

Study Material *for* Classroom Students only

GENERAL STUDIES GENERAL SCIENCE

DIVERSITY AND ECONOMIC INPORTANCE OF LIVING BEINGS

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DIVERSITY AND ECONOMIC INPORTANCE OF LIVING BEINGS

Living beings have a large array of diversity. Out of 1.7 million known organisms, 1.2 million are animals and 0.5 million plants. The largest group of organisms is insects with over 0.75 million species. Many plant and animal have not yet been discovered. Every year about 15000 new species are discovered. It is estimated that total living organsims may range between 9 - 52 million species. About 50 - 100 times more species have become extinct. A good system of classification is a must for their identification, study and bringing out relationships amongst themseleves.

The very range of organisms in terms of size, colour, habitat, physiological and morphological features makes the basis of the defining characteristics of living organisms.

- **Taxonomy**: the branch of knowledge dealing with identification, nomenclature and classification of organisms.
- **ICBN** : International Code for Botanical Nomenclature, deals with classification of plants.
- ICZN : International Code of Zoological Nomenclature, deals with classification of animals.
- Classification : process by which anything is grouped into convenient categories based on some easily observable characters.
- Taxonomic hierarchy : hierarchy of categories/ ranks used in classification of any organism

Kingdom → Phylum / Division → Class → Order → Family → Genus → Species

The Taxonomic Hierarchy

• Binomial nomenclature : naming system given by Carolus Linnaeus, each name has two



- Aristotle : biological and morphological classification of plants and animals.
- Linnaeus : classified all living organisms into two kingdoms Plantae and Animalia.
- Whittaker : classified all living organisms into five kingdoms Monera, Protista, Fungi, Plantae and Animalia.

Five Types of Living beings (Whittaker)

- Monera: eg., Bacteria, Cyanobacteria Mycoplama etc
- → **Protista:** eg., Amoeba, *Paramecium, Plasmodium* etc.
- **Fungi:** eg., Bread Moulds, Ringworm, Mushrooms etc.
- Plants: e.g., Algae, Herbs, Shurbs, Trees etc.
- Animals: e.g., Worms, Insects, Fishes, Amphibians, Mammals, Humans, etc.
- The main criteria of the five kingdom classification were:
 - (a) Cell structure, (b) Body organisation
 - (c) Mode of nutrition (d) Reproduction
 - (e) Phylogenetic relationships

Characters	Characteristics of Five Types of Living Organisms				
Monera Protista Fun		Fungi	Plantae	Animalia	
Cell type	Prokaryotic	Eukaryotic/	Eukaryotic	Eukaryotic/	Eukaryotic
Cell wall	Cell wall Noncellular (polysaccharide + amino acid) Present in some Present (without cellulose)		Present (cellulose)	Absent	
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multiceullar/ loose tissue	Tissue/organ	Tissue/ororgan system
Mode of nutrition	Autotrophic (chemosynethtic and photosynthetic heterotrophic (saprophyte/ parasite)	Autotrophic (photosynthetic) and heterotrophic/	Heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthic)	Heterotrophic/ (holozoic/ saprophytic)

VIRUSES

Virus is a nucleoprotein entity, capable of multiplication by taking over cellular machinery of the host cell without involving growth and division. They are obligate parasites. They become active inside a living cells. It has both the characters of living and non living, so it is a **connecting link between living and non living**. It cannot mulitply over artificial medium.

- Virology: Study of virus
- **Ivanovsky:** discovered virus, 1992. (During the test of Mosaic diseases in tabacco).
- **Dr. Stanley:** first isolated the virus causing mosaic disease in tabacco in the form of crystals.

Types of Viruses: Depending upon the host, viruses are of following types

- (a) **Bacteriophages:** infecting bacteria
- (b) Coliphages: bacteriophage of Escherichia coli
- (c) **Cyanophages:** infecting blue–green algae
- (d) Phycophages: infecting algae
- (e) **Zymophages:** mycophages over yeast
- (f) Mycophages: infecting fungi
- (g) Phytophages: plant viruse
- (h) **Zoophages:** animal viruses

Structure of Virsus

Structurally virus consists

(1) **Envelope.** It is no outer thin loose covering Envelope is composed of both viral (especially proteins) and host component (Lipids and carbohydrates). Surface of envelope is smooth or possesses outgrowths called **spikes**

- (2) **Capsid.** it is the protein coat of viruses which is meant for protectig. nucleoid and enzymes
- (3) Nucleoid. It is the nucleic acid core of virus. Nucleic acid may be
 - (a) Double Stranded or ds DNA. Adenovirus,
 - (b) **Single stranded or ss DNA.** Coliphage
 - (c) Single staranded or ss RNA. They are called as Retro virus. They contain enzyme reverse transcriptase, which from DNA from RNA. eg., Poliomyelities virus,
 - (d) Double Stranded or ds RNA, Reo-virus,

Prion

Exceptionally small pathogenic entity, made of protein only is resistant to UV radiations, temperature of 90°C for 3 minutes but is senstitive to proteases. It causes disease like scrapie of sheep, mad cow disease and certain degenerative nervious diseases of humans (e.g., Kuru, Cruetzefldt–Jacob disease).

Viroid

Obligate parasite made of only single strand of RNA. There is no protein. Viroid is resistant to organic solvents but is sensitive to nucleases. It causes stunting of growth in plants, potato spindle and some rare diseases in animals.



KINGDOM MONERA

Monera: Includes all prokaryotes, viz, mycoplamsa, bacteria, actinomycetes all photosynthetic cynaobacteria. Classification of Monera

1.	Archaebacteria	Most primitive kind of bacteria. Methanogens, Halophiles, Thermoacidophiles are the archae-bacteria known in current time.
2.	Mycoplasma	Completely lack a cell wall. They are the smallest living cells known and can survive without oxygen.
3.	Cyanobacteria	Photosynthetic, also known as the Blue Green Algae.
4.	Chlamydiae	They are obligate intracellular pathogens.
5.	Rickettesae	They are obligate intra-cellular pathogens.
6.	Eubacteria	They are the modern day bacteria.
7.	Actinomycetes	They are the link between bacteria and fungi. Also known as the Ray fungi.

Economic Importance of bacteria

1. Biological Nitrogen Fixation : It is the process of conversion of atmospheric nitrogen into ammonia and then into compounds of nitrogen like nitrate and nitrates with the help of microorganisms like bacteria. The bacteria which help in this process are ammoniafying and nitrifying bacteria respectively.



2. Rhizobia or Rhizobium leguminosarum : symbiont inside root nodules of leguminous plants such as gram, peas, soyabean etc have ability to fix nitrogen. Thus the crop rotation with leguminous crops helps in retaining soil fertility.



- 3. Thiobacillus denitrificans, Pseudomonas denitrificans : Denitrifying bacteria, convert soil nitrates to nitrogen.
- 4. **Pseudomonas :** digest the hydrocarbons in petroleum, used to clean up oil spills, developed by Anand Chokroborty.
- 5. Bacillus thurin-giensis (also called BT) : biological pest control, through genetically modified plants.

- 6. Bacillus megatherium : flavour Tea and coffee.
- 7. **Methylobacterium butyrate :** biodegradable plastic (polyhydroxy butyrate).
- 8. Agrobacterium tumefaciens : genetic engineering.
- 9. Bacteria are used in industrial production.

Acetobacter aceti	acetic acid;
Clostridium butylicum	butyric acid, riboflavin, and vitamin B.
Lactobacillus	lactic acid

- 10. **Streptococcus :** produce streptokinase, used as a 'clot buster' for removing clots from the blood vessels of heart patients.
- 11. Bacteria are used in production of dairy products

Streptococcus lactis : Butter

Streptococcus lactis, Streptococcus cremoris: Butter Milk

Lactobacillus lactis : Cheese

Streptococcus lactis, Lactobacillus : Curd

Streptococcus thermophilus, Lactobacillus vulgaricus : Yoghurt

12. Clostriduim botulinum : secrete toxin Botulin, causes food poisoning or botulism of packed foods. Botulin used in botox cosmetic therapy

Growth of the Bacteria

- Bacterial growth follows Sigmoid Curve of growth. Three Phases are
 - (a) Lag Phase: growth is slow and steady
 - (b) Log Phase : exponential growth
 - (c) Stationary Phase : growth is slowed down to minimum.



Pasteurization

5

- To preserve the milk for many days pasteurization is done. There are two methods of pasteurization-
 - (a) Low Temperature holding method (LTH)
 : Milk is boiled at 62.8 degree Celsius for 30 minutes.
 - (b) High Temperature short time method (HTSt) : Milk is boiled at 71.7 degree Celsius for 15 seconds.

Gram Staining

- It was discovered by H.C. Gram in 1884
- It allows classification of bacterial morphology on the basis of differential staining properties.
- Gram positives : larger peptidoglycan in cell wall in



CYANOBACTERIA

- Also known as blue-green algae, blue-green bacteria, and Cyanophyta
- Kind of bacteria that obtain their energy through photosynthesis. Contains *Chlorophyll a* similar to green plants and are **photosynthetic** autotrophs.
- Converted the early reducing atmosphere into an oxidizing one,
- Habitat : terrestrial and aquatic
- Forms blooms and blue–green paint or scum in water.
- Heterocysts : specialised cells to fix atmospheric nitrogen, which contain *niff gene* and produced enzyme Nitrogenase vital for nitrogen fixation.

Heterocysts are also formed under the anoxic environmental conditions when fixed nitrogen is scarce.

Economic Importance of Cyanobacteria

- 1. Anabaena : biofertilizer of rice fields, used in symbiotic association of the aquatic fern Azolla.
- 2. Anabeana and Aulosira : eradication of mosquitoe larvae from the ponds and lakes.
- Spirulina : richest source of protein, contains about 60% (51-71%) protein, it is a complete protein containing all essential amino acids. It is source of Vitamin B₁₂. It is also used as biofertilizer, harvested in the Sambhar Lake of Gujrat for the use as Green manure.
- 4. Trichodesmium : responsible for the red colour of the Red sea.

IMPORTANT POINTS

- In leather industry separation of hair and fat from leather is done by bacteria. This is called tanning of leather.
- Pickles, syrup is kept in salt or in dense liquid of sugar so that in case of bacterial attack bacteria are plasmolysed and destroyed. Therefore, pickles etc. do not get spoiled soon and can be preserved for long time.
- In the cold storage objects are kept at low temperature (-10 degree celsius to -18 degree celsius). It reduces the groth rate of bacteria as well as activity of respiratory enzymes.

BIOREMEDIATION

Bioremediation is a waste management technique that involves the use of organisms to remove or neutralize pollutants from a contaminated site.

Microorganisms used for Bioremediation

Microorganisms used to perform the function of bioremediation are known as **bioremediators.**

- (a) Deinococcus radiodurans digest toluene and ionic mercury from highly radioactive nuclear waste.
- (b) Photobacterium and Photophoraum: used to remove water toxicity
- (c) **Pseudomonas putida:** used to clear oil pollution and remove water toxicity.
- (d) Dechloromonas aromatica: capable of degrading perchlorate and aromatic compounds.
- (e) *Nitrosomonas, Nitrobacter, Paracoccus*: remove unwanted mineral nitrogen compounds (i.e. ammonia, nitrite, nitrate)
- (f) **Methylibium petroleiphilum**: capable of methyl tert-butyl ether (MTBE) bioremediation
- (g) Phanerochaete: bioremediation of: pesticides, polyaromatic hydrocarbons, PCBs, dioxins, dyes, TNT and other nitro explosives, cyanides, azide, carbon tetrachloride, and pentachlorophenol.

Landfarming

It is a bioremediation treatment process that is performed in the upper soil zone or in biotreatment cells. Contaminated soils, sediments, or sludges are incorporated into the soil surface and periodically turned over (tilled) to aerate the mixture.

Phytoremediation

It is bioremediation using plants. Phytoremediation consists of mitigating pollutant concentrations in contaminated soils, water, or air, with plants able to contain, degrade, or eliminate metals, pesticides, solvents, explosives, crude oil and its derivatives etc.

Plants used for Phytoremediation

- (a) **Sunflower:** Arsenic and radioactive Caesium-137 and strontium-90
- (b) Willow: Cadmium (Cd), Zinc (Zn), & Copper (Cu)
- (c) Alpine pennycress: Cadmium and zinc
- (d) Indian Mustard, Ragweed, Hemp: Lead
- (e) Barley : Sodium chloride

Rhizofiltration

It is a form of phytoremediation that involves filtering water through a mass of roots to remove toxic substances or excess nutrients. It is applicable to the treatment of surface water and groundwater, industrial and residential effluents, downwashes from power lines, storm waters, acid mine drainage, agricultural runoffs, diluted sludges, and radionuclidecontaminated solutions.

Groundwater remediation

It is the process that is used to treat polluted groundwater by removing the pollutants or converting them into harmless products.

Biological Methods used in Groundwater remediation

- (a) Bioaugmentation: it is inoculation of microorganism strains known to be capable of degrading the contaminants in ground water.
- (b) Bioventing: It is an in situ remediation technology that uses microorganisms to biodegrade organic constituents in the groundwater system.
- (c) Biosparging: It is the use of indigenous microorganisms to biodegrade organic constituents in the saturated zone, air (or oxygen) and nutrients (if needed) are injected.

(d) Bioslurping : it combines elements of bioventing and vacuum-enhanced pumping of free-product that is lighter than water (light non-aqueous phase liquid or LNAPL) to recover free-product from the groundwater and soil, and to bioremediate soils.

Bioleaching

It is the extraction of metals from their ores through the use of living organisms. Bioleaching is used to recover copper, zinc, lead, arsenic, antimony, nickel, molybdenum, gold, silver, and cobalt.

Microorganisms used for Bioleaching

- (a) Thiobacillus: Iron
- (b) **Aspergillus & Penicillium:** Cu, Sn, Al, Ni, Pb and Zn

KINGDOM PROTISTA

• They are eukaryotic, unicelluar organisms.

- **Nutrition :** photosynthetic, parasitic and saprotrophic.
- **Food Reserves :** starch glycogen, paramylon, chrysolaminarian and fat.
- **Reproduction :** asexual by binary fission, budding, sporulation, cyst formation and sexual by cell fusion and zygote formation.

IMPORTANT ORGANISM

- 1. Euglena : primarilly photosynthetic, in the absence of sunlight it behave like heterotrophs by predating on other smaller organisms so it is called as plant-animals.
- 2. Gonyaulax : forms Red Tides in oceans, secrete toxin saxitoxin which kill fishes, eating such fishes and crabs causes. paralytic shellfish poisoining (PSP).
- 3. Noctyluca and Gonyaulax : *Fire Algae,* show biolumine-scence.

Classification of Protista			
Nutrition	Type Note		
	Euglena	Plant Animals, found in stagnant water	
Photosynthetic	Diatoms or Golden Algae	Cell walls form two thin overlapping shells like a soap box. Walls are embedded with silica, are indestructible, forms diato - maceous earth / diatomite / kiesulguhr. Diatomite is used in polishing, filtration of oils and syrups.	
	Dinoflagellates or Golden–Brown Algae	They have two flagella so called as dinoflagellates. e.g. Noctyluca, Gonyaulax, Gymnodium	
Saprophytic	Slime Moulds	Fungi-animals, link between Protista and Fungus	
Heterotrophic or Parasitic Protozoa	Amoeboid Protozoans	They move and capture their prey by putting out pseudopodia (false feet). e.g. Entamoeba , Amoeba ,	
Zooflagelates		The parasitic forms cause diseases e.g. Trypanosoma, Leishmania, Giardia, Trychomonas	
	Cilliates	They are actively moving organisms because of the presence of thousands of cilia. e.g. Paramoecium	
Sporozoans Diverse organisms that have an infect stage in their life cycle.		Diverse organisms that have an infectious spore-like stage in their life cycle.	

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KINGDOM FUNGI

- Habitat : air, water, soil and on animals and plants. They prefer to grow in warm and humid places.
- Fungi are filamentous. Their bodies consist of long, slender thread-like structures called hyphae. The network of hyphae is known as mycelium. (Exception : Yeasts are unicellular)
- Some hyphae are continuous tubes filled with • multinucleated cytoplasm - these are called coenocytic hyphae. Others have septae or cross walls in their hyphae.
- The cell walls of fungi are composed of chitin and polysaccharides.
- Nutrition : Saprophytic, Parasites and Symbionts (Lichen and Mycorhizza)
- Reproduction : takes place by •
 - Vegetative means by fragmentation, (a) fission and budding.
 - (b) Asexual reproduction by spores called conidia or sporangiospores or zoospores.
 - (c) Sexual reproduction by oospores, ascospores and basidiospores. The various spores are produced in distinct structures called fruiting bodies.

IMPORTANT ORGANISMS

- 1. Rhizopus : Spoilage of food, fermentation of rice and soyabean to form sufru, synthesis of fumaric acid cortisone lactic acid alcohol and antibiotic ramysin
- 2. Mucour : Spoilage of food, fermentation of rice and soyabean to form sufru, synthesis of Citric acid and antibiotic ramysin, remove heavy metal contamination from water.
- 3. Neurospora crassa: Drosophilla of the plant, help to study genetics of plant
 - Aspergillus flavus : guiena pig of plant kingdom
- 5. Claviceps : produce lysergic acid which is used as hellucinogenic LSD
- 6. Sachharomyces cerevisiae : brewer yeast, baker yeast
- Aspergillus : alcohol fermentation, synthesis 7. of antibiotics aspergillic acid (flavicin) fumigallin, industrial synthesis of Citric acid, Oxalic acid and Gallic acid
- 8. Penicillium : synthesis of antibiotics Penicillin (wonder drug and first antibiotic) and griesofulvin, ripening of cheese

	Habitat and nutrition	Note
ycetes	Aquatic habitats Decaying wood in moist	Only asexual reproduction aplanospores (non-motile). e.g.
	and damp places	

Classification of fungus

Name / Type		nutrition	Note
Phyco-mycetes (Non-Septate Mycelium)	Oo-mycetes	Aquatic habitats Decaying wood in moist	Only asexual reproduction by zoospores (motile) or aplanospores (non-motile).e.g. Albugo and Phytopthora
	Zygo-mycetes (Conjugation fungi)	and damp places Obligate parasites on plants.	Only sexual reproduction by Zygospores. e.g. Mucor and Rhizopus
	Asco-mycetes (Sac fungi)	Decomposers Parasitic Coprophilous (growing on dung)	Sexual spores are ascospores ; fruiting bodies are ascocarps . e.g. Aspergillus, Claviceps and Neurospora
Eu-mycetes (Septate mycelium)	Basdio-mycetes (Club fungi) (mushrooms, bracket fungi or puffballs)	Soil, Logs and tree stumps Living plant bodies as parasites (rust and smuts)	Sexual spores are basidiospores ; fruiting bodies are basidiocarps . e.g. Agaricus, Ustilago and Puccinia
	Deutero-mycetes (fungi Imperfectii)	Saprophytes, Parasites Decomposers of litter Help in mineral cycling	Only the asexual or vegetative phases of these fungi are known. No proper classification is known. e.g. Alternaria , Colletotrichum and Trichoderma

- 9. Mushrooms
 - (a) **Agaricus :** White button mushroom, source of protein, antibiotic and anticancer propertiees
 - (b) **Lentinus :** Shiitake Mushroom, source of food and anticancer properties
 - (c) **Ganoderma : (wonder mushroom),** Anticancer, antioxidant and antibacterial property
 - (d) Amanita: (Toadstool) Poison mushroom
 - (e) Catharelleus : source of vitamin D
- 10. **Gibberella fujikori :** produce plant hormone Gibberlin.
- 11. **Trichoderma : Biocontrol agent** in Intregated Pest Management (IPM)

LICHENS

- It is symbiotic association of Algae and Fungi.
- The algal component is **phycobiont** which is autotrophic and fungal component as **mycobiont**, which is heterotrophic.
- Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for its partner.
- Different names are given to different lichens on basis of their habitats as
 - (a) Saxicolous : growing on rocks
 - (b) Lignocolous : growing on wood
 - (c) Terricolous : growing on soil
- 4. Lichens are very good indicators of Sulphur dioxide pollution in air.

5. **Usnea :** produce Usnic acid, which is highly inflammable and is also responsible for the **forest fires**.

KINGDOM PLANTAE

- All eukaryotic type of organisms which have chlorophyll and carotene as major pigment are called as Plants.
- They are considered as Thallophyta as their main body structure is thallus.

- These types of organisms are autotrophic being photosynthetic. Some plants are heterotrophic for example is the insect eating Pitcher plants.
- The cell wall is made up of Cellulose.
- The life cycle shows alternation of generations between Gametophyte (as to one which forms gametes) and Sporophyte (as to one which form

IMPORTANT ORGANISMS OF PLANTAE

Red Algae

- (a) **Corallina** : deposit calcium carbonate on its surface and is found with corals, so is **Coralline Algae**
- (b) **Rhodomela :** source of Industrial production of Bromine
- (c) Gelidium and Gracileria : used to make agar for biological research and Jellying agenls in food industries.
- (d) **Chondrus : Irish moss**, produce **Carrageenin** which is an emulsifier and cleaning agent

Brown Algae

- (a) **Saragassum:** Gulf Weed, is a large free floating alga of North Atlantic Ocean, which is called as saragasso sea.
- (b) *Macrocystis*: Trees of Sea/ Kelp. It is also a source of potassium.
- (c) Laminaria: source of iodine and Alginic acid. It is also used as a food article called as Kombu. It is richest source of potassium and is used as Natural Pottasium Fertilizer

Green Algae

- (a) **Chlamydomonas:** live in fresh water, rich in ammonia. Chloroplast found in it is **cup shaped**.
- (b) Ulothrix: live in fresh water. Collar shaped chloroplast is present.
- (c) Volvox: lives in fresh water, it lives in a colony form
- (d) Chlorella: aquatic, lives in diverse habitats rich in organic compounds. Bell shaped chloroplast is present. It is used as food source rich in protien, vitamin and minerals,

10

Classification of Plants

Name / Type		Habitat	Note :
Algae	Red Algae	Salt water, Brackish & Fresh water (some)	Presence of red pigment r-phycoerythrin e.g. Corallina ,Rhodomela, Gelidium, Gracileria
	Brown Algae	Salt water, Brackish & Fresh water (some)	e.g. Saragassum, Macrocystis and Laminaria
	Green Algae	Fresh water brackish water salt water	Contain Chlorophyll a, b, carotien and Xanthophyll e.g. Chlamydomonas, Ulothrix and Volvox
Bryophyte (amphibians of the plants) Live in soil but are	Liverworts	Moist, shady habitats, streams, marshy ground, damp soil, bark of trees and deep in the woods.	Eastern Himalayas are called as golden mine of liverworts e.g Riccia and Marchantia
dependent on water for sexual reproduction. Lack true roots, stem or leaves.	Mosses	Grow close together in clumps or mats in damp or shady locations.	They do not have flowers or seeds. Mosses form dense mats on the soil, they reduce the impact of falling rain and prevent soil erosion . e.g Funaria , Polytrichum and Sphagnum
Pteridophyte (Reptile or snakes	Ferns	Found in cool, damp, shady places though some may flourish well	In evolution trends they are the first terrestrial plants to possess vascular tissues – xylem and phloem. e.g. Psilotum, Selaginella, and Azolla
Gymnosperms (medium-sized trees or tall coniferous trees and shrubs.)	Conifers	In temperate coniferous forest at low and medium hills. In tropical evergreen forest.	They are flower less or fruit less plants. Seeds are formed but are uncovered. They have well developed vascular bundles. e.g.
Angiosperms (modern day flowering Plants)	Dicot (Two cotyledons in seeds)	Mostly terrestrial, rarely aquatic.	They are flowering as well as fruiting plants. seeds are born under covering of fruits. Fruits are produced as a
	Monocot (One cotyledons in seeds)		is characteristic feature of Angiosperms.
	,		e.g. Mangnifira and Azadirecta

is source of chlorellin antibiotic, and it is used in prolonged space flight for food, oxygen, disposal of $\rm CO_2$ and waste.

- (e) Spirogyra: lives in stagnant fresh water. Spirally coiled chloroplast is present. It is also called as pond silk/ water silk
- (f) Chlorella and Chlamydomonas : are used in sewage oxidation tanks.
- (g) **Colouring of Snow :** It is caused by excess growth of some cryophytic algae like

Chalamydomonas nivalis (red snow), **Chlamydomonas flavovirens** (yellow snow) and **Ancylonema** (purple- brown snow).

Bryophytes

(a) **Sphagnum or Bog Moss :** provide **Peat** which is used as fuel, and because of their capacity to hold water as packing material for transshipment of living material.

Pteridophytes

- (a) **Psilotum:** link between bryophyte and pteridophyte
- (b) Selaginella: Club moss/ spike moss, not a true moss.
- (c) Selaginella bryopteris: is the famous sanjeevini booti of Himalayas
- (d) **Azolla:** Water Fern, used as biofertilizer in rice field.

Gymnosperms

- (a) Pinus or Pine Palm : It shows a phenomenon yellow shower or sulphur shower or yellowish cloud. which is produced due to excessive dispersal of it's seeds in forest which are yellow in colour, edible and winged.
- (b) Cedrus: wood is fragnant, insect repellent, rot resistant, extremely stable and durable. Being oily it does not take polish. It is been used in electric pole, railway sleepers, packing cases, coffins, wagons, bridge construction. Perfumed oil is obtained from stem, leaves and even saw dust. Useful medicinally in curing skin diseases
- (c) Sequoia gigantean : it is the tallest and largest gymnosperm. also called as Red Wood Tree and father of forest.
- (d) **Ginko & Cycas** : are living link between Pteridophytes and Gymnosperms. They are called as **living fossils**.
- (e) Cycas : secrete sago so is sago palm. [Commercially actual sago is obtained from actual palm tree (Metrxylon rumphii) (Angiosperm).] Its seeds were also eaten in Gaum but they are toxic and cause disease similar to parkinson's disease.
- (f) **Ephedra :** an anti asthama drug **Ephidrine** is obtained from stem of it.
- (g) **Araucaria :** it is found in australia and south america. it is called as **monkey puzzel**.
- (h) Junipers : red cedar wood oil is extracted from heart wood of it.
- (i) **Abies : Canada balsum** is extracted from it which is used in making lenses

DIVERSITY OF HIGHER PLANTS

Flowering plants exhibit enormous variation in shape, size, structure, mode of nutrition, life span, habit and habitat. A typical angiosperm plant has long plant axis differentiated into underground root and above the ground shoot. Root for the extensive root system underground and shoot forms the stem, its branches, leaves, flowers and fruits.

Vegetative organs like root, stem, leaves takes part in nourishing and fixing the plant while reproductive organs like flower, fruits and seeds are require in multiplication.

Important Point

- Banyan Tree (*Ficus bengalensis*) is the Nation tree of India.
- Smallest angiosperm is Wolffia
- Tallest angiosperm is Eucalyptus
- Sequoia (Gymnosperm) is the second tallest tree.

Nutrition

Plants are autotrophic that is they produce their own food by the process of Photosynthesis. Some plants are heterotrophic that is they depend on others for food habits.

Habitat

Habitat is the natural home of an organism. Plant are broadly divided into aquatic and terrestrial

- 1. Aquatic plant
- (a) **Marine** Only two angiosperms are marine e.g., *Zostera and Thalassia*
- (b) Freshwater grow in pond, lake, river etc. e.g., Water lilly, *Hydrilla*

MANGROVES

- Mangroves are various kinds of trees up to medium height and shrubs that grow in saline coastal sediment habitats in the tropics and subtropics.
- The mangrove biome, or mangal, is saline woodland or shrubland characterized by a depositional coastal environments, where fine sediments (often with high organic content)

collect in areas protected from high-energy wave action.

- Mangrove swamps protect coastal areas from erosion, storm surge (especially during hurricanes), and tsunamis.
- The mangroves' massive root systems are efficient at dissipating wave energy. Likewise, they slow down tidal water enough that its sediment is deposited as the tide comes in, leaving all except fine particles. In this way, mangroves build their own environment.
- They are often the object of conservation programs, including national biodiversity action plans.
- The Sundarbans is the largest mangrove forest in the world, located in the Ganges river delta in Bangladesh and West Bengal, India.
- The Pichavaram Mangrove Forest near Chidambaram, South India, by the Bay of Bengal, is the world's second largest mangrove forest.
- Major mangals live on the Andaman and Nicobar Islands and the Gulf of Kutch in Gujarat, Bhitarkanika Mangroves, Godavari-Krishna mangroves and Maldives.
- There are mangroves in certain muddy swampy islands of the Maldives.

2. Terrestrial plants: They are of two type

- A. Mesophyte growing in moist habitats
- **B.** Xerophytes growing in dry habits. Xerophytes can be of following type
 - (a) **Pssamophytes** are those growing sand
 - (b) Lithophytes are those growing on rocks
 - (c) **Halophytes** are those growing in salt rich areas

EPIPHYTE

Epiphytes are the plants which grow on other trees/ plant for space and mechanical strength. They are called as **Space parasites**.

HETEROTROPHIC PLANTS

(a) Saprophytes obtain food from dead decaying matter. They are called as Humus plants. They are non green and have leaves in form of scales. eg Orchid, Bird nest orchid, Indian pipe (*Monotropa*).

(b) **Parasites** obtain nourishment by depending partially or wholly on host

e.g.,

- (i) Amarbel/Dodder (*Cascuta*) It is stem parasite of Kadam Tree.
- (ii) **Corpse flower (***Rafflesia***):** Total root parasite.
- (iii) **Sandal wood tree**: It is a partial root parasite.

(c) Carnivorous/Insectivores plants:

They are predator plants which are otherwise autotrophic. **They grow on soils deficient in Nitrogen,** this nitrogen deficiency is overcome by trapping and digesting small animals and insects.

e.g.,

- (i) **Pitcher plant (***Nepenthes***):** Leaf of this plant is modified into large pitcher.
- Sundew (Drosera): The upper surface of its leaves have Tentacles, the tentacle's head secrete sticky purple juicethat shines in the sun (hence Sundew).
- (iii) **Venus fly trap (***Dionea***):** The leaves of this plant have spines and digestive glands.
- (iv) Water flea trap (*Aldrovanda*): Rootless free floating aquatic plant.
- (v) Bladderwort (Utricularia) : It is rootless and aquatic. The dissected leaves are modified into a Bladder, which traps small animals.
- (d) Symbiosis amongst Plants
- Symbiotic nitrogen fixation occurs in plants that harbor nitrogen-fixing bacteria within their tissues. The best-studied example is the association between legumes and bacteria in the genus Rhizobium.
- 2. **Myrmecophily** symbiotic relationship between ant and higher plants.

MYCORRHIZA

• A mycorrhiza is a symbiotic association between a fungus and the roots of a vascular plant.

•	Plant provides the fungus with relatively
	constant and affect access to carbonyarates,
	such as glucose and sucrose.

• Fungus helps in uptake of phosphate ions in soils

with a basic pH. Fungi also have a protective role for plants rooted in soils with high metal concentrations, such as acidic and contaminated soils and also against soil pathogens.

OTHER IMPORTANT PLANTS		
Taxus	Used in making taxol used as anticancer drug	
Sarpagandha (<i>Rauwolfia)</i>	A compound which it contains called reserpine, is used to treat high blood pressure and mental disorders including schizophrenia. It has been used for millennia as an antidote against bites of venomous reptiles	
Safoo/jharka	Used in unani and homeopathy medicines	
Haldiya/pitrohini	Used in chineese medicine as anti microbial, also known as yunan gold thread	
Strychnine/STRYCHNOS	(NUX VOMICA/Poison Nut). It is a major source of the highly poisonous alkaloids strychnine and brucine. Strychnine is a deadly poison, lower concentration of it can be used in gastric and cardiac disoeders.	
Ashok, (Saraca asoca)	help in uterine disorder, Diabetesd	
Aswagandha (Withania)	help to reduce stress and nervous disorder.	

KINGDOM ANIMALAE

They are multicellular organisms without chlorophylly. They posses eukaryotic cells. Most animals have organ-system level of organismation. Lower forms have cellular or tissue level or organisation. Nutrition is primarily ingestive with digestion in an internal cavity but some forms have absorptive nutrition and lack an internal digestive cavity. Reproduction is generally sexual. Lower forms have asexual reproduction also.

Basis of Classification

- (a) Levels of Organisation : Cellular level, Tissue level, Organ level and Organ system level.
- (b) Body symmetry : Asymmetrical, Radial symmetry and Bilateral symmetry.
- (c) Developmental Layers of embryo: Diploblastic and Triploblastic.
- (d) Nature of Coelom : Coelomates, Pseudocoelomates and Acoelomates.
- (e) Patterns of digestive, circulatory or reproductive

systems. : Complete and Incomplete

- **Coelom**: It is internal or body cavity, present between endoderm and mesoderm. It is filled with a fluid and is lined by a layer derived from mesoderm. It is meant for increasing body size, providing space for storage, organ development, diffusion of materials and hydrostatic skeleton. on the basis of type or presence of coelom animals are of three types:
- (a) **Coelomates** Animals possessing coelom are called, e.g., annelids, molluscs, arthropods, echinoderms, hemichordates and chordates.
- (b) Pseudocoelomates the Coelom is not lined by mesoderm, instead, the mesoderm is present as scattered pouches in between the ectoderm and endoderm. Such a body cavity is called pseudocoelom e.g., Aschelminthes. (Roundworms)
- (c) Acoelomates The animals in which the body cavity is absent e.g., Platyhelminthes (Flatworms)



- Notochord : Notochord is a mesodermally derived rod-like structure formed on the dorsal side during embryonic development in some animals. Animals with notochord are called chordates and those animals which do not form this structure are called **non-chordates**, e.g., porifera to echinoderms. Muscles for body movement are attached to it. in vertebrates, notochord in replaced by cramium and vertebral column.
- Dorsal Hollow Nervous System : It is present mid-dorsally above the notochord. It may differentiate into brain and spainal cord. In nonchordates the central nervous system is generally ventral, solid and double.
- Pharyngeal Gill slits : They are paired perforations found on the lateral sides of pharynx. In lower chordates they take part in circulation of water for respiration. In higher chordates they occur only in the embryo stage. Gill slits are absent in nonchordates.

- **Tail :** Tail is metamerically segmented postanal part of the body meant for balancing. In nonchordates tail or pygidiu is terminal but nonsegmented.
- Vertebral Column : Notochord is replaced by vertebral column around the spinal cord and cranium around the brain. Thus all vertebrates are chordates but all chordates are not vertebrates.
- Amnion : is an embryonic membrane present in some Vertebrates. the vertebrates can be of two types

(a) **Amniota :** Vertebrates with aminion.e.g. reptiles, birds and mammals.

- (b) **Anamniota :** Vertebrates without amnion. e.g. fishes and amphibians.
- **Gnathostomata :** Animals with Jaws, Paired appendages, Paired nares, Internal ear, and an exoskeleton. e.g Fishes, Amphibians, Reptilses Birds and Mammals.



CLASSIFICATION OF ANIMALS

Invertebrates			Vertebrates		
Phylum	Note		Phylum	Note	
Sponges (Porifera)	Collar cells are the characteristics cells of sponges. e.g., Spongia (bath sponge)		Fishes (Pisces)	1.dermal scales 2.cold blooded 3. paired fins 4.muscular tail 5.Eyes without lids 6. Two chambered heart	
Coelenterata (Cnidarial) Ctenophora	Stinging cells or Cnidoblasts or cnidocytes are the characteristics cells of Coelenterata e.g Hydra (fresh water polyp)			Cartilaginous Fishes : 1. Endoskeleton is cartilaginous. 2. Mouth is ventral. 3. Ovovivipary generally occurs. e.g. Sharks, Torpedo (Electric Ray) Chimaera (Rabbit or Rat Fish)	
(Platyhelminthes)	Gland cells & Protonephridia are	ľ		Bony Fishes : 1. Endoskeleton is bony 2. Mouth is terminal. 3. Mostly oviparous. e.g. Catla Catla Singhi Bhetki Rohu	
(Aschelminthes)	used in excretion. e.g. Ascaris (intestinal roundworm)	1	Amphibians	1. Aquatic larval stage & terrectrial adult stage. 2. Cold blooded 3. Larva stage is	
Segmented Worms (Annelida)	Nephridia help in osmoregu–lation and excretion and are characteristics of annelida e.g. Pheretima (earth worm)			fish–like (tadpole) 4. Eye have eylids. 5. Three chambered Heart, Inter–mixing of blood 7. Gills in Larva and Lungs in adults. e.g. Froge, Toad,	
Insects (Arthropoda)	Body is segmented in to head, thorax and abdomen. Aappendages are jointed. Book gills and book lungs for respiration. Green glands and malpighian tubules for excretion. Largest no. of animals. e.g. Cockroach, Spiders etc.		Reptiles	1. Amniotic tetrapods with dry skin 2. Cold blooded 3. Two Pairs of limbs with five fingers 4. Four chambered heart, Inter –mixing of blood 5. Oviparous 6. Internal fertilisation and presence of foetal covering called amnion.e.g. Lizards, Chameleon, Snake, etc.	
Mollusca	Soft bodied animals. Second largest no. of animals e.g. Pila (Snail), Pearl oyster, Octopus		Birds	1. Warm blooded 2. Tetrapods in which the fore limbs are modified into wings 3. the body covered by feathers 4. the jaws are modified into horny beaks 5. Sweat glands	
Echinodermata	Spiny body animals. Due to an endoskeleton of calcareous ossicles. e.g. Asterias (Star fish)	ł		are absent 6. Bone is porous, Bone marrow is absent. 7. Four chambered heart, 8. Oviparous e.g. Ostrich, Kiwi, Penguin, Pigeon, Owl etc.	
Protochordata	They have Notochord, Dorsal Hollow Nervous System, Pharyngeal Gill Slits and Tail. But are marine non–vertebrate chordates. e.g. Herdmania (Sea potato)		Mammals	1. Warm blooded, 2. Females have mamary glands (modified sweat glands) for feeding the young ones 3. Heart is four chambered. it ensures biconcave and enucleate (oval and flat in camel and Liama) 4. Mammals are viviparous where the foetus is nourished by the mother through placentae	

Difference between Invertebrates and Veterbrates

	Invertebrates	V	/eterbrates
1.	No internal skeleton	1. T	hey have an internal skeleton
2.	backbone is not present	2. A	A backbone is present
3.	Tail is absent	3. T	ail is usually present
4.	Nerve cord is ventral and solid	4. N	Nerve (spinal) cord is dorsal, and hollow.
5.	They have 3 or more pairs of limbs, if present	5. T	hey have 2 pairs of limbs

IMPORTANT ORGANISMS OF ANIMALS

Sponges

- (a) Spongia: Bath sponge
- (b) Spongilla: Fresh water sponge

Coelenterata

- (a) Hydra: Fresh Water Polyp
- (b) Aurelia: Jelly Fish
- (c) Physalia: Portugese Man of War
- (d) Obelia: Sea Fur
- (e) Adamsia: Sea anemone
- (f) Pennatula : Sea Pen/Sea Feather
- (g) Gorgonia : Sea Fan

CORALS

- They are coelenterate animals, live in the : skeleton secreted by them. Coral may be single living/Solitory or in Colonies. The colonial coral grow continuously and form Coral Reefs in shallow warm water. Coral Reef: is a mound of limestone found in a sea habitats and formed chiefly by stony corals. Reefs are of three types. Fringing reef : formed near the shore. (a) (b) Barrier Reef : formed in the sea some distance from the shore. (C) Coral/legoon/Atolls Islands : a ring like ; reef occur around a lagoon. Lakshadives, Maldives and Fijji Islands are coral Islands. The Great Barrier Reef : is the world's largest reef system composed of over 2,900 individual reefs and 900 islands stretching for over 2,600 kilo metres (1,600 mi) over an area of approximately 344,400 square kilo metres (133,000 sq mi). The reef is located in the Coral Sea, off the coast of Queensland in north-east Australia. Examples :
- (a) Corallium Ruby/Moonga is most precious coral (b) Heliopora Blue coral

Flat Worm

- (a) **Taenia :** Causes **Taeniasis disease** in humans, it is found in Pork and Beef called as **pork tapeworm**
- (b) **Fasciola :** Liverfluke

Round Worm

- (a) **Ascaris : giant intestinal roundworm;** parasite of human intestine.
- (b) Wuchereria: causes Elephantiasis or Filaria; it is the parasite of lymph nodes and vessels of humans. It is spread by mosquito Culex.

Segmented Worm

- (a) Pheretima: Earthworm is also called as Nature's Ploughman as it burrows inside the soil so it enhances soil aeration.
- (b) Hirudinaria: Blood Leech

Arthopodes

- (a) Scorpion (Palamnaeus): last leg is modified to sting, show vivipary, dancing patterns occur for courtship
- (b) Spider (Araneus): The web of spiders is woven by Silk Glands. Web is knit to trap insects and other animal, they are paralysedby a poison Chelicerae.
- (c) Mosquito Aedes : Asian tiger mosquito, spreads Dengue fever Virus, Chikungunya fever Virus, Yellow fever virus, West Nile virus and St. Louis encephalitis. It has black and white striped legs, and small black and white striped body.
- (d) Mosquito Culex : Spreads Filaria
- (e) Mosquito Anopheles : Spreads Malaria.
- (f) Rat flea (Xenopsella) : It transmit Plague
- (g) Tse Tse Fly (Glossina): It transmit African Sleeping Sickness or Meningo encephalitis
- (h) Sand fly (Plebotomus) : It transmit kala azar or dum dum fever
- (i) Silk Moth (Bombyx Mori): Used in sericulture.
- (j) Lac insect (Kerria lacca) : Used in lac Production.

	> Arthopoda (Anima	Is with jointed legs)	
Class–I	Crustaceans	Marine and — fresh water	Cephalothorax Prawn, Crab and abdomen Arrow Arro
Class-II	→ Myriapedes →	 Terrestial, — air breathing 	 Head, trunk or —> Centipeeds Head, thorax and Millipedes and abdomen
Class-III -	→ Insects →	 Mostly — Terrestial, rarely aquatic 	 Head, thorax, abdomen and Wings Cockroach, Honeybee, Mosquito, Housefly Butterfly and Silkmoth
Class-IV		 Terrestial, — air breathing 	→ Cephalothorax → Scorpion, Spiders, Ticks, Mites and abdomen
Class-V	Onychophore	 Live in cervices — of rock, in moist places 	→ Worm like → Peripatus
HONEY BEE	(Apis) AND APICUL	TURE	Silk worms preferred food is White Mulberry due to its attraction to mulberry odorant cis- jasmine.
 It lives caefstes workers is the o continues Scout b same to for less longer d Apicultur for colle Honey is 25 % w (B1, B6, glucose (1.5%). Bees wa of the creams a Bee vend arthritis 	n nests called hives. - Queen (2-5yrs), Dro (10 weeks to more than hly fertile female of to lay eggs for 2 - ees search for food worker bees by dance than 75 m and tail w istances (Frisch). re is the rearing of be- ecting of honey and w near neutral sugary ater, 3.3% minerals, C, D) L-fructos (= (35%), sucrose (1.9) w is secreted by abde worker bees. It is u and oinments. om is used in treatmes	It has three main ones (57 days) and 10 months) Queen the colony which 5 years. and intimate the ces – round dance vagging dance for ees or bee keeping vax. syrup having 17 – abundant vitamins Lacvulose, 41 %), %) and dextrin ominal wax glands sed in cosmetics, ent of rheumatiod	 Life cycle of Silk moth and Stages of production The silk moth lays thousands of eggs. If left (1) If left (2) If left (2)
SERICULTUR			(a) Tasar silk: on leaves of Terminalia ; in India Japan and China
 Sericultu silkworms 	re, or silk farming , (Bombyx mori) for the	is the rearing of production of silk.	(b) Eri Silk: on castor oil plant, in India and China
China and	I India are the two main 60% of the world's	ain producers, with	(c) Muga silk: on Bamboo varities; in Assam, India
India is t world, it productio	he second largest silk r contribute to 18% of n.	nanufacturer in the the total raw silk	 (d) Coan silk: on leaves of pine, ash cypress, juniper and oak; in southern Italy, Greece, Romania, Turkey (a) Coan silk in 10 in 10 in
Silk prod	Silk production centers in India: Karnataka, Andhra		(e) Anaphe silk: in Africa
Pradesh,	Tamil Nadu, West Benga	al, Gujarat and J&K	region, China and Sudan

LAC PRODUCTION

- Lac is the scarlet resinous secretion of a number of species of lac insects (Kerria lacca).
- India is the largest producer of lac. The leading producer of Lac in India is Jharkhand, then West Bengal, and Maharashtra
- Bangladesh, Myanmar, Thailand, Laos, Vietnam, China, and Mexico are also the producers of Lac
- Step of lac production
- Cultivation begins when a farmer gets a stick (broodlac) that contains eggs ready to hatch and ties it to the tree to be infested.
- 2. Thousands of lac insects colonize the branches of the host trees and secrete the resinous pigment.
- 3. The coated branches of the host trees are cut and harvested as sticklac.
- The harvested sticklac is crushed and sieved to remove impurities.
- 5. The sieved material is then repeatedly washed to remove insect parts and other soluble material. The resulting product is known as seedlac.
- Seedlac which still contains 3-5% impurities is processed into shellac by heat treatment or solvent extraction.

Molluscs

- (a) **Pila :** Apple snail
- (b) Loligo: Squid /Sea arrow
- (c) Aplysia: Sea hare
- (d) Chiton: Sea mouse
- (e) Octopus: Devil Fish, two eyes and four pairs of arms, most intelligent of all invertebrates, can eject a thick blackish ink from ink sac present on their 8th leg to escape from predators. All octopuses are venomous, but only one group, the blue-ringed octopuses, is known to be deadly to humans.

(f) Pinctada: Pearl oyster

PEARL PRODUCTION

- Pearl is a hard object produced within the soft tissue
- Pearl is made up of calcium carbonate in minute crystalline form, Aragonite and Calcite deposited in concentric layers.
- Pearls are formed inside the shell of certain mollusks as a defense mechanism against a potentially threatening irritant such as a parasite inside its shell, or an attack from outside.
- Artificial Pearl Productions : Cultured pearls are the response of the shell to a tissue implant. A tiny piece of mantle tissue from a donor shell is transplanted into a recipient shell. This graft will form a pearl sac and the tissue will precipitate calcium carbonate into this pocket.

Echinodermata

- (a) Asterias: Star fish
- (b) Echnius: Sea Urchin
- (c) Cucumeria: Sea cucumber
- (d) Antedon: Sea Lilly

Fishes

(a) Sharks:

- (i) **Dog Fish (Scoliodon):** called as dog fish because of its shape of mouth.
- (ii) **Cracharodon:** great white shark, man eating shark found in Hoogly river, Kolkata
- (iii) **Rhincodon:** Whale shark
- (b) Electric Ray (Torpedo) : has electric organs for stunning the prey
- (c) Sting Ray(Trygon) : has Stinger in its tail for stunning the prey
- (d) Flying Fish (Exocoetus): It can leap into air by powerful tail and remain air borne for long distances.
- (e) Sea Horse (Hippocampus)
- (f) **Rohu (Labeo):** common fresh water edible carps.
- (h) Cat Fish or Magur (Clarius)

 (i) Climbing perch (Anabes) : can come out of water and creep on land, here it is picked by birds and taken to their nest hence it is believed to climb nests

Mosquito fish (Gambusia)

The fish feeds on mosquito larvae (larvaevorous) and is, therefore, used as larvicidal in biological control of mosquito.

Amphibians

- (a) Common Indian toad (Rana tigrina)
- (b) Toad (Bufo)
- (c) Flying frog (Rhacoporous)
- (d) Giant Salamander of China, (Andrias): Largest Amphibian.

Reptiles

- (a) Flying lizard (Draco)
- (b) Garden lizard (Calotes)
- (c) Girgit (Chameleon): have long tongue having a sticky tip on the end, can change their skin colour, ovoviviparous, hear vibrations in the air, can rotate and focus their eyes separately to observe two different objects simultaneously.
- (d) Glass snake or limbless lizard (Ophisaurus)
- (e) Snakes
 - (i) King Cobra : Snake which build nest, only snake in the world that can spit their venom, not blind, in fact they see very well even at night
 - (ii) **Python/ajgar/anaconda:** it is non poisonous snake
 - (iii) Krait and Viper : highly poisonous snake
 - (iv) Sea snake (Hydrophis) : it is ovoviviparous
- (f) **Tua tara (Sphenodon) : living fossil**, has median **Third Eye** on its forehead.
- (g) Turtle or Tortoise
- (h) Muggar or Crocodile (Crocodilus)
- (i) Gharial (Gavialis)
- (j) Alligator
- (k) King of dinosaurs: Tyranosaurus

Birds

- (a) Archeopterix : extinct primitive bird that existed 150 million years ago.Link between reptiles and birds
- (b) **Ostrich(Struthio):** largest living bird. It is flightless.
- (c) **Kiwi (Apteryx):** flightless national bird of Newzealand
- (d) Penguin (Aptenodytes): flightless bird of Antartic region. Emperor penguin Deepest Diver Bird., Gentoo Penguin Fastest swimming Bird.
- (e) House Sparrow (Passer): now endangered in India
- (f) **Crow (Corvus):** does not occur in Chitrakoot (U.P) and Kodai kanal (T.N).
- (g) Vulture (Sargogyps): now endangered in India due to over use of drug chemical Diclofenac
- (h) Peacock (Pavo): national bird of India
- (i) Great Indian Bustard (Choriotis nigriceps): now endangered in India
- (j) Crane or Saurus (Crus) : tallest bird of India
- (k) Hooded Pitohui (Pitohui): Poisonous Bird, found in papau New Guinea, possesses toxins in its skin and feathers.
- Bald Eagle(Heliaectus): Largest bird nest, Population was adversly effected by DDT, now restored after the ban on DDT,

Mammals

- (a) Platypus : It is the only oviparous mammal. It is the only poisonous mammal.
- (b) **Kangaroo** (*Macropus*) : is a marsupial animal, that is have pouches to carry young ones
- (c) Bat (Flitter) : Flying mammals
- (d) *Flying fox (Pteropus) :* is a frugvivores (eating fruits) Bat.It is one of the well known reservoir of virus Ebola.
- (e) **Rabbit (oryctolagus)** it is crepuscular (moveout in twilight) and fossorial (live in burrows)
- (f) Whale (balanoptera) it is the largest mammal

- (g) **Dolphin (Platinista): It is the National aquatic animal of India.** In India River Dolphin is found in Ganges and Brahmaputra
- (h) Indian Porpoise (Delphinus) : It is found in Bay of Bengal
- (i) **Dugong (Gentle Sea Cow):** It is medium sized marine mammal. It is found along the western coastal borders in India.
- (j) Lion (Panthera leo): In India, it is found only in (Gir National Forest) Gujarat
- (k) Tiger (Panthera tigris): It is the National Mammal of India
- (I) Panther Tendua (Panthera padrus)
- (m) Cat/ Felis domestica

- (n) **Dog/Canis familiaris**
- (o) Horse/Equus caballus
- (p) Ass/Equus assinus
- (q) Rhino/Rhinoceros indicus
- (r) Cow/ Bos indicus
- (s) Buffalo/Bos bubalus
- (t) Camel/Camelus dromaderius
- (u) Rhesus Monkey /Macaca mulatta
- (v) Langur/Presbytis entellus
- (w) Gibbon/Hyalobates
- (x) Gorilla/Gorilla gorilla
- (y) Chimpanzee/Anthropithecus satyrus
- (z) Humans/Homo sapiens