Invertebrates 1

BGS 115

(Theoretical Part)

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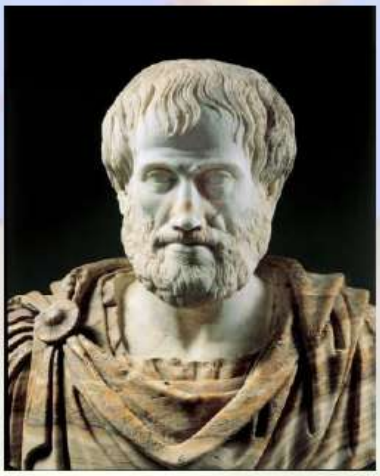
Animal taxonomy: It is the branch of Zoology concerned with the identification, description, nomenclature and classification of different kinds of animals.

Currently, more than a million animal species are known to facilitate their study and to understand the various relationships between their groups.



Aristotle

The Greek philosopher Aristotle (384-322 B.C.) was among the earliest scientists who attempted classifying living organisms. He proposed classifying animals on the basis of the presence or absence of red blood into two groups: Enaima (with blood cells) and Anaima (without blood cells).

John Ray

This was followed by other attempts to classify animals according to the environment they live in as terrestrial, aquatic and aerial, or according to the type of food they use into carnivorous and herbivorous.

Gradually, however, the idea of classifying animalswas emerged according to the morphological similarities between them. This idea was formulated clearly in the 17th century by the English naturalist John Ray (1627-1705) whose system can be considered as the first scientific approach to animal classification. Moreover, he was the first to give a precise definition of the species, the basic unit for classification of living organisms. He defined the species as" an assemblage or grouping of animals which are morphologically similar and which interbreed freely with one another, but they commonly do not interbreed with other species, and if they do so, they produce infertile (sterile) hybrids".

Linnaeus

Later the Swedish naturalist Linnaeus (1707-1778) came and laid down the basis of the system of classification we use nowadays. He classified living organisms according to the morphological and anatomical similarities between them. He also devised the system of binomial nomenclature by which each type of organism is given a name composed of two

words; the first is the name of the genus, and the second is the name of the species. Both are Latin and are written underlined or typed in italics. The name of the genus starts with a capital letter and that of the species with a small letter.

Nowadays, the classification of animals is not based upon morphological and anatomical features but also on biochemical, genetical, embryological and physiological characters.

Species having many features in common are placed in the same genus.Similarly, related genera are grouped in a family, and families with certain common characteristics constitute an order, and orders in turn are grouped into classes. From these classes, the higher taxonomic groupings known as phyla are formed. Although the relationships between the different phyla may not be obvious, it is always possible to arrange them according to the degree of complexity of structure and function into larger groups known as subkingdoms or branches (Figure 1).

There are other groups between each two successive groups of the previously mentioned levels (Ex.Subphylum, Suborder, Subfamily, Subgenus)

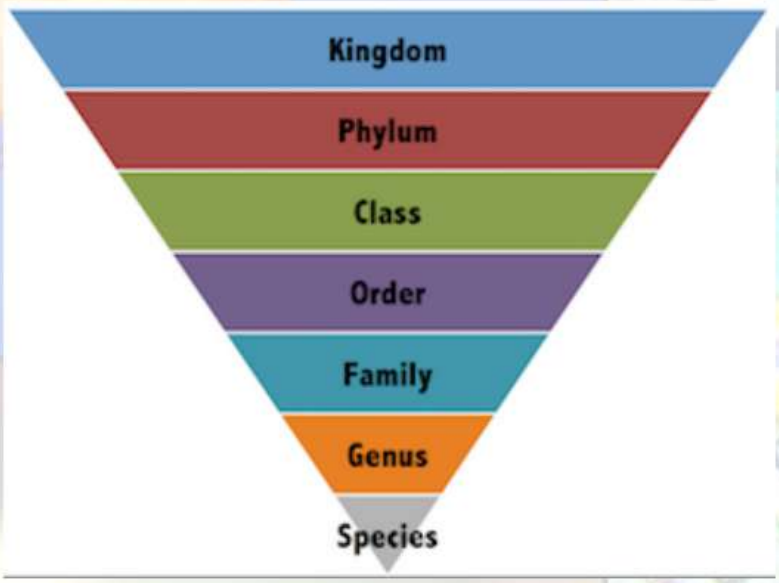


Figure 1: Linneaus's system

Thus, the animal kingdom is classified into three subkingdoms:

1- Subkingdom Protozoa: This subkingdom includes a single phylum, Phylum Protozoa, the members of which are referred to as unicellular animals (acellular) since the body of each is formed of a single protoplasmic mass that performs all life activities.

2- Subkingdom Parazoa: this includes a single phylum, Phylum Porifera, the members of which are simple multicellular animals commonly known as sponges. The body of the animal is formed of many cells which are not much differentiated and do not form proper tissues.

3- Subkingdom Metazoa: This includes the rest of the animal phyla. The body in these animals is composed of many cells which are well differentiated into distinct types and form definite tissues. The different phyla of the Metazoa show gradations from simple structural organization to complicated organ systems in the body.

Modern classification:

Scientist Robert H. Whittaker put a new classification system in 1969; this system was called Modern Classification. Whittaker classified living organisms into 5 kingdoms: Monera, Protista, Fungi, Plantae and Animalia.

Subkingdom: Protozoa

Phylum: Protozoa

General characters:

1- The great majority is very small in size and can only be seen by the aid of the light microscope. There are few species, which can be seen by the naked eye.

2- Many species live as solitary individuals, while a few live in colonies.

3- They are unicellular organisms where they contain one nucleus. The cytoplasm is usually differentiaied into outer clear ectoplasm and inner granular endoplasm.

4- They move either by pseudopodia, flagella or cilia and some have no locomotory organelles.

5- Holozoic nutrition is the most common type of nutrition. Some protozoa exhibit holophytic nutrition.

6- Osmoregulatory organelles, in the form of contractile vacuoles, are characteristic of the

great majority of the porotozoa which live in fresh water.

7- Many protozoa can exhibit aerobic respiration by simple diffusion.

8- Excretion takes place by diffusion.

9- Most of protozoa can reproduce asexually. In addition, some protozoa can reproduce sexually.

10- Encystment is a common feature of the life cycle of many protozoa.

Classification:

Phylum Protozoa is divided into four classes on the basis of the locomotory organelles found in the various species:

1- Class: Sarcodina

They include protozoa which move by pseudopodia. e.g. Amoeba, Entamoeba,….etc.

2- Class: Mastigophora

They include protozoa which move by one or more flagella. e.g. Trypanosoma, Euglena,….etc.

3- Class: Ciliophora

They include protozoa which move by cilia. e.g. Paramecium, Vorticella,….etc.

4- Class: Sporozoa

They include protozoa which have no distinct locomotory organelles. They produce resistant spores towards the end of their life cycle. e.g. Plasmodium, Monocystis,….etc.

Class: Sarcodina

***Amoeba* sp.**

Habitat: It is usually found in freshwater ponds and ditches.

Morphology (Figure 2):

Amoeba is a small jellylike mass which is constantly changing its shape due to the formation of pseudopodia. The body is surrounded by a plasma membrane, and the cytoplasm is differentiated into outer clear ectoplasm, and inner granular endoplasm.

The endoplasm contains food vacuoles, a granular nucleus with a distinct endosome, and a clear contractile vacuole.

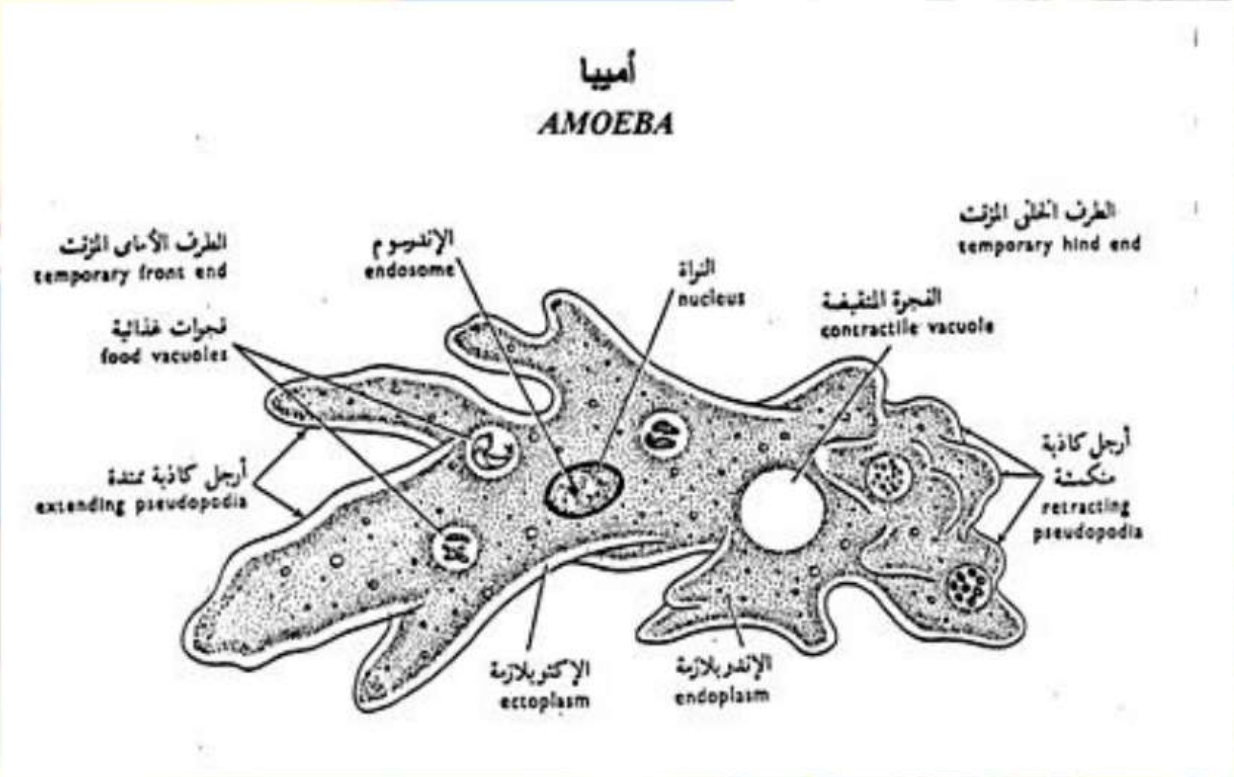


Figure 2: *Amoeba*

Locomotion:

Amoeba moves and captures food by means of the pseudopodia which arise at any point on the body surface. The sort of irregular movement is very slow and it is called amoeboid movement.

Nutrition (Figure 3):

Amoeba is holozoic in nutrition. It feeds on minute organisms which are found in its aquatic environment. When an Amoeba comes in contact with one of these organisms, it flows around it forming a cup-shaped structure which is called the food-cup. This cup gradually encloses the prey with a drop of water and in this way a food vacuole is formed inside the cytoplasm. Digestion immediately starts under the effect of the digestive enzymes which are secreted into the food vacuoles. The digested food materials are absorbed by diffusion into the cytoplasm. The remaining undigested materials are egested at any point on the surface.

Amoeba can obtain dissolved organic matter from the surrounding environment by pinocytosis.

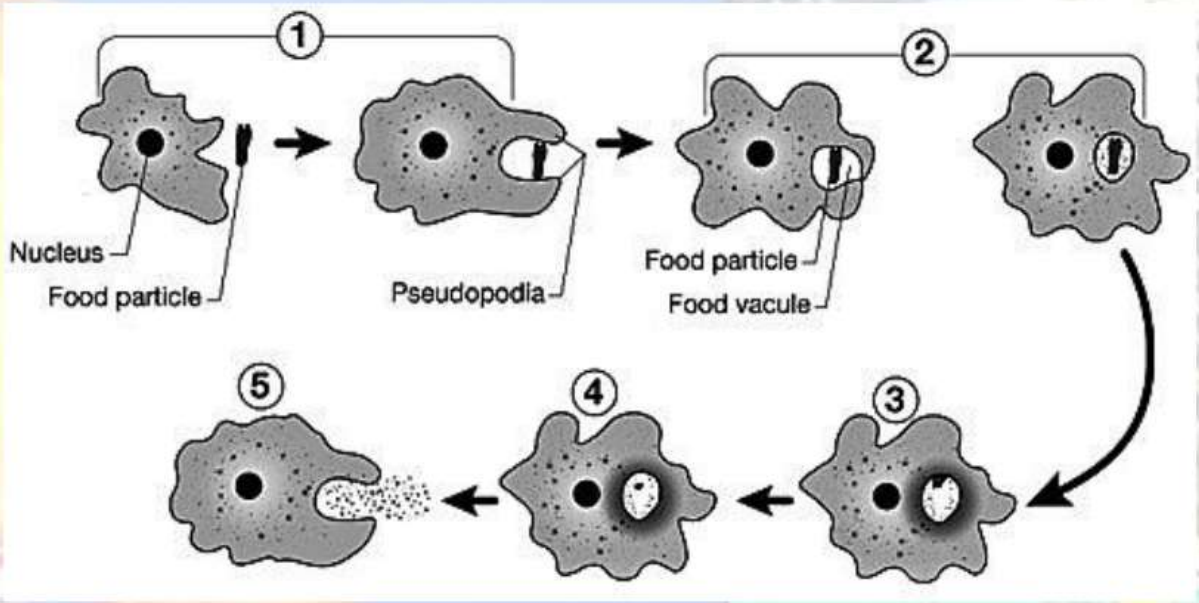


Figure 3: Nutrition of *Amoeba*

Osmoregulation:

This is carried out by the contractile vacuole which bursts at regular intervals expelling to the exterior the excess water which diffuses into the cytoplasm from the surrounding medium.

Respiration and excretion:

Exchange of respiratory gases between Amoeba and its environment takes place by simple diffusion. The products of nitrogenous metabolism diffuse in a similar way through the body surface to the outside.

Reproduction (Figure 4):

Amoeba reproduces only asexually by binary fission. The nucleus divides into two parts which move away from each other. This is followed by the dicision of the cytoplasm into two parts, one around each nucleus. Eventually, two amoebae are produced which feed and grow gradually in size then divide again. The process of division takes about 30 minutes.

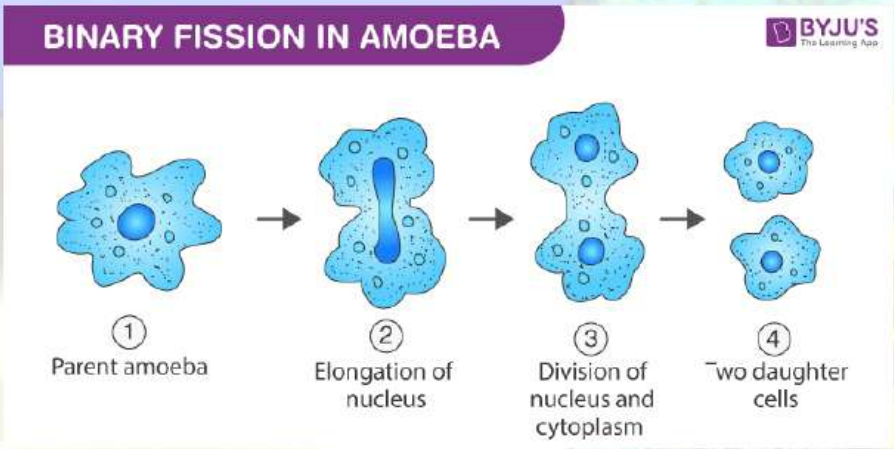


Figure 4: Binary fission of *Amoeba*

Encystment (Figure 5):

Under unfavourable conditions, Amoeba withdraws its pseudopodia, becomes spherical and forms a tough resistant cyst around itself. The nucleus of the origanism divides repeatedly to form a large number of daughter nuclei which migrate towards the

periphery and the process is called multiple binary fission. Each daughter nucleus becomes surrounded by a portion of the cytoplasm and in this way a number of small amoebae are produced inside the cyst. When the conditions of the environment improve, the wall of the cyst ruptures and the small amoebae are free.

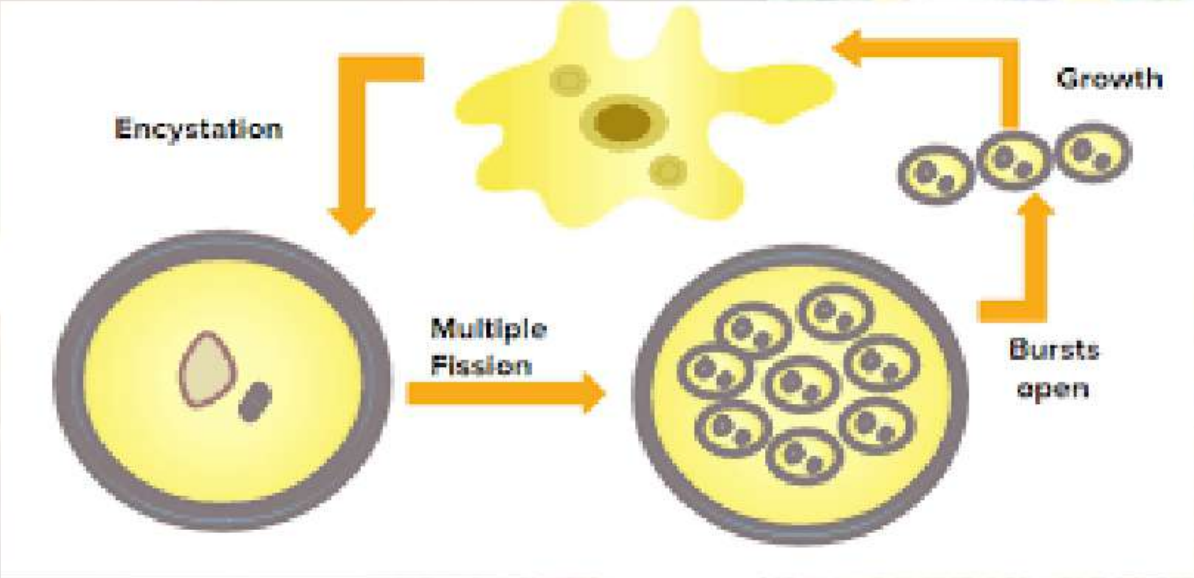


Figure 5: Encystment of *Amoeba*

Class: Mastigophora

Trypanosoma sp.

Habitat:

Trypanosoma live as parasites in the blood and some tissues of many vertebrates (definitive or final host). The life cycle usually involves another blood-sucking invertebrate host (intermediate host) which is frequently an insect.

Morphology (Figure 6):

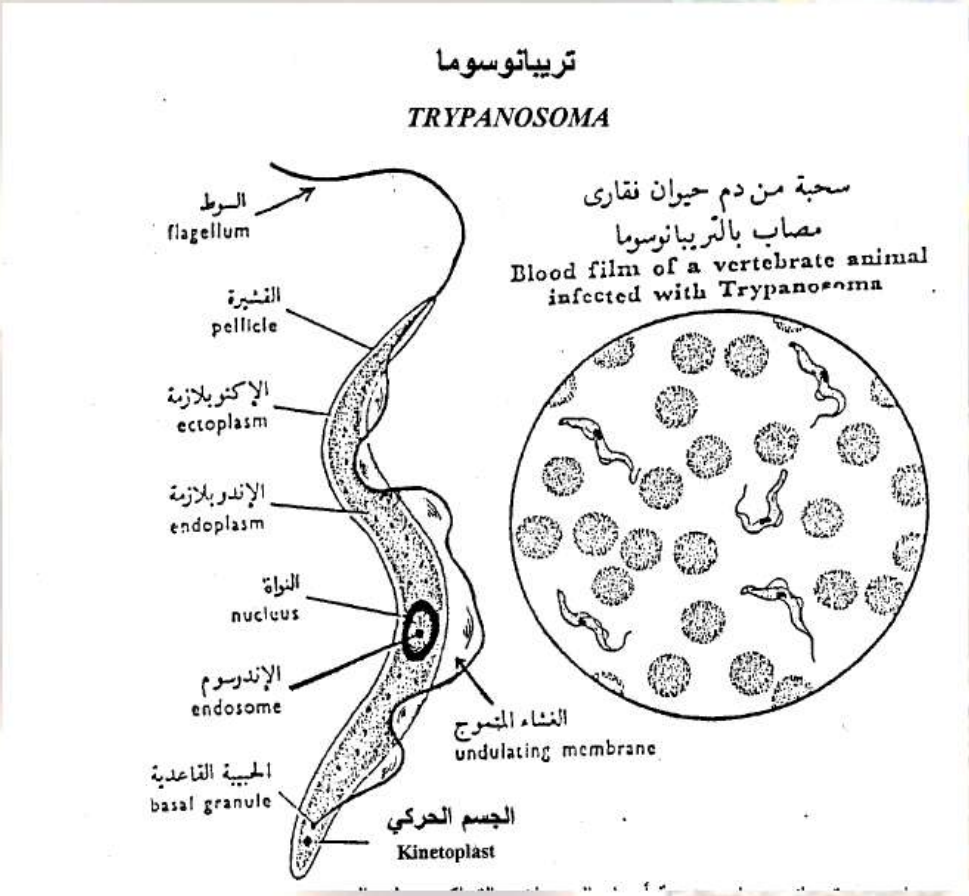


Figure 6: *Trypanosoma*

Locomotion:

Trypanosomes swim in the blood plasma of the host by the vibratile movements of the flagellum and the undulating membrane.

Nutrition:

It was believed that trypanosomes exhibit a saprozoic type of nutrition by simple diffusion. However, recent studies with the electron microscope showed that trypanosomes exhibit pinocytosis.

Osmoregulation:

No osmoregulatory mechanisms are required by trepanosomes and accordingly contractile vacuoles are absent.

Respiration and excretion:

Exchange of oxygen and carbon dioxide between trypanosomes and their environment occurs by simple diffusion through the body surface. The excretory products are also eliminated by simple diffusion through the body surface.

Reproduction (Figure 7):

Trypanosomes reproduce only asexually throughout their entire life cycle by longitudinal binary fission. The blephroplast and parabasal granule divide, and this is followed by the nucleus. The body then splits lengthwise into two equal parts, starting from the anterior end. One part retains the original flagellum, while the other forms a new flagellum.

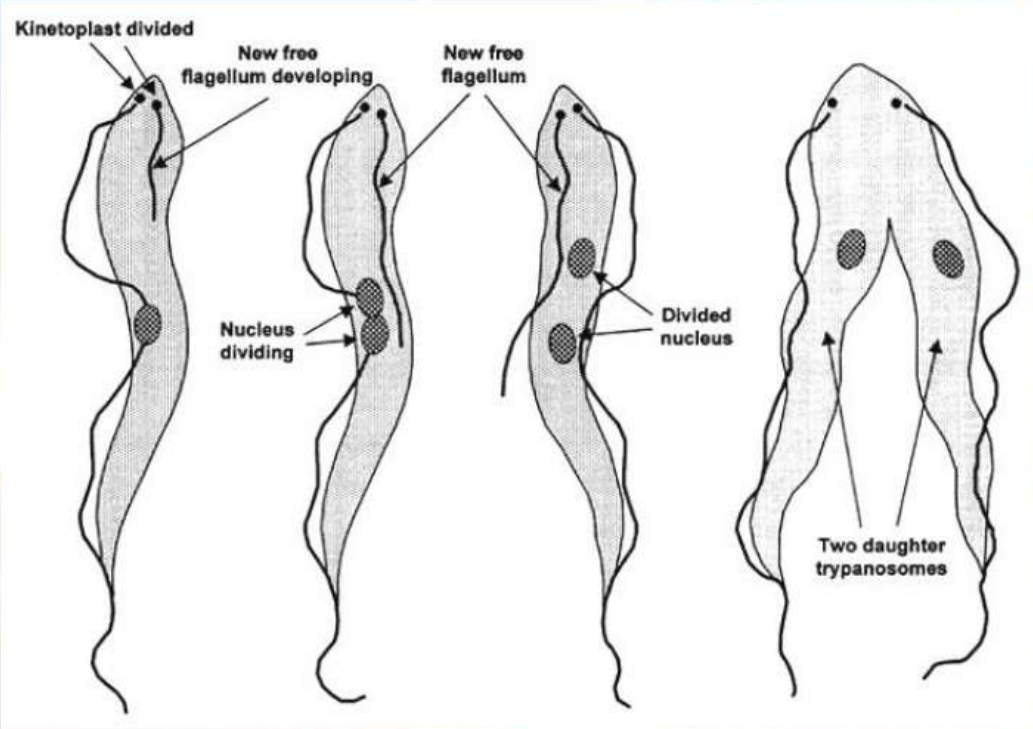


Figure 7: Longitudinal binary fission of *Trypanosoma*

Class: Ciliophora

Paramecium sp.

Habitat: Paramecium lives in freshwater ponds and streams.

Morphology (Figure 8):

It has a slipper-shaped body. The anterior end is blunt, while the posterior end is pointed. There is a firm pellicle that maintains the shape of the body. The cytoplasm is divided into an outer clear ectoplasm and an inner granular endoplasm. The body is covered by a layer of small hair-like locomotory processes known as the cilia. On the ventral surface of the animal, there is an oral grove, which extends obliquely into the endoplasm to form a wide tube known as the vestibule that ends in a cytostome. The latter opens in a short narrow cytopharynx. Just behind the cytopharynx, there is a temporary anus or cytoproct. There are two nuclei, a large kidney-shaped macronucleus (vegetative) and a small rounded micronucleus (reproductive). The endoplasm includes a number of food vacuoles and two contractile vacuoles. Th ectoplasm contains spindle-shaped structures, called trichocysts (defensive).

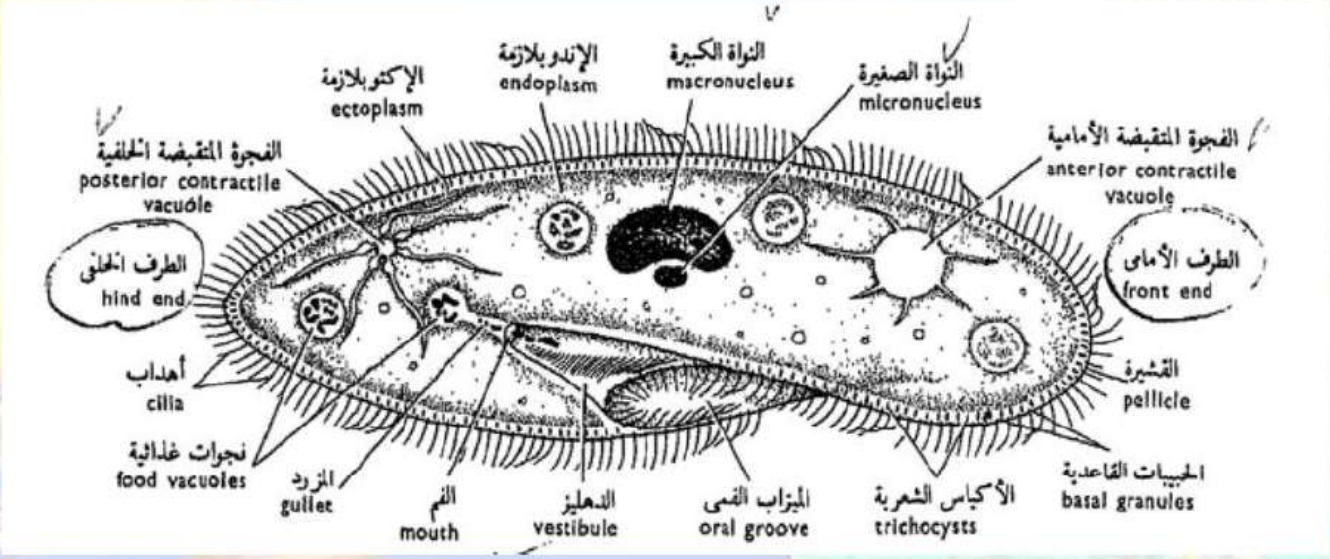


Figure 8: *Paramecium*

Locomotion:

Paramecium swims rapidly in water by means of cilia found on its body.

Nutrition:

Paramecium is holozoic and feeds mainly on bacteria, although it may feed on minute animals or unicellular plants.

Osmoregulation:

Osmoregulation is carried out by the two contractile vacuole systems.

Respiration and Excretion:

Exchange of oxygen and carbon dioxide takes place by simple diffusion through the body surface. Excretion of nitrogenous waste products takes place also by simple diffusion.

Reproduction (Figure 9):

Paramecium reproduces both asexually (by transverse binary fission) and sexually (by conjugation and autogamy).

Transverse binary fission: The micronucleus divides into two micronuclei that move towards opposite ends of the body. The macronucleus divides transversely. Other organelles become duplicated. Then a transverse furrow divides the cytoplasm into two almost equal parts. The resulting two daughter animals grow eventually to full size.

Conjugation: This process includes the following steps;

- Two individuals become sticky, adhere to one another by their oral surfaces and a protoplasmic bridge is formed between them. Each individual is known as a conjugant.

- The macronucleus in each conjugant breaks up into pieces and ultimately degenerates. In the meantime, the micronucleus divides by mitosis twice to form four nuclei, each with the normal diploid number of chromosomes. Of these four nuclei, three degenerate and only one is left.
- The remaining nucleus divides by meiosis into two nuclei; a small migratory (male) nucleus and a larger stationary (female) nucleus. Each of these two nuclei, containing haploid number of chromosomes found in the original nucleus.
- The migratory nucleus in each conjugant becomes active, moves into the other conjugant and fuses with the stationary nucleus therein. Thus, in each conjugant, a zygote or fusion nucleus is formed which contains the original diploid number of chromosomes. When this fusion is completed, the two pairing paramecia separate, and they are now referred to as the ex-conjugants.
- The zygotic nucleus in each ex-conjugant divides three times, forming eight nuclei, each with diploid number of chromosomes. Four of these nuclei enlarge, forming macronuclei, while the other four forming micronuclei. This is followed by two

cytoplasmic divisions, and accordingly four new daughter paramecia are produced from every ex-conjugant, each with one macronucleus and one micronucleus.

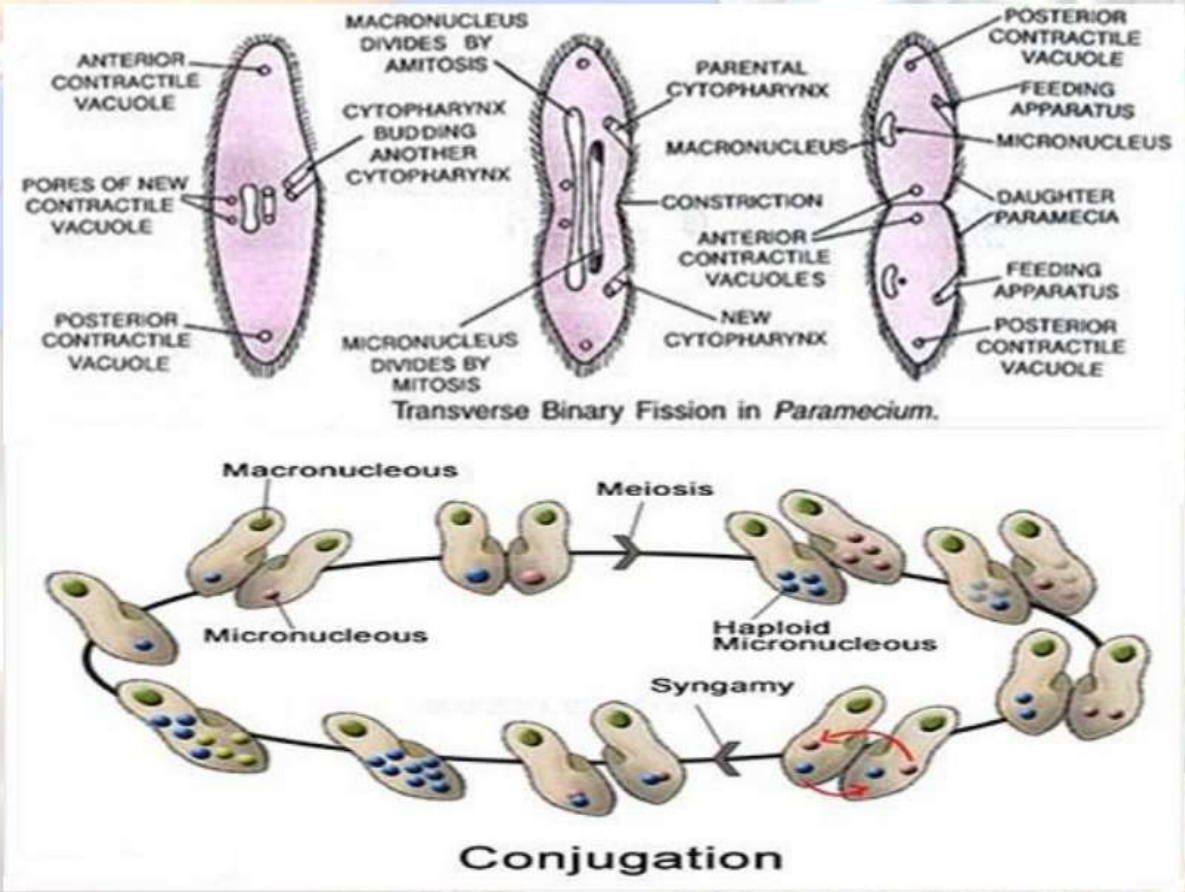


Figure 9: Reproduction of *Paramecium*

Subkingdom: Parazoa

Phylum: Porifera

General characters:

1- Sponges are sessile and mostly marine animals. They are regarded as the most primitive multicellular animals.

2- They vary in form from thin flattened crusts to vas-shaped, branched, globular or irregular shaped bodies.

3- The body is perforated by numerous pores, canals or chambers through which wter continuously flows, hence the name Porifera.

4- The body cells are far less specialized. There is no coordination between the activities of similar cells and therefore they do not form proper tissues.

5- They have a skeleton of calcerous spicules, or of organic sponging fibres.

6- They are holozoic and digestion is entirely intracellular.

7- They respire and excrete by simple diffusion.

8- They have no sensory or nerve cells, thus coordination of their activities is very limited and their responses to stimuli are local and very slow.

9- They reproduce asexually by budding, and have a remarkable power of regeneration. They also reproduce sexually by gametes, and have free swimming larvae.

Classification:

Generally, sponges exhibit three structural grades with increasing complexity, referred to as the ascon, sycon and leucon types.

Ascon type

***Leucosolenia* sp (Figure 10)**

- This is the simplest structurl type of sponges in which the body is tube or vase-shaped.
- Sponges of this type are all smll and are not usually solitary but live in colonies.
- The body wall surrounds a central cavity known as paragastric cavity lined with flagellated cells.

- The wall is thin contains many opening (ostia) which lead directly to paragastric cavity which open outside through osculum.

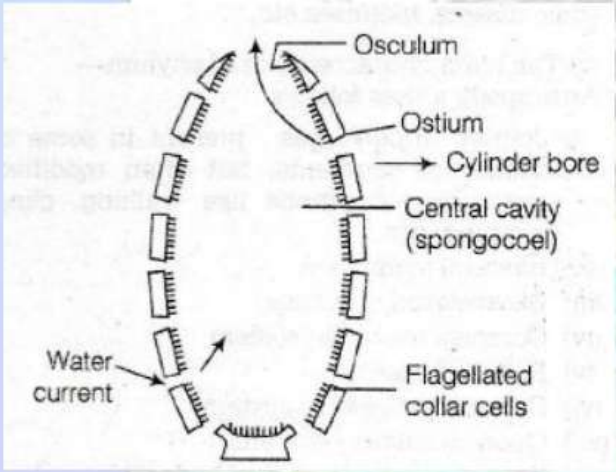


Figure 10: Leucosolenia

The body wall of *Leucosolenia* consists of two cellular layers (Figure 11):

1- The dermal layer: the outer layer is thin flattened cells pinacocytes.

2- The gastral layer: contains choanocytes with flagellates extend to the paragastric cavity, and between the two layers there is a jelly substance contains three types of cells (scleroblasts, amoebocytes and **porocytes**). **Scleroblasts** secrete calcareous spicules,

amoebocytes can develop into any other cell in the body and **porocytes** acts as a pore.

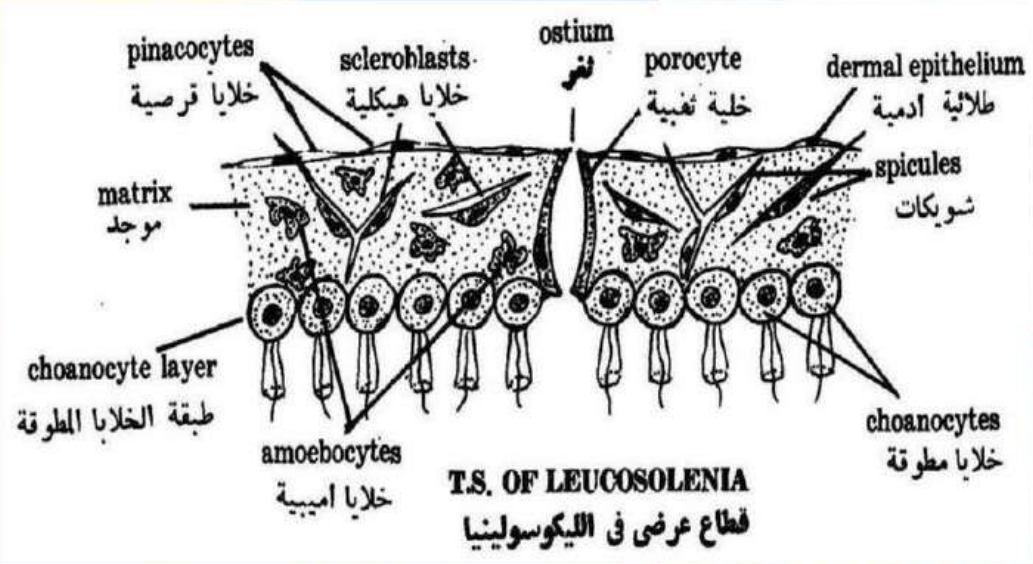


Figure 11: Body wall of *Leucosolenia*

Sycon type

***Sycon* sp (Figure 12)**

- This is a solitary marine sponge, live attached to rocks in shallow waters; it has a vase shaped body with a single large osculum at the free end.
- The body wall is relatively thick, folded forming many horizontal flagellated chambers
- The flagellated chambers are lined with choanocytes

Water is drawn through the ostia into the inhalant canals, then pass to the flagellated chambers then to the paragastric cavity, and finally to the outside through the osculum

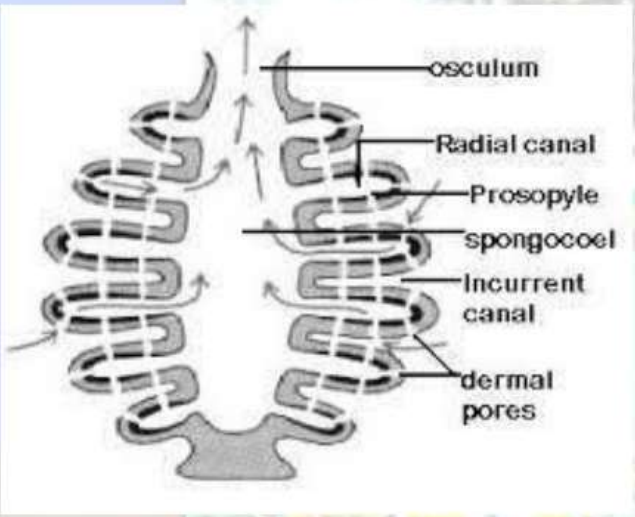


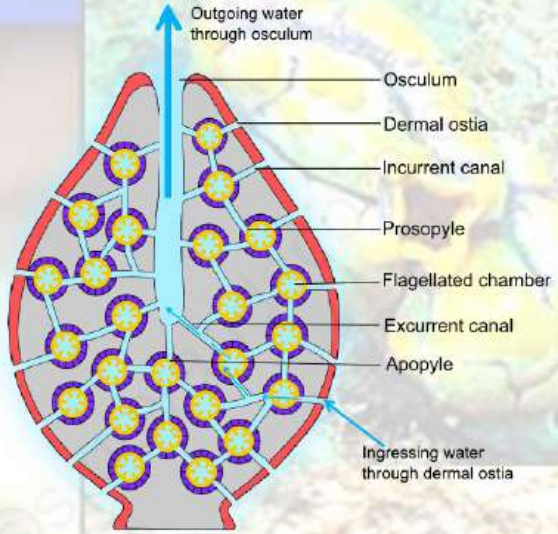
Figure 12: *Sycon*

Leucon type

Euspongia sp (Figure 13)

- Spherical, irregular or cup shape.
- They live on the sea bottom attached to rocks.
- The body surface contains minute ostia, in between there are several larger oscula with more complex structure.

- It contains a complex network of branching spongin fibres extends whitin the jelly and gives the animal the characteristic spongy texture.
- The layer of choanocytes is highly folded and the paragastric cavity is reduced.
- The ostia found on the outer surface lead into large subdermal cavities , from which some inhalant canals extend to the flagellated chambers



Leucon type canal system (Ex: Spongilla)

Figure 13: *Euspongia*

Subkingdom: Metazoa

Phylum: Coelentrata

General characters:

1- They are simple aquatic nimls which are mostly marine and sessile.

2- They are radially symmetrical animals.

3- They are multicellular animals and consist of different types of cells arranged in two layers, an outer ectoderm and an inner endoderm, separated by a structureless jelly-like mesogloe.

4- There is a single cavity within their body known as the gastrovascular cavity or coelenteron. Digestion is partly extracellular occurring in the gastrovasculr cavity, and partly intracellular taking place within food vacuoles inside the endeodermal cells.

5- Respiration and excretion tke place by simple diffusion.

6- They possess a simple diffuse nervous tissue in the form of a nerve net or concentrated rings.

7- They reproduce asexually and sexually.

8- Some colonial forms secrete massive external calcerous skeletons.

Classification:

The phylum Coelentrata is classified into 3 min classes:

1- Class: Hydrozoa (e.g. Hydra sp).

2- Class: Scyphozoa (e.g. Aurelia sp).

3- Class: Actinozoa (e.g. Alcyonium sp).

Class: Hydrozoa

***Hydra* sp (Figure 14):**

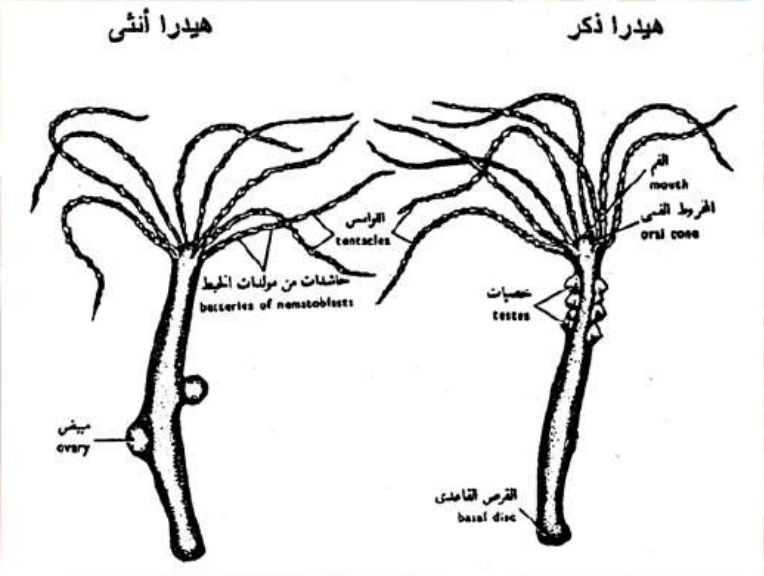


Figure 14: *Hydra*

Hydra is a genus of small, fresh-water organisms. It measures from 2 to 20 mm in length.

Hydra has a tubular, radially symmetric body, secured by a simple adhesive foot called the basal disc.

At the free end of the body (the oral cone), there is a mouth opening surrounded by 6 to 8 thin, mobile tentacles. Each tentacle is clothed with highly specialised stinging structures called nematocysts.

If Hydra attacked, the tentacles can be retracted to small buds, and the body column itself can be retracted to a small gelatinous sphere.

Nutrition:

Hydr is mainly holozoic and carnivores, feeding on marine crustceans and small aquatic animals which come within reach of its tentacles.

The tentacles of the hydra carry a number of nematoblasts that store in them penetrating filamentous sacs that penetrate the body of the prey in contact with the tentacles of the hydra in order to anesthetize and immobilize it. The tentacles bring the prey closer to the mouth. By entering the prey into the gastrovascular cavity, the glandular cells in the endoderm layer activate and secrete digestive enzymes, which are partially digested and called

extracellular digestion. As a result of this digestion, the prey breaks up into small pieces that are captured by the food vacuoles and is known as intracellular digestion.

After the digestion is complete, the undigested remains are expelled into the gastrovascular lumen and from there to the mouth and then out.

Locomotion:

Hydra is essentially sessile and lives ttached by a sticky secretion to the substratum. Occasionlly, it moves from one place to another by one of the following means:

1- **Gliding:** *Hydra* can glide slowly along its attachment by pseudopodia from the basal disc.

2- **Walking (Figure 15):** the body at first extends and then bends and fixes the tentacles to the substratum. It then releases the attachment of the basal disc, reattaches the basal disc near the tentacles and again takee an upright position by releasing its tentacles.

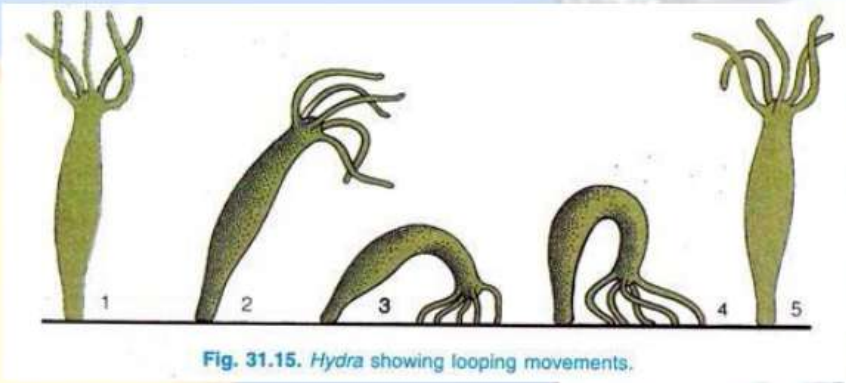


Fig. 31.15. *Hydra* showing looping movements.

Figure 15: Walking of *Hydra*

3- **Somersaulting (Figure 16):** *Hydra* extends its body and is bent to one side to place the tentacles on the substratum. The basal disc is freed from its attachment, and the animal stands on its tentacles, the body then contracts strongly till it appears like a small knob.

The body is then extended and bent to place the basal disc on the substratum, the tentacles loosen their hold and the animal regains an upright position

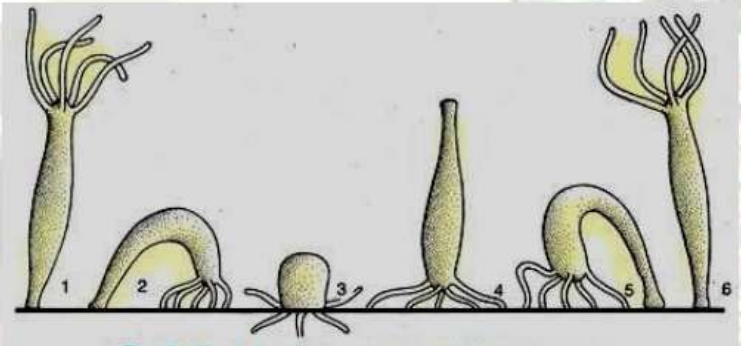


Fig. 31.16. *Hydra* showing somersaulting movements.

Figure 16: Somersaulting of Amoeba

4- **Floating (Figure 17):** Hydra can produce a bubble of gas secreted by some ectodermal

cells of the basal disc which helps the animal to float on the surface of the water and is passively carried from one place to another by water current.

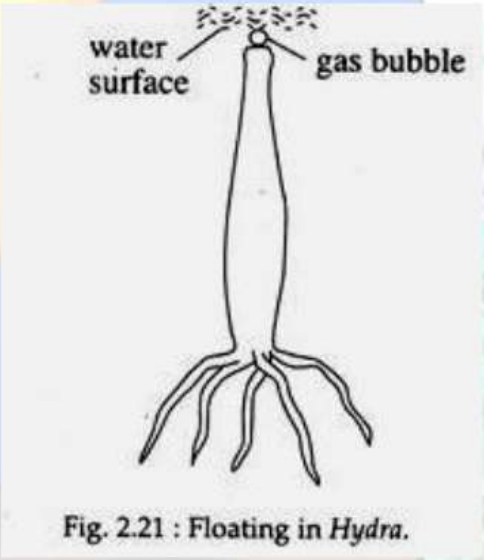


Fig. 2.21 : Floating in *Hydra*.

Figure 17: Floating of *Hydra*

Respiration and excretion:

Hydra possesses no specil tissues for either respiration or excretion; both processes take place by simple diffusion.

Reproduction:

- When food is plentiful, many *Hydra* reproduce asexually by producing buds in the body wall, which grow to be miniature adults and break away when they are mature (Figure 18).

- When a hydra is well fed, a new bud can form every two days. When conditions are harsh, often before winter or in poor feeding conditions, sexual reproduction occurs in some *Hydra*. Swellings in the body wall develop into either ovaries or testes. The testes release free-swimming gametes into the water, and these can fertilize the egg in the ovary of another individual. The fertilized eggs secrete a tough outer coating, and, as the adult dies (due to starvation and/or cold), these resting eggs fall to the bottom of the lake or pond to await better conditions, whereupon they hatch into nymph *Hydra* (Figure 19).

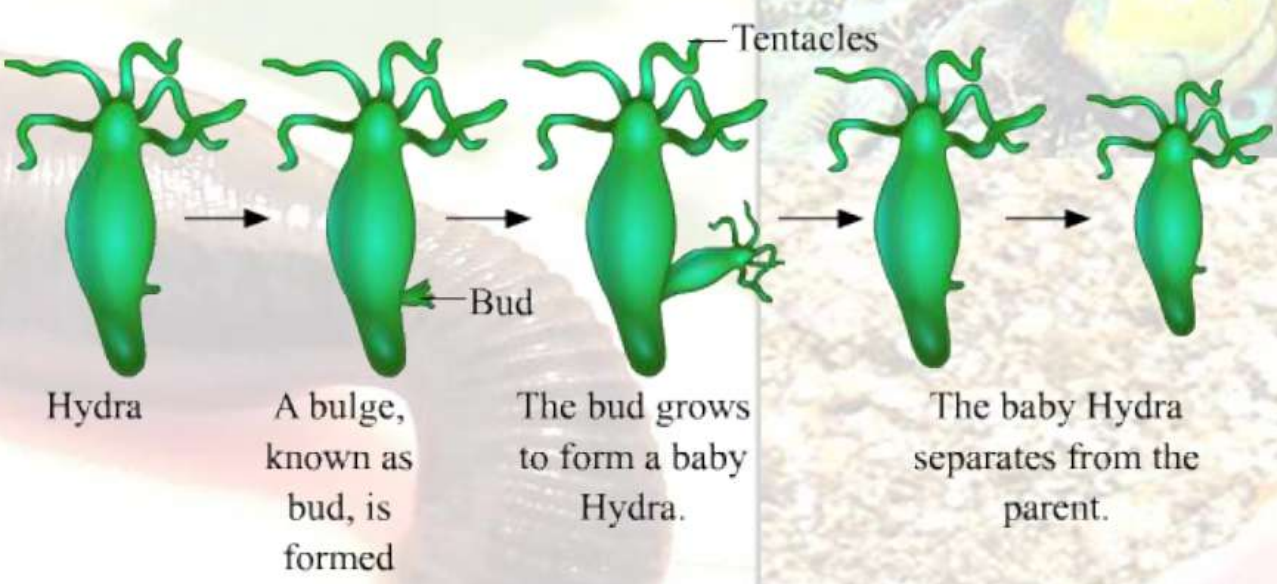


Figure 18: Budding of *Hydra*

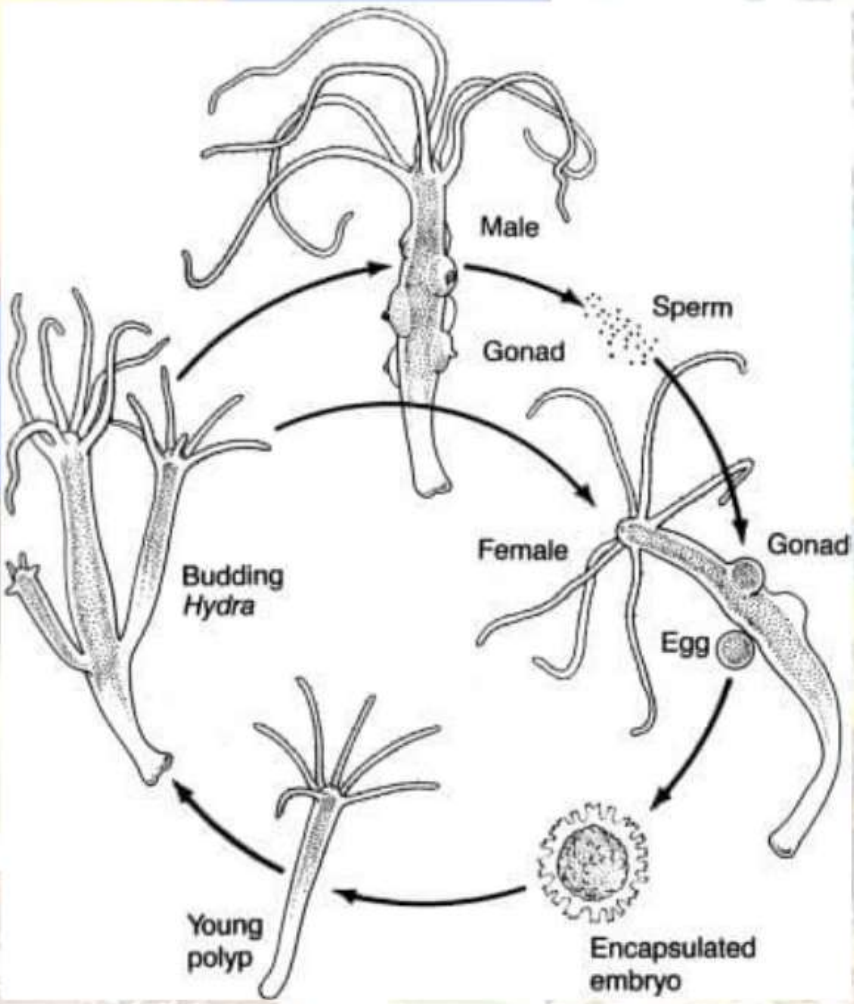


Figure 19: Sexual reproduction of *Hydra*

Phylum: Platyhelminthes

1- They are the first animals which illustrate the development of organ systems.

2- They may be free living or parasites.

3- They are bilateral symmetry and dorsoventrally flat worms.

4- They show three germinal layers i.e. ectoderm, mesoderm and endoderm.

5- A true body cavity or coelom is absent, and the space between the body organs is filled with loose parenchyma.

6- Muscular system is well developed

7- The alimentary canal is either absent or highly branched. Anus is absent.

8- Excretory system consists of flame bulbs or flame cells or protonephridia connected to the excretory ducts.

9- Circulatory and respiratory systems are absent.

10- Nervous system and sense organs are poorly developed, consists of a pair of ganglia connected to 3 pairs of nerve cords.

11- Usually hermaphrodite animals.

12- Fertilization is internal and development may be direct or indirect

Classification:

Phylum Platyhelminthes is divided into 3 clsses:

1- Class: Turbellaria

They include free-living in flt-worms which live in fresh or mrine wter, and sometimes on land. e.g.: *Planaria* sp.

2- Class: Trematoda

They include parasitic leaf-like worms. e.g.: *Schistosoma* sp.

3- Class: Cestoda

They include parsitic worms. e.g.: *Taenia* sp.

Class: Trematoda

These are parasitic unsegmented flat-worms. The body is covered by a thick non-ciliated layer known as the tegument. They have a digestive system and adhesive organs in the form of suckers by which they cling to the tissues of their hosts. This class includes two distict subclasses; Monogenea and Digenea.

Subclass: Digenea

***Schistosoma*:**

This is a group of trematodes that inhabit the blood stream of certain vertebrate hosts. They are unique amongst digenetic trematodes in being dioeceous, i.e.

sexes are separated. They are called schistosomes or split bodies because of the groove found in the ventral surface of the male, in which the female is held during copulation and egg-laying.

When man becomes infected with schistosomes, an important disease develops which is known as schistosomiasis or bilharziasis.

***Schistosoma haematobium* & *Schistosoma mansoni*:**

Two species infect man in Egypt. *S. haematobium* which lives in venous vesical plexus and drops the eggs in the venules of the urinary bladder to pass out with the urine. The other species is *S. mansoni* which lives in the mesentric veins and drops the eggs in the venules of the rectum to pass out with the faeces.

S. haematobium: the sexes are separate but usually found in pairing condition (Figure 20). The male (10-15 mm long) broader and shorter than female (16-20 mm) and has a cylindrical appearance but is actually flat with the sides rolled ventrally to form the gynaecophoric groove in which the narrower female is partly lodged. The body of male covered with tubercles for clinging to the walls of the venules while

moving against the blood stream. The female body is cylindrical and smooth to pass easily through the small blood vessels for laying the eggs.

The suckers are two: oral and ventral sucker.

Digestive system:

The alimentry canal starts with small the buccal cavity then oesophagus which leads to branched intestine. The two intestinal caeca reunite in the posterior third of the body forming one caecum. (united in the anterior half of the body in *S. mansoni*).

Reproductive system:

The male genital system is formed of 4-5 testes which lie posterior to the ventral sucker (8-9 testes in S. mansoni), from the testes erect vasa efferentia and unite into vas deferense which swells up forming vesicula seminalis, this opens behind the posterior sucker by the genital opening.

The female g. s. consists of one ovary lies in the posterior half of the body (but in *S. mansoni* lies anterior to the middle of the body). The oviduct runs forwards with the median vitelline duct and unite in

Mehlis gland into a long uterus. The uterus extends forwards to open by the genital opening.

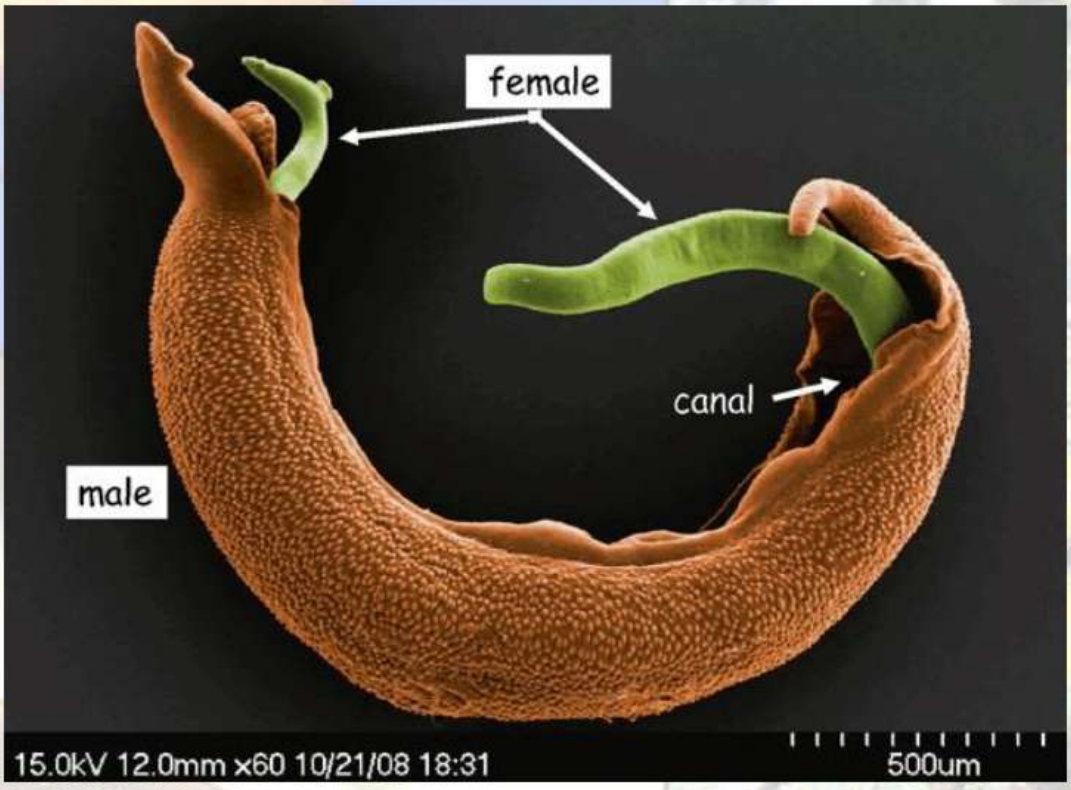


Figure 20: Male of *Schistosoma* embrassing the female

Class: Cestoda

Cestodes or tapeworms are usually differentiaited into 3 parts:

a- The scolex or the head which is found at the anterior end and carries the organs by which the body is attached to the mucosae of the intestine (Figure 21).

b- The neck which is immediately found behind the scolex. This is the region of growth from which all the distal portions of the worm are derived.

c- The strobili which consists of a series of segments or proglottids, beginning with the immature proglottids, then the mature proglottids which contain the fully developed sex organs, and the distal most gravid proglottids which are reservoirs of eggs.

***Taenia saginata* & *Taenia solium*:**

T. sginata, which is commonly named the beef-tapeworm, is a cosmopolitan parasite among beef-eating people. The pork tapeworm, Taenia solium, occurs wherever raw or inadequately cooked pork is consumed. Cattle and pigs are the intermediate hosts

of Taenia sginata and T. solium respectively. These tapeworms are generally found in the middle third of the intestine.

Digestive system:

Cestodes in general, lack an alimentary canal, yet they obtain the required food materials by pinocytosis through the tegument from the digested food materials found in the intestine of the host.

Reproductive system:

The male genital system consists of numerous small spherical testes. A slender tubule, the vas efferens comes out from each testis, the vas efferentia join together to form a convoluted tube, the vas deferens. The vas deferens then dilates to form the vesicular seminalis and ends by muscular cirrus which is enclosed in a cirrus pouch. The cirrus opens by the male genital opening in the genital atrium which is located in the middle of the lateral margin of the proglottid.

The female genital system consists of one ovary which is located at the distal part of the proglottid. The ovary is composed of two symmetrical lobes and from

each lobe short duct arises which leads into the median oviduct. The oviduct passes backwards before opening into the ootype, which is surrounded by the cells of the Mehli's gland. There is a compact vitelline gland, in which their secretions are carried out through the vitelline duct which opens into the ootype. Two other canals arise from the ootype; the uterus which extends anteriorly, and the vagina which extends anteriorly, then laterally to open by the female genital pore in the genital atrium. The proximal part of the vagina may be slightly swollen to form the receptaculum seminis.

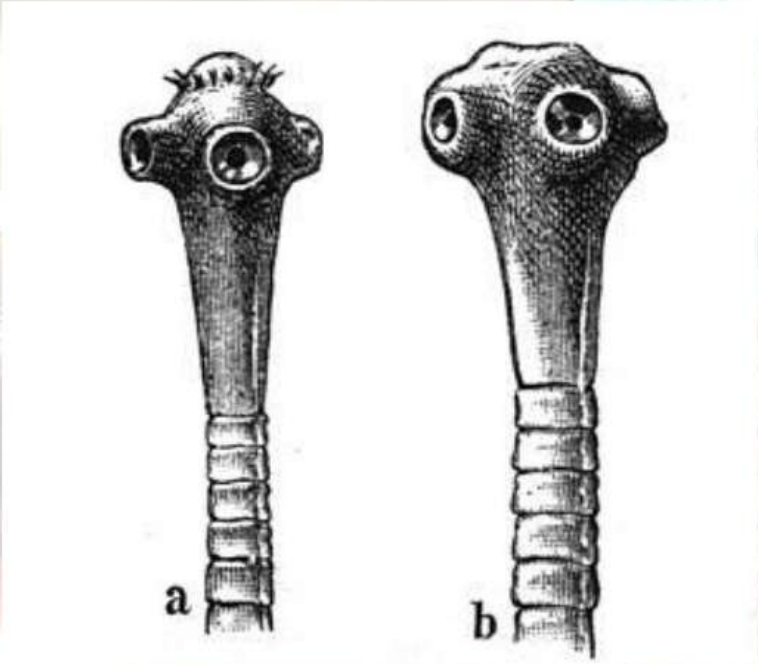


Figure 21: Scolex of *Taenia*

Phylum: Aschelminthes

General characters:

1- They may be free living (aquatic and terrestrial) or parasitic on plants and animals.

2- They are bilaterally symmetrical, triploblastic and pseudocoelomate animals.

3- The body is cylindrical and unsegmented with smooth cuticle and well developed muscle fibres.

4- Alimentary canal is complete with a mouth, a well-developed muscular pharynx and anus.

5- Two lateral excretory tubes removes body wastes from the body cavity through one excretory pore.

6- No respiratory or circulatory systems.

7- Nervous system with circumenteric ring, 6 anterior and 6 posterior nerves.

8- Sexes are separated; often females are longer than males.

Ascaris (Figure 22)

Some species of this genus are the largest round worms. There are 3 species: *A. lumbricoides* which lives in the small intestine of man, *A. megalocephala* lives in the small intestine of the horse and *A. vitulorum* in that of the cow. They resemble each other closely and differ in few detalis.

The body form is cylindrical, Long and the length in male about 15-26 cm and in female about 22-30 cm. The two ends are tapring. The female is the larger and has a straight posterior end, while the male is slender and has a sharply curved posterior end.

There are 4 longitudinal streaks run the entire length of the body, 2 thin white dorsal and ventral lines and 2 broader and darker lateral lines.

The mouth lies at the anterior end of the body and the execretory pore lies on the ventral side, 2 mm behind the mouth. The female genital opening lies on the ventral side near the anterior end. The cloaca (the genital duct joins the hind gut) in male opens near the posterior end and two copulatory spicules project from the cloaca.

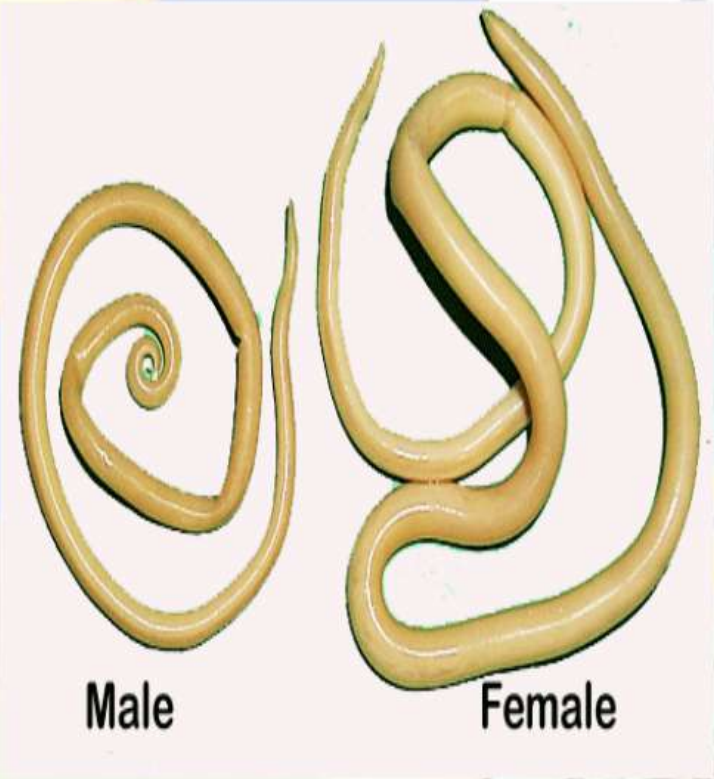


Figure 22: *Ascaris*

Phylum: Annelida

General characters:

1- These animals are found on land, in moist soil, freshwater or in the sea and they are free living or ectoparasites.

2- They are triploblastic, coelomate and bilaterally symmetrical animals.

3- They have an elongated and metamerically segmented body.

4- The body covered with a thin non- chitinous cuticle and the body wall is muscular with circular and longitudinal muscles.

5- They possess chaetae on the segments, some forms with parapodia.

6- The alimentary canal is elongated and a tube like. It extends from the mouth to the anus.

7- The respiration takes place through the external surface of the body.

8- They have closed type of circulatory system, i.e., the blood flows in the blood vessels.

9- The excretion by tube- like organs, called nephredia. In each segment a pair or more nephredia are present.

10- The nervous system consists of a brain and double nerve cord, with many ganglia in each segment.

11- Sexes are separated or occur in the same body. Development may be direct or through a trochophore larva. Regeneration is also common.

Classification:

Class: Oligochaeta

Includes the earthworms, live in moist soil or in freshwater. They are hermaphrodite and without parapodia. e.g.: *Allolobophora caliginosa*.

Class: Polychaeta

They include marine forms swim freely in water or live burrowing in the sand and mud near the shore. The sexes are separated and have parapodia. e.g.: *Neries*

Class: Hirudinea

They include the leeches which feed on the blood of vertebrates. They are hermaphrodite and without parapodia and chaetae. E.g.: *Hirudo medicinalis.*

***Allolobophora caliginosa* (Figure 23)**

The earthworms live in moist soil, build burrows and feed on organic matter.

The body is cylindrical and divided into great number of segments separated by intersegmental grooves, pointed at the anterior end and flattened at the posterioend.

The mouth and anus open at the anterior and posterior ends respectively.

The clitellum (secretes the cocoon) is the thickned skin of segments 26-34 and lies on the dorsal and lateral sides but theses segments are distinct on the ventral side. The edges of the clitellum are thichened on segements 31-33 forming the puberty crests.

Every body segment, except the first and the last, bears 4 pairs of chaetae, two ventral pairs and one pair on each lateral side.

The external body openings:

- The mouth on the first sement.
- The anus on the last segment.
- The female genital openings (2) on the ventro-lateral sides of segment 14.
- The male genital openings (2) on the ventro-lateral sides of segment 15.
- The spermathecal pores are 2 pairs lies in the intersegmental grooves between segments 9-10 and 10-11 and they are serrrounded by three pairs of copulatory papillae on segments 9, 10 , 11
- The dorsal (coelomatic) pores lies mid- dorsaly on the grooves from 8-9 to the posterior end, connect the internal coelom with the external environment.
- The excretory pores or nephridiopores lie on the ventral side, a pair on each segment except the first three segments and the last segment.

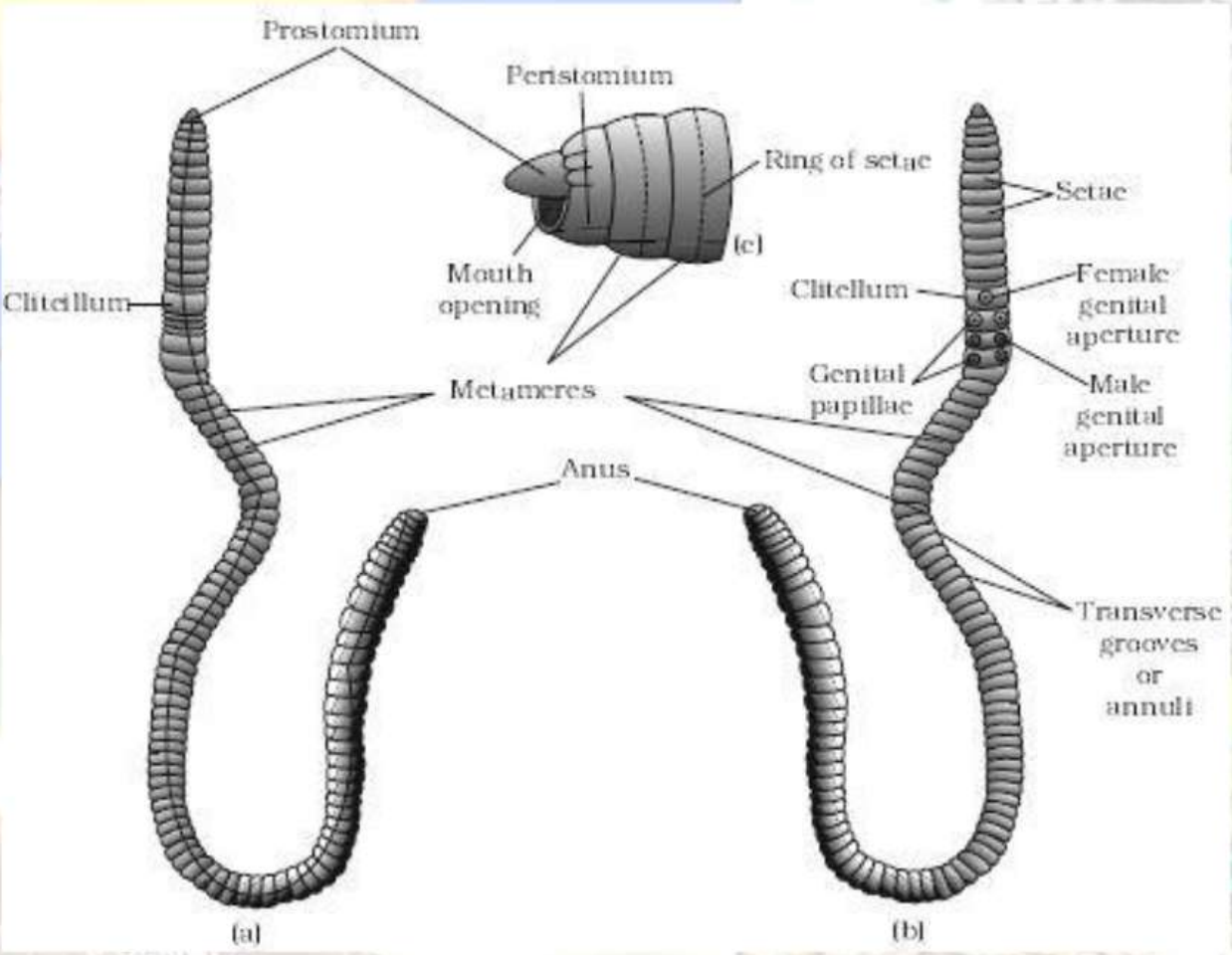


Figure 23: *Allolobophora caliginosa*

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