جامعة جنوب الوادي

كلية التربية

ZOOLOGY 2 (INVERTEBRATES)

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Theoretical Part

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Contents

PRINCIPLES OF SYSTEMATIC ZOOLOGY

The number of animals inhabiting the earth today is more than one million. Since it is impossible for man to keep in mind separately all the million of animals which exist. He must of necessity arrange them into groups. This arrangement is created the origin of classification or taxonomy or systematic. In such a system animals with several similar characters are placed together in the same group. Members of a group will show marked similarities and many features common with other members of their own group. So, the branch of zoology for grouping or classification of animals on scientific bases is called taxonomy or systematic zoology. Taxonomy is a man-made system for orderly storage and retrieval of things or bits of information about them. As we said before the different kinds of organism run into millions, so we can refer to them each has a name and place in a classificatory system which shows its relationship with other organism.

The terminology of classification is part of the language of the science of biology. Its importance increases as the subject expands into new fields of knowledge such as ecology, when the recognition of different kinds of organism and the interaction between them forms a significant part before we going further we have to know what is the meaning by these terms systematic, classification, taxonomy and nomenclature.

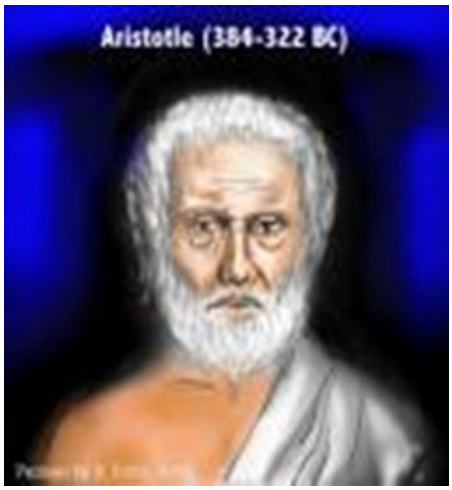
A- Systematic: Is the scientific study of the kinds, diversity of organisms and all relationships among them. The term was originally stemmed from the Greek word systema.

B- Zoological classification: is the ordering of animals into groups (or sets) on the bases of their relationships of association by similarity.

C- Taxonomy: The term was derived from the Greek word taxis. Meaning arrangement and Nomo's meaning low. So, taxonomy is the theoretical study of classification, including its bases, principles, procedures and rules.

D- Zoological nomenclature: Is the application of distinctive to each of the groups recognized in any given zoological classification. Thus nomenclature is an essential or secondary outcome of classification.

HISTORY OF SCIENTIFIC TAXONOMY



The history of classification goes back to **early man**, who distinguished one group and another by purely personal and practical criteria. For example, he would think of plant as harmful or harmless, edible or inedible, and some what the same standards would be used in classification of animals. We still talk of weeds, flowers, fruits and vegetables, and if they are herbivores and carnivores.

One of the first persons collected and organized animals classification system was the **Greek philosopher Aristotle (384-322),** who characterized animals according to their way of living, their actions, their habitats and their body parts. He classified about 500 types of animals in 11 categories according to their structure from and their degree of development at birth. He arranged the animals world in a hierachy a graded series in which he remarked different categories one above the other.

John Ray (1627- 1705):-

(born Nov. 29, 1627, Black Notley, Essex, Eng.—died Jan. 17, 1705, Black Notley), leading 17th-century English naturalist and botanist who contributed significantly to progress in taxonomy. His enduring legacy to botany was the establishment of species as the ultimate unit of taxonomy.

He classified some of 18,600 species of plants according to general differences in anatomical organization. He did the same for animals and arranged them in six classes: quadrupeds, birds, amphibians, fishes, insects and worms. He published important works on botany, zoology and natural theology. He classified plants according to similarities and differences that

emerged from observation. He was among the first to attempt a biological definition for the concept of **Species**.

Robert C. Hooke (1635-1703):-

He was 26 years old when he took the assignment from Wren and joined the Royal Society for Scientists. Hooke a taught himself technical drawing, a skill he used to capture observations through his microscope.

Hooke applied his technical abilities to invent ways of controlling the height and angle of microscopes, as well as mechanisms of illumination. Variations in light allowed Hooke to see new detail, and he used multiple sources of illumination before producing any single drawing. Hooke's technical efforts created magnifications of 50x, enabling insight to a world not yet known in the 1600s.1

When Hooke viewed a thin cutting of cork he discovered empty spaces contained by walls, and termed them pores, or cells. The term cells stuck and Hooke gained credit for discovering the building blocks of all life. Hooke calculated the number of cells in a cubic inch to be 1,259,712,000, and while he couldn't grasp the full effect of his discovery, he did at least appreciate the sheer number of these cells.

Carlos Linnaeus (1707 – 1778):-

(born May 23, 1707, Råshult, Småland, Sweden—died January 10, 1778, Uppsala), Swedish naturalist and explorer who was the first to frame principles for defining natural genera and species of organisms and to create a uniform system for naming them (binomial nomenclature).

Carl Linnaeus, also known as or Carolus Linnaeus, is often called the Father of Taxonomy. His system for naming, ranking, and classifying organisms is still in wide use today (with many changes). His ideas on classification have influenced generations of biologists during and after his

own lifetime, even those opposed to the philosophical and theological roots of his work.

NAMING ANIMALS (NOMENCLATURE)

Any system of classification demands a method of naming. Any method of naming things is arbitrary, though in biology many of the names refer to some characteristic or property of the organism. The scheme which is universally adopted is the binomial system, devised by Linnaeus and used in his book *Systema Naturae*, which was written in Latin, 1758 (10^{th} edition). Since this was the international language for communication between scholars. Biological classification as we use it today dates from the 18^{th} centuries and is based on the binominal system, a standard method for naming plants and animals. Under the binomial system, each species: plant or animal has two names.

The first is the generic name which indicates the genus to which it belongs and always written was a capital letter as a Latin.

Care should be taken to see that the generic name is used correctly. When it used as a common name or it should be written with a small letter.

The second is the trival name often called the specific name which designating the species which the organism belongs. It is not capitalized and is treated as Latin noun in apposition with the generic name thus-marina. The name of the species therefore is the binominal, in this case Arenicola marina. Generic and specific names are normally printed in italics, expect as the title of a paragraph or a list.

Linnaeus and nomenclature:-

Although lists of names in binary from appeared more than once in 15^{th} Century manuscripts and were more extensevely used by Gaspard Bauhin at the end of 16^{th} century and then by Joachim Jug a little later , it was Karl

Linnaeus who established the system . Linnaeus was Swedish biologist who set him self the task of recording the animals and plants as God had created them. He produced classified lists of names, many of which were binary, gave a bird description of the plants and animals and arranged the according to a variety of characters which seemed to him to be important. The first was species planetarium published in 1753 and containing binary names for over 7000 plants.

For the animals Linnaeus achieved similar uniformity in the 10^{th} edition of his *systema Nature* in 1758. These works now constitute the origins of modern botanical and zoological nomenclature and names given before these dates are considered invalid. Although the same name cannot be used for two different animals, it can be used for a plant and an animal that is the name for a plant can not preoccupy that for an animal. For example Bougainvillea applies both to a tropical shrup and to a colonial hydrozoan. So, Linnaeus successfully formulated a system of classification of living organisms depending on superficial resemblances in structure, colour, habit (aquatic-terrestrial) diet (carnivores-herbivores-omnivores) etc.

The Linnaean hierarchy:-

In addition to introducing the binomial system, Linnaeus subdivided the plant and animal kingdoms into groups or taxa. In the 1^{st} edition of the systema Naturae the natural world of plants and animals, is divided into a decending sequence of categories as follows:

Empire

Kingdom

Class

Order

Genus

Species

Variety

The animals known to Linnaeus were thus arranged in a single schema from man to warm. The names given to the groups were all Latinized, those in the categories above the genus, unlike generic and sub generic names, being treated as plurals. Empire and variety are no longer recognised as legitimate terms in formal classification although verietal names are sometimes used informally. Later workers increased the number of categories by adding the phylum and family. The Linnaeus hierachy has thus been modified to give the following seven obligatory categories into which in modern taxonomic practice all animals must be classified.

Kingdom

Phylum

Class

Order

Family

Genus

Species

These are sufficient for a relatively small group of animals, but some such as the arthropods, are so numerous and diverse that five categories below phylum level results in groups that are still too large and heterogeneous for convenient systematic handling. In this case the number of categories can be increased by using the prefixe super- , sup- , and infra- while other categories , not obligatory , for example , division , cohort , trible , may also be employed .

UNITS OF CLASSIFICATION:-

The basic unit of classification is the species. It adopted by Linnaeus and it has been used ever since. A species has never been defined to the satisfaction of all biologists, but when applied to group of organisms, it indicates that they have certain common characteristics. An attempt to define a species has been made as follows:

1- A species is a group of organisms which do not differ from one another more than the offspring of a single pair may do.

2- Gradations from one species to a closely related one, do not occur. There are no intermediate forms, but sharp and distinct differences between each species and any other.

3- Members of a species can interbreed freely with one another, but not usually with members of another species; if they do, the hybrid off spring are infertile.

4- Usually, the geographical locations inhabited by a particular species, are distinct from those inhabited by most nearly related species.

It must be pointed out that there are exceptions to each of above. Thus, there is no clear definition which will suit all cases. Perhaps, the commonest method of distinction is the non-interbreeding characteristic.

From the species, we group organisms in upward manner as previous description, a group of species which are closely related from a genus, and genera are further grouped into a family. Families with closed relationship are placed in the same order and orders into a class. Similar classes are placed in the same phylum, and phyla into a kingdom. Each higher category includes wider range of species. Where necessary, subgroupings are made. The introduction of sub- and super- categories appears to be almost a personal matter and many taxonomists have used them according to their private

opinion. In some cases, this has led to considerable confusion which has been increased by the use of grade, branch divisor etc.

It would perhaps be advisable for the students at this level to concentrate on the essential sever categories: kingdom, phylum, class, order, Genus, Species. The full classification as follows:

Kingdom
Subkingdom
Branch
Grade
Divisin
Subdiovision
Superphylum
Phylum
Subphylum
Superclass
Class
Subclass
Intraclass
Suberorder
Order
Suborder
Section
Superfamily
Family (idea)
Subfamily (inae)
Tribe (ini)
Supergenus
Genus
Subgenus
Superspecies
Species
Variety

TAXONOMIC TYPES

There are two types of taxonomy: artificial and natural.

1- The artificial classification:-

At which animals are grouped according to:-

A- Their place of living (Aquatic or terrestial)

B- Type of feeding (Herbivorous, carnivorous, omnivorous)

C- Area of living (hot, cold, icy) etc …

2- Natural taxonomy and taxonomic methods:

While the natural classification at which animals are grouped depending on the degree of relationships among the individual of each group The earliest efforts at natural classification were based on three lines of investigation, comparative morphology, comparative anatomy and paleontology. These are now supplemented by comparative physiology, cytology and genetics, serology, ecology, embryology, and geography.

In both animals and plants, morphology and anatomy are the most widely used instruments of classification. By their use, majority of cases, newly discovered forms can be quickly allocated to their respective categories. In lower organisms, such as bacteria and fungi however, similar appearance may be deceptive, since there may be wide physiological differences.

Two sorts of bacteria which look similar may cause quite different diseases. There is need for the newer methods in these lower groups. Paleontology therefore has been of great value, especially where sufficient fossils have been discovered to provide a chronological record of the evolution of a particular group.

There are many cases where fossil discoveries have confirmed classification based on morphology of present forms. Though the fossil record is but fragmentary, new finds will continue to fill in the present

"missing links. Cytology, by microscopic examination of cells, is a modern way of supplementing results obtained by the order methods. It is of particular use in the lower groups. Genetics, by chromosome counts and interbreeding techniques, has helped to confirm and even to correct earlier opinions. Embryology in turn, help for revealing of some important characters are not available in the adult stage .e.g. prostomium, and deuterostomium; type of cleabvage (spiral or radial) ,type of gastrulation (invagination, epipoly, etc..), type of larvae etc.….

The importance of taxonomy:

1- Taxonomy provides a useful convenient and universal system into which all observations about an organism or a group of organisms can be compiled.

2- It helps for the exchange of applied informations on a given organism or organisms and this help in the study other branches of biology.

3- Taxonomy provides good discrimination for the organisms introduced from abroad and how to control it from wide spread.

4- Good information about an organism and its relation with other organisms provides useful tool for its biological control.

THE TYPE SYSTEM:

It was Linnaeus practice to select a "typical" specimen of a plant or animal for description and to keep this specimen in his museum as the type or reference specimen. It is therefore to this type that the description refers and not to the species as a whole. In this way there can be no ambiguity arising from variation within the species. This procedure is still followed and type specimen is carefully preserved for the most part in the great museums of the world. But ambiguities arise in other ways. Doubt may exist about who first described a species, or when the same name is used for two different organisms, or the procedure for combining two species, or splitting a third.

Such problem calls for a set of regulations. International rules for zoological nomenclature were prepared in 1931 to clarify the position with an international commission to interpret the "Rules" and to suspend them where a change in nomenclature would result in undue confusion.

DISCRIMINATION BASES OR ANIMAL CLASSIFICATION

The animal kingdom is divided into a number of major subdivision or phyla on the basis of several morphological features which are considered to be fundamental and basic. Some of these characteristics are: Homologous and analogous structure. Type of symmetry, number of germ layers type of digestive system, type of body cavity, fate of the blastopore, body segmentation, skeletal system, larval forms etc …

1-HOMOLOGY AND ANALOGY:

A- Analogous structures:

Are those which perform the same function but they have the same origin and structure. e. g. the wings of birds and insects.

Both of which have the same function of flight but they are different in structure and embryonic origin. e. g. the gills of fishes and gills of crustaceans have the same function for respiration but they are different in origin and structure.

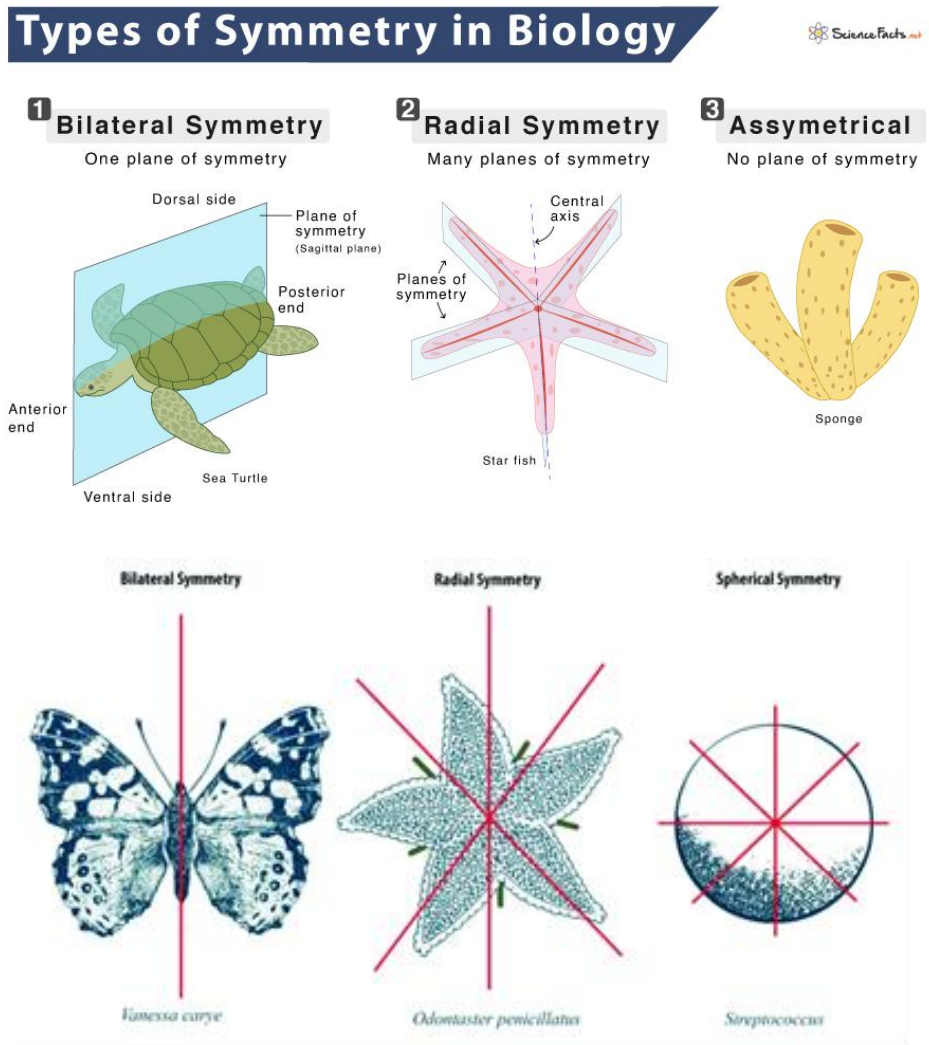
B- Homologous structures: (Opposed to analogous)

These structures are those have the same embryonic origin and basic structures but they may or may not perform the same function. e. g. Wings of birds and bats have the same origin and function. e. g. Wings of birds and human arm have the same origin and structure and they are different in the function. So, Homology is an important basis for covering the evolution

relationships. Analogy reflects similar adaptations by different types of animals.

2- SYMMETRY:

Symmetry refers to the arrangement of parts in relation to planes and centralized axes, the regularity of the form. In a symmetrical animal one or several planes will divide the organism into parts with essentially equivalent geometrical designs. Animals are either symmetrical or asymmetrical.



(A) Asymmetry animals: Amoeba is an asymmetric organism; no plane can divide it into equal parts. Many of Protista and most of porifera are asymmetrical.

(B) Spherical symmetry: It takes the shape of a ball; such a body can be divided into similar halves by a cut through center in any direction. e. g. Volvox.

(C) Radial symmetry: It is cylindrical in form and may be divided into number of similar parts, only around a central longitudinal axis. A longitudinal axis is defined as line segment extending form is pole of an organism to another pole on the opposite end. e .g . Hydra, Jelly fishes, sea Anemones and adult Echinoderms as star fish and sea urichin etc…

(D) Bilateral symmetry: Animals with bilateral symmetry generally, have their main organs arranged in pairs either side of the sagittal axis which passes from the head (anterior end) to the tail (posterior end).

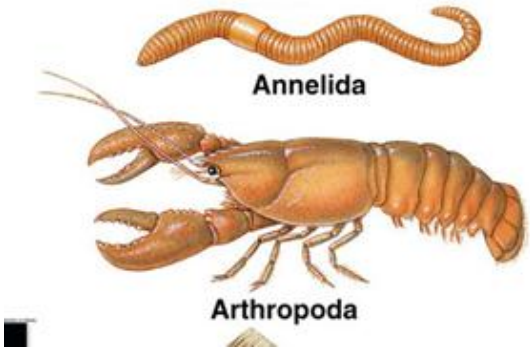
The sagittal axis is the only plane that will divide the body of a bilaterally symmetrical animal into two halves. It can be recognized dorsal, ventral surfaces as will as right and left sides. Bilateral symmetry is characteristic of the most successful animals living at the present time, including all vertebrates and most of invertebrates. It is noticeable that, the perfect symmetry is not to found any where in the animal kingdom. Animals show spherical symmetry only approach to a spherical form. Although the human body is considered a good example for bilateral symmetry, the right and left sides are not identical. The human heart for example, is located to the left of the midline. Never theses, the concept of symmetry is of great importance in the classification. Of animals as will become evident when the different phyla are studied.

Bilateral animals and few other are polar. They have anterior end called oral end and posterior one called aboral end. At the oral end concentrates the nervous tissue within a head. Such a morphological state as known as cephalization and polarity are adaptions for the most efficient means against the environments. The complexity of organism structure and the

concentration of major sense organs and neural materials at the anterior end the organism are obvious in most advanced animals.

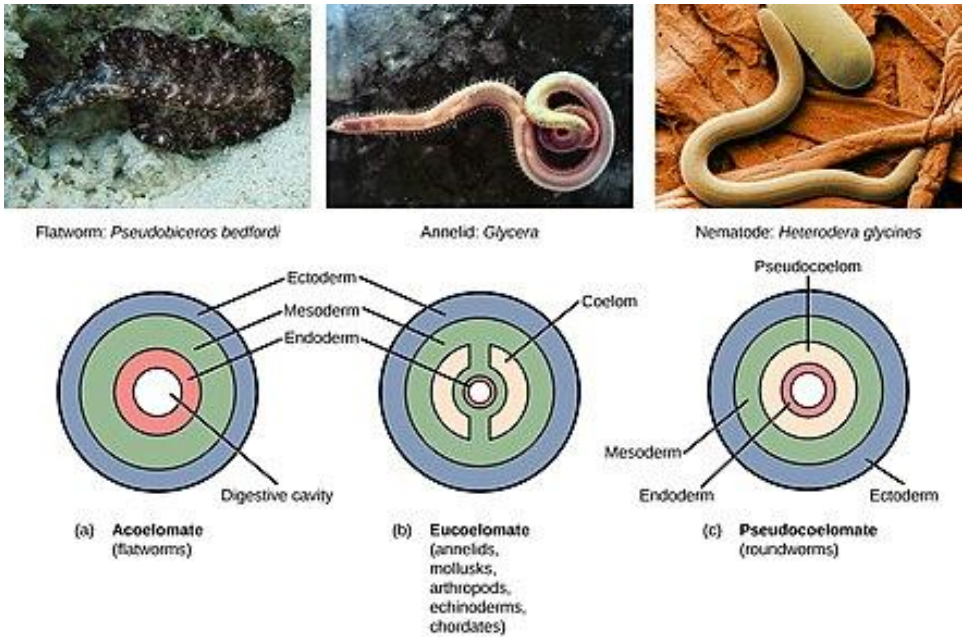
3- METAMERIC:

Metameric animals have bodies composed of more or less similar parts or they have organs in a similar series along the main axis. Each part is called metameric, somite or segment. The earth worm is considered as a good example for metameric animals. Each segment is similar structurlly or functionally and acts as Simi-independent unit. So, earth worm represent Homonymous segmentation. The metameric of arthropods in different regions of the body is dissimilar. So, it called the heteronomous segmentation,



4- INTERNAL BODY CAVITIES (COELOM):-

The presence or absence of coelom in different forms is useful character in taxonomy.



(a) Acoelomate animals (Platyhelminthes) do not have internal body cavity other than the lumen of the digestive canal: the space between their body wall and visceral organs is filled with mesenchyme tissues a type of undifferentiated tissue consisting of scattered cells and extra cellular material.

(b) Pseudo-coelomates (nematodes): pseudocoelom is internal cavity originated from blastocoel of blastula .e.g. nematodes and rotifers.

(c) Coelomates: coelomate forms are those contain a cavity originated within the mesoderm while the blastocoel of blastula will disappeared. Coelom is filled with coelom fluid and acts as internal transport of nutrients, metabolic wastes and respiratory gases. Coelom acts as hydrostatic skeleton, supporting the body and assisting in locomotion.

5- CELL NUMBER:

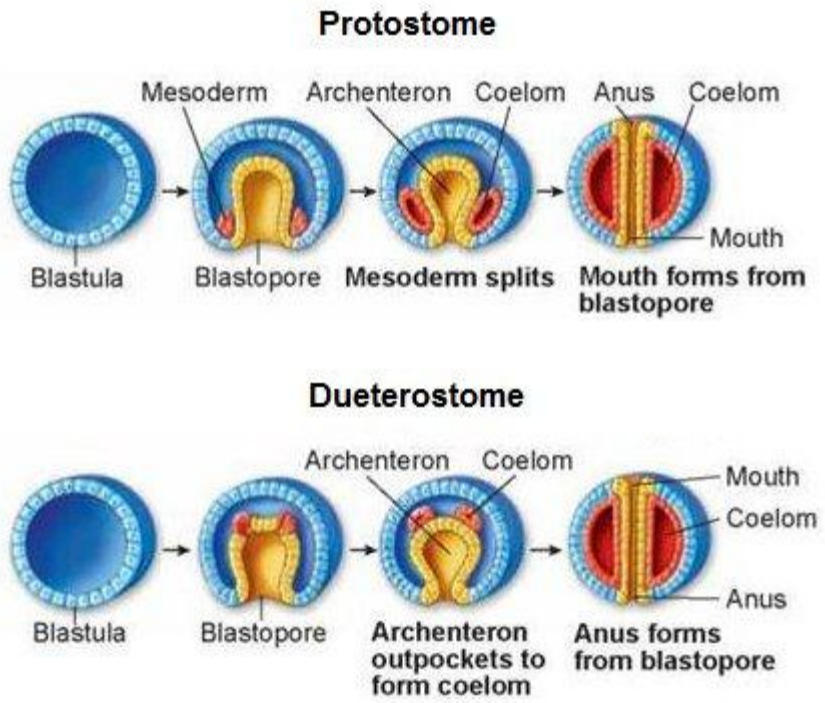
Cell number is a quick indication of gross and similarities or differences. Kingdom Protista (protozoa) are unicellular animals while metazoan are multicellular. Uni and multicellular organisms display other physiological differences in their life processes as excretions respiration.

6- THE DIGESTIVE CAVITY:

The digestive system is several forms gives indication of taxonomic characters. Parazoa (porifera) has no digestive cavity at all .acoelomates have digestive cavitvwith out anus (only moth) e.g. *Hydra* sp. and late worms. Multicellular forms have a complete digestive tract with mouth and anus.

7- EMBRYONIC DEVELOPMENT:

Embryology is very helpful science in taxonomy. The evolution developments through hundreds and thousands of years (phylogeny) for organism are compressed into a short time from fertilized egg into a new individual (ontogeny). Based on the embryonic development, metazoans are divided into protostomes and deuterostomes. Protostomes are primitive invertebrates, Mollusca, Annelida and Arthropoda while deuterostomes include chordates and echinoderms. This division is helpful in understanding the relationships between different groups of animals. The main difference between protostomes and deuterostomes is that the blastopore in protostomes is developed into a mouth while the blastopore in deuterostomes is developed into an anal opening.



Also the type of cleavage: labial a new mouth is formed elsewhere other than from blastopore e.g. enbinodermata. Hemichordate and chordata or spiral (Mollusca) is important character.

The type of gastrulation; invalidated or epiboly and other characters of embryo are taken in consideration in taxonomy.

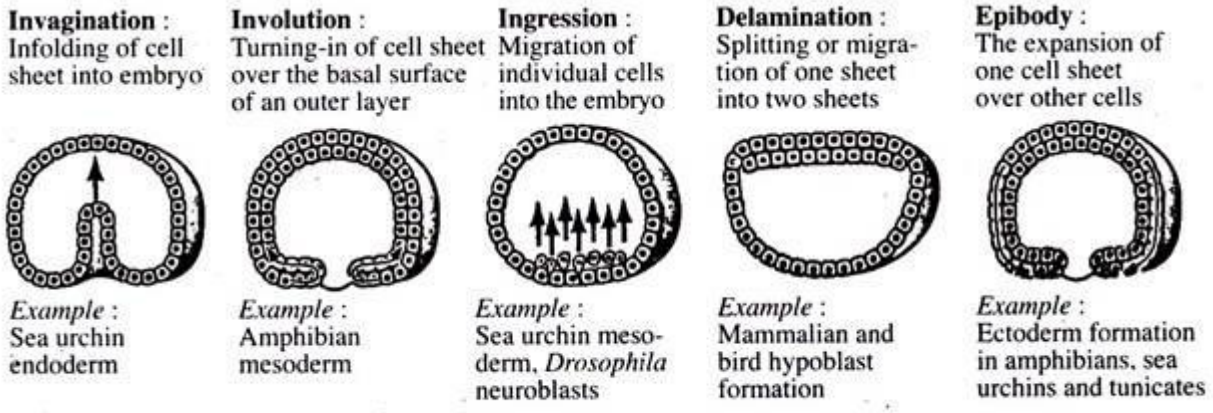
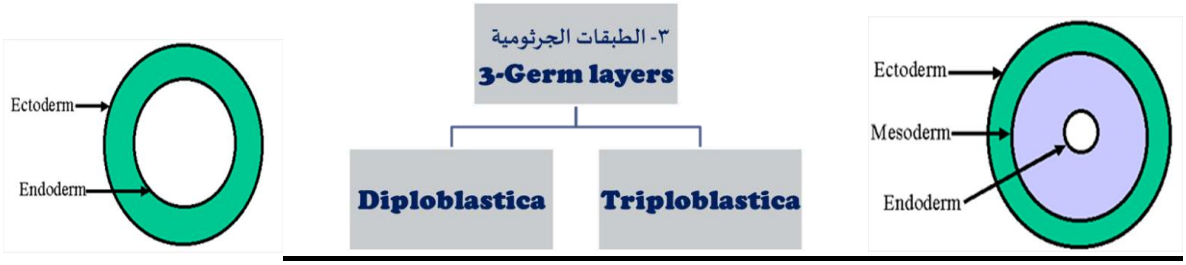


Fig. 5.35 : Types of cell movements during gastrulation.

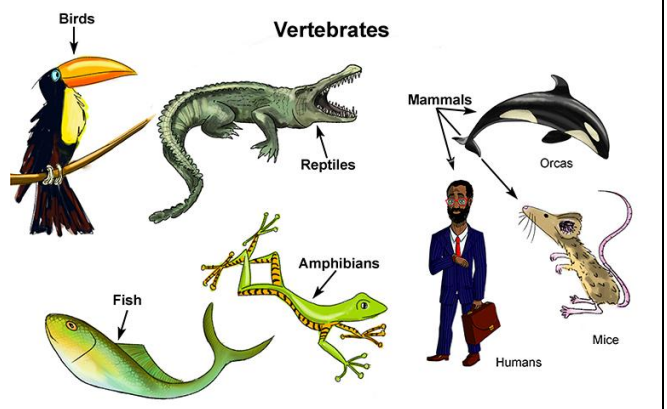
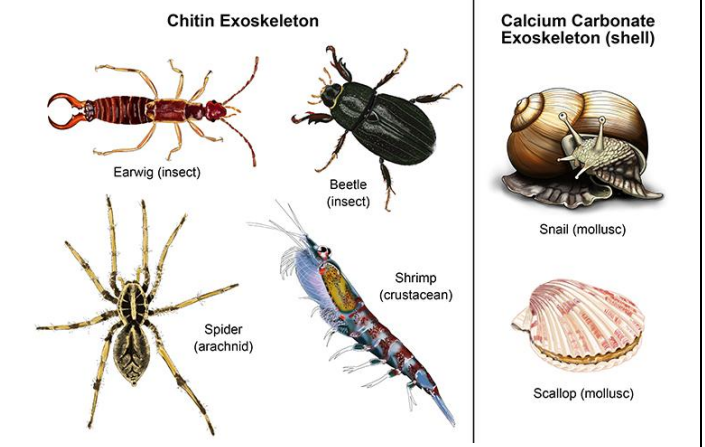
8- THE NUMBER OF GERM LAYERS:



Diploblastica are those have two germ layers; ectoderm and endoderm; e.g. coelenterates. While triploblastic are those having three germ layers; ecto-endo and mesoderm. e.g. flate worm.

9- SKELETAL SYSTEM:

Skeletal is a supporting frame work of organisms. There is two type of which; endoskeleton and exoskeleton. Endo are found in sponges, echinoderms and Chordata, while Exo is found in Mollusca.

Endoskeleton	Exoskeleton
	

10- SEXUAL CHARACTERISTICS:

A- Dioeciously organisms are unisexual, where both sexes are separated.

B- Monocots or hermaphroditic forms are containing both sexual characteristics in the same individuals. They develop male and female

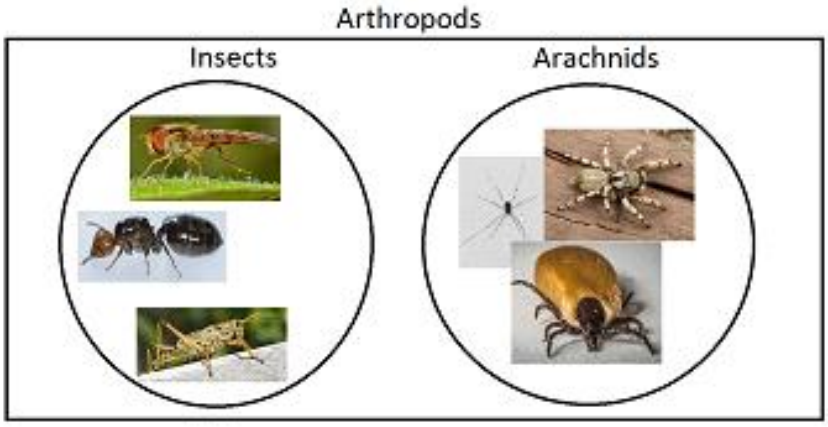
organs in the same gonad. Sporulation is important in taxonomic protozoa and very small invertebrates.

11-LARVAL FORMS:

Type of larvae is important in classification. There are several forms of larvae and each of which characterizing a special group of forms of animals e.g. vileger characterizing Mollusca, nuplius larva for arthropods, planar for coelenterates and brachularia for Echinodermata etc.

12- APPENDAGES:

Appendages are body protrusions serving different functions as feeding, location and sensory function such as gentiles and antennae. The number and physiology of appendages of organism are good means of taxonomy especially among arthropods. Arachnid (spider) has eight legs while insect have six.



Kingdoms of The Living Organism

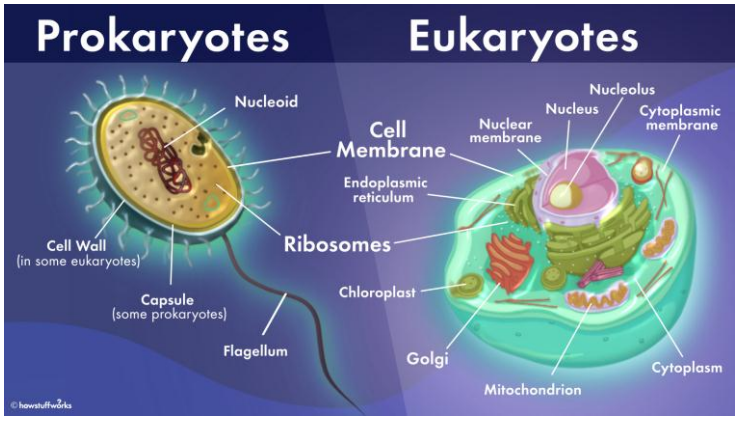
Our conception of the kingdoms in the living organisms has been revised several times over the years. From Aristotle's time to the late 1800s it was traditional to divide living organism to two major kingdoms; Animalia and plantae.

In 1866 Haeckel proposed the new kingdom Protista to include all single-cells organisms.

In 1969 R. H. Whittaker proposed a five-kingdom system that incorporated the basic prokaryote-eukaryote distinction.

Prokaryotic cells are cells without a nucleus. The DNA in prokaryotic cells is in the cytoplasm rather than enclosed within a nuclear membrane. Prokaryotic cells are found in single-celled organisms.

Eukaryotic cells are cells that contain a nucleus. Eukaryotic cells are usually larger than prokaryotic cells and they are found mainly in multicellular organisms.



Kingdom: Monera (the prokaryote's: Bacteria & blue green algae)

kingdom : Protista (unicellular algae & protozoans)

kingdom : Plantae (multicellular plants)

kingdom : fungi (Nonphoto-synthetic plant like organisms)

kingdom : Animalia (Multicellular animals)

Kingdom: Protista

Phylum: Protozoa

INTRODUCTION

The Protozoa are considered to be a subkingdom of the kingdom Protista, although in the classical system they were placed in the kingdom Animalia. More than 50,000 species have been described, most of which are free-living organisms; protozoa are found in almost every possible habitat.

Anton van Leeuwenhoek was the first person to see protozoa, using microscopes he constructed with simple lenses. Between 1674 and 1716, he described, in addition to free-living protozoa, several parasitic species from animals, and *Giardia lamblia* from his own stools. Virtually all humans have protozoa living in or on their body at some time, and many persons are infected with one or more species throughout their life. Some species are considered commensals, i.e., normally not harmful, whereas others are pathogens and usually produce disease. Protozoan diseases range from very mild to life-threatening. Individuals whose defenses are able to control but not eliminate a parasitic infection become carriers and constitute a source of infection for others.

General characters:

1- Very small in size, can only be seen by the light microscope and live in all environments.

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

3- Protozoa are unicellular eukaryotes. As in all eukaryotes, the nucleus is enclosed in a membrane. In majority of cases there is only one nucleus in the cytoplasm with distinct (endosome). The endosome lacks DNA in the parasitic amoebas and trypanosomes. In the phylum Apicomplexa, the vesicular nucleus has one or more nucleoli that contain DNA. The ciliates have both a micronucleus and macronucleus, which appear quite homogeneous in composition. Cytoplasm is

usually differentiated into outer clear ectoplasm and inner granular endoplasm containing organelles.

4- The plasma membrane enclosing the cytoplasm. The outer surface layer of some protozoa, termed a pellicle, is sufficiently rigid to maintain a distinctive shape, as in the *Trypanosoma* and *Giardia*. However, these organisms can readily twist and bend when moving through their environment. In most protozoa the cytoplasm is differentiated into ectoplasm (the outer, transparent layer) and endoplasm (the inner layer containing organelles); the structure of the cytoplasm is most easily seen in species with projecting pseudopodia, such as the amoeba.

5- They move either by pseudopodia, flagella, cilia and some have no locomotors organelles.

6- Nutrition: some are heterotrophic: feeds on other organisms (bacteria, algae, smaller protozoa,) and some are autotrophic. The nutrition of all protozoa is holozoic; that is, they require organic materials, which may be particulate or in solution. Amoeba engulfs particulate food or droplets through a sort of temporary mouth, perform digestion and absorption in a food vacuole, and eject the waste substances. Many protozoa have a permanent mouth, the cytosome or micropore, through which ingested food passes to become enclosed in food vacuoles. Pinocytosis is a method of ingesting nutrient materials whereby fluid is drawn through small, temporary openings in the body wall. The ingested material becomes enclosed within a membrane to form a food vacuole.

7- Osmoregulatory organelles, in the form of contractile vacuoles present in freshwater forms.

8- Respiration by simple diffusion through the body surface.

9- Excretion takes place by simple diffusion through the body surface.

10- All protozoans can reproduce asexually, either by binary fission or by multiple fission. Division is longitudinal in the flagellates and transverse in the ciliates. Endodyogeny is a form of asexual division seen in *Toxoplasma* and some related organisms. Two daughter cells form within the parent cell, which then ruptures,

releasing the smaller progeny which grow to full size before repeating the process. In schizogony, a common form of asexual division in the Apicomplexa, the nucleus divides a number of times, and then the cytoplasm divides into smaller uninucleate merozoites. But some protozoans can reproduce sexually by forming male and female gametes. In *Plasmodium, Toxoplasma*, and other apicomplexans, the sexual cycle involves the production of gametes (gamtogony), fertilization to form the zygote, encystation of the zygote to form an oocyst, and the formation of infective sporozoites (sporogony) within the oocyst.

Some protozoa have complex life cycles requiring two different host species; others require only a single host to complete the life cycle.

11- Encystement is common in protozoa under unfavorable conditions.

CLASSIFICATION OF PROTOZOA

Class: Sarcodina

Are protozoans in which:

(1) Move by pseudopodia

(2) Most members are free living forms but there are some parasitic forms.

(3) They live in moist soil and aquatic habitats.

(4) Some forms have shell consists of one or many chambers acts as exoskeleton.

Class: Mastigophora

They are protozoans in which:

(1) The body possesses one or more flagella

(2) Amoeboid action is rare

(3) Syngamy occurs in only a few groups and is then not followed by abundant spore formation

(4) Most members are free-living but some are parasitic

(5) Some members have chloroplasts (phytomastigophora) while other has not (zoomastigophora).

Class: Ciliophora

They are protozoans in which:

(1) Move by Cilia.

(2) Amoeboid action is rare.

(3) Exchange or gentian materials take place by conjugation**.**

(4) Free living and parasitic forms.

(5) Some forms have more than one nucleus.

Class: Sporozoa

They are protozoans in which:

(1) Have no distinct locomotory organelles

(2) The body may be amoeboid

(3) Multiplication is typically by the formation of large number of spores following syngamy

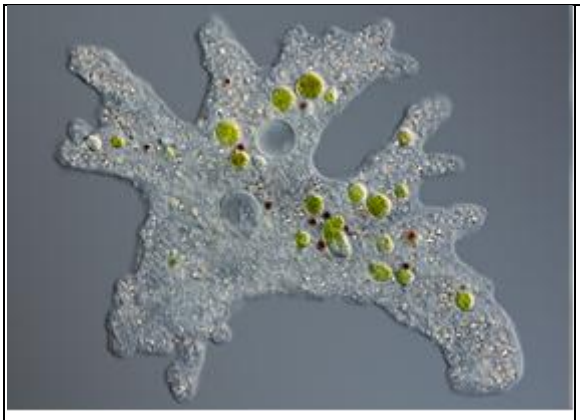
(4) They are exclusively parasitic.

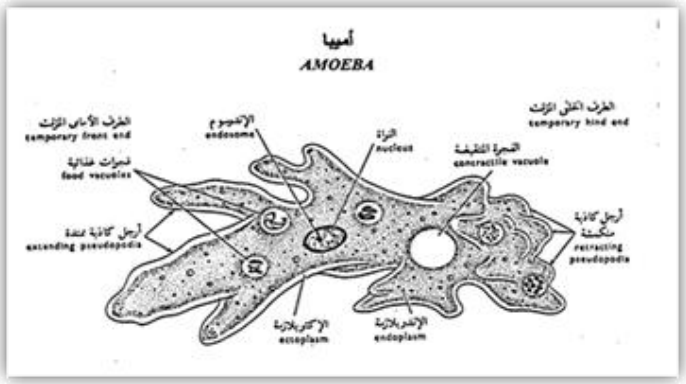
Kingdom: Protista

Phylum : Protozoa

Class : Sarcodina

e.g. : *Amoeba* sp.





An **amoeba** often called ***amoeboid***, is a type of cell or organism which has the ability to alter its shape, primarily by extending and retracting pseudopods.

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

Morphology: 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.

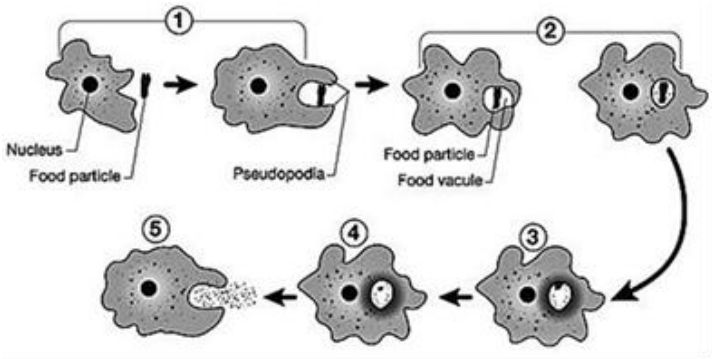
Locomotion:

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:

The mode of nutrition in amoeba is known as holozoic nutrition. It involves the ingestion, digestion, absorption, assimilation and egestion of food material.

Amoeba does not have any specialized organ for nutrition. Its entire process is carried through the body surface with the help of pseudopodia.



Osmoregulation:

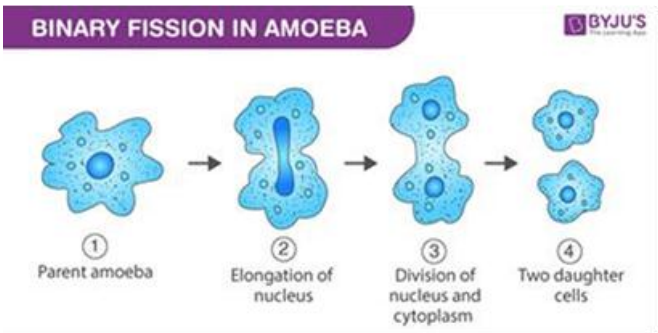
This is carried out by the contractile vacuole which bursts at regular intervals expelling to the exterior the excess water which diffuses into the cytoplasm from the surrounding medium.

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:

Amoeba reproduces only asexually by binary fission. The nucleus extends and divides into two parts which move away from each other. The division of cytoplasm follows the division of the nucleus. So, two amoebae are produced from a single parent.

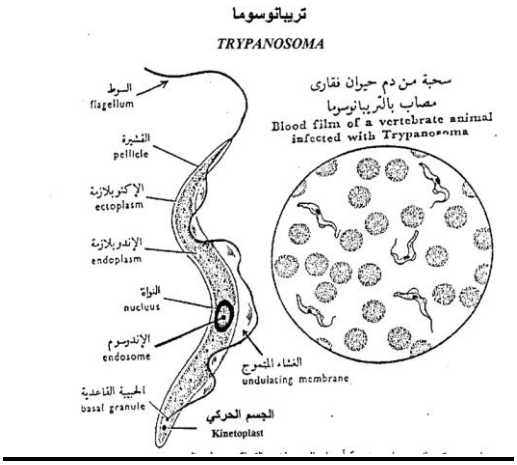


Kingdom: Protista

Phylum : Protozoa

Class :Mastigophora

e.g. : ***Trypanosoma* sp.**



Habitat:

Trypanosoma live as a parasite in the blood and some tissues of many vertebrates (definitive or final host).

Morphology:

Trypanosoma has a fusiform body. There is a firm pellicle that maintains the shape of the body. The cytoplasm is divided into an outer ectoplasm and an inner endoplasm. In endoplasm, there is a large oval nucleus with a central endosome. There is a long flagellum arises from a basal granule or blepharoplast and it is joined to the body by a thin undulating membrane, and it continues anteriorly in front of the body as a free flagellum. A large granule known as the parabasal granule or kinetoplast is located very close to the basal granule.

Locomotion:

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

Nutrition:

The mode of nutrition in trypanosomes is parasitic because it draws its food from the host by simple diffusion.

Osmoregulation:

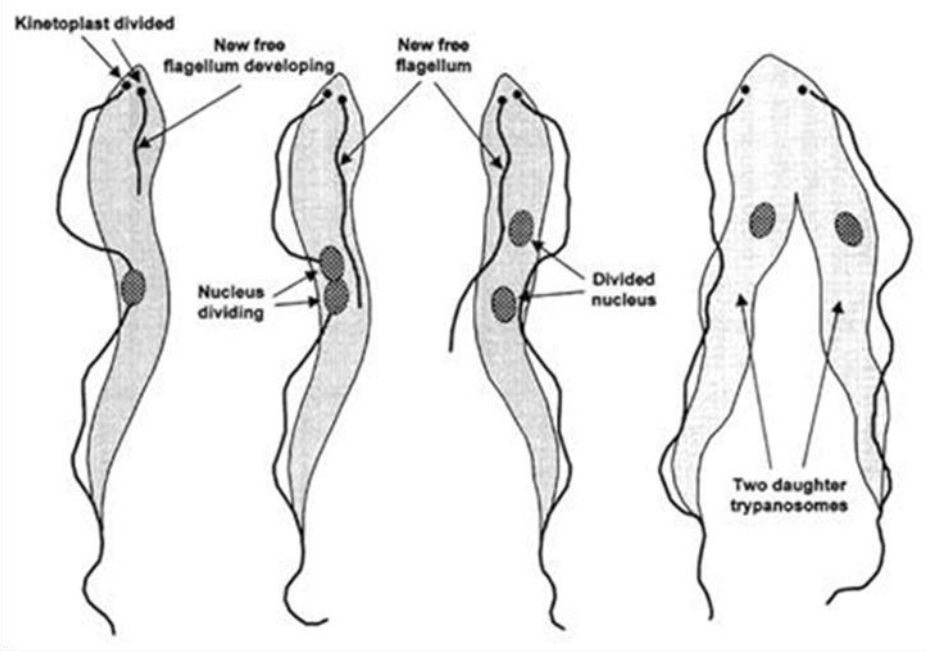
No osmoregulatory mechanisms are required by trypanosomes and accordingly contractile vacuoles are absent.

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:

Trypanosomes reproduce only asexually throughout their entire life cycle by longitudinal binary fission. The blepharoplast 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.

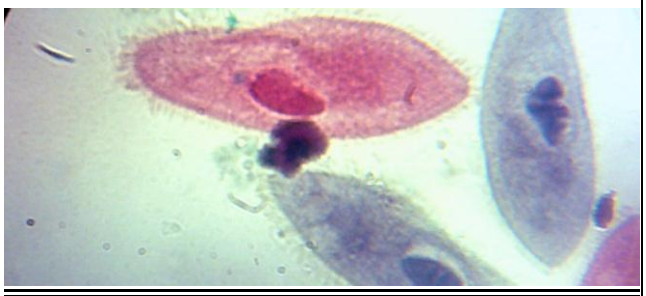


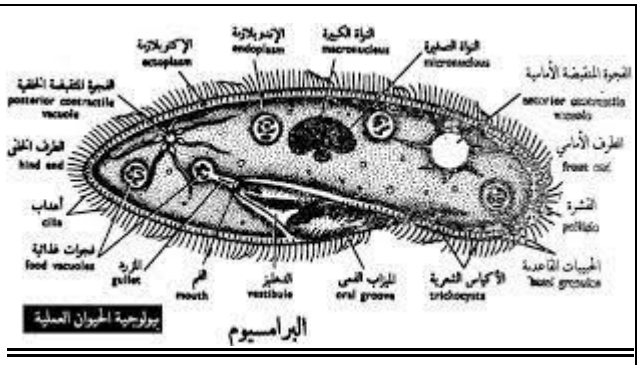
Kingdom: Protista

Phylum : Protozoa

Class : Ciliophora

e.g. : *Paramecium* sp.





Paramecium is agenus of microscopic, single-celled, and free- living protozoans.

Habitat:

Paramecium is widespread in freshwater, brackish, and marine environments and is often abundant in stagnant basins and ponds.

Morphology:

Pellicle is the covering of paramecium. It holds the shape of animals but elastic enough to permit contractions.it has a double membrane, the outer membrane is continuous with cilia and the inner with ectoplasm.

Oral groove: situated at the ventral surface of the body.it drives food materials into the body. Oral groove leads into v-shaped cavity called vestibule. The vestibule leads into oval-shaped opening called cytosome. The cytosome leads into funnel-shaped cytopharynx which ends in the cytoplasm.

Cytoplasm of *paramecium:*

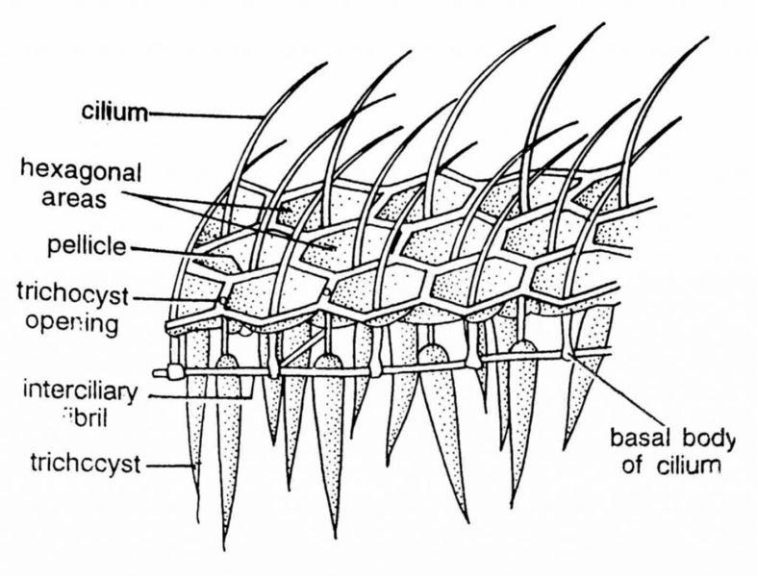
A thin layer of ectoplasm (clear, firm cytoplasm) lies directly beneath the pellicle consists of basal granule and trichocysts, Endoplasm central part of cytoplasm. It contains nucleus, contractile vacuoles and food vacuoles.

Cilia:

Short hair like structures arising from basal granule of ectoplasm, covered all over the body. It helps in locomotion as well as in food collection.

Trichocysts:

Embedded in the ectoplasm are trichocysts (spindle-shaped bodies) that may be released by chemical, electrical, or mechanical means. The precise function of trichocysts is unclear; they may be extruded as a reaction to injury, or they may be used as an anchoring device, as a mechanism of defense, or as a means of capturing prey.



Nucleus:

Paramecium has two kinds of nuclei: bean or kidney shape nucleus called a macronucleus, control the vegetative function and at near it small nucleus called a micronucleus control reproductive function.

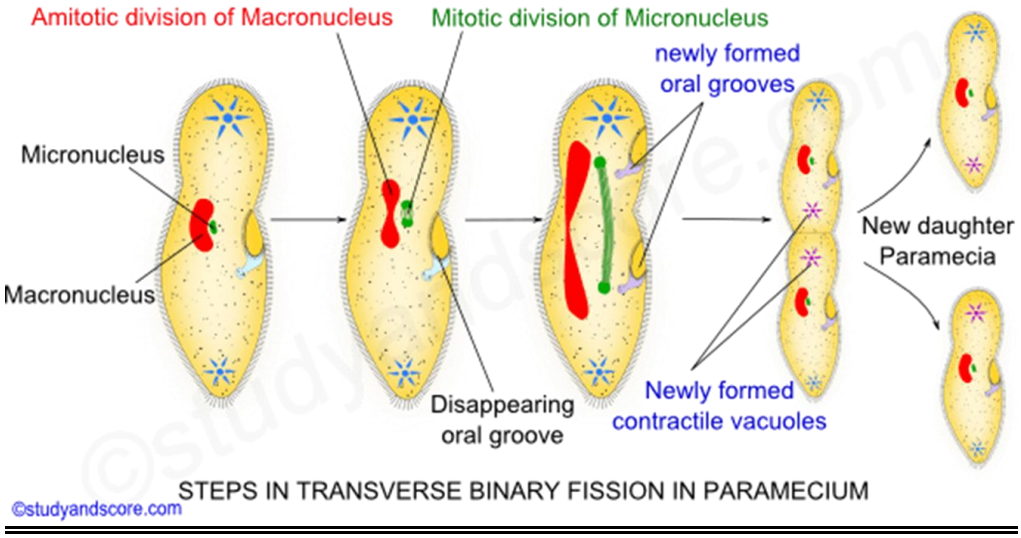
Osmoregulation:

Depending on the species, a paramecium has from one to several contractile vacuoles located close to the surface near the ends of the cell. Contractile vacuoles function in regulating the water content within the cell and may also be considered excretory structures, since the expelled water contains metabolic wastes.

Reproduction:

- Types (Asexual and sexual)
- Asexual reproduction
- The process is without involvement of gametes
- Paramecium exhibited binary fission.

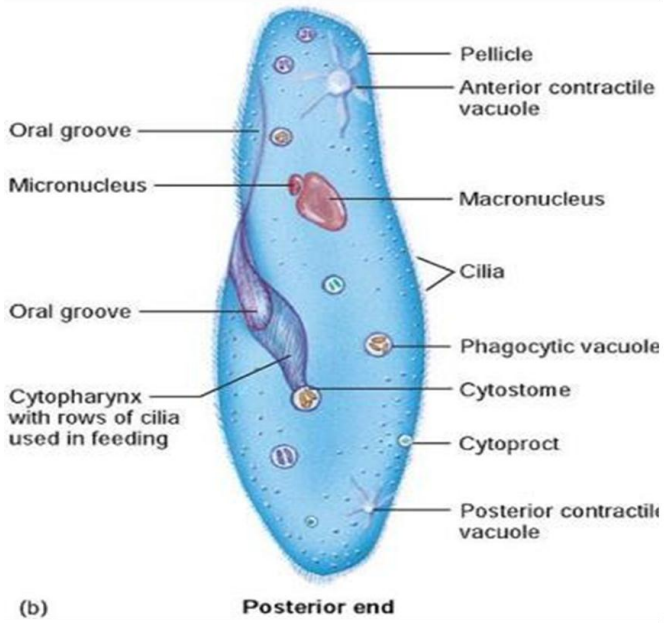
- Process step:
- Stop feeding
- Disappearance of oral apparatus.
- 3-Micronucleus is elongates and become divided into two daughter micronuclei -MITOSIS
- Macronucleus is elongates and become divided into two daughter micronuclei- AMITOSIS

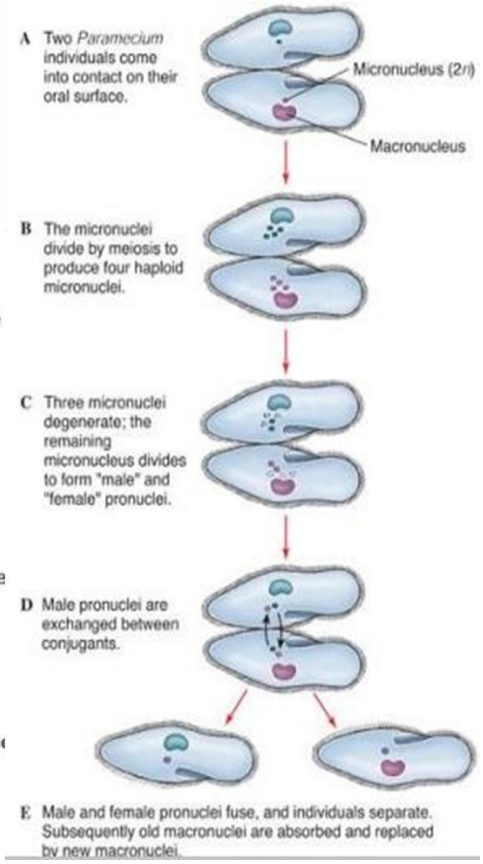


STEPS IN TRANSVERSE BINARY FISSION IN PARAMECIUM

Conjugation (sexual reproduction)

- Temporary union of two individuals of same species for mutual exchange of genetic martials- conjugants
- Stick together through their oral grooves region.
- The following apparatus cilia, trichocysts, feeding, pellicle and ectoplasm degenerate.
- Macronucleus has no role in conjugation, but micronucleus divides twice
- As a result of meiotic division four haploid daughter micronuclei are produced. Three are degenerate and disappear.
- Remaining one micronucleus divides by mitosis to form two unequal pronuclei. (Larger is called female pronucleus and smaller one called male pronuclues.


Pellicle
Anterior contractile vacuole
Oral groove
Micronucleus
Macronucleus
Cilia
Oral groove
Phagocytic vacuole
Cytopharynx with rows of cilia used in feeding
Cytostome
Cytoproct
Posterior contractile vacuole
(b)
Posterior end


A Two Paramecium individuals come into contact on their oral surface.
Micronucleus (2n)
Macronucleus
B The micronuclei divide by meiosis to produce four haploid micronuclei.
C Three micronuclei degenerate; the remaining micronucleus divides to form "male" and "female" pronuclei.
D Male pronuclei are exchanged between conjugants.
E Male and female pronuclei fuse, and individuals separate. Subsequently old macronuclei are absorbed and replaced by new macronuclei.

Phylum: Porifera (Sponges)

Sponges constitute the Phylum Porifera (L. porus, pore+ ferre, to bear) which are the simplest type of metazoans. The term Porifera was coined by Robert Grant and it means “pore bearers” - pore bearing animals - due to the presence of tiny pores on their body. The study of Porifera or sponges is called Para zoology. The Phylum Porifera includes more than 5000 animal species, mostly marine, but includes about 150 fresh water inhabitants also. They found in all seas, wherever there are rocks, shells, submerged timbers, or coral to provide a suitable substratum. Most sponges prefer relatively shallow water, but some groups including most glass sponges, live in deep water.

The body wall has numerous pores called ostia. The body encloses large cavity called spongocoel. Water enters the spongocoel through the ostia and inters connecting canals present in the body wall. All inter connecting are collectively called canal system. Water leaves the spongocoel through a large aperture called osculam. The canals inside the body are linked by flagellated collar cells or choanocytes. The food particles present in water current are taken by these cells.

Barell sponge

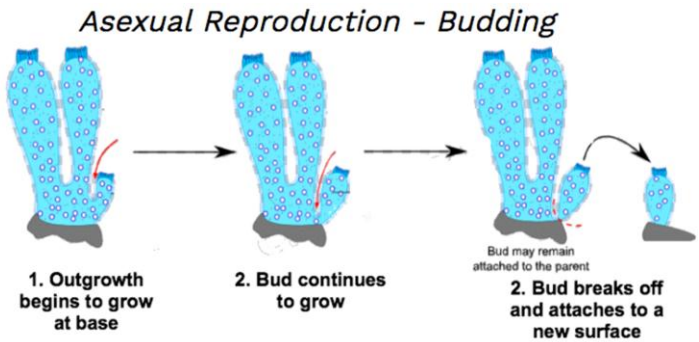
Yellow tube Sponge

Most important characteristics:

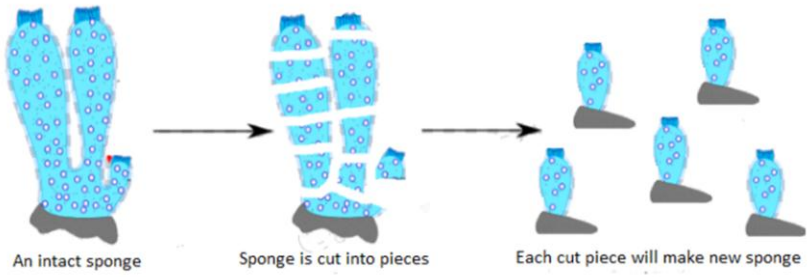
- Sponges are sessile and mostly marine animals which show little or no detectable movement.
- They are primitive multicellular animals.

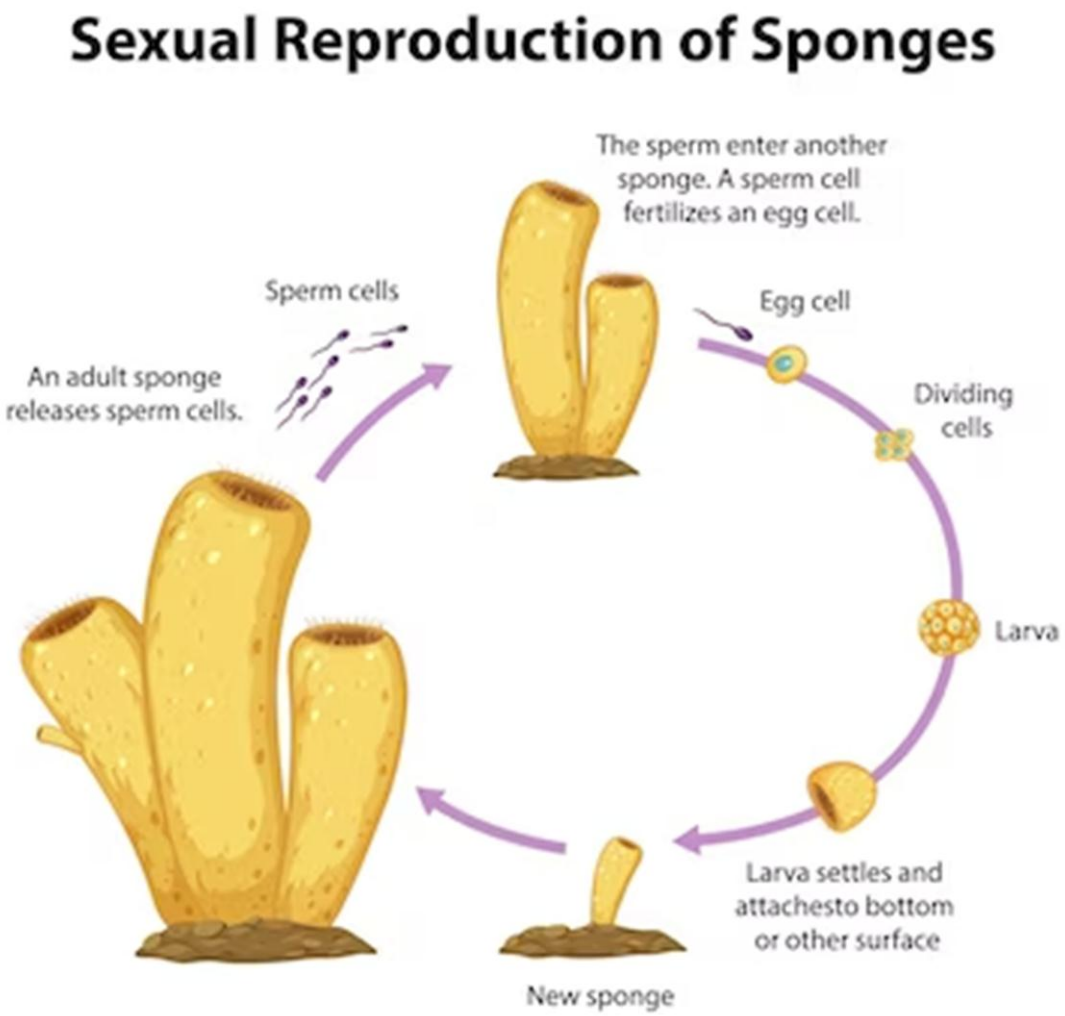
- They are thin flattened or have irregular shapes.
- The body has numerous pores or canals.
- Inside the body there is a single cavity lined by flagellated cells.
- The body cells are less specialized; they do not form proper tissues or organs.
- They have a skeleton of calcareous spicules or organic spongin fibres.
- They are holozoic, digestion is entirely intracellular. They generally feed on bacteria and other food particles that are present in the water
- They respire and excrete by simple diffusion.
- They have no sensory or nerve cells.
- They reproduce asexually by budding, gemmule formation or by regeneration, they also reproduce sexually by gametes (most sponges are hermaphrodite).

Gemmule : An asexually produced mass of cells, which are capable of developing into a new organism or into an adult freshwater sponge. They are small bud-like cells, which are formed by sponges to withstand unfavorable environmental conditions



Asexual reproduction- regeneration





- There are three types: (ascon, sycon and leucon).

The Ascon type (*Leucosolenia)*

- This is the simplest type of sponges.
- The body is tube in shape, live in colonies. It has triradiate spicules.

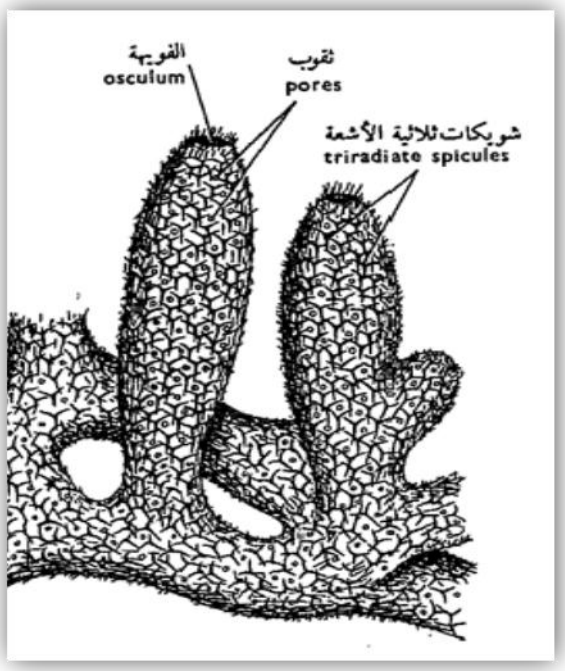
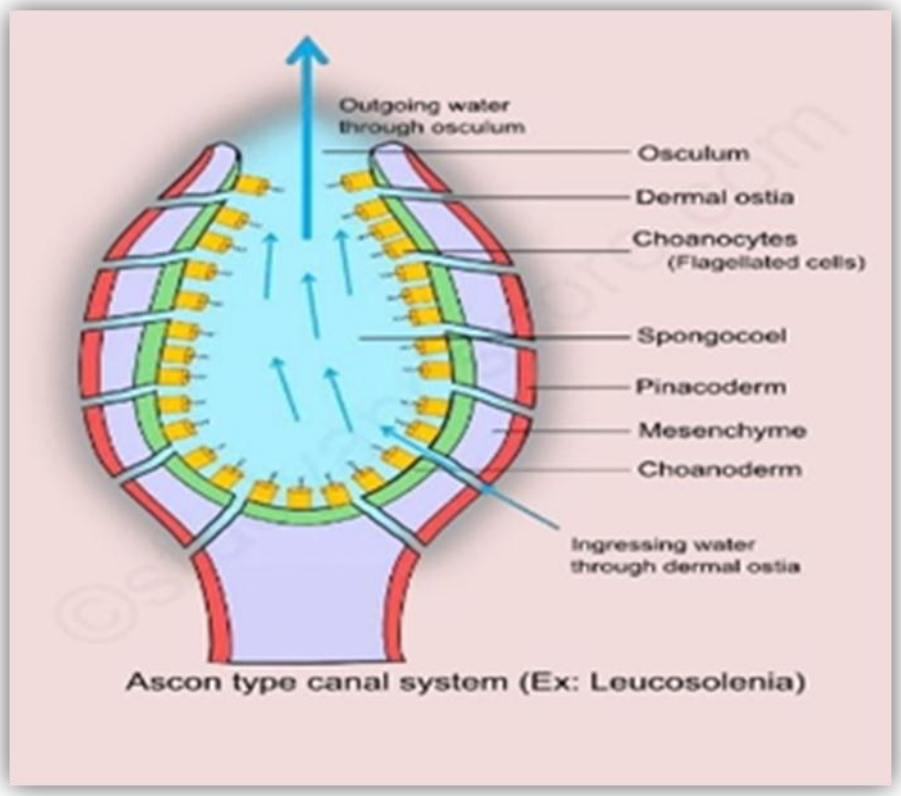


Figure 1: *Leucosolenia*

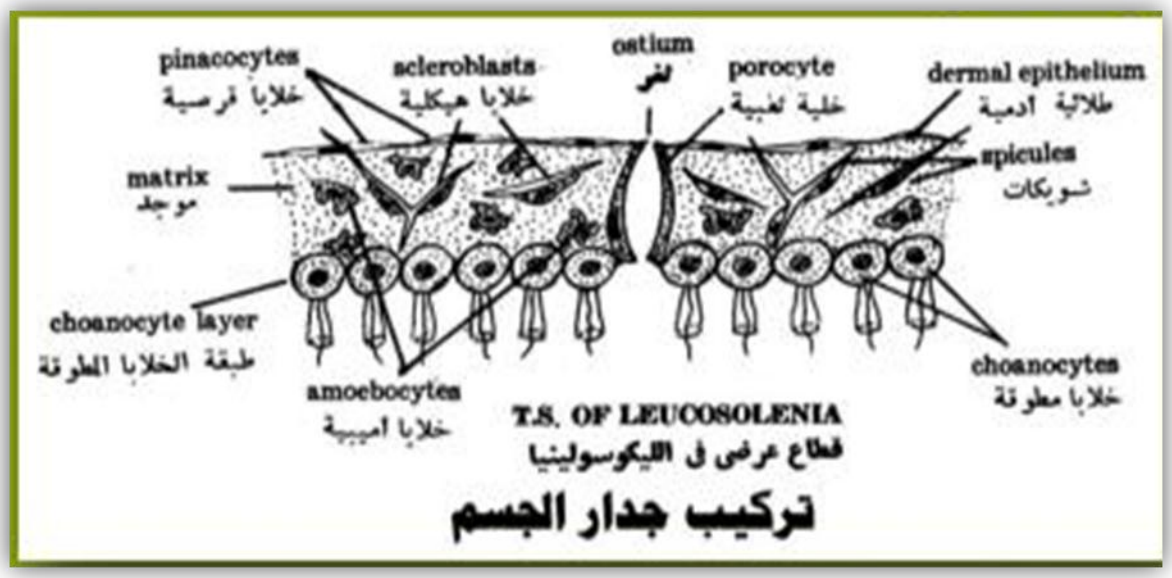
- The body wall surrounds a central cavity known as paragastric cavity lined with flagellated cells.
- The wall is thin, contains many openings (ostia) which lead directly to the paragastric cavity which open outside through osculum.



Internal structure of *Leucosolenia*

The body wall of *Leucosolenia* consists of two cellular layers:
1- The dermal layer: the outer layer formed of thin flattened cells: **pinacocytes.**
2- The gastral layer: contains choanocytes with flagellates extend to the paragastric cavity.

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**.**



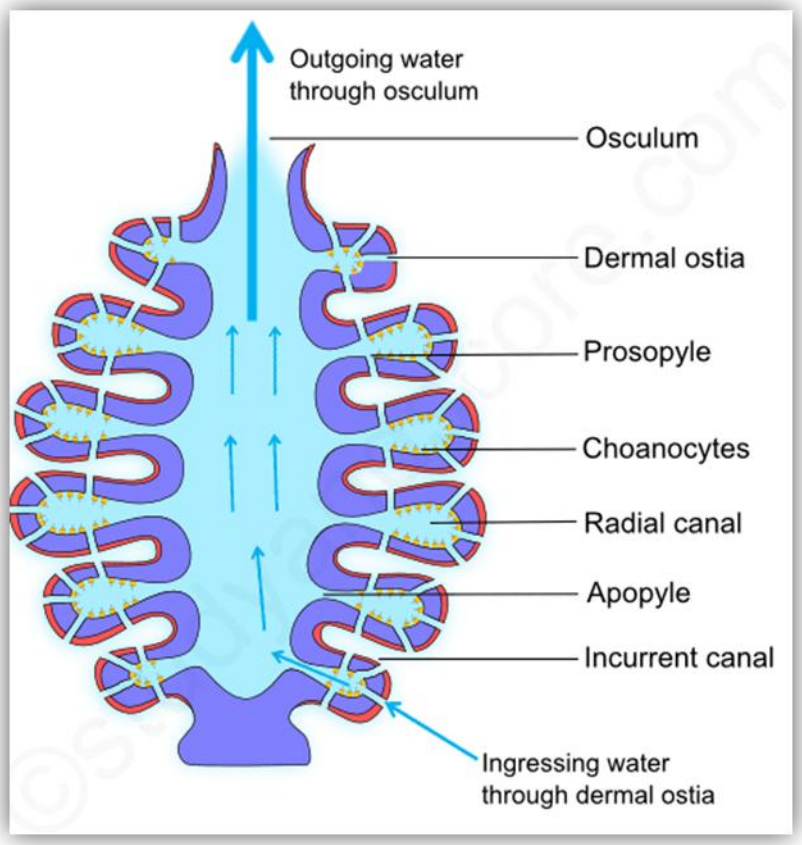
Body wall of *Leucosolenia*

The Sycon type: *Sycon*

- 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 2: The sycon type

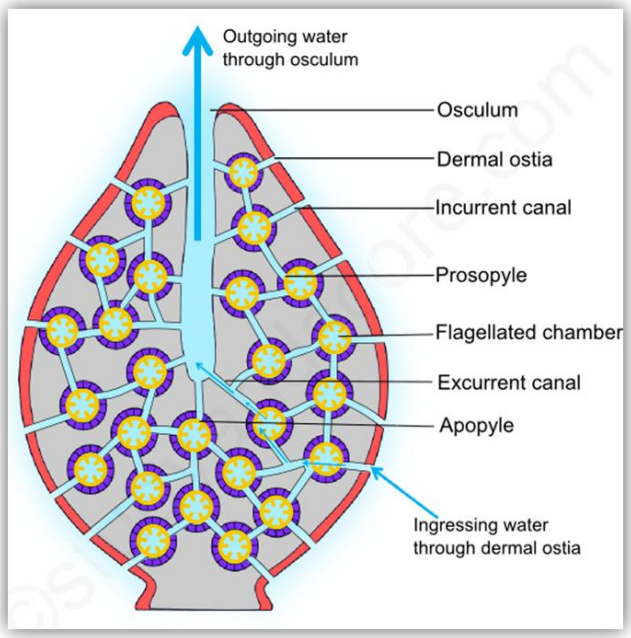


Sycon type canal system

The Leucon type: *Euspongia*

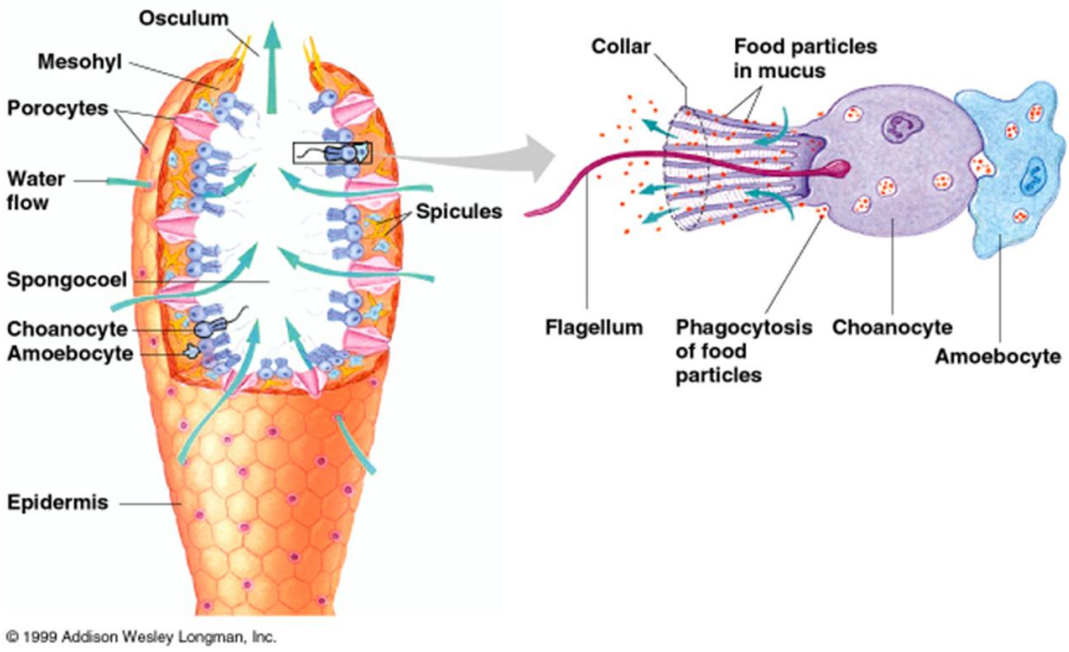
- Spherical, irregular or cup shape.
- They live on the sea bottom attached to rocks.
- The body surface contains minute ostia, in between there are several larger oscula with more complex structure.
- It contains a complex network of branching spongin fibres extends within the jelly and gives the animal 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.

Euspongia



Leucon type canal system

Feeding in porifera



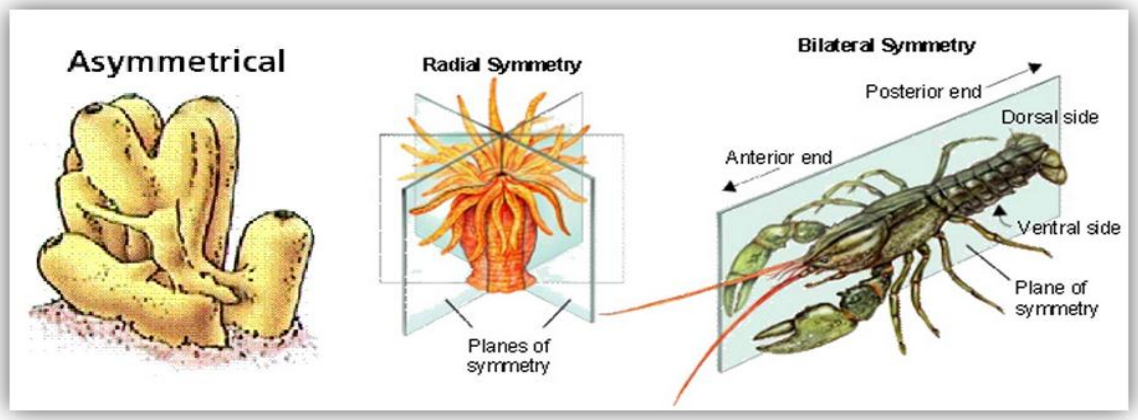
Porifera are filter feeders. The movement of choanocyte flagella draws water through its collar. Food particles are trapped in the mucus coating the projections, engulfed by phagocytosis and either digested or transferred by amoebocytes which transport nutrients to other cells of the sponge body.

Subkingdom: Eumetazoa

- **…….Diploblastica**

Phylum: Coelenterata

1. Simple aquatic metazoa, mostly marine and sessile.
2. They are radially symmetrical (the body is divided into two symmetrical halves if cut in any direction pass in through the axis).
3. There are two layers in the body (ectoderm, endoderm) separated by a jelly – like mesogloea.
4. They have nematocysts (stinging structures), not found in any other phylum.
5. There is a single cavity (the gastrovascular cavity or coelenteron cavity).
6. Respiration and excretion by simple diffusion.
7. They have a simple diffuse nervous tissue in the form of a nerve net.
8. They reproduce asexually by budding, and sexually by gametes.
9. Most have two forms during the life cycle (hydroid form or polyp), and free swimming jelly-fish like form (medusa).
10. Some forms with external calcareous skeleton.



Types of Symmetry

Radial symmetry generates identical body halves around the central axis whereas bilateral symmetry generates only two sides as left and right.

Classification of Coelenterata

- **Class: Hydrozoa**

  Most have the polyp and medusa forms during the life cycle.

- **Order: Hydroidea**

  Have the polyp form only: ex.:*Hydra*

- **Order: Calyptoblastea**

  Have the two forms (polyp and medusa) ex.: *Obelia*

- **Class: Scyphozoa**

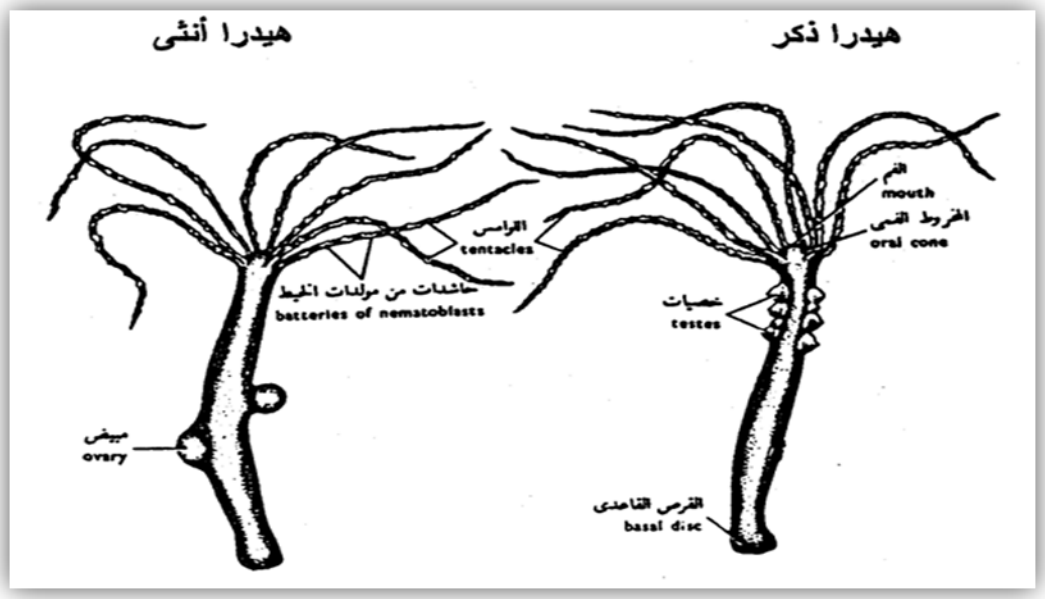
  Contains the jelly-fishes, have only the medusa form.

- **Class: Actinozoa**

  Contains the sea anemones (the sea flowers) and the stony corals, have only the polyp form.

e.g. *: 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 specialized 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.



Hydra

- *Hydra* is generally sedentary or sessile, but do move, especially when hunting. They have different distinct methods for moving: 'looping‘, 'somersaulting‘, floating, swimming,…….
- *Hydra* mainly feeds on aquatic invertebrates such as *Daphnia* and *Cyclops*.

Locomotion in *Hydra*

1- Looping = walking: 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 take an upright position by releasing its tentacles.

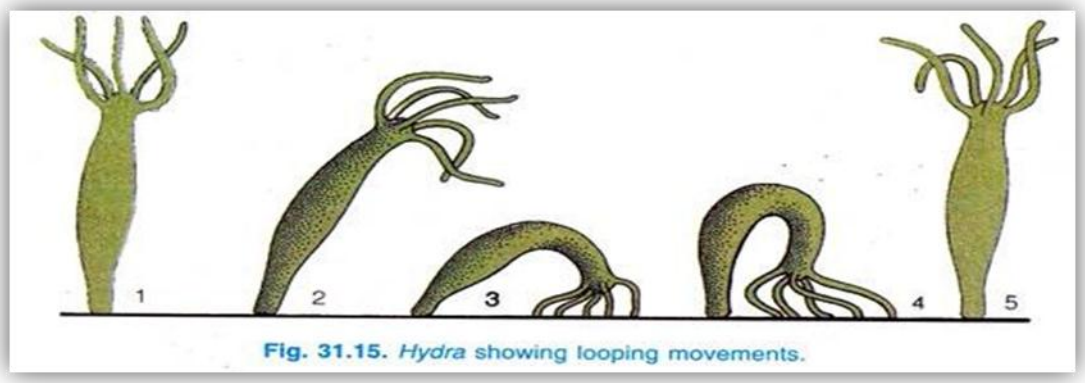
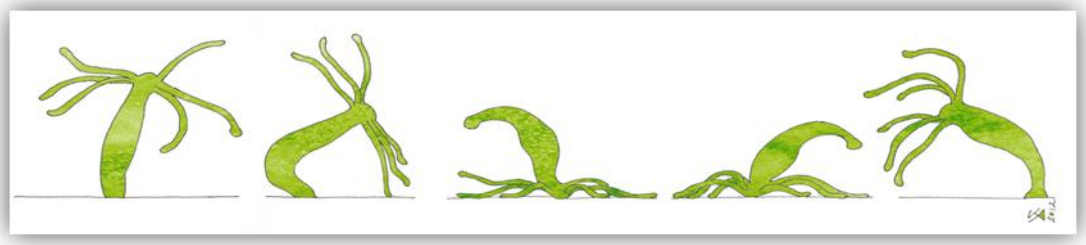


Fig. 31.15. *Hydra* showing looping movements.

2- Somersaulting: *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 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



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

4- Cuttlefish-like movement: The tentacles are fixed to the substratum and with the pedal disc up, *Hydra* moves over the substratum by pulling its tentacles along.

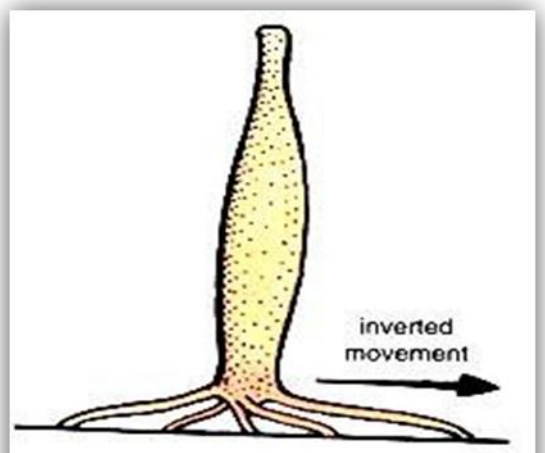


Fig. 31.17. *Hydra* showing cuttle-fish-like movements.

5- Floating: *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.

6- Swimming: By freeing itself from the substratum and with the help of wave-like

movements of the tentacles, *Hydra* swims in water

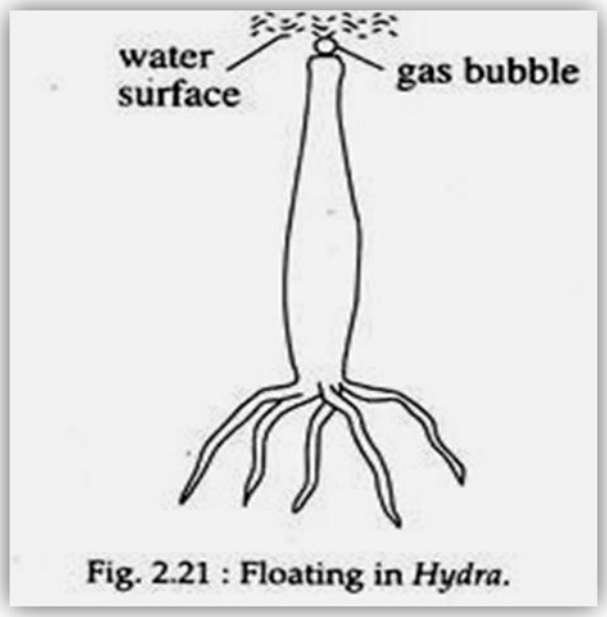


Fig. 2.21 : Floating in *Hydra*.

7- Climbing: *Hydra* can climb by attaching its tentacles to some distant objects and then releasing the basal disc and by contracting the tentacles the body is drawn up to a new position.

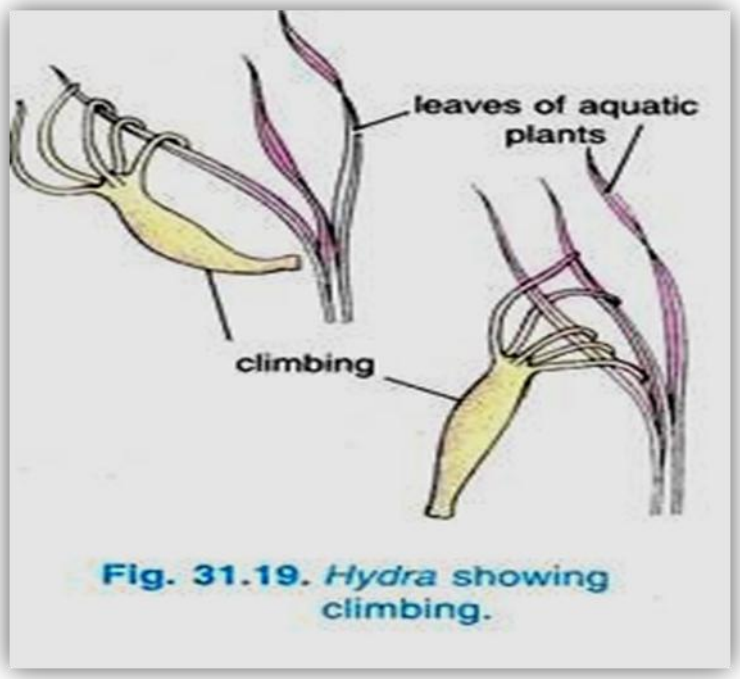
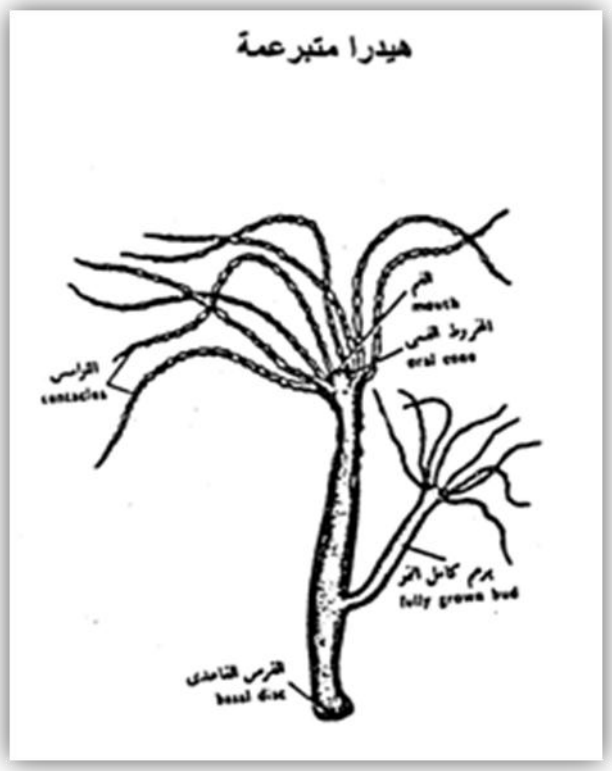


Fig. 31.19. *Hydra* showing climbing.

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.

- When *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. Some *Hydra* species are hermaphrodite.



Budding in Hydra

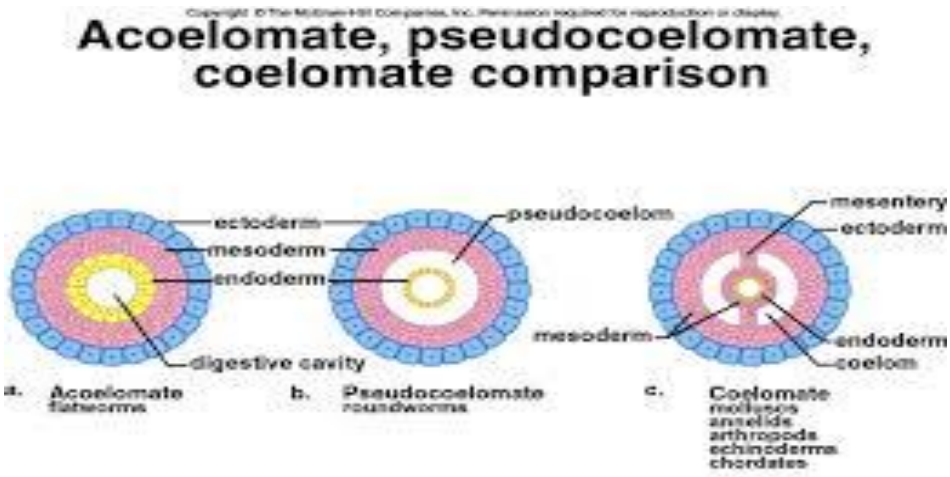
Subkingdom: Eumetazoa

- **…….Triploblastica**

Triploblastic animals have three germ layers: ectoderm, mesoderm and endoderm. Mesoderm allows development of muscle layers in body wall, allows more elaborate organs, more specialization and greater division of labor.

- They are classified into three groups according to the presence of the true coelom, Acoelomata, Pseudocoelomata and coelomata.

- The true coelom is a fluid-filled body cavity, which is completely lined by the tissues derived from the mesoderm.



Acoelomata: (Animals without body cavity)

Phylum: Platyhelminthes

- **General characters:**
- They are the first animals which illustrate the development of organ system.
- May be free living or parasites.
- They are soft bodied, unsegmented worms.
- They are bilateral symmetry and dorsoventrally flat worms.
- They show three germinal layers i.e. ectoderm, mesoderm and endoderm.
- A true body cavity or coelom is absent, and the space between the body organs is filled with loose parenchyma.
- Muscular system is well developed.
- The alimentary canal is either absent or highly branched. Anus is absent.
- Excretory system consists of flame bulbs or flame cells or protonephridia connected to the excretory ducts.
- Circulatory and respiratory systems are absent.
- Nervous system and sense organs are poorly developed, consists of a pair of ganglia connected to 3 pairs of nerve cords.

- Usually hermaphrodite animals.
- Fertilization is internal and development may be direct or indirect
- Direct development: It is a type of development in which an embryo develops into a mature individual without involving a larval stage.
- Indirect development: It is a type of development that involves a sexually-immature larval stage, having different food requirement than adults.

Classification of Platyhelminthes

Class 1 Turbellaria

- Mostly Free-living fresh water organism
- Body: dorso-ventrally flattened
- Hooks and sucker usually absent
- Examples: *Planaria*

Class 2 Trematoda

- Mostly parasitic
- Body: dorso-ventrally flattened leaf like
- Hooks and sucker are present
- Examples; *Fasciola hepatica* (Liver fluke) *Schistosoma* (blood fluke)

Class 3 Cestoda

- Exclusive parasitic
- Body: dorso-ventrally flattened tape like
- Hooks and sucker are present
- Digestive system-absent
- Excretion: Protonephridia with flame cell
- Examples: *Taenia* (tapeworm)

Schistosoma haematobium

- ***Schistosoma*** is a genus belongs to Class: Trematoda, Order: Digenea, commonly known as **blood flukes**. They are parasitic flatworms responsible for a highly significant group of infections in humans termed *schistosomiasis.*

- 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.

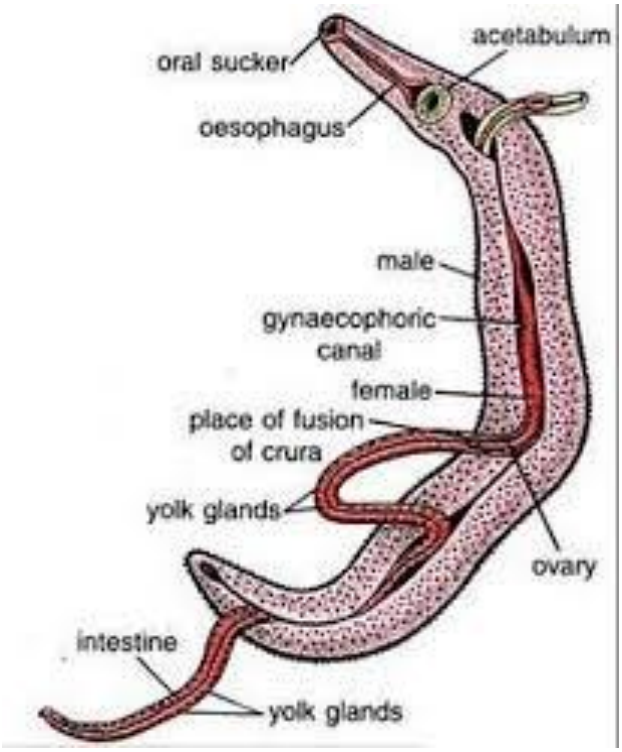
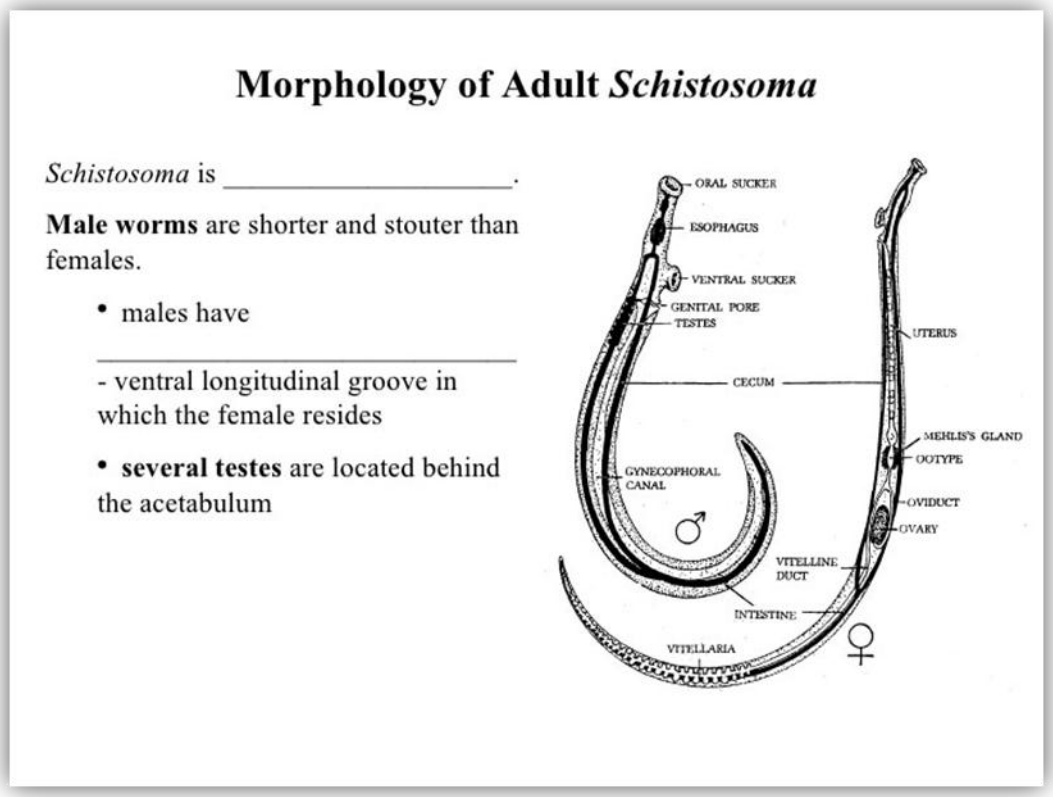


Figure 3: Male embracing female



Morphology of *Schistosoma*

- ***S. haematobium***: the sexes are separate but usually found in pairing condition. 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.

Life cycle

- Eggs are eliminated with faeces or urine to the water. Under optimal conditions the egg hatch and release miracidium , which swim and penetrate specific snail intermediate host (*Bulinus truncatus* snail for *S. haematobium* and *Biomphalaria alexandrina* snail for *S. mansoni*). The stages in the snail include 2 generations to produce the infective stage (cercariae). Upon release

from the snail, the (cercariae) swim, penetrate the skin of the human host, and migrate through several tissues to their residence in the veins.

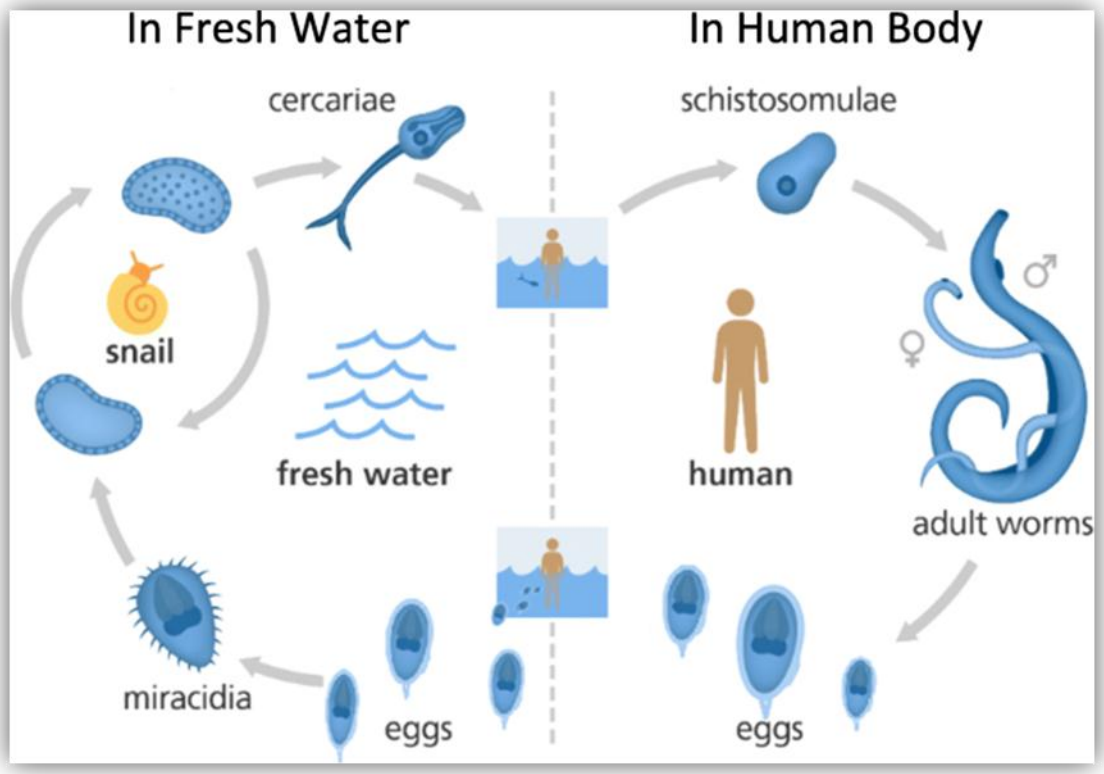


Figure 4: Life cycle of *Schistosoma*

Biomphalaria alexandrina

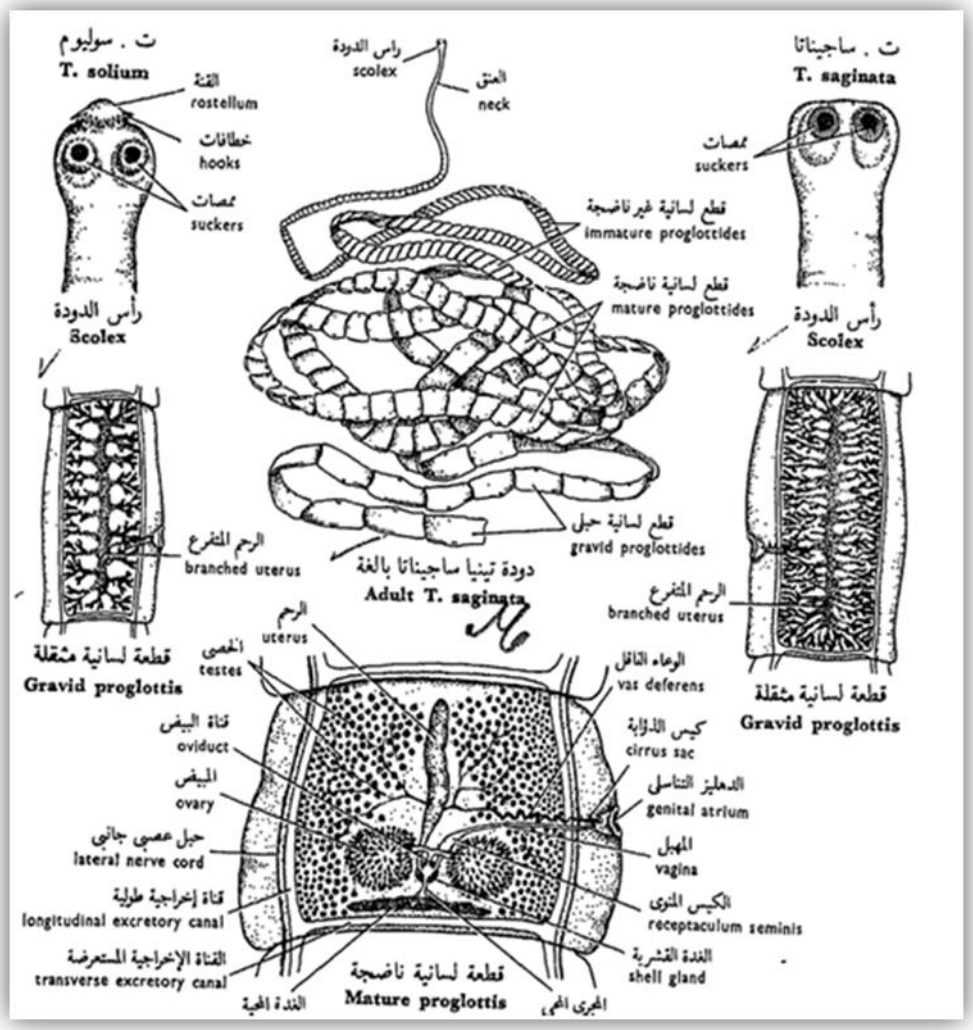
Bulinus truncatus

Taenia saginata

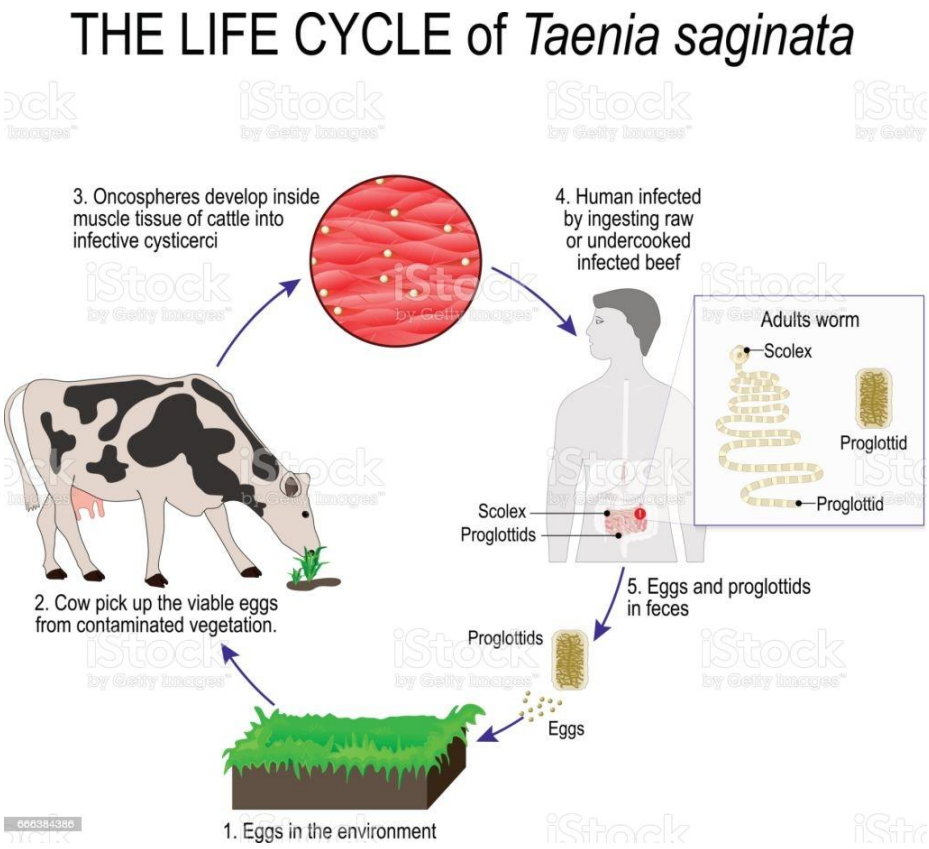
T. saginata is the largest of species in the genus *Taenia*. An adult worm is normally 4 to 10 m in length, but can become very large; specimens over 22 m long are reported. Typical of cestodes, its body is flattened dorsoventrally and heavily segmented. It is entirely covered by a tegument. The body is white in colour and consists of three portions: scolex, neck, and strobila. The scolex has four suckers, but they have no hooks. Lack of hooks and a rostellum is an identifying feature from other *Taenia* species. The rest of the body proper, the strobila, is basically a chain of numerous body segments called proglottids. The neck is the shortest part of the body, and consists of immature proglottids. The midstrobila is made of mature proglottids that eventually lead to the gravid proglottids, which are at the posterior end. An individual can have as many as 1000 to 2000 proglottids.

T. saginata does not have a digestive system, mouth, anus, or digestive tract. It derives nutrients from the host through its tegument, as the tegument is completely covered with absorptive hair-like microtriches. It is also an acoelomate, having no body cavity. The inside of each mature proglottid is filled with muscular layers and complete male and female reproductive systems, including the tubular unbranched

uterus, ovary, genital pore, testes, and vitelline gland. In the gravid proglottid, the uterus contains up to 15 side branches filled with eggs



Taenia



Life cycle of *Taenia*

The eggs are released when a proglottid detaches from the tapeworm in the intestinal lumen or when a segment disintegrates outside the host. The eggs are small diameter 30–40 µm) and round. *The eggs are highly resistant and can remain infective in a moist environment for weeks or months.

Carried by feces of humans infected with Taenia, they contaminate pastures or feed either directly or via sewage. When the cattle ingest the eggs, the oncospheres hatch in the small intestine, migrate into the intestinal wall, and are transported with the bloodstream into the striated musculature of the cattle.

Pseudocoelomata

A pseudocoelomate is an organism with body cavity that is not derived from the mesoderm, as in a true *coelom*, or body cavity

Phylum: Aschelminthes (Nematods)
(the round worms)

- They may be free living (aquatic and terrestrial) or parasitic on plants and animals.
- They are bilaterally symmetrical, triploblastic and pseudocoelomate animals.
- The body is cylindrical. unsegmented with smooth cuticle and well developed muscle fibers.
- The alimentary canal is complete with a mouth, a well-developed muscular pharynx and anus.
- Two lateral excretory tubes removes body wastes from the body cavity through one excretory pore.
- No respiratory or circulatory systems.
- Nervous system with circumenteric ring, 6 anterior and 6 posterior nerves.
- Sexes are separated. Often females are longer than males.

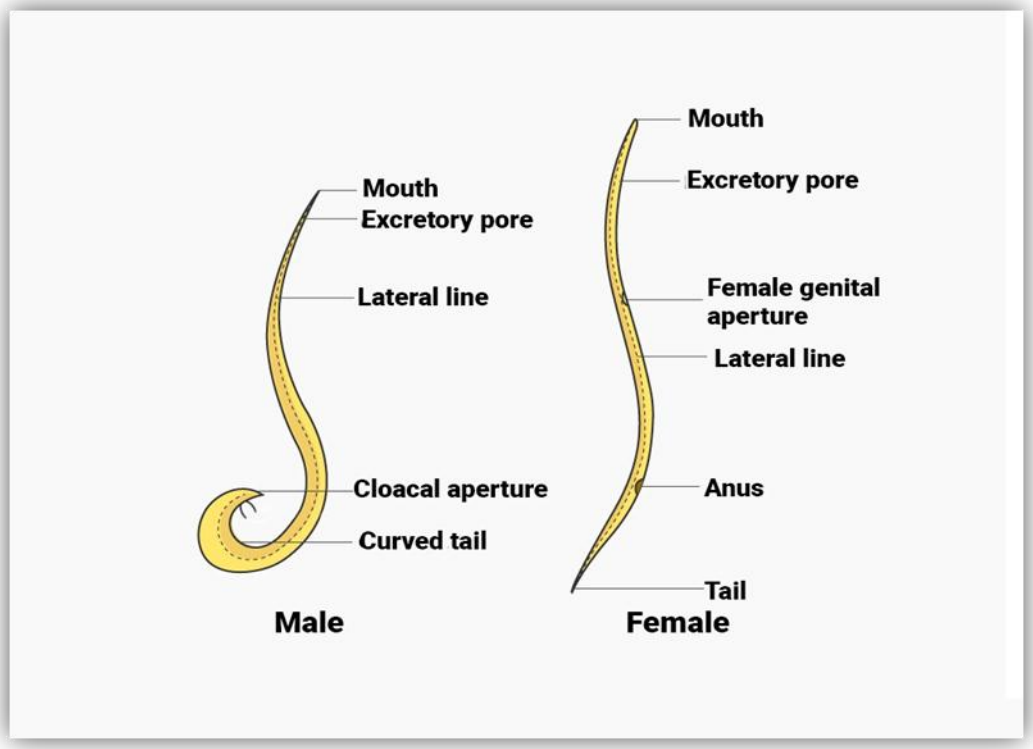
Order: Ascaridata

Genus: *Ascaris*

- 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 others closely and differ in few details.
- 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 dorsal and ventral lines (contain two nerve cords) and 2 broader lateral lines (contain two execretory canals).

- 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.



-

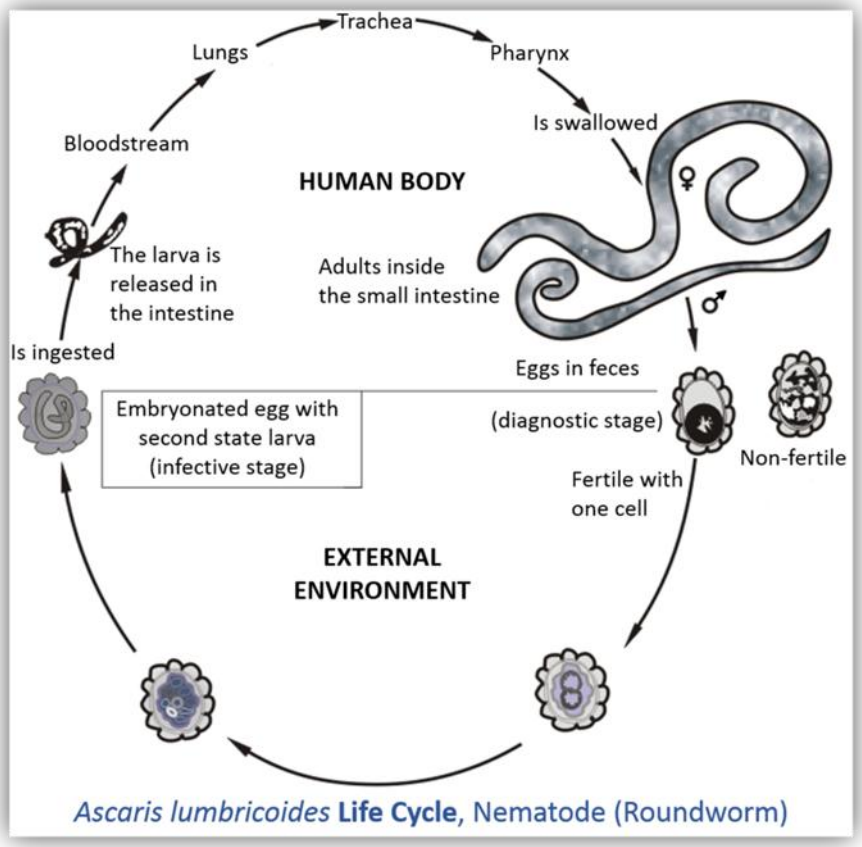
Ascaris

- The female lays about 200,000 eggs daily which pass out with the faeces.

- The infective stage is the egg which contains an embryo, that molts inside the egg ready to infect a new host.

- *Ascaris lumbricoides*, infects humans via the fecal-oral route. Eggs released by adult females are shed in feces. Unfertilized eggs are often observed in fecal samples but never become infective. Fertilized eggs embryonate and

become infective after 18 days to several weeks in soil, depending on the environmental conditions (optimum: moist, warm, shaded soil). When an embryonated egg is ingested, a Rhabditiform larva hatches then penetrates the wall of the gastrointestinal tract and enters the blood stream. From there, it is carried to the liver and heart, and enters pulmonary circulation to break free in the alveoli, A microworm moves through the small intestine and matures into an adult worm until it emerges through the abdominal cavity. Fertilization can now occur and the female produces as many as 200,000 eggs per day for 12–18 months. These fertilized eggs become infectious after two weeks in soil; they can persist in soil for 10 years or more.



Life cycle of *Ascaris lumbricoides*

Coelomata

Phylum: Annelida

General characters:

- These animals are found on land, in moist soil, freshwater or in the sea and they are free living or ectoparasites.
- They are triploblastic, coelomate and bilaterally symmetrical animals.
- They have an elongated and metamerically segmented body.
- The body covered with a thin non- chitinous cuticle and the body wall is muscular with circular and longitudinal muscles.
- They possess chaetae on the segments, some forms with parapodia.
- The alimentary canal is elongated and a tube like. It extends from the mouth to the anus.
- The respiration takes place through the external surface of the body.
- They have closed type of circulatory system, i.e., the blood flows in the blood vessels.
- The excretion by tube- like organs, called nephredia. In each segment a pair or more nephredia are present.
- The nervous system consists of a brain and double nerve cord, with many ganglia in each segment.
- Sexes are separated or occur in the same body. Development may be direct or through a trochophore larva. Regeneration is also common.

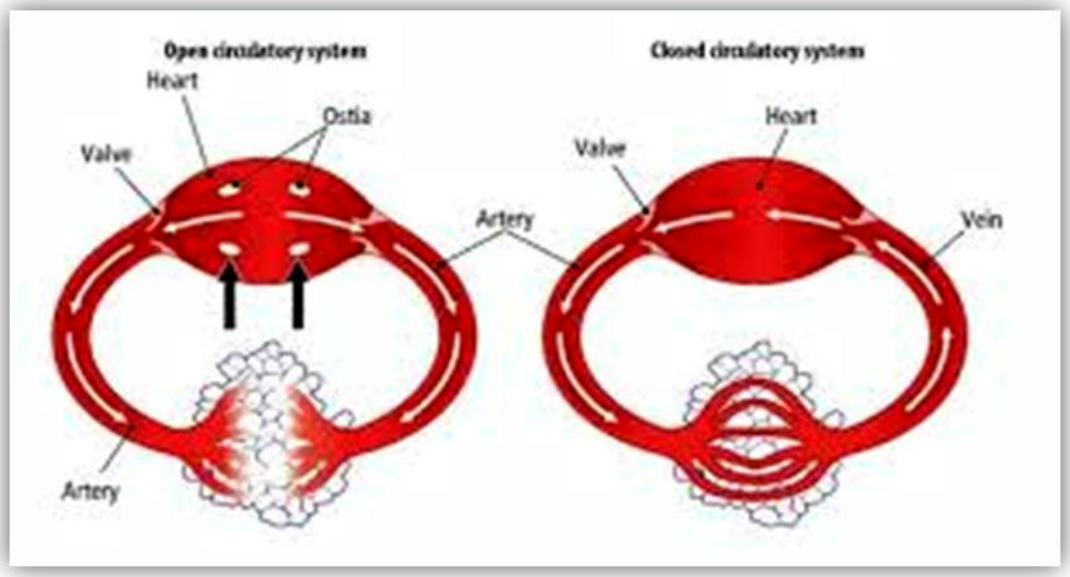


Figure 5: Opened and closed circulatory system

Classification of Annelida

Class: Oligochaeta

Includes the earthworms, live in moist soil or in freshwater. They are hermaphrodite and without parapodia. Ex. *Allolobophora*

Class: Polychaeta

Includes marine forms swim freely in water or live burrowing in the sand and mud near the shore. The sexes are separated and have parapodia. Ex. *Neries*

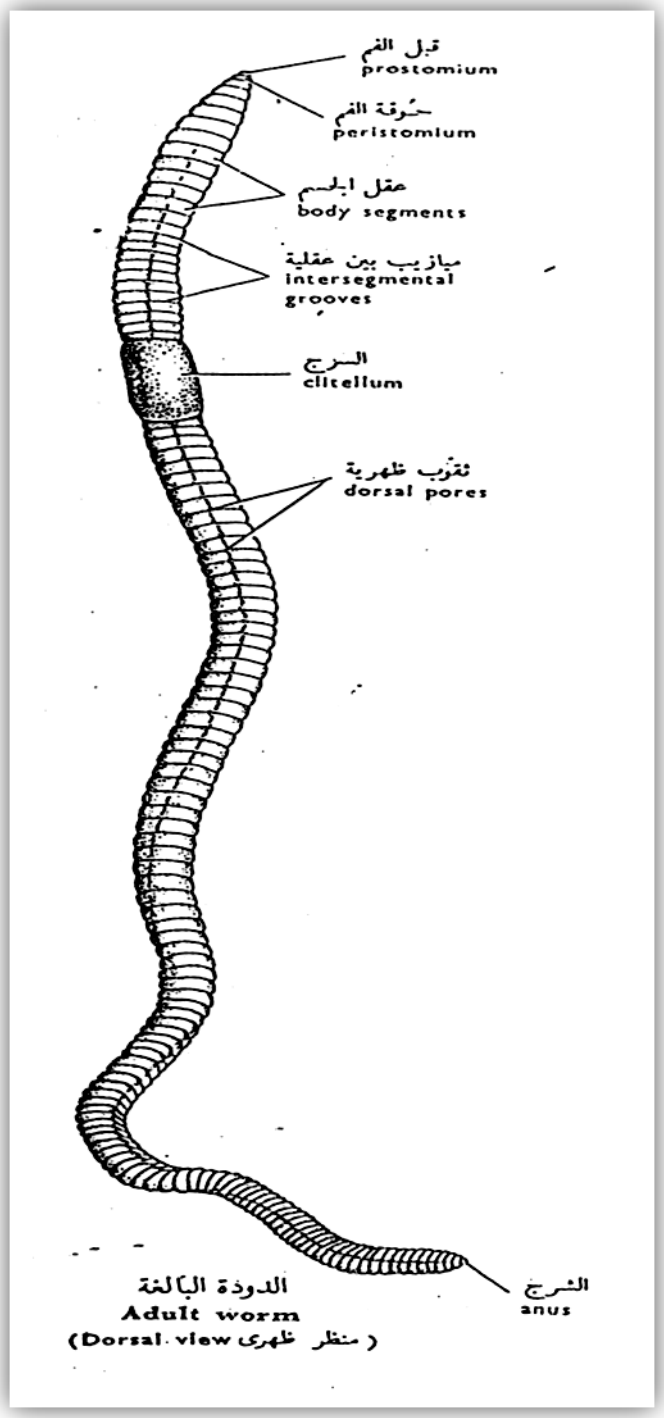
Class: Hirudinea

Includes the leeches which feed on the blood of vertebrates (parasites). They are hermaphrodite and without parapodia and chaetae. Ex.: *Hirudo*

Allolobophora caliginosa

- 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 posterior end.

- The mouth and anus open at the anterior and posterior ends respectively.
- The clitellum (secretes the cocoon) is the thickened skin of segments 26-34 and lies on the dorsal and lateral sides but these segments are distinct on the ventral side. The edges of the clitellum are thickened on segments 31-33 forming the puberty crests.
- Everybody segment, except the first and the last, bears 4 pairs of chaetae, two ventral pairs and one pair on each lateral side.

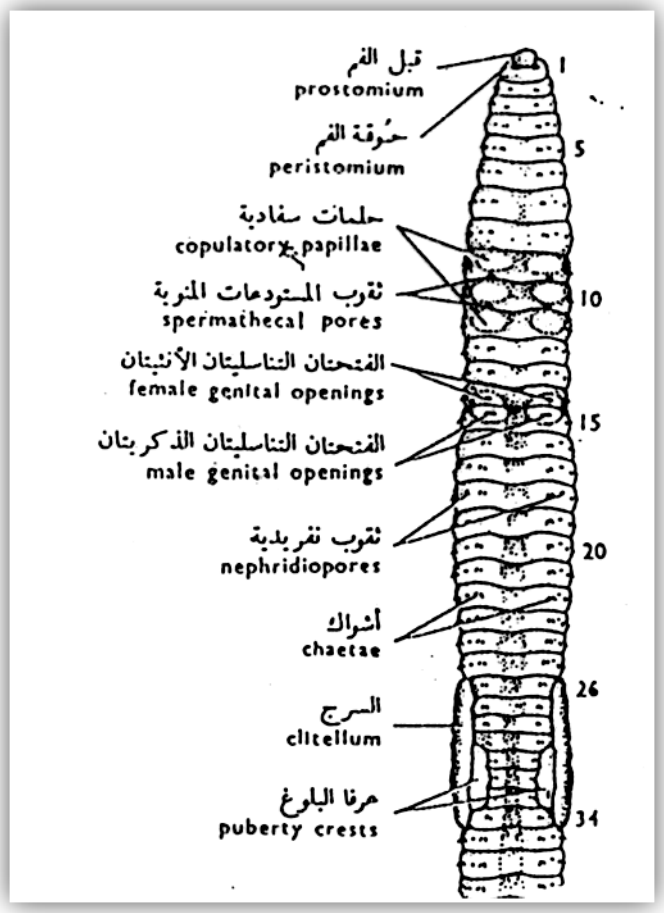


Allolobophora caliginosa

The external body openings:

- The mouth on the first segment.
- 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 surrounded by three pairs of copulatory papillae on segments 9, 10 , 11
- The dorsal (coelomatic) pores lies mid- dorsally on the grooves from 8-9 to the posterior end, connect the internal coelom with the external environment.
- The excretory pores or nephridiopores lies on the ventral side, a pair on each segment except the first three segments and the last segment.



Ventral view of *Allolobophora*

جامعة جنوب الوادي

كلية التربية

ZOOLOGY 2 (INVERTEBRATES)

Code: 107 SC.BIO

Practical Part

By/

Dr. Azza M. Gaber

Biology and Geology

(The first Year Students)

2022-2023

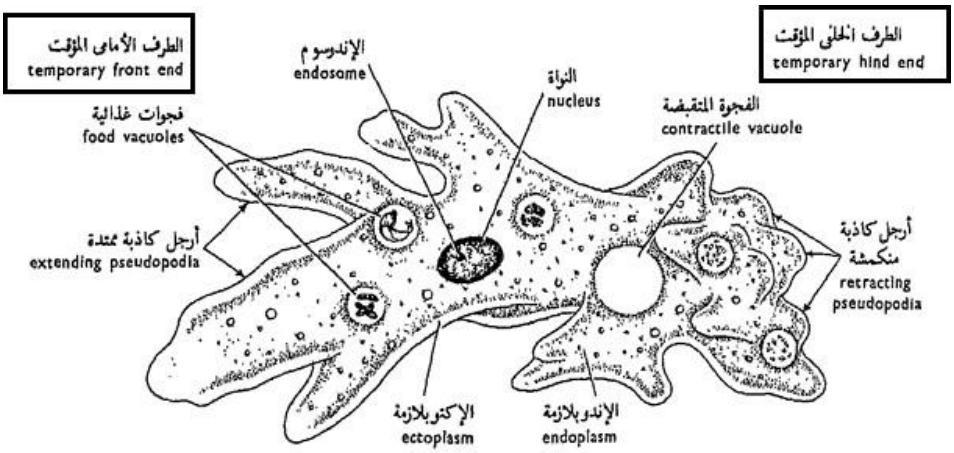
Kingdom : Protista

Subkingdom : Protozoa

Phylum : Protozoa

Class : Sarcodina

e.g. : *Amoeba* sp.



Amoeba proteus

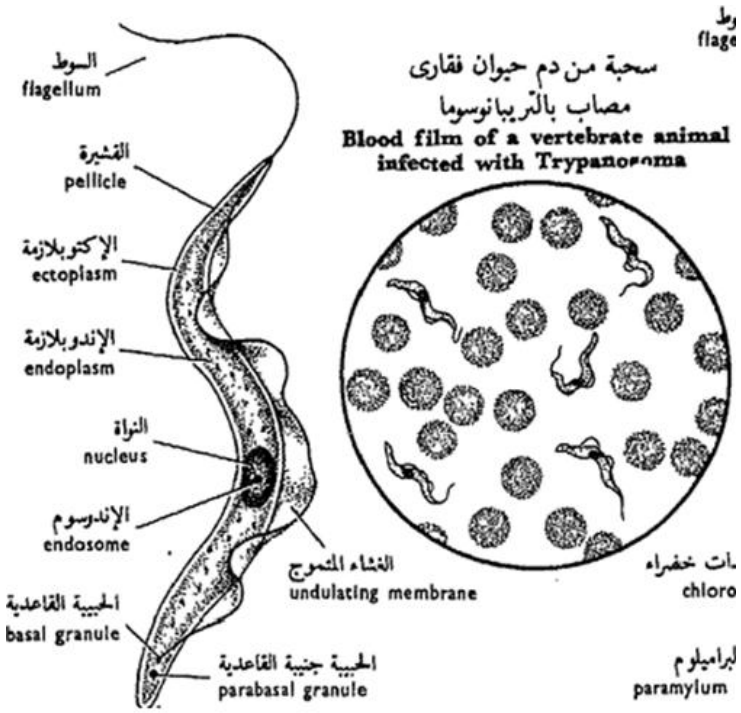
Kingdom : Protista

Subkingdom : Protozoa

Phylum : Protozoa

Class : Mastigophora

e.g. : *Trypanosoma* sp.



Trypanosoma

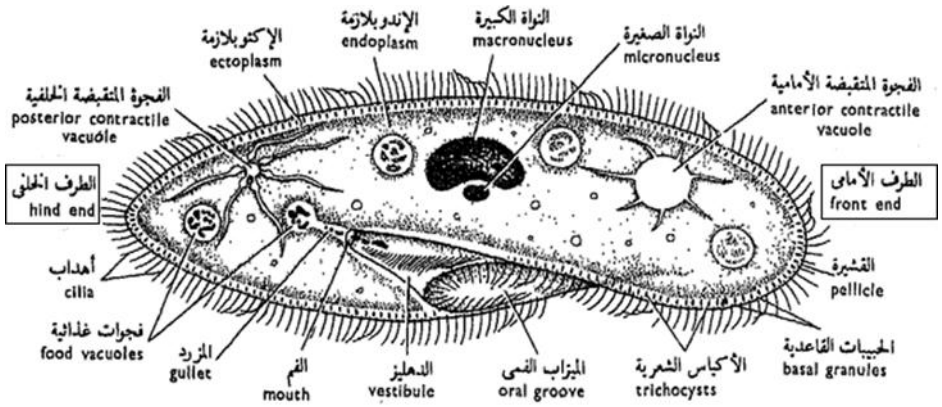
Kingdom : Protista

Subkingdom : Protozoa

Phylum : Protozoa

Class : Ciliophora

e.g. : *Paramecium* sp.



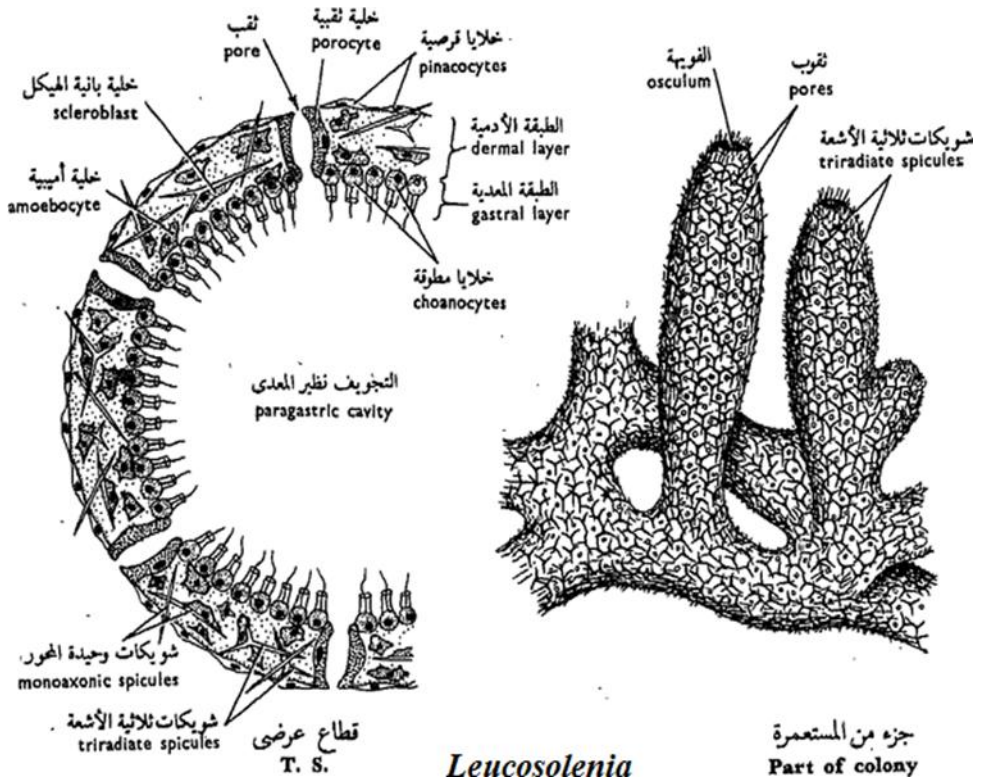
Paramecium

Kingdom :Animalia

Subkingdom :Metazoa

Phylum : Porifera (sponges)

e.g. : *Leucosolenia* (The ascon type)



Kingdom :Animalia

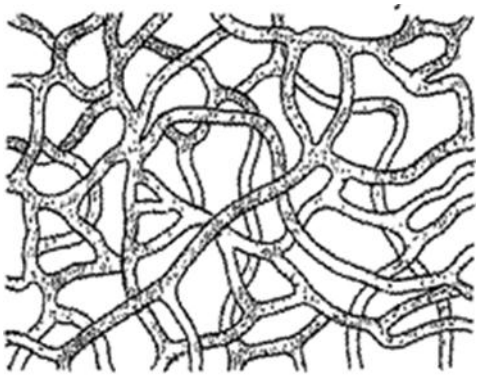
Subkingdom :Metazoa

Phylum : Porifera (sponges)

e.g. : *Sycon* (The sycon type)

e.g. *:Euspongia sp.* (The leucon type)

Sycon



الألياف الإسفنجينية من إسفنج الحمام

Spongin fibres from bath sponge

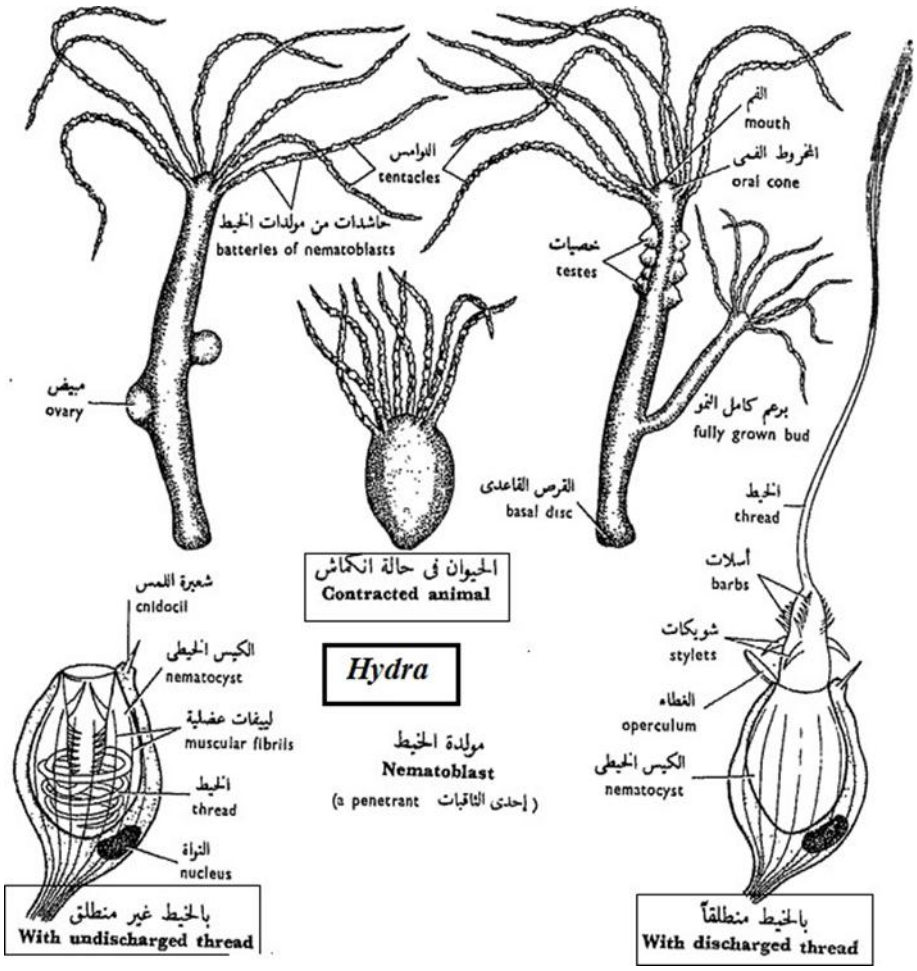
Kingdom : Animalia

Subkingdom : Eumetazoa

Phylum : Coelenterata

Class : Hydrozoa

e.g. : *Hydra* sp.



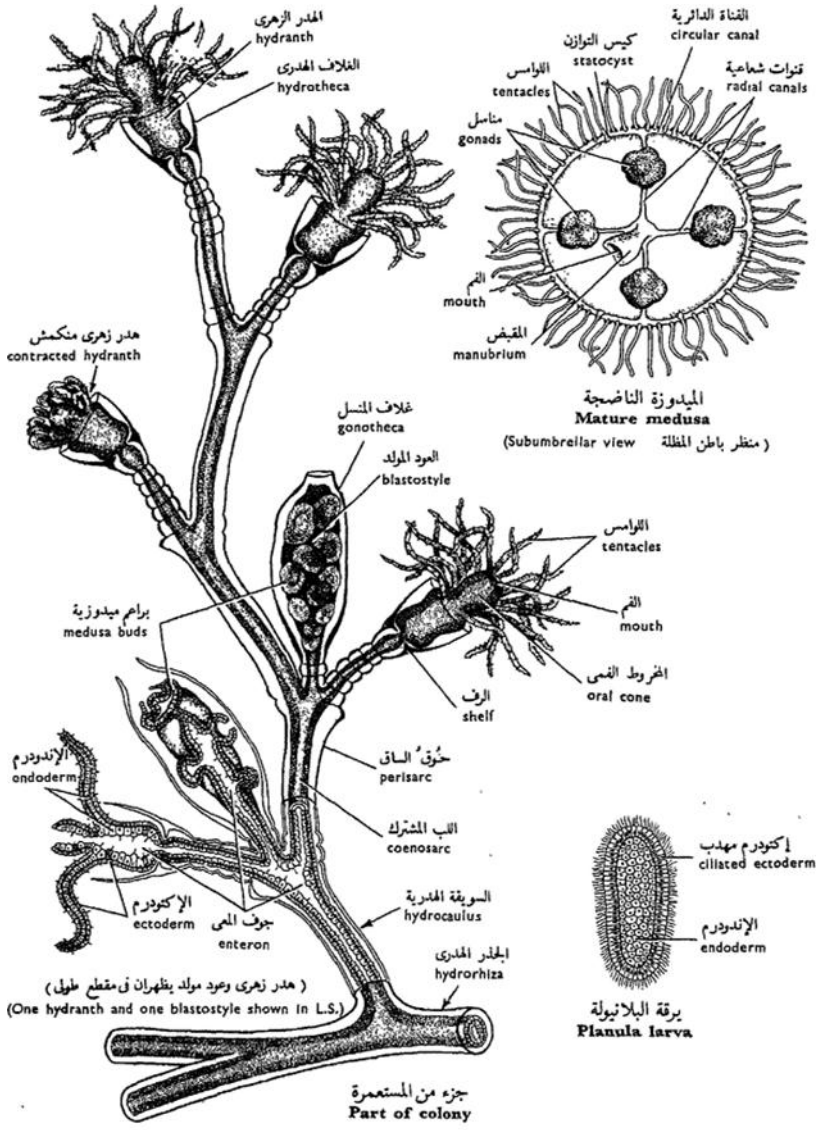
Kingdom : Animalia

Subkingdom : Eumetazoa

Phylum : Coelenterata

Class : Hydrozoa

e.g. : *Obelia* sp.



Obelia

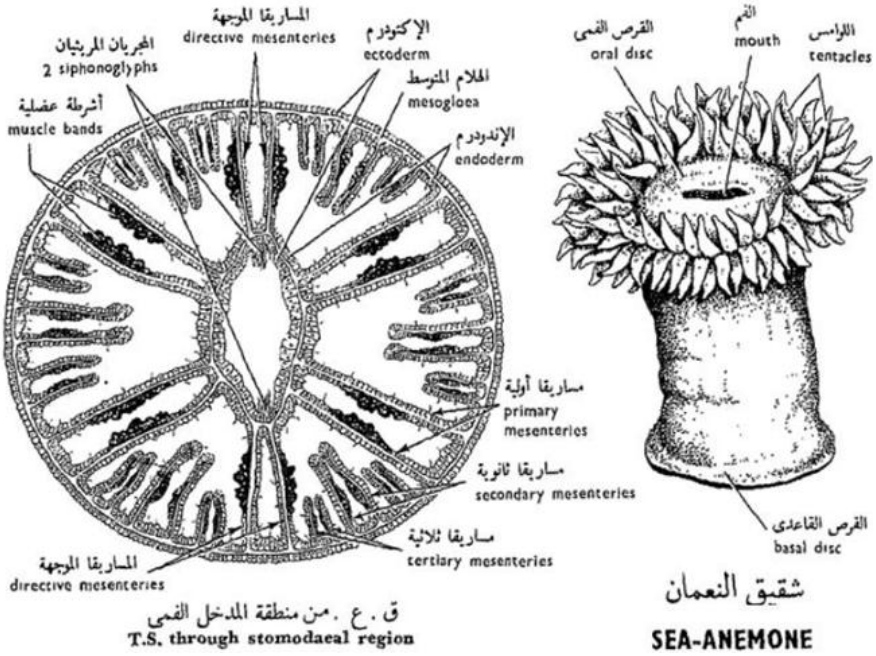
Kingdom : Animalia

Subkingdom : Eumetazoa

Phylum : Coelenterata

Class : Actinozoa

e.g. : *Sea anemone*



ق . ع . من منطقة المدخل الفمى

T.S. through stomodaeal region

شقيق النعمان

SEA-ANEMONE

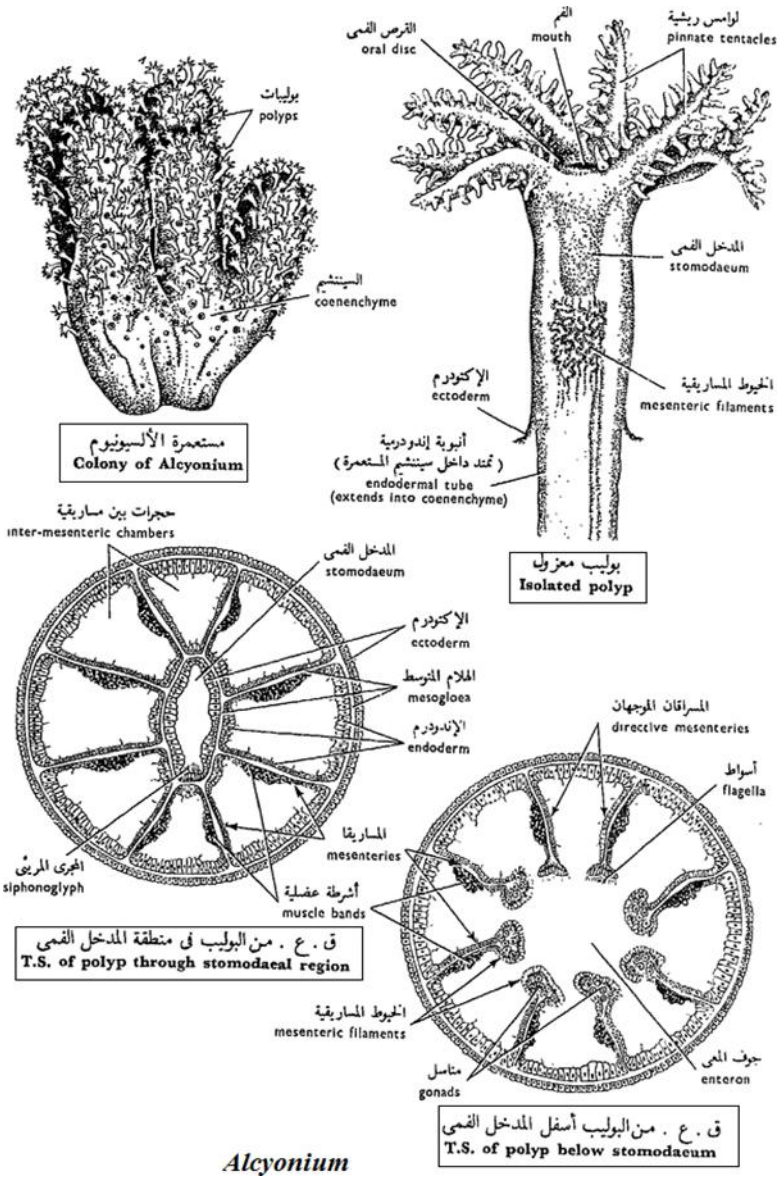
Kingdom : Animalia

Subkingdom : Eumetazoa

Phylum : Coelenterata

Class : Actinozoa

e.g. : *Alcynium sp.*



Alcyonium

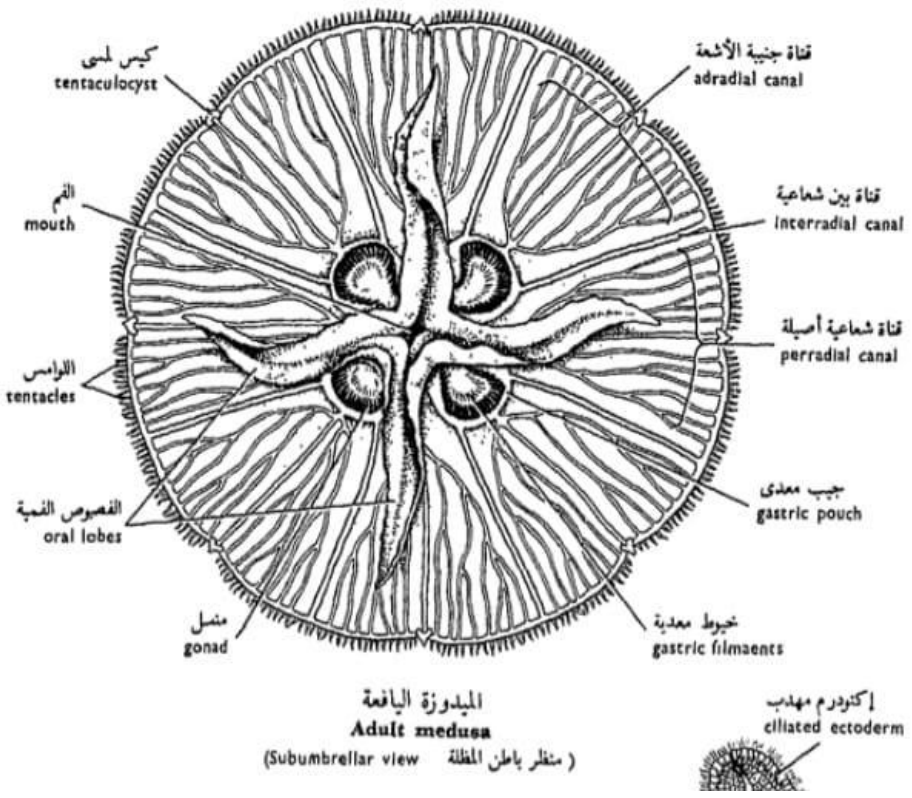
Kingdom : Animalia

Subkingdom : Eumetazoa

Phylum : Coelenterata

Class : Scyphozoa

e.g. : *Aurelia sp.*

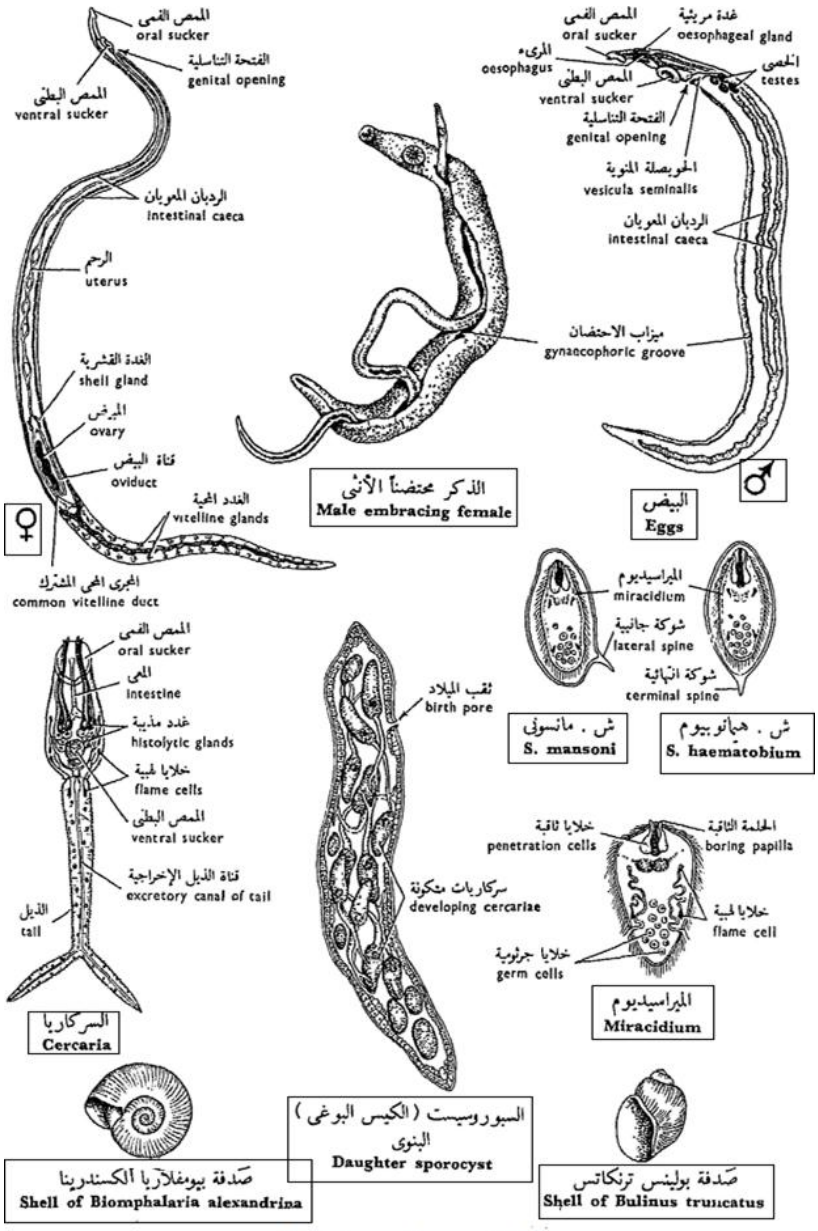


Phylum : Platyhelminthes

Class :Trematoda

Order : Digenea

e.g. : *Schistosoma haematobium*



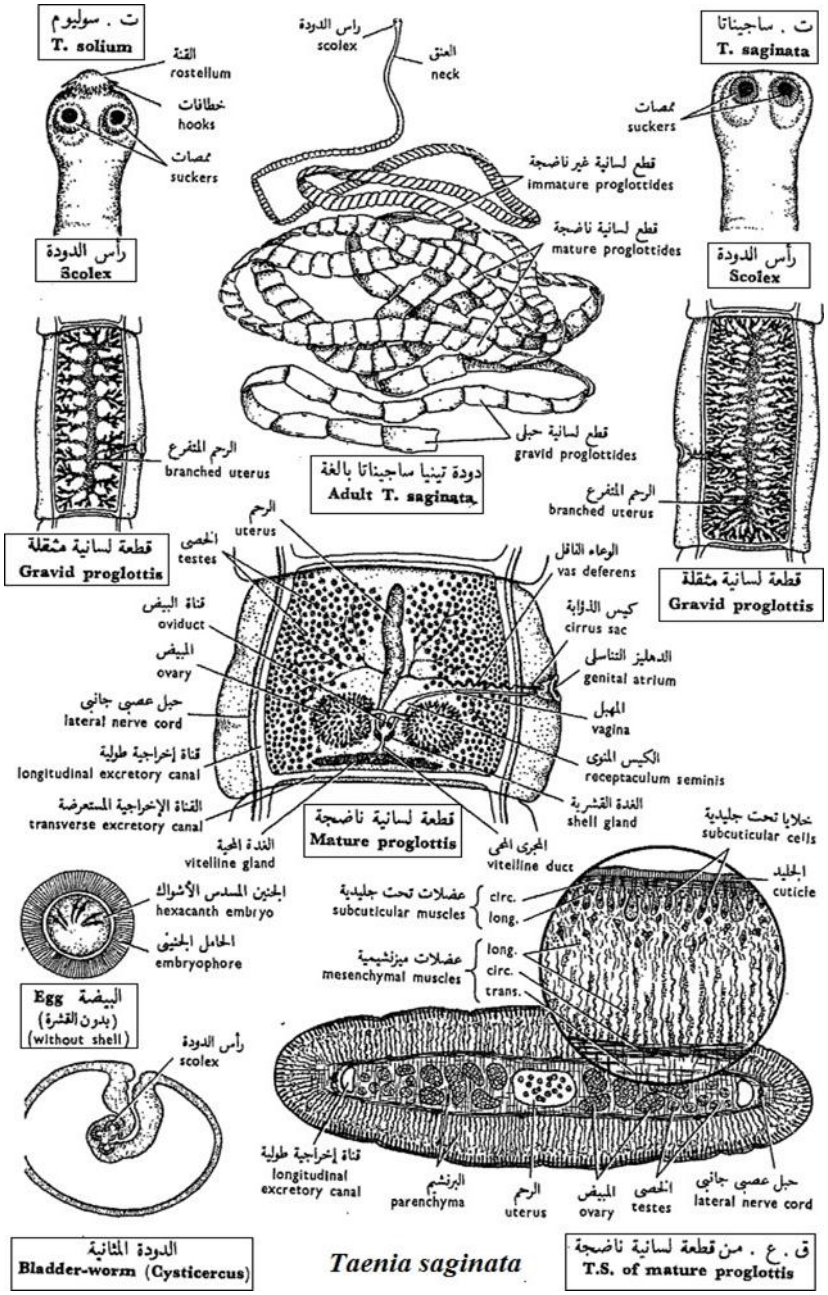
Schistoma haematobium

Phylum : Platyhelminthes

Class :Cestoda

e.g. :*Taenia saginata*

e.g. :*Taenia solium*



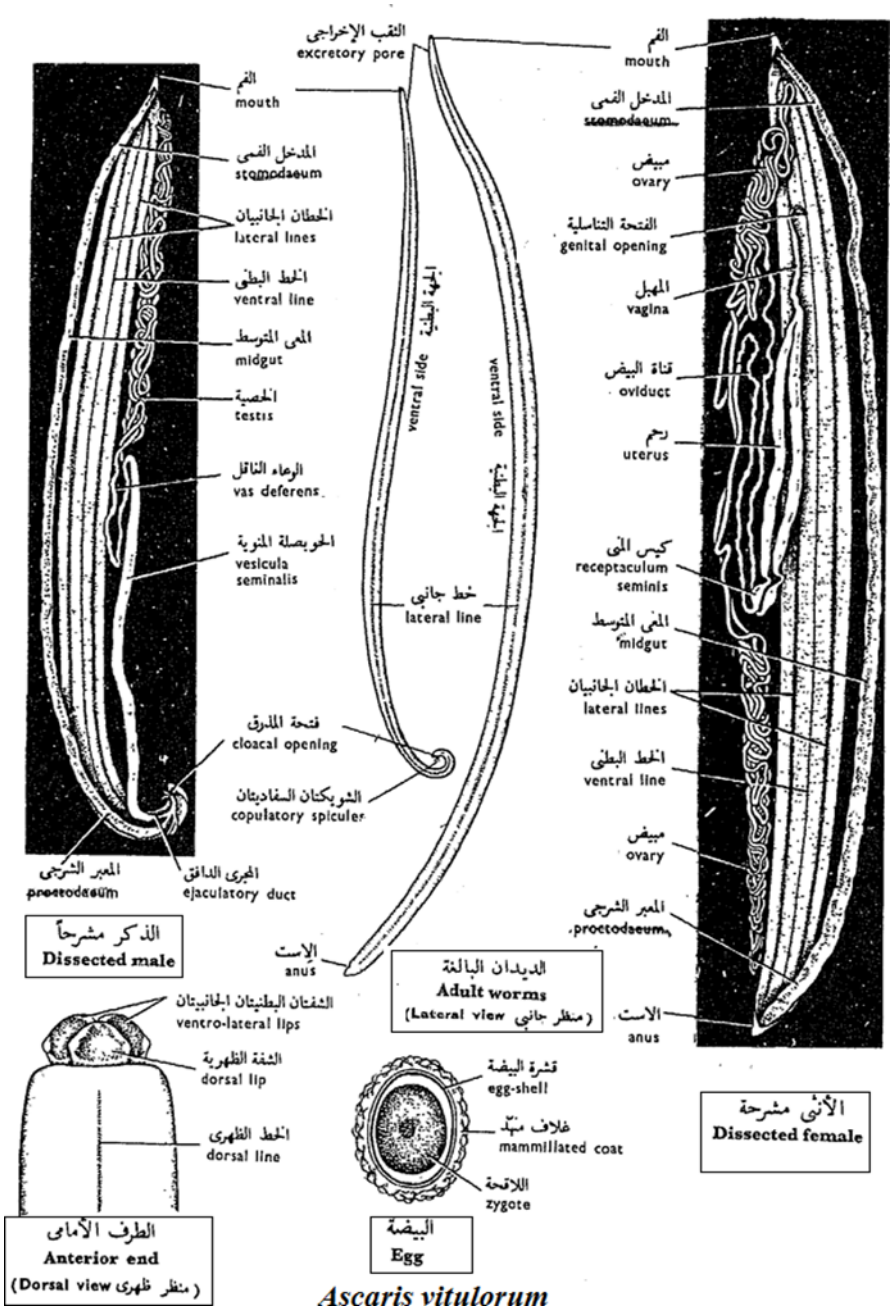
Kingdom : Animalia

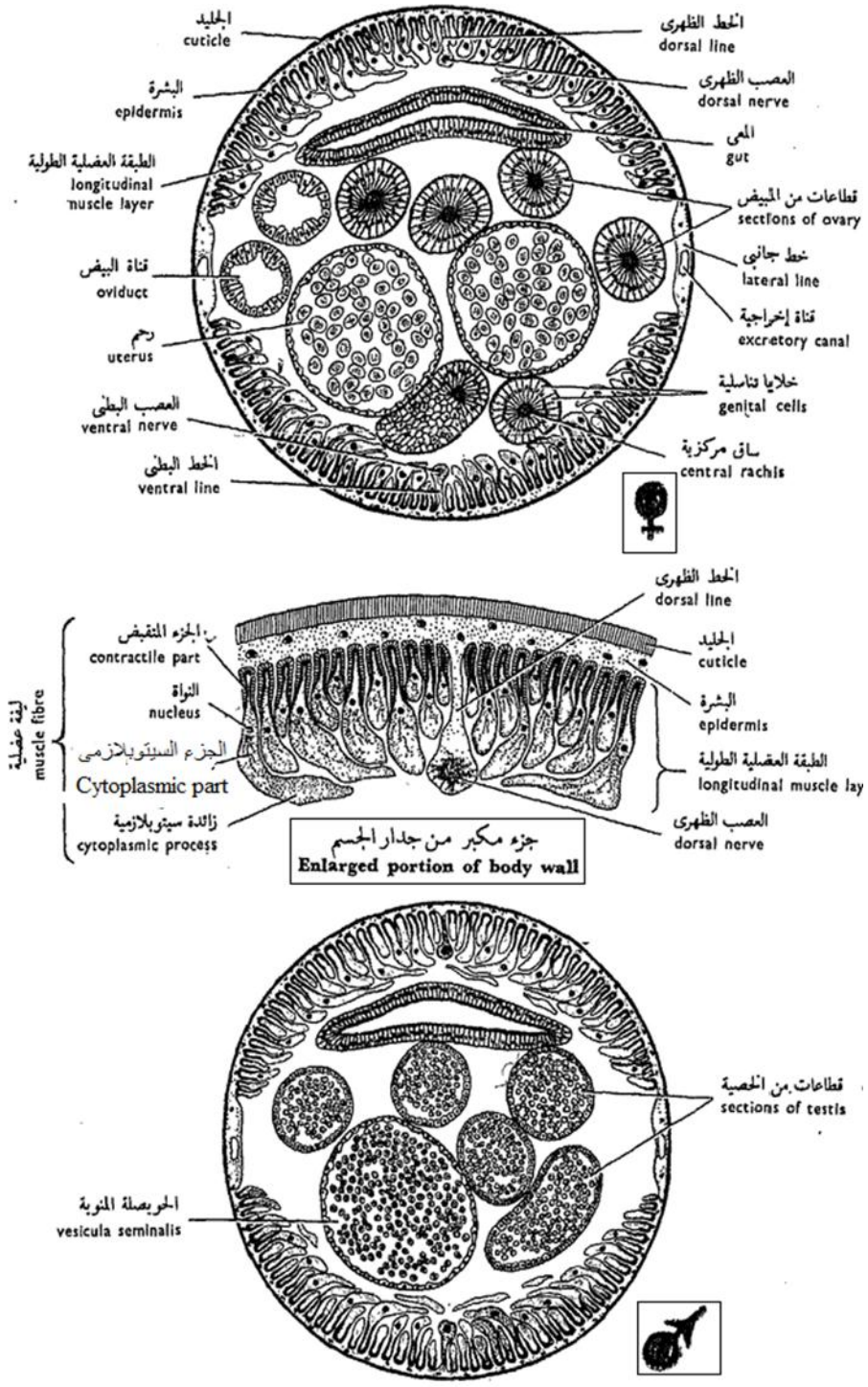
Subkingdom : Eumetazoa

Phylum :Aschelminthes

Order : Ascaridata

e.g. : *Ascaris vitulorum*





T.S. of female and male *Ascaris vitulorum*

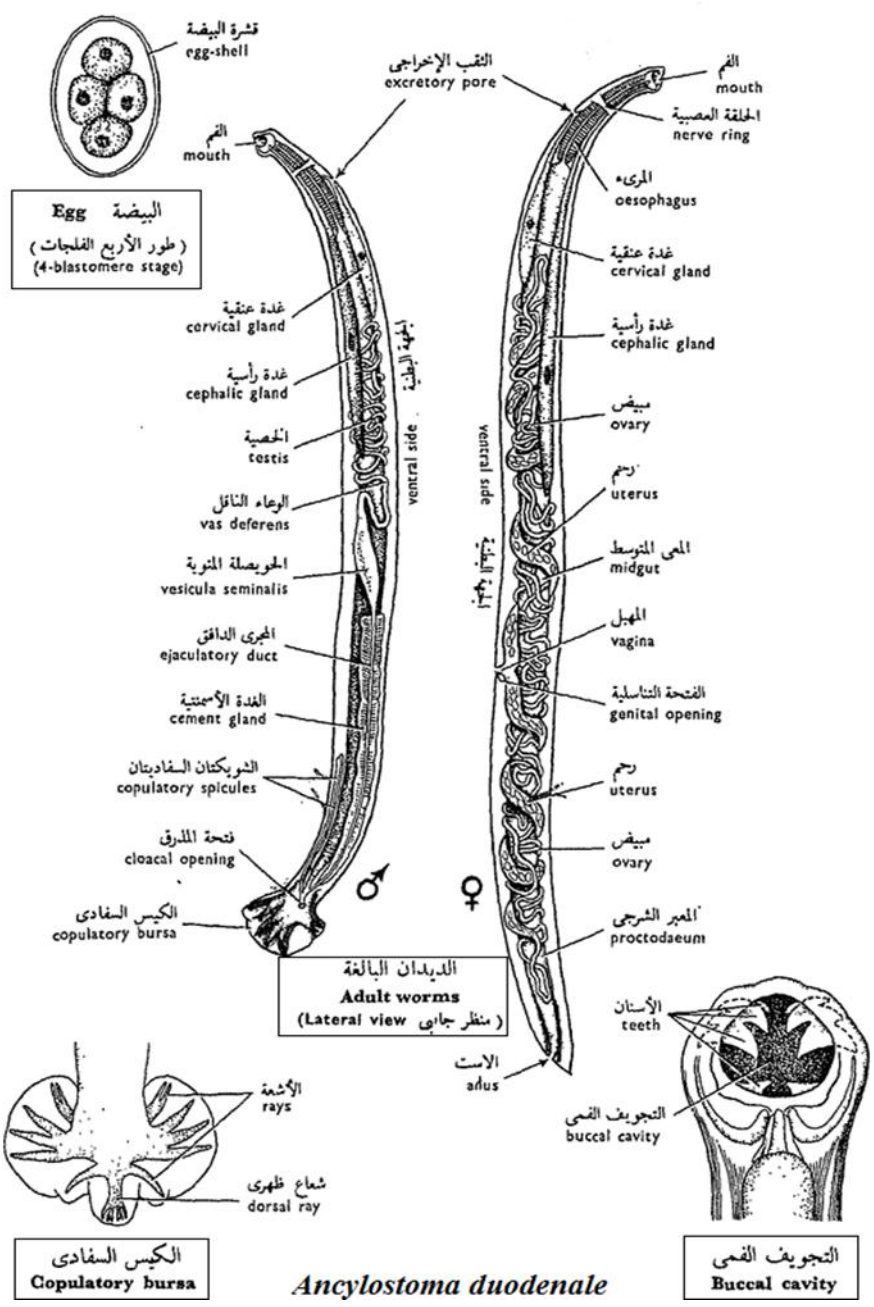
Kingdom : Animalia

Subkingdom : Eumetazoa

Phylum :Aschelminthes

Order : strongylata

e.g. : *Ancylostoma duodenale*



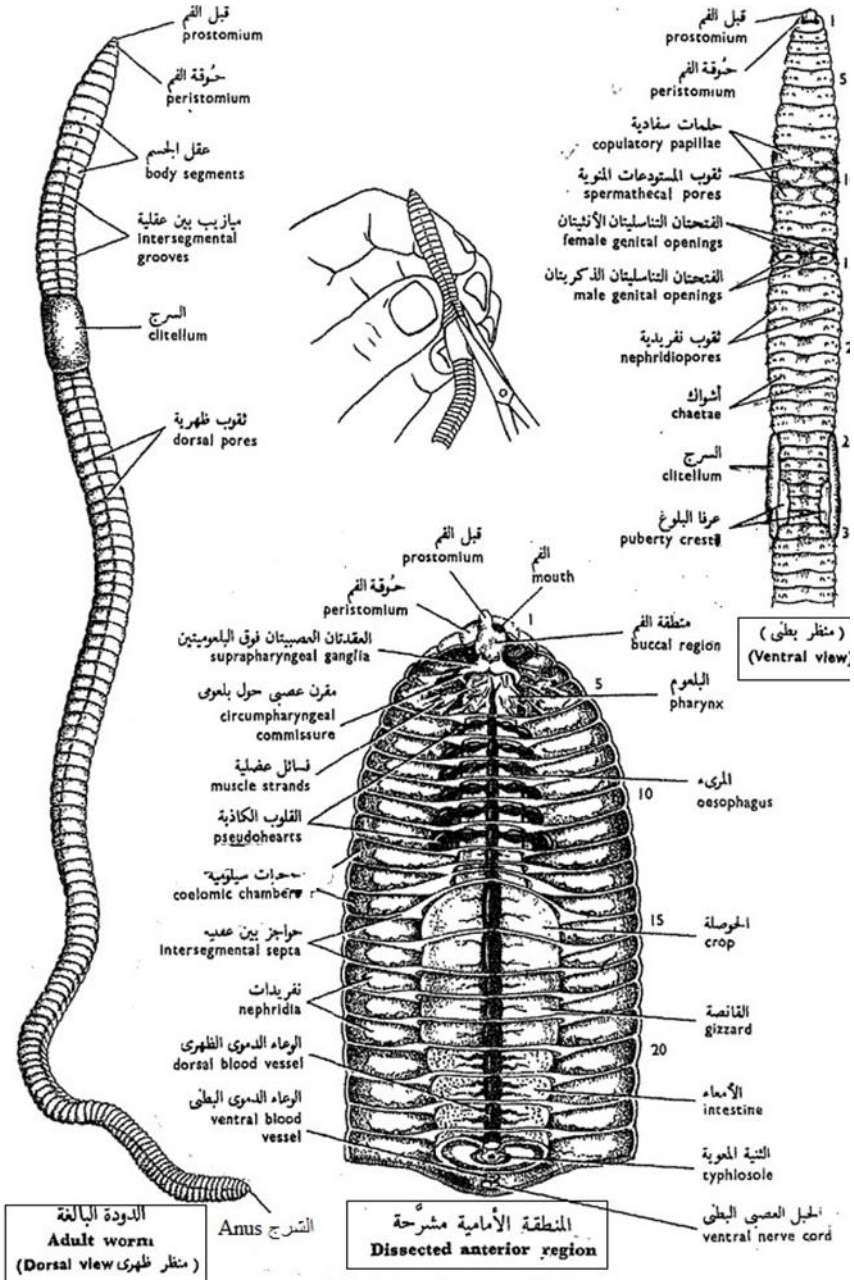
Kingdom : Animalia

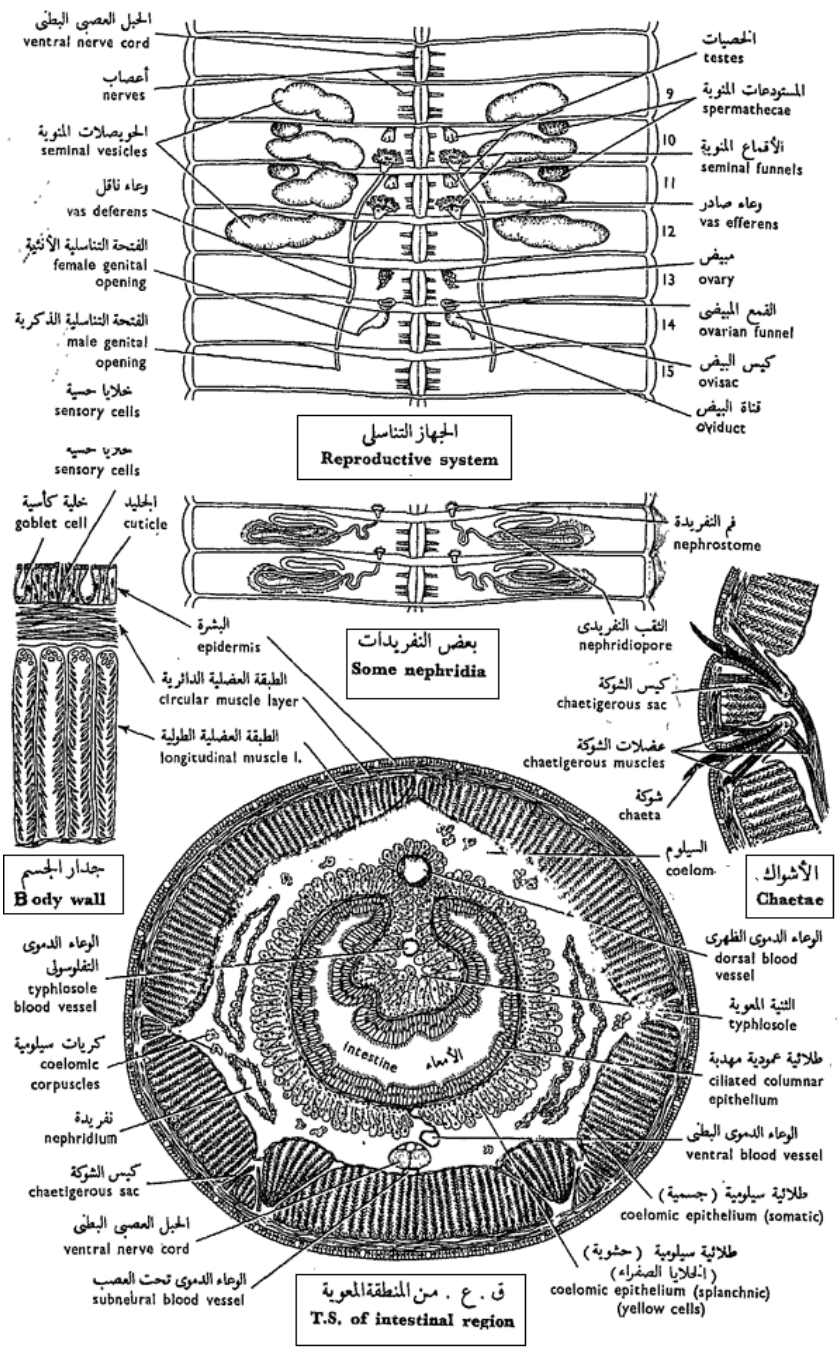
Subkingdom: Eumetazoa

Phylum : Annelida

Class : Clitellata

e.g. : *Aporrectodea caliginosa*





Allolobophora caliginosa

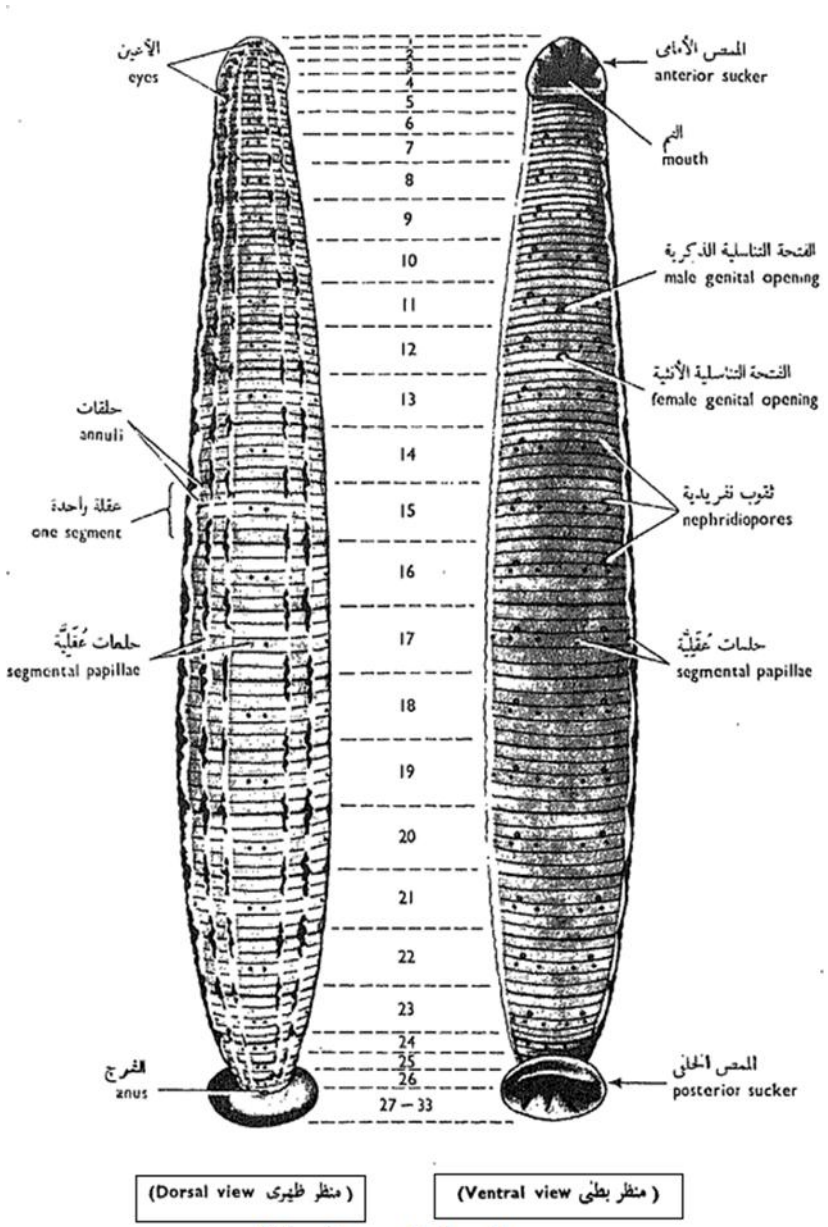
Kingdom : Animalia

Subkingdom: Eumetazoa

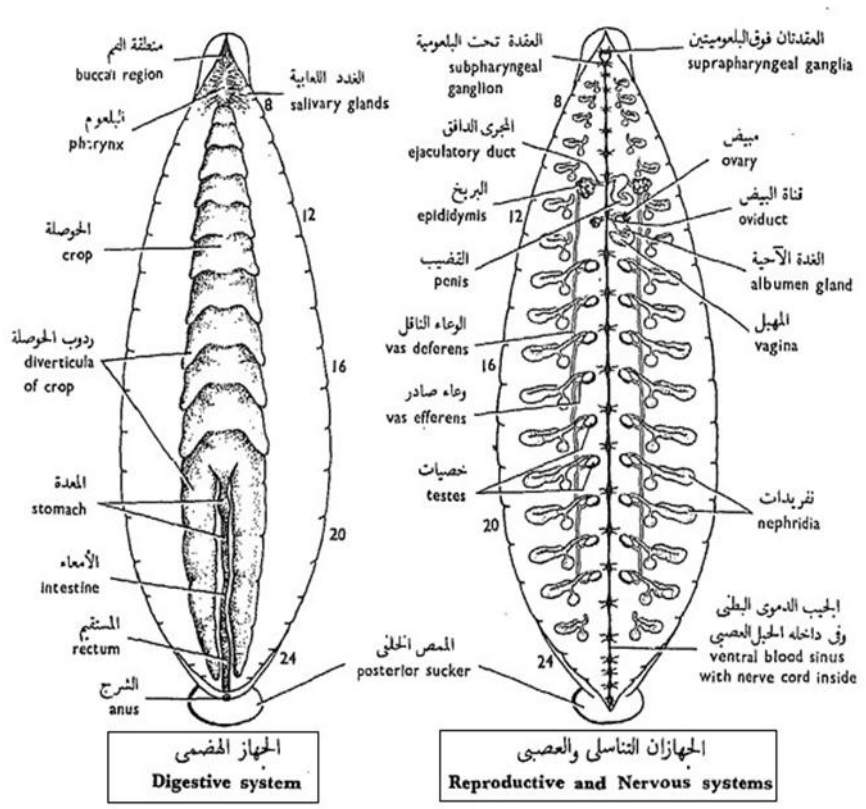
Phylum : Annelida

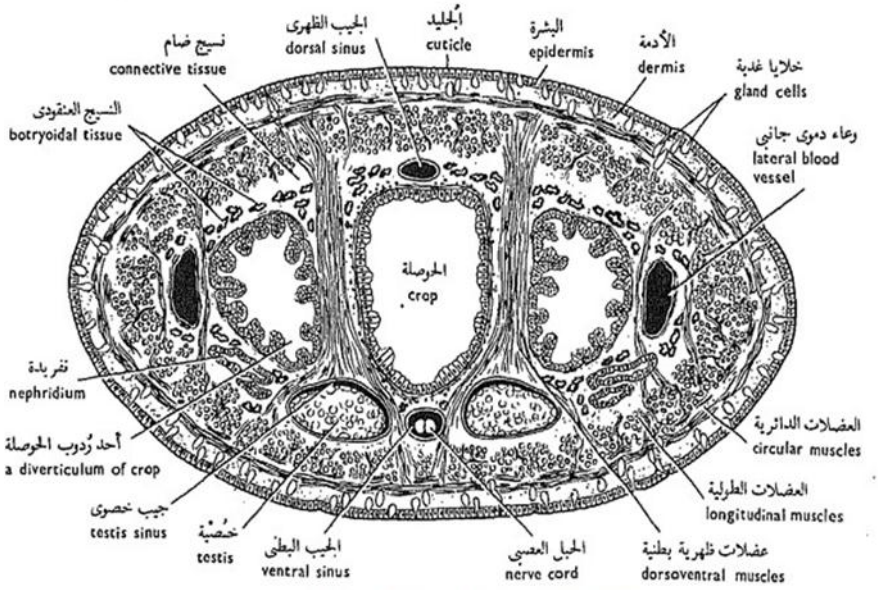
Class : Clitellata

e.g. : *Hirudo medicinalis*



Hirudo medicinalis





T.S. of *Hirudo medicinalis*