2018

INTEGRATED LEARNING PROGRAMME, ILP

IASBABA

[ENVIRONMENT: PART I]

Integrated Learning Programme 2018 is a step towards 'Enabling a person located at the most remote destination a chance at cracking AIR 1 in UPSC/IAS'

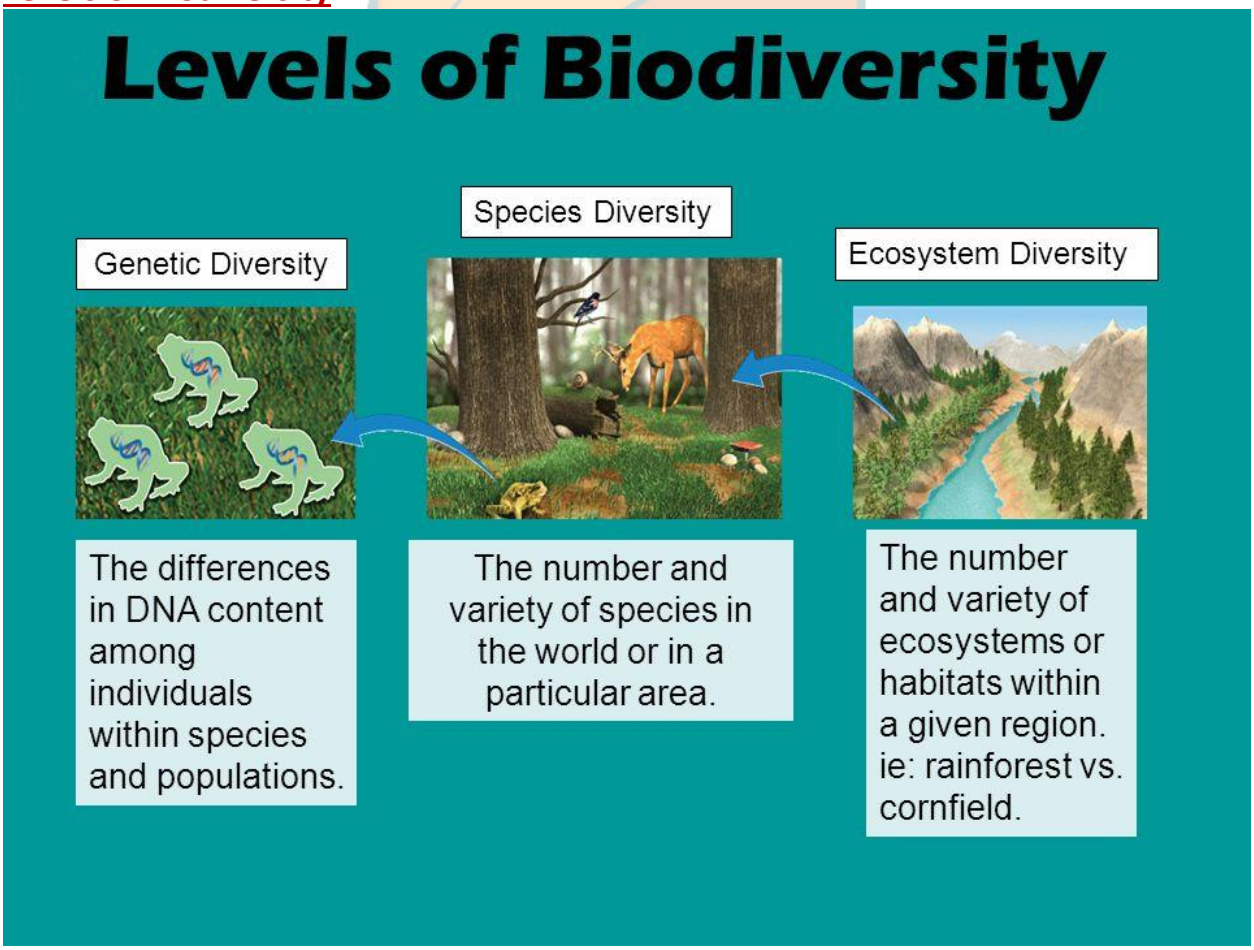
CONTENTS

INDIAN BIODIVERSITY – FLORA AND FAUNA

Biodiversity

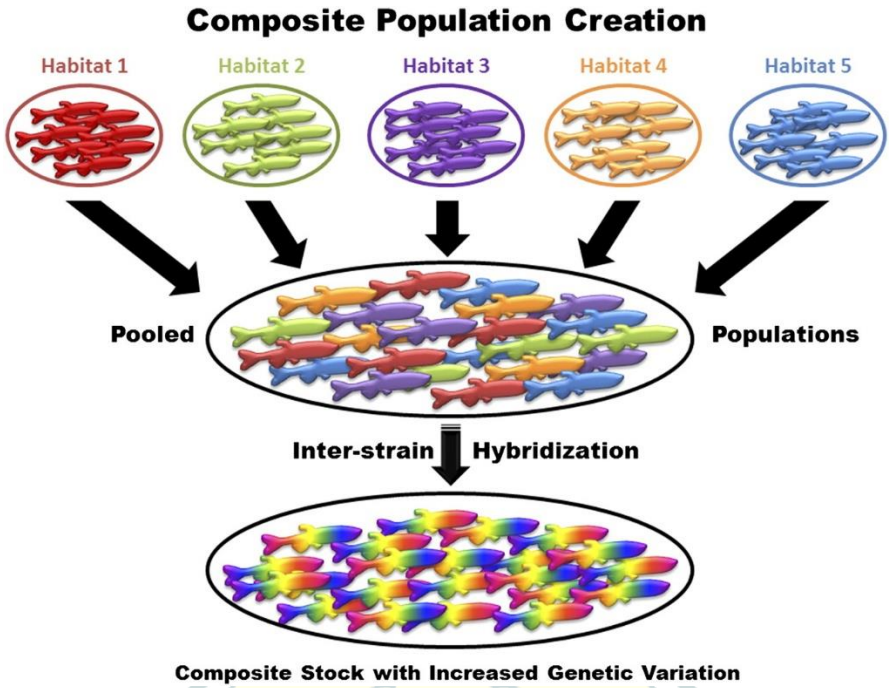
- Word "**biodiversity**" is contraction of the term "**biological diversity**" in 1995.
- **Definition** - The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable.
- In other words, Biodiversity or Biological diversity includes all the different plants, animals and microorganisms, the genes they contain and the ecosystems of which they form a part.
- India is a recognized as one of the mega-diverse countries, rich in biodiversity and associated traditional knowledge. **We have 7-8% of species of world and that too just on 2.4% of world's land.**

Levels of Biodiversity



- Biodiversity is considered to exist at 3 levels – genetic, species and ecosystems.

Genetic Diversity



- It is **variation in genes within a particular species**.
- A single species might show high diversity at the genetic level [E.g. Man: Chinese, Indian American, African etc.]. India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.
- It is the total number of genetic characteristics in the genetic makeup of a species.
- It allows species to adapt to changing environment.
- It ensures that some species survive drastic changes and thus **carry on the desirable genes** (just like what they say in movie "Lucy", carrying information).
- The beautiful butterflies, roses, parakeets or coral in a myriad hue, shapes and sizes are result of Biodiversity.

Species Diversity

- It is the **variety of living organisms on earth**.
- **Species have different genes** and they do **not inter-breed** in nature.
- Closely-related species have many common hereditary characteristics.
    - For example - about 98.4% of the genes of humans and chimpanzees are the same.
- $\textbf{\textit{Species diversity}} = \frac{\textit{one specie population}}{\textit{total number of organisms across all species}}$ *in a given biome*
- "**Zero**" mean infinite diversity and "**one**" represents only one species present.
- **Endemism** – it is the ecological state of a species being unique to a defined geographic location, such as an island, nation, country or other defined zone, or habitat type. Organisms that are indigenous to a place are not endemic to it if they are also found elsewhere. A particular type of animal or plant may be endemic to a zone, a state or a country. The extreme opposite of endemism is **cosmopolitan distribution**.
- Among animals, insects are the most species-rich taxonomic group, making up more than 70 per cent of the total. That means, out of every 10 animals on this planet, 7 are insects.

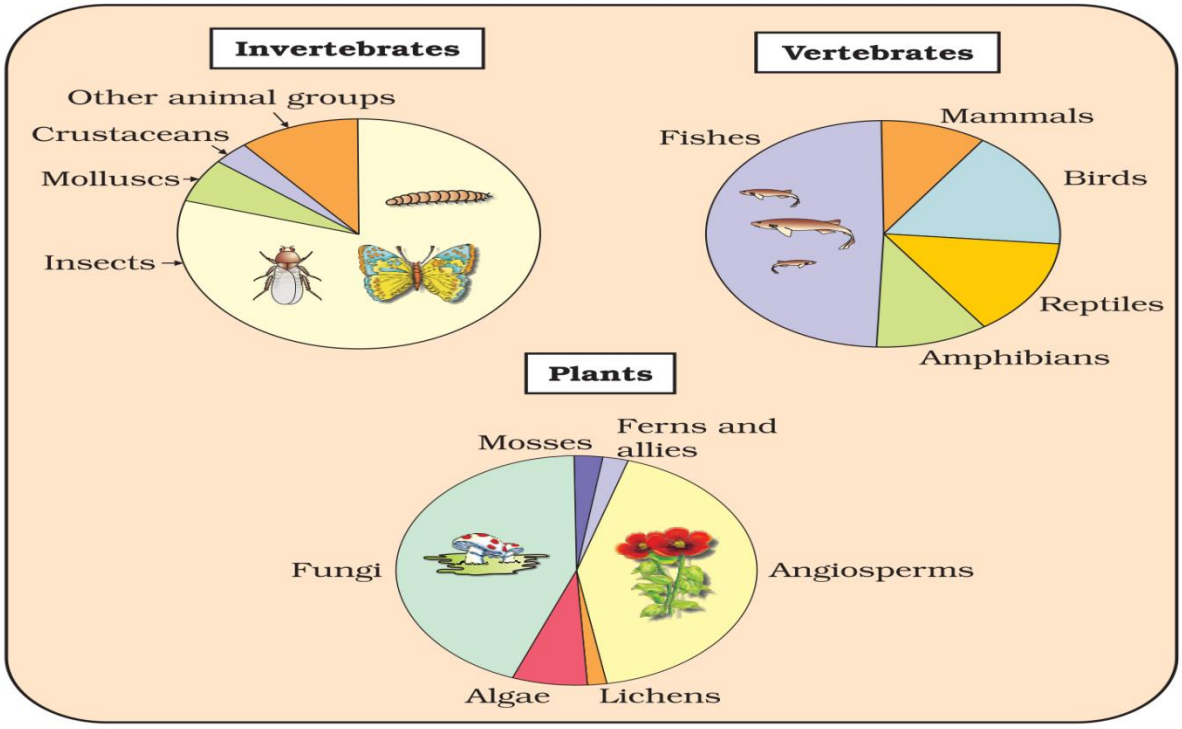


Figure 15.1 Representing global biodiversity: proportionate number of species of major taxa of plants, invertebrates and vertebrates

- The number of fungi species in the world is more than the combined total of the species of fishes, amphibians, reptiles and mammals.

The Himalayan Range is very rich in species diversity. Which one among the following is the most appropriate reason for this phenomenon?

(a) It has high rainfall that supports luxuriant vegetative growth.
(b) It is a confluence of different bio-geographical zones.
(c) Exotic and invasive species have not been introduced in this region.
(d) It has less human interference.

Species diversity decreases as we move away from the equator towards the poles. With very few exceptions, tropics (latitudinal range of 23.5° N to 23.5° S) harbour more species than temperate or polar areas.

- Tropical Amazonian rain forest in South America has the greatest biodiversity on earth.
  - More than 40,000 species of plants
  - More than 3,000 species of fishes
  - More than 1,300 species of birds
  - 427 of mammals
  - 427 of amphibians
  - 378 of reptiles

- More than 1,25,000 species invertebrates.

Consider the following statements:

1. Biodiversity is normally greater in the lower latitudes as compared to the higher latitudes.
2. Along the mountain gradients, biodiversity is normally greater in the lower altitudes as compared to the higher altitudes.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

What is the importance of Species Diversity to the Ecosystem?

- Communities with more species, generally, tend to be more stable than those with less species.
- Stable means not too much variation in productivity from year to year, resistant to occasional disturbances (natural or man-made) and also resistant to alien species invasion.

Bioprospecting

- Bioprospecting can be defined as the systematic search for and development of new sources of chemical compounds, genes, micro-organisms, macro-organisms, and other valuable products from nature. It entails the search for economically valuable genetic and biochemical resources from nature. So, in brief, bioprospecting means looking for ways to commercialize biodiversity.

- Nations endowed with rich biodiversity explore molecular, genetic and species-level diversity to derive products of economic importance.

Keystone Species

- Keystone species, in ecology, a species that has a disproportionately large effect on the communities in which it occurs.
- Such species help to maintain local biodiversity within a community either by controlling populations of other species that would otherwise dominate the community or by providing critical resources for a wide range of species.
- These species are very important **as addition to or loss from an ecosystem leads to major changes in occurrence of at least one other species**.

- E.g. In an airplane (ecosystem) all parts are joined together using thousands of rivets (species). If every passenger travelling in it starts popping a rivet to take home (causing a species to become extinct), it may not affect flight safety (proper functioning of the ecosystem) initially, but as more and more rivets are removed, the plane becomes dangerously weak over a period of time. Furthermore, which rivet is removed may also be critical. Loss of rivets on the wings (key species that drive major ecosystem functions) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.

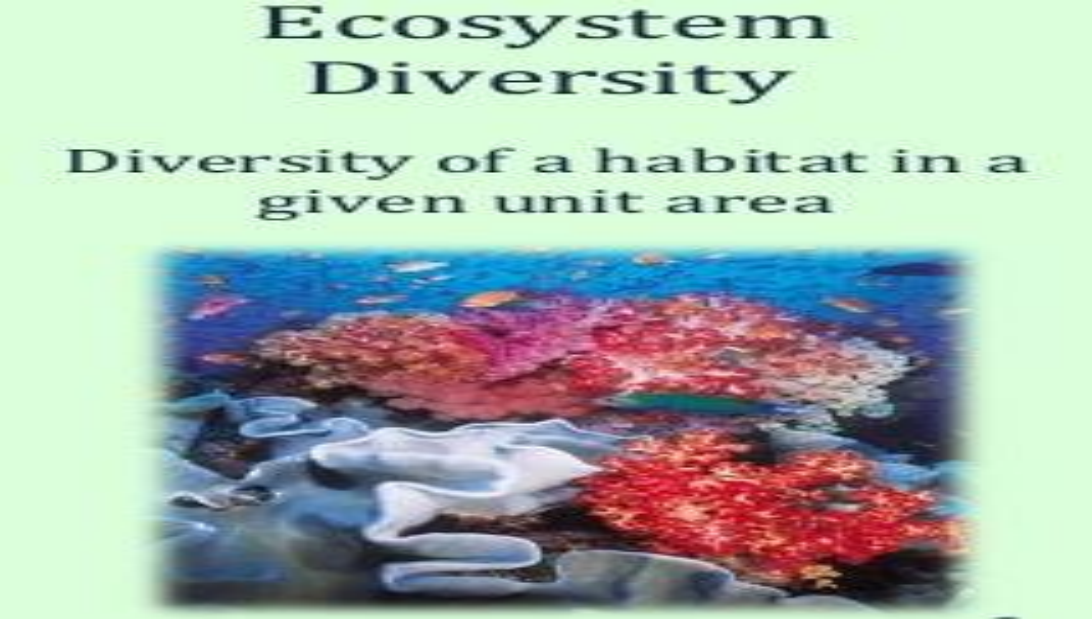
When a keystone species is removed from a habitat, the habitat is dramatically changed. All other species are affected and some may disappear from that ecosystem or even become extinct.

Example

The population of deer or rabbits would explode without the presence of a predator. The ecosystem cannot support an unlimited number of animals, and the deer soon compete with each other for food and water resources. Their population usually declines without a predator such as a mountain lion.

Without the keystone species, new plants or animals could also come into the habitat and push out the native species. Some species of hummingbirds are keystone species in the Sonoran Desert of North America.

Ecosystem / Community Diversity



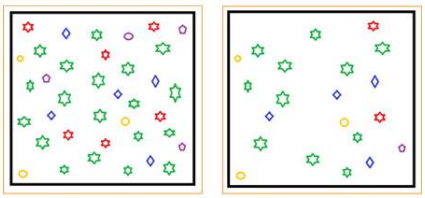
- It refers to **different types of habitats**.
    - A **habitat** is the cumulative factor of the climate, vegetation and geography of a region.
- World consists of several types of habitat. E.g. Corals, grasslands, wetlands, desert, mangrove and tropical rain forests.
- **Change in climatic conditions is accompanied by a change in vegetation** as well.
- Each species adapts itself to a particular kind of environment.
- As the environment changes, species best adapted to that environment becomes predominant. Thus the **variety or the biodiversity of species in the ecosystem is influenced by the nature of the ecosystem**. E.g. species have more diversity in the Western Ghats than deserts of the Rajasthan.

Measurement of Biodiversity

Species Richness

- It is the **measure of number of species found in a community (**how rich they are?)

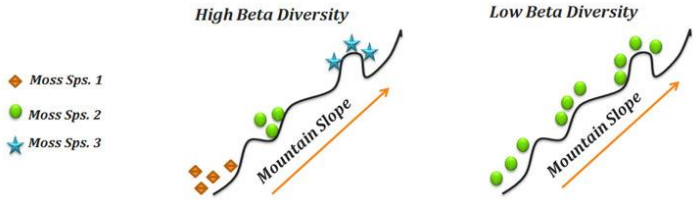
Alpha diversity



Alpha Diversity of Two Communities

- It is the **diversity within a particular area** or ecosystem.
- It is **expressed by the number of species** (i.e. species richness) in that ecosystem.

Beta diversity

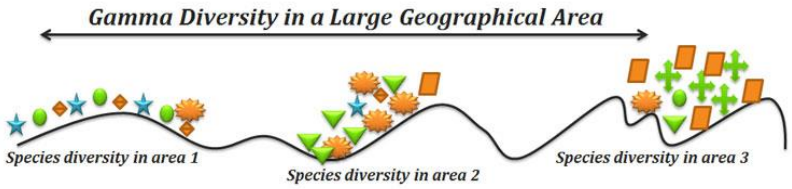


Beta Diversity of Two Habitats (Mountain Slopes)

- It is a **comparison of diversity between ecosystems**.

- It is measured as the **change in amount of species** between the ecosystems.

Gamma diversity



Gamma Diversity

- It is a **measure of the overall diversity** for the different ecosystems within a region.

Species Evenness

- It measures the proportion of species at a given site. E.g. low evenness indicates that a few species dominate the site.

Food web and its components are very important because tampering with them means disturbance in chain which leads to destruction of the species.
Man is only a strand in the delicate web of relationship in the global ecosystem. Every time a species becomes extinct, the strand is broken and many species, including humans, move closer to extinction.

Services provided by Biodiversity

- It provide a number of natural services for human beings

Ecosystem services

- Protection of water resources
- Soils formation and protection
- Nutrient storage and recycling
- Pollution breakdown and absorption
- Contribution to climate stability
- Maintenance of ecosystems
- Recovery from unpredictable events

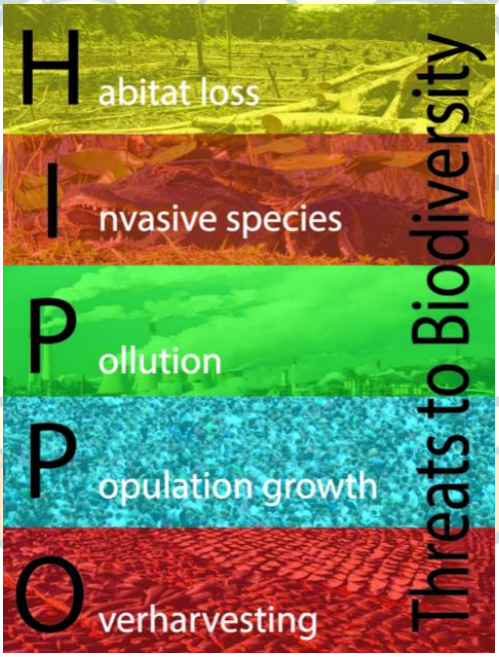
Biological services

- Food
- Medicinal resources and pharmaceutical drugs
- Wood products
- Ornamental plants
- Breeding stocks, population reservoirs
- Future resources
- Diversity in genes, species and ecosystems

Social services

- Research, education and monitoring
- Recreation and tourism
- Cultural values

Causes for Biodiversity Loss



- The accelerated rates of species extinctions that the world is facing now are largely due to human activities. There are four major causes ('The **Evil Quartet**' is the sobriquet used to describe them).
- **Habitat loss and fragmentation**
    - Most important cause.

- Tropical rain forests witnesses most dramatic examples of habitat loss. (Once covering more than 14% of the earth's land surface, these rain forests now cover just 6%)
- The Amazon rain forest (They are so huge that they are called as **'lungs of the planet'**) which are habitat of millions of species is being cut and cleared for cultivating soya beans or for conversion to grasslands for raising beef cattle.
- **Pollution** also threatens the survival of many species. When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected, leading to population declines.

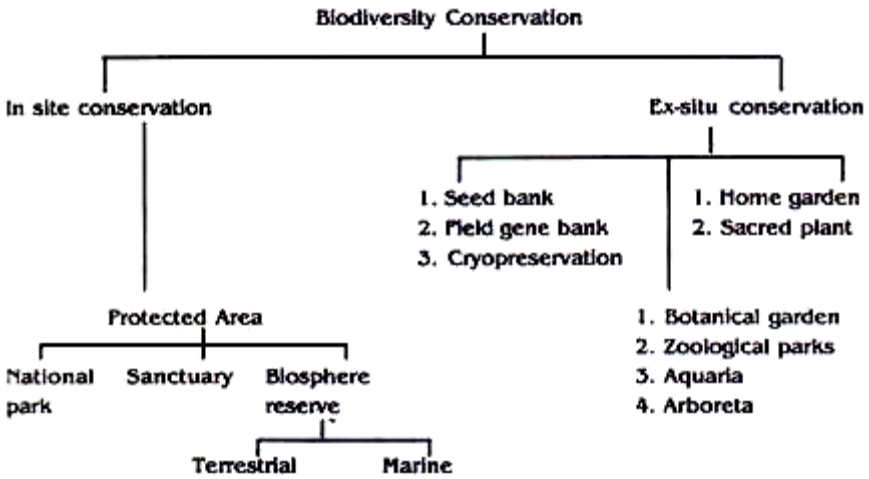
- **Over-exploitation**
  - Human's '**need'** for food and shelter turns to '**greed'** for profits.
  - Many species extinctions in the last 500 years (Steller's sea cow, passenger pigeon) were due to overexploitation by humans.
  - Over harvesting of marine fish populations endangered the continued existence of some commercially important species.
- **Alien species invasions**
  - The introduction of exotic species is due to – **horticulture, agriculture, European colonization and accidental transport**. Introduction of alien species unintentionally or deliberately can cause decline or **extinction of indigenous species**.
  - For example – introduction of **Nile perch** into Lake Victoria in east Africa led to the extinction of an ecologically unique assemblage of more than 200 species of **cichlid fish** in the lake.
  - Invasive weed species like **carrot grass (Parthenium), Lantana and water hyacinth (Eicchornia)** can cause damage to environment and poses threat to native species.
- **Co-extinctions**
  - **When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct**.
  - **For example** –When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate.
  - Another example - **coevolved plant-pollinator mutualism** where extinction of one invariably leads to the extinction of the other.
- **Diseases**
  - Since the animals are **more vulnerable** to infection, the anthropological activities may increase the incidence of diseases in wild species, leading to their extinction.
- **Shifting or Jhum cultivation**
  - The shifting or Jhum cultivation by poor tribal people greatly affects the forest structure which is a store house of biodiversity.
- **Other reasons**
  - Poaching, global warming and other calamities.

Biodiversity Conservation

- In simple words it means conserving the biodiversity or saving the biodiversity.
- Conservation of biodiversity is **protection, upliftment and scientific management of biodiversity** so as to maintain it at its threshold level and derive sustainable benefits for the present and future generation.
- In other words, conservation of bio-diversity is the **proper management of the biosphere by human beings** in such a way that it gives maximum benefits for the present generation and also develops its potential so as to meet the needs of the future generations.
- Biodiversity conservation leads to conservation of essential ecological diversity to preserve the continuity of food chains.
- Conservation of biodiversity has many objectives –
    - To maintain essential ecological processes and life supporting systems.
    - To preserve the genetic diversity of species.
    - To make sustainable utilization of species and ecosystems.
    - It provides a vast knowledge of potential use to the community.

Modes of conservation

When we conserve and protect the whole ecosystem, its biodiversity at all levels is protected - we save the entire forest to save the tiger. This approach is called **in situ (on site) conservation**. However, when there are situations where an animal or plant is endangered or threatened and needs urgent measures to save it from extinction, **ex situ (off site)** conservation is the desirable approach.



Ex-situ Conservation

- Conserving biodiversity outside the areas where they naturally occur or in other words threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care.
- **Example** - **Zoological parks, botanical gardens and wildlife safari parks**.
- In recent years ex-situ conservation has advanced beyond keeping threatened species in enclosures. Now gametes of threatened species can be preserved in viable and fertile condition for long periods using **cryopreservation** techniques, eggs can be fertilized **in vitro**, and plants can be propagated using **tissue culture** methods. Seeds of different genetic strains of commercially important plants can be kept for long periods in **seed banks**.
- **National Gene Bank of India** -

  - It is primarily responsible for **conservation of unique accessions on long-term basis**, as base collections for posterity, predominantly in the form of seeds.

The National Gene Bank is mainly concerned with ex situ conservation in a seed gene bank of the following mandate species:

- Indigenous crops of the region such as sorghum, millets, cowpeas, cucurbits, bambara nuts, traditional vegetables and their wild relatives.
- Utilised wild and weedy plant species such as medicinal plants.
- Introduced crops such as maize, rice, cassava, sweet potato and beans that have become adapted to the region.

Advantages of ex-situ conservation

- It gives **longer life time** and breeding activity to animals.
- Genetic techniques can be utilized in the process.
- Captivity breed species can again be reintroduced in the wild.

Disadvantages

- The favourable conditions may not be maintained always.
- Few life forms cannot evolve.
- This technique involves only few species.

Zoological Parks

A zoo (short for **zoological garden** or **zoological park**, and also called an **animal park or menagerie**) is a facility in which animals are confined within enclosures, displayed to the public, and in which they may also breed.

- Purpose of zoos – initially it was entertainment but over the decades, zoos have got transformed into **centers for wildlife conservation and environmental education**.
- They play role of saving individual animals and species conservation (through captive breeding).
- They sensitizing visitors regarding the value and need for conservation of wildlife.

Botanical Garden

Botanical garden refers to the scientifically planned collection of living trees, shrubs, herbs, climbers and other plants from various parts of the globe.

Purpose of botanical gardens -

- To **study the taxonomy** as well as growth of plants.
- To study the introduction and acclimatization process of exotic plants.
- It acts as a **germplasm** (the genetic material of germ cells) **collection**.
- It helps **development of new hybrids**.
- It augments **conserving rare and threatened species.**
- It facilitates training of staff.
- It acts as a **source of recreation**.

Safari Park

- A safari park is larger than a zoo and smaller than game reserves (large areas of land where wild animals live safely or are hunted in a controlled way for sport (in Africa)).

In-situ Conservation

- The conservation of species in their natural habitat or natural ecosystem is known as **in situ conservation.**
- In the process, the natural surrounding or ecosystem is protected and maintained so that all the constituent species (known or unknown) are conserved and benefited. suitable mechanism.
- The established natural habitats are -
    - National parks
    - Sanctuaries
    - Biosphere reserves
    - Reserved forests
    - Protected forests
    - Nature reserves
- The above natural habitat will be covered under chapter **PROTECTED AREA NETWORK- other part of VAN**

Advantages

- If it is a cheap and convenient way of conserving biological diversity.
- It offers a way to preserve a large number of organisms simultaneously, known or unknown to us.
- The existence in natural ecosystem provides opportunity to the living organisms to **adjust to differed' environmental conditions and to evolve in to a better life form**.

Disadvantage

- Only disadvantage - it requires large space of earth which is often difficult because of growing demand for space.

Which one of the following is not a site for in-situ method of conservation of flora?

a) Biosphere Reserve
b) Botanical Garden
c) National Park
d) Wildlife Sanctuary

Indian Biodiversity

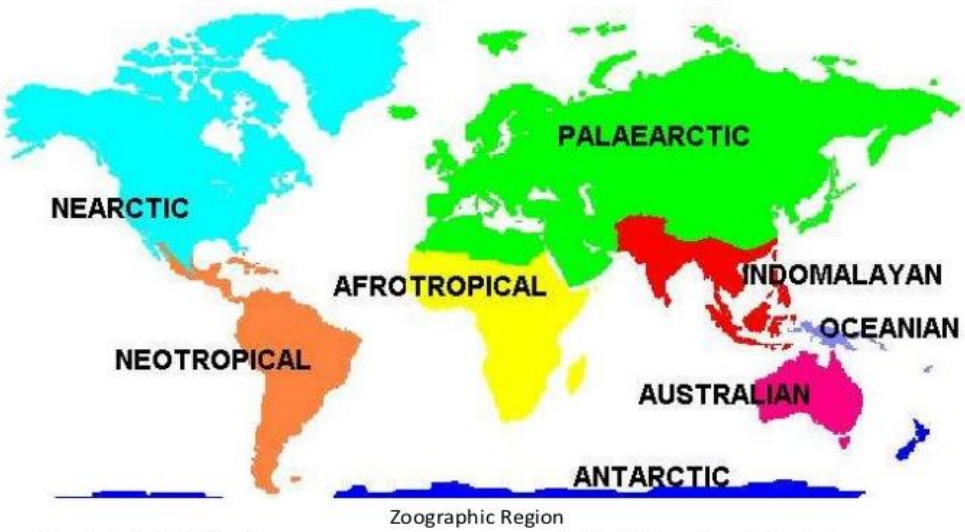
- India is one of the recognized megadiverse countries of the world.
- In terms of species richness –
  - 7^{th} rank in mammals
  - 9^{th} rank in bird
  - 5^{th} rank in reptiles.
- In terms of endemism of vertebrate groups, India's position is 10^{th} in birds with 69 species, 5^{th} in reptiles with 156 species and 7^{th} in amphibians with 110 species.
- India's geographical area under forest and tree cover – **24.16% (Indian forest report 2015)**

India represents –

a) 2 realms
b) 5 Biomes
c) 10 Bio-geographic zones
d) 25 Bio-geographic provinces

Realms

- Biogeographic realms are large spatial regions within which ecosystems share a broadly similar biological evolutionary history.
- Realm is a continent or sub-continent sized area with unifying features of geography and fauna & flora.
- In world - 8 biogeographic realms are there –
  - Nearctic realm
  - Palaearctic realm
  - Africotropical realm
  - Indomalayan realm
  - Ocenaia realm
  - Australian realm
  - Antarctic realm
  - Neotropical realm



Zoographic Region

Afrotropical=Ethiopian **Indo-Malaysian=Orient**al

Note: Regions Paleartic and Neartic are often united as Holarctic region

- In India – 2 realms are there –
    - Himalayan region represented by Palearctic Realm
    - Rest of the sub-continent represented by Malayan Realm

Biomes of India

- Biosphere, which is one of the level of organizations in ecology, has many divisions and each division is known as **Biome**.
- Each biome has different climate, vegetation, animals and soil type. **No two biomes are same.**
- **Climate, vegetation, animals decide the boundaries of biomes**.
- Most important climatic factors are – **temperature and precipitation**.

5 biomes of India are –

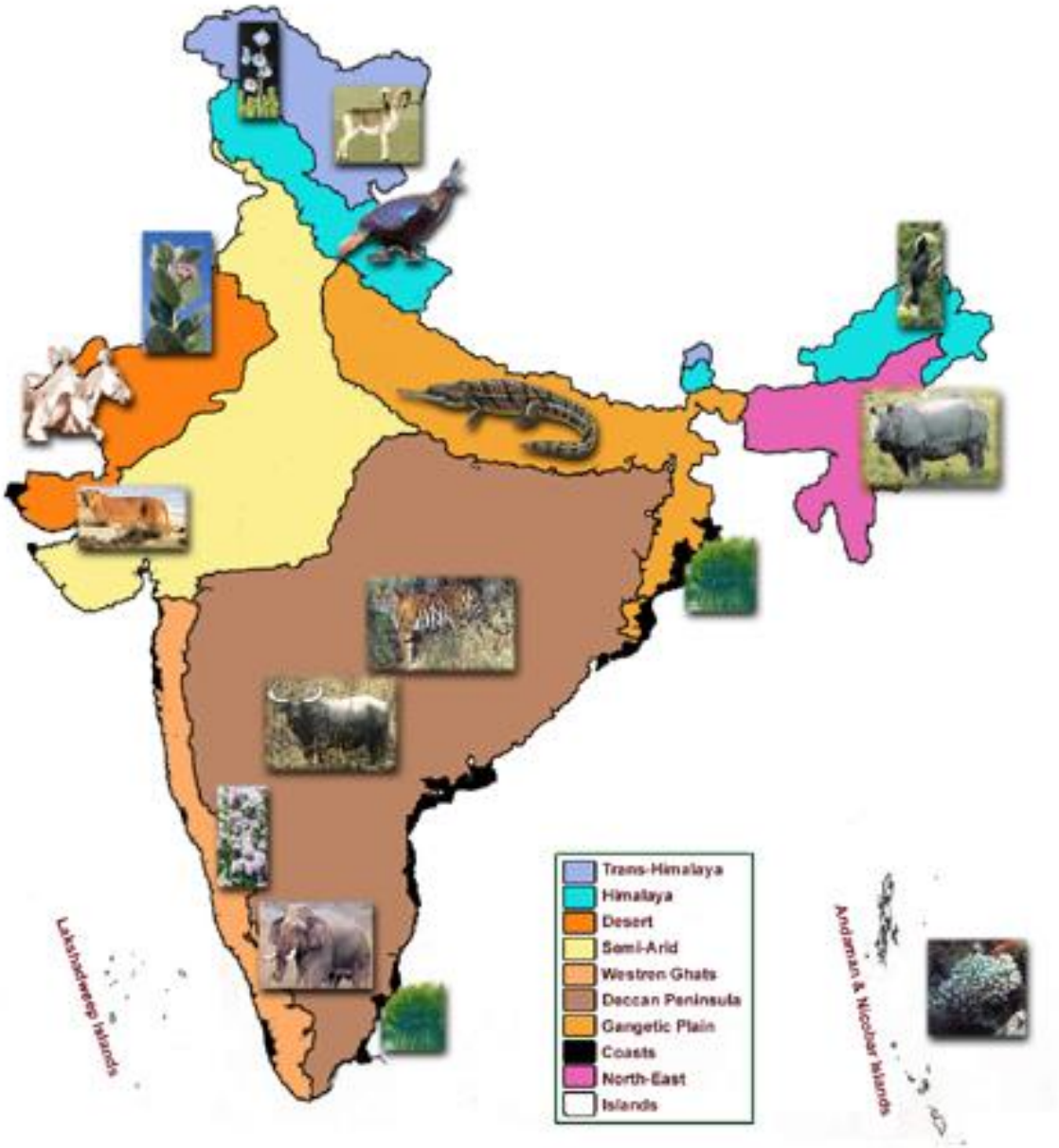
1. Tropical Humid Forests
2. Tropical Dry or Deciduous Forests (including Monsoon Forests)
3. Warm deserts and semi-deserts
4. Coniferous forests and
5. Alpine meadows

Biogeography deals with the geographical distribution of plants and animals. Biogeography is divided into branches -

1. Phyto-geography (plant geography) – It deals with origin, distribution and environmental interrelationships of plants.
2. Zoogeography - It deals with the migration and distribution of animals.

There are 10 biogeographic zones which are distinguished clearly in India. They are as follows –

1. **Trans-Himalayas**
    - Extension of the Tibetan plateau.
    - High-altitude cold desert in Laddakh (J&K) and Lahaul Spiti (H.P)



2. **Himalayas**
    - Mountain chain running from **north-western to northeastern India**
    - It comprises a diverse range of biotic provinces and biomes.

3. **Desert**
    - Extremely **arid** area west of the Aravalli hill range
    - Comprises both the **salty desert of Gujarat and the sand desert of Rajasthan**.

4. **Semi-arid –**
    - Zone between the desert and the Deccan plateau, including the Aravalli hill range.

5. **Western Ghats**
    - Hill ranges and plains running along the western coastline, south of the Tapti river.
    - Covers an extremely diverse range of biotic provinces and biomes.

6. **Deccan peninsula**
    - Largest of the zones
    - Covers much of the southern and southcentral plateau with a predominantly deciduous vegetation.

7. **Gangetic plain**
    - Defined by the Ganges river system, these plains are relatively homogenous.

8. **North-east India**
    - The plains and non-Himalayan hill ranges of northeastern India.
    - Wide variation of vegetation.

9. **Islands**
    - The Andaman and Nicobar Islands in the Bay of Bengal.
    - A highly diverse set of biomes.

10. **Coasts**
    - A large coastline distributed both to the west and east, with distinct differences between the two.

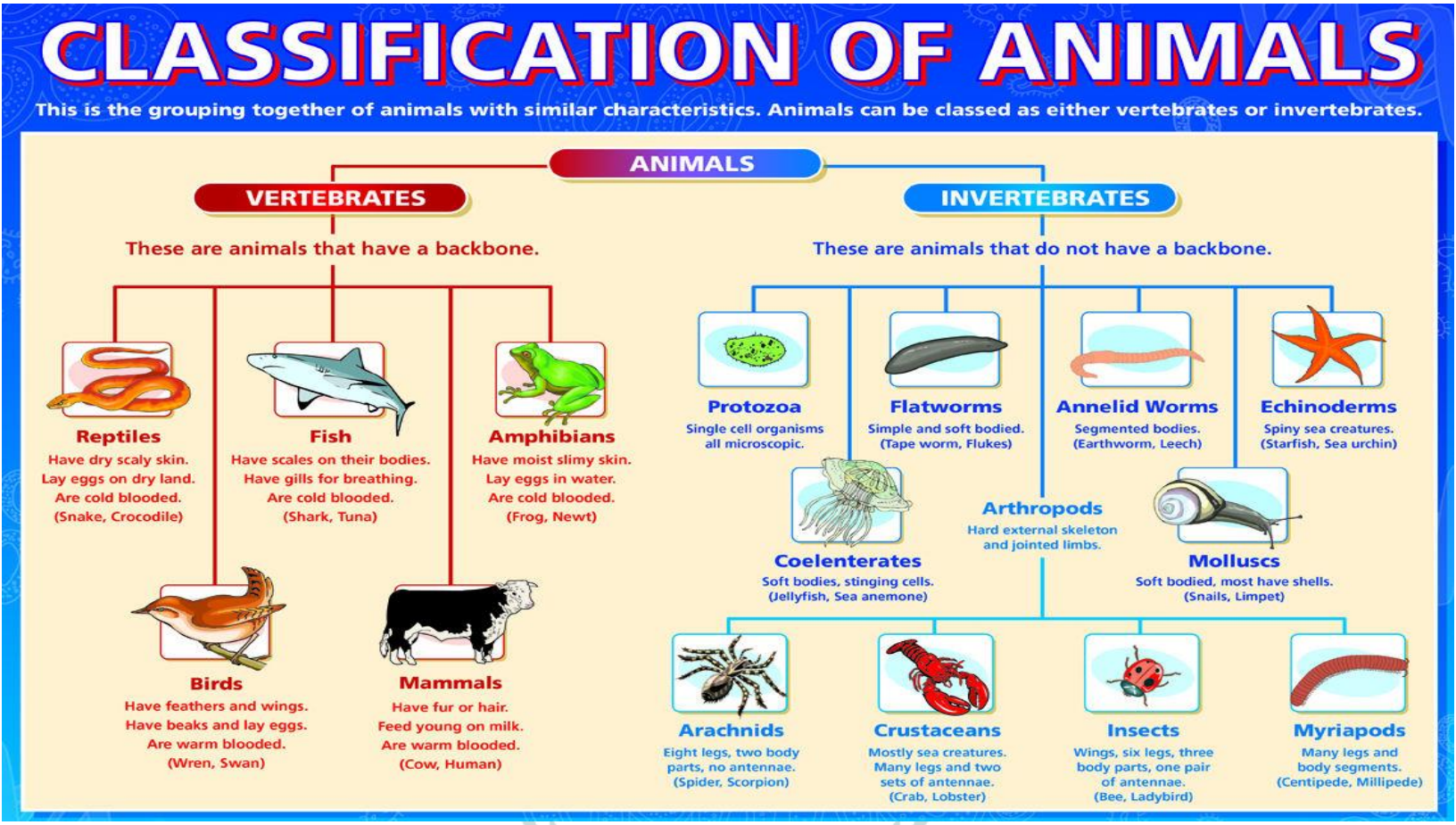
Bio-geographic Provinces

- It is a ecosystematic or biotic subdivision of realms.
- India is divided into 25 bio geographic zones.

Biogeographic zones and Biogeographic Provinces of India

S.No.	Biographic zones (10)	Biogeographic provinces (25)
1	Trans Himalaya	1A: Himalaya – Ladakh Mountains 1B: Himalaya – Tibetan Plateau 1C: Trans – Himalaya Sikkim
2	The Himalaya	2A: Himalaya - North West Himalaya 2B: Himalaya - West Himalaya 2C: Himalaya - Central Himalaya 2D: Himalaya - East Himalaya
3	The Indian desert	3A: Desert - Thar 3B: Desert – Katchchh
4	The Semi-Arid	4A: Semi - Arid - Punjab Plains 4B: Semi - Arid - Gujarat Rajputana
5	The Western Ghats	5A: Western Ghats - Malabar Plains 5B: Western Ghats - Western Ghats Mountains
6	The Deccan peninsula	6A: Deccan Peninsular - Central Highlands 6B: Deccan Peninsular - Chotta Nagpur 6C: Deccan Peninsular - Eastern Highlands 6D: Deccan Peninsular - Central Plateau 6E: Deccan Peninsular - Deccan South
7	The Gangetic Plains	7A: Gangetic Plain - Upper Gangetic Plains 7B: Gangetic Plain - Lower Gangetic Plains
8	The Coasts	8A: Coasts - West Coast 8B: Coasts - East Coast 8C: Coasts – Lakshadweep
9	Northeast India	9A: North - East - Brahmaputra Valley 9B: North - East - North East Hills
10	Islands	10A: Islands - Andaman 10B: Islands – Nicobars

Fauna



Click here for high resolution

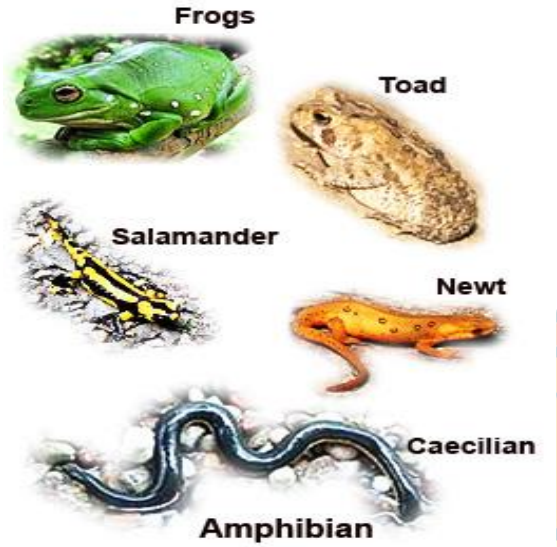
Vertebrates

- Animals with backbones and spinal columns.
- Most advanced organisms on Earth.
- Represents only a very small percentage of all animals but their size and mobility often allow them to dominate their environment.

Fishes

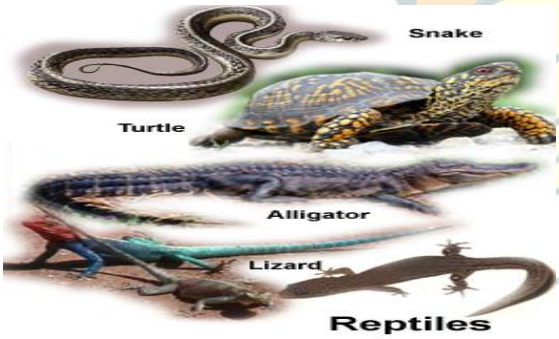
- Cold blooded
- Live in water
- Breathe under water using gills, not lungs
- Have scales and fins
- Lay many eggs

Amphibians



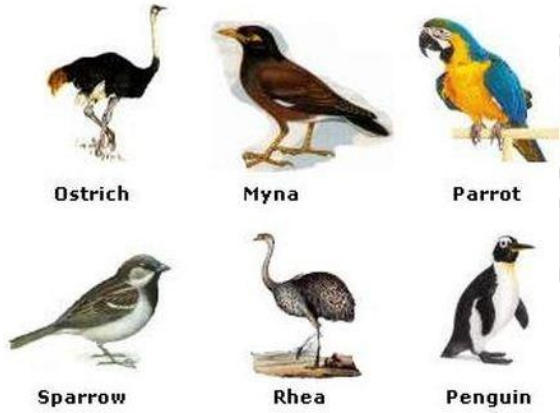
- Cold blooded
- Live on land & water
- Webbed feet
- Breathe with lungs and gills
- Moist smooth skin
- Four legs (sometimes none)
- Lay many eggs

Reptiles

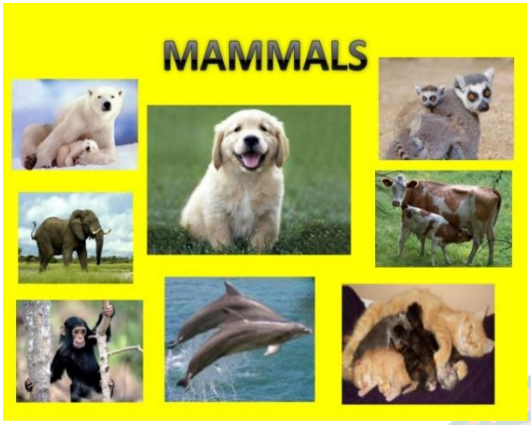


- Cold blooded
- Have scales
- Have dry skin
- Usually lay eggs
- Ear holes instead of ears
- 4 legs or no legs

Aves



- Warm blooded
- Have feathers and wings
- Lay eggs
- Have2 legs
- Ear holes instead of ears



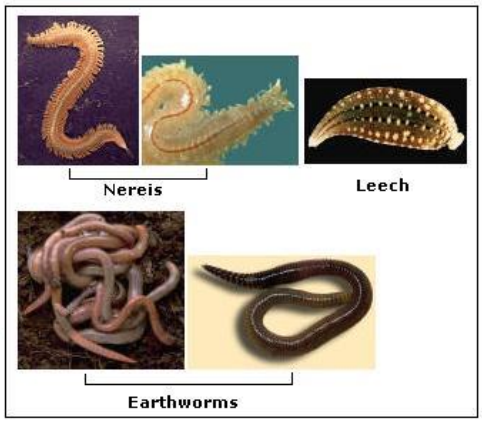
Mammals

- Warm blooded
- Have hair or fur
- Give birth to live young
- Mammal mother nurse their young one with milk
- Breathe with lungs
- Mammals live on land have 4 legs (or 2 legs & 2 arms), and ears that stick out.

Invertebrates

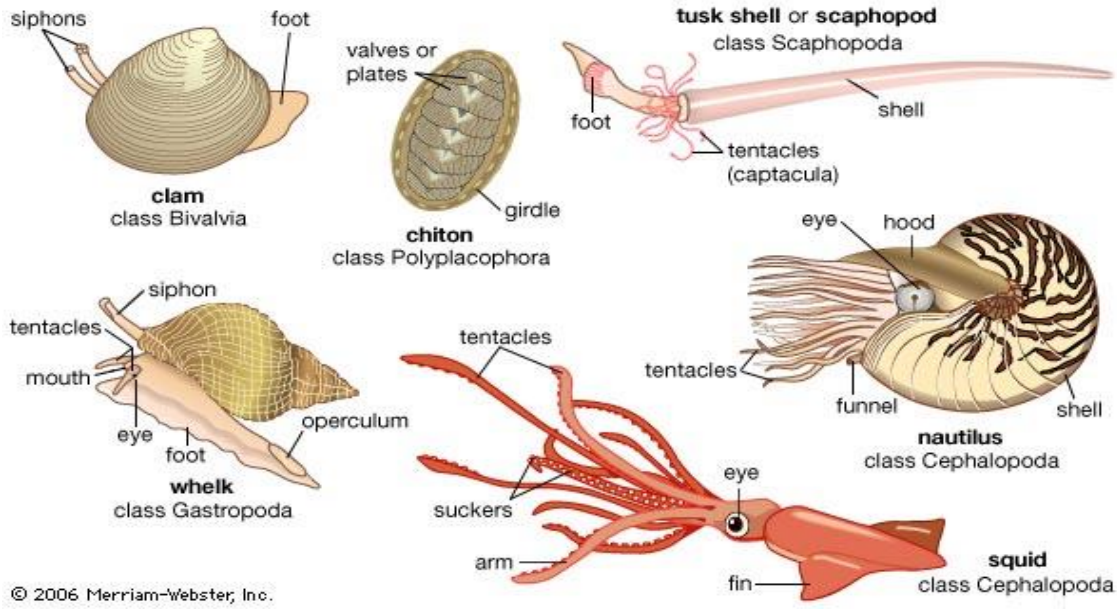
- They do not have backbones.
- 98% animal species in the world are invertebrates.
- They don't have an internal skeleton made of bone. Many invertebrates have a fluid-filled, hydrostatic skeleton, like the jelly fish or worm. Others have a hard outer shell, like insects and crustaceans.

Annelids



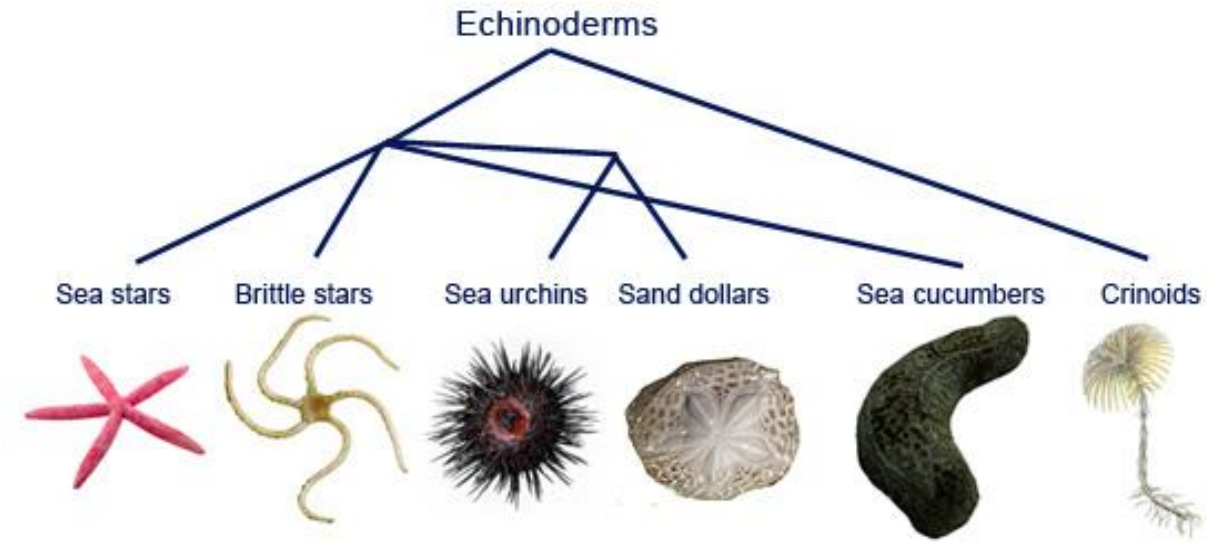
- Their bodies are divided into segments.
- Very well-developed internal organs.
- Found almost anywhere in the world.
- Don't have any limbs.
- Example - earthworms, leeches, roundworms, etc.

Mollusks



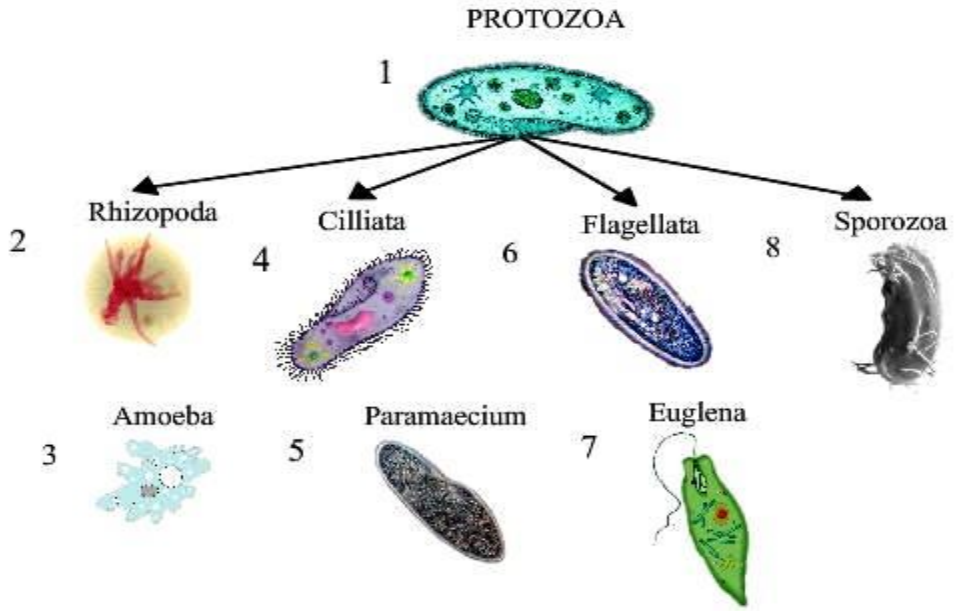
- Most of them have soft, skin-like organ covered with a hard outside shell.
- Some mollusks live on land like snail and slug.
- Other mollusks live in water like oyster, mussel, clam, squid and octopus.

Echinoderms



- They are marine animals which live in the ocean.
- Example - sea star, sea urchin, sand dollar and sea cucumber.
- Most of them have arms or spines that radiate from the center of their body.

Protozoa



- Simple, single-celled animals.
- Smallest among all animals.
- Most protozoa are microscopic.
- They do breathe, move and reproduce like multicelled animals.
- Example - amoebas, Flagellates etc.

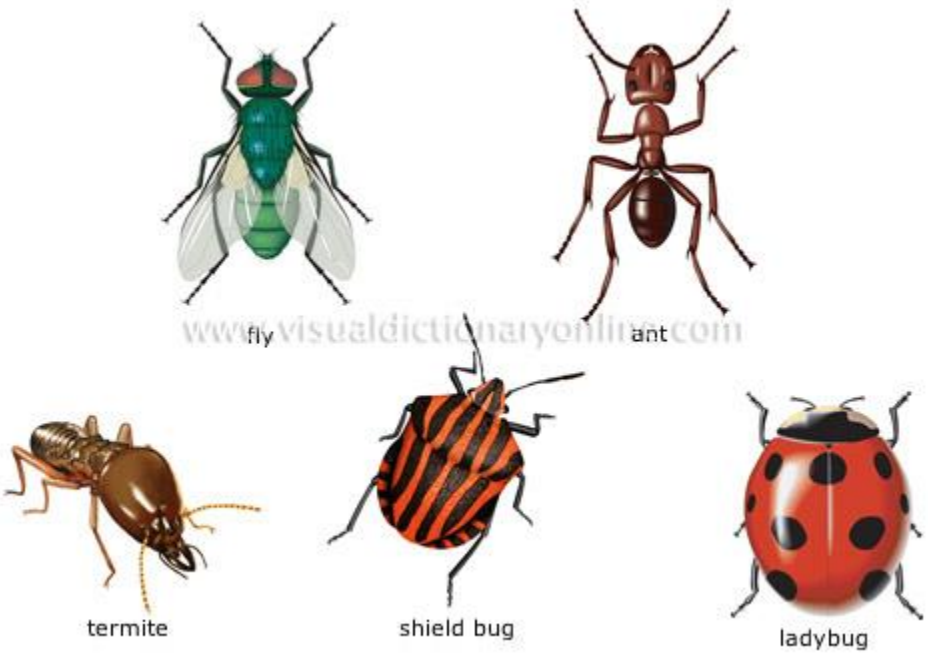
Arthropods

- They have limbs with joints that allow them to move.
- They also have an exoskeleton, which is a hard, external skeleton.
- **They include the crustaceans, insects and arachnids**.

Crustaceans

- They live mostly in the ocean or other waters.
- They have a hard, external shell which protects their body
- Example - crab, lobster and barnacle.

Insects



- They are class of invertebrates within the arthropod phylum.
- They have a chitinous exoskeleton, a three-part body, three pairs of jointed legs, compound eyes and one pair of antennae.

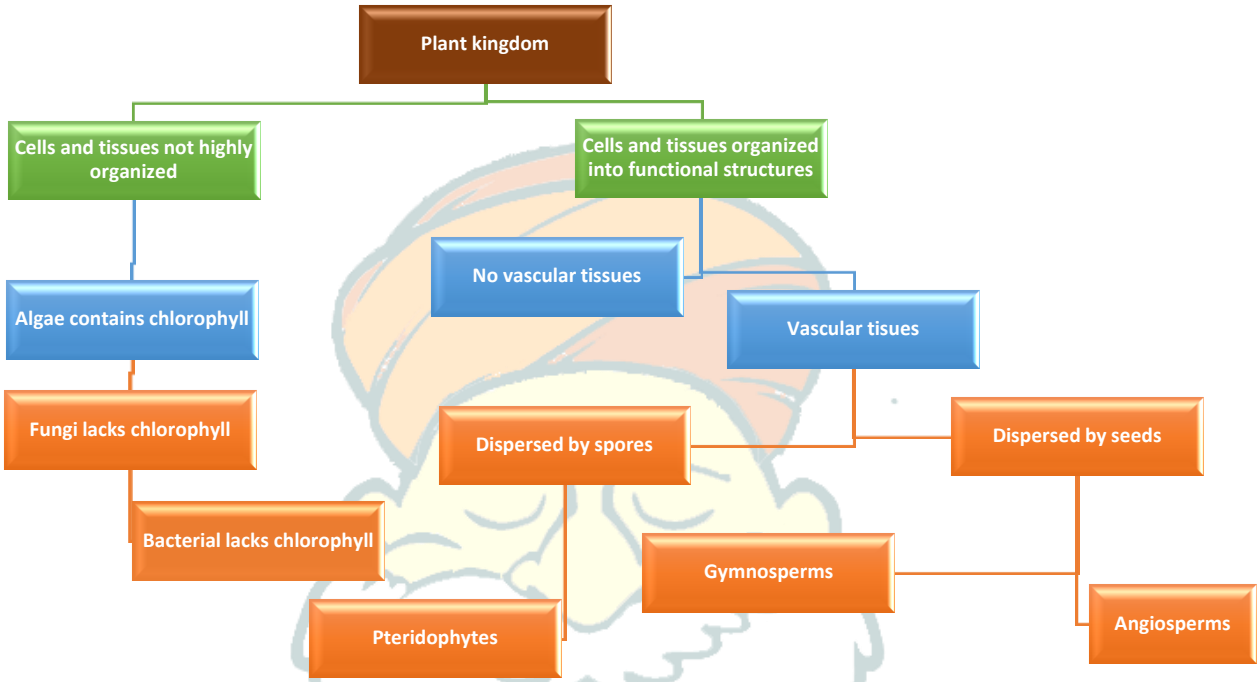
- They are very adaptable, living almost everywhere in the world.
- They have an exoskeleton that covers their entire body.
- Example - fly, beetle, butterfly, moth, dragonfly, bee, wasp and praying mantis.

Arachnids

- They are a class of joint-legged invertebrate animals (arthropods).
- Example - spiders, scorpions, ticks and mites.
- They do not have antennae.
- They have 2 body parts and 4 pairs of legs.

Floral Diversity

India ranks 10th in the world and 4th in Asia in terms of plant diversity. India represents nearly 11 % of the world's known floral diversity.

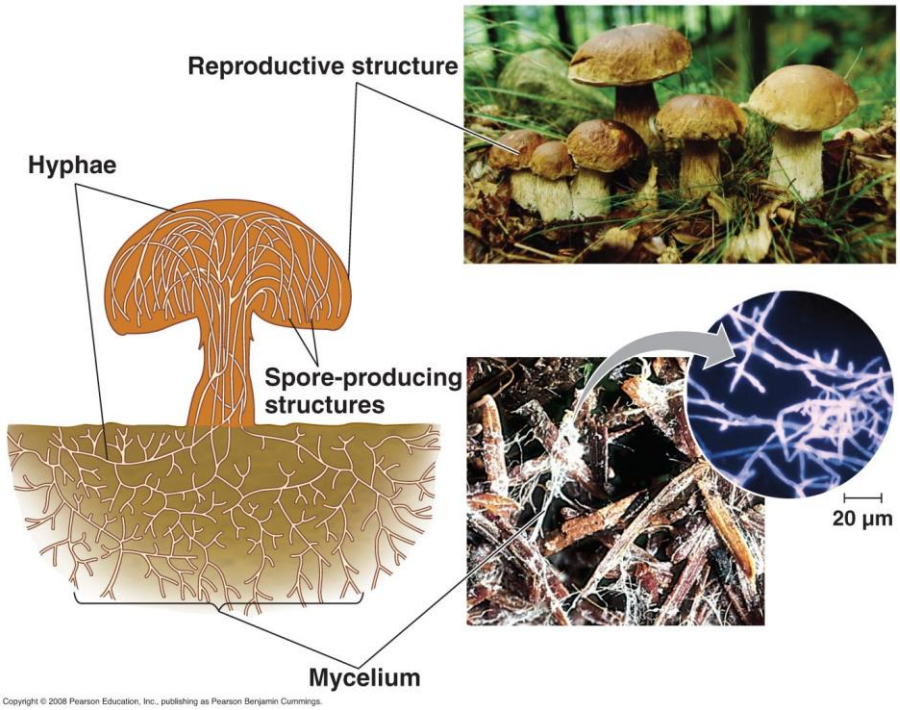


Important groups found in India

1. Algae

- The green **non differentiated plants** (non - differentiated into organs like root, stem and leaf) possessing **chlorophyll** are known as Algae.
- They **grow in water** or in moist situations.
- **Fresh-water algae** - green or blue-green in color
- **Marine water algae** - red or brown.
- These are autotrophic plants, as they can manufacture their own food.

2. Fungi



- **Non-green non differentiated plants** characterized by total absence of chlorophyll are called Fungi.
- They grow either on dead, rotten organic matters as **saprophytes (**a plant, fungus, or microorganism that lives on dead or decaying organic matter**)** or live as **parasites** on other living bodies, which are referred to as hosts.
- **Moulds** and **mushrooms** are the familiar examples of saprophytic fungi.
- The maximum diversity of fungi is in the Western Ghats followed by the eastern Himalaya and the western Himalaya. About 3500 species are endemic to the country.

3. Bacteria

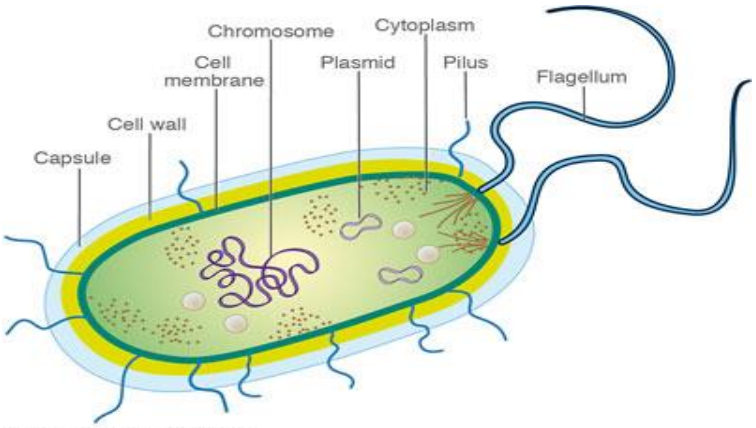


Diagram of a Bacterium

- It is neither plant nor animal.
- These are non-chlorophyllous micro-organisms which lead saprophytic or parasitic existence.
- If bacteria form a parasitic association with other organisms, they are classed as **pathogens**. Pathogenic bacteria are a **major cause of human death and disease** and cause infections such as **tetanus, typhoid fever, diphtheria, syphilis, cholera, foodborne illness, leprosy and tuberculosis.**
- Saprophytic bacteria are rather beneficial. They are soil borne and many of them are used in industries.
- Other uses of bacteria include sewage treatment, breakdown of oil spills, cheese through fermentation.
- They were among the **first life forms to appear on Earth**, and are present in most of its habitats.
- **Bacteria inhabit soil, water, acidic hot springs, radioactive waste, and the deep portions of Earth's crust.**

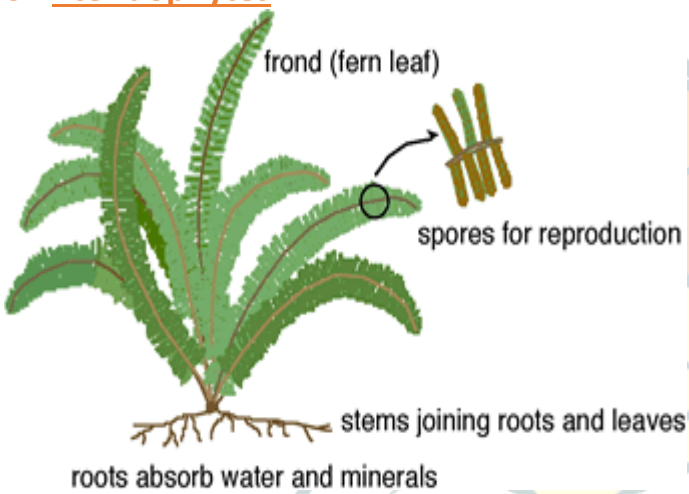
4. Lichens

- A lichen is a peculiar combination of an algae and a fungus - the two live deriving mutual benefit. (**Lichen = algae + fungi**)
- They are group of greyish green plants which grow on rocks, three-trunks, dead wood, etc.
- Algae manufactures carbohydrate food which becomes available to the fungus, and the latter absorbs and retains water and thus keeps the algal cells moist. So it is a nice **example of symbiosis**. (algae makes food and fungi eats food))
- In wetlands – found commonly
- In rivers and streams – rare
- In ground water – Not found

5. Bryophytes

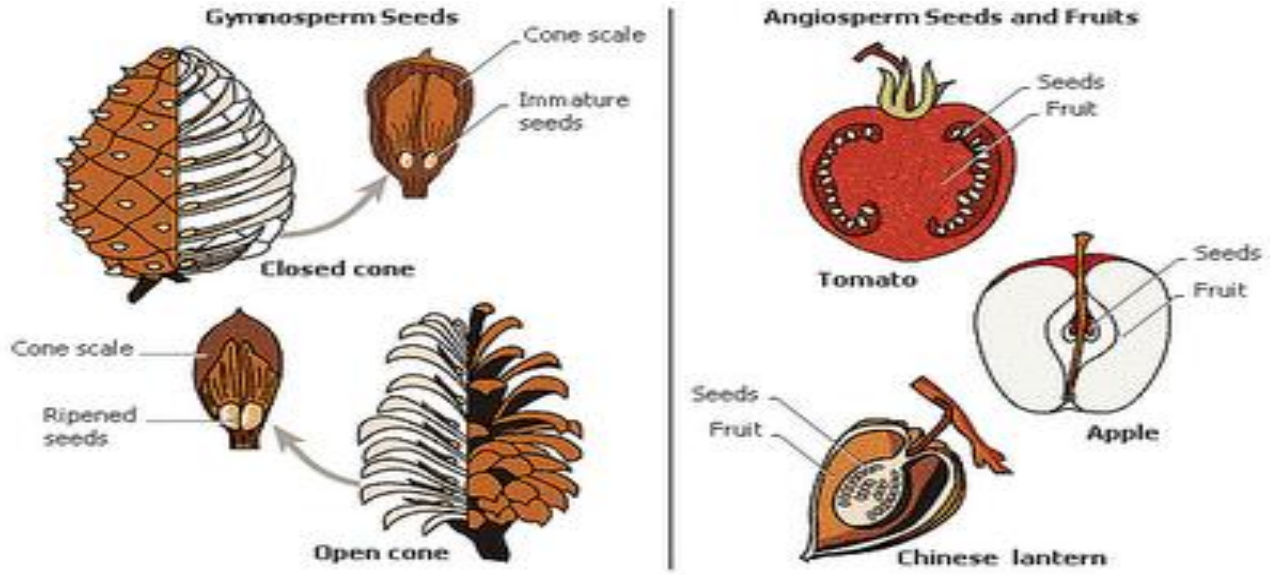
- The plant body is differentiated into a small stem and simple leaves, but true roots are absent.
- They usually grow in moist places. E.g. Liverworts, mosses
- 2nd largest group of green plants in India distributed largely in Eastern Himalaya, North-eastern India, Western Himalaya and the Western Ghats.
- Mosses constitute the major component of Indian bryoflora followed by liverworts and hornworts.

6. Pteridophytes



- The pteridophytes have well-differentiated plant bodies, consisting of roots, stems and leaves.
- They possess vascular bundles (*a strand of conducting vessels in the stem or leaves of a plant, typically with phloem on the outside and xylem on the inside*).
- Most of them are terrestrial plants and some of them are aquatic.
- This group includes the vascular cryptogams · like dub-mosses, horse-tails and fems which are universally distributed all over the world.
- The north-eastern region (including Eastern Himalaya) is rich in pteridophytic diversity, followed by south India (including Eastern and Western Ghats) and north India (including Western Himalaya).

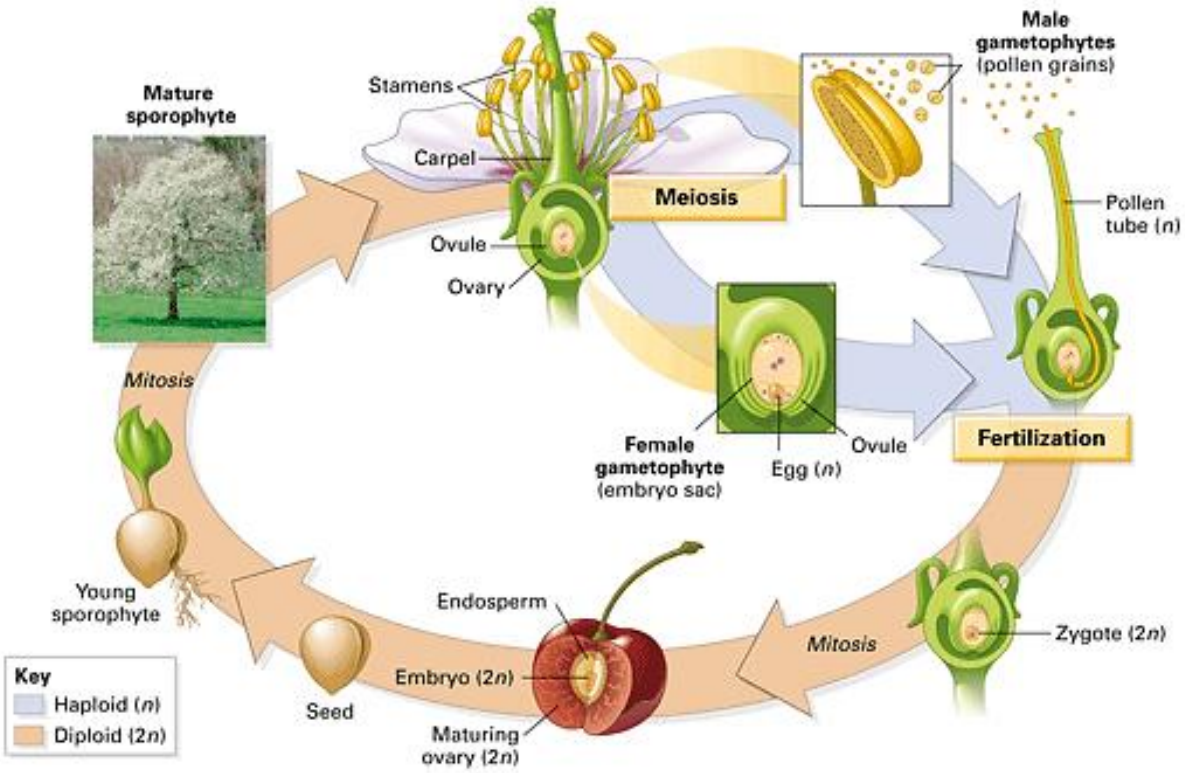
7. Gymnosperms



- Gymnosperms (gymnos=naked, sperma=seed) are the naked-seeded plants.

- Their naked condition stands in contrast to the seeds and ovules of flowering plants (**angiosperms**), which are enclosed within an ovary.
- They have very simple flowers without accessory whorls and the microsporophylls (stamens) and carpels remain aggregated in cones.
- Ovules are present on the surface of the carpels and are directly pollinated by the pollen grains.
- There is nothing like ovary, style and stigma, and naturally there is no fruit.
- E.g. Cycas, Pinus, Gnetum.
- The species of Gnetum and Cycas are mostly confined to North Eastern region, Eastern and Western Ghats, and Andaman & Nicobar Islands.
- Gymnosperms have major economic uses. **Pine, fir, spruce, and cedar** are all examples of conifers that are used for lumber. Some **other common uses** for gymnosperms are soap, varnish, nail polish, food, gum, and perfumes.

8. Angiosperms



- The **flowering plants** (angiosperms), also known as **Angiospermae** or **Magnoliophyta**, are the most diverse group of land plants. Angiosperms (angeion=a case) are the closed seeded plants.
- Like gymnosperms, **angiosperms are seed-producing plants.** They are distinguished from gymnosperms by characteristics including flowers, endosperm within the seeds, and the production of fruits that contain the seeds.
- Angiosperms are the most highly developed plants which bear flowers having conspicuous accessory and essential whorls.
    - **Carpels have the ovary, style and stigma**.
- With the stimulus of fertilization, the **ovary usually develops into the fruit** and the **ovules into seeds**. Thus the seeds remain within the fruits.

Wildlife of India

Himalayan Mountain System

- West Himalayas have low rainfall, heavy snowfall (temperate conditions), whereas in east Himalayas, there is heavy rainfall, snowfall only at very high altitudes, whereas at lower altitudes conditions are similar to the tropical rain forests.
- Flora and fauna of both Himalayas differ.

1. Himalayan foothills

Flora

- Monsoon evergreen and semi-evergreen forests.
- Species - sal, silkcotton trees, giant bamboos; tall grassy meadow with savannahs in tarai.

Fauna

- Big mammals like elephant, sambar, swamp deer, cheetal, hog deer, barking deer, wild boar tiger, panther, wild dogs, hyena, black bear, sloth bear, porcupine, Great Indian one horned rhinoceros, wild buffalo, gangetic gharial, golden langur. (don't worry all of them will be covered in red data book)

2. Western Himalayas (High altitude region)

Flora

- Natural monsoon evergreen and semi-evergreen forests.
- Rhododendrons, dwarf hill bamboo and birch forests mixed with alpine pastures.

Fauna

- Wild ass, wild goats (thar, markhor, ibex) and sheep (Nayan, Marcopolo's sheep, bharal or blue sheep), antelopes (Chiru and Tibetan gazelle), deers (hangul of Kashmir stag and shou or Sikkim stag, musk deer), marmots and pikas or mouse hares, golden eagle, snow cocks, snow partridges, snow leopard, wolf, fox, cats, black and brown bears.
- Birds - Himalayan monal pheasant, western trogopan, Koklass, white crested khalij cheer pleasant; Griffon vultures, lammergiers, choughs, ravens.

3. Eastern Himalayas

Flora

- Oaks, magnolias, laurels and birches covered with moss and ferns.
- Coniferous forests of pine, fir, yew and junipers with undergrowth of scrubby rhododendrons and dwarf bamboos.
- Lichens, moss, orchids, and other epiphytes dominant (due to high humidity and high rainfall).

Fauna

- Red panda, hog badgers forest badgers, crestless porcupines, goat antelopes (Scrow, Goral, Takins).

Peninsular - Indian sub-region

It has two zones -

1. Peninsular India and its extension into the drainage basin of the river system
2. Desert region of Rajasthan - the Thar of Indian desert region.

1. Peninsular India.

- It is home to **tropical moist deciduous** to **tropical dry deciduous** and scrub vegetation depending upon the variation in rainfall and humidity.

Flora

- North and east extensions - Sal (higher rainfall)
- Southern plateau - teak trees
- West Ghats - evergreen vegetation (flora and fauna similar to evergreen rainforests of NE India).
- In dry areas of Rajasthan and Aravalli hills – scattered trees and thorny scrub

Fauna

- Elephant, wild boar, deers (cheetal or axis deer), hog deer swamp deer or barasinga, sambar, muntjak or barking deer, antelopes (four-hourned antelope, nilgai, blackbuck, chinkara, gazelle), wild dog or dhole, tiger, leopard, cheetah, lion, wild pig, monkey, striped hyena, jackal gaur.

2. Indian Desert

Flora

- Thorny trees with reduced leaves, cacti, other succulents are the main plants.

Fauna

- Mostly burrowing one animals.
- Rodents among mammals - largest group (like Indian desert gerbils (they are mouse like)).
- Other animals - wild ass, black buck, desert cat, caracal, red fox, reptiles (snakes, lizards and tortoise).
- Desert lizards include agamids, lacertids and geckos.
- Birds - Great Indian bustard.

Tropical rain forest region

- Distribution - areas of Western Ghats and North East India.

Flora

Sholas in southern western ghats. These are the tropical montane forest.

- Evergreen vegetation known as "**sholas**" occur in the Nilgiris (an offshoot of Western ghats).
- They also occur in Aanaimalai and Palani hills.
- The rain forests have dense and lofty trees with much species diversity.
- Mosses, ferns, epiphytes, orchids, lianas and vines, herbs, shrubs make diverse habitat.
- Ebony trees predominate in these forests.
- A variety of tropical orchids are found.
- **Stratification (**layers of trees and plants**)** in rain forests is very distinct - 3 horizontal layers are distinguished.

Fauna

- There are wild **elephants, gaur** and **other larger animals**.
- Most species are **tree dwellers**.
    - Most prominent - **hoolock gibbon** (only ape found in India), golden langur, capped langur or leahnonkey, Assam macaque and the pig-tailed macaque, lion-tailed macaque, Nilgiri langur slender loris.
    - Bats, giant squirrel, civets, flying squirrels, Nilgiri mongoose, spiny mouse.

Andaman and Nicobar Islands

Flora

- These are home for tropical rain forests.
- Giant Dipterocarpus, Terminalia and Lagerstroemia are dominant.
- Mangroves are also **distributed in the coastal areas**.

Fauna

- A number of reptiles and marine animals occur in this area.
- Among mammals, **bats and rats** predominate (3/4th of the total mammals on islands).
- **Andaman pig, crab-eating macaque, palm civet and deer's** (**spotted deer, barking deer, hog deer, sambar).**
- Among marine mammals there are **dugong, false killer whale, dolphin**.
- Among birds are rare one is **Narcondum hombill, Nicobar pigeon and megapode**. There are also other birds like **white-bellied sea-eagle, white-breasted swiftlet and several fruit pigeons.**

- **Salt-water crocodile, a number of marine turtles, coconut crab, lizards** (the largest being water monitor), 40 species of snakes including **cobra, viper, voral and sea snake, python**, etc. are present.

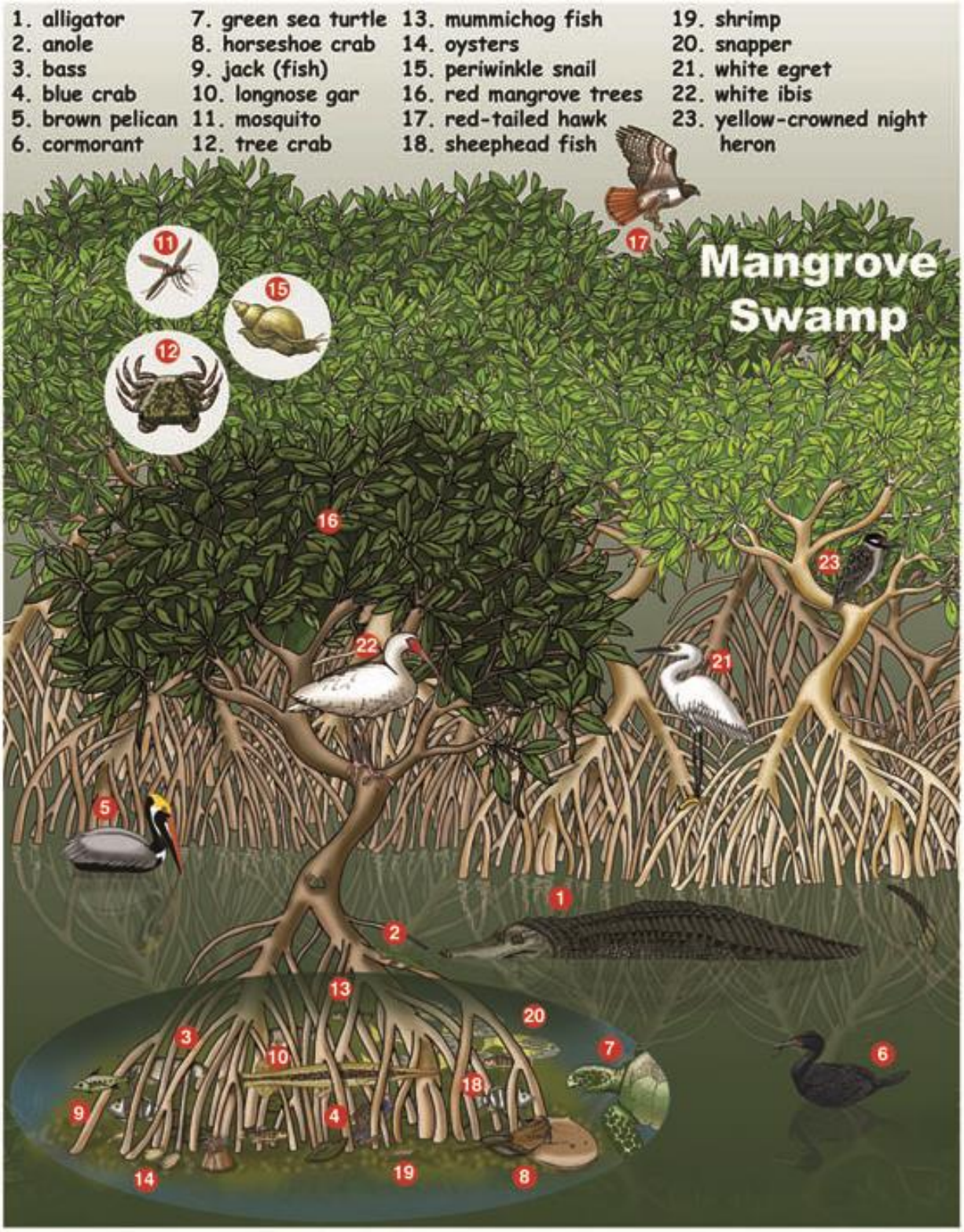
Mangrove swamps of Sundarbans

- Sundarbans are Delta of the Ganges **where both the Brahmaputra and Ganges join** and drain into the Bay of Bengal.

Flora

- The lower tidal zones are pioneer trees like Sonneratia and avicennia.
- Above this zone there are rhizophora, bruguiria and excaecaria-cereops forest (covering nearly 70% of mangrove forest).
- Above this level there are supporting forest of phoneix in association with excaecaria.
- There are heriteria forest in the highest portion with thick undergrowth phoneix and neepa plams. (in short – lower to highest – Pioneer trees → cereops forest → supporting forest → heriteria forest)


Mangroves
of Gujarat
Sundarbans
mangroves
Mahanadi
mangroves
Krishna Godavari
mangroves
Ratnagiri
mangroves
Goa
mangroves
Andaman and
Nicobar Islands
mangroves
Cauvery
deltaic
mangroves



Fauna

- **Fish, small crabs, dorippe** (the one that has unusual association with sea anemone), weaver ants.

- In the higher regions of mangroves, there are **spotted deer, pigs, monitor lizard, monkeys.**
- The most important animal of Sunderbans is the **Royal Bengal Tiger**.