Basic Principle of Ecology

Unit: I

Subject Name

Environmental science

Course Details
Semester –III/IV

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Syllabus

- **UNIT-I (Basic Principle of ecology)**
- Definition, Scope and basic principles of ecology and environment. **Ecosystem:** Basic concepts, components of ecosystem.
- Food chains and food webs. Ecological pyramids, Energy flow in ecological systems, Characteristics of different ecosystems.
- **Biogeochemical Cycles**: Importance, gaseous and sedimentary cycles. Carbon, Nitrogen, Phosphorus and Sulphur Cycles.
- Basic concepts of sustainable development, SDGs, Ecosystem services, UN Decade for Eco restoration.

Syllabus

- **UNIT-II (Natural Resources and Associated Problems)**
- Natural resources and associated problems.
- **Forest resources:** Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people.
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
- **Food resources:** World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
- **Land resources:** Land as a resource, land degradation, man induced landslides. Equitable use of resources for sustainable lifestyles.
- **Non Renewable Energy Resources:** Fossil fuels and their reserves, Nuclear energy, types, uses and effects,
- **Renewable Energy Resources:** hydropower, Solar energy, geothermal, tidal and wind energy, Biomass energy, biogas and its advantages.

Syllabus

- **UNIT-III (Biodiversity Succession and Non-renewable energy Resources)**
- Biodiversity and their importance, Threats to biodiversity, major causes, extinction's, vulnerability of species to extinction, IUCN threat categories, Red data book.
- Strategies for biodiversity conservation, principles of biodiversity conservation in-situ and ex-situ conservation strategies,Mega diversity zones and Hot spots, concepts, distribution and importance.
- **Succession:** Concepts of succession, Types of Succession. Trends in succession. Climax and stability.

Syllabus

- **UNIT-IV (Pollution and Solid Waste Management)**
- **Air pollution:** sources of air pollution, Primary and secondary air pollutants. Origin and effects of SO_X, NO_X, CO_X, CFC's, Hydrocarbon,, control of air pollution.
- **Water pollution:** sources and types of water pollution, Effects of water pollution, Eutrophication,
- **Soil pollution:** Causes of soil pollution, Effects of soil pollution
- **Noise Pollution:** Major sources of and effects of noise pollution on health,
- **Radioactive and thermal pollution:** sources and their effects on surrounding environment.
- Solid waste disposal and its effects on surrounding environment
- Climate change, global warming, acid rain, ozone layer depletion,

Syllabus

- **UNIT-V (Role of Community and Environmental Protection Acts)**
- Role of community, women and NGOs in environmental protection, Bioindicators and their role, Natural hazards, Chemical accidents and disasters risk management,
- Environmental Impact Assessment (EIA)
- **Salient features of following Acts:**
  - a. Environmental Protection Act, 1986, Wildlife (Protection) Act, 1972.
  - b. Water (Prevention and control of pollution) Act, 1974.
  - c. Air (Prevention and control of pollution) Act, 1981. Forest (Conservation) Act, 1980.
  - d. Wetlands (Conservation and Management) Rules, 2017;
  - e. Chemical safety and Disaster Management law.
  - f. District Environmental Action Plan. Climate action plans.

Content

- Definition of environment
- Segment of environment
- Segment of atmosphere
- Multidisciplinary nature of evs
- Scope and importance of evs
- Food chain
- Food web
- Ecological pyramids
- Energy flow in an ecosystem
- Ecosystem and ecology
- Components of ecosystems
- Forest ecosystem
- Impact of deforestation,
- mining and transportation activity.

Course Objective(CO1)

- **To help the students in realizing the inter-relationship between man and environment and help the students in acquiring basic knowledge about environment.**
- To develop the sense of awareness among the students about environment and its various problems.
- To create positive attitude about environment among the student.
- To develop proper skill required for the fulfillment of the aims of environmental education and educational evaluations
- To develop the capability of using skills to fulfill the required aims, to realize and solve environmental problems through social, political, cultural and educational processes

Course Outcome

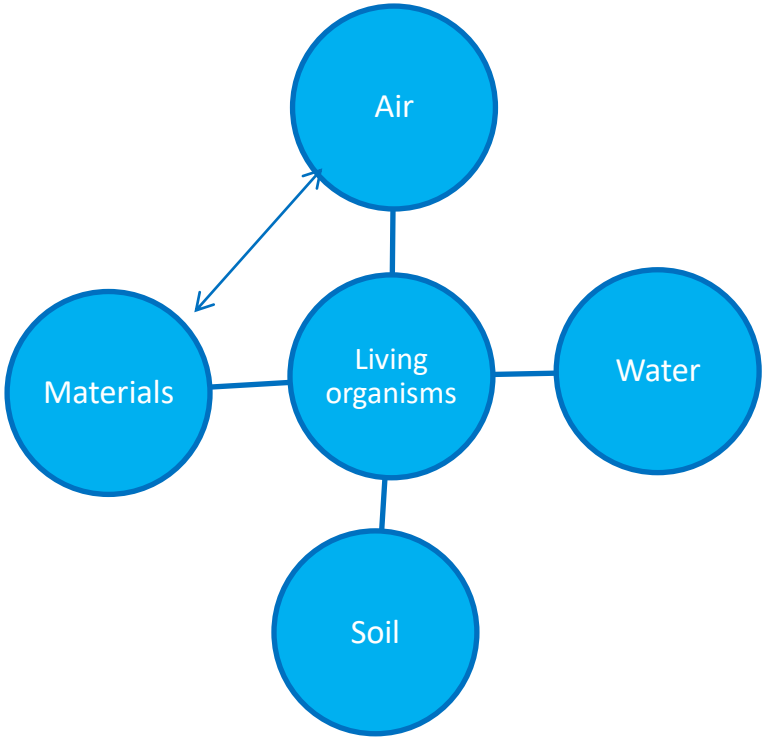
CO 1	Understand the basic principles of ecology and environment. Ecosystem: Basic concepts, components of ecosystem, food chains and food webs. Ecological pyramids	K1,K2
CO 2	Understand the different types of natural recourses like food, forest, Minerals and energy and their conservation	K1.K2
CO 3	Understand the importance of biodiversity, Threats of biodiversity and different methods of biodiversity conservation.	K1,K2
CO 4	Understand the different types of pollution, pollutants, their sources, effects and their control methods.	K1,K2,K3
CO 5	Understand the basic concepts of sustainable development, Environmental Impact Assessment (EIA) and different acts related to environment	K1,K2,K3

Topic mapping with CO

Topic	Topic outcome	CO Map	Extend of mapping
Environment and its segment	Students understand the meaning of environment	CO1	1
Segment of atmosphere Multidisciplinary nature of EVS Scope and importance of evs	.Students understand different segment of atmosphere Students understand the basic knowledge of basic science Students understand the scope of environmental SC.	CO1	1
Food chain and food web	Students understand the definition and types of food chain	CO1	2
Ecological pyramid	Students understand the graphical representation of food chain	CO1	1
Ecosystem and its types	Students understand the interaction between the biotic and abiotic Components .along its types	CO1	1
Components of ecosystem	Students understand the living and non living components	CO1	1
Function of ecosystem	Students understand the functions of ecosystems.	CO1	2
Forest recourses	Students understand the functions and value of forest	CO1	1
Deforestation	Students understand the ill effect and causes of deforestation	CO1	1
Mining and transportation activity.	Students understand the ill effects of mining and transportation activity	CO1	1

Environment(CO1)

- The word ‘Environment’ is derived from the French word ‘Environner’ which means to encircle, around or surround.
- The biologist Jacob Van Uerkal (1864-1944) introduced the term ‘environment’ in Ecology.
- Ecology is the study of the interactions between an organism of some kind and its environment.
- As given by Environment Protection Act 1986, Environment is the sum total of land, water, air, interrelationships among themselves and also with the human beings and other living organisms.
- Biotic (living)
- Abiotic (non living)



Environmental Science(CO1)

- Environment studies is a multidisciplinary subject where different aspects are dealt with in a holistic approach.
- The science of Environment studies comprises various branches of studies like chemistry, physics, life science, medical science, agriculture, public health, sanitary engineering, geography, geology, atmospheric science, etc.
- It is the science of physical phenomena in the environment. It studies the sources, reactions, transport, effect and fate of a biological species in the air, water and soil and the effect of and from human activity upon these.
- Environmental Science deals with the study of processes in soil, water, air and organisms which lead to pollution or environmental damages and
- The scientific basis for the establishment of a standard which can be considered acceptably clean, safe and healthy for human beings and natural ecosystems

Definition of Environment(CO1)

DEFINITIONS :

Some important definitions of environment are as under:

1. According to Boring, 'A person's environment consists of the sum total of the stimulation which he receives from his conception until his death.' Indicating that environment comprises various types of forces such as physical, intellectual, mental, economical, political, cultural, social, moral and emotional.

2. Douglas and Holland defined that 'The term environment is used to describe, in aggregate, all the external forces, influences and conditions, which affect the life, nature, behaviour and the growth, development and maturity of living organisms'.

Scope :

The scope of the term 'Environment' has been changing and widening by the passage of time.

In the primitive age, the environment consisted of only physical aspects of the planet earth ie., land, water and air as biological communities.

As of now, it includes social, economic and political conditions also.

Scope of Environment(CO1)

Scope :

- The scope of the term ‘Environment’ has been changing and widening by the passage of time.
- In the primitive age, the environment consisted of only physical aspects of the planet earth ie., land, water and air as biological communities.
- As of now, it includes social, economic and political conditions also.
- The scope of environmental studies is very wide and it deals with many areas like

i) Conservation of natural resources,
ii) Ecological aspects,
iii) Pollution of the surrounding natural resources,
iv) Controlling the pollution,
v) Social issues connected to it, and
vi) Impacts of human population on the environment.

Segments of Environment (CO1)

SEGMENTS OF ENVIRONMENT:

The environment consists of four segments of the earth namely

1.Atmosphere, **2.Hydrosphere,**

3.Lithosphere and **4. Biosphere**

1. **Atmosphere:** The Atmosphere forms a distinctive protective layer about 100 km thick around the earth.

- A blanket of gases called the atmosphere surrounds the earth and protects the surface of earth from the Sun's harmful, ultraviolet rays.
- It sustains life on the earth. It also regulates temperature, preventing the earth from becoming too hot or too cold.
- It saves it from the hostile environment of outer space. The atmosphere is composed of nitrogen and oxygen besides, argon, carbon dioxide and trace gases.
- The atmosphere has a marked effect on the energy balance at the surface of the Earth.
- It absorbs most of the cosmic rays from outer space and a major portion of the electromagnetic radiation from the sun.
- It transmits only ultraviolet, visible, near infrared radiation (300 to 2500 nm) and radio waves. (0.14 to 40 m) while filtering out tissue-damaging ultra-violate waves below about 300 nm.

Segments of Environmental Education(CO1)

2. Hydrosphere: The Hydrosphere comprises all types of water resources oceans, seas, lakes, rivers, streams, reservoirs, polar icecaps, glaciers, and ground water (75-80%).

- Oceans represent 97% of the earth's water and about 2% of the water resources is locked in the polar icecaps and glaciers.
- Only about 1% is available as fresh water as surface water in rivers, lakes, streams, and as ground water for human use.

3. Lithosphere: Lithosphere is the outer mantle of the solid earth.

- It consists of minerals occurring in the earth's crusts and the soil e.g. minerals, organic matter, air and water.

4. Biosphere: Biosphere indicates the realm of living organisms and their interactions with environment, such as atmosphere, hydrosphere and lithosphere.

Elements of Environment(CO1)

Elements of Environment

Environment is constituted by the interacting systems of physical, biological and cultural elements inter-related in various ways, individually as well as collectively.

- These elements are:

(1) Physical elements

Physical elements are space, landforms, water bodies, climate, soils, rocks and minerals. They determine the variable character of the human habitat, its opportunities as well as limitations.

(2) Biological elements

Biological elements such as plants, animals, microorganisms and men constitute the biosphere.

(3) Cultural elements

Cultural elements such as economical, social and political elements are essentially man- made features, which make the cultural background.

Segment of Environment(CO1)

Divided into four segments

- Atmosphere
- Hydrosphere
- Lithosphere
- Biosphere

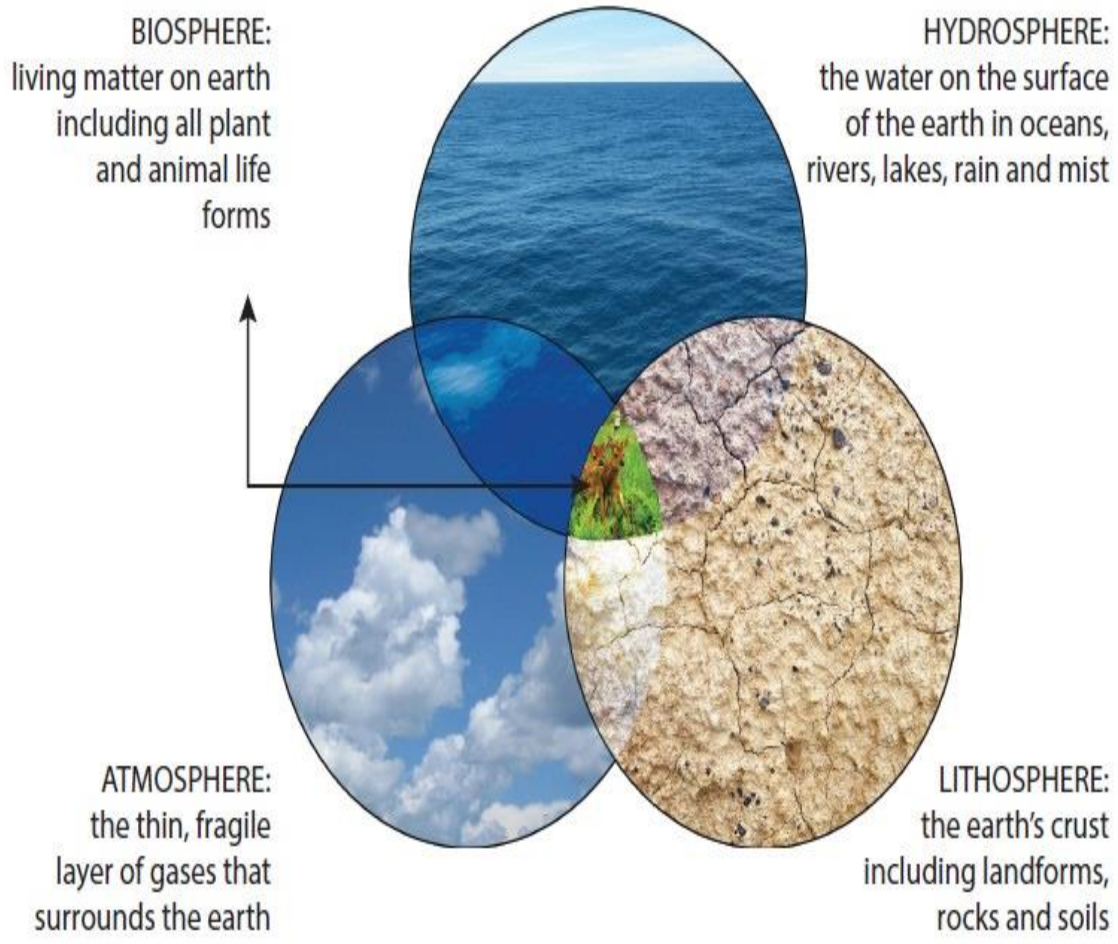


Figure 7.1 Biosphere

Segment of Atmosphere(CO1)

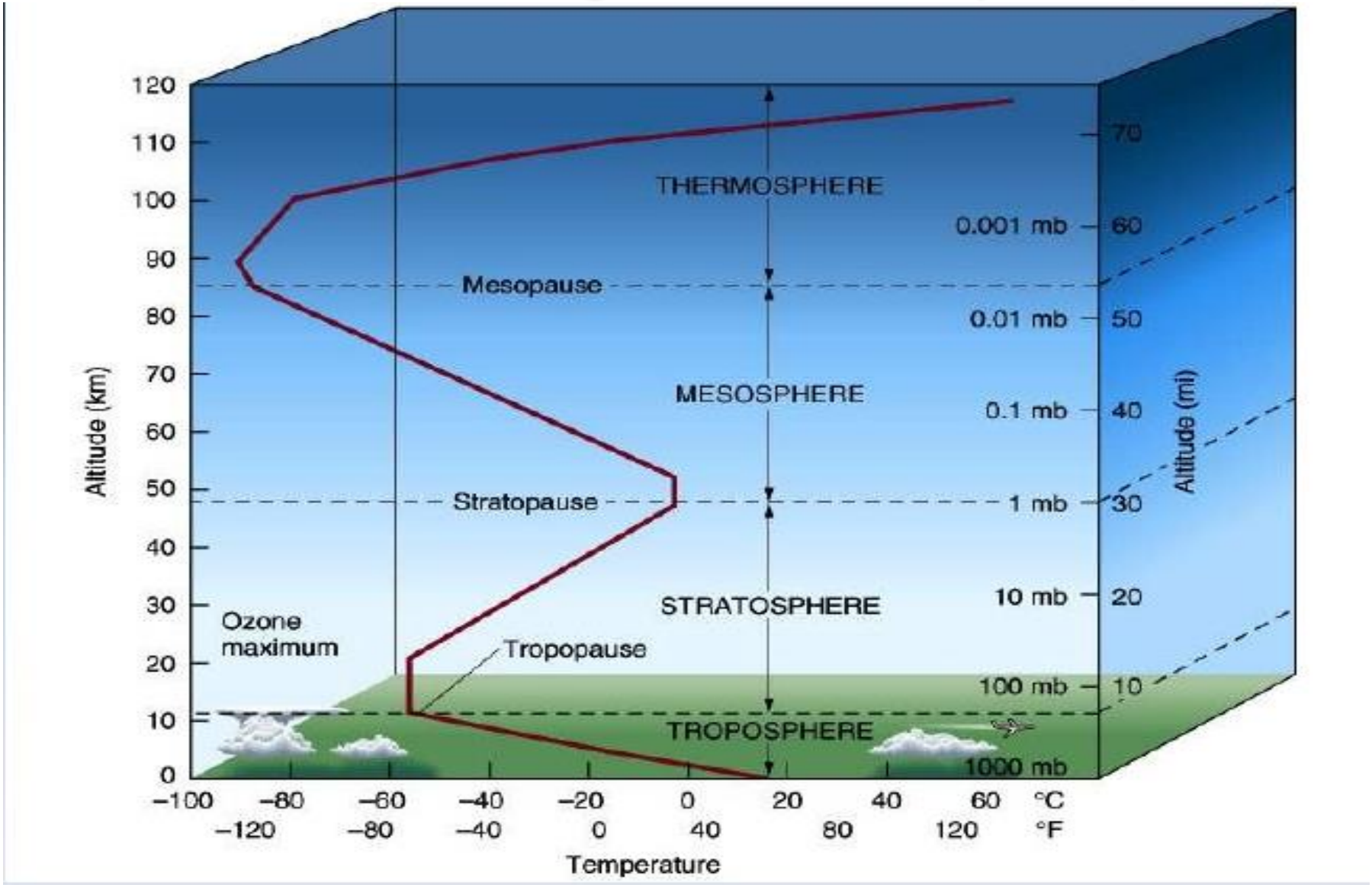
Segment of atmosphere

- Troposphere
- Stratosphere
- Mesosphere
- Thermosphere
- Exosphere

Table : Major Regions of the Atmosphere

Region	Altitude range (km)	Temperature range (°C)	Important Chemical Species
Troposphere	0-11	15 to -56	N_2, O_2, CO_2, H_2O
Stratosphere	11-50	-56 to -2	O_3
Mesosphere	50-85	-2 to -92	O_2^+, O^+, NO^+
Thermosphere	85-800	-92 to 1,200	O_2^+, O^+, NO^+
Exosphere	800 above		H^+, He^{++}

Graph between height and temperature of different segment of atmosphere(CO1..)

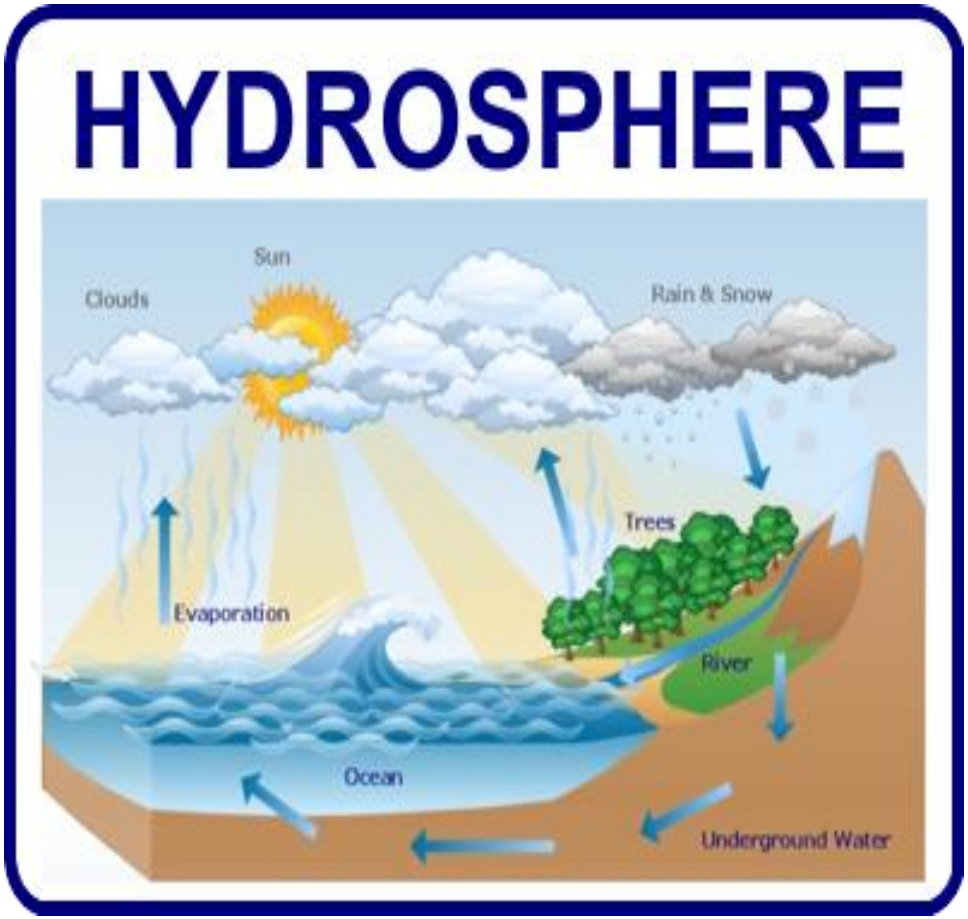


Hydrosphere(CO1)

- It include all the water bodies on the earth (ocean, sea, lake, river, stream, ground water, reservoir, ice and water vapors in the atm.)

- 71% water on earth

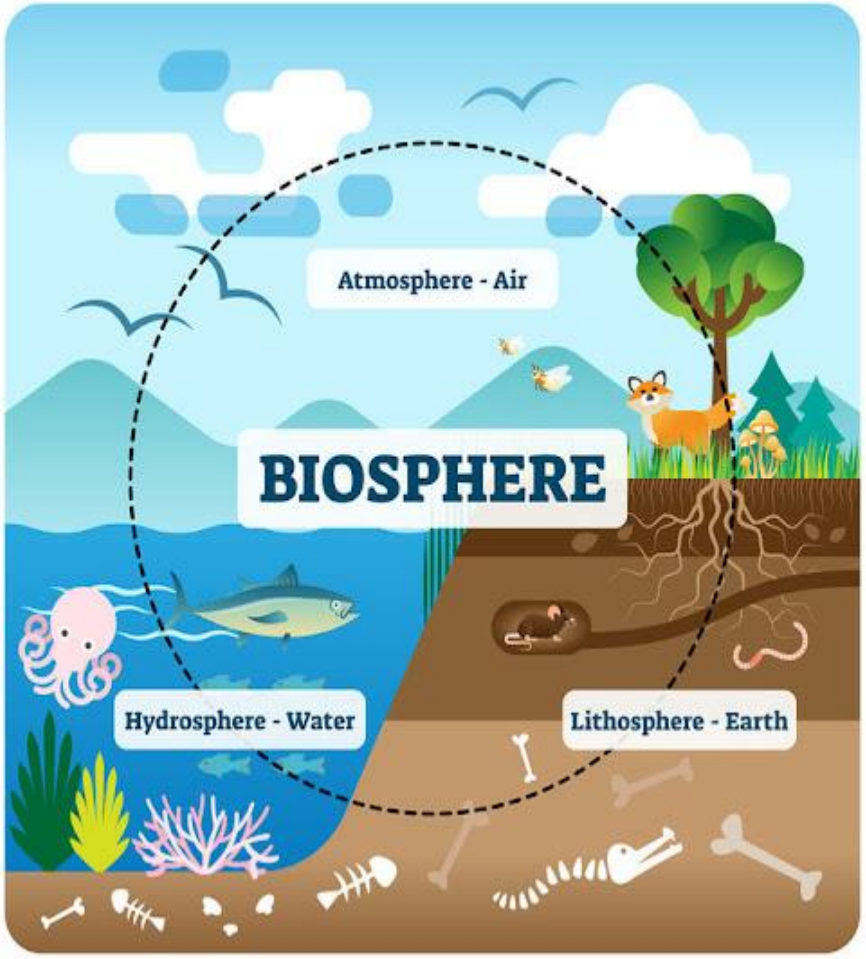
  - 97.5% in ocean and sea
  - 2.5% fresh water (68.7% in ice & glaciers, 29.9% ground water, 0.26% rivers & lakes)



Biosphere(CO1)

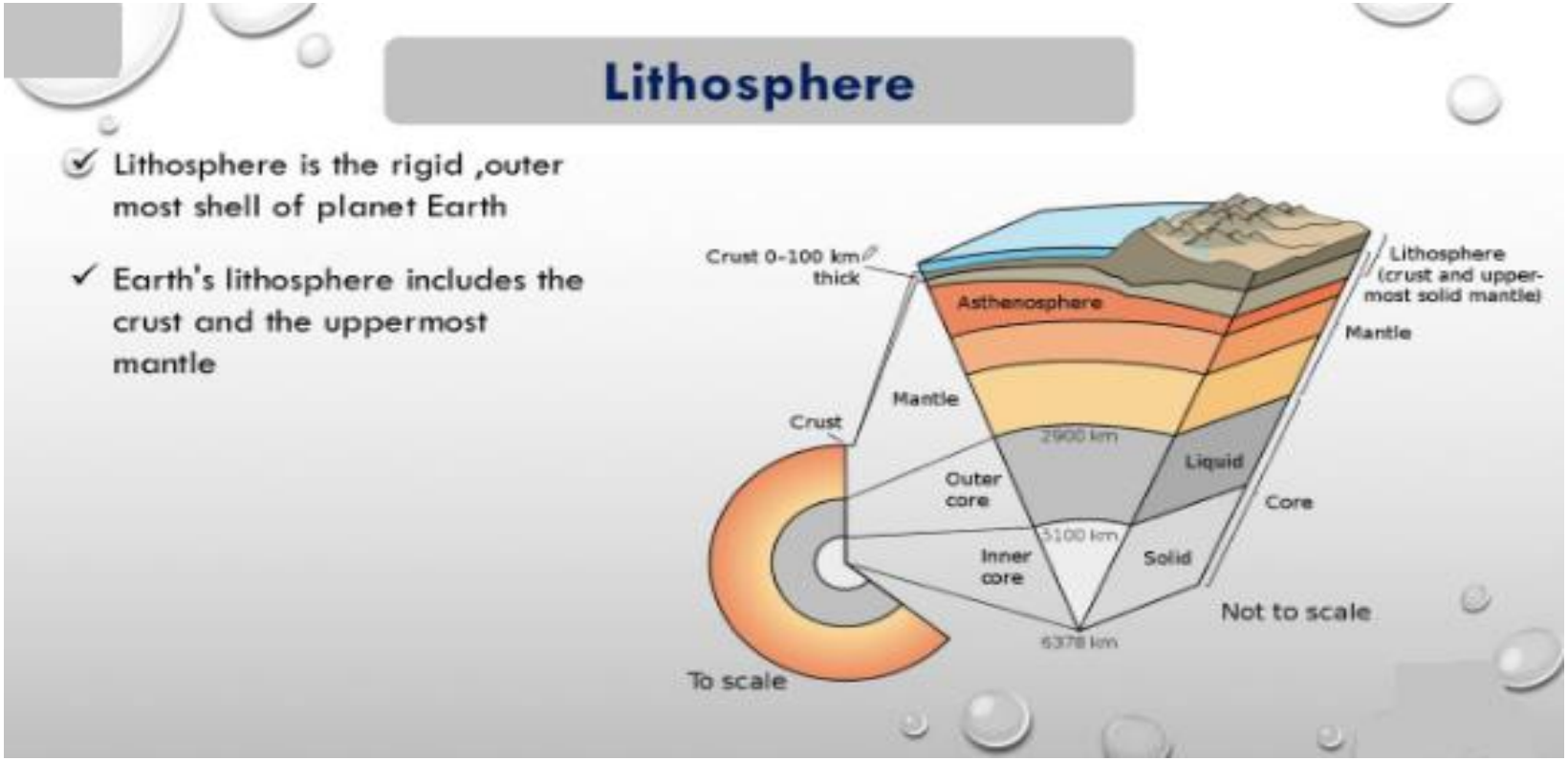
Biosphere:

- The **biosphere** (from Greek βίος *bíos* "life " and σφαῖρα *sphaira* "sphere"), also known as the **ecosphere** (from Greek οἶκος *oîkos* "environment" and σφαῖρα), is the worldwide sum of all ecosystems.
- It can also be termed the zone of life on Earth. The biosphere is virtually a closed system with regard to matter, with minimal inputs and outputs
- The biosphere is postulated to have evolved, beginning with a process of biopoiesis (life created naturally from non-living matter, such as simple organic compounds) or biogenesis (life created from living matter), at least some 3.5 billion years ago.



Lithosphere(CO1)

The lithosphere is the solid, outer part of the Earth. The lithosphere includes the brittle upper portion of the mantle and the crust, the outermost layers of Earth's structure.



ECOSYSTEM(CO1)

ECOLOGY : The German biologist Ernst Haeckel in 1869 coined the word "Ecology" combining two Greek words – *oikos*, meaning "household" or "home" and *logos*, meaning "study of" – to coin ecology.

- It is the science that deals with the study of organisms in their natural home interacting with their surroundings ie., other living organisms and physical components.
- Ecology examines the life histories, distribution and behaviour of individual species as well as the structural and functions of a natural system in terms of population, communities, ecosystems and landscape.

ECOSYSTEM : An ecosystem includes all the organisms that live in a particular place, together with their physical environment

Types of ecosystem

Natural ecosystem

Artificial ecosystem

ECOSYSTEM(CO1)

Ecosystem :

- The ecosystem is the structural and functional unit of ecology where the living organisms interact with each other and the surrounding environment.
- In other words, an ecosystem is a chain of interaction between organisms and their environment.
- The term "Ecosystem" was first coined by A.G.Tansley, an English botanist, in 1935.

Types of Ecosystem

An ecosystem can be as small as an oasis in a desert, or as big as an ocean, spanning thousands of miles.

- There are two types of ecosystem:
- Terrestrial Ecosystem
- Aquatic Ecosystem

Terrestrial Ecosystems

Terrestrial ecosystems are exclusively land-based ecosystems. There are different types of terrestrial ecosystems distributed around various geological zones.

- They are as follows:
- Forest Ecosystems
- Grassland Ecosystems
- Tundra Ecosystems
- Desert Ecosystem

ECOSYSTEM(CO1)

Forest Ecosystem

- A forest ecosystem consists of several plants, animals and microorganisms that live in coordination with the abiotic factors of the environment.
- Forests help in maintaining the temperature of the earth and are the major carbon sink.

Grassland Ecosystem

- In a grassland ecosystem, the vegetation is dominated by grasses and herbs.
- Temperate grasslands, savanna gragrasslands are some of the examples of ssland ecosystems.

Tundra Ecosystem

- Tundra ecosystems are devoid of trees and are found in cold climates or where rainfall is scarce.
- These are covered with snow for most of the year. The ecosystem in the Arctic or mountain tops is tundra type.

Desert Ecosystem

- Deserts are found throughout the world.
- These are regions with very little rainfall.
- The days are hot and the nights are cold.

ECOSYSTEM(CO1)

Aquatic Ecosystem

These ecosystems present in a body of water. These can be further divided into two types, namely:

1.Freshwater Ecosystem

2.Marine Ecosystem

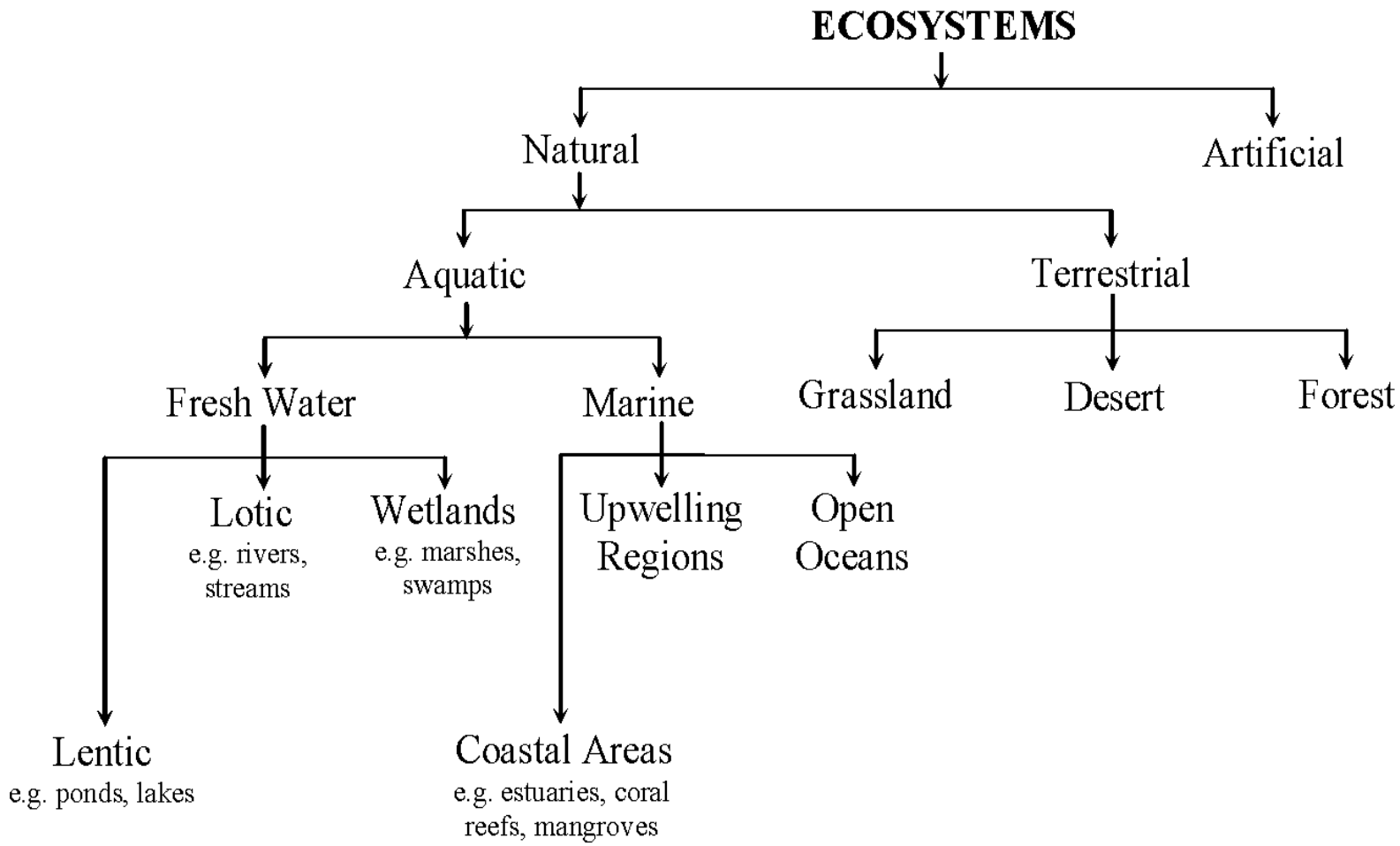
Freshwater Ecosystem

- The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands.
- These have no salt content in contrast with the marine ecosystem.

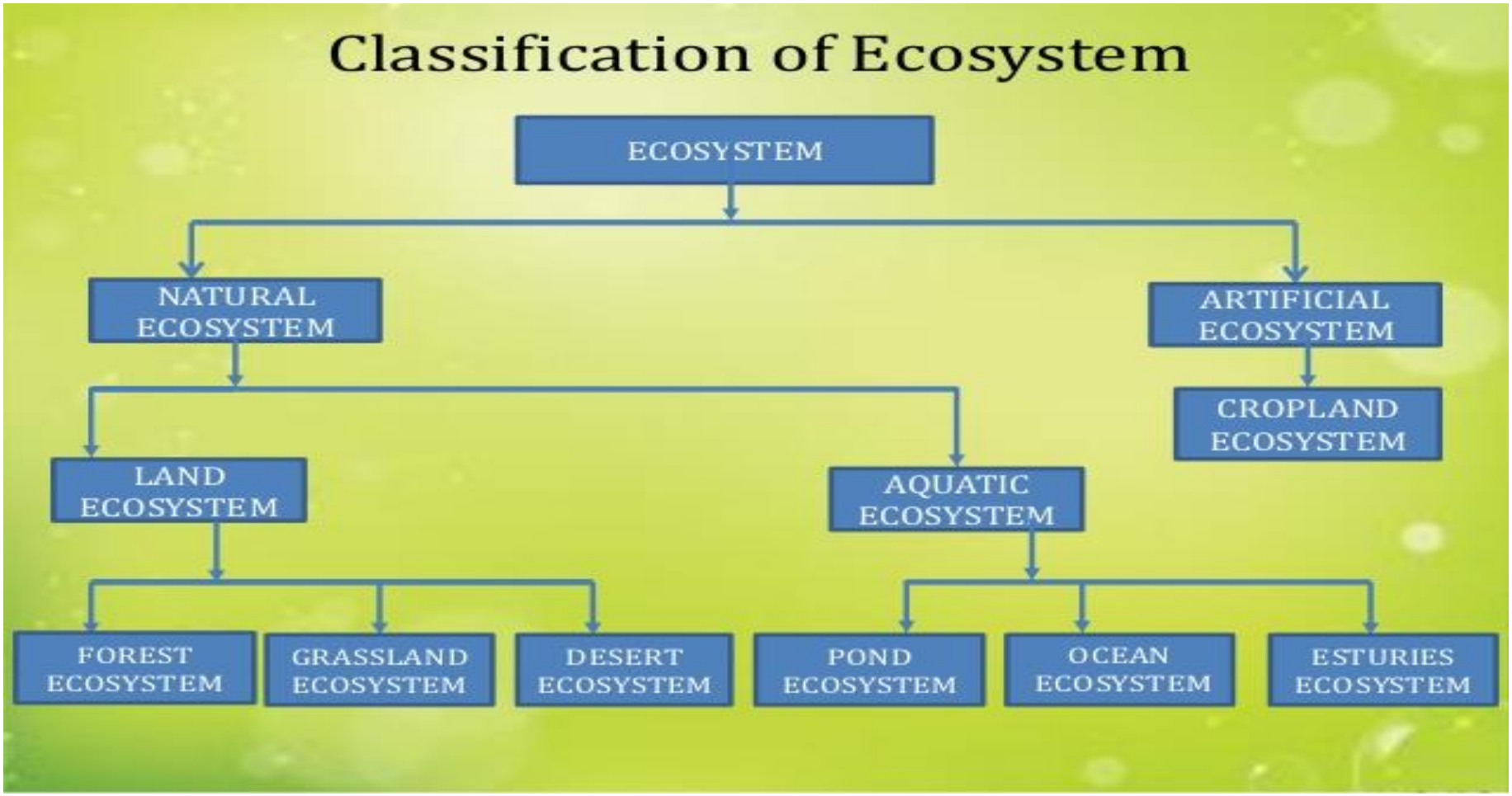
Marine Ecosystem

- The marine ecosystem includes seas and oceans.
- These have a more substantial salt content and greater biodiversity in comparison to the freshwater ecosystem.

ECOSYSTEM(CO1)



ECOSYSTEM(CO1)



ECOSYSTEM(CO1)

- **Forest ecosystem**
  Forests are natural plant communities with dominance of phanerophytes and occupy nearly 40% of the land.
- In India, the forests occupy roughly 10% of the total land area. According to Champion and Seth (1968), Indian forests are of 11 types, which are classified on the basis of physiography, physiognomy floristics, habitat etc.
- The different components of forest ecosystems are as follows:

Abiotic components

- These include inorganic and organic substances present in the soil and atmosphere. The climate (temperature, light, rainfall, etc.) and soil (minerals) vary from forest to forest. In addition to minerals the occurrence of litter is characteristic feature of majority of forests.

ECOSYSTEM(CO1)

- ***Biotic components***

***a) Producers*:**

- These are mainly trees that show much species diversity and greater degree of stratification especially in tropical moist deciduous forests. Besides trees, there are also present shrubs and ground vegetation.
- In these forests, the producers include the dominant tree species such as Tectona grandis, Butea frondosa, Shorea robusta and Lagerstroemia parviflora. In temperate coniferous forests, shrubs and ground flora are insignificant.
- In temperate deciduous forests the dominant trees are species of Quercus, Acer, Betula, Thuja, Picea, etc., whereas in temperate coniferous forests, the producer trees are species of Abies, Picea, Pinus, Cedrus, Juniperus, Rhododendron, etc.

b) Consumers

These are as follows:

i) Primary consumers

- These are the herbivores that include smaller animals feeding on tree leaves as ants, flies, bettles, leaf hoppers, bugs, spiders, etc., and larger animals grazing on shoots and/ or fruits of producers as elephant, neelgai, deer, moles, squirrels, shrews, flying foxes, mongooses, etc.

ECOSYSTEM(CO1)

ii) Secondary consumers

- These are the carnivores like snakes, birds, lizards, fox, etc. feeding on the herbivores.

iii) Tertiary consumers

- These are the top carnivores like lion, tiger, etc., that eat carnivores of secondary consumers level.

c) Decomposers

- These are wide variety of microorganisms including fungi (species of Aspergillus, Polyporus, Alternaria, Fusarium, Trichoderma, etc.), bacteria (species of Bacillus, Pseudomonas, Clostridium, etc.), and actinomycetes (species of Streptomyces). Rate of decomposition in tropical and subtropical forests is more rapid than in the temperate ones.

http://ecoursesonline.iasri.res.in/mod/page/view.php?id=89600

ECOSYSTEM(CO1)

Grassland ecosystem

- Grasslands occupy roughly 24% of the earth's surface (Shantz, 1954). Whyte (1957) divided grassland into 8 types based on the floral characteristics. The different components of a grassland ecosystem are:

Abiotic components

- These include nutrients present in soil and the atmosphere. Thus the elements like C, H, O, N, P, S, etc. are supplied by carbon dioxide, water, nitrates, phosphates and sulphates present in air and soil of the area.

Biotic components

These are as follows:

a) Producers

They are mainly grasses, as species of Dichanthium, Cynodon, Desmodium, Dactyloctenium, Digitaria, Setaria, Sporobolus, etc. Besides them a few forbs and shrubs also contribute to primary production.

ECOSYSTEM(CO1)

Consumers

These are as follows:

i) Primary consumers

The herbivores feeding on grasses are mainly such grazing animals as cows, buffaloes, deers, sheep, rabbit, mouse, etc. Besides them, there are also present some insects as Leptocorisa, Dysdercus, Oxyrhachis, Cicindella, Coccinella, some termites and millipeds, etc. that feed on the leaves of grasses.

ii) Secondary consumers

Snake, lizard, birds, jackals, fox, etc. are common secondary consumers which feed on herbivores.

iii) Tertiary consumers

These include hawks which feed on secondary consumers.

c) Decomposers

Several fungi (Mucor, Aspergillus, Penicillium, Cladosporium, Rhizopus, Fusarium, etc.), actinomycetes and bacteria decay the dead organic matter of different forms of higher life. They bring about minerals back to the soil, thus making them available to the producers.

ECOSYSTEM(CO1)

Desert ecosystem

The areas with an annual rainfall of less than 25 cm come in deserts. They occupy about 17% of land. Due to extremes of both, water and temperature factors the biota is much more varied and is poorly represented. The various components of the ecosystem are:

Abiotic components

In desert ecosystem temperature is found to be very high and rainfall is very low. A dry atmosphere, high temperature and intense illumination favour the rate of transpiration.

Biotic components

These are as follows:

a) Producers

These are shrubs, especially bushes, some grasses, and a few trees. The shrubs have widespread branched root system with their leaves, branches and stems variously modified. Sometimes a few succulents like cacti are also present. Some lower plants like lichens and xerophytic mosses may also be present.

b) Consumers

Insects, reptiles, nocturnal rodents, birds, camels, etc. are the main consumers.

c) Decomposes

These are very few, as due to poor vegetation the amount of dead organic matter is correspondingly less. They are some fungi and bacteria, most of which are thermophilic.

ECOSYSTEM(CO1)

Forest Ecosystem

The classification is as per the respective climate – boreal, temperate or tropical. Forest ecosystems in temperate zones may have a flora of coniferous type, deciduous type or a combination of both the types. Rainforest ecosystems in the tropics have the most diverse plant and animal ecosystem than any other region on the earth. Here, trees grow tall and foliage is dense and lush with a warm and humid environment, with species right from the root level up till the canopy. The Boreal forests are featured in the far north, with a rich population of the coniferous trees, known as the taiga.

Desert Ecosystem

The most defining feature of this ecosystem is the amount of precipitation it receives, which is the least as compared to any ecosystem. This ecosystem can exist from the Arctic to the tropics, not all deserts are hot, some are often windy. Some contain rocks while some have sand dunes. Flora is very rare but highly adaptive animal species and insects are found here.

ECOSYSTEM(CO1)

Grassland Ecosystem

- These are found in savannas, steppes, and prairies, in the temperate and tropical regions.
- They can exist in colder regions as well(Siberian Steppe) and share a common characteristic: semi-aridity.
- Flowers may be scattered along with the grass but trees are almost non-existent.
- Grasslands are ideal for animal-grazing.

Marine Ecosystem

- It contains saltwater and inhabits a variety of species.
- They are the most abundant ecosystems on the planet.
- Marine enclose not only the oceanic bed but also the tidal zones, salt marshes, estuaries, saltwater swamps, coral reef, mangroves etc.

Tundra Ecosystem

- Tundra denotes polar regions at lower altitudes.
- It is characterized by harsh environmental conditions similar to deserts and is usually windswept, snow-covered and treeless.
- The soil is frozen throughout the year and during the brief summers, snow melts to produce shallow ponds, thus giving rise to small flowers and lichens.

ECOSYSTEM(CO1)

Freshwater Ecosystems

- As opposed to marine ecosystems, they pertain to the ecosystem found in the rivers, ponds, lakes, freshwater swamps, springs which have freshwater.
- They embody planktons, algae, insects, amphibians and underwater plants.
- They cover only a small portion of earth nearly 0.8 per cent.
- Freshwater involves lakes, ponds, rivers and streams, wetlands, swamp, bog and temporary pools.
- Freshwater habitats are classified into lotic and lentic habitats.
- Water bodies such as lakes, ponds, pools, bogs, and other reservoirs are standing water and known as lentic habitats.
- Whereas lotic habitats represent flowing water bodies such as rivers, streams.

Lotic Ecosystems

- They mainly refer to the rapidly flowing waters that move in a unidirectional way including the rivers and streams.
- These environments harbor numerous species of insects such as beetles, mayflies, stoneflies and several species of fishes including trout, eel, minnow, etc.
- Apart from these aquatic species, these ecosystems also include various mammals such as beavers, river dolphins and otters.

ECOSYSTEM(CO1)

Lentic Ecosystems

- They include all standing water habitats.
- Lakes and ponds are the main examples of Lentic Ecosystem.
- The word lentic mainly refers to stationary or relatively still water.
- These ecosystems are home to **algae**, crabs, shrimps, amphibians such as frogs and salamanders, for both rooted and floating-leaved plants and reptiles including alligators and other water snakes are also found here.

Wetlands

- Wetlands are marshy areas and are sometimes covered in water which has a wide diversity of plants and animals.
- Swamps, marshes, bogs, black spruce and water lilies are some examples in the plant species found in the wetlands.
- The animal life of this ecosystem consists of dragonflies and damselflies, birds such as Green Heron and fishes such as Northern Pike.

ECOSYSTEM(CO1)

Marine Water Ecosystem

- Marine ecosystem covers the largest surface area of the earth.
- Two third of earth is covered by water and they constitute of oceans, seas, intertidal zone, reefs, seabed, estuaries, hydrothermal vents and rock pools.
- Each life form is unique and native to its habitat.
- This is because they have adaptations according to their habitat.
- In the case of aquatic animals, they can't survive outside of water.
- Exceptional cases are still there which shows another example of adaptations (e.g. mudskippers).
- The marine ecosystem is more concentrated with salts which make it difficult for freshwater organisms to live in. Also, marine animals cannot survive in freshwater.
- Their body is adapted to live in saltwater; if they are placed in less salty water, their body will swell (osmosis).

ECOSYSTEM(CO1)

Ocean Ecosystems

- Our planet earth is gifted with the five major oceans, namely Pacific, Indian, Arctic, and the Atlantic Ocean.
- Among all these five oceans, the Pacific and the Atlantic are the largest and deepest ocean.
- These oceans serve as a home to more than five lakh aquatic species.
- Few creatures of these ecosystems include shellfish, shark, tube worms, crab small and large ocean fishes, turtles, crustaceans, blue whale, reptiles, marine mammals, seabirds, plankton, corals and other ocean plants.

ECOSYSTEM(CO1)

Structure of the Ecosystem

- The structure of an ecosystem is characterised by the organisation of both biotic and abiotic components.
- This includes the distribution of energy in **our environment**.
- It also includes the climatic conditions prevailing in that particular environment.

The structure of an ecosystem can be split into two main components, namely:

Biotic Components

Abiotic Components

- The biotic and abiotic components are interrelated in an ecosystem.
- It is an open system where the energy and components can flow throughout the boundaries.

Biotic Components

Biotic components refer to all life in an ecosystem. Based on nutrition, biotic components can be categorised into autotrophs, heterotrophs and saprotrophs (or decomposers).

ECOSYSTEM(CO1)

Producers

- **It** include all autotrophs such as plants.
- They are called autotrophs as they can produce food through the process of photosynthesis. Consequently, all other organisms higher up on the food chain rely on producers for food.

Consumers or heterotrophs are organisms that depend on other organisms for food. Consumers are further classified into primary consumers, secondary consumers and tertiary consumers.

- ***Primary consumers*** are always herbivores that they rely on producers for food.
- ***Secondary consumers*** depend on primary consumers for energy. They can either be a carnivore or an omnivore.
- ***Tertiary consumers*** are organisms that depend on secondary consumers for food. Tertiary consumers can also be an omnivore.
- ***Quaternary consumers*** are present in some food chains. These organisms prey on tertiary consumers for energy. Furthermore, they are usually at the top of a food chain as they have no natural predators.

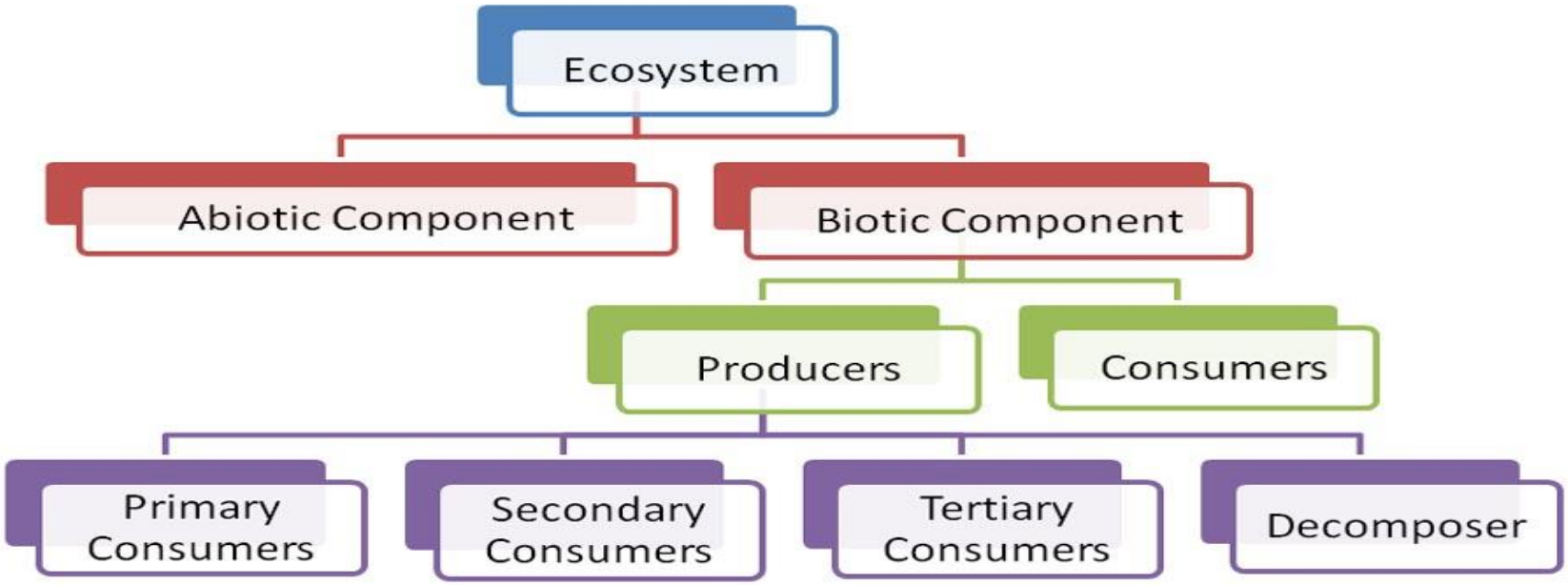
ECOSYSTEM(CO1)

Decomposers

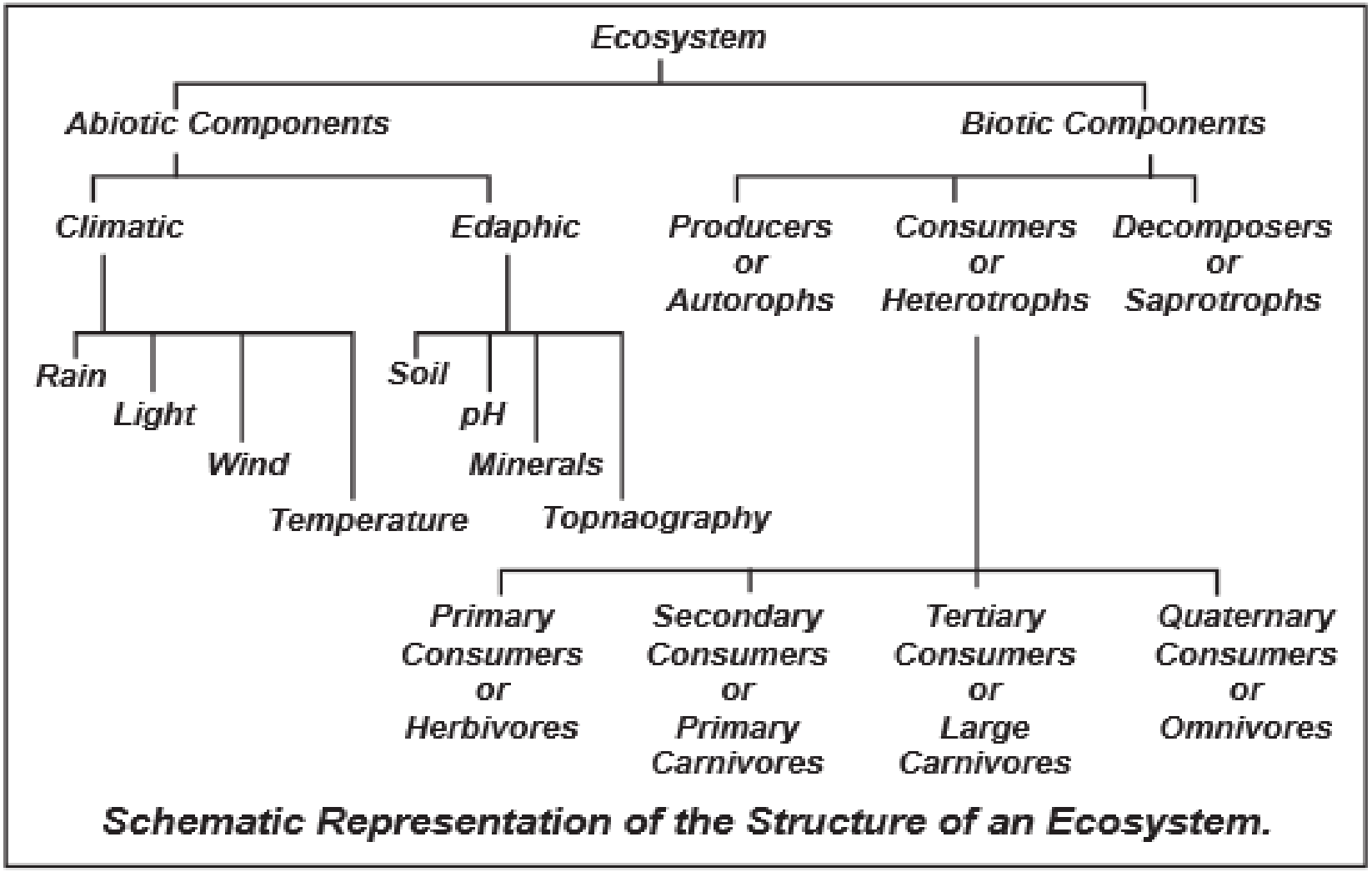
- These include saprophytes such as fungi and bacteria.
- They directly thrive on the dead and decaying organic matter.
- Decomposers are essential for the ecosystem as they help in recycling nutrients to be reused by plants.

Abiotic Components

- Abiotic components are the non-living component of an ecosystem.
- It includes air, water, soil, minerals, sunlight, temperature, nutrients, wind, altitude, turbidity, etc



ECOSYSTEM(CO1)



Schematic Representation of the Structure of an Ecosystem.

Food chain(CO1)

Functions of Ecosystem

The functions of the ecosystem are as follows:

1. It regulates the essential ecological processes, supports life systems and renders stability.
2. It is also responsible for the cycling of nutrients between biotic and abiotic components.
3. It maintains a balance among the various trophic levels in the ecosystem.
4. It cycles the minerals through the biosphere.
5. The abiotic components help in the synthesis of organic components that involves the exchange of energy.

Food chain(CO1)

- It is sequential transfer of energy from one organism to another organism with help of food.
- It may also be defined-"who eats whom".
- Food chain is a linear sequence of organisms which starts from producer organisms and ends with decomposer species.
- Food chain follows a single path whereas food web follows multiple paths.
- From the food chain, we get to know how organisms are connected with each other.
- The food chain also explains the feeding pattern or relationship between living organisms.
- Trophic level refers to the sequential stages in a food chain, starting with producers at the bottom, followed by primary, secondary and tertiary consumers.
- Every level in a food chain is known as a trophic level.

Food chain(CO1)

The food chain consists of four major parts, namely:

Sun

Producers

Consumers

Decomposers

The Sun:

- The sun is the initial source of energy, which provides energy for everything on the planet.

Producers:

•The producers in a food chain include all autotrophs such as phytoplankton, cyanobacteria, algae, green plants.

•This is the first stage in a food chain.

•The producers make up the first level of a food chain.

•The producers utilize the energy from the sun to make food. Producers are also known as autotrophs as they make their own food.

•Producers are any plant or other organisms that produce their own nutrients through photosynthesis.

•For example, green plants, phytoplankton and algae are some examples of producers in a food chain.

Food chain(CO1)

Consumers: Consumers are all organisms that are dependent on plants or other organisms for food.

- This is the largest part of a food chain/web, as it contains almost all living organisms.

It includes

- Herbivores which are animals that eat plants, Herbivores are known as primary consumers
- Carnivores which are animals that eat other animals, Carnivores are secondary consumers.
- Parasites are those organisms that live on other organisms by harming them
- Scavengers, which are animals that eat dead animals' carcasses.

Here

- The second trophic level includes organisms that eat producers.
- Therefore, primary consumers or herbivores are organisms in the second trophic level

Food chain(CO1)

Decomposers: Decomposers are organisms that get energy from dead or waste organic material.

- This is the last stage in a food chain.
- Decomposers are an integral part of a food chain, as they convert organic waste materials into inorganic materials like nutrient-rich soil or land.

- Decomposers complete a life cycle.
- They help in recycling the nutrients as they provide nutrients to soil or oceans, that can be utilised by autotrophs or producers.
- Thus, starting a whole new food chain.

Food chain(CO1)

Types of Food Chain

- Grazing Food Chain
- Detritus Food Chain

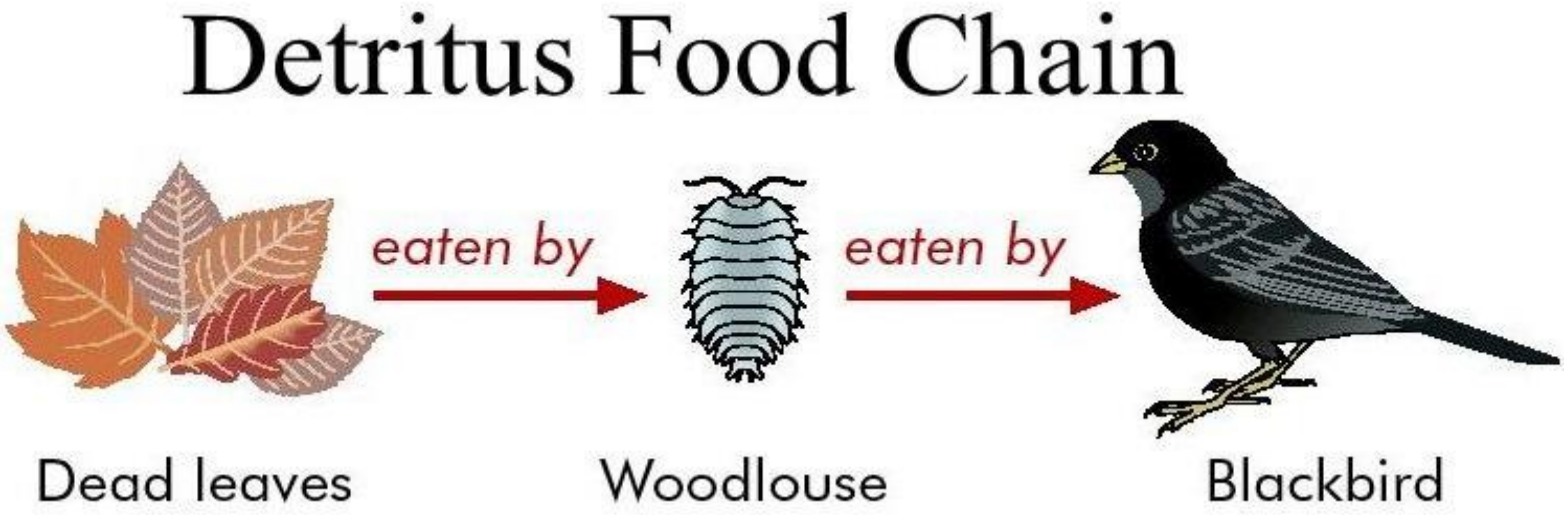
Grazing food chain:

- This type of food chain starts from the living green plants goes to grazing herbivores, and on to carnivores.
- Ecosystems with such type of food chain are directly dependent on an influx of solar radiation.

Food chain(CO1)

Detritus food chain:

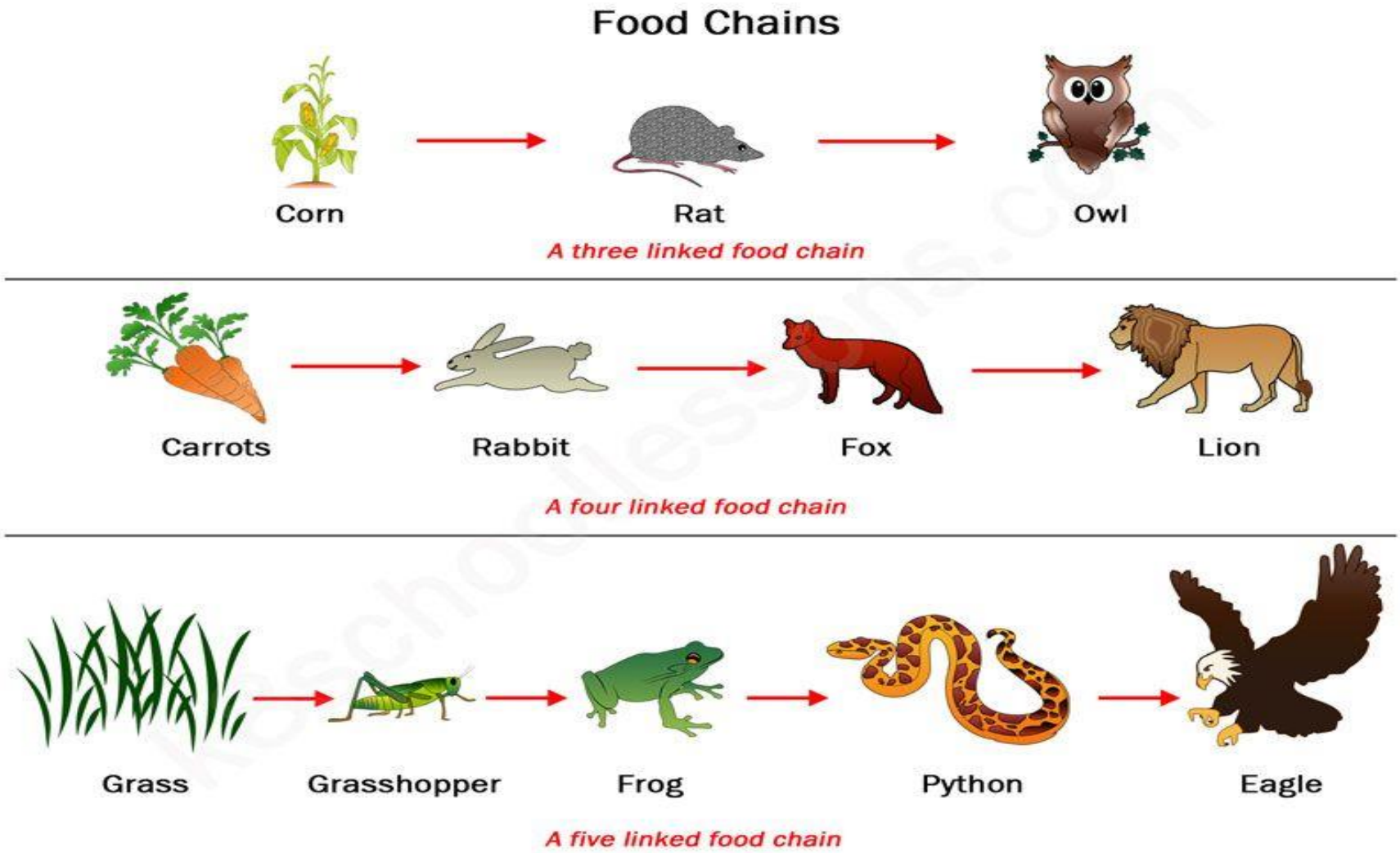
- This type of food chain goes from dead organic matter into microorganisms and then to organisms feeding on detritus (detrivores) and their predators.
- Such ecosystems are thus less dependent on direct solar energy.
- These depend chiefly on the influx of organic matter produced in another system.
- For example, such type of food chain operates in the decomposing accumulated litter in a temperate forest.



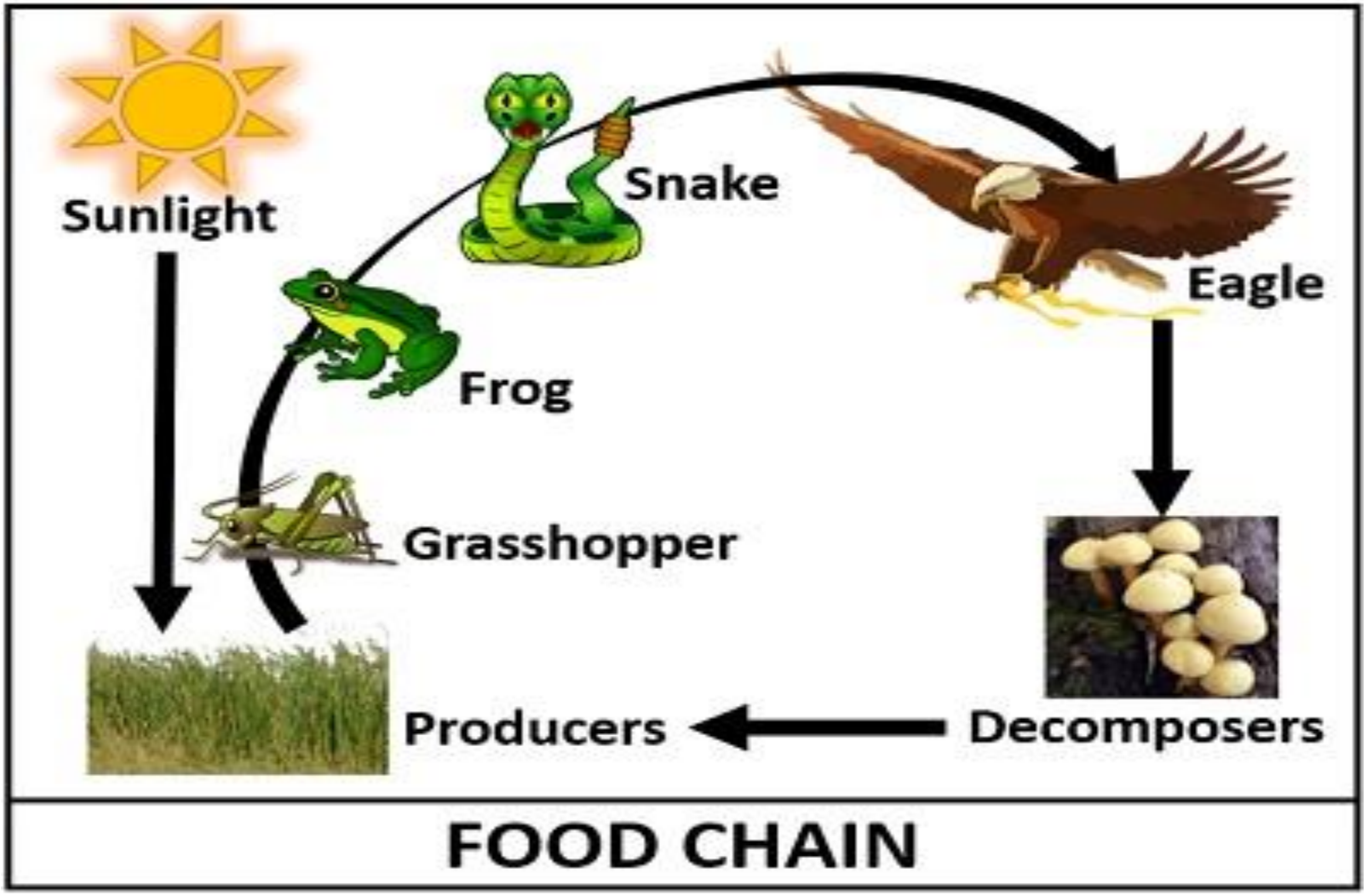
Significance of Food chain(CO1)

- 1. The studies of food chain help understand the feeding relationship and the interaction between organisms in any ecosystem.
- 2. They also help us to appreciate the energy flow mechanism and matter circulation in ecosystem and understand the movement of toxic substances in the ecosystem.
- 3. The study of food chain helps us to understand the problems of bio-magnifications.

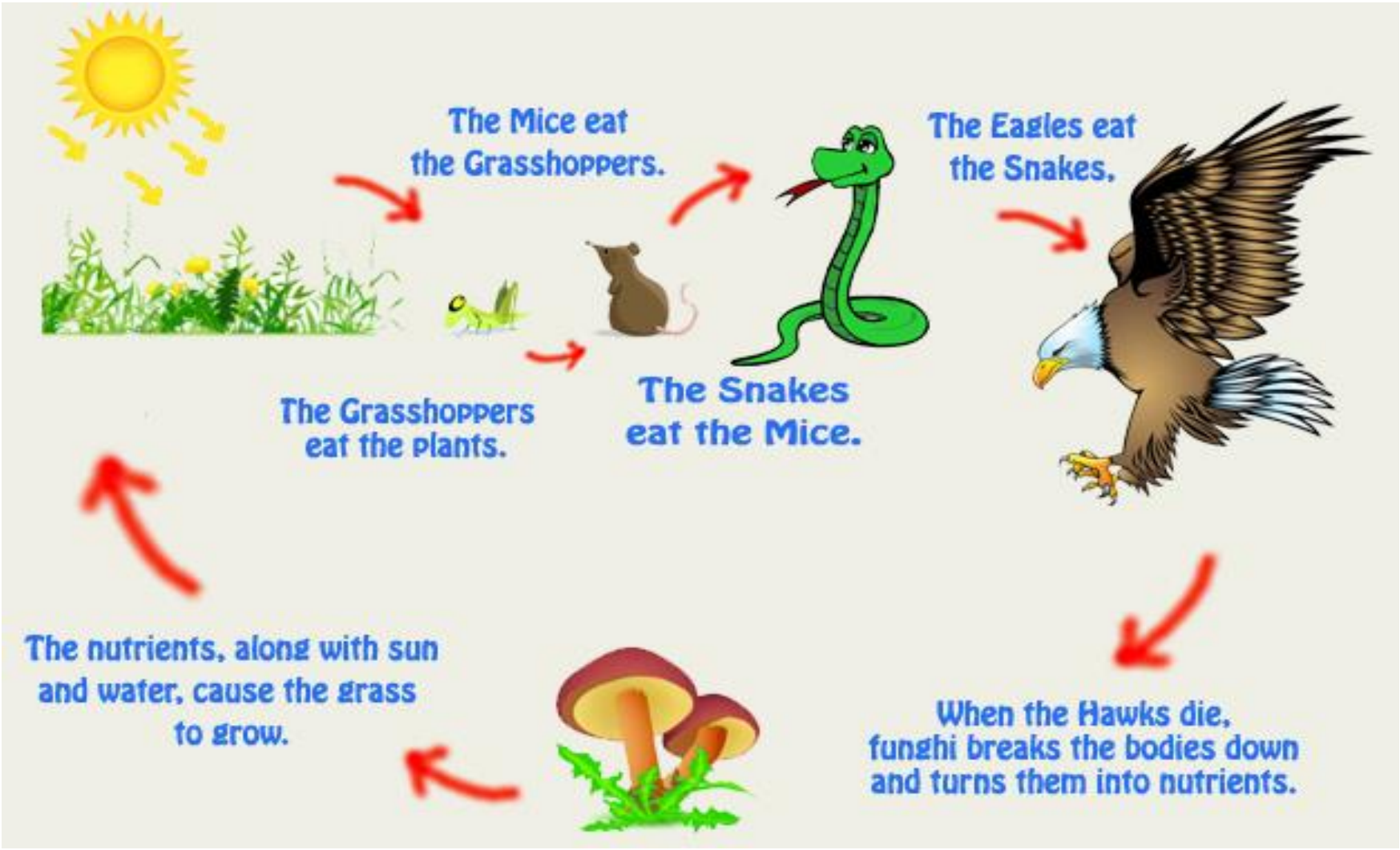
Terrestrial Food chain(CO1)



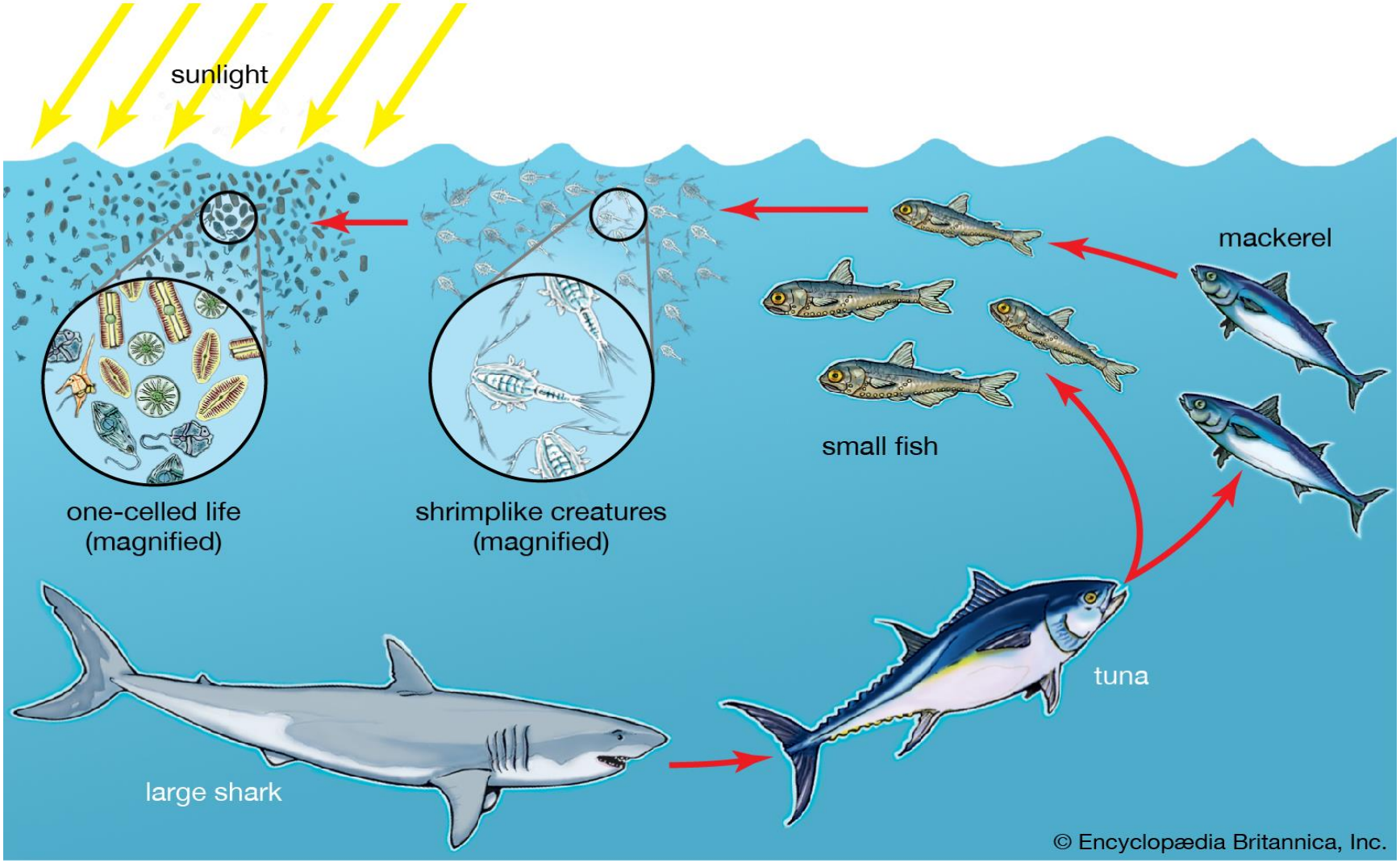
Terrestrial Food chain(CO1)



Terrestrial Food chain(CO1)



Aquatic Food chain(CO1)

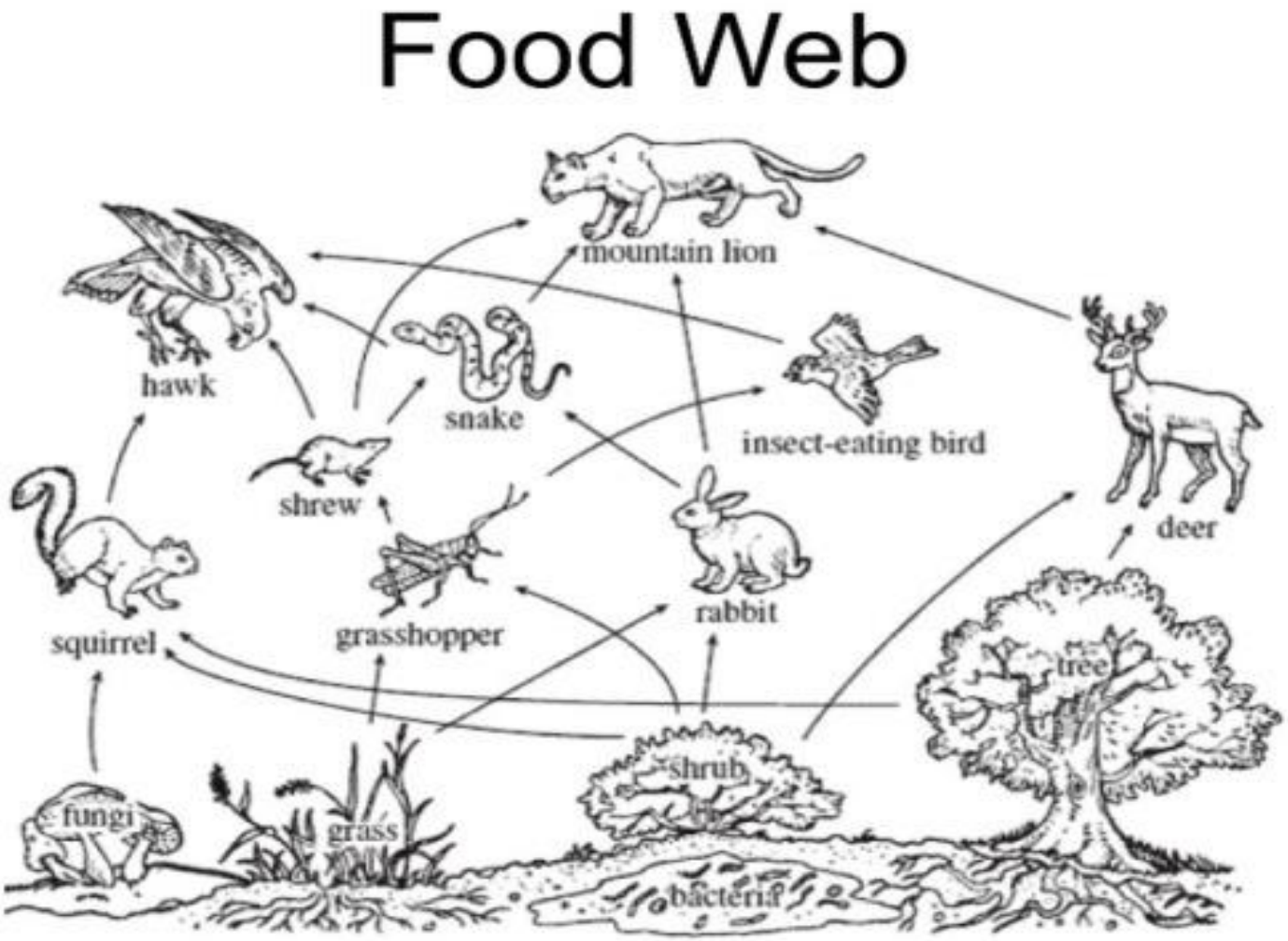


Food Web(CO1)

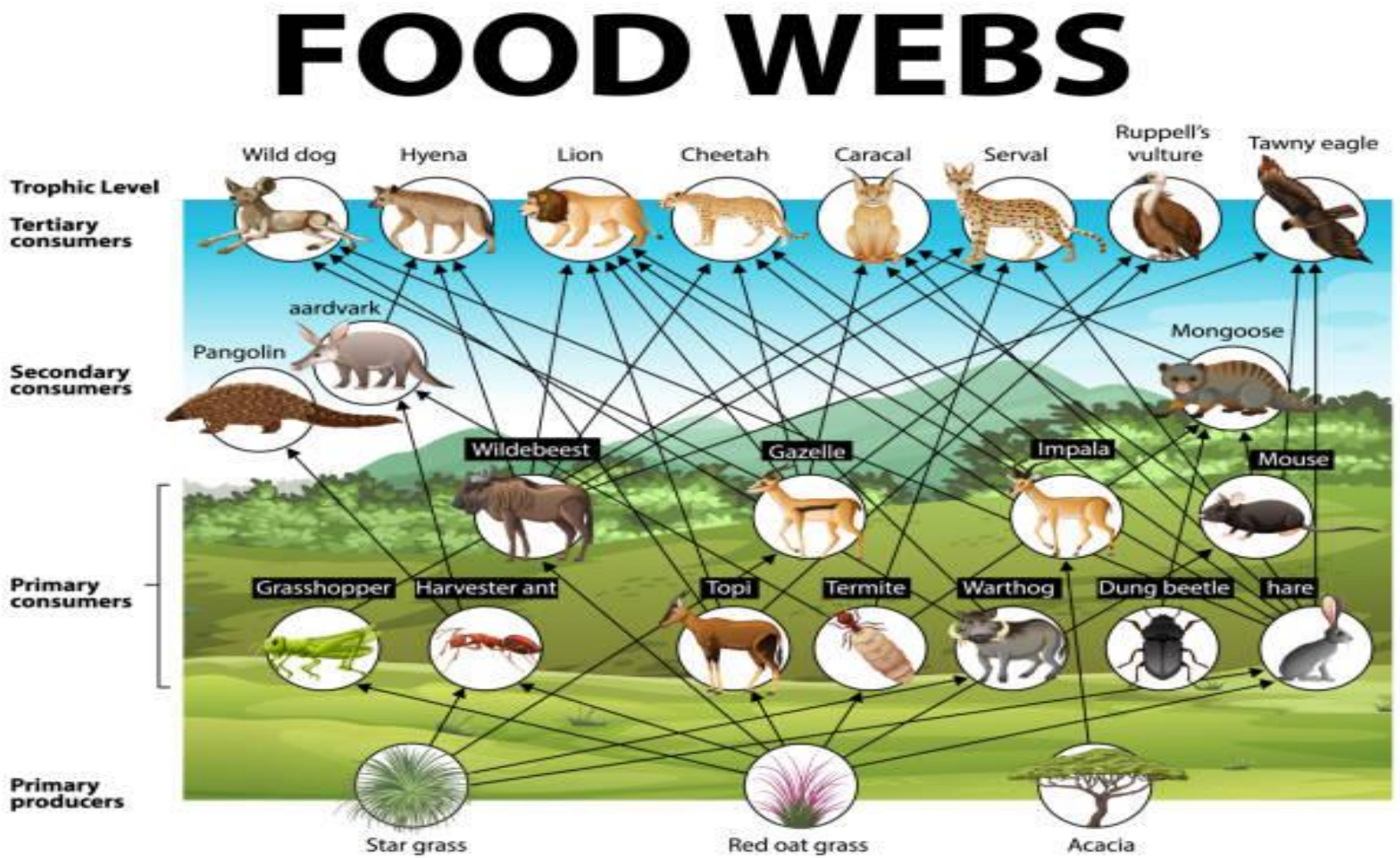
Food Web:

- Several interconnected food chains form a food web.
- A food web is similar to a food chain but the food web is comparatively larger than a food chain.
- Occasionally, a single organism is consumed by many predators or it consumes several other organisms.
- Due to this, many trophic levels get interconnected.
- The food chain fails to showcase the flow of energy in the right way.
- But, the food web is able to show the proper representation of energy flow, as it displays the interactions between different organisms.
- When there are more cross interactions between different food chains, the food web gets more complex.
- This complexity in a food web leads to a more sustainable ecosystem.

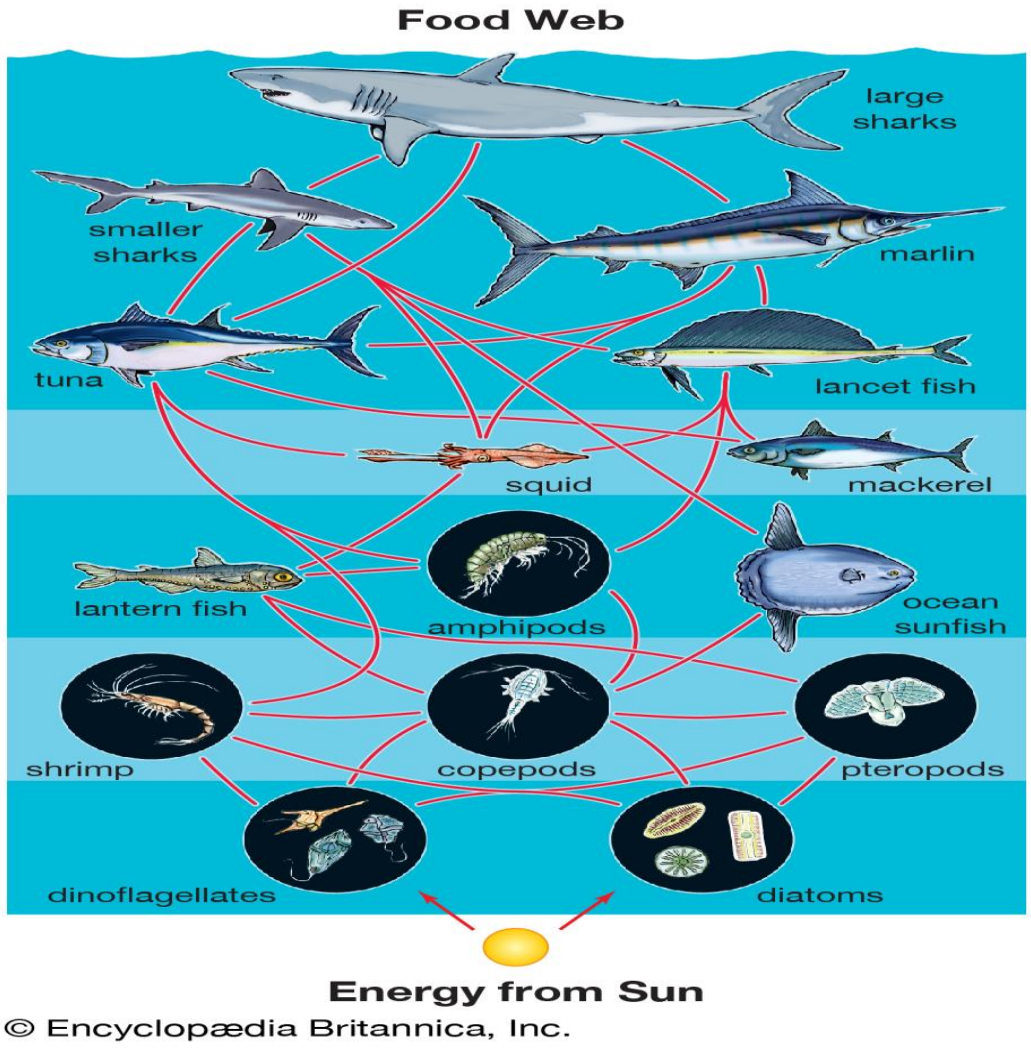
Terrestrial Food Web(CO1)

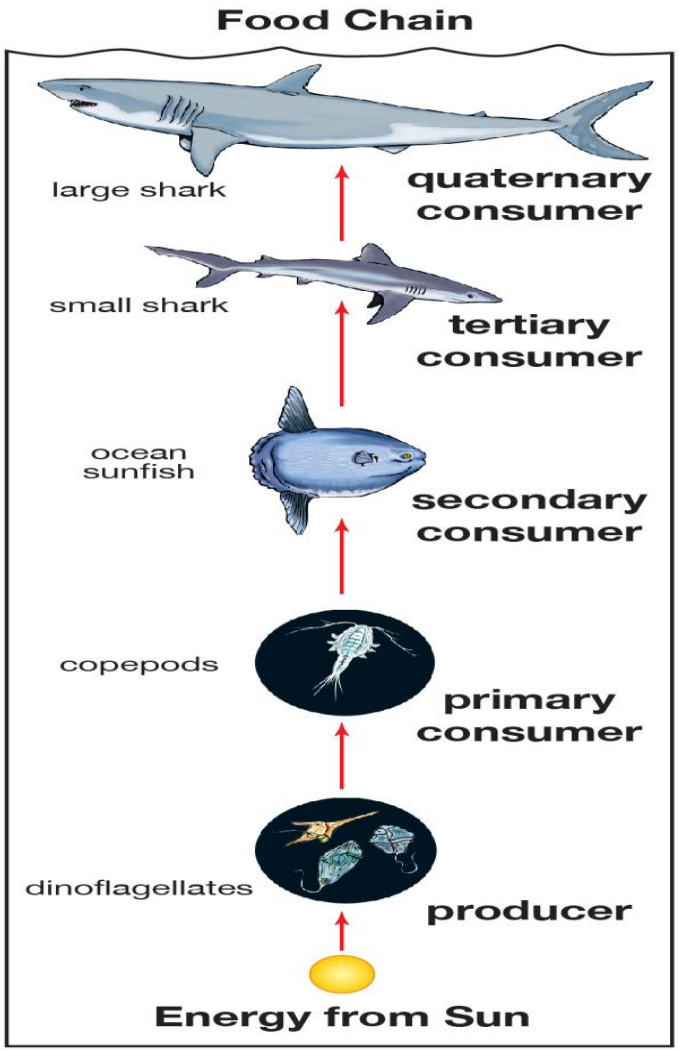


Terrestrial Food Web(CO1)



Aquatic Food Web(CO1)





Ecological pyramid(CO1)

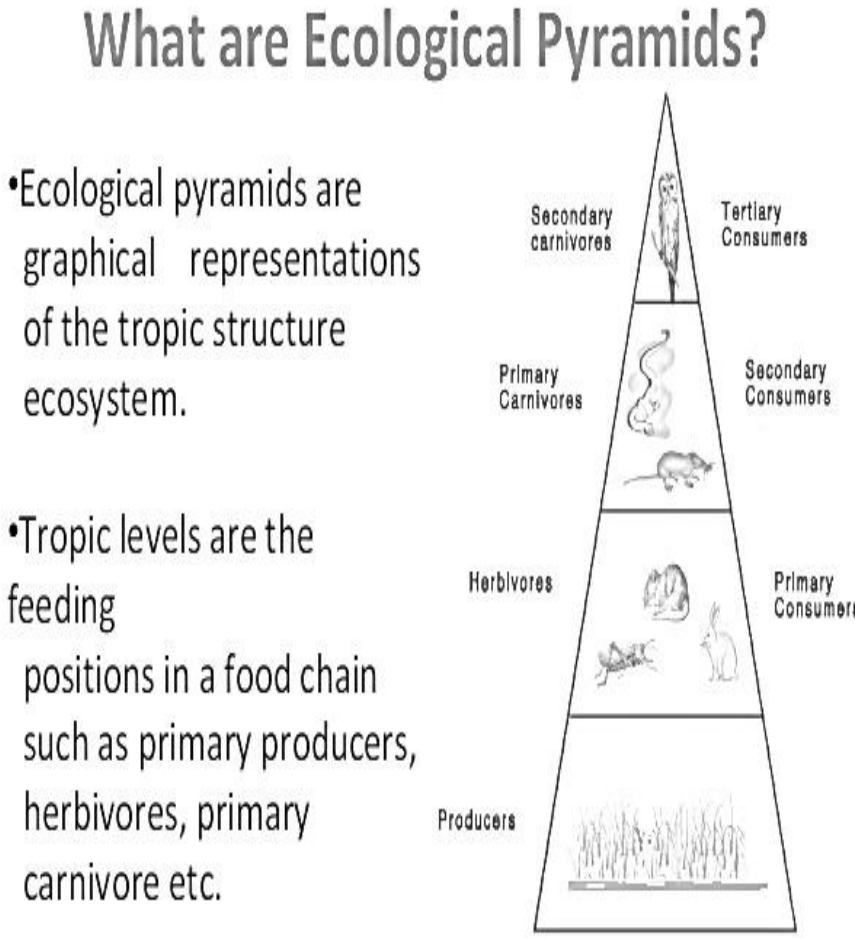
Ecological pyramid

- An ecological pyramid is also known as trophic pyramid, Eltonian pyramid, energy pyramid, or sometimes food pyramid is a graphical representation designed to show the biomass or bioproductivity at each trophic level in a given ecosystem.
- Or It is a graphic representation of the relationship between organisms at various trophic levels in a food chain.
- The basis of an ecological pyramid is the biomass, energy, and number. Just as the name suggests ecological pyramids are in the shape of a pyramid.
- The concept was first introduced by Charles Elton, the pioneer British Ecologist.

1.Pyramid of numbers

2.Pyramid of biomass

3.Pyramid of energy



Ecological pyramid(CO1)

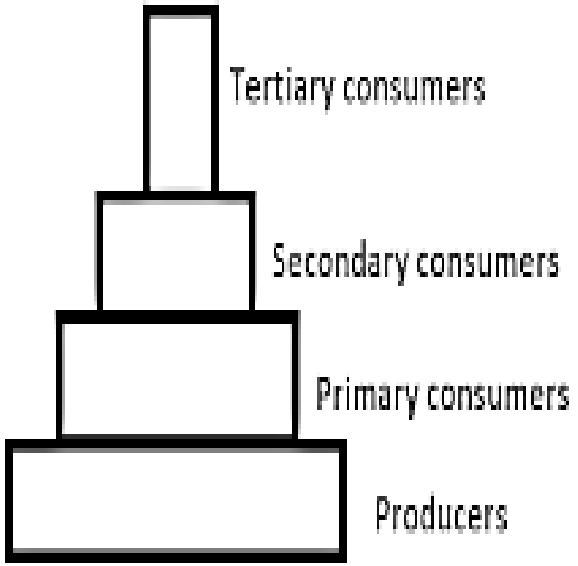
Pyramid of numbers :

- Here the factor that is taken into account is the number of organisms in each trophic level.

Upright Pyramid of Numbers

Inverted Pyramid of Numbers

Partly upright pyramid of numbers



Pyramid of numbers

Ecological pyramid(CO1)

Upright Pyramid of Numbers

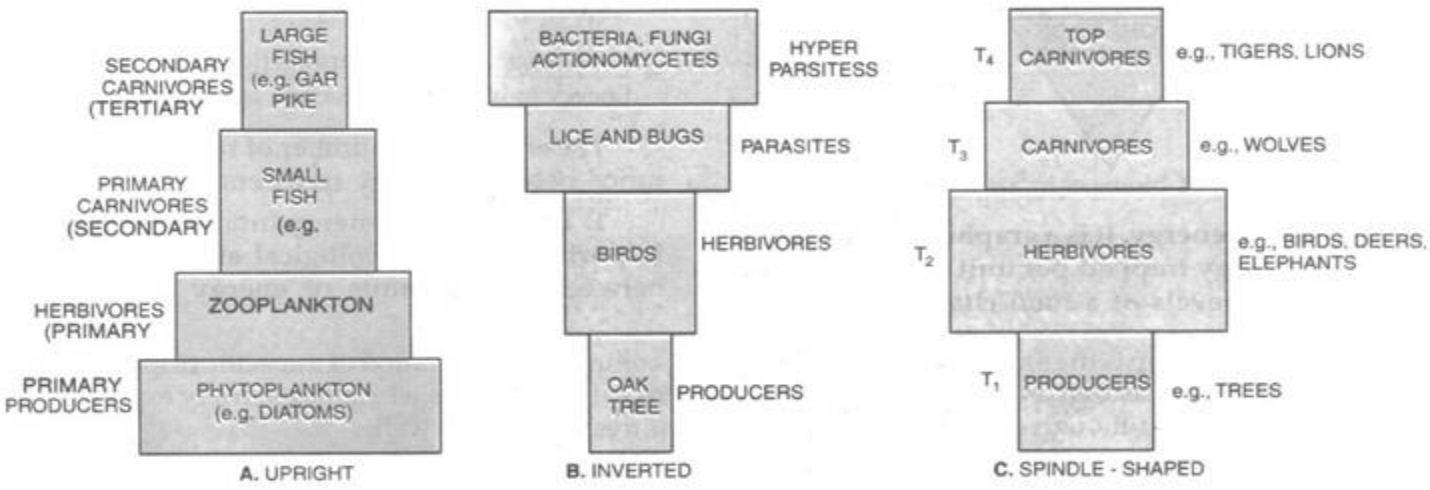
- As we go up the levels of the pyramid, the number of organisms decreases. The producers form the largest number and hence are at the bottom of the pyramid.

Inverted Pyramid of Numbers

- Here, the number of individuals increase from the lower level to the higher trophic level. For example, the tree ecosystem.

Partly upright pyramid of numbers

It is seen in the forest ecosystem where the number of producers are lesser in number and support a greater number of herbivores and which in turn support a fewer number of carnivores.



Pyramids of numbers : **A.** In pond ecosystem; **B.** In parasitic food chain; **C.** Tree ecosystem.

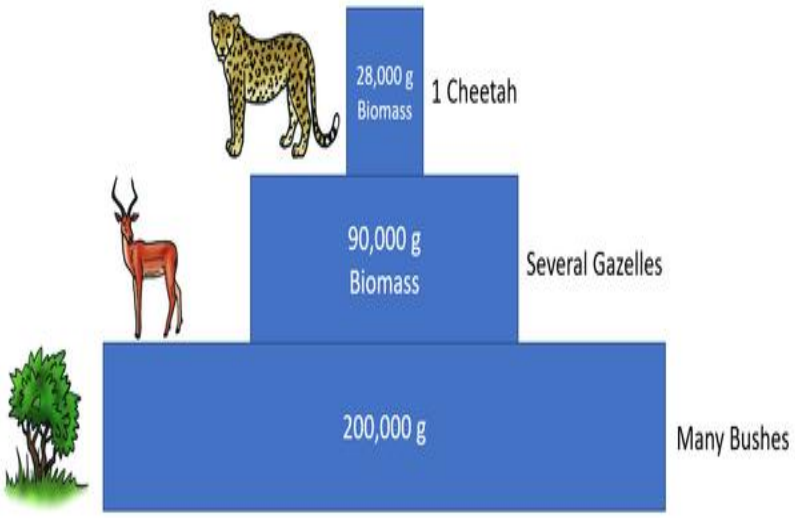
Ecological pyramid(CO1)

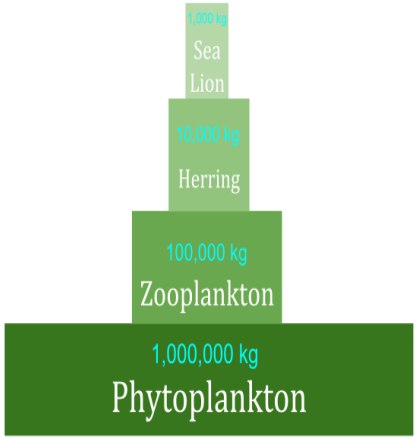
Pyramid of biomass :

- It is generally ascertained by gathering all organisms occupying each trophic level separately and measuring their dry weight.
- Each trophic level has a certain mass of living material at a particular time called standing crop, which is measured as the mass of living organisms (biomass) or the number in a unit area.

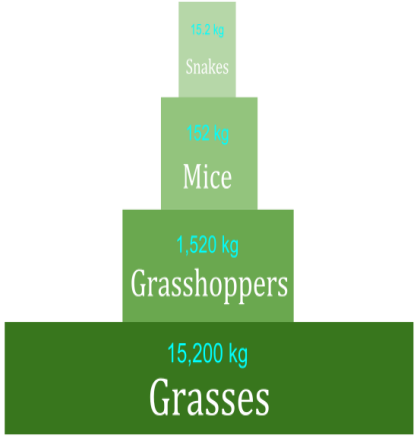
Types of pyramid of biomass

- Upright pyramid of biomass and
- Inverted pyramid of biomass.





Aquatic Ecosystem



Terrestrial Ecosystem

Ecological pyramid(CO1)

Pyramid of biomass :

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Types of pyramid of biomass

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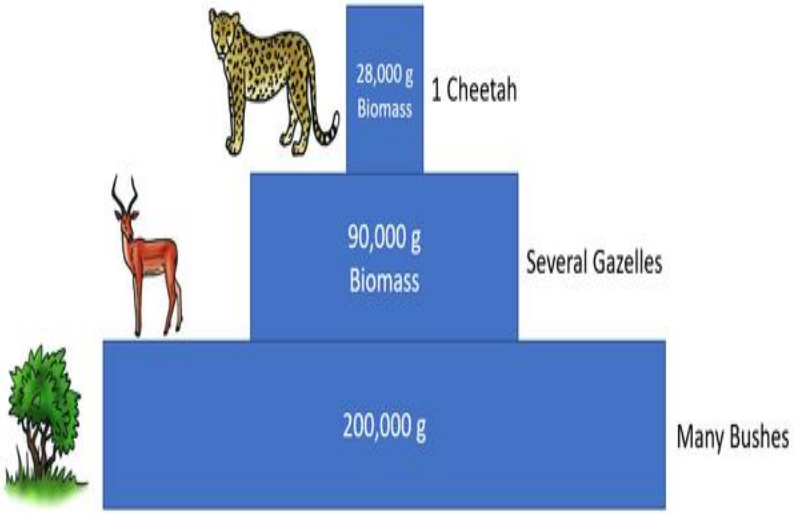
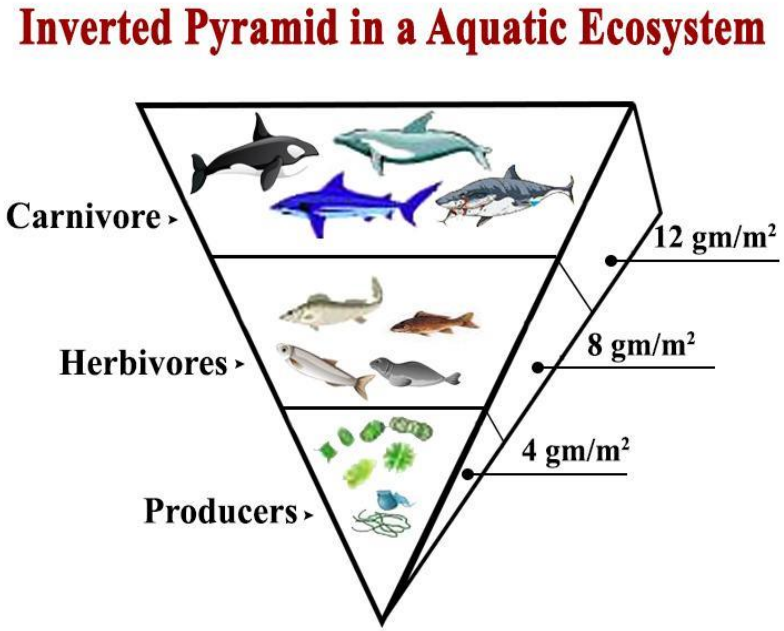


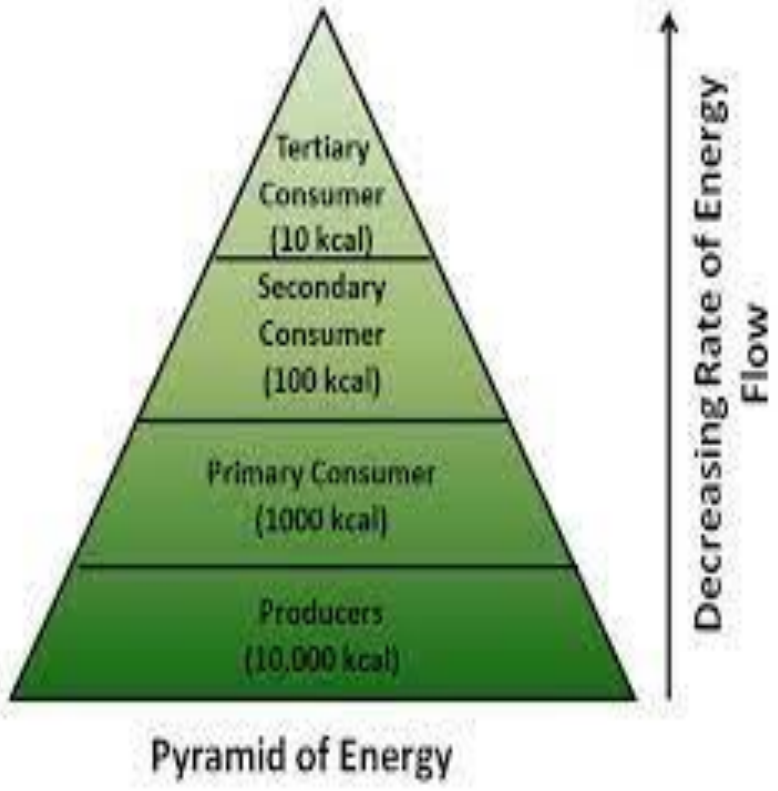


Ecological pyramid(CO1)

Pyramid of energy

- It is a graphical structure representing the flow of energy through each trophic level of a food chain over a fixed part of the natural environment.
- An energy pyramid represents the amount of energy at each trophic level and loss of energy at each is transferred to another trophic level.
- Energy pyramid, sometimes called trophic pyramid or ecological pyramid, is useful in quantifying the energy transfer from one organism to another along the food chain.

https://bharatgogreen.com/what-is-an-ecosystem/



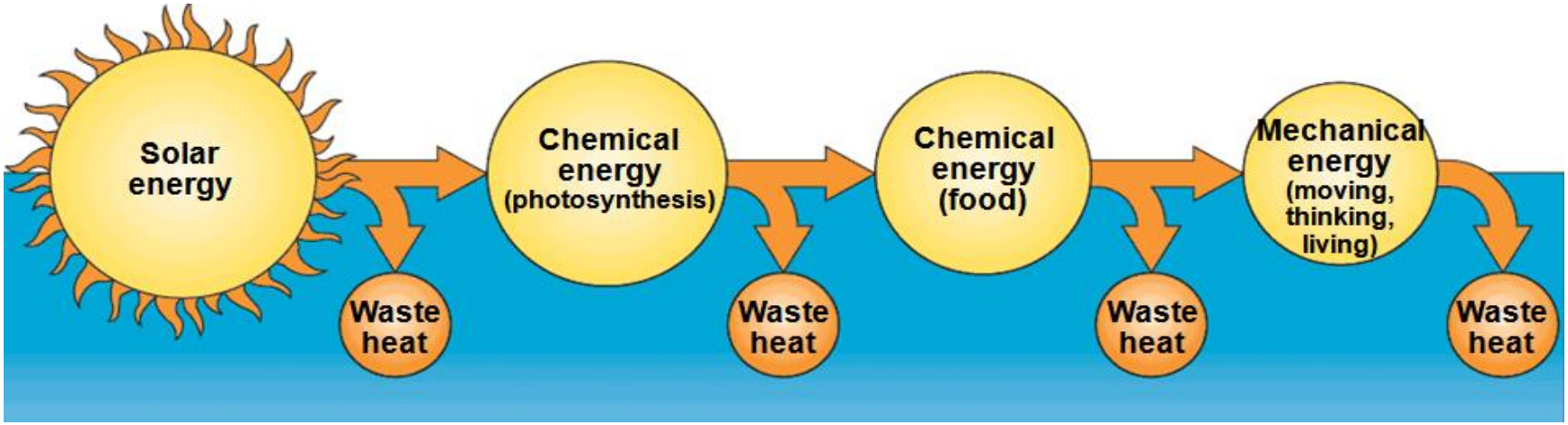
Pyramid of Energy

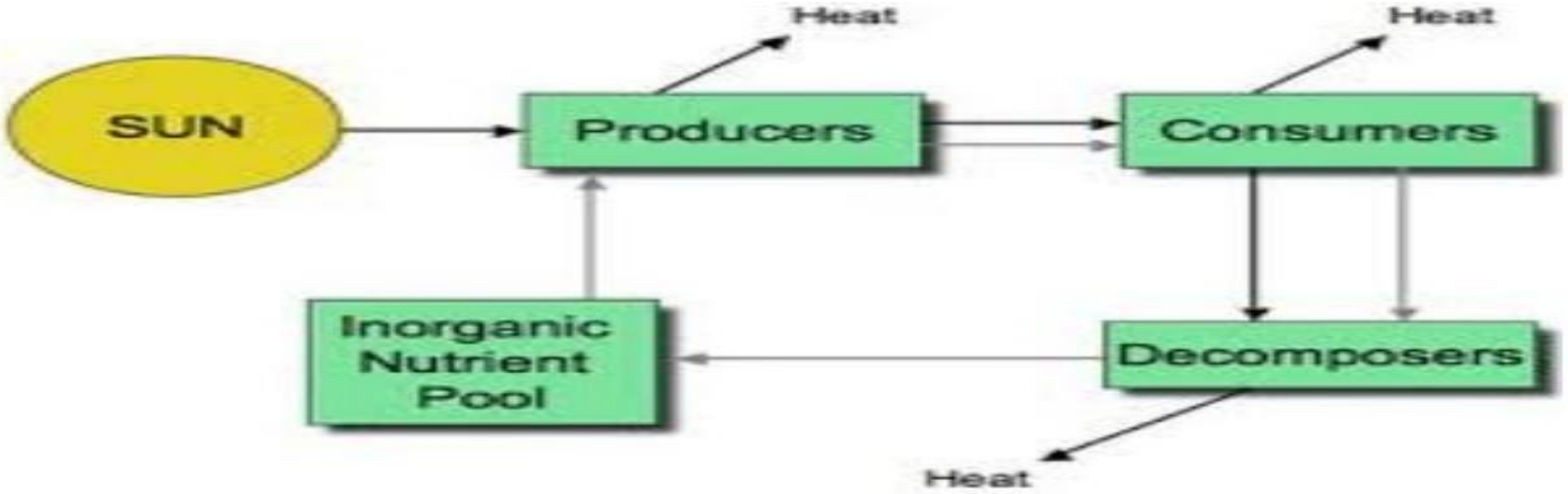
Energy flow(CO1)

Energy flow

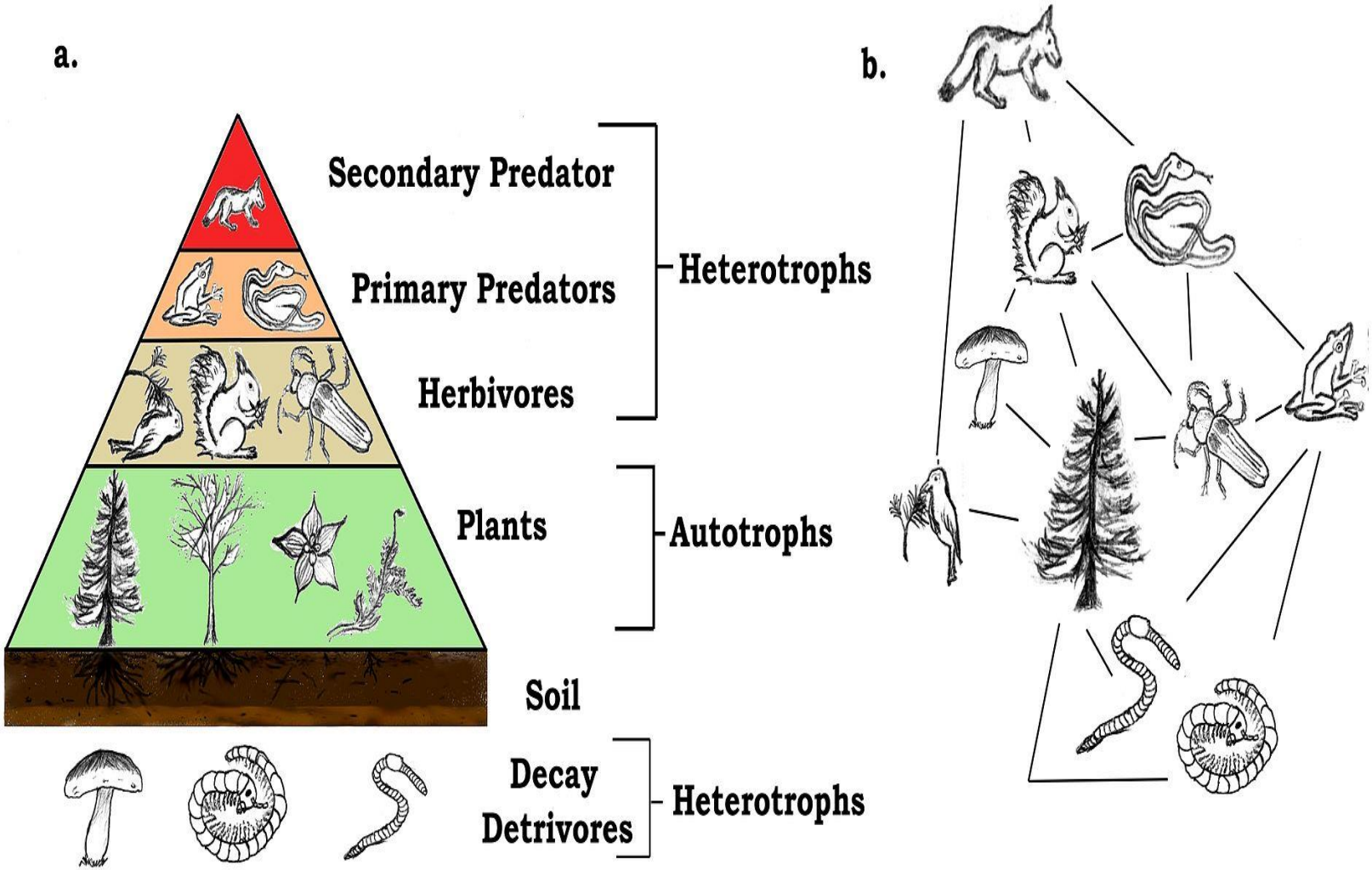
- It is the flow of energy through living things within an ecosystem.
- All living organisms can be organized into producers and consumers, and those producers and consumers can further be organized into a food chain.
- Each of the levels within the food chain is a trophic level.
- In order to more efficiently show the quantity of organisms at each trophic level, these food chains are then organized into trophic pyramids.
- The arrows in the food chain show that the energy flow is unidirectional, the head of the arrows show the direction energy is moving in, and that energy is lost as heat at each step along the way.
- The unidirectional flow of energy and the successive loss of energy as it travels up the food web are patterns in energy flow that are governed by Thermodynamics, which is the concept of energy exchange between systems.
- Trophic dynamics relates to Thermodynamics because it deals with the transfer and transformation of energy (originating externally from the sun via solar radiation) to and among organisms.

Energy flow(CO1)





Energy flow(CO1)



Energy flow(CO1)

Autotroph → Herbivore → Primary carnivore → Secondary carnivore etc.

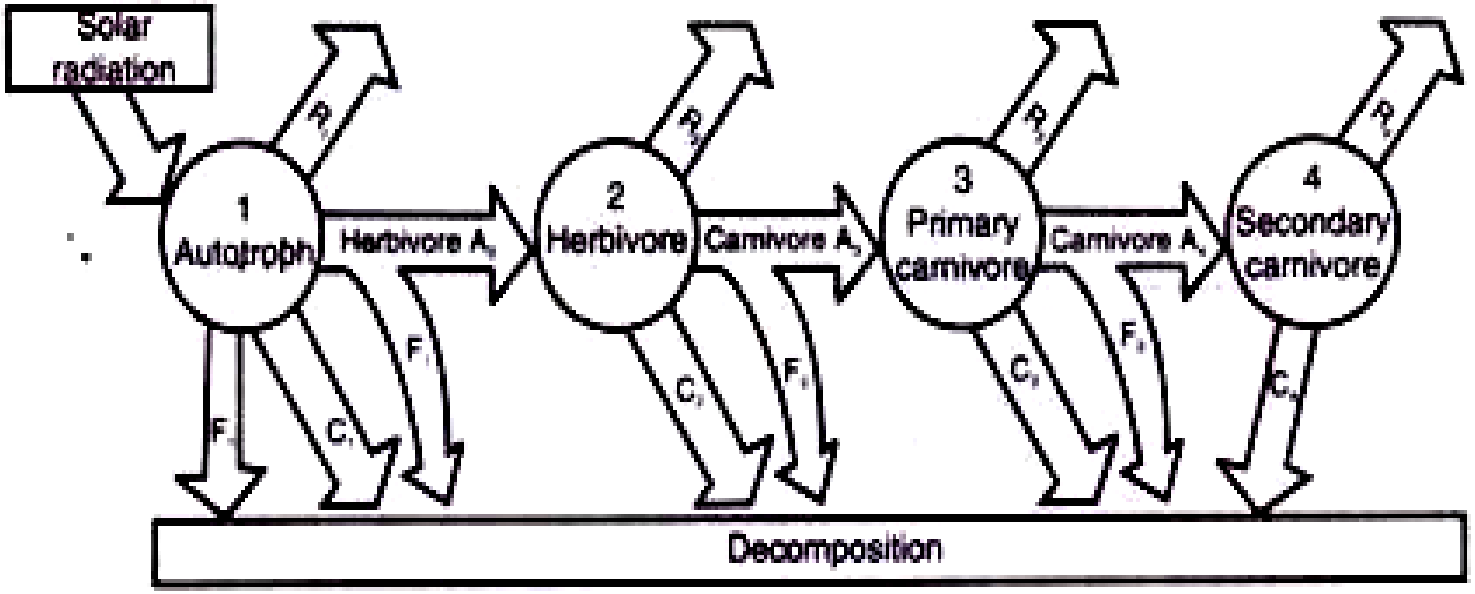


Fig. 3.8. Diagrammatic representation of a grazing food chain showing input and losses of energy at each trophic level. Trophic levels are numbered and used as subscripts to letters indicating energy transfer. A—assimilation of food by the organisms at the trophic level; F—energy lost in the form of faeces and other excretory products; C—energy lost through decay; and R—energy lost to respiration.

Quiz (CO1..)

- Energy flow is---------- in nature.
- Material flow is ----------in nature in an ecosystem.
- ---------- breakdown organic matter
- Every food chain starts with a ----------.
- Define the concept of Ecosystem? What are the basic concept of an ecosystem?
- Discuss the role of producers, consumers and decomposers in an ecosystem?
- Discuss the structure and function of balanced ecosystem
- Write short notes on food chain, food web and ecological pyramids?

Repair of ecosystem (CO1..)

- Repair or reconstruct ecosystems damaged by humans or natural forces
- People are now being held responsible for their actions for degradation of ecosystem

5 “R’s” for Restoration of Ecosystem (CO1..)

- **Restoration** (manipulation of nature to re-create species composition & ecosystem)
- **Rehabilitation**(to bring an area back to a useful state for human purposes)
- **Remediation** (process of cleaning chemical contamination from a polluted area by physical or biological methods)
- **Reclamation** (used to restore the shape, original contour and vegetation of a disturbed site)
- **Recreation** (attempts to construct a new biological community on a site)

Biogeochemical cycle(CO1..)

Biogeochemical cycle

- It is a pathway by which a chemical substance is turned over or moves through the biotic (biosphere) and the abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth.

Ecological systems (ecosystems) have many biogeochemical cycles operating as a part of the system, for example, the water cycle, the carbon cycle, the nitrogen cycle, etc.

- All chemical elements occurring in organisms are part of biogeochemical cycles.
- In addition to being a part of living organisms, these chemical elements also cycle through abiotic factors of ecosystems such as water (hydrosphere), land (lithosphere), and/or the air (atmosphere).

Biogeochemical cycles mainly refer to the movement of nutrients and other elements between biotic and abiotic factors.

- The term biogeochemical is derived from "bio" meaning biosphere, "geo" meaning the geological components and "chemical" meaning the elements that move through a cycle.
- The matter on Earth is conserved and present in the form of atoms. Since matter can neither be created nor destroyed, it is recycled in the earth's system in various forms.

Biogeochemical cycle(CO1..)

Types of Biogeochemical Cycles

Biogeochemical cycles are basically divided into two types:

- **Gaseous cycles** – Includes Carbon, Oxygen, Nitrogen, and the Water cycle.
- **Sedimentary cycles** – Includes Sulphur, Phosphorus, Rock cycle, etc.
- The major cycles include:

Water ,Carbon, Nitrogen, Phosphorus and Sulphur Cycles.

Water cycle :

It is also known as the hydrologic cycle or the hydrological cycle, describes the continuous movement of water on, above and below the surface of the Earth.

- **During this process, water changes its state from one phase to another, but the total number of water particles remains the same and following physical processes occur. Like**
- evaporation, condensation, precipitation, infiltration, surface runoff, and subsurface flow. The water goes through different forms: liquid, solid (ice) and vapor.

Biogeochemical cycle(CO1..)

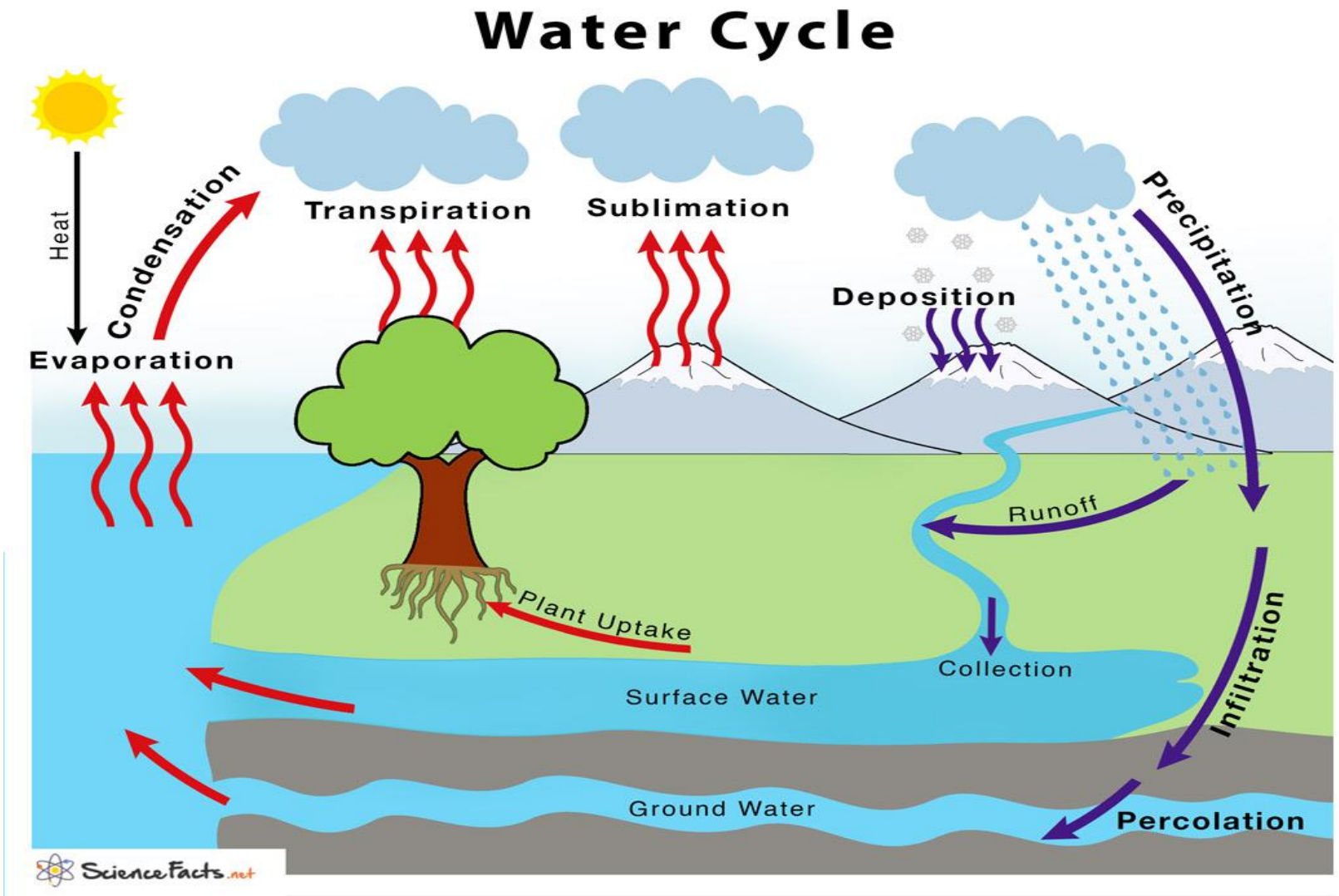
Evaporation

- The sun is the ultimate source of energy, and it powers most of the evaporation that occurs on earth.
- Evaporation generally happens when water molecules at the surface of water bodies become excited and rise into the air.
- These molecules with the highest kinetic energy accumulate into water vapour clouds.
- Evaporation usually takes place below the boiling point of water.
- Another process called **evapotranspiration** occurs when evaporation occurs through the leaves of plants.
- This process contributes to a large percentage of water in the atmosphere.

Sublimation

- Sublimation occurs when snow or ice changes directly into water vapour without becoming water.
- It usually occurs as a result of dry winds and low humidity. Sublimation can be observed on mountain peaks, where the air pressure is quite low.
- The low air pressure helps to sublimate the snow into water vapour as less energy is utilised in the process.
- Another example of sublimation is the phase where fog bellows from dry ice.
- On earth, the primary source of sublimation is from the ice sheets covering the poles of the earth.

Biogeochemical cycle(CO1..)



Biogeochemical cycle(CO1..)

Condensation

- The water vapour that accumulated in the atmosphere eventually cools down due to the low temperatures found at high altitudes.
- These vapours become tiny droplets of water and ice, eventually coming together to form clouds.

Precipitation

- Above 0^0 C , the vapours will condense into water droplets.
- However, it cannot condense without dust or other impurities.
- Hence, water vapours attach itself on to the particle's surface.
- When enough droplets merge, it falls out of the clouds and on to the ground below.
- This process is called precipitation (or rainfall).
- In particularly cold weather or extremely low air pressure, the water droplets freeze and fall as snow or hail.

Deposition

This refers to changing of water vapor directly to ice.

Advection

The movement of water through the atmosphere. Without advection, water that evaporated over the oceans could not precipitate over land.

Biogeochemical cycle(CO1..)

Infiltration

- Rainwater gets absorbed into the ground through the process of infiltration.
- The level of absorption varies based on the material the water has seeped into.
- For instance, rocks will retain comparatively less water than soil.
- Groundwater can either follows streams or rivers.
- But sometimes, it might just sink deeper, forming aquifers.

Runoff

- If the water from rainfall does not form aquifers, it follows gravity, often flowing down the sides of mountains and hills; eventually forming rivers.
- This process is called runoff.
- In colder regions, icecaps form when the amount of snowfall is faster than the rate of evaporation or sublimation.
- The biggest icecaps on earth are found at the poles.

Transpiration

The release of water vapor from plants and soil into the air.

Percolation

Water flows vertically through the soil and rocks under the influence of gravity.

Biogeochemical cycle(CO1..)

Carbon cycle

- It shows the movement of carbon in elemental and combined states on earth.
- Diamond and graphite are the elemental forms of carbon and in combined state.
- It is found as carbonates in minerals and as carbon dioxide gas in the atmosphere.

Carbon cycle is the process where carbon compounds are interchanged among the biosphere, geosphere, pedosphere, hydrosphere,* and *atmosphere of the earth.

Carbon Cycle Steps

Following are the major steps involved in the process of the carbon cycle:

1.Carbon present in the atmosphere is absorbed by plants for photosynthesis.

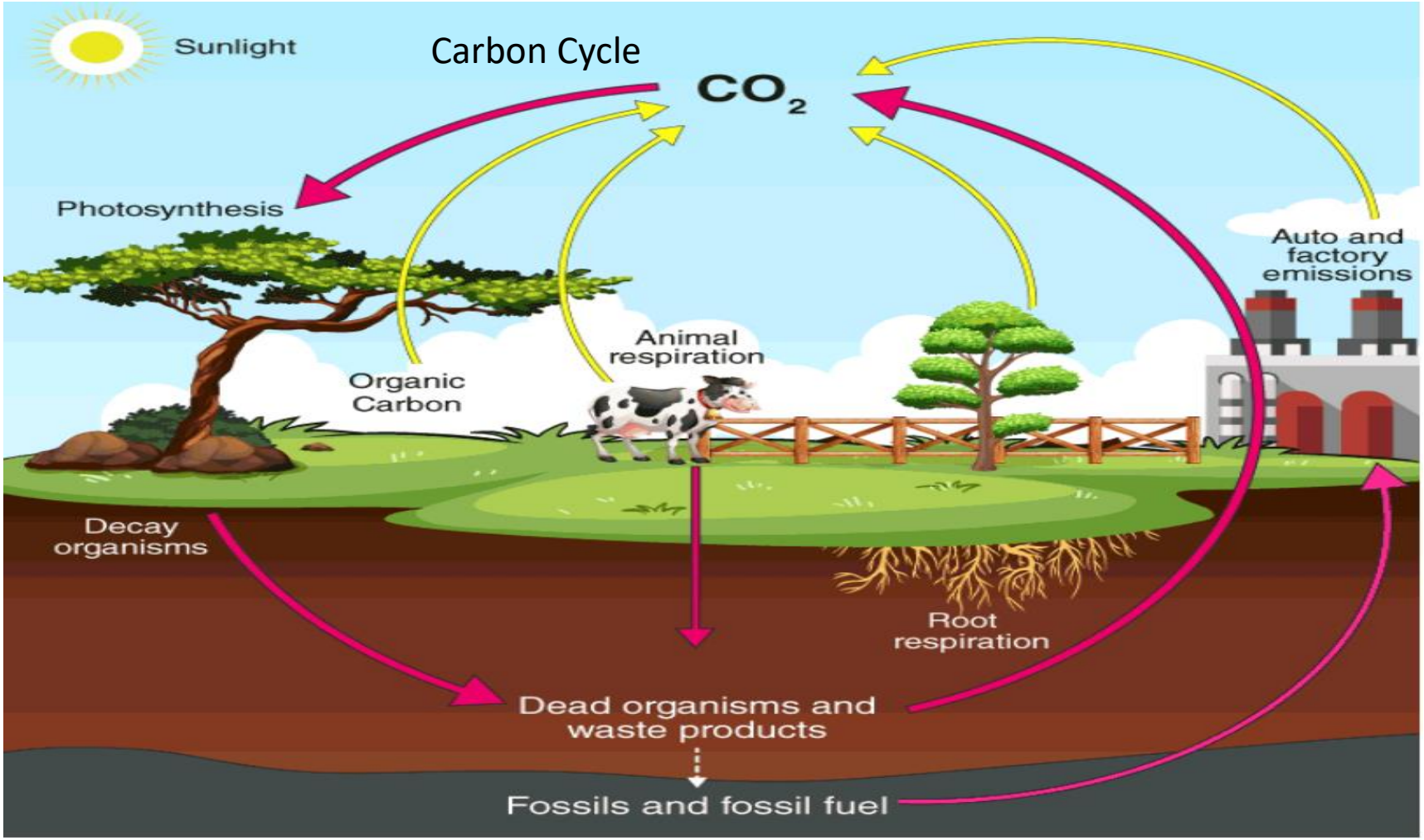
2.These plants are then consumed by animals and carbon gets bioaccumulated into their bodies.

3.These animals and plants eventually die, and upon decomposing, carbon is released back into the atmosphere.

4.Some of the carbon that is not released back into the atmosphere eventually become fossil fuels.

5.These fossil fuels are then used for man-made activities, which pumps more carbon back into the atmosphere.

Biogeochemical cycle(CO1..)



Carbon Cycle diagram showing the flow of carbon, its sources and paths.

Biogeochemical cycle(CO1..)

Carbon Cycle on Land

- Carbon in the atmosphere is present in the form of carbon dioxide.
- Carbon enters the atmosphere through natural processes such as respiration and industrial applications such as burning fossil fuels.
- The process of photosynthesis involves the absorption of CO_2 by plants to produce carbohydrates.
- The equation is as follows:

$$CO_2 + H_2O + \text{energy} \rightarrow\rightarrow (CH_2O)n + O_2$$

Biogeochemical cycle(CO1..)

Oceanic Carbon Cycle

- This is essentially a carbon cycle but in the sea.
- Ecologically, oceans take in more carbon than it gives out.
- Hence, it is called a “carbon sink.” Marine animals convert carbon to calcium carbonate and this forms the raw building materials require to create hard shells, similar to the ones found in clams and oysters.
- When organisms with calcium carbonate shells die, their body decomposes, leaving behind their hard shells.
- These accumulate on the seafloor and are eventually broken down by the waves and compacted under enormous pressure, forming limestone.
- When these limestone rocks are exposed to air, they get weathered and the carbon is released back into the atmosphere as carbon dioxide.

Biogeochemical cycle(CO1..)

Nitrogen cycle

- It is the biogeochemical cycle by which nitrogen is converted into multiple chemical forms as it circulates among atmosphere, terrestrial, and marine ecosystems.
- The conversion of nitrogen can be carried out through both biological and physical processes.
- Important processes in the nitrogen cycle include fixation, ammonification, nitrification, and denitrification.
- The majority of Earth's atmosphere (78%) is atmospheric nitrogen, making it the largest source of nitrogen.

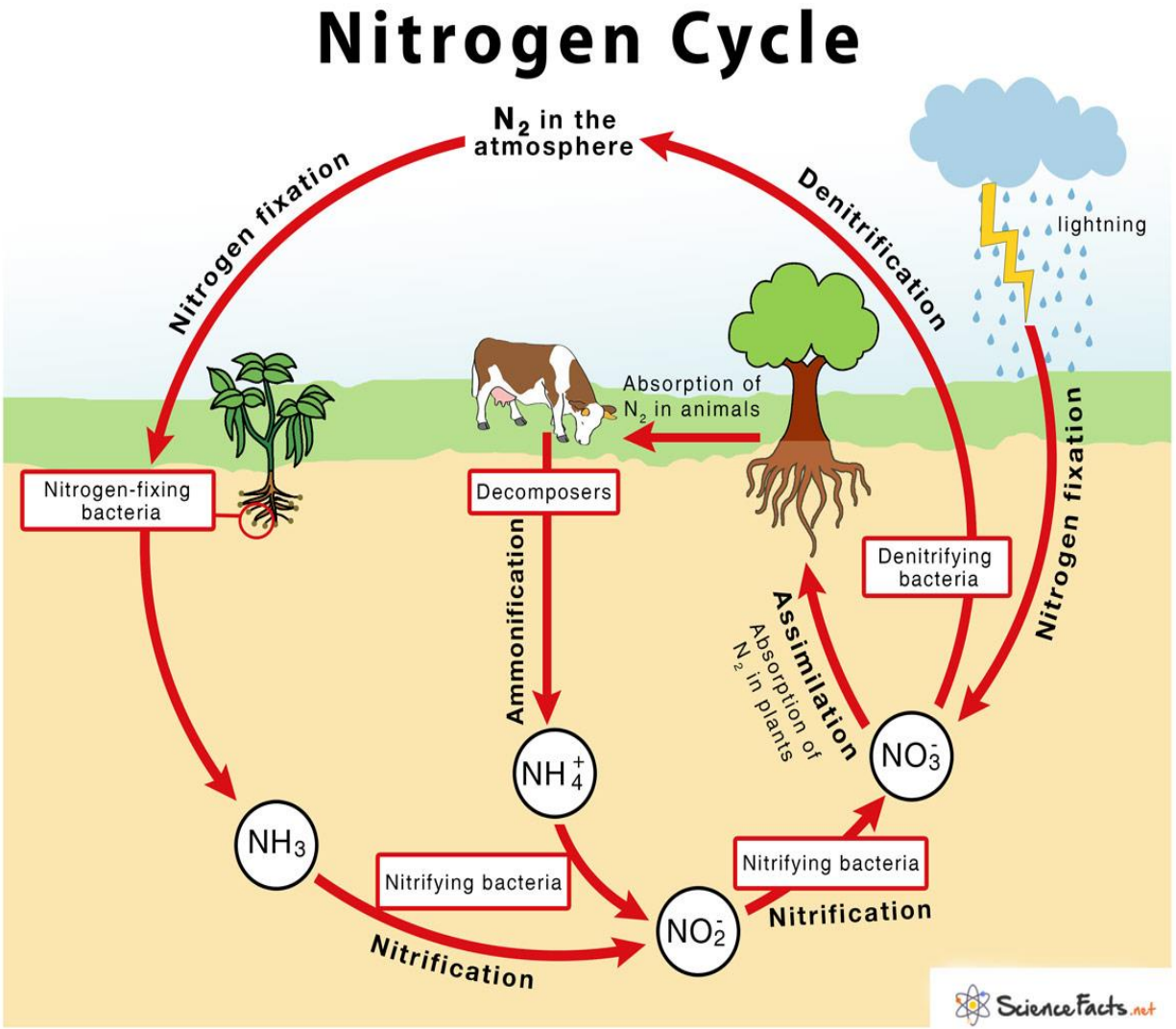
Process:

- Nitrogen is present in the environment in a wide variety of chemical forms including organic nitrogen,ammonium (NH^+_4), nitrite (NO^-_2), nitrate (NO^-_3), nitrous oxide (N_2O), nitric oxide (NO) or inorganic nitrogen gas (N_2).
- Organic nitrogen may be in the form of a living organism, humus or in the intermediate products of organic matter decomposition.
- The processes in the nitrogen cycle is to transform nitrogen from one form to another.

Biogeochemical cycle(CO1..)

Steps;

- Nitrogen fixation
- Assimilation
- Ammonification
- Nitrification
- Denitrification
- Dissimilatory nitrate reduction to ammonium
- Anaerobic ammonia oxidation



Biogeochemical cycle(CO1..)

Nitrogen fixation :

- The conversion of nitrogen gas (N_2) into nitrates and nitrites through atmospheric, industrial and biological processes is called nitrogen fixation.
- Atmospheric nitrogen must be processed, or "fixed", into a usable form to be taken up by plants.

Assimilation :

- Plants can absorb nitrate or ammonium from the soil by their root hairs.
- If nitrate is absorbed, it is first reduced to nitrite ions and then ammonium ions for incorporation into amino acids, nucleic acids, and chlorophyll.

Ammonification :

- When a plant or animal dies or an animal expels waste, the initial form of nitrogen is organic.
- Bacteria or fungi convert the organic nitrogen within the remains back into ammonium (NH_4^+) .This process called ammonification or mineralization.

Biogeochemical cycle(CO1..)

Nitrification :

- The conversion of ammonium to nitrate is performed primarily by soil-living bacteria and other nitrifying bacteria.
- In the primary stage of nitrification, the oxidation of ammonium (NH^+_4) is performed by bacteria such as the *Nitrosomonas* species, which converts ammonia to nitrites (NO^-_2).
- Other bacterial species such as *Nitrobacter*, are responsible for the oxidation of the nitrites (NO^-_2) into nitrates (NO^-_3).
- It is important for the ammonia (NH_3) to be converted to nitrates or nitrites because ammonia gas is toxic to plants.

Biogeochemical cycle(CO1..)

Denitrification :

- It is the reduction of nitrates back into nitrogen gas (N_2), completing the nitrogen cycle.
- This process is performed by bacterial species such as *Pseudomonas* and *Paracoccus*, under anaerobic conditions.

Dissimilatory nitrate reduction to ammonium:

- Dissimilatory nitrate reduction to ammonium (DNRA), or nitrate/nitrite ammonification, is an anaerobic respiration process.
- Microbes which undertake DNRA oxidise organic matter and use nitrate as an electron acceptor, reducing it to nitrite, then ammonium ($NO_3^- \rightarrow NO_2^- \rightarrow NH_4^+$)**.**

Anaerobic ammonia oxidation:

- In this biological process, nitrite and ammonia are converted directly into molecular nitrogen (N_2) gas.
- This process makes up a major proportion of nitrogen conversion in the oceans. The balanced formula for this "anammox" chemical reaction is:

$$NH^+_4 + NO^-_2 \rightarrow N_2 + 2H_2O$$

https://en.wikipedia.org/wiki/Nitrogen_cycle

Biogeochemical cycle(CO1..)

Phosphorus cycle :

- It is the biogeochemical cycle that describes the movement of phosphorus through the lithosphere, hydrosphere, and biosphere.
- Unlike many other biogeochemical cycles, the atmosphere does not play a significant role in the movement of phosphorus, because phosphorus and phosphorus-based compounds are usually solids at the typical ranges of temperature and pressure found on Earth.
- Specifically focused on the cycle in terrestrial and aquatic systems.
- Phosphorus is an essential nutrient for plants and animals.
- Phosphorus is a limiting nutrient for aquatic organisms.
- Phosphorus forms parts of important life-sustaining molecules that are very common in the biosphere.
- Phosphorus occurs most abundantly in nature as part of the orthophosphate ion $(PO4)3-$, consisting of a P atom and 4 oxygen atoms.

Biogeochemical cycle(CO1..)

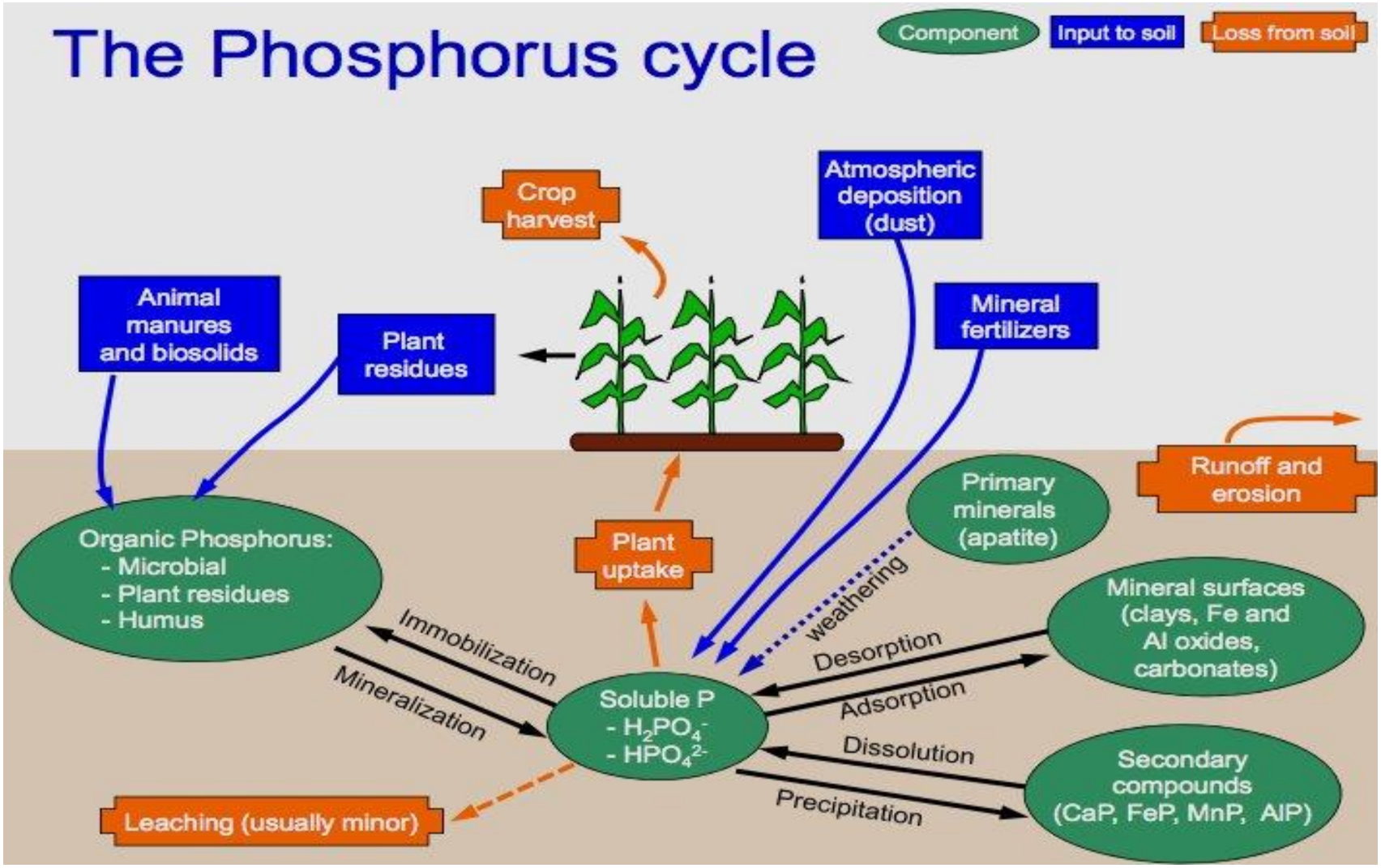
Phosphates move quickly through plants and animals; however, the processes that move them through the soil or ocean are very slow, making the phosphorus cycle overall one of the slowest biogeochemical cycles.

The global phosphorus cycle includes four major processes:

- Tectonic uplift and exposure of phosphorus-bearing rocks such as apatite to surface weathering;
- Physical erosion, and chemical and biological weathering of phosphorus-bearing rocks to provide dissolved and particulate phosphorus to soils, lakes and rivers;
- Riverine and subsurface transportation of phosphorus to various lakes and run-off to the ocean;
- Sedimentation of particulate phosphorus (e.g., phosphorus associated with organic matter and oxide/carbonate minerals) and eventually burial in marine sediments (this process can also occur in lakes and rivers).

- https://en.wikipedia.org/wiki/Phosphorus_cycle

Biogeochemical cycle(CO1..)



Biogeochemical cycle(CO1..)

Sulfur cycle:

- It is biogeochemical cycle in which the sulfur moves between rocks, waterways and living systems.
- It's important in geology as it affects many minerals and in life because sulfur is an essential element (CHNOPS), being a constituent of many proteins and cofactors, and sulfur compounds can be used as oxidants or reductants in microbial respiration.
- The global sulfur cycle involves the transformations of sulfur species through different oxidation states, which play an important role in both geological and biological processes.

Steps of the sulfur cycle:

- Mineralization of organic sulfur into inorganic forms, such as hydrogen sulfide (H_2S), elemental sulfur, as well as sulfide minerals.
- Oxidation of hydrogen sulfide, sulfide, and elemental sulfur (S) to sulfate (SO_4^{2-}).
- Reduction of sulfate to sulfide.
- Incorporation of sulfide into organic compounds (including metal-containing derivatives).

Biogeochemical cycle(CO1..)

These are often termed as follows:

Assimilative sulphate reduction in which sulphate (SO_4^{2-}) is reduced by plants, fungi and various prokaryotes. The oxidation states of sulphur are +6 in sulphate and –2 in R–SH.

Desulfurization in which organic molecules containing sulphur can be desulfurized, producing hydrogen sulphide gas (H_2S, oxidation state = –2). An analogous process for organic nitrogen compounds is deamination.

Oxidation of hydrogen sulphide **It** produces elemental sulphur (S_8), oxidation state = 0. This reaction occurs in the photosynthetic green and purple sulphur bacteria and some chemolithotrophs. Often the elemental sulphur is stored as polysulfides.

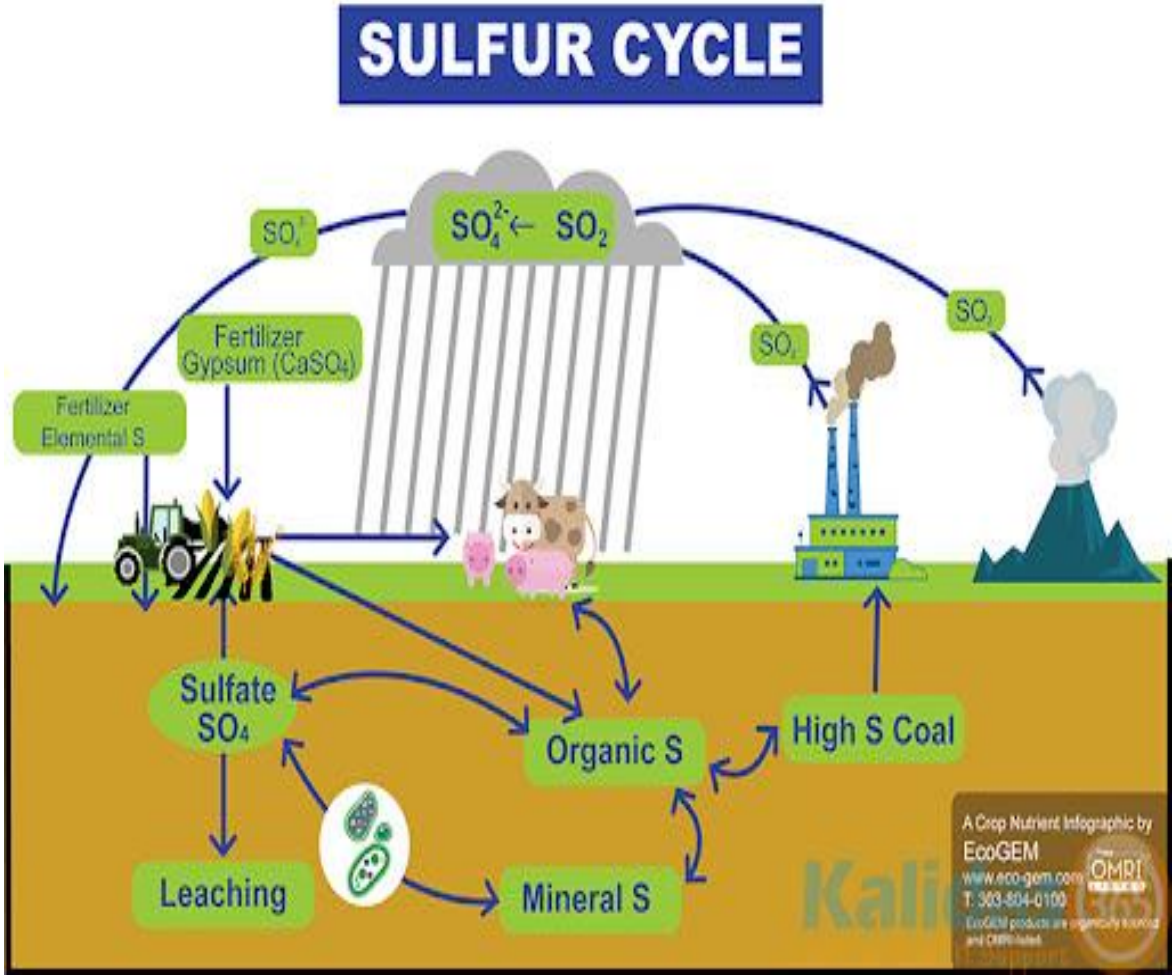
Oxidation in elemental sulphur by sulphur oxidizers produces sulphate.

Dissimilative sulphur reduction in which elemental sulphur can be reduced to hydrogen sulphide.

Dissimilative sulphate reduction in which sulphate reducers generate hydrogen sulphide from sulphate.

Biogeochemical cycle(CO1..)

Sulfur has four main oxidation states in nature, which are -2, +2, +4, and +6.
The common sulfur species of each oxidation state are listed as follows:
S^{2-}: H_2S, FeS, FeS_2, CuS
S^0: native, or elemental, sulfur
S^{2+}: SO
S^{4+}: SO_2, sulfite (SO_3^{2-})
S^{6+}: SO_4^{2-} (H_2SO_4, $CaSO_4$), SF_6



https://en.wikipedia.org/wiki/Sulfur_cycle

Ecosystem services (CO1..)

Ecosystem services

- These are the many and varied benefits to humans provided by the natural environment and from healthy ecosystems. Such ecosystems include, for example, agroecosystems, forest ecosystems, grassland ecosystems and aquatic ecosystems.
- These ecosystems, functioning in healthy relationship, offer such things like natural pollination of crops, clean air, extreme weather mitigation, and human mental and physical well-being.
- Collectively, these benefits are becoming known as 'ecosystem services', and are often integral to the provisioning of clean drinking water, the decomposition of wastes, and resilience and productivity of food ecosystems.
- While scientists and environmentalists have discussed ecosystem services implicitly for decades, the Millennium Ecosystem Assessment (MA) in the early 2000s popularized this concept.
- There, ecosystem services are grouped into four broad categories: *provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and oxygen production; and *cultural*, such as spiritual and recreational benefits.
- To help inform decision-makers, many ecosystem services are being valuated in order to draw equivalent comparisons to human engineered infrastructure and services.

Ecosystem services (CO1..)

- Ecosystem services are defined as the gains acquired by humankind from surroundings ecosystems.
- Per the 2006 Millennium Ecosystem Assessment (MA), ecosystem services are "the benefits people obtain from ecosystems".
- The MA also delineated the four categories of ecosystem services
- Supporting,
- Provisioning,
- Regulating and
- Cultural

Regulating services

•Purification of water and air
•Carbon sequestration and climate regulation
•Waste decomposition and detoxification
•Predation regulates prey populations
•Biological control pest and disease control
•Pollination
•Disturbance regulation, i.e. Flood protection

Ecosystem services (CO1..)

Provisioning services

The following services are also known as *ecosystem goods*:

- Food (including seafood and game), crops, wild foods, and spices
- Raw materials (including lumber, skins, fuel wood, organic matter, fodder, and fertilizer)
- Genetic resources (including crop improvement genes, and health care)
- Biogenic minerals
- Medicinal resources (including pharmaceuticals, chemical models, and test and assay organisms)
- Energy (hydropower, biomass fuels)
- Ornamental resources (including fashion, handicraft, jewelry, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)

Ecosystem services (CO1..)

Cultural services

•Cultural (including use of nature as motif in books, film, painting, folklore, national symbols, advertising, etc.)

•Spiritual and historical (including use of nature for religious or heritage value or natural)

•Recreational experiences (including ecotourism, outdoor sports, and recreation)

•Science and education (including use of natural systems for school excursions, and scientific discovery)

•Therapeutic (including Ecotherapy, social forestry and animal assisted therapy)

- As of 2012, there was a discussion as to how the concept of cultural ecosystem services could be operationalized, how landscape aesthetics, cultural heritage, outdoor recreation, and spiritual significance to define can fit into the ecosystem services approach.
- Who vote for models that explicitly link ecological structures and functions with cultural values and benefits.
- Likewise, there has been a fundamental critique of the concept of cultural ecosystem services that builds on three arguments:

Ecosystem services (CO1..)

1.Pivotal cultural values attaching to the natural/cultivated environment rely on an area's unique character that cannot be addressed by methods that use universal scientific parameters to determine ecological structures and functions.

2.If a natural/cultivated environment has symbolic meanings and cultural values the object of these values are not ecosystems but shaped phenomena like mountains, lakes, forests, and, mainly, symbolic landscapes.

3.Cultural values do result not from properties produced by ecosystems but are the product of a specific way of seeing within the given cultural framework of symbolic experience.

The Common International Classification of Ecosystem Services (CICES) is a classification scheme developed to accounting systems (like National counts etc.), in order to avoid double-counting of Suporting Services with others Provisioning and Regulating Services.

Ecosystem services (CO1..)

Supporting services

- These may be redundant with regulating services in some categorisations, but include services such as nutrient cycling, primary production, soil formation, habitat provision.
- These services make it possible for the ecosystems to continue providing services such as food supply, flood regulation, and water purification.
- Slade et al outline the situation where a greater number of species would maximize more ecosystem services

Sustainable development(CO1..)

Sustainable development

- It is an organizing principle for meeting human development goals while simultaneously sustaining the ability of natural systems to provide the natural resources and ecosystem services on which the economy and society depend.
- The desired result is a state of society where living conditions and resources are used to continue to meet human needs without undermining the integrity and stability of the natural system.
- Sustainable development can be defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- **Sustainable development can be defined** as the practice of maintaining the productivity by replacing resources used with resources of equal or greater value without degrading or endangering natural biotic systems.
- Sustainable development binds together concern for the carrying capacity of natural systems with the social, political and economic challenges faced by humanity. Sustainability science is the study of the concepts of sustainable development and environmental science.
- There is an emphasis on the present generations' responsibility to regenerate, maintain and improve planetary resources for use by future generations.

Sustainable development(CO1..)

The concept of sustainable development

- **It** was described by the 1987 Bruntland Commission Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
- There are four dimensions to sustainable development – society, environment, culture and economy – which are intertwined, not separate.
- Sustainability is a paradigm for thinking about the future in which environmental, societal and economic considerations are balanced in the pursuit of an improved quality of life.
- For example, a prosperous society relies on a healthy environment to provide food and resources, safe drinking water and clean air for its citizens.

Goals of Sustainable development(CO1..)

Goals of Sustainable development :

The 17 SDGs are: (1) No Poverty, (2) Zero Hunger, (3) Good Health and Well-being, (4) Quality Education, (5) Gender Equality, (6) Clean Water and Sanitation, (7) Affordable and Clean Energy, (8) Decent Work and Economic Growth, (9) Industry, Innovation and Infrastructure, (10) Reducing Inequality, (11) Sustainable Cities and Communities, (12) Responsible Consumption and Production, (13) Climate Action, (14) Life Below Water, (15) Life On Land, (16) Peace, Justice, and Strong Institutions, (17) Partnerships for the Goals.

Sustainable development(CO1..)

UN Decade for Eco restoration :

The SDGs build on decades of work by countries and the UN, including the UN Department of Economic and Social Affairs

- In June 1992, at the Earth Summit in Rio de Janeiro, Brazil, more than 178 countries adopted Agenda 21, a comprehensive plan of action to build a global partnership for sustainable development to improve human lives and protect the environment.
- Member States unanimously adopted the Millennium Declaration at the Millennium Summit in September 2000 at UN Headquarters in New York.
- The Summit led to the elaboration of eight Millennium Development Goals (MDGs) to reduce extreme poverty by 2015.
- The Johannesburg Declaration on Sustainable Development and the Plan of Implementation, adopted at the World Summit on Sustainable Development in South Africa in 2002,
- It is reaffirmed the global community's commitments to poverty eradication and the environment, and built on Agenda 21 and the Millennium Declaration by including more emphasis on multilateral partnerships.

Sustainable development(CO1..)

- At the United Nations Conference on Sustainable Development (Rio+20) in Rio de Janeiro, Brazil, in June 2012, Member States adopted the outcome document "The Future We Want" in which they decided, inter alia, to launch a process to develop a set of SDGs to build upon the MDGs and to establish the UN High-level Political Forum on Sustainable Development.
- The Rio +20 outcome also contained other measures for implementing sustainable development, including mandates for future programmes of work in development financing, small island developing states and more.
- In 2013, the General Assembly set up a 30-member Open Working Group to develop a proposal on the SDGs.
- In January 2015, the General Assembly began the negotiation process on the post-2015 development agenda.
- The process culminated in the subsequent adoption of the 2030 Agenda for Sustainable Development, with 17 SDGs at its core, at the UN Sustainable Development Summit in September 2015.

Sustainable development(CO1..)

- 2015 was a landmark year for multilateralism and international policy shaping, with the adoption of several major agreements:
  - Sendai Framework for Disaster Risk Reduction (March 2015)
  - Addis Ababa Action Agenda on Financing for Development (July 2015)
  - Transforming our world: the 2030 Agenda for Sustainable Development with its 17 SDGs was adopted at the UN Sustainable Development Summit in New York in September 2015.
  - Paris Agreement on Climate Change (December 2015)

Now, the annual High-level Political Forum on Sustainable Development serves as the central UN platform for the follow-up and review of the SDGs

Sustainable development(CO1..)

- Today, the Division for Sustainable Development Goals (DSDG) in the United Nations Department of Economic and Social Affairs (UNDESA) provides substantive support and capacity-building for the SDGs and their related thematic issues,
  including water, energy, climate, oceans, urbanization, transport, science and technology, the Global Sustainable Development Report (GSDR), partnerships and Small Island Developing States.
- DSDG plays a key role in the evaluation of UN systemwide implementation of the 2030 Agenda and on advocacy and outreach activities relating to the SDGs.
- In order to make the 2030 Agenda a reality, broad ownership of the SDGs must translate into a strong commitment by all stakeholders to implement the global goals.
- DSDG aims to help facilitate this engagement.

5 “R’s” for Restoration of Ecosystem (CO1..)

- **Restoration** (manipulation of nature to re-create species composition & ecosystem)
- **Rehabilitation**(to bring an area back to a useful state for human purposes)
- **Remediation** (process of cleaning chemical contamination from a polluted area by physical or biological methods)
- **Reclamation** (used to restore the shape, original contour and vegetation of a disturbed site)
- **Recreation** (attempts to construct a new biological community on a site)

Faculty Video Links, Youtube & NPTEL Video Links and Online Courses Details (CO1..)

- Self Made Video Link:

- Youtube/other Video Links
- https://www.youtube.com/watch?v=T21OO0sBBfc, https://www.youtube.com/watch?v=qt8AMjKKPDohttps://www.youtube.com/watch?v=yAK-m91Nxrs https://www.youtube.com/watch?v=ha_O-1uOWkk, https://www.youtube.com/watch?v=brF0RWJyx9w

Daily Quiz (CO1)

- If there is a shortage of deer in forest, what tiger might do?
  a) Eat grassland leaves
  b) Die due to starvation
  c) Hunt for other animals
  d) Fasting until they find deer
  Answer b
- 2. In the food relationship, where the tiger eats the deer and the deer eats plants. Which of the following conditions is true?
  a) The tiger is the prey
  b) The tiger is the primary consumer
  c) The deer is the predator
  d) The deer is the prey
  Answer d
- 3. Which of the following condition is true about food chain?
  a) Provide more energy for next trophic level
  b) Provides food for succeeding organisms
  c) Consume energy from next trophic level
  d) Do not pass energy to next trophic level
  View Answer b)

Daily Quiz (CO1)

- 4.Which of the following conceptual spheres of the environment having less storage capacity for matter?
- A)Atmospheres b.Lithospheres
- C. Hydrosphere. d) Biospheres
- Answer A
- 5. Which of the following is a constituent of eco-system? a) Plants b) Birds c) Animals d) All of these
- Answer-d
- 6.Components required to build up the environmental awareness include :
- a. Exposure to real life situations b.Sustainable development
- C.Conservation of resources d.All of the above
- Answer- d

Daily Quiz (CO1..)

- 7.What kind of Eco-system is known as sustainable? a) The one in which all species are in balance b) The one in which there are no animals c) The one in which animals feed on each other d) All of these
- Answer a
- 8.An Eco-System comprises of a) Living organisms b) Non-living organisms c) Both living and non-living organisms d) Only plants
- Answer--c
- 9. Which of the following statement is TRUE? a) Eco-Systems may vary in size b) Eco-Systems are always very large c) Eco-Systems are always very small. d) None of these is true.
- Answer---a
- 10. If one part of Eco-System is damaged, what happens? a) It doesn't have any impact on the Eco-system b) It completely destroys the eco-system c) It has an impact on everything else in the eco-system d) All of these
- Answer ---c

Weekly Assignment (CO1..)

- 1.What is ecosystem? Give its components.
- 2.Give physiognomic characteristics.
- 3.Write note on ecological energetics.
- 4.Write note food chain, food web and trophic levels.
- 5.Write note on ecological pyramids.
- 6.Describe nitrogen cycle.
- 7.Describe hydrological cycle.
- 8. Define the term Environmental science? Briefly discuss the scope and importance of environmental science.
- 9. How would environmental awareness help to protect our environment
- 10.. Discuss in brief the different segments of environment?
- 11..Define the concept of Ecosystem? What is the basic concept of an ecosystem?
- 12.. Discuss the role of producers, consumers and decomposers in an ecosystem?
- 13.Discuss the structure and function of balanced ecosystem
- 14. Write short notes on food chain, food web and ecological pyramids?

MCQ s (CO1..)

- How many types of ecological models are there?
  a) One
  b) Two
  c) Three
  d) Four
  View Answer
- advertisement
- 2. Food chains are often used in ecological modeling.
  a) True
  b) False
  View Answer
- 3. Which of the following food chain correctly describes the flow of energy in an ecosystem?
  a) Grass->lion->human
  b) Cow->grass->lion
  c) Grass->goat->human
  d) Leaf->bird->lizard

MCQ s (CO1..)

4.The species which are in danger of extinction are called:
(a) Vulnerable species
(b) Rare species
(c) Endangered species
(d) Normal species
Answer c
5. The forest cover in our country has recently increased due to:
(a) Increase in natural forest growth
(b) Increase in net sown area
(c) Plantation by different agencies
(d) None of the above
Answer c
6. **This factor contributes to the carbon cycle**
(a) fossil fuel combustion
(b) respiration
(c) photosynthesis
(d) all of these
Answer: (d)

MCQ s (CO1..)

7. The source of carbon to plants in the carbon cycle is

(a) fossil fuels
(b) carbonate rocks
(c) atmospheric carbon dioxide
(d) all of the above

Answer: (c)

8. The role of bacteria in the carbon cycle is

(a) Breakdown of organic compounds
(b) Chemosynthesis
(c) Photosynthesis
(d) Assimilation of nitrogen compounds

Answer: (a)

9. In the carbon cycle, the human body returns carbon to the atmosphere through this way:

(a) formation of glucose
(b) waste products
(c) photosynthesis
(d) cellular respiration

Answer: (d)

MCQ s (CO1..)

- **10.Respiration and photosynthesis are central to this process**
(a) nitrogen cycle
(b) phosphorous cycle
(c) carbon cycle
(d) sulphur cycle
Answer: (c)
11The difference between the phosphorous cycle and carbon cycle lies in the fact that
(a) the phosphorous cycle does not include a gaseous phase but the carbon cycle does
(b) phosphorous does not enter living entities but carbon enters
(c) the phosphorous cycle includes a solid phase, the carbon cycle does not
(d) primary reservoir of the phosphorous cycle is the atmosphere, but rocks are the primary reservoirs for carbon cycle
Answer: (a)

Old Question Papers

- Autonomous syllabus

Expected Questions for University Exam (CO1..)

- 1.What is ecosystem? Give its components.
- 2.Give physiognomic characteristics.
- 3.Write note on ecological energetic.
- 4.Write note food chain, food web and trophic levels.
- 5.Write note on ecological pyramids.
- 6.Describe nitrogen cycle.
- 7.Describe hydrological cycle.
- 8Describe the different segment of atmosphere?
- 9. Breifly describe the need of public awareness about the environment?
- 10. Knowing about the environment is not an end, but rather a beginning
- 12. Discuss the the biotic and abiotic components of pond ecosystem?
- 13.. The flow of energy is unidirectional in nature while circulation of matter and nutrient is cyclic in nature in an ecosystem? Explain it with example?
- 14. What are the minerals? Discuss the effects of mining activity on the environment?

Summary (CO1..)

The term environment refers to ones surroundings. The physical and biological factors along with their chemical interactions that affect an organism or a group of organisms. The environment is the biotic and abiotic surrounding of an organism or population, and consequently includes the factors that have an influence in their survival, development and evolution. The environment can vary in scale from microscopic to global in extent. Examples include the marine environment, the atmospheric environment and the terrestrial environment. The sum total of all surroundings of a living organism, including natural forces and other living things, which provide conditions for development and growth as well as of danger and damag

Summary (CO1..)

Atmosphere The following points highlight the vital role played by atmosphere in the survival of life in this planet.

• The atmosphere is the protective blanket of gases which is surrounding the earth. It protects the earth from the hostile environment of outer space.

• It absorbs IR radiations emitted by the sun and reemitted from the earth and thus controls the temperature of the earth.

• It allows transmission of significant amounts of radiation only in the regions of 300 – 2500 nm (near UV, Visible, and near IR) and 0.01 – 40 meters (radio waves). i.e it filters tissue damaging UV radiation below 300 nm.

• It acts as a source for CO_2 for plant photosynthesis and O_2 for respiration

• It acts as a source for nitrogen for nitrogen fixing bacteria and ammonia producing plants. • The atmosphere transports water from ocean to land.

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Effects of Industry on our Environment(CO1)

- **Adverse Effects of Industry on our Environment**
- (i) Industrial practices release enormous quantities of air and water pollutants.
- (ii) They generate huge amounts of hazardous wastes.
- (iii) Industrial effluents have polluted many lakes, rivers, and coastal environments.
- (iv) Industrial accidents, such as Bhopal gas tragedy, often have tragic environmental consequences.
- **i) Pollution prevention:**
- Try to create less of the pollutant or waste or eliminate it.
- **(ii) Recycling and reuse:**
- They not only reduce pollution, but they also conserve natural resources.
- **(iii) Treatment:**
- It is used to reduce the volume or toxicity of the waste.

Soil Erosion(CO1..)

- Soil Erosion
- Excessive water-supply and wind removes the top fertile layer of the farm. Loss of nutrient rich soil not only reduces productivity, but also results in silting of water bodies and streams and induces release of soil carbon from particulate organic material, which contributes to global warming.
- b) Ground water contamination
- Leaching of nitrates (NPK fertilizers) may cause ground-water pollution. E.g. haemoglobin combines with nitrite to from methaemoglobin which is unable to carry the oxygen so reduces oxygen uptake in the lungs.
- **c) Water-logging and salinity**
- Due to improper drainage, water gets accumulated in the farm known as water-logging. When water evaporates, it causes salinity in the soil. As a result the crop plants die.

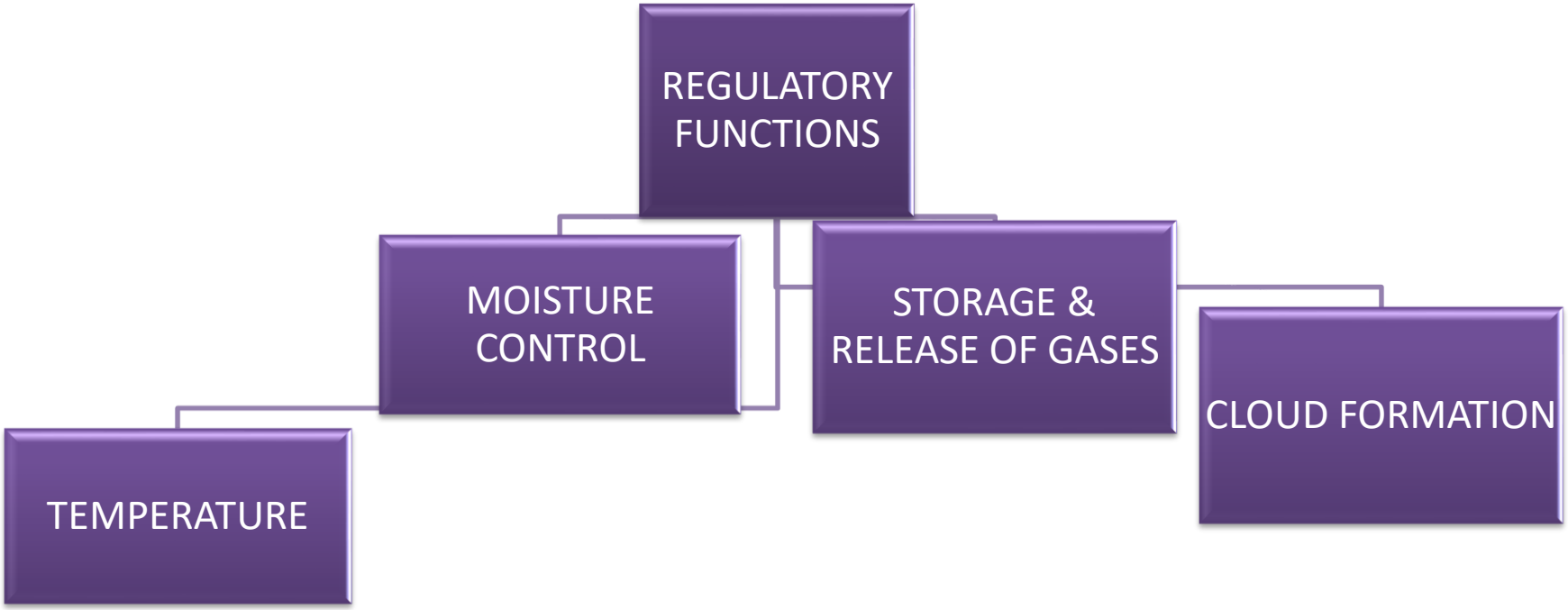
Eutrophication and biological magnification(co1)

- **Eutrophication**
- When the water runoff with chemical fertilizers reach to the nearby water body small water plants grow in excess known as Algal Bloom. It prevents or stops intermixing of atmospheric oxygen to dissolved oxygen in water. The water plants and animals start dying due to lack of oxygen. The dead parts will deposit at the bottom of the water body. The process continues and cause threat to the water-body. The process is known as Eutrophication. The water body is known as eutrophic water body e.g. Chilka Lake in Orissa.
- **Biomagnification**
- Concentration of the toxic substance increases several times when it is transferred from one organism to another, in the food-chain known as Biomagnification. E.g. increase in DDT concentration caused reproductive failure in birds i.e. their eggs hatch before time.

Natural recourses(CO1)

- Renewable
  - Forest, Water, Wind, Solar
- Non-renewable
  - Minerals, Fossil fuels

Forest Resources (CO1..)



OVER EXPLOITATION OF FOREST(CO1)

– **OVER EXPLOITATION OF FOREST:**

Due to overpopulation, the forest materials like food, medicine, shelter, wood & fuel are not sufficient to meet the people's demand. Hence exploitation of forest increases day by day

- ***Reason for over exploitation in India:***
- In India forest area required to maintain good ecological balance is 33% but at present is only 22% there. Hence over exploitation of forest occur.
- ***Causes of over exploitation:***
    - Increasing agricultural production
    - Increasing industrial activities
    - Increase in demand of wood resources

Thank You