

# **GENERAL MORPHOLOGY**

# **HELMINTHES**

The name helminthes is derived from the Greek words helmins or helminthos, a worm

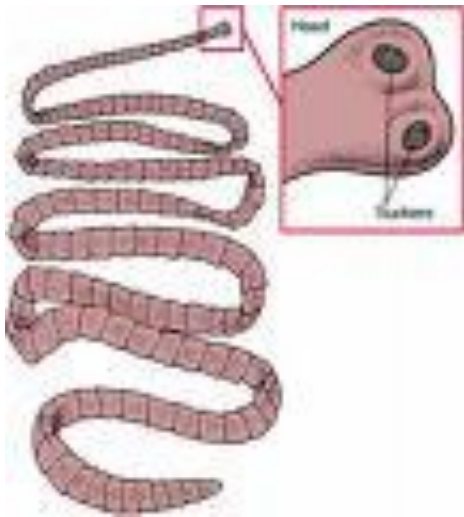
- Platyhelminthes - Flukes, tapeworms & other flatworms
- Nemathelminthes- round worm & their relatives.
- Acanthocephala - Thorny headed worm

The annelida (earthworm & leeches) are not helminthes, though some (eg. Leeches) may be parasite & others (earthworms) may serve as intermediate host for helminthes.

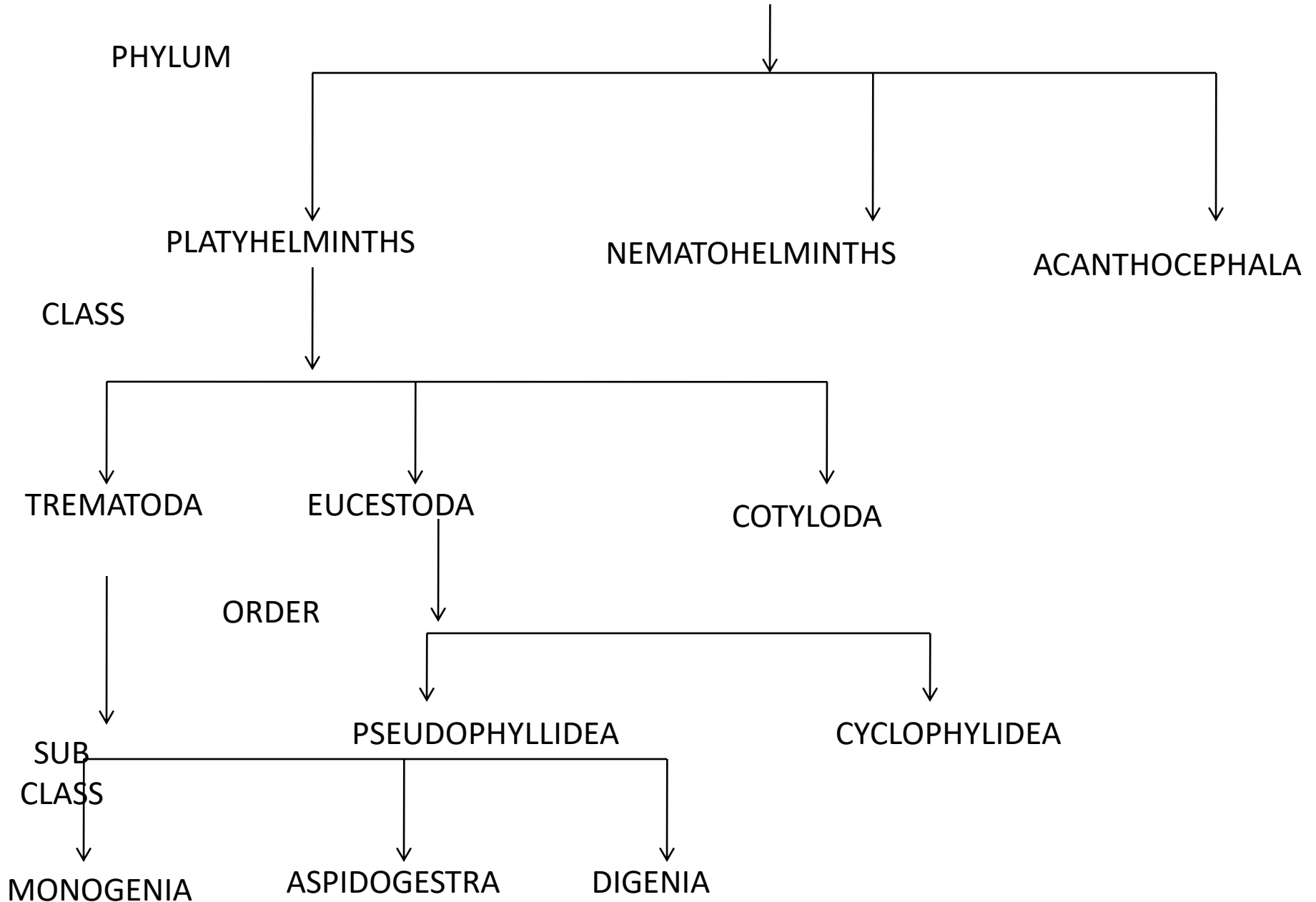
# Phylum : Platyhelminthes

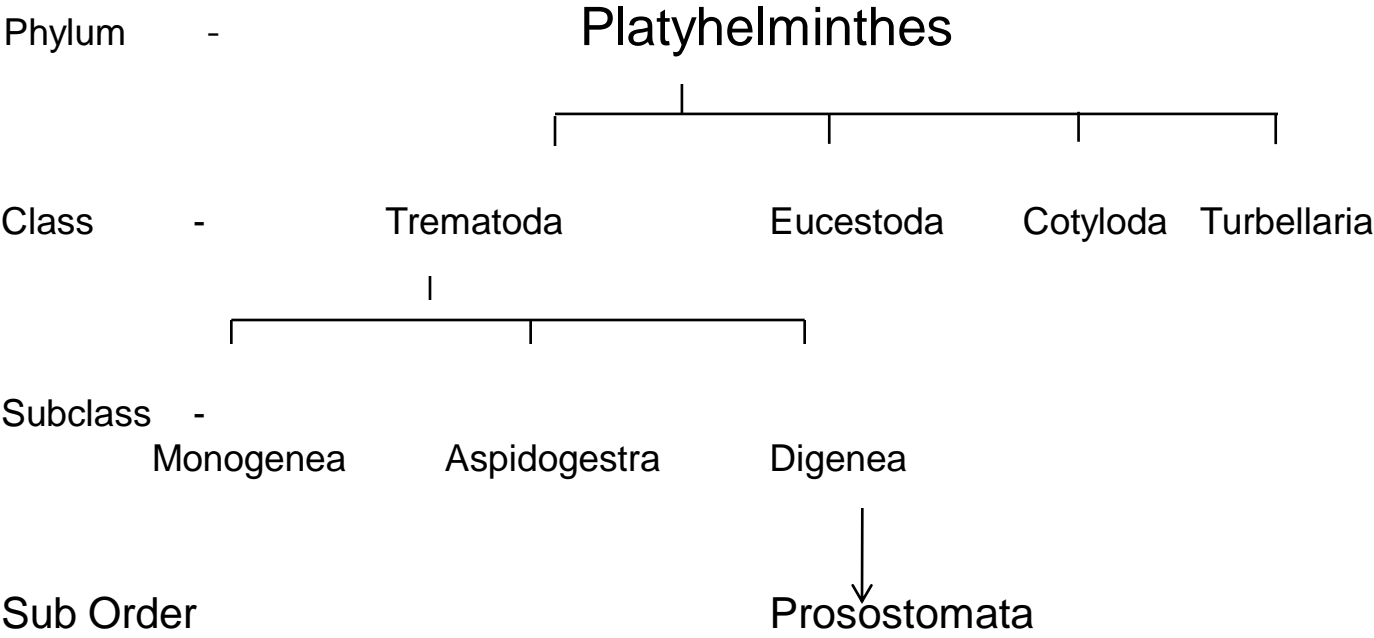
## Characters :

1. They are dorsoventrally flattened.
2. Usually hermaphrodite.
3. Solid body without a body cavity.
4. The organs are embedded in tissue called the parenchyma.
5. Excretory organs are flame cells.
6. Respiratory and blood vascular systems are absent.
7. Not metamerically segmented.
8. Most of the species are parasite except class Turbellaria.
9. The life history is usually indirect.



# HELMINTH PARASITE





## Class – Trematoda (Flukes)

1. Body is dorsoventrally flattened, unsegmented & leaf shaped.
2. All the organs are embedded in parenchyma (tissue).
3. No body cavity is present.
4. Suckers, hooks or clamps attached this species to the exterior or the internal organs of their host.



## Class – Trematoda (Flukes)

5. A mouth and an alimentary canal are present but usually there is no anus.
6. The mouth leads into a muscular pharynx, succeeding which is an intestine and this divided into two branches.
7. The branch excretory system has flame cells and it discharges in to a excretory bladder which usually have a posterior opening.
8. The reproductive system is hermaphrodite, except in the family schistosomatidae, which are unisexual.
9. The life history is direct (monogenea) or indirect (Digenea).





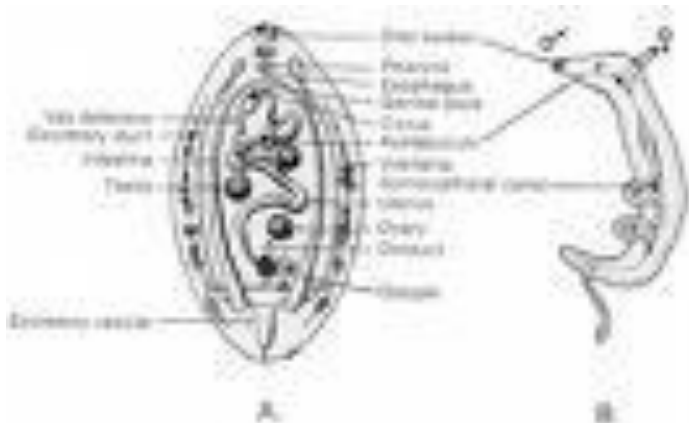
## Sub-Class - Monogenea

1. Parasitic chiefly on cold blooded aquatic or amphibious vertebrates (Fish, amphibious & reptiles).
2. Primarily ceto-parasites particularly of gills, skin, fin & buccal cavity.
3. There is a posterior adhesive organ or haptor which bear suckers, clamps and hooks.
4. Life cycle is direct.
5. Larvae which hatches from eggs are called **“Oncomiridium”**.

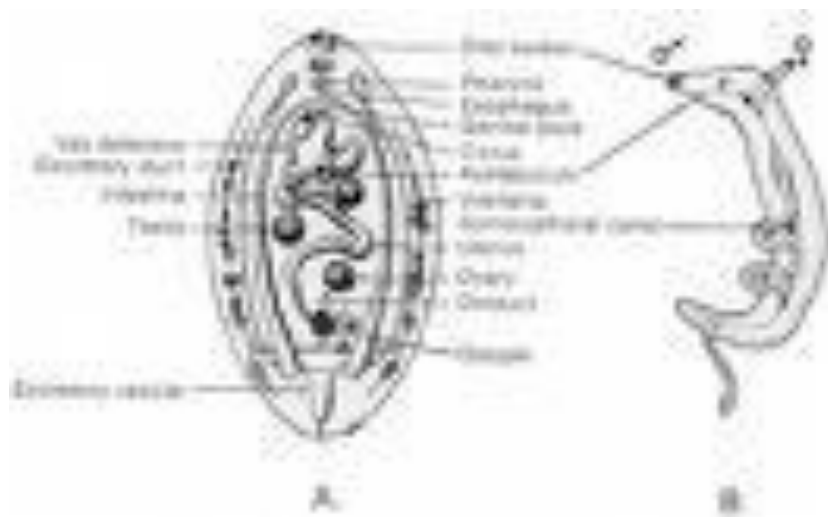


## Sub Class – Digenea

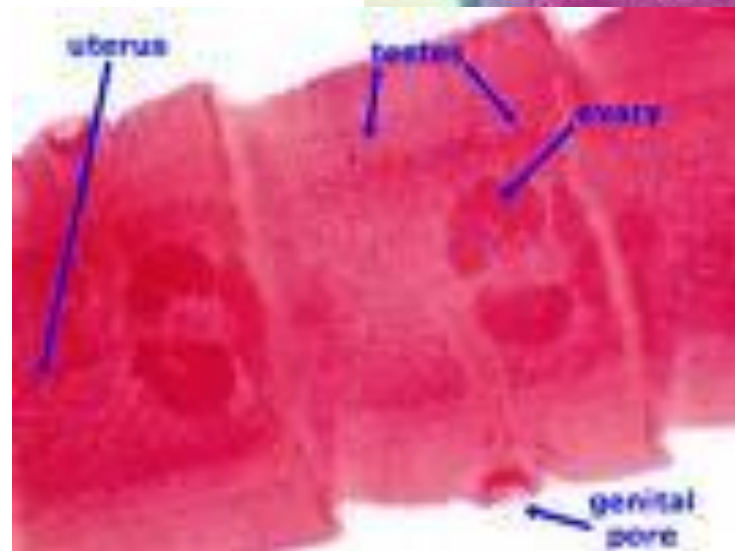
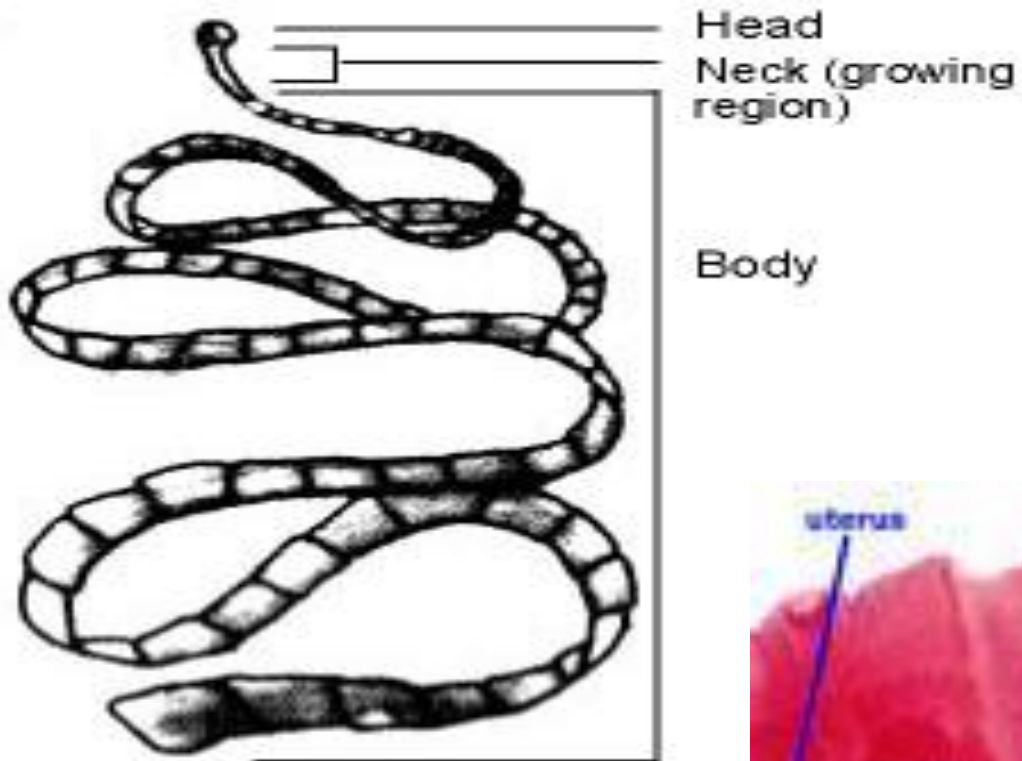
1. Dors ventrally flattened some long & narrow, some leaf shaped, while a few, the amphistomes have thick fleshy bodies, the schistosomes are long and worm like.
2. The cuticle/tegument may be smooth or spiny. The tegument is metabolically active surface like cestodes.
3. Body unsegmented consisting of one segment / piece.
4. These are generally two suckers (organ of attachment) one at anterior end called oral sucker and another called ventral sucker or acetabulum usually in the anterior third of the ventral surface but its position varies and in some forms the ventral sucker may be missing. In case of amphistomes, the ventral sucker situated in the posterior end of the body.



5. Digestive system open in the mouth surrounded by oral sucker, muscular pharynx, esophagus, intestine which leads to two blind caeca.
6. Length of intestinal caeca varies from genus to genus. It may be branched internally & externally both & may be sub branched in some particular genera.
7. Almost all species are endo-parasite of domestic animals.
8. Have indirect life cycle, a mollusc as 1<sup>st</sup> H & a vertebrate final host.
9. Larvae hatch from egg called miracidium have ciliated epithelium.



# CESTODES



1- They are flat ribbon like & usually very much longer than broad & vary in size from a few m.m. to several meters in length.

2- They are completely parasitic.

3- Body divided into 3 parts

(i) Head or scolex

(ii) Neck

(iii) Strobillus

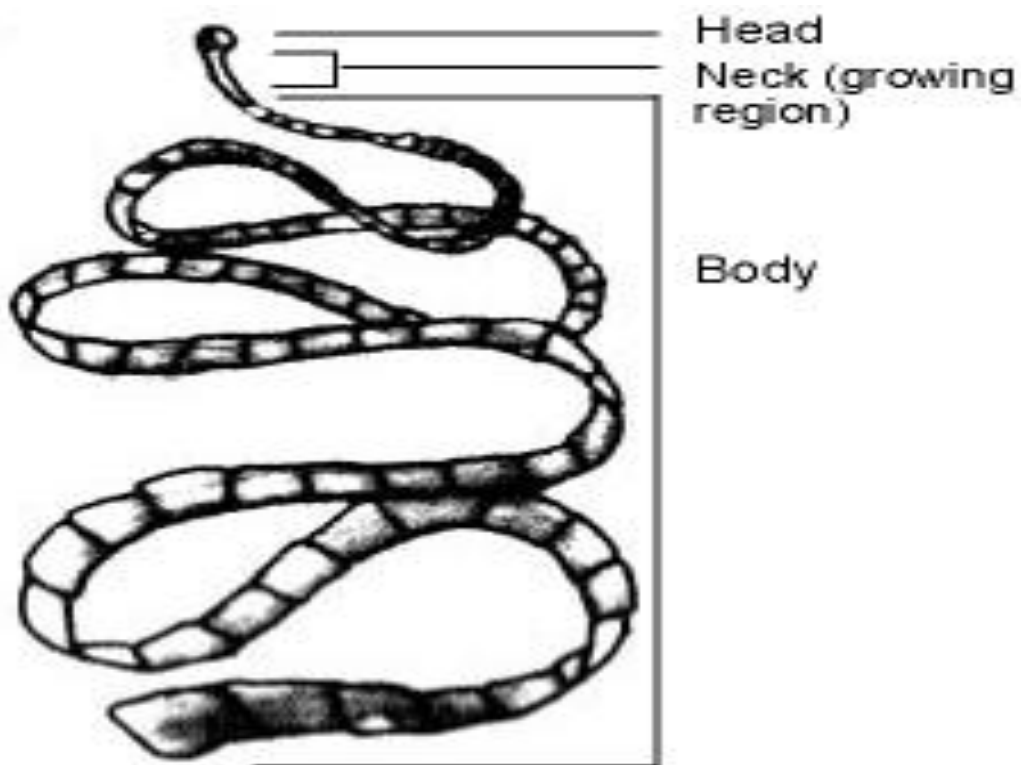
**Head or scolex :-** Globular in shape & having a rostellum (1), suckers (4), may or may not provided with hooks.

**Neck :-** neck is very small.

**Strobillus :-** stobila consist of a number of segments or proglottids.

- 4- Body surface is metabolically active.
- 5- Body cavity & alimentary canal are absent.
- 6- They are hermaphrodite.
- 7- Mature proglottides usually contains one or two sets of male & female reproductive organ.
- 8- Genital pore are marginal.
- 9- Life-cycle is indirect.

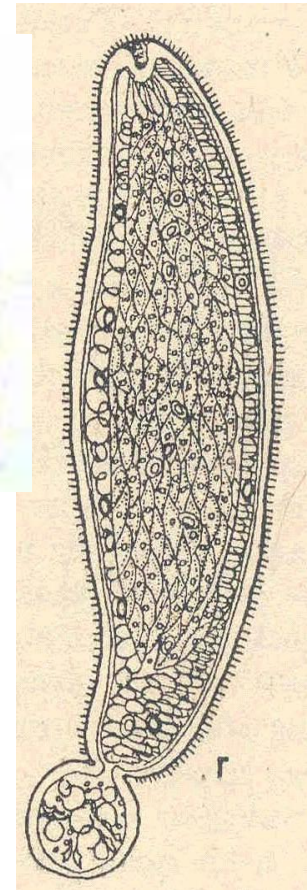
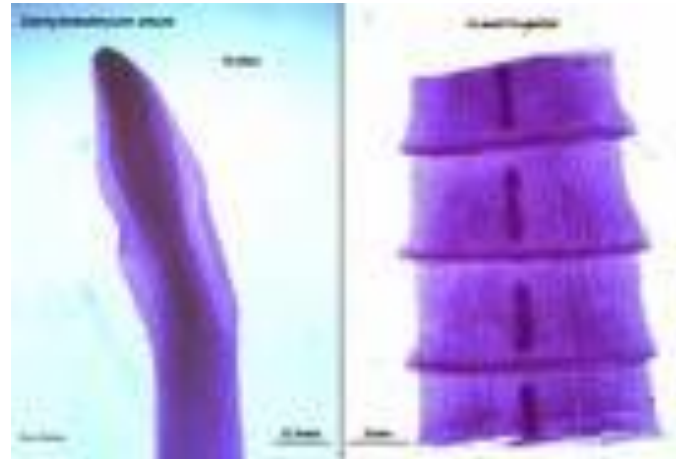






# CLASS - COTYLODA

## GENERAL MORPHOLOGICAL CHARACTER



*Diphyllobothrium latum*1



- 1- Head is spatula shaped & provided with bothria/groove-2 in no. (1 dorsal & 1 ventral).
- 2- Rostellum & suckers absent.
- 3- Genital pore is situated midventral surface.
- 4- Life-cycle is indirect.



# **DIFFERENCE BETWEEN EUCESTODE & COTYLODA**

## **EUCESTODE**

- 1- Head is globular in shape**
- 2- Rostellum & 4 suckers are present in head.**
- 3- Genital pore are marginal.**

## **COTYLODA**

- 1- Head is spatula shaped.**
- 2- Rostellum & sucker is absent.**
- 3- Genital pore is situated midventral surface.**

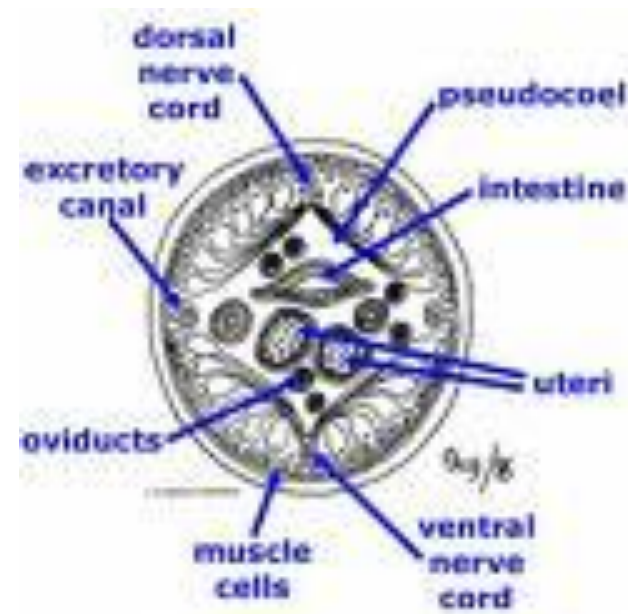
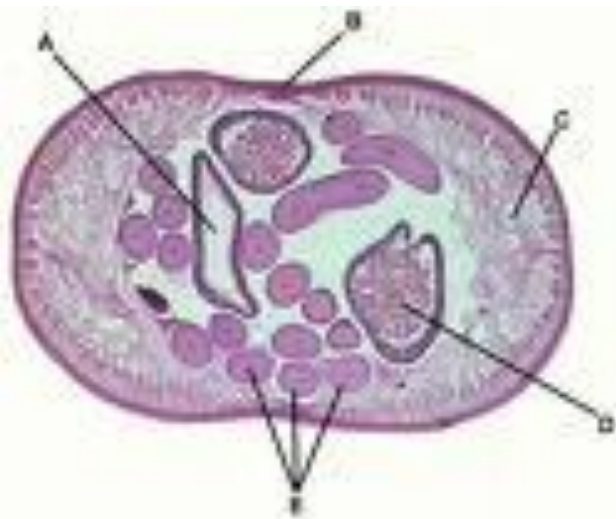
# Phylum: Nematelminthes

## Characters:

- 1) Cylindrical worm, both ends usually somewhat pointed.
- 2) The body is not metamerically segmented.
- 3) The cuticle, which usually looks smooth to the unaided eye, may show various cuticular structures under magnification but annulations are absent.
- 4) The alimentary canal, which is a tube usually consisting of a mouth at the anterior end of the worm a muscular pharynx & oesophagus & an intestine leading to an anus which is not terminal.
- 5) A short tail is present.



6. Between muscle cells and alimentary canal there is a percentile space filled with fluid.
7. Adult female are larger in size than male though both are similar to look at with a few exception.
8. Most are free-living found in water, soil and plant some are found in lower vertebrate. A very few are parasite on vertebrates especially on man and animal.
9. Nematodes are very host specific.
10. The L/C may be direct or indirect.
11. The sexes are in separate individual (Unisexual).



# 1. SUB CLASS – ADENOPHORED (APHASNIDIA)

- 1- PHASMIDA ABSENT.
- 2- OESOPHAGUS CYLINDRICAL.
- 3- CAUDAL PAPILLAE REDUCED OR ABSENT.

Order.-

ENOPLIDA



## 2. SUB CLASS - SECERNENTEA (PHASMIDIA)

- 1- PHASMIDA ARE PRESENT.
- 2- EXCRETORY CANALS ARE PRESENT.
- 3- EGGS ARE WITHOUT POLAR PLUGS.

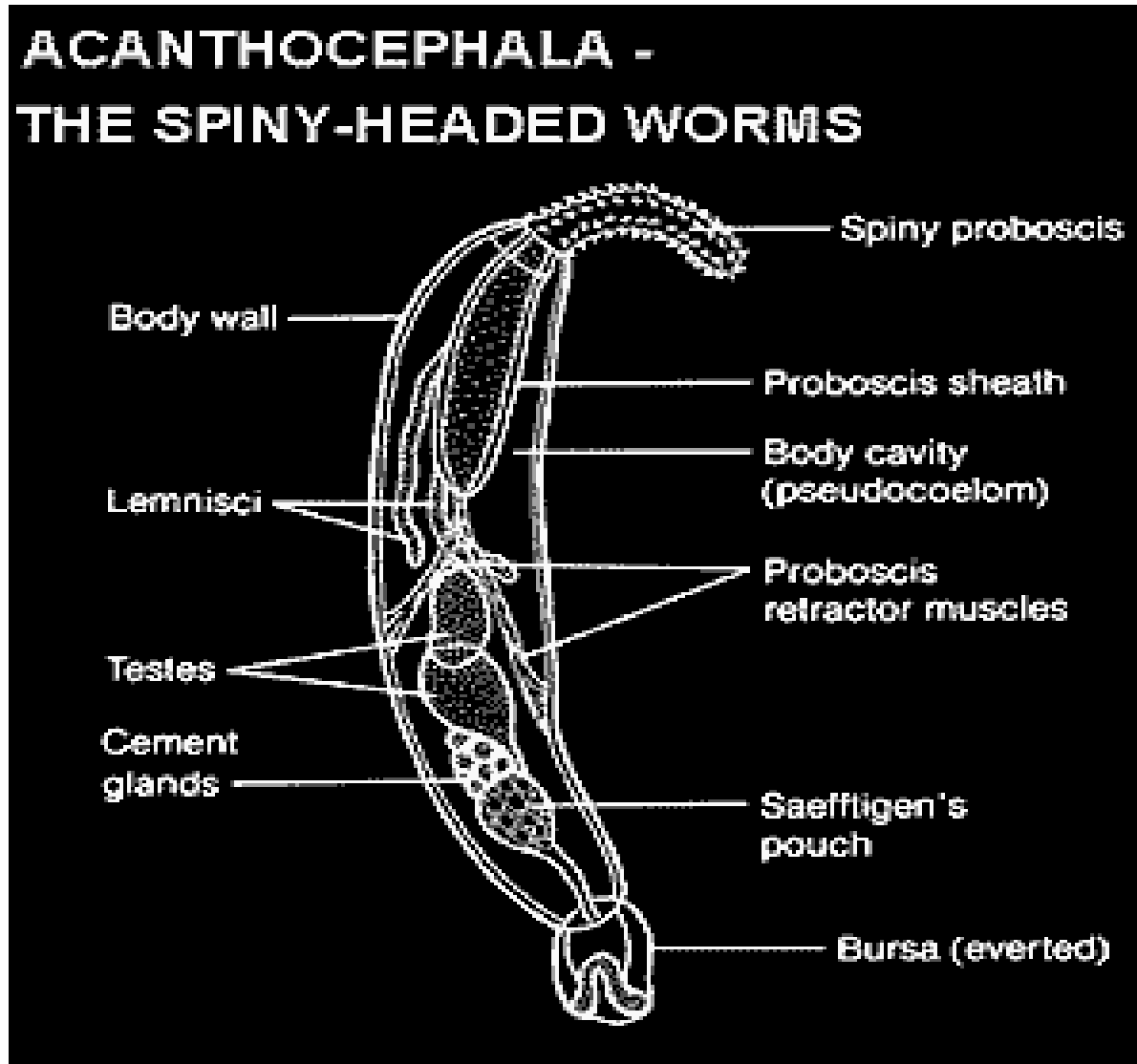
### Order

ASCORIDIDA- ROUND WORM  
HAVING LIFE CYCLE  
RHABDITIDE INTEREDIMATE  
HOST



<b>Nemathelminthes</b>	<b>Platyhelminthes</b>
1) Popularly known as roundworm.	1) Popularly known as tape worm or flukes or flatworms.
2) Body round/cylindrical in shape with both the ends are pointed or tapered.	2) Dorsoventrally flattened.
3) Having a body cavity.	3) Body cavity absent.
4) Alimentary canal & anus present.	4) Alimentary canal may or may not present but anus is absent.
5) Generally unisexual.	5) Generally hermaphrodites except family schistosomatidae.
6) L/C may be direct or indirect.	6) L/C usually indirect.
7) Excretory organs are lateral longitudinal canals.	7) Excretory organ is flame cells.
8) Mostly free living, a few are parasitic.	8) Mostly parasitic, except class turbellaria.

# ACANTHOCEPHALA

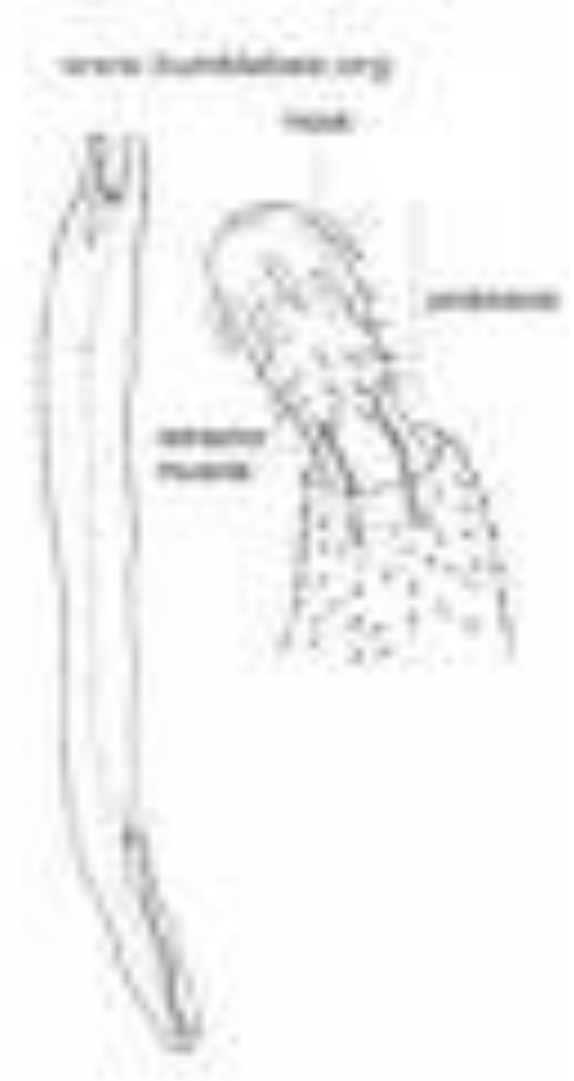


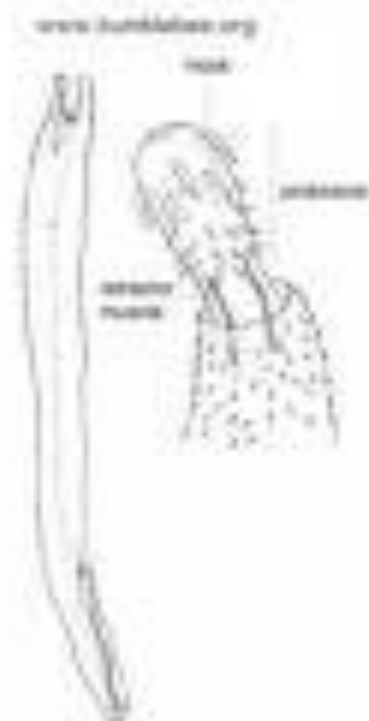


# External features

- Body is elongated, becoming tapered at both ends, with size ranging from 1.5mm-.5m in length.
- Body wall is covered with a thin epicuticle of muccopolysacchorides and a noncelbular cuticle (1 micron or less).
- Body is divided into two major regions- the presoma and the trunk.
  - Presoma is composed of the proboscis- a retractile organ armed with hooks and spines, and the neck- an unarmed region posterior to the proboscis.
  - Trunk is the major bulk of the animal, surface may be smooth, wrinkled, or irregularly ringed; some genera arm the trunk with spines.

- Proboscis serves as an attachment organ within the hosts intestine or for locomotion.
  - Contains alternating rows of hooks and spines in a definite pattern.
  - Hooks are larger structures with roots sunken deep in proboscis





# Internal Features:

- A. Body wall made up of epicuticle, and muscle layer.
- B. Syncytial epidermis is composed of three layers.
  - Thin outer layer of parallel radial fibers and pores extending into the middle layer.
  - Middle layer of randomly arranged fibers.
  - Very thick inner layer of radial fibers and a series of channels known as lacunae;s without definite walls but having

- Reproductive system is unique in Acanthocephala because the organs are suspended within a ligament sac.
- Alimentary Canal is Absent.
- Ligament sacs are hollow tubes of connective tissue.
  - Females have two sacs, a dorsal and a ventral.
  - Males have one sac, a dorsal enclosing the testes.
- Females generally longer than males.

- Digestive system- mouth, anus, and digestive tube are completely lacking, nutrients taken in via pores and diffusion.
- Circulatory system is absent.
- Excretory system consists of a mass of flame bulb protonephridia

## COLLECTION OF ACANTHOCEPHALA



# Differentiated with Nematode

- Worm are cylindrical.
- Body is unsegmented.
- Alimentary canal is present.
- The life cycle may be direct and indirect .
- They are free living or parasite.
- The sexes are separate or unisexual.
- Excretion is through canal or Gland.



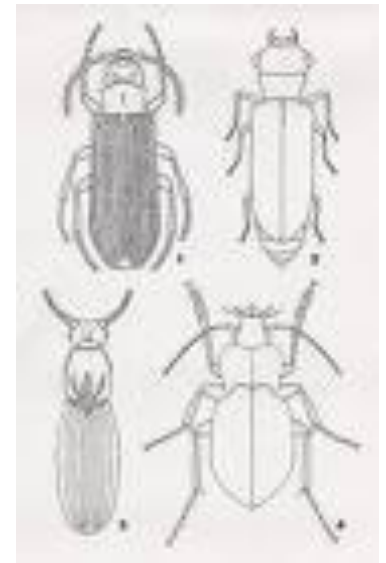
# Phylum-Arthropoda

# *General characteristics*

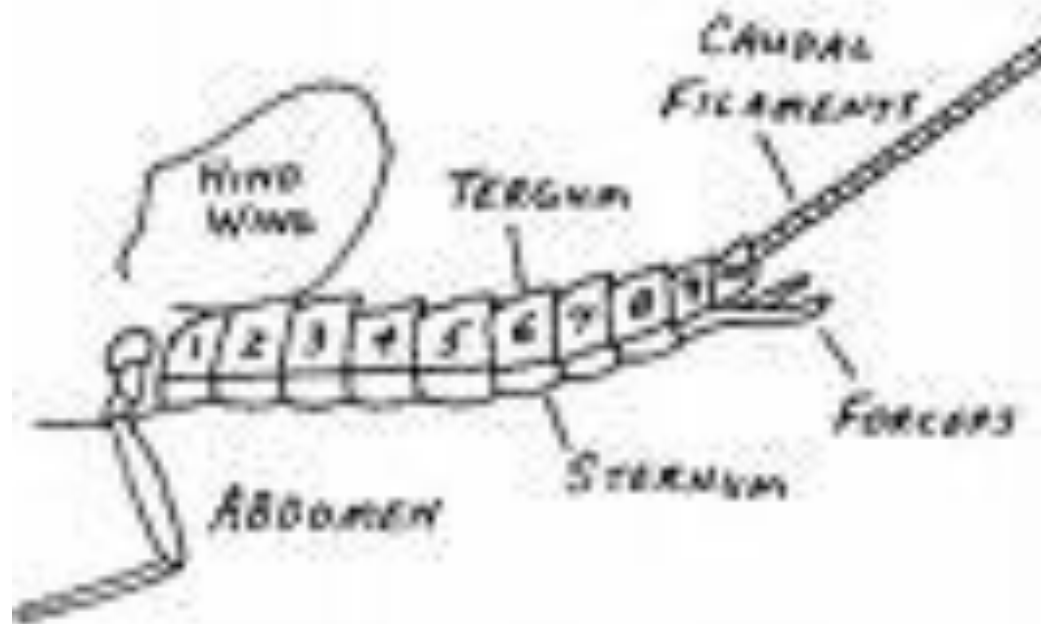
1. Body is segmented.
2. Segments are grouped to form 3 parts, *i.e.*, head, thorax and abdomen.  
In some forms head and thorax fuse to produce **cephalothorax**.
3. Anterior end is differentiated into distinct head. It is formed by the fusion of anterior six embryonic segments. The head bears well developed sense organs.



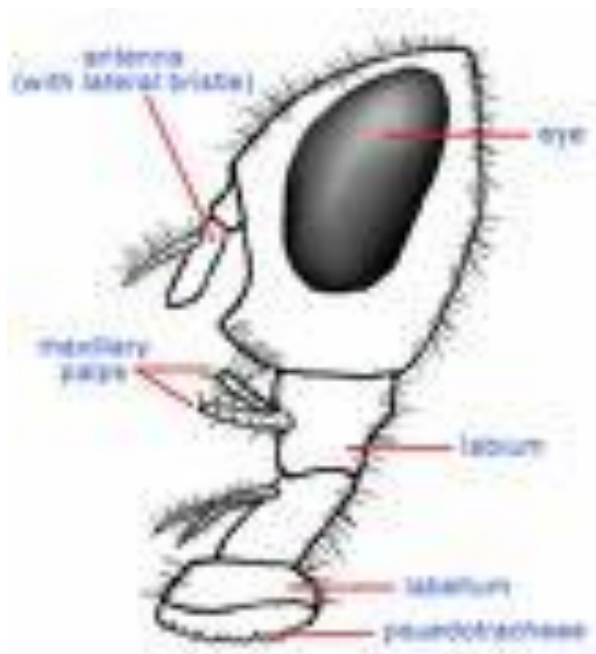
4. Appendages of arthropods are jointed, hence their name. They are paired and usually present one pair per segment. But in some forms they are restricted to certain segments only.
5. An exoskeleton made of **chitin** and strengthened with proteins and calcium carbonate occurs on the outside. It usually occurs in the form of plates called **sclerites**. Exoskeleton is secreted by the underlying epidermis.
6. Moulting or periodic casting of exoskeleton occurs to facilitate growth as the old exoskeleton becomes inelastic.



7. Muscles occur as continuous sheets, but are found in the form of bundles in various segments each specialized to move a particular segment. The muscles are striated.
8. The perivisceral body cavity is called **haemocoel** as it is full of **haemolymph** (blood). The true coelom is restricted to the gonads.
9. Animals are bilateral symmetrical.



10. Alimentary canal is complete. The mouth is surrounded by movable appendages called **mouth parts**, modified according to the habit of feeding of the animal.
11. In most of the forms cutaneous respiration is absent due to the presence of hard exoskeleton. Respiration takes place by special structures such as **gills, tracheae or book-lungs**.
12. Development can be direct (without I/H) or indirect (with I/H).



13. Circulatory system is of open or lacunar type i.e., blood flows in open spaces (lacunae) without any wall of their own. The blood is colourless and contains WBCs only. Dorsal pulsatile heart is present.
14. Excretion is brought about usually by green glands in aquatic forms and malpighian tubules (Insecta & Arachnida also have coxal glands) in terrestrial animals. (Nephridia occur in onychophores). Excretory product is ammonia/urea in aquatic forms and uric acid in terrestrial species.

15. The animals are unisexual/dioecious and exhibit the phenomenon of sexual dimorphism. Fertilization is internal.
16. The animals are oviparous. Ovovivipary is occasional, e.g., Scorpion.
17. Most of the arthropods possess an endocrine system which consists of neurosecretory cells in the brain, at the base of compound eyes and glands in the thorax.
18. Hormones control reproduction, moulting and metamorphosis.
19. Various sense organs found in arthropods include antennae, sensory hair for touch, chemoreceptors, simple and compound eyes, statocysts, etc.

# Classification of arthropods

The phylum Arthropoda includes the following classes of importance:

## **Class: CRUSTACEA LARMARK, 1815**

This class includes the crayfishes, lobsters, shrimps, crabs, woodlice and their relatives. Most of the species are aquatic and breathe by means of gills, but some, such as the wood—lice, are terrestrial. Crustacea have two pairs of antennae and numerous pairs of limbs on the thorax and abdomen and these limbs are frequently biramous. The class is divided into two subclasses.

- **Subclass: Entomostraca Muller, 1785**
- Species belonging to this subclass are usually small Crustacea with a variable number of body segments. The abdomen often ends in a caudal fork.
- To this subclass belong some species which are intermediate hosts of parasitic helminths, among which are the species of the genus *Cyclops*. which act as intermediate hosts of the tapeworm *Diphyllbothrium latum* and of the nematode *Dracunculus medinensis*, and *Daphnia*, which act as the intermediate hosts of the spiruroid nematode *Echinuria uncinata*.  
The subclass also contains the parasitic copepods, some of which are serious pests of fish culture.



- **Subclass: Malacostraca Latreille, 1802**
- Species belonging to this subclass are usually larger than the Entomostraca and possess a constant number of body segments. Typically there are eight segments in the thorax and seven in the abdomen. The character of the appendages clearly marks off the thorax and the abdomen.
- To this subclass belong the shrimps, lobsters, crayfishes and crabs. This subclass also includes important intermediate hosts of parasitic nematodes, among which are the terrestrial wood—lice and their aquatic relatives belonging to the genus *Asellus* and the 'freshwater - shrimp' *Gammarus pulex*.
- **CLASS: MYRIAPODA LANKESTER, 1904**
- Species of this class are the centipedes and millipedes. Their bodies consist of a number of segments which are, with the exception of the head, not grouped into definite body areas.
- There are two orders:
- (1) The *Diplopoda* (millipedes), which are chiefly vegetarian species and have two pairs of limbs on each segment of the body behind the head; some of them are serious pests of crops.
- (2) The *Chilopoda*. (centipedes), which are chiefly carnivorous and have one pair of limbs on each segment of the body behind the head; some species of them are useful enemies of other pests of garden and other crops and some are poisonous arthropods.

- **CLASS: INSECTA LINNAEUS, 1758**

This class includes all the insects. Their bodies are divided into three parts, namely, a *head*, which bears one pair of antennae, a *thorax*, consisting of three segments, which bears three pairs of legs and, typically, two pairs of wings, and an *abdomen*, consisting of a variable number of segments which either has no appendages or the appendages on it are modified for various special purposes. Insects breathe by means of tracheae.

- **CLASS: ARACHNIDA LAMARCK, 1815**

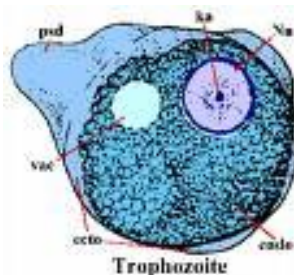
- This class includes the king—crabs, scorpions, spiders, ticks, mites and their relatives. They not only vary much in structure among themselves, but they also differ considerably from other arthropods.

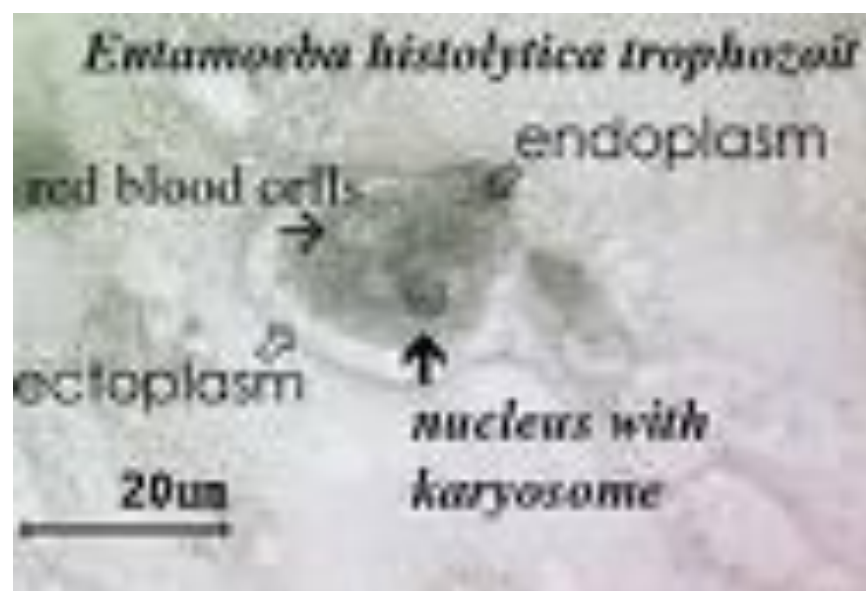
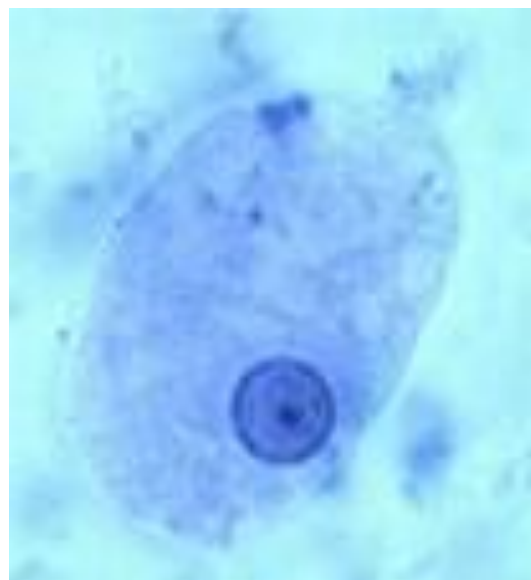
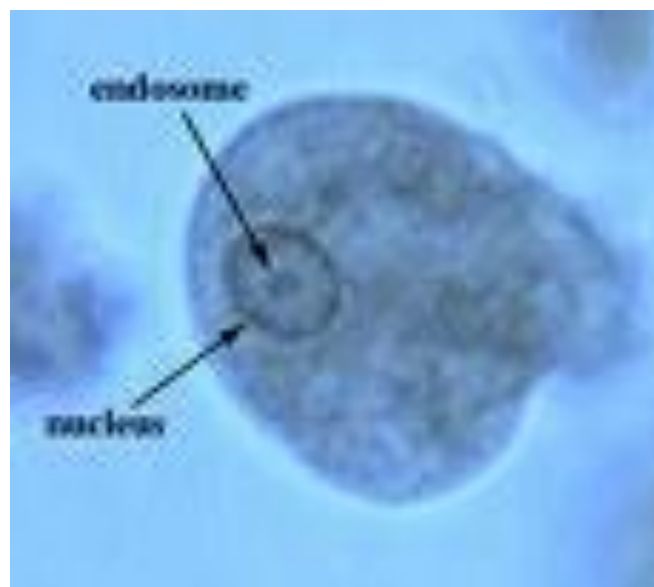
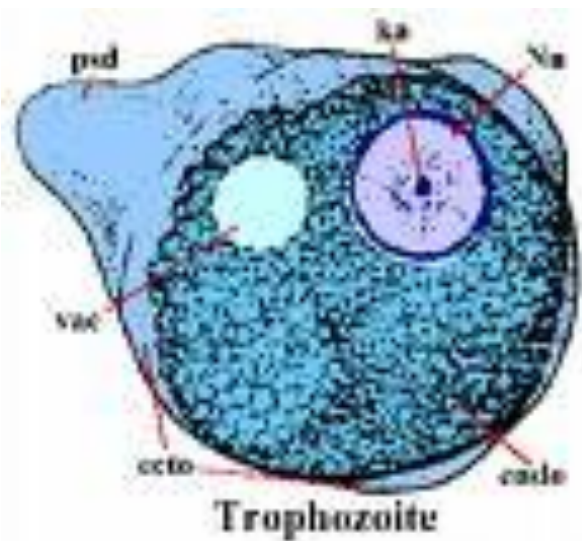
- **CLASS: PENTASTOMIDA HEYMONS, 1926**

- These are the tongue worms and are of uncertain systematic position: some consider them as arthropods, while others regard them as annelids; still others assign them to a distinct phylum.

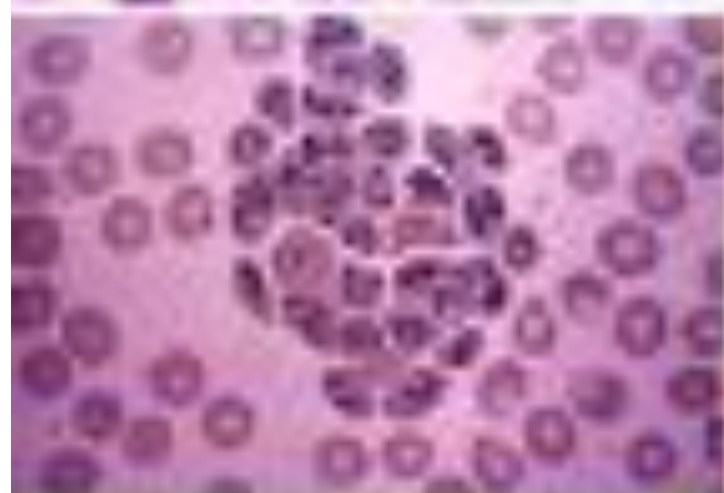
# PROTOZOA

1. Proto means first and zoan means animal.
2. The first animal life which appeared on this earth belonged to this category. It means that the plant and animal life had a common origin.
3. The flagellates which lost their chromatophores and turned their mode of nutrition from holophytic to holozoic, are considered to be the most primitive form of animal life.
4. The ciliates are most highly organised form of protozoa.
5. These are unicellular.
6. All the vital functions of life are stored in the tiny individual.





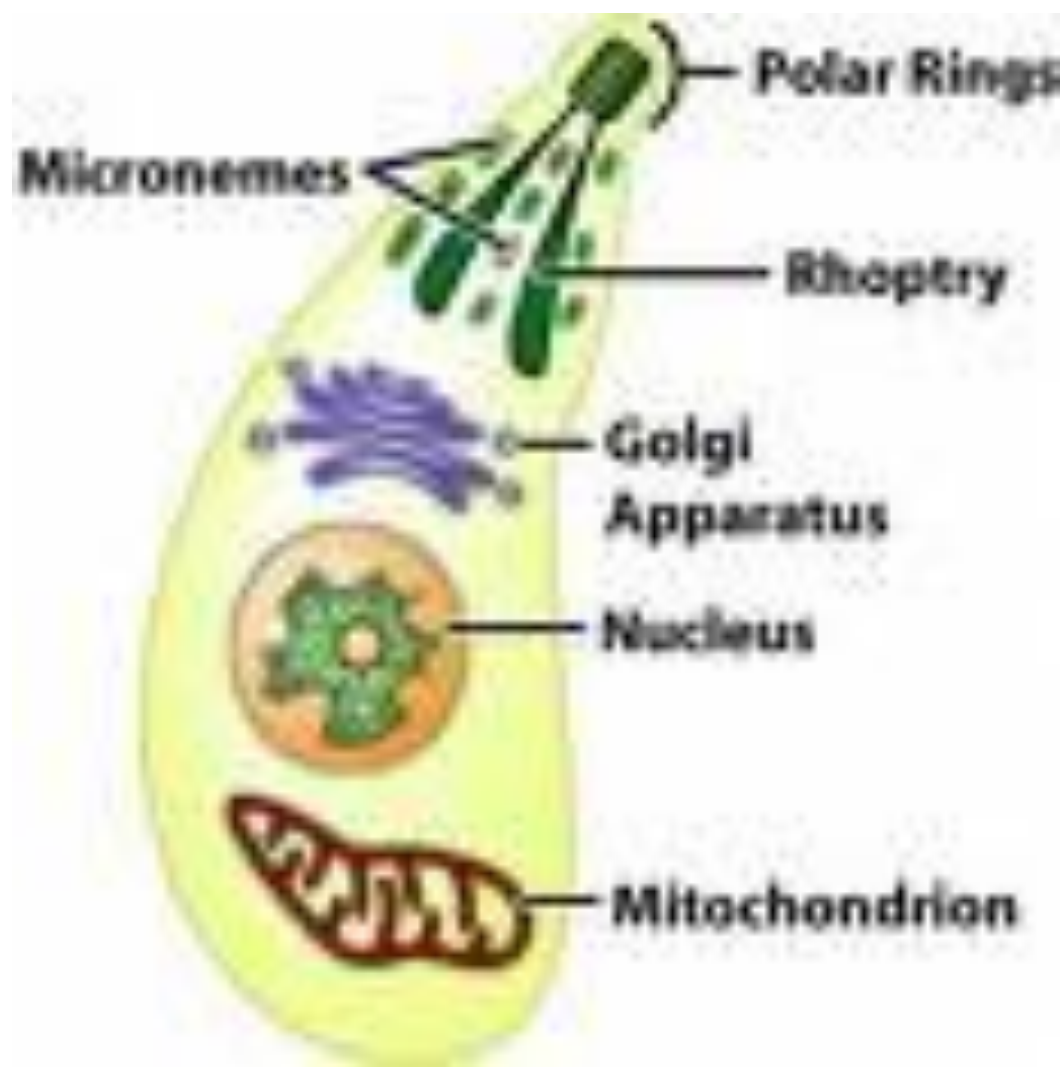
7. At present more than 65,000 species of protozoa are known. The majority of them are free living, either on land or in water. Nearly 7000 species are parasitic both in vertebrate and invertebrate animals. Some of them live as commensals with other organisms and some of them are great benefit to the host.
8. However, a comparatively, small number of them are truly parasitic and of great veterinary and medical importance. The protozoa are unicellular animals in which the various activities of metabolism, locomotion, etc. are carried out by organelles of the cell.
9. Comparable forms occur in the plant kingdom (unicellular plants) and, in general, protozoa are differentiated from these by the absence of chlorophyll-containing chromatophores and their mode of nutrition (holozoic).





## Protozoa

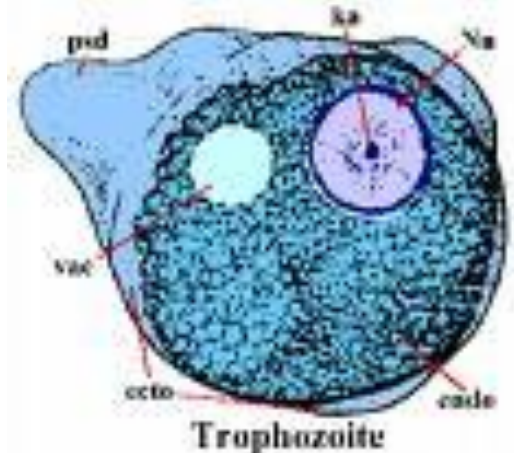
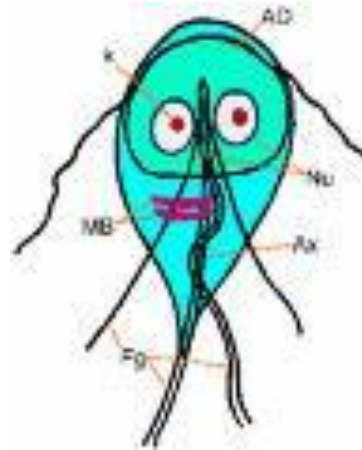
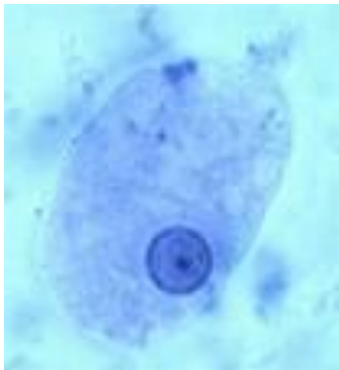






# General characteristics of Protozoans

1. Protozoa are unicellular or acellular animals of different shape and size.
2. The nucleus is well defined and enclosed in a nucleoplasm. It may be either vesicular (*Trypanosoma*) or compact (*Balantidium*),
3. There are some species which have two similar nuclei (*Giardia*) or two dis-similar nuclei (*Balantidium*).
4. Cytoplasm may be divided into ectoplasm and endoplasm. The endoplasm may contain granules, vacuoles and some times pigments.



# *General characteristics of Protozoans*

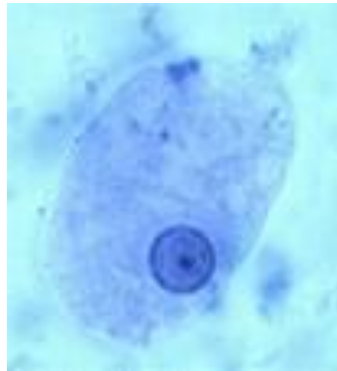
5. Locomotion is either by gliding (*Sarcocystis*, *Toxoplasma*) or by means of pseudopodia (*Entamoeba*) flagella (*Mastigophora*) or cilia (*Balantidium*).
6. Nutrition may be holozoic (*Entamoeba*, *Balantidium*), holophytic, or saprozoic.
7. Reproduction is either asexual by simple binary fission (flagellates) or by both asexual (binary fission, budding, multiple fission or schizogony or merogony) followed by sexual processes (gametogony), e.g. apicomplexa or conjugation, e.g. ciliates.

# Nucleus

Protozoa are *eukaryotic* (nucleus enclosed in a membrane) whereas the bacteria are *prokaryotic* (nucleus dispersed in cytoplasm).

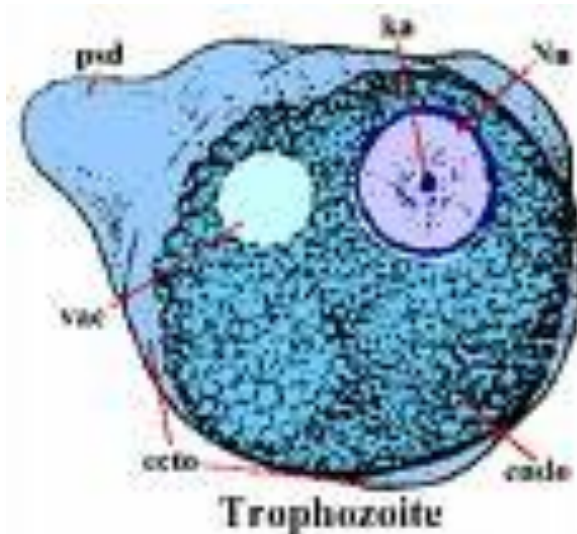
Usually only one nucleus is present, although in some forms more than one nucleus may be present in some or all stages of development.

The vesicular type of nucleus is seen most commonly in the Mastigophora and the Sarcodina.



# • *Cytoplasm*

This is the extranuclear part of the protozoan cell. It may be differentiated into an outer ectoplasm and an inner endoplasm, the former often being homogeneous and hyaline in appearance and the latter frequently containing granules, vacuoles and sometimes pigment. In some forms (e.g. Sarcodina) there is no definite limiting membrane, but usually a pellicle serves as such in the majority of species.



# • Locomotion

Protozoa may move by gliding or by means of pseudopodia, flagella or cilia. **Gliding** is seen in *Toxoplasma*, *Sarcocystis* and other forms, this being achieved without the aid of cilia or flagella.

**Pseudopodia** are used by the amoeba-like organisms, the structures being temporary locomotor organelles which are formed when required and retracted when not needed.

**Flagella** are whip—like filamentous structures which arise from a basal granule or blepharoplast in the cytoplasm of the organism. They are composed of a central axial filament, the axoneme, which is surrounded by a contractile cytoplasmic sheath . Flagella are typically seen in the Mastigophora.

**Cilia** are fine, short, flagella—like structures originating from a basal granule embedded in the pellicle or ectoplasm. They are the organs of locomotion in the ciliates, but they may also aid in the ingestion of food or serve as tactile structures.

- ***Organelles for nutrition***

In the amoeba—like forms, particulate food material is acquired by means of pseudopodia. An advance on this is a specialized opening called the cytostome through which food particles are engulfed and passed to food vacuoles. In the ciliates the cytostome may be lined with cilia which further assist in the ingestion of food.

*Food vacuoles* occur in the cytoplasm and contain particulate material in various stages of digestion. Non—digestible material may be extruded from the cell either via a temporary opening or through a permanent cytoppyge.

Excretion of waste products may occur directly through the body wall or by means of contractile vacuoles which periodically discharge waste material through the body wall or, in a few instances, through an anal pore.

# NUTRITION OF PROTOZOA

**Nutrition may be holophytic, holozoic or saprozoic.**

The *holophytic* protozoa are forms which possess characteristics of plants, carbohydrates being synthesized by chlorophyll which is carried in chromatophores or in the bodies of algae or other protophyta which inhabit the cytoplasm of the protozoan. None of these forms is of medical or veterinary importance.

The *holozoic* protozoa utilize preformed food material derived from living animals or plants. Food material is ingested by pseudopodia or through a cytostome and passes to a food vacuole for digestion. Some forms (e.g. *Entamoeba*, *Balantidium*) ingest the tissue cells of the hosts.

The *saprozoic* protozoa absorb nutrients through the body wall, these being utilized directly by the organisms.  
Stored food material.

- **Reproduction**

Reproduction in the protozoan may be either asexual or sexual. *Binary fission* is the commonest form of asexual reproduction. In this two daughter cells result from a 'parent' cell, division being along the longitudinal axis, although in ciliates it along the transverse axis. The nucleus divides first and cytoplasmic division follows.

In ***schizogony***, an asexual form of reproduction the nucleus divides several times before the cytoplasm does. New progeny are formed along the plasmalemma of the parasite.

In some of the sporozoans the nucleus of the parent cell divide mitotically into a large number of nuclear bodies, each of which becomes associated with a portion cytoplasm and little or nothing of the parent cell remains except the greatly expanded limiting membrane. The dividing form is known as schizont and the daughter forms are merozoites.

***Budding*** is an asexual reproductive process in which two or many daughter forms are produced by the 'parent' cell. There is usually an unequal fragmentation of the nucleus and cytoplasm, but the budded forms are separated off and then grown to full size.



*Endopolyogeny* is a form of asexual multiplication (internal budding) whereby new progeny are formed within the parent cell. *Endodyogeny* is a simplified form of endopolyogeny, resulting in two daughter cells. It is seen in forms such as *Toxoplasma* and *Sarcocystis*.

*Conjugation* is a form of sexual reproduction which occurs in the ciliates. In this, two organisms pair and exchange nuclear material (from the micronucleus). The individuals separate and nuclear reorganization takes place.

*Syngamy* is sexual reproduction in which two gametes fuse to form a zygote. The male gamete is a microgamete and the female a macrogamete which are produced from microgametocyte (microgamonts) and macrogametocytes (macrogamonts), respectively. The process of gamete formation is gametogony, and the gametes may be similar in size (isogamy) or may markedly differ (anisogamy).

*Sporogony* normally follows syngamy, and a number of, or very many, sporozoites are formed within the walls of a cyst. This is an asexual process of multiple fission.

# ***Classification of Protozoa***

- **More than 65000 protozoans have been described. The classification of protozoa is constantly being changed due to more and more information and discoveries being done on morphology, life cycle, cytology, electron microscopy and biochemistry.**
- **According to biologists the classification of species is based on differences in morphological, physiological, behavioral aspects while the differences in genera are based on their relation to the gene pool of the population to which they belong.**
- **protozoa is a sub-kingdom of the kingdom : Animalia. In this the ending for orders and sub-orders are -ida and -ina respectively, for class and sub-class -ea and -ie and for higher taxa, -a. The main phyla of veterinary importance are: Sarcomastigophoria, Apicomplexa and Ciliophora.**

**The parasitic flagellates are now grouped together with the amoebae and certain amoebae like species in the Phylum-Sarcomastigophora sub-phylum: Mastigophora, class: Zoomastigophorea.**

### ***Phylum : Sarcomastigophora.***

- 1. With flagella, pseudopodia or both.**
- 2. Nucleus is single.**
- 3. No spore formation.**
- 4. Sexuality when present, essentially syngamy.**

### ***Phylum : Ciliophora.***

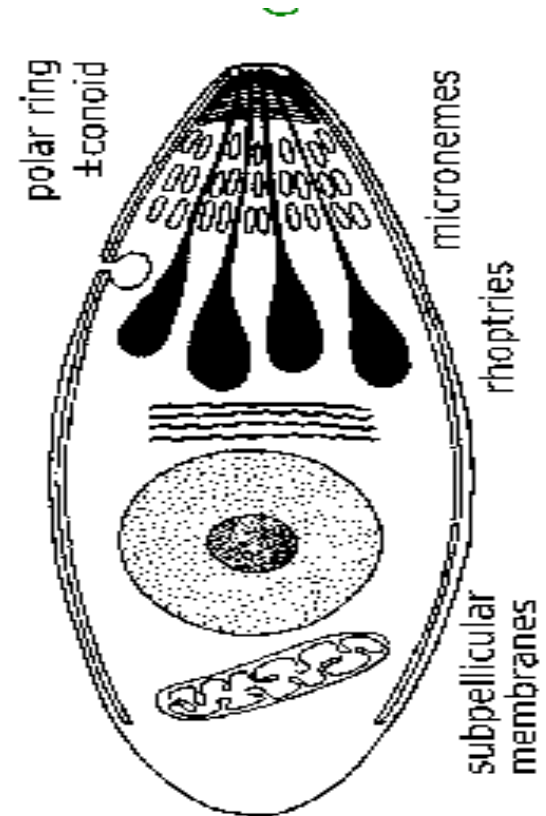
- 1. Simple cilia or compound ciliary organelles typical in at least one stage of life cycle.**
- 2. Usually with two types of nucleus.**
- 3. Asexual reproduction by transverse binary fission, but budding and multiple fission also occur.**
- 4. Sexuality involving conjugation.**
- 5. Contractile vacuole typically present.**

### ***Phylum: Apicomplexa.***

- 1. Apical complex generally consisting of polar ring (s), rhoptries, micronemes, conoid, and sub-pellicular microtubules present at some stage.**
- 2. Micropore (s) generally present at some stage.**
- 3. Sexual reproduction by syngamy.**
- 4. All species are parasitic.**

# PROTOZOA

- ✓ The protozoa are unicellular animals in which the various activities of metabolism, locomotion, etc.
- ✓ Are carried out by organelles of the cell.
- ✓ Comparable forms occur in the plant kingdom (unicellular plants) and, in general, protozoa are differentiated from these by the absence of chlorophyll – containing chromatophores and their mode of nutrition (holozoic).



- ✓ The protozoa, on the other hand, have a well-defined nucleus and do not have a rigid cell wall, allowing , at times a marked variation in size and shape.
- ✓ Since the discovery of protozoa by Antoni van Leeuwenhoek, some 45000 species have been described.
- ✓ The majority of these are free-living and are found in almost every habitat on land and in water.
- ✓ Although the parasitic protozoa are smaller in numbers, they nevertheless assume an important role as producers of global disease which, apart from producing death or deformity, saps the energy and initiative and decays the moral fibre of mankind in many parts of the world.

# STRUCTURE OF PROTOZOA

## Nucleus

- ✓ Protozoa are eukaryotic (nucleus enclosed in a membrane).
- ✓ The vesicular type of nucleus consists of a nuclear membrane which bounds the nucleoplasm in which, lying more or less central is an intranuclear body, the endosome or the nucleolus.
- ✓ The compact type of nucleus contains a large amount of chromatin and a small amount of nucleoplasm.

- ✓ **This is the extranuclear part of the protozoan cell.**
- ✓ **It may be differentiated into an outer ectoplasm and an inner endoplasm, the former often being homogeneous and hyaline in appearance and the latter frequently containing granules, vacuoles and sometimes.**

- **Gliding is seen in toxoplasma.**
- **Pseudopodia amoeba-like organisms.**
- **Flagella.**
- **Cilia.**



# **PREPRODUCTION OF PROTOZOA**

- ✓ **Reproduction in the protozoan may be either asexual or sexual.**
- ✓ **Binary fission is the commonest form of asexual reproduction.**
- ✓ **In schizogony, an asexual form of reproduction, the nucleus divides several times before the cytoplasm does.**
- ✓ **New progeny are formed along the plasmalemma of the parasite.**

- ✓ **The dividing form is known as a schizont and the daughter forms are merozoites.**
- ✓ **Budding is an asexual reproductive process in which two or many daughter forms are produced by the 'parent' cell.**
- ✓ **Endopolyogeny is a form of asexual multiplication (internal budding) whereby new progeny are formed within the parent cell.**
- ✓ **Endodyogeny is a simplified form of endopolyogeny, resulting in two daughter cells. It is seen in forms such as Toxoplasma and Sarcocystis.**

- ✓ **Conjugation is a form of sexual reproduction which occurs in the ciliates.**
- ✓ **Syngamy is sexual reproduction in which two gametes fuse to form a zygote.**
- ✓ **Sporogony normally follows syngamy, and a number of, or very many, sporozoties are formed within the walls of a cyst. This is an asexual process of multiple fission.**

# CLASSIFICATION OF PROTOZOA

- **Protozoa include four major phylum .**
  - **Sarcomostigophora**
  - **Apicomlexa.**
  - **Ciliophora.**
  - **Myxospora.**
- **The classification of the phylum protozoa adopted .**

<b>Sub Kingdom</b>	<b>Protozoa</b>	
<b>Phylum</b>	<b>Sarcomastigophora</b>	<b>With flagella,pseudopodia or both; single nucleus; typically no spore formation; sexuality when present, essentially syngamy.</b>
<b>Subphylum</b>	<b>Mastigophora</b>	<b>One or more flagella present in trophozoites; asexual reproduction basically binary fission, sexual reproduction unknown in many groups.</b>
<b>Class</b>	<b>Phytomastigophorea</b>	<b>Chromatophores present' commonly only one or two emergent flagella; mostly free-living.</b>

<b>Sub Kingdom</b>	<b>Protozoa</b>	
<b>Class</b>	<b>Zoomastigophorea</b>	<b>Chromatophores absent; one to many flagella; amoeboid forms, with or without flagella, in some groups; sexuality in some groups; pre-dominantly parasitic</b>
<b>Order</b>	<b>Rhizomastigida</b>	<b>Pseudopodia and /or one to four flagella; mostly free-living.</b>
<b>Order</b>	<b>Kinetoplastida</b>	<b>One to four flagella, kinetoplast with mitochondrial amnities. Mostly parasitic Leaf-like, may be rounded.</b>

<b>Sub Kingdom</b>	<b>Protozoa</b>	
<b>Order</b>	<b>Retortamonadida</b>	<b>Two or four flagella; one turned posteriorly and associated with ventreal cytostomal area</b>
<b>Order</b>	<b>Diplomonadida</b>	<b>Bilaterally symmetrical; with two karyomastigonts, each with four flagella. Mostly parasitic.</b>
<b>Order</b>	<b>Trichomonadida</b>	<b>Typically four to six flagella, one recurrent and attached to undulating membrane if present, axostyle present' sexuality unknown; true cysts unknown. Parasitic</b>

<b>Sub Kingdom</b>	<b>Protozoa</b>	
<b>Subphylum</b>	<b>Sarcodina</b>	<b>Pseudodia typically present; flagella when present restricted to developmental stage; asexual reproduction by fission, sexual reproduction if present usually by flagellate gametes. Mostly free living</b>
<b>Superclasses</b>	<b>Rhizopoda</b>	<b>Locomotion by formation of podia; nutrition phagotrophic.</b>
<b>Order</b>	<b>Amoebida</b>	<b>Naked; usually uninucleate. Free-living and parasitic.</b>



<b>Sub Kingdom</b>	<b>Protozoa</b>	
<b>Phylum</b>	<b>Myxospora</b>	<b>Amoeboid germinal elements in multicellular spores' trophozoites multicellular showing differentiation of somatic and germinal element; all species parastic.</b>
<b>Class</b>	<b>Myxosporea</b>	
<b>Order</b>	<b>Myxosporid a</b>	<b>Parasites of cold-blooded vertebrates. Various genera in fishes.</b>

<b>Sub Kingdom</b>	<b>Protozoa</b>	
<b>Phylum</b>	<b>Ciliophora</b>	<b>Simple cilia or compound ciliary organelles in at least one stage of life-cycle; usually two types of nucleus, transverse binary fission; sexuality involving conjugation. Mostly free living</b>
<b>Class</b>	<b>Kinetofragminophorea</b>	<b>Characters of subphylum.</b>
<b>Order</b>	<b>Trichostomatida,</b>	<b>Vestibulum near anterior end of body with cylostome at its base; ciliation uniform. Digestive tract</b>