B.Sc. ZBC-106

ZOOLOGY PRACTICAL

DIRECTORATE OF DISTANCE EDUCATION

SWAMI VIVEKANAND
SUBHARTI UNIVERSITY
Meerut (National Capital Region Delhi)

ZOOLOGY PRACTICAL

B.Sc. ZBC-106

Self Learning Material

Directorate of Distance Education

SWAMI VIVEKANAND SUBHARTI UNIVERSITY
MEERUT–250 005
UTTAR PRADESH

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Syllabus

ZOOLOGY PRACTICAL

(B.Sc. ZBC-106)

1. Study of whole mount of *Euglena, Amoeba* and *Paramecium,* Binary fission and conjugation in *Paramecium.*
2. Study of *Sycon* (T.S. and L.S.), *Hyalonmea, Spongilla.*
3. Study of Obelia, Physalia, Aurelia, Metridium, Pennatula, Fungia, Meandrina, Madrepora.
4. One specimen/slide of any ctenopore.
5. Study of adult *Fasciola hepatica, Tenia sodium* and their life cycle (Slides/micro-photographs).
6. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs).
7. Study of following specimens :

   Annelids-*Aphrodite, Nereis, Heteronereis, Pheretima, Hirudinaria.*

   Arthropods-*Limulus, Palaemon, Daphnia, Sacculina, Cancer, Eupagurus, Solopendra, Julus, Bombyx, Periplaneta, termites and honey bees.*

   Molluscs-*Chiton, Pila, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus.*
8. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm.
9. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
10. Mount of mount parts and dissection of digestive system and nervous system of Periplaneta.*
11. To submit a Project Report on any related topic on life cycles/coral/coral reefs.

CONTENTS

UNIT 1

PROTOZOA

STRUCTURE

- *Amoeba* : Examination of culture, and prepared slide *Amoeba proteus.*
- *Euglena* : Culture examination and slides of Englena.
- *Paramecium* : Culture examination. Prepared slides for structure, binary division and conjugation.
- Study of prepared slides : *Polystomella, Gregarina, Tryanosoma, Noctiluca* and *Vorticella.*
- Examination of reactal protozoans *Opalina, Balatidium* and *Nyctotherus.*

• 1.1. *AMOEBA*

Aim

To culture Amoeba in the laboratory.

Requirements

Beaker (1000 ml), glass trough, dried hay, distilled water, pipette, dropper, slides, cover slip, microscope.

Method

1. Collection of *Amoeba*—*Amoeba* can be collected from pond water. They are usually found close to leaves and other organic matter in ponds. Alternately, a pure culture of Amoeba can be obtained from a supplier of biological material.
2. Medium preparation—Boil 100 milliliters of pond water for ten minutes.
3. Add five grains of uncooked rice to the cooled water.
4. Let the mixture stand in open petri plates for 2 days
5. Inoculate this culture medium with 20 ml of the sample containing *Amoebae.*
6. After 5 days, collect a few drops of water from the bottom of the culture.
7. Place a drop of water on a slide, cover it with a cover slip and observe under the microscope.

Note : *Amoeba does not remain active for a long time once it is removed from culture. Using pieces of cover slip glass to raise the cover slip to allow oxygen to enter the water and adding water from the sides of the cover slip allows Amoebae to remain active for a longer time.*

• 1.2. *AMOEBA PROTEUS* : WHOLE MOUNT

Phylum	– Protozoa
Sub Phylum	– Sarcomastigophora
Super Class	– Sarcodina
Class	– Rhizopoda

Order	– Lobosa
Genus	– Amoeba
Species	– *proteus*

Comments

1. It is a unicellular, microscopic organism.
2. Its locomotory organs are pseudopodia.
3. Body has an irregular, asymmetrical shape covered by a semipermeable thin, flexible plasmalemma.

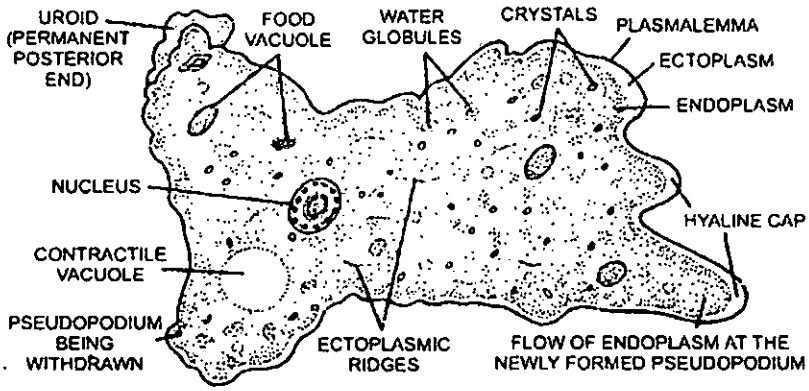


Fig. *Amoeba*

4. Outer cytoplasm is called ectoplasm and inner cytoplasm is called endoplasm. Pseudopodia are formed from the projections of ectoplasm.
5. Endoplasm has a spherical nucleus, a contractile vacuole and food vacuotes.
6. Nutrition is holozoic.
7. Reproduction is by binary fission or multiple fission.

Habit and habitat

It is normally found in fresh water pools, slow-flowing streams, marshes, ponds, etc. It is more common in water bodies that are rich in dead organic matter.

Study of pond water

Pond water may contain different types of animals including

(a) Protozoans

(b) Multi cellular animals

Protozoans

Protozoans found in pond water may be ciliates, flagellates or may have other locomotory organs like pseudopodia. Once you have determined whether a protozoan moves with cilia, flagella or pseudopodia, some of the common protozoans found in pond water can be identified with the help of the key below. For other protozoans/multi-cellular animals seek the help of your teacher.

Ciliophora

Member of ciliophora move with the help of **cilia**. Cilia may be united to form rows or tufts (cirri), resides locomotion, cilia are also used for feeding.

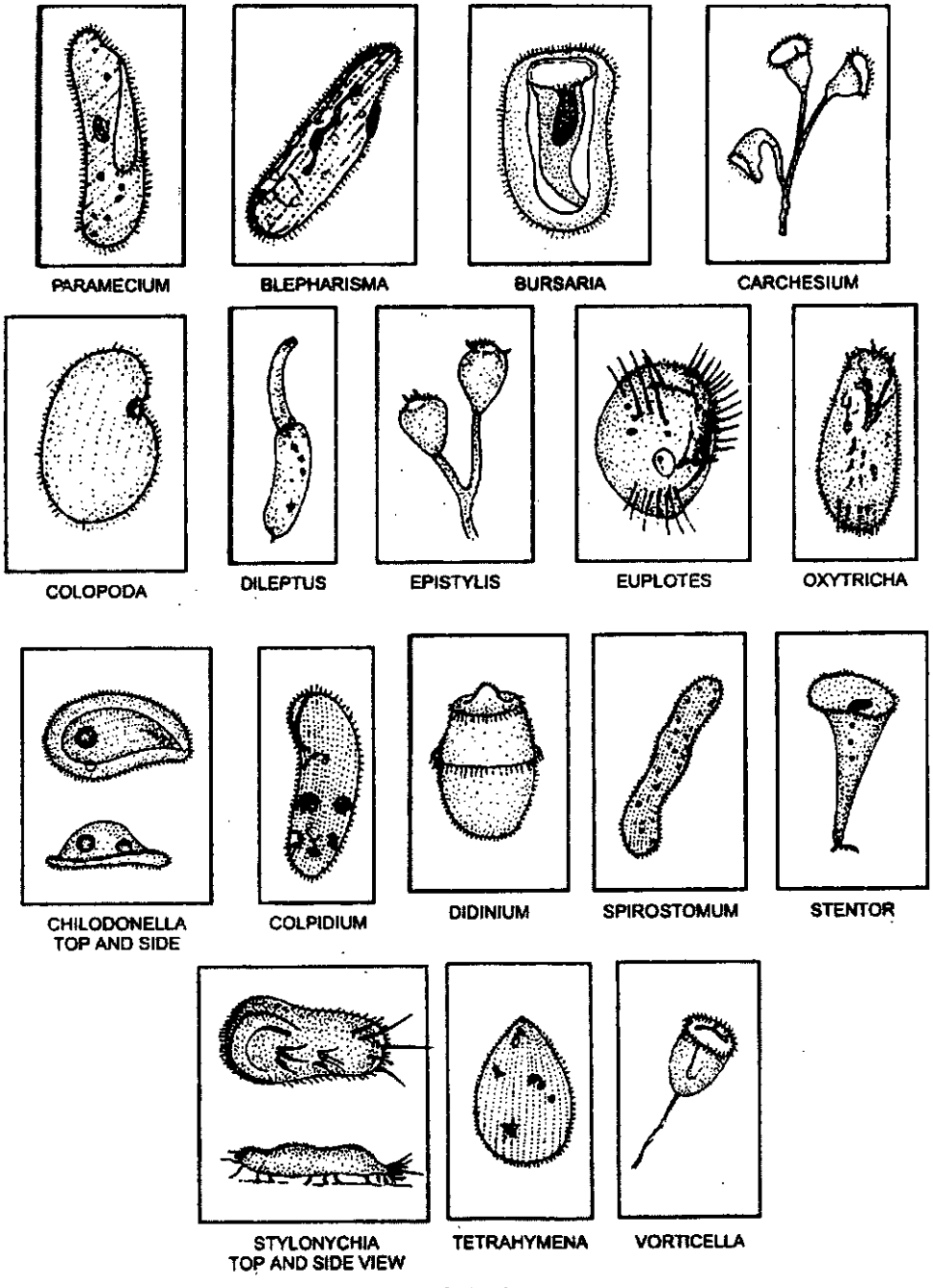
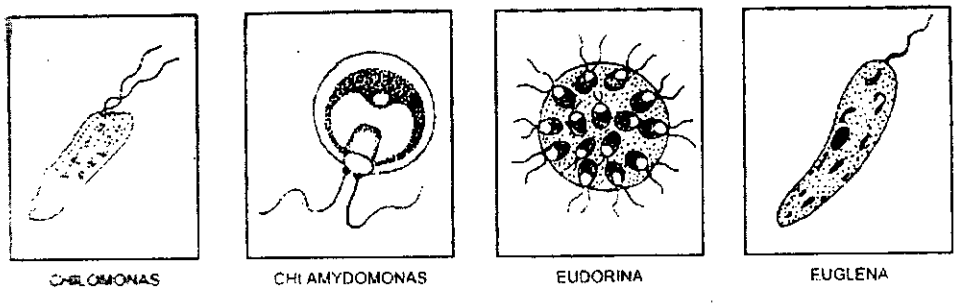


Fig. Ciliophora

Mastigophora

Members of Mastigophora move with the help of **flagella.** In colonial Mastigophorans the beating of flagella causes the movement of the entire colony.



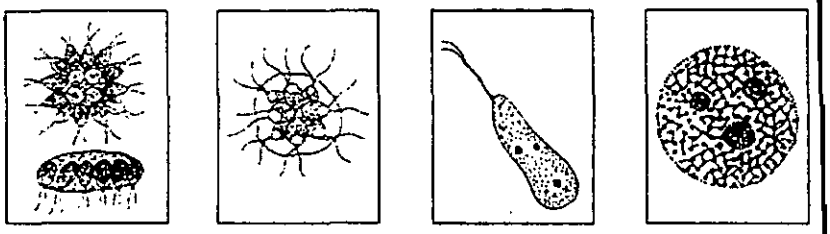


Fig. Mastigophora

Sarcodina

Most members of Sarcodina move with the help of **pseudopodia**.

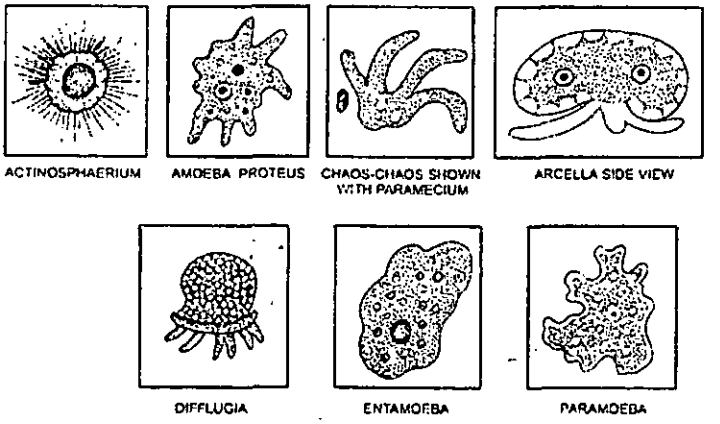


Fig. Sarcodina

Multi cellular animal in pond water

Pond water also has several small, microscopic multi-cellular animals. Thes include coelenterates rotifers, crustaceans, crustacean larvae etc. these should nc be confused with protozoans.

• 1.2. *EUGLENA*

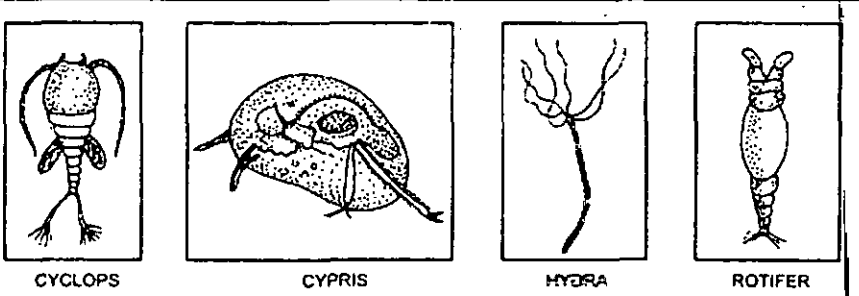


Fig. Multi cellular animal in pond water

Classification -

Phylum – Protozoa
Subphylum – Sarcomastigophora
Superclass – Mastigophora
Class – Phycomastigophorea
Order – Eugfenida
Genus – *Euglena*
Type – *viridis.*

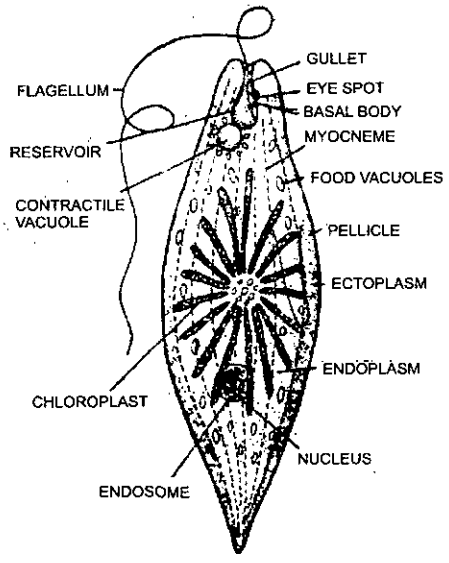


Fig. Euglena

Comments

1. A small free living and freshwater form.
2. Body spindle shaped and usually *green in colour* and is surrounded with tough & elastic membrane – the pellicle.
3. In the middle of anterior end lies a cytostome leading into a small cytopharynx which dialates behind into a reservoir.
4. Near the reservoir a large *contractile vacuole* is present.
5. Ectoplasm full of myonemes and endoplasm has a small rounded nucleus and conspicuous *chloroplasts* arranged like a star.
6. A long flagellum originates from two roots on the side of reservoir.
7. A tiny eye spot is also present near the roots of flagellum.
8. Reserve food in the form of pyrenoid bodies.
9. *Nutrition holophytic* asometimes saprophytic also.
10. Reproduction through longitudinal binary fission, but in adverse circumstances through encystment and palmella stage.

• 1.3. *PARAMECIUM*

Aim

To culture Paramecium in the laboratory.

Requirements

Beaker (1000 ml), glass trough, grains of wheat, stems of dry hay, distilled water, pipette, dropper, slides, cover slip, and microscope.

Method

1. Add 20–30 grains of wheat and 20–30 stems of dry hay to 500 ml distilled water in a beaker.
2. Boil the mixture for 20 minutes.
3. Allow the mixture to cool.
4. Cover the mixture with cellophane sheet and allow it to stand in the dark for 3 days.

5. Collect 5 ml water from a pond and add it to the mixture.

6. Cover the mixture again and allow it to stand for 3 days.

7. After 5-6 days, collect a few drops of water from the culture (water around the grains of wheat is particularly rich in Paramecia).

8. Place a drop of water on a slide, cover it with a cover slip and observe under the microscope.

Paramecium

Classification-

Phylum	– Protozoa
Subphylum	– Ciliophora
Class	– Ciliata
Subclass	– Holotrichia
Order	– Hymenostomatida
Genus	– Paramecium
Type	– *caudatum.*

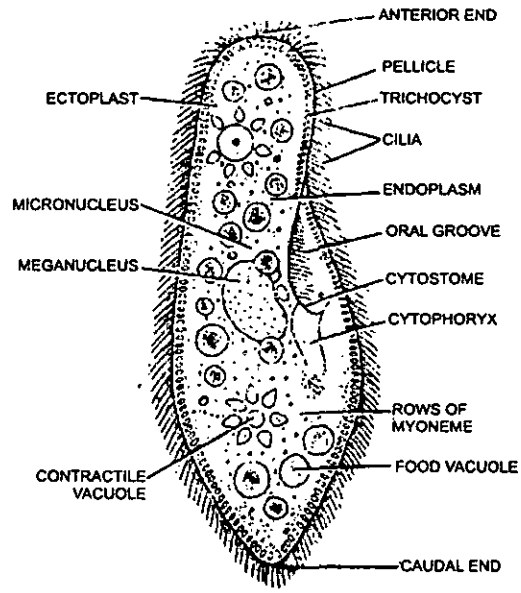


Fig. Paramecium

Comments

1. Fresh water, free living, omnipresent and is found in stagnant water.

2. Body like a slipper with anterior end narrow and rounded and posterior end broad and pointed. Uniform ciliation all over body except at post, end where cilia are large & form a ***caudal tuft.***

3. Body is surrounded by a tough & elastic *pellicle.*

4. Cytoplasm well differentiated into ecto and endoplasm.

5. Ectoplasm is having uniform row of trichocysts and longitudinal rows of myonemes.

6. On one side lies an oral groove which extends into gullet near the middle.

7. At the base of gullet lies an apperture the cytostome, which opens into a tubular cytopharynx.

8. Behind the cytopharynx, on the side, lies the cytopyge or anus.

9. Endoplasm possesses a large ***kidney shaped meganucleus and a small micronucleus.***

10. Contractile vacuoles two or even more.

11. Nutrition ***heterotrophic*** and reproduction by asexual as well as sexual methods.

12. Sexual reproduction through endomixis, conjugation or hemimixis and asexual reproduction through *binnary fission.*

Paramecium in binnary fission

1. It is a slide of Paramecium showing asexual mode of reproduction.

2. It occurs during favourable conditions when food is available in large quantities and temperature is favourable.

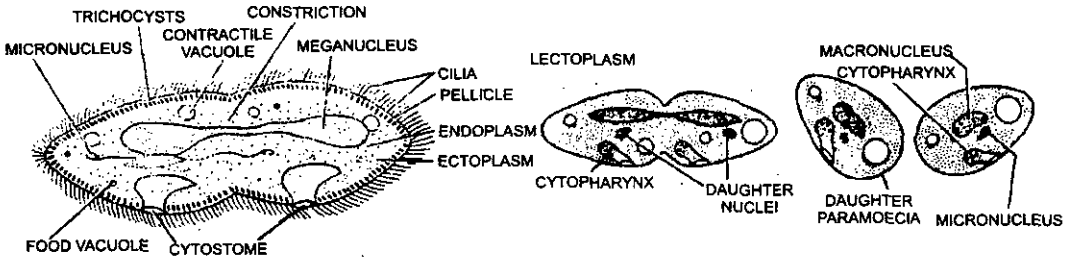


Fig. Paramecium in binary fission

3. A median constriction starts developing in the cytopharynx region.

4. The cytopharynx is divided into two and each half develops the missing part.

5. The macronucleus elongates and then divides through constriction amitotically.

6. The micronucleus divides mitotically

7. Ultimately one Paramecium gives rise to two daughter paramaecia.

Paramaecium in Conjugation

(1) It is the slide of Paramaecium showing conjugation.

(2) In conjugation (sexual reproduction) the two paramaecia come in contact and unite through the edges of their oral groove.

(3) The pellicle, all along the union of two forms, is disintegrated. At this stage they are called ***gametocytes*** or ***conjugants***.

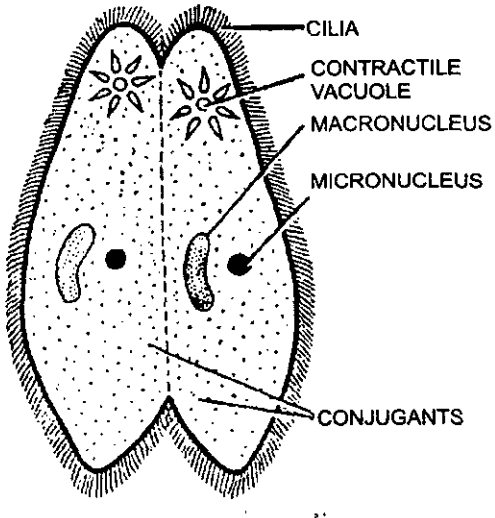


Fig. Paramacium in conjugation

(4) The macronucleus of each conjugant disappears and their micronuclei divides twice and forms 4 haploid micronuclei.

(5) Out of these four micronuclei three daughter micronuclei disintegrate, while remaining one divides into two unequal daughter pronuclei. Of these, the smaller one is the active ***male migratory pronuleus,*** whereas the larger one is the ***stationary female pro nucleus.***

(6) The migratory male pronucleus of each conjugant moves through the protoplasmic bridge into the other conjugant and ultimately fuses with stationary female pronucleus forming zygote.

(7) The nucleus of zygote is diploid and is called amphinucleus and this type of mixing of two nuclei from different individuals is called amphimixis.

(8) After zygote formation the nucleus continue division and forms four daughter paramecia.

(9) ***The conjugation occurs only when nutrition Is deficient and when temperature of water is below the optimum.***

(10) Conjugation results in rejuvenation and transference of hereditary materials and occurs indifferent strains.

• 1.4. STUDY OF PREPARED SLIDES

Polystomella

Classification-

Phylum	– Protozoa
Subphylum	– Sarcomastigophora
Superclasses	– Sarcodina
Class	– Rhizopoda
Subclass	– Granuloreticulosa
Order	– Foraminifera
Genus	– *Elphidium (Polystomella)*
Type	– *strigilates.*

Comments

1. It is a marine protozoan common on sea shores.

2. Body enclosed in a many chambered shell and each chamber is perforated with numerous pores.

3. Chambers are arranged in a spiral fashion..

4. Ectoplasm gives rise to numerous thread like extensions-the reticulopodia, which project out of the pores.

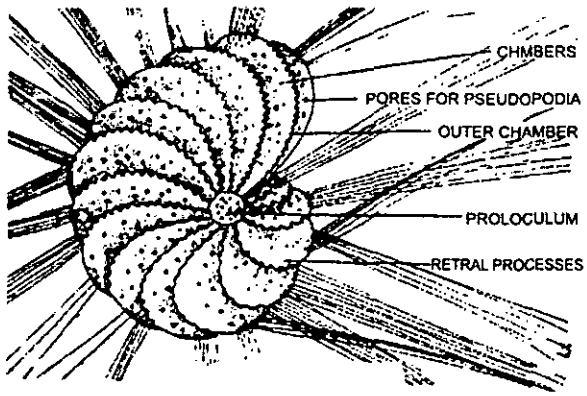


Fig. Polystomella

5. Adults exhibit **dimorphism and alternation of generation** between a *microspheric* and a *megalospheric* form.

6. Microspheric form has small central chamber - the *proloculum* and many scattered nuclei. It reproduces only asexually i.e., through multiple fission.

7. The megalospheric form has large central chamber and only one nucleus. It reproduces only sexually i.e., through *gametogamy* and *conjugation.*

8. *Nutrition holozoic.*

Gregarina

Classification-

Phylum	– Protozoa
Subphylum	– Sporozoa
Class	– Telosporia
Subclass	– Grigarina
Order	– Eugregarinida
Genus	– *Gregarina*
Type	– *blattarum.*

Comments

1. Gregarina are intracellular parasites of intestines of Cokroaches.

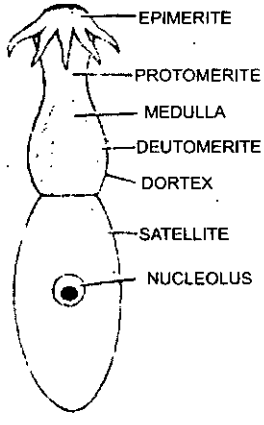


Fig. Gregarina

2. Body is bipartite in sporont or sporadin and *tripartite* in *trophozoite.*

3. Different parts of body are *epimerite, protomerite* and *deutomerite.*

4. The epimerite is the part which sucks food from inside the host cells. *It is absent in sporont.* ***The deutomerite contains a large nucleus.***

5. Trophozoite converts into sporont, which is changed into a cysted gamont. The gamonts or gametes, in favourable condition, fuse and produce spores. Each spore gives rise to 8 sporozoites, which invade the intestinal cells and grow into trophozoites.

6. ***Nutrition saprozoic and locomotion through contraction of myonemes which are longitudinal.***

Trypanosoma

Classification -

Phylum	– Protozoa
Subphylum	– Sarcomastigophora
Superclass	– Mastigophora

Class – Zoomastigophora
Order – Kinetoplastida
Genus – *Trypanosome*
species – *gambiense.*

Comments

1. It is an endoparasite in the blood, *lymphatic system* a: cerebrospinal fluid of human beings, causing a disease ***sleeping sickness.***

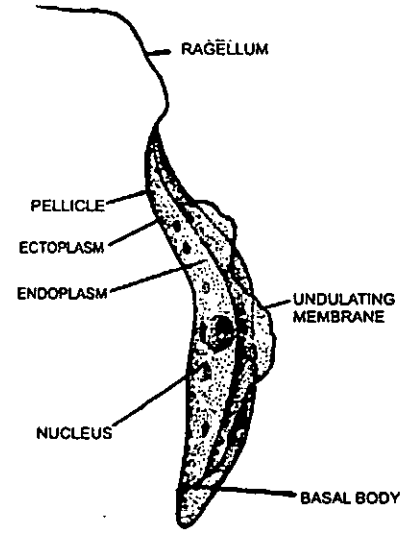


Fig. Trypanosome

2. The body is flat and somewhat *spindle- like.*
3. Body surrounded by a strong but thin pellicle.
4. *Cytostome, cytopharynx* and *cytopyge* are absent.
5. Near the posterior end from a kinetoplast originates a *flagellum* whic runs along the body length connected with an *undulating* membrane. Part of thi flagellum remains free at the anterior end.
6. The body contains a large central nucleus surrounded by numerous metachromatic granules.
7. It shows pollmorphism in its life cycle.
8. Its Intermediate host is ***Tse tse fly-Glosslna palpalis.***
9. Nutrition saprozoic and reproduction through fission.

Noctiluca

Classification
Phylum – Protozoa
Subphylum – Sarcomastigophora
Superclass – Masligophora
Class – Phytomastigophora
Order – Dinoflagellata
Genus – Noctiluca
Type – *scintillans.*

Comments

1. Marine and pelagic form abundantly found near sea shore and imparting reddish colour to sea water in day.

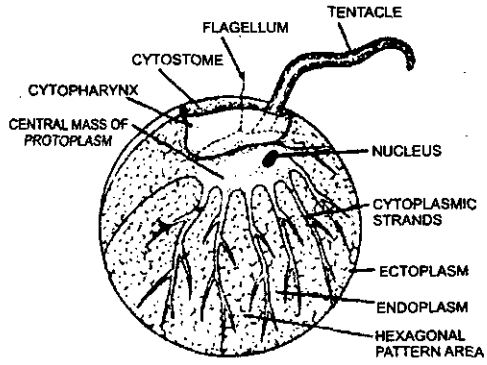


Fig. Noctiluca

2. Body round and somewhat ball like.

3. Body enclosed in a smooth cellulose envelope which shows hexagonal patterns.

4. *Chromatophores* are green and the nutrition is holozoic.

5. Shows phosphorescence by emitting greenish light at night.

6. The body gives off, above, a collar *like cytopharynx* at the floor of which is present a sulcus, which gives off a small flagellum and a large tentacle. The *flagellum helps in food capturing* and *tentacle helps in locomotion.*

7. Near the cytopharynx lies a nucleus and a mass of *protoplasm.*

8. Cytoplasm gives of a vacuolated appearance.

9. From the central mass of protoplasm radiates numerous strands.

10. Asexual reproduction occurs through fission and sexual through *syngamy.*

Vorticella

Classification	– Protozoa
Subphylum	– Ciliophora
Class	– Ciliata
Sub class	– Peritrichia
Order	– Peritrichida
Genus	– *Vorticella*
Type	– *campanula*

Comments

1. These are freshwater and solitary animals found attached to the aquatic plants or stones etc.

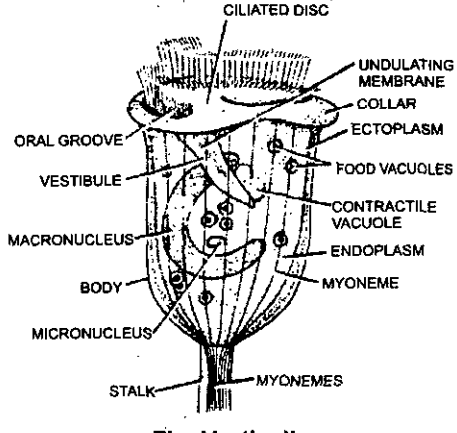


Fig. Vorticella

2. *Body of these animals is devoid of ciliation* except at the free anteri end which is surrounded by cilia.

3. Body bell-shaped and is connected with a contractile stalk at its base.

4. Ectoplasm has vertical and oblique rows of *myonemes.*

5. Endoplasm is having a large semicircular macronucleus and a sma *micronucleus* attached to the former.

6. Stalk also has myonemes and is thus constrictable.

7. The anterior end of bell-shaped body is made of a collar and a peristomi disc separated by a peristomial groove. Three rows of long cilia are arrange anticlockwise and are inserted in *peristomial groove.*

8. Peristomial groove leads into *cytopharynx* and is having an *undulatin membrane.*

9. Nutrition *heterotrophic* and reproduction through *fission* an *conjugation.*

• 1.5. EXAMINATION OF RECTAL PROTOOANS

Opalina

Classification –

Phylum	– Protozoa
Subphylum	– Sarcomastigophora
Superclass	– Opalinida
Order	– Opalina
Genus	– *Opalina*
Type	– *ranarum.*

Comments

1. It is an *endoparasite* in the rectum of vertebrates especially frogs and toads.

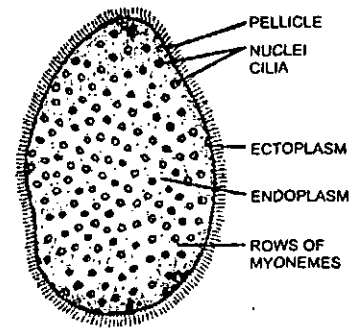


Fig. Opalina

2. Body some what oval and flattened with uniform cilliation all over.

3. *Cytostome, cytopharynx, cytopyge* and vacuoles are absent, but a tough pellicle is present.

4. Cytoplasm differentiated into ectoplasm and endoplasm.

5. Ectoplasm has oblique rows of *myonemes.*

6. *Endoplasm has numerous nuclei.*

7. Nutrition *saprozoic.*

8. Reproduction through *plasmotomy, binnary fission, encystment* and *conjugation.*

Balantidium

Classification -

Phylum	– Protozoa
Subphylum	– Ciliophora
Class	– Ciliata
Subclass	– Holotrichia
Order	– Trichostomatida
Genus	– *Balantidium*
Type	– *coli.*

Comments

1. It is an endoparasite in the caecum and ascending colon of human beings.

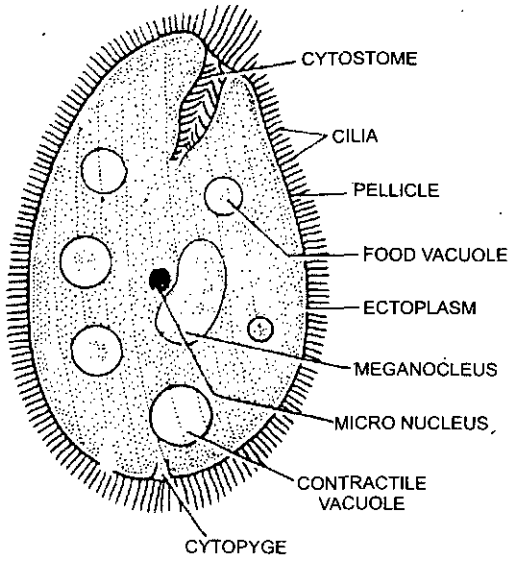


Fig. Balantedium

2. It is supposed to the the largest available protozoan.
3. Ciliation over body almost uniform.
4. At the anterior end lies a wide aperture -the cyiostome which opens into a tubular *cytopharynx.*
5. Cytopharynx is lined by an undulating membrane.
6. Ectoplasm and endoplasm clearly differentiated.
7. Ectoplasm bears rows of myonemes arranged in a semicircular fashion.
8. Endoplasm bears a large, dumbbell-shaped macronucleus, a small micronucleus and one or two large contractile vacuoles.
9. A small *cytopyge* is present on one side near posterior end.
10. Nutrition heterotrophic and reproduction through fission, encystment and conjugation.

Nyctotherus

Classification -

Phylum	– Protozoa
Subphylum	– Ciliophora
Class	– Ciliata

Subclass	– Spirolrichia
Order	– Heterotrichida
Genus	– *Nyctotherus*
Type	– *cordiformis.*

Comments

1. Endoparasites in the rectum of vertebrates and intestine of sc invertebrates.

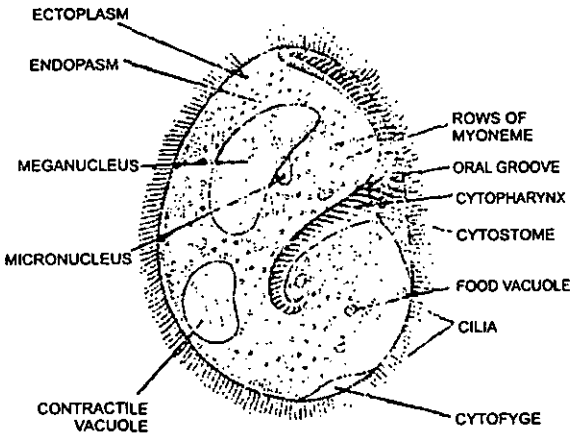


Fig. Nyctotherus

2. Body some what bean-shaped and bears uniform ciliation all over.

3. Cytoplasm well differentiated into ectoplasm and granu endoplasm.

4. The ectoplasm is having oblique rows of myonemes.

5. Endoplasm is having a large and some what kidney-sha *macronucleus*, a small *micronucleus* attached to it, a large eccentric contrac vacuole and numerous small *food vacuoles*.

6. On one side it bears a deep oral groove which, near the middle of animal, communicates through a wide cytostome continuing into a deep and coi tube the *cytopharynx*.

7. Near the posterior end is present a small *cytopyge* of the anus.

8. The oral groove bears rows of aboral cilia and cytopharynx be *undulating membrane.*

9. Nutrition is generally saprozoic.

10. It reproduces through *multiple fission, encystment* and *conjugation*.

UNIT 2

PORIFERA

STRUCTURE

- *Sycon* General characters, Sicules glycerine preparation. Transverse and longitudinal sections-prepared slides.
- Gemmule of *Spongilla* permanent preparation.
- Different kinds of sponge spicules and sponging fibres of euspongia-prepared slides.
- *Euplectella* (Venus's flower-basket), *Spongilla* (fresh-water sponge), *Euspongia* (bath sponge)

• 2.1. *SYCON*

Classification –

Phylum – Porifera

Class – Calcarea

Order – Heterocoela

Genus – *Sycon* or *Scypha*

Type – *ciliata.*

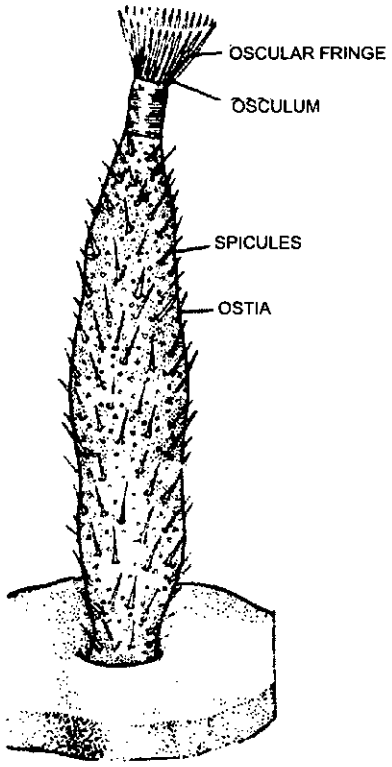


Fig. Sycon

Comments

1. It is a marine, colonial and hermophrodite sponge which is attached to rocks near sea shore in shallow waters.

2. Each sponge is a vase-like cylinder perforated with numerous ostia all over and a large osculumat the apex.

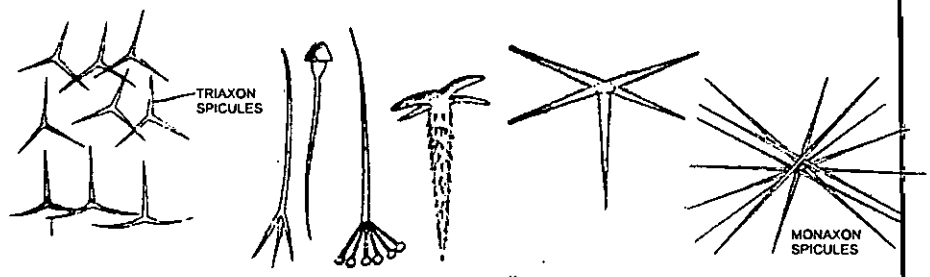


Fig. Spicules

3. Osculum is surrounded with a fringe of monaxon spicules.

4. Canal system is of syconoid type.

5. Radial canals are lined with chonanocytes.

6. Skeleton is made up of *monaxon, triaxon* and *tetraxon calcarious spicules.*

7. Reproduces asexually and sexually.

Spicules of Sponge

1. The spicules are structures which form the supporting skeleton in sponges.

2. They may be either *calcareous* or *silicious* in nature.

3. They may be either *monaxon* (having one ray) *triaxon* (having 3 rays) or *tetraxon* (having 4 rays).

4. Some times they form specialised *amphidiscs.*

5. They are secreted by special scleroblast cells.

6. Each of them has a central organic axis around which minerals are deposited.

L.S. Sycon

Comments

1. It is the slide L.S. of Sycon

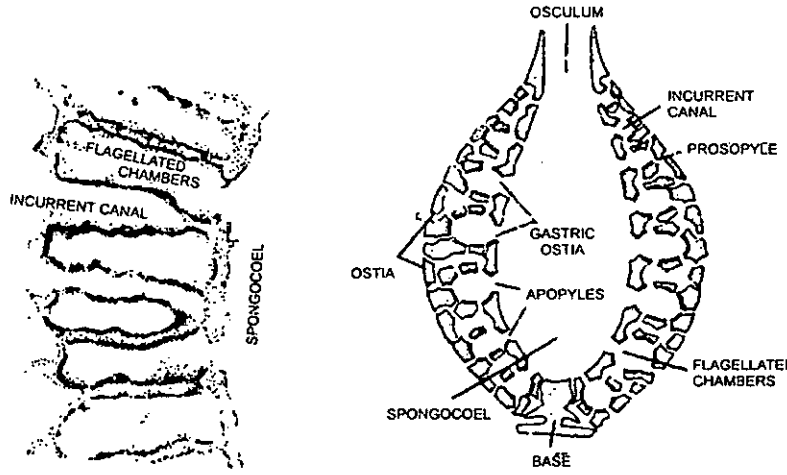


Fig. L.S. Sycon

2. Body wall is diploblastic with an outer ectodermal or dermal epithelial layer and inner gastric epitheliallayeror endoderm.

3. Noncellular . mesenchyme layer with interspersed monaxon and triaxon spicules is present in between the two layers.

4. The dermal epithelium is made by flat pinacocytes and is perforated by ostia.

5. The ostia lead into incurrent canals which through prosopyles lead into radial canals which are lined with choanocytes.

6. The radial canals lead into small excurrent canals which are lined by pinacocytes.

7. The excurrent ccnals open into spongocoele.

8. The canal system is of syconoid type.

Sycon T.S.

1. It is the slide of T.S. of Sycon.

2. Body wall is diploblastic with an outer dermal layer and inner gastric layer.

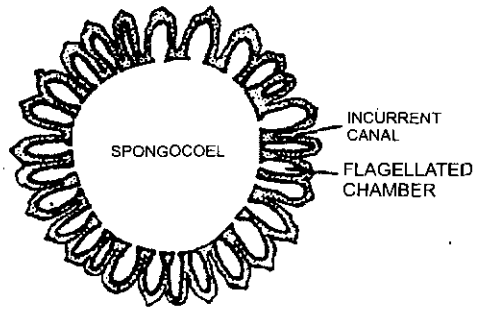


Fig. T.S. Sycon

3. The gastric layer is made up of mesenchym with interspersed *monaxon* and *triaxon* spicules and lined internally with flat *pinacocyte* cells.

4. The dermal layer is also made by *flat pinacocytes* and is perforated by ostia.

5. The ostia leads into *incurrent canals* which, through prosopyles, lead into radial canals which are lined with choanocytes.

6. The radial canals lead into small excurrent canals and are lined by pinacocytes.

7. The *excurrent canals* open into *spongocoel.*

8. The canal system is of *syconoid type.*

• 2.2. GEMMULE

Procedure for slide preparation

(a) Keep the gemmules in a cavity block/watch glass.

(b) Pass through 70% alcohol (gemmules are preserved in 90% alcohol, therefore, we must take it to 70% before we can use borax carmine dissolved in 70% alcohol).

(c) Stain with borax carmine (dissolved in 70% alcohol).

(d) Dehydrate by passing through 90% and 100% alcohol. Clear in xylene and mount in Canada Balsam/DPX.

Note :

1. Gemmules are fragile. Pressing too hard on the cover slip can cau them to rupture.

2. Some instructors may advice students to break a cover slip and place small piece of glass at each corner of the cover glass when thick specimens li gemmules need to be mounted.

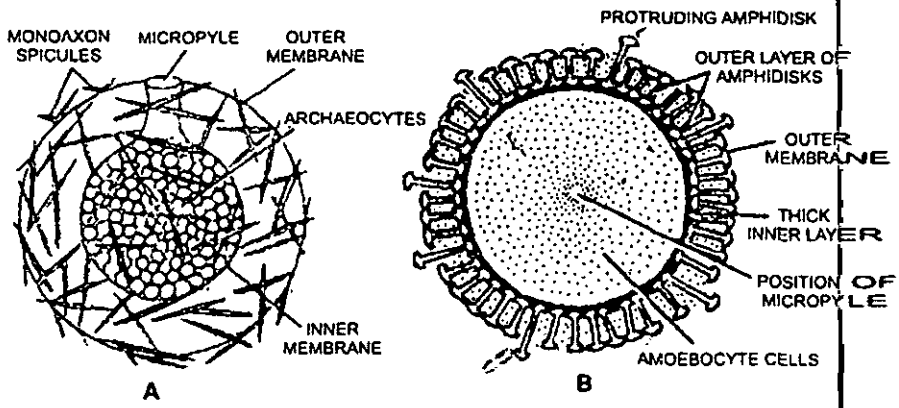


Fig. A-Gemmuleof *Spongilla*.B-Gemmule of *Epthydatia*.

Comments

1. Gemmules are asexual reproduction bodies found in fresh wafer spong and some marine sponges. They are also called **Internal buds**.

2. These are formed to tide over adverse conditions like drought and cold.

3. Gemmule is a small ball like structure that has a group of archaeocyt in a cyst.

4. Archaeocyte cells of gemmules contain reserve food particles produc by thesocyte cells.

5. The cyst has an outer and an inner chitinous layer. The 2 layers form resistant capsule around the cyst.

6. A **micropyle** is present at one end for migration of cells outside.

7. Apart from Spongilla the gemmules of other sponges have amphidi spicules in their capsule.

8. When favourable conditions return archaeocyte cells come o through the micropyle and develop into a new sponge.

• 2.3. SPONGIN FIBRES OF *EUSPONGIA*

Comments

1. Spongin forms a cement like or fibrous matrix in which spicules may embedded.

2. In commercial bath sponges the skeleton is made entirely of spong fibres.

3. Spongin fibres form a network of branched fibres. The shape of the fib may differ ;n different species.

4. Spongin fibres are secreted by **spongioblasts**.

5. Spongin fibres are made of a protein that is similar to silk in i constitution.

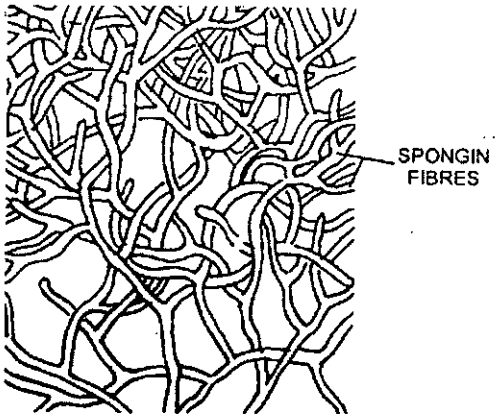


Fig. Spongin fibres of *Euspongia*

• 2.4. *EUPLECTELLA*

Classification –

Phylum – Porifera

Class – Hexaclinelide

Order – Hexasterophorn

Genus – *Euplectella*

Type – *aspergillum.*

Comments

1. It is a marine sponge found in deep waters in Pacific oceans near West Indies and Phillipines islands.

2. Commonly called **"venus-flower basket"** by local inhabitants.

3. The body is tubular, curved and basket-like and is made up of triaxon spicules.

4. At the base is present a bunch of glassy spicules for attachment.

5. Body perforated by numerous apertures, which are not true ostia but simply parietal gaps.

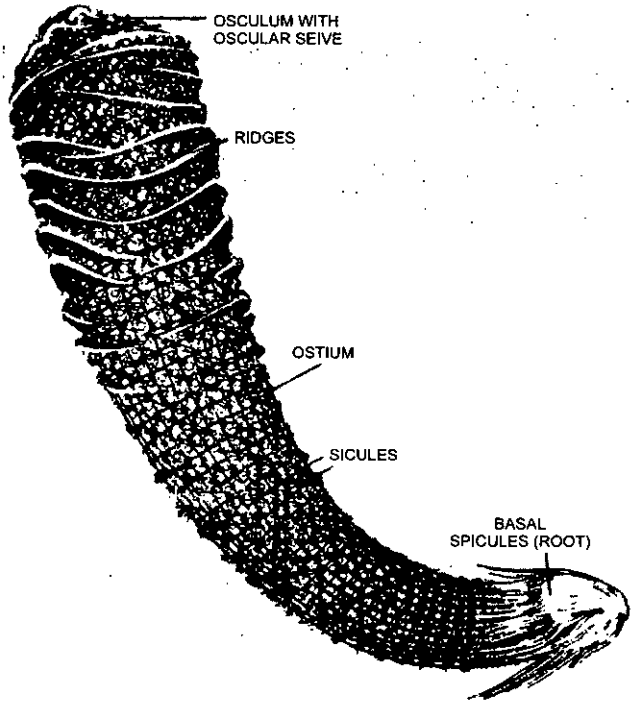


Fig. Euplectella

6. Canal system syconoid type, where ostia communicate with incur canals, which communicates with radial canals through prosopyles which, int open into spongocoel and to outside through osculum.

7. Osculum is covered over by a sieve plate.

8. Radial canals are lined with choanocytes.

9. In the spongocoel often live a pair of decapod symbionts-Spong venusta, which never escape out of It and die inside.

10. Dried skeleton is presented in marriages in Japan. It is also used drawing-room decorations.

11. Reproduction both asexual and sexual.

Spongilla

Classification

Phylum	– Porifera
Class	– Demospongia
Subclass	– Monaxonida
Order	– Haplosclarina
Genus	– Spongilla
Type	– *lacustris*

Comments

1. It is a common freshwater colonial sponge found usually attached sticks or pieces of wood in lakes and ponds.

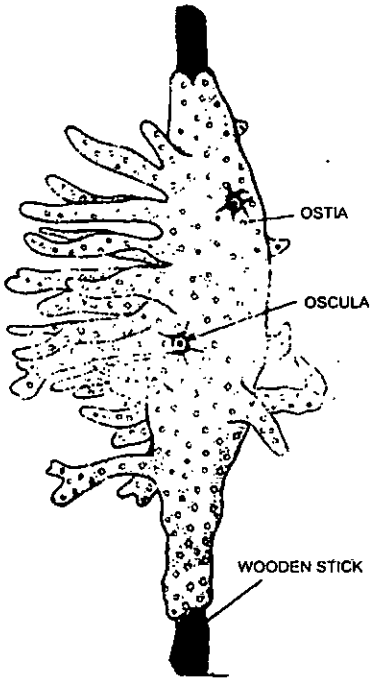


Fig. Spongilla

2. Usually yellowish brown in colour and comprised of numerous sn individuals with a common flat base.

3. Every individual is perforated with numerous ostia and also has osculum for one individual or one osculum for more than one individual. In later case two such individuals are said to represent each other's branches.

4. Canal system is of ***rhagon type*** and skeleton is of spongin fibres with interspersed silicious monaxon spicules.

Euspongia or (Spongia)

Classification

Phylum	– Porifera
Class	– Demospongia
Subclass	– Keratosa
Genus	– *Euspongia*
Type	– *officinalis*

Comments

1. It is a marine sponge of commercial value and is found in Mediterranean sea, West Indies and along American coasts.

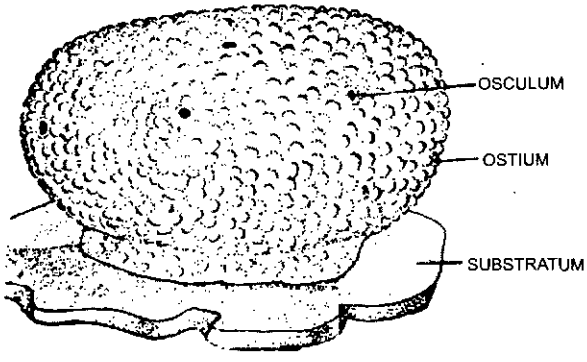


Fig. Euspongia or (Spongia)

2. It is commonly found in shallow water attached to substratum.

3. Skeleton is made up of spongin fibres. ***The silicious spicules being absent.***

4. It is usually of a globular shape with numerous oscula mounted on well marked projections-the ***canals.***

5. Its dried skeleton is commonly used as bath sponges.

UNIT 3

COELENTERATA

STRUCTURE

- *Hydra* live speciments.Prepared slidesof entire speciments. Longitudinal and transvrse section-prepared slides.
- *Obelia* Colony-prepared slide. Medusa-prepared slide.
- *Aurelia* General morphology. Tentaculocyst prepared slide.Prepared slides.
- *Physalia* (Porgues man ofwar), *Corailium* (redcoral),*Fungia* (Mushroom coral),*Madrepara* (staghom coral), *Pennatula* (seapen),Sagartia of*Metridium*(sea anaemone).

• 3.1. *HYDRA (W.M.)*

Classification –

Phylum	– Coelenterata
Class	– Hydrozoa
Order	– Hydroidea
Suborder	– Anhomedusae
Genus	– *Hydra*
Type	– *fusca*

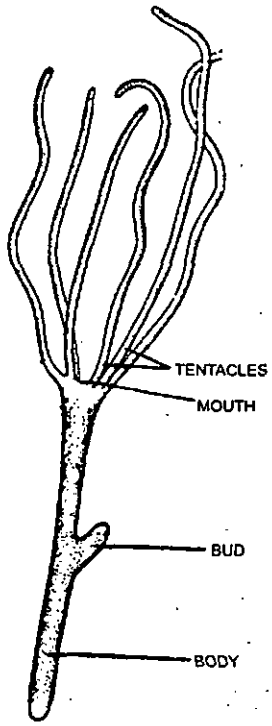


Fig. Hydra

1. It is a fresh water form cosmopolitan in distribution.

2. It is found attached to aquatic weeds.

3. Body differentiated into a long tubular trunk and a hypostome or mouth surrounded by a ring of long tentacles.

4. Through the body runs a cavity- the coelenteron which also extends into tentacles.

5. Bodywall diploblastic and is made up of outer ectoderm and inner endoderm and a gelatinous *mesogloea* inbetween the two layers.

6. The outermost covering of ectoderm is in the form of transparent cuticle.

7. The specialised organs of offence and defence -the nematocysts are present.

8. Along the body, 'at places', are found small buds, which are future young ones.

9. Reproduces asexually as well as sexually.

3. HYDRA : LONGITUDINAL SECTION

Comments

The longitudinal section of Hydra shows the following structures :

1. Body wall is double layered (diploblastic).

2. A gelatinous, acellular layer called **mesoglea** occurs between the outer ectoderm and inner endoderm.

3. Ectoderm is made up of epithelio muscular cells, epithelial cells, sensory cells, nerve cells, gland cells, nematoblasts and reproductive cells.

4. Coelenteron is lined by endoderm and is made up of epithelio muscular cells, secretory cells, sensory cells, nerve cells and interstitial cells.

5. Buds and reproductive organs are present laterally on the body. Testes are located closer to the tentacles while ovaries lie near the base.

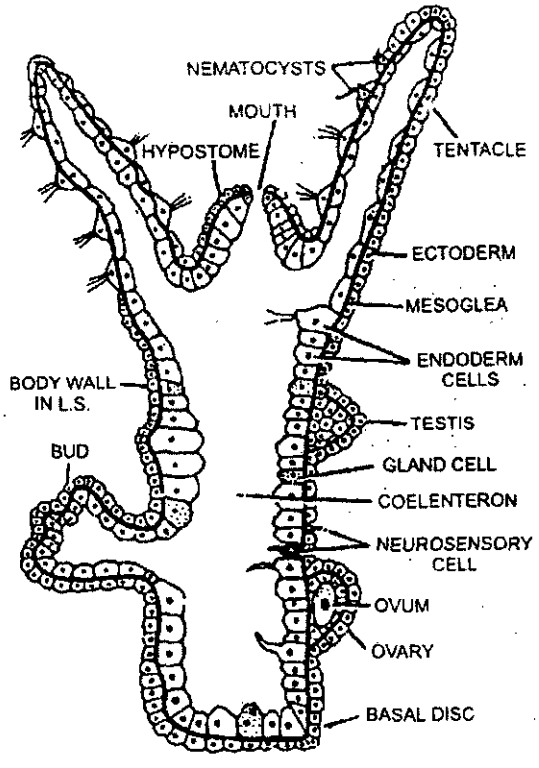


Fig. Hydra : L.S.

6. The central cavity of the body is called the coelenteron or gastro vascu cavity that extends into tentacles and buds as well.

T.S. Hydra

1. It is the slide of T.S. of Hydra.
2. In the centre appears a hollow cavity-the coelenteron.

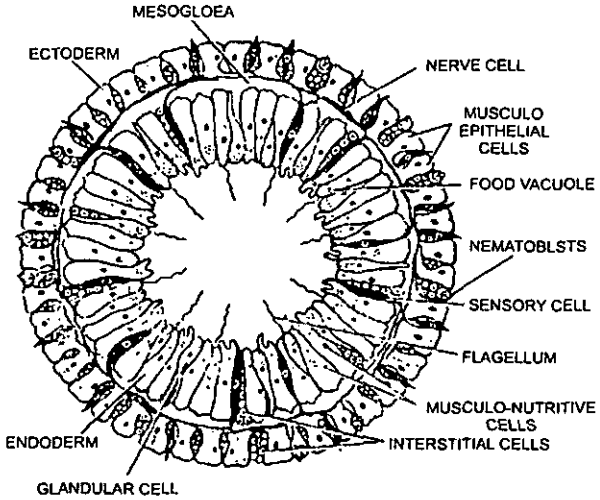


Fig. Hydra T.S.

3. Bodywall is diplobastic. It is comprised of an outer ectoderm, an inne endoderm and a non-cellular gelaiinous mesogloea inbetween.
4. The ectoderm and endoderm cells vary in shape and size according t their functions.
5. The ectoderm is having epithelio-muscuiar cells, interstitial cell. nematoblast cells, sensory and nerve cells.
6. The endoderm is having nutritive, secretory, sensory and gland cells.

• 3.2. *OBELIA* COLONEY

Obelia (W.M.)

Classification –

Phylum	– Coelenterata
Class	– Hydrozoa
Order	– Hydroidea
Type	– *Obelia.*

Comments

1. It is the slide of obelia, which is a marine, colonial and arborescen animal.
2. It is found attached to submerged objects like rocks and weeds etc.
3. All the individuals in a colony are attached through branches to a horizontal hydrorhiza. The branches are called hydrocauli.
5. Each branch bears three types of zooids – the polyp, the medusae and the blastostyles, thus making it polymorphic.
6. The polyp has a vase-tike or bell-like body enclosed in a cup-like hydrotheca. At its distall end lies distinct a raised area – the hypostome with an apical mouth surrounded with tentacles. It is the organ of feeding.

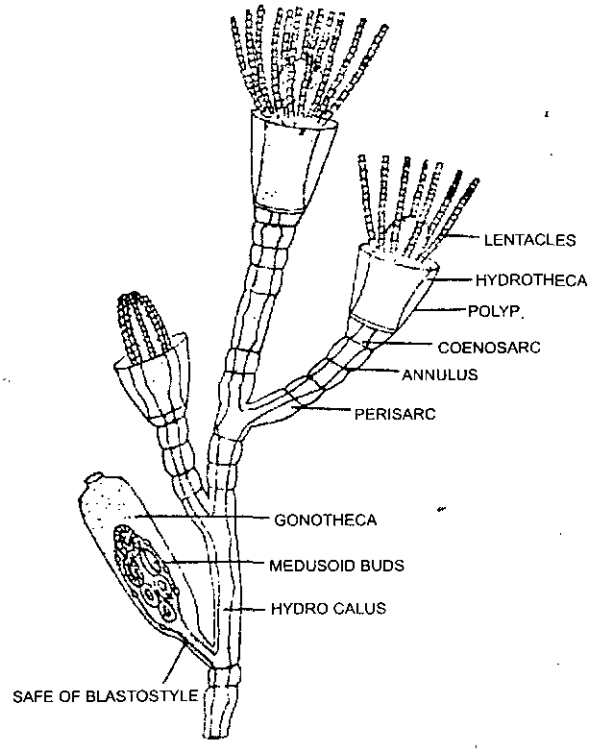


Fig. Obelia

7. The medusae are saucer-shaped zooids and are produced in blastostyles.

8. The blastostyles or gonozooids are club shaped and are devoid of mouth or tentacles. They are enclosed in gonotheca.

9. Gonads are borne on medusae.

10. Life history shows alternation of generations and development through planula larva.

Medusae of Obelia (W.M.)

1. It is the slide of Obelia medusa which is a reproductive zooid responsible

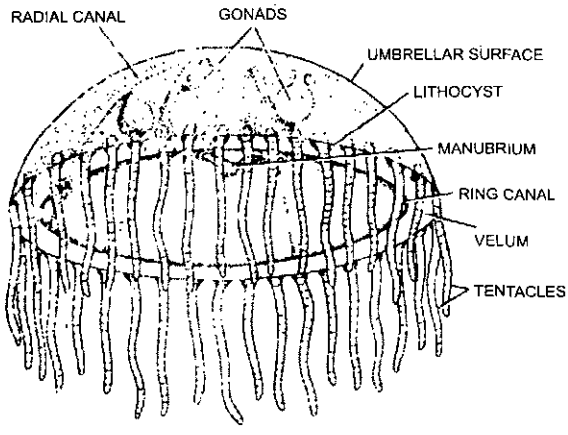


Fig. Medusa Obelia

for giving rise to new progeny.

2. These are saucer-like or umbrella-shaped structures and are developed from blastostyles asexually.

3. All along the margin they bear a ring of tentacles (velum).

4. The inner surface of the dome of saucer bears 4 radial canals.

5. aech radial canal bears a distinct gonad.

6. In the centre, where the radial canals meet, there is present a tubul structure-the manubrium, bearing a rectangular mouth.

7. The medusae are free-swimming zooids.

8. On maturation these gonads release germ cells - the ova and sperm in the sea water.

• 3.3. *AURELIA*

Classification –

Phylum – Coelenterata

Class – Scyphozoa

Order – Semeaostomease

Genus – *Aurelia*

Type – *aurata*

Comments

1. It is a cosmopolitan jelley fish which is found in coastal waters.

2. The adults are exclusively *medusoid* forms.

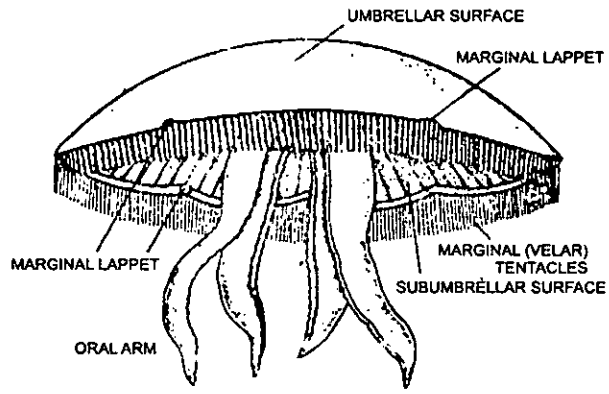


Fig. Aurelia

3. The polyp is represented by schyphistoma and hydratuba stages.

4. The body is like an inverted bowl or umbrella and is radial symmetrical. The margins of umbrella bear tentacles and is notched at 8 points.

5. Each notch has a pair of soft & leaf - like marginal lappet and one tentaculocyst in between the lappets.

6. The outer convex surface of bowl is known as umbrellar surface and th lower concave surface as subumbrellarsurface.

7. The lower concave subumbrellar surface bears a small manubhur (mouth) and gives off four long oral arms along the radiae.

8. *Velum* is absent but endodermal gastric tentacles are present.

9. In each inter-radial space is present a globular structure – the gastri pouch.

10. From each gastric pouch comes out many branched and unbranche radial canals which run along subumbrellar surface and open into a circular cana which runs along the margin.

11. Along the roof, in between the arrows, lie reddish and horse-shoe-shape gonads.

12. Sexes are separate and they exhibit alternation of generation.

Tentaculocyst of Aurelia

1. It is the slide of tentaculocyst of Aurelia which is also known as

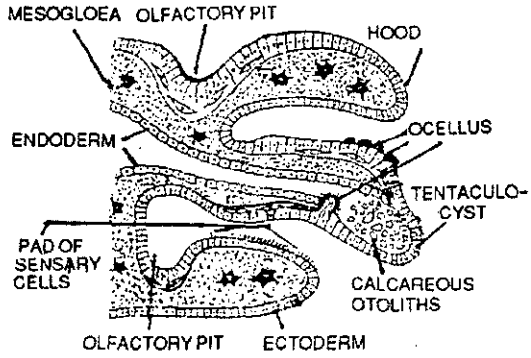


Fig. Tentaculocyst of Aurelia

rhopalllum statocyst.

2. It is a club-shaped structure and is located between the two marginal lappets. It is covered by the hood (the bell margin) on outer side.

3. Inside the distal end of the club-shaped structure lies a mass of polygonal statollth cells containing statollth particles of Calcium sulphate and Calcium phosphate.

4. A pad of ciliated sensory epitheliae cells lies below the club-shaped structure & the epidermis at the sides & base of tentaculocysts is thickened & tall sensory epithelial cells are found at intervals.

5. The tentaculocyst is traversed by an extension of ***circular canal*** and is therefore a specialized hollow tentacle.

6. It is the organ of ***Equilibrium*** and controls the umbrallar surface during swimming.

• 3.4. *PHYSALIA*

Classification –

Phylum	– Coelenterata
Class	– Hydrozoa
Order	– Siphonophora
suborder	– Physophorida
Genus	– *Physalia*
Type	– *pelagica*

Comments

1. It is a colonial sponge. The colony bears a transparent bluish or pinikish baloon-like large float or pneumatophore at the top.

2. The pneumatophore floats above the surface and the whole colony remains inside water.

3. A pair of gas glands are located on the lower side along the inner surface and are responsible for floating of the colony.

4. The gas glands secrete gases similar in composition as air. The gas is a mixture of 90%; 1.5-3.5% 02 and other gases 5-7%.

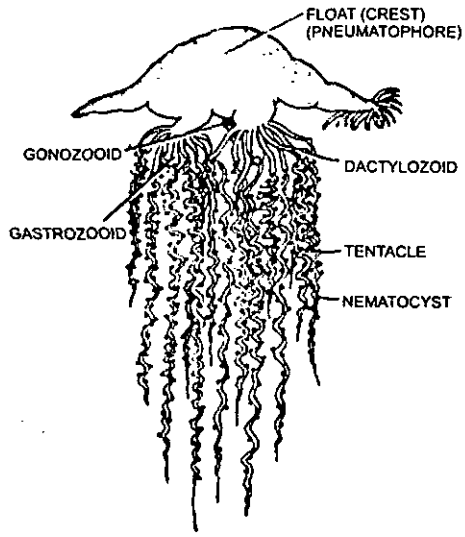


Fig. Physalia

5. The colony is polymorphic and is comprised of bunches of zooids comprising of a large gastrozoid in the centre, a few gonozoids along the base of gastrozoid and numerous dactylozoids around the gastrozoid.

6. The gastrozoid has a distinct mouth but no tentacles and is the nutritive zooid.

Corallium (red coral)

Classification –

Phylum	– Coelenterata
Class	– Anthozoa
Subclass	– Octocorallia
Order	– Gorgonacea
Genus	– *Corallium*
Type	– *rubrum*

Comments

1. It is the dried skeleton of a ***"red coral"*** or ***"Moonga"*** which is found off the Mediterranian sea (off Africa and Italy).

2. It is branched, colonial and is red in colour and grows upto 30 cm. in height.

3. It represents only *polypoid generation* and is *dimorphic.*

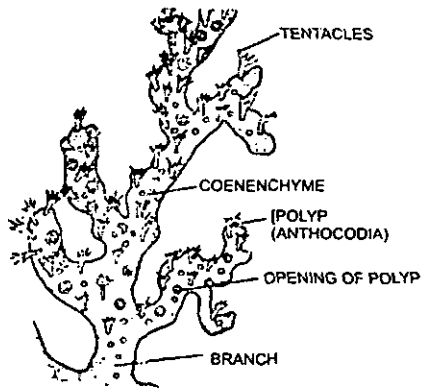


Fig. Corallium

4. The polyps are white and are of two types-the large, tentaculate and retractile ***anthocodia*** and minute and *nontentaculate siphonozoids* distributed in between anthocodia and represented through minute pores.

5. The coenosarc gets calcified and hard and is bright red in colour.

6. Skeleton is formed by calcareous spicules, which appear as extremely hard spines.

7. The *anthocodia* have 8 tentacles and few gonads. The mesentaries are in multiples of eight. ***A dry colony hear bunches of small thorns which are nothing but dried calcareous spicules.***

8. The *anthocodia* act as feeding as well as reproductive zooids, whereas *siphonozoids* help only in producing feeding currents.

9. It is of commercial utility and is used as precious beads in jewellery from ancient times.

10. The anthocodiaare viviparous.

Fungia

Classification –

Phylum	– Coelenterata
Class	– Anthozoa
Subclass	– Hexacorallia
Order	– Madreporaria
Genus	– *Fungia*
Type	– *elegans.*

Comments

1. It is the dried skeleton of a "mushroom coral", which is found in gulf of California.

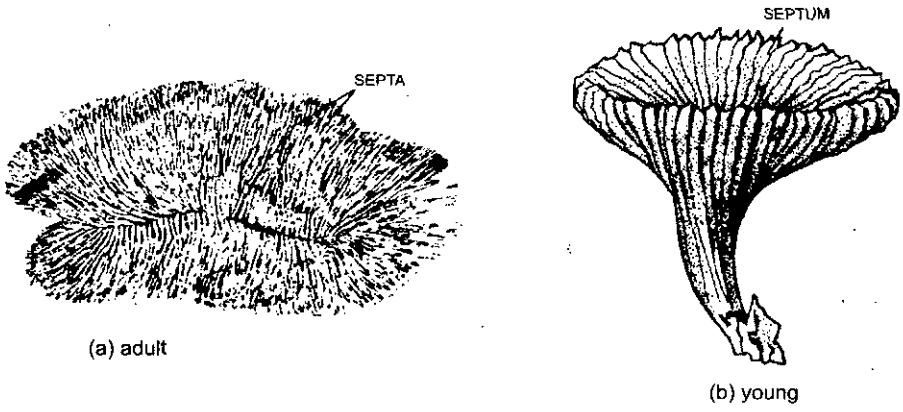


Fig. Fungia

2. It is solitary, large and above with below

3. The siphonoglyphs are absent and the theca is present on the lower surface only.

5. The skeleton is calcareous and stony.

6. It encloses a single large polyp having row of tentacles.

7. Mesentaries (septa) are in multiples of six and are connected with small synaptacula.

8. The life-cycle is strange in the sense that the young coral develops f Planula and is stalked and differentiated into a disc (anthocyathus) and a con stalk (anthocaulus). The disc, later on, breaks up and becomes an adult. remaining stalk once again develops a disc which later on separates off again.

9. Reproduction usually sexual, but the strange asexual reproduct occurs through transverse fission.

10. The tentacles on oral disc bear cilia which help in producing f currents for feeding during day.

MADREPORA (STAG HORN CORAL)

Classification –

Phylum – Coelenterata

Class – Anthozoa

Order – Madreporaria

Genus – *Madrepora*

Comments

1. Diploblastic, acoelomate animal with a gastrovascular cavity cal coelenteron and tissue grade of body organization.

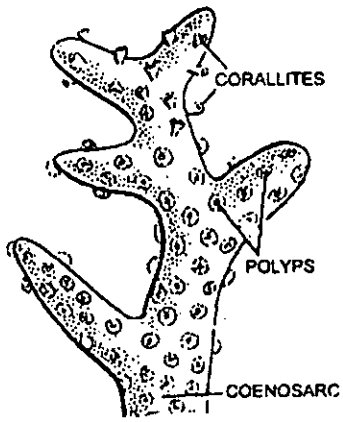


Fig. *Madrepora*

2. The animal is colonial and in the form of a polyp, the medusoid sta being totally absent.

3. There are several small polyps in raised cylindrical cups or calyces c the corallium.

4. Cups are without columella and have 6 to 12 septa.

5. Lateral polyps have 12 tentacles; terminal polyps have 6 tentacles.

6. Corallium made of calcium carbonate is porous, loose and branched.

7. Mesenteries are arranged in pairs bilaterally.

8. Coenosarc is represented by a network of canals connecting the polyps.

9. It is commonly called stag horn coral because it resembles the horns male deers.

10. It is amongst the principle builders of coral reefs.

Habit and habitat

It is a colonial, marine organism that contributes significantly to coral re formation.

Pennatula

Classification-

Phylum	– Coelenterata
Class	– Anthozoa
Subclass	– Octocorallia
Order	– Pennatulacea
Genus	– *Pennatula*
Type	– *aculeata*

Comments

1. It is commonly known as "**sea pen**" and is found off the eastern coasts of North America.

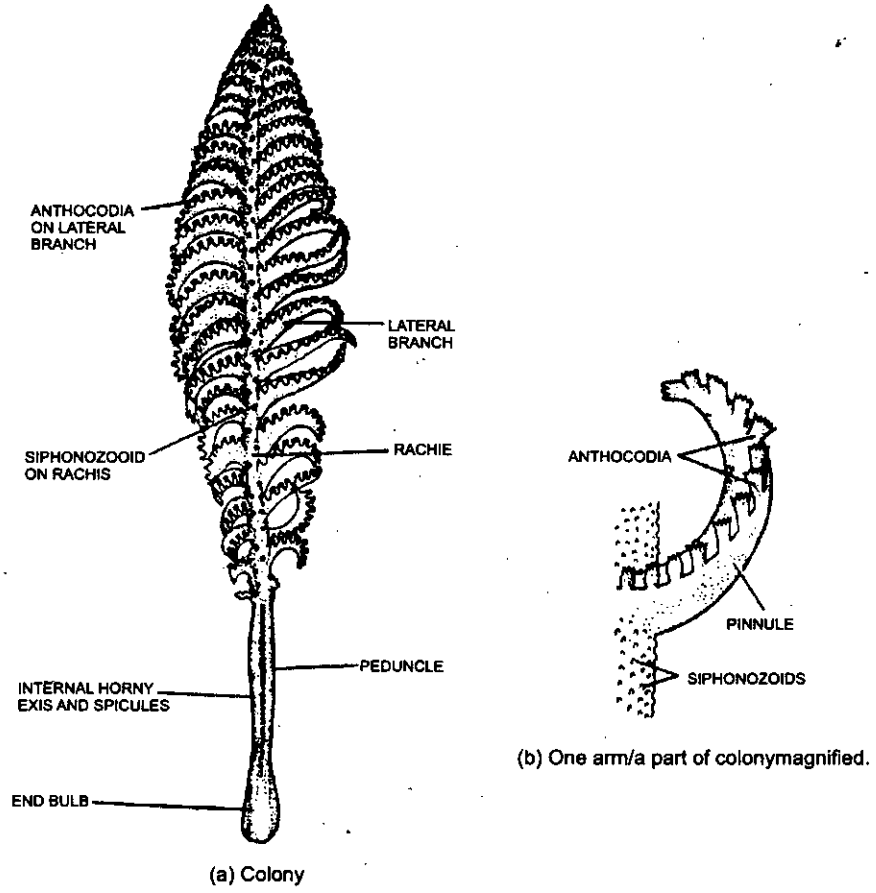


Fig. Pennatula

2. The colour is usually red and the fully formed colony measures about 10 cm in height.

3. The colony is elongated, dimomorphic, feather-like and is differentiated into a lower peduncle or stalk and an upper rachis.

4. The peduncle is dialated at its lower tip into an end bulb, which remains burried in mud or sand at the sea bottom and is devoid of zoids.

5. The rachis is narow at two ends, dialated in the middle and bears two rows of lateral branches—the pinnules.

6. Each pinnule is a long, slightly curved, flattened and fleshy projection of the rachis and bears, along its upper margin, a row of anthocodia—the autozoids.

7. Each anthocodia (autozold) bears a ring of 8 tentacles, few gonads an mesentaries in multiples of eight (8). They serve to feed the colony and undertak the task of reproduction also.

8. The rachis, all through its length along dorsal and lateral sides, bears minute spinules— the siphonozoids.

9. The siphonozoids are without tentacles and gonads, with reduce mesentaries and are having distinct siphonoglyphs, which help in producing wate currents.

10. Skeleton is a horny axis which supports only the peduncle and rachis bu does not extend into pinnules.

11. Sexes are separate.

METRIDIUM (SEA ANEMONE)

Classification

Phylum – Colenterata

Class – Anthozoa

Order – Actiniana

Genus – *Metridium*

Comments :

1. Diploblastic, acoelomate animal with a gastrovascular cavity callec coelenteron and tissue grade of body organization.

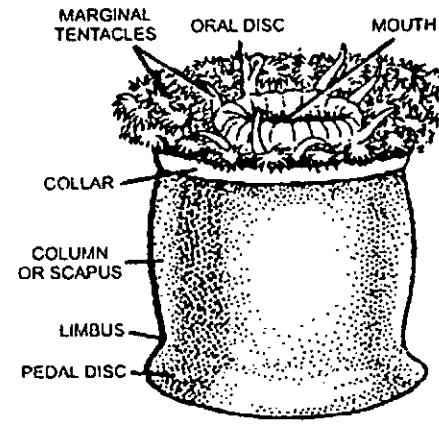


Fig. Metridium

2. The animal is **solitary** and in the form of a polyp, the **medusoid stage being totally absent**.

3. The muscular body is divided into an oral disc, a column and an aboral pedal disc.

4. The **oral disc** bears a large slit like mouth surrounded by a crown of nematocyst bearing tentacles.

5. Mouth internally opens in pharynx. On either side of pharynx a ciliated groove or siphonoglyph is present.

6. A continuous current of water produced by cilia reaches the body cavity and carries oxygen to the tissues and removes waste matter.

7. Reproduction is generally through sexual means. Asexual reproduction through budding and fission are comparatively rare.

8. It is commonly called Sea Anemone because of its flower like polyp that resembles the plant genus *Anemone*.

Habit and habitat

Sea Anemones may show a proto cooperative relationship with hermit crab. It is a solitary marine animal found attached to corals or rocks at varying depths.

UNIT 4

HELMINTHES

STRUCTURE

- *Fasciola* Specimens in situ and preparedslides. transverse section nd prepared slides. Larval forms-prepared slides.
- *Taenia* : Prepared slides of scolex, mature and gravid proglottids and transverse section of mature proglottid.
- *Planaria, Polystomuth, Paramphistomum, Schistosma, Echinococcus* and *Dipylidium* Cysticerus (Bladder worm) and Cysticeroid.
- *Ascoris* External characters. Dissected specimens of male and female. Transverse section of male and female-prepared slides. Specimens *Ascaris lumbricoides* (from man) *Enterobius vermicularis* (from man), *Ancylostoma duodenale* (fromman) prepared slides.

• 4.1. FASCIOLA ENTIRE

Classification –

Phylum	– Platyhelminthes
Class	– Trematoda
Order	– Digenea
Family	– Fasiolidae
Genus	– *Fasciola*
Type	– *hepatica*

Comments

1. It is commonly known as "*Liver fluke*" and is an endoparasite in the b duct of sheep.

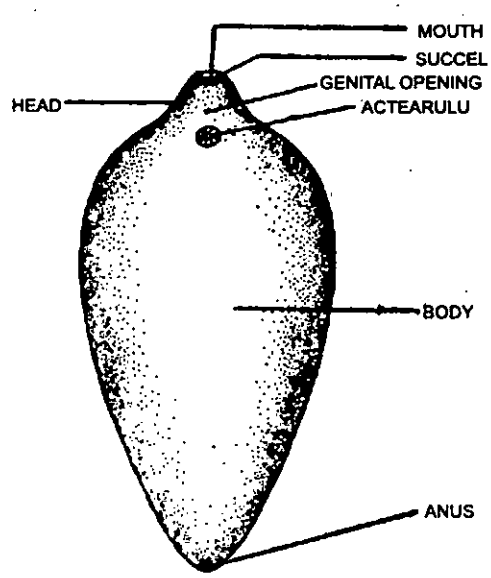


Fig. Fasciola Entire

2. It is cosmopoliton and pathogenic and measures about 20 to 50 mm. in length and 5 to 15 mm. in width.

3. Body leaf-like and flattened.

4. Mouth and oral sucker are situated on a small protuberance-the "head".

5. A little behind the oral sucker is present a *ventral sucker* or *acetabulum* on the mid ventral side.

6. In between the oral and ventral suckers, c along the ventral surface, is present a p small genital opening.

7. In the posterior part lies a sub-terminal excretory pore or "anus".

8. Among the digestive organs the most conspicuous is intestine, which is a highly branched and convoluted structure.

9. They are hermaphrodite and the reproductive organs occupy almost whole of the body space.

10. ***The life cycle includes an intermediate host in the form of snail-Limnea (a mollusc).***

11. It causes liver rot, *liver cirrhosis, eosinophilia* and *anemia.*

T.S. Fasciola through uterus

1. It is the slide of T. S. of fasciola passing through uterus region.

2. The section is some what elliptical and shows following features:'

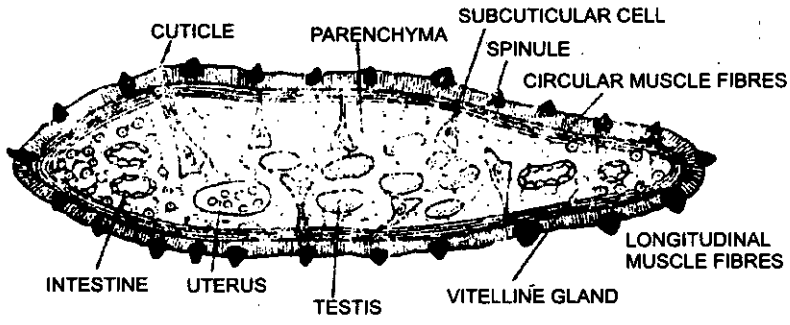


Fig. T.S. Fasciola through Uterus

(a) The outermost layer is a thick cuticle and is comprised of closely packed columnar cells.

(b) Embeded in the cuticle are present many small and thick spinules, which project above the cuticle and serve as organs of defense.

(c) Below the cuticle is present a circular muscle layer, a longitudinal muscle layer, oblique muscle layer and ultimately a parenchyma or mesenchyme.

(d) Subcuticular cells and vertical muscle strands are distributed in parenchyma.

3. The body cavity is absent and the whole body space is filled with parenchyma cells thus imparting these animals an acoelomate grade.

4. Embeded in parenchyma are present larger rectangular or irregular egg-filled pouches-the uteri.

5. Above and below the uterine pouches are present many small and rounded pouches - the testes filled with dott-like structures the sperm's.

6. Near either narrow end, embeded in parenchyma, are present a few small, rounded, hollow and villinous structures – the intestine.

7. In addition, distributed in parenchyma, are present large numbers *vitelline glands.*

T. S. Fasciola through testes

1. It is the slide of T.S. of Fasciola passing through the region of testes.

2. The section is some what elliptical and shows following features:

(a) The Outermost layer is a thick cuticle and is comprised of closely pa columnar cells.

(b) Embeded in the cuticle are present many small and thick spinu which project above the cuticle and serve as organs of defense.

(c) Below the cuticle are present a circular muscle layer, a longitud muscle layer and ultimately a layer of parenchyma or mesenchyme.

(d) Distributed in the parenchyma are present subcuticular cells vertical muscle strands.

3. The body cavity is absent and the whole body space in filled v parenchyma cells thus imparting these animals an acoelomate grade.

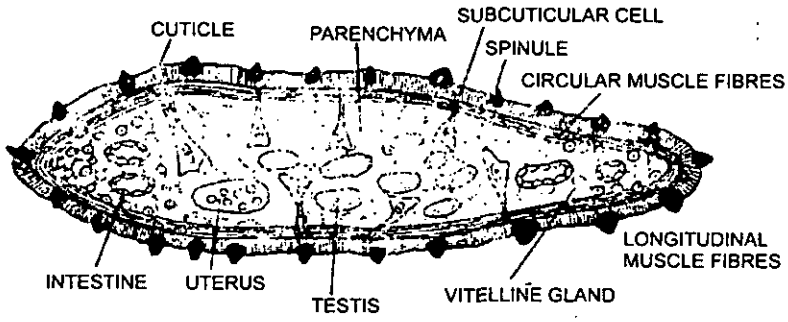


Fig. T.S. Fasciola through Testes

4. Embeded in parenchyma are present large numbers of small round or oval pouches-the testes filled with many dott-like structures-*the sperms*.

5. Above or below the testes is present a few *uterine pouche* stilled wi eggs.

6. Near either narrow end, embeded in parenchyma, are preser numerous villinous structures-frte intestine.

7. In addition, distributed in parenchyma, are present large numbers vitelline glands.

T.S. Fasciola through cirrus sac

1. It is the slide of T.S. Fasciola passing through cirrus sac.

2. The section is some what elliptical and shows following features:

(a) The outermost layer is a thick cuticle and is comprised of closely packe columnar cells.

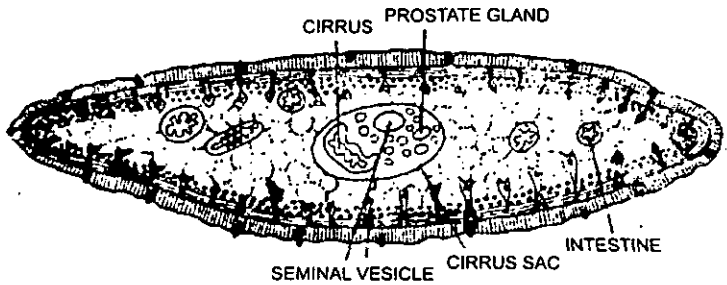


Fig. T.S. Fasciola through Cirrus Sac.

(b) Embeded in the cuticle are present many small and thick spinules, which project above the cuticle and serve as organs of defense.

(c) Below the cuticle are present a circular muscle layer, a longitudinal muscle layer and ultimately a layer of parenchyma or mesenchyme.

(d) Distributed in the parenchyma are present subcuticular cells and vertical muscle strands.

3. The body cavity is absent and the whole body space is filled with parenchyma cells thus imparting these animals an acoelomate grade.

4. In the centre, embeded in parenchyma, is present a large round pouch-ffte cirrus sac.

5. It contains an irregular hollow structure the cirrus, a large rounded, hollow and accentric seminal vesicle and many small rounded and hollow structures-the prostate glands.

6. Near either narrow end, embeded in parenchyma, are present a few small, rounded, hollow and villinous structures-the intestine.

7. In addition, large numbers of vitelline glands are present distributed in parenchyma.

T. S. Fasciola posteriot sucker

1. It is the slide of T.S. of Fasciola passing through *posterior sucker.*

2. The section is some what elliptical and shows following features.

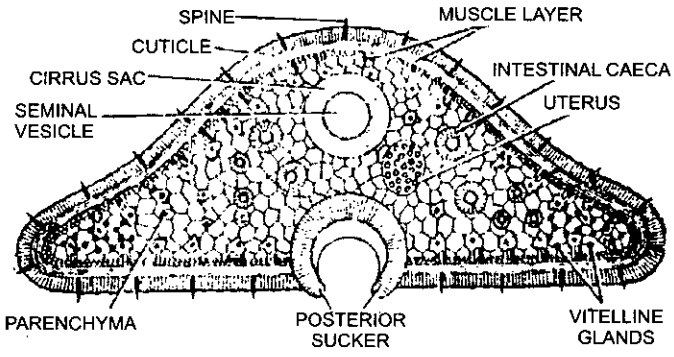


Fig. Fasciola Posterior (Ventral) Sucker

(a) The outermost layer is a thick cuticle and is comprised of closely packed columnar cells.

(b) Embeded in the cuticle are present many small and thick spinules, which project above the cuticle and serve as organs of defense.

(c) Below the cuticle is present a circular muscle layer, a longitudinal muscle layer and ultimately a parenchyma or mebenchyme layer.

(d) Distributed in parenchyma are present subcuticular cells and vertical muscle strands.

3. The body cavity is absent and the whole body space is filled with parenchyma cells thus imparting these animals an acoelomate grade.

4. Along the lower surface in the centre is present a semicircular depression- the posterior sucker which is lined with a thick muscular layer.

5. Embeded in the parenchyma are present a pair of small, hollow tubular vas deferense near the central region and many hollow, circular and villinous intestinal caeca near either narrow end.

6. In addition large numbers of vitelline glands are present distributed in parenchyma.

Miracidium larva of Fasciola

1. It is the slide of *Miracidium larva* of Fasciola.

2. It is the first free swimming larval stage and is hatched out directly of the egg.

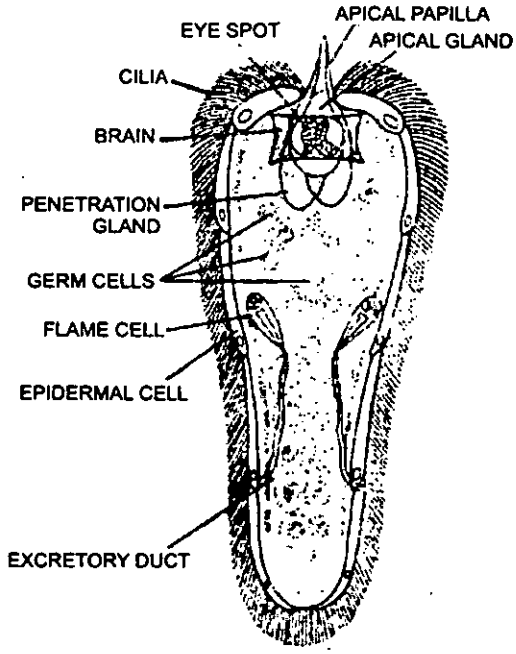


Fig. Miracidium Larva of Faciola

3. It is some what conical and flat and bears uniform ciliation all over.

4. At the anterior end the body is projected into a small and pointed apical papilla.

5. Body is covered with epidermal plates arranged in 5 rows. These plates are 6, 6, 3, 4 & 2 respectively in different rows.

6. In the region of apical papilla is present a large pitcher-shaped multinucleated apical gland in the centre and 1 to 3 pairs of penetration glands around it.

7. A tetraradiate brain and a pair of small and buckish eye spots are present above the penetration and apical glands.

8. The body wall is comprised of an outermost ciliated, a glandular epidermis, a well represented muscular layer and a layer of mesenchyme cells filling the whole body space.

9. In the posterior half is present a pair of flame cells [protonephridia] connected with long excretory ducts opening to out side through excretory pores.

10. The inside of the larva is filled with rounded germ balls of different sizes. These give rise to further larval stages.

11. After spending a short free swimming life it penetrates into a gastropod of genus Limnia or Planorbis (intermediate host) in which it transforms into a sporocyst stage. In case it does not find an intermediate host it dies.

12. The presence of apical gland, penetration glands and ciliated ectoderm are all larval parasitic adaptations.

Redia larva of Fasciola

1. It is the slide of Redia larva of Fasciola.
2. It is the third larval stage in the life-cycle of Fasciola.

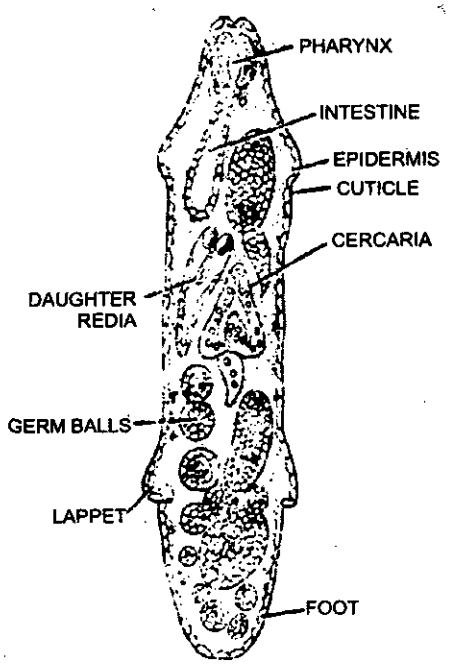


Fig. Redia Larva

3. It develops from the germ balls present inside the sporocyst.
4. It is elongated and sac-like and it has a pair of downwardly directed projections in the posterior half-f/ie lappet and a muscular ring in the anterior half -the collar. They act as organs of locomotion.
5. The bodywall of redia is comprised of a thick cuticle, a squamous epithelium, a muscularanda mesenchyma layer.
6. An oral sucker surrounding the mouth, a small muscular pharynx and a small pouch - the intestine terminating into a blind-sac are present near the anterior tip
7. The inside of redia is filled with numerous germ balls, a few daughter rediae and a few cercaria, which escape out through birth pore situated on one side behind the collar.
8. Near the lappets are present branched flame cells which are attached to the wall through a common excretory duct.
9. It gives rise to daughter rediae and the next larval stage - the cercaria.

Cercaria larva of Fasciola

1. It is the slide of Cercaria larva which is the IVth larval stage in the life-cycle of Fasciola.
2. It develops from germ balls inside the redia larvae which are present inside the digestive gland of intermediate host-the mollusc (*Limnaea*).
3. It is characterised by having a flat and oval body and a long *tail*.
4. It is a free swimming larval stage.
5. From inside the redia it escapes through birth pore and then to outside water through the alimentary canal of the intermediate host.

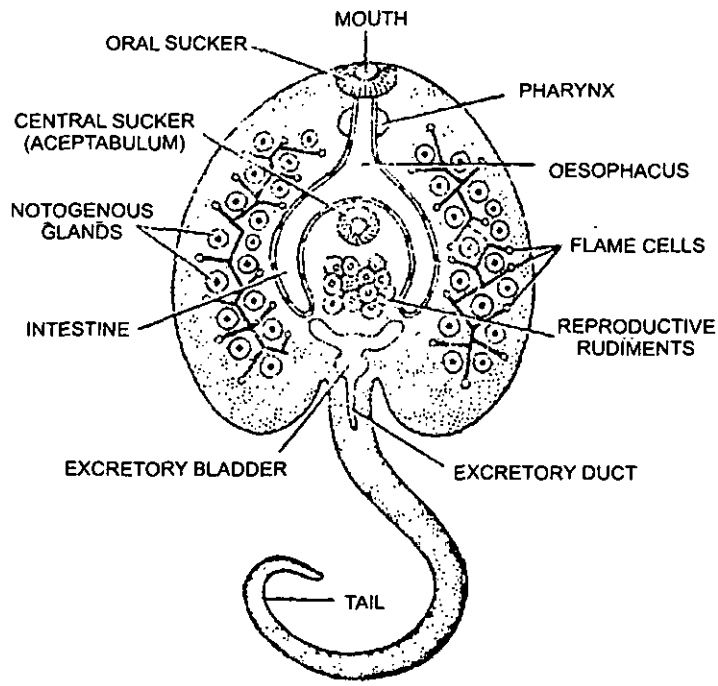


Fig. Cercaria larva of fasciola

6. In this larva the digestive organs are- a mouth surrounded by muscular oral sucker, a highly muscular pharynx, a small oesophagus, and a bifi intestine,

7. In the space between two limbs of intestine is present a ventral sucke and a mass of germ cells -the reproductive rudiment.

8. Near the joint of tail with body is present a globular excretory bladde opening to outside through a pair of excretory pores. The bladder is connectec with a pair of diverticula infront and an excretory ductbehind.

9. The flame cells (protonephridia) increase in number through simple multiplication and are situated on either side of intestinal limbs.

10. Body wall, as usual, is comprised of a cuticle, an epithelial layer, a muscular layer and parenchyma (mesenchyme) cells.

11. We most important feature of the larva is the presence of numerous cytogenous glands, which are distributed among the flame cells and help in secreting a cyst in order to transform the larva Into next stage.

12. It leads a short free swimming life, after which it is attached to water plants and transforms into last stage - the metacercaria.

(b) Taenia : Prepared slides of scolex, mature and gravid proglottids and transverse section of mature proglottid.

• 4.2. SCOLEX OF TAENIA (W.M.)

1. It is the slide of scolex (head) of Taenia-a tapeworm (cestode) parasite of human beings.

2. It is knob-like and tetraradiate or quadrangular and measures about 1 mm.

3. At its tip is a large aperture- the mouth, which is surrounded by two rings of curved and chitinous hooks - the rostellum on are arranged.

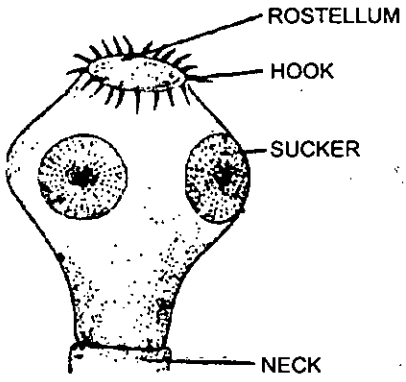


Fig. Scolex Taenia

4. It is the organ of attachment which through hooks remains embeded in the intestinal mucosa of the host.

5. It bears four large suckers which are arranged along the four corners.

6. The scolex continues behind into a slender neck.

Mature proglottid of Taenia (W.M.)

1. It is the slide of a mature *proglottid* of *Taenia.*

2. It is enclosed in bodywall which is comprised of a cuticle, a muscular layer and the mesenchyme (parenchyma cells).

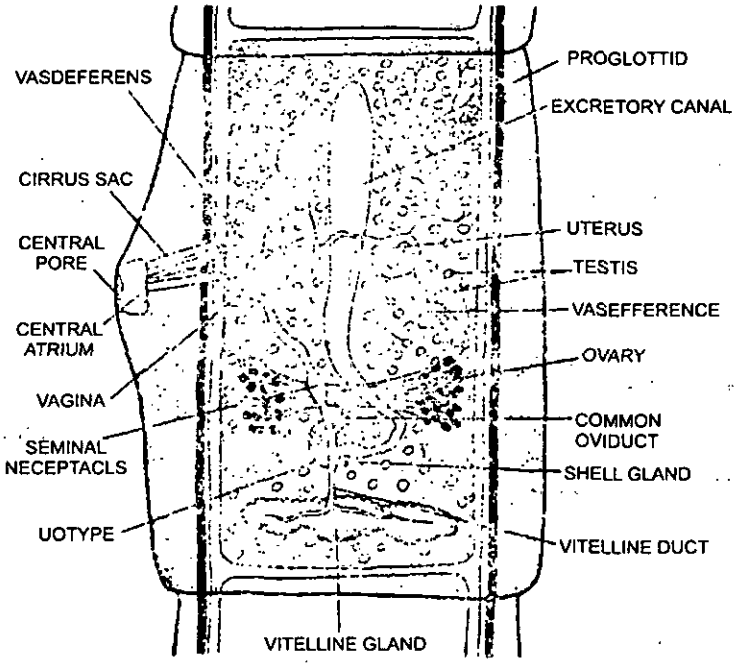


Fig. Mature Poglottid Taenia

3. The mature segment contains male and female reproductive organs, lateral and transverse excretory canals and lateral longitudinal nerves.

4. The male reproductive organs include highly branched testes, *vas-efference*, a highly convoluted vas-deferense and a cirrus sac.

5. The female reproductive organs include a pair of ovaries, oviducts, an ootype, shell (Mehlis's) gland, vitelline gland, uterus, seminal receptacle, vagina and genital atrium.

7. Sexes are **united**. Male reproductive organs include a single testis, a vas deferens and a penis. Female reproductive system includes ovary, oviduct 2 vaginae and vitelhne ducts.

Habit and habitat

It is a monogenetic parasite that lives in the urinary bladder of toads, frogs, turtles, etc.

PARAMPHISTOMUM

Classification

Phylum	– Platyhelminthes
Class	– Irematoda
Order	– Digenea
Genus	– Paramphistomum

Comments

1. Triploblastic, acoelomate animal with organ grade of body organization and a dorso ventral ly flattened body.

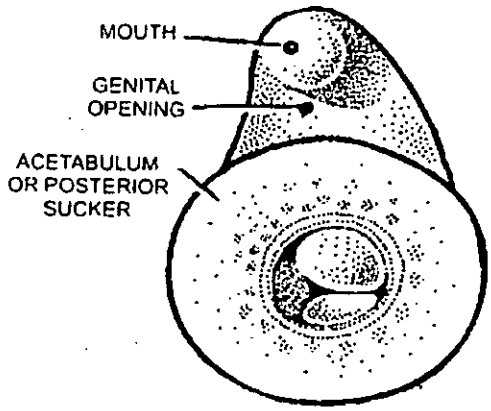


Fig. Paramphistomium

2. It is small and triangular. Anteriorly, it has a mouth but no oral sucker.

3. Ventral sucker is large, situated posteriorly and acts as an adhesive organ.

4. Mouth leads to pharynx which in turns opens into a forked unbranched mestine.

5. Sexes are united. Male reproductive system includes two testes. sperm ducts, seminal vesicle and cirrus. Female reproductive system includes ovary, ootype, vitellaria and folded uterus.

6. It is called an amphistomc parasite because acetabulum or posterior sucker is large and found near posterior end of the body.

Habit and habitat

It lives as an endoparasite in the rumen of goat, sheep, deer, etc.

Schistosoma

Classification –

Phloem	– Pistyhelminthes
Class	– Trematoda
Family	– Schistoeomatidae
Order	– Digenea

Genus – *Schistosoma*

Type – *haematobium*

Comments

1. It is commonly called "*blood fluke*" and ..... in the hepatic portal system and mesenteric vessels of man.

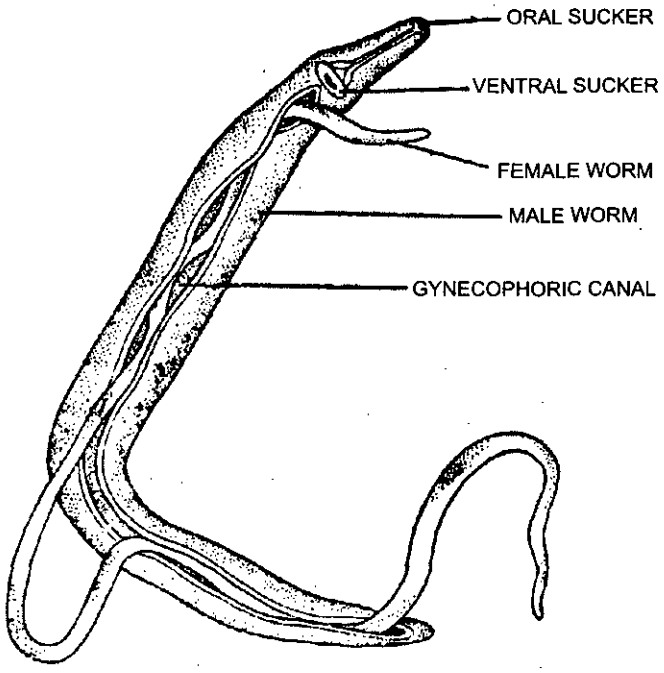


Fig. Schistosoma

2. These animals are acoelomate, bilaterally symmetrical and are some what flattened dorsoventrally.

3. The sexes are separate, but the females always live in the gynacophoric canal of the male.

4. The males are usually smaller and stouter, whereas the females are longer and slenderer.

5. The gynacophoric canal is formed as a result of folding of the ventral body wall.

6. Both males and females are having oral and ventral suckers, but the ventral sucker of male is extremely powerful.

7. Digestive system, in either sex, is comprised of oesophagus and intestine, the pharynx being absent.

8. ***Life-cycle Involves a mollusc -the snail (Bullnus).***

9. Infection in man occurs through skin penetration by cercaria while walking or swimming in water.

Echinococcus

Classification—

Phylum – Platyhelminthes

Class – Cestoda

Order – Cystophyllidea

Genus – *Echinococcus*

Sps. – *granulosus.*

Comments

1. It is the slide of Echinococcus which is a cestode endoparasite of do cats and foxes and which is commonly known an ***"hydatid worm"***.

2. The worm is small, dorsoventrally flattened and is ribbon shaped.

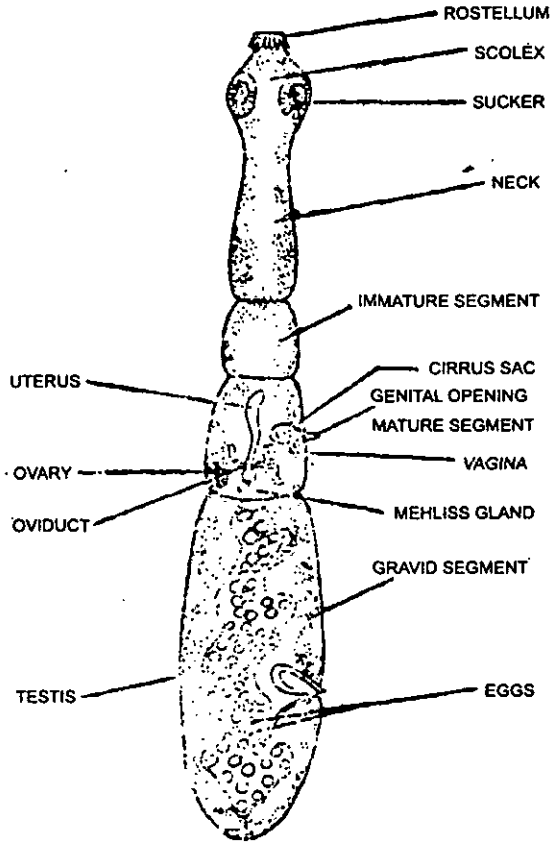


Fig. Echinococcus

3. It is generally comprised of four segments. The scolex, an immatu segment, a mature segment and a gravid segment.

4. The scolex is retractile, located on a small slender neck and bears fou suckers arranged in four rediae and a mouth supported with double rings of 30-3 hooks -*the rostellum*.

5. The immature segment contains rudiments of various organs but th *mature segment contains male and female reproductive organs only.*

6. ***The gravid segment contains irregular uterus full of developin eggs - the onchospheres*** and a genital opening.

7. ***Intermediate host is man, monkey and catties*** etc. in which transforms into a hydatid cyst.

DIPYLIDIUM CANINUM (THE DOG TAPEWORM)

Classification

Phylum	– Platyhelminthes
Class	– Cestoda
Order	– Cyclophyliidea
Genus	– *Dipylidium*
Species	– caninum

Comments

1. Triploblastic acoelomate animal with organ grade of organization and a dorsoventrally flattened body.

2. Adult worm measures 25 centimetres in length. The body is divisible into a **scolex** and about 200 **proglottids.**

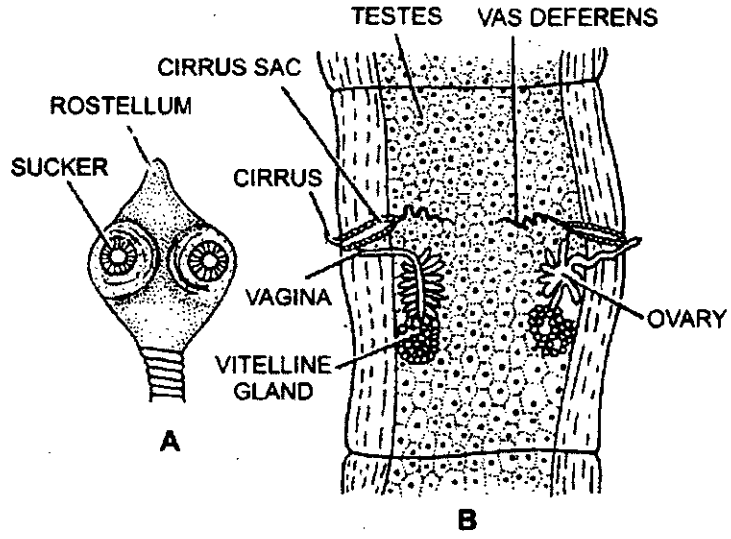


Fig. *Dipylidium* : A. scolex and B. mature proglottid.

3. Scolex bears 4 suckers, a retractile rostclluni and 4 rows of hooks.

4. Each mature proglottid bears two sets of male and female reproductive organs.

5. Male reproductive system contains numerous testes, vas deferens and cirrus.

6. Female reproductive system contains ovary, oviduct, ootype, vagina and uterus.

7. It is digenetic. Its primary host is dog and the intermediate hosts are common dog louse – *Ctenocephalous cams* and dog flea - *Pulex irritans.*

8. Humans especially children are infected by accidentally swallowing infected lice and flea.

9. It is commonly called the dog tapeworm.

Habit and habitat

Adult Dipylidium is found in the intestine of dogs, cats and man.

Cysticercus larva (inverted)

1. It is the slide of cysticercus larva (inverted) of *Taenia*-a tapeworm.

2. It is the second larva in the life history of Taenia and it develops from ***onchosphere*** (*hexacanth*) stage in the muscles of pig.

3. In its transformation to cysticercus stage the onchosphere loses its hooks. The central mass of cells degenerate and thus the whole onchosphere transforms into a hollow bladder. The bladder enlarges in size and then an imagination occurs on one side and develops into a proscolex on which suckers develop through invaginations.

4. The cysticercus bears a scolex, a neck and a bladder-like body.

5. The scolex, like in adult, bears rostellum and four muscular suckers.

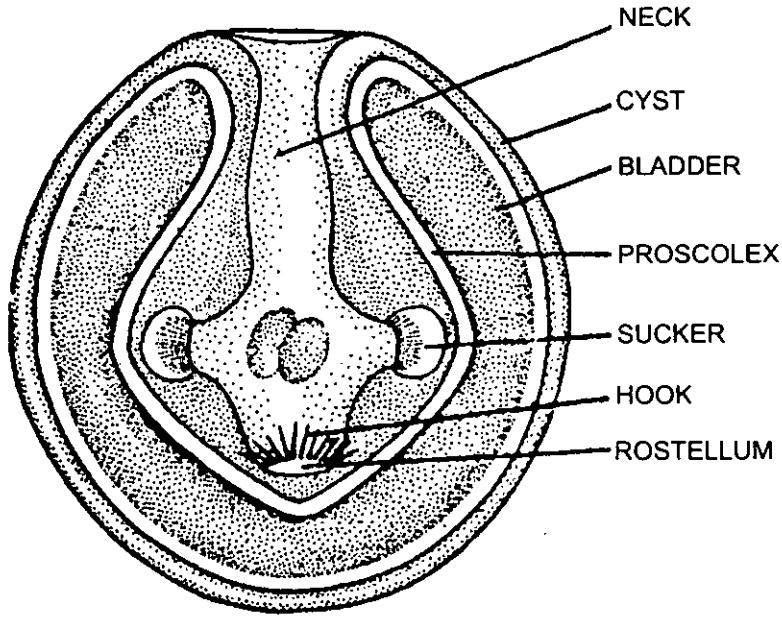


Fig. Cysticercus Larva (Inverted)

6. The rostellum is comprised of two rows of hooks which surrou nd tl mouth.

7. The alimentary canal and all other organ-systems are absent.

8. ***For further development it should be eaten up by man with pork.***

Cysticercus larva of Taenia

1. It is the slide of cysticercus larva of Taenia-a tapeworm.

2. It is the second larva in the life history of Taenia and it develops fro *onchosphere* (*hexacanth*) stage in the muscles of pig (intermediate host).

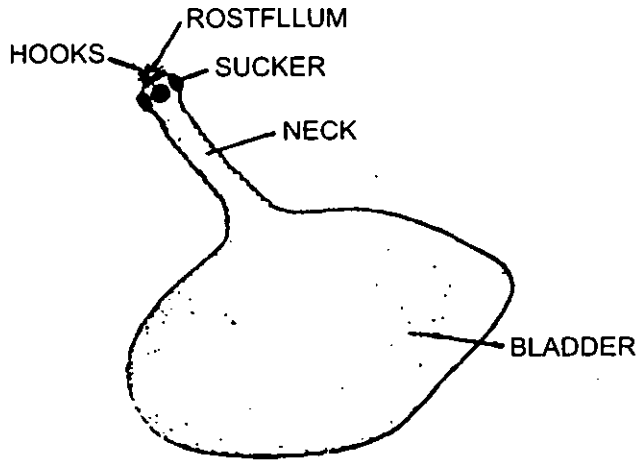


Fig. Cysticercus Larva Taenia

3. The cysticercus possesses a scolex, a neck and a *bladder-like* body.

4. The scolex, like in adult, bears a *rostellum* and four muscular suckers.

5. The rostellum is comprised of two rows of hooks and surrounds t mouth.

6. The alimentary canal and other organ-systems are absent.

7. ***For its further development it should be eaten up by man wi pork.***

• 4.4. *ASCARIS*

Classification

Phylum	– Nemathelminthes
Class	– Nematoda
Order	– Ascaroidea
Genus	– *Ascaris*
Type	– *lumbricoides.*

Comments

1. It is a common endoparasite in the intestine of human beings.

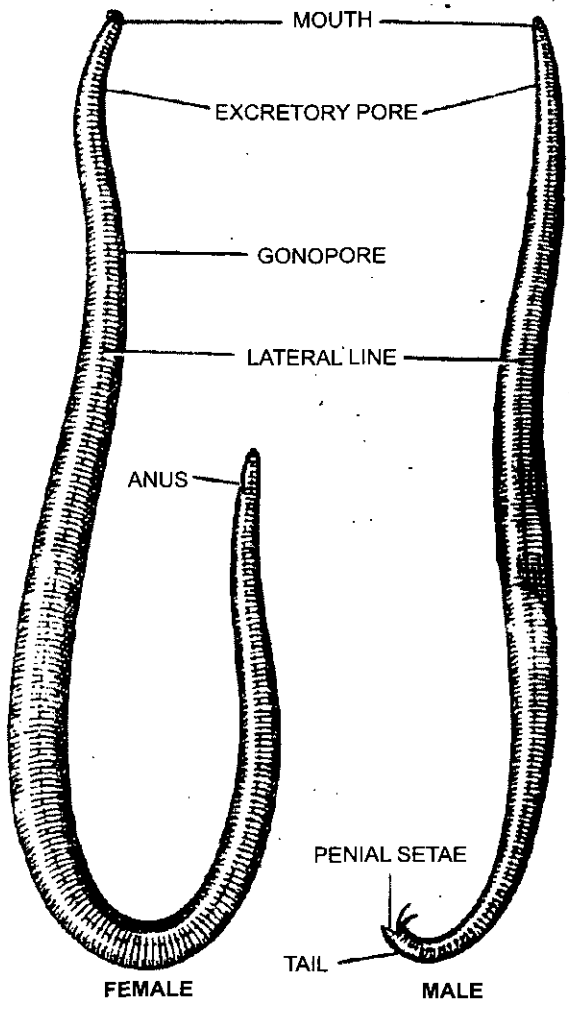


Fig. Ascaris

2. Body worm-like and has pseudoseg-mentation.
3. The females are larger and stouter than males and measure about 20-30 cm in length, whereas males reach to about 15-26 cm in length.
4. Mouth is having 3 distinct lips.
5. Pharynx has few caeca but no posterior bulb.
6. The posterior end of female is straight and that of male is curved.
7. Male bears a pair of subterminal ***penlal setae*** at post. end.
8. Body is marked with four longitudinal canals or lines which run along the whole body length.

9. Excretory pore lies near the anterior end and the female genital open lies near the middle.

10. *The fertilized eggs pass out with faeces and hatch into embryos in wc and moist soil* and infection occurs through contaminated hands and drink water.

T. S. Ascaris male

1. It is the slide of T. S. of male Ascaris.
2. The section shows the following features:

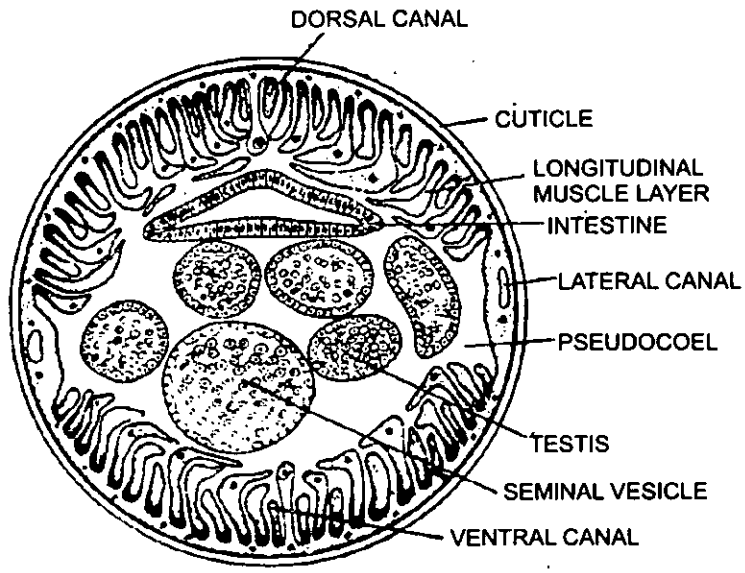


Fig. T.S. Male Ascaris

(a) Body wall is comprised of thick cuticle, a syncitial hypodermis an layer of muscles.

(b) The muscle layer is devided through lateral, dorsal and ventral car into four segments or groups.

(c) Body cavity is pseudocoel and is filled with various structures i.e large and hollow intestine, many small and rounded testes filled with large num of sperms in various stages of development and a large rounded seminal ves filled with sperms.

(d) The lateral canals contain excretory vessels and the dorsal and ven canals contain nerve cords respectively.

T. S. female Ascaris

1. It is the slide of T.S. of *female Ascaris*.
2. The section shows the following features:

(a) Body wall is comprised of thick cuticle, a syncitial hypodermis ar layer of muscles.

(b) The muscle layer is divided by lateral, dorsal and ventral canals four segments or groups

(c) Body cavity is a pseudocoel and is filled with various structures ie large and hollow structure -the intestine, numerous small, rounded and s structures - the ovaries, hollow structures - the oviduct, and large and roun uterii filled with numerous ova.

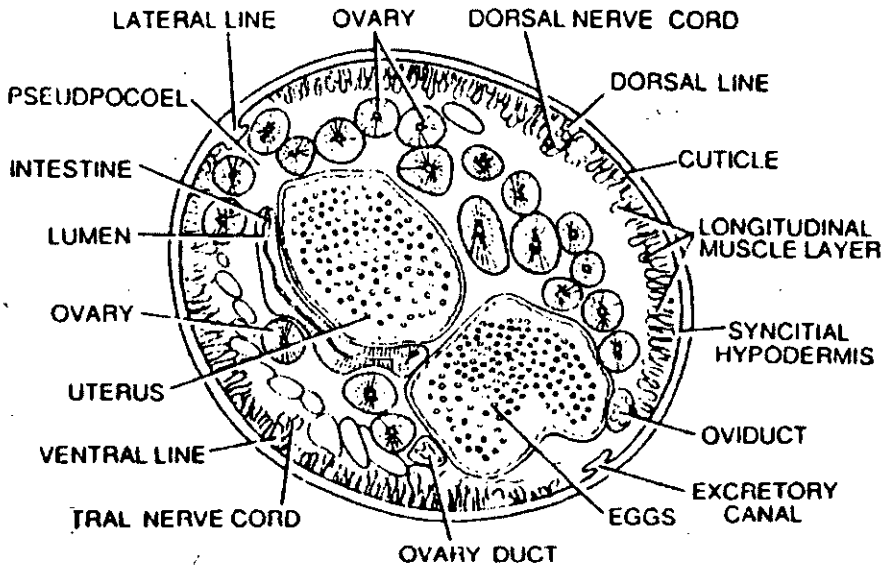


Fig. T.S. Ascaris Female

(d) The lateral canals contain excretory vessels and the dorsal and ventral canals 6ontain nerve cords respectively.

Enterobius

Classification –

Phylum	– Nemathelmlnthas
Class	– Nematoda
Order	– Oxyuroidea
Genus	– *Enterobius*
Type	– *vermicularis*

Comments

1. Commonly known as *pinworm* and is an endoparasite in caecum, colon and appendix of human beings. It is cream coloured.

2. Mouth is having three *lips*.

3. Pharynx has a *posterior bulb*.

4. Females are larger and stouter in size and have straight tail.

5. Males have one pair of setae near the caudal region and are smaller & thin.

6. The female worms creep out, lay eggs in perianial region of the rectum during night and causes intense itching and pain.

7. Infection through contamination by eggs, which pass into alimentary canal through fingernails at the time of scratching the anal region during intense itching.

8. Piperazine salts are very effective for their treatment.

Ancylostoma

1. It is commonly known as hook-worm and is found in tropical and subtropical regions.

2. It is a parasite in the intestine of human beings.

3. Mature worm is cylindrical and is grey or white.

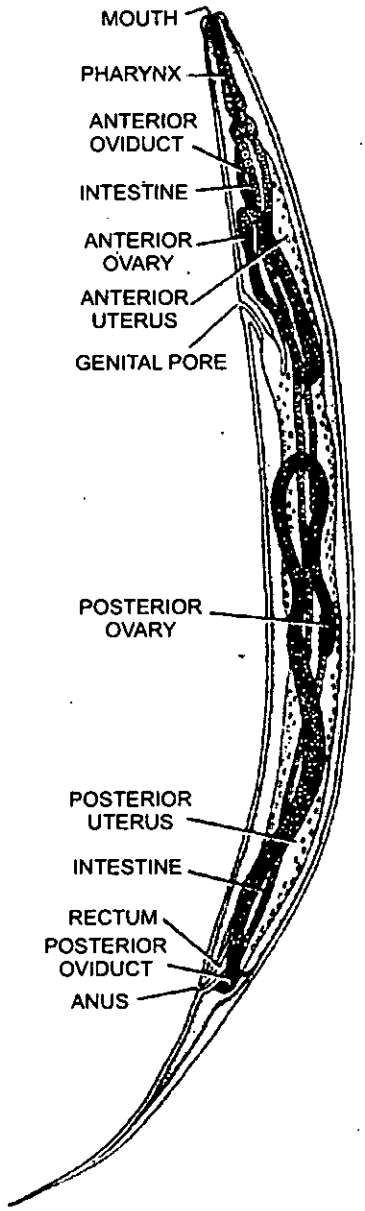
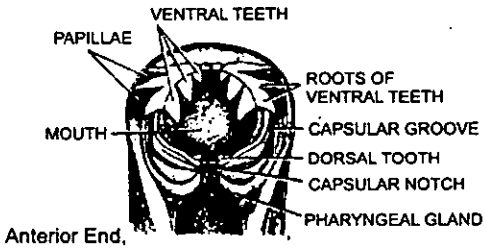
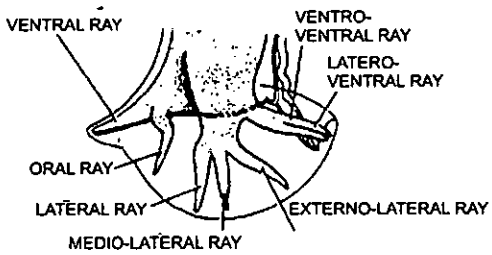


Fig. Enterobius



(a) High power structure of buccal capsule



Posterior End. (b) High power structure of burse

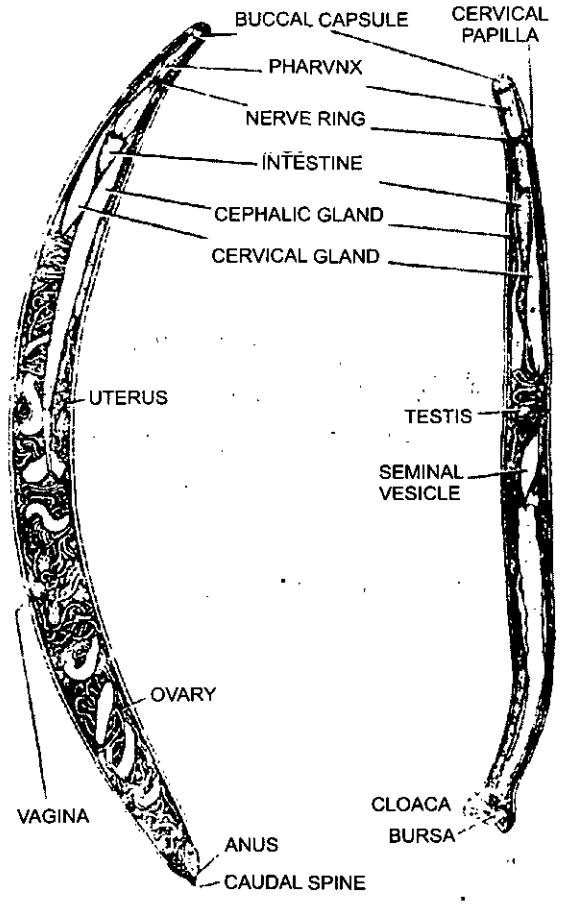


Fig. Ancyclostoma, female and male)

4. Posterior end of females is bluntly rounded and is provided in males with an umbrella-like bursa for copulation.

5. Males about 8-10 mm. in length and females about 10-12 mm. in length.

6. A buccal capsule is present around mouth, which is without lips but with a dentate chitinous plate on ventral side of buccal capsule.

7. Males have a cloacal aperture and females have anus.

UNIT 5

CELL BIOLOGY

STRUCTURE

- Preparation of giant chromosomes, onion root tip for the stages of mitosis.
- Preparation of Study of Prokaryotic and eukaryotic cell; Cell division – Prepared slides.

• 5.1. STUDY OF GIANT CHROMOSOMES FROM PREPARED SLIDE

(a) Polytene Chromosome

Aim

To prepare a slide of Polytene chromosomes from Drosophila/Chironomous larva.

Theory

Polytene chromosomes are giant chromosomes found in the salivary glands, malpighian tubules, gut lining and adipose tissue cells of some Dipteran larvae.

Materials Required

Glass slides, needles, coverslip, dissecting microscope, compound microscope, spirit lamp, saline solution, Acetocarmine.

Drosophila larva

The third instar larva of Drosophila that is white in colour is used. Drosophila larva can be obtained by culturing the fly in the lab.

Chironomous larva

These are red coloured larvae found in ponds, pools and ditches. These can be collected and placed in normal saline.

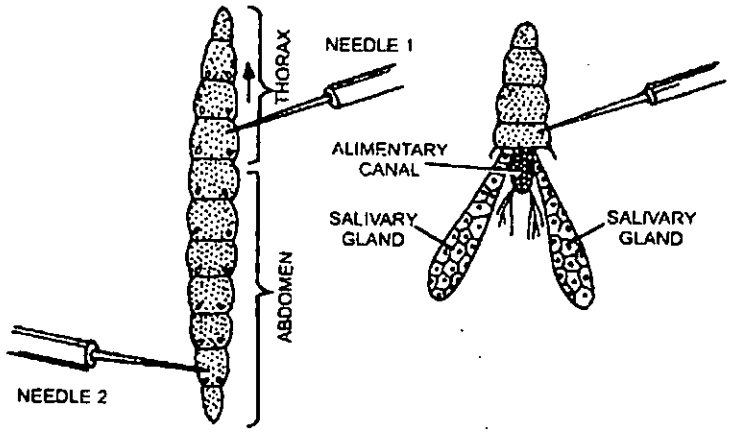


Fig. Dissection of salivary gland of *Dorsophila* larva.

Procedure

- Put a few drops of saline on a clean glass slide.
- Place a larva on the slide and place the slide in a dissecting microscope.
- Identify anterior and posterior ends.
- Take a needle in each hand.
- Place one needle at the junction of thorax and abdomen and the other needle at the posterior end.

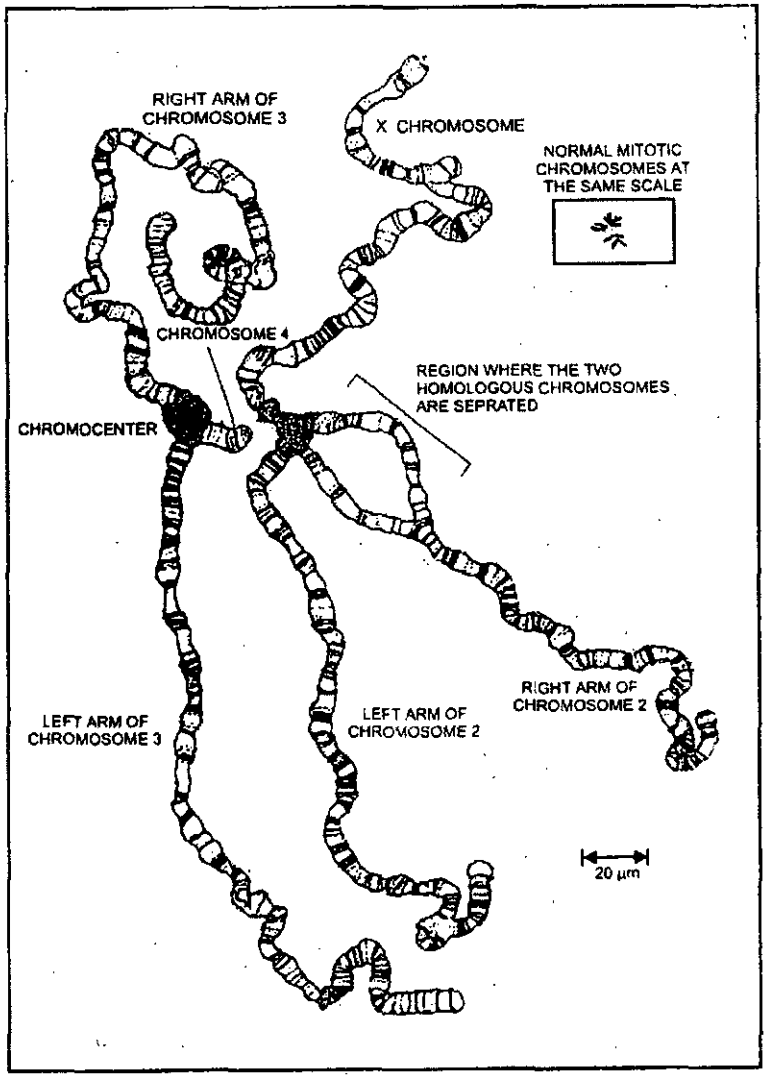


Fig. Polytene chromosomes of *Dorsophila* larva.

- Pull the first needle forwards to separate the abdomen from the thorax.
- View the anterior portion to see the salivary glands floating in saline.
- Separate the salivary glands carefully and place them on a fresh glass slide.
- Put a drop of acetocarmine on it.
- Cover it with a coverslip and press gently with your thumb.
- Squash the tissue with the back of a pencil.
- Leave for 5-10 minutes and then warm the slide on a burning spirit lamp.
- Blot excess stain, if any.
- Observe under the microscope.

Comments

1. Giant chromosomes were first observed by E.G. Balbiani in 1881 salivary gland cells of Dipteran species.

2. These chromosomes may reach a size upto 200 times (or more) the size corresponding chromosomes at meiosis or in nuclei of normal mitotic cells.

3. These giant chromosomes are formed by repeated cycles endo-reduplication of single chromatids. This means that the chromat replicates without cell division, as a result, the Lumber of chromatids kee increasing. This process is called Polyteny and therefore, these chromosomes a called Polytene chromosomes.

4. Polytene chromosomes show another characteristic feature i.e., Somat pairing. As a result, the number of these chromosomes always appears to be half that in normal somatic cells.

5. Polytene chromosomes show characteristic banding pattern. There are alternating chromatic and a4chromatic regions.

6. Occasionally the bands form reversible puffs or Balbiani rings. Thes are regions of differential gene activation.

7. The structure of Polytene chromosomes from *Drosophila melanogaste* is as follows:

- 5 long and 1 short strand radiate from an amorphous chromocentre.
- The chromocentre is formed by the centromeres of chromosomes.

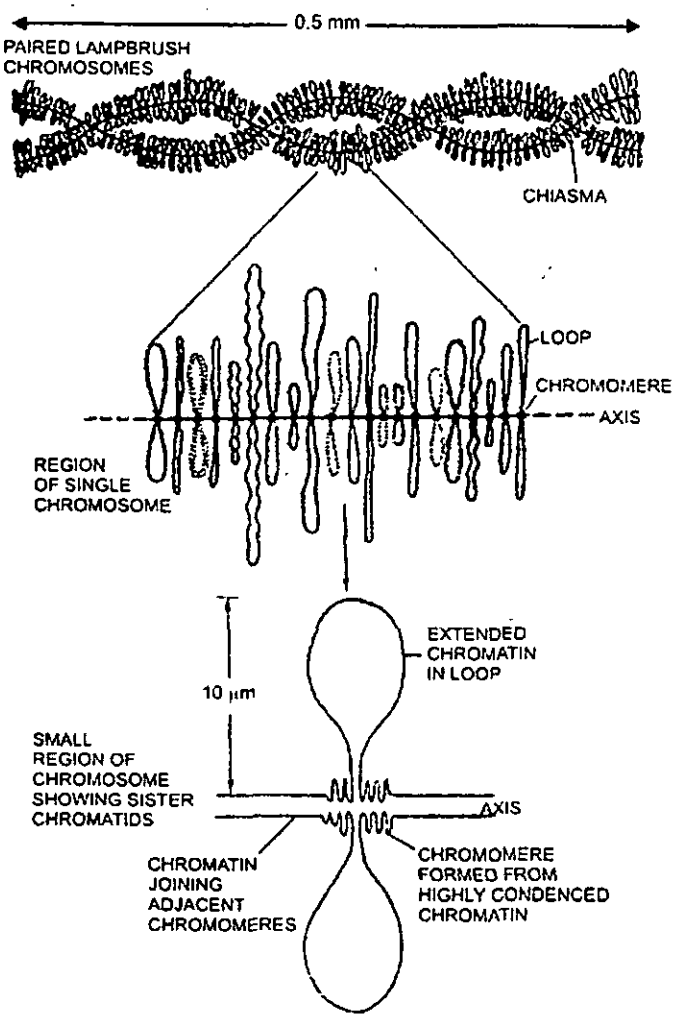


Fig. Lampbrusch chromosome

• One long strand corresponds to 'X' chromosome and the remaining 4 long strands correspond to the arms of II and III chromosomes. The short strand corresponds to chromosome IV.

• In males, the Y chromosome remains fused with chromocentre and is indistinct.

8. Though Polytene chromosomes are commonly found in salivary glands, they have also been isolated from malpighian tubules, fat bodies, gut epithelia etc.

9. The reason for their occurrence is not known though various hyotheses have been proposed. However, they have greatly helped the study of cytogenetics.

(b) Lampbruh Chromosomes

Aim

Study of prepared slide of Lampbrush chromosomes.

Materials Required

Microscope, slide of lampbrush chromosomes from amphibian oocyte, drawing sheet, pencil.

Comments

• Lampbrush chromosomes are transitory structures that exist during the extended Diplotene in oocytes of most invertebrates and vertebrates except mammals.

• The chromosomes have a lampbrush like appearance due to twin loops (400-800 nm length) emerging from the chromomeres.

• Identical loops occur on both pairs of sister chromatids. Chromomeres have highly condensed chromatin which is generally not transcribed.

• The loops are sites of RNA transcriptions.

• The position of each loop is fixed. A given loop always contains the same DNA sequence.

• Lampbrush chromosomes were first seen in salamander oocytes by Fleming in 1882.

• They have been widely used in studies of chromosome organization, gene expression, me ecular morphology of RNA transcription, etc.

• 5.2. MITOTIC CELL DIVISION

The mitotlc cell division or mitosis occurs in somatic cells of all animals and plants. From the mitotic division one parent cell produces two identical daughter cells with same number of chromosomes as in the parent cell. The mitotic division may conveniently be studied in onion root tips in the laboratory.

Experiment -1

To prepare a slide of root tip of onion by squash method and to identify, study and draw the various mitotic stages.

Material required:

Onion root tips fixed in Carnoy fluid (6 parts absolute ale + 3 parts glacial acetic acid + 1 part Chloroform); Aceto carmine stain; stides; cover slip; bloting paper; spirit lamp; watch glass; 1 -N HCi, 45% Acetic acid and filter paper.

Procedure :

Take large sized mature onions about a week before the experiment. Cut all the dried roots from the stem at the base of the bulb. Now place these onions on the mouth of coupiin jars filled with water in such a way that the stem portion must be

dipped continuously n water. In about a weeks time new roots would develop and would start growing downward in the water. Take the onions and cut the mi I ke white portion of root tips viz., upto 5 mm length. Cut each piece into smaller piece and fix them in Carnoy fixative for half an hour. Transfer the material to 90% alcohol and then to 70% alcohol keeping the material for 10 minutes in each. Now preserve the material in 70% alcohol. At the time of proceeding for experiment i the laboratory take few pieces from 70% alcohol in a watch glass in few drops of 1- N HCl and leave for 5 minutes. By this procedure the material would become sof Now drain off the HCI and wash the pieces with a little distilled water at least twic or thrice. Now put the root tips on a clear slide on right hand side and pour a few drops of 2% Acetocarmine. Warm the slide gently on sprit lamp for few minutes a least 3-4 times but never let it boil. Cool and leave for 10 minutes in the stain. Nov drain the excess of stain with the help of filter paper and put few drops of 45% aceti acid. Place a cover slip over the material and put above the coverslip a piece c blotting paper or filter paper folded two to three times. Press the coverslip gentl with your thumb to break the cell membranes. The blotting paper or filter pape would save the coverslip from breaking and would also absorb the excess stai which will ooze out from the coverslip. Take care that your thumb may not mov side ways while pressing. Seal the coverslip with nail polish if you want to keep th slide for sometime.

Fix the slide under low power of microscope and focus. Now change to hig power and observe the various stages which would appear as shown in the attache photographs. Draw the various stages and write down comments on each of them

Different stages of Mitotic eell division

1. The Interphase stage

The slide shows interphase stage which is characterised by the following features,

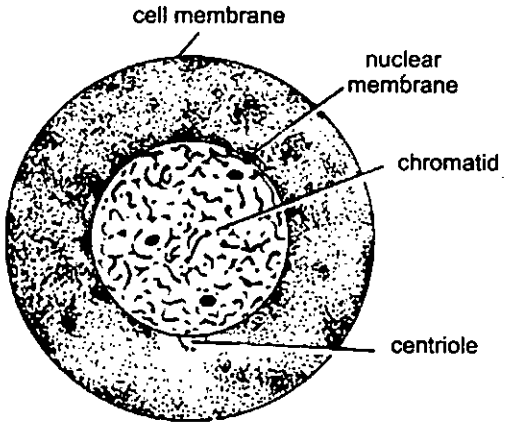


Fig. Early Interphase

(1) The nucleus is conspicuous and large and nuclear membrane is also intact and nucleolus quite large.

(2) The chromosomes are thread like and appear as a network.

(3) In this stage active protein synthesis and nucleic acid duplication takes place.

2. The Early Prophase stage.

The slide shows early prophase stage which is characterised by following features.

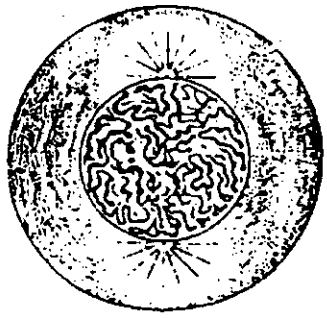


Fig. Early Prophase

(1) The nucleus is intact, large and prominent and nuclear membrane is also intact.The nucleolus is large and conspicuous.

(2) The chromosomes appear as long thread like structures.

3. The Late Prophase stage

It is the slide of late prophase of mitosis & it is characterised by the following features.

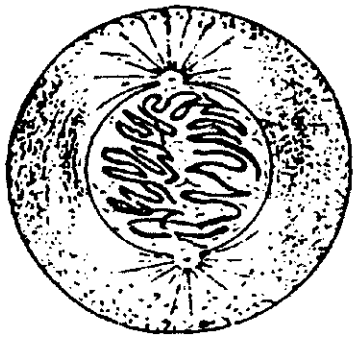


Fig. Late Prophase

(1) The nuclear membrane or envelop has been broken down and nucleolus has disappeared.

(2) The chromosomes are now visible as thick rods and each has divided into two chromatids.

(3) Spindle fibres are also visible.

(4) Both centrioles have reached the opposite poles.

4. The Metaphase stage

The slide shows metaphase stage of mitosis which is characterised by following features :

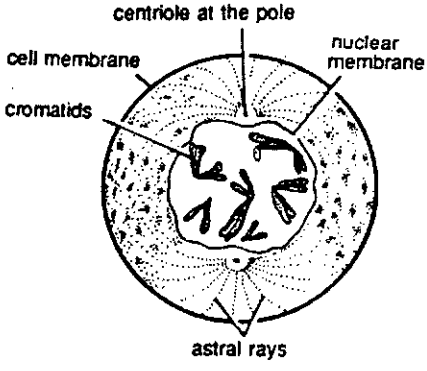


Fig. Early Metaphase

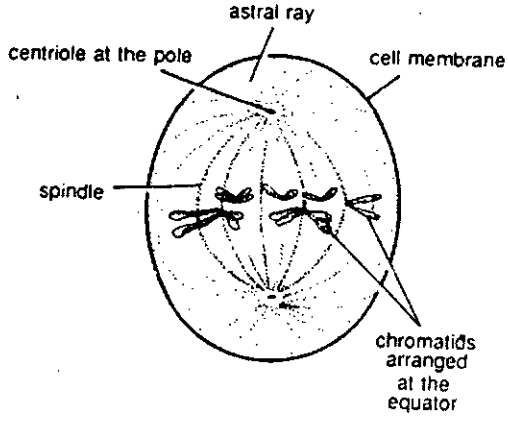


Fig Late Metaphase

(1) Spindle fibres are faintly visible.

(2) Chromosomes are arranged in a row on the equator of the spindle.

(3) The nuclear membrane and nucleolus are absent.

(4) Each chromosome has splitted longitudinally into two identical chromatids attached at centomere only.

(5) Theoretically the centromere of chromatids are attached to spindle fibres and the arms of the chromatid are directed towards opposite poles.

5. The Anaphase stage

The slide shows ***anaphase stage*** of mitosis which is characterised by following features:

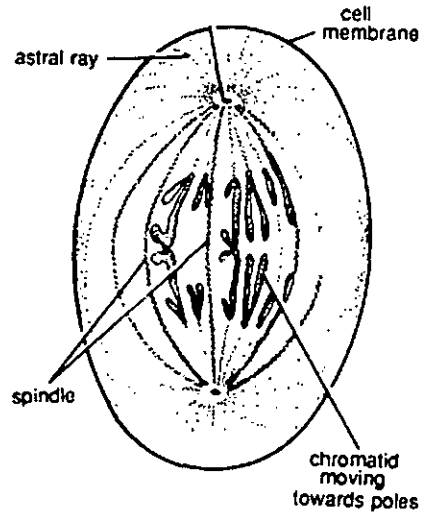


Fig. Early Anaphase

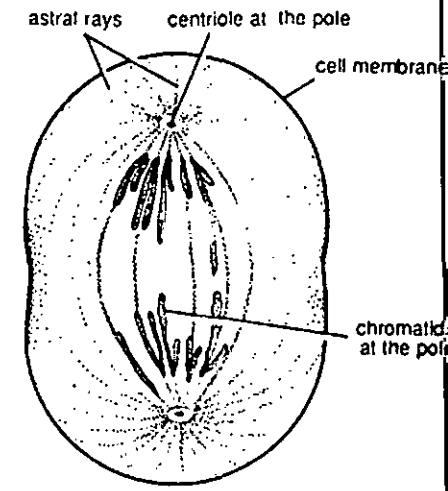


Fig. Late Anaphase

(1) The ***centromeres*** of two chromatids are now sep? rate and are connected to independent spindle fibres of respective side but the chromatid's arms have reversed their direction and are now facing towards equator.

(2) The ***chromatids*** appear as V, L or J shaped.

(3) The spindle fibres have started contracting and thus the chromatids have also started separating from each other and moving towards respective poles.

(4) The ***nuclear membrane*** and ***nucleolus*** have not yet appeared.

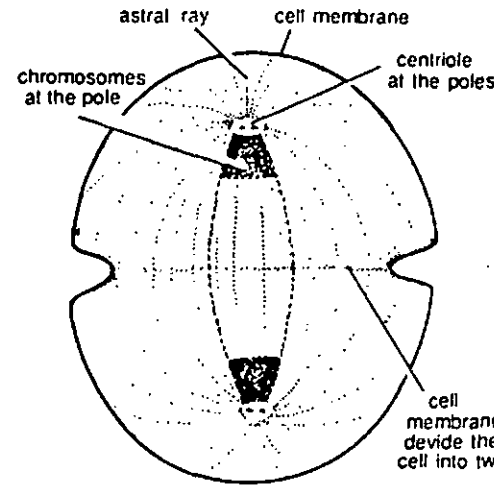


Fig. Telophase

6. The Telophase stage

The slide shows ***Telophase stage*** which is characterised by following features:

(1) The ***chromotids*** have reached the poles and have started showing uncoiling.

(2) The chromatids at this stage appear slightly elongated & thread like.

(3) The ***nuclear membrane*** has reappeared and so also the ***nucleolus***. As such two daughter nuclei are visible.

5.2. PROKARYOTIC AND EUKARYOTIC CELLS

Similarities

- Plasma membrane of similar construction.
- Identical genetic code for encoding information in DNA.
- Similar protein synthesizing mechanisms.
- Shared metabolic pathways (e.g., Glycolysis, TCA cycle).
- ATP as energy currency molecule.
- Similar mechanism of photosynthesis between blue green algae and green plants.
- Proteasomes of similar construction.

Did You Know?

According to the **andosymbiotic theory** mitochondria and chloroplast may have a prokaryotic origin. For example, chioro-plasts are hypothesized to be derived from ancient prokaryotic algae that became endo- symbionts. According to this theory, of the two membranes surrounding the chloro¬plast, one is homologous to the cell membrane of the prokaryotic algae and the other membrane is homologous to the vacuolar membrane provided by the host cell.

A. Bacterial Cell-Escherechia coli

1. *E. coli* is a rod shaped bacterium that measures 2 μm in length and 0.5 um in thickness.

2. There is no capsule. The outermost covering is a rigid **cell wall composed** of proteins, lipids, amino sugars and **muramic** acid.

3. **Plasma membrane** composed of lipoproteins is present beneath the cell wall. The respiratory chain enzyme system is localized in the plasma membrane.

4. Often, the plasma membrane is invaginated to form complex whorls called **mesosomes.**

5. Cytoplasm is dense and colloidal. Membrane bound organelles such as ER, mitochondria, etc. are lacking.

6. Cytoplasm contains granules of fats, proteins, glycogen and free 70S ribosomes.

7. There is no nucleus. **A single, circular** molecule of DNA is packed in the light nuclear region called **nucleoid.**

Did you know?

E. coli is a resident of the human intestine. It is non-pathogenic and lives as a commensal. The presence of *E. coli* in drinking water is an indication of contamination of water with faecal matter.

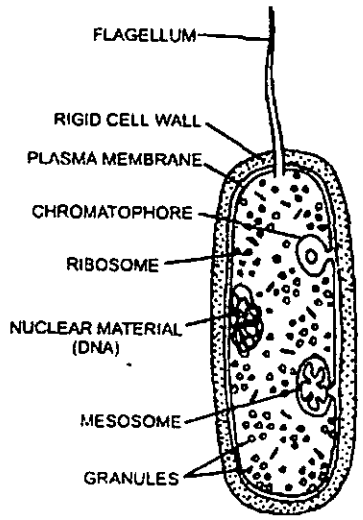


Fig. Generalized bacterial cell.

Generalized Animal Cell

1. The plasma membrane forms the outermost layer.
2. A rigid cell wall made of cellulose is absent.
3. Centriole is present.
4. Cilia or flagella may be present.
5. Nucleus, mitochondria, endoplasmic reticulum and ribosomes present.
6. The plasma membrane may have specialized structures like microdesmosomes, etc.

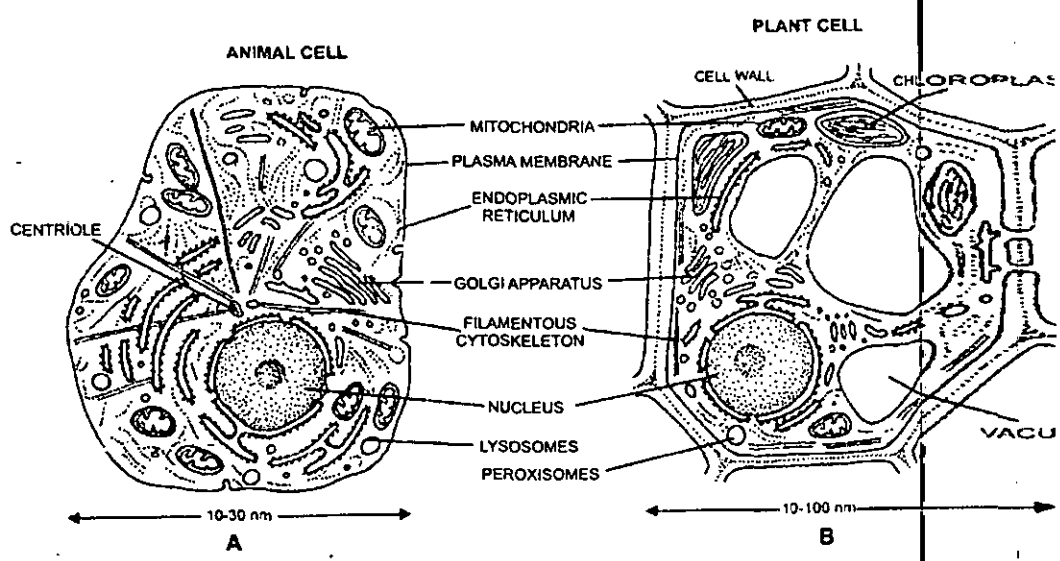


Fig. Thin sections of (A)generalized animal cell and (B) generalized cell from a higher plant.

Generalized Plant Cell

1. A cell wall made of cellulose forms the outermost layer.
2. Cell membrane, nucleus, mitochondria, endoplasmic reticulum ribosomes are present.
3. A large membrane bound vacuole occupies upto 90% of the plant cell.

4. Plasrids are present.
5. Centrioles are absent (in cells of higher plants).

THE FIRST MEIOTIC DIVISION OR HETEROTYPIC DIVISION)

1. First Prophase stage

This stage is divided into following stages:

(a) Leptotene sub stage

The slide shows the first or leptotene sub-stage belonging to first prophase of first meiotic division and is characterised by following features :

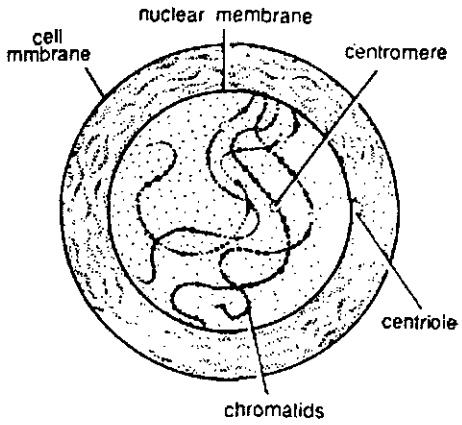


Fig. Leptotene

(1) The nuclear membrane is distinct and so also the nucleolus.

(2) The chromosomes are visible as thread like structures with a some what beaded appearance due to presence of chromomeres.

(3) The centhole has divided into two but is still on the same pole

(b) Zygotene sub stage

The slide shows zygotene sub stage belonging to the prophase of first meiotic division and is characterised by following features :

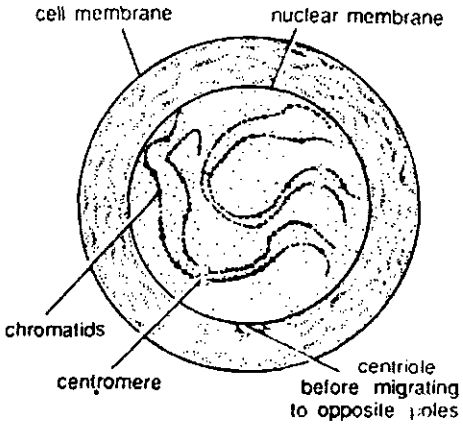


Fig. Zygotene

(1) The nuclear membrane and nucleolus are still present and are quite prominent.

(2) The chromosomes have started condensing and thickening. The homologous chromosome have started pairing known as *synapsis*.

(3) The pairing begins at a few points only.

(4) The paired chromosomes are called *bivalents* or *diads*.

(c) Pachytene sub-stage

The slide shows ***pachytene sub stage*** of first prophase of first meiotic divis

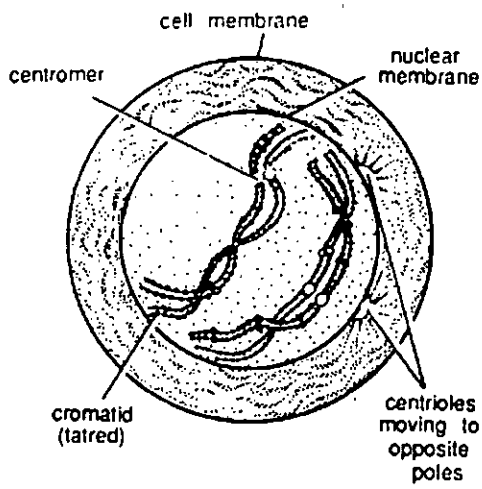


Fig. Pachytene

(1) The *nuclear membrane* and *nucleolus* are still intact and visible.

(2) The *synaptic bivalent chromosomes* have started showing coilin twisting around each other. The points of contact are called **chiazmata**.

(3) Further, each chromatid of a bivalent homologue starts split lengthwise into two Chromatids resulting thereby into a tetravalent or tet ***There Is no splitting at the centromere.***

(d) The Diplotene sub-stage

The slide shows the fourth or diplotene stage of first prophase of first m division and is characterised by following characters (Fig. 33):

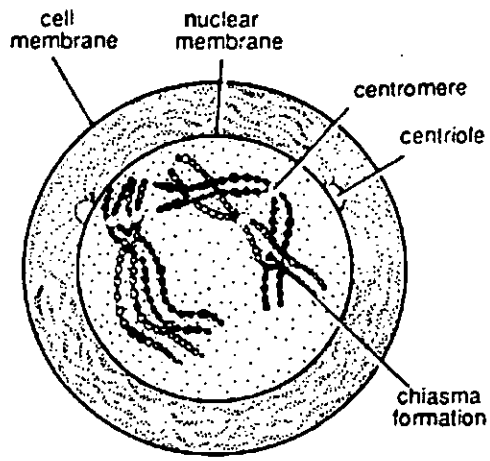


Fig. Diplotene

(1) The *nuclear membrane* and *nucleolus* have started disintigrating.

(2) The *chromatids* from the tetrad have started separating at a numb points, but at certain points they appear to cross each other. These poin crossing over are known as chiasmata and this phenomena is known as cro *over.*

(3) The chromatids have started sliding in opposite directions and thu chiasmata started moving towards the tip ofthecromatids.

(e) The Diakinesis sub-stage

The slide shows diakinesis stage of 1st prophase of 1st meiotic division and is characterised by following features :

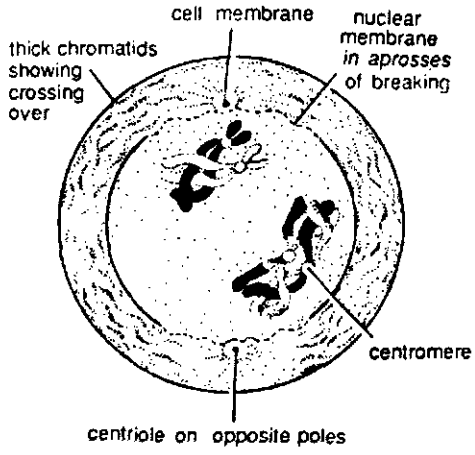


Fig. Diakinesis

(1) The chiasmata have terminated and chromosomes are at this stage very thick and dark bivalents.

(2) It is difficult to differentiate the two chromatids of a bivalent chromosome due to condensation of *chromomeres*.

(3) The *nucleus* and *nuclear membranes* have disappeared.

2. The metaphase stage of 1st meiotic division

The slide shows metaphase stage belonging to first meiotic division and is

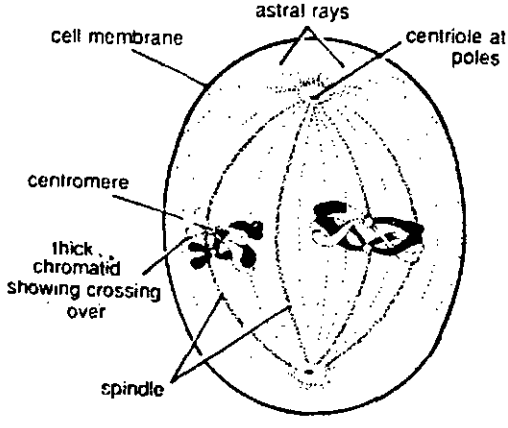


Fig. Metaphase

characterised by following features :

(1) It is different from mitotic metaphase.

(2) The nucleolus and nuclear membrane are absent and spindle has formed.

(3) The homologous chromosome have started arranging themselves in a line at the equatoroi the spindle.

(4) The chromosomes get attached to spindle fibres by their centromeres.

(5) The arms of each homologous chromosome of a tetrad are always directed towards the opposite pole.

3. Anaphase stage of 1st Meiotic division

The slide shows anaphase stage of first prophase of 1st meiotic division and is characterised by following features :

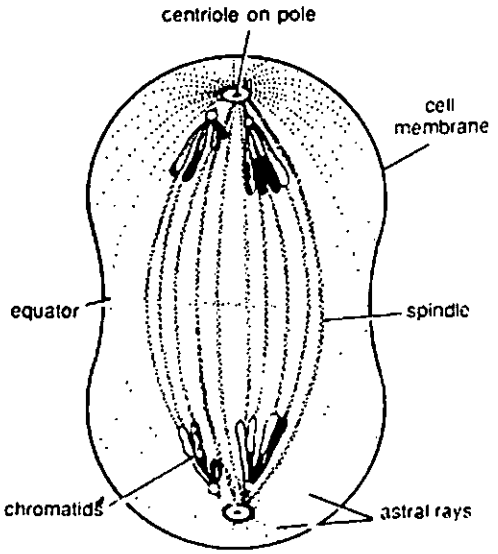


Fig. Anaphase

(1) In the beginning of this stage, as soon as spindle fibres starts contracting, the chromosomes of a homologous pair reverse their arrangement from that of metaphase stage and now their arms are facing towards equator and their centromere towards opposite poles.

(2) The most characteristic feature of this division is that each chromosome is having two chromatids, one coming from mother (maternal) and the other from father (paternal).

(3) The spindle fibres in later stage have contracted and the chromosomes have reached mid way to poles.

(4) Hence, the chromatid number has been reduced to half.

4. Telophase stage of 1st Porphase of Meiotic division

This slide shows telophase stage belonging to first prophase of meiotic division and is characterised by following features :

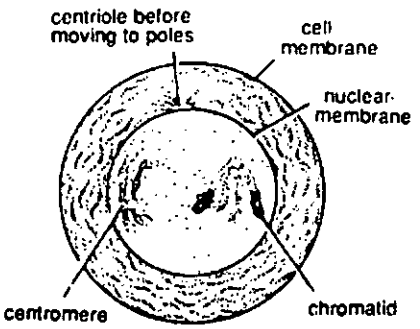


Fig. Telophase

(1) In this stage the separation of homologous chromosomes has completed and they have reached the opposite pole.

(2) The nuclear membranes have reappeared around.

(3) The chromosomes have started uncoiling.

(4) The division pf nucleus is followed by cytokinesis *i.e.,* the division of cytoplasm.

THE SECOND MEIOTIC DIVISION OR HOMEOPTYPIC DIVISION

The characteristic features of this division are that the spindle now forms at right angle to the previous spindle formed in heterotypic division (first meiotic division). The details are similar to those described for mitosis. The specific characters are as follows :

1. Prophase II

(1) The slide shows second prophase stage of meiotic division :

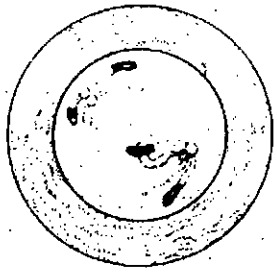


Fig. Prophase

(2) The nuclear membrane and nucleolus once again disappear.

(3) The spindle starts appearing.

(4) The chromosomes appear as dyads and are thick and coiled.

2. Metaphase II

The slide shows metaphase of second meiotic division and is characterised by following features

(1) The dyads have been arranged on the equator of spindle.

(2) The spindle has formed.

(3) The arms of two chromatlds of each dyad are facing towards opposite pole.

3. Anaphase II

The slide shows anaphase II stage of second meiosis and is characterised by following features :

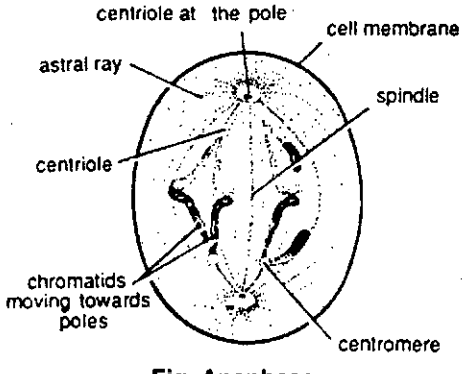


Fig. Anaphase

(1) The centromeres of dyad have divided and both have started separating due to contraction of spindle fibres.

(2) The arms of chromatids of a dyad are facing to equator and their centromeres are facing towards poles.

(3) The haploid ctiromatids are still thick, short, stumpy & coiled.

4. Telophase II

The slide shows IInd telophase stage of second meiotic division and is characterised by following features :

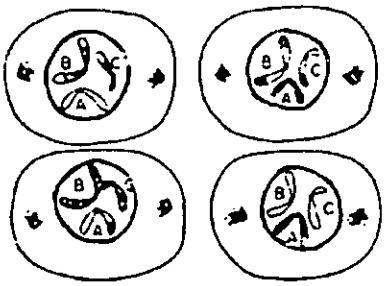


Fig. Telophase

(1) The haploid chromatids have reached the poles.

(2) Around them nuclear membrane has reappeared.

(3) The chromatids have started uncoiling and are now appearing as comparatively long and thin thread like structures.

(4) This stage is followed by cytokinesis in which the two nuclei are separated by cell membrane and they become independent haploid daughter cells.

B.Sc. ZBC-106

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