FEC 7: Introduction to Environmental Science

Details of Course:

S. No.	Contents
1	ENVIRONMENTAL STUDIES: ECOSYSTEMS, BIO-DIVERSITY & ITS CONSERVATION The Multidisciplinary Nature of Environmental Studies Definition, scope and importance of Environmental Studies. Biotic and a biotic component of environment, need for environmental awareness. Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and function of different ecosystem Bio-diversity and its Conservation: Introduction to biodiversity —definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity : Habitat loss, Poaching of wildlife, man wildlife conflicts, rare endangered and threatened species(RET) endemic species of India, method of biodiversity conservation: In-situ and ex-situ conservation.
2	NATURAL RESOURCES: PROBLEMS & PROSPECTS Renewable and Non-renewable Natural Resources Concept and definition of Natural Resources and need for their management Forest resources: Use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems, Water conservation, rain water harvesting, watershed management. Mineral resources: Uses are exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes causes by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Urban problems related to energy, case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
3	ENVIRONMENTAL POLLUTION CONTROL Environmental Pollution, Definition, types, causes, effects and control measures of (a) Air pollution, (b) Water pollution, (c) Soil pollution, (d) Marine pollution, (e) Noise pollution, (f) Thermal pollution. Nuclear hazards. Solid waste and its management: causes, effects and control measures of urban and industrial waste.
4	Disaster Management, Social Issues, Human Population and the Environment. Social Issues, Human Population and the Environment, Sustainable development, Climate change, global warming, acid rain, ozone layer depletion, Environmental ethics: Issues and possible solutions, Consumerism and waste products, , Wasteland reclamation. Population growth, problems of urbanisation.

Assessment Plan:

- Tests
- Assignments

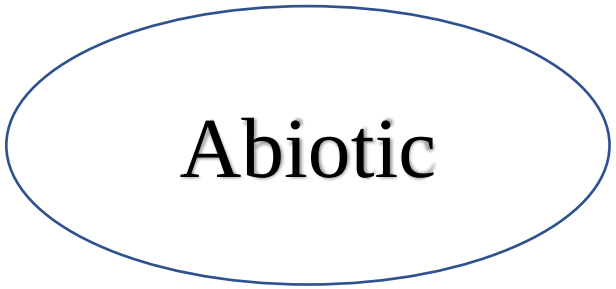
Reading Material:

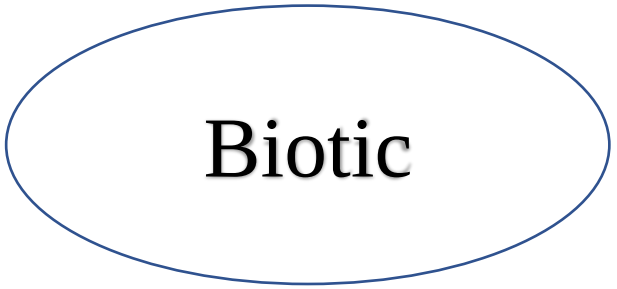
- A Textbook of Environmental Studies – S. Chawla
- Textbook for Environmental Studies – E. Bharucha
- Essential Environmental Studies – S. P. Misra and S. N. Pandey

Environment

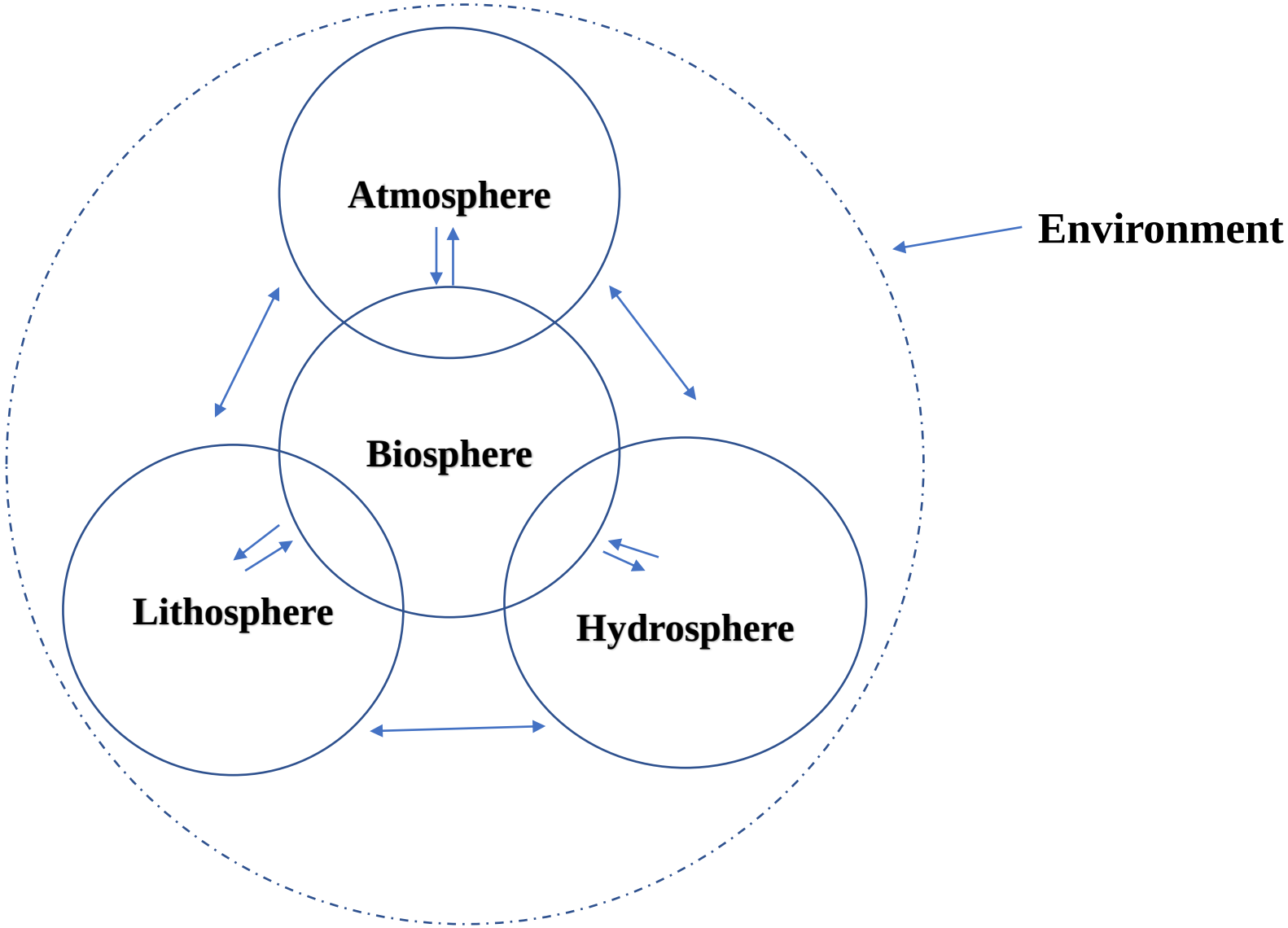
Environ – to surround

Environment is defined as the social, cultural and physical conditions that surround, affect and influence the survival, growth and development of people, animals or plants.

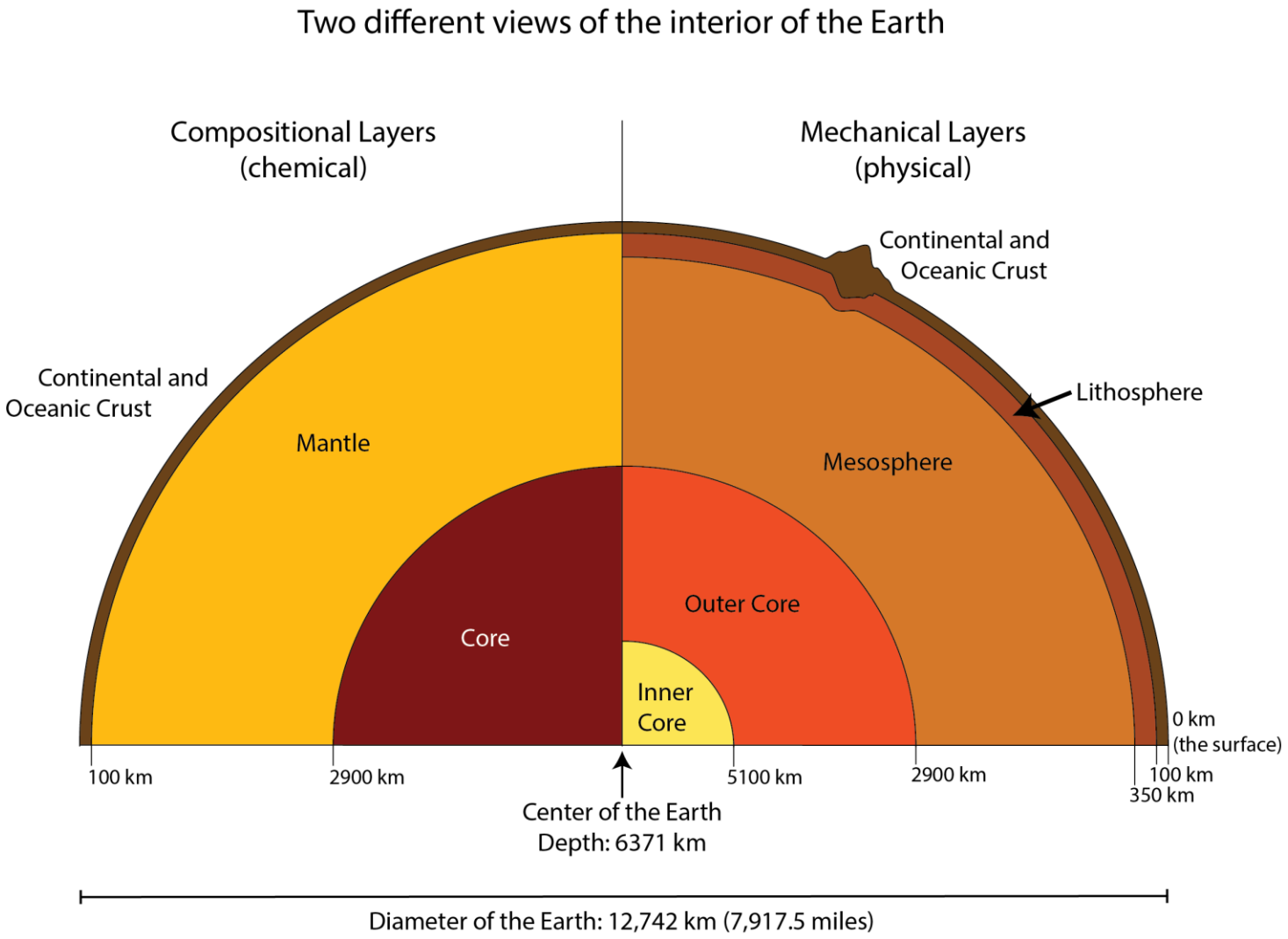




Concept of Environment as a functional system



Lithosphere



- **Soil**
- **Sand, gravel and stone**
- **Micronutrients in soil**
- **Microorganisms in soil**
- **Minerals**
- **Oil, coal and gas**

Biosphere

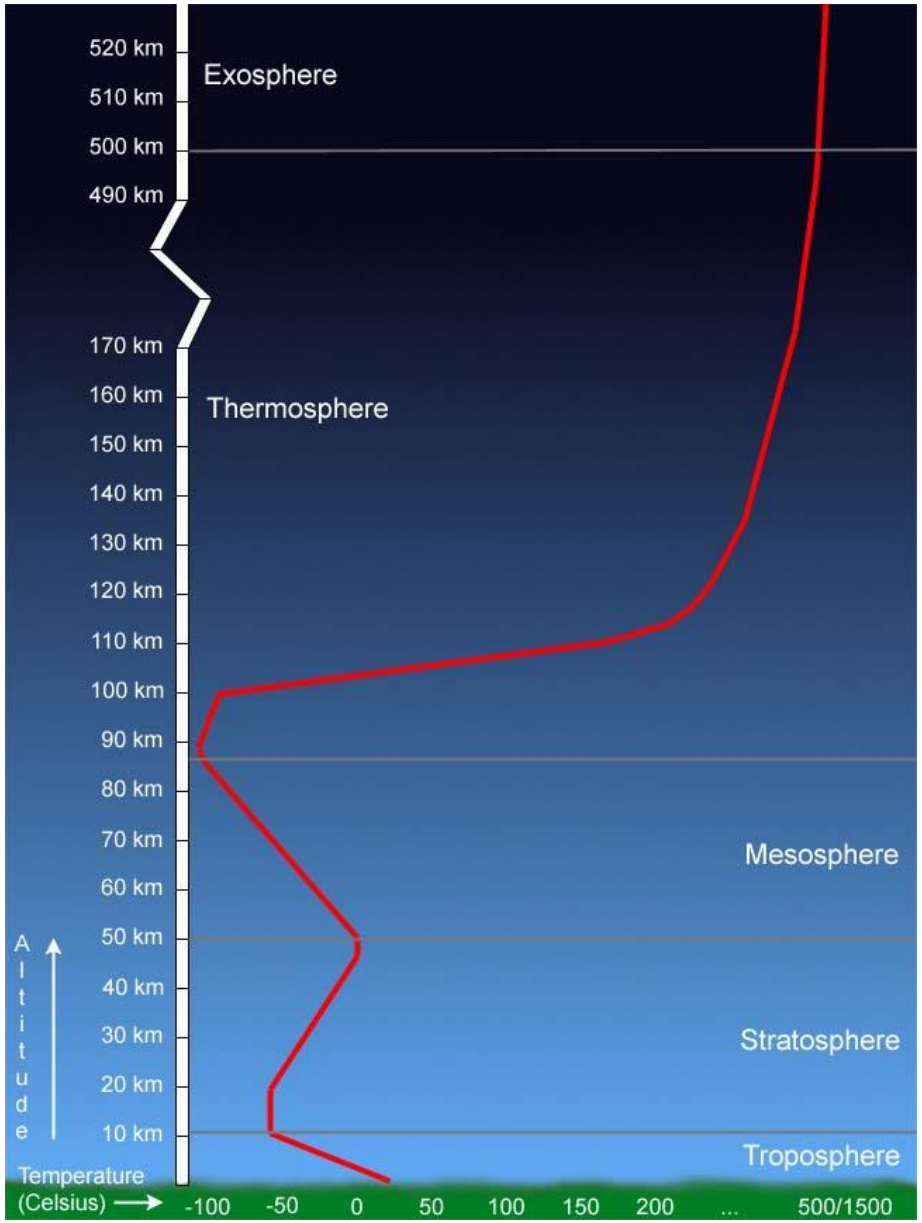
- Supports life

- Ecosystem is the basic unit

- Important because it provides –

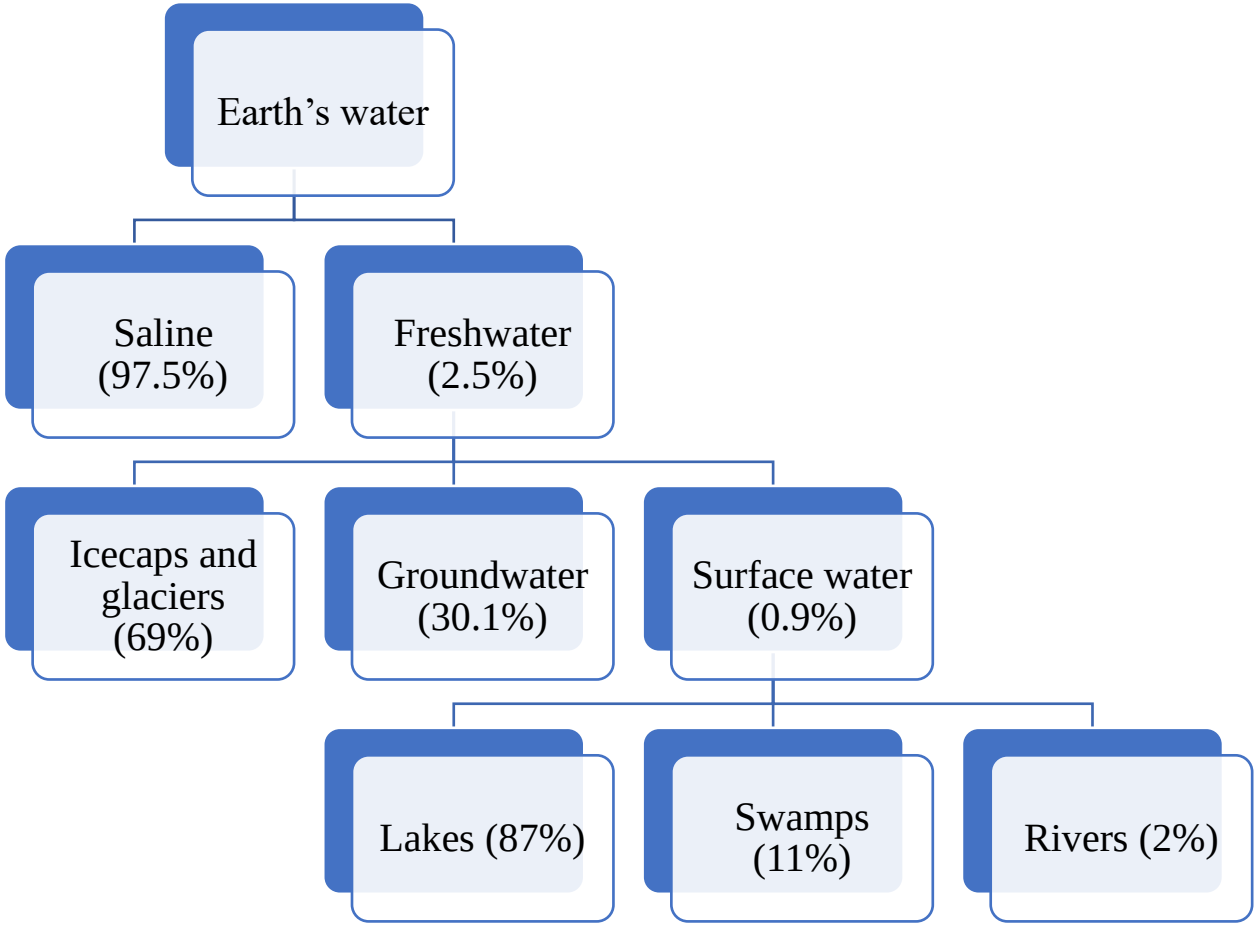
a. Food for humans
b. Food for all forms of life
c. Energy
d. Timber and other construction materials

Atmosphere



- The **troposphere** is the first layer above the surface and contains half of the Earth's atmosphere. Weather occurs in this layer.
- Many jet aircrafts fly in the **stratosphere** because it is very stable. Also, the ozone layer absorbs harmful rays from the Sun.
- Meteors or rock fragments burn up in the **mesosphere**.
- The **thermosphere** is a layer with satellites and space shuttle orbits.
- The atmosphere merges into space in the extremely thin **exosphere**. This is the upper limit of our atmosphere.

Hydrosphere

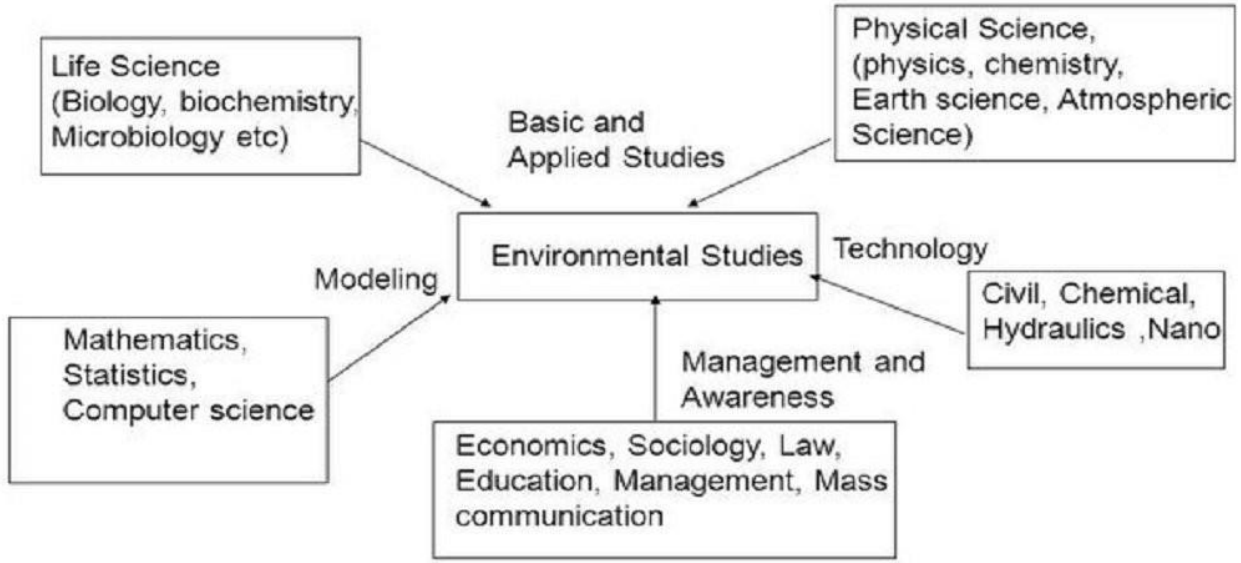


Distribution of earth's water

- Water for drinking
- Water for washing and cooking
- Water for agriculture and industry
- Food resources
- Hydro-electricity

Multidisciplinary nature of Environmental Studies

Components include biology, geology, chemistry, physics, engineering, sociology, health, anthropology, economics, statistics, computers and philosophy.



Scope and importance of Environmental Studies

SCOPE:

- Conservation and management of natural resources
- Conservation of biodiversity
- Control of pollution
- Sustainable development

IMPORTANCE:

- Check exploitation of environment
- Concern for the changing environment
- Helps understand ecology
- Helps maintain healthy life
- Imparts knowledge about conservation of energy
- Develops social responsibility and appreciate nature

Need for environmental awareness


Ecosystem

Ecology

- Study of interactions between an organism and its physical environment
- Classified by:

I. Level of complexity or scope, eg. Behavioral ecology
II. Organisms under study, eg. Animal ecology
III. Biome under study, eg. Desert ecology
IV. Climatic area, eg. Tropical ecology
V. Spatial scale, eg. Micro or macro ecology
VI. Phenomena under investigation, eg chemical ecology
VII. Technique used for investigation, eg theoretical or quantitative ecology
VIII. Philosophical approach, eg conservation ecology
IX. Interdisciplinary fields, eg agro ecology

Evolution of ecosystems and succession

- Natural selection, life history, development, adaptation, populations and inheritance.
- Ecological succession – orderly changes in the composition or structure of an ecological community.

1. Primary and secondary succession
2. Seasonal and cyclical succession

- Causes – Changes in the soil due to internal and external factors and changes caused by climatic factors

Ecosystem

“A natural unit with living and non-living parts that interact to form a stable unit”

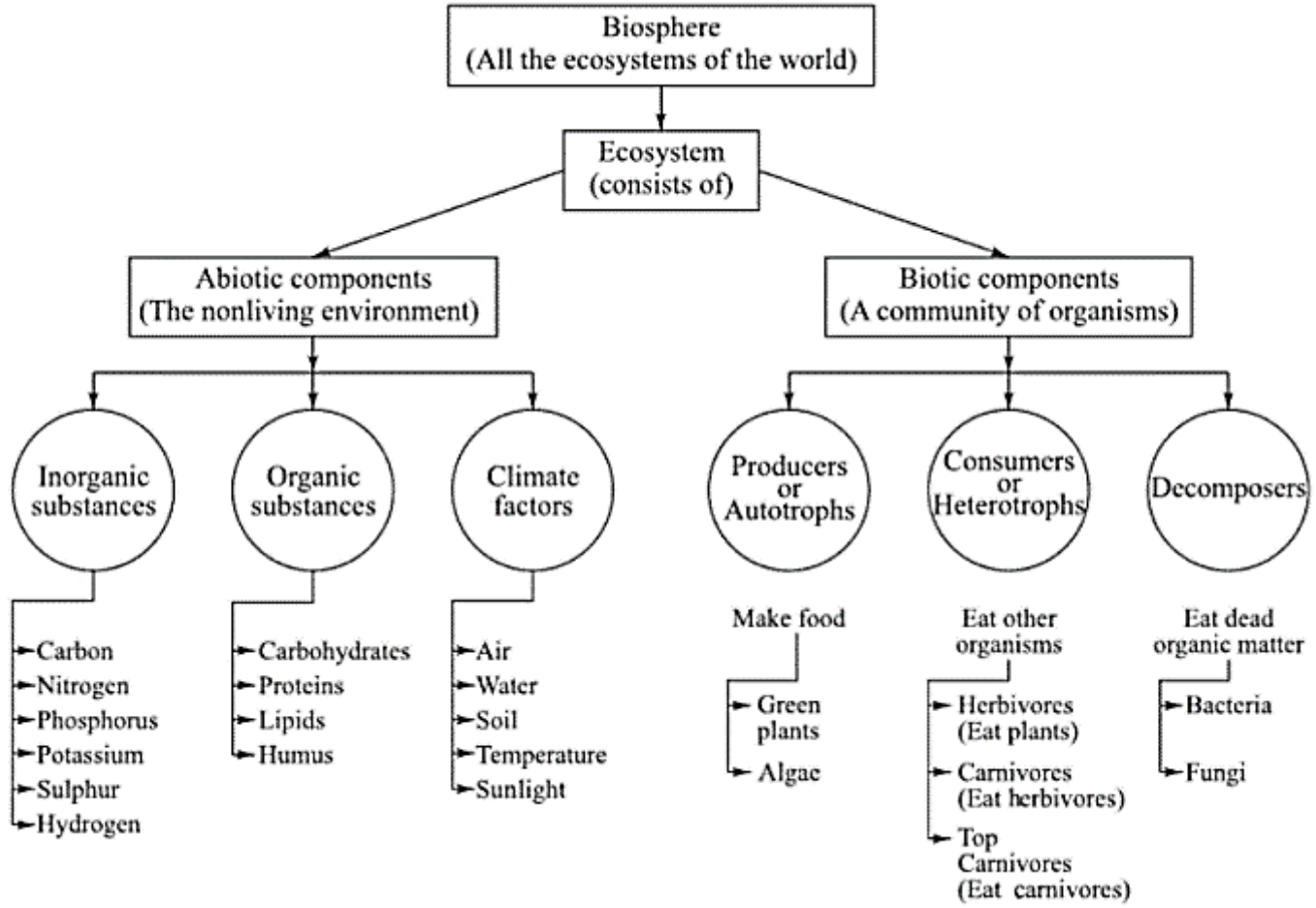
BALANCED ECOSYSTEM CONCEPT

STRUCTURE

FUNCTION

Structural aspects of an ecosystem

Composition of biological community, quantity and distribution of abiotic materials, conditions of existence



Functional aspects of an ecosystem

- Food chains
- Energy flow
- Nutrient cycles
- Evolution

Importance of an ecosystem

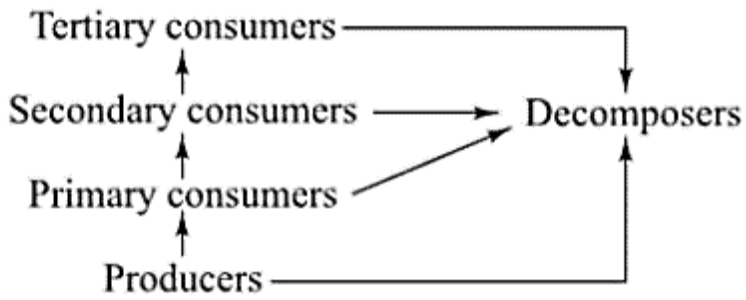
- Helps in water retention
- Purifies air
- Provides recreation
- Provides minerals and food
- Regulates nutrient recycling
- Helps in erosion control
- Gives us solar energy
- Maintenance of biogeochemical cycles, helps in disease control and preserves genetic diversity.

Food Chain

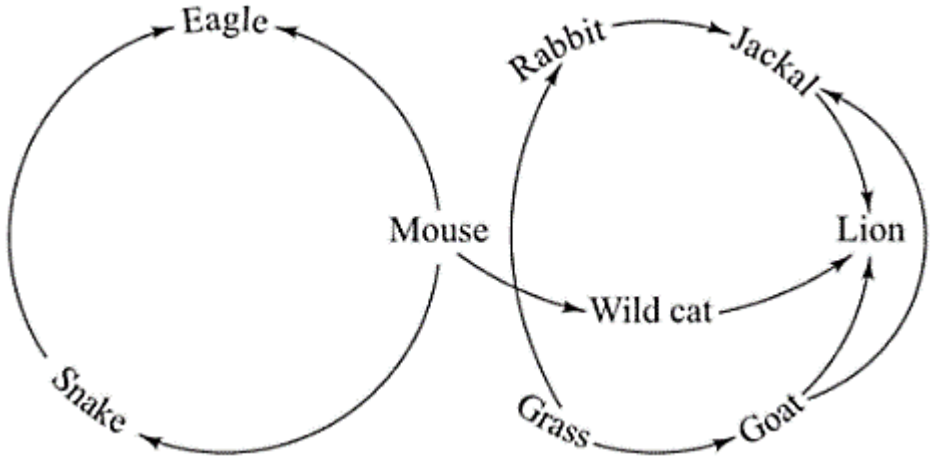
"A feeding hierarchy in which organisms in an ecosystem are grouped into trophic levels and are shown in a succession to represent the flow of food energy and the feeding relationship between them"

Food chains overlap and the complex network of inter-connected food chains is called a **FOOD WEB**.

In Food Chain
A → B represents A is being eaten by B



Food chain



Food web

Types of food chains

- Grazing food chain

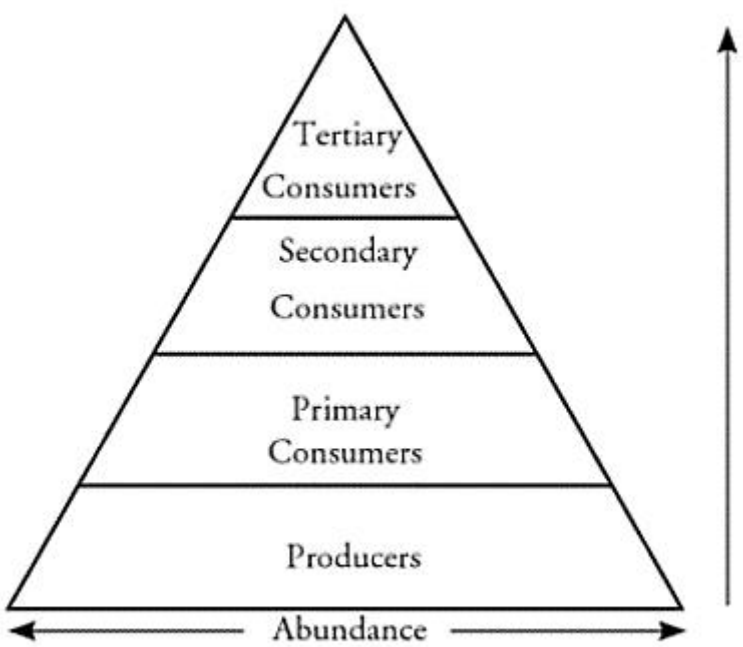
Examples (a) Grass → Grasshopper → Frog → Snake → Hawk
(b) Green plants → Goat → Wolf → Lion

- Detritus food chain

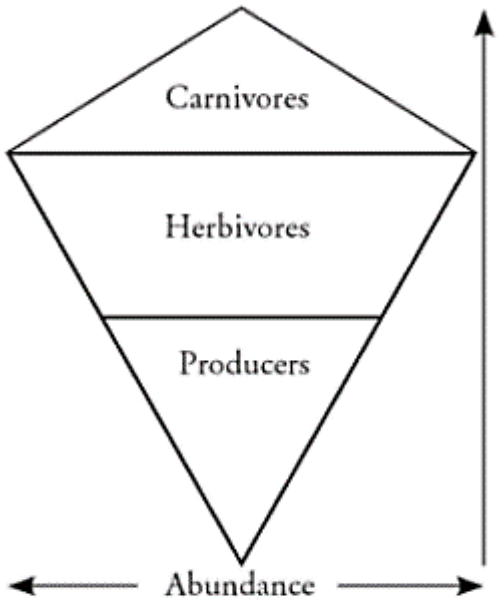
Examples (a) Dead plants → Soil mites → Insects → Lizards
(b) Dead organic matter → Bacteria → Protozoa → Rotifiers

Ecological Pyramids

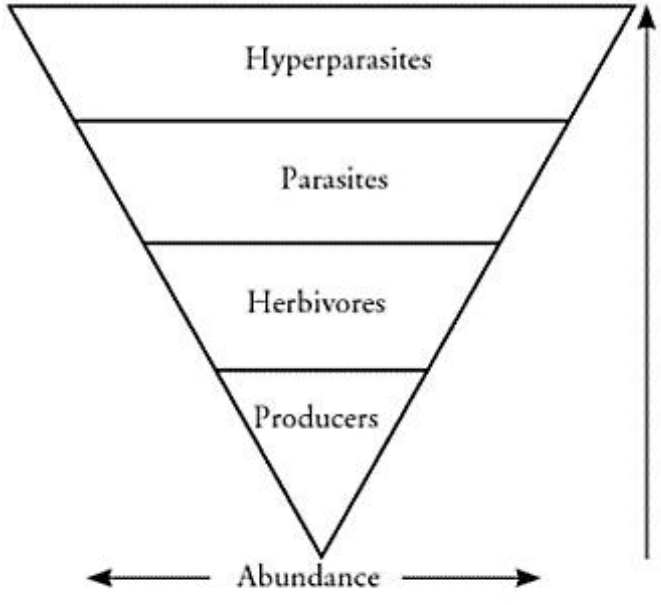
1. Pyramid of numbers



(a) Upright pyramid



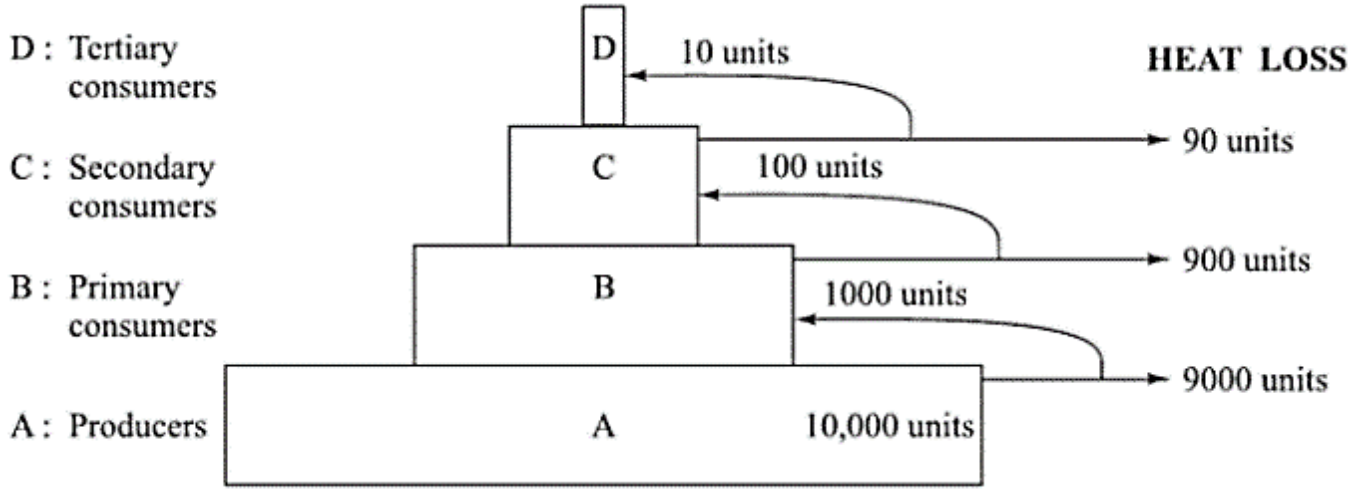
(b) Spindle shaped



(c) Inverted pyramidal shaped

Ecological Pyramids

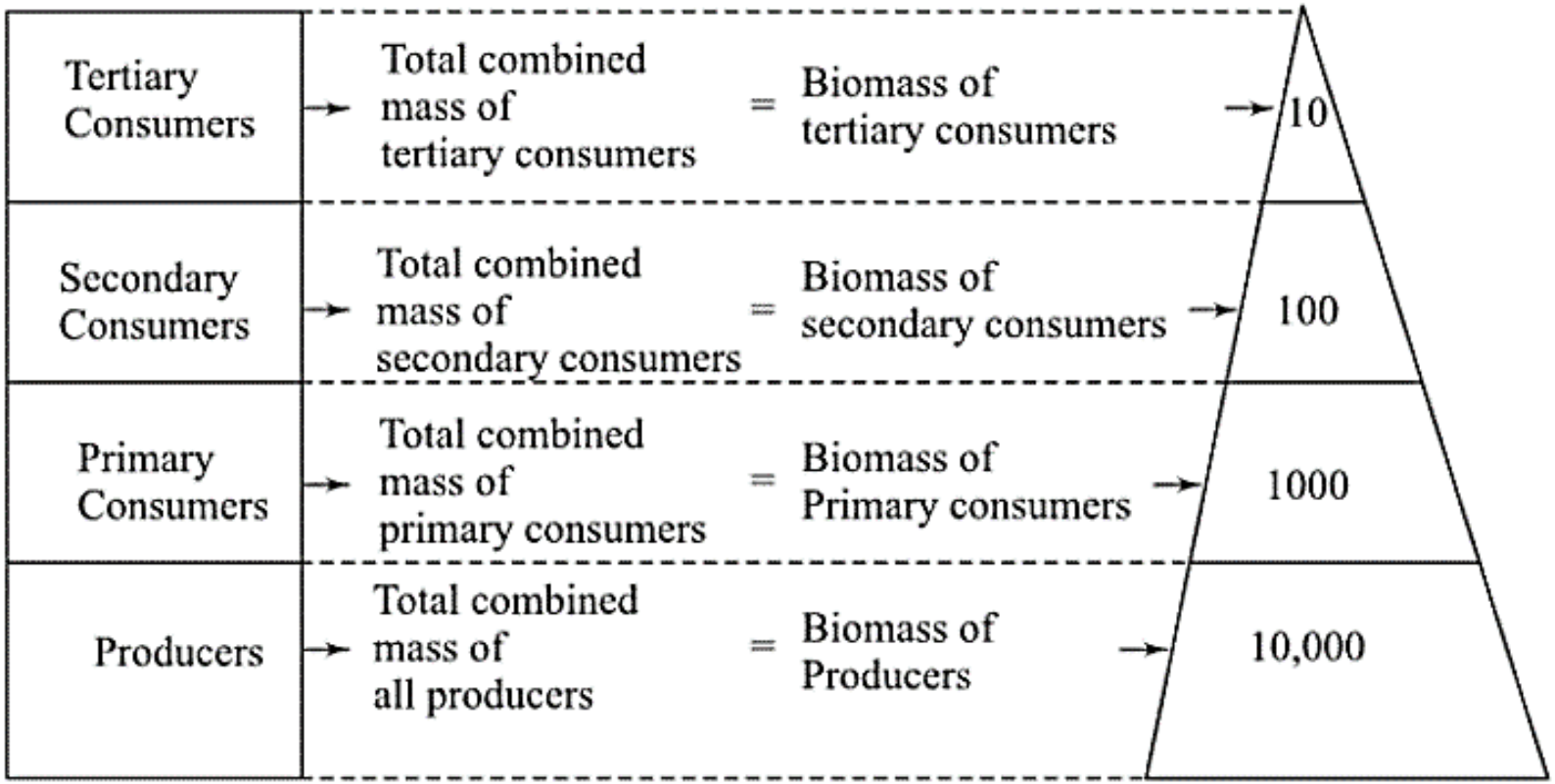
2. Pyramid of energy flow



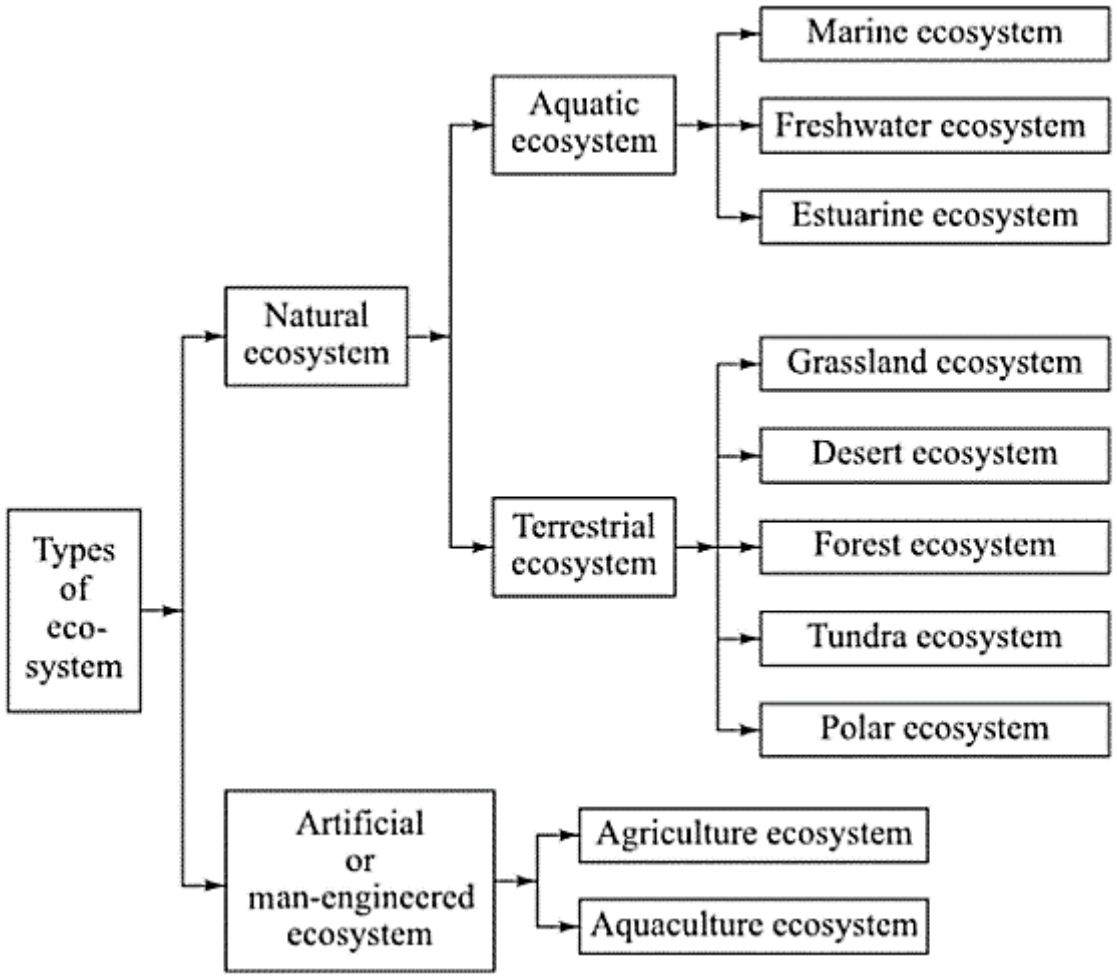
- **First law of thermodynamics**
- **Second law of thermodynamics**

Ecological Pyramids

3. Pyramid of biomass



Types of ecosystems



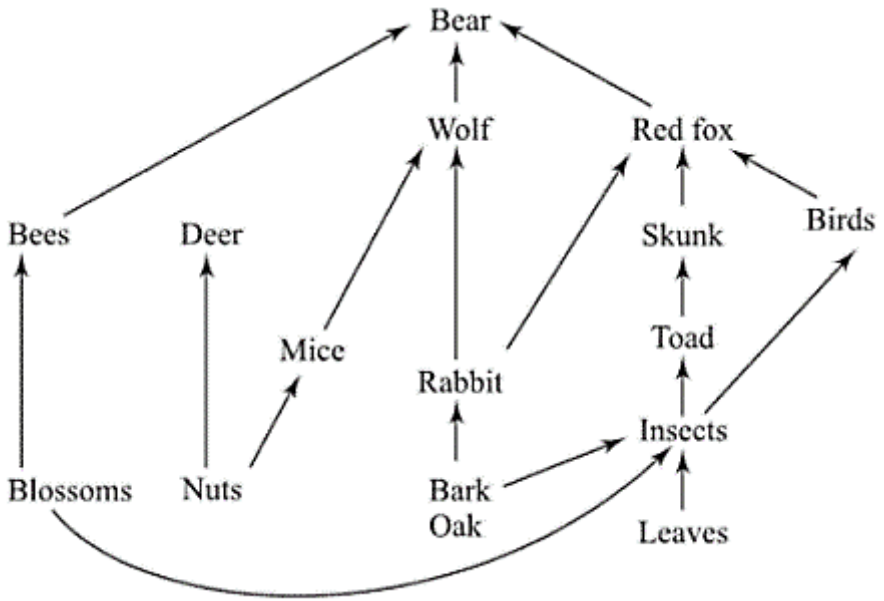
Differences between natural and artificial ecosystems

Natural ecosystems	*Artificial ecosystems*
(i) Polyculture systems	(i) Monoculture system
(ii) Stable ecosystems	(ii) Fragile ecosystems
(iii) Less productive in terms of yield of grains, milk, fish or meat	(iii) Highly productive as they are given increased supply of energy in the form of labour, extra nutrients, fossil fuels, fertilisers, pesticides, etc.
(iv) Pollution free	(iv) Generate lots of pollutants.
(v) *Examples:* Aquatic ecosystems and terrestrial ecosystems	(v) *Examples:* Agriculture ecosystems and aquaculture ecosystems
(vi) Functions: • Air purification • Water purification	(vi) Functions: • To supply large quantities of grains, etc. • To supply large quantities of fish, meat, milk, etc.

Similarities between natural and artificial ecosystems

(i) Both are open systems with no constraints of boundaries.
(ii) Both have all the essential components such as abiotic and biotic members.
(iii) Both permit constant interaction between biotic and abiotic components.

Forest Ecosystem



Forest type	Plants Examples	Common Animal Examples	Rare Animal Examples
Himalayan Coniferous	Pine, deodar	Wild goats and sheep, Himalayan black bear.	Snow leopard, Hangul, Himalayan brown bear, Musk deer, Himalayan Wolf.
Himalayan Broadleaved	Maple, oak		
Evergreen North-east, Western Ghats, Andaman & Nicobar	Jamun, Ficus, Dipterocarpus	Tiger, Leopard, Sambar, Malabar whistling thrush, Malabar Pied hornbill, tree frogs.	Pigmy Hog, Rhino, Liontailed macaque
Deciduous – Dry	Teak, Ain, Terminalia	Tiger, Chital, Barking deer, Babblers, Flycatchers, Hornbills.	
Moist	Sal		
Thorn and scrub, Semiarid forests	Babul, Ber, Neem	Blackbuck, Chinkara, Fourhorned antelope, Partridge, Monitor lizard.	Wolf, Bustard, Florican, Bustards,
Mangrove Delta Forests	Avicenia	Crocodile, shorebirds – sandpipers, plovers, fish, crustacea.	Water monitor lizard.

Direct uses of forest products

Fruits – mango, jamun, awla

Roots – Dioscoria

Medicine – Gloriosa, Foxglove

Fuelwood – many species of trees and shrubs

Small timber for building huts and houses

Wood for farm implements

Bamboo and cane for baskets

Grass for grazing and stall feeding livestock

Indirect uses of forest products

Building material for construction and furniture for the urban sector

Medicinal products collected and processed into drugs

Gums and resins processed into a variety of products

Raw material for industrial products and chemicals

Paper from bamboo and softwoods

Grassland Ecosystem

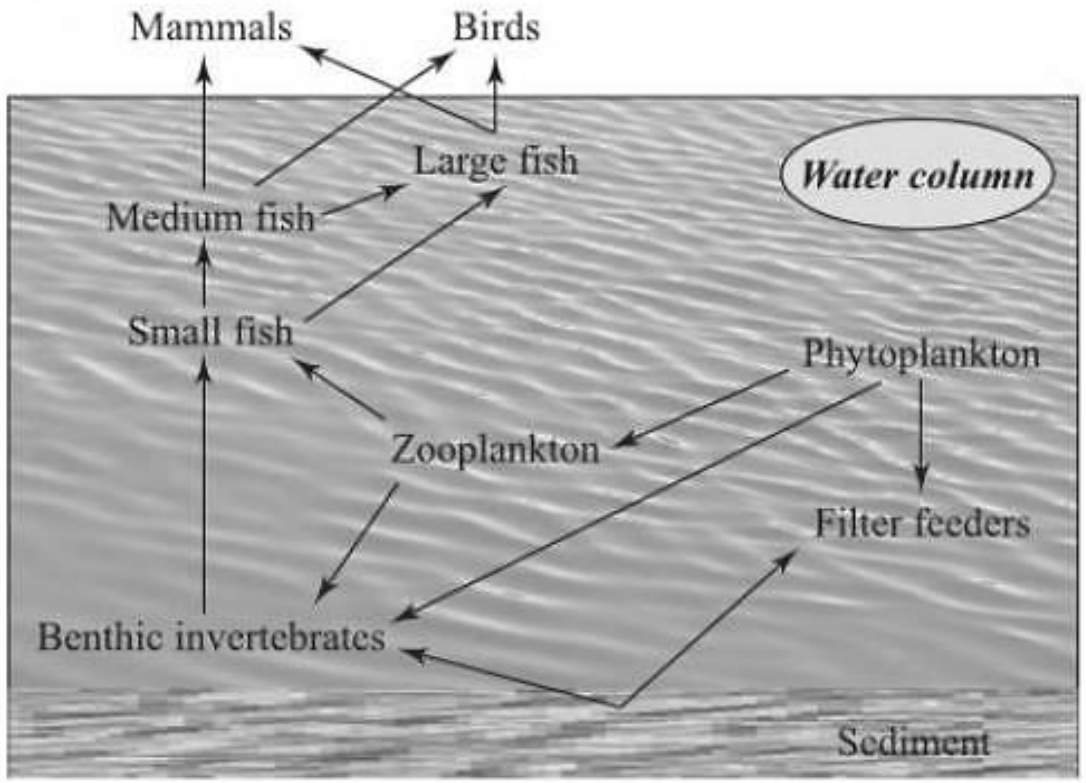
Desert Ecosystem

Tundra Ecosystem

Polar Ecosystem

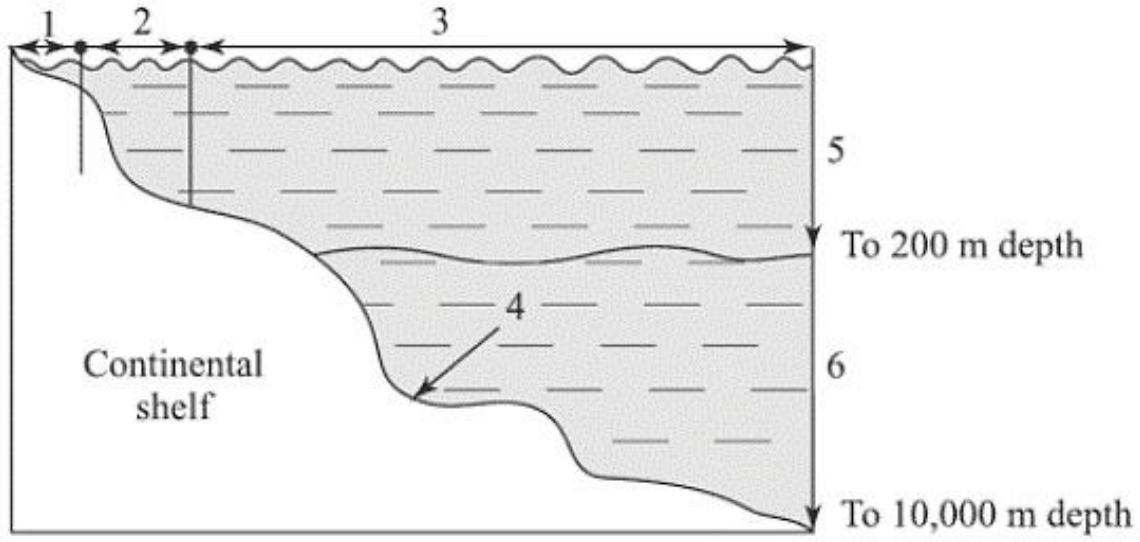
Aquatic Ecosystem

- Pond (or freshwater) ecosystem
- Marine ecosystem
- Estuarine ecosystem



Freshwater ecosystem

Marine ecosystem



1 = Littoral zone
2 = Neritic zone
3 = Pelagic zone
4 = Benthic zone
5 = Photic zone
6 = Aphotic zone.

Horizontal and vertical zonation in the ocean

Estuarine ecosystem

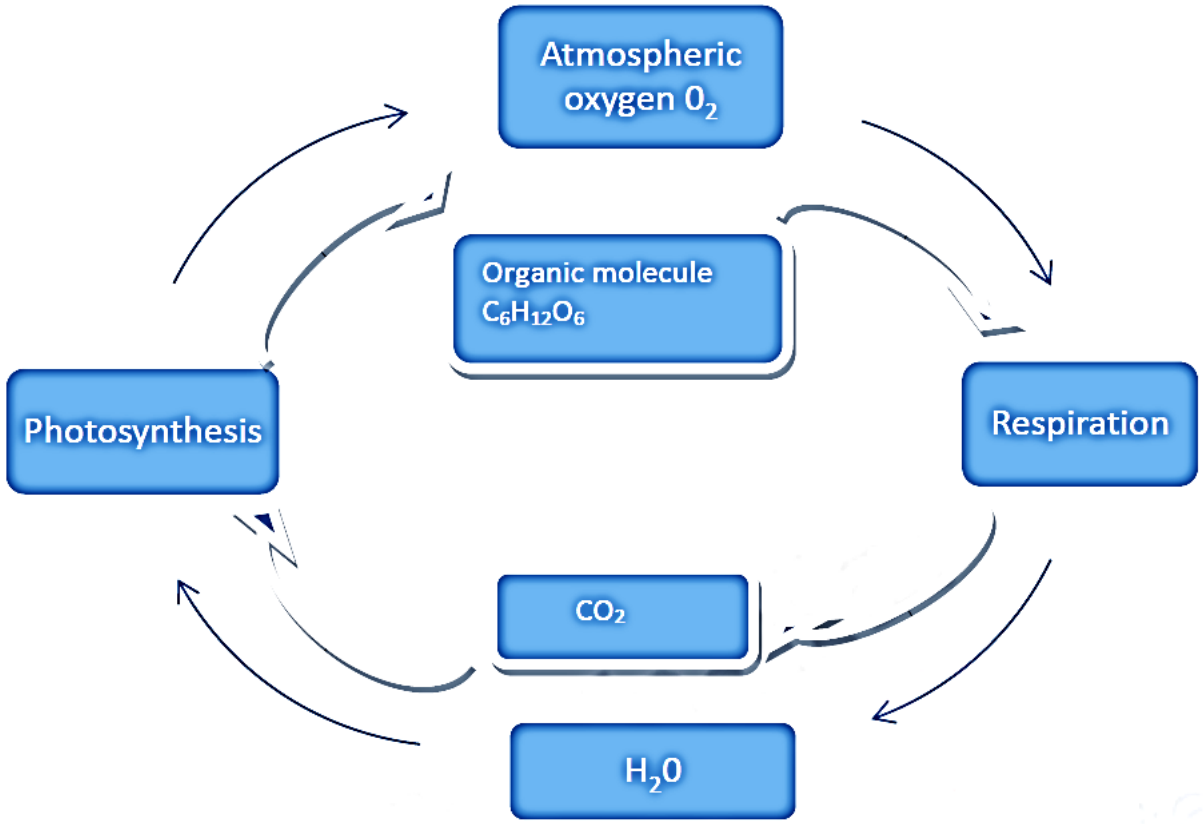
ECOSYSTEM DEGRADATION

Biogeochemical cycles

INTRODUCTION

- Biogeochemical processes continuously recycle chemical elements between the atmosphere, the hydrosphere, the biosphere, and the lithosphere.
- Every life form needs to actively uptake some elements called nutrients to maintain their biological activity.
- These nutrients move in a closed circuit on Earth called the biogeochemical cycle.
- In the following module, we will concentrate on the global cycles of the elements O, C, S, N, and P.

OXYGEN CYCLE



Oxygen Cycle Steps

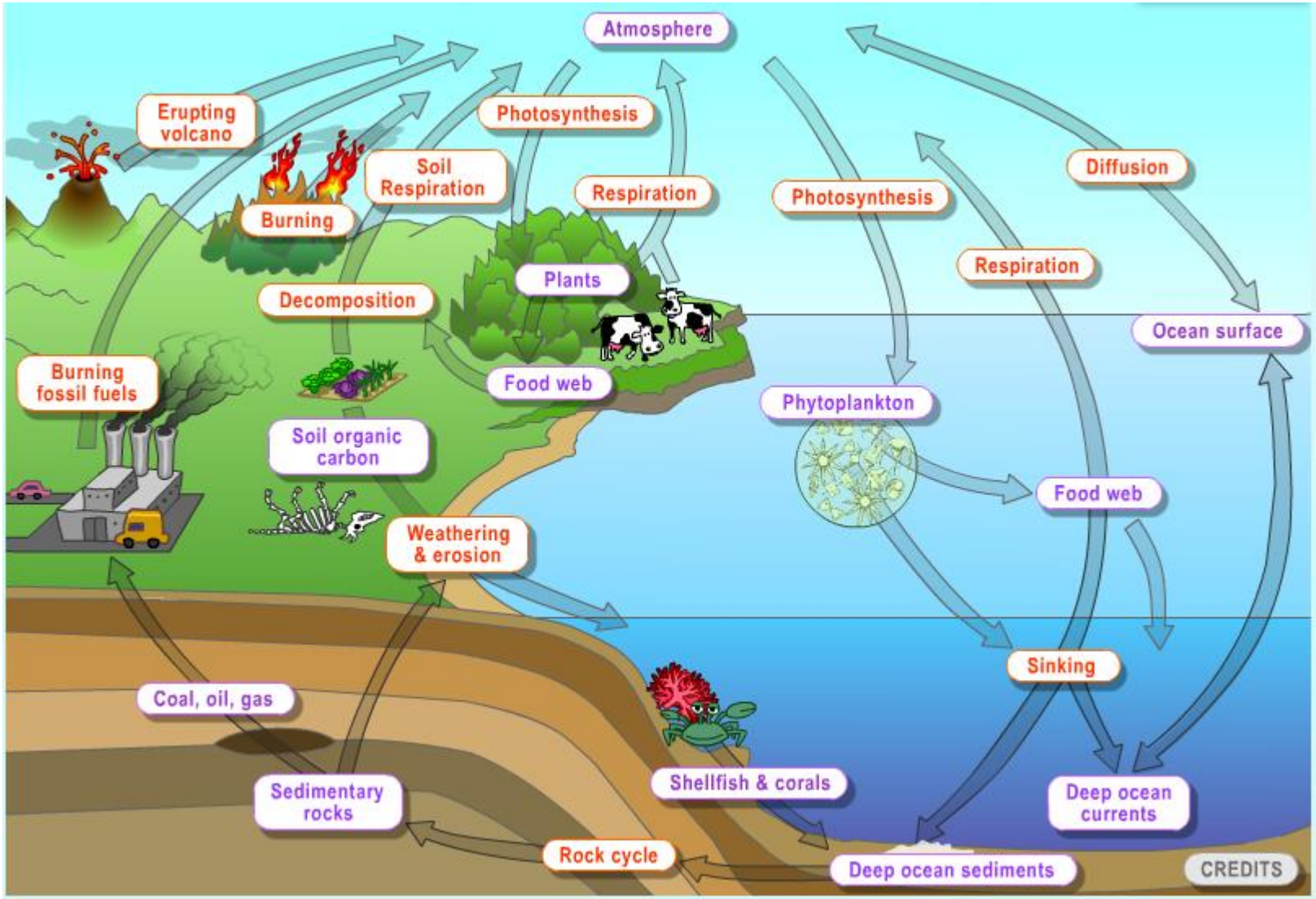
- Atmosphere –
  i. Photolysis

- Biosphere
  i. Photosynthesis
  ii. Respiration

- Lithosphere – form silicates and oxides, released back by weathering

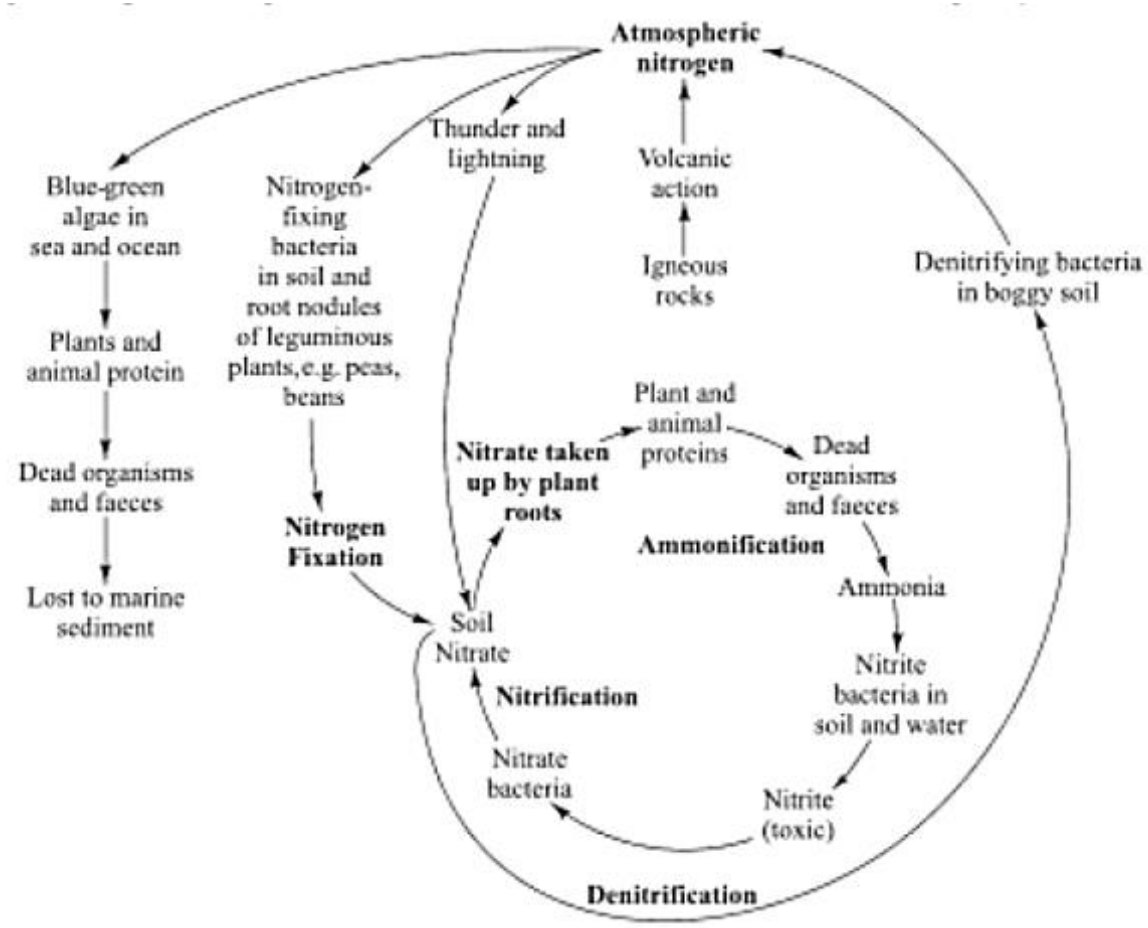
- Hydrosphere – dissolved oxygen

CARBON CYCLE



HOW DO HUMANS AFFECT THE CARBON CYCLE?

NITROGEN CYCLE



Rhizobium – nitrogen fixation

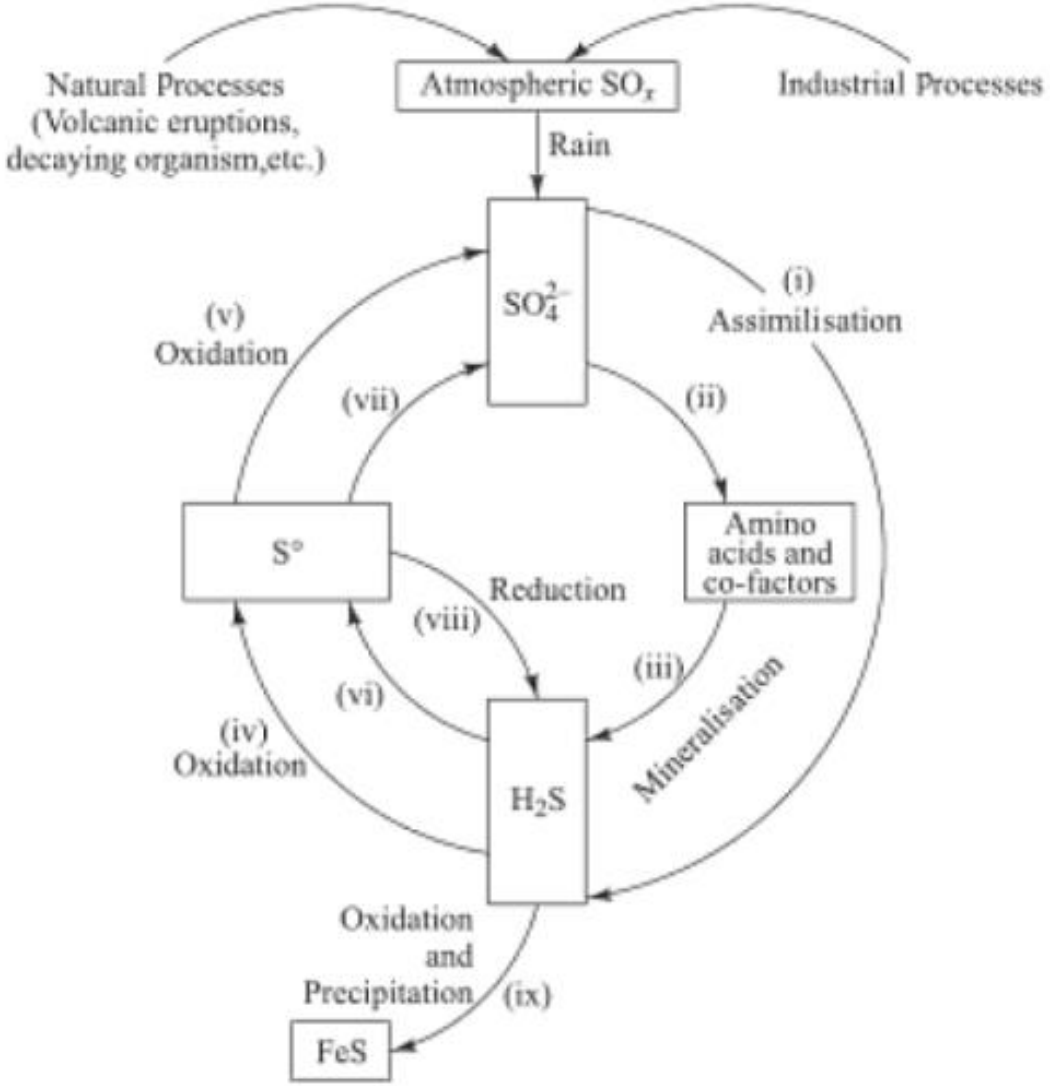
Nitrosomonas – NH3 to NO2-

Nitrobacter – NO2- to NO3-

Pseudomonas – NO3- to N2

HOW DO HUMANS AFFECT THE NITROGEN CYCLE?

SULPHUR CYCLE



(i) Sulphate Reducing Bacteria (SRB)

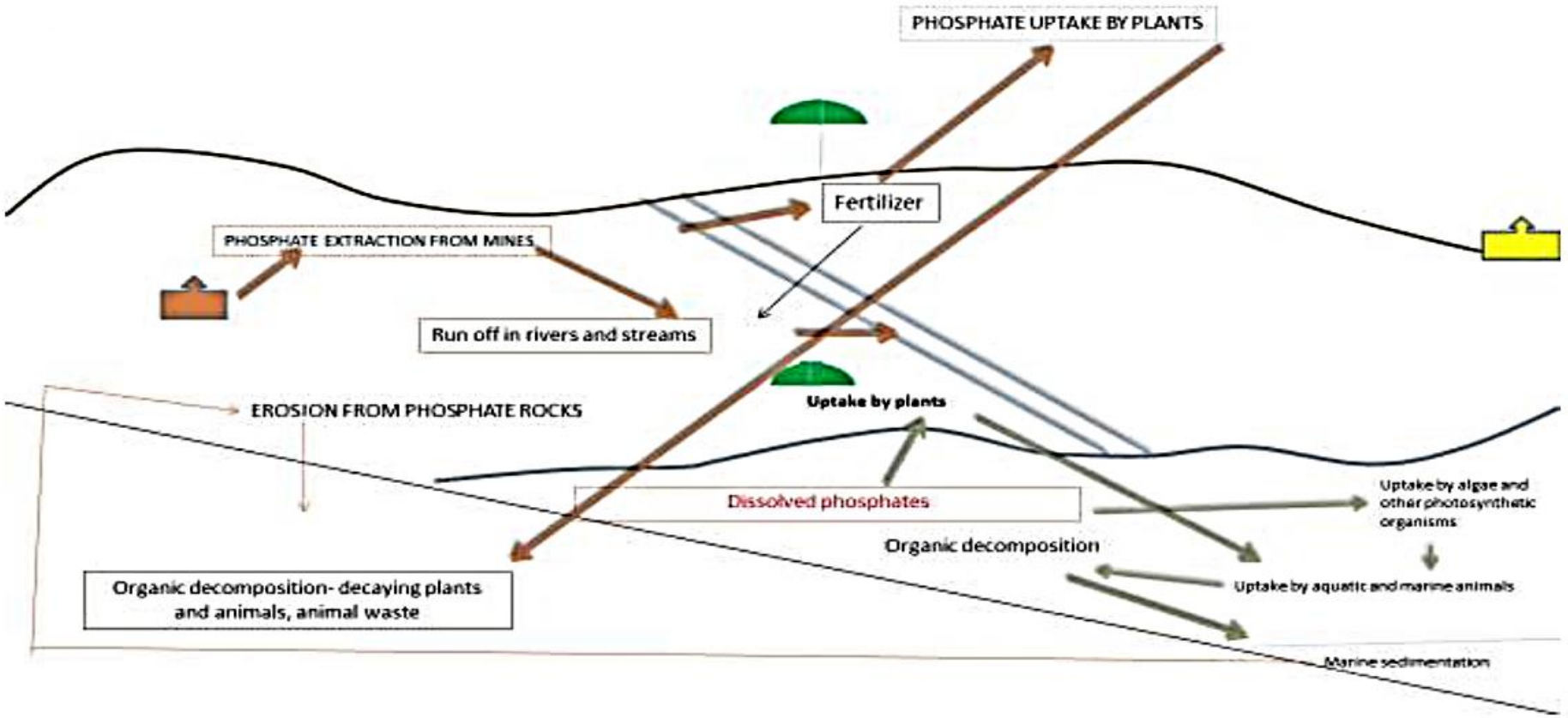
(v) Sulphide Oxidising Bacteria

(vi & vii) Anoxygenic phototrophic bacteria

(viii) Sulphur Reducing Bacteria

HOW DO HUMANS AFFECT THE SULPHUR CYCLE?

PHOSPHORUS CYCLE



HOW DO HUMANS AFFECT THE PHOSPHORUS CYCLE?

BIODIVERSITY

THREE LEVELS OF BIODIVERSITY

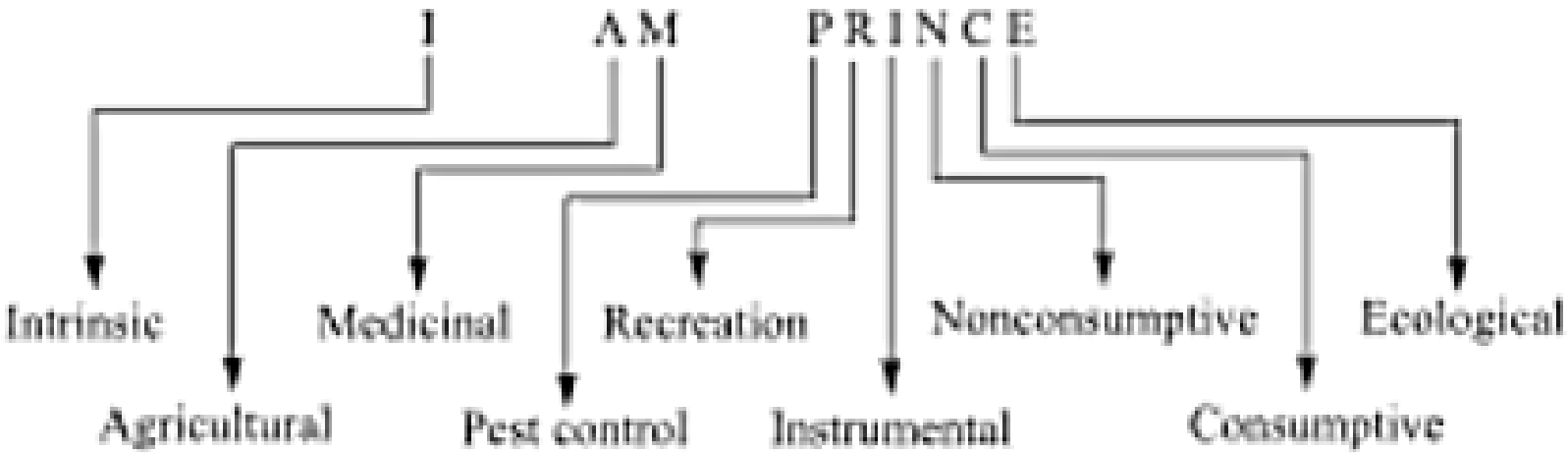
- Genetic diversity
- Species diversity
- Ecosystem diversity

Species Richness

Species Evenness

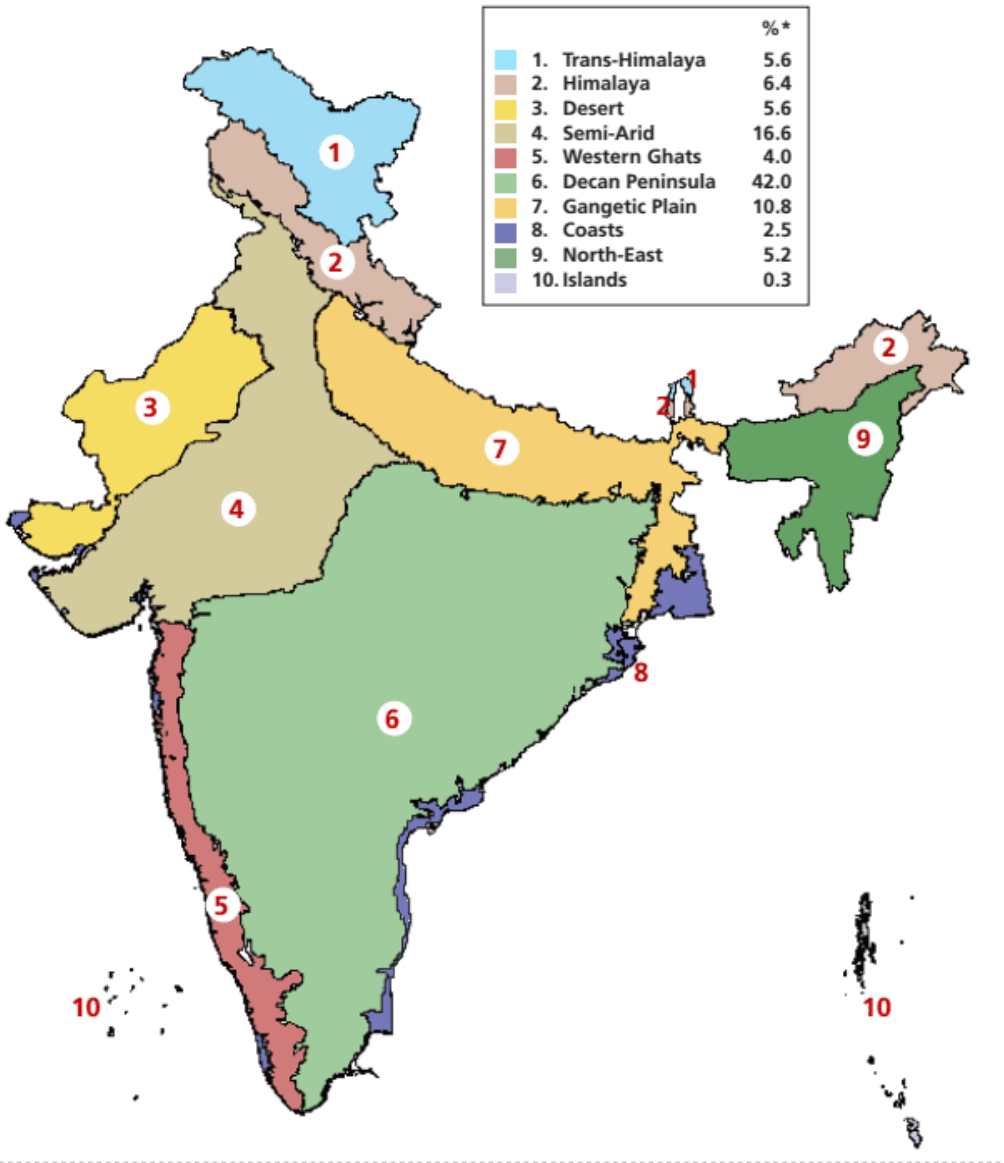
DIVERSITY = ORIGINATION – EXTINCTION + IMMIGRATION

VALUES OF BIODIVERSITY



BIOGEOGRAPHIC ZONES OF INDIA

- Biogeographic Zone
- Biotic Province
- Land Region
- Biome



IMPORTANT TERMS

- Hot spots of biodiversity
- Endemic species
- Extinct, Extinct in the wild
- Critically endangered
- Endangered species
- Vulnerable species
- Rare and threatened species

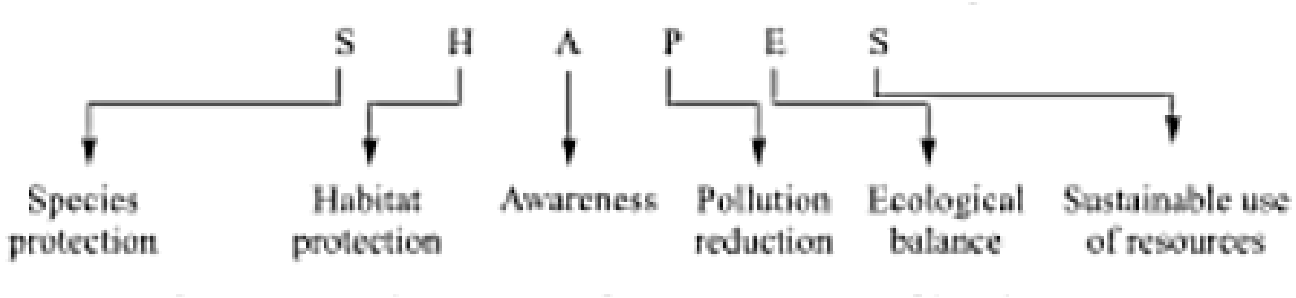
THREATS TO BIODIVERSITY

- Degradation of habitat
- Over-exploitation of resources
- Pollution
- Extinction of weaker species due to aggressive non-native species
- Poaching of wildlife

HUMAN-WILDLIFE CONFLICT

CONSERVATION OF BIODIVERSITY

OBJECTIVES



CONSERVATION METHODS