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CLASS X - SCIENCE
OUR ENVIRONMENT
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PK HITS🔥

500

5 March

- 10% Law {Numerical}
- Ozone {formation}
- Biomagnification

TOPICS TO BE COVERED

- Ecosystem
- Types and components of Ecosystem
- Food Chain
- Ecological Pyramids
- Food Web
- Biological magnification
- Ozone
- Wastes

ENVIRONMENT

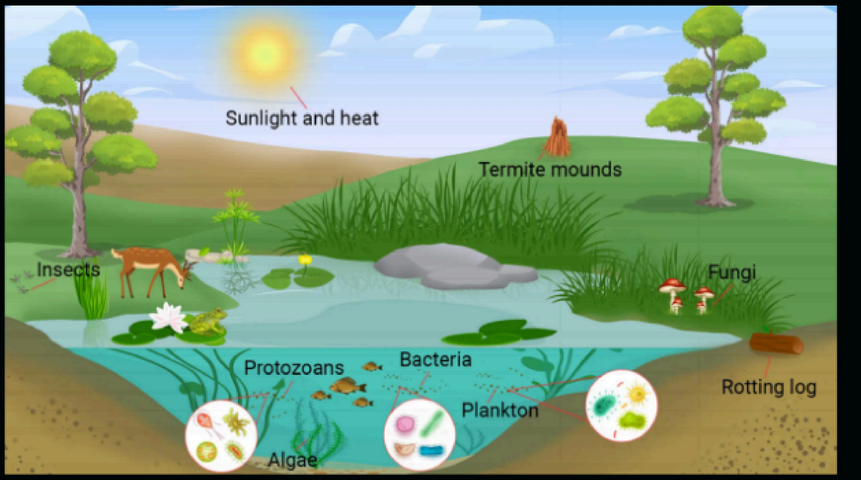
The environment refers to the surroundings and conditions in which an organism or community of organisms lives, including physical, chemical, and biological factors

Habitat - Specific place or type of environment where an organism or community of organisms naturally resides or is adapted to live. .

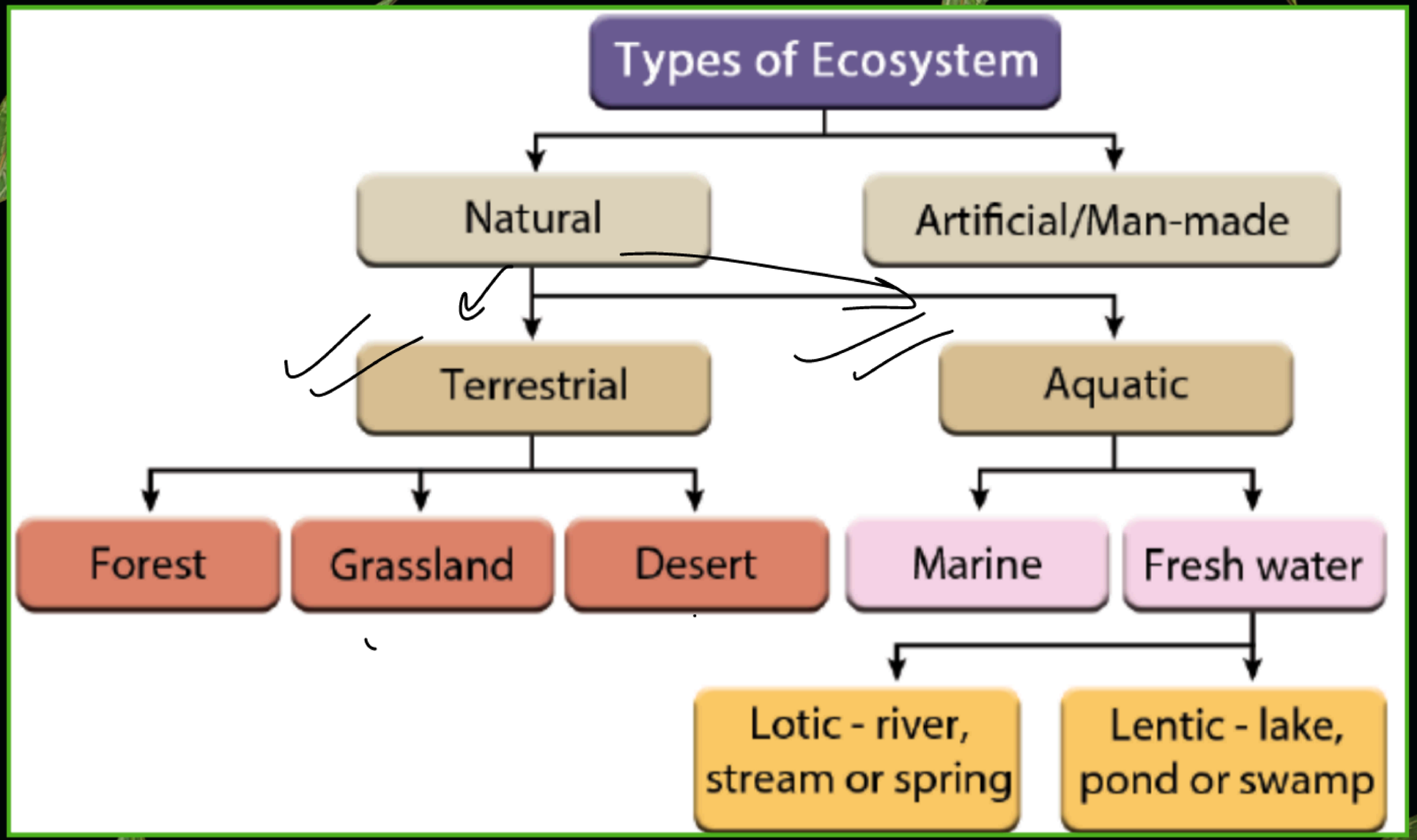
ECOSYSTEM

→ Cyclic

An ecosystem is a community of living organisms (plants, animals, and microorganisms) interacting with each other and their physical environment (such as air, water, and soil).



This dynamic system involves the flow of energy and the cycling of nutrients, creating a complex web of relationships and interdependencies.


Types of Ecosystem
Natural
Artificial/Man-made
Terrestrial
Aquatic
Forest
Grassland
Desert
Marine
Fresh water
Lotic - river, stream or spring
Lentic - lake, pond or swamp

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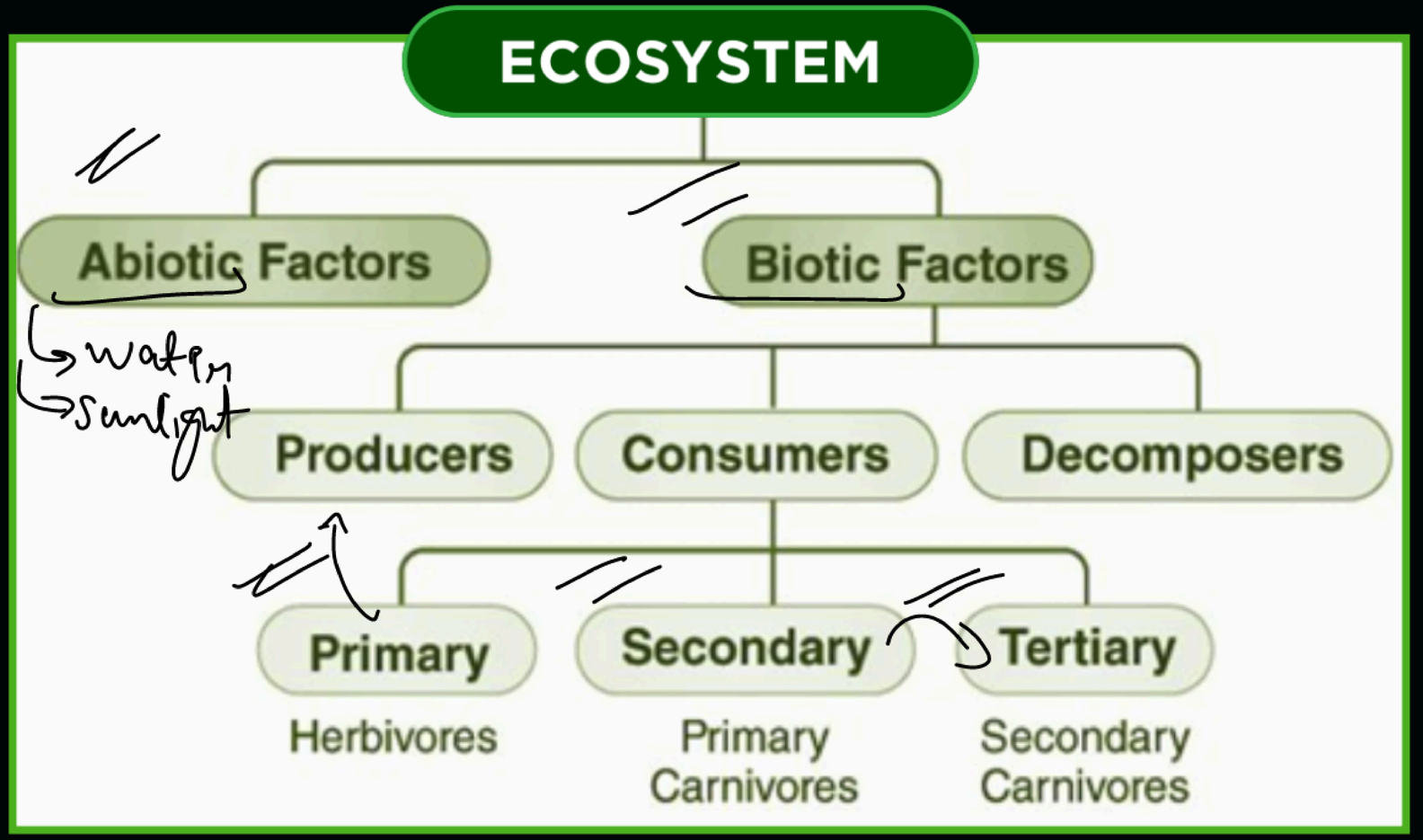
TYPES OF ECOSYSTEM

I. Natural Ecosystem : It exist in nature on its own e.g. eg-forest, lake, ocean depending upon the habitats, it may be

- Terrestrial (desert, grassland, forest)
- Aquatic (ponds lakes)

II. Artificial ecosystem: It is created and maintained by humans, also known as man-made ecosystem.
Agro-system is the largest artificial ecosystem.
e.g. aquarium, garden

COMPONENTS OF ECOSYSTEM



1. ABIOTIC COMPONENT

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All the non-living components such as air, water, land, CO_2, O_2, light, etc., form abiotic components. These components include physical factors such as light, temperature, water, etc.

Factors affecting ecosystem are:

i. **Light**: It is the primary source of energy in all ecosystems. This energy is commonly used by green plants containing chlorophyll during the process of photosynthesis.

ii. **Temperature:** The distribution of plants and animals is greatly influenced by extremes in temperature.

iii. **Atmospheric Gases:** The most important gases are CO_2, O_2, and nitrogen. O_2 is used by all living organisms during respiration, while CO_2 is used by green plants for photosynthesis. These gases also determine the variety of animals living in a particular place.

iv. **Water:** It is essential for life, and all organisms depend on it for survival, especially in desert areas.

2. BIOTIC COMPONENT

All the living components such as plants, animals, bacteria etc form the biotic components.

On the basis of nutrition, the following are types:

Producers

Producers are organisms capable of creating their own food by utilizing abiotic components. They are also known as **autotrophs**.

E.g., all green plants and blue-green algae.

- They serve as the primary source of nutrition for the entire ecosystem.
- They maintain the balance of atmospheric gases by releasing oxygen and absorbing carbon dioxide

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Consumers

Consumers rely either directly or indirectly on producers for their food, making them heterotrophs.

Category	Definition	Examples
Herbivores	Animals that primarily consume plants directly. They are also referred to as primary or first-level consumers.	Goats, Horses
Carnivores	Animals that hunt and eat other animals for their sustenance. These are termed secondary or second-level consumers. Certain carnivores that feed on secondary-level carnivores are identified as tertiary or third-level consumers.	Lions, Tigers
Omnivores	Animals with a diet consisting of both plants and other animals.	Humans, Bears
Parasites	Organisms that live on or within a host organism, deriving nutrients without causing the host's death.	Lice, Cuscuta (Dodder Plant)

Decomposers

Decomposers are organisms that derive nourishment from dead and decaying organic material. They break down the remnants of dead plants and animals, releasing nutrients that benefit other organisms and ecosystems. Examples include bacteria and fungi.

Their roles in the environment include:

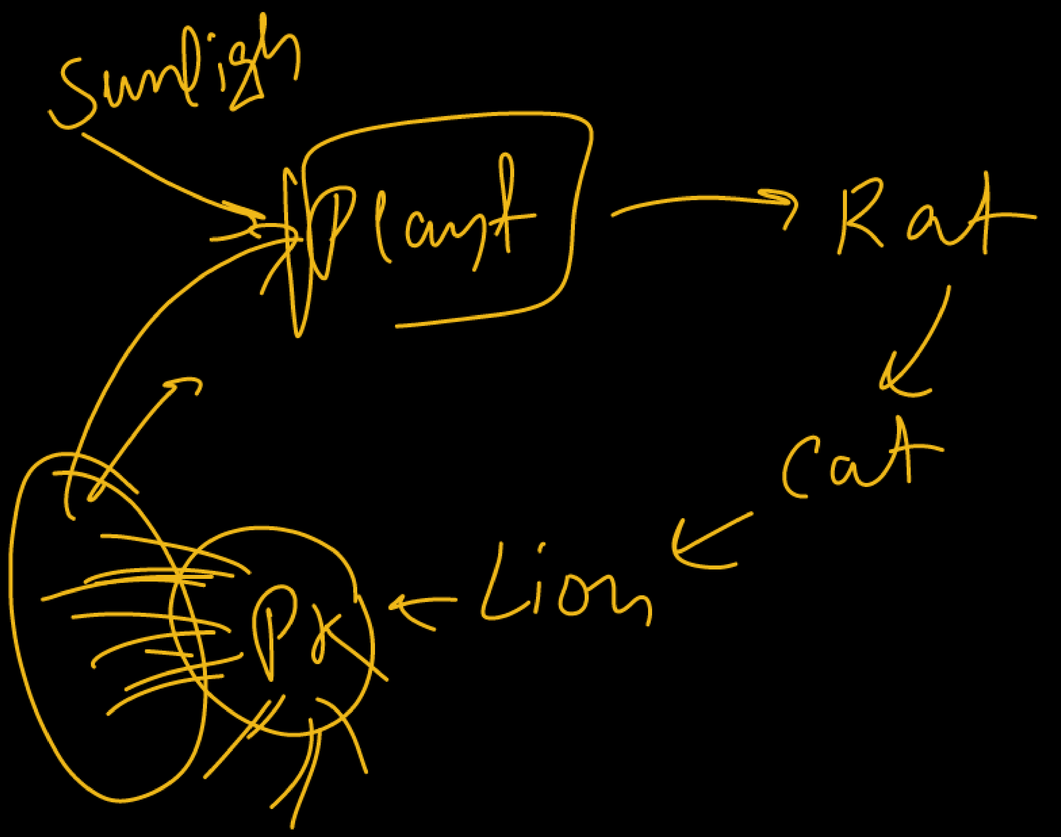
- Assisting in reducing organic waste and replenishing soil nutrients.
- Cleaning the environment by breaking down decaying organic matter and waste.

THE FUNCTIONING OF ECOSYSTEM

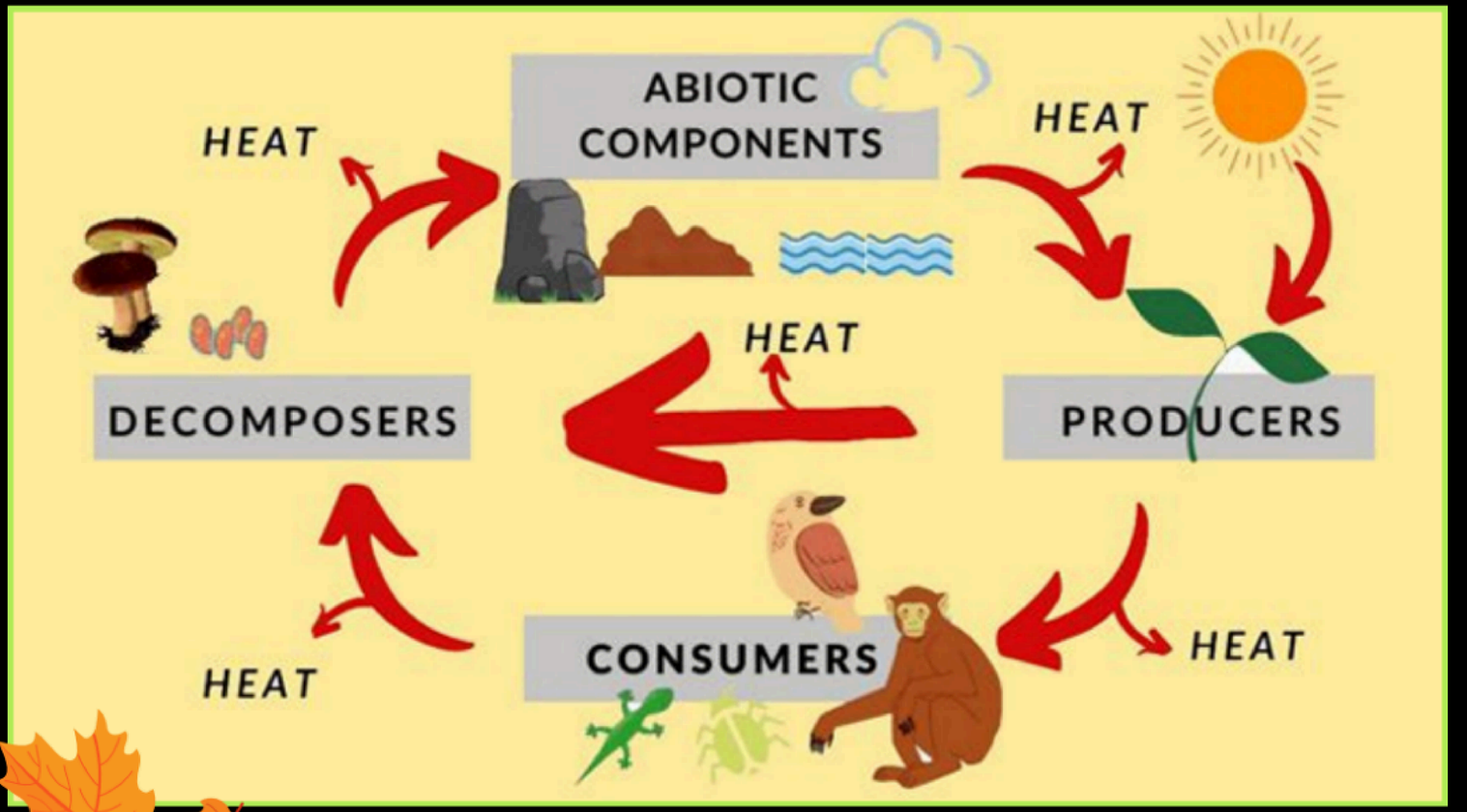
Ecosystem functions as a self-sufficient or independent unit in nature.

All the non-living & living components makes the ecosystem function as follows:

- **From the nutrient pool of the earth (soil, water and air), carbon dioxide, and water are absorbed by the producer organisms (green plants).**
- **With the help of sunlight energy, the producer organisms convert these inorganic substances into organic compounds like carbohydrates which act as food.**
- **The consumers derive their energy directly or indirectly, from producers. When the producers and consumers die, then decomposers act on their dead bodies to return the various elements back to the nutrient pool (soil, water and air).**


Sunlight
Plant
Rat
Cat
Lion
Px

An ecosystem involves input of energy and matter which are exchanged between living and non - living components in a cyclic process.



FOOD CHAIN

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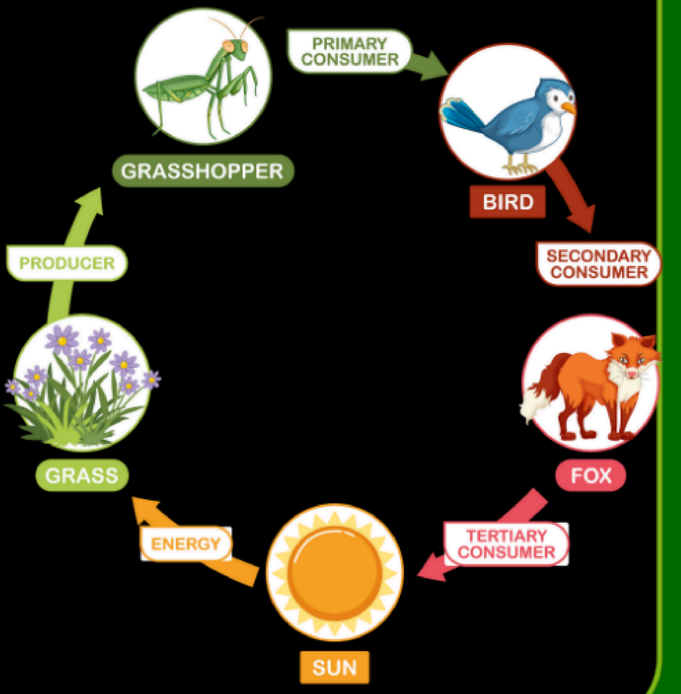
A food chain is the sequence of living organisms in which one organism consumes another for energy transfer.

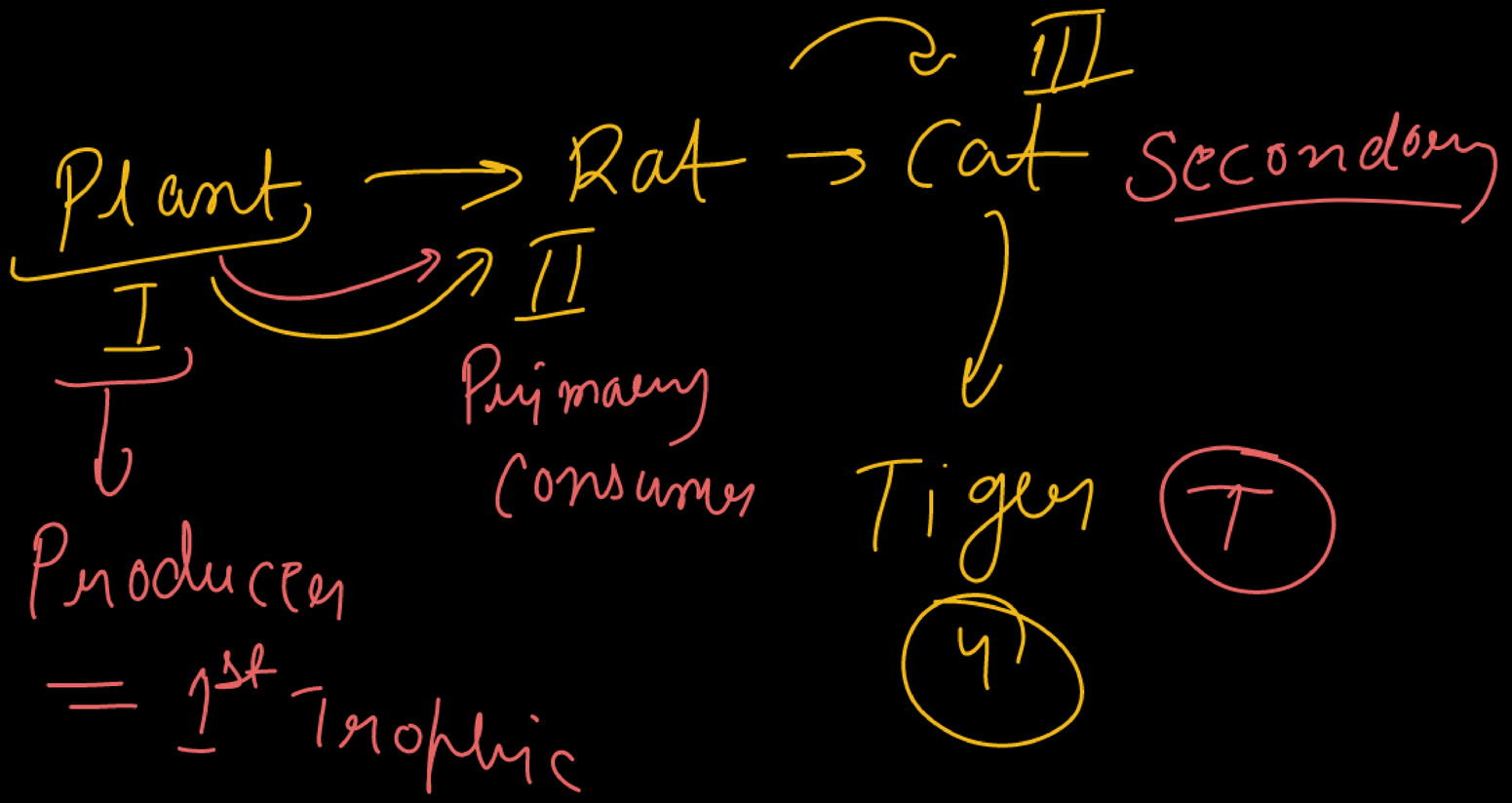
It illustrates how energy flows through an ecosystem, from one trophic level to another.It represents the transfer of energy from one organism to another, starting with producers and moving through various levels of consumers.

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

Levels:

1. **First trophic level** → Producers (autotrophs)
2. **Second trophic level** → Herbivores or primary consumers
3. **Third level** → Carnivores or secondary consumers
4. **Fourth level** → large or tertiary level consumers




Plant
Rat
Cat
Secondary
I
II
III
Primary
Consumer
Producers
= 1st Trophic
Tiger
T
4

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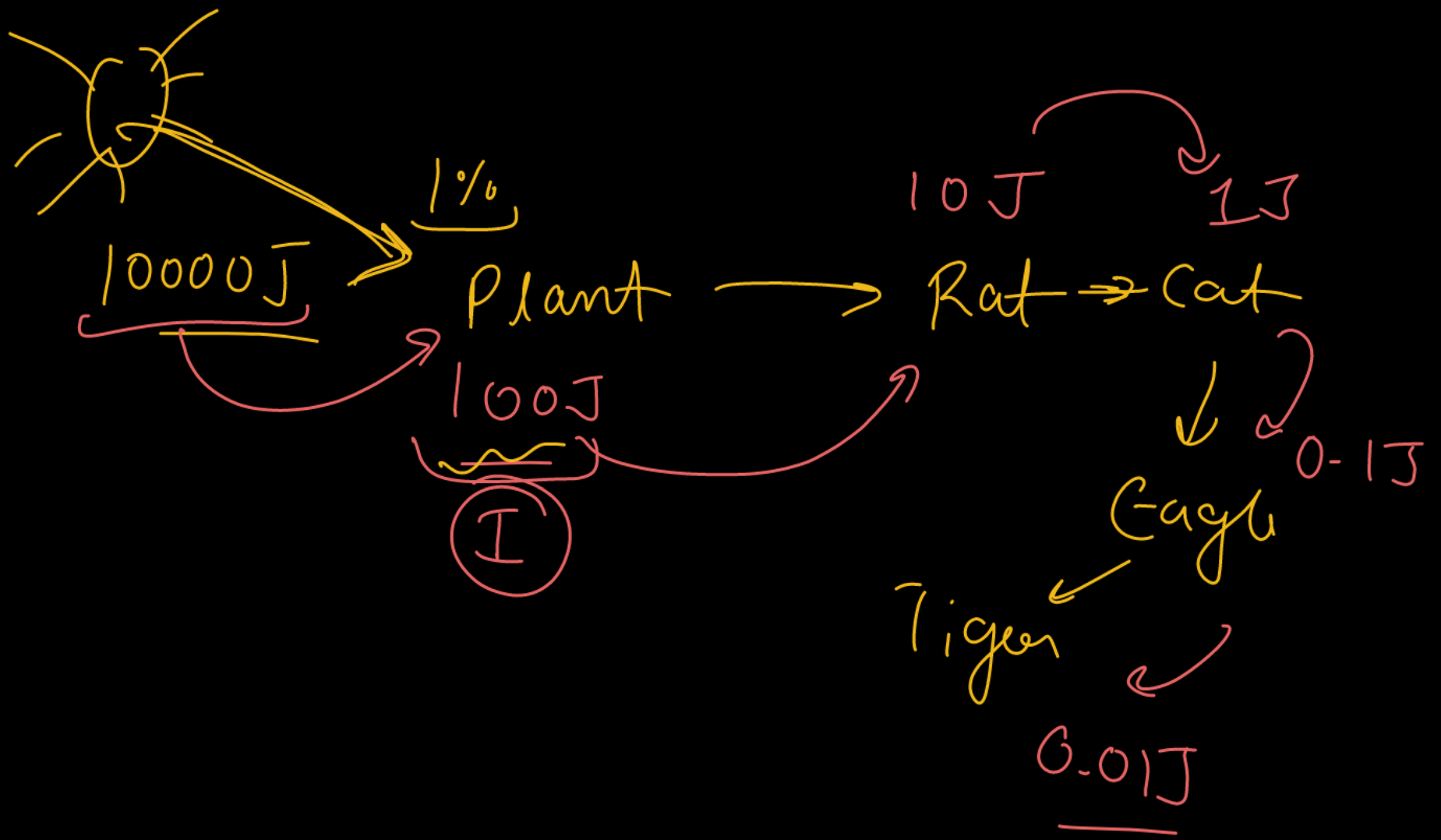
Energy Flow between trophic levels or food chain:

- ***Unidirectional Flow of Energy:*** *Energy flows in one direction, starting from the sun (as the ultimate energy source) to producers and then to consumers.*
- Green plants capture 1% of sunlight and convert in into food energy.
- ***Trophic Levels:*** Each level in the food chain is called a trophic level.
- ***Energy Loss:*** Only about **10% of energy** is passed from one trophic level to the next, with the rest lost as heat (as per the **10% law of energy transfer**).

10% Law

It states that, only about 10% of the energy at one trophic level is transferred to the next trophic level in a food chain or web.

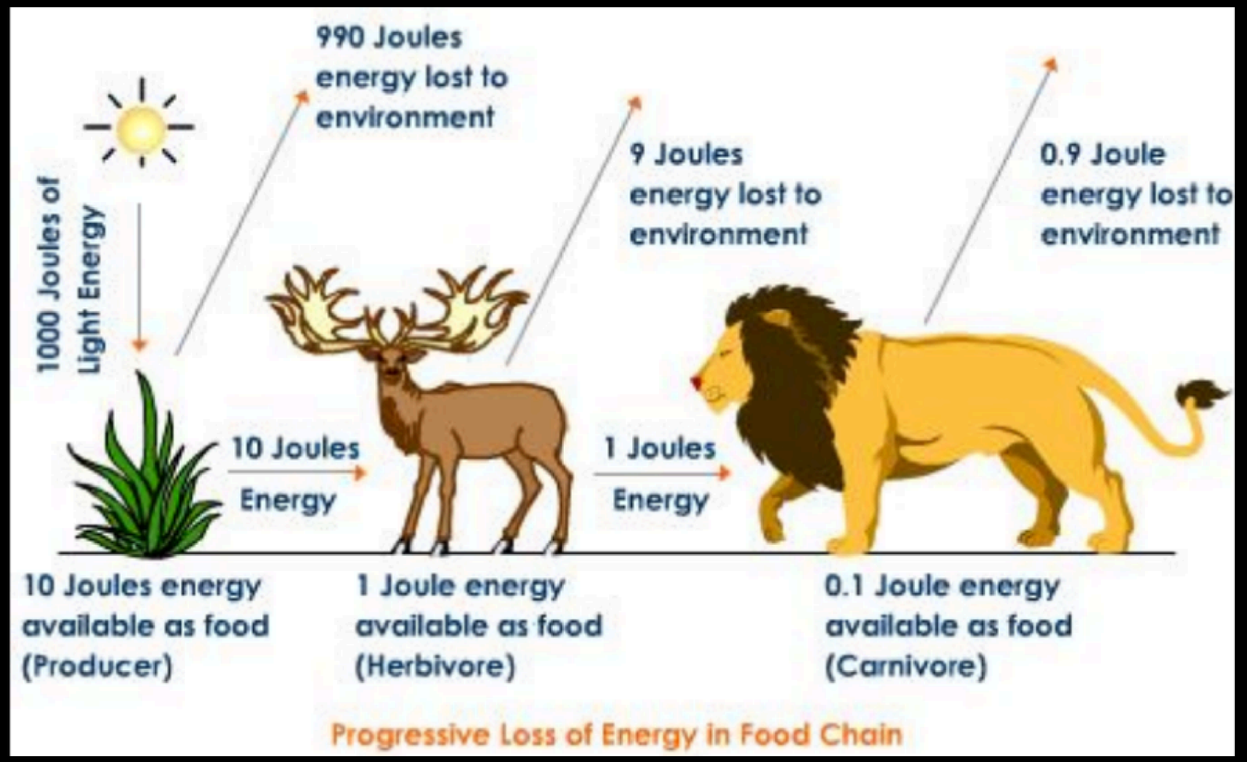

1%
10000J
Plant
100J
I
10J
1J
Rat
Cat
0-1J
Eagle
Tiger
0.01J

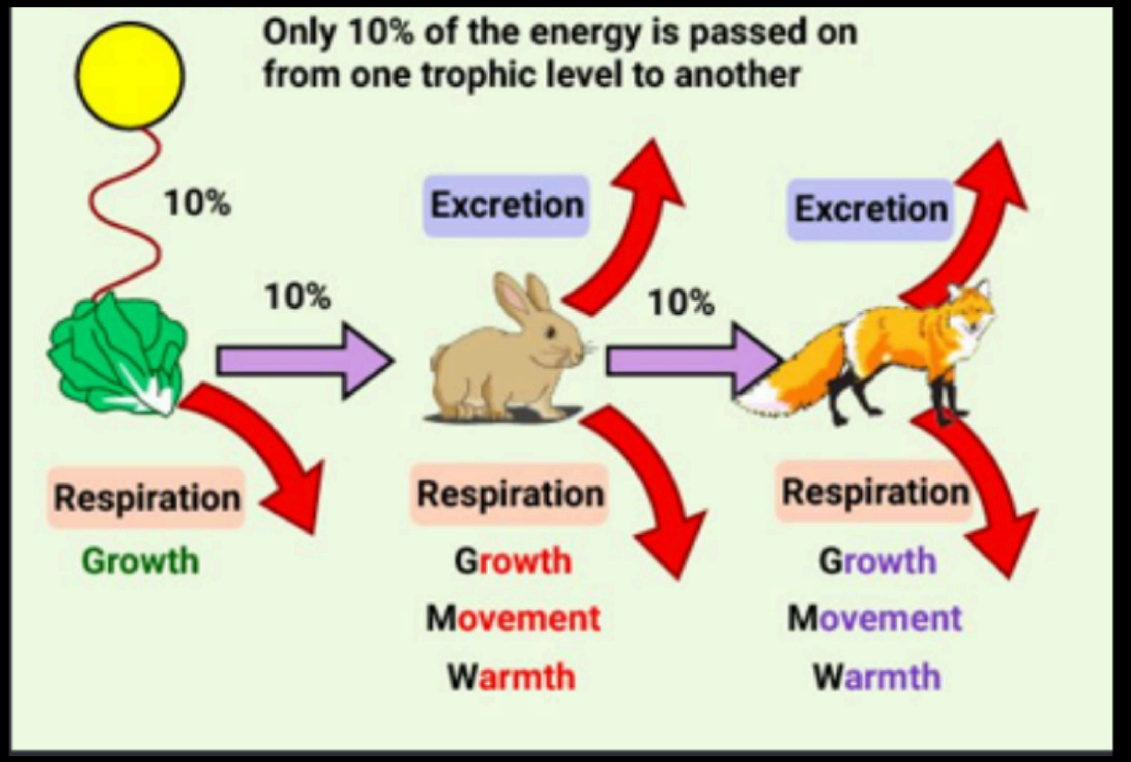
Significance:

Food chains maintain ecological balance and help understand the interdependence of organisms in an ecosystem.
Example: Grass → Grasshopper → Frog → Snake → Eagle

- *90% energy is lost in the form of heat, only 10% energy is transferred to the successive trophic levels.*
- Since, so little energy is available for the next level of consumers, food chains generally consist of only three or four steps.
- The loss of energy at each step is so great that very little usable energy remains after four trophic levels.

Q → Why there is only
3-4 Trophics in a food chain?


990 Joules
energy lost to
environment
9 Joules
energy lost to
environment
0.9 Joule
energy lost to
environment
1000 Joules of
Light Energy
10 Joules
Energy
1 Joules
Energy
10 Joules energy
available as food
(Producer)
1 Joule energy
available as food
(Herbivore)
0.1 Joule energy
available as food
(Carnivore)
Progressive Loss of Energy in Food Chain


Only 10% of the energy is passed on
from one trophic level to another
10%
10%
10%
Excretion
Excretion
Respiration
Growth
Respiration
Growth
Movement
Warmth
Respiration
Growth
Movement
Warmth

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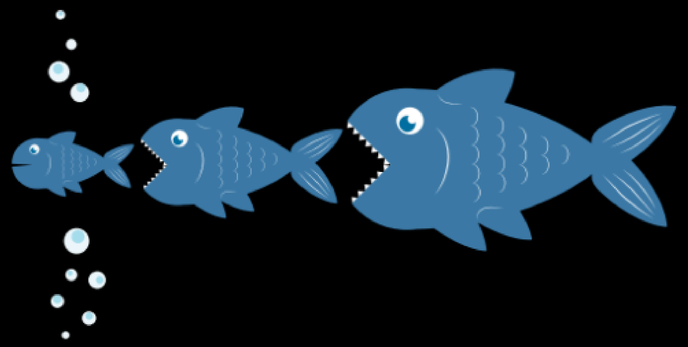
Q. In a food chain, the energy available at the producer level is 50,000 J. Calculate the energy available to the tertiary consumer following the 10% law.

Producers → PC → SC → TC

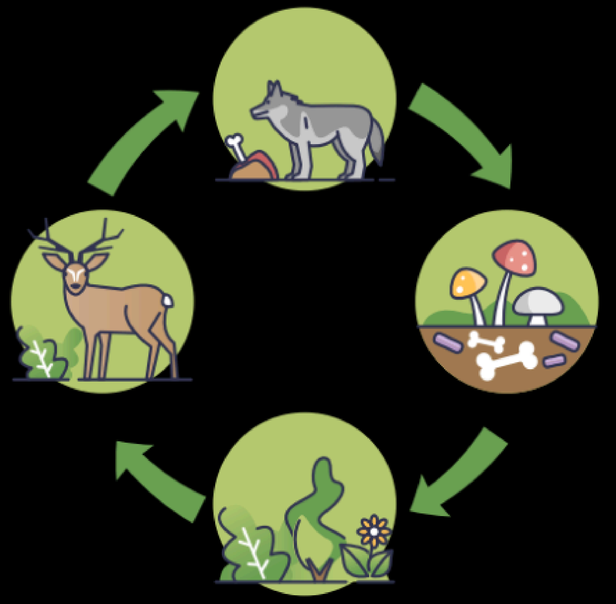
I → 50,000 → 5000 → 500 → 50



Q. The energy at the secondary consumer level is 100 J. Using a diagram, explain the energy flow and calculate the energy at the producer level.

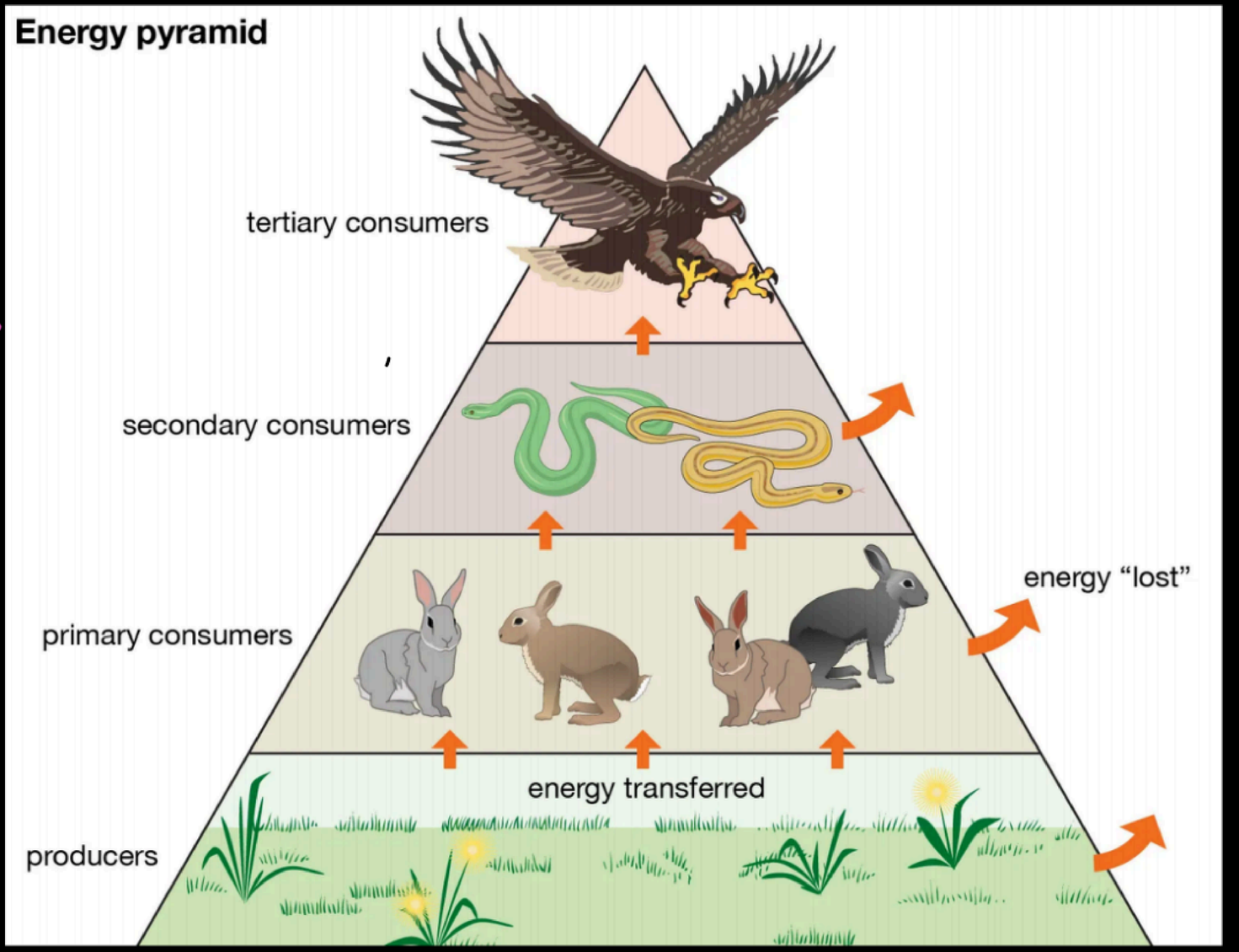
Producer → PC → SC

10,000 J | 1000 | 100 J



ENERGY PYRAMID

10% law



FOOD WEB

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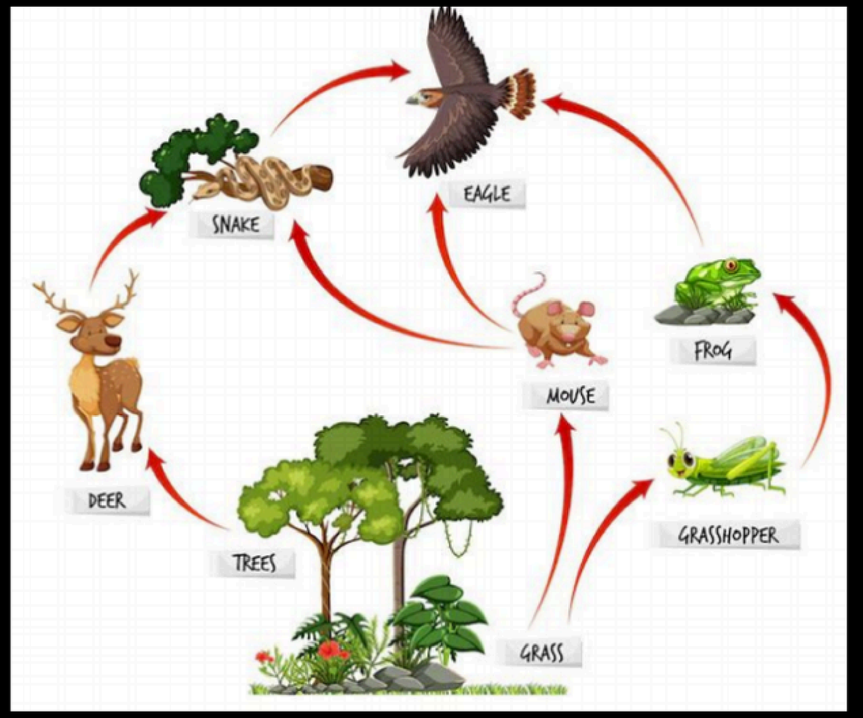
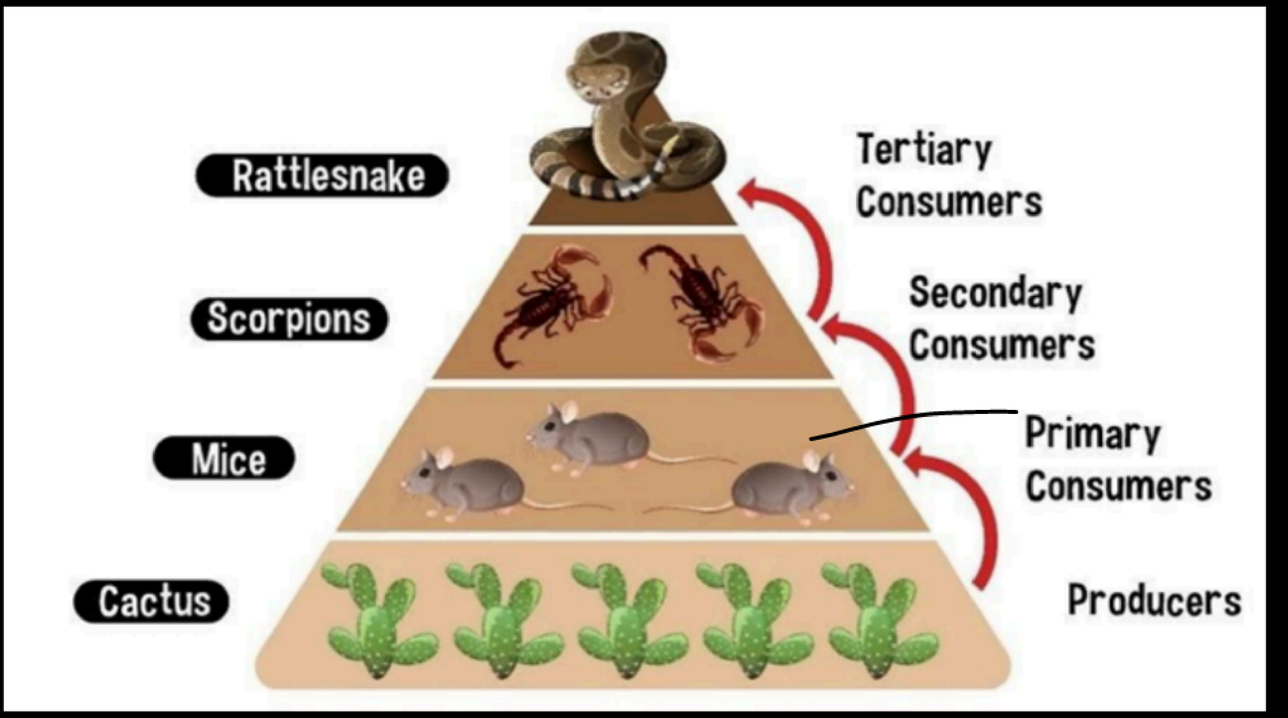
A food web is a network of interconnected food chains that represent the multiple pathways through which energy and nutrients flow within an ecosystem.

It demonstrates how different organisms are interdependent for food.



In deserts:



FOOD WEB

Significance of Food Chain are:

- **Energy Flow:** Transfers energy from producers to consumers, sustaining life.
- **Ecosystem Balance:** Regulates population levels and prevents overexploitation of resources.
- **Nutrient Recycling:** Decomposers recycle nutrients back into the soil for plants.
- **Biodiversity Support:** Maintains a variety of species in an ecosystem.
- **Environmental Indicator:** Reflects the health of ecosystems; disruptions signal ecological issues.
- **Human Survival:** Supports agriculture, fisheries, and natural resource management.

FOOD CHAIN V/S FOOD WEB

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Food Chain

- A food chain is a linear flow of energy and nutrients from one organism to another.
- An organism of higher level trophic feeds on a specific organism of lower trophic level.
- Does not affect the adaptability and competitiveness of organisms.

Food Web

- A food web can be termed as the combination of many different food chains and the relationship between organisms.
- An organism of a higher trophic level has access to more members of a lower trophic level.
- It has a role in improving the adaptability and competitiveness of an organism.

BIOMAGNIFICATION

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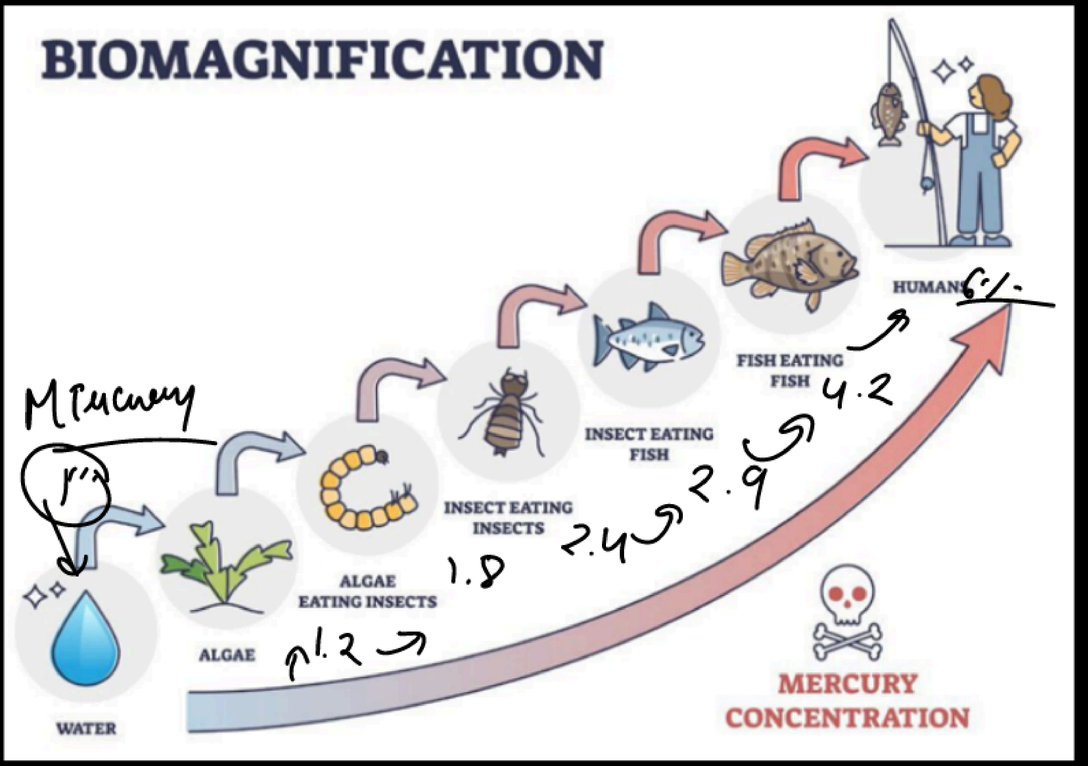
Biomagnification is the process by which the concentration of harmful substances (like pesticides, heavy metals, or toxins) increases at each successive trophic level in a food chain.



Cause:

- *Introduction of pollutants (non-biodegradable substances) into the ecosystem.*
- *These substances are absorbed by producers and cannot be metabolized or excreted.*

Examples of Toxins:

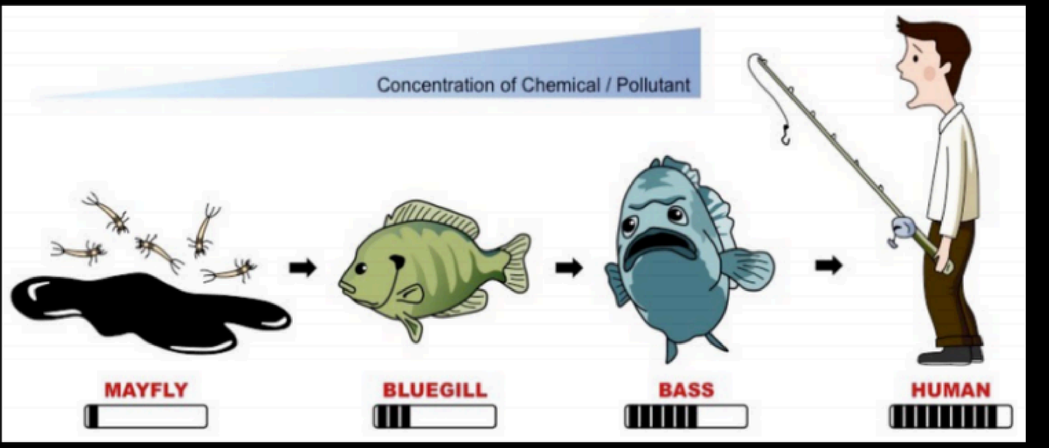
- DDT (Dichlorodiphenyltrichloroethane): A pesticide that enters aquatic ecosystems.
- Mercury: Found in water bodies, leading to poisoning in aquatic life and humans.

Impact on Ecosystem:

- Top consumers (like humans and birds of prey) are most affected due to higher toxin levels.
- Causes health issues like reproductive failure, developmental problems, and death.

Preventive Measures:

- Reduce the use of pesticides and fertilizers.
- Proper disposal of industrial waste.
- Use biodegradable substances.



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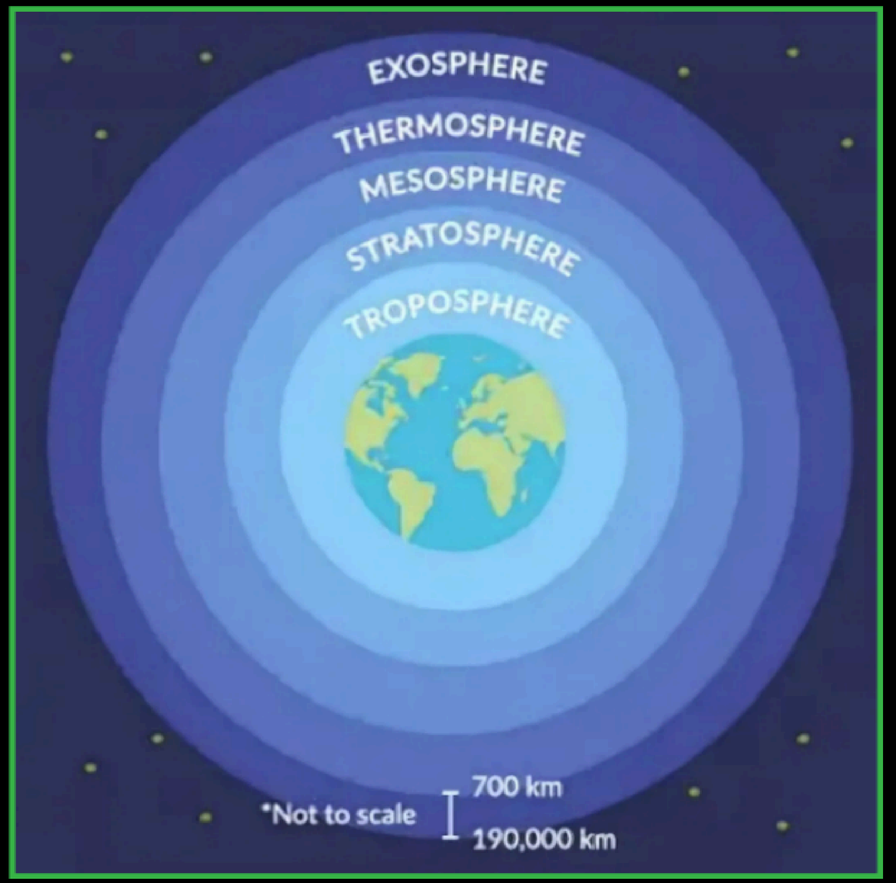
OZONE

O_3

- *In the troposphere, ozone is a deadly poison. However, at the higher levels of the atmosphere,that is, in the stratosphere, ozone performs an essential function.*

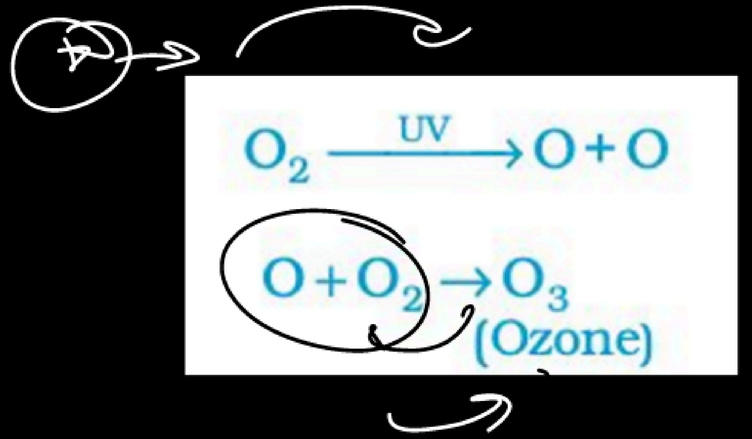
- Ozone is a molecule consisting of three oxygen atoms (O_3), present in the Earth's atmosphere.

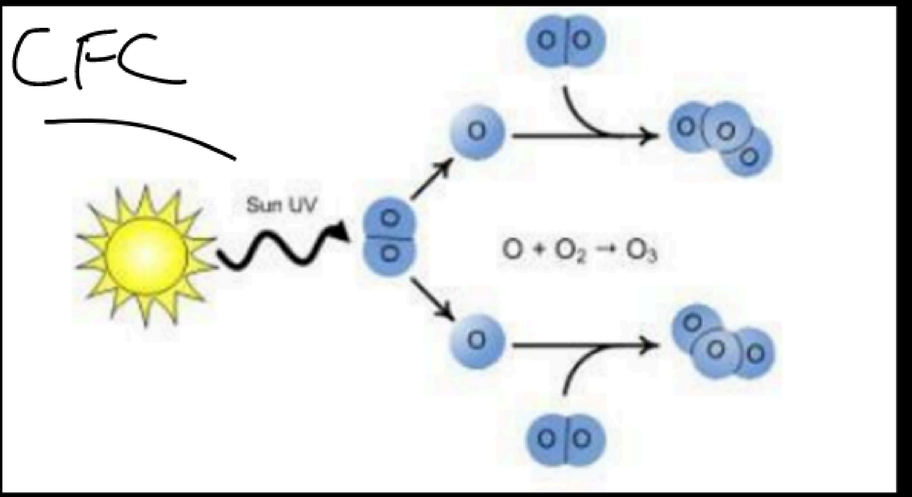
- It creates a protective shield in the stratosphere, known as the ozone layer, which absorbs harmful ultraviolet (UV) radiation from the sun.



Formation of Ozone:

High-energy UV radiation from the sun splits oxygen molecules (O_2) into individual oxygen atoms. These highly reactive oxygen atoms combine with O_2 to form ozone molecules (O_3).





Function of the Ozone Layer:

The ozone layer, concentrated in the upper atmosphere, plays a vital role in absorbing most of the sun's harmful UV rays.

Without it, increased UV exposure could lead to skin cancer, cataracts, and disruptions in global rainfall patterns.

Depletion of the Ozone Layer:

The ozone layer is primarily depleted by synthetic chemicals called chlorofluorocarbons (CFCs), used in refrigerators and other appliances.

CFCs are stable and persist in the atmosphere. When exposed to UV radiation, they release chlorine, which reacts with ozone, breaking it down into oxygen molecules.

$$CFC \xrightarrow{UV} Cl_2 + O_3 \rightarrow$$

Ozone hole is a region of exceptionally depleted ozone in the stratosphere over the Antarctic that happens at the beginning of the Southern Hemisphere spring (August–October).

In 1987, the United Nations Environment Programme (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 levels. It is now mandatory for all the manufacturing companies to make CFC-free refrigerators throughout the world.

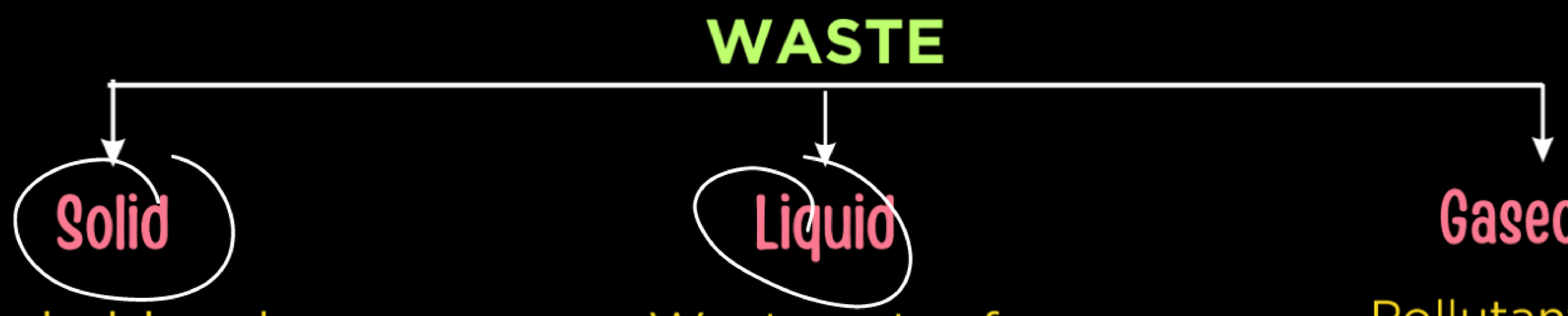
HARMFUL EFFECTS OF DEPLETION OF O_3 LAYER:

- ***Respiratory Issues:*** Ground-level ozone can exacerbate respiratory problems like asthma and other lung diseases.
- ***Irritation:*** It can cause discomfort by irritating the eyes, nose, and throat.
- ***Plant Damage:*** Ozone can negatively impact vegetation, reducing crop yields and harming forests.

- ***Air Quality:*** Ground-level ozone contributes to smog, leading to poor air quality and environmental pollution.
- ***Global Warming:*** The loss of stratospheric ozone protection intensifies UV radiation effects, indirectly influencing climate change.

WASTES

WASTE: Unwanted or unusable substances produced as a result of various human and natural activities.



Type of Waste	Biodegradable Wastes	Non-Biodegradable Wastes
Definition	**Consists of organic materials that can be broken down by microorganisms.**	**Materials that do not decompose easily and persist for long periods.**
Decomposition	Decomposes naturally in the environment by the action of microorganisms.	Does not decompose naturally.
Environmental Impact	Environment friendly.	Harmful to the environment and causes pollution.
Composition	Made up of natural ingredients.	Made up of synthetic materials.
Recycling/Conversion	Can be converted into manure or recycled.	Can be reused or recycled.
Examples	Food scraps, paper, wood crumbles, etc.	Plastic bags, cans, disposable bottles, certain plastics, glass, etc.

METHODS OF WASTE DISPOSAL

Landfill

Incineration

Waste Compaction

Biogas Generation

Composting

Vermicomposting

1. RECYCLING

- Converts waste materials into new products.
- Reduces the amount of non-biodegradable waste.
- Recyclable materials include tin cans, metal objects, rags, paper, and glass.

2. LANDFILL

- Disposes of waste that cannot be reused or recycled.
- Waste is spread in thin layers in low-lying areas.
- Soil is added on top of each layer of waste.
- Landfilled areas are not suitable for building for 20 years.

3. COMPOSTING

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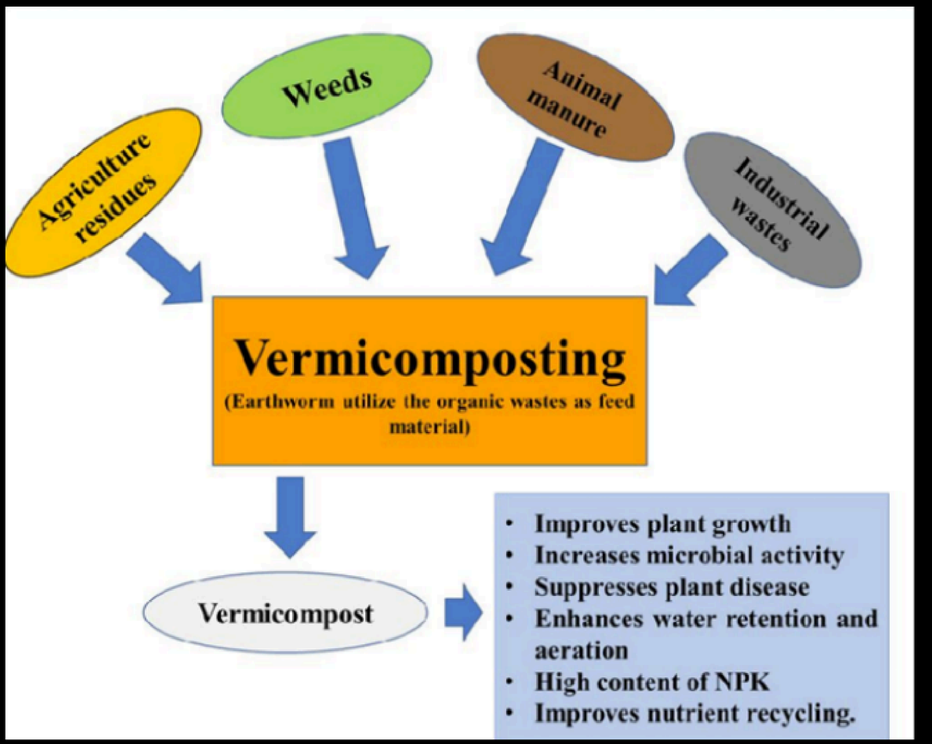
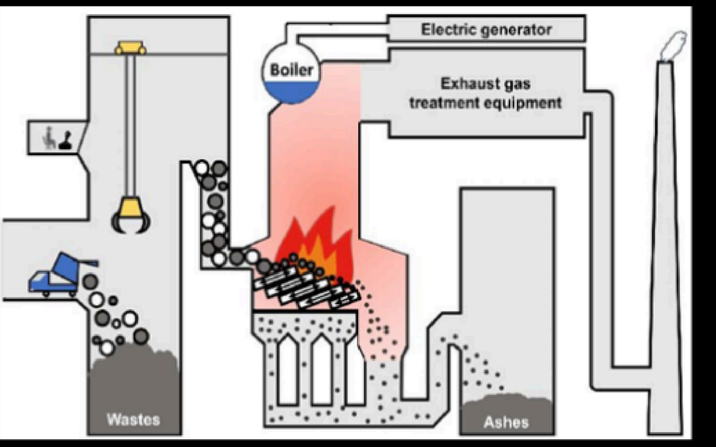
Worms

- Decomposes organic waste into nutrient-rich soil.
- Vermicomposting uses worms to speed up the process.
- Benefits of composting include improved plant growth, increased microbial activity, suppressed plant diseases, enhanced water retention, and improved nutrient recycling.



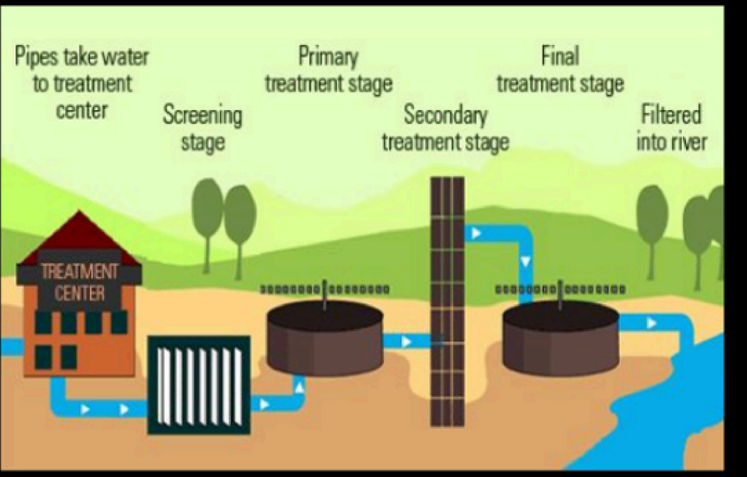
4. INCINERATION

- Burns substances at high temperatures to form ash.
- Significantly reduces the volume of waste.
- Commonly used to dispose of hospital waste.



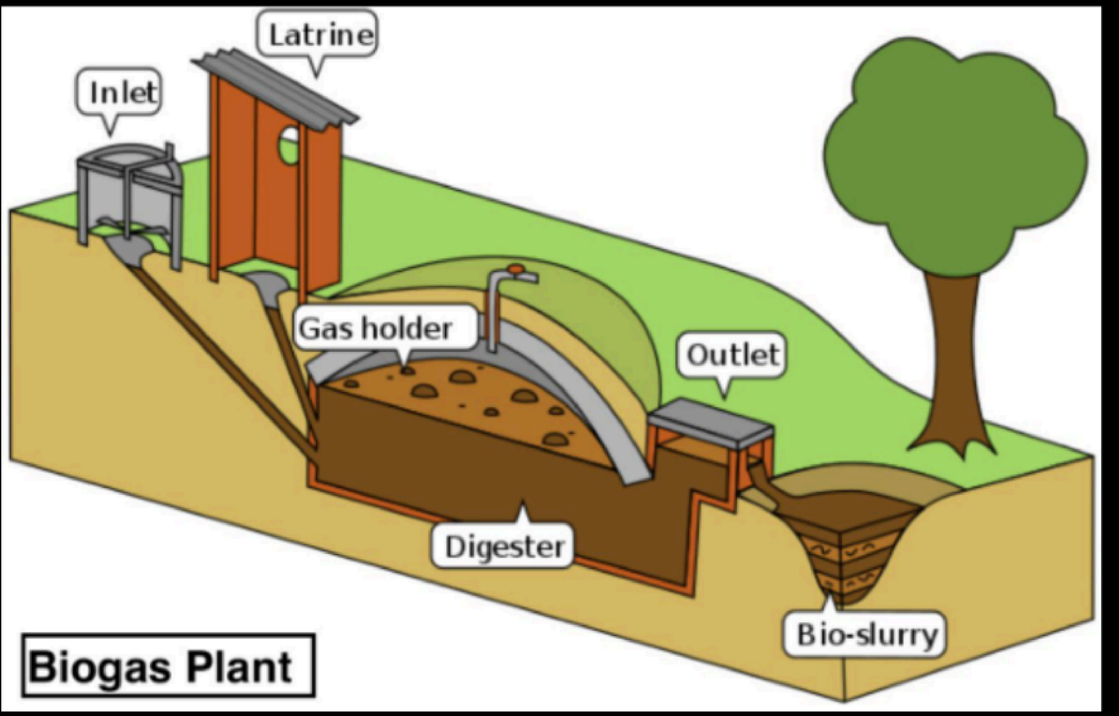
5. SEWAGE TREATMENT

- Sewage treatment plants (STPs) filter sewage.
- Organic matter in sewage settles and decomposes in large tanks.
- Cleaned water is released into water bodies.



6. BIOGAS PRODUCTION

- Biogas plants convert biodegradable waste into biogas with the help of microbes.
- Organic matter serves as food for these microbes.
- The process can be aerobic (with oxygen) or anaerobic (without oxygen).
- Biogas is used as fuel, and the residue is used as manure.



WASTES

Ways in which biodegradable wastes would affect the environment:

- **Landfill Emissions:** Decomposition of biodegradable wastes produce methane, a potent greenhouse gas that contributes to climate change.
- **Soil Contamination:** It can lead to the leaching of harmful substances into the soil, impacting its quality and fertility.
- **Water Pollution:** It can contaminate water sources, leading to water pollution and negatively affecting aquatic ecosystems.
- **Odor and Aesthetic Issues:** It can produce unpleasant odors and aesthetically unappealing conditions, impacting the quality of life for nearby residents.

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Q.Which statement shows the interaction of an abiotic component with a biotic component in an ecosystem? (2021)

a) A grasshopper feeding on a leaf

b) Rainwater running down into the lake

c) An earthworm making a burrow in the soil

d) A mouse fighting with another mouse for food

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Q.The number of atoms of oxygen present in ozone are

O_3

I. 3

II. 4

III. 2

IV. 1

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Q. “Energy flow in a food chain is unidirectional”. Justify.

Flow of energy in ecosystem is always unidirectional. This is because the energy that captured by autotrophs cannot revert back to solar input and energy which passes to herbivores cannot come back to autotrophs. The energy moves progressively through various levels.

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Q._____ is not a biodegradable pollutant.

I. Paper

II. Cotton cloth

III. Cotton

IV. DDT

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Q.The amount of energy that flows from one trophic level to another in a food chain is (2023)

a) 5%

b) 10 %

c) 20 %

d) 15 %

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Q.The primary consumers are

a) Carnivores

b) Herbivores

c) Omnivores

d) Producers

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Q.With regard to various food chains operating in an ecosystem, man is a:

(a) Consumer

(b) Producer

(c) Producer and consumer

(d) Producer and decomposer.

(2020)

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Q. Choose the incorrect statement from the following:

(a) Ozone is a molecule formed by three atoms of oxygen.

(b) Ozone shields the surface of the earth from ultraviolet radiations.

(c) Ozone is deadly poisonous.

(d) Ozone gets decomposed by UV radiations.(2020)

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8

Q. We do not clean ponds or lakes, but an aquarium needs to be cleaned. Explain

An aquarium is an example of an incomplete artificial ecosystem. In aquarium the uneaten food as well as the waste generated by the fishes mixes with the water and is left untreated due to the lack of decomposers The waste materials thus accumulate in the water making it toxic. Hence an aquarium has to be cleaned after regular intervals.

NE	AE
⇒ Decomposers	X

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Q. Why do food chains in an ecosystem do not have more than 4 to 5 trophic levels?

According to 10% percent law only 10 % energy is transferred from one trophic level to another so during the transfer of energy the loss of energy at each step of food chain is so great that very little amount of usable energy remains after four to five trophic levels. Hence, food chains generally consist of only four or five trophic levels

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Q. Why are crop fields known as artificial ecosystem?

- Human Intervention: They are created and managed by humans for agricultural purposes, involving deliberate planting, cultivation, and harvesting.
- Monoculture: Often characterized by the cultivation of a single crop species, leading to simplified biodiversity compared to natural ecosystems.
- Controlled Conditions: Farmers control factors such as water, nutrients, and pests to optimize crop growth, in contrast to the more dynamic and diverse conditions in natural ecosystems.
- Selective Breeding: Agricultural practices often involve the selective breeding of plants to enhance desirable traits, diverging from the natural processes of evolution.
- Artificial Inputs: The use of fertilizers, pesticides, and irrigation represents artificial inputs not typically found in natural ecosystems.

Abhay Premier League

अभय

Q.In the following food chain, plants provide 500 J of energy to rats. How much energy will be available to hawks from snakes?

Plants → Rats → Snakes → Hawks (2017)

500J → 5

Answer: In an ecosystem, only 10% of energy is transferred from one trophic level to next, i.e. 10 percent law and rest is dissipated into the environment. Therefore, if plants (being producers-1st trophic level)-transfer 500 J of energy to rats (2nd trophic level) then rats would transfer 50 J of energy to snakes (3rd trophic level) which in turn will transfer only 5 J of energy to hawks (4th or last trophic level) in a food chain.

Plants	→ Rats	→ Snakes	→ Hawks
5000 J	500 J	50 J	5 J

Grass → Insect → Frog → Snake → Hawk
10000 00 10000 0 10,000 → 1000 → 100

अभय

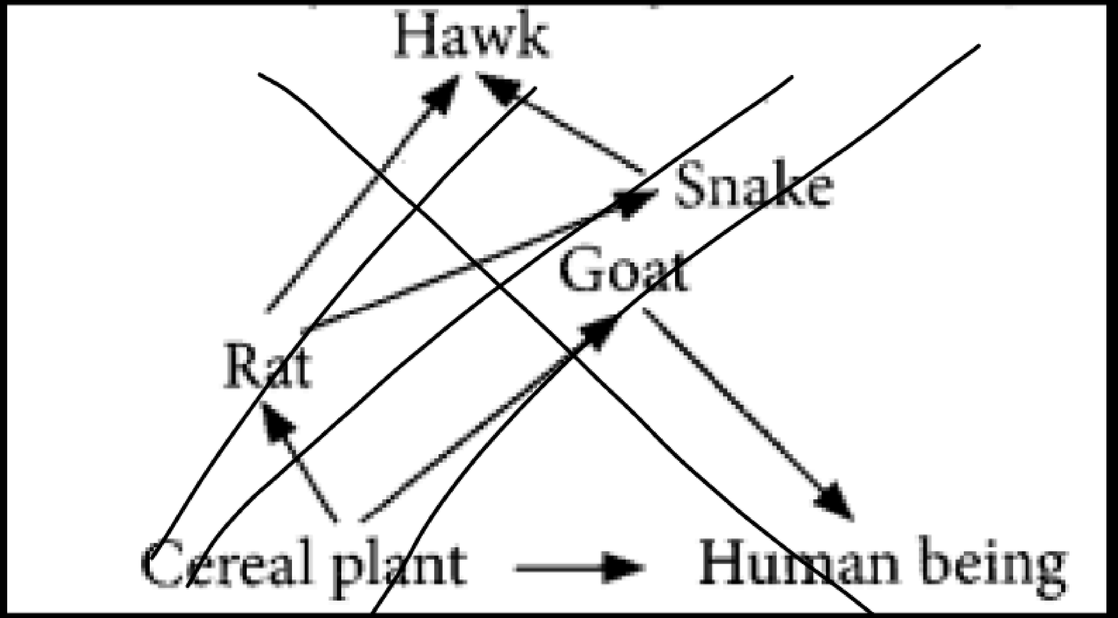
(a) Create a food chain of the following organisms.
Insect, Hawk, Grass, Snake, Frog
(b) Name the organism at the third trophic level of the created food chain.
(c) Which organism of this food chain will have the highest concentration of non- biodegradable chemicals?
(d) Name the phenomenon associated with it.
(e) If 10,000 Joules of energy is available to frogs, how much energy will be available to snakes in this food chain? (2020)

(a) Grass → Insect → Frog → Snake → Hawk
(b) Frog is present in the above created food chain.
(c) Hawk is the top consumer of the food chain, so, it will have high concentration of non- biodegradable chemicals.
(d) biomagnification
(e) As per 10% law of flow of energy in an ecosystem, only 10% of energy is received by the next trophic level. Hence, in the given food chain, if 10,000 Joules of energy is available to frog, then the energy available to snakes will be 1000 Joule.

Grass	→	Insect	→	Frog	→	Snake	→	Hawk
10,00000 J		10,0000 J		10,000 J		1000 J		100 J

Q.Construct a food web using the organisms mentioned above(2023)

Hawk, Rat, Cereal plant, Goat, Snake, Human being



YOU HAVE TWO HOMES:

EARTH

+

YOUR BODY.

TAKE CARE OF THEM.