Biyani Girls College

Session - (2017-2018)

Set A

B.Sc. (Part I) Zoology

First Paper (Diversity of Animals and Evolution)

Time allowed: Three Hour **Maximum Marks: 33**

Question No. 1 part-I is compulsory. Attempt four questions from Part-II selecting at least one question from each section. All questions in Part-II carry equal 6 marks.

Part – I

Q1. Answer the following question in maximum 25 words: 1 x 9 = 9

(i) Define Protostomia with suitable examples.

Ans. Protostomia represents those animals in which the blastopore finally becomes the oral aperture (mouth). Members of phylum Annelida, phylum Arthropoda andphylum Mollusca exhibit this condition.

(ii) What are key characters

Ans. A key is a device, which when properly constructed and used, enables a user to identify an organism.

(iii) Differentiate redial and bilateral symmetry.

Ans. Identification key is a printed or computer-aided device that aids the identification of biological entities, such as plants, animals, fossils, microorganisms, and pollen grains

(iv) On the basis can evolutionary relationship between blue green algae and bacteria be proved?

Ans. Prokaryotic nature l.e. lack a membrane-bound nucleus, mitochondria, Golgi apparatus, chloroplasts, and endoplasmic reticulum of the blue-green algae has caused them to be classified with bacteria in the prokaryotic kingdom Monera.

(v) Animals of which phylum contain Cnidoblast cells?

Ans. Phylum Coelenterata have cnidoblast or nimetocyst cell which function mainly to protection.

(vi) Archeocyte cell?

Ans. Archeocyte cell are very important cell which they found in phylum porifera. This cell is a totipotent cell then produce whole animal.

(vii) Phylum Mollusca is divided into how many classes? Name them.

Ans. Phylum Mollusca is divided into major five classes and these are Monoplacophora, Polyplacophora, Gastropoda, Bivalvia, Cephalopoda,

(viii) What is Haemocyanin and which phylum represent it.

Ans. Haemocynin is blood pigment that carries blood oxygen which is present in phylum arthopoda and Mollusca etc.

(ix) What is alteration of generation?

Ans. The occurrence in one life history of two or more different forms differently produced, usually an alternation of a sexual with an asexual form.

<u>Part – II</u>

Section-A

Q2. Describe various kinds of symmetry and types of coelom found in the animals with the help of suitable diagrams and examples. (1x6)

Ans. Symmetry or Body symmetry

Body symmetry is the similarity of parts in different regions and directions of body. On the basis of symmetry, the animals are divided into the following categories.

Asymmetrical

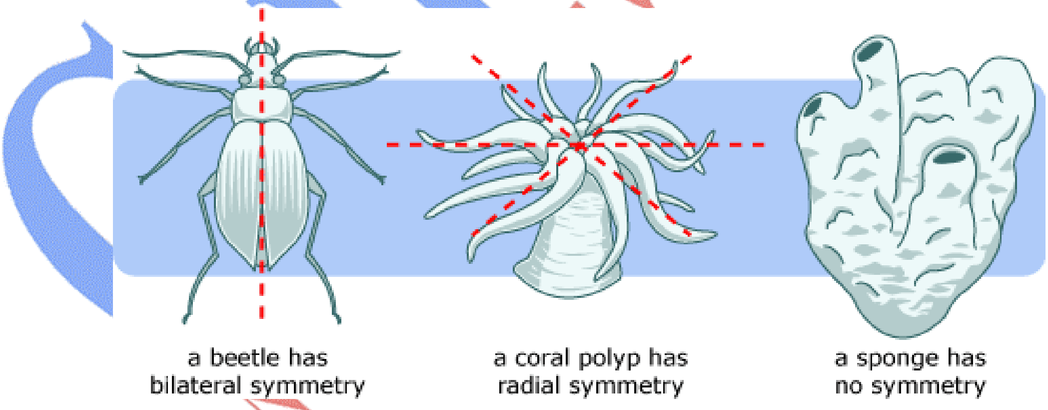
Animals which cannot be divided into two equivalents halves through any plane are described as asymmetrical. For example some sponges which forms various shapes.

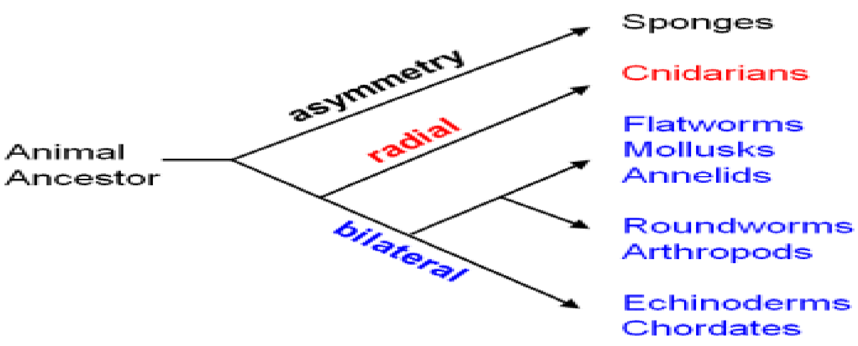
Radially symmetrical

Animals which can be divided into two equivalent halves if they are cut through any of the radial planes. Radial symmetry allows animals, such as jellyfish, corals, and sea anemones, to reach out in all directions from one central point.

Bilaterally symmetrical

These are those animals which can be divided into two equivalent right and left halves only if they are cut in vertical plane passing through their median longitudinal body axis. For example fishes, human beings. Bilaterally symmetrical animals tend to be active and to move forward at an anterior end, which eventually led to concentration of sensory organs in the anterior end, or head (a trend known as cephalization).

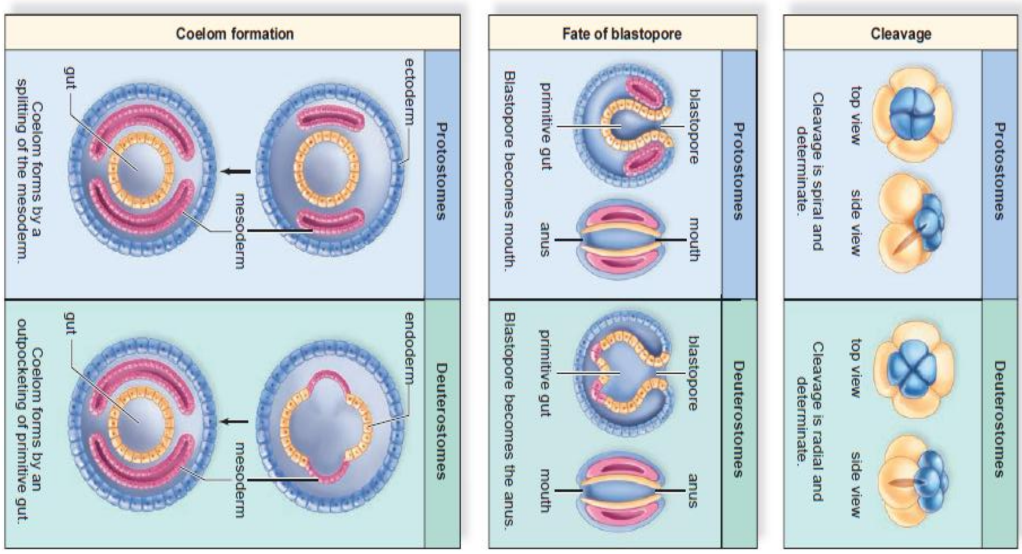




Coelom

1. Coelom is defined as a body cavity lined by mesoderm.
2. It lies between the body wall and the digestive tract in which various internal organs are found suspended.
3. Since diploblastic animals lack mesoderm, hence, coelom does not occur in them.
4. It is found in Annelida, Mollusca, chordates. In animals like arthropods, the coelom is reduced in the adults and found to filled with blood, hence referred to as the haemocoel.
5. On the basis of coelom, the animals are classified into three types :

A. **Acoelomate –** The animals in which the coelom is absent, eg. porifera, coelenterate and Flatworms. In them the space between ectoderm and endoderm is filled with parenchyma
B. **Pseudocoelomate –** The body cavity is not completely lined with mesoderm. Instead the mesoderm is present as scattered pouches in between the ectoderm and endoderm eg. Roundworms
C. **Eucoelomate –** The true coelom is a body cavity which arises as a cavity in embryonic mesoderm. In this case the mesoderm of the embryo provides a cellular lining called as coelomic epithelium or peritoneum to the cavity. The coelom is filled with coelomic fluid secreted by the peritoneum. True coelom found in annelids to chordata. True coelom is of two types
D. **Schizocoelom** – It developed by the splitting up of mesoderm. It is found in annelids, arthropods and mollucs. Body cavity of arthropods and mollucs are called haemocoel
E. **Enterocoelom** – The mesoderm arises from the wall of the embryonic gut or enteron as hollow outgrouths or enterocoelomic pouches. It occurs in echinodermates, hemichordates and chordates

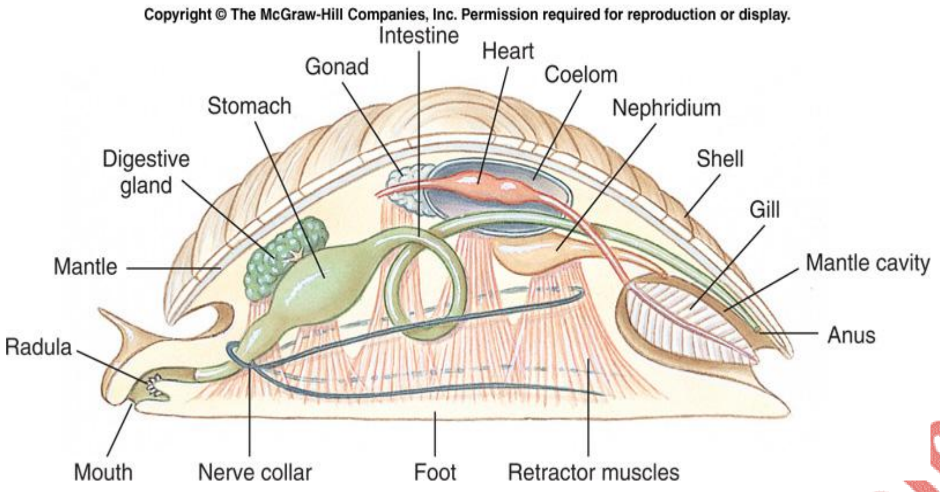


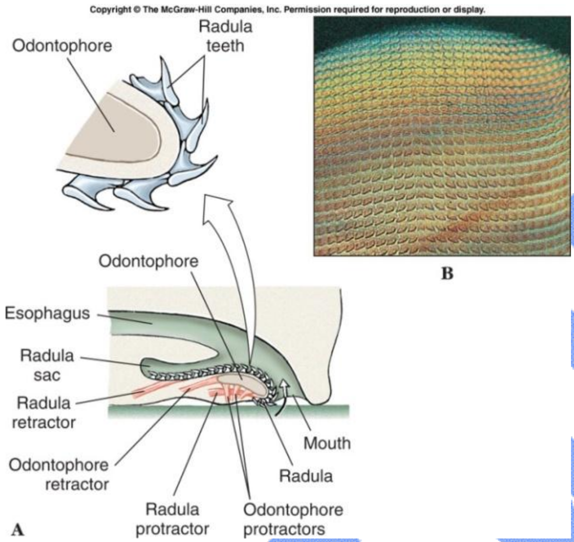
Q3. Describe the general characters of phylum Mollusca and classify up to order level with special features and examples.

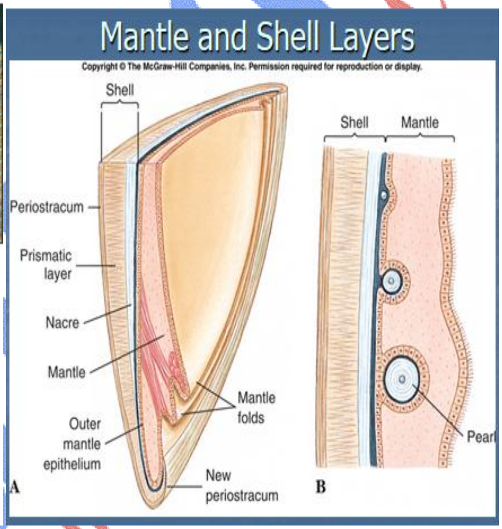
Ans. Phylum Mollusca

General characters:-

- Molluscs inhabit marine, freshwater, and terrestrial habitats.
- Body bilaterally symmetrical; unsegmented; often with a definitive head.
- Possess a muscular foot
- Possess a specialized tissue – Mantle
- Secretes the shell aids in Respiration, reproduction etc.
- Visceral mass contains all major organ systems
- Complex digestive system; rasping organ (radula)
- Open circulatory system
- Respiratory pigment is hemocyanin
- Nervous system consists of paired ganglia
- Well developed sense organs (eyes in cepahlopods)
- Sexes are separate – larval stages in some (Veliger, Glochidium)







Classification:-

There are six major classes:-

- Class Monoplacophora
- Class Bivalvia (Clams, oysters)
- Class Gastropoda (snails, slugs)
- Class Cephalopoda (Squid, octopus)
- Class Polyplacophora (Chitons)
- Class Scaphopoda (Tusk shells)

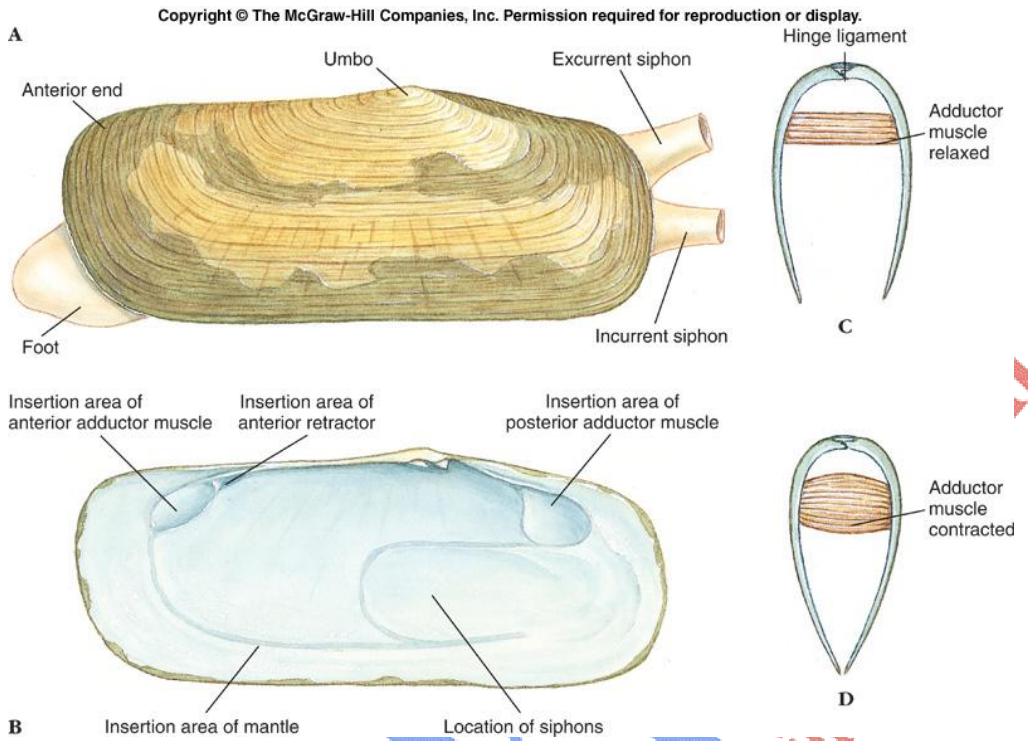
  Additional classes not covered

  Class Caudofoveata

  Class Solengastres

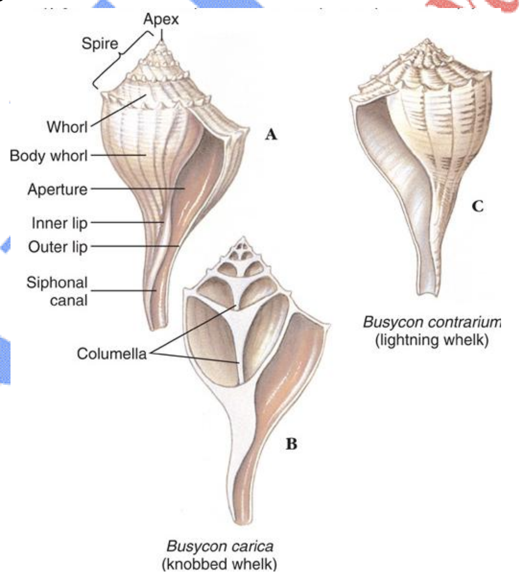
1. Class - Bivalvia (Pelecypoda)

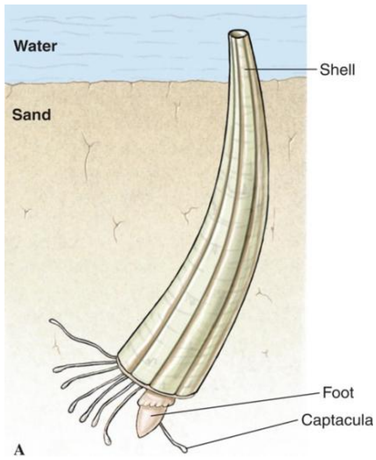
- Body enclosed in mantle
- shell has two lateral valves with dorsal hinge
- Umbo – oldest part of shell
- Head greatly reduced
- No radula
- No eyes, a few species with eyes on mantle margin
- foot usually wedge-shaped



2. **Class Gastropoda:-**

- Body usually asymmetrical with a coiled shell (torsion)
- Some species lack shell and are not coiled
- Head well-developed
- Radula present
- Mantle modified into a lung or gill
- Foot large and flat

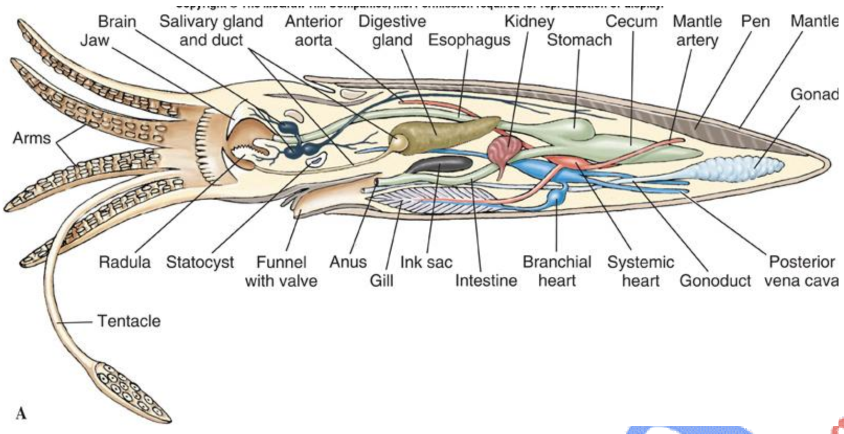




3. **Class Cephalopoda:-** ***Exam.:-*** *Squids, Cuttlefish, Chambered Nautilus, and Octopuses*

- Shell often reduced or absent
- Head well developed with a modified radula to form a beak
- Foot modified into arms and/or tentacles
- Nervous system with centralized brain

- Complex, well-developed eyes



4. Class- Polyplacophora:Exam. Chitons

- Elongated, dorsoventrally flattened
- Reduced head
- Bilaterally symmetrical
- Radula present
- Shell of eight dorsal plates
- Foot broad and flat
- Multiple gills, along sides of body between foot and mantle edge

5. Class – Scaphopoda:Ex. Tusk Shells

- Body enclosed in a one-piece tubular shell open at both ends
- Conical foot
- Mouth with radula and tentacles
- Head absent
- Mantle used for respiration

The word Aplacophora is derived from three words a=not,plax=plate and pherein=bearing. Thus this class includes animals without plate.

It has two orders namely

Order 1:- Neomenioidea

Order 2:- Chaetodermatoidea

- The characteristics are listed in points as follow.
- They have bilaterally symmetrical, cylindrical and worm like body.
- They do not have head, mantle, foot, dhell and nephridia.
- They have body covered with cuticle beset with numerouscalcareousSpicules.
- They have mouth and anus which are terminal or sub terminal at opposite ends.
- They generally have straight digestive tract with a radula.

- They have a pair of coelomoducts in the form of gonoducts opening into the terminal part of intestine or independently.
- They have a mid-dorsal longitudinal keel or crest.
- They may have sexes in the same body (hermophrodite) or may have in separate body(dioecious)

Q4. What are five Kingdome classifications? Describe in details.

Ans. ***<u>Five kingdom classification</u>***

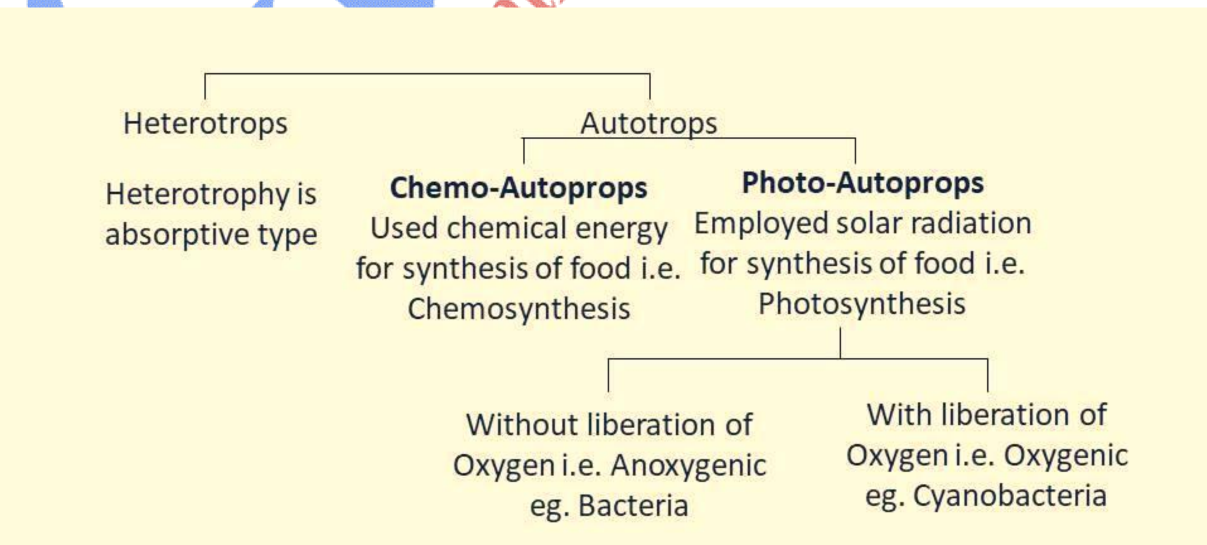
In 1969, Robert H. Whittaker (American taxonomist) suggested a five kingdom classification.

- It excluded viruses from living beings
- Whittaker used three criteria for delimiting the five kingdom

1. Complexity of cell structure
2. Complexity of body structure
3. Mode of nutrition

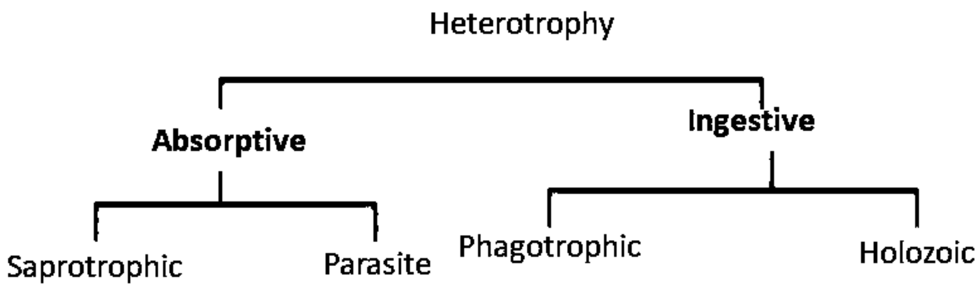
Kingdom Monera (The kingdom of prokaryotes)

- The important monerans are bacteria, mycoplasma, actinomycetes, achaebacteria and Cyanobacteria (blue green algae)
- Unicellular, colonial, mycelial and filamentous (anabaena)
- Monorans occur in almost all types of habitats
- Necked DNA (without histone), ds coiled inside the cytoplasm called nucleoid
- The cell wall contains peptidoglycan and non-cellulosic polysaccharides
- Membrane bound organelles (ER, Mito. Plastids, lysosomes, peroxisomes, Golgi apparatus etc.) are absent
- Thylakoids membrane occur freely in the cytoplasm
- Ribosomes are present but they are 70s types
- Sap vacuoles are absent but gas vacuoles can occur
- Flagella may be present and made up of protein flagellin
- Autotrophic (chemosynthetic or photosynthetic) or heterotrophic mode of nutrition



- Gene recombination can occur
- Both aerobic & anaerobic types of respiration are present

- Have important role in N_2 cycle
- Reproduction is asexual through fission, fragmentation, budding and spores



Kingdom Protista (Unicellular eukaryotes)

- The important members are diatoms, dinoflagellates, euglenoids, slime molds and protozoans (sarcodines, ciliates & sporozoans). Most of them are aquatic and constitute planktons
- Cell organelles found, 80s ribosome in cytoplasm and 70s in mitochondria and plastids (if present)
- Locomotion by flagella, cilia and pseudopodia, 9+2 protein arrangement
- Cell wall with cellulose
- Food reserve id diverse – starch, paramylon, glycogen, fat etc.
- 80% phytoplankton and zooplanktons are belong to Protista
- Slime molds are intermediate between wall-less and walled protistans
- Asexual reproduction is quite common
- Sexual reproduction is present but an embryo stage is absent

  Drawback: 1. Spindle apparatus is not formed during nuclear division

  2. Slime molds do not fit in Protista

Kingdom Fungi (Multicellular decomposers)

- Multicellular achlorophyllous and spore producing eukaryotes organisms like Rhizopus, Mildews, Rusts, Mushrooms, Bracket, Fungi, Morels, Yeast and Lichens etc.
- The body of a fungus is called mycelium
- Fungal wall contain chitin or fungus cellulose
- A double envelope organization occurs in fungal cells.
- Golgi bodies or dictyosomes are unicisternal
- Reserve food is glycogen and oil
- Asexual reproduction is quite common

  Drawback: 1 Yeasts are exceptional in being unicellular

Kingdom Plantae (Multicellular Producers)

- The important members are green algae, brown algae, red algae, bryophytes, pteridophytes, gymnosperms and angiosperms
- Body form is generally irregular due to occurrence of branches
- Body organs are external
- Except in some lower forms, structural organization is of tissue and organ level
- Plant cells possess cell wall mostly made of cellulose
- Mature cells have central vacuoles.

- Plastids and inorganic crystals often occur
- Food reserve is starch and fat
- Plants trap energy with the help of chlorophylls and carotenoids
- Lower forms produce spores. Vegetative reproduction is common
- Sexual reproduction is found in all. An embryo stage is present except in algal groups

Kingdom Animalia (Multicellular Consumers)

- Metazoa includes all animals of the two kingdom classification except protozoa
- Organisms are multicellular, tissue, organ and organ system level
- Body organs are internal
- Body has a definite shape and symmetry
- Animals possess sense organs and nervous system
- Sexual reproduction involves formation of gametes inside gonads. Embryo stage usually present. Embryo attached with placenta

Advantages of five kingdom classification

- It brings out phylogeny in the living world
- Kingdom Animalia has become more homogeneous with the exclusion of protozoa
- Separation of fungi from plants as well as slime molds is a wise steps
- Creation of kingdom monera for prokaryotes is fully justified become they have their own level of structural and biochemical organization

Disadvantages of five kingdom classification

- Kingdom Protista is highly heterogeneous group with several lines of evolution
- It is very difficult to make distinction of unicellular and multicellular forms of algae. Placing algae in three kingdom seems to be unrealistic
- Slime molds do not fit into kingdom Protista
- Viruses do not find any places in this system of classification
- Red and brown algae are not related to other members of kingdom plantae

Section-B

5. Write short notes on the following – (2x3)

a) Locomotion in amoeba

Ans.Ans. Amoeboid movements:

It is a form of locomotion particularly characteristic of many of the sarcodine Protozoans but it is also found in a wide variety of metazoan cells, ranging from the oocytes of sponges to the white blood corpuscles of vertebrates. The discovery of amoeboid movements among plant zoospores, animal ova, in-the endoderm cells lining the digestive tract of a great variety of animals, in the nuclei of some animals -all these instances of amoeboid movement occurring in such widely different tissues inevitably place it among the most important phenomena known to occur in organisms.

Rolling movement theory in Amoeba verrucosa by Jennings (1904): Jennings observed that in A verrucosa, a carbon particle on Amoeba's upper surface first passes forward and then turning downwards along the anterior tip, remains on the lower surface for a time as the body rolls forward and then passes upward at the posterior end to repeat the cycle. But Jennings found it impossible to explain for A proteus which moves with pseudopodia.

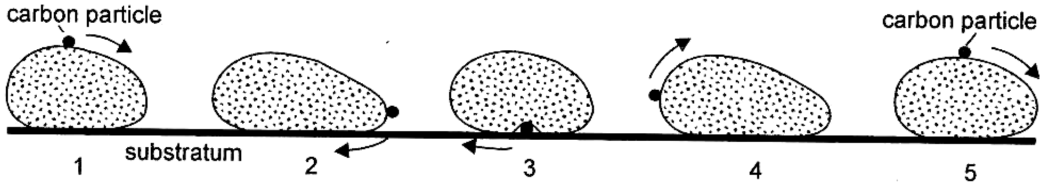


Fig: Rolling movement theory

Sol-gel theory by Hyman (1917) and supported by Mast and Pantin: The colloidal character of cytoplasm differentiates the properties of ectoplasm and endoplasm. The ectoplasm is a colloidal gel, the plasmagel and endoplasm a sol, the plasmasol. Amoeboid movement is interpreted as a result ofcoordinated gelation and solation. At the end, gel under goes solation and contraction forces the fluid sol forwards and there is transformation sol to gel (gelation) at the anterior end, so that solation is balanced by gelation. (Forcing out a pseudopodium at some point).

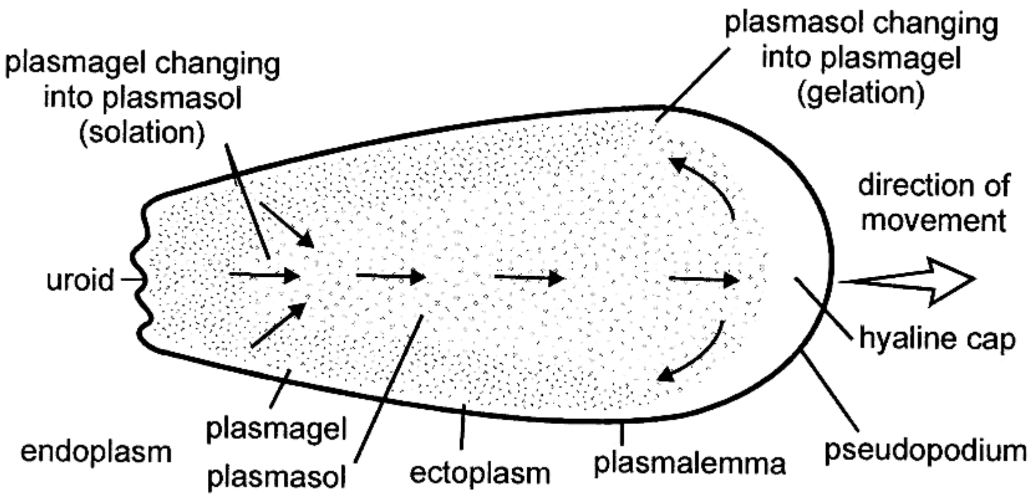


Fig: Sol and gel theory

b) Sexual reproduction in paramecium

Ans. Paramecium in Conjugation (Sexual Reproduction):

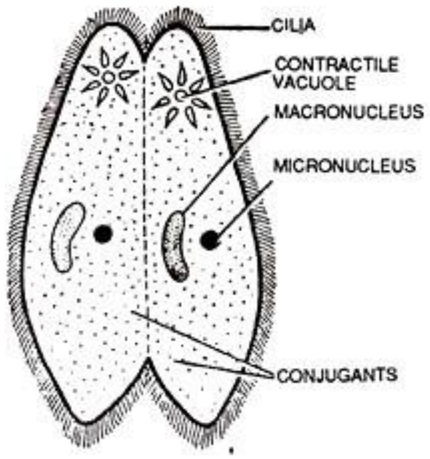


Fig. 82 PARAMAECIUM IN CONJUGATION

(1) In conjugation (sexual reproduction) the two paramaecia come in contact and unite through the edges of their oral groove.
(2) The pellicle, all along the union of two forms, is disintegrated. At this stage they are called gametocytes or conjugant.
(3) The macronucieus of each conjugant disappears and their micronucleus divides twice and forms 4 haploid micronuclei.
(4) Out of these four micronuclei three daughter micro nuclei disintegrate, while remaining one divides into two unequal daughter pronuclei. Of these, the smaller one is the active male migratory pro-nucleus, whereas the larger one is the stationary female pro-nucleus.
(5) The migratory male pro-nucleus of each conjugant moves through the protoplasmic bridge into the other conjugant and ultimately fuses with stationary female pro-nucleus forming zygote.
(6) The nucleus of zygote is diploid and is called amphinucleus and this type of mixing of two nuclei from different individuals is called amphimixis.
(7) After zygote formation the nucleus continue division and forms four daughter paramecia.
(8) The conjugation occurs only when nutrition is deficient and when temperature of water is below the optimum.
(9) Conjugation results in rejuvenation and transference of hereditary materials and occurs in different strains.

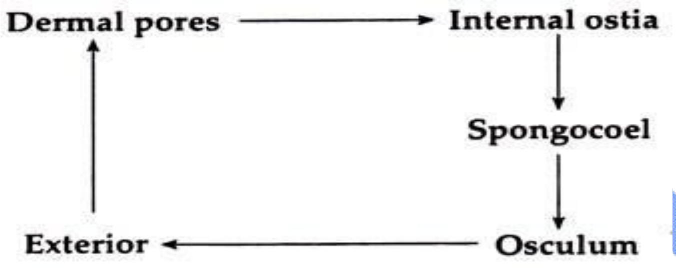
6. What is canal system? Describe the different types of canal system in Porifera. (1x6)

Ans. Body of all sponges is the perforated by large number of apertures through which water enters Inside body and flows through a system of criss-crossing canals collectively forming the canal system which is a characteristic feature of poriferans. Following types of canal systems are found in sponges:

Ascon type, with flagellated spongocoel
Sycon type, with flagellated radial canals
Leucon type, with flagellated chambers
Rhagon type, with conical shape and broad base

ASCON TYPE

This is the simplest type of canal system and is found in Leucosolenia and other homocoela. Ostia are present on the surface of body and lead directly into the spongocoel, which is lined by flagellated choanocyte cells. Spongocoel opens to the outside through a narrow circular opening, the osculum located at the distal free end of the sponge body. Water enters through ostia into spongocoel and goes out of body through the osculum.



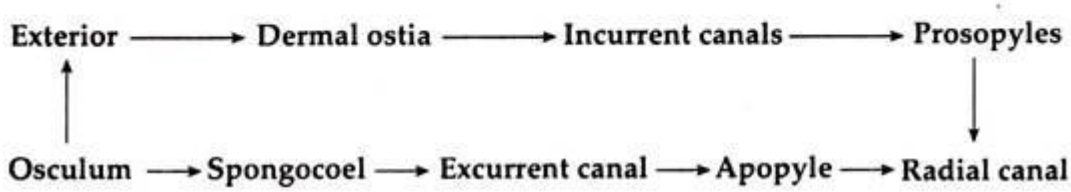
Ascon type

SYCON TYPE

This type of canal system is a characteristic of syconoid sponges, e.g. Scypha and Grantia. Body wall is secondarily folded to form incurrent and radial canals, which open into the spongocoel by an opening called apopyle. Both types of canals are interconnected by minute pores called prosopyles. Incurrent pores or ostia are found on the outer surface of body and open into the incurrent canals, which lead into adjacent radial canals through minute openings called prospyles. Radial canals are the flagellated chambers that open into central spongocoel by internal openings called apopyles. Spongocoel is a narrow, without flagellated cells but is lined by pinacocytes and opens to exterior through the osculum.

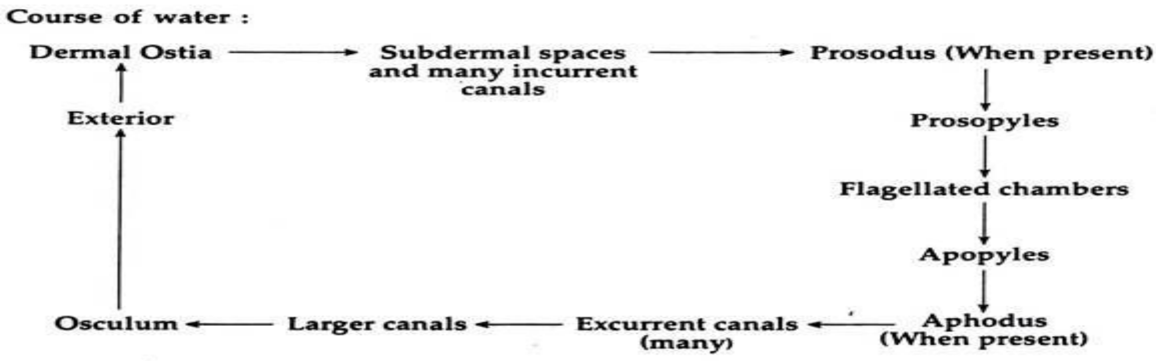
In more complex sycon type, as found in Grantia, the incurrent canals travel along an irregular course through the tissue and connect to the radial canals, thus forming large sub-dermal spaces.

Course of water :



LEUCON TYPE

In this case, the radial canals get divided into small rounded or oval flagellated chambers by further folding of the body wall. This is a characteristic feature of the leuconoid sponges such as Spongilla. Incurrent canals open into flagellated chambers through prosopyles. Flagellated chambers, in their turn, communicate with excurrent canals through apopyles. Excurrent canals are formed as a result of division of spongocoel which has almost disappeared in these sponges. Thus excurrent canals communicate with the outside through a small spongocoel and an osculum.



Leuconoid type

This type of canal system has varying degree of complexity of canals and based on that it can be classified into the following three types:

Eurypyloustype: In this type, the flagellated chambers communicate directly by broad apertures called the apopyles, with the excurrent canals. Incurrent canal brings water into the flagellate chamber through prosopyle. E.g. *Plakina*

Aphodaltype: In this type, the apopyle is drawn out as a narrow canal, called aphodus, which connects the flagellated chamber with excurrent canal. Here also incurrent canal brings water into the flagellate chamber. E.g. *Geodia.*

DiplodalType: In some sponges, besides aphodus, another narrow tube, called prosodus, is present between incurrent canal and flagellated chamber. E.g., *Spongilla and Oscarella.*

RHAGON TYPE

In Demospongiae, leuconoid condition is derived from the larval stage, called rhagon as found in Spongilla. The body is conical and tent like in shape, tapering towards the osculum. The spongocoel is bordered by oval flagellated chambers opening into it by apopyles. Mesenchyme is considerably thick and is traversed by incurrent canals and subdermal cavity. Water enters into the subdermal cavity through ostium and then enters the incurrent canal or it can be called prosodus. Flagellate chambers are connected to the spongocoel through the excurrent canal or it can be called aphodus. This canal system is primitive as compared to diplodal type and when the larva grows transformed to diplodal type.

Significance of Canal System

The flagella of choanocytes beat to produce a water current, which enters the sponogocoel through ostia. It carries food particles and oxygen and sweeps away the metabolic wastes through osculum. Therefore, the canal system serves the function of food collection, respiration and excretion. In simple type of canal system, there is lesser number of cells and thin body wall but as the canal system becomes more complex, the number of flagellated cells increases and the force to draw water current is increased. The syconoid canal system is therefore more efficient than the asconoid type and the leuconoid type is the most efficient

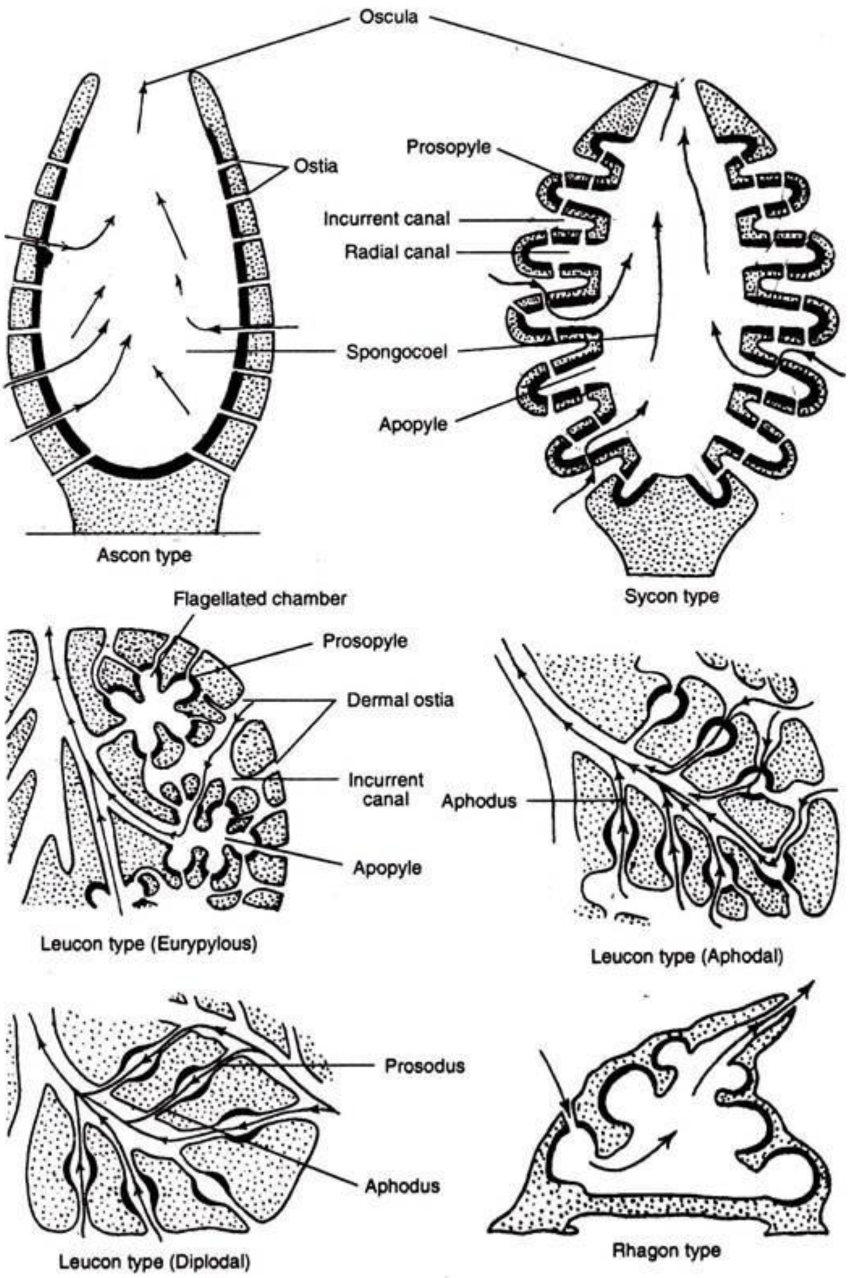


Fig. 11.12: Schematic representation of canal system in sponges. The sycon type of canal system drawn here actually represents the syconoid (Stage I) type. Dark bands indicate choanocyte layers and arrows denote the course of water flow (after Hyman).

7. Describe the life cycle of animal obelia.

Ans.Life History of Obelia:

Fertilisation:

Fertilisation usually takes place in open sea water where the gametes are set free. Sometimes, the sperms are carried into the female medusae with water currents and there they fertilize the eggs in situ. However, the parent medusae die soon after liberating their respective gametes.

Development:

The zygote undergoes complete or holoblastic and equal cleavage to form a single-layered blastula with a blastocoele. Some cells migrate into blastocoele, eventually filling it completely to form a solid gastrula known as stereo gastrula. Its outer cell layer becomes the ectoderm and inner cell mass the endoderm.

The gastrula elongates and. its outer layer of ectoderm cells becomes ciliated, and now it is called planula. Soon, a cavity called enteron develops in the solid endodermal cell mass by the process of delamination and the planula becomes a two-layered larva having an outer ciliated ectodermal cells and an inner layer of endodermal cells.

The planula after a short free-swimming existence settles on some solid object by its broader end. The free end forms a manubrium with a mouth and a circlet of tentacles. Thus, a simple polyp or hydrula is formed which grows a hydrorhiza from its base, from which an Obelia colony is formed by budding.

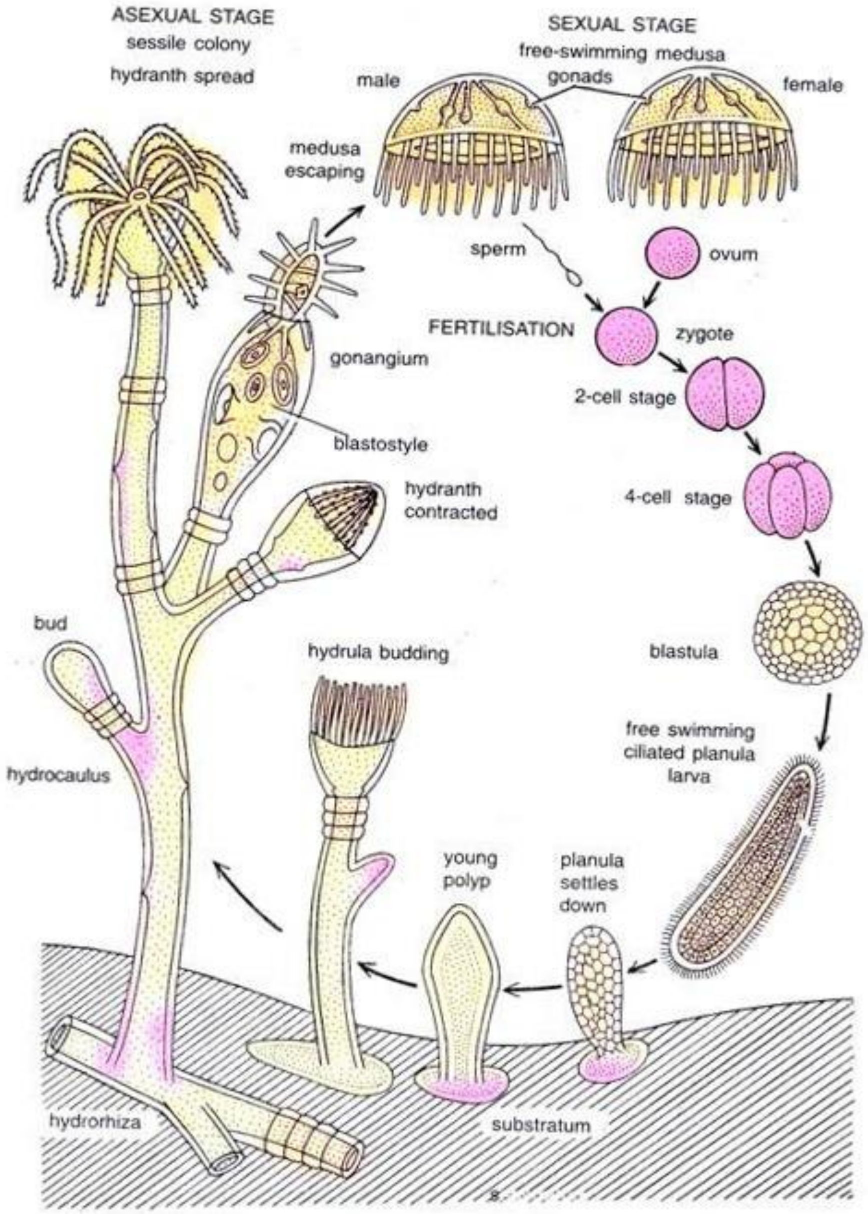


Fig. 32.11. *Obelia.* Stages in the development and life history.

The free swimming planula stage in the life history of Obelia, helps in the dispersal of the species. The life history may be represented as male and female gametes → zygote → planula larva → hydrula → colony → sexual medusae → gametes → zygote and so on.

Alternation of Generations and Metagenesis of Obelia:

It is clearly evident from the life history of Obelia that there is an alternation of polypoid and medusoid generations.

The polypoid generation is asexual and produces polyps and blastostyles by asexual budding. The blastostyle also produces medusae by asexual budding. The medusae do not produce medusae but they give rise to gametes, which after fertilisation develop into a polypoid colony from which medusae are produced again by budding.

Thus, an asexual polypoid generation alternates with a sexual medusoid generation. This phenomenon is known as alternation of generations, till recently. The term alternation of generations means that the individual exists in two distinct forms, which alternate each other regularly in the life history. One individual possesses the power to reproduce the other by asexual reproduction, which again by sexual reproduction gives rise to the next generation. Therefore, a true alternation of generations is always between a diploid asexual and haploid sexual generations, as is exhibited by fern plant.

But, in Obelia the condition is somewhat different and, therefore, objections were raised to use the term alternation of generations for it. Because, in Obelia, there are no true two generations to alternate each other. The medusae are modified zooids capable of free swimming existence and moreover they are not produced directly from a zygote but are budded off from the blastostyle.

The gonads found in medusa are not formed in it but actually they are formed in the ectoderm of blastostyle which later on migrate into the medusa and become situated on its radial canals. Thus, it is rather difficult to distinguish between sexual and asexual generations. Hence the term metagenesis is used to replace the term alternation of generations in Obelia.

Thus, in the life history of Obelia, there is a regular alternation between fixed polypoid and free-swimming medusoid phases, both of them being diploid.

Such an alternation of generations between two diploid phases is known as metagenesis. Although, the phenomenon of metagenesis is also reported in other groups of animals but it is well represented by polymorphic hydrozoan like Obelia. Obelia shows polymorphism in which the polyps are for feeding the colony, blastostyles for budding and medusae for disseminating gametes.

Advancement of Medusa over Polyp:

Medusa exhibits many features of advancement over polyp, few of them are as follows:

1. The epidermis resembles the epithelium of higher Metazoa forming a thin, protective and sensitive layer of small cells.

2. The enormous development of mesogloea reduces the gastro vascular cavity or enteron to a system of canals and also provides lightness which helps in buoyancy.
3. The nervous system shows differentiation into two nerve rings constituting the central nervous system and nerve nets forming the peripheral nervous system.
4. The marginal sense organs present at the bases of 8 tentacles are of special advantage to the free swimming habit of the medusa.
5. The mode of sexual reproduction provides wide dispersal of the species due to its free swimming habit.
6. **Similarities between Polyp and Medusa:**
7. Striking as is the difference between polyp and medusa. They are strictly homologous or typically similar structures. Both of them are formed on the same pattern.

However, the features of similarity between them are listed below:

1. Both are radially symmetrical.
2. Both are diploblastic with outer epidermis (ectodermal) and inner gastro dermis (endodermal).
3. The mouth is homologous in both the cases; the mouth situated on the hypostome in polyp is homologous with the mouth situated on the manubrium of the medusa. Anus is absent in both the cases.
4. The stomach, radial canals and circular canal of medusa are homologous with the gastro-vascular cavity of the polyp. All these are lined by gastro dermis and serve the purpose of digestion and distribution of digested food.
5. Both are carnivorous; the food is captured and ingested with the help of tentacles.
6. Digestion is extracellular as well as intracellular in both the cases.
7. The outer, exumbrellar surface of the medusa is homologous with the base of the polyp providing attachment with the parental colony.

Derivation of Medusa from Polyp:

Striking as is the difference between polyp and a medusa, they are strictly homologous structures, and the more complex medusa is readily derived from the simpler polyp-form. The apex of the umbrella of medusa corresponds with the base of a hydranth. The mouth and manubrium are also homologous structures.Suppose the tentacular region of a polyp to be pulled out, as it were, into a disc-like form and afterwards to be bent into the form of saucer with the concavity distal, that is towards the manubrium. The result of this to be a medusa-like body with a double wall to the entire bell, the narrow space between the two layers containing a prolongation of coelenteron and being lined with gastro dermis. From such a form the actual condition of things found in the medusa would be produced by the continuous cavity in the bell being for most part obliterated by the growing together of its walls so as to form the endodermal lamella. The cavity would remain only along four meridional areas, the radial canals and as a circular area the circular canal close to the edge of the bell. In this way a medusa is derived completely from a polyp (Fig. 32.12).

Section-C

8. Describe the life cycle of *Fasciola hepatica*. (1x6)

Ans.9. Life History of Fasciola Hepatica:

(i) Copulation and Fertilization of Fasciola Hepatica:

Though F. hepatica is hermaphrodite even then cross- fertilisation is of common occurrence. Hence, before fertilisation copulation occurs; during copulation, which occurs in the bile duct of the sheep, the Cirrus of one Fasciola is inserted into the Laurer's canal of other Fasciola and the sperms are deposited into the oviduct, so that cross-fertilisation takes place.

During self- fertilisation, which occurs only when cross-fertilisation does not take place, the sperms from the same Fasciola enter the female genital aperture and pass down the uterus to fertilize the eggs in the oviduct.

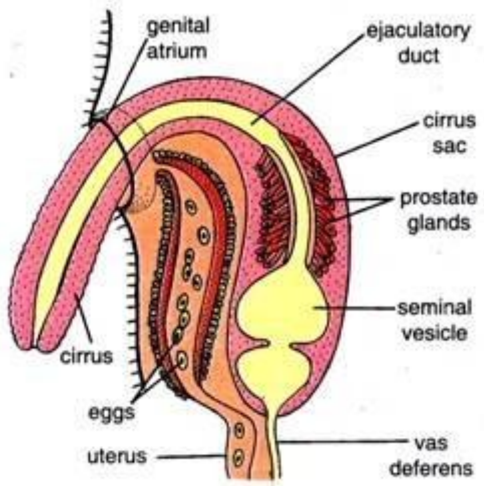


Fig. 41.13. *Fasciola hepatica.* Cirrus protruded through gonopore.

(ii) Formation of Egg Capsules in Fasciola Hepatica:

The eggs are brownish in colour, oval in shape and measure about 130 to 150 μ in length and 63 to 90 μ in width.

As referred to, the eggs are fertilised in the oviduct, the fertilised eggs receive yolk cells from vitelline glands and they get enclosed in a chitinous shell formed by granules in the yolk cells giving out droplets, the shell hardens and becomes brownish yellow; the shell has an operculum or lid. Mehlis's glands play no role in the formation of the shell.

The completed **'eggs'** are called capsules which are large in size and they pass into the uterus where development starts. Capsules come out of the gonopore into the bile duct of the sheep, they reach the intestine and are passed out with the faeces. The capsules which fall in water or damp places will develop at about 75°F. Capsules are produced throughout the year, and one fluke may produce 500,000 capsules.

(iii) Development of Fasciola Hepatica:

Development starts in the uterus and is continued on the ground. The fertilised egg divides into a small propagatory cell and a larger somatic cell. The somatic cell divides and forms the ectoderm of the larva. Later the propagatory cell divides into two cells, one of which forms the endoderm and mesoderm of the larva, and the other forms a mass of germ cells at the posterior end of the larva.

This method of development takes place in the formation of all larval stages during the life history. In two weeks time, a small ciliated miracidium larva is formed and it comes out of the shell by forcing the operculum. The miracidium produces a proteolytic enzyme which erodes the lower surface of the operculum.

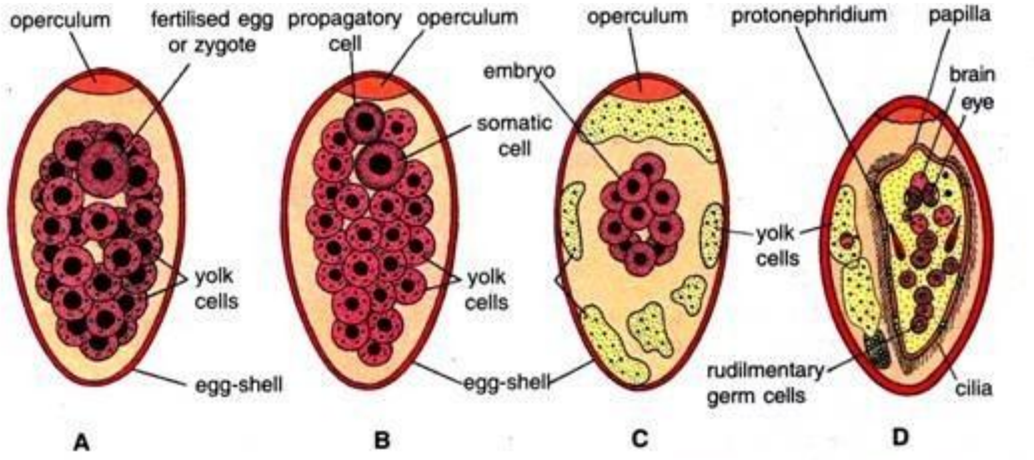


Fig. 41.14. *Fasciola hepatica.* Early stages of development. A—Fertilised egg; B—Two cell stage; C—Many cell stage; D—Miracidium in capsules.

(iv) Miracidium Larva:

Miracidium larva is a minute, oval and elongated, free-swimming stage, it is covered with 18 to 21 flat ciliated epidermal cells lying in five rings.

The first ring is made of six plates (two dorsal, two lateral and two ventral), second ring has again six plates (three dorsal and three ventral), third ring has three plates (one dorsal and two ventrolateral), fourth ring has four plates (two right and two left) and fifth ring has two plates (one left and one right).

A sub-epidermal musculature, consisting of outer circular and inner longitudinal fibres, is situated beneath the epidermal cells. The sub-epidermal musculature is followed by a layer of cells constituting the sub-epithelium. All these, i.e., epidermal cells, sub-musculature and sub- epithelium, together form the body wall of miracidium.

Anteriorly it has a conical apical papilla, and attached to it is a glandular sac with an opening called apical gland.

On each side of the apical gland is a bag-like penetration gland. There are two pigmented X-shaped eye spots and a nervous system. There is a pair of protonephridia, each with two flame cells. The flame cells open to the exterior by two separate excretory pores or nephridiopores situated laterally in the posterior half of the body.

Towards the posterior side are some propagatory cells (germ cells), some of which may have divided to form germ balls which are developing embryos. The miracidium does not feed, it swims about in water or moisture film, but it dies in eight hours unless it can reach a suitable intermediate host, which is some species of amphibious snail of genus Limnaea or even Bulinus or Planorbis.

After getting a suitable host the miracidium adheres to it by its apical papilla and enters the pulmonary sac of the snail, from where it penetrates into the body tissues with the aid of penetration glands and finally reaches to snail’s digestive gland. In the tissues the miracidium casts off its ciliated epidermis, loses its sense organs and it swells up and changes in shape to form a sporocyst.

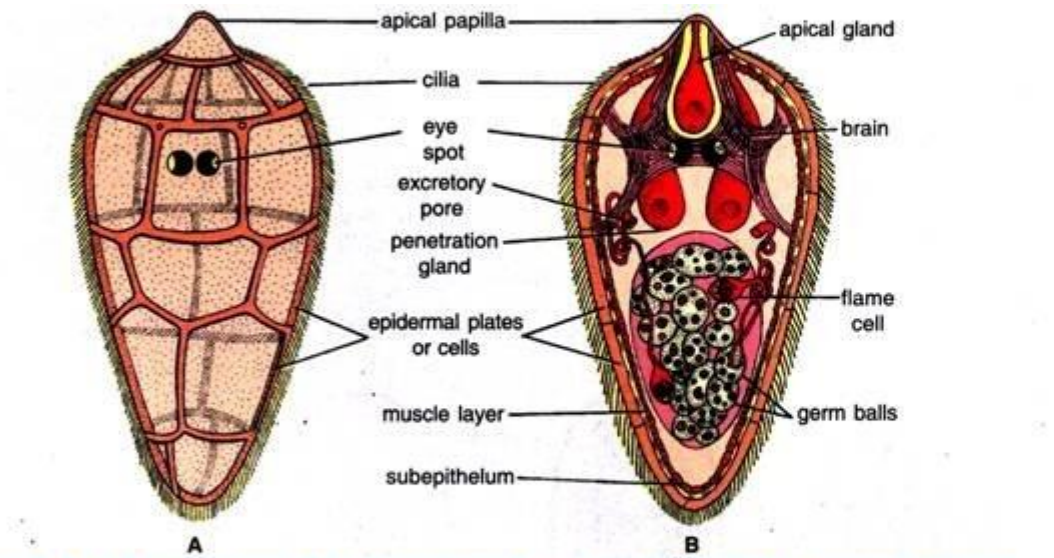


Fig. 41.15. *Fasciola hepatica*. Miracidium larva. A—External structure; B—Internal structure.

(v) Sporocyst:

The sporocyst is an elongated germinal sac about 0.7 mm long and covered with a thin cuticle, below which are mesenchyme cells and some muscles.

The glands, nerve tissue, apical papilla and eye spots of miracidium disappear. The hollow interior of sporocyst has a pair of protonephridia each with two flame cells it has germ cells and germ balls. The germ cells have descended in a direct line from the original ovum from the miracidium developed.

The sporocyst moves about in the host tissues and its germ cells develop into a third type of larva called redia larva. A sporocyst forms 5 to 8 rediae. The rediae larvae pass out of the sporocyst by rupture of its body wall into the snail tissues with the aid of the muscular collar and ventral processes, then the rediae migrate to the liver of the snail.

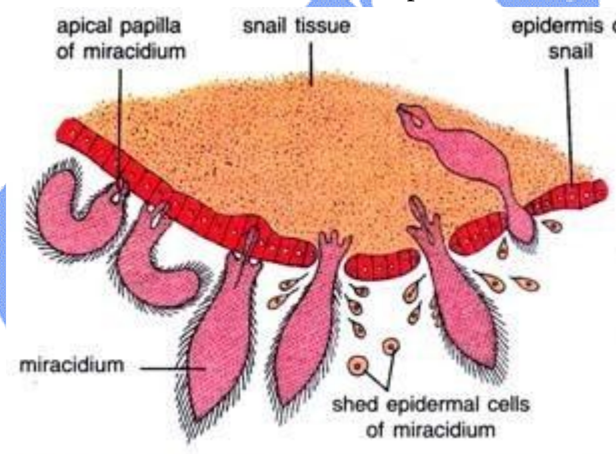


Fig. 41.16. Miracidium of *Fasciolopsis buski*. Stage of penetration through snail epidermis.

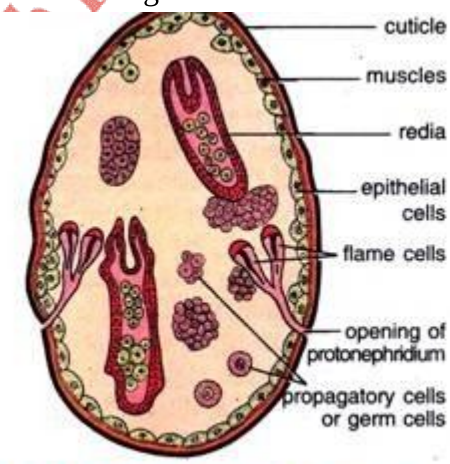


Fig. 41.17. *Fasciola hepatica*. Sporocyst.

(vi) Redia:

The redia is elongated about 1.3 mm to 1.6 mm in length with two ventral processes called lappets or procruscula near the posterior end and a birth pore near the anterior end.

Body wall has cuticle, mesenchyme and muscles, and near the anterior end, just in front of the birth pore, the muscles form a circular ridge, the collar used for locomotion. Redia has an anterior mouth, pharynx in which numerous pharyngeal glands open, sac-like intestine and there is a pair of protonephridia with two pairs of flame cells. Its cavity has germ cells and germ balls.

The germ cells of redia give rise during summer months to a second generation of daughter rediae, but in winter they produce the fourth larval stage, the cercaria larva. Thus, either the primary redia or daughter redia produce cercaria larvae which escape from the birth pore of the redia into the snail tissues. Each redia forms about 14 to 20 cercariae.

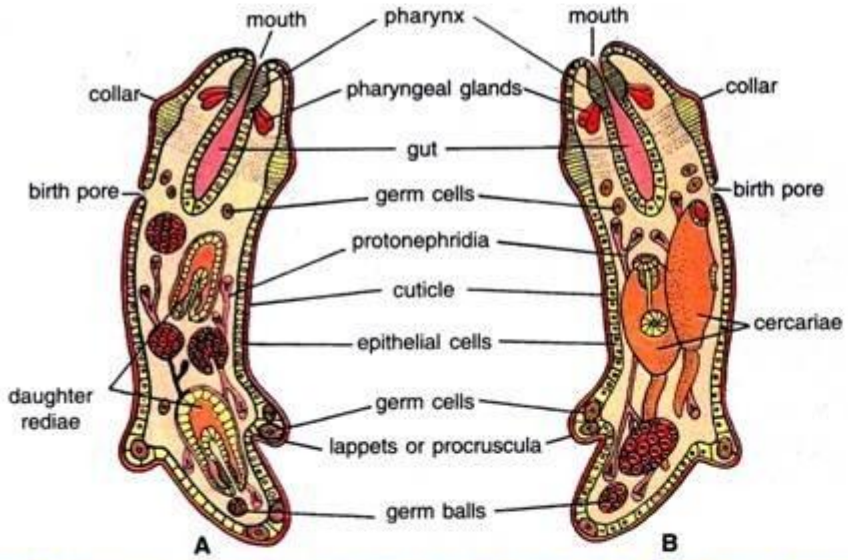


Fig. 41.18. *Fasciola hepatica.* A—Redia with daughter rediae; B—Redia with cercariae.

(vii) Cercaria:

The cercaria (Fig. 41.19) has an oval body about 0.25 mm to 0.35 mm long and a simple long tail. Its epidermis is soon shed and replaced by cuticle; below the cuticle are muscles and cystogenous glands. It has rudiments of organs of an adult; there are two suckers (oral sucker and ventral sucker) and an alimentary canal consisting of mouth, buccal cavity, pharynx, oesophagus and a bifurcated intestine.

There is an excretory bladder with a pair of protonephridial canals (excretory tubules) with a number of flame cells. An excretory duct originates from the bladder, travels through the tail and bifurcates to open out through a pair of nephridiopores.

There are two large penetration glands, but they are non-functional in the cercaria of Fasciola.

It also has the rudiments of reproductive organs formed from germ cells. The cercariae escape from the birth pore of the redia, then migrate from the digestive gland of the snail into the pulmonary sac from where they pass out into surrounding water. The time taken in snail from the entry of miracidia to the exit of cercariae is five to six weeks.

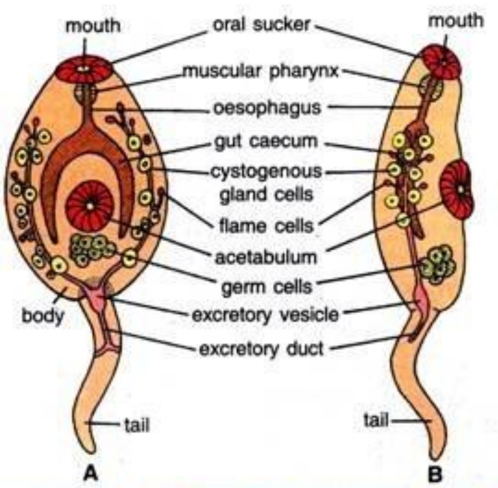


Fig. 41.19. *Fasciola hepatica*. A—Cercaria in ventral view; B—Cercaria in lateral view.

(viii) Metacercaria:

The cercariae swim about in water for 2 to 3 days; they then lose their tails and get enclosed in a cyst secreted by cystogenous glands.

The encysted cercaria is called a metacercaria (Fig. 41.20) which is about 0.2 mm in diameter and it is in fact a juvenile fluke. If the metacercariae are formed in water they can live for a year, but if they are formed on grass or vegetation then they survive only for a few weeks, they can withstand short periods of drying.

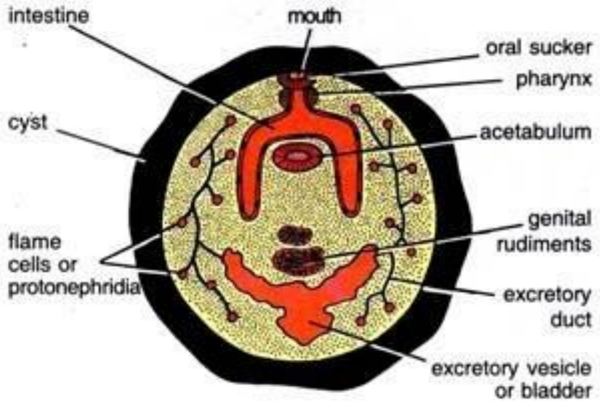


Fig. 41.20. *Fasciola hepatica*. Metacercaria.

The various larval stages (the miracidium, sporocyst, redia, and cercaria) are all formed in the same way from germ cells which are set aside at the first division. There is, thus, a distinction between germ cells and somatic cells, and germ cells alone form the various larval stages.

Infection of the primary host (Sheep):

Further development of the metacercaria takes place only if it is swallowed by the final host, the sheep.

Metacercariae can also infect man if they are swallowed by eating water cress on which cercariae encyst, but such cases are rare. But the metacercarie are not infective until 12 hours after encystment. In the alimentary canal of a sheep, the cyst wall is digested and a young fluke emerges and bores through the wall of the intestine to enter the body of the host.

After about two to six days they enter the liver and their movements in the liver may cause serious injuries.

The young flukes stay in the liver for seven or eight weeks feeding mainly on blood and then they enter the bile duct and bile passages. The young flukes have been growing in the liver and after several weeks in the bile duct they become sexually mature adults. The period of incubation in the sheep takes 3 to 4 months.

However, the life history of Fasciola hepatica (Fig. 41.21) can be summarised as under:

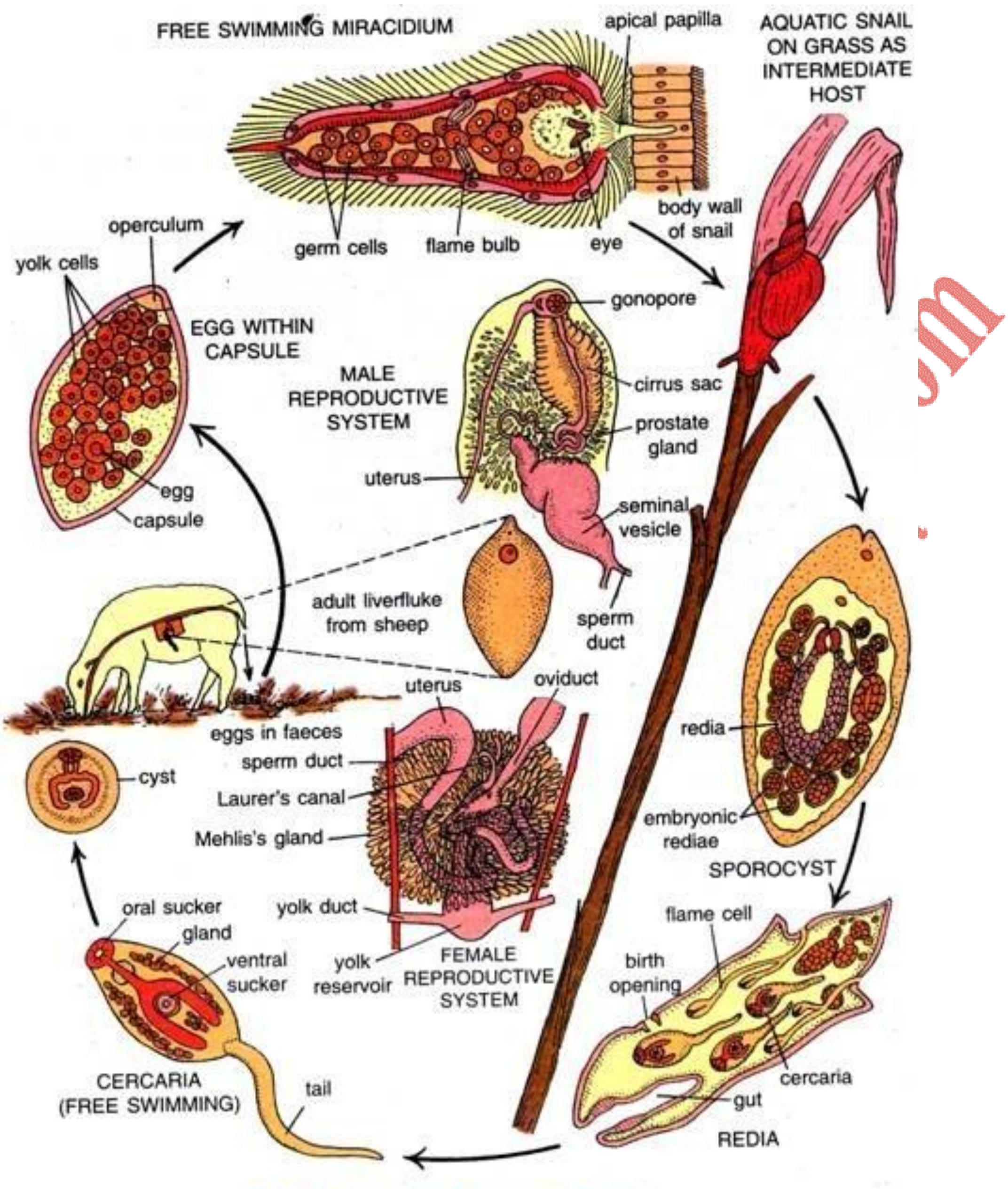


Fig. 41.21. *Fasciola heptica.* Life history.

Adult flukes in liver → copulation and fertilisation → laying of capsules in the bile ducts → capsules in the intestine (stages in sheep's body) → capsules out in faeces → miracidia escape from capsules (stages in open) → miracidia → sporocysts → rediae → cercariae → (stages in snail's body) → cercariae → metacercariae (stages in open) → metacercariae young flukes → adult flukes (stages in a fresh sheep's body).

Characteristic Features of Life History of Fasciola Hepatica:

Life history of Fasciola Hepatica is complicated because of parasitism. A sheep harbours about 200 flukes which will produce about 100 million eggs. The miracidium larva is free living and is structurally adapted to seek out an intermediate host, a snail Limnaea, which is found conveniently in water and damp places in grass in wide areas where sheep graze.

The sporocyst forms 5 to 8 rediae, each of which produces 8 to 12 daughter rediae, each daughter redia forms 14 to 20 cercariae; so that about a thousand cercaria larvae are produced from each egg. From this large number some cercariae are bound to infect a new sheep, thus, ensuring a continuance of the race.

Life history of Fasciola Hepatica affords an example of alternation of generations. The fluke is the sexual generation and it alternates, not with an asexual generation, but with parthenogenetic generations of sporocysts and rediae. Such an alternation of a sexual generation with a series of parthenogenetic generations is called heterogamy.

This theory of parthenogenetic development in the various larval stages is now discounted, and formation of various larvae from germ cells is regarded as simple mitotic asexual multiplication; this asexual multiplication of various larvae is called polyembryony.

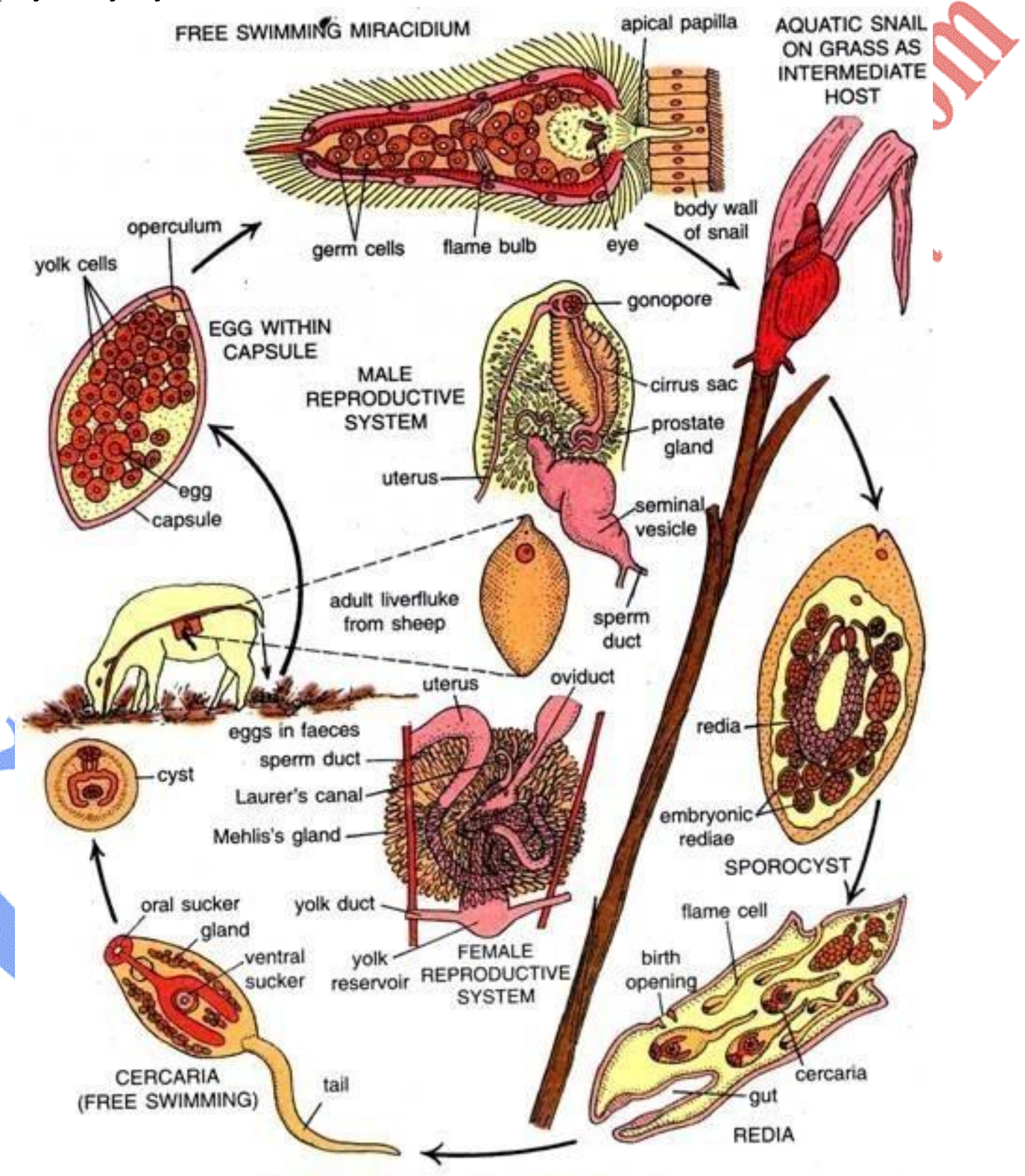


Fig. 41.21. *Fasciola heptica*. Life history.

Thus, there is a period of asexual multiplication during larval stages, followed by sexual reproduction in the adult fluke. This may be regarded as an alternation of generations, but more probably it is continuous life history in which asexual multiplication occurs in the larval stages due to parasitism.

The free swimming larval stages, miracidia and cercariae of F. hepatica, are morphologically more advanced than the adult fluke because they bear organs of locomotion, sense organs, cellular epidermis and a well developed body cavity.

9. Describe habit, habitat, morphology and the nervous system of *Neries*

Ans.1. External Structures of Nereis Dumerilii:

The body of Nereis dumerilii is approximately 7-8 centimetres in length. The colour is light violet and the regions of the body which are richly supplied with blood vessels appear reddish. The glittering appearance of the surface is due to the intersection of two sets of fine lines. The animal is long, narrow and cylindrical (Fig. 17.2).

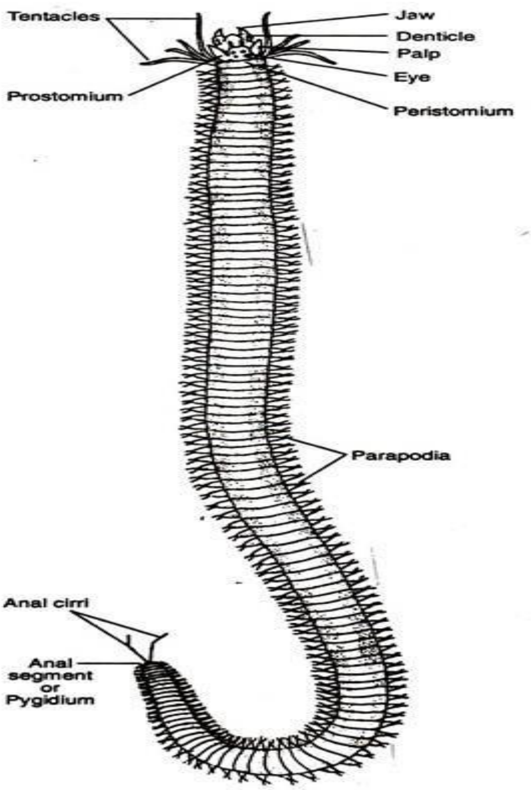


Fig. 17.2: External features of *Nereis*—dorsal view (after Bloom and Krekeler).

The body is divisible into about 80 segments or metameres and a distinct head is present at the anterior end. All the segments excepting the head and the last segment bear laterally placed, hollow, muscular and vertical, movable paired appendages parapodia (Sing. Parapodium).

The terminal segment is termed as the anal segment or pygidium and it bears at its posterior end a small round opening, the anus. Anal segment bears a pair of elongated anal cirri. On the ventral surface and near the base of the parapodium lies a nephridial aperture. Thus a pair of nephridiopores is present in each parapodial segment.

Nervous System of Nereis Dumerilii:

The nervous system of Nereis dumerilii consists of:

(A) Central nervous system,

(B) Visceral nervous system and

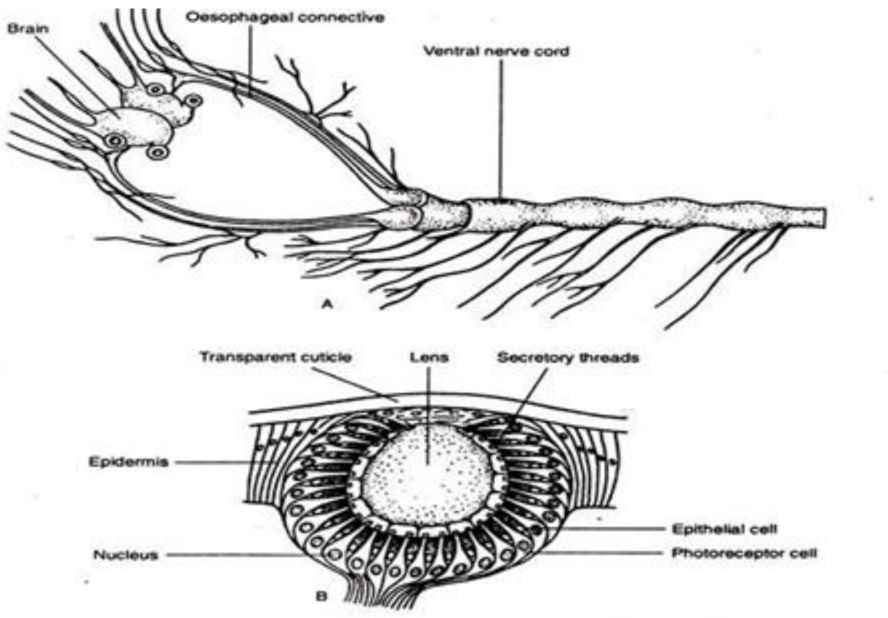
(C) Sense organs.

A. Central nervous system:

It includes

(1) Cerebral ganglia or brain:

It is present in the prostomial region as a large bilobed mass (Fig. 17.11A). The brain contains specialized cells, which produce hormone to speed up regeneration, It has also been experimentally demonstrated that extirpation of brain leads to precocious sexual maturity.



ig. 17.11: A. Nervous system at the anterior region of *Nereis* (after Parker and Haswell). B. Sectional view of an eye of *Nereis* (after Kaestner).

(2) Oesophageal connectives:

Two stout nerves, each originating from the posterior region of the brain turn around the two sides of the mouth and unite on the ventral wall of the pharynx.

(3) Ventral nerve cord:

It originates from the ventral side of the pharynx, i.e., the region where two oesophageal connectives meet, and it runs posteriorly along the mid- ventral line. The ventral nerve cord is formed of two separate cords which are enveloped by a common connective tissue sheath. Along its path, the cord possesses a ganglion in each segment. The individual ganglion is also formed by the fusion of two ganglia.

(4) Peripheral nerves:

These are nerves given off by brain, oesophageal connectives and ganglia of the ventral nerve cord. From brain, nerves are supplied to the tentacles, palpi and eyes. The oesophageal connectives supply branches to innervate peristomeal tentacles. The ganglion on the ventral nerve cord sends nerves to the various parts of the corresponding segment.

B. Visceral nervous system:

In addition to the nerves belonging to the central nervous system, another set of nerves is given off from the brain. These fine nerves with ganglia innervate the anterior part of the alimentary system. It is known as stomatogastric or visceral nervous system.

C. Sense organs.

Following sense organs are present in Nereis dumerilii:

(a) Eyes:

There are two pairs of eyes. Each eye is a cup-shaped and darkly pigmented structure. The concave side bears the retina, a circular aperture, pupil and a lens of gelatinous consistency (Fig. 17.11B).

Many elongated and slender cells which are arranged parallelly form the wall of the cup. These cells through the union of their outer ends form the optic nerve and their inner ends extend towards the lens as clear and hyaline rods. The region of the cuticle which covers the eyes, acts as the cornea.

(b) Olfactory organs:

The olfactory organs are known as nuchal organs. These paired organs are present on the posterior and dorsal side of the prostomium and remain in close contact with the hinder part of the brain. Each nuchal organ has two pits lined with ciliated epithelium.

(c) Tactile organs:

The tentacles, palpi and cirri are regarded as specialised tactile sense organs. With the help of specialised sensory cells they can discriminate the changes in the environment.

10. Write short notes on any two: (2x3)

a) Life cycle of *Ascaris*

Ans.Life History of *Ascaris Lumbricoides*:

The life history of *Ascaris Lumbricoides* is monogenetic as it involves only one host, i.e., man.

However, the life history of *Ascaris Lumbricoides* can be studied as under:

(i) Copulation and Fertilization:

Copulation takes place in host's intestine. During copulation male *Ascaris Lumbricoides* moves in such a way that its cloacal aperture faces the vulva of the female and then male thrusts its penial setae to open the vulva of female.

Then, soon the cloacal wall of male contracts causing transfer of sperms into the vagina of the female and they come to lie in the seminal receptacle part of the uteri, wait for eggs to come through the oviduct for fertilisation.

During fertilisation the entire sperm enters the egg. Soon, after fertilisation the glycogen globules of the egg migrate to the surface to form the fertilisation membrane which soon hardens into a thick, clear inner chitinous shell. Soon, thereafter, the fat globules of the egg form a lipoid layer below the chitinous shell.

Now, as the fertilised egg passes down, the uterine wall secretes an outer thick, yellow or brown albuminous (proteinous) coat or outer shell having a characteristic wavy surface or rippling's. These eggs are now known as mammiliated eggs; such eggs are elliptical in shape measuring 60-70 μ by 40-50 μ.

(ii) Zygote:

So, to say the zygote has a thick, clear inner shell, a lipoidal layer and an outer shell which is warty and yellow or brown in colour.

The fertilised eggs (zygotes) are laid by female Ascaris in the small intestine of the host and they pass out with the faeces; they are un-segmented when they leave the host. One female may lay from 15,000 to 200,000 eggs in a day; the egg production of Ascaris is astounding, one mature female may have up to 27 million eggs.

The eggs become stained yellowish or brown in the intestine. Eggs fall on the ground and can remain alive for months in the moist soil though complete drying kills them. In order to develop they require oxygen, moisture and a temperature lower than that of the human body, the most favourable temperature is 85°F. They require a period of incubation outside the human body.

(iii) Early Development (Outside the Host):

The stages of early embryonic development, say the cleavage or segmentation, etc., start in the soil. The pattern of cleavage is spiral and determinate.

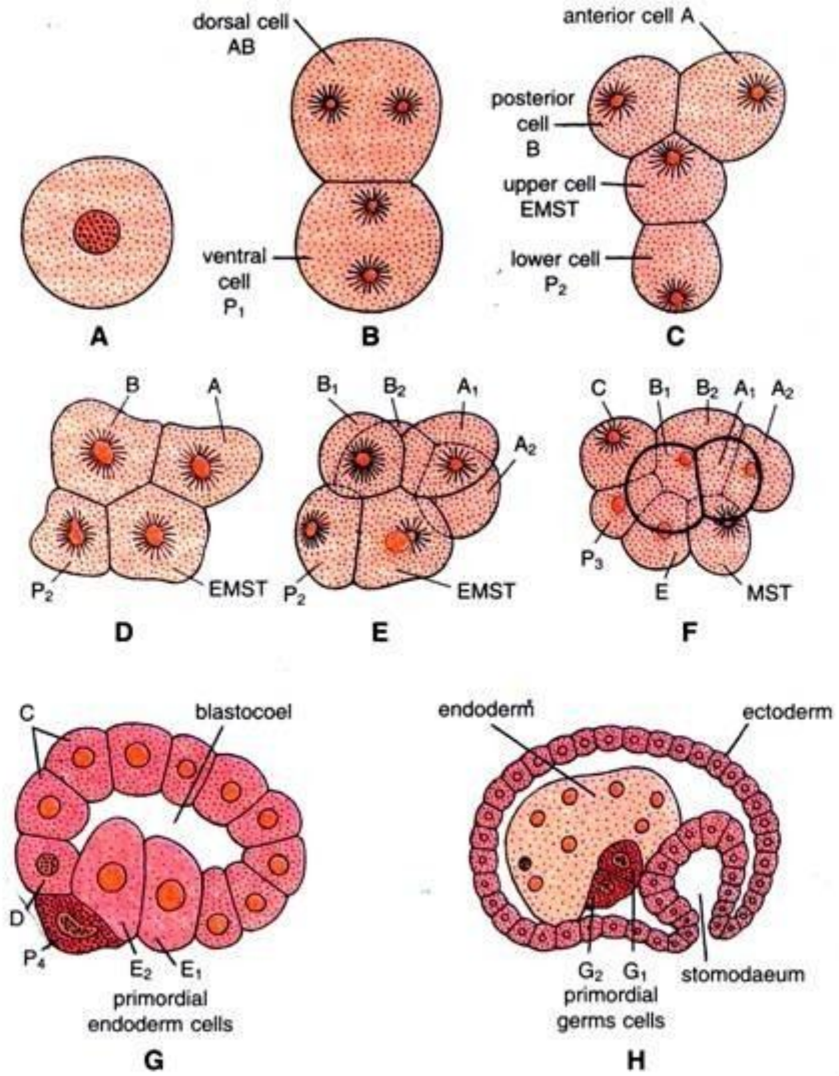


Fig. 46.16. *Ascaris.* Early stages of development. A—Zygote; B—2-cell stage; C—4-cell stage (T-shaped); D—4-cell stage (rhomboidal); E—6-cell stage; F—8-cell stage; G—Median sagittal section through blastula; H—Median sagittal section through the embryo after invagination of stomodaeum and the primordial germ cells.

The fertilised egg undergoes two cleavages to form four cells or blastomeres; in fact the first cleavage results in a dorsal cell AB and a ventral cell P_1, the second cleavage causes AB to divide into an anterior cell A and a posterior cell. B, while the ventral cell P_1 divides into a dorsal cell EMST and a ventral cell P_2.

These four cells are at first arranged in the shape of a T in Ascaris, but later they become arranged in a rhomboid shape, as P_2 comes to lie posterior to EMST, which is characteristic of nematodes. However, these four cells are now called A, B, P_2 and S_2or EMST. These cells undergo further cleavage to form smaller blastomeres.

However, in the next cleavage A and B divide into A_1, A_2 and B_1 B_2 cells respectively, P_2 divides into P_3 and C, while EMST into MST and E. Thereafter, P_3 and E divide into P_4 and D and E_1 and E_2 respectively. The P_4 further divides into G_1 and G_2.

The fate of the various cells resulted so far is fixed, i.e., the descendants of A and B will give rise to the entire ectoderm, except that of the posterior end, MST form the mesoderm of the body wall, pseudocoel cells, and the lining of the stomodaeum, the descendants of E (E_1 and E_2) give rise to the entire endoderm of the intestine, the descendants of P_4 (G_1 and G_2) will give rise the germ cells and C and D will together take part in the formation of ectoderm and mesoderm.

Thus, the cleavage of embryonic cells continues giving rise to a blastula at the 16-celled stage which is characterised by having a cavity, the blastocoel. Then gastrula is formed by epiboly or overgrowth of ectodermal cells over the endodermal cells, and by invagination of stomodaeum and endodermal cells.

Finally a juvenile is resulted in about 10-14 days from the beginning of segmentation. Structurally, a juvenile possesses an alimentary canal, a nerve ring and a lateral excretory system.

This juvenile resembles very much with Rhabditis (a soil nematode), hence, it is also referred to as rhabditiform larva or rhabditoid. This larva moults within the egg shell in about seven days and becomes the second stage juvenile or second stage rhabditoid; this stage of the life history of Ascaris is infective to the host.

Data suggest that under favourable conditions of oxygen, moisture and temperature, the eggs of Ascaris lumbricoides with infective juveniles may remain viable for about six years in the soil.

(iv) Infection to Host:

We know that there is no secondary host in the life history of Ascaris Lumbricoides, hence, infection to host (man) occurs when he swallows the infective eggs of Ascaris with contaminated food or water.

Thus, when the infective eggs reach in the small intestine of the host, the egg shells are dissolved by the action of host's digestive juices and the infective second stage juveniles are set free. These juveniles are about 0.2-0.3 mm long and 13-15 µ in diameter and have all the structures of the adults except the reproductive organs.

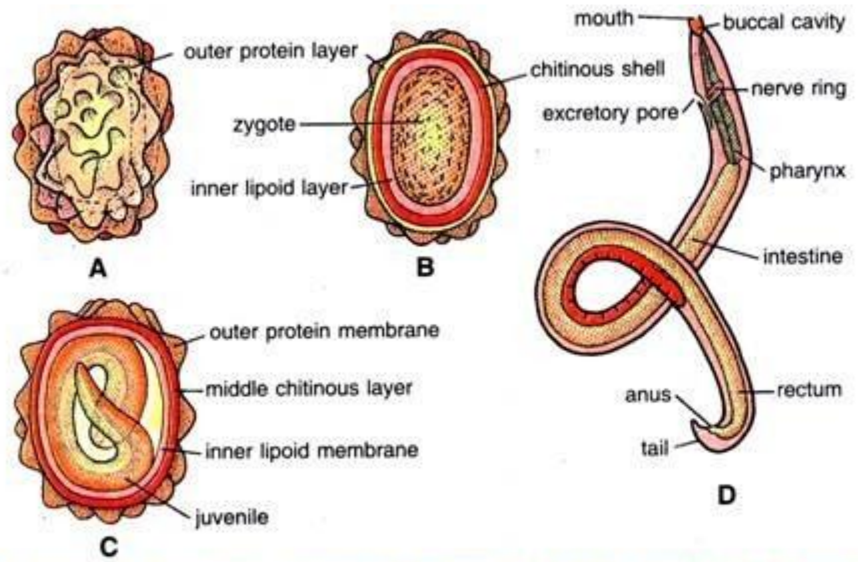


Fig. 46.17. *Ascaris*: A—An entire mammiliated egg; B—Mammiliated egg in section; C—Embryonated egg; D—Rhabditiform larva.

(v) Later Development in New Host:

They do not develop in the intestine but go on a typical wandering tour of 10 days.

They bore through the intestine wall and enter the mesenteric circulation and pass through the hepatic portal vein to enter the liver, from where they enter the hepatic vein and through the postcaval vein come to the right side in the heart, from where they are carried several times through the body along with the blood stream, then they go through pulmonary arteries into the lungs.

In the lungs, juveniles rupture the capillaries and enter the alveoli where they live for some days, here they grow and moult to become 3rd stage larvae which moult again to become 4th stage larvae.

From the alveoli of the lungs, the 4th stage juveniles make their way through the bronchioles and bronchus into the trachea and then to the throat from where they are swallowed into the oesophagus and reach the small intestine for the second time.

During this 10-day tour, the juveniles have grown about ten times and are 2 to 3 mm long. In the intestine the fourth and final moulting takes place, and in 60 to 75 days, they grow into adult males and females and attain sexual maturity. The length of life of the parasite in the host averages only 9 months to a year.

However, the life history of Ascaris lumbricoides can be represented as:

Adults → fertilised eggs pass out → larvae develop in egg shell and moult twice → swallowed by man → intestine where juveniles hatch → bore through intestine → mesenteric veins → hepatic portal vein → liver → hepatic vein → postcaval vein → right side of heart → pulmonary artery → lungs → alveoli where third moulting occurs → bronchioles → bronchus → trachea → glottis → oesophagus → intestine where fourth moulting occurs → grow into adults.

b) Beroe

Ans. 1. Commonly known as "Mitre jelly fish" and is found in groups or swarms throughout (cosmopolitan).

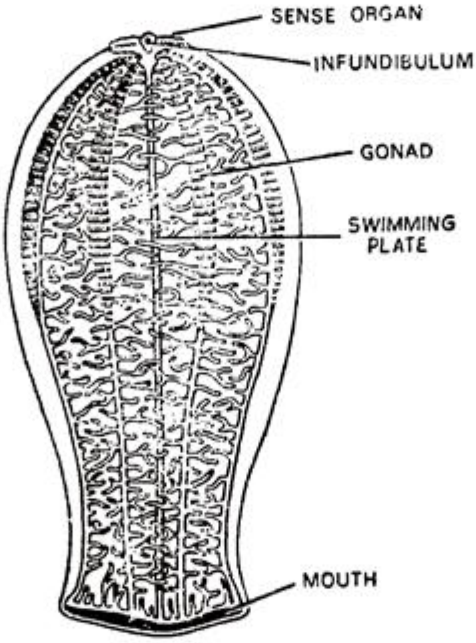


Fig. 179. BEROE

2. Body thimble-shaped and laterally compressed with broad oral and narrow aboral end.
3. Tentacles and oral lobes are absent and mouth is a wide opening leading into stomodaeum (pharynx).
4. All along the body length run four pairs of meridional canals, which give off large number of branches on all sides to form a sort of complex network.
5. The meridional canals along with a pair of stomodaeal canals unite into a circular horizontal tube which runs around mouth.
6. Swimming plates are well developed and run all along the body length.
7. In their upper halves the swimming plates are connected with gonads.
8. Development through a larva known as cydippid.

c) Reproductive system in *Leech*

Ans.Reproductive System of Hirudinaria:

Leeches are hermaphrodite (monoecious), i.e., each individual possesses a complete set of well differentiated male and female reproductive organs. Self-fertilisation does not occur. Cross- fertilisation, preceded by copulation, is being effected.

Male Reproductive Organs of Hirudinaria:

The male reproductive organs consist of:

(i) Testis sacs
(ii) Vasa efferentia
(iii) Vasa deferentia
(iv) Epididymis
(v) Ejaculatory ducts
(vi) Atrium

(i) Testis Sacs:

There are usually eleven pairs of testis sacs in segment twelfth to twenty- second, one pair in each segment, lying ventrally, one on either side of the ventral nerve cord. Each testis sac is small spherical coelomic sac, from the walls of which spermatogonia or sperm-mother cells are budded off. The spermatogonia float in the coelomic fluid within each testis-sac and develop into spermatozoa.

(ii) Vasa Efferentia:

From the posterior border of each testis-sac arises a short sinuous duct, the vas efferens, through which the mature spermatozoa are passed into the vas deferens. All the vasa efferentia of one side open into the common vas deferens of that side.

(iii) Vasa Deferentia:

They are a pair of slender longitudinal ducts running forward, from twenty-second to the eleventh segment, lying along the ventral body wall on either side of nerve cord. Each vas deferens is enclosed within a tubular coelomic space which contains amoeboid corpuscles similar to those of the haemocoelomic fluid.

(iv) Epididymis:

Each vas deferens, in the tenth segment, swells to form closely convoluted and compact mass, the epididymis or sperm-vesicle. The two epididymis serve to store the spermatozoa.

(v) Ejaculatory Ducts:

From the inner and anterior end of each epididymis arises a short narrow ejaculatory duct or ductus ejaculatorious.

(vi) Atrium:

It is a pyriform sac situated in the ninth and tenth segments, to which join the ejaculatory ducts of both the sides. The atrium is made of an anterior prostate chamber and a posterior penis sac. The prostate chamber possesses thick muscular walls covered over with several layers of unicellular prostate glands.

The penis-sac is an elongated muscular chamber and contains a tubular coiled penis which can be everted and is often seen protruding out through the male genital aperture on the ventral side of the second annulus of tenth segment.

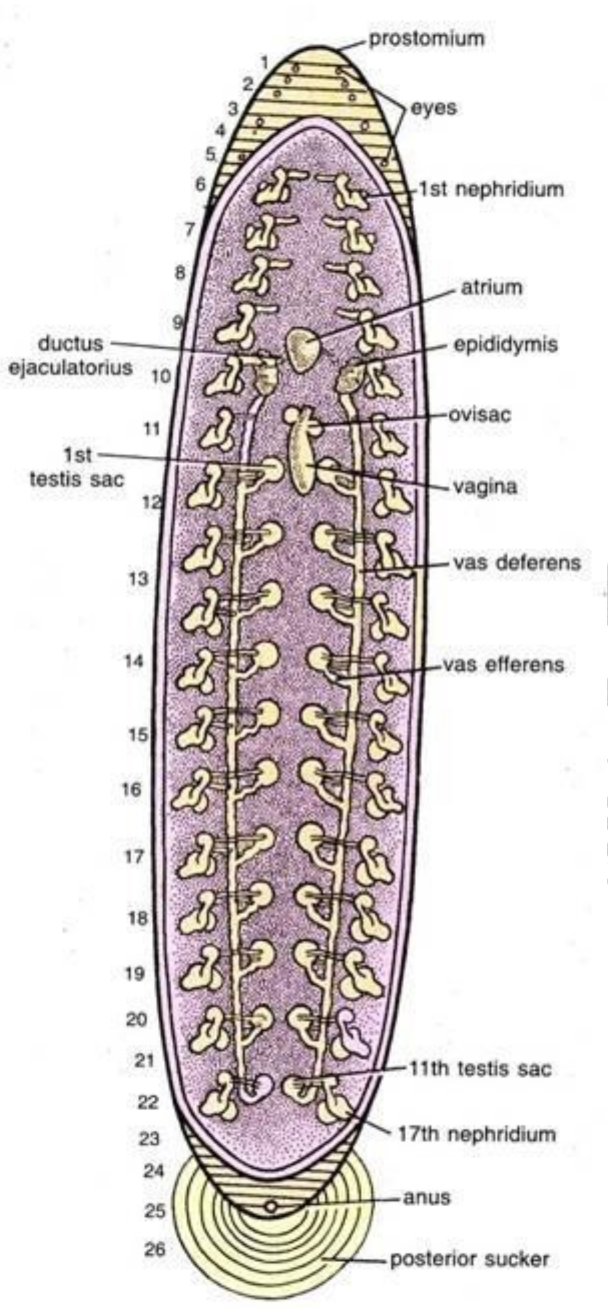


Fig. 67.27. *Hirudinaria.* Reproductive and nephridial system.

The spermatozoa produced in testis-sacs are stored in the epididymis. From the epididymis of each side the spermatozoa pass into the prostatic chamber where they are glued together by a secretion of the prostate glands to form bundles called spermatophores. The spermatophores pass into the narrow canal of the penis, through which they are transferred into vagina of other leech during copulation.

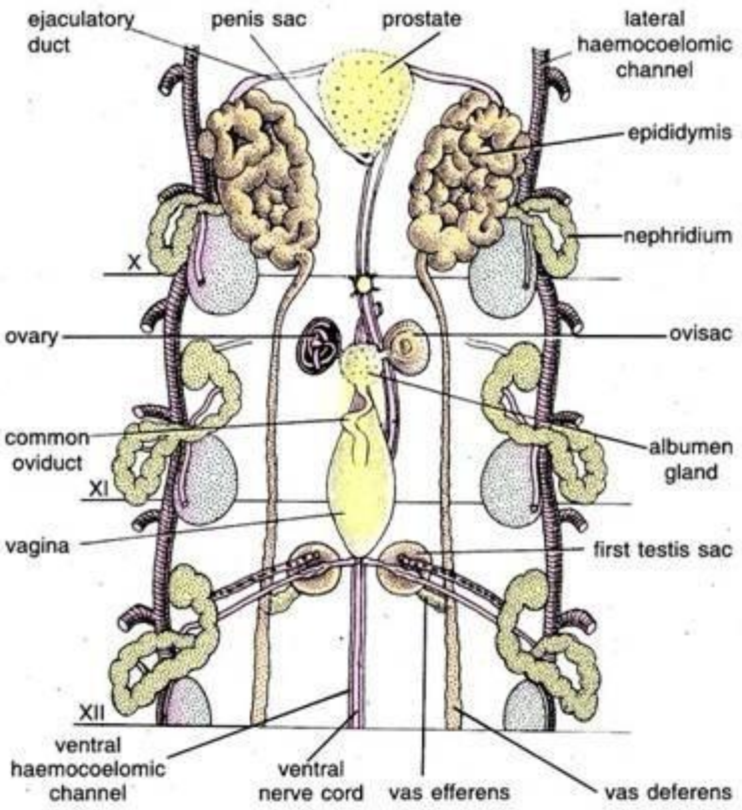


Fig. 67.28. *Hirudinaria*. Reproductive organs of X, XI and XII segments of body.

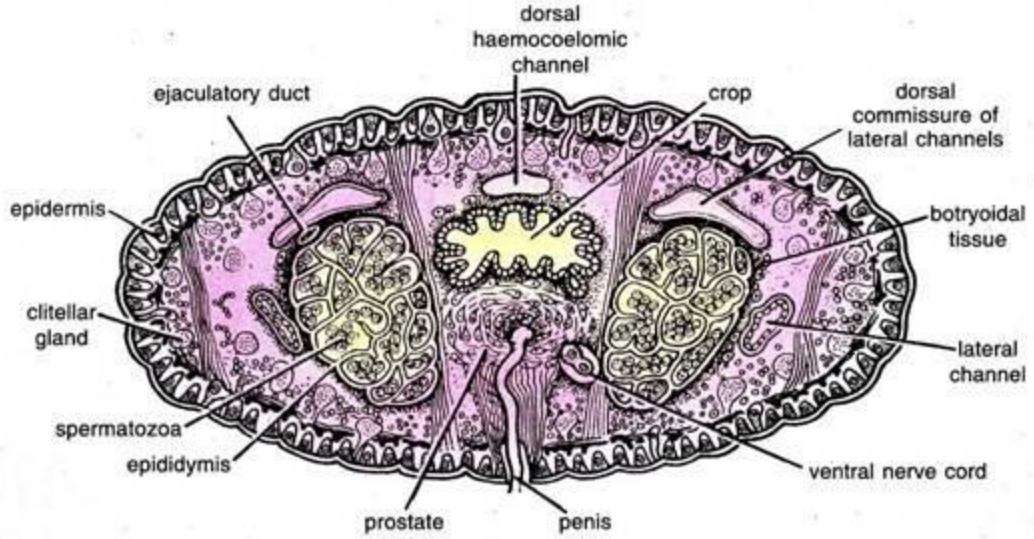


Fig. 67.29. *Hirudinaria*. T.S. of body through the region of epididymes, prostate glands and penis-sac.

Female Reproductive Organs of Hirudinaria Granulosa:

The female reproductive organs consist of:

(i) A pair of ovisacs

(ii) A pair of oviducts

(iii) Common oviduct

(iv) Vagina

(i) Ovisacs:

There is a single pair of globular ovisacs enclosing coelomic spaces and an ovary in each, situated in the eleventh segment. Each ovary is a coiled nucleated cord from which ova are budded off; it terminates in club-like ends. The coiled ovaries remain floating in the haemocoelomic fluid enclosed within the ovisacs.

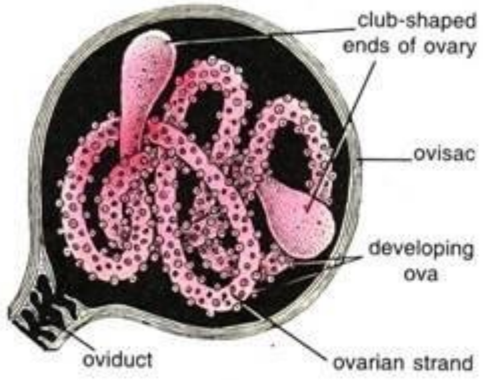


Fig. 67.30. *Hirudinaria*. Ovisac dissected to show the ovary.

(ii) Oviducts:

From the base of each ovisac arises a short slender tube, the oviduct. The right oviduct passes beneath the ventral nerve cord.

(iii) Common Oviduct:

The oviducts of two sides unite to form a common oviduct which is like an S. The common oviduct lies in the eleventh segment. At the junction of oviducts is a mass of unicellular albumen glands opening into the common oviduct. The common oviduct opens into a pear-shaped muscular vagina.

(iv) Vagina:

The vagina is a large pear-shaped muscular bag lying in the posterior part of the eleventh segment. It increases in size during the breeding season and also becomes internally thrown into a large number of longitudinal folds.

It opens to the exterior through a mid-ventral female genital aperture in the second annulus of eleventh segment. The ova, budded off from the ovaries, pass through the oviducts into the vagina where they remain for some time.