لافقريات نظري

مرحلة الثانية

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Invertebrate: are groups of animals show a great differences اختلاف كبير in morphologyبالشكل , internal structure الشكل الداخلي , and phylogeny but all are shearing character of lacking vertebrates جميعها تتشارك بعدم وجود عمود فقري .

Invertebrates consist about 97% **of the all known animal** species, the remaining 3% **are the rest of animal species**. These animals include a numerous groups with great benefits for man and others are harmful.

Some invertebrate's benefits

1. Crayfish, clams, shrimps...etc. considered to be a great resource of food for man.
2. Used in scientific research such as drosophila which used in genetics and protozoan in cytology.
3. Some species acts as indicator for water pollution such as *daphynia* (crusticea)

4. Some insect produce wax, honey, and silk. And also play on important role in plant fertilization.

5. Used in biological control as a biological a genets to control many pests such as lady beetls which used against aphids and citrus pest/and *Macrocelus sp.* (Mites) used against immature stages of house fly.

6. Invertebrate species play significant role in food chain and serve as food for other animals.

The harms of invertebrates:

1. Many invertebrates' species are post on agriculture products in farms and stores such as grasshopper, Bettles, Nematods, mites.
2. Some other species with medical importance transmit and cause variable diseases to man and his animals. ex, nematods, ticks/flat worm, plasmodium, schistosoma, flies, fleas, mosquetos....etc.
3. Several group of marine invertebrates such as cnidarians, protozoan, sponges, are accumulated on the emerged parts of ships and electric generators causing in reduction of their efficiency that is called (Biofouling).

Animal classification:

The **main purpose** of classifying animals is to show the most probable evolutionary relationship of the different species to one another.

A phylum represents broad grouping of related animals which have a common ancestry and are characterized by having similar structures.

Classification: systematic arrangement in groups or categories according to established criteria

The following characters are used to establish phyla:

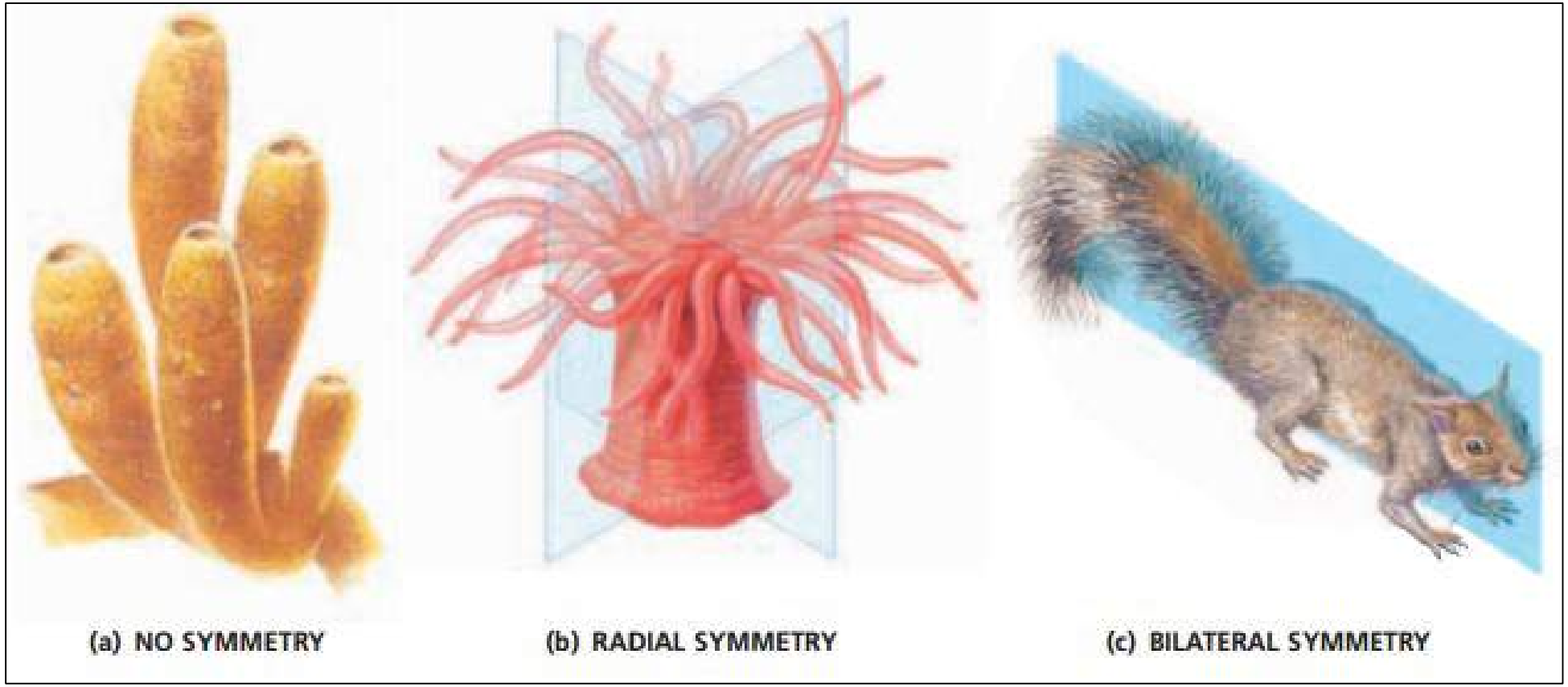
1. Number of cells, animal that belong to the phylum protozoa are unicellular. The rest of animal kingdom consist of metazoan.

2. Type of symmetry:

A symmetrical animal include those animal which no plane that can be used to divide their body into equivalent parts (ex. Protozoa and porifera).

a. **Bilaterally symmetrical:** their bodies can be divided by a single plane into two equivalent parts(ex: arthropoda)

b. **Radially symmetrical:** these animal can be divided into two equivalent parts by more than one plane (ex: coelentrata).

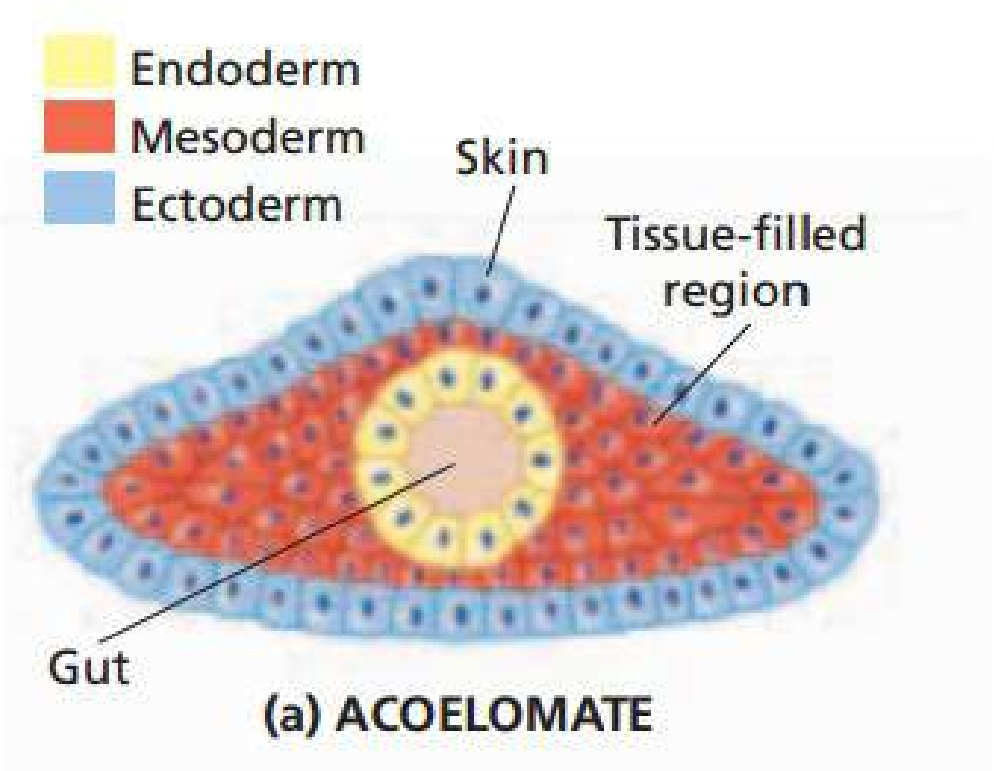


(a) NO SYMMETRY

(b) RADIAL SYMMETRY

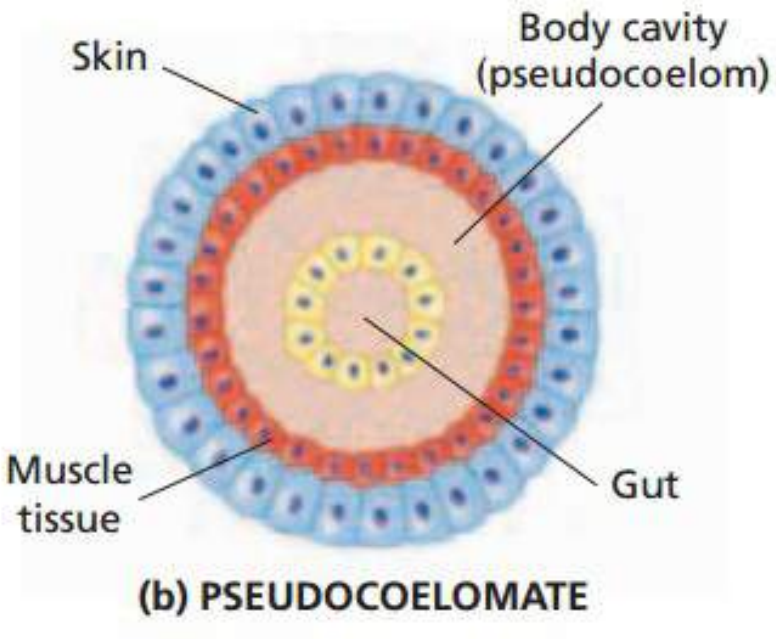
(c) BILATERAL SYMMETRY

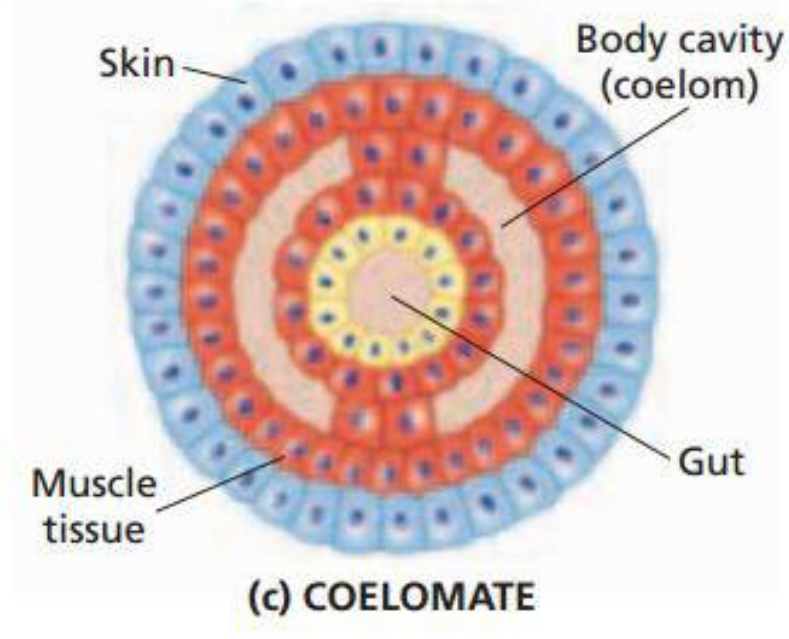
3. Presence or absence of body cavity in the bilateral phyla, some type of body cavity (space between the body wall and internal organs) is found. animals that do not have such a cavity termed (**a coelomate**)where the region between their internal organs and body wall is filled with cells.(ex. Platyhelminthes)

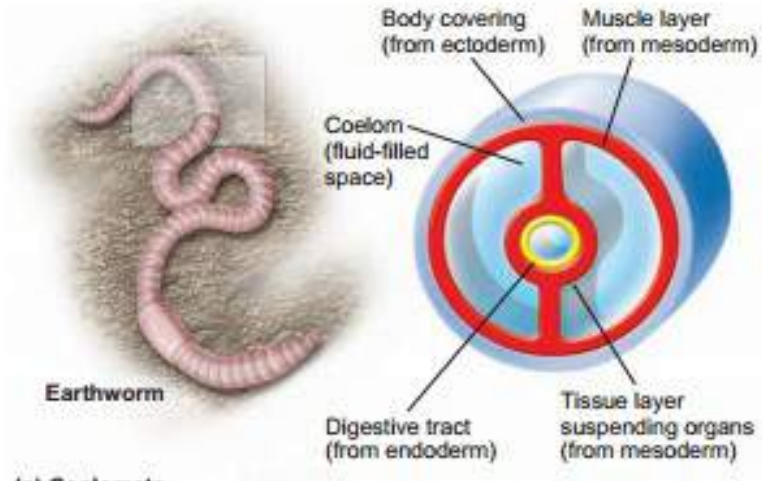


b. Animal that do have a body cavity, but this cavity do not surrounding by the cells of the mesoderm and do not lined with peritoneum is termed (Pseudo coelomate) ex. Aschelminthes.

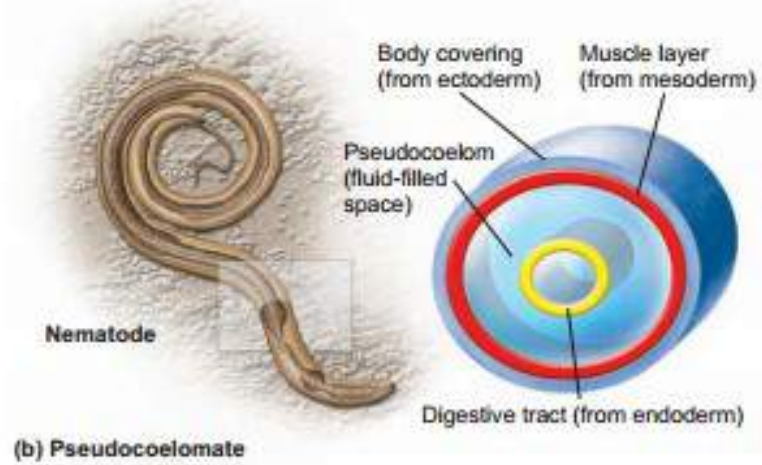
c. Coelomate is a term for those animals with a body cavity which surrounded by the mesodermic cells and -lined with peritoneum (ex. Annelida)



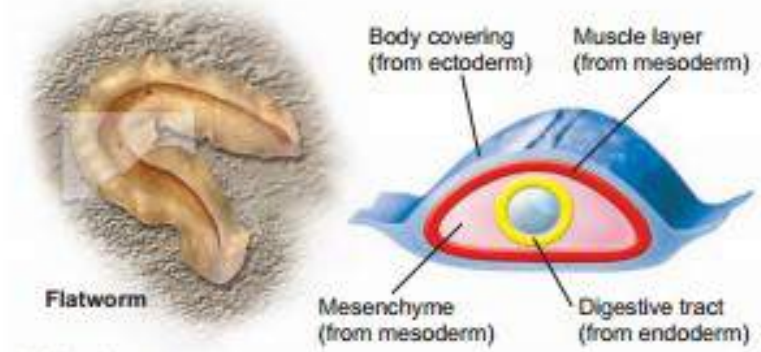




(a) Coelomate

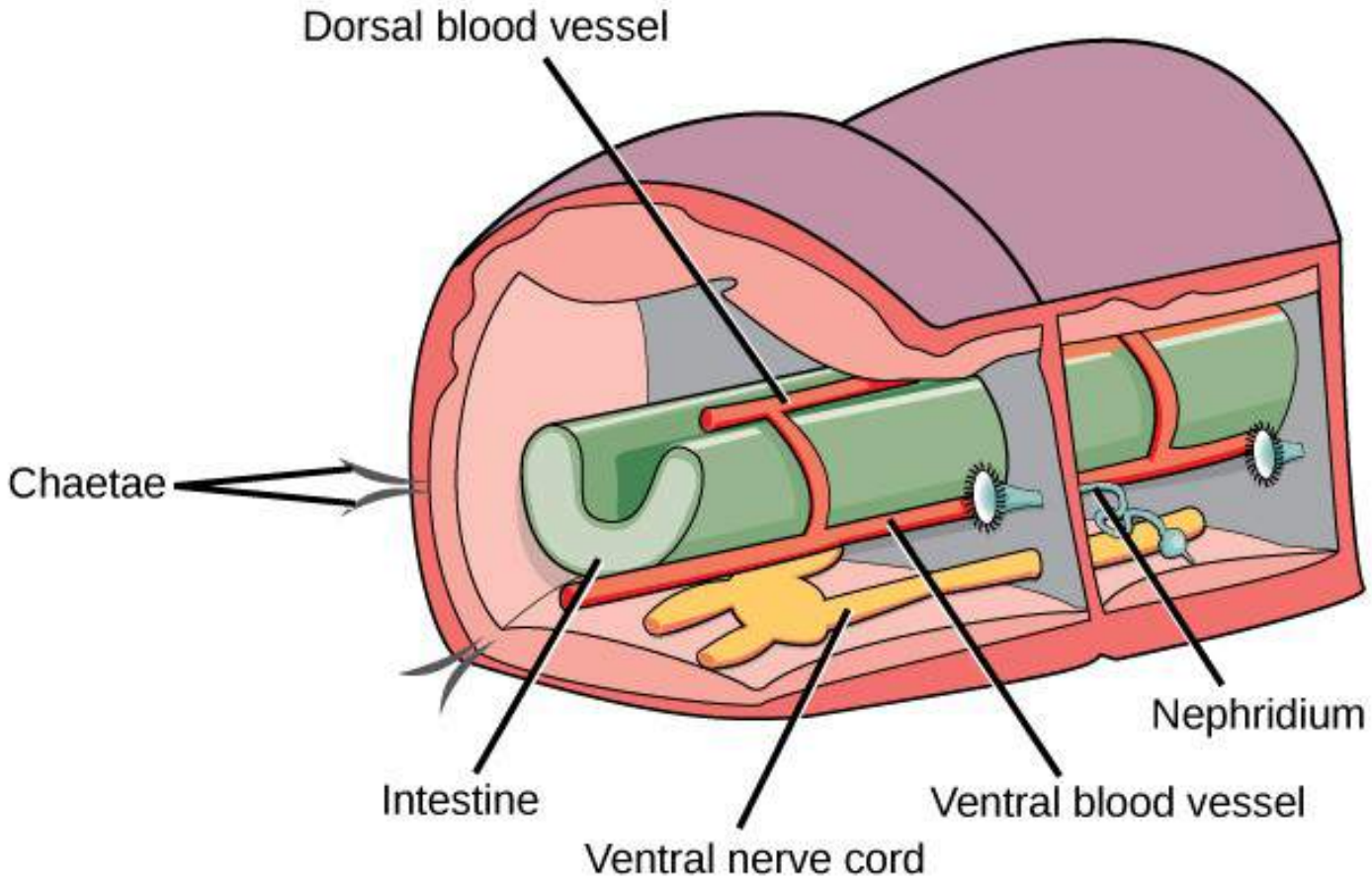


(b) Pseudocoelomate



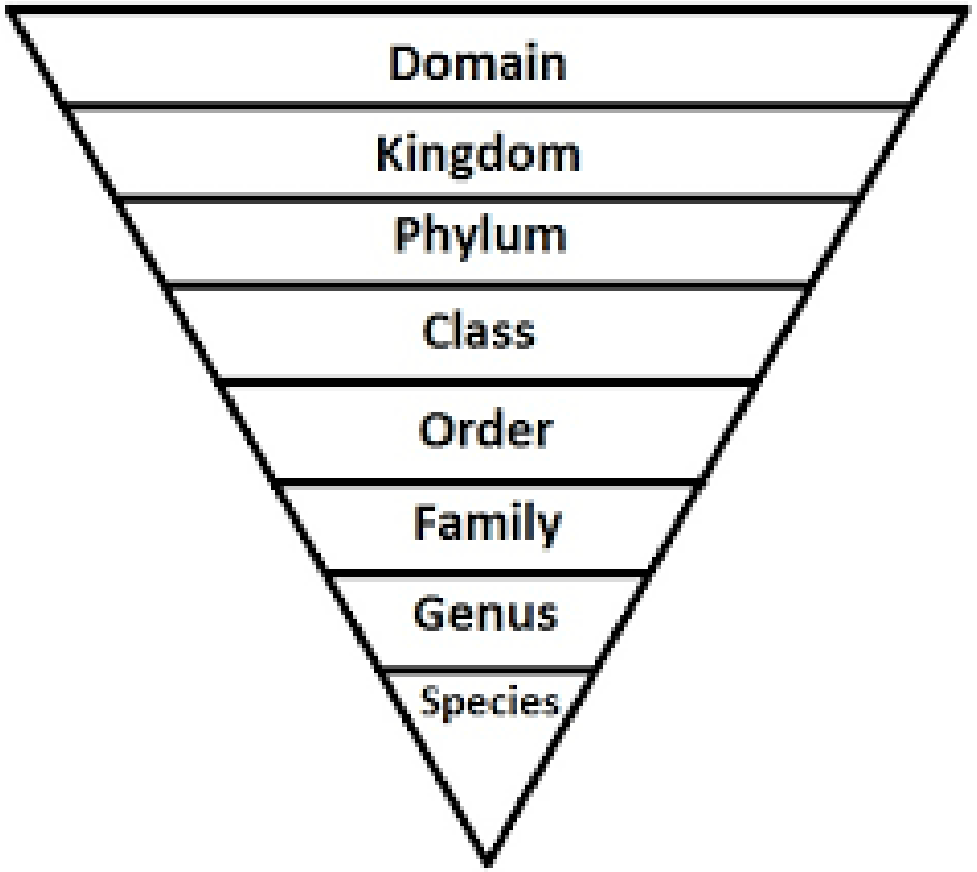
(c) Acoelomate

4. Presence or absence of segmentation: The segmentation or (Metamerism). The linear repetition of part. It appears both externally and internally (ex. Annelide).



Taxonomic levels:

Taxonomy: the basic rules to arranged and classify organisms.



The lowest level of classification is the **species**, each kind of animal and plant belongs to a single species, by definition

species is a series of population that are capable in nature of inter breeding with one another to produce fertile offspring,

put that are unable to interbreed with other species, this definition of species is applieable only to sexually reproduction organism, for others that reproduce a sexually species are erected on the bases of anatomical, physiological and behavioral differences.

Species that have a number of similar structures, in common comprise the genus,

genera are combined into family.

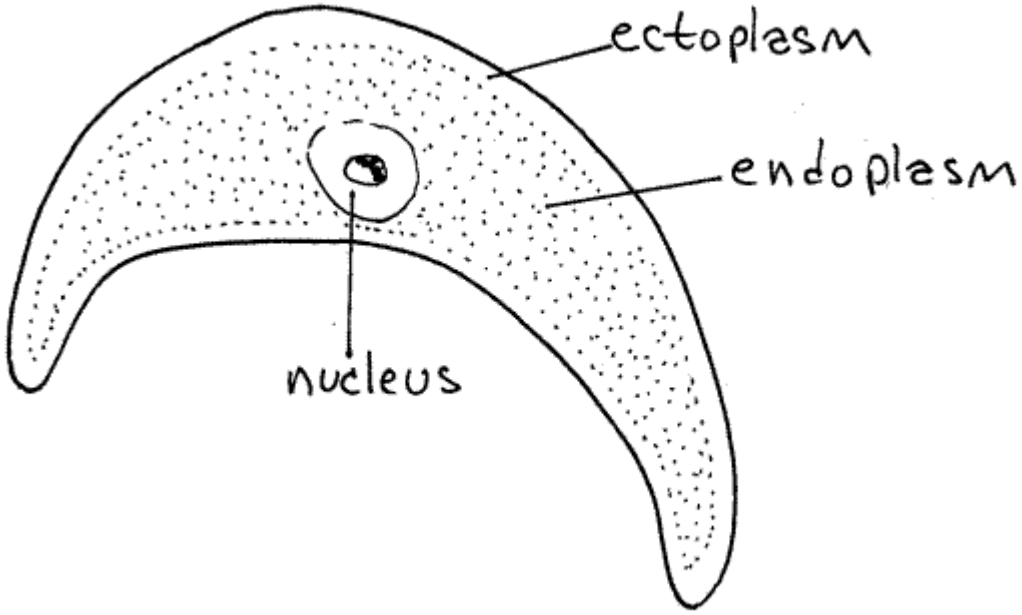
Families into an order, orders into a class, classes into a phylum, finally all the phyla of animals comprise the animal kingdom. Example of system of classification used are as follow:

Kingdom	Animalia
Phylum	Annelida
Class	Hirodinea
Order	Anathobdellida
Family	Hirodinidae
Genus	Hirudo
Species	medicinalis

1- Phylum: Protozoa

The Protozoa are a diverse group of unicellular eukaryotic organisms. Protozoa are mainly microscopic organisms, ranging in size from 10 to 52 micrometers.

The cytoplasm of a protozoan is differentiated into two regions. The portion of the cytoplasm just beneath the pellicle is called **ectoplasm**. It is relatively **clear** and **firm**. The inner cytoplasm, called **endoplasm**, is usually **granular** and **more fluid.**



A regular arrangement of **microtubules**, called the pellicle, underlies the plasma membrane of many protozoa. The pellicle is rigid enough to maintain the shape of the protozoan, but it is also flexible.

Protozoan have organelles that are similar to the organelles of other eukaryotic cells carry out specific functions in protozoa. Some protozoan organelles reflect specializations for unicellular lifestyles.

Nutrition:

Protozoan show a wide variety of types of nutrition

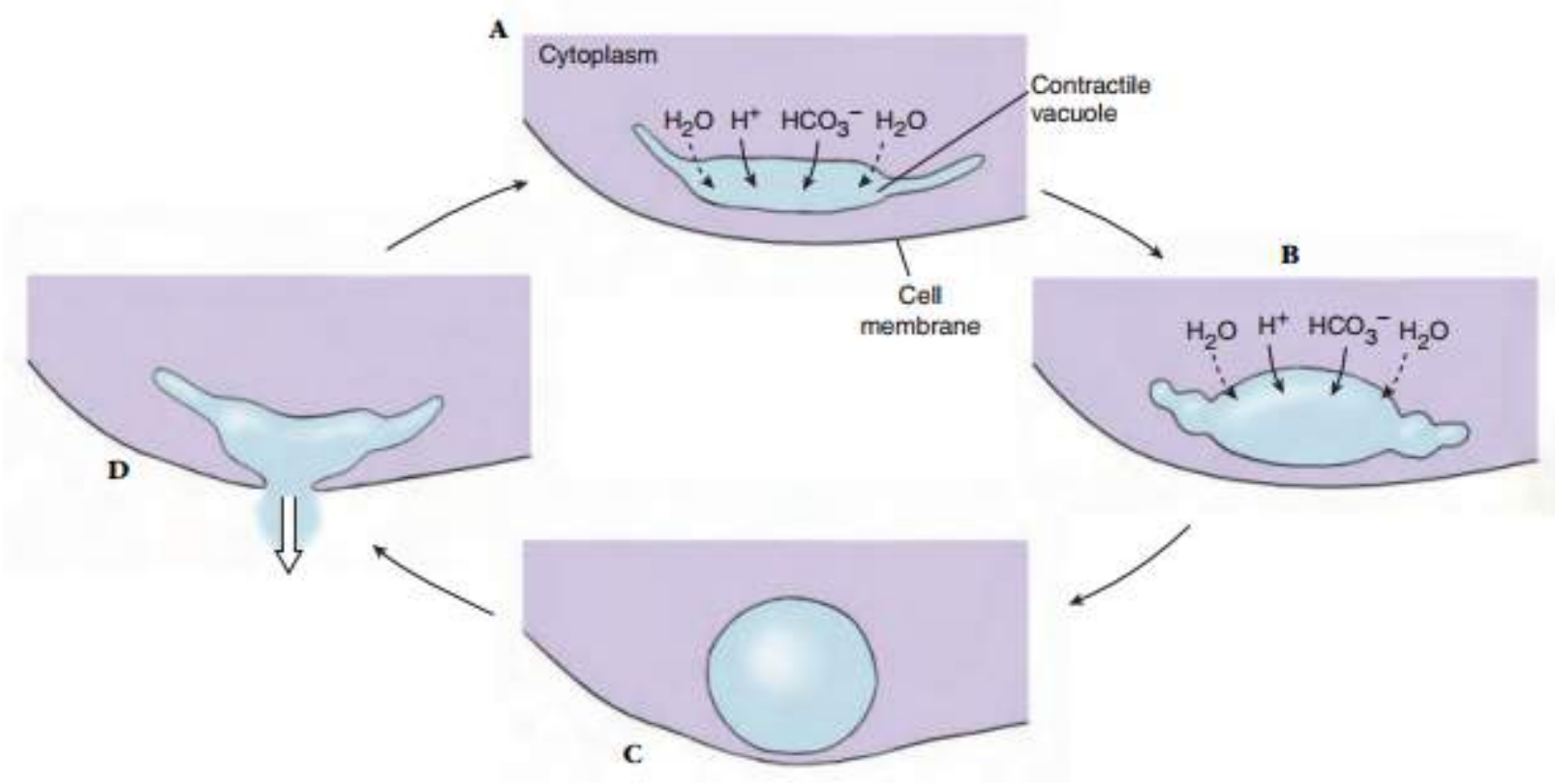
1. Autotrophic: chlorophyll bearing flagellate use photosynthesis to produce organic compound by their own, it is also termed (phytotrophic).
2. Sarprozoic: the colorless flagellate and sporozoan cannot ingest solid food but subsist entirely on dissolved substance actively absorbed from the medium, in the case of internal parasite the medium is the host.
3. Heterotropic (holozoic): these protozoan subsist on other organisms such as bacteria, small algae and even other protozoan ex: amoeba, paramecium.

Digestion and excretion:

Digestion: In the saprozoic and hetero tropic protozoan the food digest in the food vacuole, with its residual un digestible matter the vacuole is moved to any part of the cell surface and its contents are emptied to the outside.

Excretion: The osmotic flooding in the protozoan is controlled by the contractile vacuole, the contractile vacuole fills with excess water and empties its contents to exterior.

The contractile vacuoles are absent in parasitic and marine protozoan, **because** of the concentration in the cytoplasm is ordinary the same as that of the surrounding medium.



Respiration:

Protozoan are able to carry on respiration exchange (inspiration & expiration by diffusion via cell membrane.

Locomotion:

The locomotion of protozoan can be performed by pseudopodia or flagella, or cilia, these locomotion organelle are used for movement and food capturing.

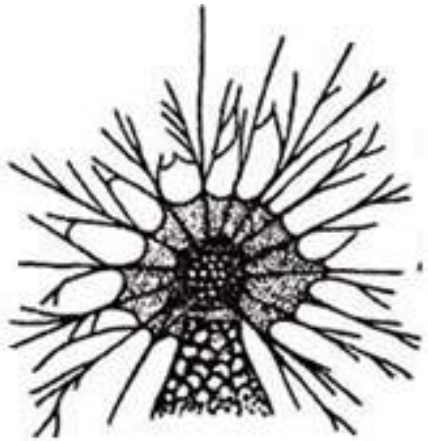
Pseudopodia:

Mostly found in order sarcodina, they are in variable forms:

1. Lobopodia: extension of the cytoplasm (ex: *Amoeba sp.*)
2. Filopodia: a thread like extension of the cytoplasm (ex: *Euglypha sp.*)
3. Rizopodia: a thread like reticulated extension of the cytoplasm (ex: *Actinosphaerium sp.*)

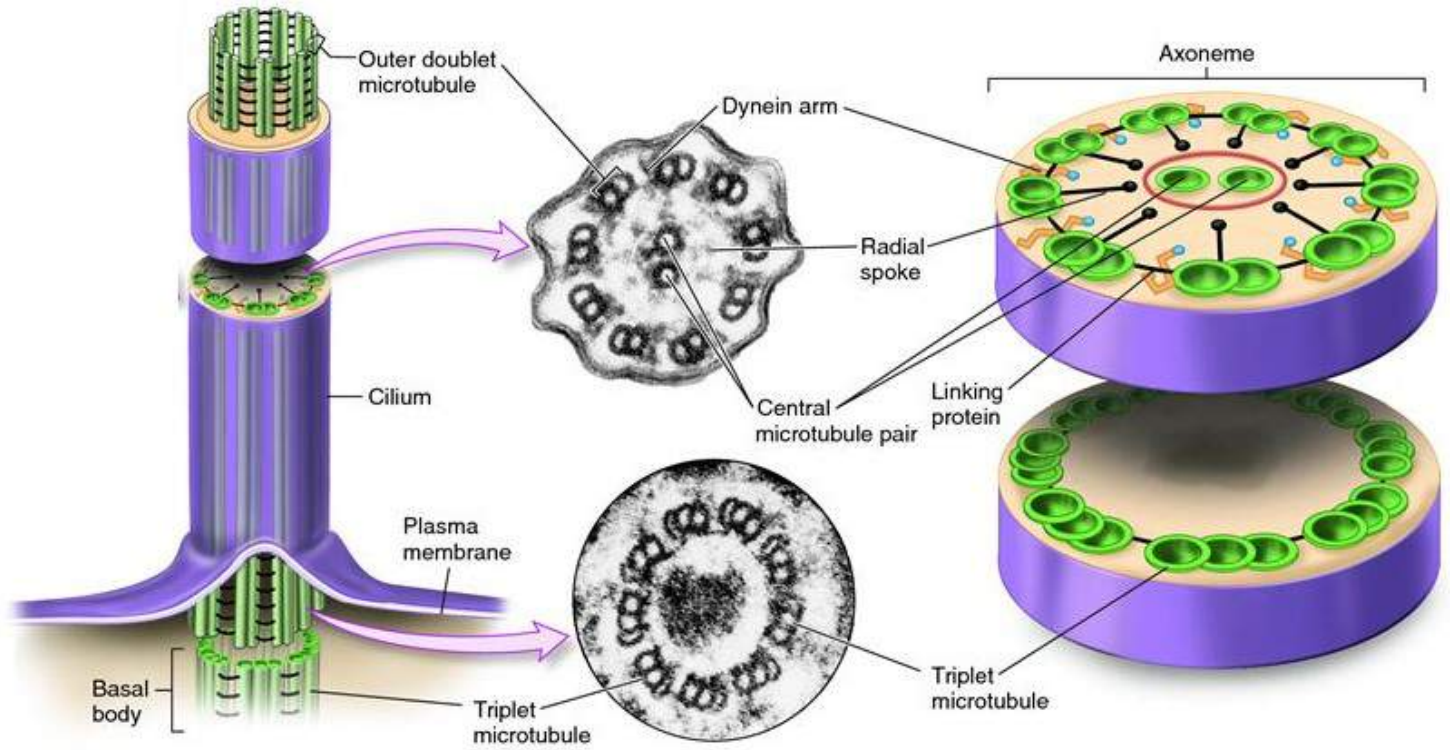
Lobopodia

Filopodia

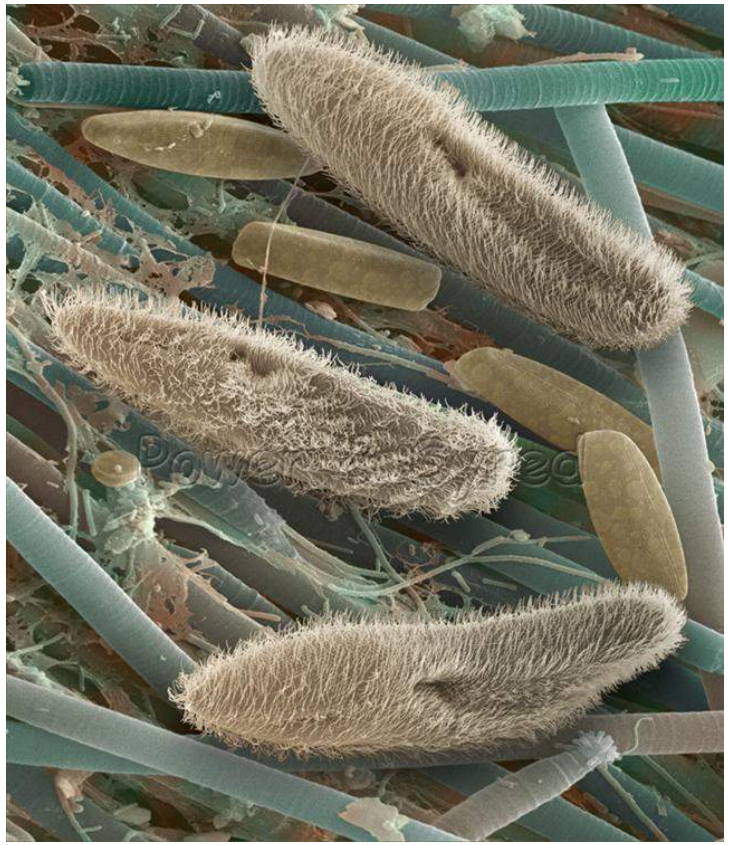


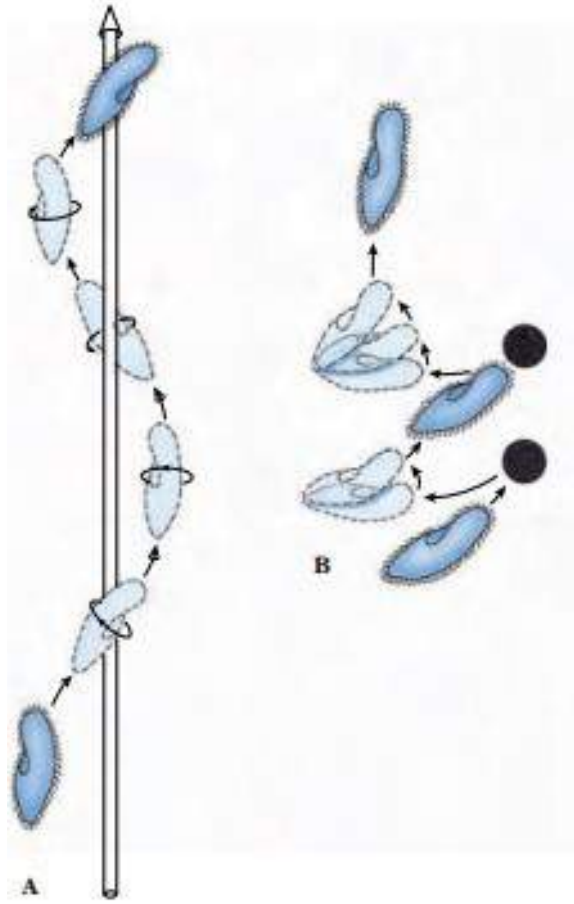
Rizopodia

Flagella: this locomotion organelles is found in the order flagellate. Flagellum is bounded by a membrane of cytoplasm within which a number of fibrils called the Axoneme, it is originated from the basal body, most flagella are long.



Cilia: short and thin, it is found in numerous number originated from the kinetosome, cilia could be fused with each other to form cirri or membranella, it's found in ciliates.



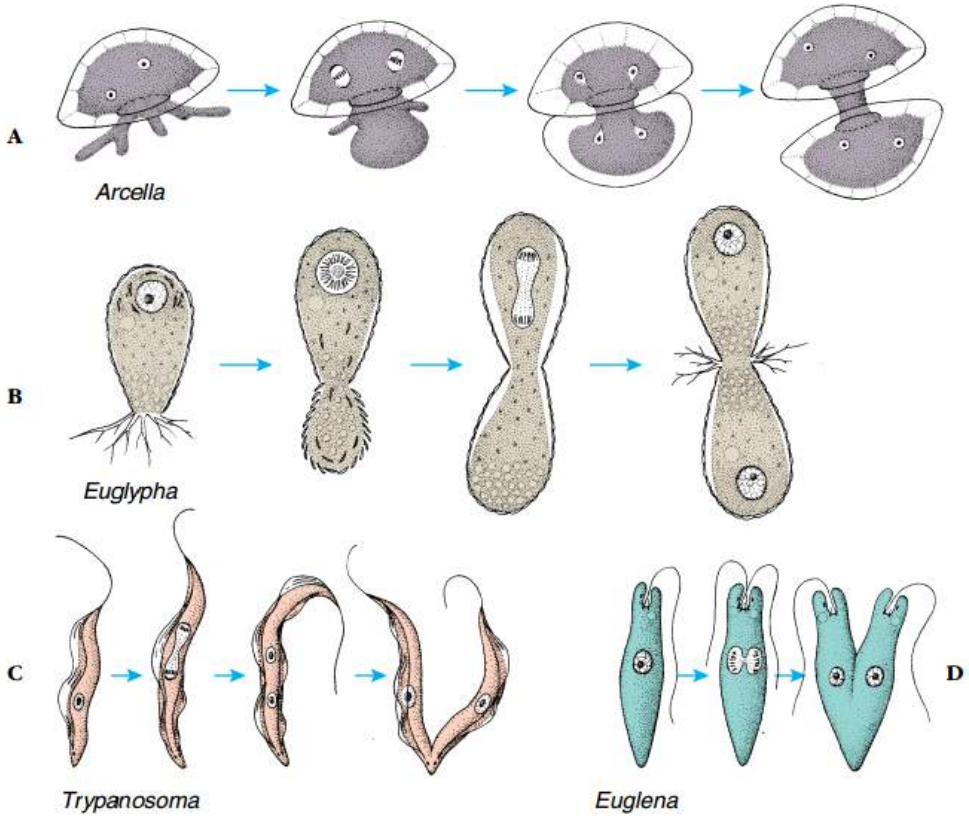


Reproduction:

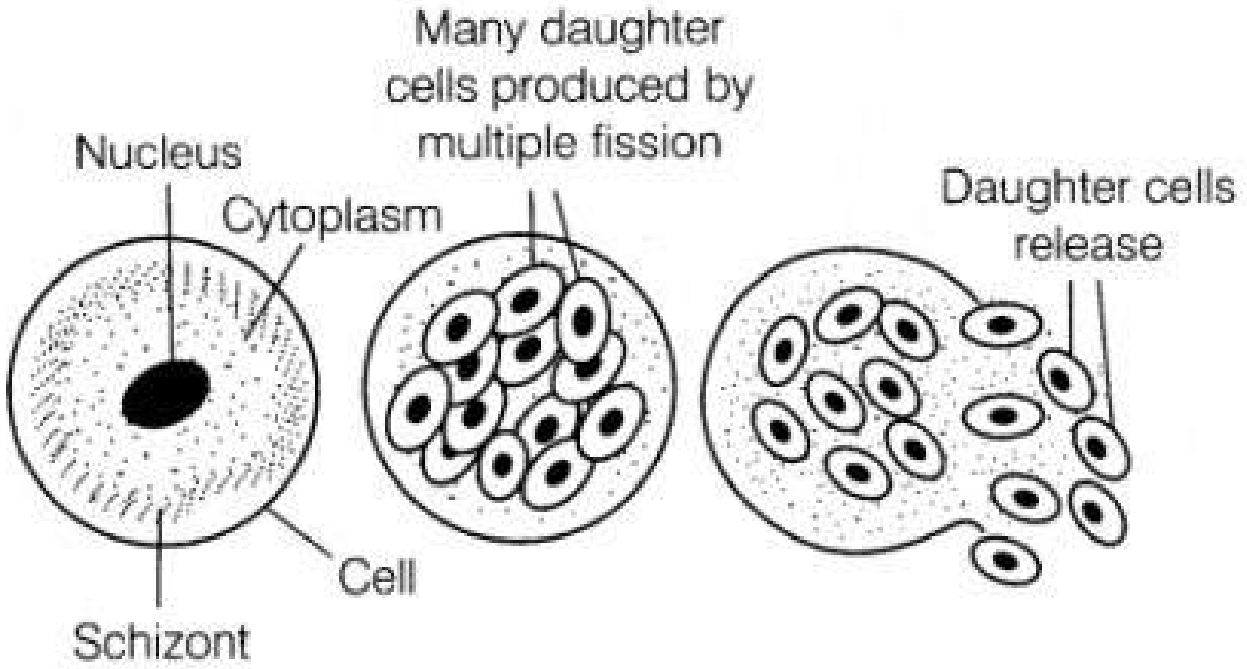
Protozoan exhibit both asexual & sexual reproduction.

1. **Asexual reproduction**: in which the parent cell produce daughter cells with same genetic constitute.

   a. **Binary fission:** where by the protozoan divide into two nearly equal parts in (nucleus & cytoplasm).



b. **Multiple fission:** it is performed by dividing the nucleus into many small fraction then each fraction surrounded by small amount of the cytoplasm, then the mother cell covered by protective covering. This type of reproduction is found in some flagellates and sporozoan during unfavorable condition, it's also called (sporulation) or (schyzogony).



Multiple fission in *Plasmodium*

c. **Budding**: the bud appears as a small growth from the mother cell, a separate from parent and grow to a new individual, budding can be found as internal or external in some ciliates such as order suctoria.

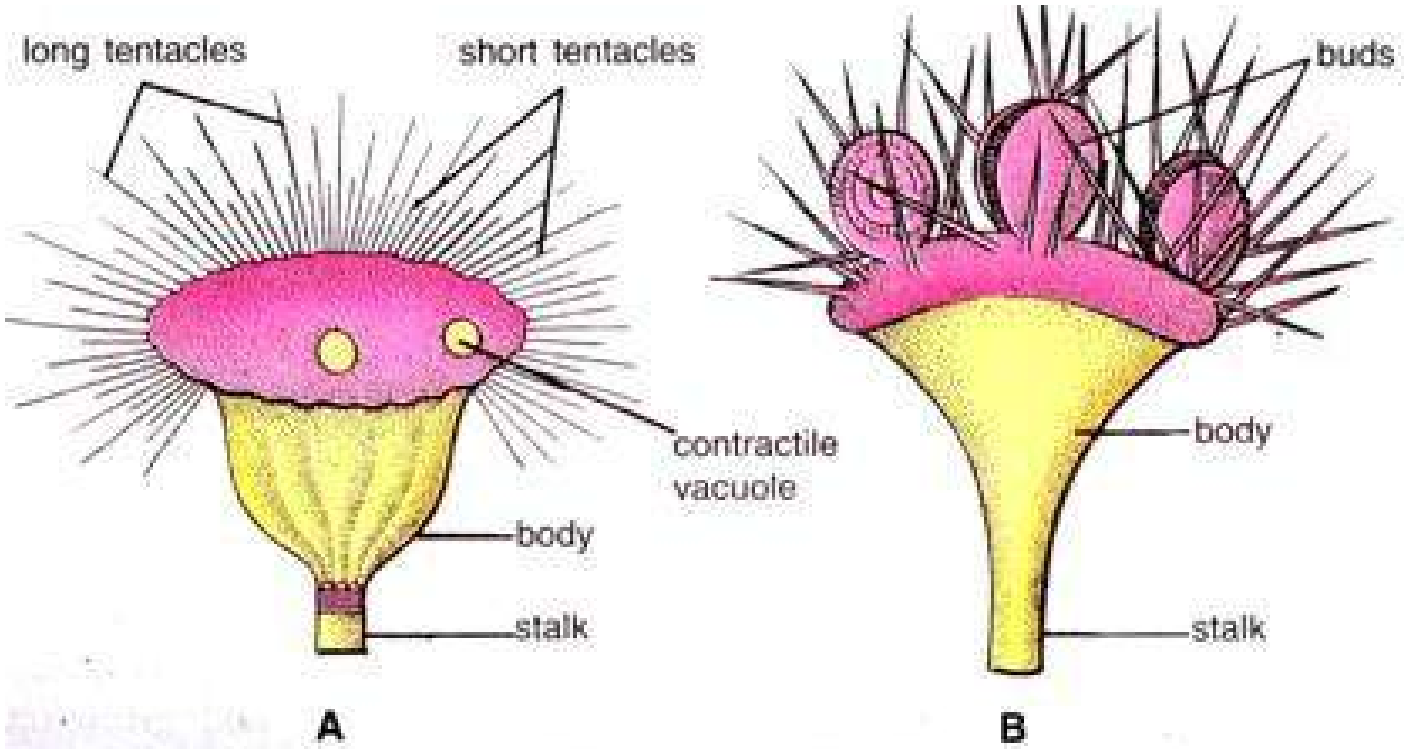


Fig. 22.31. *Ephelota*. A—Entire animal; B—Showing budding.

d. **Plasmotomy**: this type of reproduction is found in protozoan with many nucleus such as the *opalina sp.* Where the division is includes only the cytoplasm.

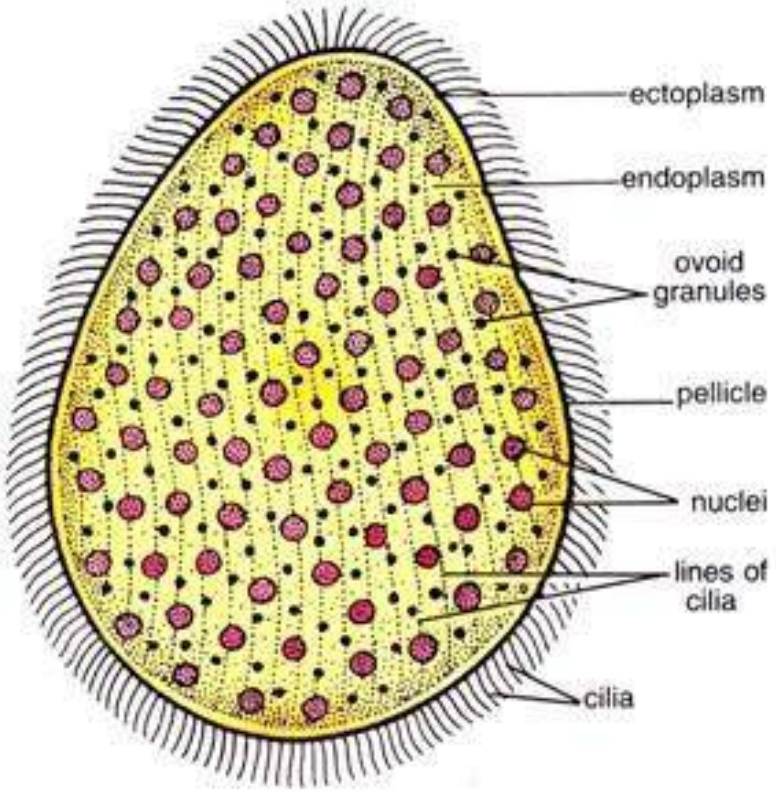
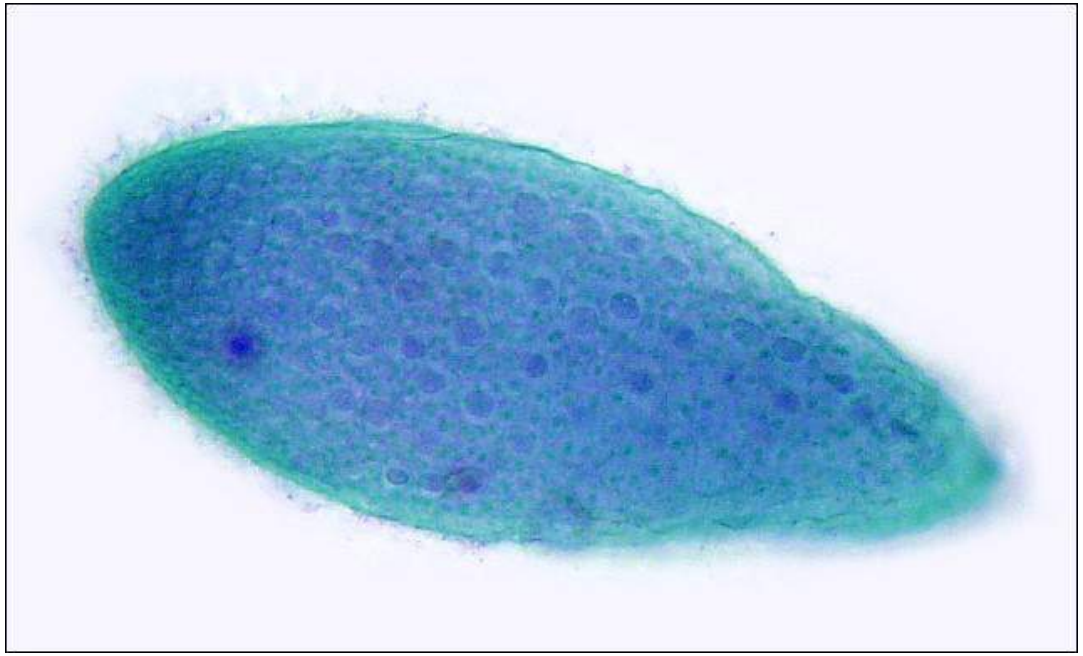


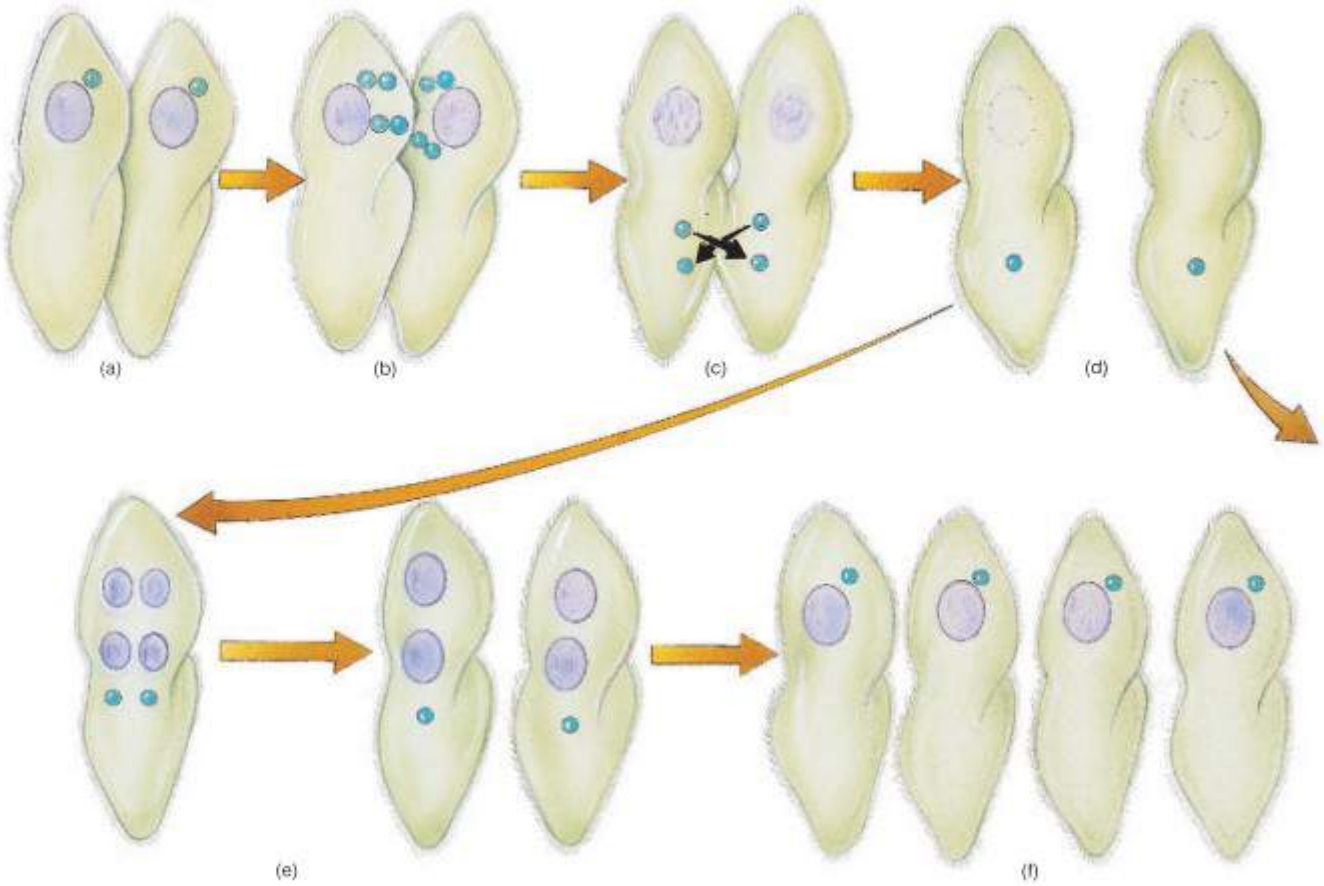
Fig. 22.13. *Opalina ranarum.*



1. Sexual reproduction: the biological significance of sexual reproduction is provides **not only for increase in numbers** but also for a change in the genetic makeup of the individual.

   a. **Syngamy:** this type of sexual reproduction involves fusion of two individual followed by meiosis to produce offspring with new genetic constitution, it is found in many flagellates, sarcodina and sporozon.

b. Conjugation: it is a specialized sexual reproduction performed by ciliates in which two individuals form a lateral attachment then exchange nuclear material, separate and subsequently undergo division to produce from 4 to 32 individuals with new constitutions.



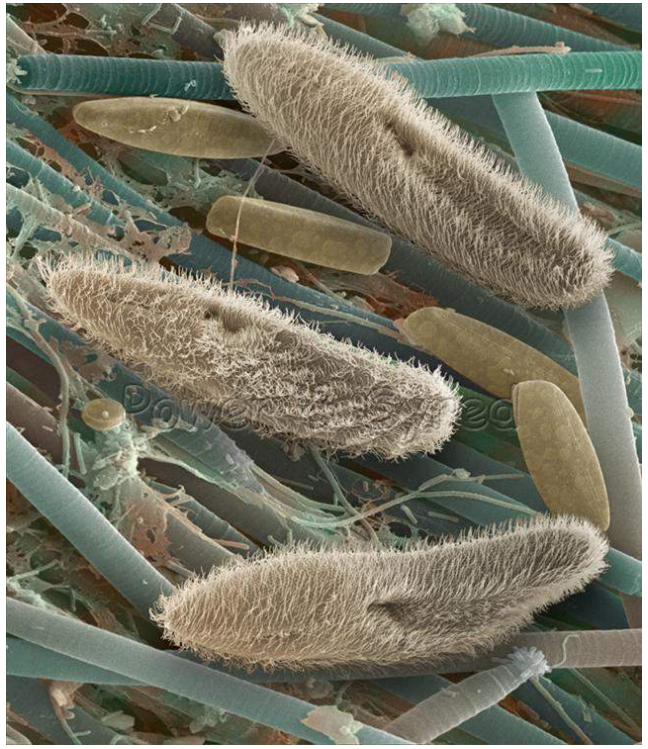
Classification:

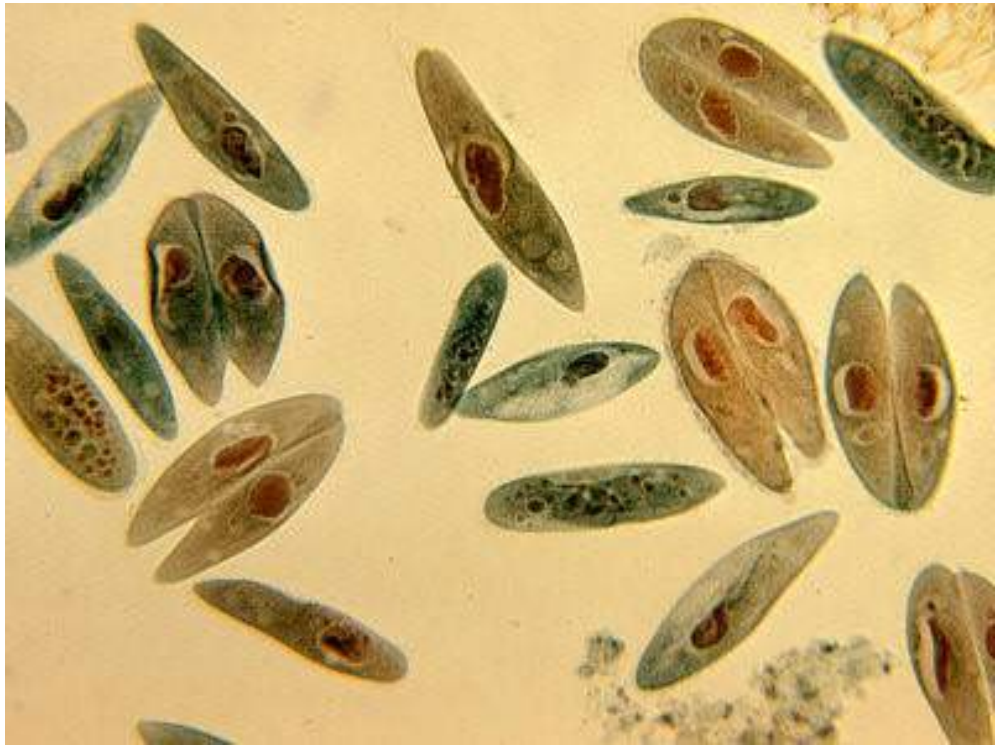
The phylum protozoa can be divided into four classes, based primarily upon the type of locomotors organelle, which they possess, these classes are:

1. **Class sarcodina:** includes protozoan which move by means of pseudopodia, the cell wall is plasma membrane, most of them are **heterotrophic** or **saprozoic** in feeding, reproduce sexually by syngamy and asexually by binary fission or multiple fission or plasmotomy and divided into five ordered.

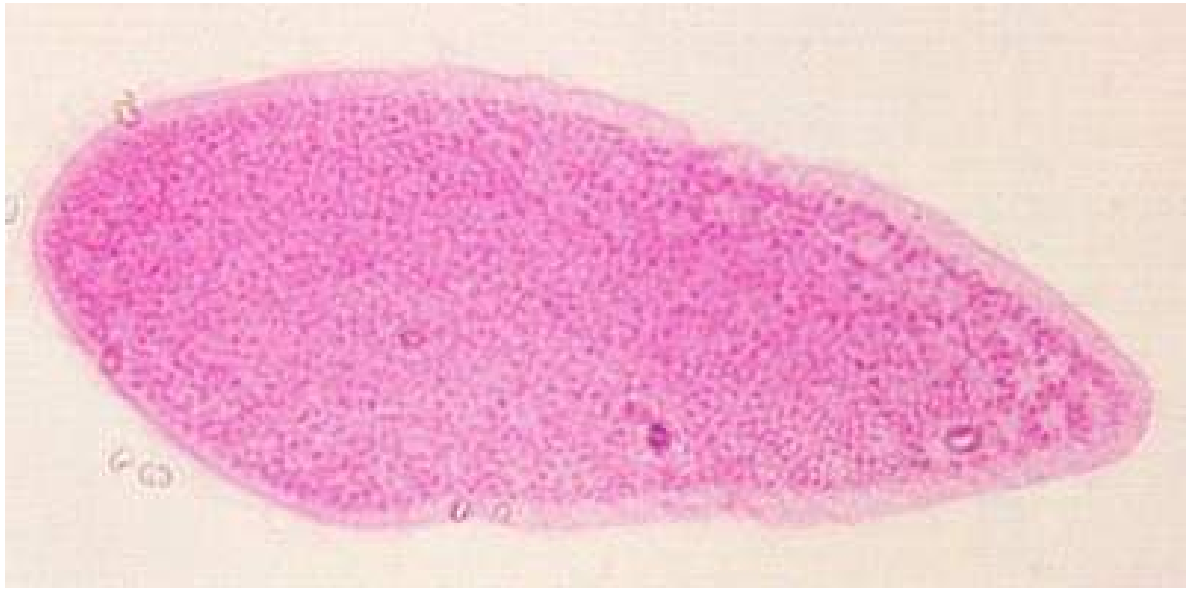
2. Class flagellata: which possess one OF several flagella for locomotion, the cell wall is a pellicle, some of them bear chlorophyll, so they are **Autotrophic**, others colorless flagellates are **saprozoic**, reproduce sexually by syngamy and asexually by longitudinal binary fission or plasmotomy or multiple fission. It's divided into nine order.

3. Ciliata: they possess cilia which is moved by it, have two nucleus (macro & micro nucleus) and two or more contractile vacuoles, reproduce sexually by conjugation and Asexually by transversal binary fission or budding in few species, its divided into five orders, Generally they covered by the pellicle.





4. Class sporozoa: sporozoan are lack the locomotion organelle and contractile vacuole, they are all parasites, reproduce sexually by syngamy and asexually by multiple fission (sporolation), it is divided into two order only.



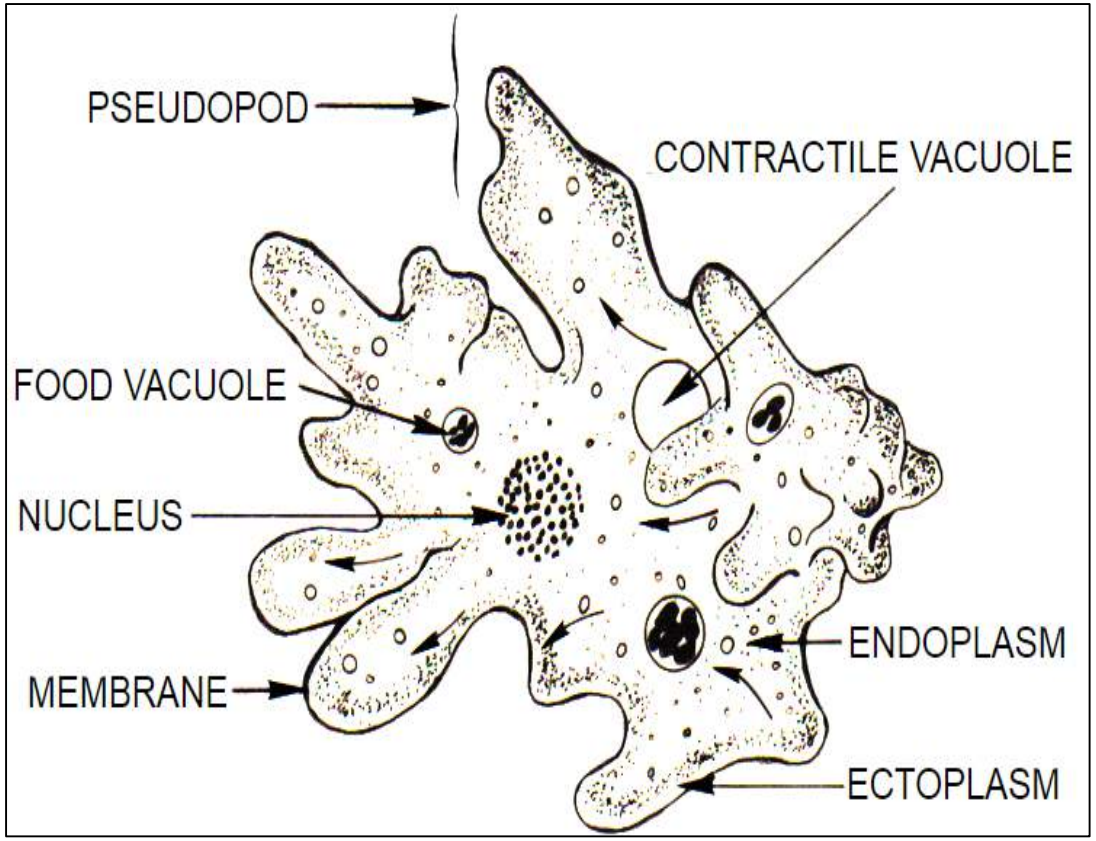
Some examples of protozoan

1. Class: Sarcodina

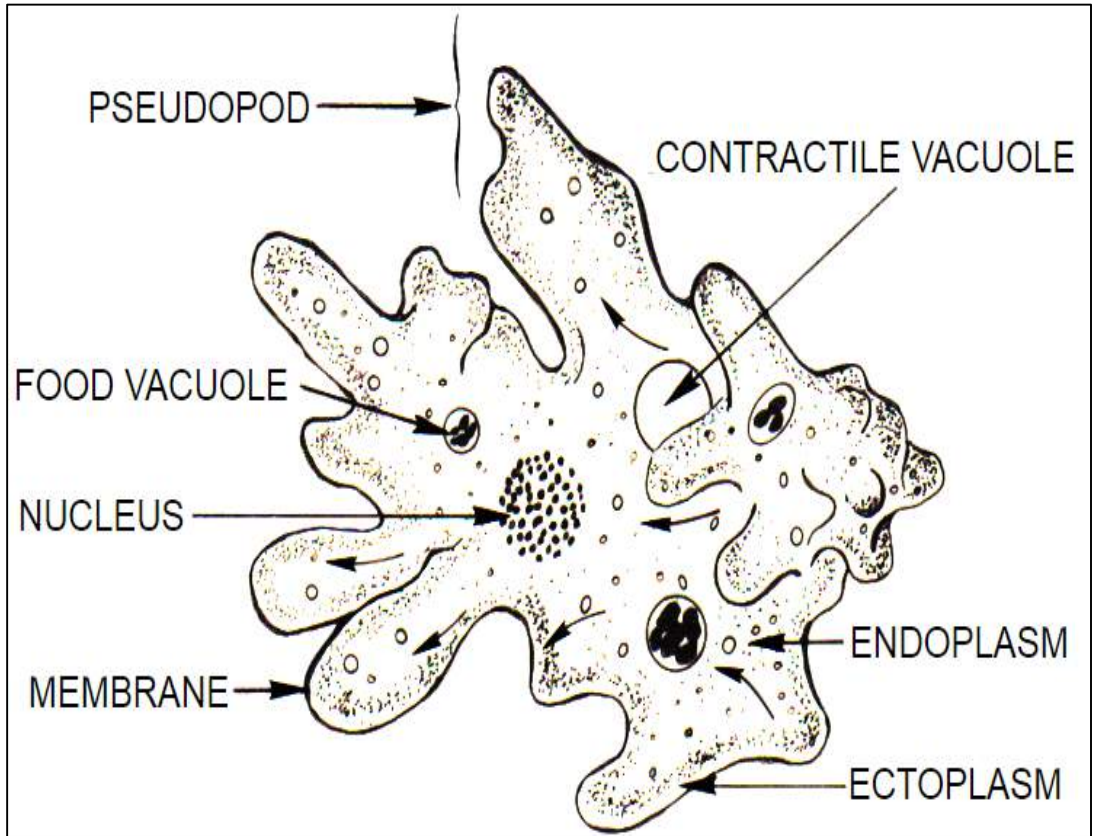
Order: Amoebina

Amoeba sp.

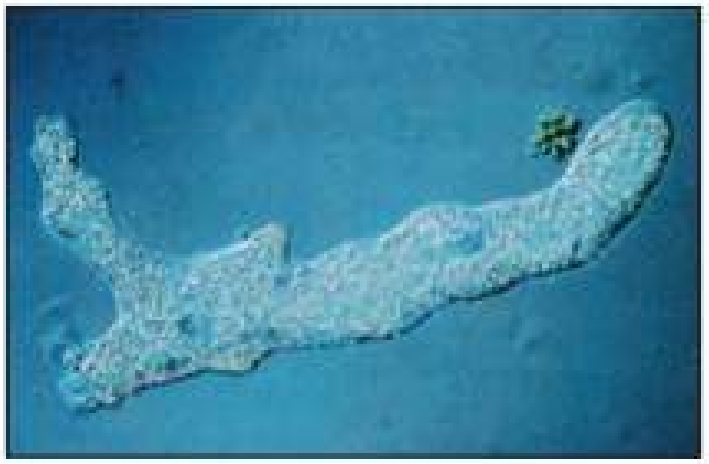
The amoeba cell wall is flexible called plasma membrane which enables the *amoeba* to move, the nucleus with a discoid shape, reproduction by binary fission, pseudopodia (lobopodia) are the locomotion organelle which also used for food cupturing.



Pseudopodium appears as a small growth from the ectoplasm (**plasmogel**), the plasmogel converts into plasmosol (that is become more fluid) in the posterior region of the organism, and form pseudopodium where it is again converted into the more viscous plasmogel in the anterior region of the pseudopodium.



Digestive enzymes (proteinase, lipase, amylase, peptidase and cellulose) are then released into the vacuole. After digestion has been done the nutrition are absorbed from the vacuoles then the vacuole is moved with its residual undigested matter to the cell surface and the content are emptied to the outside


Pylomyxa

It is much similar to amoeba, **but** it is larger and has many nucleus and many contractile vacuoles, it reproduce asexually by **plasmotomy**.

Order: Arcellinida

Arcella

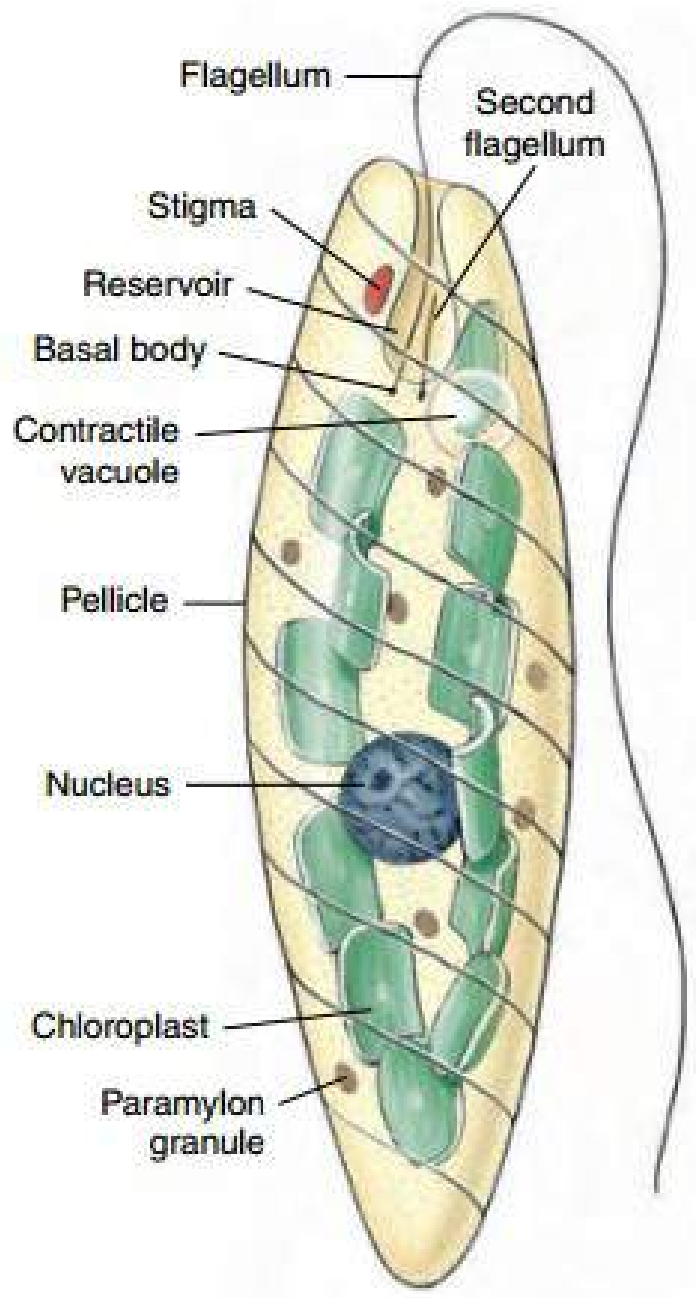
It is a genus of testate amoebae or Arcellinida. Usually found in freshwaters and mosses, and rarely in soils. An *Arcella* is typically enclosed in a chitinous, umbrella-shaped test (or shell) that has a single central aperture through which the pseudopods – which are used for locomotion – extend out. The test is composed of organic material with a diameter of up to 300 µm and is **transparent** or **light-yellow**-colored in young *Arcella*, but browns while aging due to the progressive deposition of iron and manganese compounds. Most species are **binucleate**.

2. Class: Flagellata

Order: Euglenoidina

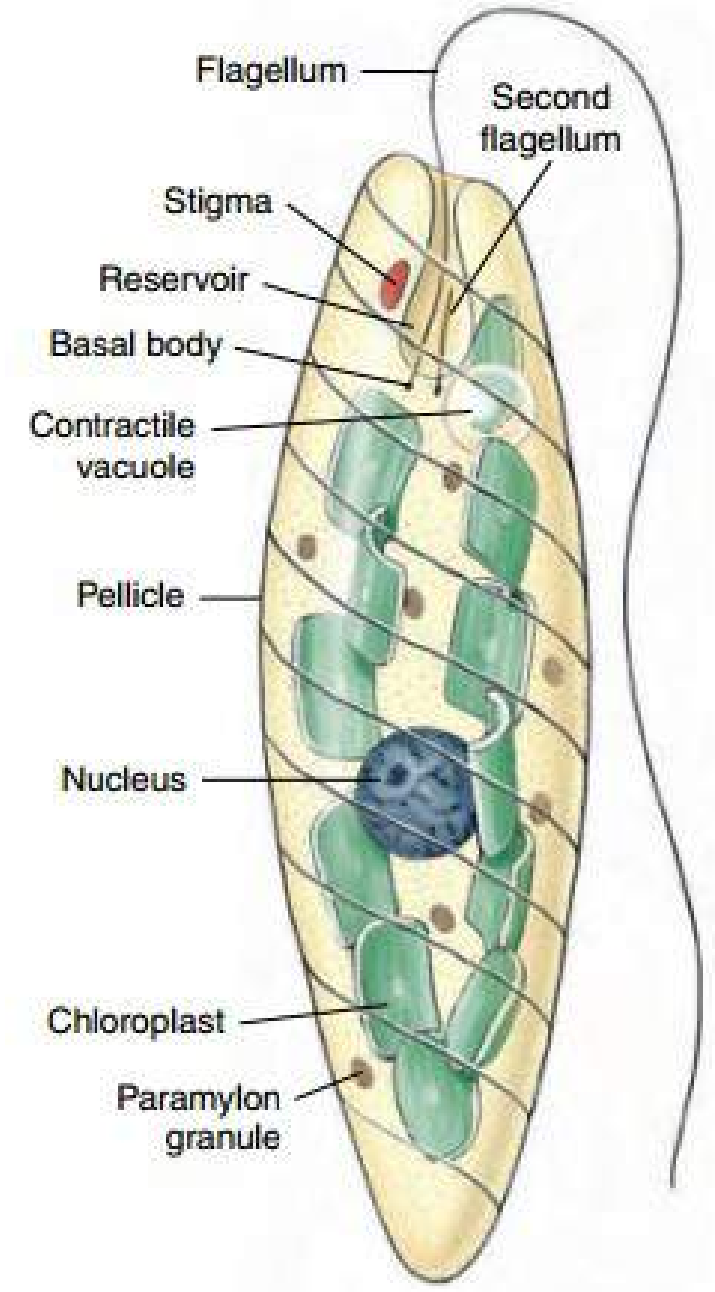
Euglena sp.

The cell is covered by the pellicle, it bears a chlorophyll in chloroplast which distribute in the cytoplasm around the nucleus so it is phytotrophic (**Autotrophic**) in their feeding. They also can be (saprozoic) when it is found in enriched media with decayed organic matter, or during light scarcity.



The contractile vacuole emptied their contents into the reservoir, then to the outside via the cytosome.

The locomotion organelle are the flagella, euglena has two flagella, one is long and the other very short, It reproduce sexually by (syngamy) and asexually by (binary fission) or multiple fission (sporulation), during unfavorable condition.



Order: opalinina

Opalina sp.

Despite of the presence of cilia around the *opalina* as a locomotion organelle, the opalinina orders considered to be not ciliate, but flagellate. Because of

The *opalina sp.* Lives in the rectum of frog. The *opalina* are surrounded by the cilia, and had many nuclei distributed in the cytoplasm.

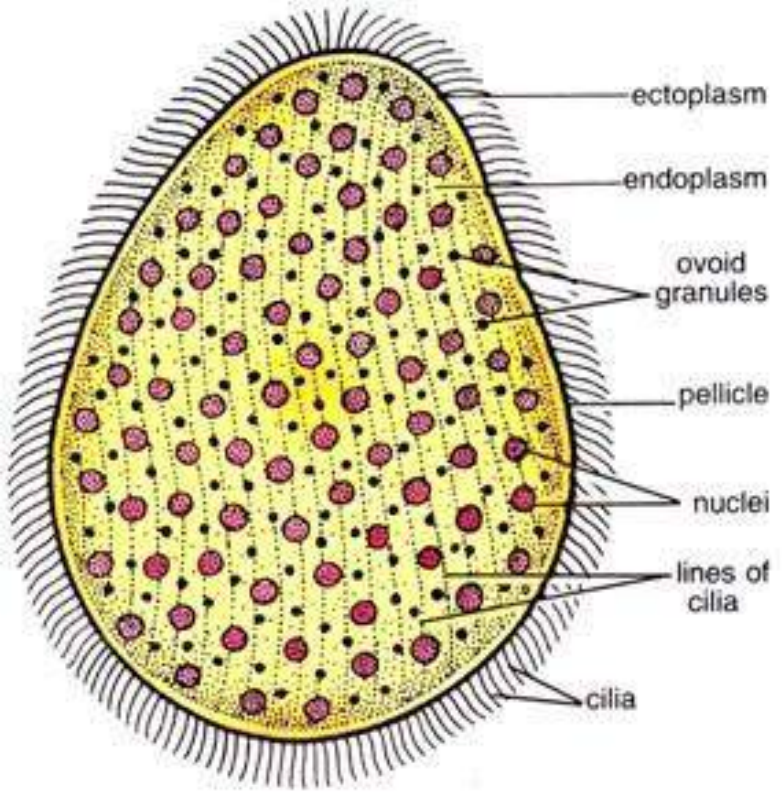
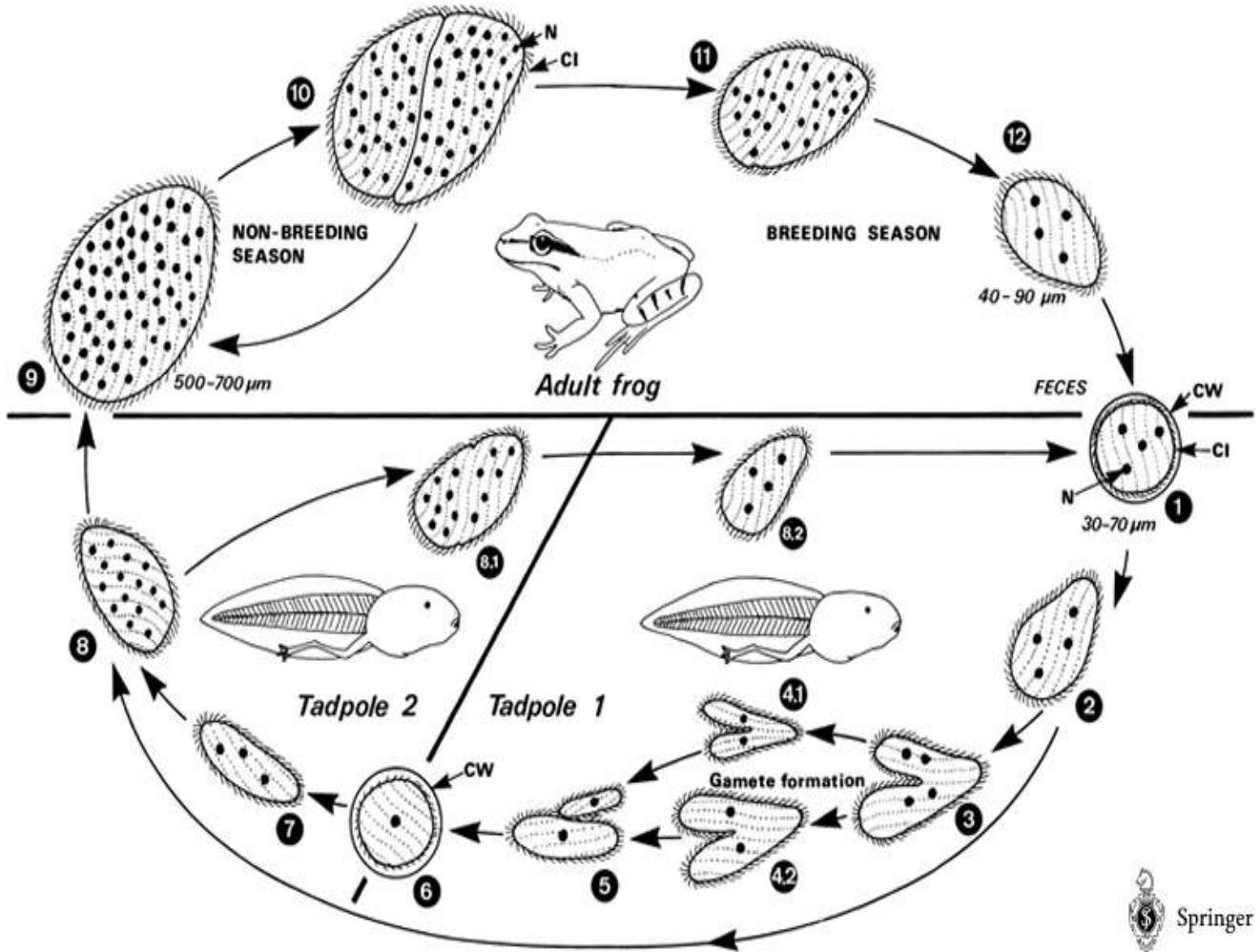


Fig. 22.13. *Opalina ranarum.*

The offsprings take their way to the outside with feses of the frog, then they are swallowed by the young frog to continue their life cycle in the frog intestine, where in the offspring reproduce by syngamy to form **zygotes** which after squent division grow into mature *opalina*.



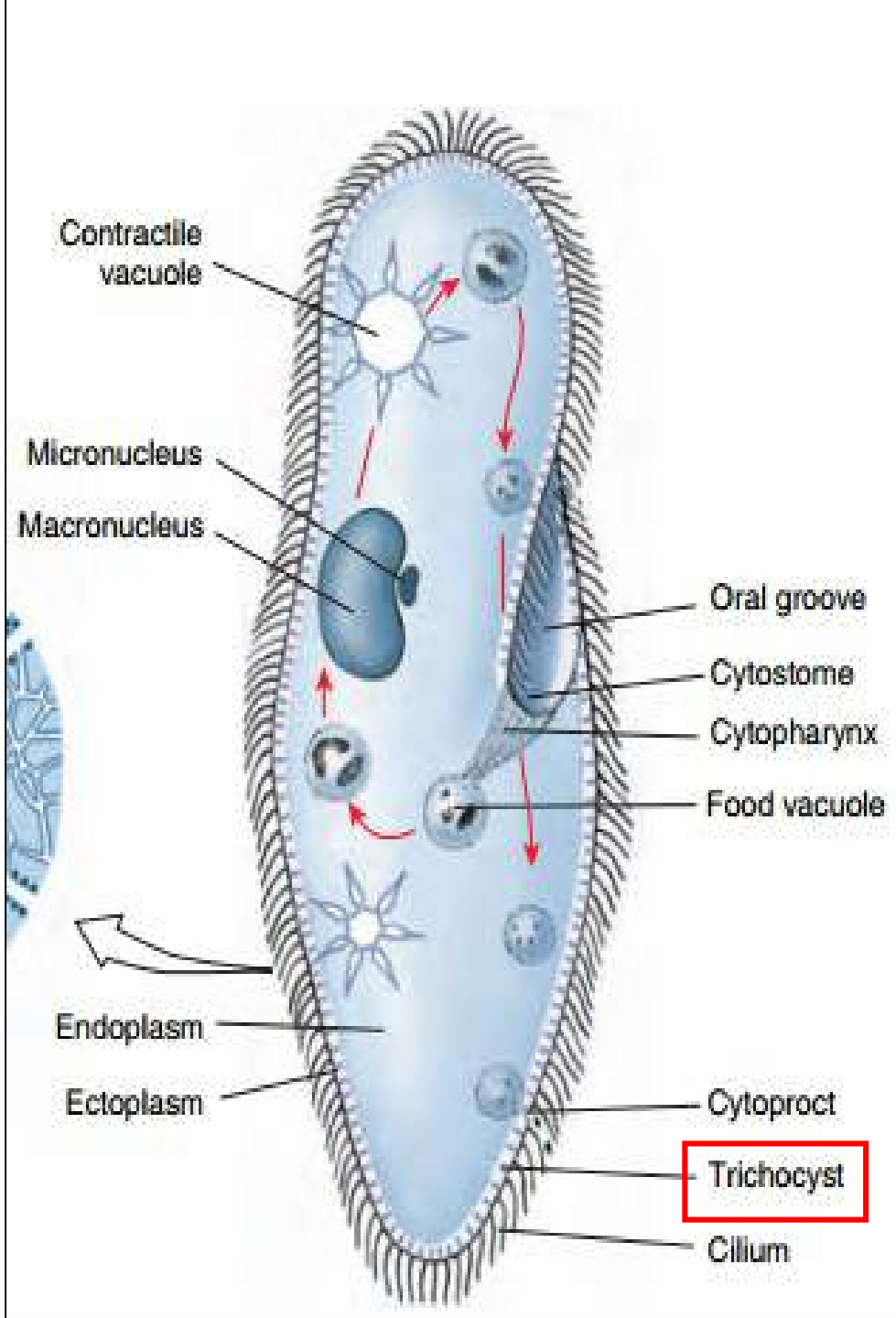
3. Class: Ciliata

Order: Holotricha

Paramecium sp.

The paramecium is covered with a pellicle, on which appear the trichocysts.

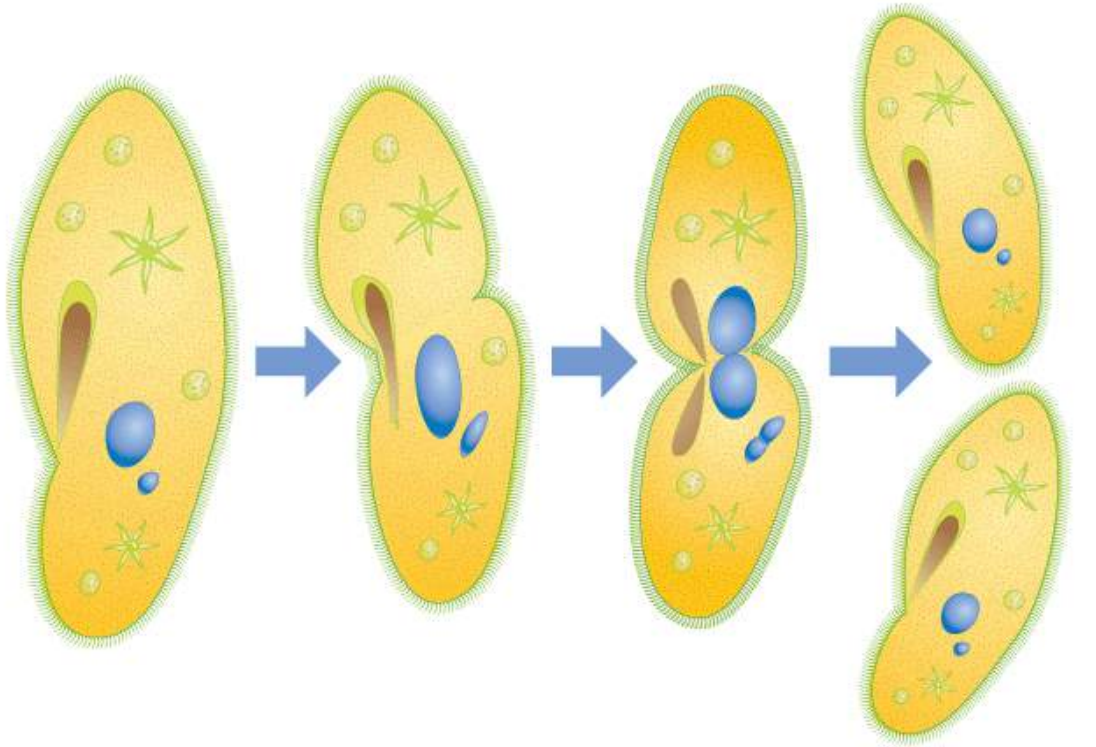
Trichocysts: is rod like or oval structure, consists of an extended filamentous shaft plus a thorn like tip, the trichocyst discharges through a pore in the pellicle, they arranged at right angles to the body surface of the paramecium, its **functions** are protection, food capture, and temporary anchorage.

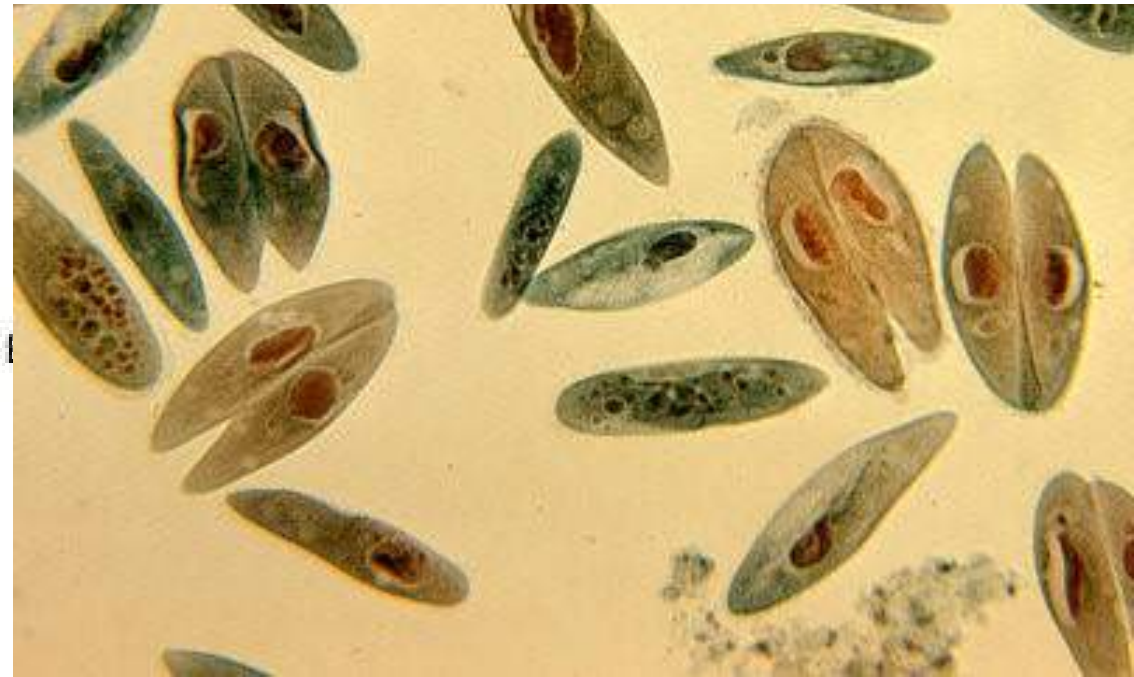


Paramecium like other ciliate has the most advance feeding apparatus of all protozoan.

It has two nucleus (macro & micro), the contractile vacuoles provide with radiating canal to collect the fluid from the cytoplasm then emptied their contents to the outside via the pellicle.

Paramecium has two contractile vacuoles. The reproduction performed a **sexually** by transversal binary fission and **sexually** by (Conjugation).





Order: Suctoria

Acineta sp.

It is found to live in fresh and marine water. There body is vas-like, bearing a tentacles arranged terminally in one side or more.

Its reproduce asexually by **internal budding** in which the new buds are formed in side invaginations on the body of the cell. They complete their development and leave the mother to grow into a new individual.

Ephelota

Another species of suctoria is *Ephelota* which has a stem-like thick and striated body. The tentacles distributed on the whole body. The macronucleus is large elongated. Reproduce asexually by external budding. It's found in marine sticking on the algae and some cnidarian species.

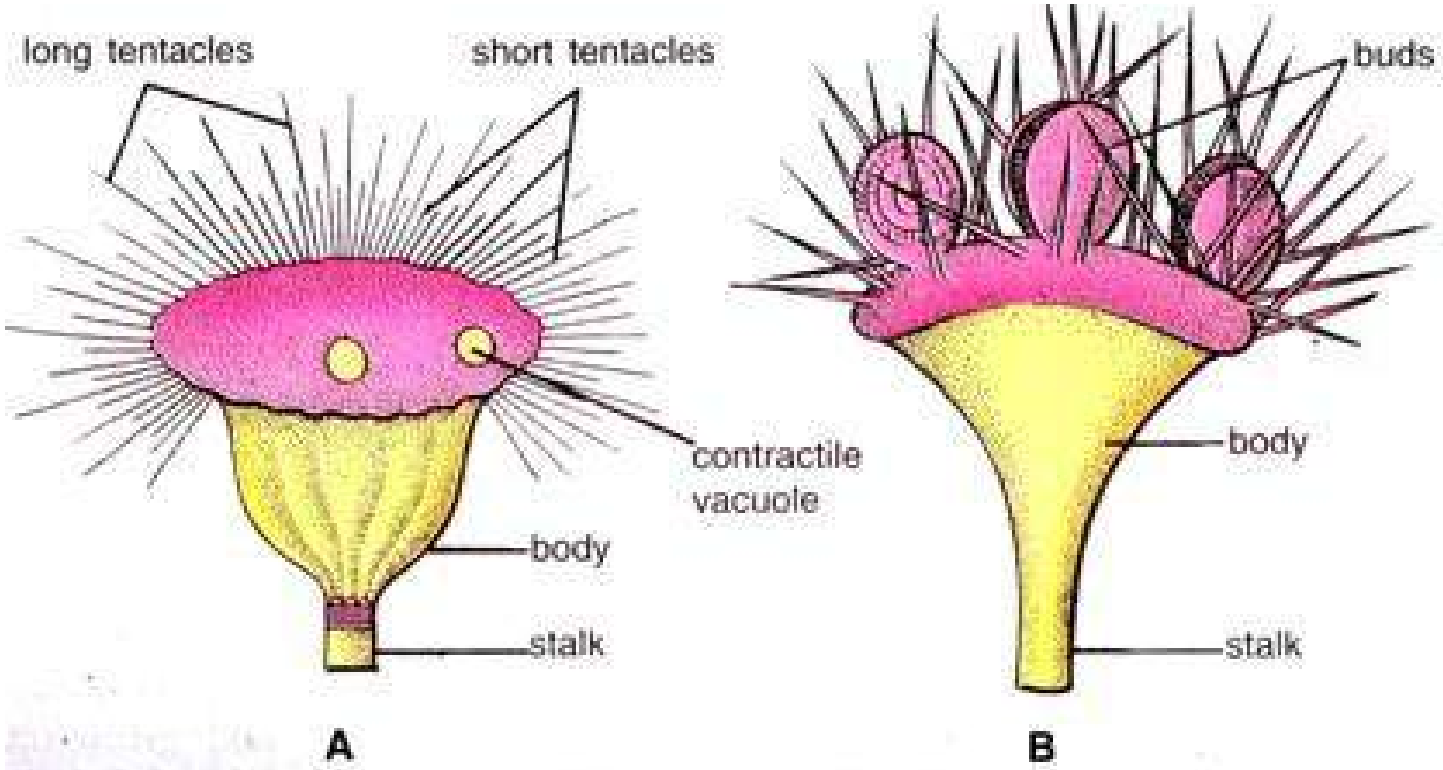


Fig. 22.31. *Ephelota*. A—Entire animal; B—Showing budding.

Phylum porifera (Sponges)

The porifera (L. porus, pore, ferre, to bear)

The phylum name is based on the fact that in sponges the sides of the body are perforated by many small pores.

The term (porifera) was established by Grant in 1836.

The main characters of porifera:

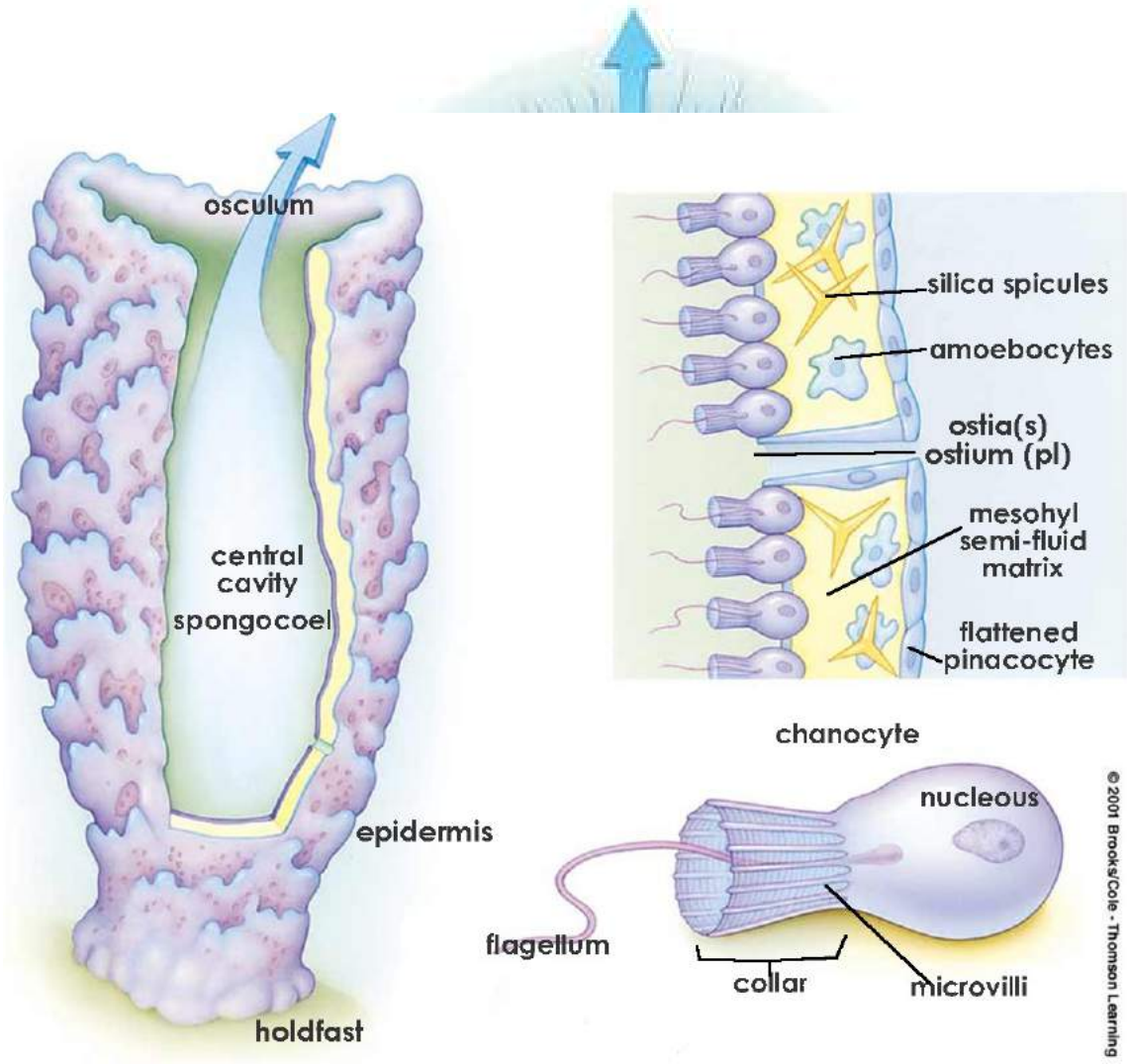
1. The adults are sessile, most of them are marines except one family (Spongillidae) lives in fresh water

2. In spite of the fact that sponges are metazoan their cells still have a considerable degree of independence instead of being organized into tissue and organs

3. The majority of sponges are asymmetrical.

4. The sides of the sponge's body are perforated by many small pores (ostia) through which water flaws in ward, being expelled through one or more larger (Osculum).

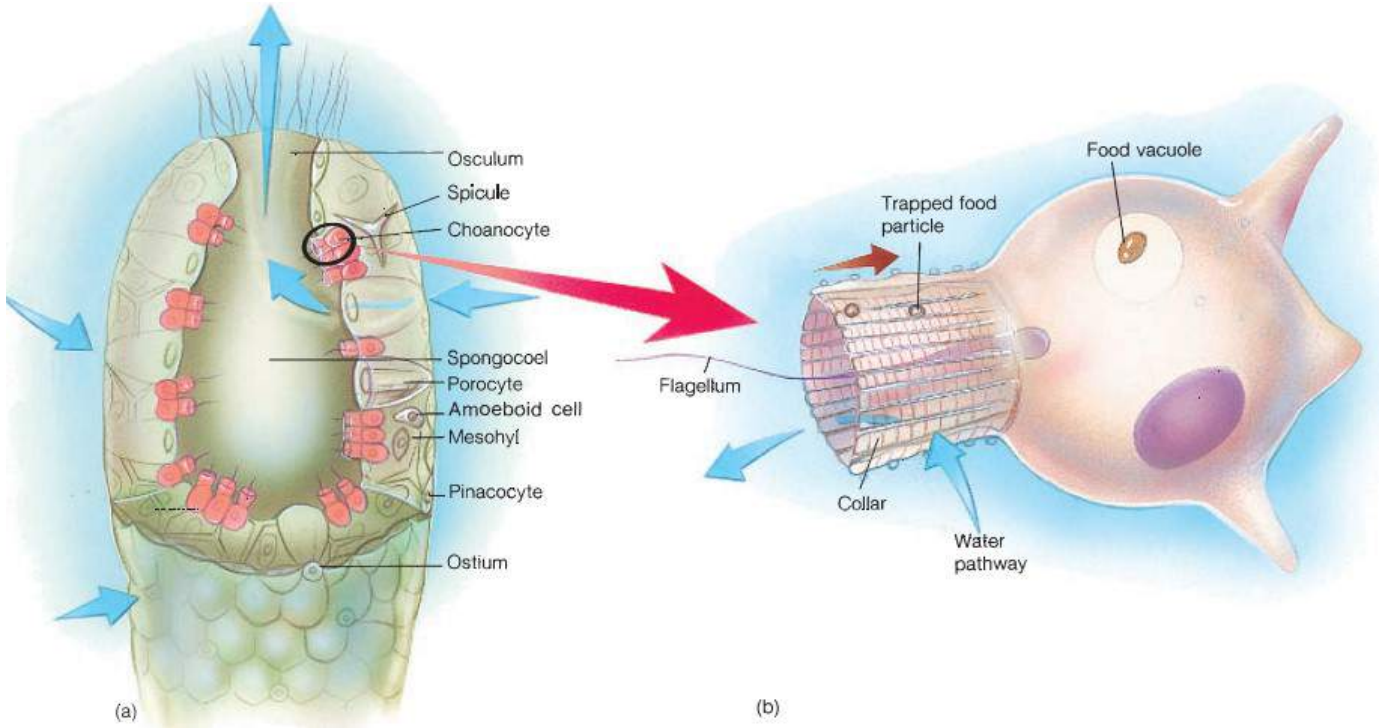
5. A skeleton is found in nearly all sponges located in the mesoglea, and consists of **calcareous spicules**, or **siliceous spicules**, and **sponging fibers**.



6. Respirator and excretion performed by the water current.

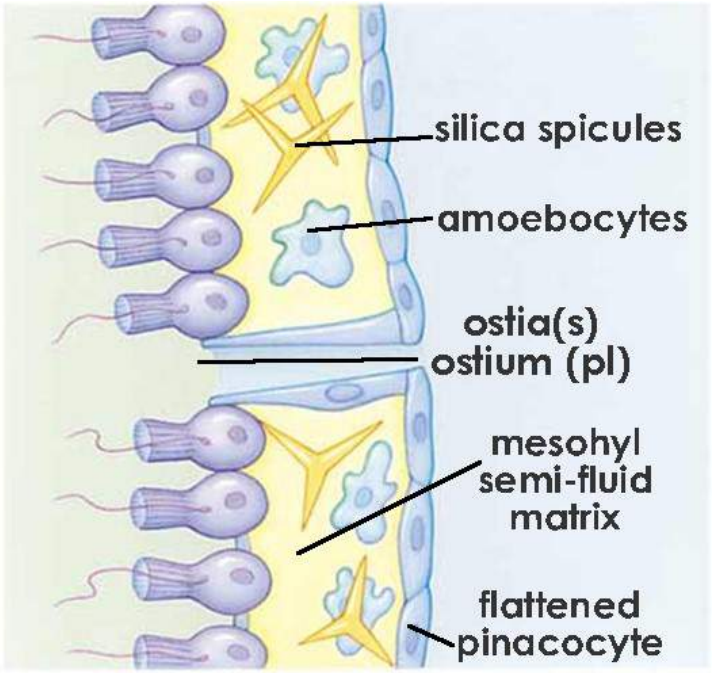
7. Sponge **do not** have a nervous system.

8. Sponges is lined with **choanocytes** which are found in all sponges but is no other animal.



9. Sponges reproduce both sexually and asexually, most species are hermaphroditic

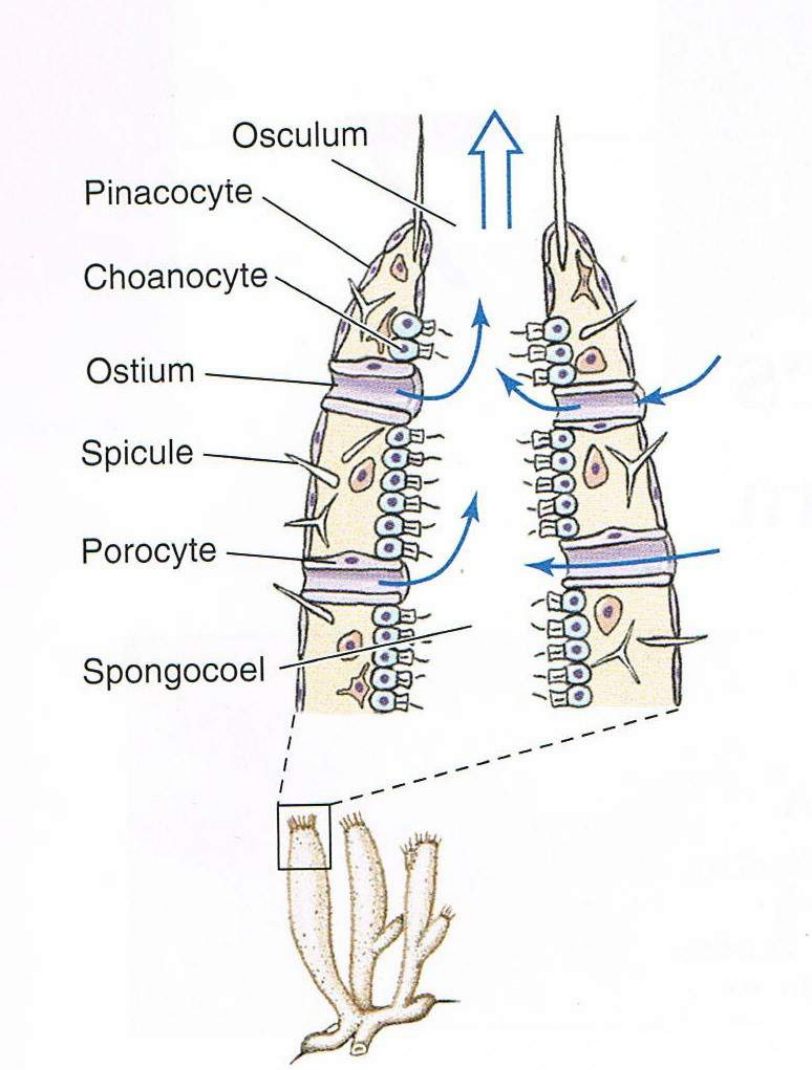
10 The body wall consists of the outer layer and the inner layer between these two layers is the **mesoglea** which composed of a gelatinous substance.



chanocyte

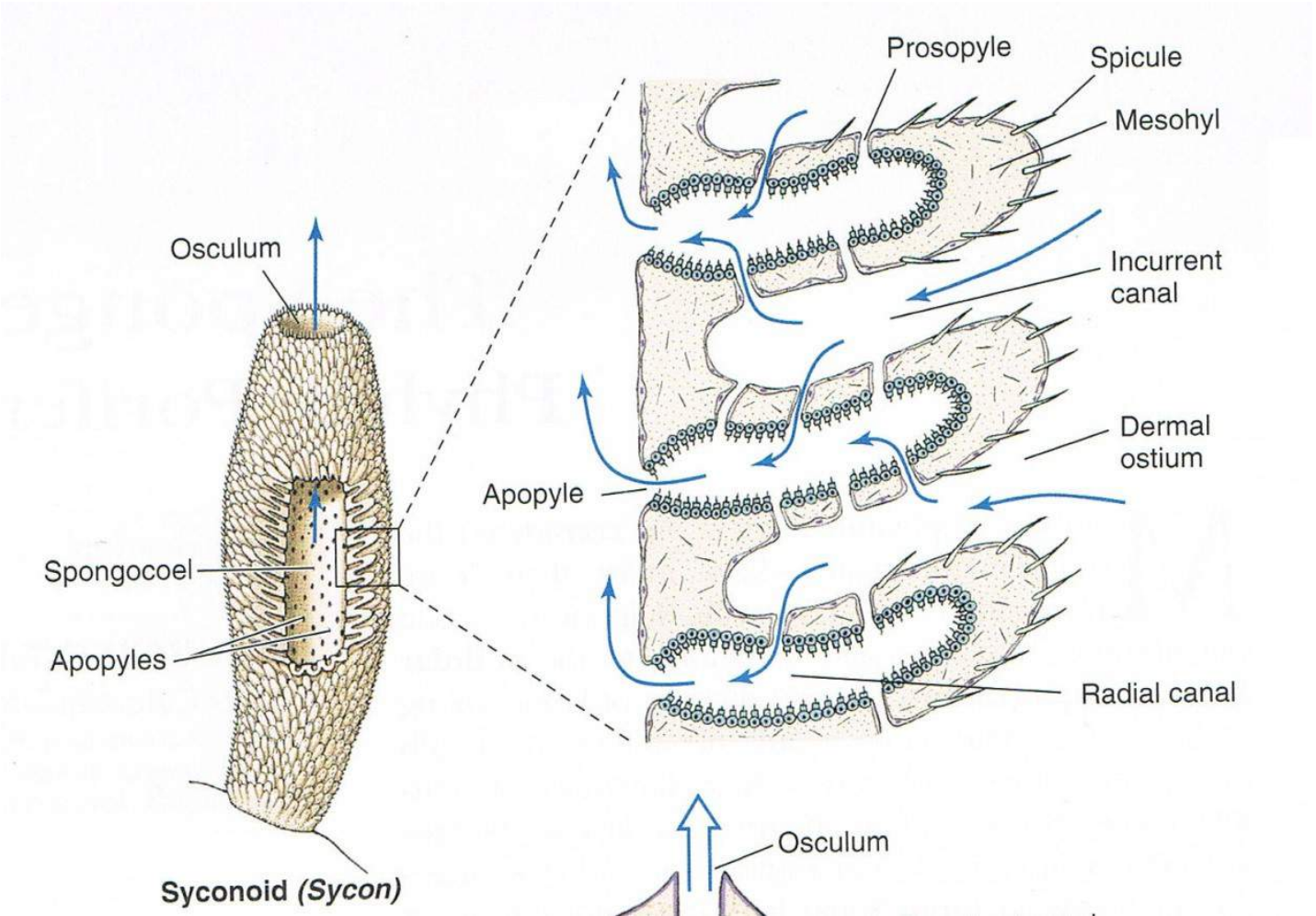
Types of water canal

1. The asconoid type, it is simplest type with vas-like body, A central cavity (spongocoel) opens to the exterior through a large opening at the top (Osculum), distributed throughout the body wall are porocytes. The spongocoel is lined with choancytes.



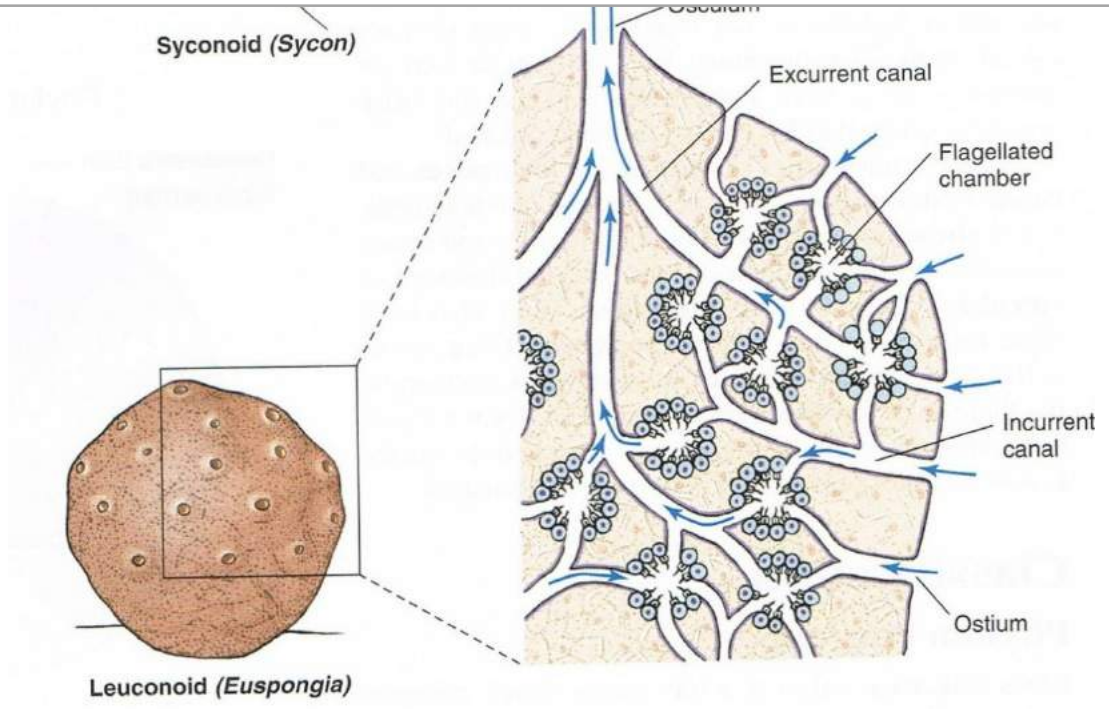
Asconoid (*Leucosolenia*)

2. Syconoid type, the walls are thick and folded, contain alternating incurrent canals (Radial canals) are lined with choenocytes.



The spongocoel is reduced by filling with radial canals which are leading from the flagellated chumbers to the osculum.

majority of sponges as well as the largest are of the leuconoid type, this fact can be attributed to apoby plan that provides a highly efficient system for producing a water current.



Classification of sponges:

Sponges can be divided into **four** classes on the **basis of the skeleton**

1. **Class calcarea (calci spongiae)**: consists of the those sponges having spicules of calcium carbonate, syconoid, leuconoid and all the asconoid sponges are membres of this class

The class include two orders namely:

a. Order Homocoela (ex. *Leucosolenia sp.)*

b. Order Heterocoela (ex. *Grantia sp.* And *Sycon sp.*)

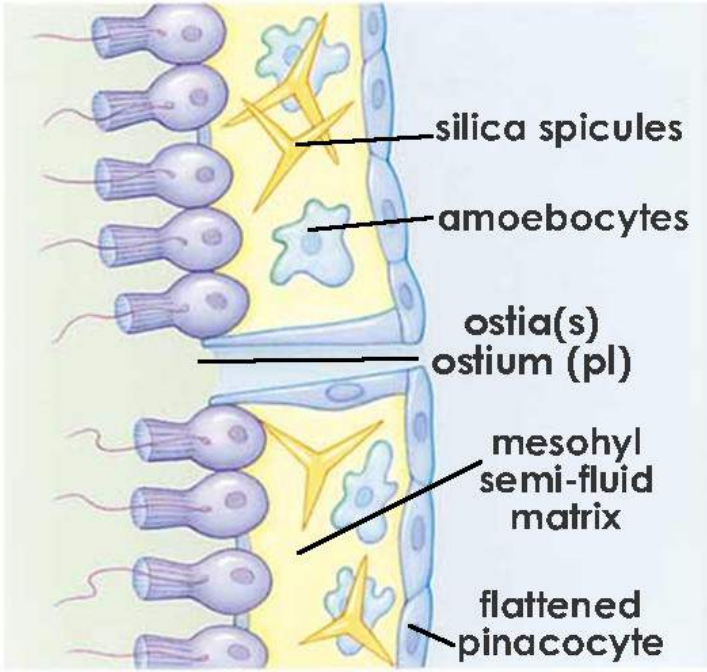
2. Class Hexactinellida: consists of sponges with ciliceous, six pointed spicules. Hexactinellida, commonly known as glass sponges have syconoid and leuconoid types. Ex: *Hyalonema*

3. Class Desmospongiae: consist of leuconoid sponges, which forms about 95% of the sponges, the skeleton consists of siliceous spicules, sponging fibers, or both sponging and siliceous spicules and some with no skeleton at cell. This class consists of four orders namely: order: Manaxonida, order: myxosponges (ex. *Euspongia sp.*)

Structure & physiology

The body wall of sponges consists of the other layer, the inner layer and between those two layers is the mesoglea which consists of gelatinous substance.

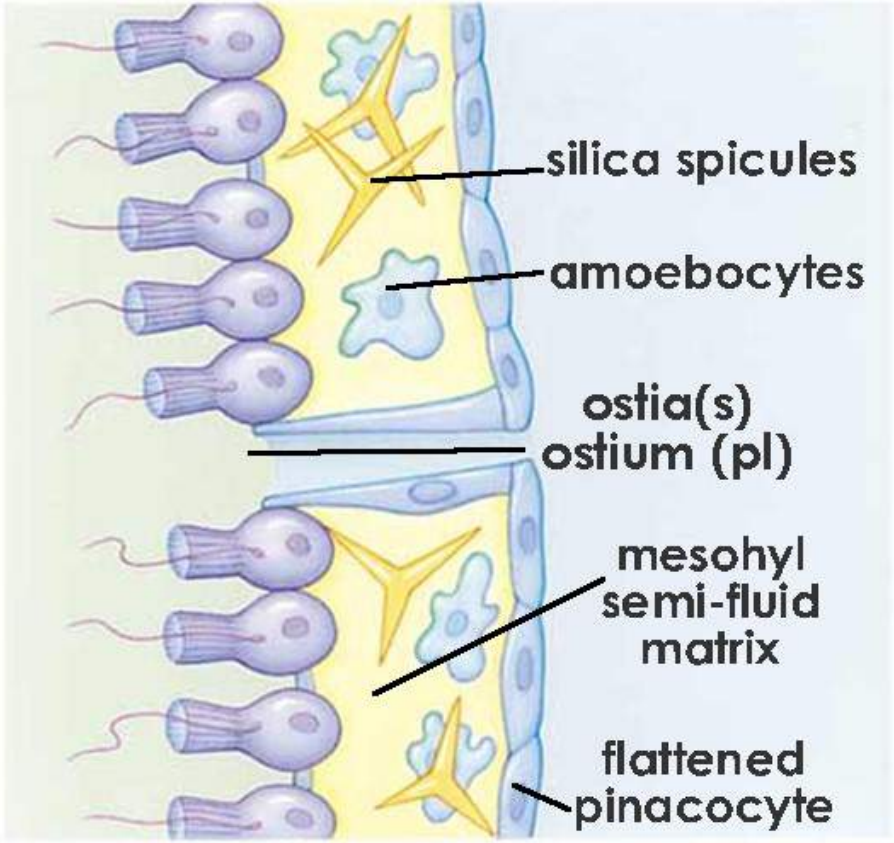
In spite of the low grade of construction, there is some differentiation of cells for specific functions.



chanocyte

Cells of sponges:

1. **Pinacocyte**: it is flexible cells in the outer layer of the body wall
2. **Porocytes**: a tubular cells which extend from the outer to the inner surface surrounding the pores.
3. **Amoebocytes**: they are found in the mesoglea in different type with different function:



chanocyte

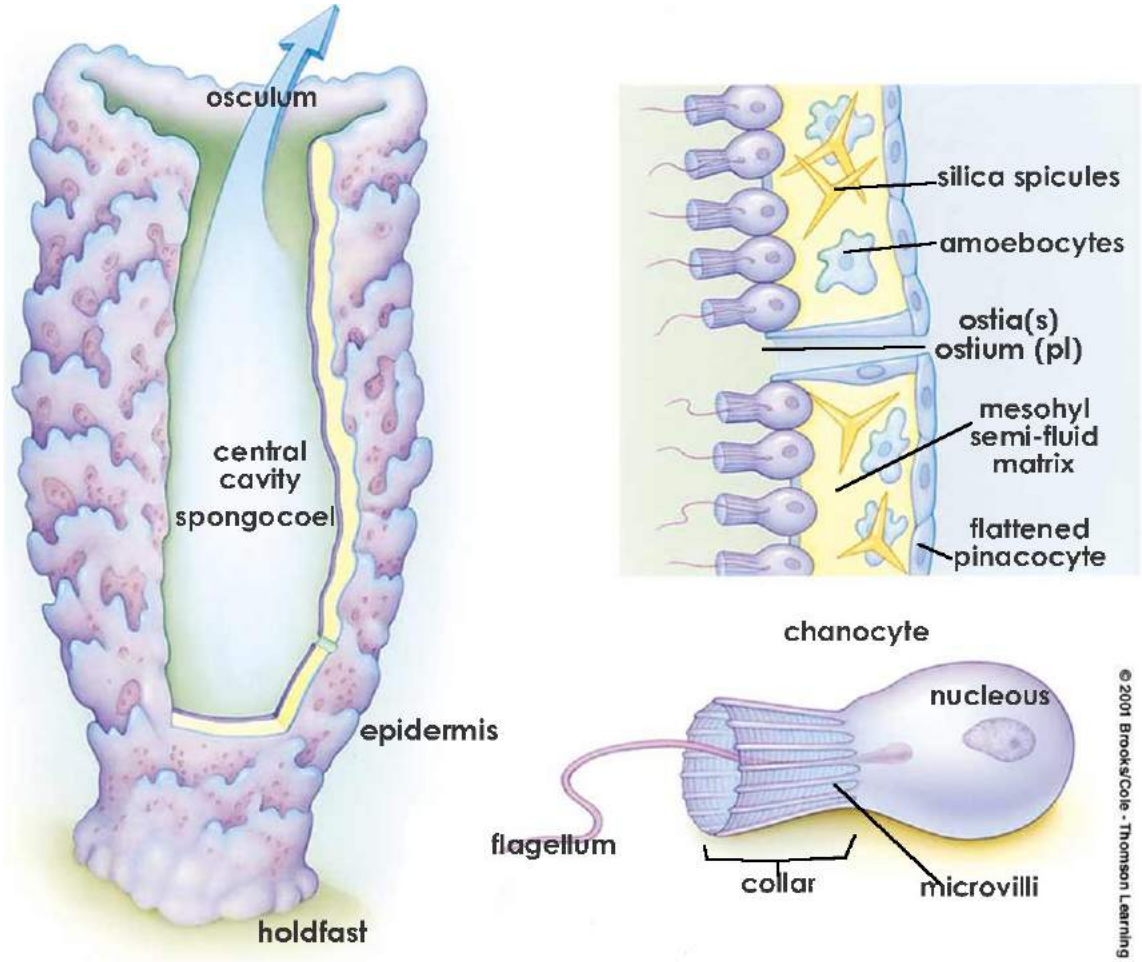
a. **Chromocytes** : consists the chromoplasts which give the color of sponges

b. **The ocytes** : cells in which food is digested and stored as a glycogen

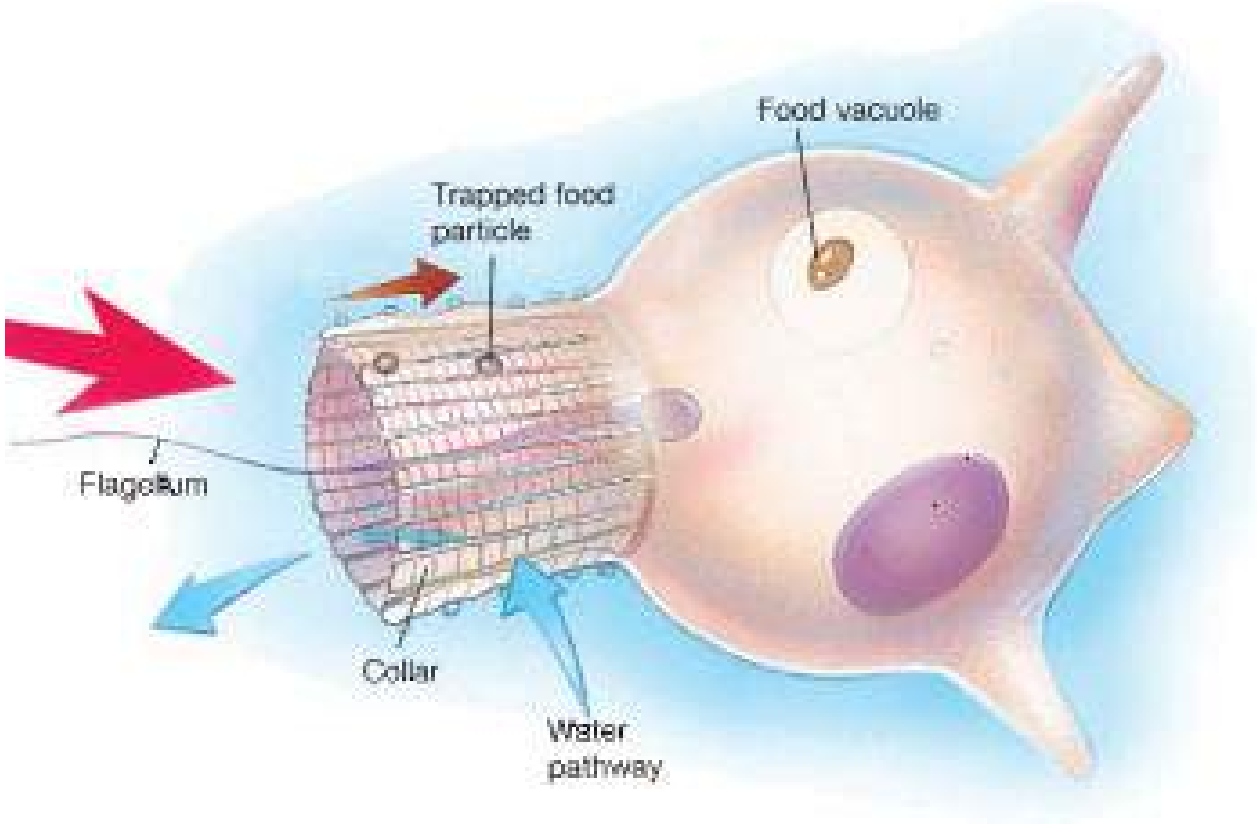
c. **Sclerocytes**: secrete the skeleton.

d. **Archeaocytes**: give rise to eggs and sperm and it play an important role in regeneration process.

4. Gland cell: secrete some adhesive substance on the body surface.



8. Choanocytes (flagellated collar cell) : it has oval or spherical shape, lined the body cavity and radial canals, these cells create the water current by flagella beating, it is also give rise to eggs and sperm, capture and ingest food.



Feeding:

Sponges feed on organic debris and microscopic organisms, brought it by the water current. The food is ingested by the **choanocytes** or **amoebocytes**, the end product of digestion then diffuse throughout the body.

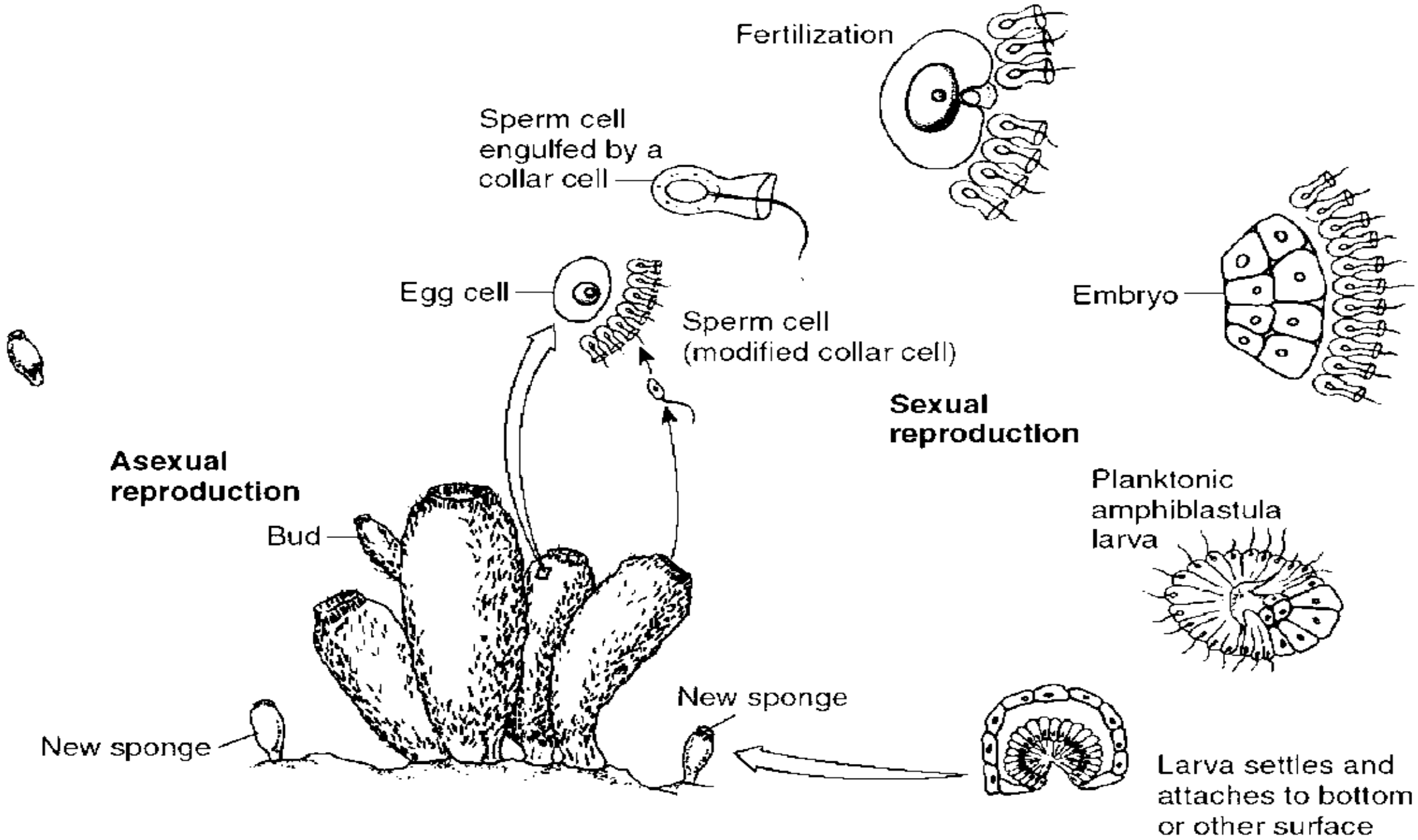
Respiration & excretion:

Sponges reproduce sexually and asexually. They have no permanent sex organs, instead, the eggs and sperm develop from both amoebocytes and choanocytes. Most species are **hermaphroditic** or **monoecious**, eggs and sperm being formed by the same individual. Sperm leave one individual and enter another by the water current (**cross fertilization**) that means despite of being the eggs and sperm are produced in the same individual it do not fertilize themselves.

❖Sexual reproduction:

Newly arrived sperm is entered a choanocyte or an amoebocytes, which transports it to an egg located adjacent to choanocyte. The fertilized egg then develops within the mesoglea into **blastula with flagellated** cells, at one end of the blastula, an opening then develops at the opposite end and the embryo turns itself inside out.

Through the osculum of the mother, and swim for a short time, the amphilblastual **settles on the bottom** and, **attaches** to any object then the embryo half invagenates, resulting in an embryo whose inner layer is flagellated and develops into **a** young sponges.


Fertilization
Sperm cell engulfed by a collar cell
Egg cell
Sperm cell (modified collar cell)
Embryo
Sexual reproduction
Asexual reproduction
Bud
Planktonic amphiblastula larva
New sponge
New sponge
Larva settles and attaches to bottom or other surface

❖Asexual reproduction:

1. **Budding**: the bud appears as a small growth from the mother, it can either separate from the mother or remain attached, and developed to a new individual.

2. Gemmules: they are formed in all fresh water sponges and in some marine species.

a. Fresh water Gemmule: consists of an aggregation of amebocytes, enriched with food material which is provided by other amebocytes. The outer amebocytes ultimately secrete a thick hard cove providing with spicules, this cover will protect the Gemmule until its growing to a new individual.

   Fresh water sponges form a large numbers of gemmules are able to survive freezing during the winter and hutch the following spring, developing into a new sponge.

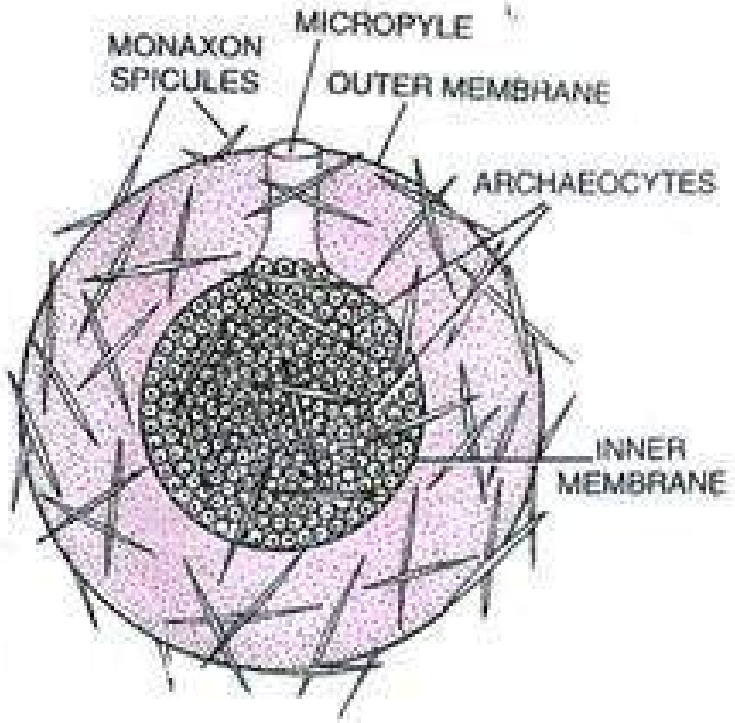
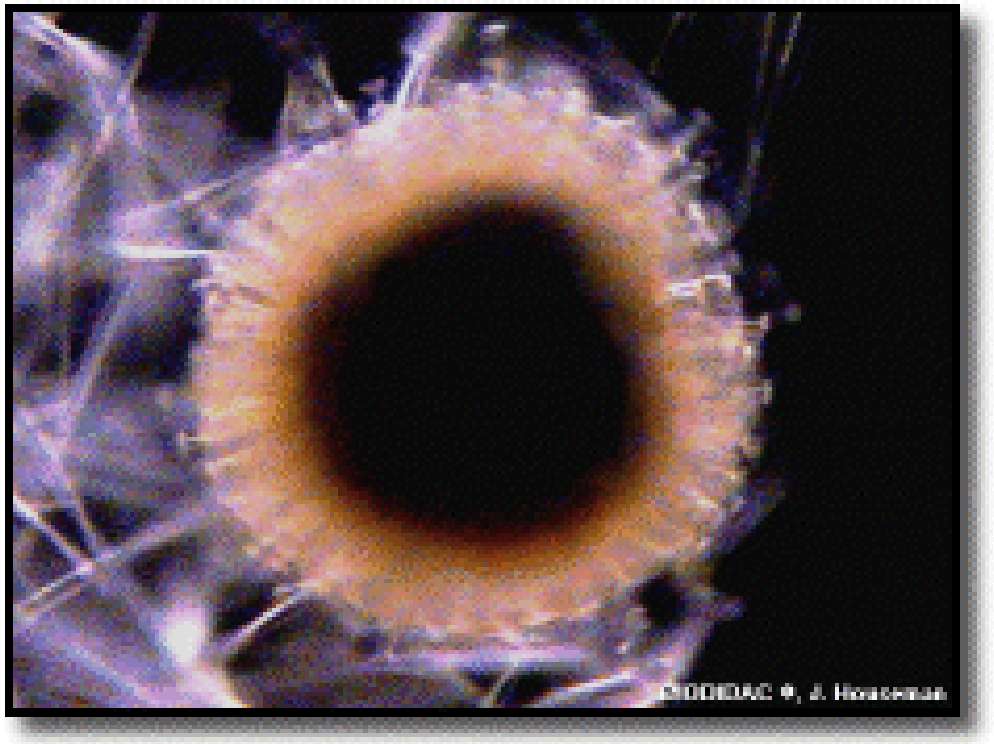


Fig. 1.13. Gemmule



b. Marine Gemmules: marine sponges formed gemmules continually throughout the year. This gemmule consist of aggregation of amebocytes, then surrounded by pinacocytes, the pinacocytes turned into a columnar cell, flagella on the interior cells, then it leaves the mother to swim in the water for a short time before attaches and loose their flagella then grow into a new sponge.

3. The reduction bodies:

Reduction bodies are formed under various adverse conditions by many fresh water and marine sponges

- The reduction body consists of an internal mass of amebocytes covered by pinacocytes, upon the return of favorable conditions, the reduction body can develop into a complete sponge. Usually the mother sponge disintegrates leaving the reduction bodies.

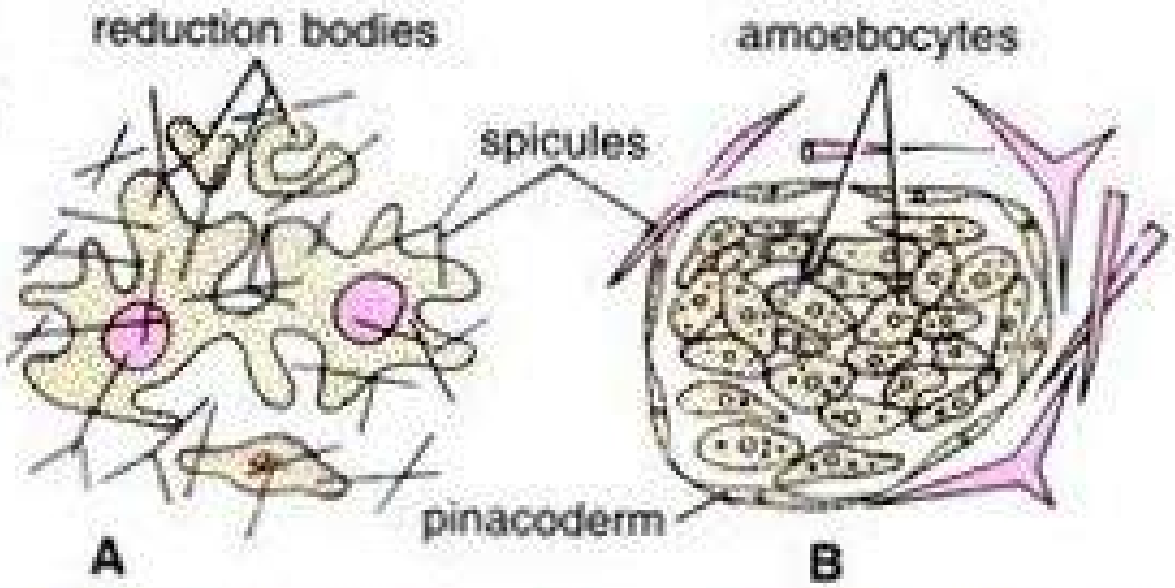


Fig. 28.13. Formation of reduction bodies. A—Reduction bodies of a calcareous sponge; B—Reduction body in section.

Regeneration:

Sponges have a remarkable ability regenerate. Any piece is capable of ultimately regeneration into a complete sponges.

Phytogeny:

There is no evidence that any other group of animal evolved from sponges,

Because sponges are so different from all other metazoan it is more likely that the sponges diverge early from the main evolutionary line. Although some Investigator think that the possible ancestor of sponges is choanflagellates (Flagellate), these protozoan are similar in appearance to the choanocytes in sponges.

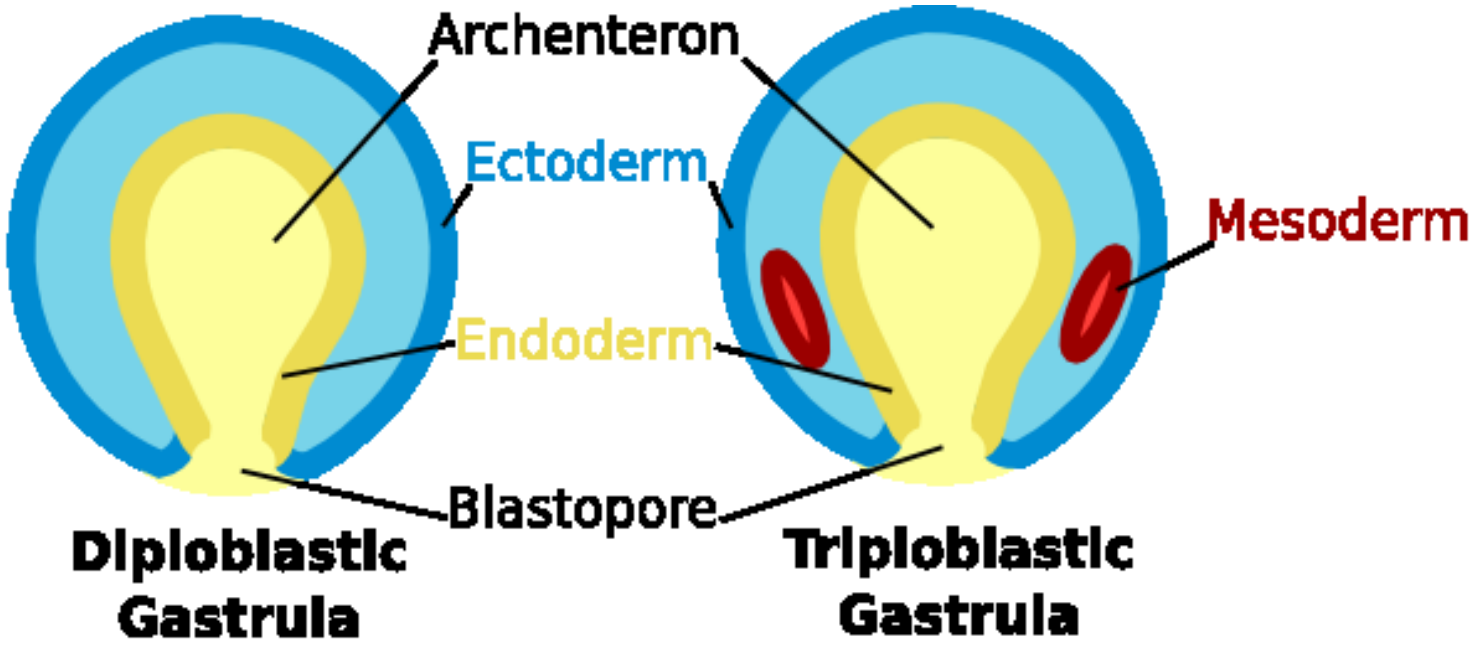
- Coelenterate (GK.Kilos, hollow, enteron, mtestine). It is also called cnidarian (ak. Knide, nettle)

The main characters

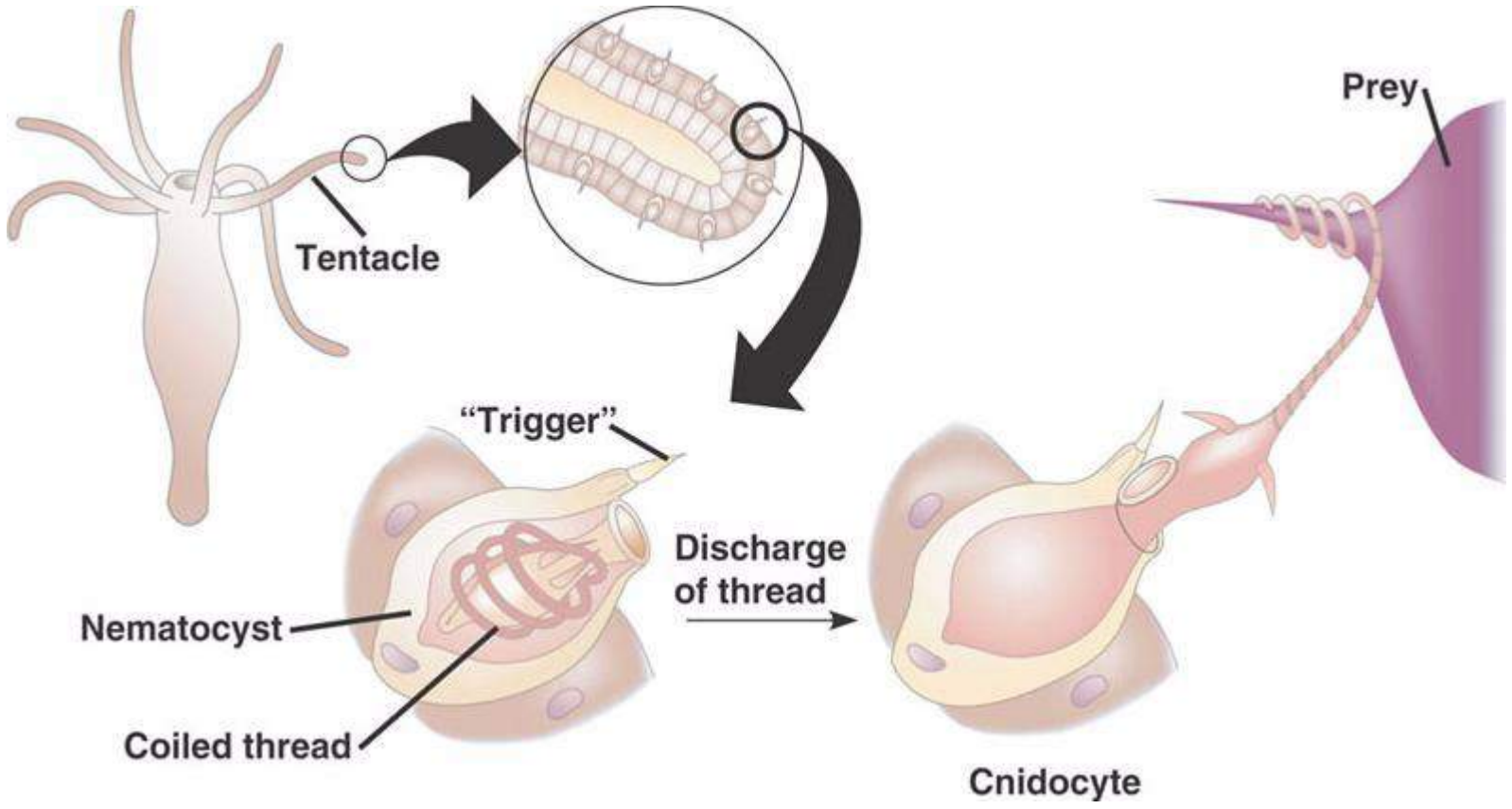
1. Diploblastic animals that are their bodies are constructed from only two germ layers, the **ectoderm** and **endoderm**.
2. Cnidarian are aquatic, radially symmetrical animals.

3. Cnidarians have a ciliated free swimming stereogastrula called the planula larva occurs in the life cycle of most cnidarians.

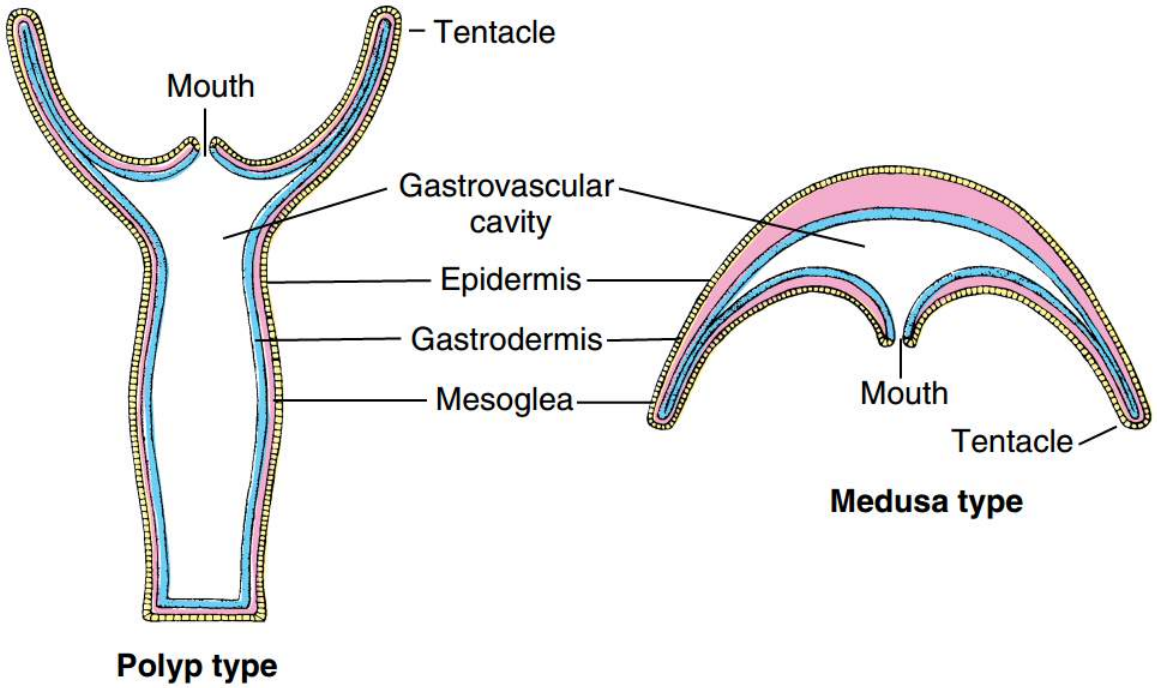
4. Cnidarians are primitive in their lack of organs and specific system.



5. Cnidocytes is specialized cells which are unique to and characteristic of all cnidorians.



8. Respiration exchange occurs across the general body surface, by diffusion, nitrogenous wastes (ammonia) also diffuse through the body surface.
9. Almost all cnidoria are carnivorous, feed mainly on small crustacean, contact with the tentacles.



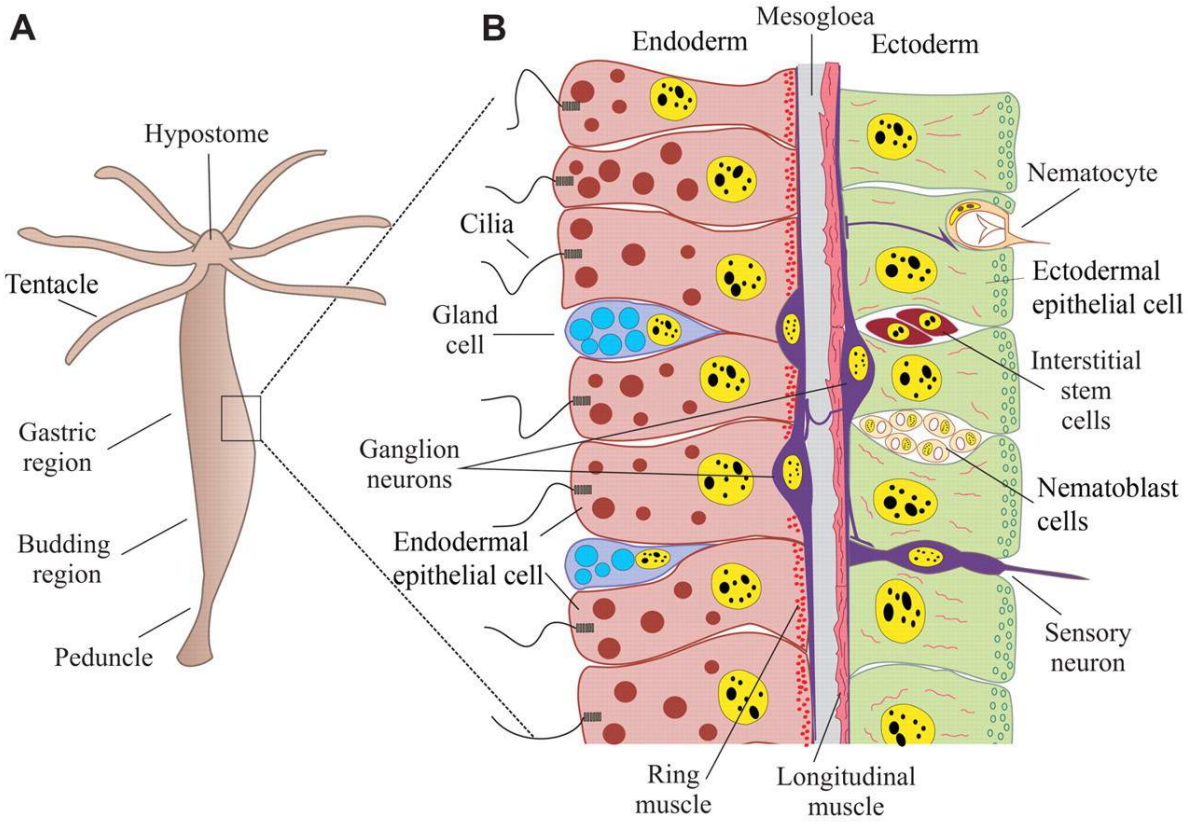
Body wall and cells of cnidarians

Body wall is composed of epidermis, mesoglea, and gastrodermis

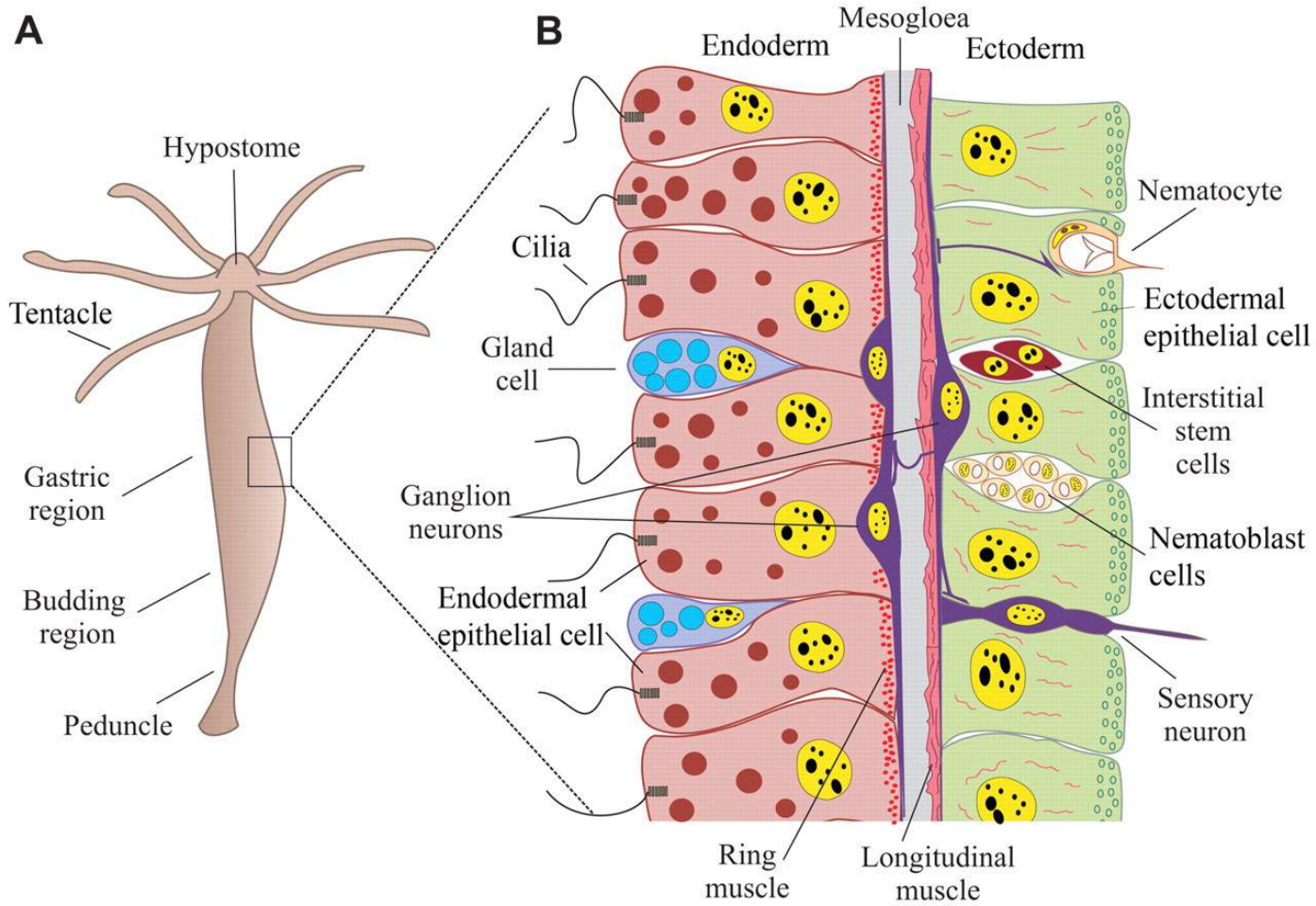
1. Epidermis cells

a. **Myoepithelial cells,** columnar or flattened, resting against the mesoglea they formed most of the epidermal surface.

b. **Interstitial cells,** located beneath the epidermal surface, it is rounded cells with large nuclei. These cells give rise to the sperm and eggs as well as to any other type of cells.



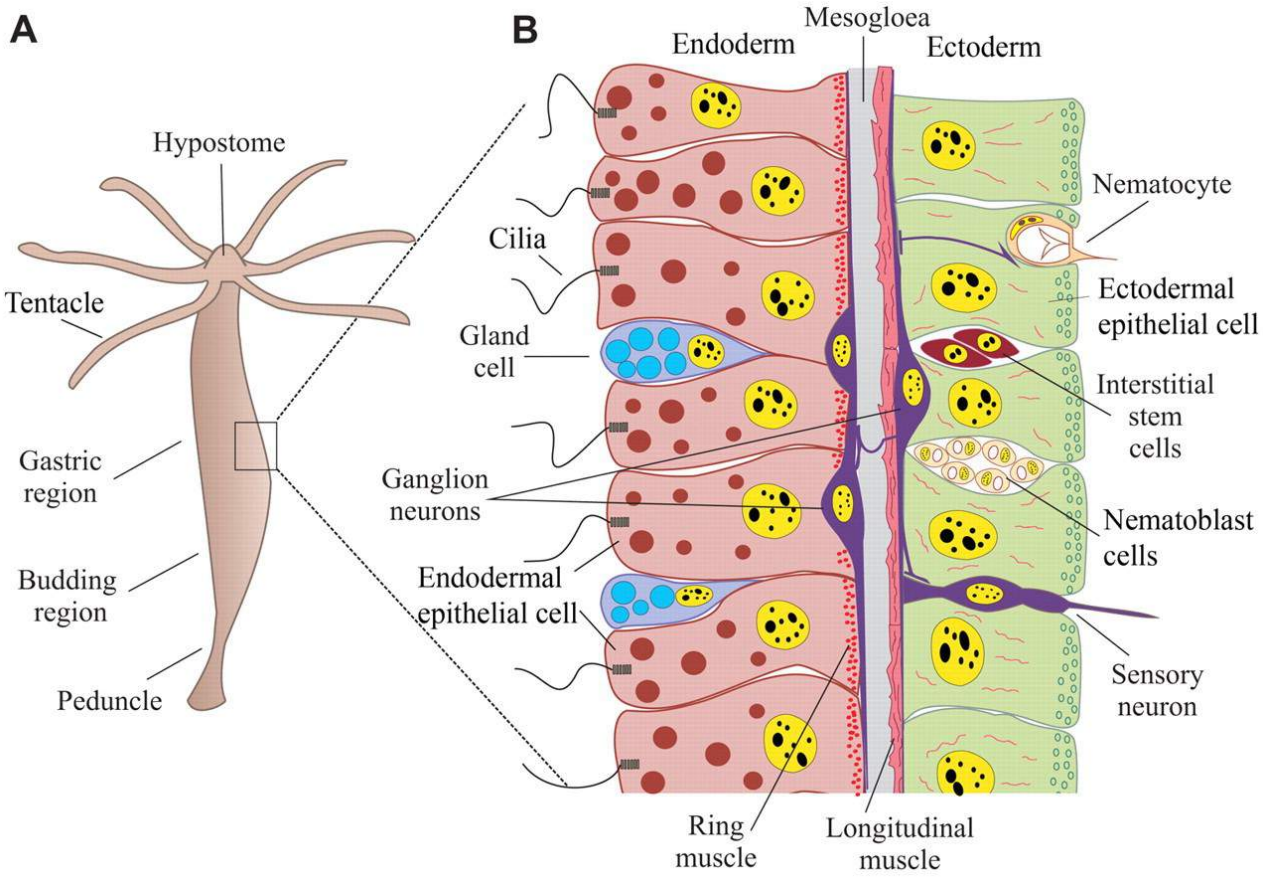
c. **Cnidocytes**, it is rounded or ovoid cell, in hydrozoa and scyptozoa this cell contains a process called a cniclocil, their function in prey capture, and many can inject a toxin they are located throughout the epidermis especially abundant on the tentacles.



d. **Gland cell**, they are found in the epidermis particularly in the adhesive basal disc and around the mouth. They are secreting mucus.

e. **Sensory or receptor cells**, elongated cells, located at the right angles to the epidermal surface, the base of each cell gives rise to a number of neuron processes, they are abundant on the tentacles.

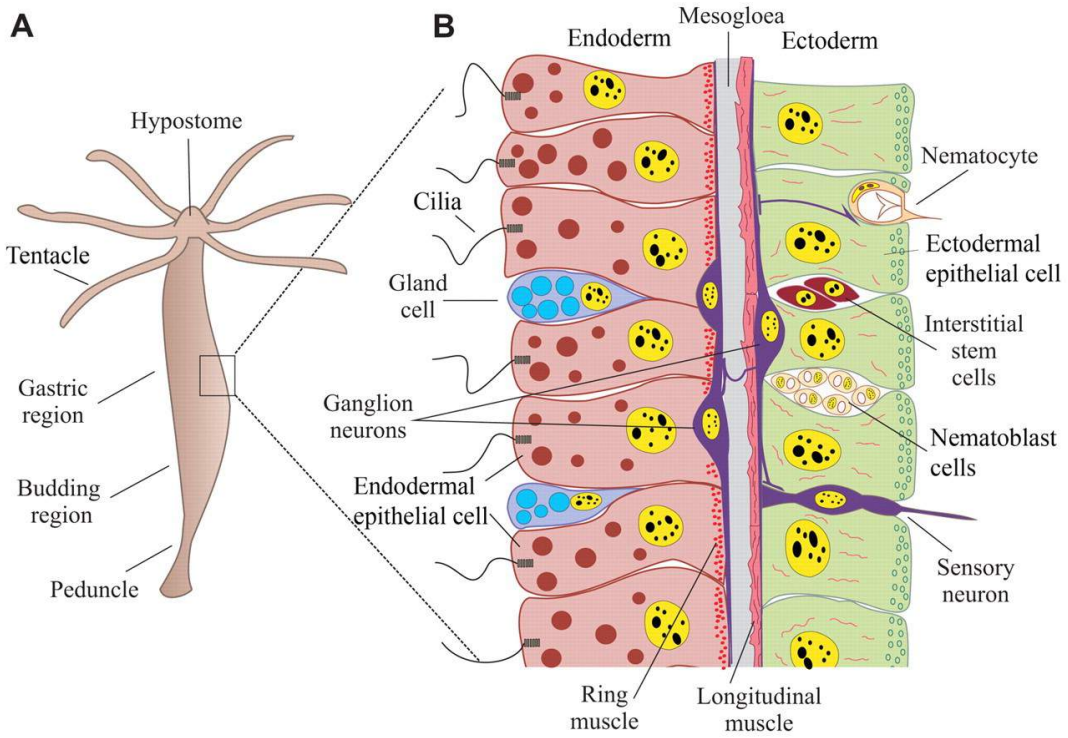
f. **Nerve cells**, located at the base of epidermis next to the mesoglea, forming net of cells.



2. Gastrodermis cells

a. **Nutritive cells**, it is a myoepithelial similar to that of the epidermis, but it is ciliated, its function to capture and digest food.

b. **Gland cell**, ciliated cells, secreting the digestive enzymes.



Classification of phylum cnidarian

1. Class hydrozoa

a. Having a polypoid, medusoid, or both forms in the life cycle.
b. Mesoglea a cellular.
c. Gonads epidermal.
d. Cnidocytes confined to the epidermal layer, includes five orders, hydraida , trachylina, actinulida, siphonophora, and order stylasterda,

2. Class scyphozoan

a. The polypoid form is small, medusoid form is dominant
b. Mesoglea cellular.
c. Gonads are gastrodermal
d. Stomach is tetraseptate. Include four orders: stauromedosae, coronatae, semaeostomeae, and order rhuzostomeae.

3. Class Anthozoa

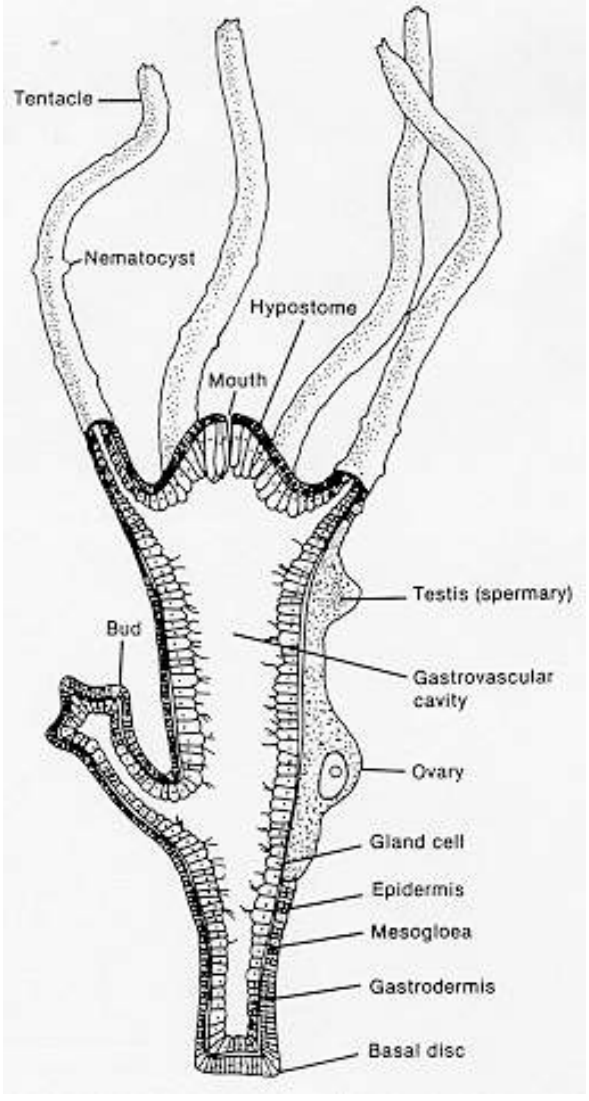
a. The dominant form is the polypoid
b. Mesoglea is cellular.
c. Gonads gastrodermal.
d. With complex system of septa, arranged in multiples of six (at least 12 septa)
e. Mostly solitary forms divided in to two subclasses: Alcyonaria, and zoantheria, each subclass includes six orders.

Some Cnidarian species

1) **Class: hydrozoa**

   Order: hydraida

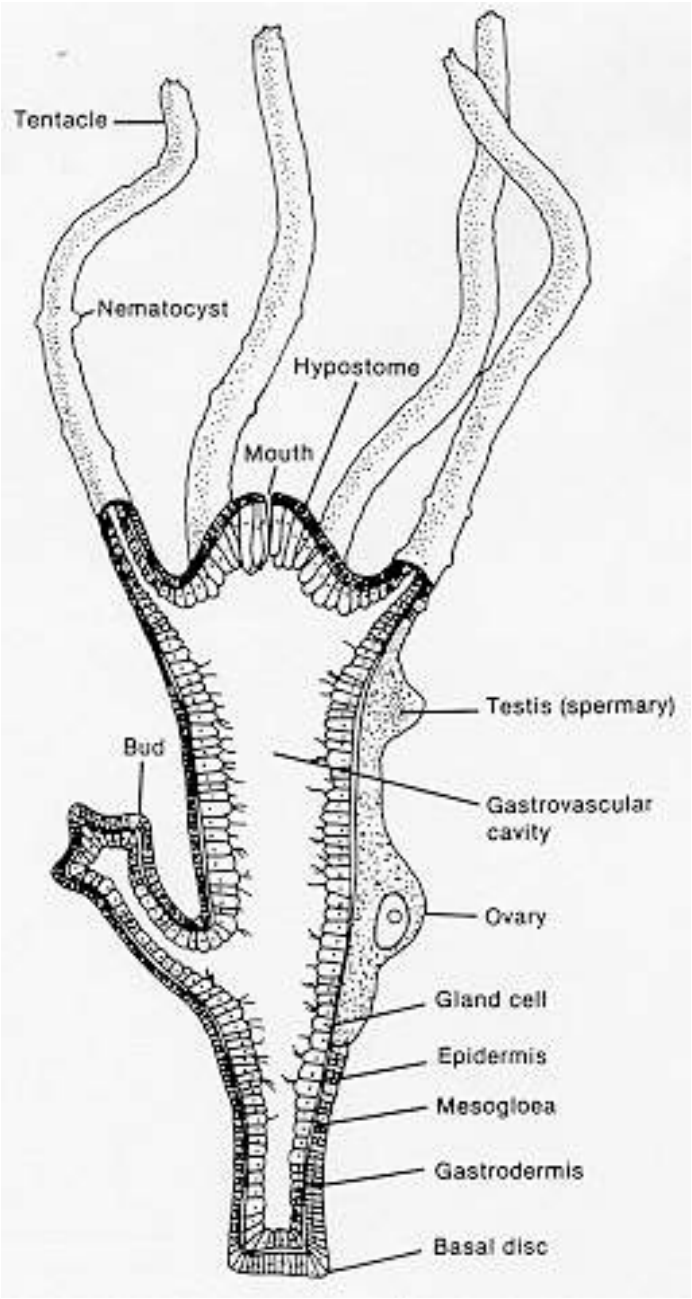
Genus: *Hydra*



The hydra exists as a solitary polyp, about 2 cm length live in the fresh water

it reproduce asexually by budding, the buds form on the stalk as simple evagination as the body wall. The distal end of the bad forms a mouth and a circle of tentacles , then the whole bud drops off to form a new individual budding is the usual means of reproduction during the warmer months.

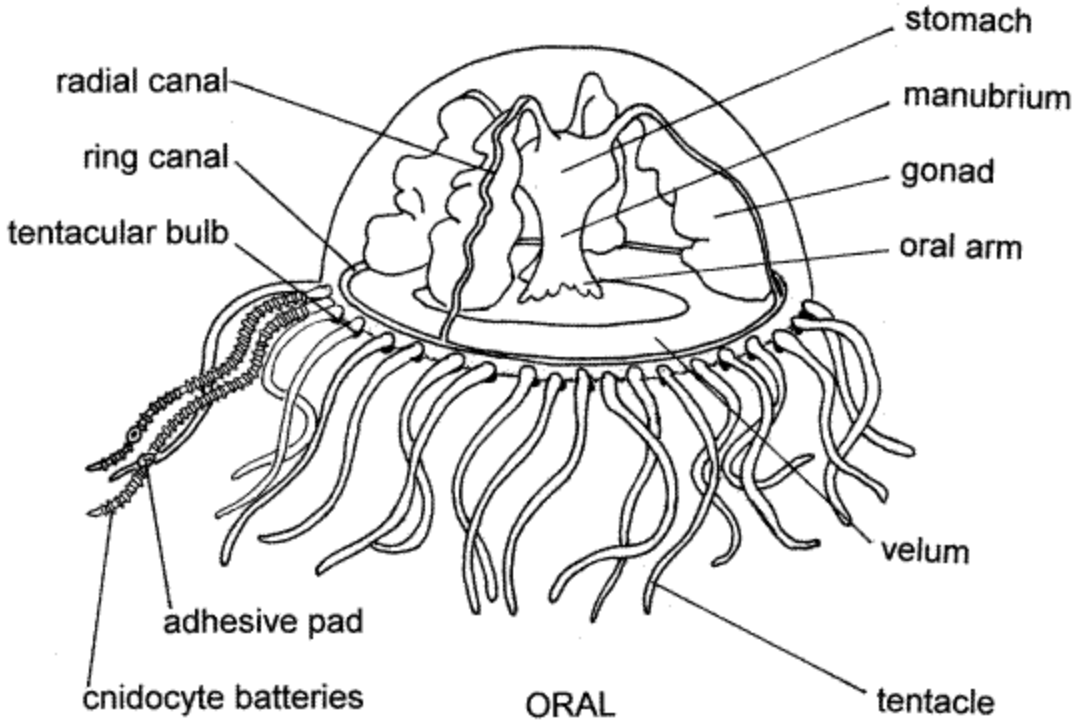
It also reproduce sexually, most hydras are dioecious the germ cells originate from interstitial cells which aggregate in the stalk to form ovaries or testes. The sperm liberated from the testes in to the surrounding water penetrate the exposed surface of the egg. This is thus fertilized in situ. The egg then undergo in to a **gastrula** which becomes covered by chitinous shell. The remains in its protective shell through the winter, during spring the young hydra emerges. Each individual may bear several ovaries, so a number of eggs maybe produced each season.



Genus: *Gonionemus sp.*

Hydrozoans possessing small solitary polyps and free medusa. The polyp reproduces asexually by budding and produce either medusa or polyp. *Gonionemus* medusa is atypical hydrozoans which characterized by

a) Small ringing forms 0.5 cm to 6 cm in diameter bell shaped.
b) The lower surface is covered with velum.
c) With tube like extention called the manubrium which opens in the mouth.



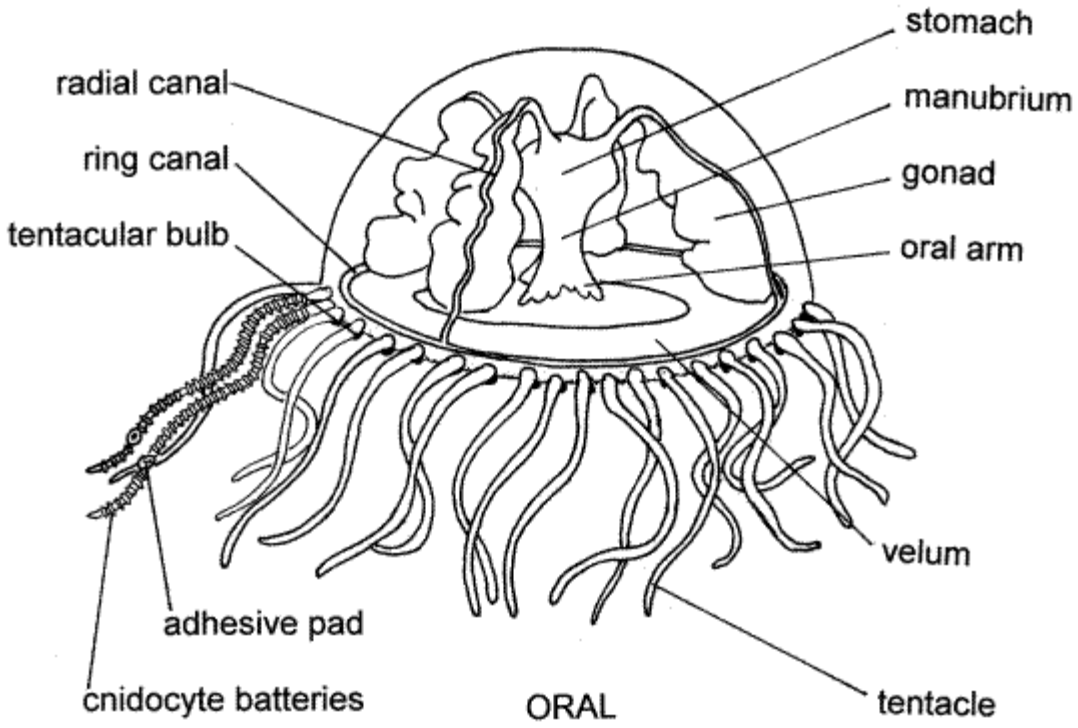
d) Four radial canals extend the radia canals goined with a ring canal.

e) The mesoglea is thick and gelatinous.

f) The gonad is spirad like epidermal, located beneath the radial canals.

g) The tentacles long, hung down from the margin of the bell.

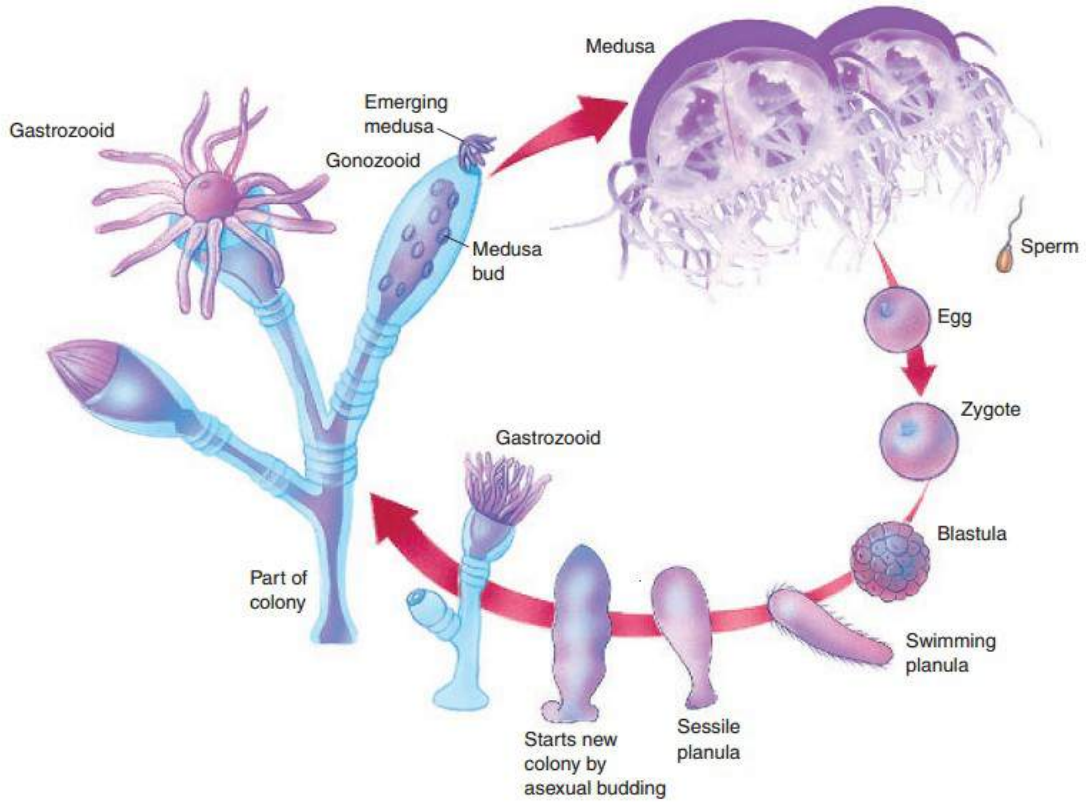
h) Fertilization is external in the sea water.



Obelia sp.

Obelia is colonial species, all the individuals of colony are connected through the network of living tubes (coenosarc), thus tubes are covered with a nonliving (perisarc) secretes by the epidermis. *Obelia* colony consists at least two types of polyps,

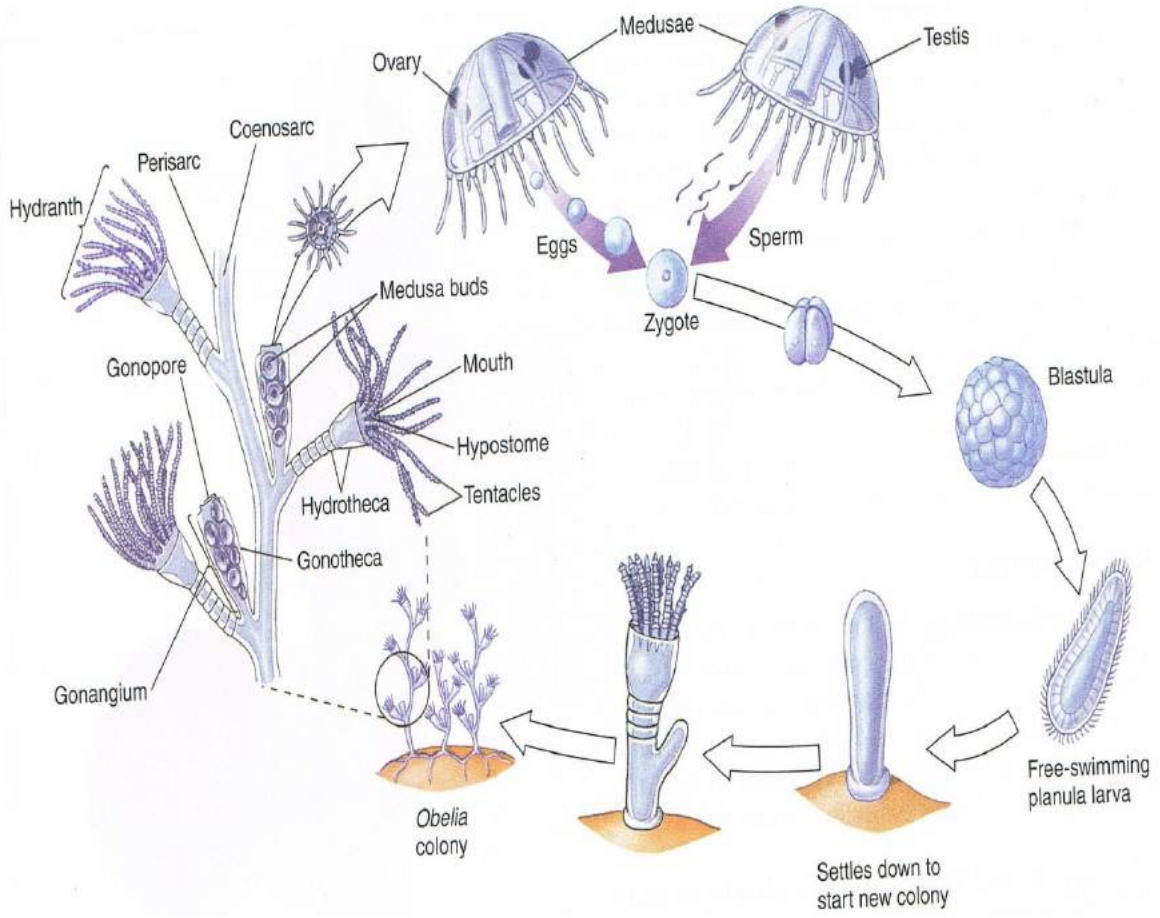
- (gastrozooid) nutritive polyps which captures and ingests and digest food and
- (gonazooid) reproductive polyp which produce asexually the medusoid bud which developed in to free medusa capable of producing the gametes to complete the sexual phase of the life cycle.



In *Obelia* colony as in many other cnidarian species the polymorphism and metagenesis are characteristic Polymorphism: it is associated with colonial organization it means that the colony consists several structurally and functionally different polyps such as

1. Gastrozooid: capture and ingest prey.
2. Gonazooid: reproductive polyp produces new individuals.
3. Dactylozooid: defensive polyp, capture prey.

Metagenesis: it is the alternation of polyp which is (asexual) and medusoid the (sexual) forms

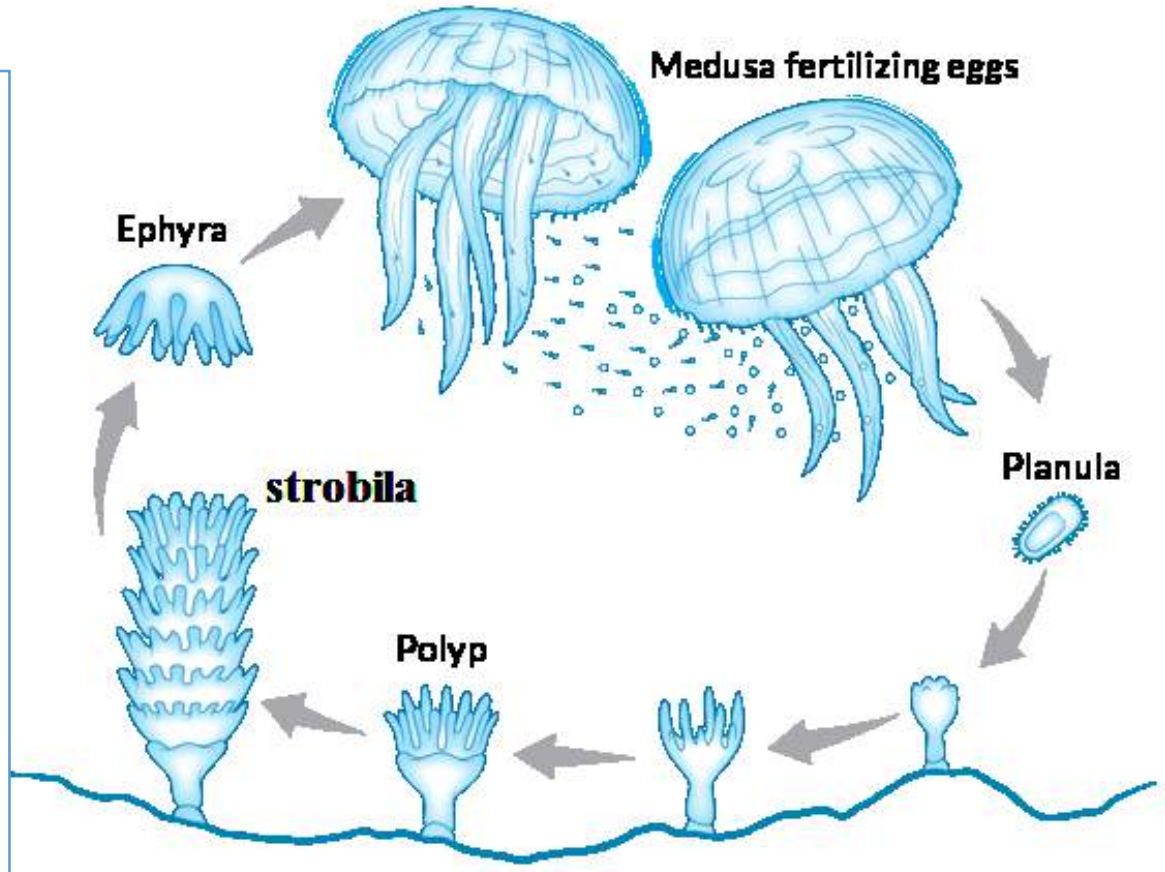


2) Class scyphozoan

Order: semeaostomeae

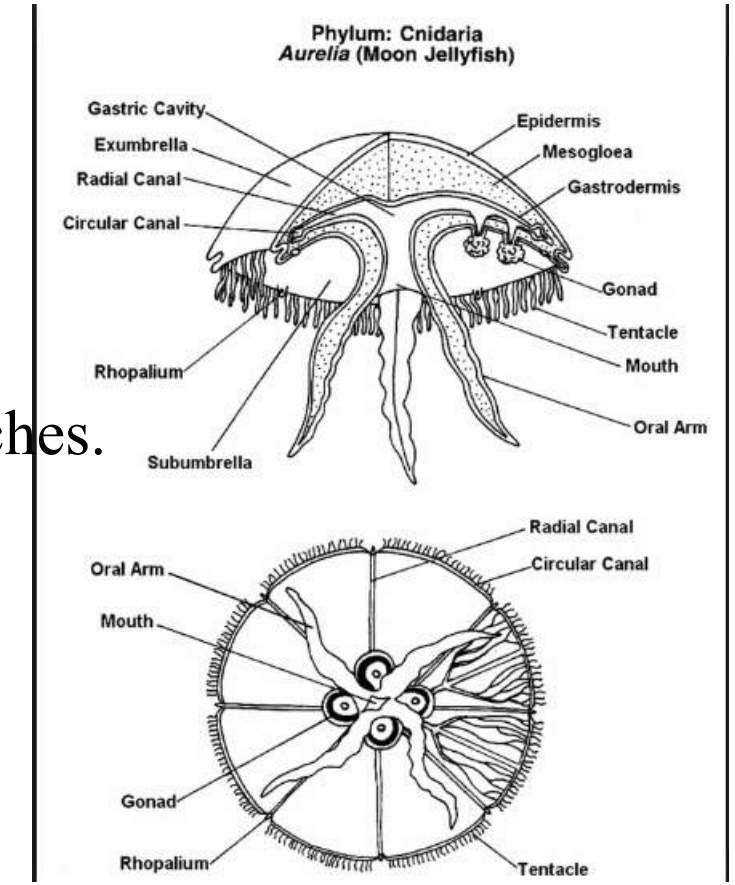
Aurelia sp

Planula develops in to a young polyp which reproduce asexually by budding, the new polyp reproduce asexually by transversal binary fission to become scyphistoma larva, which develops in to strobila larva, then in to ephyra larva (medusa).



Aurelia medusa is the typical of scyphozoans medusa, which characterized by:

1. Star like, lacks vellum
2. With 16 radial canals of which 8 branched and 8 simple canals all canals joined to the circular canal.
3. With 8 sensory organs exist as lobs around the medusa (Rhoplia).
4. With a numerous number of short tentacles.
5. Gonad Four arms endodermal located on the gastric paches.
6. are found around the mouth.
7. Fertilization internal occurs in the oval arms.
8. Mesoglea thick gelatinous and fibrous.

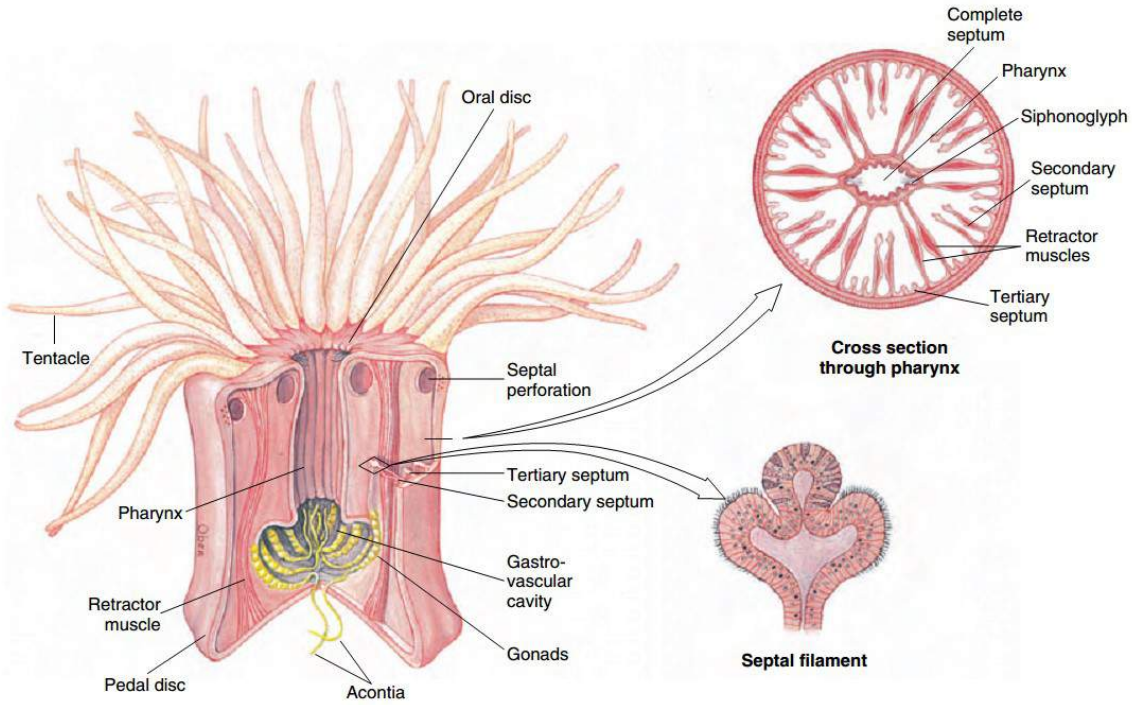


3) Class Athozoa

Sub class: Zoantheria

Metridium sp.

The common name for metridium is (sea anemonas) it is solitary polyp, layer and heavier than hydrozoans polyp. The gastric cavity is partitioned by longitudinal radiating septa, there are two types of septa complete and incomplete arranged in pairs.



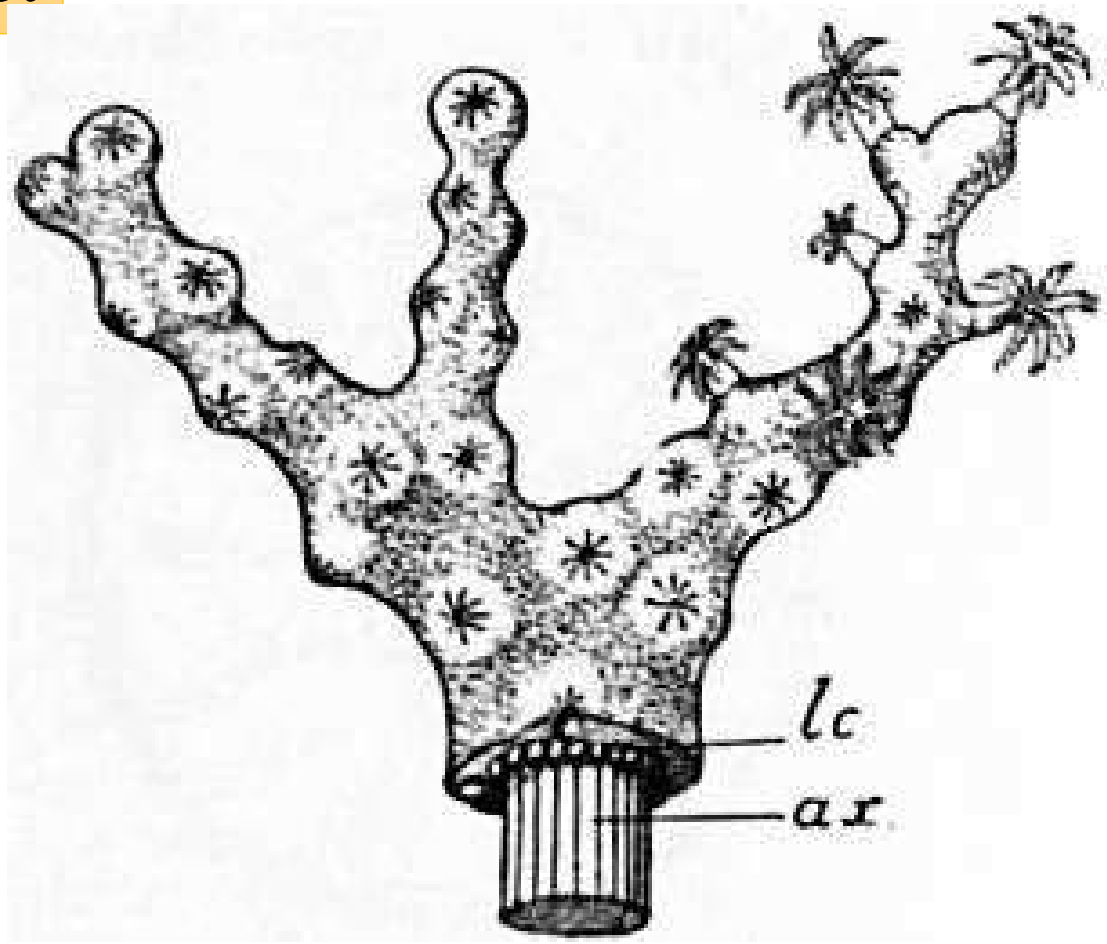
Class Anthozoa

Subclass: Alcyortaria

Corallium sp.

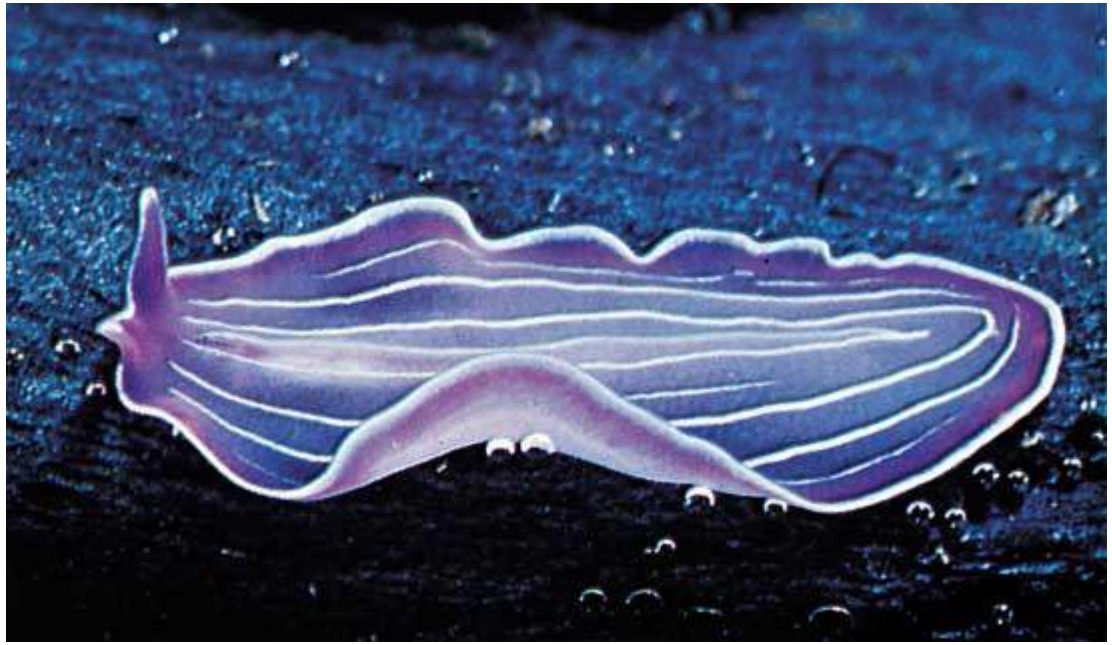
It is colonial species with two types of small polyps. The gastrozooid, and siphonozooid, the latter acts as a water circulator in the colony. It has calcareous internal skeleton secrete by the mesoglea. The gastroozoid polyp with 8 pinnate tentacles (feather like) and 8 complete septa.

Corallium are dioecious and hermaphroditic species reproduce asexually by budding of new polyps in to a new polyp.



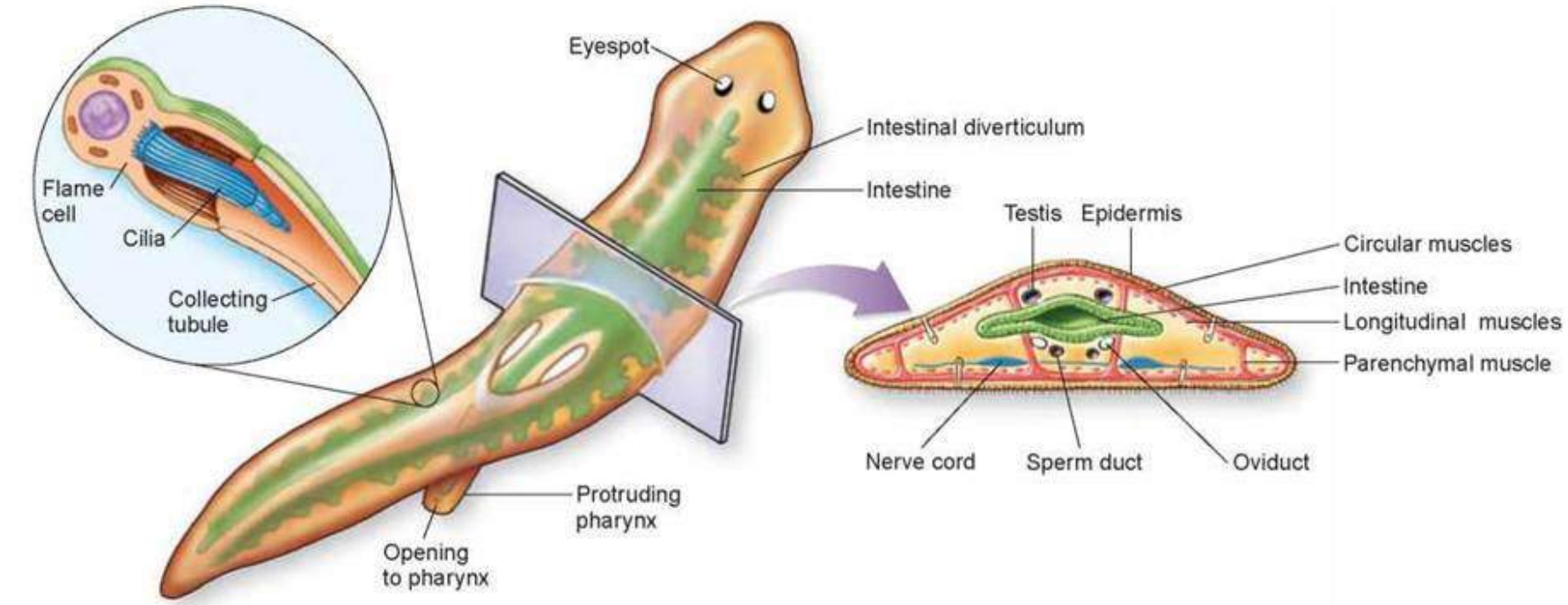
Phylum: Platyhelminthes

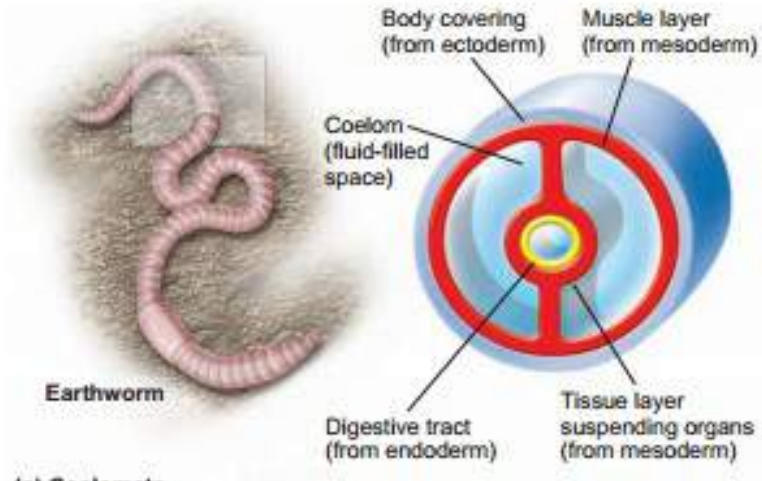
Platyhelminthes (Gk. Platy, flat, helminthes, worms). It is commonly known as the flatworms,



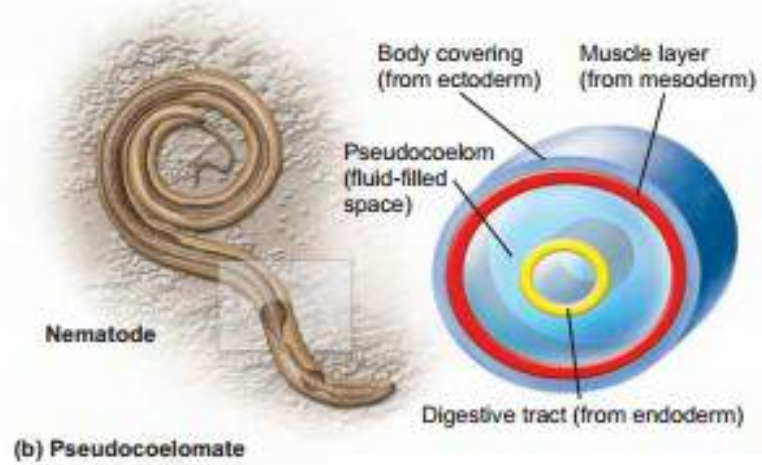
The main characters are:

1. Bilaterally symmetrical animals, acoelomate in which the space between the surface layer and the internal organs fills with the parenchyma.

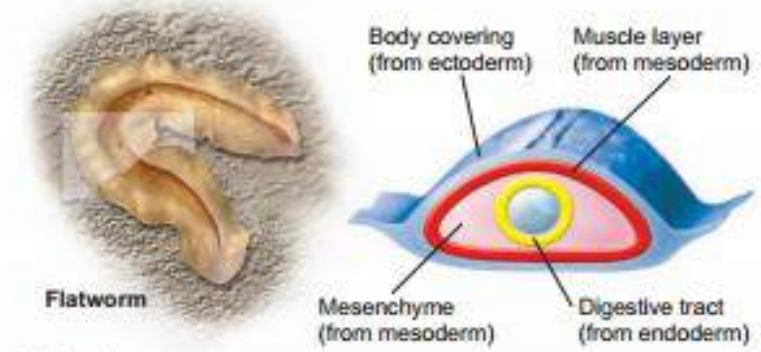




(a) Coelomate



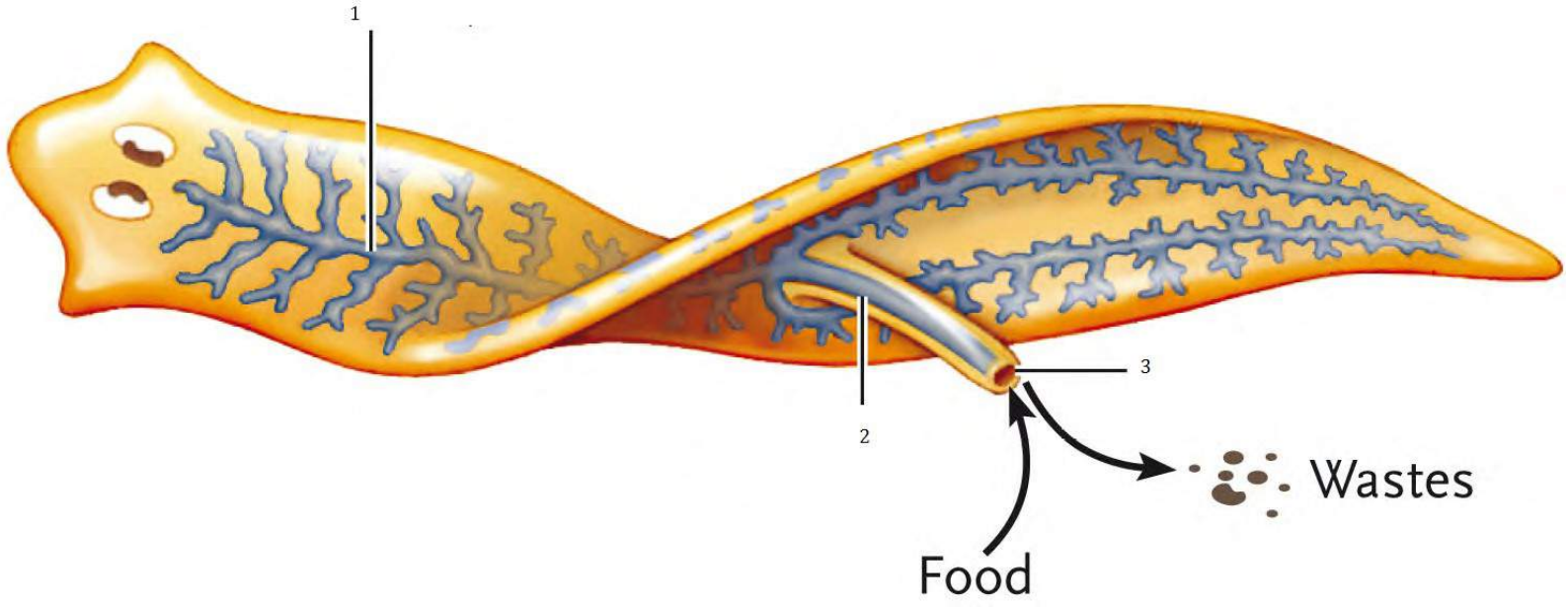
(b) Pseudocoelomate



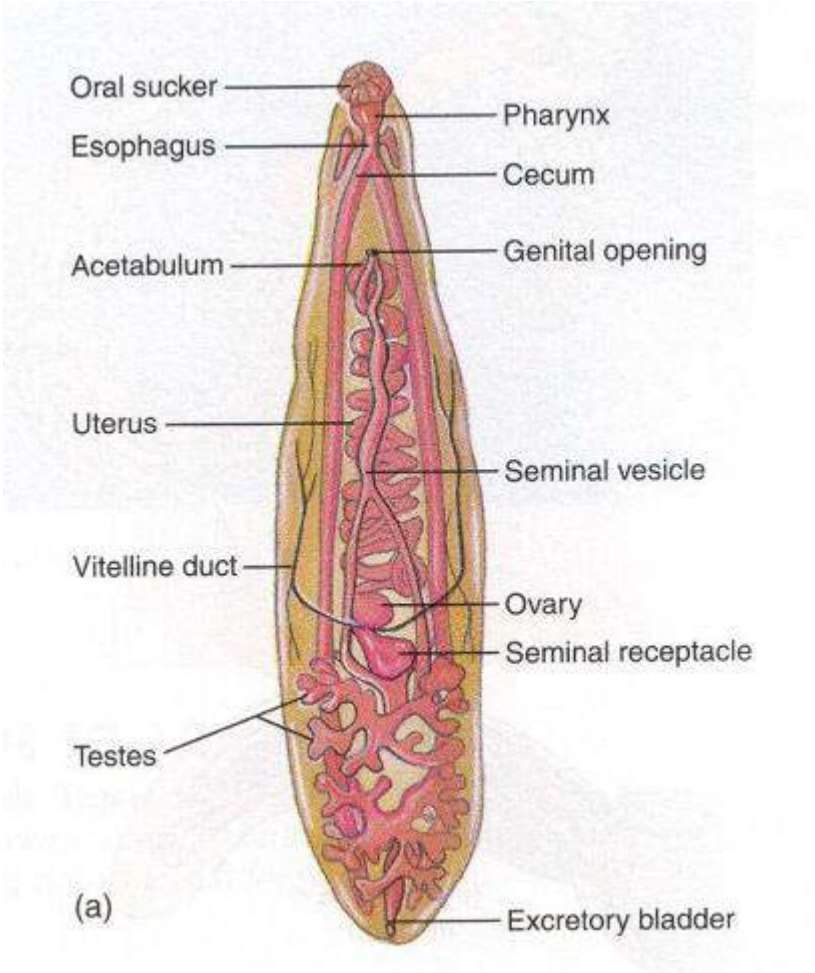
(c) Acoelomate

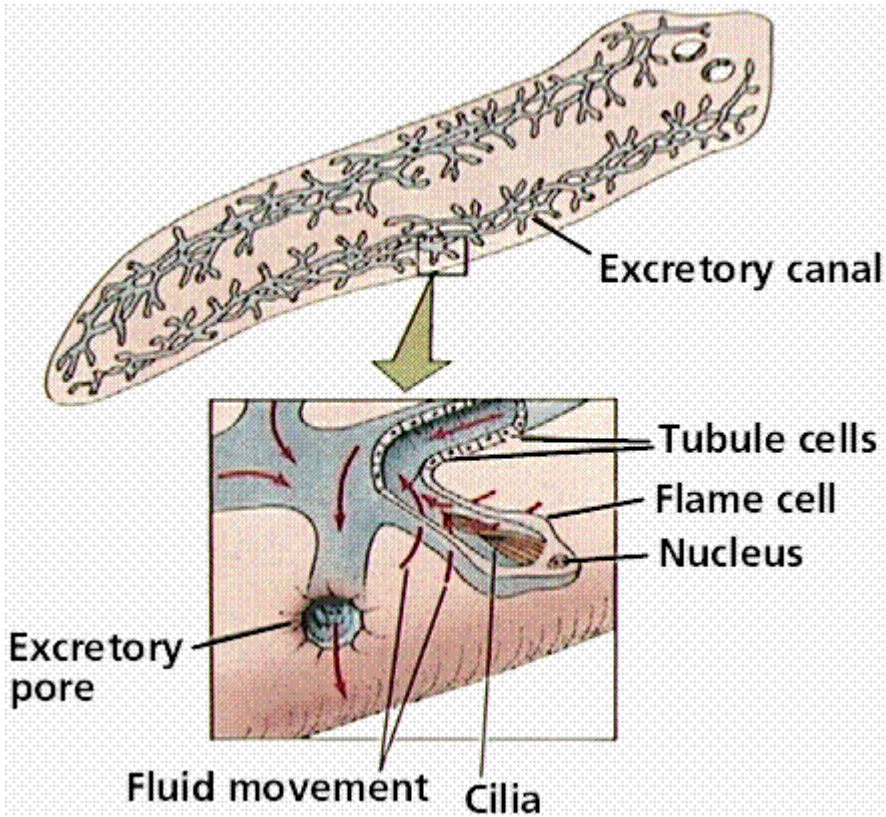
2. Dorsoventrally, flattened, vary in size from microscopic (free living) species to about 15 m long (tope worms)

3. With blind digestive system in which the mouth is only opening, lacks anus, respiratory and circulatory systems.

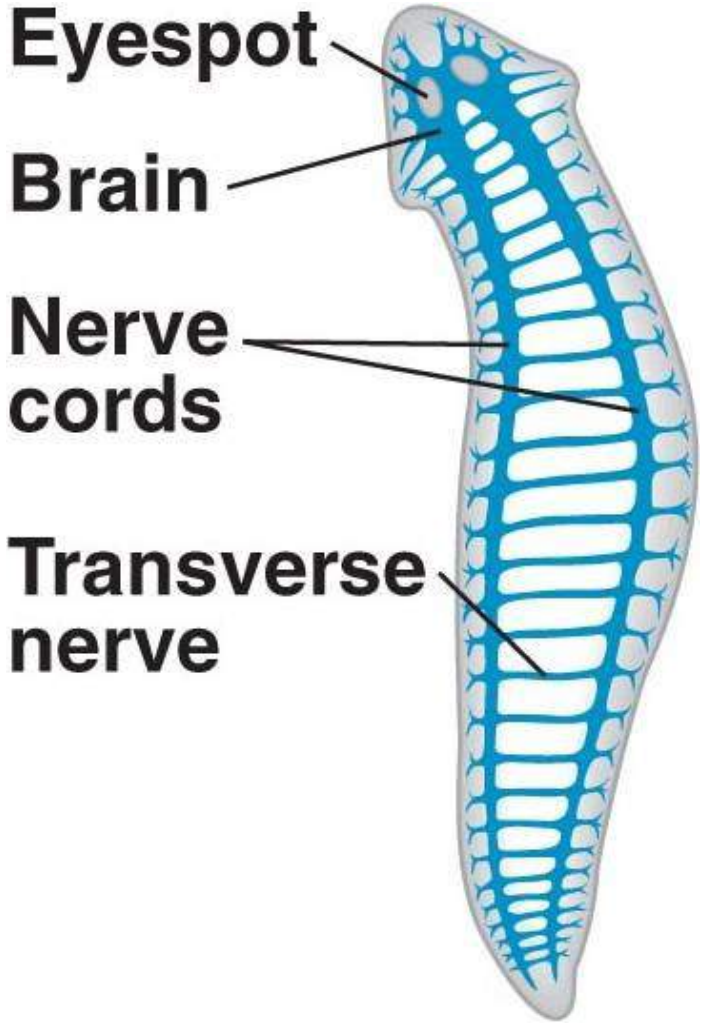


4. Excretory system well organized and ends with flame cell. Some like trematoda have a bladder **at the posterior end**. Respiration through the body wall.





6. Nerve system with a brain in the scolex and pair of cords connected by cross connection (ladder like).



6. The majority are hermaphroditic, few are dioecious, reproduce sexually, and some species able to reproduce asexually such as turbellarians.
7. With three germ layers (triploblastic)
8. The majority is marine species, but there are fresh water species.
9. Divided in to three classes, two are entirely parasitic (trematoda and cestoda) the third class turbellaria is freeliving.

Classification

Platyhelminthes phylum is divided into three classes namary:

1. Class Turbellaria

a) Most of them are free living, lived in fresh water and salt waters, and in moist terrestrial habitats

b) All of them have intestine except one order (Acoela)

c) Most of them have rhabdoids structure, which dissolve and form a slim sheath around the worm.

d) Move by cilia which are distributed on the body wall.

e) In general they are predator, or scavengers, a few are herbivores or commensals.

2. Class Trematoda

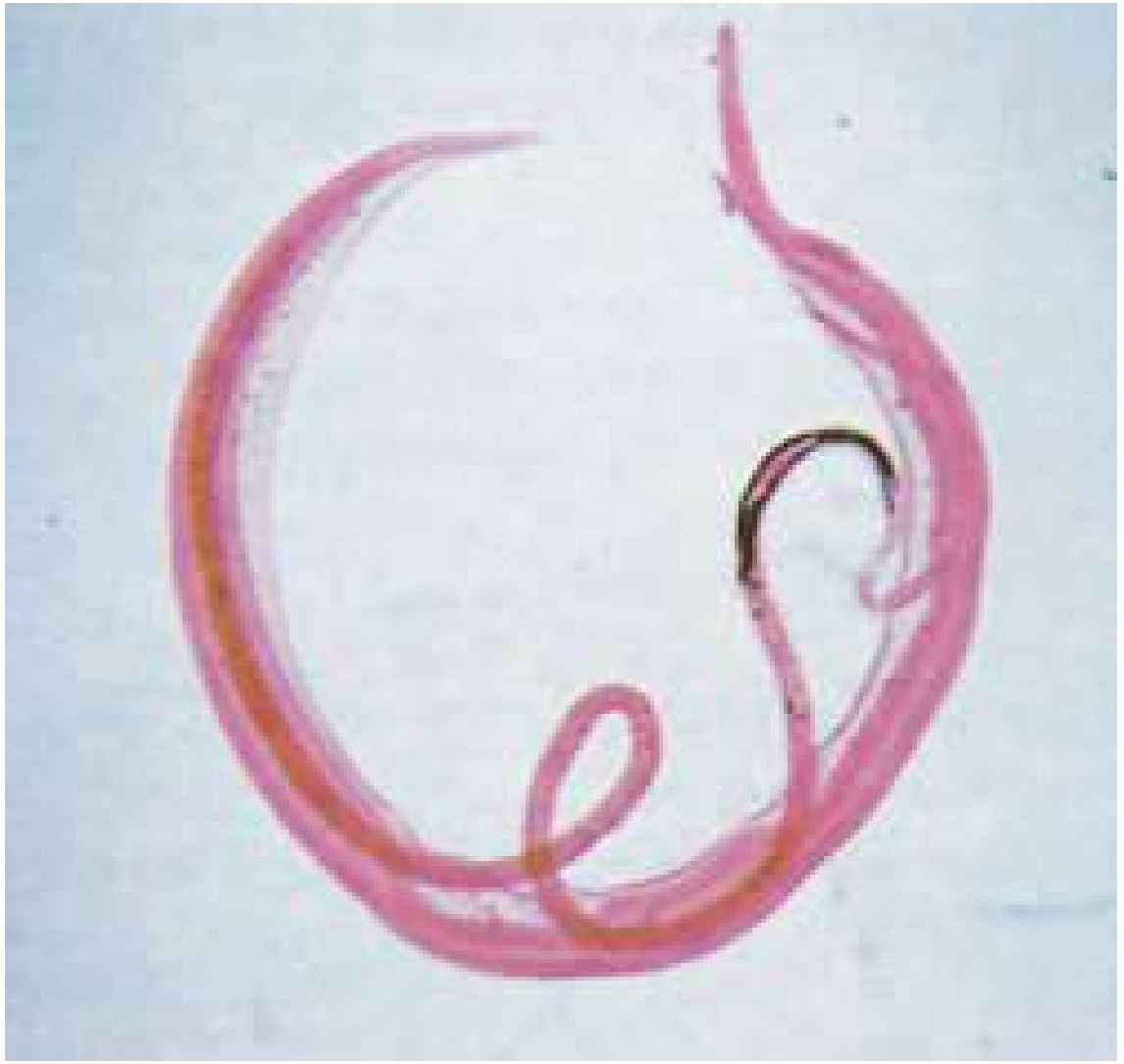
a) Consist the flukes, which are either internal or external parasites.

b) They have a forked digestive tract.

c) They have one or more suckers for attachment to the host.

d) Life cycle indirect with one or more different host and a number of developmental stages such as (*schistosoma*) or direct life cycle (infect a single species).

e) Hermaphroditic species, the reproductive system is adapted for copulation, except some species which are dioecious such as *Schistosoma sp.*



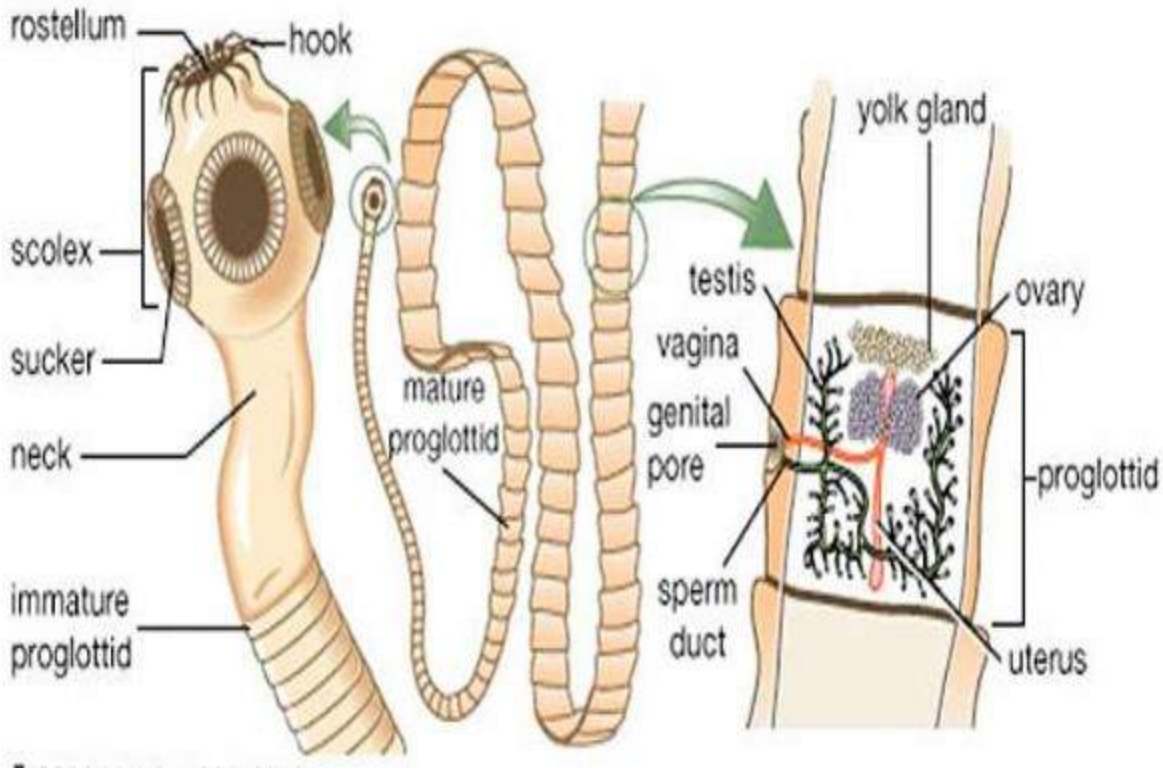
3. Class Cestoda

a) Tape worms, have a **scolex with hooks** and suckers for attachment, neck, and a chain of proglottids budded off from the neck region.

b) gut is absent.

c) Life cycle is indirect, involves a larval stages they need one or more intermediate host in their life cycle.

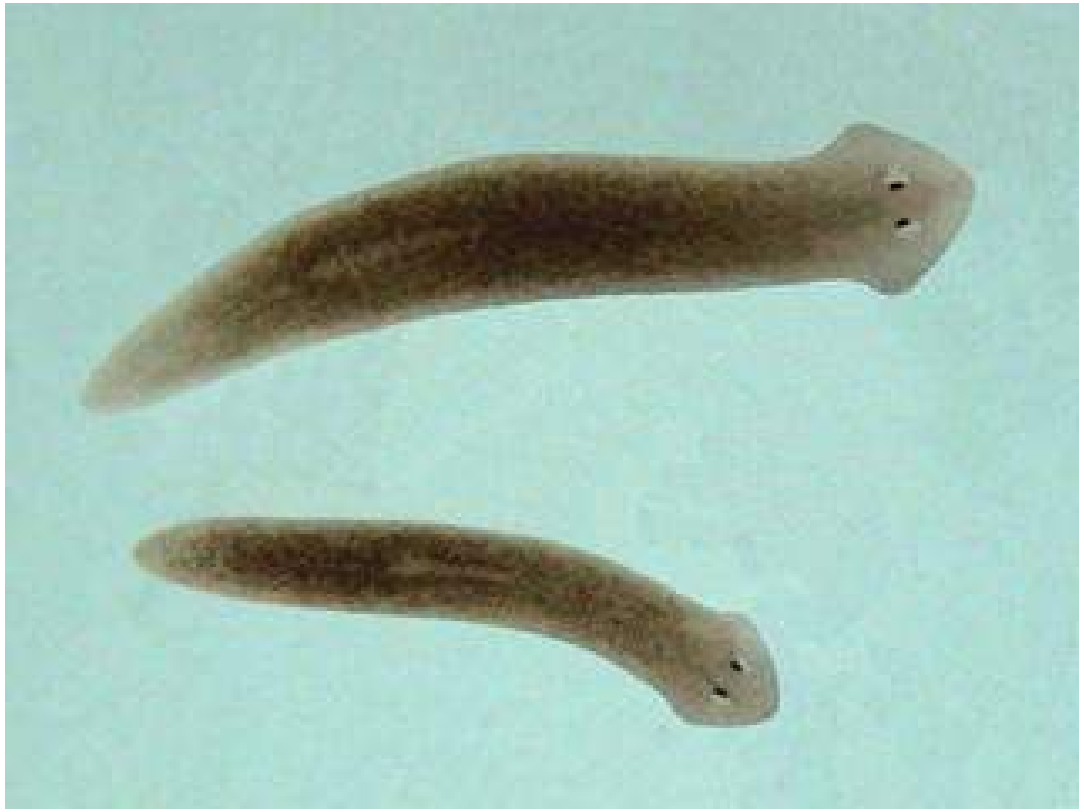
d) They are hermaphroditic worms, and all internal parasites.



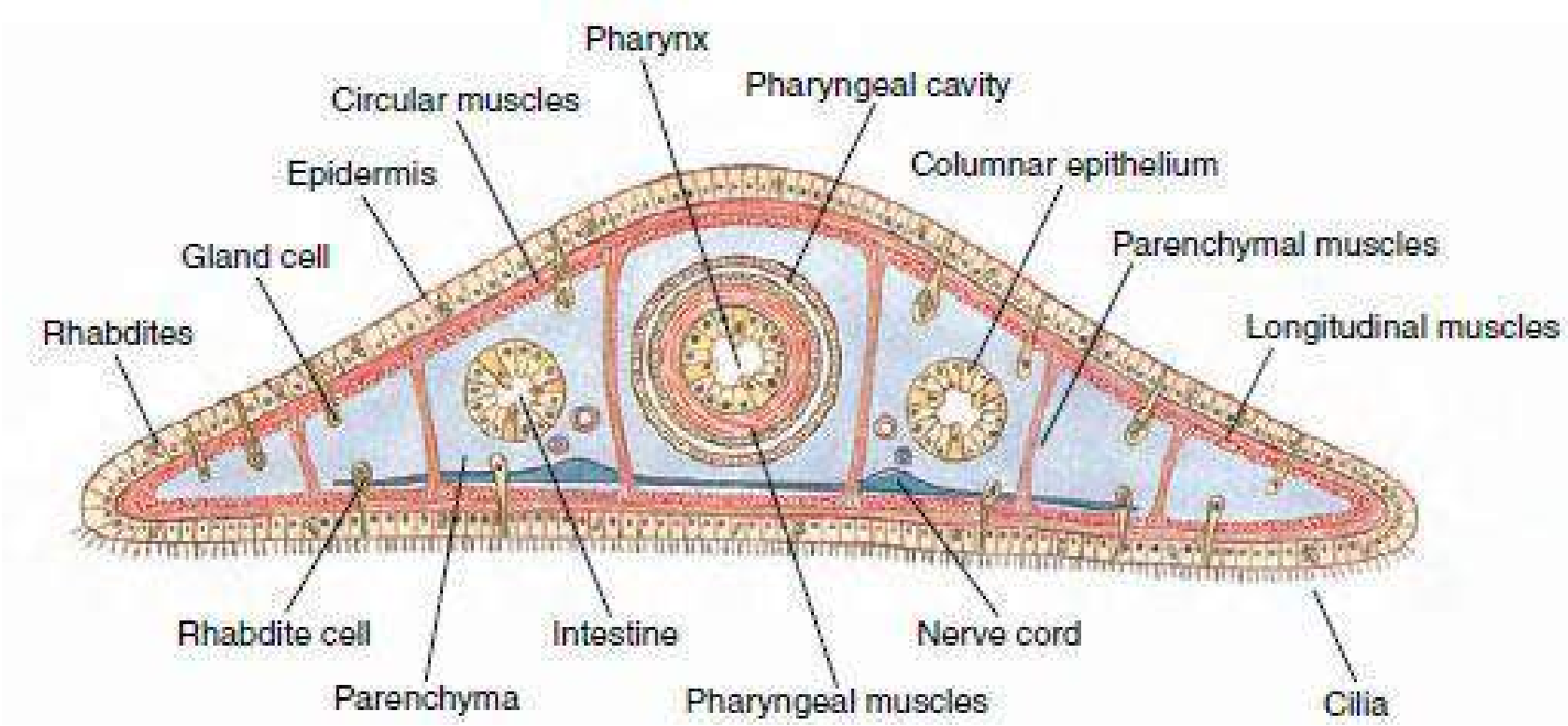
Class: Turabellana or Tricladida

Planaria sp.

- *Planaria* is common in fresh water, benthic habitats with **dark brown or gray color** it is varied in size from body wall.
- Consist of ciliated epidermis, basal lamina, circulator, longitudinal and dorsoventred muscles, and intercellular fibers to support the body wall, numerous.

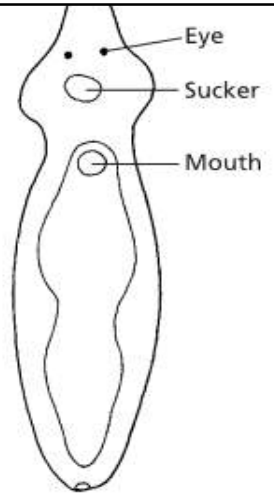


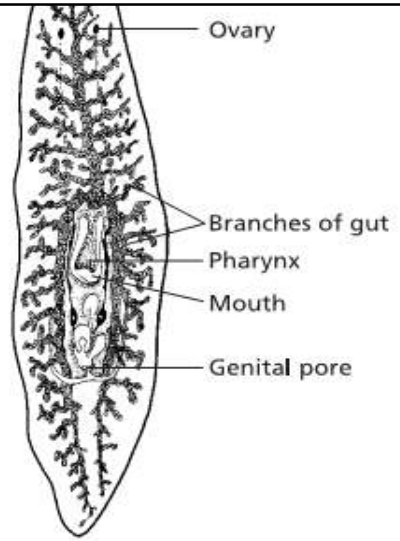
Gland cell present for providing adhesion and mucus secretion. Rhabdite which rod shape secretion released to the surface where they dissolve to form mucus is important for attachment and prey trapping.

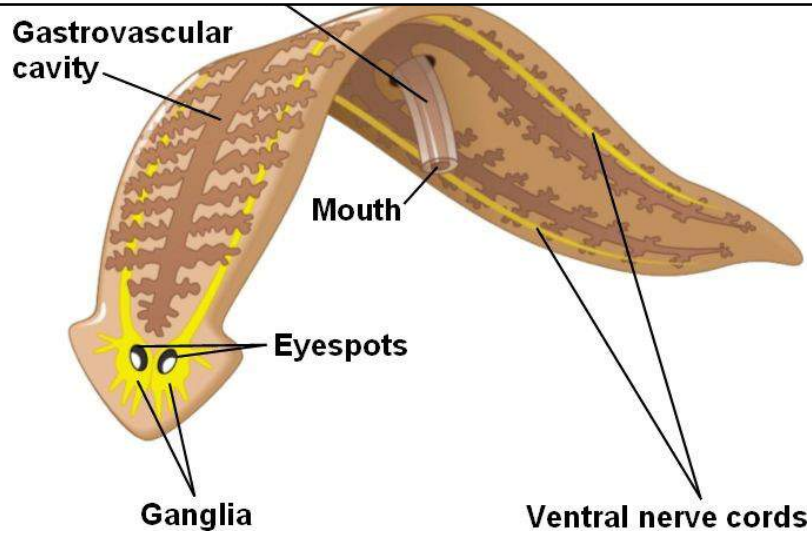


❖Digestive system

The name of the order Tricladida refer to the branching intestine of these groups of turbellarias. The gut is a blind sac, the mouth is used for both ingestion and digestion. The digestion is extracellular in the first, and then the food fragments digested entracellular by the phagocytic cells.

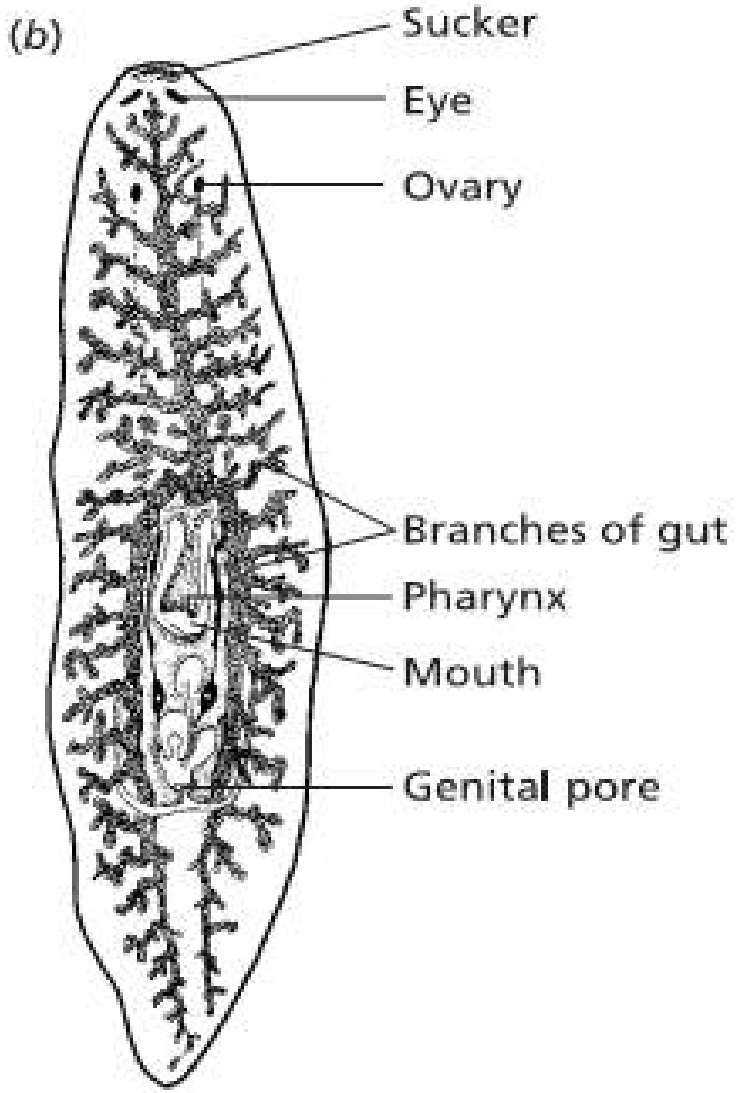






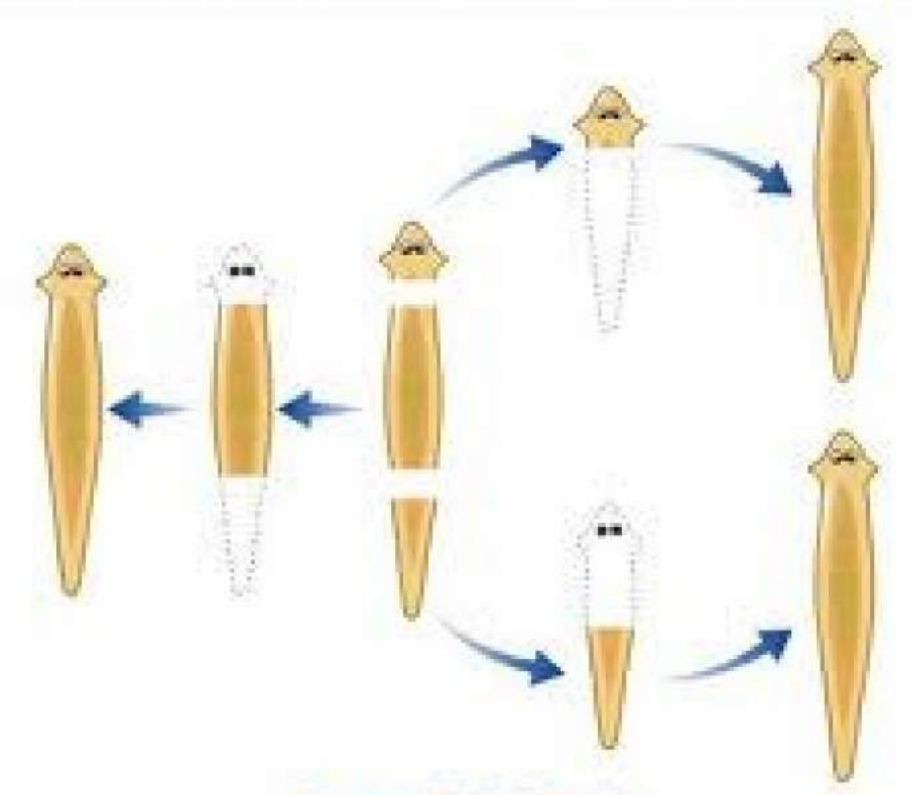
Digestion enzymes are supplied by the pharynx and by gland cell of the intestine,

planaria are able to with stand prolonged periods of starvation, and utilize part of the gut, all of the parenchyma, and reproductive system.



The body volume may be reduced to as little as third of the body.

These parts regenerated with favorable condition, the undigested food is digested by the mouth.



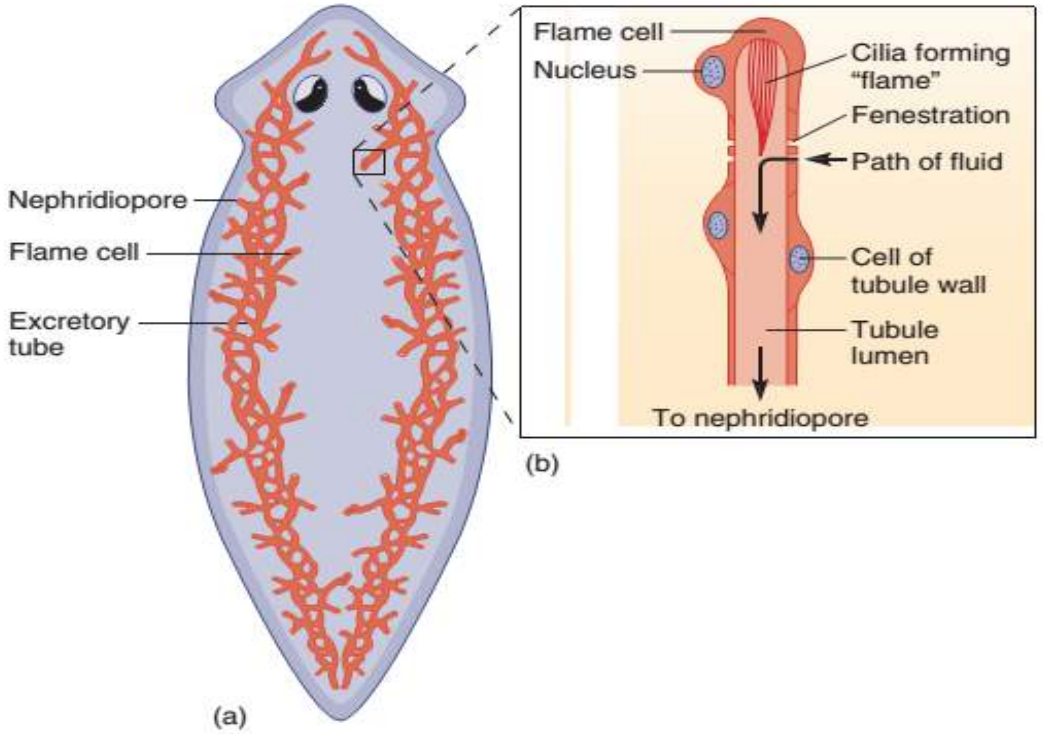
Its feed on small living animals

dead layer ones (carnivorous).

❖ Excretory system

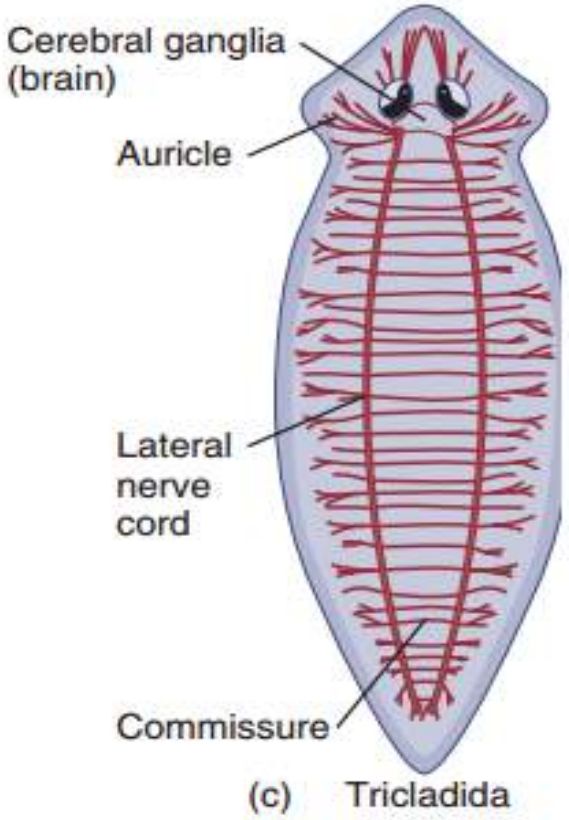
Consist of a series of branched tubules, each of which has a closed inner end with a **flame cell.**

Flame cell is a cup shaped cell containing a tuft of cilia. The beating of the ciliary tuft is like the candle flame. From which is derives its name. The tubules open on to the body surface.



❖ Nerve system

With one pair of cords, the cords have cross connections, the cords are organized in to an anterior brain Consists of two ganglion fuse to form inverted v shape. One pair of eyes is present.

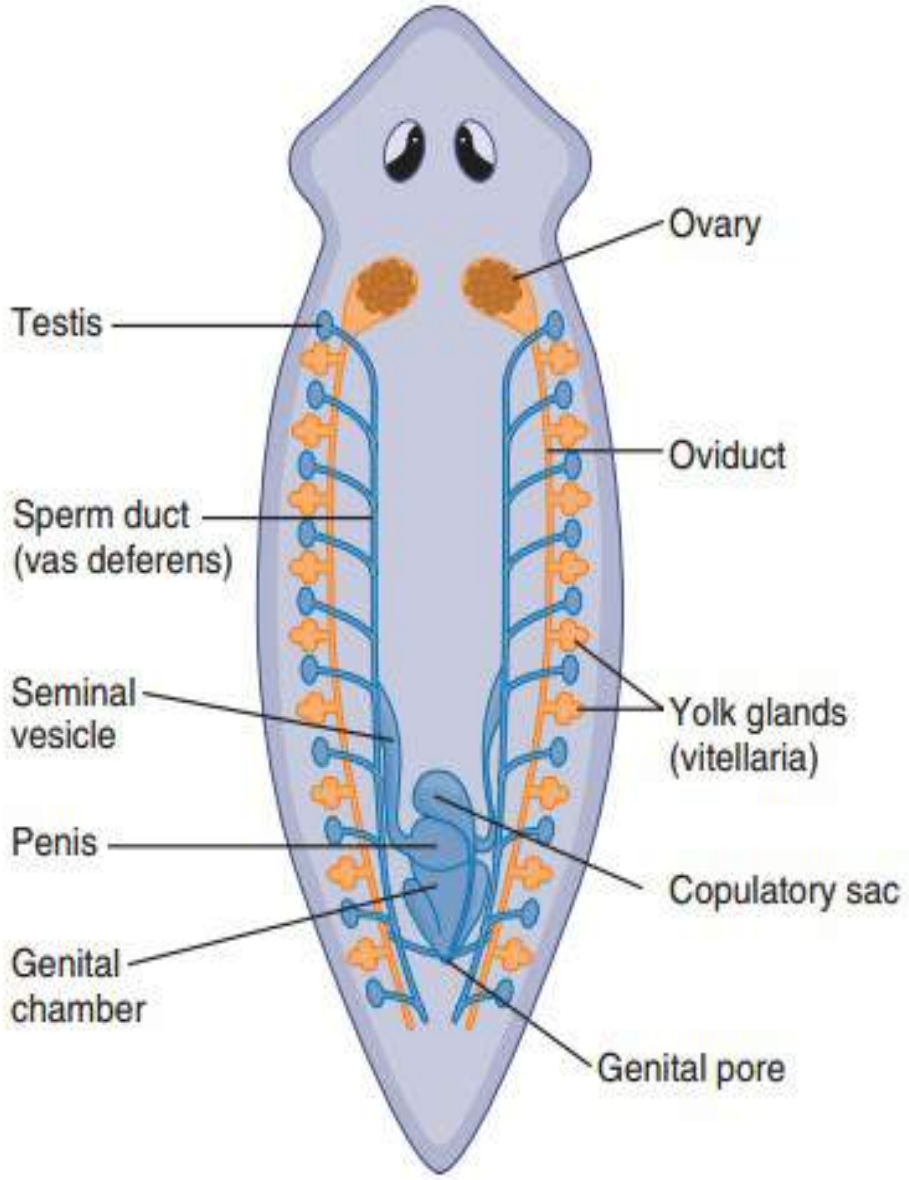


- **Respiration** through the body wall.
- **Circulatory system** is absent.

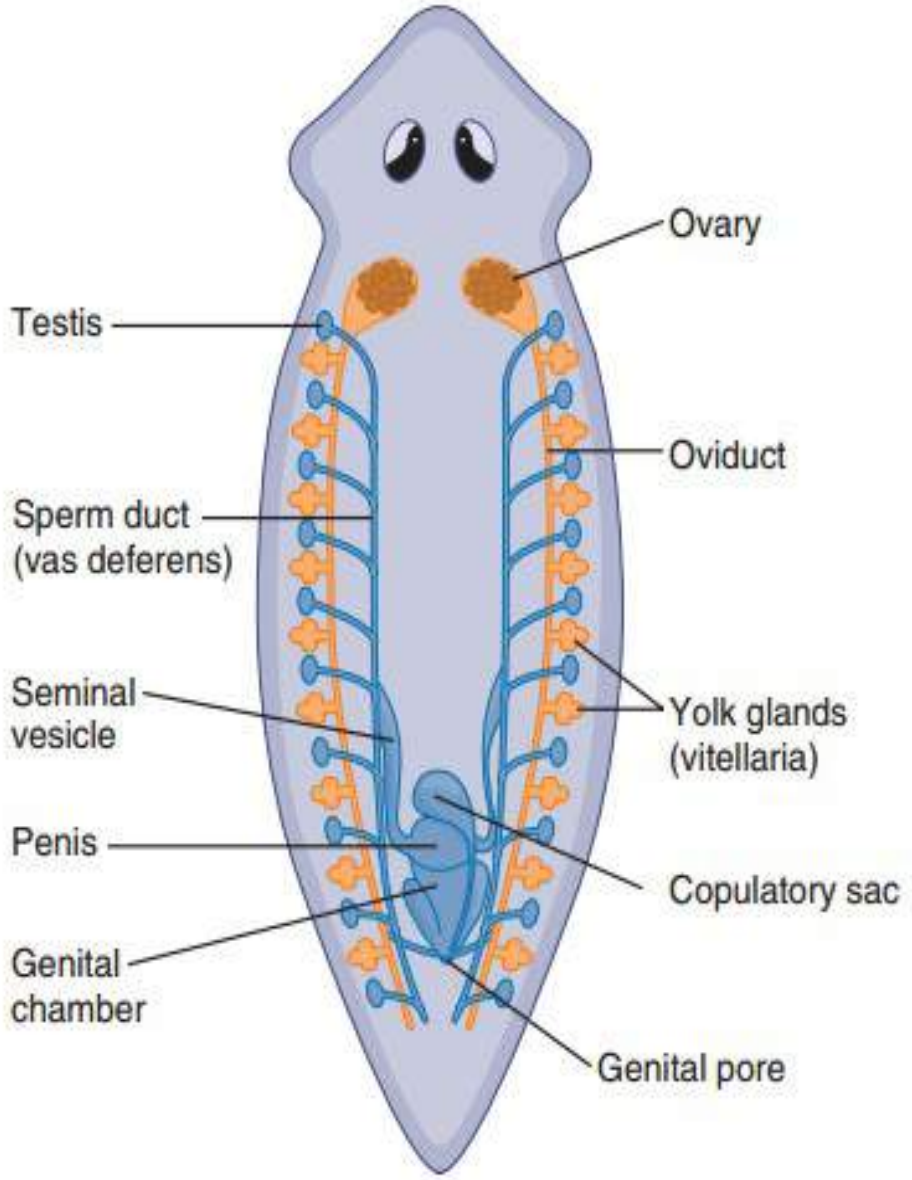
Reproductive system

The vast majority as flat worms are hermaphroditic except some species which are dioecious.

The male part of the system has a set of several testicles, distributed throughout the body in two or more rows. The testicles are connected to a pair of sperm ducts which run posteriorly towards the gonopore.



The female part is formed by two ovaries in the anterior region. Exiting the ovaries, a pair of oviducts runs posteriorly towards the gonopore.

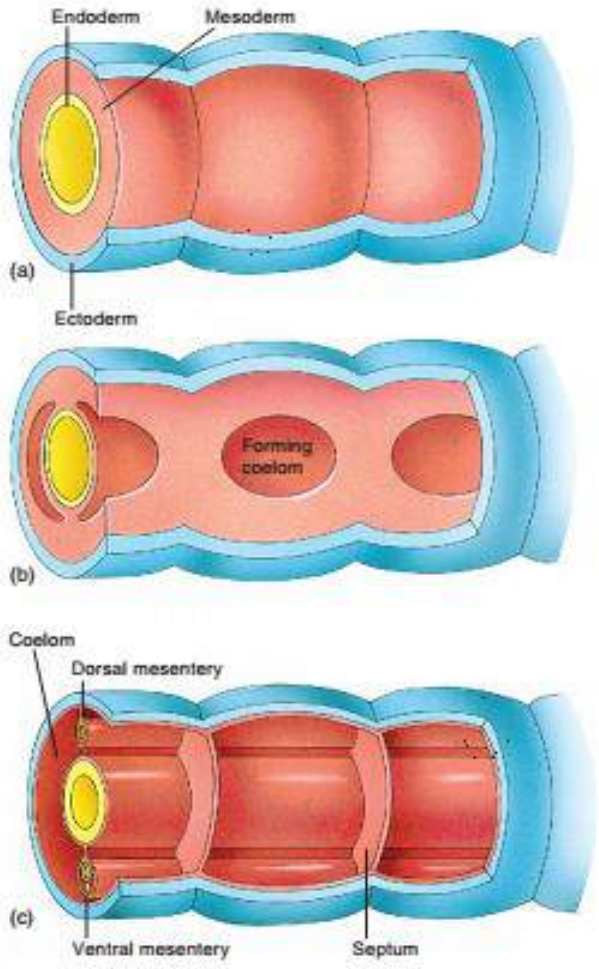


Phylum: Annelida

- Annelid (L-annelus, little ring).

The main, characters:

1. Segmented, coelomates, bilateral symmetrical animals.



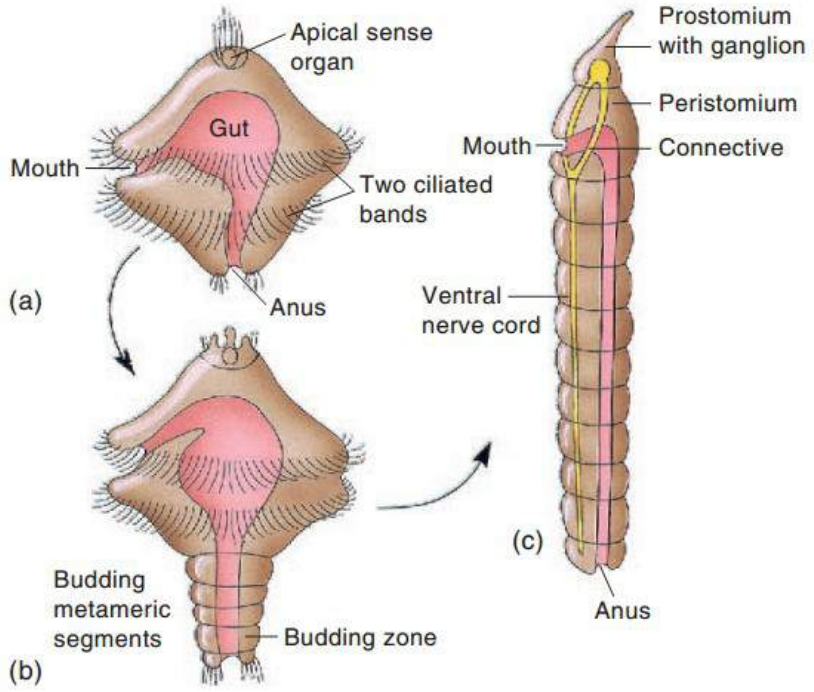
2. Circulatory system is closed.

3. Respiration is performed through the body wall or gills on the paradodia which is the locomotion organs.

4. Excretory system is a pair of nephridia for each segment.

5. Nervous system with double ventral nerve cords extending along the body. The brain is consists of a pair of dorsal ganglia

6. Hermaphroditic or diaccious animals, development direct or indirect are indirect development then the trochophore larva is present.



7. The body is covered by a fibrous cuticle.

8. The gut is a straight tube extending through the body between the mouth and anus.

Classification

Phylum Annelida can be divided into four classes:

1. Class Archiannelida

a) Marine worm is found in the sand with about 4 cm long.

b) With ciliated epidermis.

c) Lacks of parapodia, but the prostomium with one pair of tentacles.

d) The body segments are dull.

e) The development indirect with trochophor larva.

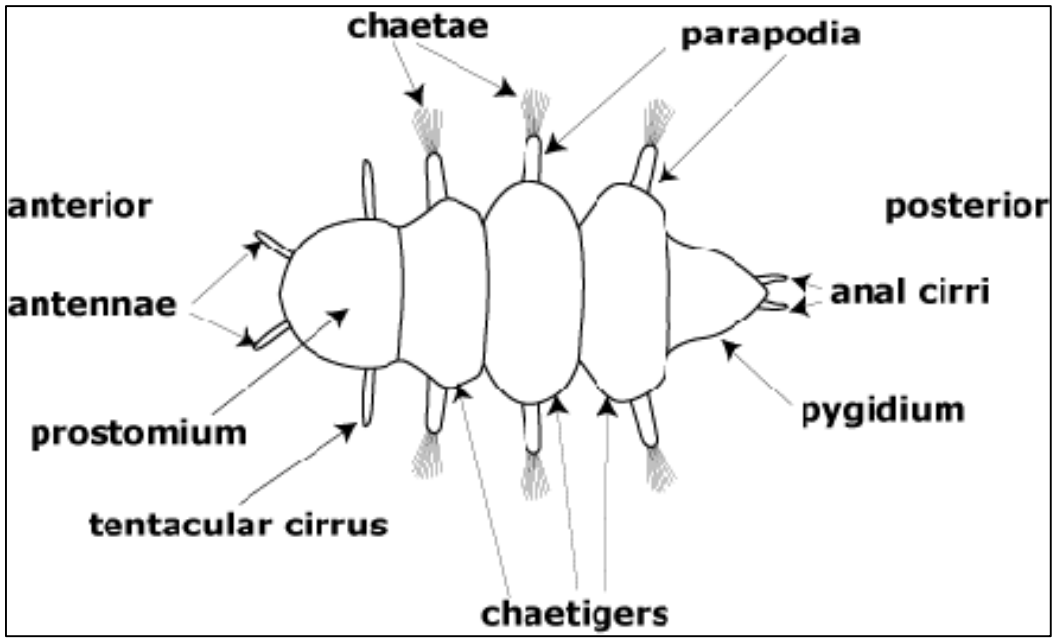
2. Class Polychaeta

a) Marine annelids.

b) Have locomotion organs (parapodia) which also used for respiration.

c) The prostomium with two pairs of tentacles and palps.

d) Diacious, fertilization external, development indirect with trochophore larva.



3. Class: Oligochaeta

a) Includes the earth worm and some fresh water annelids.

b) Respiration through the body wall.

c) Lacks of parapodia, arid tentacles.

d) Hermaphroditic, **development direct**, eggs deposit in cocoons secrets by the clitellum.

4. Class Hirudinea

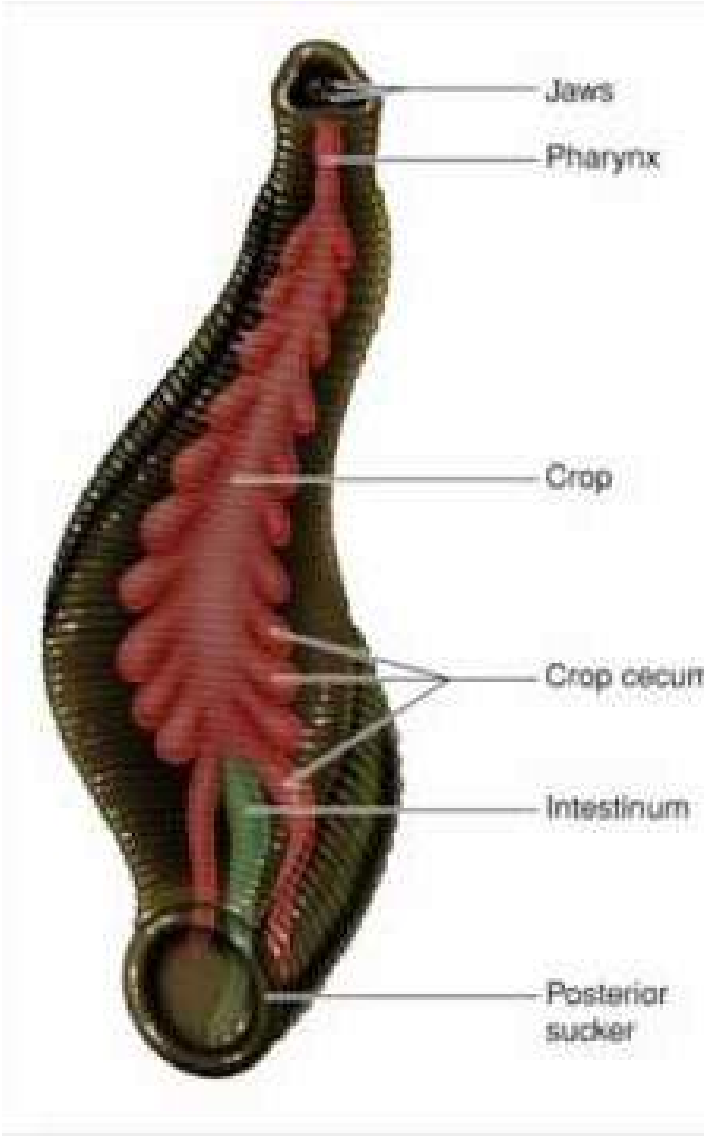
a) With two sucker anterior and posterior sucker.

b) Hermaphrodites, with direct development eggs deposit in cocoons secrets by the clitellum.

c) Ectoparasites on vertebrates or predators.

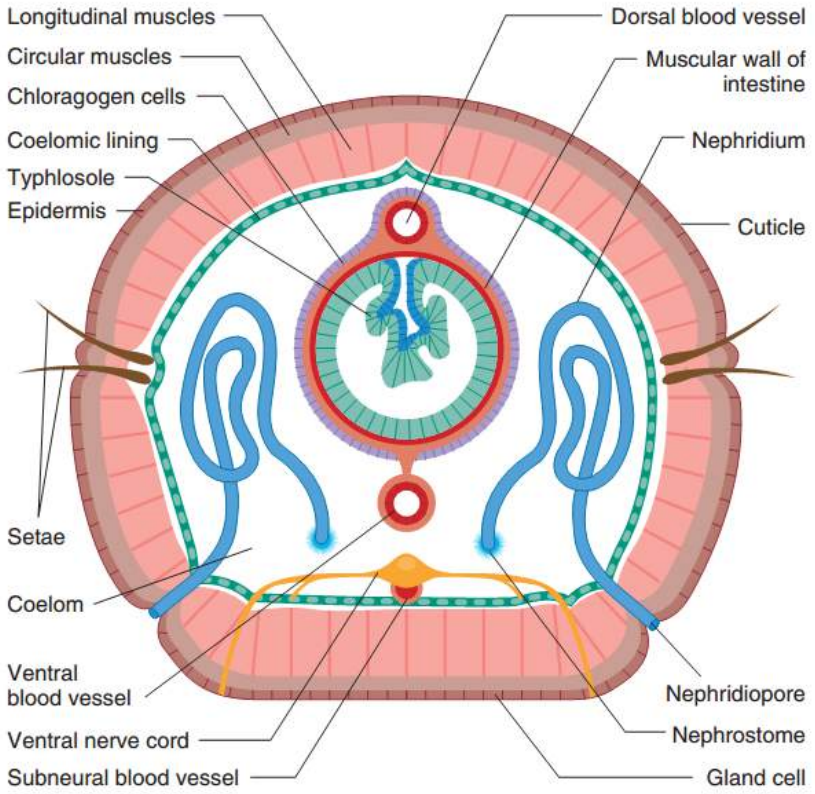
d) The body with segment subdivided externally to many secondary rings.

e) Lacks of parapodia and tentacles.



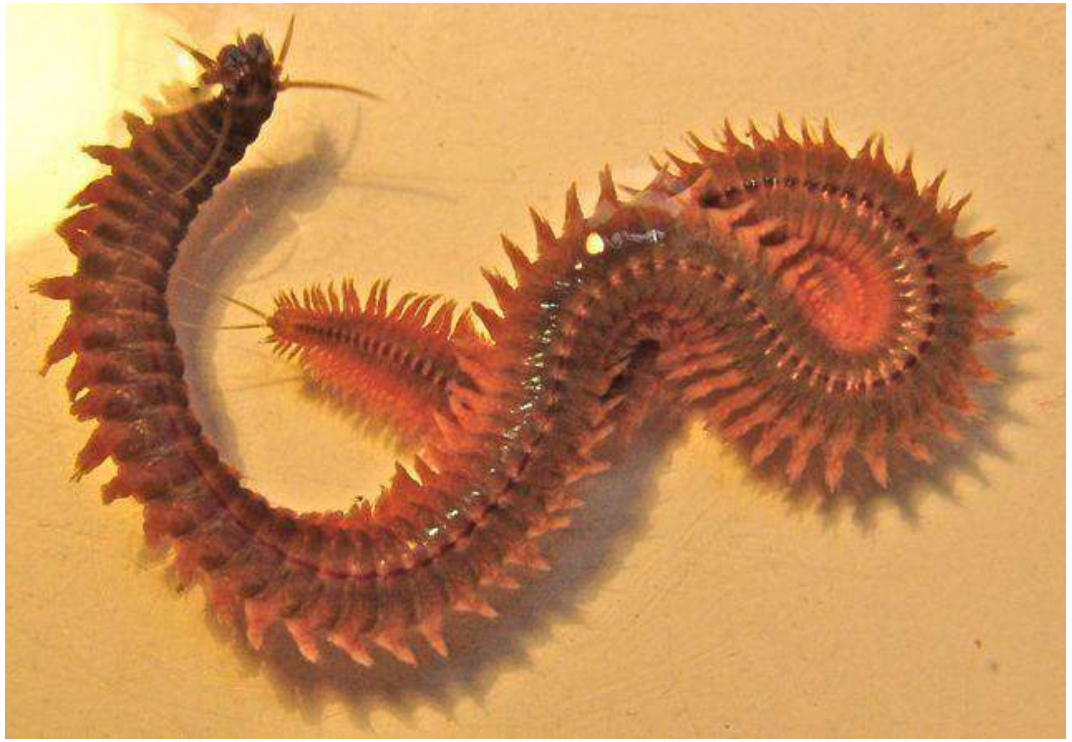
The structure of the body wall

The body wall consists of outer layer which is a thin, nonliving cuticle. Below is a single layer of columnar epithelium, then a thin layer of connective tissue, then a layer of longitudinal muscle cells, and finally the peritoneum.

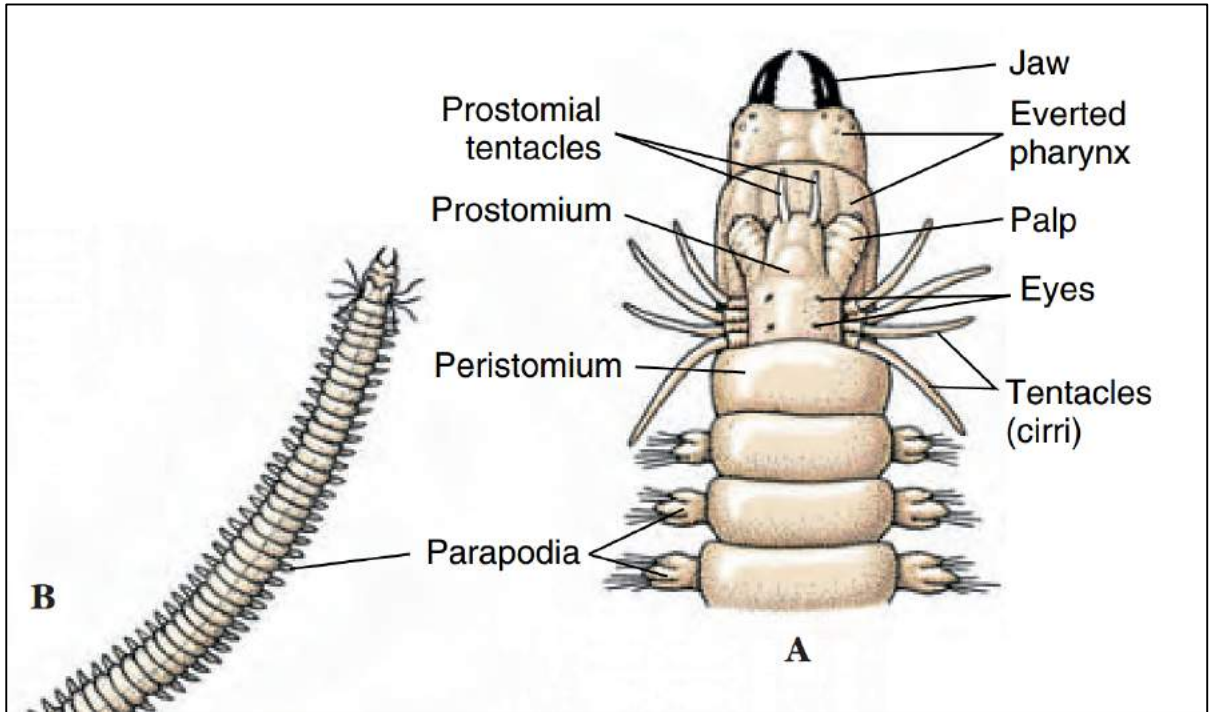


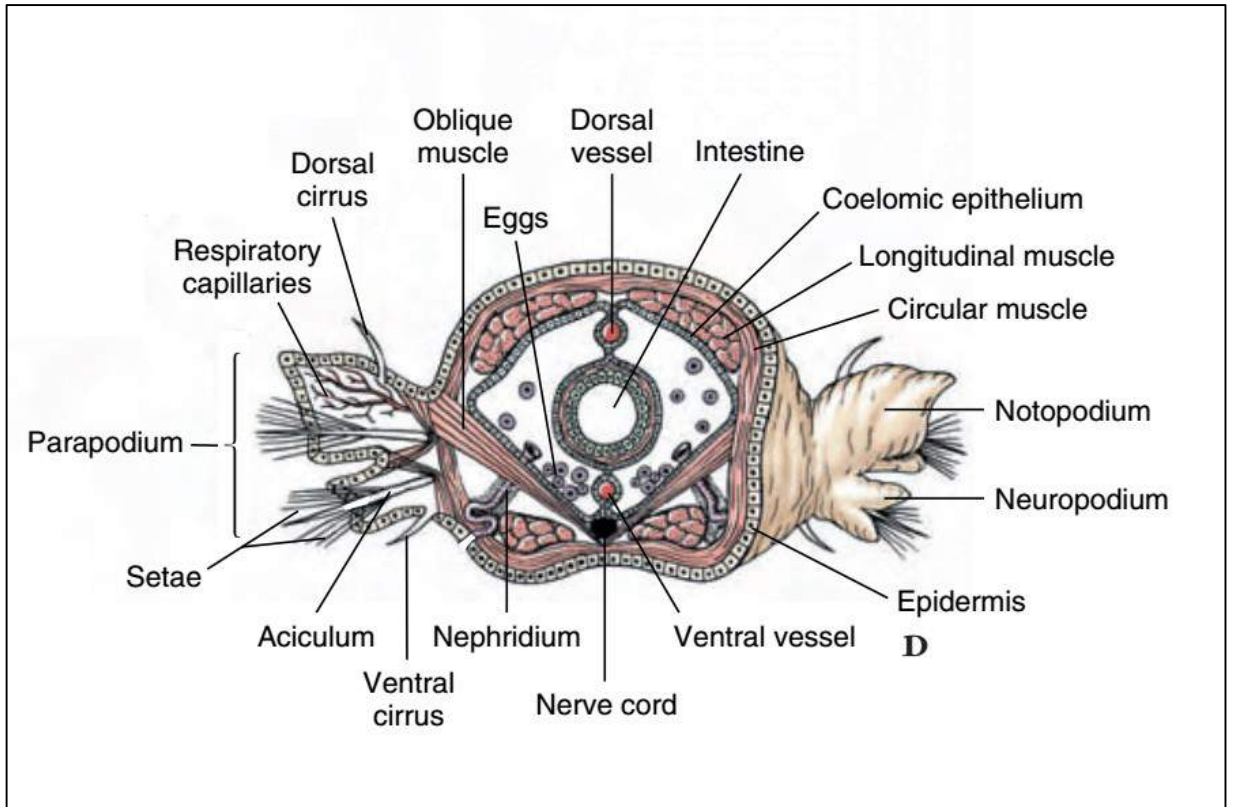
Nereis sp.

Nereis is marine species with red or pink-green or a combination of colors.



- Head with tentacles for food capturing and palps it moves by the parapodia,
- parapodia is fleshy **paddle like** consists of
  - one upper division (notopodium) and
  - a ventral division supported by one or more of aciculum from the dorsal division (neuropodium) project the cirrus. Pair of parapodia extends from each segment.

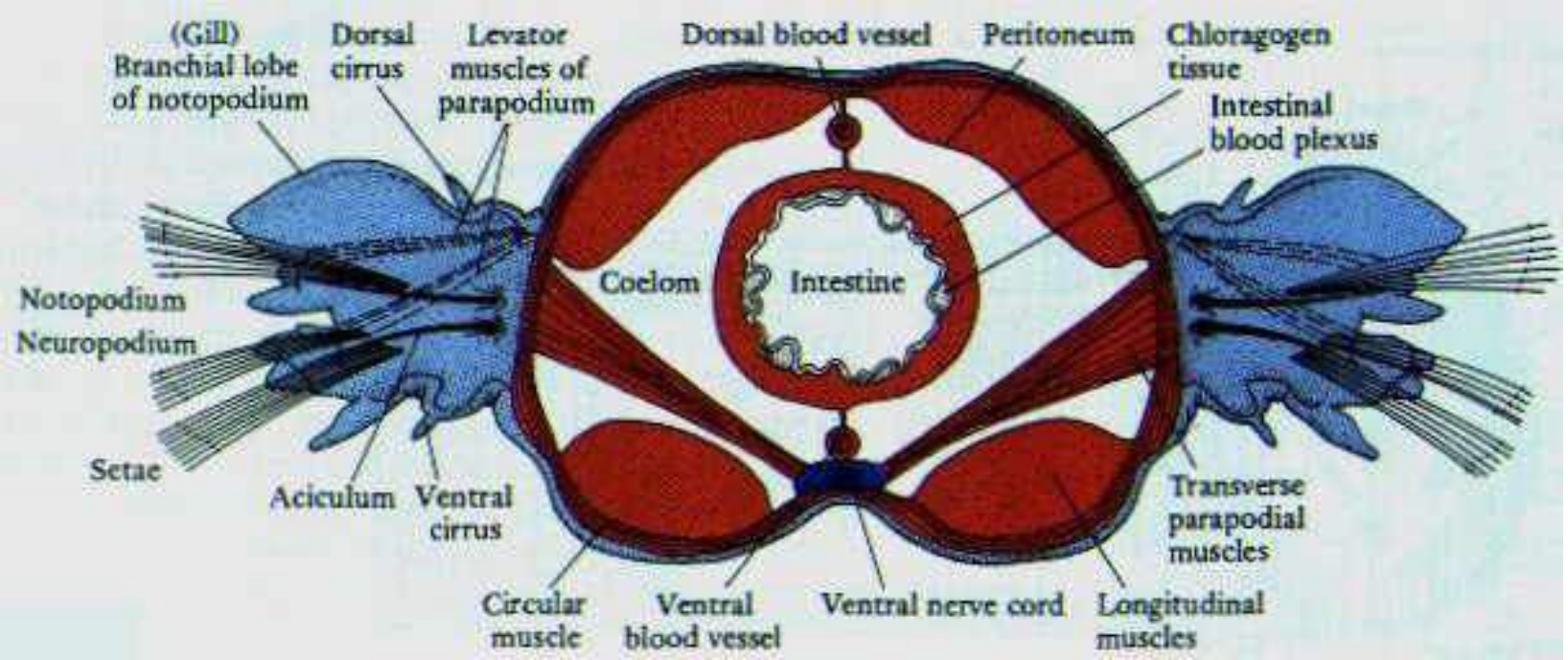




❖ Digestive system

Alimentary canal is a straight tube extending from the mouth at the interior end of the body to the anus at the end of posterior part. It is consists of mouth, pharynx, short esophagus, stomach, intestine and rectum.

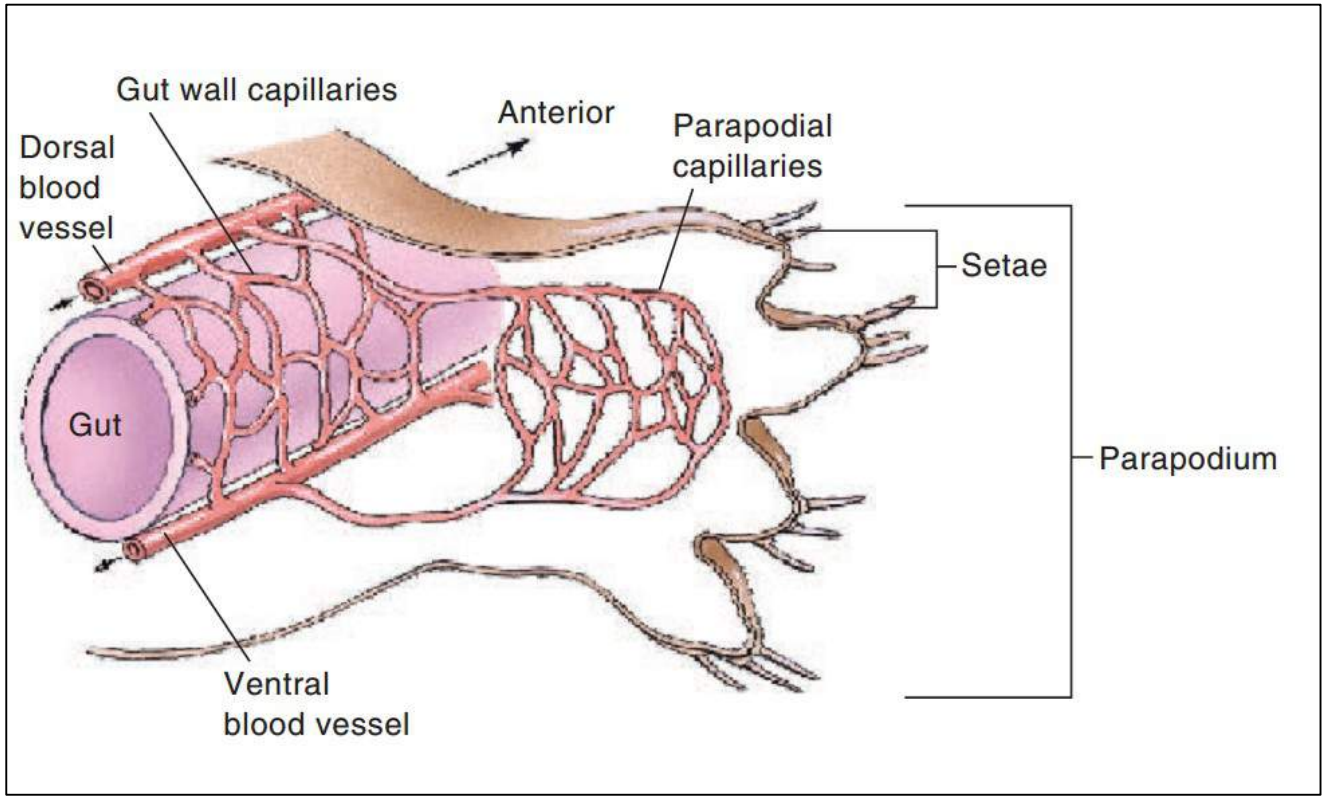
Digestion is extracellular; the digestive enzymes are released from the epithelium of the stomach into the cavity. The intestine is surrounded by a layer of (chloragogen) cells which is the chief center of synthesis and storage of fat and glycogen.



❖ Circulatory system

- Annelids have a closed circulatory system that is the blood way flows within blood vessels.
- Blood flows anteriorly in a dorsal blood vessel, then ventrally in lateral vessels around the sides of the intestine and finally posteriorly in a vessel ventral to the intestine.

- In each segment vessels branch from ventral vessel to the organs. The dorsal blood vessels move the blood by means of wave (instead of the heart). The blood of most annelids contains a respiratory pigment (Hemoglobin) which contains iron some annelids have (**chlorocruorin**) which is green iron.

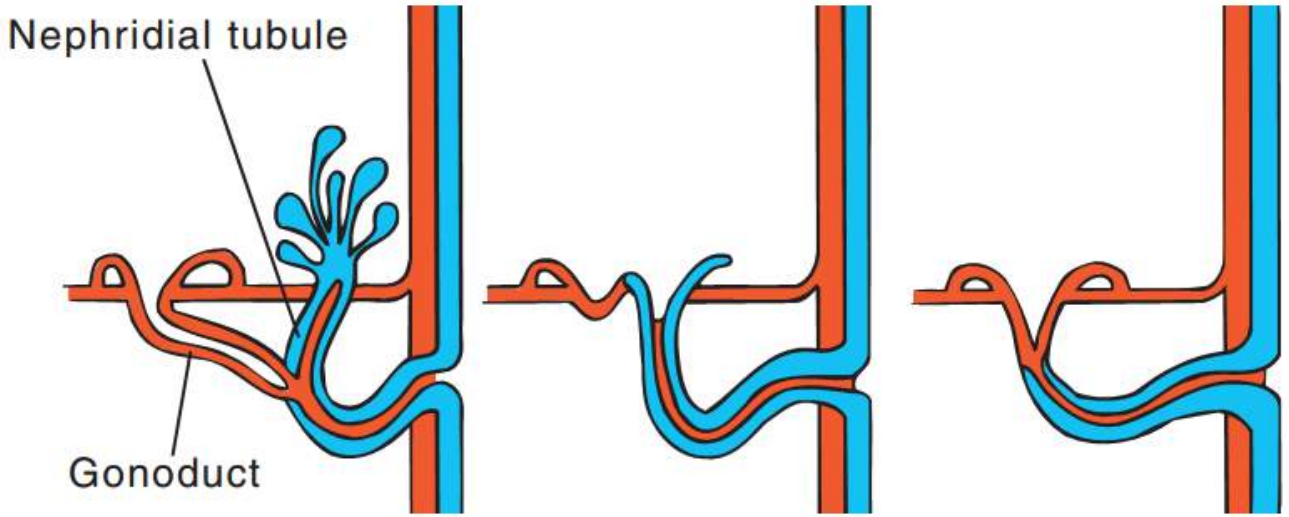


❖ Respiration

In polychaeta the respiration exchange occurs a cross the body wall and the parapodia which bear the gills.

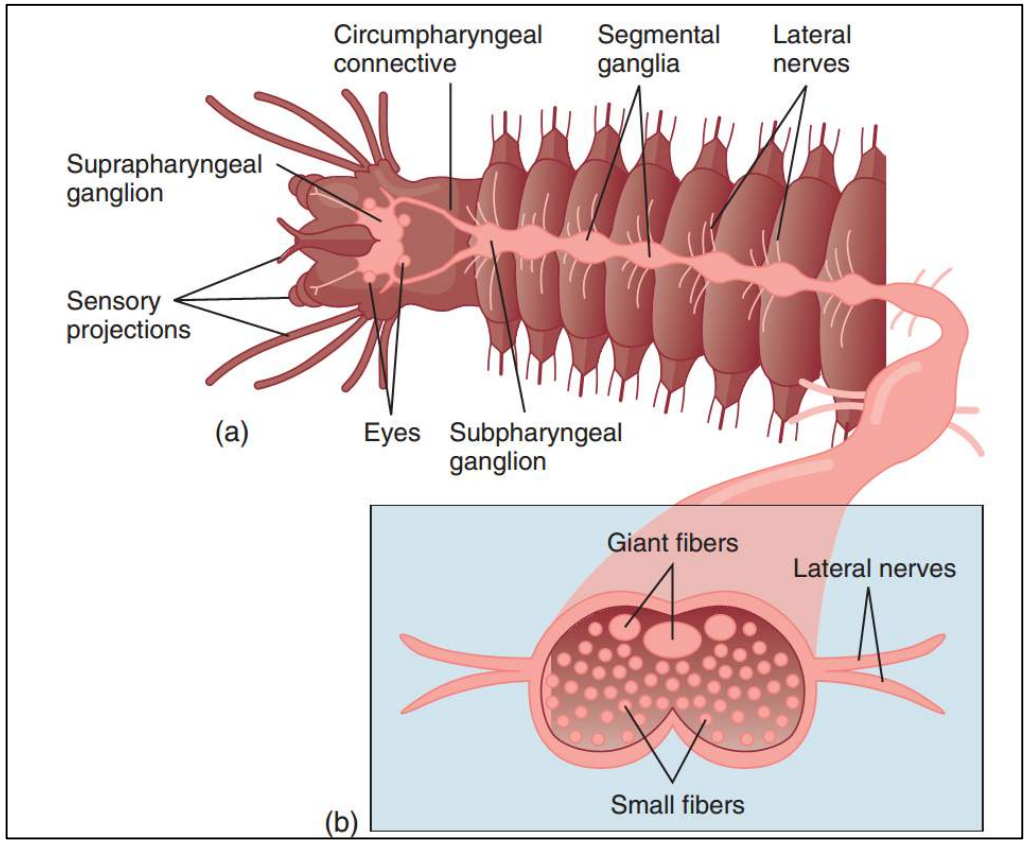
❖ Execratory system

Execratory organs in annelids are the nephridia which is distributed as one pair per segment the anterior end of the nephridia tubules is situated in the coelom of the segment immediately anterior to that form which the nephridia pore opens.



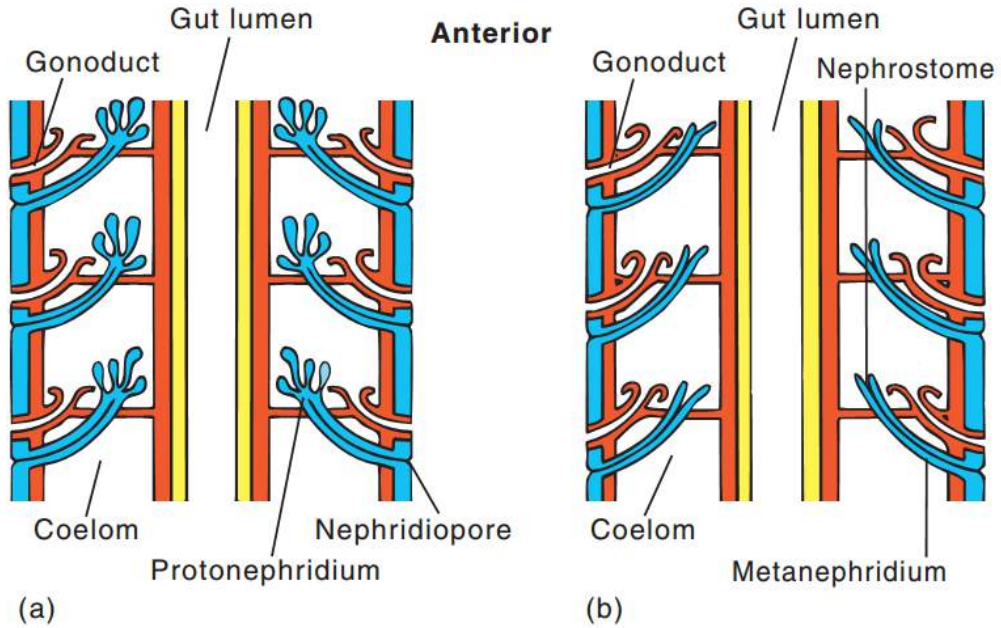
❖ The nervous system

The nerve system consists of bilobed brain located dorsally to the pharynx, and a pair of circumpharyngeal connectives that join the brain to the nerve cord, a nerve cord ventral to the digestive tract is present, two pairs of eyes is present on the prostomium. The eyes function is photoreceptors.



❖ Reproductive system

Neries as most of polychaeta is dioecious the gonad are present only during the breeding season and found on the wait of the coelom simply as masses of gametes, the gametes are released into the coelomic fluid and then to the outside through the nephridia ducts, fertilization is external development indirect, the fertilized egg develops into trochephore larva which is oval ciliated structure, feed on zooplankton.



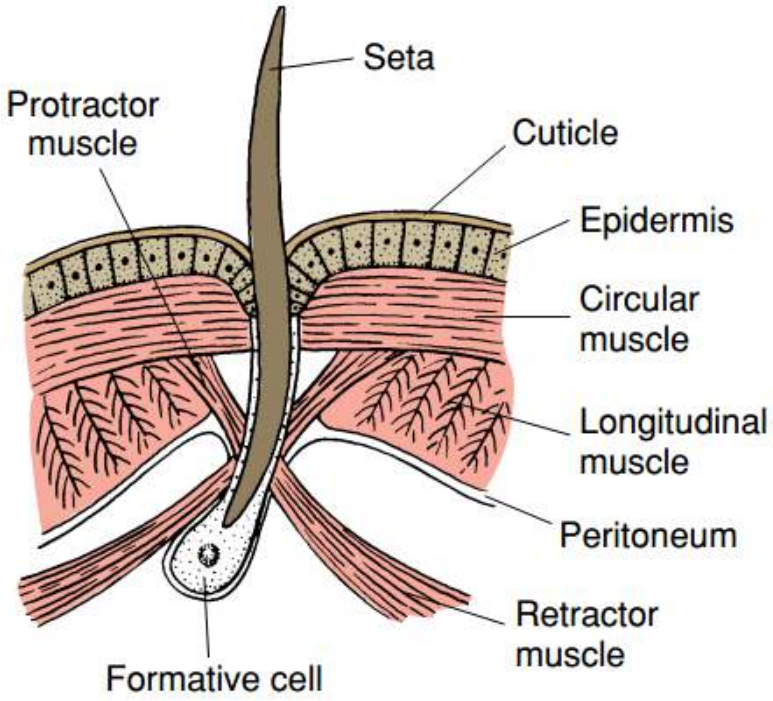
❖ Epitoky

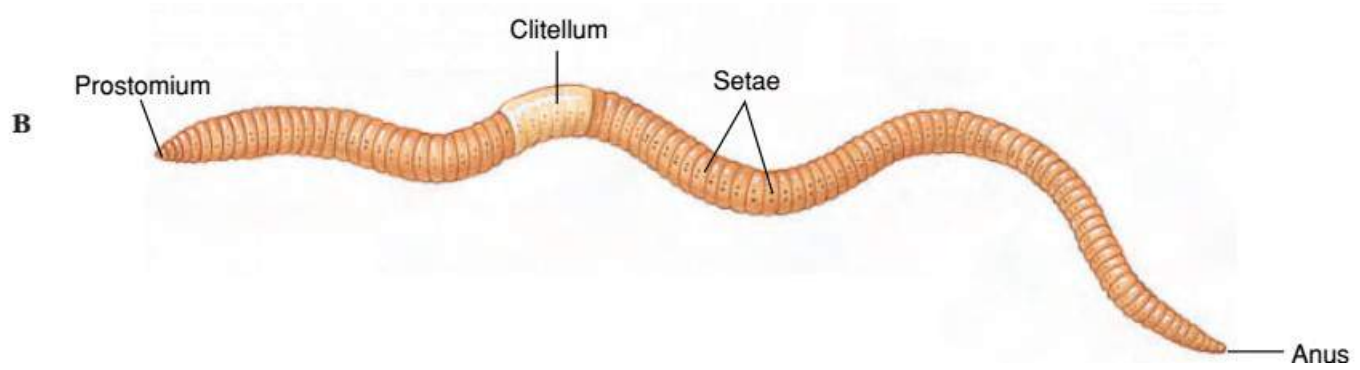
It is a reproductive phenomenon characteristic to many polychaetes, which is the morphological changes in reproductive individuals or (epitoke) the changes include

- Larger eyes, reduced prostomial palps and tentacles.
- The posterior segments are much enlarged and their parapodia contain fans of long setae.

lumbricus sp.

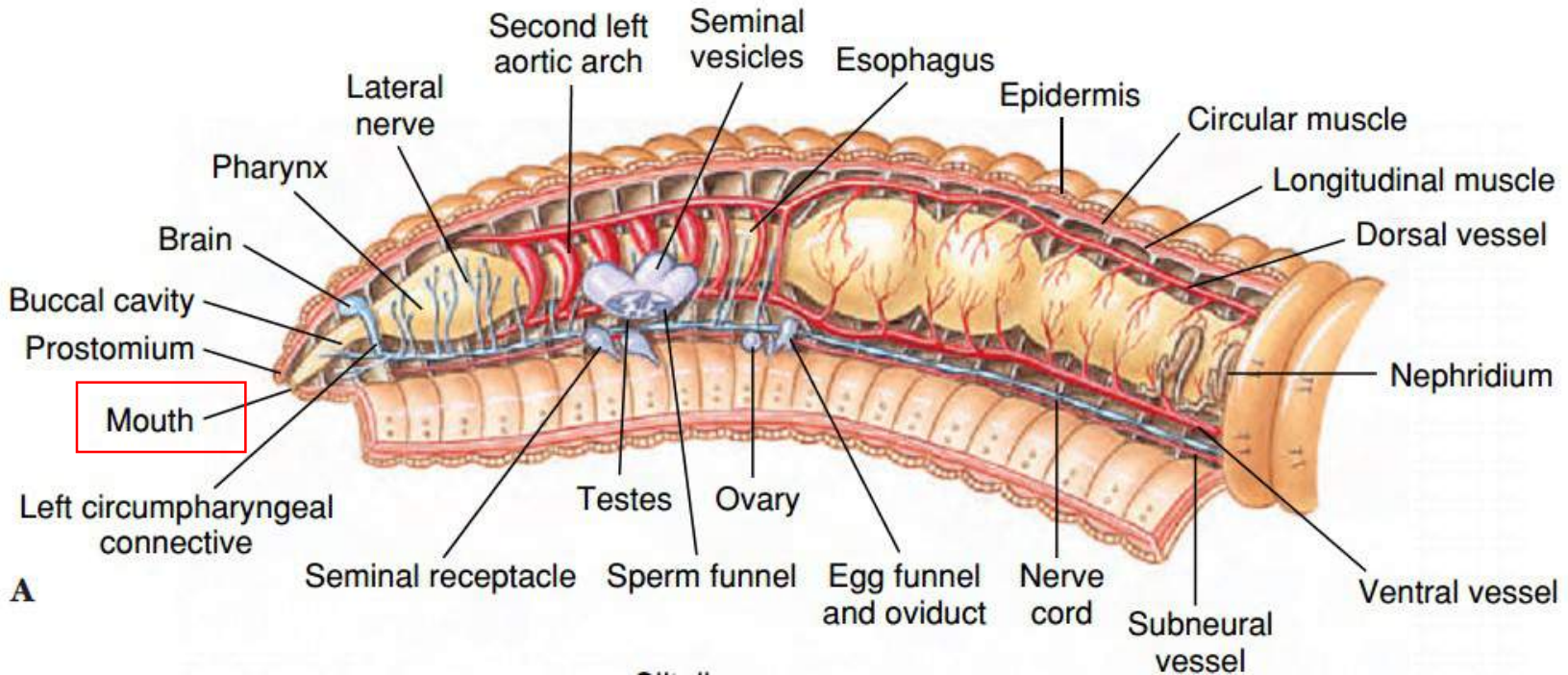
Live in the ground with 10-30 cm length. Scavenger (feed on dead materials). (Head is reduced, lacks of appendages. Locomotion by setae, eight per segment arranged in four pairs.

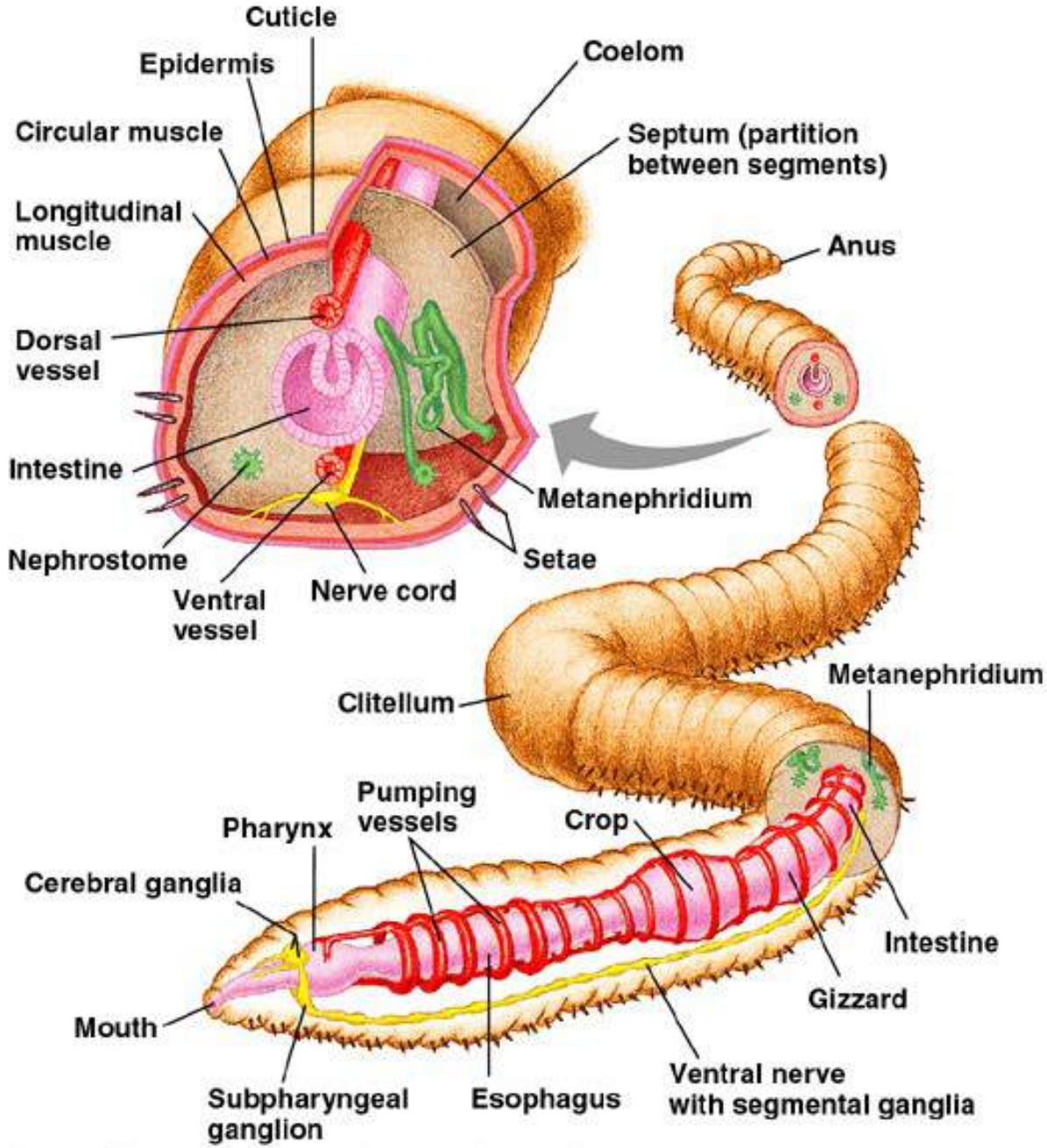




❖Digestive tract

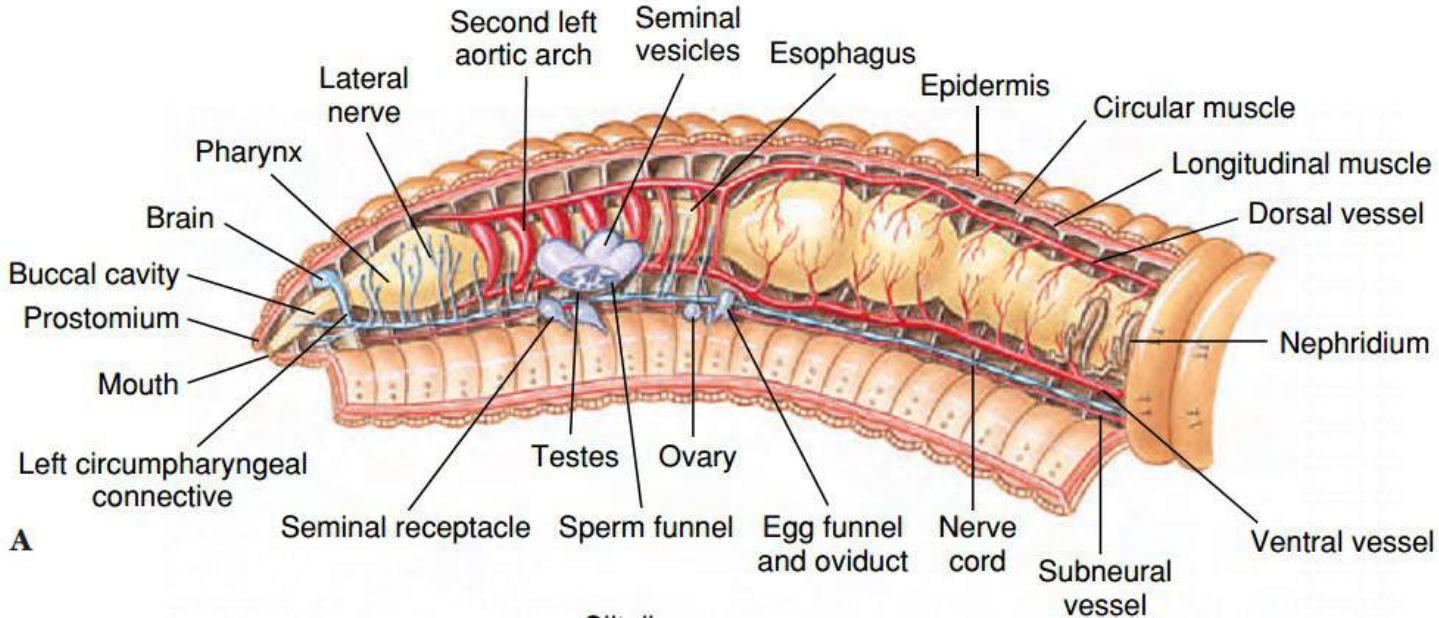
Consists of mouth, pharynx, and esophagus (with crop and gizzard) at the posterior and of the esophagus. The crop is used for food storage whereas the gizzard to grind food particles.



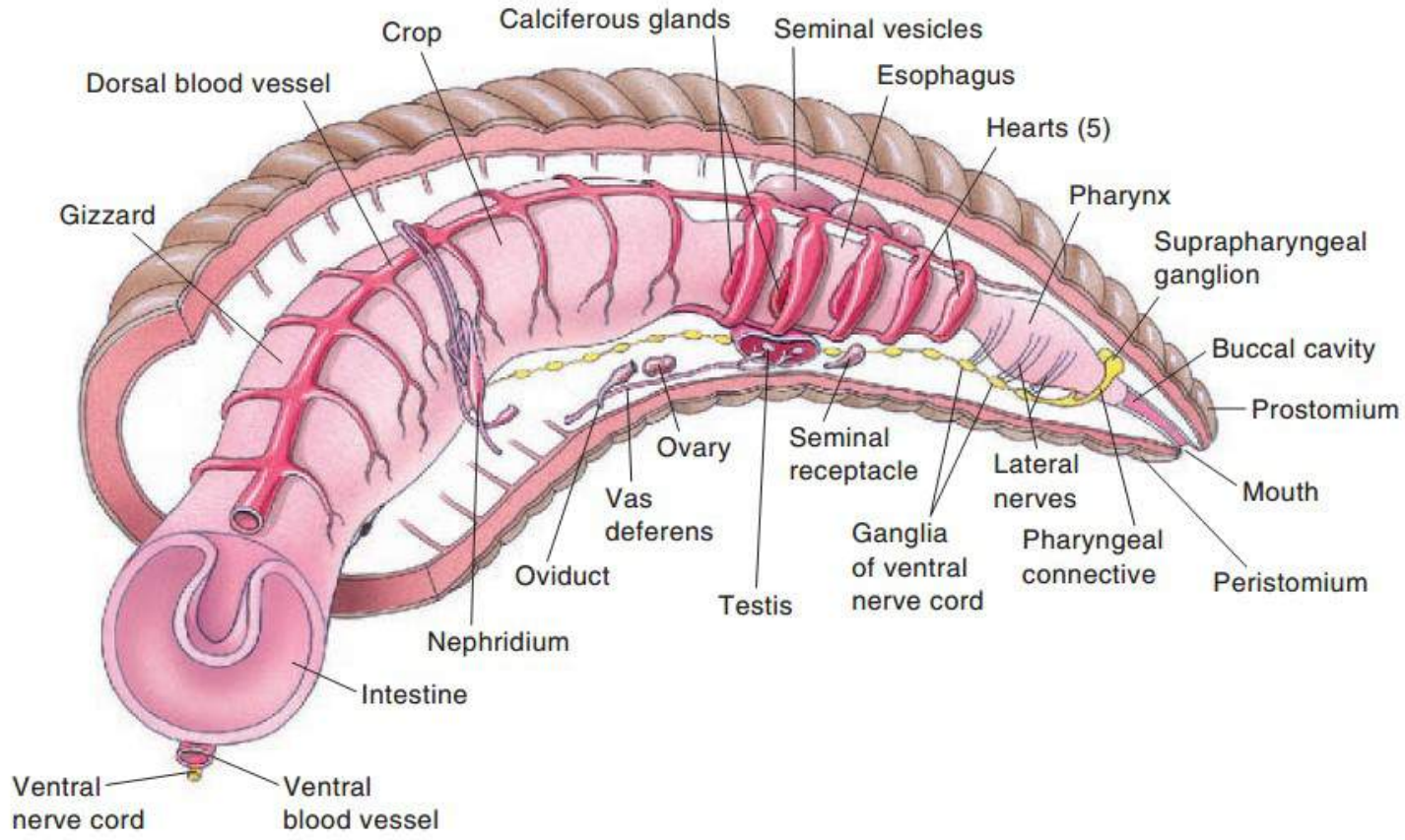


In the wall of the esophagus are Calciferous gland whose function is excretory, to excrete the excess calcium and bicarbonate ions from the blood which eliminated with the feces.

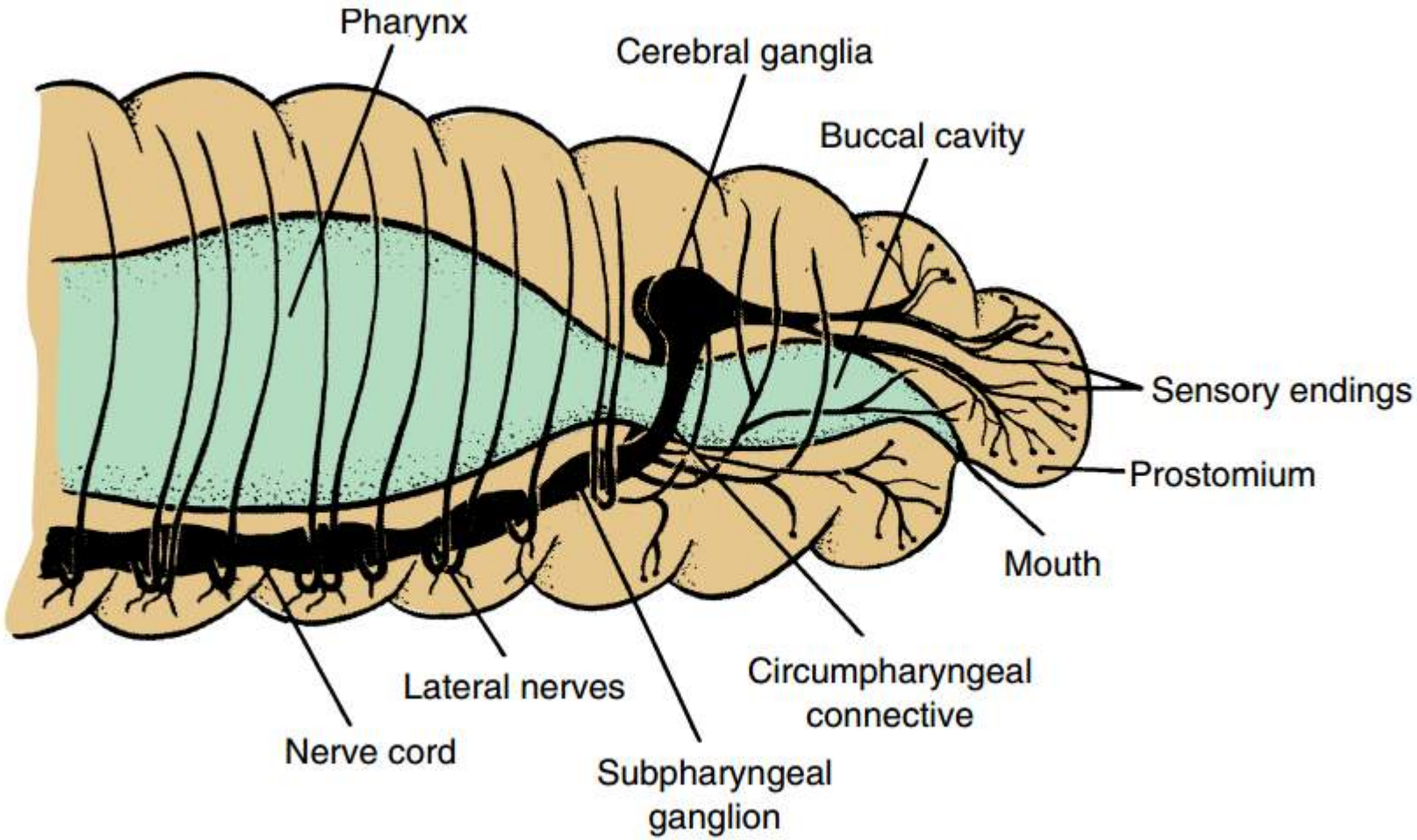
- The intestine is surrounded by chlorogogen cells
- Respiration occurs across the body wall.



- Circulatory system: it is very much as in polychaeta but with five pairs of vessels connect the dorsal vessel with ventral at the segment 7-11 these connected vessels called pseudoheart.

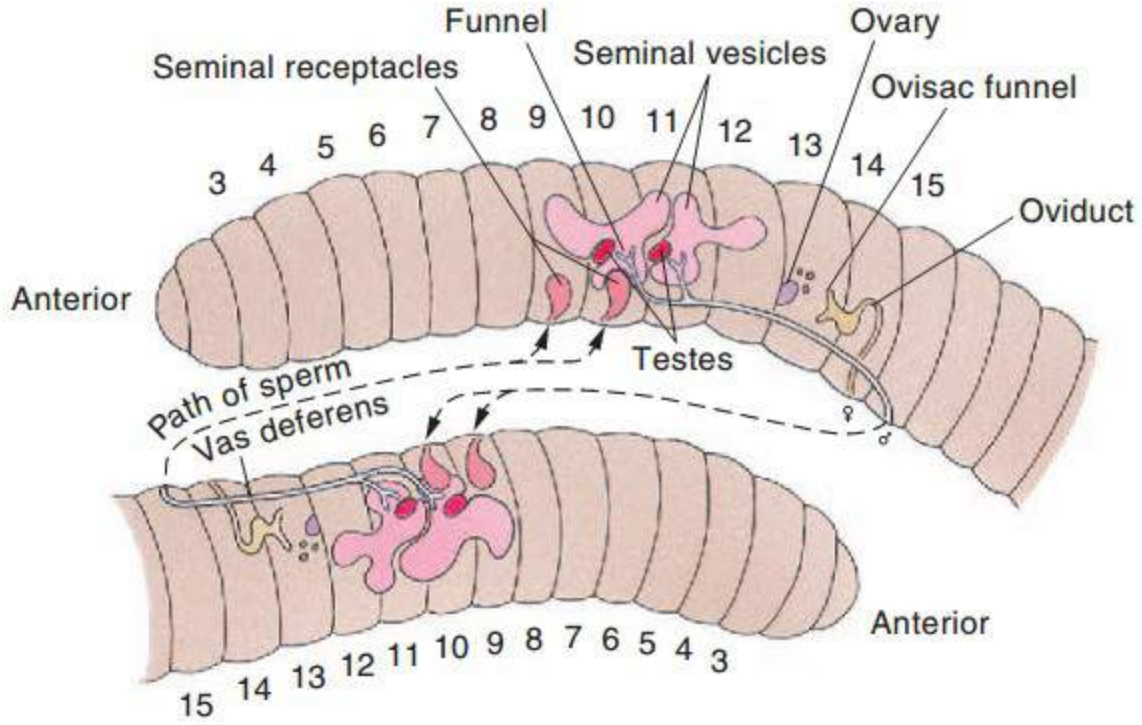


- Excretion: by the nephridia.
- Nerve system: similar to that of polychaeta.

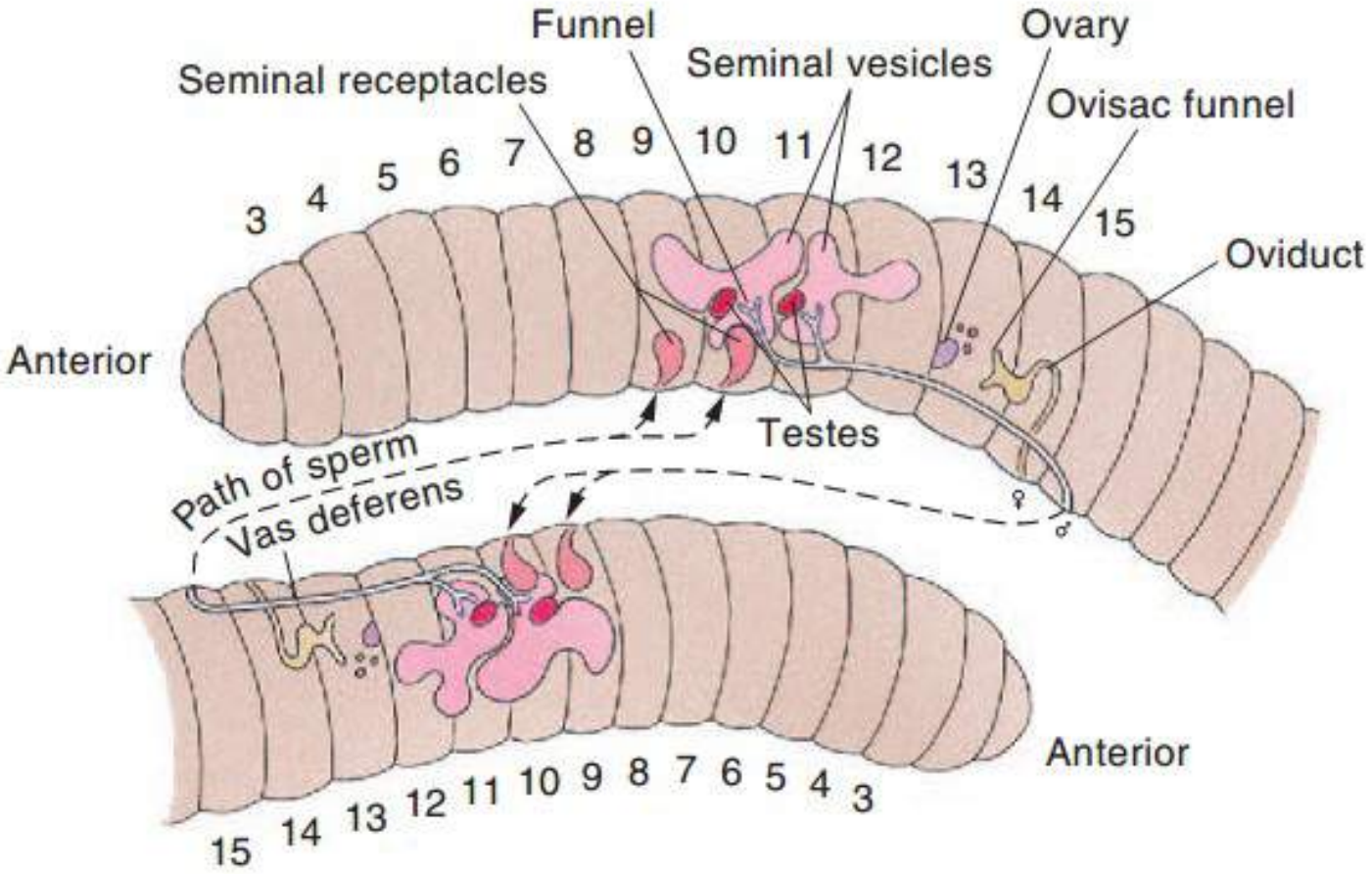


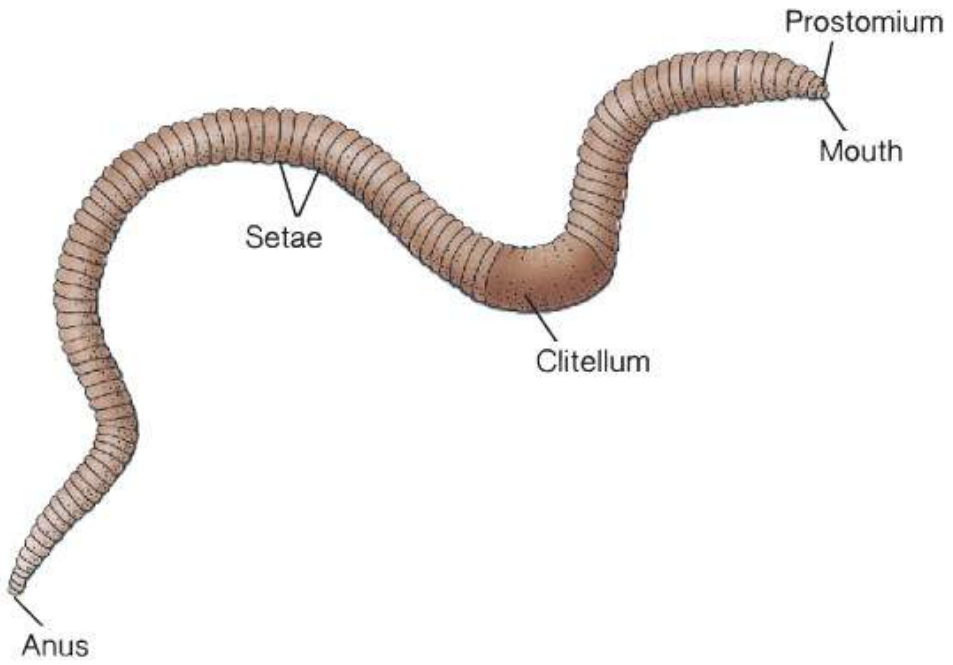
Reproductive system

- *lumbricus* is hermaphroditic, the fertilization is internal, **the male reproductive system** with two pairs of testes at the segment 11. The testes are in a pair of seminal capsules to which three pairs of seminal. Vesicles are attached a pair of genital pore are opened at segment 15.



Female reproductive system with a pair of ovaries at the segment 13 which are opened at segment 14 with, one pore. *Lumbricus* has a **clitellum** which is a group of segments swollen and glandular, secrets a cocoon as a part of the process of reproduction. The fertilized eggs laid in a cocoon in the soil and hutch into a small worm.

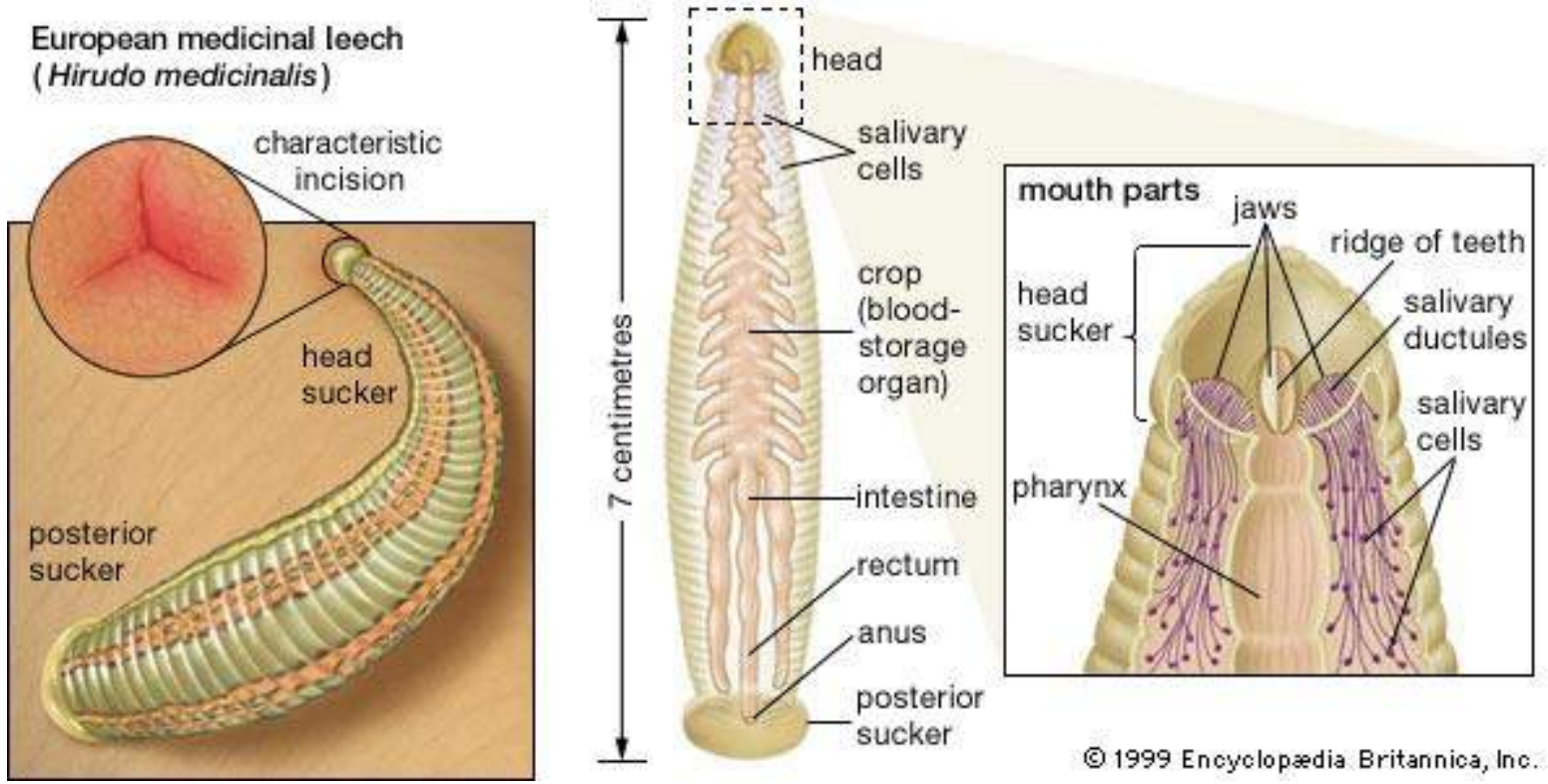




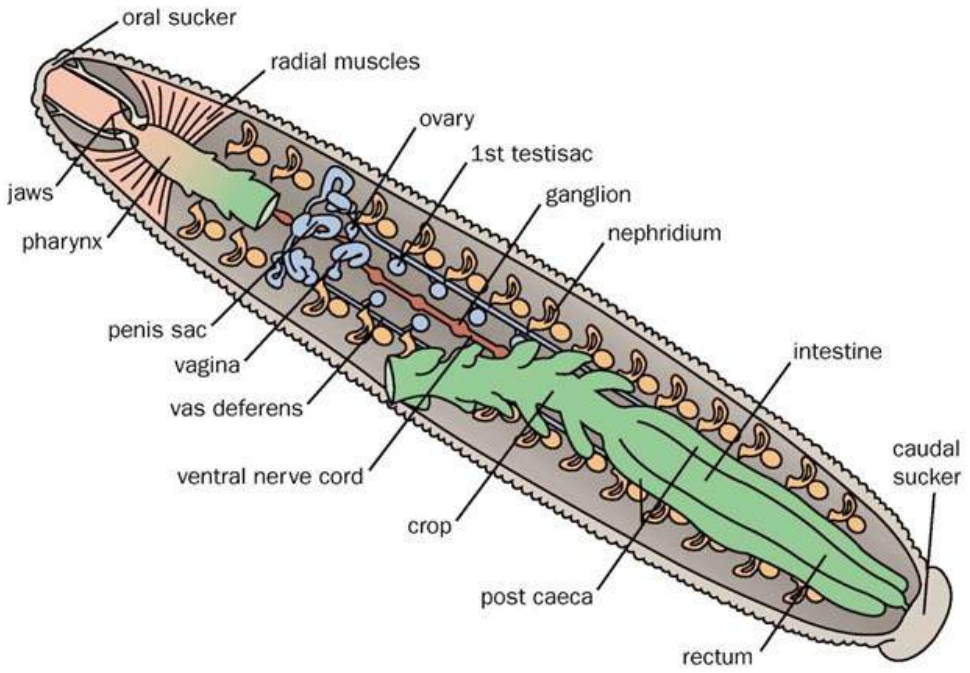
Hirudo medicinalis

The common name is leeches, they are found in the fresh water as external parasites on the fishes frogs and other aquatic vertebrates. With dorsoventrally flattened body, consists of 34 segments subdivided externally

they have a sucker at the head (anterior sucker) arid another larger sucker at the posterior and (posterior sucker) for attachment on the host. The mouth with three jaws in its cavity; which are used to cut through the skin of the host. Salivary glands are found in the pharyngeal wall, secrets an antigoagulant enzymes (Hyrodin).



The digestive tract with large crop. *Hyrodina* is hermaphroditic species, the gonads with one pair of ovaries and 9 pairs of testes located in segments 12-20. The ovaries and their pores are in segment 11. It has a clitellum in the anterior half of the body. The reproductive system of leeches are similar to that of oligochaentas (*lumbricus*) with the following differences:



1. Maturation of sperm is completed in the testes.
2. Seminal receptacles is lacking.
3. The ducts meet on the mid ventral surface at single pore for male and female system.

Fertilization are internal the cocoon which is produced by the clitellum receives the fertilized eggs when they are laid, then hutched in to a small leech.

Phylum: Arthropoda

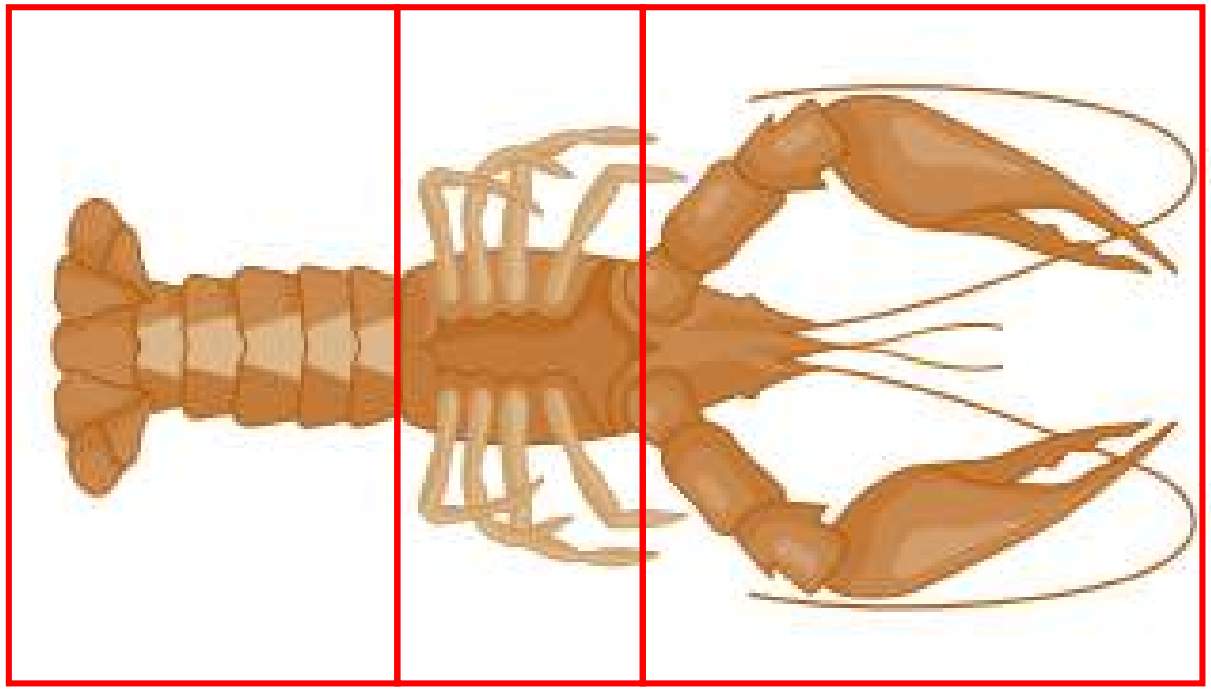
Arthropods compose more than 75% of all animal species on earth.

Arthropods, like annelids, the body is consists of segments but some segments are **fused** or **modified** for certain specialization, this is called tagmatization.

tagmatization (tagmah-ti-zashun) The specialization of body regions of a metameric animal for specific functions.

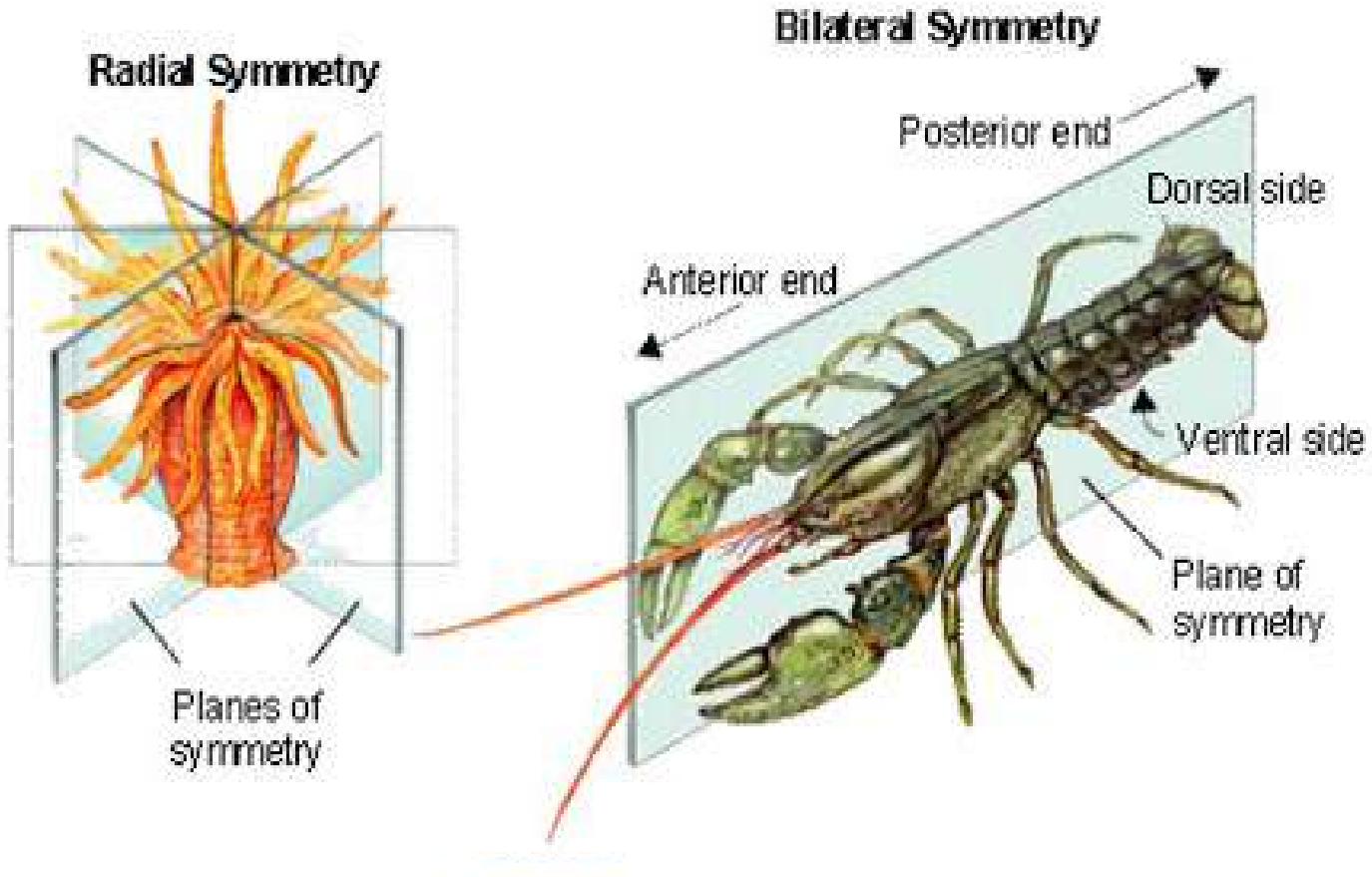
The head of an arthropod is specialized for feeding and sensory functions, the thorax is specialized for locomotion,

and the abdomen is specialized for visceral functions.



General characteristics:

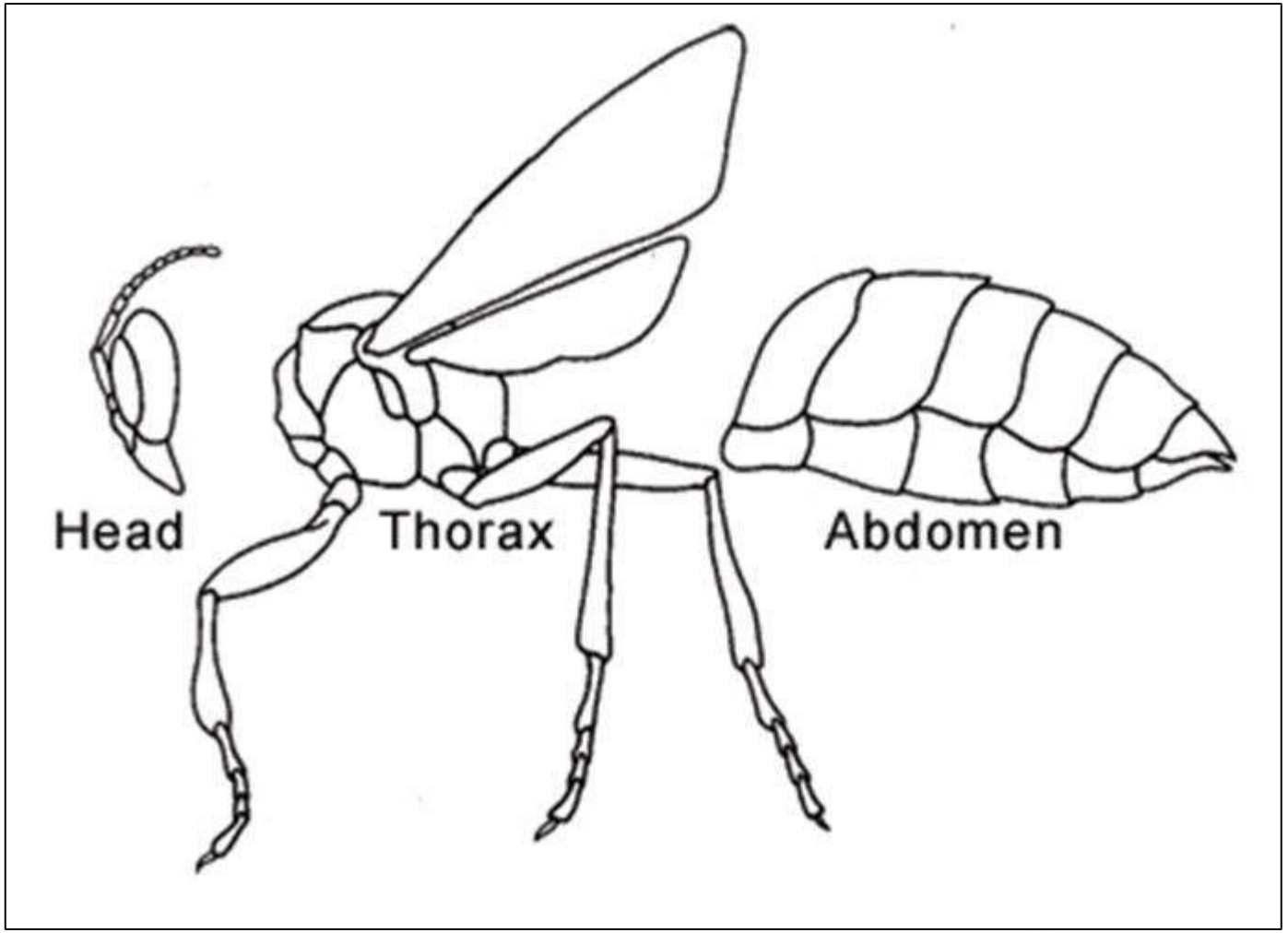
1. Bilateral symmetrical but few have radial symmetry .



2. Hard exoskeleton of chitin consists of hardened chitin and proteins in several layers secreted by epidermis excellent for protection and waterproof. The skeleton contains various folds, flaps and spines, some parts are modified for feeding, respiration, swimming, mating and/or sensory organs.

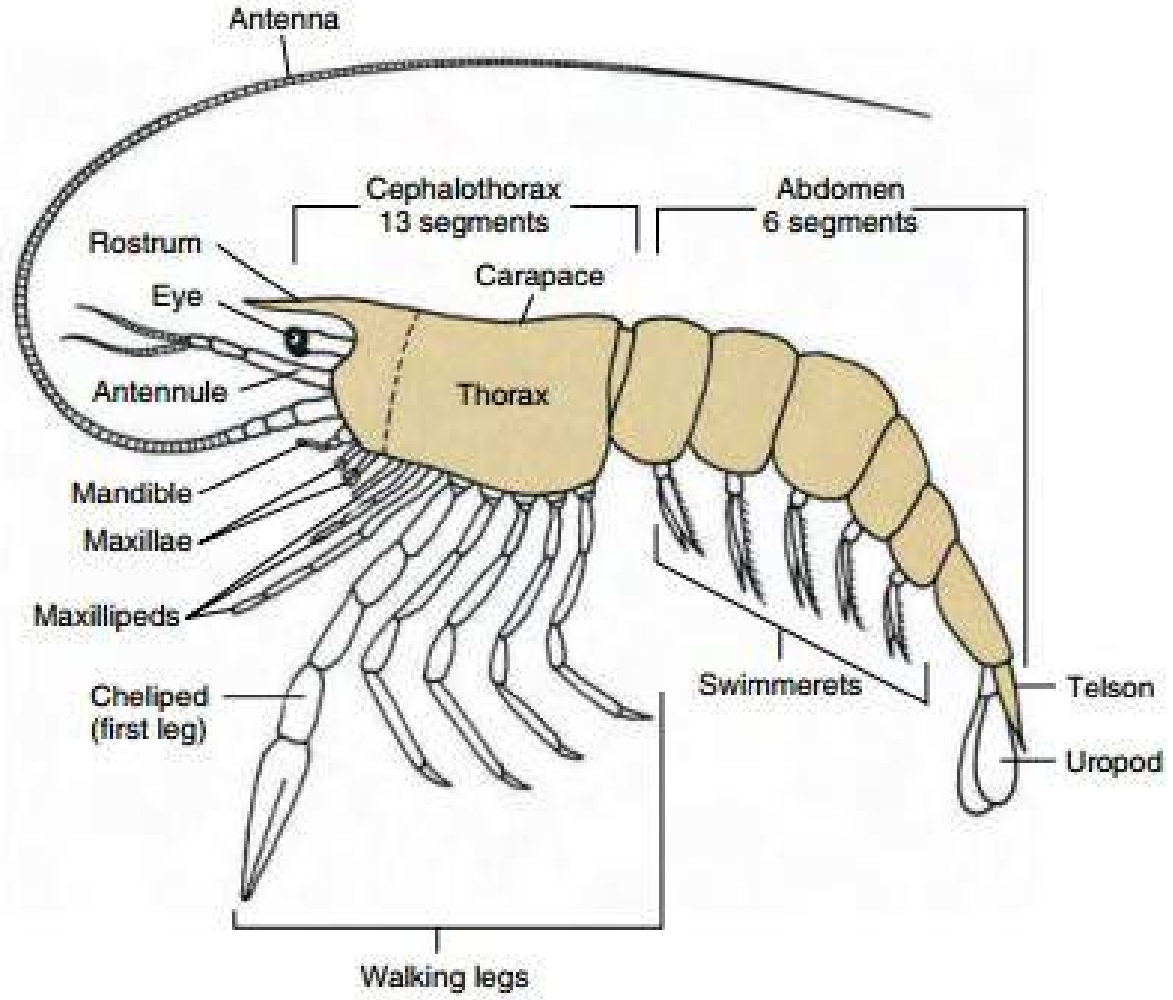
3. Segmented body allows infinite possibilities for adaptive modifications, lots of fusion of segments into a variety of body forms: (types of tagmatization in arthropods)

- Cephalothorax & abdomen
- Head & trunk
- Head - thorax – abdomen



4. **Jointed appendages** that give arthropods generalized appendages which were modified into many specialized organs for walking, grasping, and eating.

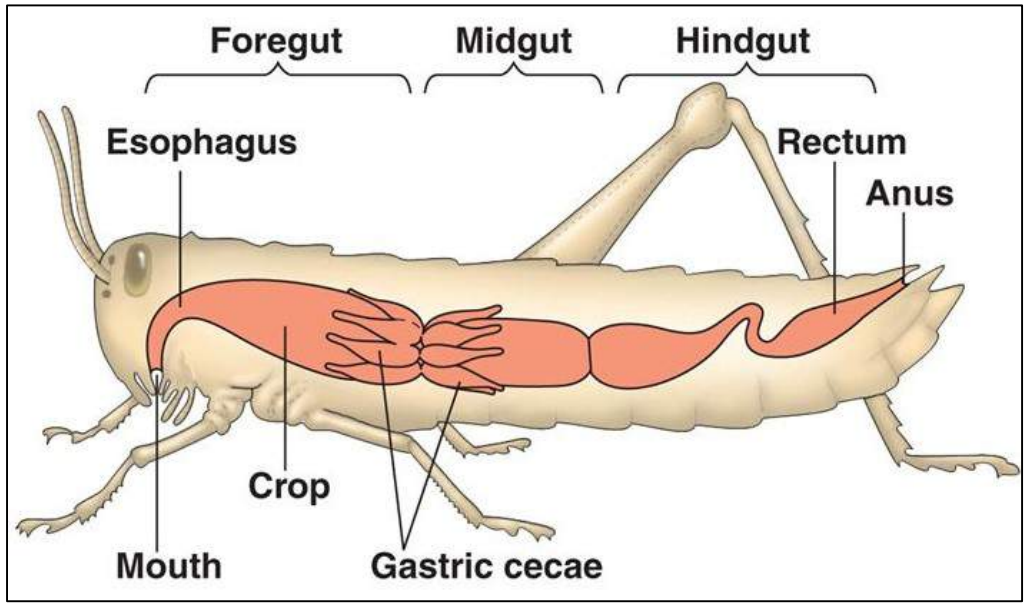
5. Cephalization (well-developed head): with many sense organs, antennae and compound eyes are characteristic sense organs of arthropods.



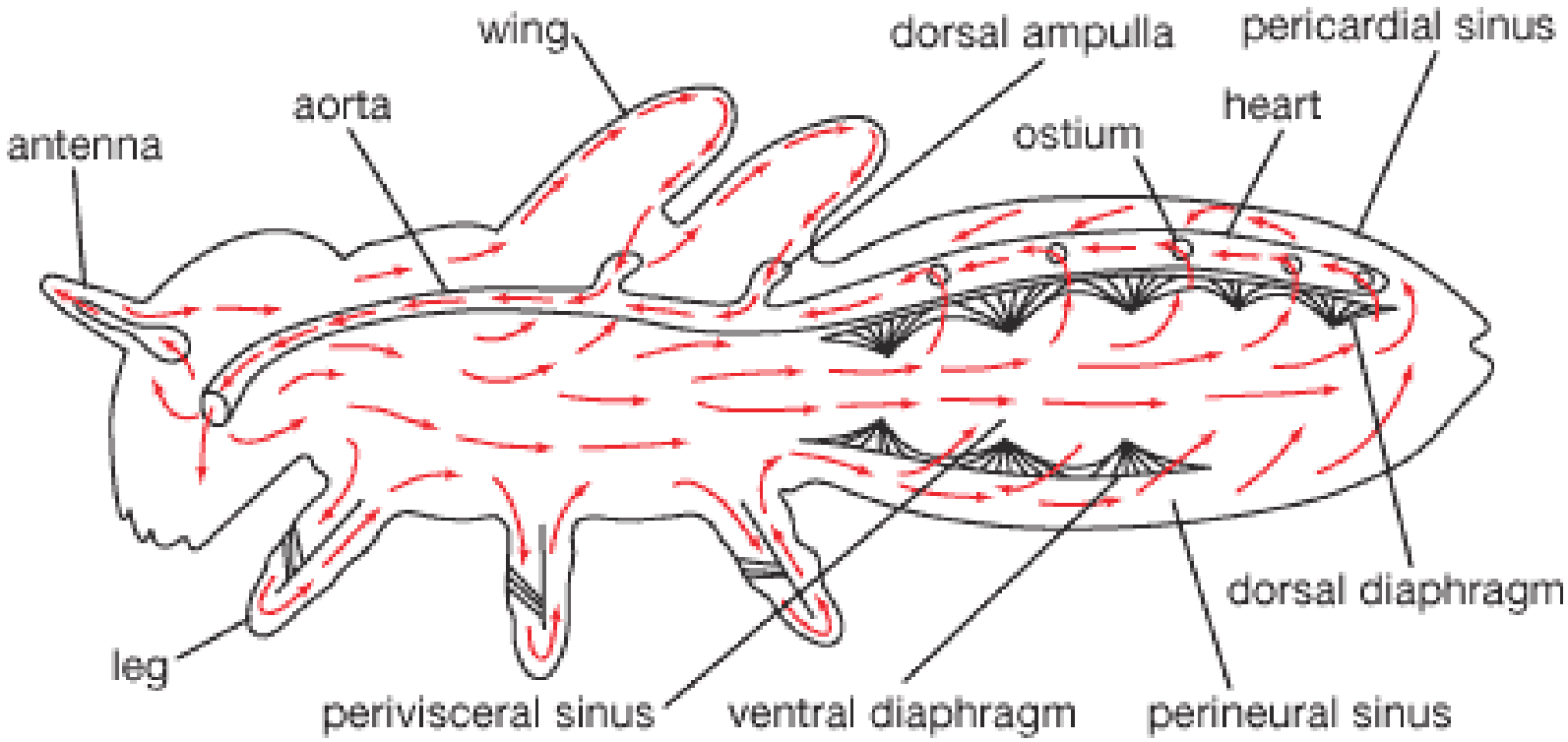
6. **Complex muscular system**: layers of muscles around internal organs both striated and smooth muscle fibers muscle bundles to move skeleton.

7. **Coelom** is reduced as hemocoel in body cavity, so it is more important for circulation than movement.

8. **Complete digestive system**: many feeding appendages to get food into mouth with specialized areas for grinding and storing food and accessory glands-that secrete enzymes.

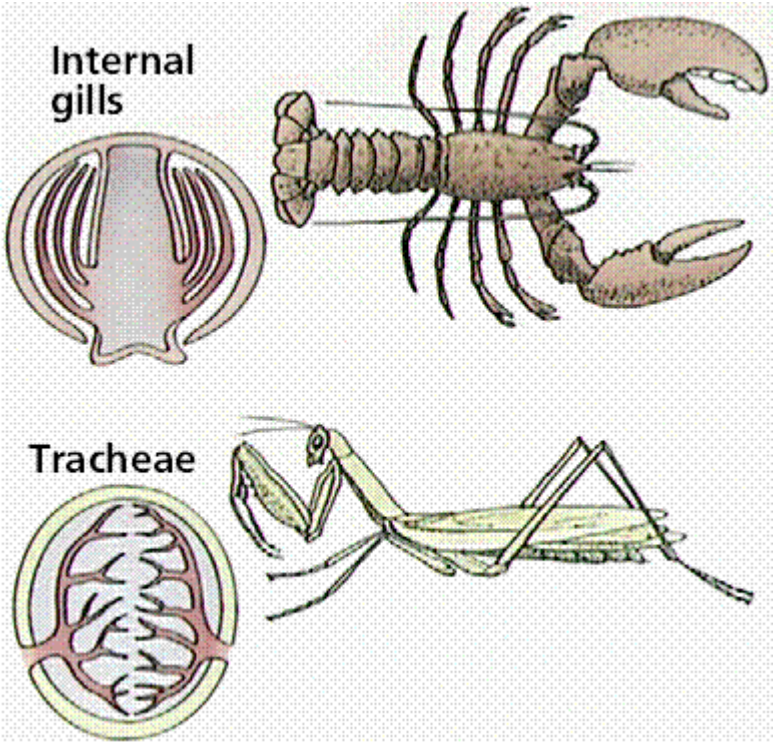


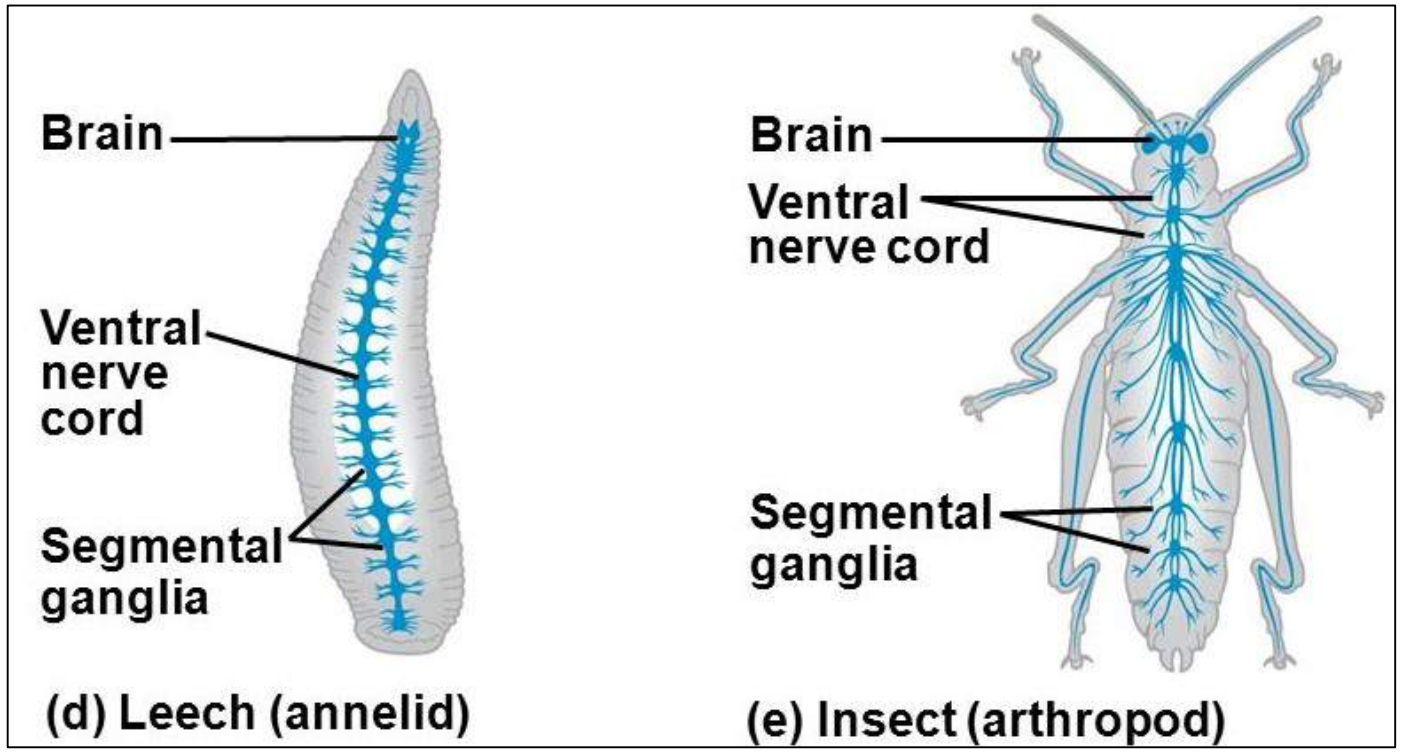
9. Open circulatory system: dorsal (upper) vessel directs blood forward toward the brain; an open system allows the blood to circulate back through the body (beating heart).



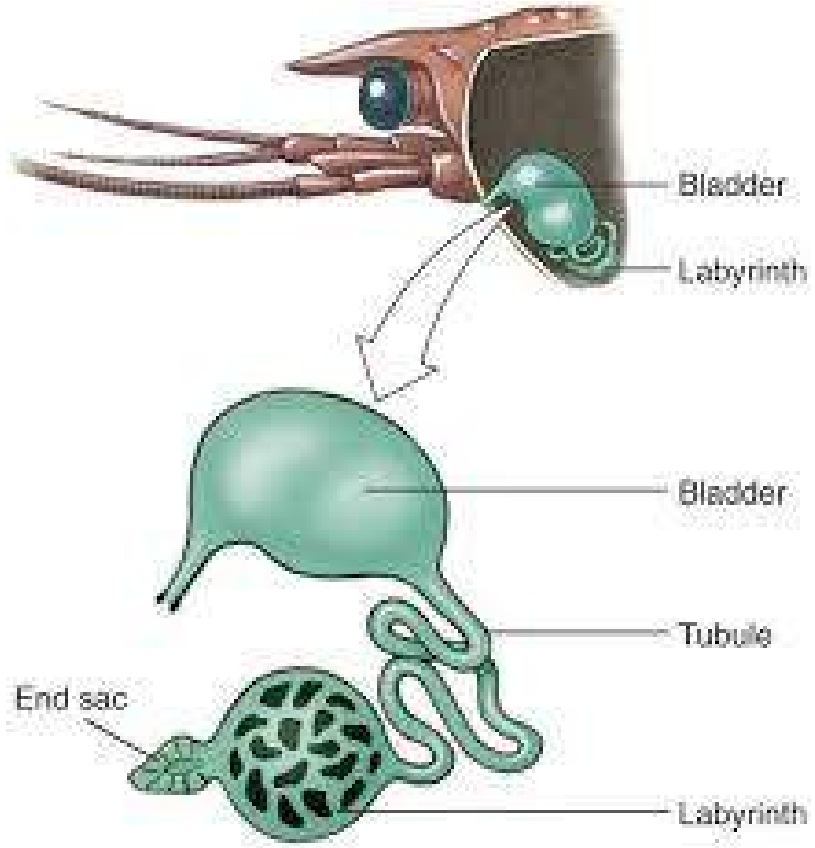
10. Well-developed respiratory system: Many different kinds depending on habitat such as: gills, book gills, lungs, book lungs or tracheae.

11- Nervous system: similar to annelids in which dorsal brain and double nerve cord with paired ganglia in each segment.





12. Efficient excretory system prevents excessive water loss in land (green or coxal gland).



Classification of Arthropods:

There are 6 classes, more than 95% belong to the three classes Insecta, Arachnida and Crustacea.

Arthropods are typically classified into five subphyla, of which one is extinct:

1. **Trilobites**
2. **Chelicerates**
3. **Myriapods**
4. **Crustaceans**
5. **Hexapods**

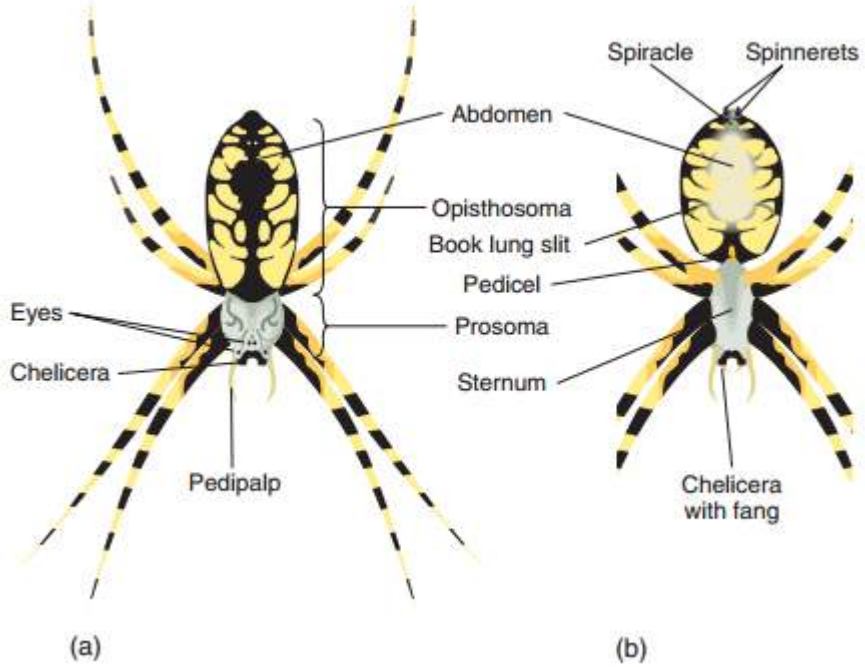
1. Subphylum: Trilobites

(meaning three lobes) are a group of formerly numerous marine animals that disappeared in the Permian–Triassic extinction event, though they were in decline prior to this killing blow, having been reduced to one order in the Late Devonian extinction.

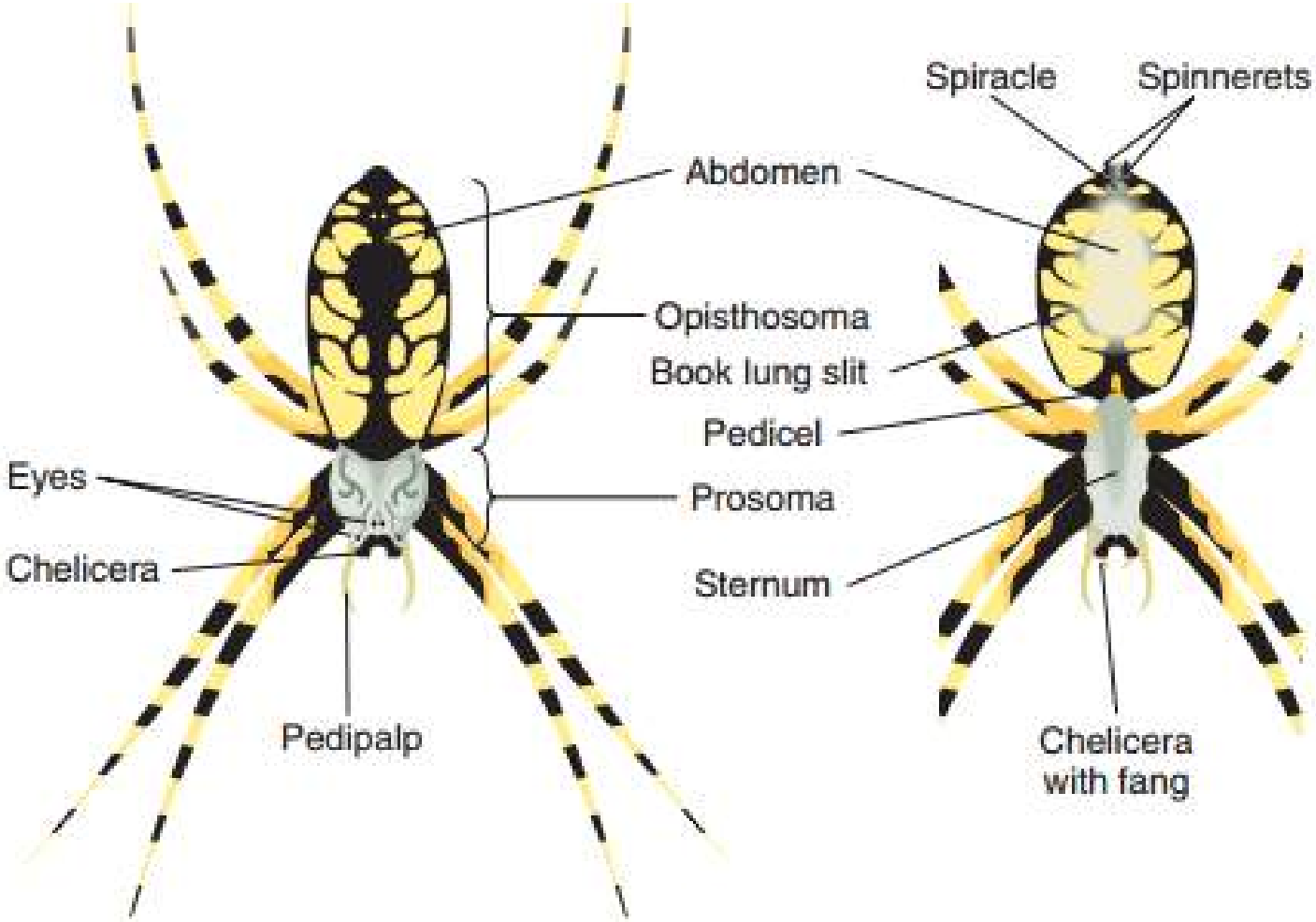
2. Subphylum: Chelicerates

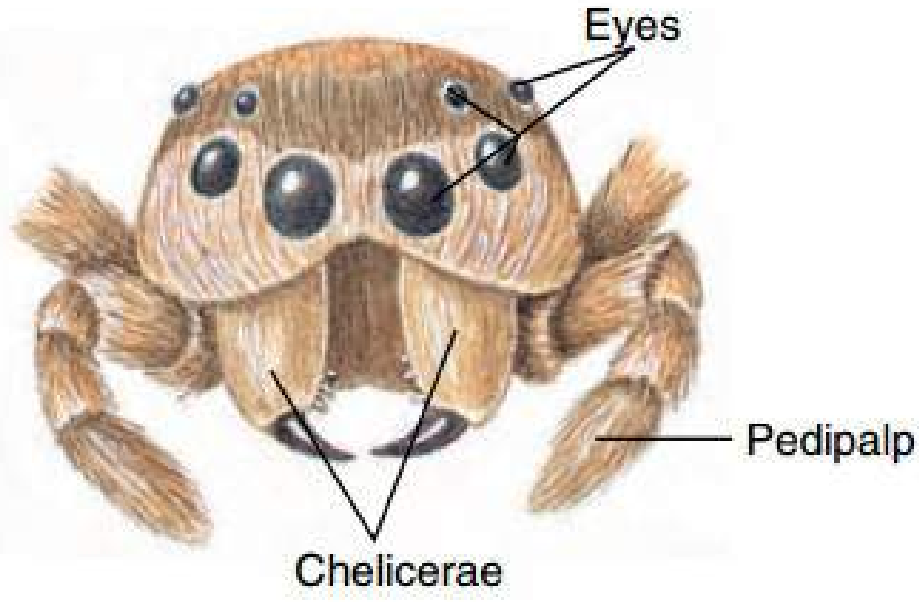
a. Class Arachnids:

All arachnids have eight legs, although the front pair of legs in some species has converted to a sensory function, while in other species, different appendages can grow large enough to take on the appearance of extra pairs of legs. The term is derived from the Greek word (aráchnē), meaning spider. Spiders are the largest order in the class.



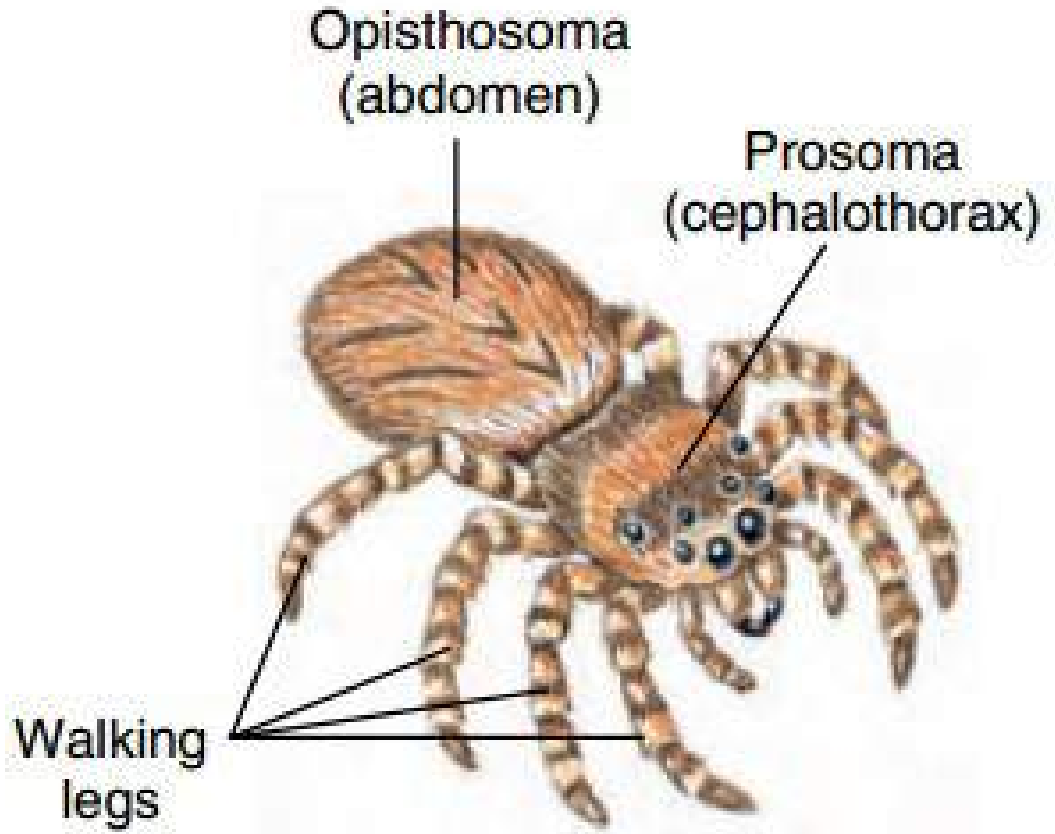
Appendages: the first pair, the chelicerae, serve in feeding and defense. The next pair of appendages, the pedipalps, have been adapted for feeding, locomotion, and/or reproductive functions.





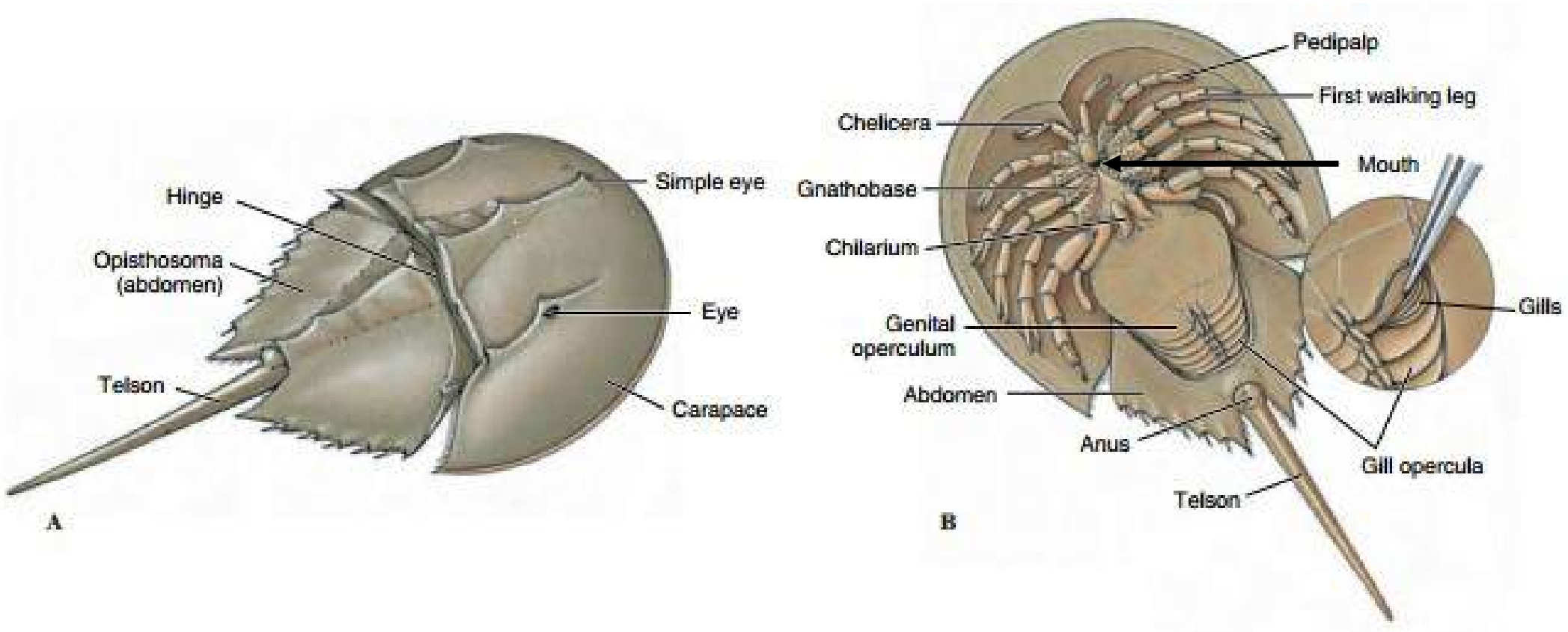
Arachnids are further distinguished from insects by the fact they do not have antennae or wings. Their body is organized into two tagmata, called the prosoma, or cephalothorax, and the opisthosoma, or abdomen.

The cephalothorax is derived from the fusion of the cephalon (head) and the thorax, and is usually covered by a single, unsegmented **carapace**.

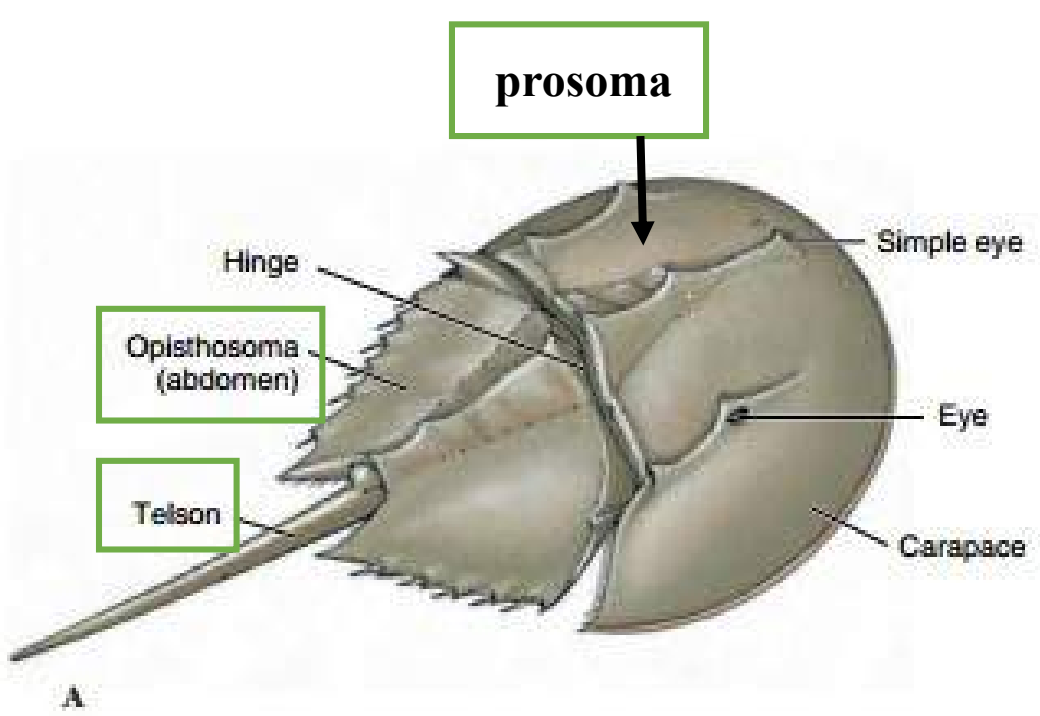


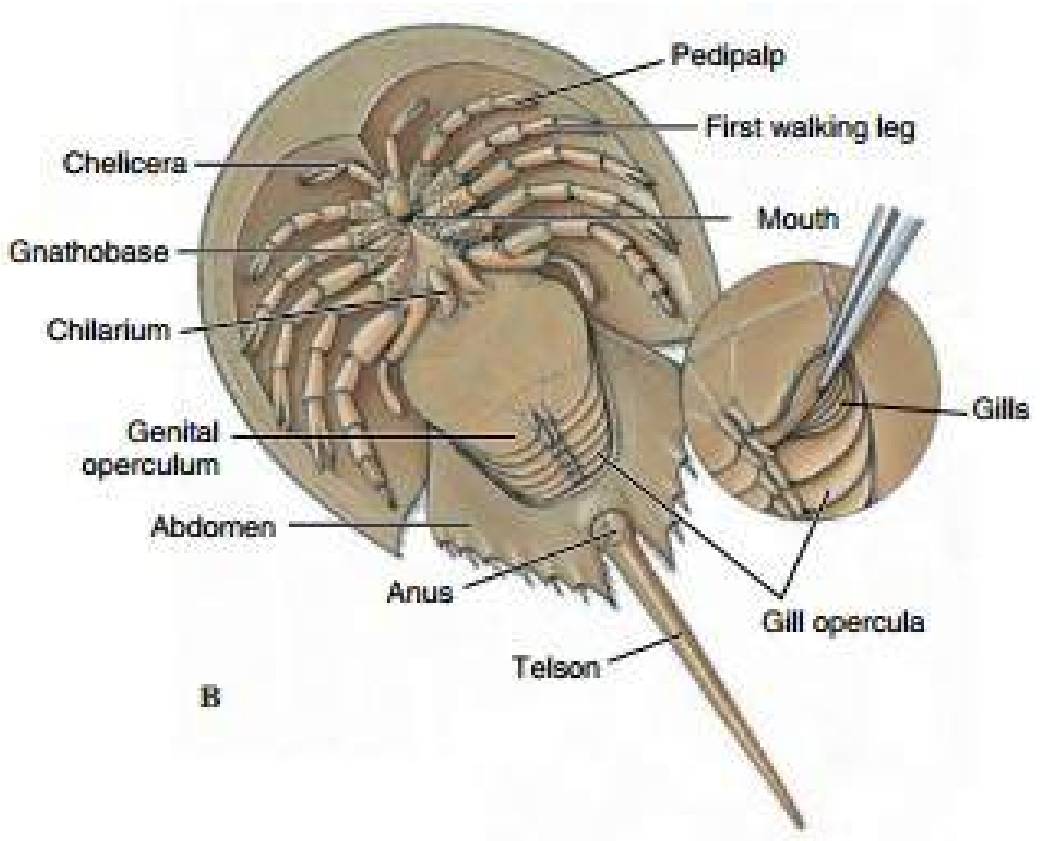
b. Class Merostomata:

The name "Merostomata" derives from the Greek roots (meros, "thigh") and (stoma, "mouth"), in reference to the animals' possession of appendages which are mouthparts at their proximal end, but swimming legs at their distal end.



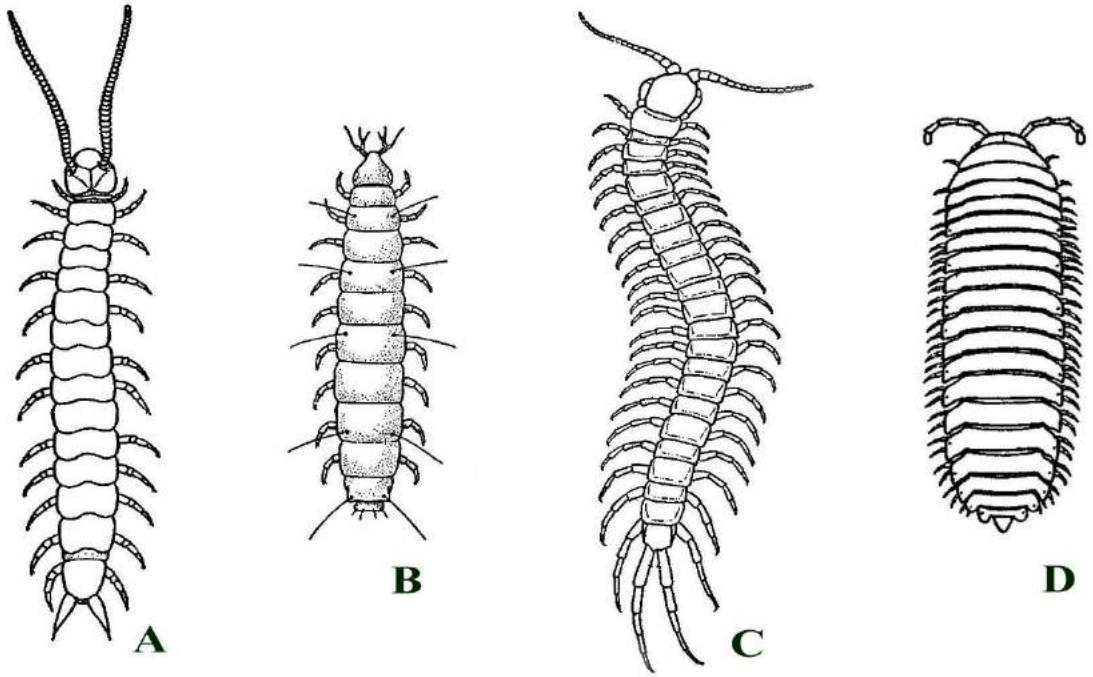
Six pairs of appendages on the ventral side of the prosoma, the first one is a pair of small chelicera for feeding, then 5 pairs of walking legs, so the pedipalps are modified into walking legs in female and into grasping appendages in male which help the male in mating.





3. Subphylum Myriapods

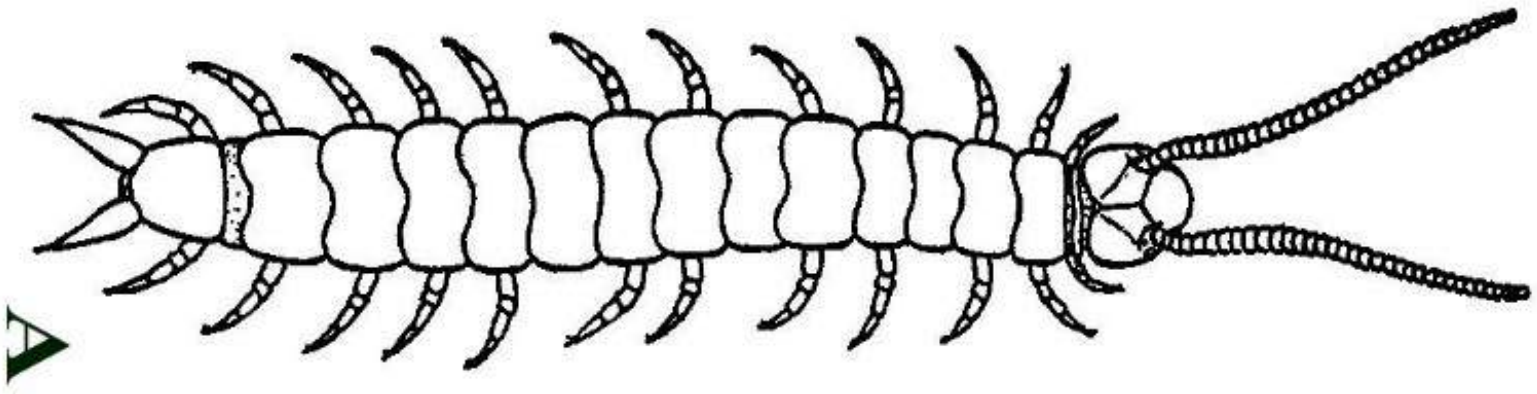
Myriapods have a single pair of antennae and, in most cases, simple eyes. The mouthparts lie on the underside of the head. A pair of mandibles lie inside the mouth. Myriapods breathe through spiracles that connect to a tracheal system similar to that of insects.



a. Chilopoda

Centipedes (from Latin centi "hundred", and *pedis*, *"foot"*). They are elongated with one pair of legs per body segment. Centipedes are known to be highly venomous, they have a varying number of legs, ranging from 30 to 354.

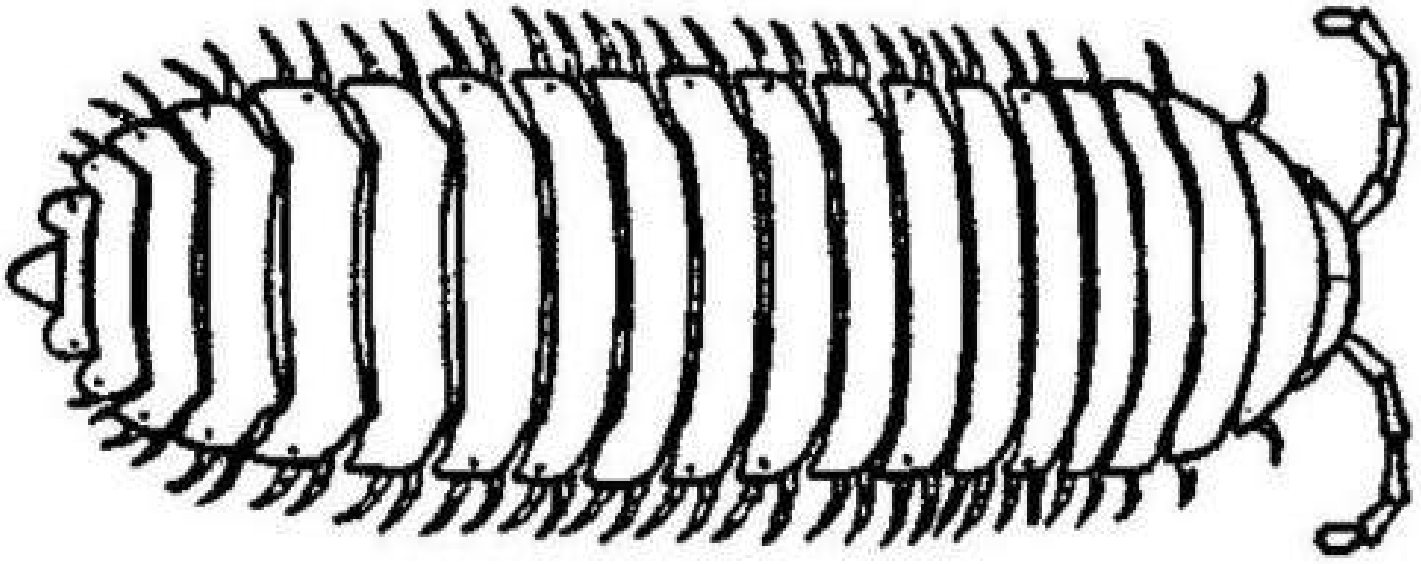
EX: *Scolopendra*



b. Diplopoda

Millipede" derives from the Latin for "thousand feet" characterized by having two pairs of jointed legs on most body segments. The name being derived from this feature. Each double-legged segment is a result of two single segments fused together.

EX: *Julus*



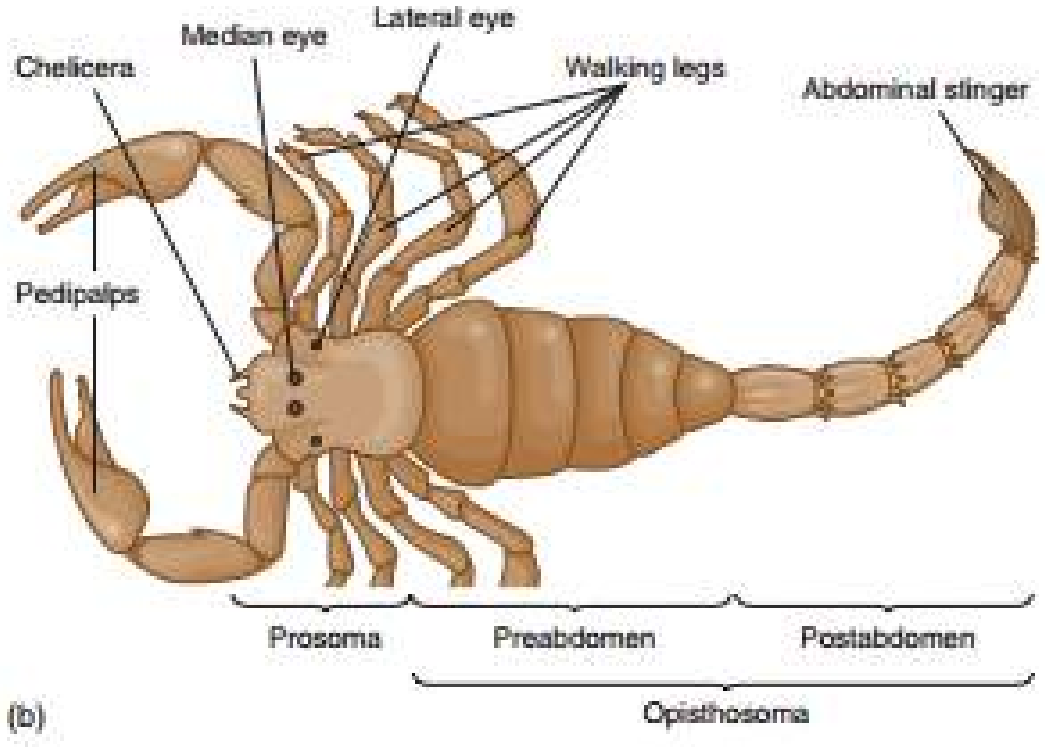
4. Subphylum: Crustaceans

Very large group of arthropods which includes such familiar animals as crabs, lobsters, crayfish, shrimp.

The body of a crustacean is composed of segments, which are grouped into three regions: the cephalon or head, the thorax, and the pleon or abdomen.

The head and thorax may be fused together to form a cephalothorax,which may be covered by a single large carapace.

The crustacean body is protected by the hard exoskeleton, which must be moulted for the animal to grow.



Ex: Lobster

They have long bodies with muscular tails, three of their five pairs of legs have claws, including the first pair, which are usually much larger than the others. Highly prized as seafood,

5. Subphylum: Hexapods

The subphylum **Hexapoda** (from the Greek Hexa six Poda legs) constitutes the largest number of species of arthropods and includes the insects.

Hexapods have bodies divided into an anterior head, thorax, and posterior abdomen. In most insects the second and third thoracic segments also support wings.

The abdomen consists of eleven segments in all true insect.

The appendages on the abdomen are extremely reduced, restricted to the external genitalia and sometimes a pair of sensory cerci on the last segment.