PROTOZOA TO ECHINODERMATA

Taxonomy is the branch which deals with the study of **nomenclature, classification** and their **principles.** Taxonomy word was given by **"Candolle".** It is a Greek world. **Taxis**- arrangements, **Nomos -** Law

HOSTORICAL BACKGROUND OF TAXONOMY:

Aristotle: He is known as the **"father of zoology ".** (Book : **Historia Animalium)**
He is also known as the father of ancient animal - classification. he classified animals into two groups on the basis of their natural similarities and differences into -

(1) **Anaima :** Those animals which don't have Red blood or in which RBC are absent e.g. Sponges, Cnidaria, Mollusca, Arthropoda. Echinodermata like Invertebrates.
(2) **Enaima :** These animals have red blood. This group includes all vertebrates and it has been further divided into two bus groups.
(a) **Vivipara :** It includes animals which given birth to young-ones. e.g. Man, Whale and other mammals.
(b) **Ovipara :** It includes animals which lay eggs. e.g. Amphibians, Pisces, Aves, Reptiles etc.

Pliny : He classified animal into two groups :

(i) Flying (ii) Non-flying

John-Ray : He defined the term **"species".** The smallest unit of classification is the species. According to John-Ray, the organisms which develop from the same type of parents, belong to the same-species.

Mayr: According to his similar species are those which are capable of interbreeding in natural conditions. Modern definition of species in coined by **"Mayr".**

Carolus linnaeus : In 1735 the Binomial system of Nomenclture was devised by **Gespard-Bauhin.** But the detailed information about Binomial system was given by **Linnaeus.** In 1758 in the10th edition of his book **"Systema Naturae"** he gave the classification of known 4236 animals and presented the Binomial system of nomenclature of animal. He is also known as **"Father of Modern-Taxonomy".**
In binomial system the name of each animal has two parts. First part has its **genus** name and second part has its **species** name. First latter of genus name must be written in **Capital letter** and species name is written in **small letters** e.g. **Canis familiaris.** In certain species, sub-species are also found. For naming the sub species three words are used. First name is for genus second for species and third for sub-species. The method species three words are used. First name is for genus second for species and third for sub-species. The method of nomenclature of Sub-species is termed as the Trinomial nomenclature and it was given by "Huxley and Strickland". e.g. ***Homo sapiens sapiens.***

G.L. Cuvier : Coned the term **phylum.**

Julian-Huxley (1940): Proposed **New systematic.**

Engler and Prantl : Proposed **Phylogenetic classification.**

Key for identification of animal was developed by **John Ray.**

Invertebrate and **vertebrate** term given by **Lamark**

Robert Whitaker (1969) : Proposed **Five - Kingdom system classification** to slow phylogenetic relationship.
(1) Monera (2) Protista (3) Fungi (4) Plantae (5) Animalia

"Linnaeus" classified animal kingdom into 6-classes
(1) Mammalia (2) Aves (3) Amphibia (4) Insecta (5) Pisces (6) Vermes

SEQUENCE OF CLASSIFICATION

Smallest unit of classification is **"Species". Genus** includes various types of species. **Family** is made up of various genera. Many families join together to form an **order,** many orders join together to form a **class** and many classes form a **Phylum.** All the phyla unite to form the largest unit i.e. **Kingdom.** Various grouping levels or ranks in classification known as *Obligate categories.*

e.g. Kingdom - phylum - class - order - family - genus - species

Based on this, all animals are included in the animals kingdom - groups and written in the following Hierarchical manner. For example obligate category of man can be written as

Kingdom	→	Animalia
Phylum	→	Chordata
Class	→	Mammalia
Order	→	Primates
Family	→	Hominidae
Genes	→	***Homo***
Species	→	***Sapiens***

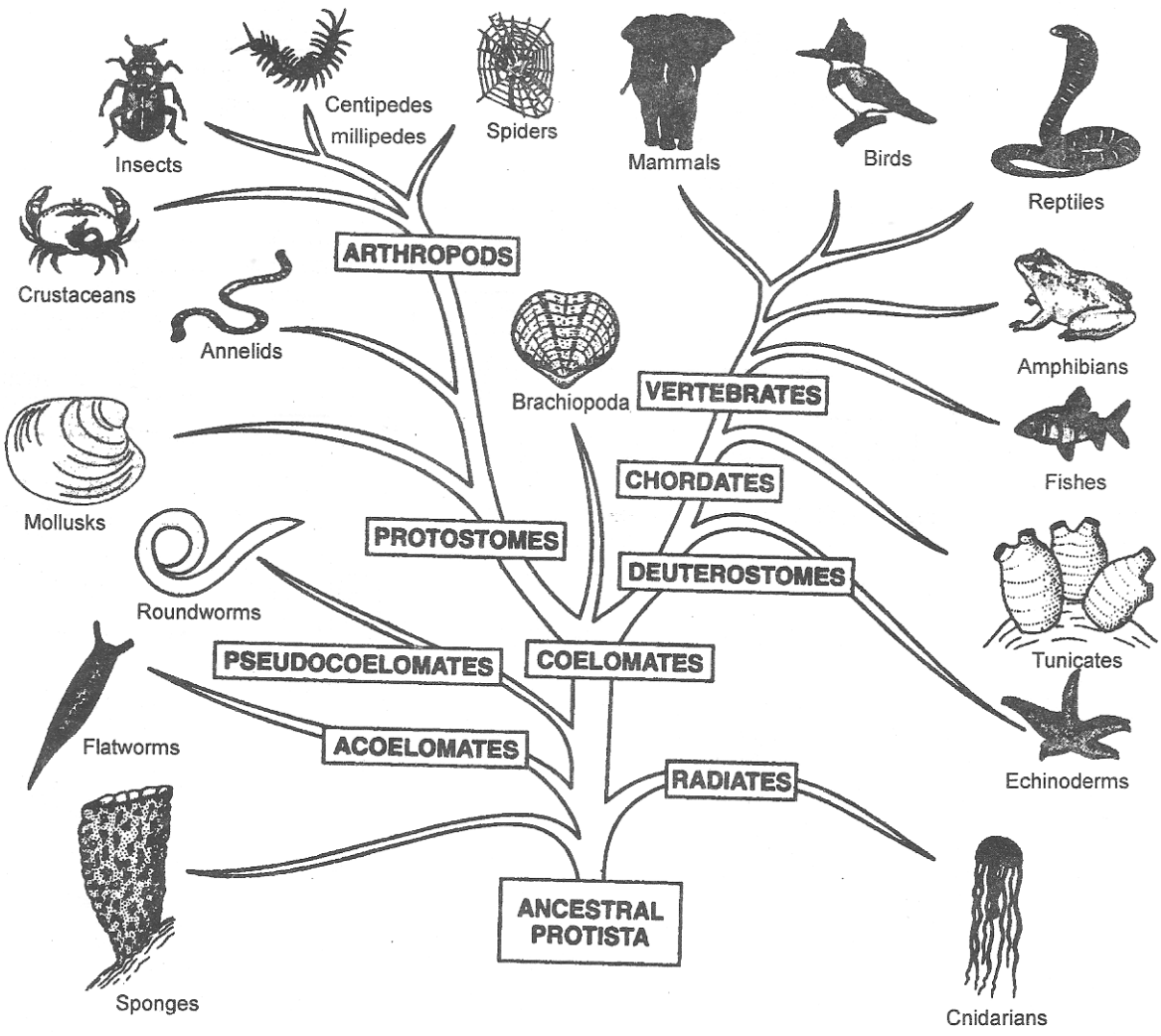
IMPORATNT PHYLA

Stoker and usinger classified whole animal kingdom into 31 phyla. Out of which 10 are major and 21 are minor phyla. Main phyla are :

1.	**Protozoa**	**-**	e.g.	***Amoeba, Paramoecium*** etc.
2.	**Porifera**	**-**		Sponges etc.
3.	**Coelenterata**	**-**		***Hydra,*** Jellyfish etc.
4.	**Ctenophora** (minor phylum)	-		**Beroe** etc.
5.	**Plathyelmintes**	**-**		**Tape worm etc**
6.	**Nemathelminthes - Nematoda**	**-**		*Ascaris* etc
7.	**Annelida**	**-**		Earthworm, Leach etc.
8.	**Arthropoda**	**-**		Insects, Scorpion, Fly etc.
9.	**Mollusca**	**-**		Snail, **Pila, Octopus** etc.
10.	**Echinodermata**	**-**		Star fish etc.
11.	**Hemichordata**	**-**		***Balanoglossus***
12.	**Chordata**	**-**		Fish, Snake, Birds, Monkey etc.

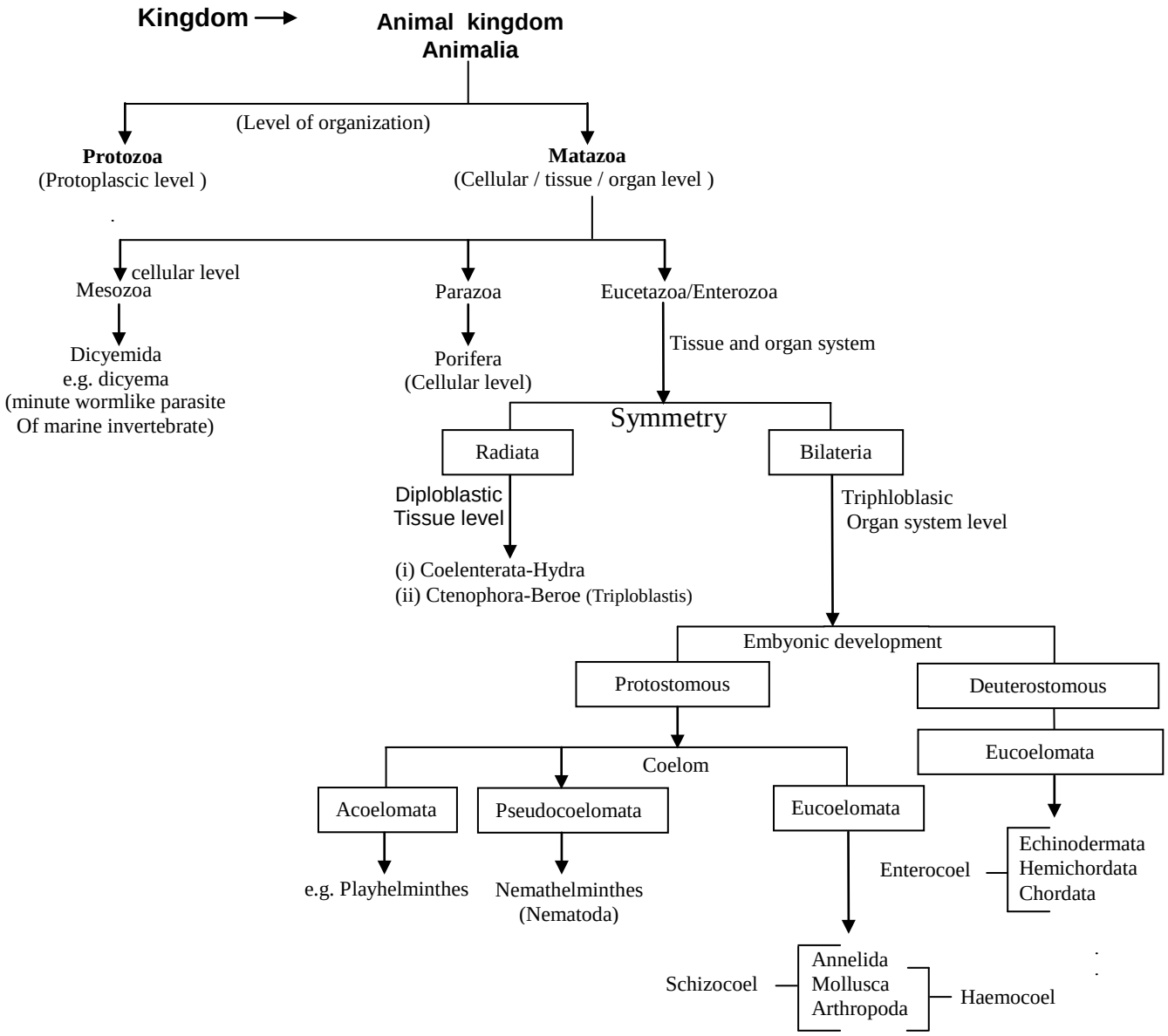
ANIMAL KINGDOM EVOLUTIONARY TRENDS

1. Animals show 3 structural levels : Cellular level (Porifera), tissue level (Coelenterate), and oragn-system level (**Platyhelminthes** to **Chordata**).
2. Animal bodies have 4 kinds of symmetry : Spherical (egg.) Radial (*Hydra*), Biradial (Combjelly), and bilateral (Frog, Rat).
3. Most animals develop from 3 germ layers : Ectoderm, Mesoderm and Endoderm.
4. Flatworms are ecoelomeates, roundworms are pseudocoelmoates, other animals above nematodes are coelomates.
5. Most animals are unisexual. Some are bisexual (liverfluxe, earthworm) .
6. Digestive trace in incomplete in **Coelenterata** to **Platyelminthes,** and complete in all other phyla.
7. Respiration in animals may be body surface (*hydra*), bronchial (Prawn), pulmonay, tracheal (Insects), or cutaneous (earthworm).
8. Circulatory system is open in **Arthropoda** and **Mollusca** and closed in **Annelida** and **Chordata.**
9. Animals have a variety excretory organs: Flame cells (liver fluke), intracellular tubules (Roundworms), nephridia (Earthworm), malpighian tubules (Insects), antennary (Crustaceans), kidneys (vertebrates).
10. Most animals have head, appendages, skeleton and nervous system.



The Phylogeny of the major groups of animals

OUTLIE OF ANIMAL CLASSIFICATION



PHYLUM - PROTOZOA

- It is 3rd **largest phylum.** One called body performed all the biological activities like multicellular animals. So they are termed as **"Acelluar"** organism, proposed by **Dobell.**

- Protozoans were first studied by **Leeuwnhoek,** And the name Protozoa was coined by **Goldfuss.** Study of protozoon's in known as **Protozoology.**

- They are world wide, Cosmopolitan mostly **Microscopic, Aquatic, terrestrial, free living** (Amoeba) or **parasitic** (Plasmodium). Solitary or colonial (Proteropongia). Causes serous diseases or pathogenic.

- Protozoas are small microscopic, **Eukaryotic Unicellular,** Colourless, Spherical, Oval, Bell shaped, Spindle shaped slipper like having irregularly Symmetry

- Body level of organisation of Protozons is **Protoplasmic level.** Consists of uninucleate or multinucleate protoplasm mostly **nacked** or some have body bounded by delicate membrane or a firm **pellicle, Test, Lorica or shell.** In few groups of protozoa **$CaCO_3$** & **Silica shell's** Exoskeleton is found e.g. **Radiolarian group** & **Foraminiferan group.** Number of nuclei vary from one to many. Few show **nuclear dimorphism.** .e.g. Parmoecium Body performs all necessary biological activity so in them **subcellular - Physiological division of Labour** is found.

- Locomotion by means of (1) Finger-like Pseudopodia e.g. ***Amoeba***

  (2) Whip like Flagella e.g. ***Euglena***

  (3) Hairy cillia e.g. ***Paramoecium***

  (4) By contraction

  (5) No motion

- **Nutrition** of Protozoans are mainly **holozoic** (Amoeba), **Mixotrophic.** (Euglena), **Parasitic, Saprozoic** (Plasmodium) and Digestion is **intracellular** take place in **food vacuole.**

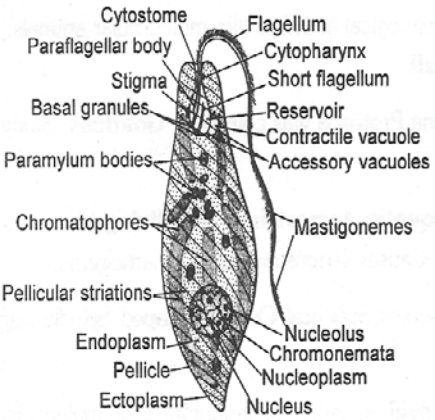
- **Respiration** and **Excretion** take place by exchange of gases through body surface. Some excretion may occure through **contractile vacuole.** Nitrogenous waste is **Ammonia.** Some fresh water protozoans get rid of excess water through contractile vacuole known as **Osmoregulation.** **Amoeba** ahs one and **Paramoecium** has two vacuoles.

- **Reproduction** takes place by

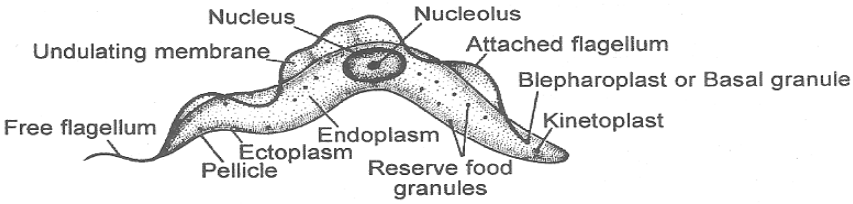
Asexual		Sexual	
(1)	Binary fission (***Ameoba***)	(1)	Syngamy (***Plasmodium***)
(2)	Transverse fission (***Paramoecium***)	(2)	Conjugation (***Paramoecium***)
(3)	Longitudinal fission (***Trypansoma, Euglena***)		
(4)	Multiple fission (***Plasmodium***)		
(5)	Budding		

Some also form cyst which help in unfavourable condition for reproduction of organism. They do not have natural - death because in unicellular animals there is no division of somatoplasm & germplasm so these are considered as **immortal.**

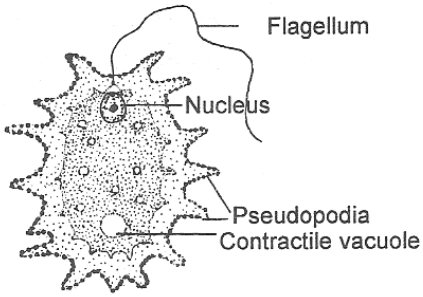
WITNESS FEW COMMON PROTOZOANS



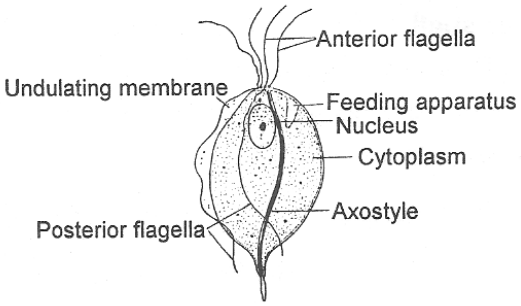
Euglena viridis



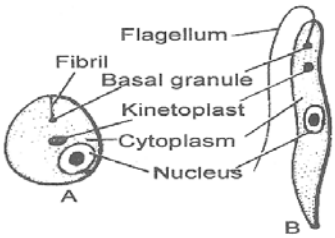
Trypanosoma gambiense



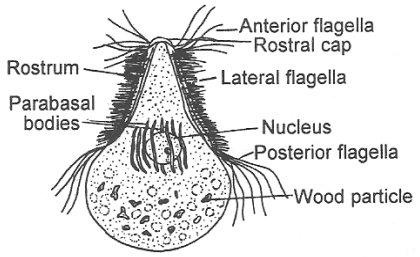
Mastigamoeba



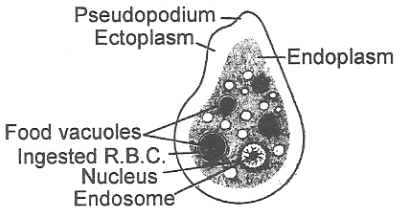
Trichomonas vaginalis



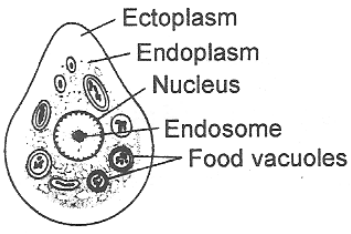
Leishamania donovani :
(A) Leishmania form,
(B) Leptomonad form



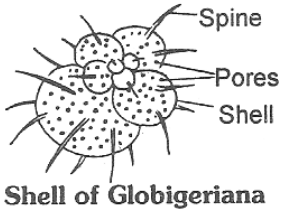
Trichonympha



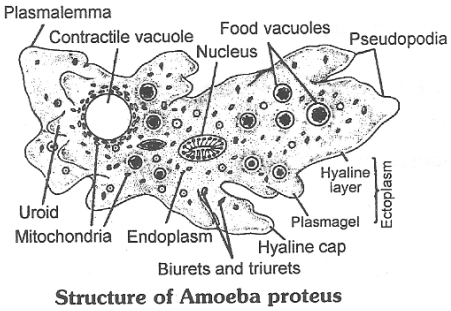
Trophozoite of Entamoeba histolytica



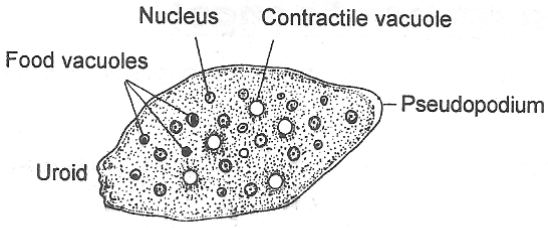
Entamoeba gingivalis



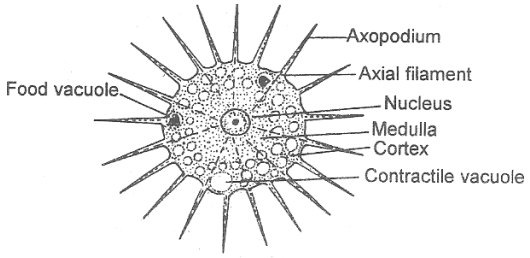
Shell of Globigeriana



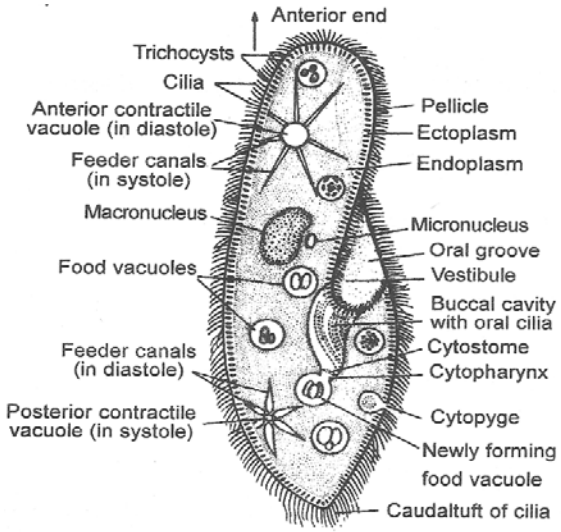
Structure of Amoeba proteus



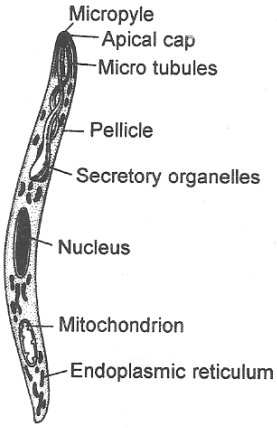
Pelomyxa (Chaos-chaas)



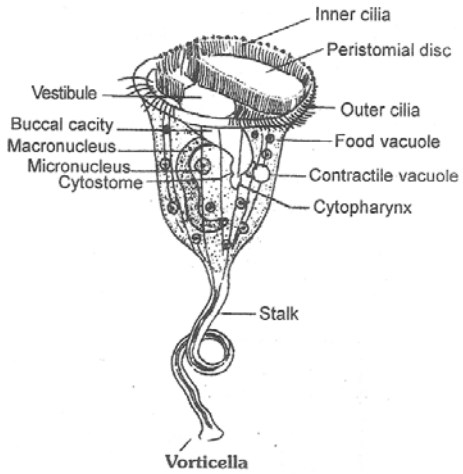
Actinophrys



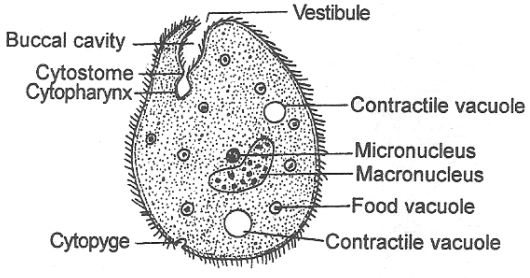
Paramecium caudatum



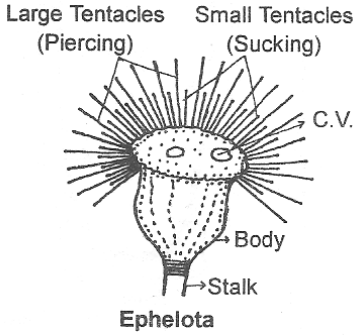
Ultra structue of a Sporozoite of Plasmodium



Vorticella



Balantidium coli



Ephelota

PHYLUM – PORIFERA (Common Name – Sponge)

- **Ellias** proved that sponges are animals. **Robert grant** gave the name Porifera. Study of sponges is known as **Parazoology.** Phylogenetically evolved from choano flagillates (Proterospongia)
- All are **aquatic,** mostly **marine** but few are found in **fresh water** also. They are **sessible, solitary** or **colonial.** Entire body with pres i.e. numerous mouthlets **Ostia** and one opening for exit **Osculum.**

- Sponges have various body form and shapes i.e. **Gase shape, cylindrical** with radial symmery ***(Leucosolenia)*****, irregular** shape (asymmetrical).
- Sponges have **Cellular level** of organisation with two germ layer i.e. **Diploblasitc** and do not posses head and appendages.
- Body wall consists of

(1) Outer <u>Dermal</u> layer or <u>Pinacoderm</u>

(1) Pinacocytes (Flat cell)

(2) Procytes (oval)

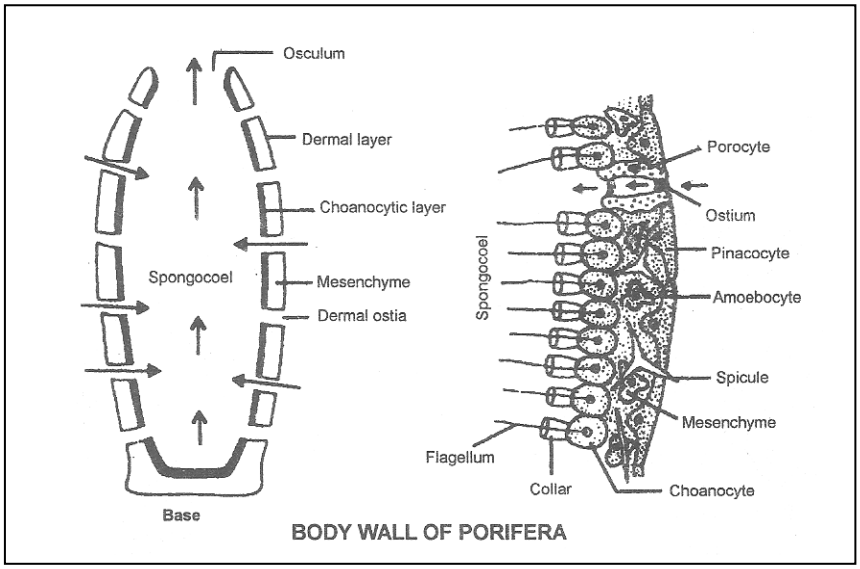
(2) Inner <u>Choanocytic</u> layer or <u>Choanoderm</u>

(1) Collar cell or Choanocytes (Flagelated)
- Characteristic of Porifera
- Choanocytes discovered by - **H.J. Clark**

(3) Between these two layers gelatinous material <u>Mesenchyme</u> is there.

Consist of Ameobocytes

Amoebocytes	Scleroblast	-	For skeleton
	Spongioblast	-	For skeleton
	Thesocytes	-	For food storage (Glycogen)
	Phagocytes	-	To engulf by phagocytosis
	Trophocytes	-	For Distribution of food
	Archaeocytes	-	Formation ova & spermatazoa (Totipotant cells)
	Collencytes	-	Connective tissue cell
	Chromocytes	-	Pigmented
	Myocytes	-	Highly contractile (at osculum)



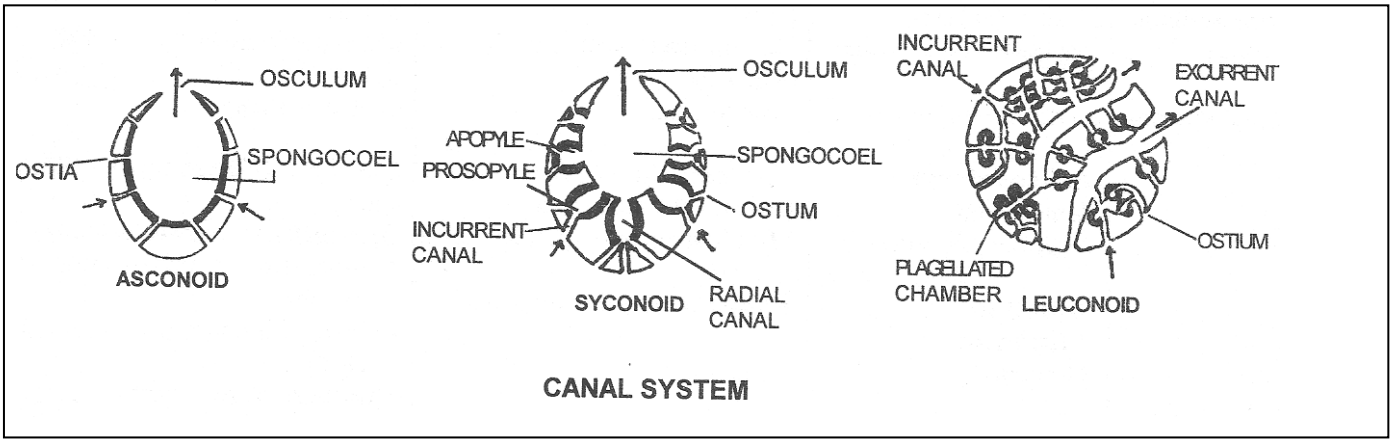
BODY WALL OF PORIFERA

- Body wall enclosed a large cavity the spongocoel or **paragastirc cavity** with small cavitied canals. **Choanocytes** with flagella is lined in Songocoel and radial canal.
  Ceaselles beating of flagellate caused current of water enter through ostia perforating porocytes and various canals and enters in spongocoel and finally leave through large aperatrue **osculum.**

- **Canal system :** Canal system of porifera helps in **nutrition, respiration & excretion.** Canal are developed due to folding of inner wall. There are four types of canal systems

  (1) Asconoid (2) Syconoid (3) Leuconoid (4) Rhagon
  (simplest canal) (Complex and most efficient canal system)

  e.g. ***Leucosolenia, Olynthus*** *e.g.* ***Scypha*** *e.g.* ***Eupongia & spongilla*** *e.g.* ***Larva of Demospongia***



CANAL SYSTEM

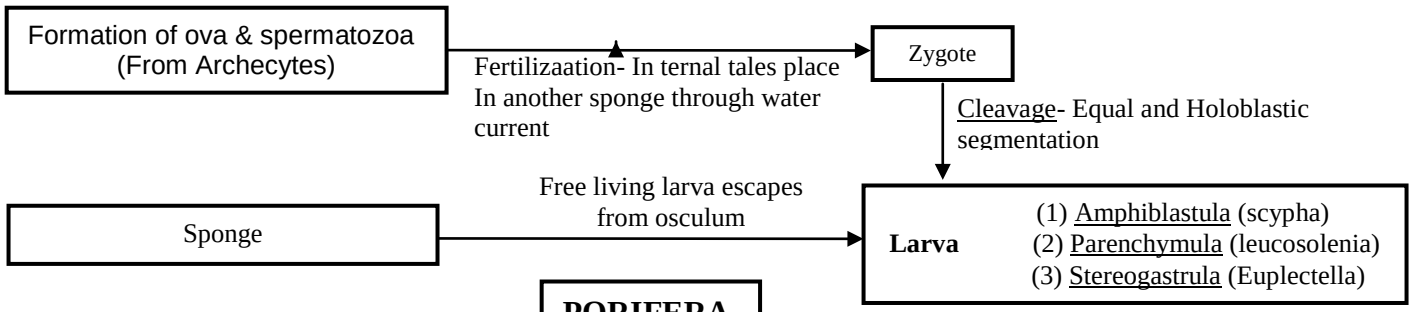
- Skeleton is internal, consist of tiny calarious **calcoblast** or siliceous specules **sillicoblast** or fine spongin fibre **spongioblast,** located in mesenchyma.
  There are for types of spicules in sponges
  (1) Monoaxon (Usually at osculum) (2) Triaxon
  (3) Tetraaxon (4) Polyaxon
  Scleroblast secrets spicules and Spongioblast secrets spongin fibre.

- **Digestive cavity** and mouth in absent. Nutrition is holozoic. Digestion is **intracellular** and occurs in food vacuoles of choanocytes.
  Food particle strained out by collar cell and pass them to amoebocytes.
  Food is stored in **thesocytes.**
  Distribution of food form ingestive cell to other is brought by the movable amoeboid cell.

- **Respiration** and **Excretion** takes place by diffusion of gases through body surface. Excretory matter in Ammonia.

- Sponges do not have **nervous system.**

- **Reproduction** takes place by means of
  (A) **Asexual** - By Budding - Special cell mass **Gemmules** containing **Archaeocytes.**
  Endogenous budding of asexual reproduction is sponge is known as **Gemmulation.**
  (B) **Sexual -** Sponges are **Hermaphrodite,** fertilization internal and cross fertilization (Protogynous condition).



PORIFERA

(On the basis of Skeleton)

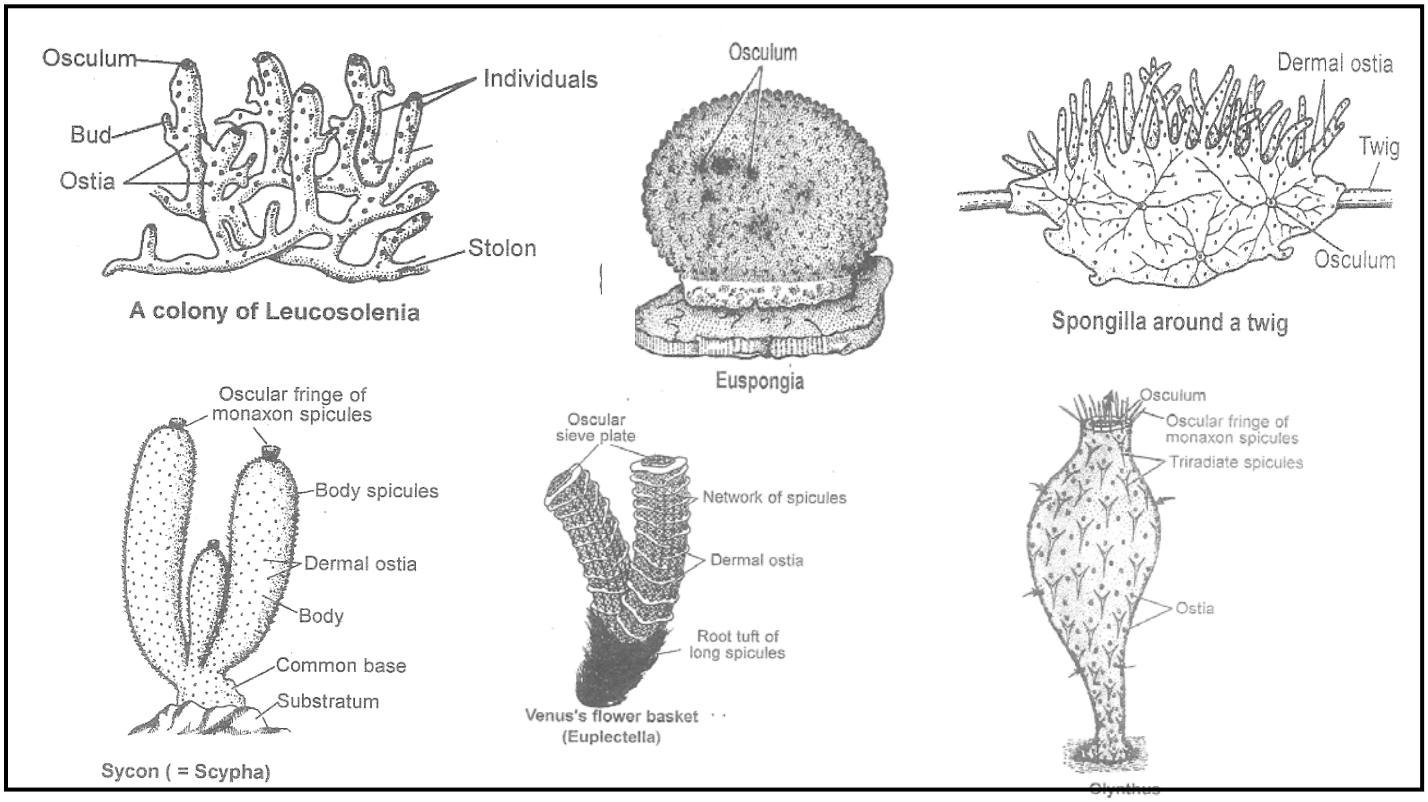
	Calcarea	Hexactinellida	Demospongia
Skeleton	- Calcareous spicules	6 rayed siliceous spiculas (Glass sponge)	1 or 4 rayed silicious spicules or spongin fibre
Choanocytes	- Relativity large.	Small	Small
Inhabit	- All marine in shallow water	All marine and inhabit in deepwater	Marine or fresh in deep or shallow water
Canal system	- Ascon or sycon type	Leucon type	Leucon / Rhagon
e.g.	***Leucosolenia (smallest)*** **Scypha (Sycon) -** Urn sponge ***Leucilla*** ***Clathrina*** ***Grantia***	***Euplectella -*** (Venus flower basket, Bridal gift in Japan) ***Hyalonema -*** (Glass rope sponge) ***Pheronema -*** *(*Bowl sponge*)*	***Spongia (Euspongia)-*** (Bath sponge) ***Spongilla -*** (Fresh water sponge) ***Ephydatia -*** (Sulpher sponge) Freshwater ***Cliona -*** (Boring sponge) harm full to Oyster ***Hippospongia -*** (Horse - sponge or Horny sponge) ***Chaplin -*** Marmaid's gloves ***Poterion -*** Neptun's Cup ***Oscarella -*** Skeleton absent ***Chondrosina -*** Skeleton absent ***Helichondria -*** Bread sponge ***heliclona -*** Finger sponge

Largest sponge - ***Spheciospongia***
Hypothetical simple sponge & between larva & sponge - ***Olynthus***
Scrimps - (Spongicula fish) A crustacean, shows commensalisms with ***Euplecella***

UNIQUE FEATURES

1. Pores all over the body.
2. Cellular level of body organisation.
3. A canal system of intercommunicating cavities for the passage of water current.
4. Lack of mouth and digestive cavity.
5. Choanocytes lining the main cavity (spongocoel) or certain canals (radial canals).
6. Presence of spongin fibres.

WITNESS FEW COMMON SPONGES



PHYLUM – COELENTERATS

- **Leuckart** named **Coelenterata. Hatschek** named **Cnidaria** on the basis of stinging cells. **Peyssonal & trembly** established **animal nature** of Coelenterata.
- Mostly **marine, few fresh-water** *(Hydra).* Carnivorous, some are fixed or free floating.
- Coelenterates have two types of zooids (individual)

(1) Polyp	(2) Medusa
- Cylindrical in shape - Mostly sessile, but some times motile - May be solitory or Colonial - Types of structures : Gastrozooids (Hydranth) - For Nutrition Dectylozooids - For Protection Gonozoids - For Reproduction	- Umbrella like - Free swimming - Always solitary - Types of structures : Phyllozoids - For Protection Nectophore - For Swimming Gonophore - For Reproduction Pneumatophores - For Swimming

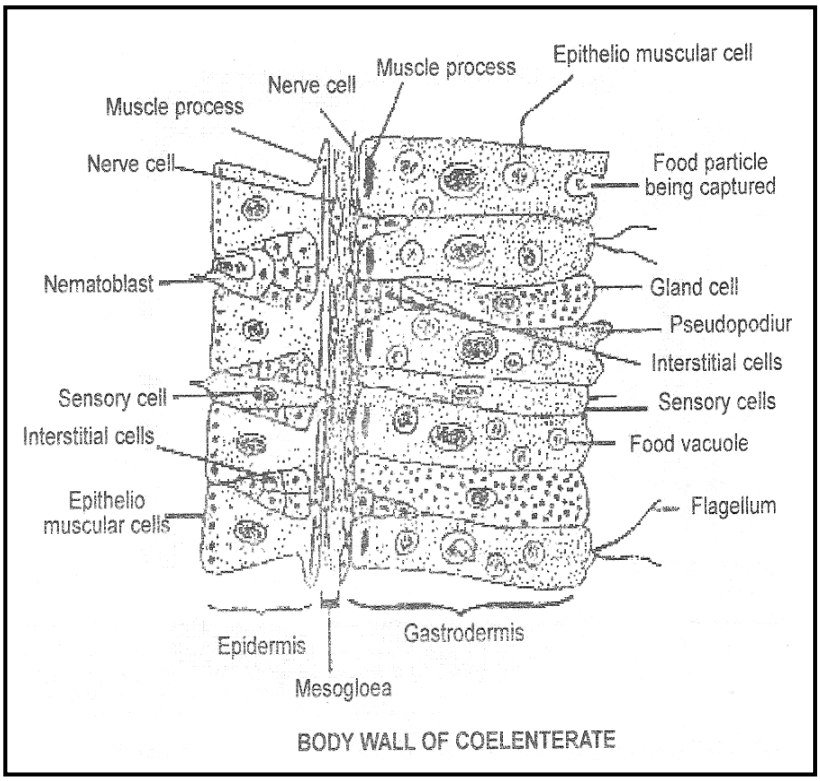
Either or both zooids may occur in a species.
If both forms are found in a group it is **Cormidia.**
If both are found in a species, two form alternate in life cycle. (Alternation of generation or Metagenesis)

- Group of different types of zooids in polyp or medusa shows polymorphism.
- Coelenterates are usually having **radial symmetry,** Anthozoans have **Biradial symmetry.**
- Coelenterates have **two Germs layers (1) Ectoderm (2) Endoderm** i.e. they are **Diploblastic**

- Coelenterates have **Tissue level of organisation.**
- No head and Appendages. The oral end (mouth) often bears slender, flexible process hollow tentacles.
- **Body wall** consists of -

(1) **Epidermis** (Outer layer)
   - **Stinging cells** or **Nematoblast** or Cnidoblast (for offence & defence) characteristic of coelenterata. Inject **Hypnotoxin.**
   - **Interstitial cells** (Totipotent) pluripotent reserve to replace worn out cells/germ cells/Nematocyst)

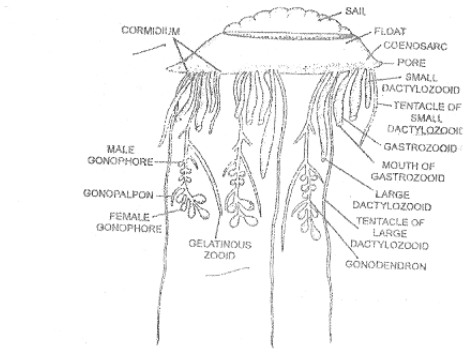
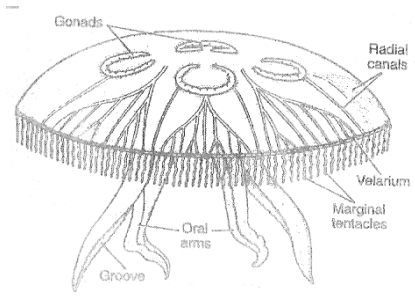
(2) **Gastrodermis** (Inner layer)
   - Nutritive cells (with food vacuole)
   - Interstitial cells
   - Between these two layers, gelatinous **Mesogloea** is present which contain free cells. Mesogloea is secreted by both above layers.



BODY WALL OF COELENTERATE

- Body of coelenterates may be supported by horny or calcareous exoskeleton.
- Cavity of the **Coelentron** is having single aperture. Mouth serve both purpose i.e. **Incomplete digestion tract (Blind sac.)**
  Digestion is **intercellular** as well as **Intracellular** i.e. takes place in Coelenteron as well as in food vocuole.
  Coelenteron is also responsible for distribution of food besides partly digesting it. This dual role named coelectron as **Gastrovascular** cavity.
- **Respiration** and **Excretion** takes place by diffusion of gases through **body surface.**
  Excretory matter is Ammonia.
- **Nervous system** Both in polyp & medusa form is loose net work of nerve fibre form nerve cell on either side of mesagolea (Diffused type). Neurons are non-polar. Sensory cell also present. Medusa have sense organ Rhopalia or statocyst / Tentaculocytes.
- Sexes may be separate or united coelenterates can reproduce **Asexually** by Budding (Polyp) and by **Sexually** (Medusa).
  Gonads have no duct. Fertilization may be **External** or **internal,** Cleavage is **Holoblastic.** Development includes larva.
  Larva of ***Obelia*** - *Planula (*free living*)* an **Scyphistoma** larva fixed polyp like.
  Larva of ***Aurelia* - Ephyra**

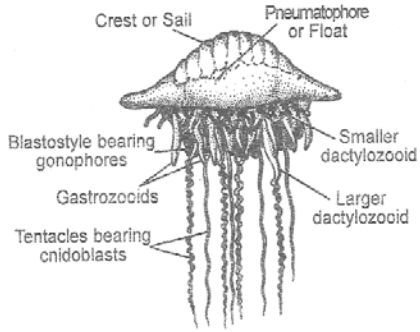
Coelenterata is classified into three classes.

Hydrozoa	Syphozoa	Anthozoa (Actinozoa)
- Polyp & medusa often show polymorphism & mategenesis. - Polyps with manubriam - Meduca have a velum (crapsedote) - Mesogelea is Acelluar - Grastrovascular cavity undivided. - Gonads are formed from epidermal interstitial cell (Ectodermal) and shed gamets directly to the surrounding water. - Cnidoblast in present only in epidermis e.g. ***Hydra*** - Fresh water polyp ***Obelia*** - the sea fur, (Polyp, Blastostyles, Medusa shows metagenesis) ***Physalia*** **-** the portugueses man of war. (Neurotoxic, gas gland present) Ref **Bougainvillea** **Porpita** **Vellela -** Little snail **Tubularia** **Millipora (sting coral)**  Physalia - the portuguese man-of-war.	- Medusa form is more common - Polyp form reduced or absent and have small manubrium - Velum absent. - Mesogloea is thick, galatinuous and contains cells. - Gastrovascular cavity undivided. - Gonads from from gastrodermal interstitial cells. (Endodermal) and shed the gamets into the digestive tract when escape through the mouth. - Cnidoblst is present in epidermis & Gastrodermis e.g. ***Aurelia*** **-** the Jelly fish, Moon jally. Larva - Ephyra Ref **Rhizostoma -** Many m(Poly stomum) **Pilema** **Cyanea -** Sun Jelly **Atolla** **Periphylla**  Aurelia - the Jelly fish	- Only polyp form - No manubrium - Velum absent. - Mesogloea constains cells & fibres - Gastro vascular cavity have compartment i.e. mesentreis. - Gonads - Gonads form form gastrodermal interstitial cells. (Endodermal) and shed gamets into the digestive tract escape via mouth - Chindoblast is present in epidermis & Gastrodermis e.g. This class has two types of animal (1)***Anemones*** - Skeleton absent ***Adamsia*** **-** the seam anemore ***Metridium*** **-** Sea anemone (2) ***Coral*** **-** $CaCO_3$ Skeleton Ref ***Astraea*** **-** the star coral ***Pennatula*** **-** the sea pen ***orgonia*** **-** the sea fan ***Pteroides*** **-** Sea father ***Renilla*** **-** Sea feather ***Renilla*** **-** Sea pansy ***Tubipora*** **-** Organ - pipe coral ***Alyconium*** **-** Dead man's finger (Soft coral) ***Corallum*** **-** Ted coral (Moonga) ***Heliopora*** **-** Blue coral ***Oculina*** -Eye coral ***Meandrina*** **-** Brain coral ***Madrepora*** **-** Stag-Horn cor ***Fungia*** **-** Mushroom coal  Sea Anemone

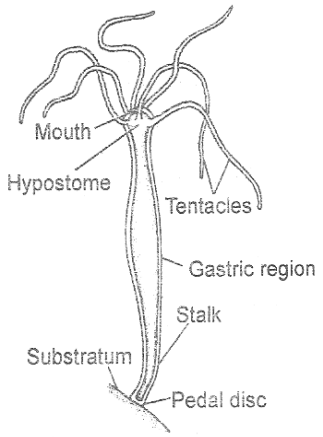
UNIQUE FEATURES

- Tissue level of organisation of the body
- Special stinging cells, the cnidoblats, for defence and offence.
- Ephithliomuscular cells with a dual role of epithelium and musculature.
- Incomplete digestive tract bounded by body wall.
- A simple nervous system in the form of a network of nerve cell and fibres.
- Simple gonands without gonoduct.

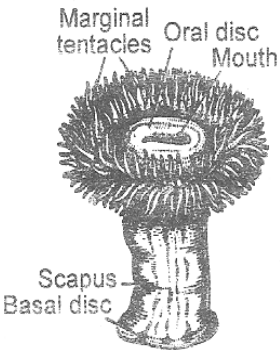
WITHNESS FEW COELENTERATES



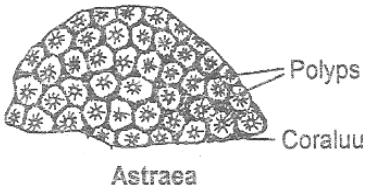
Representative of class - Hydrozoa - Physalia



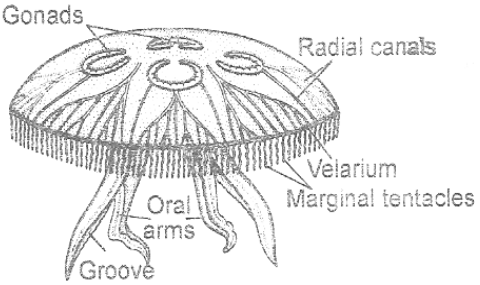
Hydra in extended : Contracted



Representative of class : Anthozoa (Metridium)



Astraea



Aurelia

