(Integrrated sciences)

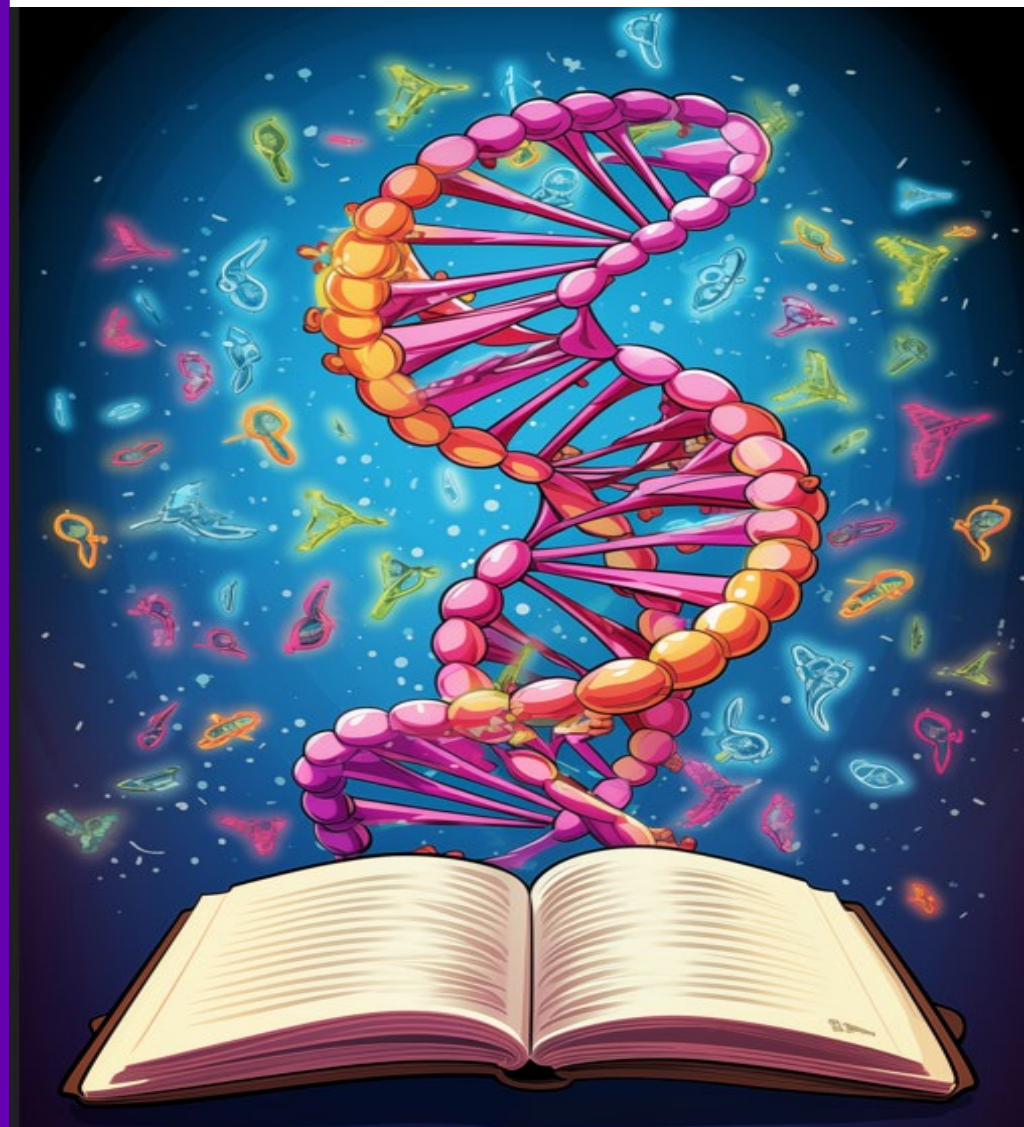
Sec 1 (Biosphere and its Stability)

Unit 1

L1

Biosphere and its Stability

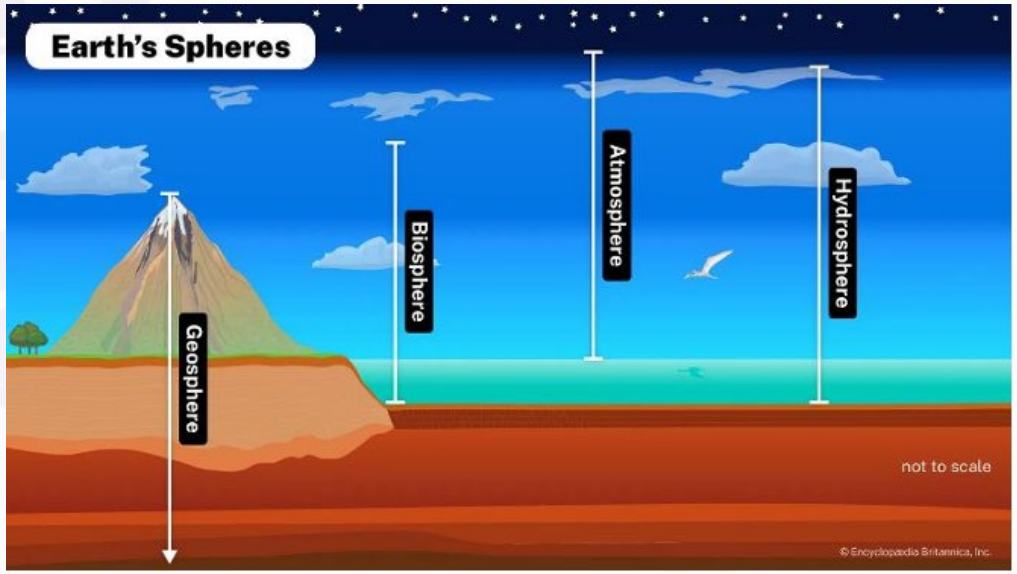
(Explanation)



Biosphere and its stability:

Biosphere: the vast system that includes all biomes on the Earth's surface, including land, water, and air.
It contains all forms of life and their interactions with the other spheres of the planet, extending from the depths of the oceans to the tops of mountains.

- The biosphere is considered includes all living organisms (plants, animals, and microorganisms) and all the environments in which they live.



- Living organisms in the biosphere interact with their surrounding environment, to exchange matter and energy.

The relationship of the biosphere with the other spheres of the Earth

The biosphere is connected with the other spheres , it does not work in isolation.

the living or organisms that make up the biosphere here interact with:

A) **Hydrosphere:** which provides them with the water necessary for all vital processes,

B) **Atmosphere:** which supplies essential gases such as **oxygen** needed for respiration and **carbon dioxide** required for photosynthesis.

C) Lithosphere : it provides mineral elements through the soil, which plants rely on for their growth and stability.

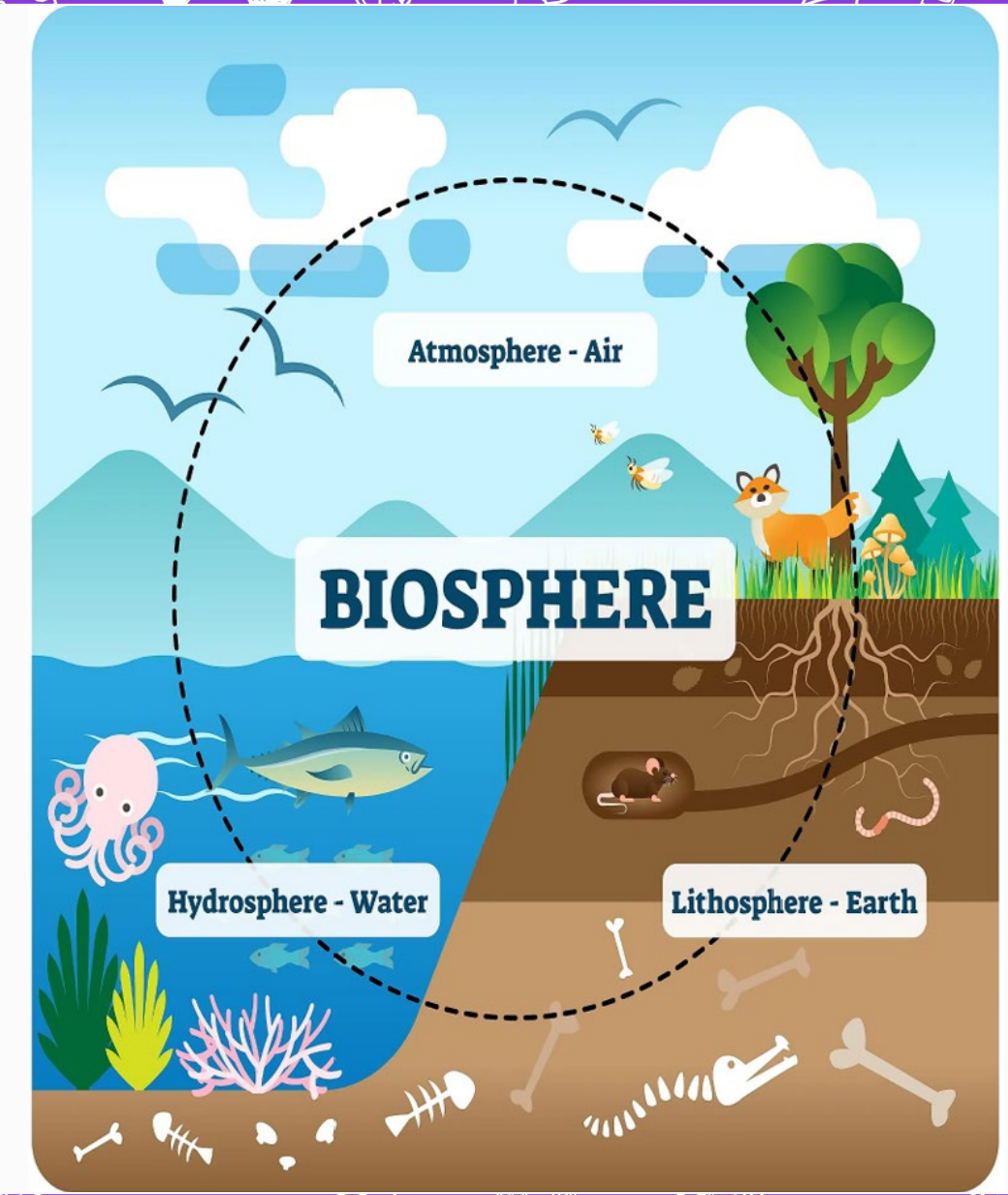
Example:

The **life cycle of a plant** represents a clear example of this interaction.

When a plant absorbs water and minerals from the soil (hydrosphere and lithosphere) and carbon dioxide from the air (atmosphere),

it uses the energy of the sun to produce food, enabling it to grow within the biosphere.

The plant releases oxygen into the air (atmosphere) and returns part of the water to the atmosphere in the form of water vapor (hydrosphere) . When the plant dies, it decomposes in the soil into simple substances (lithosphere)



Biotic and Abiotic factors

Biotic factors: It includes all living organisms such as **plants**, **animals**, and **microorganisms**.

These organisms play different roles within ecosystems:

1) Plants produce food through photosynthesis and serve as the primary source of energy for other organisms.

2) Animals are classified as consumers, feed on plants or other animals (prey) for their food.

3) Decomposers, such as **bacteria** and **fungi**, break down the remains of dead organisms and return essential materials and elements to the environment, allowing the ecosystem to benefit from them again.

Abiotic factors:

these are the **non-living components** of the environment, including light, water, temperature , soil, minerals, and air

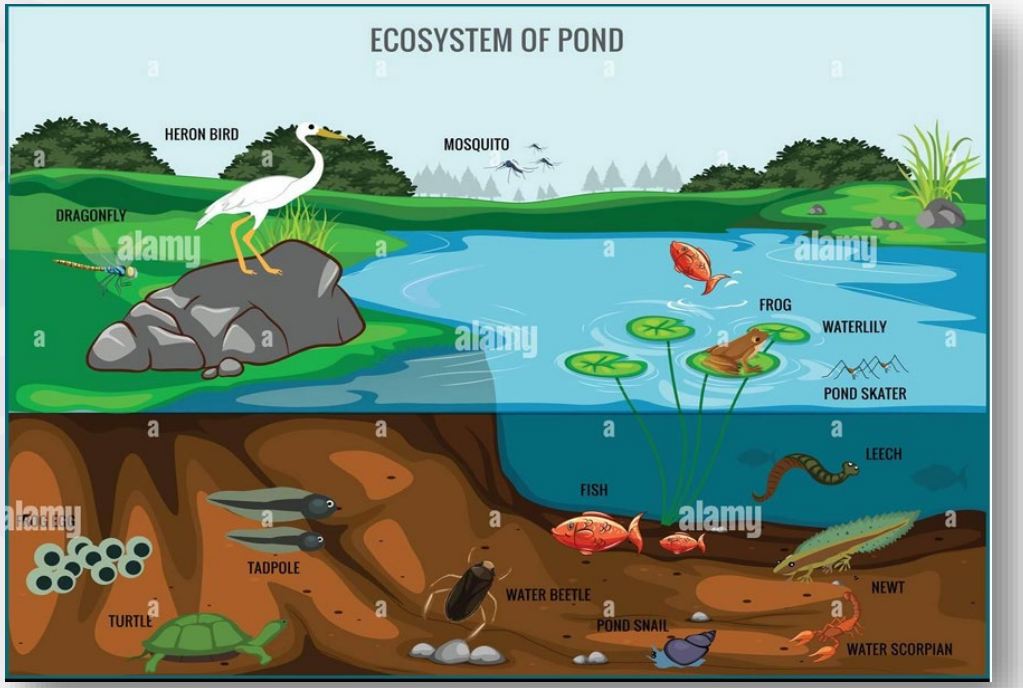
Give reason : These factors are responsible for determining the types of living Organisms that can exist in a particular area?

as each organism requires specific environmental conditions to grow and survive.

when a balanced **ecosystem** is formed? When biotic and abiotic factors interact.

Example in lake ecosystem

fish, algae, and bacteria interact with the physical and chemical elements of the water in a continuous cycle of matter and energy exchange.



Biome:

Large geographic area characterized by specific **climate conditions, plants and animals** that are adapted to that environment.

Examples:

1) rainforests in the Amazon, Africa, and Asia are biomes that share a warm, humid climate and **abundant** biodiversity

2) Deserts share harsh climatic conditions and plants adapted to drought

The highest and most comprehensive level is the **Biosphere**

Levels of organization in the biosphere

- no species in the biosphere can exist in isolation from other species or from its surrounding environment.

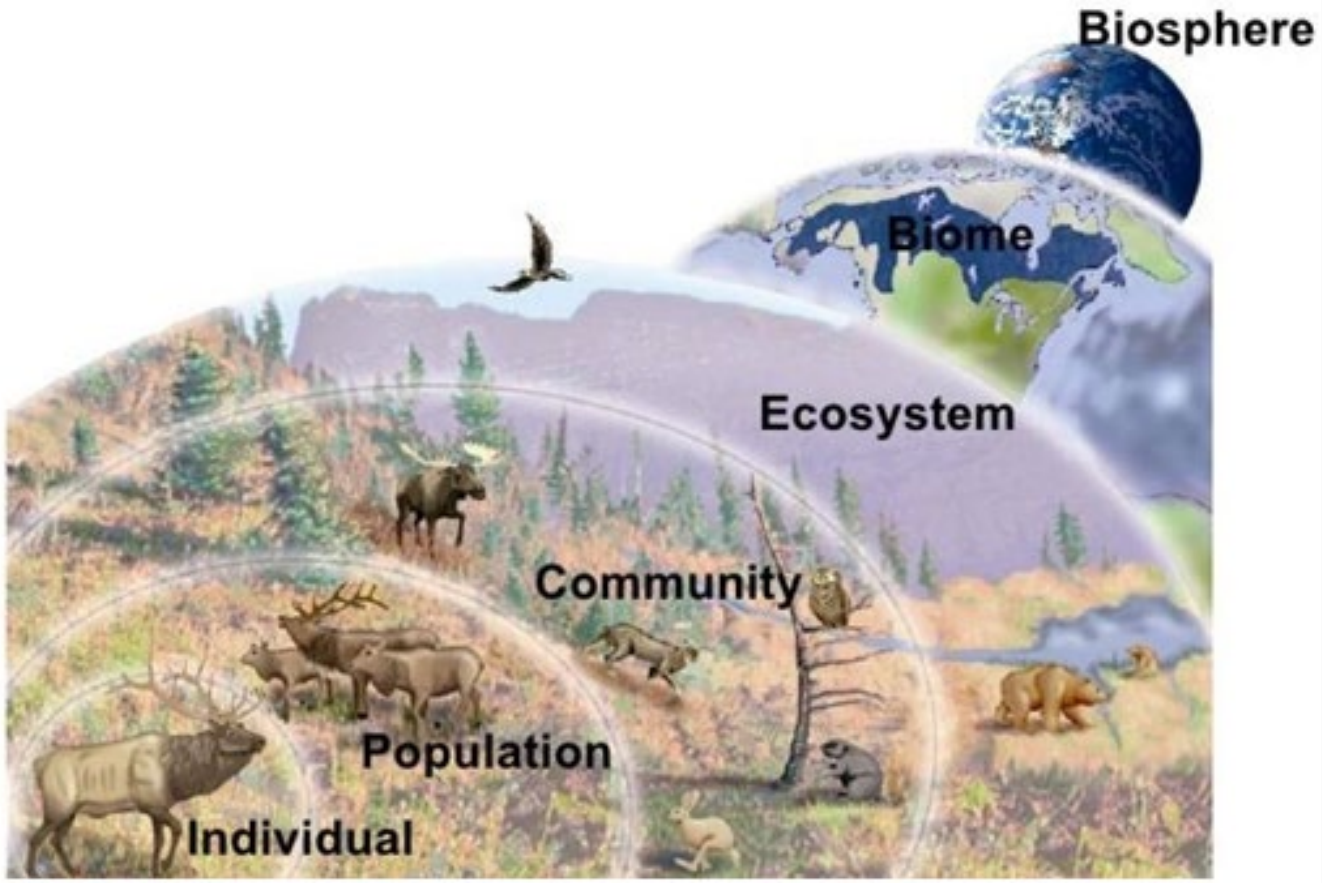
- Life on Earth is organized into **hierarchical levels**, starting with the smallest—the individual organism—and ending with the largest, the **biosphere**, which includes all life on Earth.

First: Individual organism represents the first level, (**single member of a particular species**) such as one fish in a pond or one tree in a forest

Second: Population formed when a group of individuals of the same live together, such as a herd of antelopes in the African savanna or a groups of fish in the Red Sea
where individuals share same place and time and interact in feeding, and protection.

Third: Community formed when different of multiple species live in the same area,
such as forest that includes trees, herbaceous plants, insects, birds, and mammals, all interacting within a complex web of relationships.

Levels of Organization



Food Web

interconnected food chains within an ecosystem that shows how different organisms obtain energy and nutrients from one another.

Energy transfer in the ecosystem

Autotrophic organisms (producers):

Organisms capable of converting inorganic **substances into** organic **compounds in which energy is stored.**

EX: green plants and algae, some specialized bacteria.

Plants use light energy, carbon dioxide, and water to produce sugars and organic food through the process of **photosynthesis.**

$$\underset{\text{Carbon Dioxide}}{6\,CO_2} + \underset{\text{Water}}{6\,H_2O} \xrightarrow[\textit{Chlorophyll}]{\textit{Sunlight}} \underset{\text{Carbohydrate}}{C_6H_{12}O_6} + \underset{\text{Oxygen}}{6\,O_2}$$

Producers: form the base of the pyramid because all the energy available to other levels comes from their conversion of **light** energy into **chemical** energy.

Heterotrophic organisms (Consumers):

which cannot produce their own food. but , they obtain it by consuming producers or other consumer organisms.

Consumer organisms can be divided according to their source of food:

A) Primary consumers (herbivores): feed directly on plants.

B) Secondary consumers : feed on herbivores and may extend to top predators.

C) Decomposers : occupy the next layer of the food pyramid and play a fundamental role in recycling matter within the ecosystem.

Bacteria and fungi break down the remains of dead plants and animals and convert them into simple mineral elements that return to the soil and water

What happens when: absence of decomposers?

organic matter and dead organisms accumulate, the nutrient cycle comes to a halt, and this negatively affects all levels of ecological organization.

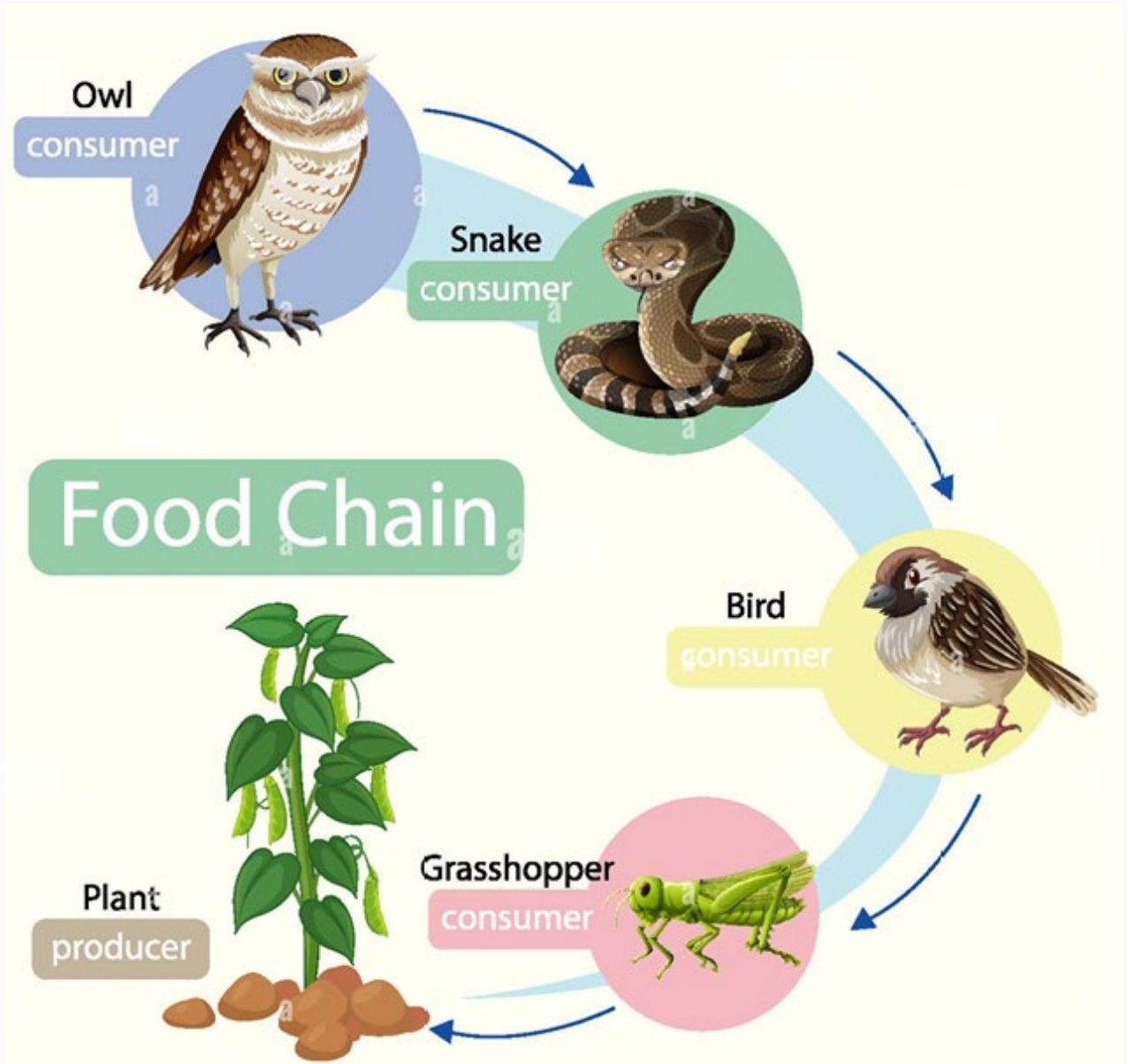
Examples of trophic levels:

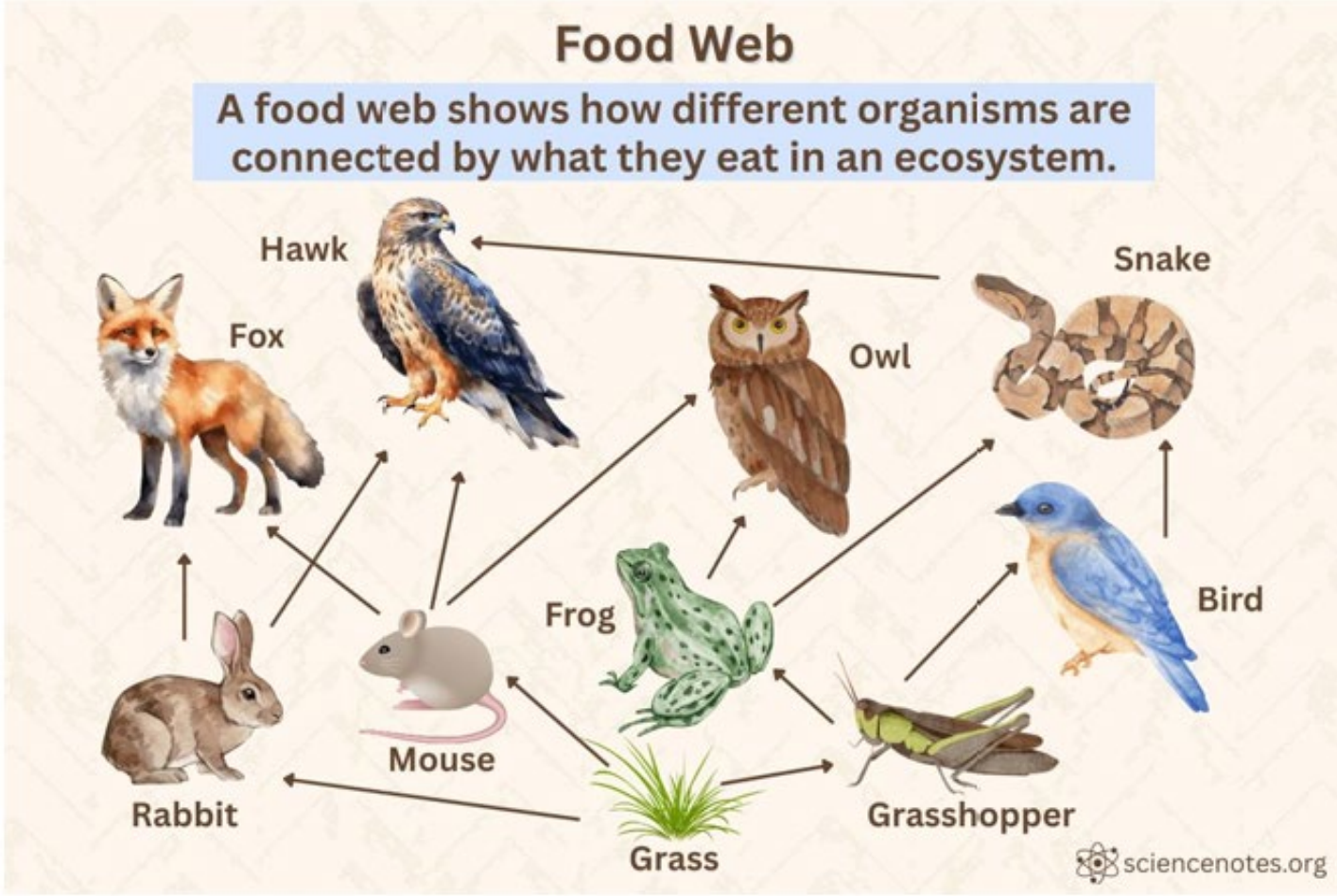
In a river ecosystem, microscopic algae (producers) feed small fish (primary consumers), which in turn feed larger predatory fish (secondary or tertiary consumers).

In a terrestrial ecosystem, trees and plants form the base, feeding rabbits and deer, which are then fed upon by wolves or eagles as higher-level consumers.

For example: in the Nile Delta and the connected lakes, algae act as **primary producers.**

Fish consume small phytoplankton and zooplankton, while water birds and large fish function as top consumers.





Energy flow in Ecosystem

when a herbivorous animal eats a plant, it does not obtain all the energy contained in that plant, but only a small part (10%).

Part of the energy transferred to the animal is stored in its cells and tissues.

As for the remaining energy (90%), it does not pass on to the next trophic level, because it is distributed through several pathways, such as:

1) Energy used by the animal in vital rocesses:

The animal uses part of the energy transferred from the plant to carry out vital processes and activities such as **digestion**, **respiration**, **movement**, and others.

These activities consume a large amount of energy.

2) Energy lost At Heat:

During the animal's activity and performance of vital processes, a quantity of thermal energy is produced and released into the environment, and it is not transferred to the organism that feeds on this animal.

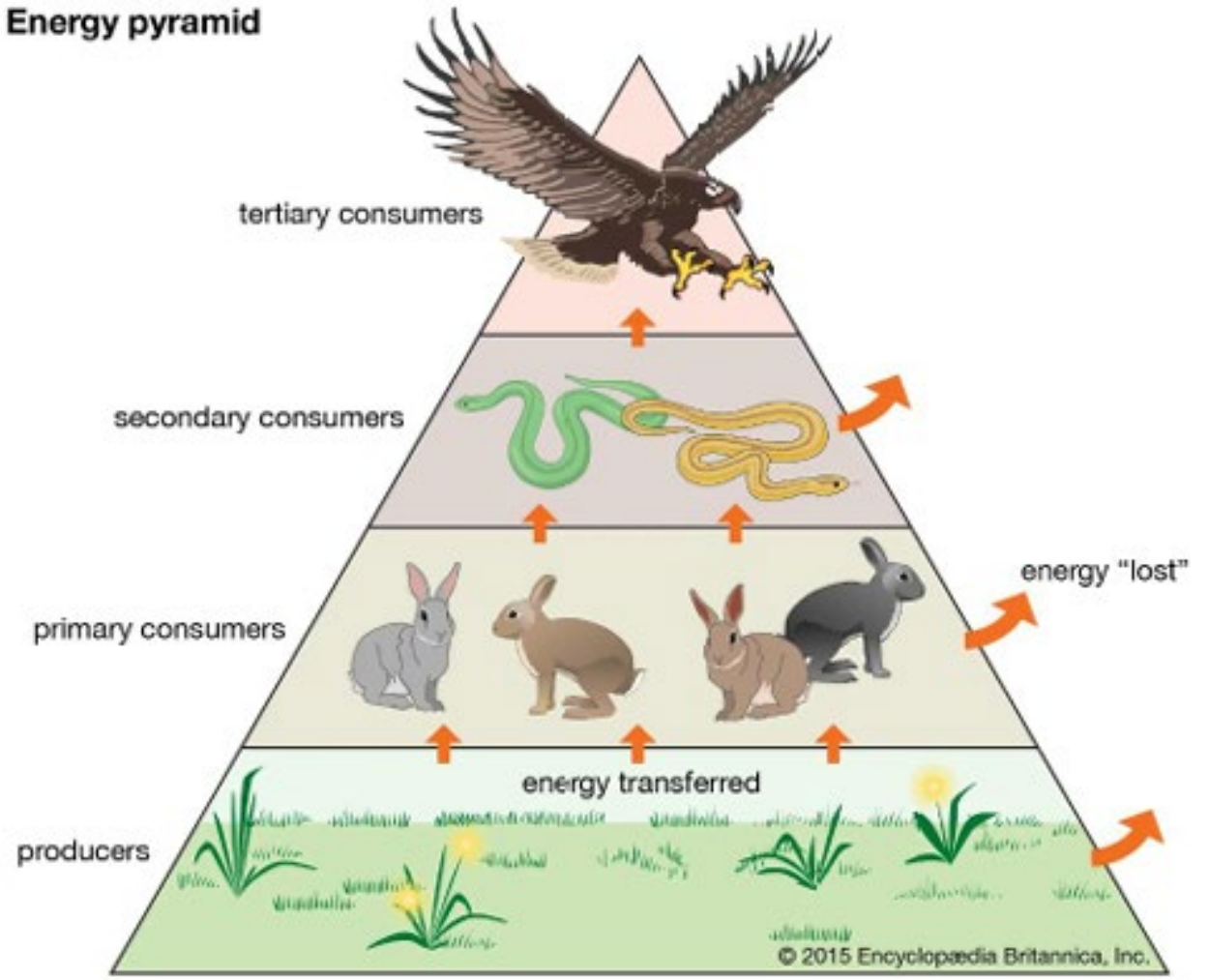
3) Energy stored in materials the animal could not digest:

Some parts of the plant eaten by the animal are not fully digested, such as tough fibers. As a result, the animal excretes part of the energy stored in its waste.

only a small portion of the energy stored in plant tissues is transferred to the herbivorous animal.

Therefore, the amount of energy transferred from one trophic level to the next decreases as
we move up the energy pyramid from producers to consumers.
For this reason, ecological pyramid models are used to represent the amount of energy, the number of organism.

The amount of energy, the number of organisms, or the biomass decreases gradually as we move from one level to the next, because the available energy becomes less.



Give reason: large predators are few in number copmared to the abundance. Of plants and herbivores. ?

because the available energy can support only a small number of individuals.

Example of energy flow:

if you have 10,000 units of energy stored in a certain number of plants (producers),only 1,000 units may reach the herbivores that feed on them (primary consumers), then 100 units to the carnivores that feed on the herbivores (secondary consumers), and perhaps only 10 units to the top predator that feeds on the carnivores (tertiary consumers).

In contrast, in desert areas. producers are limited due to scarce water and extreme heat. Animals adapt to use energy efficiently, and food webs are simpler

and rely more on sporadic food sources. There are also complex food webs composed of multiple interconnected chains, where a consumer does not depend on a single food source but on several.

Technological Applications:

Scientists have developed smart collars equipped with sensors. these are placed around the necks of wild animals in " Kenya." The sensors measure the amount of energy the animal consumes each day during its activities and while searching for food, by monitoring movement rate, pulse, and body temperature.
Using artificial intelligence, the data is analyzed to determine how much energy the animals lose. This innovation helped save herds of the endangered Iberian lynx after researchers discovered that the decline in prey numbers had drastically reduced the energy available to
them.
This allowed experts in these reserves to intervene and provide a better feeding environment.

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