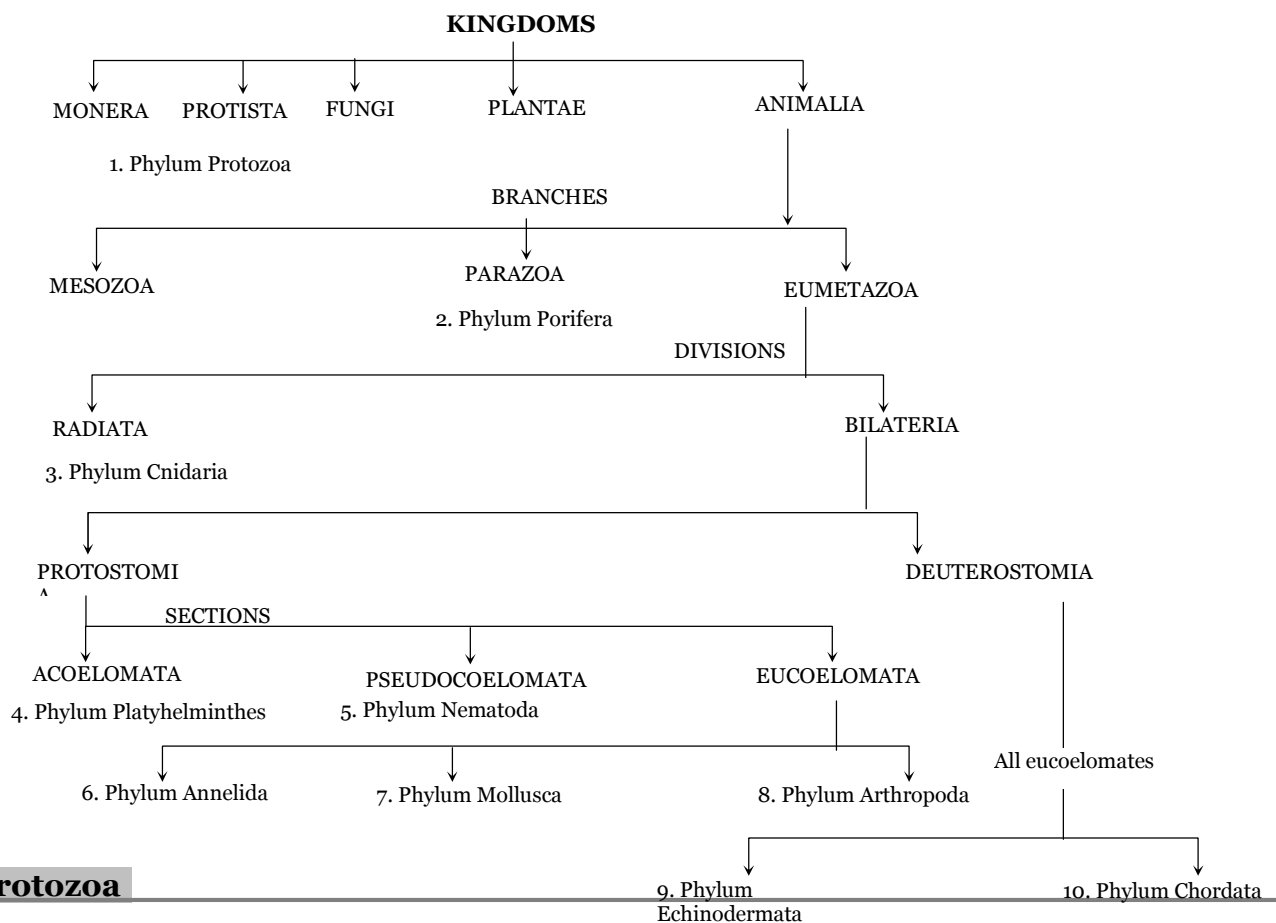


Classification

Introduction

Classification is the scientific ordering of organism (bacteria, protists, fungi, plants and animals) in a hierarchical series of groups on the basis of their relationships morphological evolutionary and others. Taxonomy is a series of classification includes classification and nomenclature. Term taxonomy was first proposed by deCandolle in 1813. Systematics is the scientific study of diversity of organisms. The term systematics was discovered by Carolus Linnaeus in 1735. Aristotle (384-322 B.C.) : known as 'Father of Zoology' was the first to classify the animals.



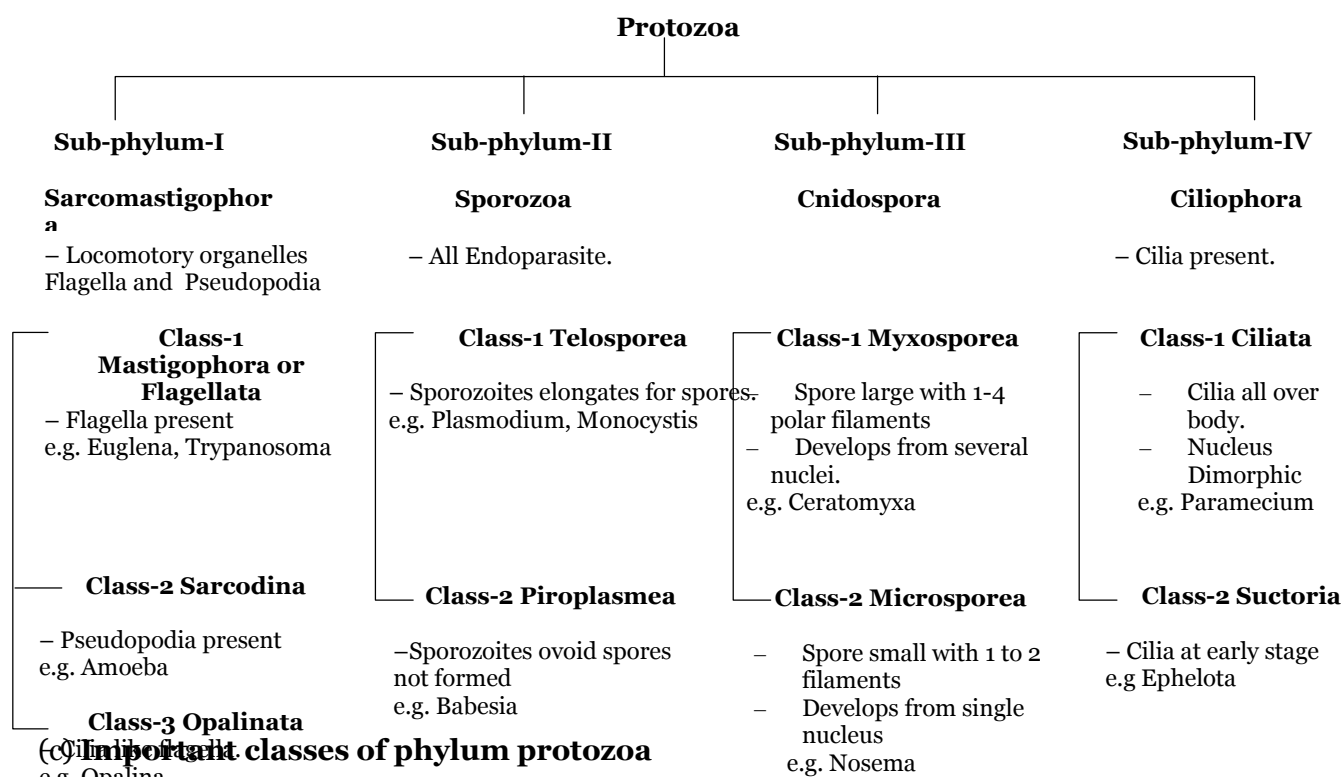
15.1 Protozoa

(i) **Phylum Protozoa** : All protists are included in this single phylum. Formerly, this group was classified as a Subkingdom of Kingdom Animalia. The whole body of a protozoan is a single eukaryotic cell which leads its own independent existence in nature. Examples-*Amoeba*, *Euglena*, *Plasmodium*, *Paramecium*, etc. Goldfuss (1817) coined the term Protozoa. Number of species is about 50,000. According to five kingdom classification whittaker (1969) protozoa are separated from animals and included in the kingdom Protista (unicellular eukaryotic organisms).

(a) **Characteristics**

- (1) Exhibit 'protoplasmic level of organisation'.
- (2) Body symmetrical or asymmetrical, free living or parasitic.
- (3) Mostly solitary, some colonial.
- (4) Nuclei is varies from one to several.
- (5) Nutrition is holozoic, holophytic, saprozoic and saprophytic.
- (6) Respiration is by diffusion through body surface.
- (7) Excretion is by diffusion through body surface Ammonotelic.
- (8) Osmoregulation is by contractile vacuole in fresh water forms.
- (9) Reproduction is asexual by binary fission, multiple fission or speculation budding.
- (10) Sexual reproduction by conjugation.

(b) **Classification of protozoa** : On the basis of locomotory organelle.



(c) **Important classes of phylum protozoa**

Class I Rhizopoda or Sarcodina : Locomotion by pseudopodia, body shape changeable. *e.g.*, *Amoeba* (free living). *Entamoeba* (Parasitic or commensal) Four types of pseudopodia are : Lobopodia (*Amoeba*) Filopodia (*Euglypha*) Reticulopodia (*Globigerina*) Axopodia (*Actinophrys*)

Classification

Class II Mastigophora or Flagellata : Locomotion by one or more thread-like flagella.

Examples

- (1) *Euglena* : connecting link between plants and animals.
- (2) *Trypanosoma* : Parasitic, causing sleeping sickness
- (3) *Leishmania* : Parasitic, causing kala-azar
- (4) *Giardia* : Parasitic causing diarrhoea
- (5) *Trichomonas*: Parasitic causing vaginitis in human female.
- (6) *Trichonympha* : Symbiotic found in gut of termite helping in cellulose digestion
- (7) *Noctiluca* : Free-living marine, luminiscent.
- (8) *Proterospongia* : Colonial with collar cells, a connecting link between Protozoa and Porifera.

Class III Sporozoa : All parasites, no special locomotory organelles, no contractile vacuole (associated with parasitism) complex life history.

Examples

- (1) *Plasmodium* : Causing malaria spread by female *Anopheles*.
- (2) *Monocystis* : Parasite in the seminal vesicle of earthworm.
- (3) *Eimeria* : Causing coccidiosis in rabbit and chicken.
- (4) *Babesia* : Causing haemoglobinuric fever in cattle.

Class IV Ciliata : Locomotory organelles are cilia, nuclei two or more.

Examples

- (1) *Paramoecium* : Free-living, slipper animalcule.
- (2) *Balantidium* : Causing balantidial dysentery in man.
- (3) *Opalina* : Rectal ciliate and endocommensal in frog.
- (4) *Nyctotheras* : Rectal ciliate and endocommensal in frog.

15.2 Porifera

(ii) **Phylum Porifera :** Porifera (Lat. Porus = pore, fere = to bear). The number of species is about 10,000. Study of sponges is called Parazology. Name of Porifera was coined by Robert Grant (1825)

(a) **Characters**

- (1) Exhibit cellular level of organisation
- (2) Multicellular grade organisms.
- (3) Solitary or colonial.
- (4) Adult are sessile.
- (5) Body wall is diploblastic i.e. outer pinacoderm (ectoderm) and inner choanoderm (endoderm) with gelatinous non-cellular mesenchyme in between.
- (6) Body cavity is spongocoel or paragastric cavity lined by choanocytes.
- (7) Characteristic cells are choanocytes or collar cells (only in sponges).
- (8) Sponges have numerous mouthlets (ostia) and one exit (osculum).
- (9) Canal system present, may be Asconoid, Syconoid or Leuconoid type.

(10) Sponges usually have a skeleton consisting of spicules or Spongin fibres.

(11) Spicules may be Calcareous or Silicious.

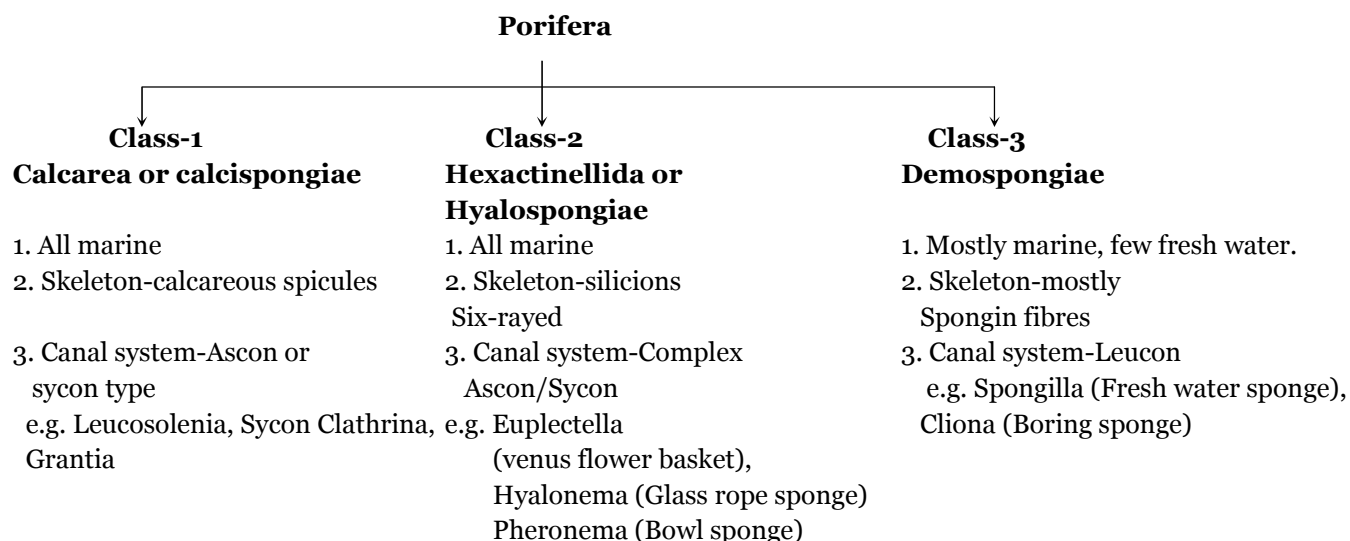
(12) Digestion is intracellular.

(13) Respiration through general body surface.

(14) Reproduction is asexual by budding or gemmule formation sexual by fusion of sperms and ovum arise from Archaeocytes.

(15) Larval form are amphiblastula or parenchymula.

(b) **Classification** : On the basis of skeleton divided into 3 classes



Zoological name	Common name
Scypha	Urn sponge, Crown sponge
Euplectella	Venus' flower-basket
Pheronema	Bowl sponge
Hyalonema	Glass-rope sponge
Cliona	Boring sponge
Chalina	Mermaids gloves (Dead man's fingers)
Spongilla	Fresh water sponge
Euspongia	Bath sponge
Poterion	Neptune's globlet
Hippospongia	Horse sponge
Hircinia	Horny sponge.

15.3 Coelenterata

(i) **Phylum Cnidaria or Coelenterata** : (Gr. Kinde, nettle or stringing cell). The number of species is 10,000. Leuckart (1847) coined the name 'Coelenterata'. Hatschek (1888) called them cnidaria.

(a) Characters

(1) Aquatic or mostly marine.

(2) Radially symmetrical.

(3) Cell-tissue grade of body organisation.

Classification

- (4) Diploblastic with two germ layers are ectoderm and endoderm. In between is gelatinous, non-cellular mesoglea.
- (5) Solitary or colonial, sedentary or free swimming.
- (6) Exhibit dimorphism with polypoid and medusoid stage.
- (7) Some members like Physalia shows polymorphism.
- (8) Anterior end of the body with hypostome on which mouth is located, surrounded by tentacles.
- (9) Blind sac-body plan.
- (10) Characteristic feature is the presence of **nematocyst** or stinging cells.
- (11) Digestion is both extracellular and intracellular.
- (12) Respiration through general body surface.
- (13) Excretion through general body surface.
- (14) Nervous System is primitive type.
- (15) Sense Organs are statocysts (tentaculocysts), Ocelli and Olfactory pits.
- (16) Reproduction are both asexual (by budding) and sexual by fusion of the male and female gametes.
- (17) Larval Stage are Planula (Obelia), Ephyra (Aurelia)

(b) **Unique Features** : The cnidarians have the following unique features

- (1) Tissue level of organisation of the body.
- (2) Special stinging cells, the cnidoblasts, ' for defence and offence.
- (3) Epitheliomuscular cells with a dual role of epithelium and musculature.
- (4) Incomplete digestive tract bounded by body wall.
- (5) A simple nervous system in the form; of a network of nerve cells and fibres in periphery
- (6) Simple. gonads without gonoducts.

(c) **Advancement** : The cnidarians show advancement over sponges in having –

- (1) Tissue level of organisation of the body with well defined layers of cells,
- (2) Digestive cavity,
- (3) Nervous system and sense organs

(d) **Classification** : On the basis of polypoid and medusoid stages. The phylum Cnidaria is divided into three classes: Hydrozoa, Scyphozoa and Anthozoa or Actinozoa.

Coelentrata

Class Hydrozoa	Class Scyphozoa	Class Anthozoa or Actinozoa
<ol style="list-style-type: none"> 1. Mostly marine, some fresh water. 2. Usually have both polyp & medusa forms 3. Medusa with velum (craspedote) 4. Mesoglea thin 5. Gastrovascular cavity not divided into compartment by mesenteries. <p>e.g. Hydra, Obelia, Bougainvillea (a plant also with same name)</p>	<ol style="list-style-type: none"> 1. All marine. 2. Medusoid phase dominant Polypoid phase-absent. 3. Medusa without velum (acraspedote) 4. Mesoglea-thick 5. Gastrovascular cavity absent (No polyp) <p>e.g. Aurelia (Jelly fish)</p>	<ol style="list-style-type: none"> 1. All marine. 2. All polyps, no medusae 3. Gastrovascular cavity divided into compartments of mesenteries.

Physalia, porpita	velella and	Rhizostoma	e.g. Metridium, Alcyonium, Gorgonia, Tubipora.
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Zoological name	Common name
Obelia	Sea fur
Millipora	Stinging coral
Physalia	Portuguese man-of-war
Velella	Little sail
Chiropsalmus	Sea wasp
Aurelia	Jelly fish
Metridium	Sea anemone
Adamsia	Sea anemone
Pennatula	Sea pen
Corallium	Precious red coral
Meandrina	Brain coral
Tubipora	Organ pipe coral
Heliopora	Blue coral
Astraea	Stony coral
Virgularia	Walking stick
Fungia	Mushroom coral
Alcyonium	Dead man's finger

15.4 Platyhelminthes

(i) **Phylum Platyhelminthes** : (Platy = flat, helmins = worms). The number of species about 13,000. Gagenbaur (1859) suggested the name platyhelminthes.

(a) Characters

- (1) Triploblastic, bilaterally, symmetrical, acoelomate, dorso-ventrally, flattened worms.
- (2) Mostly parasite, few free living.
- (3) Exhibit tissue- organ system level of organisation.
- (4) Body unsegmented (Planaria, Fasciola) or segmented (Taenia).
- (5) Cephalization appears first time.
- (6) Alimentary canal is incomplete or absent (Blind sac body plan).
- (7) Excretion through protonephridia or solenocyte or flame cells.
- (8) Respiration is anaerobic in internal parasite.
- (9) Nervous system are consists of ganglia and nerve cords.
- (10) Monoecious or hermaphrodite with well developed reproductive system.
- (11) Life cycle complicated with many larval stages.

(b) **Classification** : Divided into three classes based on mode of life, presence or absence of digestive tract and cilia on the body.

Platyhelminthes		
Class-1 Turbellaria	Class-2 Trematoda	Class-3 Cestoda
1. Mostly free living	1. Commonly called 'flukes'	1. Commonly called 'tapeworm'
2. Majority aquatic	2. Ecto- or endoparasite	2. Body-segmented
3. Cilia on body wall	3. Body without cilia	(Pseudometamerism)
4. Rhabdites (hyaline rod like structure) in	4. Body unsegmented	3. Digestive system absent
	5. Sucker-present	4. Life cycle complicated.

Classification

epidermis 5. Body unsegmented 6. Suckers-absent usually 7. Development – direct 8. Regeneration-Common feature e.g. Planaria (Dugesia)	6. Mostly-monoecious 7. Life cycle complicated with many larvae e.g. Fasciola, Schistosoma	e.g. Taenia, Echinococcus.
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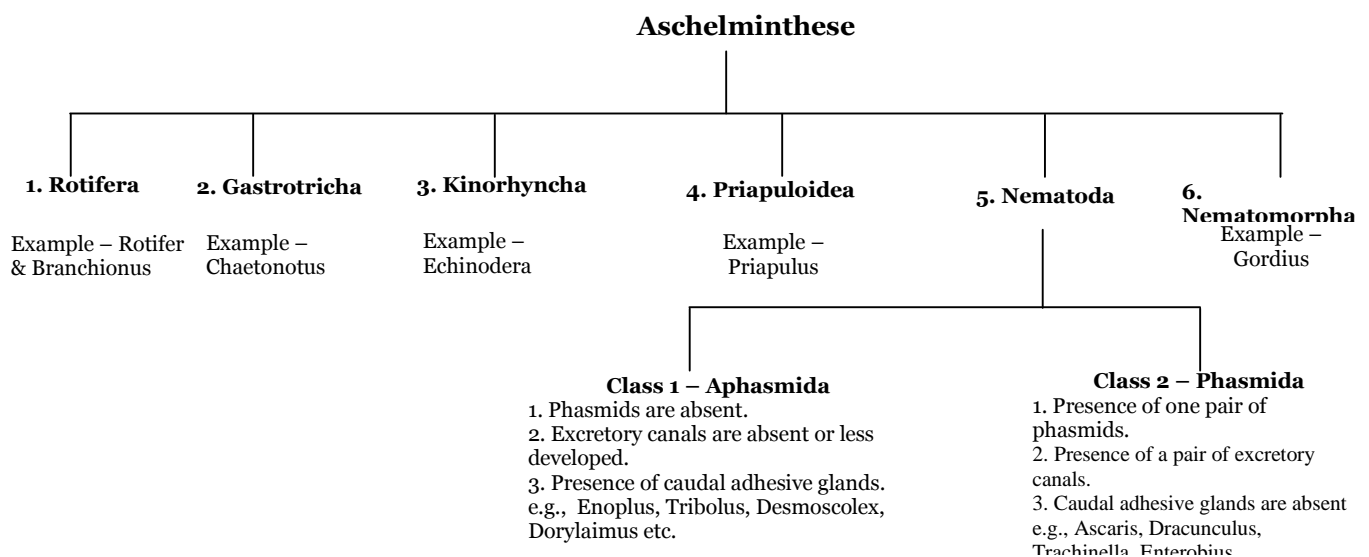
Zoological name	Common name
Fasciola hepatica	Sheep liver fluke
Fasciola gigantica	Cattle liver fluke
Schistosoma mansoni	Human blood fluke
Fasciolopsis buski	Intestinal fluke
Paragonimus westermani	Lung fluke
Taenia solium	Pork tapeworm
Taenia saginata	Beef tapeworm
Echinococcus granulosus	Dog tapeworm (Hydatid worm)

15.5 Nematelminthes

(i) **Phylum Nematelminthes (Aschelminthes)** : The number of species 15,000. The phylum name 'Aschelminthes' was proposed by Grobben (1910). Gagenbaur (1859) included these animals under the Phylum-Nematelminthes.

(a) Characters:

- (1) Triploblastic, bilaterally symmetrical, pseudocoelomate and unsegmented.
- (2) Organ-system grade.
- (3) Tube within a tube body plan but don't have true coelom
- (4) Syncytial epidermis.
- (5) Alimentary canal-complete.
- (6) Respiratory and circulatory system absent.
- (7) Excretion by Protonephridia and canals.
- (8) Nervous system consists of ganglia and nerve cords.
- (9) Usually unisexual with sexual dimorphism.



Zoological name	Common name
Ascaris	Common roundworm
Ancylostoma	Hookworm
Wuchereria	Filarial worm
Enterobius (Oxyuris)	Pinworm
Trichuris	Whipworm
Dracunculus	Guinea worm
Loa loa	Eye worm
Strongyloides	Thread worm

Disease causing roundworms of man

No.	Name	Size		Habitat	Infection	Effect	Distribution
		Female	Male				
(1)	The Giant Intestinal Roundworm (<i>Ascaris lumbricoides</i>)	20-40 cm	15-30 cm	Small Intestine	By taking eggs with food	Anaemia, diarrhoea, bronchitis, pneumonia.	Worldwide
(2)	The Hookworm (<i>Ancylostoma duodenale</i>)	12 mm	9 mm	Intestine	Larvae bore through the skin of feet	Itching and inflammation of skin, anaemia, mental and physical disorder	Europe, North Africa, Asia
(3)	The Trichina Worm (<i>Trichinella spiralis</i>)	3 mm	1.5 mm	Encysted larvae in striated muscles, adults in intestine.	By eating half cooked infected pork.	Muscular pain, pneumonia.	Europe, U.S.A.
(4)	The Filarial Worm (<i>Wuchereria bancrofti</i>)	80 mm	40 mm	Lymph Vessels.	Injected by mosquitoes. (<i>Culex</i>)	Elephantiasis or filariasis	India, Arabia, Africa, China, Japan, Malaya.
(5)	The Guinea Worm (<i>Dracunculus medinensis</i>) (Fiery serpent)	100-400 mm	40 mm	Subcutaneous tissue of limbs and shoulders	By taking infected <i>Cyclops</i> with water.	Ulcers, diarrhoea, asthma, giddiness.	India, Arabia, Africa, East Indies.
(6)	The Pin Worm (<i>Enterobius vermicularis</i>)	9-13 mm	3.5 mm	Large intestine, caecum, and appendix.	By swallowing eggs with food.	Anal itching, appendicitis, nervous trouble	Worldwide
(7)	The Whip Worm (<i>Trichuris trichiura</i>)	30-50 mm	A little smaller than female	Caecum and appendix.	By taking eggs with food.	Abdominal pain, anaemia, bloody stools.	Worldwide

15.6 Annelida

(i) **Phylum Annelida** : (L. Annulus = little ring). The number of species is 10,000. Lamarck (1801) established the phylum Annelida.

(a) **Characters:**

Classification

- (1) Bilateral, Eucoelomate (Schizocoelic)
- (2) Bodyworm like – Metamerically segmented.
- (3) Locomotion by parapodia, setal.
- (4) Alimentary canal-complete.
- (5) Excretion by Nephridia.
- (6) Tube within a tube body plan.
- (7) Unisexual or Bisexual (Hermaphrodite)
- (8) Development – direct or through Trochophore larva.

Unique features of annelids	Advancement over roundworms
<ol style="list-style-type: none"> 1. Metameric segmentation 2. Nephridia for excretion and osmoregulation. 3. Closed circulatory system with respiratory pigment dissolved in the plasma. 4. Setae in the body wall in most forms 	<ol style="list-style-type: none"> 1. Metameric segmentation, 2. Head, appendages and respiratory organs (gills) in some cases, 3. True coelom, 4. Circulatory system often with red blood, 5. Circular and longitudinal muscles in both body wall and gut wall.

(b) **Classification** : On the basis of parapodia and setae.

Annelida

Class-1 Archiannelida	Class-2 Polychaeta	Class-3 Oligochaeta	Class-4 Hirudinea
<ol style="list-style-type: none"> 1. All marine 2. Segmentation mainly internal. 3. No parapodia & setae. 4. Trochophore larva present. 	<ol style="list-style-type: none"> 1. Allmost all marine. 2. Body segments bear cirri. 3. Parapodia with numerous setae-present. 4. Sexes-separate 5. Trochophore larva present e.g. Nereis, Aphrodite, Arenicola, Polynoe 	<ol style="list-style-type: none"> 1. Commonly called 'Earthworm'. 2. Parapodia absent Setae present. 3. Hermaphrodites. 4. Cocoon formation from clitellum. e.g. Pheretima, Lumbricus 	<ol style="list-style-type: none"> 1. Ectoparasite. 2. Body segments fixed (33) 3. Sanguivorous. 4. Coelom-reduced by botryoidal tissue. e.g. Hirudo, Hirudinerea

Zoological name	Common name	Zoological name	Common name
Nereis	Ragworm, Clam worm	Sabella	Peacock-worm
Aphrodite	Sea mouse	Serpula	Fan-worm
Polynoe	Scale worm	Pheretima	Earthworm
Chaetopterus	Paddle worm	Pontobdella	Skate-sucker
Arenicola	Lugworm	Hirudo	Medicinal leech
Glycera	Smooth blood worm	Hirudineria	Cattle leech
Eunice	Palolo-worm	Sipunculus	Pea-nut worm

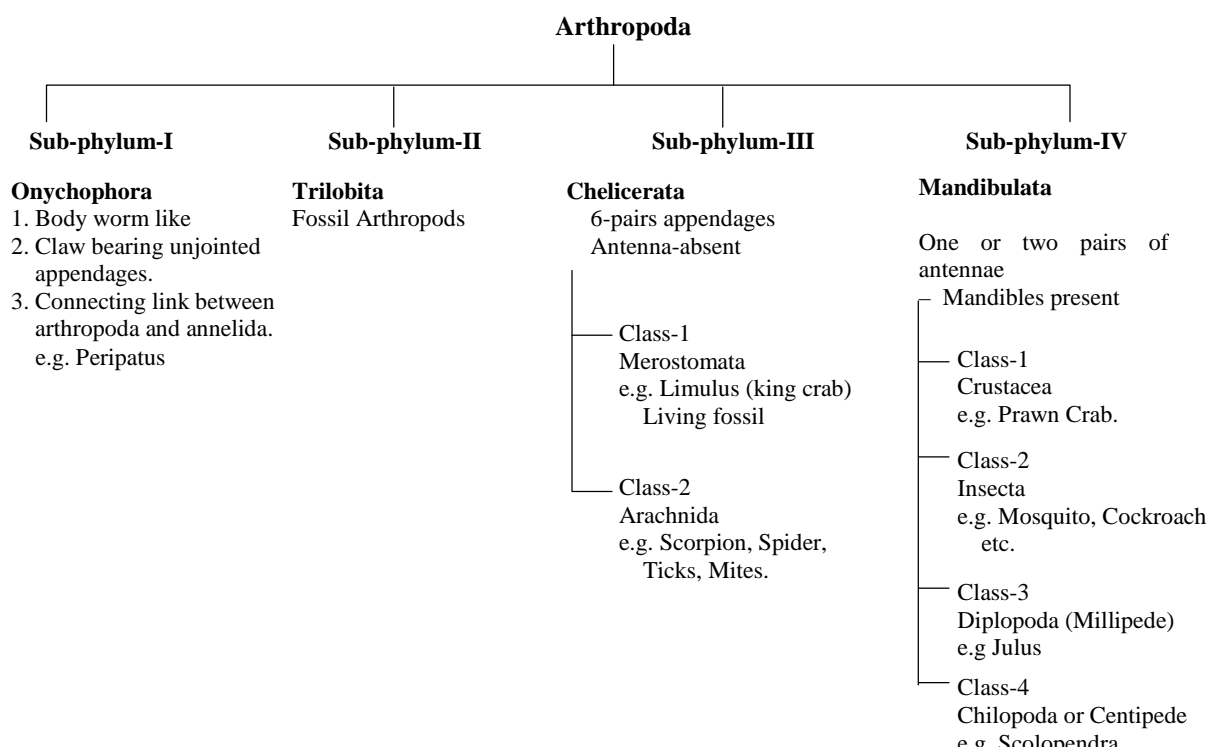
15.7 Arthropoda

(i) **Phylum Arthropoda** : (gr. Arthros-Jointed podos-leg). The number of species about 9,00,000. Von Seibold (1845) established this phylum.

(a) Characters

- (1) Bilaterally symmetrical, triploblastic and metamerically segment. (external segmentation only.)
- (2) Organ-system level of body organisation.

- (3) Body is divisible into head, thorax and abdomen.
 - (4) Body cavity-Haemocoel.
 - (5) Circulatory system-open type.
 - (6) Respiration by general body surface, gills, tracheae or book lungs.
 - (7) Excretion by Malpighian tubules and green glands.
 - (8) Sexes-separate.
 - (9) Majority-oviparous few like scorpions are vivi parous.
 - (10) Development direct or indirect.
 - (11) Exoskeleton-cuticles of chitin shows moulting or ecdysis during development.
- (b) **Unique features** : The arthropods have the following unique features
- (1) Jointed appendages modified for a variety
 - (2) Tough, jointed exoskeleton of chitinous plates.
 - (3) Tracheae for respiration in majority of a cases.
 - (4) Compound eyes in most forms.
 - (5) Malpighian tubules for excretion in majority of cases.
 - (6) Power of flight in most insects.
 - (7) Many releases pheromones into the environment.
- (c) **Advancement over annelids** : The arthropods show advancement over annelids in having
- (1) Distinct head in all species,
 - (2) Jointed appendage serving a variety of functions,
 - (3) Jointed exoskeleton for protection muscle attachment.
 - (4) Striped muscles arranged in bundles for moving particular
 - (5) Special respiratory organs, such as gills, tracheae, book-lungs, in majority of cases.
 - (6) Well developed sense organs, such as compound eyes, statocysts, auditory organs, taste receptors, etc.,
 - (7) Endocrine glands and pheromone secretion for communication.



Arthropoda

	Classes	Body Divisions	Antennae	Mouth Parts	Legs	Respiration	Excretion	Development
(1)	Crustacea (~25,000 species)	2, Cephalothorax, abdomen	2 Pairs	Chewing	1 Pair per segment or less	Body surface or gills	Green glands	Usually with larvae
(2)	Chilopoda (~2,000 species)	3, Head, thorax, abdomen	1 Pair	Chewing	1 Pair per segment	Tracheae	Malpighian tubules	Direct
(3)	Diplopoda (~7,000 species)	3, Head, thorax, abdomen	1 Pair	Chewing	1 or 2 Pairs per segment	Tracheae	Malpighian tubules	Direct
(4)	Insecta (~7,00,000 species)	3, Head, thorax, abdomen	1 Pair	Various Types	3 Pairs on thorax	Tracheae	Malpighian tubules	Usually with larvae
(5)	Arachnida (~57,000 species)	2, Cephalothorax, abdomen	None	Sucking	4 Pairs on cephalothorax	Book lungs or Tracheae	Coxal glands, or Malpighian tubules or both	Direct or with larvae
(6)	Merostomata (4 species)	2, Cephalothorax, abdomen	None		5 Pairs on cephalothorax	Book-gills	Coxal glands	With larvae

Arthropoda

S. No.	Orders	Examples
(1)	Thysanura	<i>Lepisma</i> – The Silverfish
(2)	Orthoptera	<i>Poecilocus</i> – The Grasshopper, <i>Schistocerca</i> – The Locust, <i>Achaeta</i> – The House Cricket.
(3)	Dictyoptera	<i>Periplaneta</i> - The Cockroach, Mantis - The Preying Mantis.
(4)	Phasmida	<i>Carausius</i> -The Stick Insect, <i>Phyllium</i> -The Leaf Insect
(5)	Isoptera	<i>Microtermes</i> -The Termites or White Ants
(6)	Odonata	<i>Sympetrum</i> - The Dragonfly
(7)	Anoplura	<i>Pediculus</i> - The Human Louse
(8)	Hemiptera	<i>Cimex</i> -The bedbug, <i>Dysdercus</i> -The Red Cotton Bug
(9)	Homoptera	<i>Aphis</i> - The Aphid or Plant Louse
(10)	Lepidoptera	<i>Pieris</i> -The cabbage Butterfly, <i>Bombyx</i> The Silkworm
(11)	Diptera	<i>Musca</i> -The Housefly, <i>Anopheles</i> -The Malarial Mosquito, <i>Culex</i> - The Filarial Mosquito
(12)	Siphonaptera	<i>Xenopsylla cheopis</i> -The Rat flea
(13)	Coleoptera	<i>Coccinella</i> -The Lady Bird Beetle, <i>Sitophilus</i> -The Rice Weevil
(14)	Hymenoptera	<i>Apis</i> -The Honeybee <i>Polistes</i> -The wasp, <i>Camponotus</i> -The large

Types of mouth parts in insects

Types	Examples
Biting Chewing Type	Grasshopper, cockroach, termites, beetles, caterpillars.
Piercing-Sucking Type	Mosquitoes, bugs, fleas, aphids.
Chewing-lapping Type	Bees.
Siphoning Type	Butterflies, Moths.
Sponging Type	Housefly, Fruitfly

15.8 Mollusca

(i) **Phylum Mollusca** : Second largest animal phylum. The number of species is 87,000

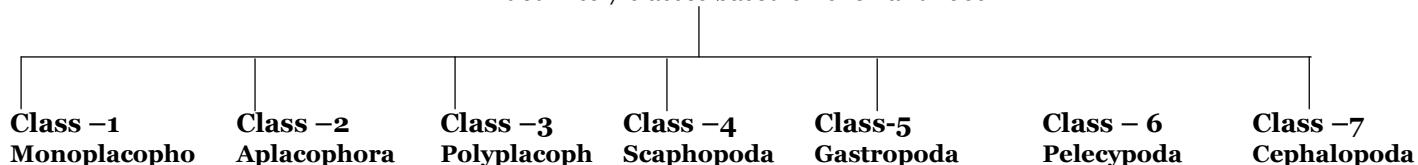
(a) Characters

- (1) Bilaterally symmetrical in general, some are asymmetrical due to torsion.
- (2) Triploblastic, organs system of body organisation.
- (3) Body is usually differentiated into head, foot and visceral mass.
- (4) Aquatic or amphibious
- (5) Flesh fold or outgrowth of dorsal body wall is mantle.
- (6) Alimentary canal is complex, often contains a rasping organ radula.
- (7) Respiration by gills called ctenidia or body surface or lung.
- (8) Excretion by sac like kidney, organ of Bojanus.
- (9) Circulatory system is open type. Blood often contains haemocyanine.
- (10) Nervous system is consist of ganglia and nerve cords.
- (11) Sexes are separate.
- (12) Development is direct or through glochidium or veliger larva

Unique features	Advancement over annelids
The molluscs show the following unique features –	The molluscs show advancement over the annelids in having.
1. Three body regions-head, visceral mass and foot.	1. A distinct head in most species,
2. A glandular fold, the mantle, over the body.	2. Muscles arranged in bundles for moving specific parts,
3. Mantle cavity with anal, excretory and genital apertures in it.	3. Well developed gills for respiration in nearly all cases,
4. Calcareous shell around the body in most cases	
5. A rasping organ, the radula in the buccal cavity	

Phylum – Mollusca

Divided into 7 classes based on shell and foot



Classification

ra		ora			(Bivalvia)	
1. Body and foot oval	1. No shell	1. Small head without eyes and tentacles	1. Commonly called tusk shell	1. Largest class	1. Body enclosed a bivalve	1. Foot located on the head.
2. Single dorsal shell	2. Body worm like		2. Shell tubular open at both ends.	2. Adult asymmetrical due to torsion	2. No head eyes, jaws and radula.	2. Modified as oral arms.
3. Only mollusc having segmentation or metamerism. e.g., Neopilina,	3. Calcareous spicules in cuticle. e.g. Cheloderma	2. Foot & external gills present. 3. Shell as eight (8) Calcarous dorsal plates e.g., Chiton.	3. No head no eyes. 4. Mouth with tentacles e.g. Dentalium.	3. Well develop head. 4. Radula present. 5. Univalve usually coiled. e.g. Pila, Aplysia	3. Larval forms glochidium or veliger. e.g. Unio Mytilis	3. Shell may be external, internal or absent. 4. Head large with well developed eyes. e.g. Octopus, Sepia, Loligo.

Zoological name	Common names
Chiton	Sea mica
Dentalium	Tusk shell
Patella	Limpet
Fissurella	Key-hole limpet
Trochus	Top shell
Pila	Apple snail
Crepidula	Slipper shell
Cypraea	Cowria
Natica	Star shell
Buccinum	Whelk
Doris	Sea lemon
Aplysia	Sea hare
Turbo	Cat's eyes
Vermetes	Worm shell
Nassa	Mud shell
Conus	Cone shell
Bulla	Bubble shell
Helix	Land snail
Limax	Slug
Pteropod	Sea butterfly
Unio	Fresh water mussel
Mytilus	Sea mussel
Spondylus	Edible oyster
Pinctada	Pearl oyster
Pecten	Scallop
Teredo	Shipworm
Solen	Razor clam
Sepia	Cuttle fish
Loligo	Squid (sea arrow)

Octopus	Devil fish
Spirula	Spiral shell
Architeuthis	Giant squid

15.9 Echinodermata

(i) **Phylum Echinodermata** : (Gr echinos = spiny dermatos = skin) . The number of species is about 6000 (living) and 20,000 (extinct). Term echinodermata was coined by Jacob Klein in 1738.

(a) Characters

- (1) Exclusively marine.
- (2) Triploblastic, radially symmetrical often pentamerous.
- (3) Sessile or creeping on sea bottom.
- (4) Head absent.
- (5) Calcareous endoskeleton present in the form of ossicles.
- (6) Complete digestive system with straight or coiled alimentary canal.
- (7) Enterocoelous coelom
- (8) Water vascular system is present.
- (9) Respiratory organs include dermal branchia, tube feet, respiratory tree.
- (10) Excretory system is absent.
- (11) Usually dioecious, fertilization external.
- (12) Echinoderms possess remarkable power of regeneration show Autotomy.
- (13) Larval forms are bilaterally symmetrical.

Unique Features	Degenerate Features
<p>The echinoderms have the following unique features—</p> <ol style="list-style-type: none"> 1. Bilateral symmetry in the larva and radial symmetry in the adult. 2. Demarcation of the body surface into alternating ambulacral and interambulacral areas. 3. Mesodermal endoskeleton of calcareous plates, usually with spines. 4. Modification of a part of the coelom into a water vascular system for aid in locomotion. 5. Characteristic tube feet for locomotion. 6. Peculiar pedicellariae for cleaning the body surface. 	<p>The echinoderms have some degenerate features—</p> <ol style="list-style-type: none"> 1. Lack of head. 2. Reduced circulatory system. 3. Absence of excretory organs. 4. Simple sense organs. 5. Incomplete digestive tract in some forms.

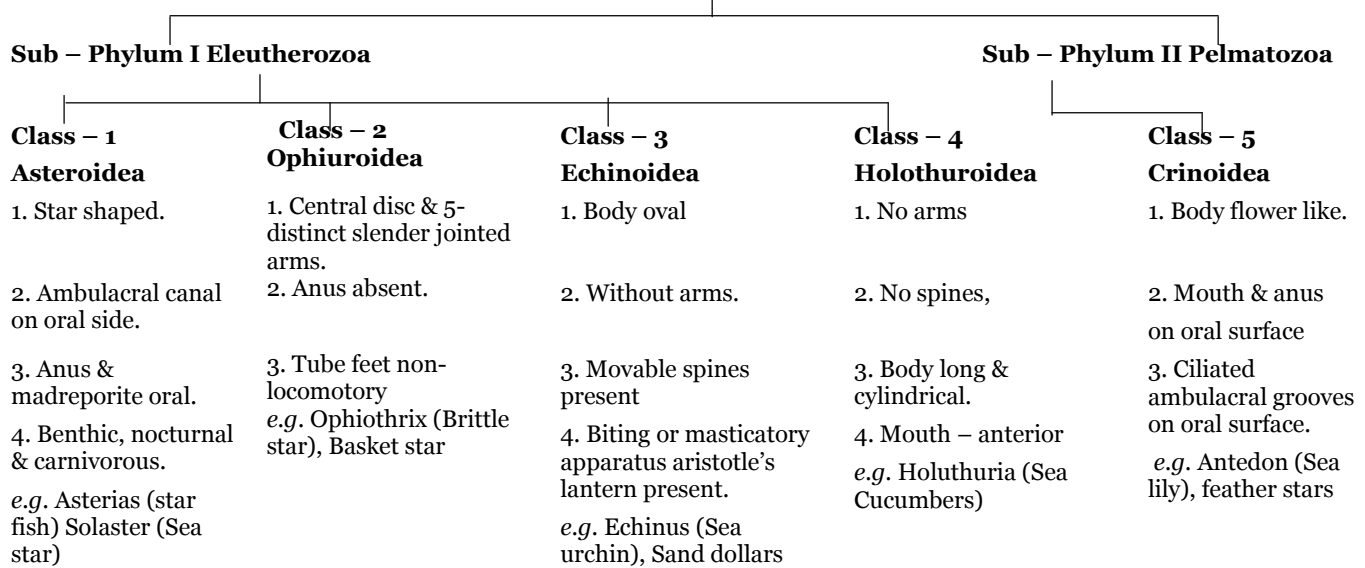
(b) **Chordate like characters** : The echinoderms resemble chordates, particularly vertebrates, in having

- (1) Radial and indeterminate cleavage of the egg.
- (2) Mesodermal endoskeleton.
- (3) Deuterostomous mouth.

Classification

- (4) Use of phosphocreatine in the energy cycle of muscle contraction.
 (5) Echinodermata and protochordata both are having enterocoelous coelom.
 (6) These resemblances support the echinoderm theory of chordate origin.
 (c) **Classification** : On the basis of body shape and digestive system.

Phylum Echinodermata



Larval forms of Echinodermata

Asteroidea	{ Dipleurula Bipinnaria Brachiolaria
Ophiuroidea	Ophiopluteus
Echinoidea	Echinopluteus
Holothuroidea	Auricularia
Crinoidea	{ Doliolaria Pentacrinoid

Zoological name	Common name
Asteroidea	
Asterias	Starfish
Pentaceros	Sea pentagon
Ophiuroidea	
Ophiothrix	Brittle star
Gorgonocephalus	Basket star
Holothuroidea	
Cucumaria	Sea cucumber
Crinoidea	
Antedon	Feather star

15.10 Hemichordata

- (i) **Phylum Hemichordata** : Triploblastic, enterocoelic coelom, dueterostome, metameric segmented.

(1) Buccal diverticulum present was considered earlier as notochord but it was not homologous to the notochord of other chordates.

(2) Body is divided into proboscis, collar and trunk.

(3) Hemichordata has recently been given the status of a separate phylum under invertebrate by Hyman.
Eg. *Balanoglossus* (Acorn worm or tongue worm), *Cephalodiscus*

(4) Larva of *Balanoglossus* is called *Tornaria*.

15.11 Chordata

(i) **Phylum Chordata** : The number of species is about 55,000. Phylum Chordata are created by Balfour.

(a) Characters

(1) Presence of notochord.

(2) Presence of dorsal tubular nervous system.

(3) Presence of paired pharyngeal gill clefts.

(4) Bilateral symmetry and metameric segmentation.

(5) Presence of post anal tail.

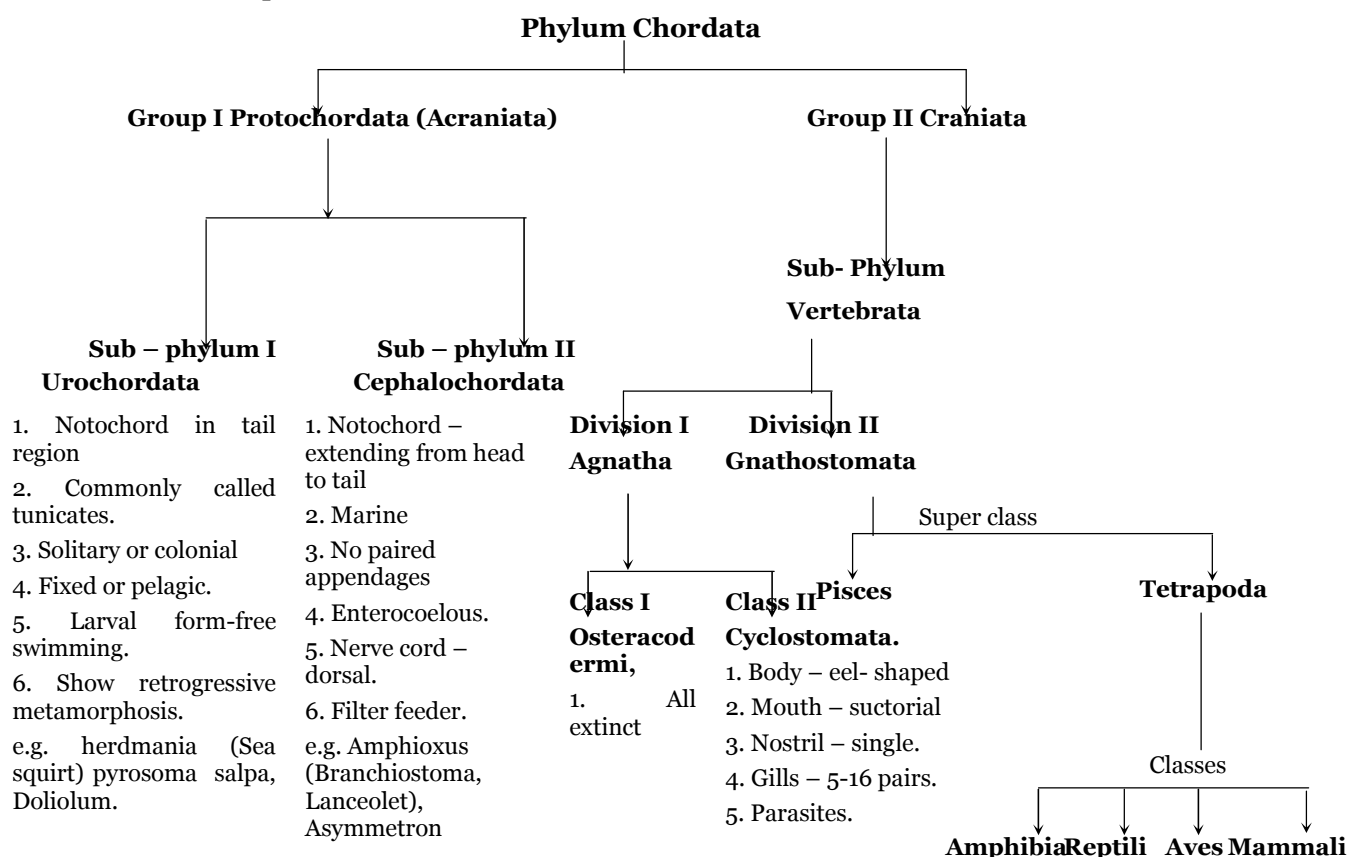
(6) Coelom is schizocoelic in vertebrates and enterocoelic in protochordates.

(7) Blood vascular system – Closed, Heart ventral.

(8) Cartilaginous or bony endoskeleton.

(9) Excretion by kidney.

(10) Sexes – separate.



Classification

e.g. Petromyzon (Lamprey) Myxine (Hag fish)

Comparative chart of different classes of vertebrate

Characters	Pisces	Amphibia	Reptilia	Aves	Mammalia
Number of species	40,000	2,500	7000	9000	4,500
Study	Ichthyology		Herpetology	Ornithology	Mammology
Origin	During Ordovician period of palaeozoic era	During Devonian period of palaeozoic era	During Carboniferous period of palaeozoic era Age of Reptiles – Mesozoic era.	Towards end of Jurassic period of mesozoic era from Reptiles.	In the triassic period of Mesozoic era from reptiles. Age of mammals coenozoic era.
Exoskeleton.	Dermal scales namely placoid cycloid or ctenoid ganoid	Absent.	Horny Epidermal scales.	Feather, claw scales on legs	Hairs, nails Hooves, claws, Horns.
Endoskeleton.	Cartilaginous or Bony	Bony Dicondylic skull Mostly procoelous vertebrae	Bony Monocondylic Skull Procoelous vertebrae	Bony (pneumatic) Monocondylic skull. Heterocoelous vertebrae (saddle shaped) – Posterior thoracic, lumber sacral, anterior caudal fused to form synsacrum	Bony Dicondylic skull. Amphiplatyon vertebrae.
Respiration	By gills	By lungs, skin or buccal lining	By lungs.	By lungs supported by air sacs	By lungs
Heart	2- chambered (tubular heart)	3- chambered.	Partially 3- chambered 4- chambered in crocodile	4- chambered	4- chambered.
Kidney	Mesonephric	Mesonephric	Metanephric	Metanephric	Metanephric.
Cranial nerves	10 pairs	10 pairs	12 pairs	12 pairs	12 pairs
Fertilization	Internal or external	External	Internal	Internal	Internal
Egg.	Macro lecithal	Mesolecithal	Macrolecithal	Macrolecithal	Alecithal microlecithal
Extra embryonic membrane	Absent	Absent	Present	Present	Present.
Temperature regulation	Cold blooded or Poikilothermic	Cold blooded or Poikilothermic	Cold blooded or poikilothermic	Warm blooded or homeothermic	Warm blooded or homeothermic

15.12 Pisces

(a) Characters of Pisces

(1) Shark is viviparous.

(2) Air bladder found in bony fishes is a hydrostatic organ.

(3) Fishes migrate mainly for breeding.

Catadromous migration : Fresh water to sea water eg. anguilla.

Anadromous migration : Sea to fresh water e.g. Salamon.

(4) Lung fishes or Dipnoi are fresh water. Three swing genera are –

Neoceratodus : Australian.

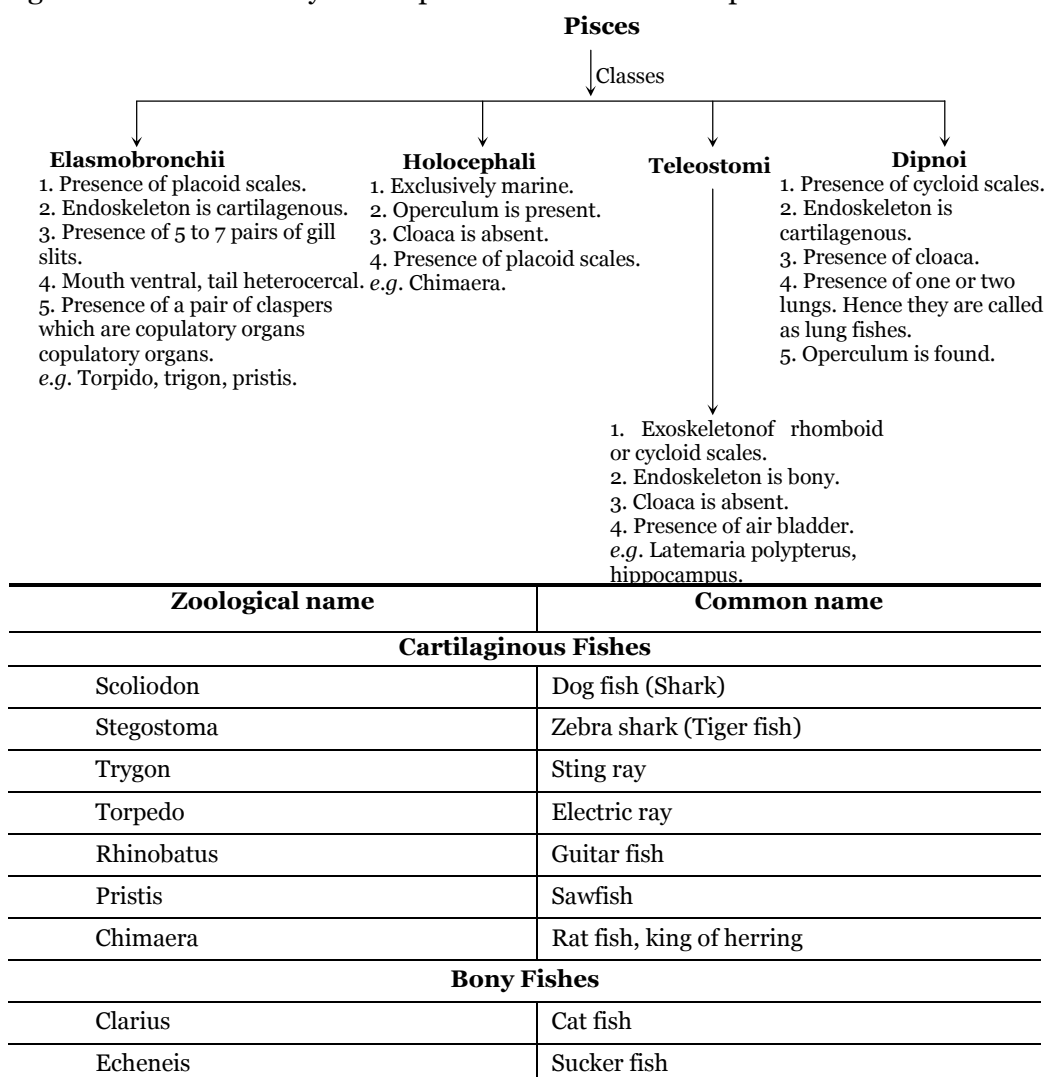
Protopterus : African.

Lepidosiren : Latin American.

(4) Stone fish is the most poisonous fish.

(5) Scoliodon has great power of smell so it is called “dog fish”.

(6) Coelocanth (Latemeria) is called living fossil because they were dominant in devonian period but 280 million year ago became extinct only some specimen form are there present.



Classification

Hippocampus	Sea horse
Gambusia	Mosquito fish
Exocoetus	Flying fish
Tetradon	Globe fish
Diodon	Porcupine fish
Cyanoglossus	Flatfish
Anabas	Climbing perch
Labeo rohita	Indian carp
Syngnathus	Pipe fish
Fistularia	Flute fish
Carassius	Gold fish
Anguilla	Fresh water eel
Oncorhynchus	Pacific salmon

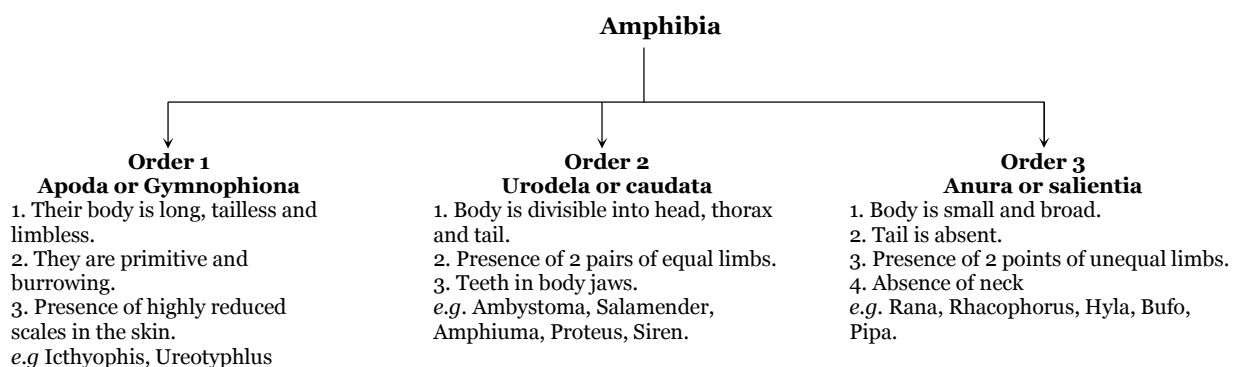
False Fishes

Common Name	Genus	Phylum
1. Jelly fish	Aurelia	Coelenterata
2. Silver fish	Lepisma	Arthropoda
3. Cray fish	Astacus	Arthropoda
4. Razor fish	Solen	Mollusca
5. Cuttle fish	Sepia	Mollusca
6. Devil fish	Octopus	Mollusca
7. Star fish	Asterias	Echinodermata
8. Hag fish	Myxine	Chordata

15.13 Amphibia

(a) Characters of Amphibia

- (1) Ichthyophis is a limbless amphibians or Cecilians showing parental care.
- (2) Ambystoma (Tiger salamander) is found in USA (North America) and Mexico. Larva is axolotl showing neoteny.
- (3) Bufo marinus is a poisonous amphibian.
- (4) Poison gland of a toad is modified parotid gland.
- (5) Horned toad is a lizard living in desert.



Zoological name		Common name
Gymnophiona		
	Urocootyphlus	Blind worm
	Ichthyophis	Caecilian
Urodela		
	Ambystoma	Tiger salamander
	Amphiuma	Congo eel
	Cryptobranchus	Helbender
	Necturus	Mud puppy
	Proteus	Cave salamander
	Siren	Mud eel
	Triton	Newt
	Salamandra	Salamander
Anura		
	Rana tigrina	Indian bull frog
	Alytes	Midwife toad
	Bufo melanostictus	Indian toad
	Pipa	Surinam toad
	Hyla	Tree frog
	Rhacophorus	Flying frog
	Bombinator	Fire bellied toad
	Xenopus laevis	African clawed toad
	Ascaphus	Bell toad
	Astylosternus	Hairy frog
	Nototrema (Gastrotheca)	Marsupial frog

15.14 Reptilia

(a) Characters of Reptilia

(1) First reptiles are called stem reptiles or cotylosauria. The genus being Seymouria (connecting link between Amphibians and reptiles).

(2) Classification of reptilia is based on the vacuities (cavity) on skull – Anapsia-no vacuity, parapsida-one pair dorsal vacuity, euryapsida-one pair dorsal vacuity, synapsida-one pair ventral vacuity and diapsida-two pairs vacuities.

(3) Sphenodon (Tutara) is a living fossil.

(4) Two viviparous lizards are phrynosoma and chameleon.

(5) Heloderma (Gila monster) is the only poisonous lizard.

(6) Glass snake (ophiosaurus) is limbless lizard.

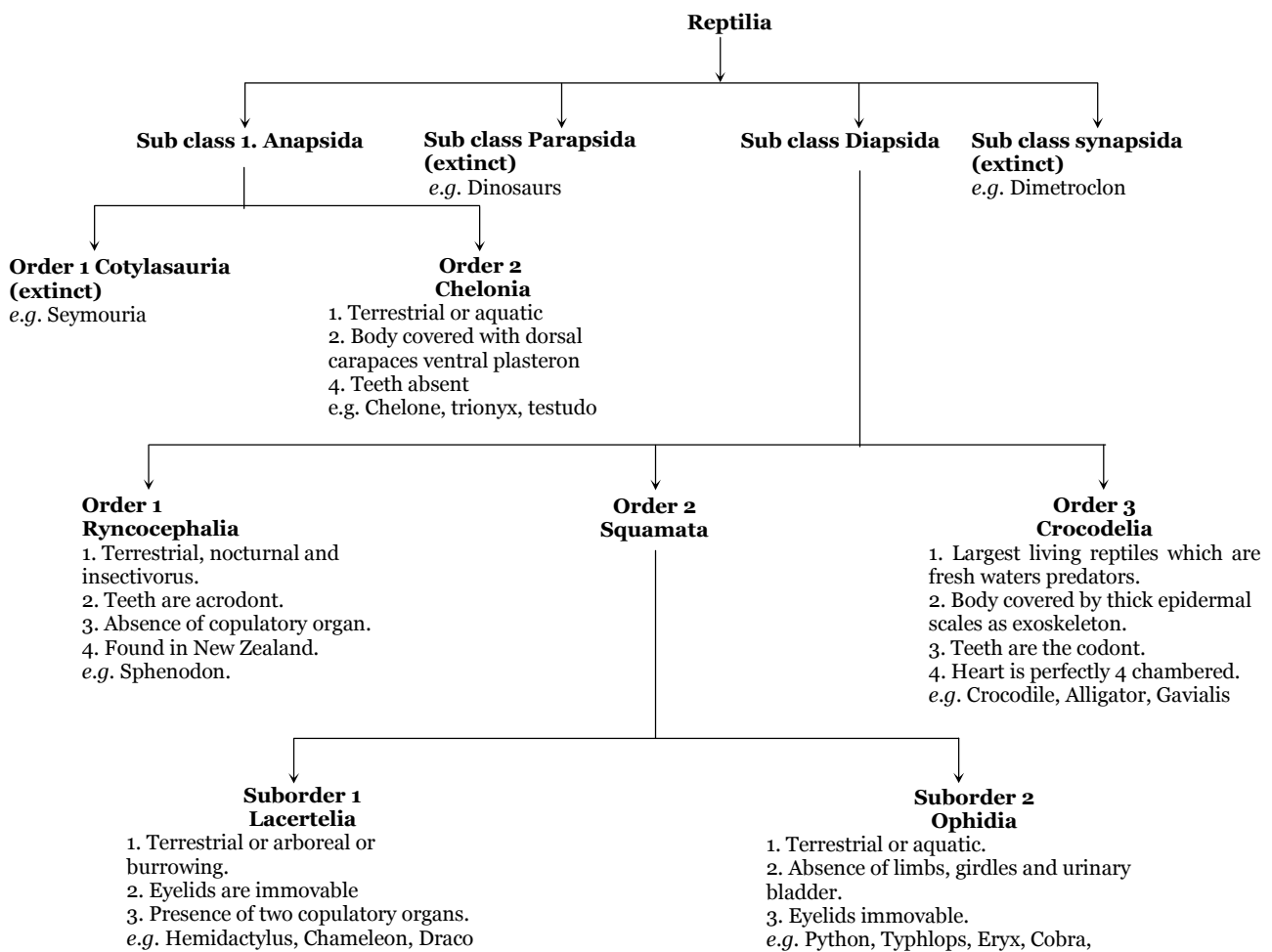
(7) Poison fang of snake is maxillary teeth located on maxilla.

Classification

(8) In India antivenom injections are prepared at Haffkin's Institute, Mumbai and Central Research Institute, Kausuali (Shimla).

(9) Dinosaurs originated along with primitive mammals during Triassic period of Mesozoic era.

(10) Dinosaurs became extinct during cretaceous period of mesozoic era.



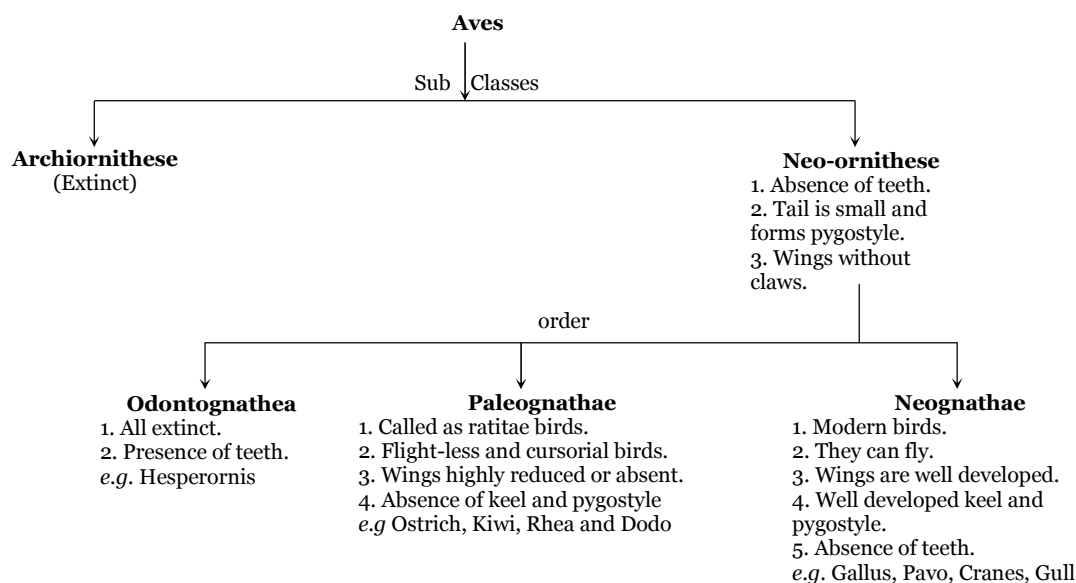
Zoological name	Common name
Chelonia	
Testudo	Tortoise
Dermochelys	Leather back turtle
Trionyx	Soft shelled turtle
Chelonia mydas	Green turtle
Kachuga	Terrapin Roofed
Rhynchocephalia	
Sphenodon	Tuatara

Squamata	
Hemidactylus	Wall/house lizard
Uromastix	Spiny tailed lizard
Calotes	Garden lizard
Draco	Flying dragon
Phrynosoma	“Horned toad”
Mabouia	Skink
Varanus	Monitor lizard

15.15 Aves

(a) Characters of Aves

- (1) Birds originated towards the end of jurassic period of Mesozoic era.
- (2) Salim Ali – known as ‘Bird man of India’
- (3) Archaeopteryx is fossil bird.
- (4) African ostrich is largest living and flightless bird
- (5) Kiwi is the smallest living flightless bird.
- (6) Dodo is a recently extinct bird from mauritius.
- (7) Humming bird (sun bird) is the smallest bird found in Cuba. (length 3 cm. & weight 2 grams).
- (8) Swift is the fastest flying bird found in Japan.
- (9) Wagtail is famous migratory bird of India.



Flightless Birds

Common name	Genus	Distribution
African ostrich	Struthio	Africa and Arabia
South American ostrich	Rhea	South America

Classification

Cassowary	Casuarius	Australia and New Guinea
Emu	Dromaius	Australia and Newzealand
Tinamou	Tinamus	South America
Kiwi	Apteryx	Newzealand

Zoological name	Common name
Passer domesticus	House sparrow
Corvus splendens	House crow
Eudynamis	Koel
Pseudogyps bengalensis	Bengal vulture
Psittacula eupatria	Indian parrot
Psittacula krameri	Rose ringed parrot
Phoenicopterus roseus	Flamingo
Pavo cristatus	Peacock or Mor (National bird)
Milvus migrans	Kite
Bubo bubo	Great horned owl
Dinopium benghalensis	Wood pecker
Columba livia	Common rock pigeon

Bird Sanctuaries

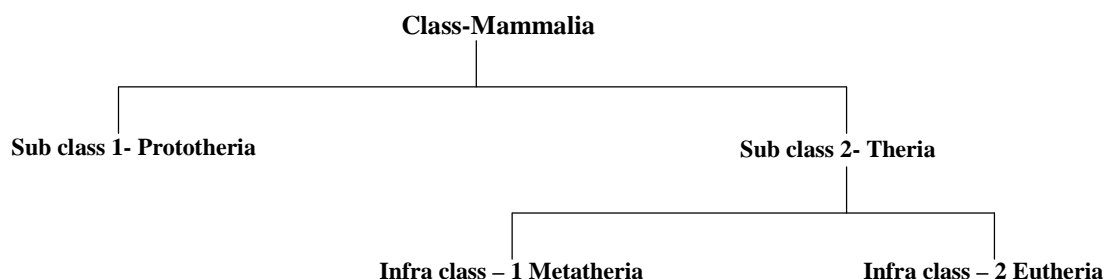
Name	Bird found
Sultanpur (Lake) Bird sanctuary ,Gurgaon Haryana	Green pigeon, Saras crane, Spoonbill, Duck
Govind Sagar Bird Sanctuary, Bilaspur H.P	Teal, Duck Goose, Grane
Keoladeo Ghana Bird Sanctuary Bharatpur, Raj.	Siberian crane, Storks, Herons, Cormorant, Egret
Chilka Lake Bird Sanctuary, Balagaon, Orissa,	Flamingo, Pelican, Egret Ibis, Sandpiper, Cormorant
Pulicat (lake) Sanctuary, Nellore A.P.	Flamingo, Pelican, Teal, Stork, Heron

15.16 Mammalia

(a) Characters of Mammalia

- (1) Prototheria consist of two genus – Ornithorhynchus (Duck billed platypus) Tachyglossus = Echidna (Spiny ant eater).
- (2) Metatherians are pouched mammals.
- (3) Eutheria includes viviparous placental mammals.
- (4) Bats are capable of echolocation.
- (5) Tiger is the National mammal of India.
- (6) Aquatic mammals are cetaceans and Sirenians.
- (7) Manatus Austrails is seacon having six cervical vertebrae.

- (8) Hippopotamus is called 'Horse of the river'
 (9) Camels are known as 'Ships of the desert'
 (10) Primates include lemurs, lorises, tarsiers, monkeys, apes and man.
 (11) Gibbon is the smallest man like ape.
 (12) Chimpanzee is the most intelligent ape.



(b) Sub class 1-Prototheria

- (1) Less developed and called as **reptile like mammals**.
- (2) Absence of pinnae
- (3) Mammary glands are without **teats**.
- (4) Absence of corpus callosum.
- (5) Testes are abdominal.
- (6) Presence of cloacal aperture.
- (7) Oviparous and exhibit **gynaecomastism**.
- (8) Inhabit Australia, New guinea and Tasmania.

Example : Echidna and Ornithorhyncus

(c) Infra class 1-Metatheria

- (1) Presence of **marsupium** or marsupial pouch.
- (2) Corpus **callosum** is less developed in the brain.
- (3) Uterus and vagina are **didelphic**.
- (4) Presence of **pinnae**.
- (5) Tail is thick and long which is used as balancing organ.
- (6) Hind legs are long and stout. The locomotion on the hindlegs is called as **leaping**.
- (7) Absence of true placenta.

(8) They give birth to undeveloped young ones which are kept in the marsupium till complete development.

(9) They inhabit Australia, America and Tasmania.

Examples : Opossum (Didelphis), Kangaroo (Macropus), Dasyurus, Bandicoot etc.

(d) Infra class 2-Eutheria

- (1) Presence of pinnae.
- (2) Well developed mammary glands with teats.
- (3) Testes are exabdominal.
- (4) Presence of true placenta. *i.e.* allanto-chorionic placenta.

Classification

- (5) Cloaca is absent.
- (6) Completely viviparous.
- (7) Presence of single vagina.
- (8) Well developed corpus callosum in the brain.