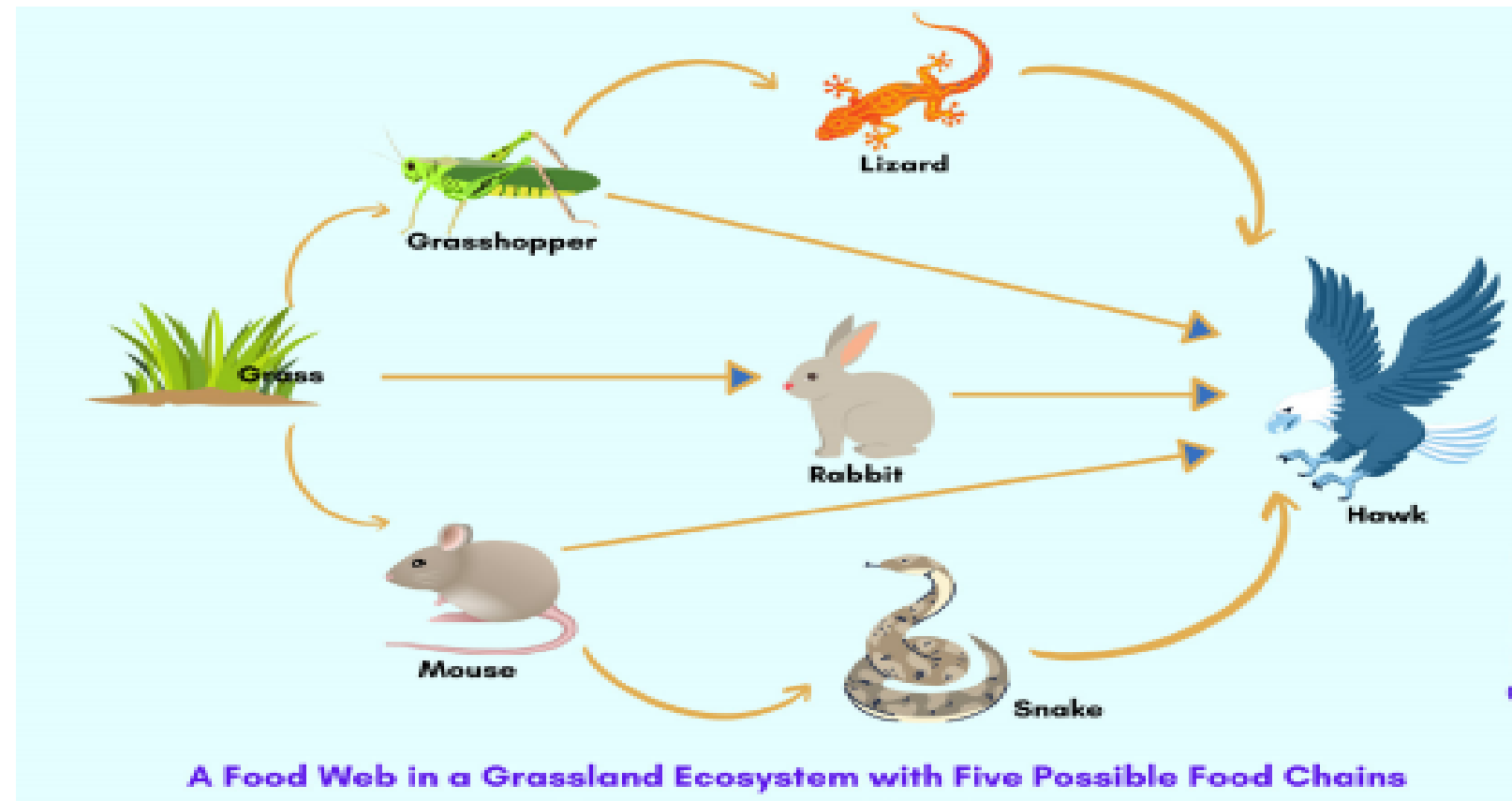
Select the correct answer using the codes given below.

- a) 1 only
- b) 2 and 3 only
- c) 1 and 3 only
- d) 1, 2 and 3

Q. Which one of the following is the correct sequence of a food chain?

- a) Diatoms-Crustaceans-Herrings
- b) Crustaceans-Diatoms-Herrings
- c) Diatoms-Herrings-Crustaceans
- d) Crustaceans-Herrings-Diatoms

Food Web



- **Multiple interlinked food chains make a food web.**
- Food web represents all the **possible paths of energy flow** in an ecosystem.
- If any of the intermediate food chains is removed, the succeeding links of the chain will be affected largely.
- The food web provides more than one alternative for food to most of the organisms in an ecosystem and therefore increases their chance of survival.

Q. With reference to food chains in ecosystems, consider the following statements:

- 1) A food chain illustrates the order in which a chain of organisms feed upon each other.
- 2) Food chains are found within the populations of a species.
- 3) A food chain illustrates the numbers of each organism which are eaten by others.

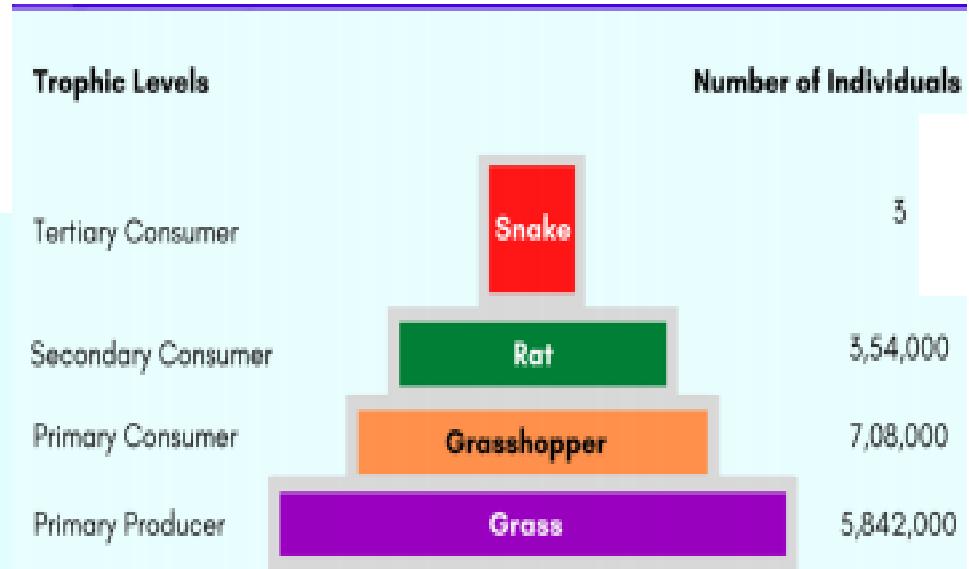
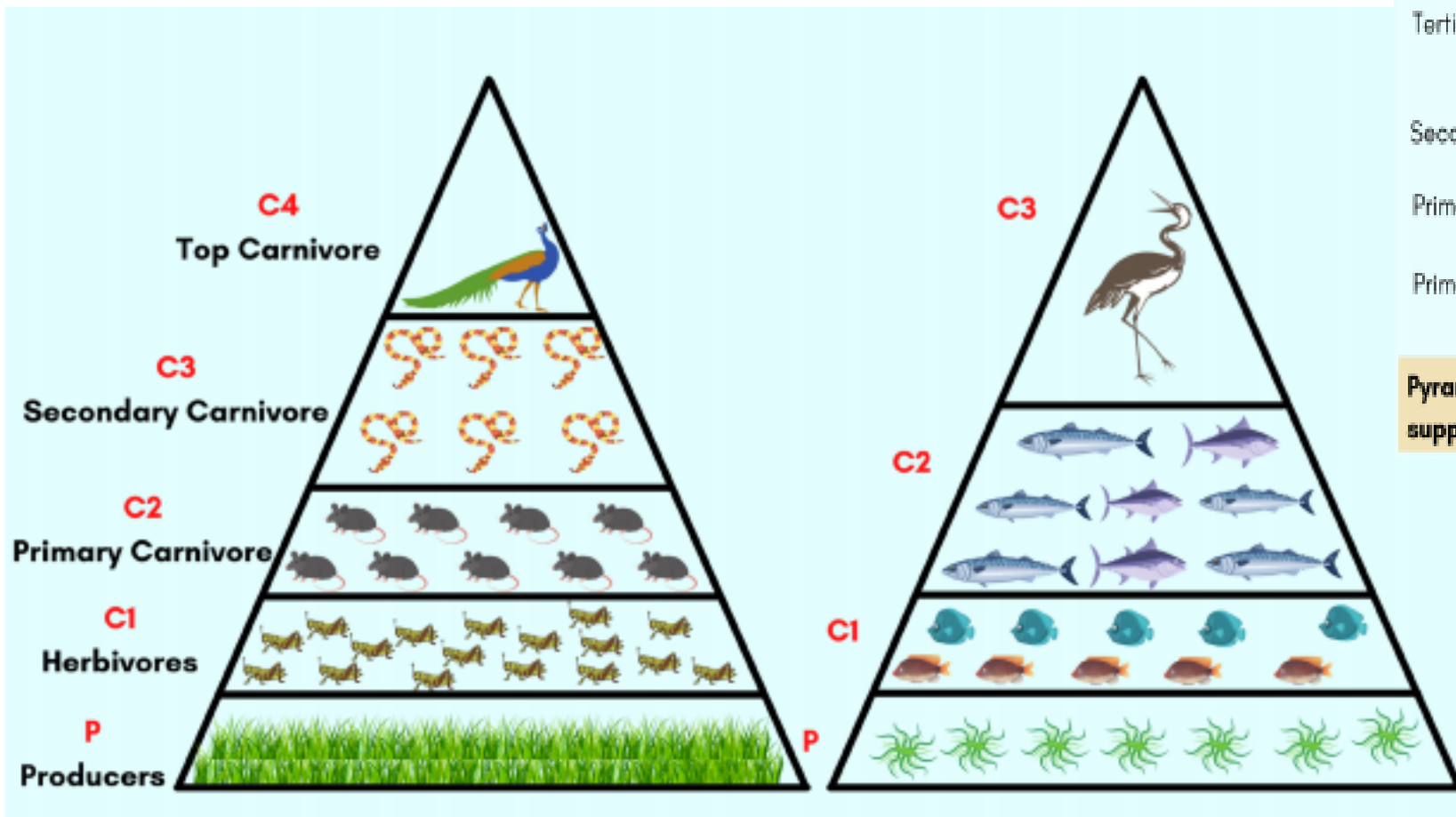
Which of the statements given above is/are correct?

- a) 1 only
- b) 1 and 2 only
- c) 1, 2 and 3
- d) None

Ecological Pyramids

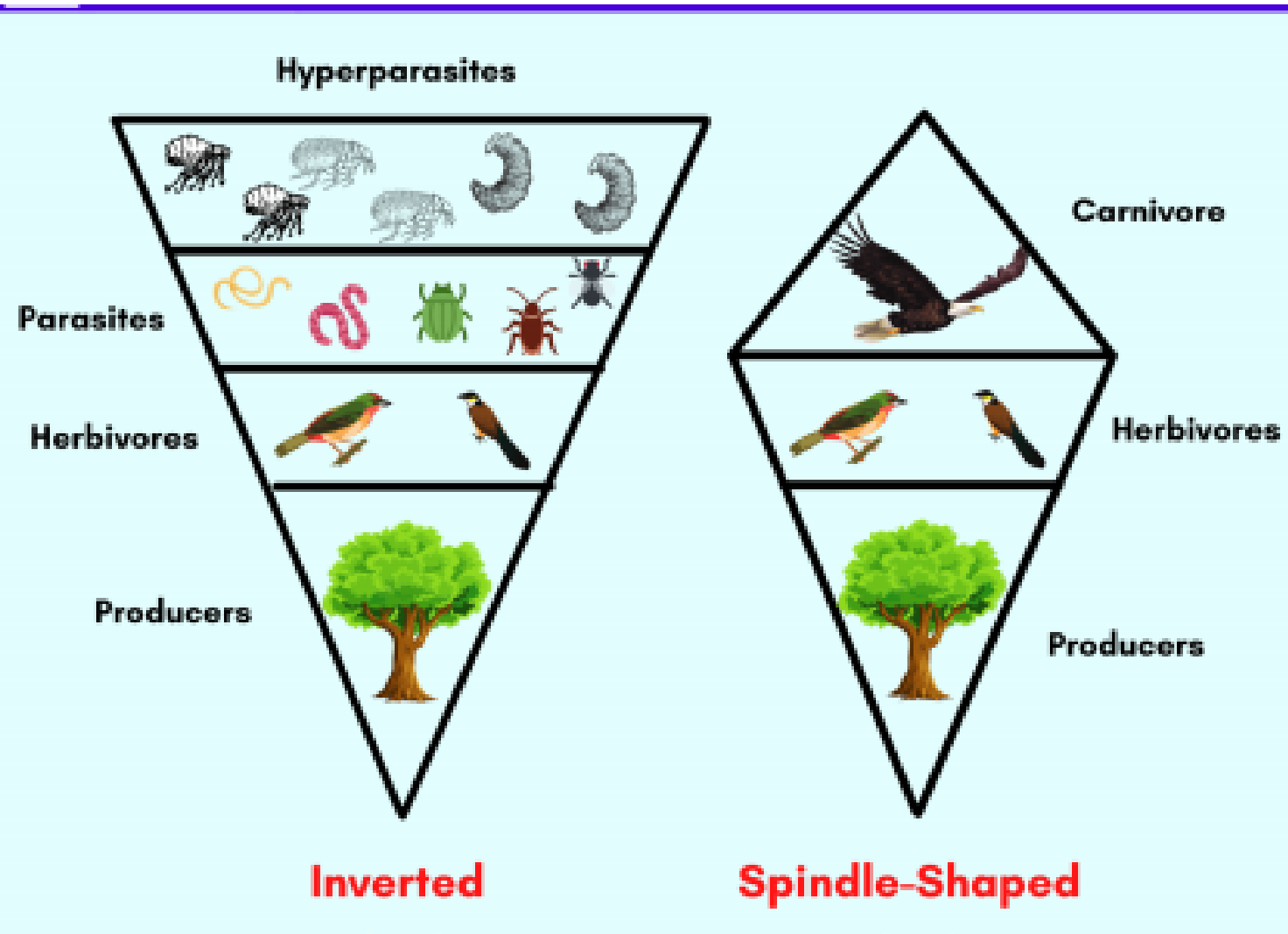
- The **pyramidal representation of trophic levels** of different organisms
- The pyramid consists of a number of horizontal bars depicting **specific trophic levels**.
- The length of each bar represents the **total number of individuals or biomass or energy** at each trophic level in an
- The ecological pyramids are of three categories:
 - 1) **Pyramid of numbers,**
 - 2) **Pyramid of biomass, and**
 - 3) **Pyramid of energy or productivity.**

Pyramid of Numbers

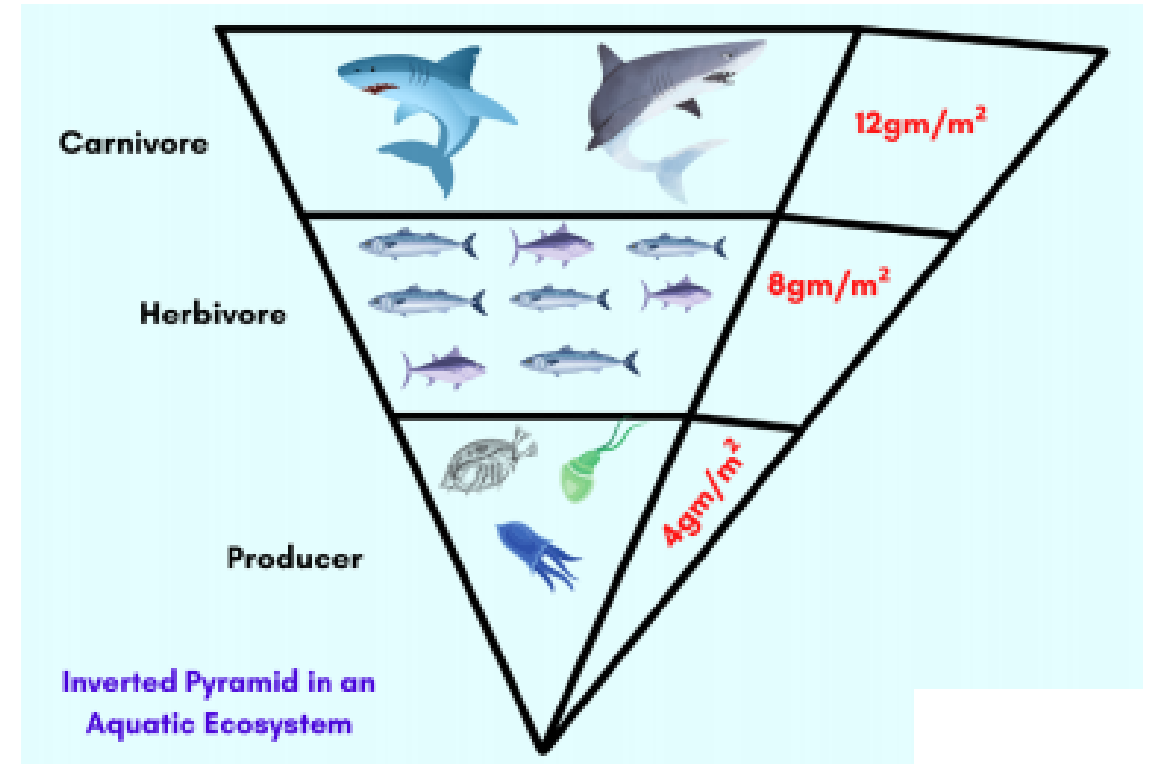
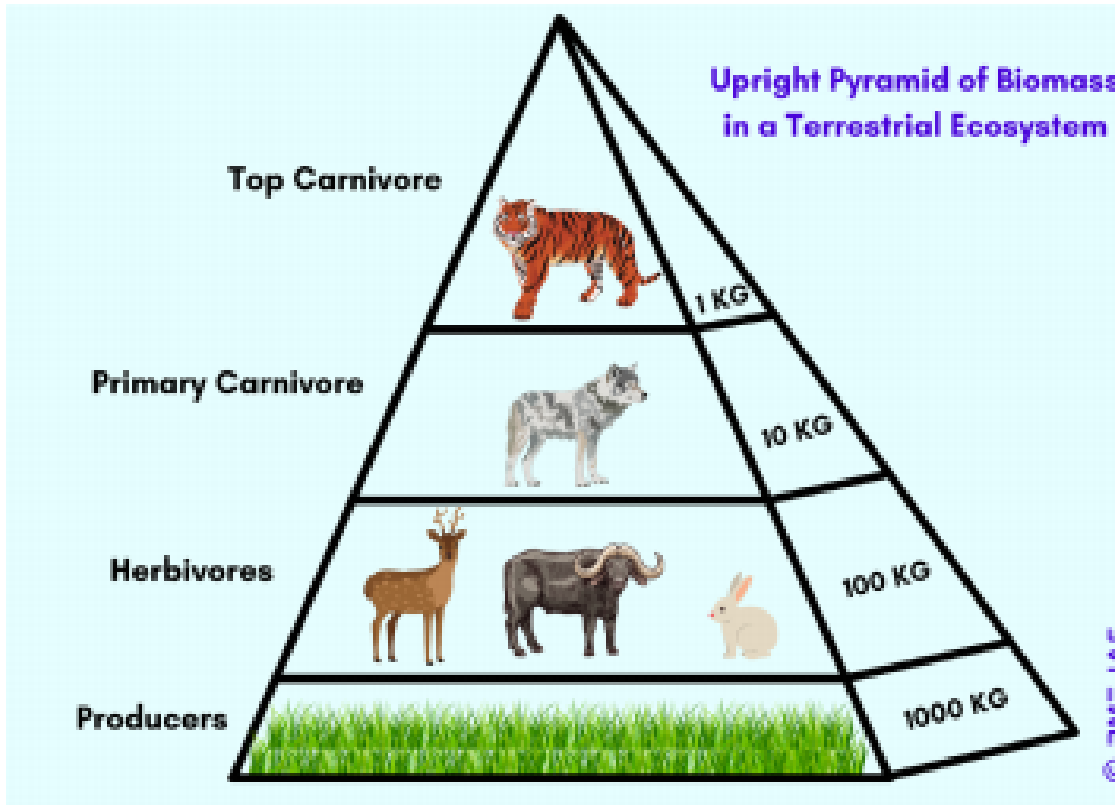


Pyramid of numbers in a grassland ecosystem. Only 3 Top-Carnivore are supported in an ecosystem based on production of nearly 6 million plants

Pyramids of Numbers (A) In a Grassland (B) In a Pond

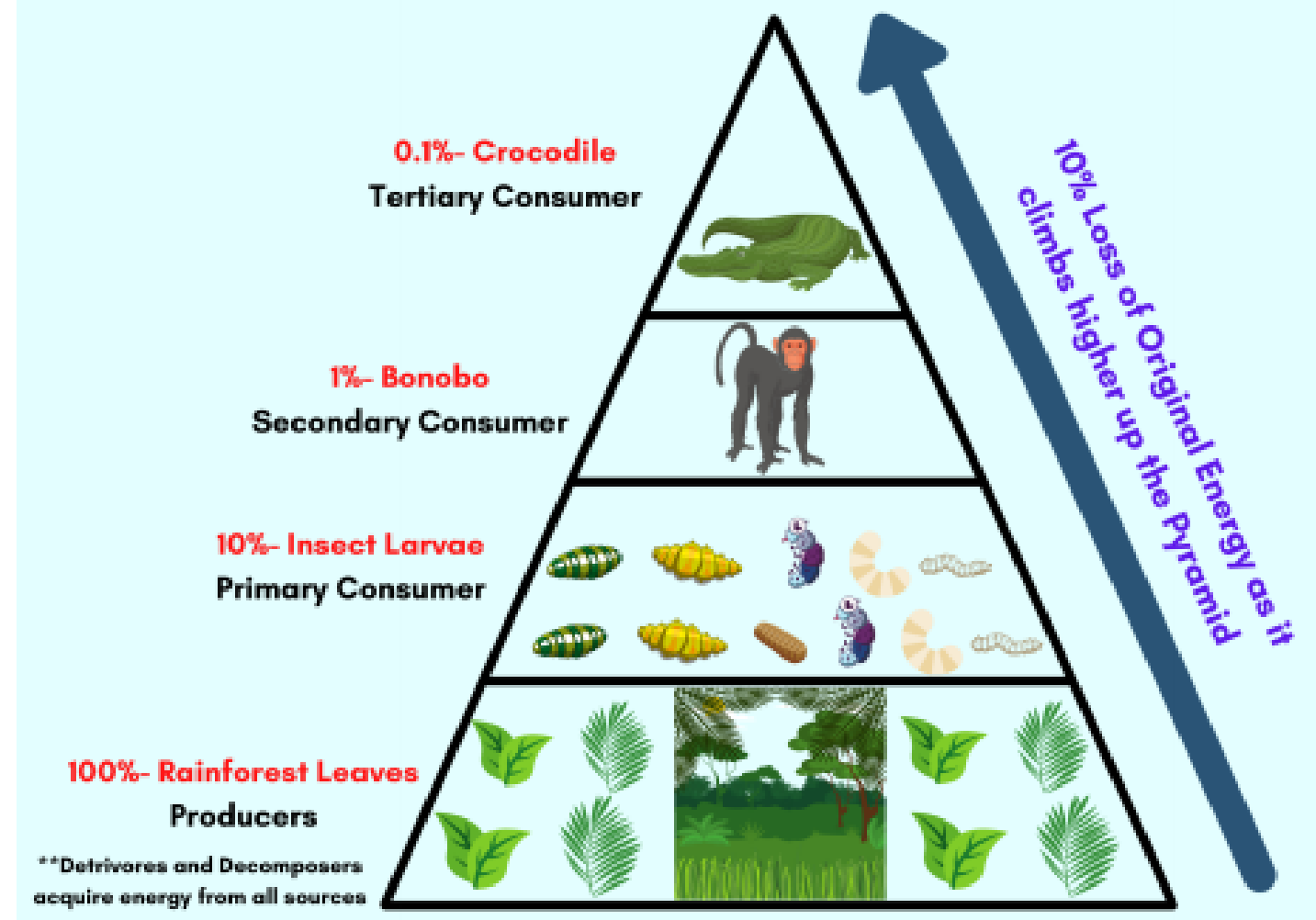


. Pyramid of Biomass



- This is because the producers are **tiny phytoplankton** that grows and reproduces rapidly.
- Here, the pyramid of biomass has a small base, with the **consumer biomass at any instant exceeding the producer biomass** and the pyramid assumes an inverted shape.

Pyramid of Energy

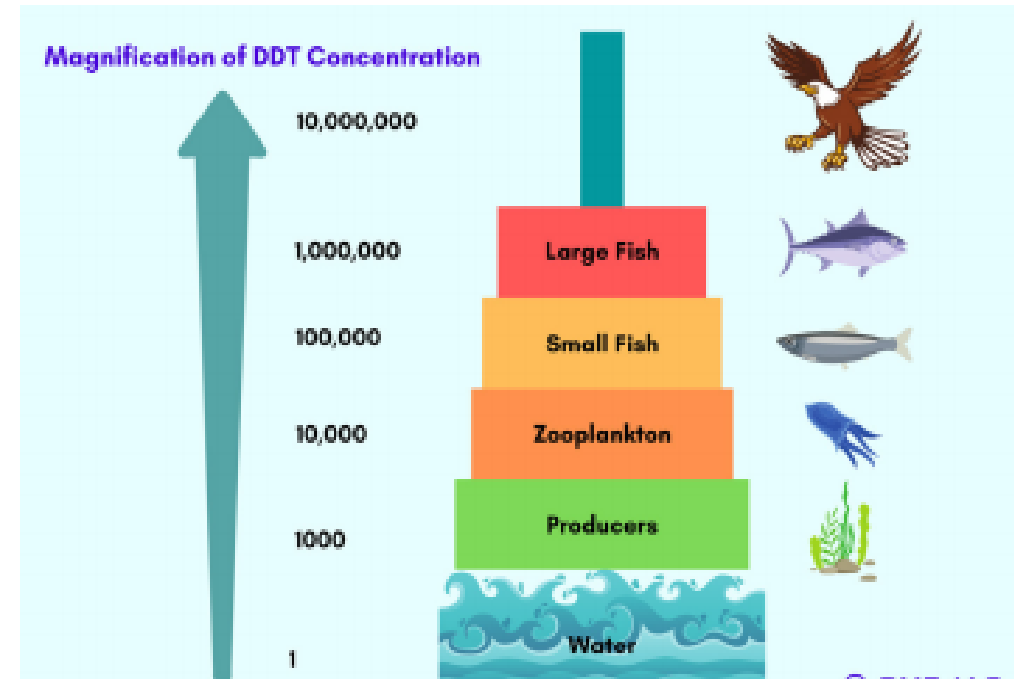


- **Energy pyramid is most suitable** to compare the **functional roles of the trophic levels** in an ecosystem.
- An energy pyramid represents the **amount of energy at each trophic level and loss of energy at each transfer to another trophic level.**
- Hence **the pyramid is always upward**, with a large energy base at the bottom.

Ecological Efficiency

- **Ecological efficiency** describes the efficiency with which energy is transferred from one trophic level to the next.
- The number of trophic levels in the **grazing food chain** is restricted as the transfer of energy follows **10 per cent law** — only 10 per cent of the energy is transferred to each trophic level from the lower trophic level.
- The energy decreases at each subsequent trophic level is due to two reasons:
 - ✓ At each trophic, a part of the available energy is **lost in respiration** or used up in **metabolism**.
 - ✓ A part of the energy is **lost at each transformation**.
- Energy pyramid concept helps to explain the phenomenon of **biological magnification** — the tendency for toxic substances to **increase in concentration** progressively **with higher trophic levels**.

- 1) Bioaccumulation
- 2) Biomagnification



- In order for biomagnification to occur, the pollutant must have:
 1. a long biological half-life (long-lived),
 2. must not be soluble in water but must be soluble in fats. E.g., DDT.
- If the pollutant is soluble in water, it will be **excreted** by the organism.
- Pollutants that dissolve in fats are retained for a long time.
- Hence it is traditional to measure the **amount of pollutants in fatty tissues** of organisms such as fish.
- **In mammals, milk produced by females is tested** for pollutants **since the milk has a lot of fat in.**