D.N.R.COLLEGE (AUTONOMOUS)

BHIMAVARAM

DEPARTMENT OF ZOOLOGY

BIOLOGY OF NON CHORDATES

P.VARA LAKSHMI

SEMESTER II,I B.Sc ZOOLOGY

ANIMAL DIVERSITY– BIOLOGY OF NONCHORDATES

UNITI

1.1 Whittaker's five kingdom concept and classification of Animal Kingdom.

PhylumProtozoa

1.2 General Characters and classification of protozoa upto classes with suitable examples

1.3 Locomotion,nutrition and reproduction in Protozoans

UNIT–II

PhylumPorifera

2.1 General characters and classification upto classes with suitable examples

2.2 Canalsystem in sponges

PhylumCoelenterata

2.3 Generalcharacters and classification upto classes with suitable examples

2.4 Polymorphism in coelenterates

2.5 Corals and coral reefs

Unit– III

PhylumPlatyhelminthes

3.1 General characters and classification upto classes with suitable examples

3.2 Parasitic Adaptations in helminthes

Phylum Nemathelminthes

3.3 General characters and classification upto classes with suitable examples

3.5.Lifecycle and pathogenecity of *Ascarislumbricoides*\

Unit– IV

Phylum Annelida

4.1 General characters and classification upto classes with suitable examples

4.2 Vermiculture-Scope,significance, earthworm species,processing,Vermicompost,economic importance of vermicompost

PhylumArthropoda

4.3 Generalcharacters and classification upto classes with suitable examples

4.4 *Peripatus*-Structure and affinities

Unit– V

PhylumMollusca

5.1 General characters and classification upto classes with suitable examples

PhylumEchinodermata

5.2 General characters and classification upto classes with suitable examples

5.3 Watervascular system in star fish

PhylumHemichordata

5.4 Generalcharacters and classification upto classes with suitable examples

5.5 Balanoglossus-Structure and affinities

UNIT-I

1. Whittaker's five kingdom concept and classification of Animal Kingdom.

PhylumProtozoa

2. General characters and classification of protozoa upto classes with suitable example.

3. Locomotion in Protozoans

4 . Nutrition in Protozoans

5. Reproduction in Protozoans.

1. WHITTAKER'S FIVEKINGDOM CLASSIFICATION

- Classification is defined as the system of assembling organisms into groups or sets based on their specifications.
- It simplifies the study of a wide variety of organisms in asystemic manner.
- R.HWhittaker proposed 5 Kingdom classifications in1969.
- According to this theory total living organisms are classified into Five Kingdoms based on their mode of Nutrition, Thallus, Cell structure, Phylogenetic relashionship,Reproductionetc.,
- Theyare-Monera,Protista,Fungi,Plantae andAnimalia
  - **Monera**-Bacteria,Cyanobacteriaetc.,(Prokayotes)
  - **Protista**-Algae,Protozoansetc.,
  - **Fungi**-Fungi
  - **Plantae**-Plants
  - **Animalia**-Animals

1. Kingdom Monera:-

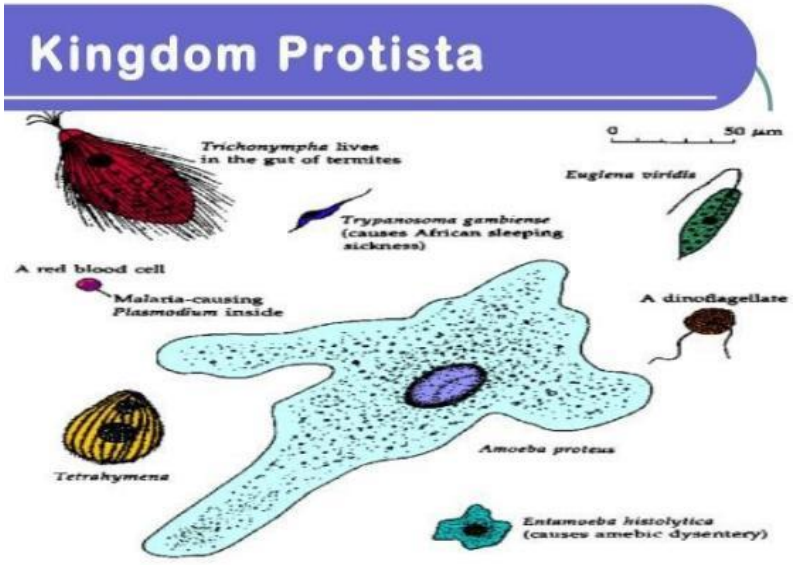
- This Kingdom includes prokaryotes and unicellular organisms.
- Nucleus &cellorganelles are absent.
- Cell wall is present in some organisms.
- These are autotrophic or heterotrophic forms.

  Eg:**Bacteria,Cyanobacteria,Mycoplasma**etc.,

2. KingdomProtista:-

- This Kingdom includes eukaryotes and unicellular organisms
- Simple eukaryotic forms
- Autotrophic or heterotrophic
- Cilia,flagella,pseudopodia etc-appendages-locomotion

  Eg;-**Diatoms,Protozoans(Amoeba,Paramoecium)** etc.,



3. Kingdom Fungi:-

- This Kingdom includes heterotrophic,multicellular,eukaryotic organisms.
- Mode of nutrition is Saprophytic nutrition(decaying organic matter as food)
- Cellwall is present, which is made up of chitin.
- These are formed Symbiotic association with bluegreen algae.Eg:-**Yeast, Mushroom,Aspergillus**etc.,

4. Kingdom Plantae:-

- This Kingdom includes eukaryitic and multicellular organisms.
- Cellwall is madeup of cellulose.
- These all are autotrophs (they perform photosynthesis)
- Vascular tissue is present(XylemandPhloem)
- This Kingdom includes other groups, they are- **Thallophyta, Bryophyta, Pteridophyta,Gymnospermsand Angiosperms.**

Eg;**All plants**

5. Kingdom Animalia:-

- This Kingdom includes multicellular and eukaryotic organisms.

- ❖ Cellwall is absent.
- ❖ Cell membraneis present, madeup of lipoproteins.
- ❖ Mode of nutrition is Heterotrophic.
- ❖ They exhibit great diversity in their body organization.
- ❖ This Kingdom further divided into Phyla,Classes and Orders.
- ❖ For example Phyla **Porifera, Coelenterata, Helminthes, Annelida, Arthropoda,Mollusca,Echinodermata, Hemichordata and Chordata**etc.,

  Eg:-**Sponges,Hydra,Insects,Starfish,Earthworms,MonkeysBirds,Man,Lion**etc.

- Each kingdom is again divided in to Phyla, Classes, Orders, Families, Genera and Speciesetc.,

Limitations:-

- ✓ Some scientists don't agree that the algae & Protozoans should be placed in to the same kingdom.
- ✓ A distinction between unicellular and multicellular is not possible in case of algae in this system of classification.
- ✓ Each group has so many diversities eg- Monera and Protista- both are cell walled,photosynthetic and non photosynthetic organisms and celluar or filamentous organisms.
- ✓ Viruses are not included in this group and they are not living cells and acellular.
- ✓ Four of the fivekingdom eukaryotes.
- ✓ Archae bacteria are differirg from other bacteria in structure,composition and physiology.
- ✓ Mycoplasma is quite different from bacteria.

2.PROTOZOA–GENERAL CHARACTERS AND CLASSIFICATION

Generalcharacters:-

- It Is the first phylum in invertebrates.
- These animals were firstdiscovery by **anton VanLeven Hook.**
- This phylum was named by **Goldfus** in 1820.
- All these are small microscopic,acellularor single cellular organisms.
- Tissues and organs are absent.
- These are live all environments(aquaticor terrestrial)
- Protozoans are Solitary or colonial forms.
- These are free living or parasitic forms.
- Body is naked but in some forms body is covered by shell or pellicle.
- Body is spherical,oval, spindle inshape. But some forms are in shapeless(Amoeba). One or more nuclei are *present*
- *Macro nucleus* involves in morphological functions and micronucleus involves in reproduction.
- Locomotion is performed by pseudopodia, cilia,flagella or reticulopodia.
- Nutrition is holozoic,holophytic,saprozoic or parasitictype.
- Digestion is intracellular.
- Respiration is by diffusion.
- Excretion is carried by **contractilevacuoles**.
- Reproduction is asexual or sexual.
- Asexual reproduction is by Binaryfission and sexual reproduction is by conjugation.

Classification:-

Phylum Protozoa is classified into 4 Sub-phyla based on their structure,nutrition and parasitic nature. Theyare-

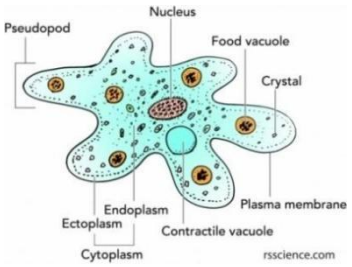
A. Sub-phylum-Sarcomastigophora

- All these are pseudopodial animalcules.
- Mostly freeliving forms but some are parasites.
- Body is externally covered by pellicle.
- It contains 3 classes. Theyare-

  Class-a)Mastigophora-Euglena, Volvox,Ebasiaetc.,

  Class-b)Opalinata:-Opalinaetc.,

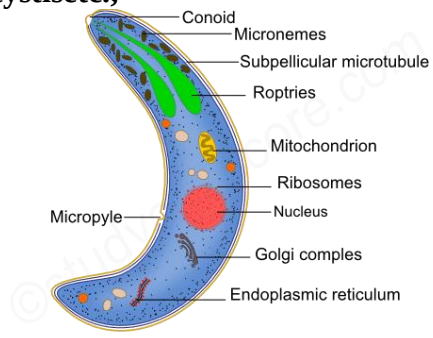
  Class-c)Sarcodina :-Amoeba,Entamoeba,Elphidiumetc



B. Sporozoa:-

- These are mostly parasites but a few are free living forms.
- Reproduction is by sexual method.
- Locomotion is carried by flagella or cilia.

Eg;-Plasmodium,Monocystisetc.,

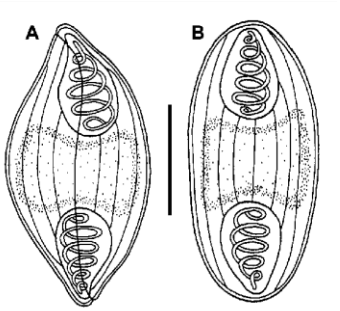


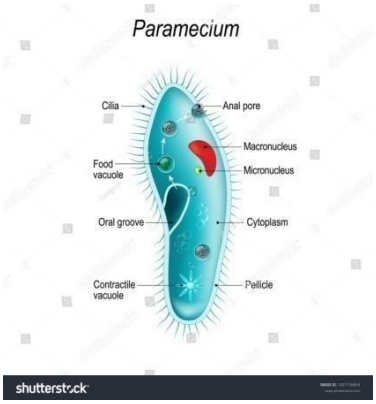
ADULT TROPHOZOITE OF MONOCYSTIS

C. Cnidospora:-

- No locomotory organs in these forms.
- Mostly parasites but a few are freeliving forms.
- Body is covered by shield.

Eg-Mixidium,Cadospora





D. Ciliophora:-

- Body hasmanycilia.
- Locomotion is carried by cilia.
- One or two nuclei are present.
- All are free living forms.
- Mostly live in fresh water bodies.

Eg.Paramoecium,votrecella,Cadospora.

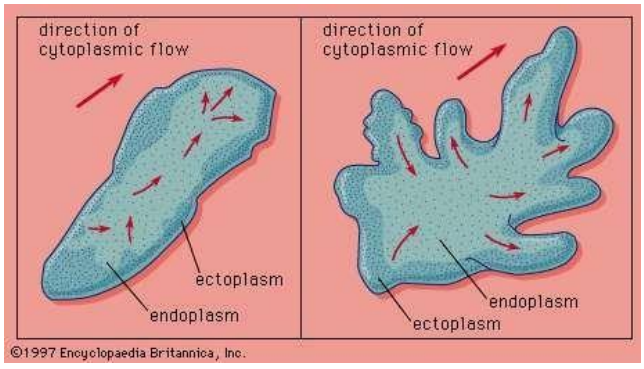
3.LOCOMOTION IN PROTOZOANS

Locomotion:

- Locomotion is defined as "the movement takes place between one place to another" for the purpose of feeding, breeding, shelter and protection.
- Generally locomotion is performed bydifferent types of locomotory organelles or limbs.
- Protozoans perform their locomotion by 4 different ways by particular locomotory organelles.
- Theyare-Pseudopodial locomotion, Flagellar locomotion,Ciliary locomotion and Peristaltic locomotion.
    1. **Pseudopodial locomotion**-Amoeba,Entamoebaetc.,
    2. **Flagellar locomotion**-EuglenaTrichomonasetc.,
    3. **Ciliary locomotion**-Paramecium,Balanditiumetc.,
    4. **Peristaltic movement**–Euglena

1. Pseudopodial locomotion:

- Some Protozoans have pseudopodia(Pseudo-false, Podia-foot)
- Pseudopodia are temporary projections or out growth soft body.
- Pseudopodia are blunt and finger like temporary protrusions of the cytoplasm and shape is varied.
- Some individuals have large number of pseudopodia. Eg: Amoeba has lobopodia (polypodia)Entamoeba has monopodia and Elphidium has reticulopodia.
- In some Protozoans cytoplasm is differentiated in to thicker ectoplasm and thinner endoplasm.
- Endoplasm pushes ectoplasm towards outside,hence pseudopodium is formed.
- Pseudopodia fixedon substratum with the help of some adhesive secretions.
- Now theAnimal moves forward.
- In Elphidium thicker and dense ectoplasm comes outside through the pores like threads called reticulopodia.



2. Flagellate locomotion:

- Certain protozoan move with the help of flagella.

- Flagella are whip like structure.
- Flagella are lessin number than cilia.
- Flagella are deloped from cytoplasm.
- They are 2-4 in number.
- Flagella mostly present at anterior end of the body.
- Flagellum has an inner axoneme surrounded by protoplasmic sheath.
- Base of the flagellum bears a kinetosome.
- Euglena has single flagellum which provides lashing movements.
- Flagella move forward and backward like effective stroke and recoverystroke.
- Flagella candirect(control) movement of the animal.

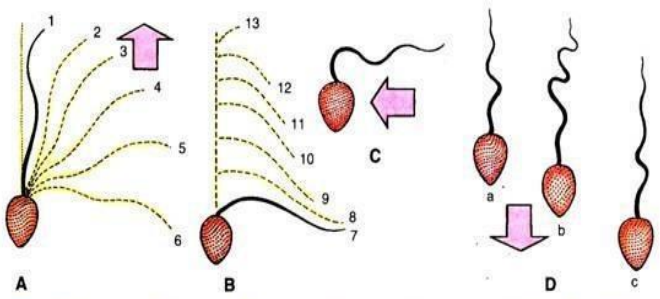


Fig. 12.5. Action of flagellum. A—Recovery stroke, successive stages from 1 to 7; B—Effective stroke, successive stages 8 to 13.

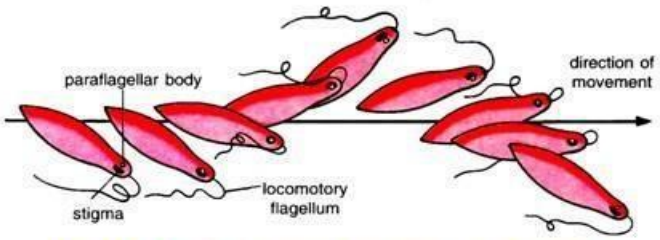
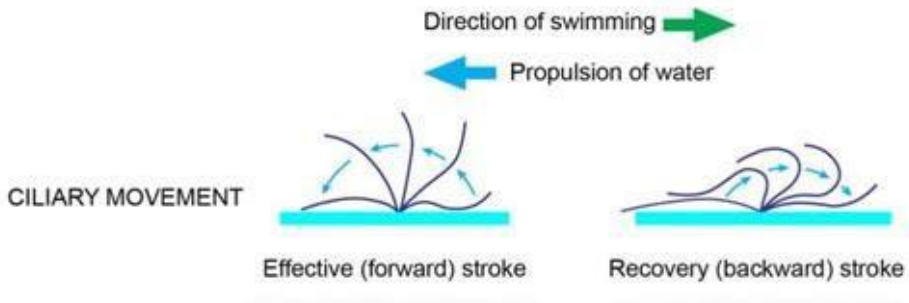


Fig. 12.6. *Euglena*. Successive stages in flagellar movement.

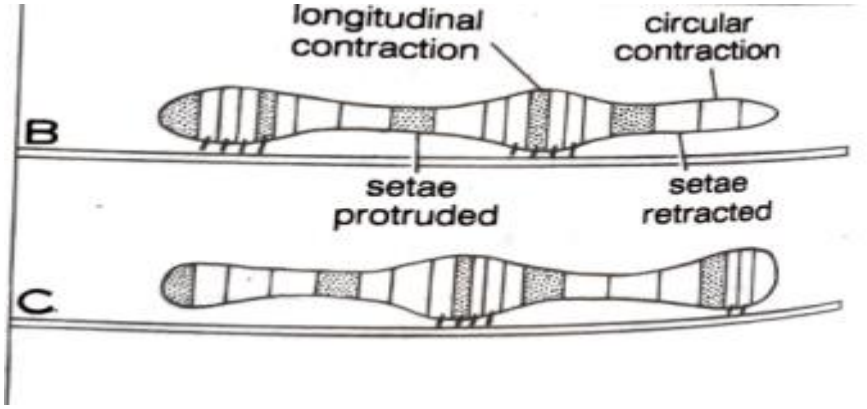
3. Ciliary locomotion:-

- Some Protozoans move with the help of cilia.
- Cilia are small hair like structure.
- Cilia present usually in large number on whole body surface (holotricha).
- In some species cilia are restricted to certain places(peritricha).
- Cilia are usually arranged in definite rows.
- Structure of cilia is similar to flagella.
- Cilium has **kinety**(kinetosome,kinetoneme,kinetodesmata).
- Movement of cilia is look like swinging of paddy crop.
- Lashing movement has an effective stroke and recovery stroke.
- Paramecium moves forward in a rotating manner by the beatingof cilia.
- Cilia act as smalloars.



4. Peristaltic movement:-

- Some protozoans move with the help of myonemes.
- Myonemes are small thread like contractile fibrils.
- Myonemes are located inthe inner layer of ectoplasm.
- In monocystis pellicle contracted by the movementof myonemes.
- The animal moves slowly forward in ajer king movement.



4.NUTRITION IN PROTOZOANS

- Protozoans obtain nutrition in many ways.
- Some synthesize their own food other get synthesized by algae living in their cyto plasm and still others capture the food.
- Some protozoa lead a parasitic life, usually doing no harm or very little arm to their hosts but occasionally cause serious diseases.
- Protozoans mostly heterotrophs or parasites.
- They are Mostly depending on

on hosts.Their modes of nutrition

are as follows-

I.Holo phytic Nutrition

- The flagellates posses chloroplasts and chromophores to synthesize their food by photosynthesis.
- They utilize sunlight,carbon dioxide and water a sraw materials.
- This method of self feeding is refer edtoas autotrophic phototrophy.
- The dextrose sugar paramylon synthesize din characteristic of euglenoid flagellates.

II. Holozooic Nutrition

- Most of the protozoa derive nutrition by ingesting other organisms.
- This modeof nutrition is side to be holozooic.
- It involves development of organelles for food capture, ingestion, digestion, assimilation and egestion of undigested food materials.
- They capture their food by flagella, pseudopodia and trichites.
- Some protozoans use axopodia,reticulopidia and tentacles to pull their pray that comes with in their reach.
- Inciliates,the ciliary oral apparatus is well developed for food capturing and drivingit towards mouth or cytostome and then pushingit into the cyto pharynx.

III. Pinocytosis

- This method also called as **cell drinking** involves ingestion of liquid food by investigation through the surface of the body.

- The pinocytosis channels are formed at some parts of the body which encloses the fluid fromthe surroundingmedium.
- The lower ends of these channels are pinchedas foodvacuoles into the endoplasm.
- Pinocytosisis onlyinduced bycertain activesubstances in themedium surroundingthecell.
- Highmolecular compounds fromtheexternalmedium are absorbedbythis method.

IV. sprozooic Nutrition

- This involves the absorption of food by osmosis through the general body surface.
- Sothis method is referred as osmotrophy.
- The food mainly is the dead organic matter rented so by the decomposing bacteria.
- This kind of nutrition Is found in mastigo amoeba and also some of the colourless flagellates.
- Suctorial feedon their ciliates withhelp oftheir tentacles which have funnel ends.
- Each tentacle consists of arounded rigid centraltube.
- As soon as the prey is attached, tentacles tips paralysis the pray with some hypnotoxin and gradually suck the body fluids with the centre
- This is acombination of more than one mode of nutrition.
- Photosynthesis as a means also take in some part of their diet it dissolved from by osmotropy or solid from by phagocytosis.
- The best examples of this kindof nutrition are flagellates like Euglena and Paranema.

V. Nutrition of parasitic protozoa

- The mechanism used by parasitic Protozoa are almost are similar to that of their non parasitic protozoa.
- Parasites inhibiting the intestine and blood have a distinct mouth through which through food particles are ingested through the process of phagotrophy.
- The osmotropic forms of Protozoa are either Coelozoic or Histozoic.
- The Coelozoic farms absorb their food by their cellsurface.
- The Histozoic farms feed onthe substances by osmotrophy.
- ParasiticSaprozoic formsalso directlyusethe Serum oftheirhost blood.

5.REPRODUCTION IN PRTOZOANS

- Reproduction is an important life process to produce youngones of the same kind.
- Single celled organisms like Protozoans lack special reproductive structures like gonads.
- Protozoans reproduce both by asexual and sexual reproduction. Out of these two, asexual reproduction is common.
- In some of the Protozoans asexual reproduction is the onlymode of reproduction.
- Protozoans reproduce by both asexual and sexual means though sexual reproduction is lesscommonand occurs incertain groups.

A) Sexual reproduction

Sexual reproduction takes place by fusion of pronuclei with the formation of gametes or with out the formation of the gametes. There are numerous chances of genetic recombination in sexual reproduction.Sexual reproduction in Protozonas occurs by the following methods.

A) Syngamy:

- It is the fusion of the pronuclei or two gametes. This is a complete fusion of the two sex cell s of the zygote. The fusion nuclei of the zygote are called as synkaryon.
- Depending on the degree of differentiation displayed by the fusing gametes syngamy is following types-

a) Autogamy

This is the fusion of the gametes derived from the same parent cell.

Ex:**Actinophrys.**

b) Hologamy:

In this type of reproduction,thetwomature Protozoan individuals themselves behave as a gametes and fuse together to form zygote.

Ex:**Corpomonas.**

c) Isogamy:

When the two fusing gametes are similar insize and shape but different in behavior they are called as isogametes. The fusion of the isogametes is called as Isogamy.Isogametes are generally produced by multiple fissions.

Ex;**Elphidium,Monocystis,Chlamydomonas** etc.,

d) Anisogamy:

Whenthe two fusing gametes defer morphologically a swell as in terms of behavior they are called as aniso gametes.Generally small and motile gametes are male or micro gametes where as the large and non-motile gametes are called female or macro gametes. The fusion of two such anisogametesis called as anisogamy.

Ex:**PlasmodiumandVolvox.**

B) Conjugation:

- It involves temporary fusion of two individuals called as conjugants at the oral or buccal regions.
- This type of reproduction is the characteristic of the suctorian sand holotrich ciliates.

- In this process fusion of the protoplasm takes place at the pointof contact between two conjugants.
- Macronuclei breakup and disappear but the micronuclei undergo meiotic division.
- After the meiotic division of the micronuclei all the micronuclei get degenerated and only one remains.
- This remaining micronucleus divides farming two gametic micronuclei.
- Out of these two, one is consideredas male pronucleus and the other is female pronucleus.
- The male pronucleus of one of the conjugant moves through fused protoplasm into the other conjugant.
- In each conjugant,these male and female pronuclei fuse to gether farming zygotic nucleus.
- Now two individuals separate and are called a sex-conjugants.
- Each ex-conjugant undergoes further nuclear and cytoplasmic divisions forming four daughter individuals.

Ex:**Paramecium**

B.Asexual reproduction

- Asexua l reproduction is the method in which reproduction occurs without fusion of pronuclei or gametes.
- Asexual reproduction does not generate new genetic recombination,the off spring show unparental inheritance without any genetic variations.
- In Protozoans a sexual reproduction occurs only underfavorable conditions.

The following are the different modes of asexual lreproduction occurring in Protozoans.

1) Binaryfission

- ✓ It is the most common method of asexual reproduction where in the parent divides into two daughter individuals.
- ✓ It involves division of nucleus followed by the division of the cytoplasm.
- ✓ Theplaneof fission offersindifferent Protozoans.

Dependingon the plane of fission binaryfission is of following types

a) IrregularBinaryfission

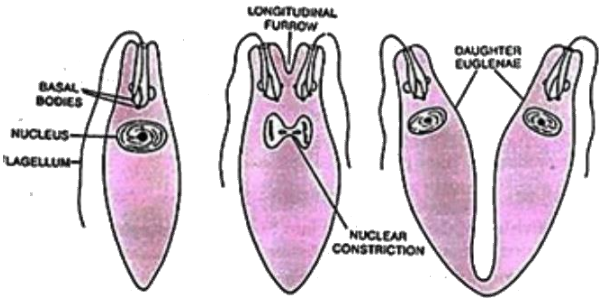
Binary fission is irregular in some of the Protozoans which do not have definite body shape. In these Protozoans there will be no defined plane of fission either and hence the name irregular binaryfission.

Ex:**Amoeba**

b) Longitudinal binaryfission

Longitudinal binary fission is common in Mastegophoran Protozoan's and in few Ciliophoran Protozoan's. This type of fission process starts at the anterior end and proceeds towards the posterior end.The plane of fissionis parallel to the longitudinal axis of the body of the organisms.

Ex:**EuglenaandVorticella.**



d)Oblique binaryfission

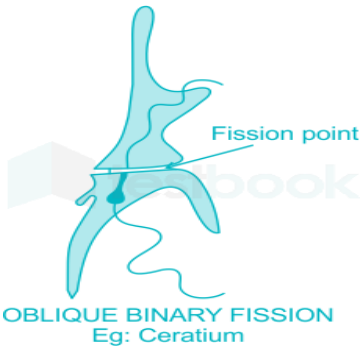
Oblique binary fission Is common ins ome Protozoans like Dino flagellates.In this type the plane of fission is oblique to the body axis of the organism.

Ex:**Ceratium**

2. Multiple fission

- Itisthe division of the parentinto numerous daughter individuals.
- Nucleu

S divides its many



Nuclei followed by the cytoplasmic division farming many daughter individuals.

- Itisprominentinsporozoansandsarcodines.
- Schizogany is the asexual kind of multiple fission and its end products of schizogany grow into trophozoites.
- Gamoganyis thesexual kind ofmultiple fissionbywhichgametes areformed.
- Sporoganyis also sexualkindof multiple fission bywhich spores areformed.

Ex:**Amoeba**

UNIT-II

phylum porifera

1. Generalcharacters and classification upto classes with suitable examples

2. Canalsystem in sponges

Phylum Coelenterata

3. Generalcharacters and classification upto classes with suitable examples

4. Polymorphism in coelenterates

1. PORIFERA-GENERAL CHARACTERS AND CLASSIFICATION

Pori-(porus)-Pores**,Feras**-Containing

Generalcharacters:-

- These are first multicellulor organisms&Metazoans.
- Different cells are present in the body but tissue is absent.
- These are diploblastic animals.
- Body has pinacoderm and choanoderm between these two layers there is mesoglea.
- This phylum includes Sponges.
- All are aquatic and mostly live in sea water.
- All are solitary or colonial forms.
- These all are sedentary forms, attached to the submergedrocks in the sea water.
- Body has radial symmetry or asymmetry.
- Body shape is vase or cylindrical or spherical in shape or shapeless.
- Many small dermal pores called **ostia** are present on entire surface of the body.
- There is a single unique opening called **Osculum** present at the anterior part of the body.
- Canalsystem is formed between ostia and osculum.
- Special cells like choanocytes, archaeocytes ,amoebocytes, etc.,are present in the body of sponges.
- Spongocoel is a central cavity lined by pinacocytes.
- Skeletal system is present, which is formed by spicules.
- Digestive system is absent.
- Digestion is intracellular.
- Nerve cells are absent.
- Circulatory system is absent but archaeocytes help in food transport.
- Respiration is by diffusion.
- Mostly hermaphrodites but some are unisexual
- Reproduction is by sexual and asexual methods.
- A sexual reproduction is by budding or formation of gemmules.
- Sexual reproduction is by syngamy.
- Fertilization is internal.
- Development is mostly indirect.
- Regenerationis very high.

Classification of Porifera

Phylum Porifera is classified in to 3 classes based on their structure and canal system. They are as follows-

A) Calcaria:

- Skeletal system is formed by calcareous spicules($CaCo_3$)
- Collarcells(Choanocytes)are large.
- Solitary or colonial forms.
- Bodyis vase or columnar in shape.
- Canalsystemis**AscanoidorSycanoid**type.Eg:
  Sycon,Grantia,Leucosoleniaetc.

B) Hexactinellida:

- Skeletalsystem is formed by siliceous spicules
- Body is cylindrical or radial symmetrical.
- Pinacoderm is not clear.
- Asexual reproduction is by budding.
- All are Marine and benthic forms.
- Development has Sterioblastula larva.Eg:**Hyalonema,Euplectell aetc**.

C) Demospongia:

- Skeletalsystem is absent.
- Body is cup shaped andsmall to large.
- Canalsystem is **Leuconoid** type.
- Mostly live in Marine waters but somelive in fresh waters.Eg:**Oscarella, Tethya,Macrociona etc.**

2. CANAL SYSTEM IN SPONGES

- The phylum porifera includes sponges.
- They are mostly marine and sedentary animals.
- All the activities of their body of the sponges depend on the current of water entering through ostia and passing out through osculum or oscula.
- Inside the body,water current flows through system of spaces which collectively constitute the canalsystem.
- The entire physiological activities of the animal depend on the water current and the exchanges between the body and the exterior arc maintained through the water current. The food and oxygen are brought through this current while excrete and reproductive bodies are excluded through this current.
- The arrangement, and complexity of the canal system varies considerably in different sponges and has been divided into threetypes :

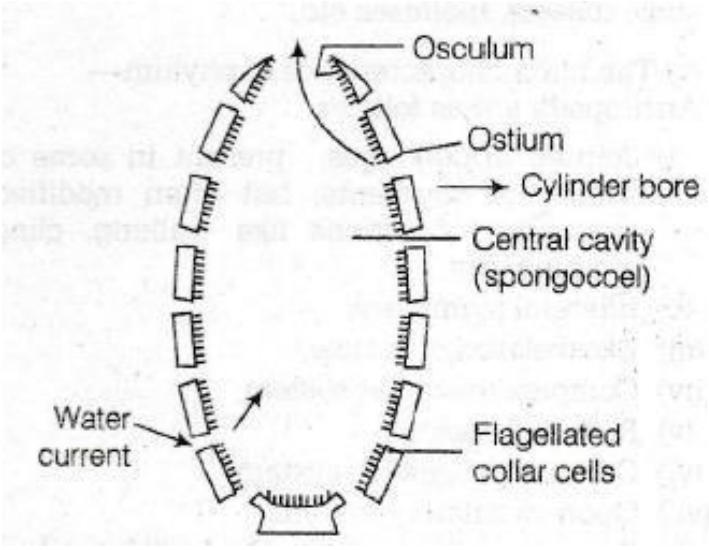
1.Ascon type2. Sycontype 3.Leucon type

1. Ascontype

- This is the simplest type of canalsystem.
- On the body surface are found regularly arranged many small rounded apertures called inhalent pores or Ostia.
- The wall is thin and these apertures open directly in the centrally placed para gastric cavity which opens outside through an opening called Osculum. The internal lining is formed by flagellated collared cells or choanocytes.
- In Ascon type water enters into paragastric cavity through ostia and escapes to the exterior through osculum.**Ex. Clathrina.**

The course of water of watercurrent is as follows:

Outsidewater ---→ Ostia----→Spongocoel---→Osculum---→outside



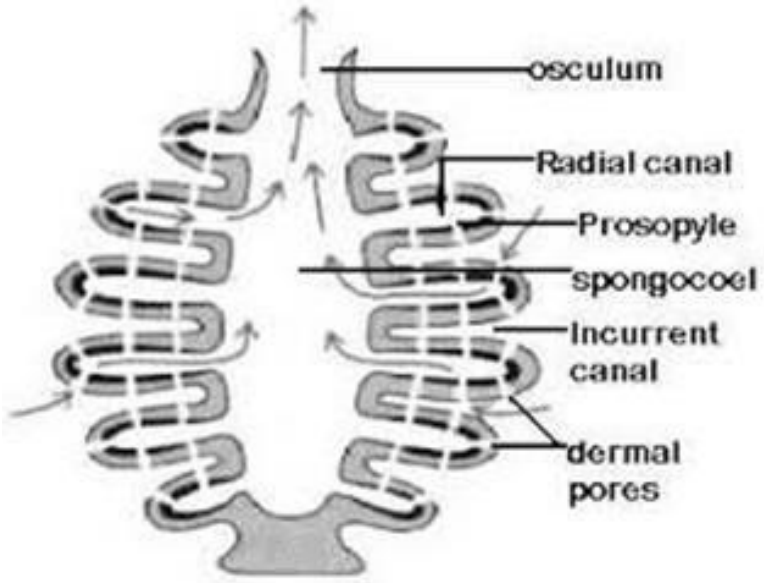
2 Sycontype

- Sycon type of canalsystem is more complex compared to the ascon type.
- This type of canalsystem is characteristic of syconoid sponges like Sycon, Grantia etc,.
- This canal system derived from the horizontal foldingof the walls of the asconoid type of canalsystem.
- Body wall of syconoid sponges include two types of canals, the radial canals and the incurrent canals paralleling and alternating with each other. Both these canals inter connected by minute pores called prosopyles.
- Radial canals are lined by choanocytes whereas other canals, spongocoel lined by pinacocytes.
- Water enters through ostia into incurrent canals and then through prosopyles enters into the radial canals due to flagellar movement of flagellated collar cells.
- Water then enters into the paragastric cavity through excurrent canal and ultimately passesout through the large osculum.

Ex:**Sycon,Grantia**

The course of water of watercurrent is as follows:

Outsidewater -----→Ostia----→incurrentcanal ---→prosopyles---→radialcanal---→apopyle---→excurrentcanal –--→spongocoel –osculum ------- → outside.

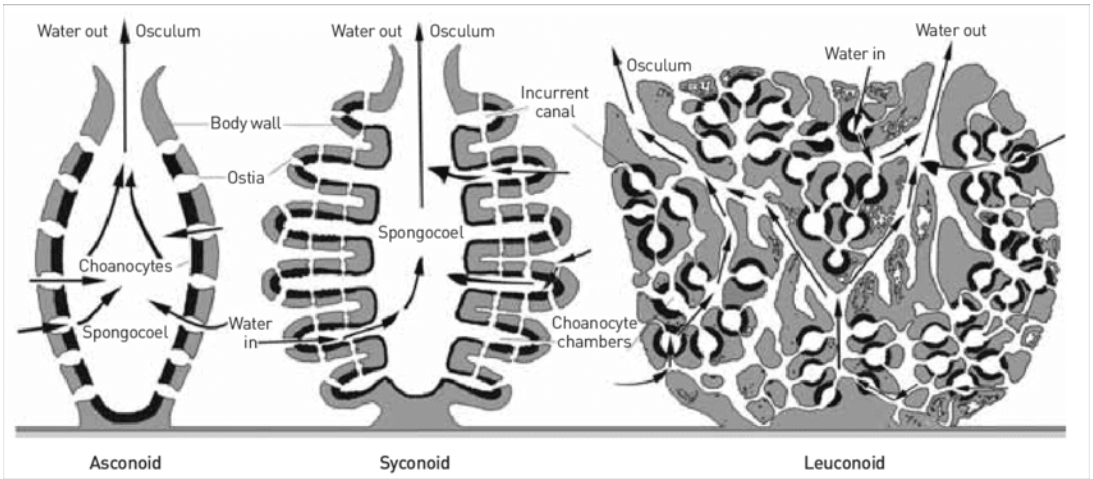


3 Leucontype

- This typeof canal system results due to further folding of thebody wall of the sycon type of canal system.
- Due to this growth and folding,the radial canals are arranged in groups.
- Each group being centered around a main excurrent canal.
- The incurrent canal system form abranching system.
- This result in thereduction of flagellated chambers and ultimately the chambers become small and spherical and irregularly scattered in the sponge wall.
- The large and spacious spongocoeli smuch reduced.

- Incurrentcanals open into flagellated chambers through prosopyles.
- Flagellated chambers,intheirturn,communicate with excurrent canals through apopyles.Thus excurrent canals communicate with the outside through a small spongocoel and an osculum.The course of water of water current is as follows:

Outside water –⟶ Ostia –⟶ incurrent canals –⟶ prosopyles –⟶ radial canals –⟶ apopyles –⟶excurrentcanals–⟶ osculum–⟶ outside.



i. Euryphylous type: This is the simplest and most primitive type of leuconoid canal system.Flagellated chambers directly communicate with the excurrent canal through broad aperture called the apopyles. **Ex: Plakina**

ii. Aphodaltype: In this system the Apopyles are drawn out as a narrow canal called aphodus. This connects the flagellated chambers with the excurrent

canals.**Ex:Geodia**

iii. Diplodaltype: Inthis type along with aphodus another narrow tube called prosodus is present between incurrentcanal and flagellated chamber. **Ex:Oscarella,Spongilla.**

3.COELENTERATA-GENRAL CHARACTERS&CLASSIFICATION

- This phylum is also called as Cnidaria.
- This phylum includes “stinging animalcules”.
- The term Coelenterata was coined byLeukart in1947.
- This phylum includes App. 9000sps.
- Mostly livein Marine but some are in fresh water(Hydra).
- These are Multicellular animals.
- Tissue grade system animals,but no organs are formed.
- Solitaryor colonial forms.
- Sedentary or free livingforms.
- Body is radial orbit lateral symmetrical.
- Two types of individuals are present; they are sedentary asexual **polyp** and free swimming sexual **medusa.**
- These exhibit Polymorphism.
- Small animals in acolonycalled zooids.
- These are diploblasic forms,an outer epidermis and inner endodermis (gastrodermis)with gelatinous mesoglea(middle).
- Gastrovascular cavity is branched and opens through the **mouth.**
- Anusis absent.
- Mouth involves in both ingestion of food and excretion of wastematerial.
- Tentacles present around the mouth.
- Tentacles help infood capturing,ingestion,locomotion,protectionetc.,
- Bodywall has nematocystsor stingingcells
- These are acoelomates (coelomisabsent)
- Nervoussystem initiating.
- Senseorgans are simple o rcomplicated.
- Digestion is extracellular.
- Mostly-Hermaphrodites,some-unisexual
- Asexual reproduction is by budding and sexual reproduction is by gametes.
- Development is indirect with **Planula** larva.
- Respiratory,circulatory,excretorysystems are absent.
- Alternation of generation or metagenesisis found in the lifehistory.

CLASSIFICATIONOFCOELETERATA

Phylum Coelenterata was classified into3 classes.Theyare-

A. Hydrozoa
B. Scyphozoa
C. Anthozoa

A. Hydrozoa(Hydro-water, Zoa-animal)

- This class includes Solitary or colonial forms.
- Live in Fresh water and marine waters.
- Radial symmetrical forms.
- Body wall covered by perisarc.
- Polymorphism includes polyp and medusa.
- Alternation of generation is present.
- Gametes are derived from ectoderm.
- Fertilization is external.
- Development is indirect(planulanlarva).

Eg;-**Hydra,Obeliaetc.,**

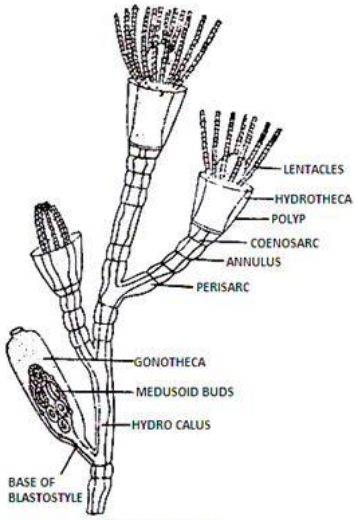
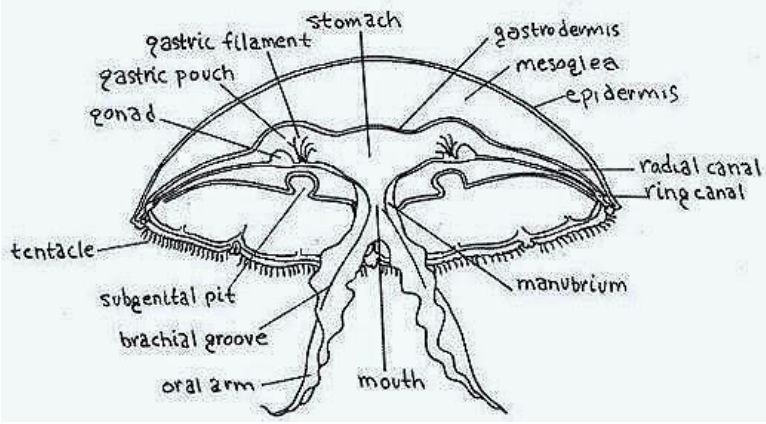


Fig. 101. OBELIA

B. Scyphozoa:-(Scypho- umbrella, Zoa-Animal)

- This class includes solitary forms.
- These are Medusoid marine forms.
- Medusa is large umbrella or bellshaped with orwithout stalk.
- Gastrocoel opens into gonads.
- Velum is present on ex-umbrella surface.
- Subumbrella surface bears median manubrium.
- These Bisexuals and sex cells are derived from gastro dermis and released in to gastrocoel.

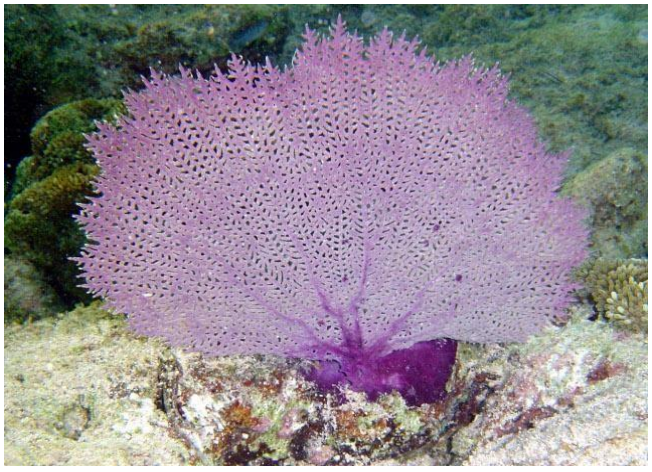
Eg;-Aurelia,Periphylla,Rhizostoma

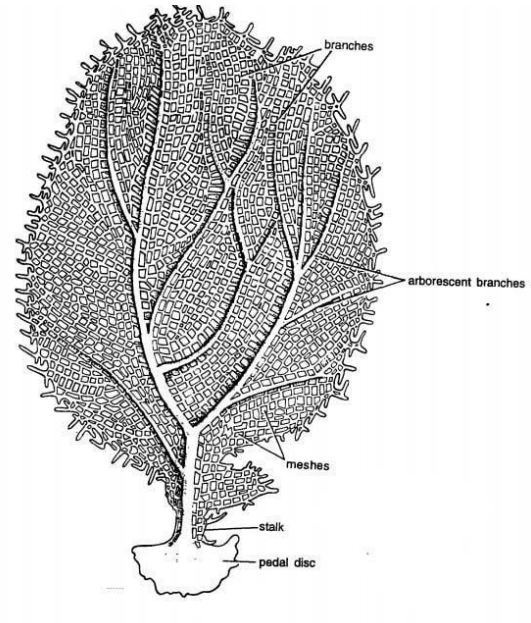


C. Anthozoa:-(Anthos-flower, Zoas- Animal)

- This class includes Polyp forms.
- These are Solitary or colonial forms.
- These are Marine forms.
- Mesoglea filled with tissue.
- Epidermis consists CaCO3 or horny material.
- Gonads open into gastro vascular cavity.
- Sex cells released in to gastrocoel.
- Fertilization is external.
- Development is indirect(Planulalarva).

Eg;-Gargonoa,Pennatula,Fungiaetc.,





4. POLYMORPHISM IN COELENTERATES

Polymorphism can be defined as occurrence of an individual in more than one form which distinctly refers from one another both morphologically and physiologically.These specialized form sarecalled zooids.

There are two types of modifications in Coelenterates. They are-

A.ModifiedPolypoidforms

a. Gastrozooids

b. Dactylozooids

c. Gonozooids

a) Gastrozooids

- These are also called as Nutritive or Trophozooids.
- These are cylindrical or funnel like structures.
- Involves in **foodcapture,digestion and nutrition.**
- Its distal end bears the mouth.
- Single tentacle is araised from its base.
- Tentacle has nematocysts or stinging cells.
- Tentacle bears many branches called **tentilla.**

b.Dactylozooids

- These are commonly called as Protective zooids or feelers.
- These are also cylindrical shaped structures.
- Mouth is absent
- Tentacle is long and coiled with nematocysts
- Tentilla are absent
- Its main functionis **Protection**.

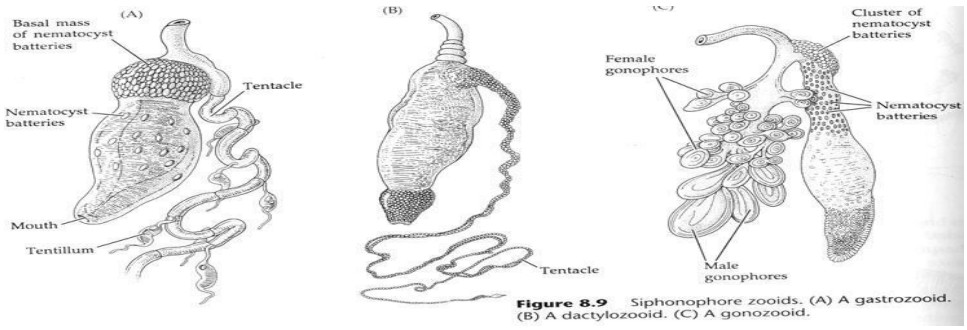
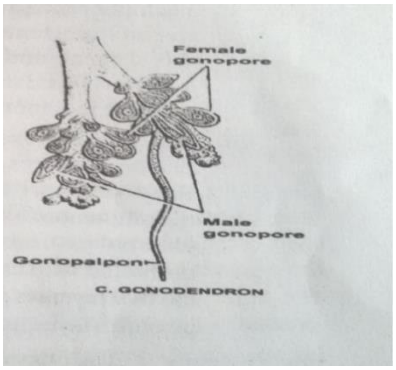


Figure 8.9 Siphonophore zooids. (A) A gastrozooid. (B) A dactylozooid. (C) A gonozooid.

C.Gonozooids



- Commonly called as Reproductive zooids.
- These are branched structures.
- Each branch bears many grape like clusters called **gonodendron.**
- Gonod endron has **gonophores.**
- Stalklike **gonopalpan** hangs from the each branch.
- Gonozooids involve in **reproduction**.

B.Medusa modification:-

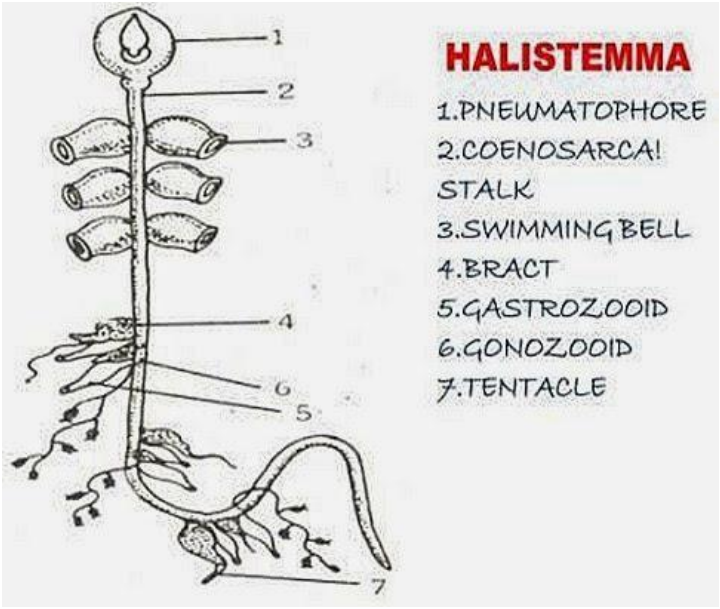
a. Nectocalyces
b. Bracts
c. Pneumatophores
d. Gonophores

a. Nectocalyces

- These are also called as Swimming bells or Nectophores.
- These are bell shaped structures.
- Nectocalyces bear medusa like velum and 4radial canal and aring canal.
- Mouth,manubrium,tentacles are absent.
- Body is highly muscular.
- Perform**Locomotion**.

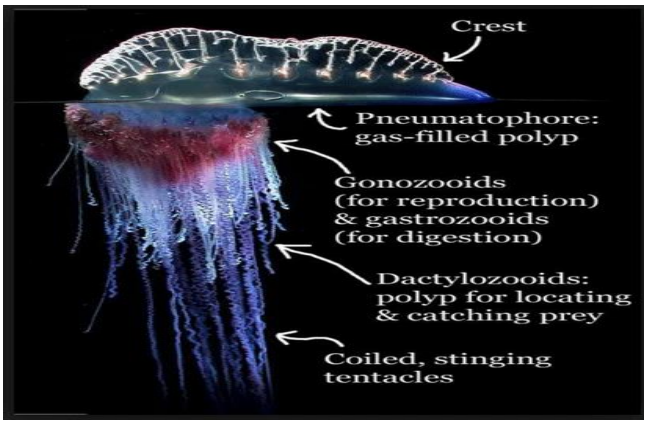
b. Bracts or hydrophylla:-

- These are also called as Phyllozooids.
- These are small bracts and leaf like structures.
- These are Helmet like bodies.
- These involve in **Protection.**



c. Pneumatophores:-

- Also called as Floats.
- These are Gas like bagand filled with gas.
- Mouth and tentacles are absent.
- Helps in **floating.**
- Ex-umbrellarsurfacehas gasbag.



d. Gonophores:-

- These are also called Reproductive zooids.
- These are group or cluster like structures on blastostyles.
- Gonophores are bell shaped and velum,radialcanals and manubrium are present.
- These are hermaphrodites,male and female gonophores are separate

C.Other types:-

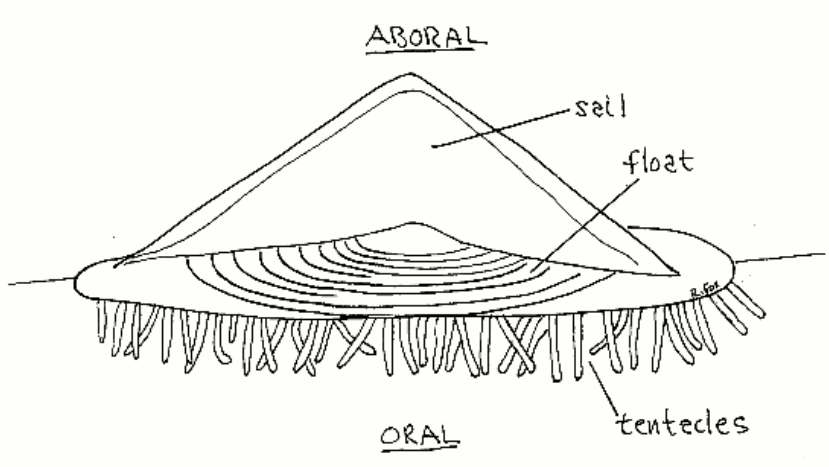
a.Physalia
b.Velella
c.Porpita
d.Halistemma

a. Physalia:-

- This is commonly called as"**Portuguese manofwar"**
- It is bluish incolour.
- Ex-umbrellahaslarge gasfilled pneumatophore.
- A group of zooids present in sub-umbrellar region called **Carmidium**
- It is free living form.
- Mouth is present insub-umbrellarregion.
- Tentacles are present.

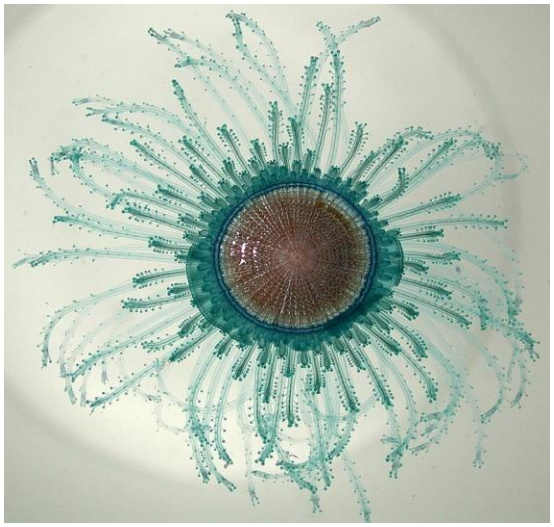
b. Velella:-

- It is also called as"**Sea sail"**
- Ex-umbrellar surface has a Sail like pneumatophore.
- Tentacles and nematocysts are present.
- Sub-umbrellar region bears manubrium with mouth.



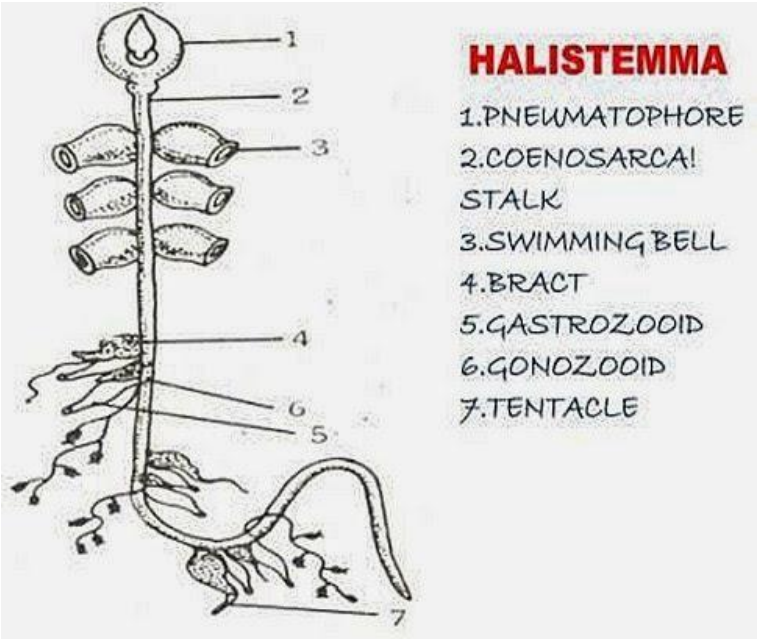
c. Porpita :-

- Body-spherical.
- Ex-umbrellar regionhas disclike pneumatophore.
- Sub-umbrellar bears manubrium with mouth.
- Tentacles are present.



d. Halistemma:-

- It is a Polymorphic colony.
- It is look like Floating stem.
- Zooids are attached to the stem.
- Sickle or half moon shaped pneumatophoreis present.
- Bell shaped necto calyces present below the pneumatophore.



UNIT-III

PhylumPlatyhelminthes

1. Generalcharacters and classification upto classes with suitable examples

2. Parasitic Adaptations in helminthes

Phylum Nemathelminthes

3. Generalcharacters and classification upto classes with suitable examples

4. Lifecycle and pathogenecity of *Ascarislumbricoides.*

1.GENERALCHARACTERS&CLASSIFICATION OF PLATYHELMINTHES

- The term Platyhelminthes was coined by Minnot in 1786.
- This phylumincludes both parasite sand freeliving forms.
- Body is dorsoventrally compressed.
- All these are triploblastic forms.
- Body is bilaterally symmetrical.
- These are organ grade system animals.
- These are acoelomates and coelom or body cavity is absent.
- Bodycavity is filled with mesenchyme or parenchymal tissue.
- Mesenchymal tissue helps in transportation,circulation,excretion etc.,
- Mesenchymal tissue acts as endoskeleton.
- True segmentation is absent.
- Alimentary canal is incomplete.
- Anusis absent.
- Head or head lobeis present.
- Suckers are present.
- Mouth may present or absent (Cestoda).
- Bodyis covered bycuticleorciliated epidermis or
- tegument.
- Sensory organs are present.
- Respiratory and circulatory systems are absent.
- Excretory system consists protonephridia or flame cells.
- Nervoussystem is initiated with nervecords.
- All are hermaphrodites.
- Fertilization is internal.
- Developmentis director indirect.

CLASSIFICATION

This phylum has mainlythreeclasses. Theyare-

A. Turbellaria

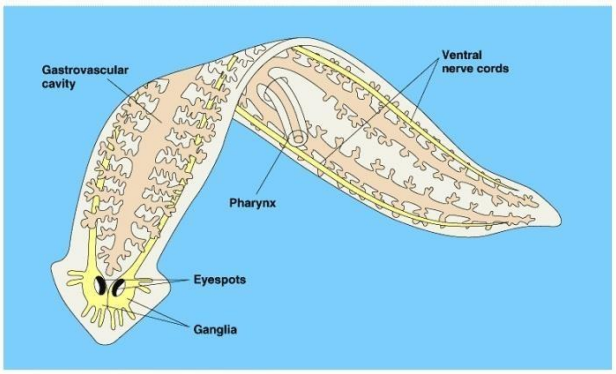
B. Trematoda

C. Cestoda

A. Turbellaria:-

- These are mostly free living but some are parasites.
- Livein mud, sand,under stones.
- Sense organs are present.
- Body is flat,leaf like and un-segmented.
- These are aquatic or terrestrial forms.
- Sucker is absent.
- Body is covered by ciliated epidermis.
- Anus is absent.
- Body has mucus glands.
- Regeneration is high.
- All these are hermaphrodites.
- Development is indirect.

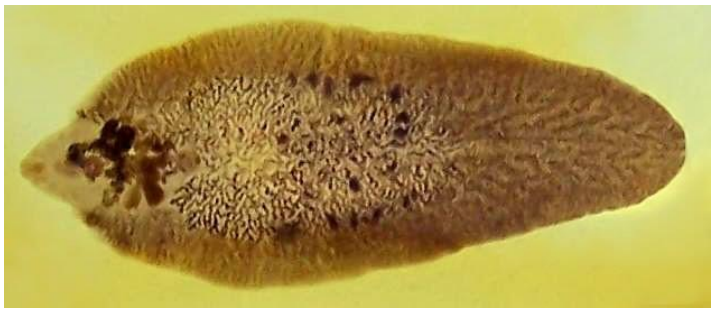
Eg:-Planaria



B. Trematoda:-

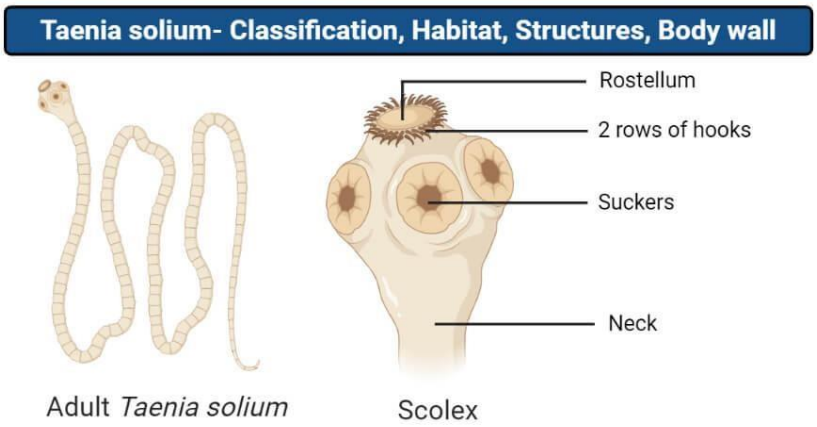
- These are ecto or endo parasites.
- All are parasites.
- Body is flat &leaf like.
- Body is non-ciliated.
- Body is covered by tegument or cuticle.
- Bodywall bears backwardly directed spinnules or spines.
- Intestine is divided into two lobes.
- One or more suckers are present.
- They have single ovary and two testes.
- Excretion iscarried by flame cells.

- Development is indirect.
  Eg;-Fasciloa,schistosoma etc.,



C. Cestoda:-

- This class includesTape worms.
- Body is flattened and ribbon like.
- These are intestinal parasites.
- Body is covered by cuticleor tegument.
- Headorscolex ispresent,which bears suckers &hooks.
- Excretion is performed by flamecells.
- Mesenchyal tissue is well developed.
- All are hermaphrodites.
- These are pseudosegmented and these segments are called proglottids.
- Development is indirect.
  Eg;-Taeniasolium,Echinicocus



2.PARASITIC ADAPTATIONS IN HELMINTHES

Adaptation may be defined as the fitness of an organism to live in its specific

environment.Helmintheshas the followingadaptations.

1. Protective covering(Bodywall):

- The outer covering of the intestinal parasites become resistant to digestive juices of the host.They develop a thick cuticle.The outer surfaceof the cuticle is formedof a fibrous protein called **keratin.**

2. Adhesive organs:

- The important adaptation met with in parasites is the development of organs of attachment.
- The adhesive organs are inthe form of suckers,acetabulum, rostellum,hooks, spines adhesive secretionsetc ,
- InTrematoda andCestoda,suckers arewell developed.The scolex bears rostellum with hooks.

3. Organsofpenetration:

- The parasites must penetrate the host's body for enter in git.
- Miracidium larva has apical papilla,which used as penetrative organ.
- There I sa pair of penetrative glands inside the body near the anterior end.

4. Cystogenousglands:

- The Cercaria larva possesses large number of cystosinous glands in their body.
- They secrete cyst around the larva.The cyst protects th elarva.

5. Loss of locomotory organs:

- Locomotion is necessary to search food material and to run and away from the enemies.
- The parasites live in a medium of food.
- Inside the host there are no enemies forth eparasites.Hence the locomotory organs are lack in parasites.

6. Senseorgans:

- In the host the environment is more or less uniform and so the sense organs are not essential.Hence they are reduced.

7. Digestivesystem:

- The elementary canal undergoes simplification and in extreme casesitis totally absent.
- InTaenia solium,the elementary canal is completely absent; it obtain sits food entirely from the surrounding medium by diffusion.
- The digestive glands are absent because the food is already in the form of digested or semidigested.
- The digestive glands are not necessary forth eparasites.

8. Anaerobiasis:

- The intestinal parasites live in an environmental completely devoid of oxygen.
- So parasites are adopted for a low metabolic rate, which requires minimum amount of oxygen.

- In the absence of oxygen energy is obtained by the fermentation of glycogen in which by glycolysis,glucoseis breakdown into lacticacid.

9. Osmoregulation:

- The osmotic pressure of the parasite remains the same as that of thei r hosts,so that there is no difficulty in maintaining life.

10. Lifehistory:

- Many parasites require more than one host to complete the life history.
- If one host becomes extinct,then the parasite can develop adaptations to live in another host or can select a new host.

11. Other important Adaptations:

- Alimentary canal is without anus as there is nou digested food to be egested.Branched intestine helps in distribution of the digested food to all parts of thebody.
- Circulatory, respiratory,sense organs are absent because they are not necessary.
- Nervoussystem is poorly developed.
- Egg shells of these animals are resistant to protect the developing zygote from unfavorable environmental conditions.

3.GENERAL CHARACTERS&CLASSIFICATION OF NEMATHELMINTHES

Nematis-thread
Helminthes-worms

Generalcharacters:-

- This phylum includes Round worms, hookworms and pin worms.
- This phylum was named by **Geganbar** in 1859.
- These areTriploblastic forms and Pseudocoelomates.
- These bilaterally symmetrical forms.
- These are Organ system grade animals.
- Mostly parasites but some are free living forms.
- Parasites are endoparasites.
- Freeliving forms are aquatic or terrestrial.
- Body is externally covered by cuticle or epidermis.
- Respiratory and circulatory systems are absent.
- Senseorgans(amphids andphasmids) are present.
- Nervoussystem consists nerveringand nervecord.
- Reproductive system is well developed.
- Gonads are simple and coiled.
- All are unisexuals.
- Development is director indirect.
- Fertilization is internal.
- Eggs are covered by shell.
- Digestive system is well development with complete alimentary canal(Anusispresent)
- Digestive glands are absent.

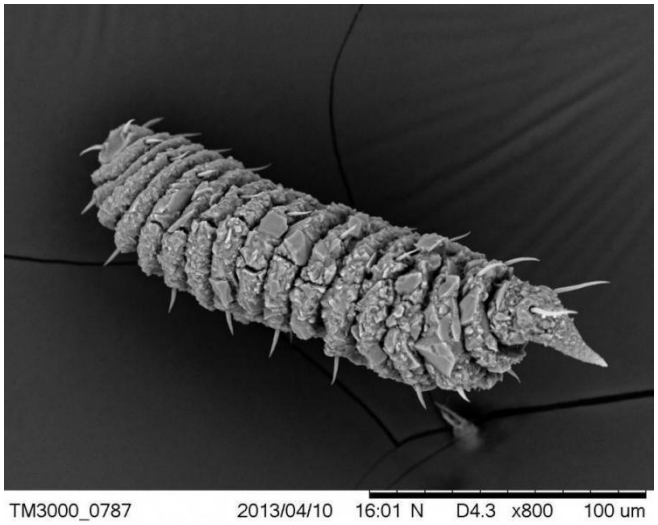
CLASSIFICATION

Phylum Nemathelminthes is classified into 2classes based on their senseorgans.Theyare-

A-Phasmidia
B-Aphasmidia

A-Phasmidia

- Phasmids are presentat caudal(posterior)region.
- Amphids also present.
- Excretorysystem is absent.
- Caudaladhesive glands arepresent.
  Mesenchyme tissue I swell developed. Eg;-**Desmoscolex,Dorylaminus**
-



Desmoscolex

B-Aphasmidia

- Phasmids are absent.
- Amphids ar epresent.
- Excretorysystem is poorly developed.
- Mesenchyme tissiue also poorly developed.
- Adhesive glands are absent.

Eg**;Ascaris,ancylostoma,oxyuris** etc.,

Ascaris

4. ASCARIS–LIFECYCLE AND PATHOGENECITY

- Ascaris lumbricoides is a largest intestinal parasite.
- It is belongs to phylum Nemathelminthes.
- It is commonly called as**Roundworm.**
- It is monogenetic parasite.
- It Is unisexual parasite.
- Usually the males are shorter than the females.
- It causes **Ascariasis** in man.

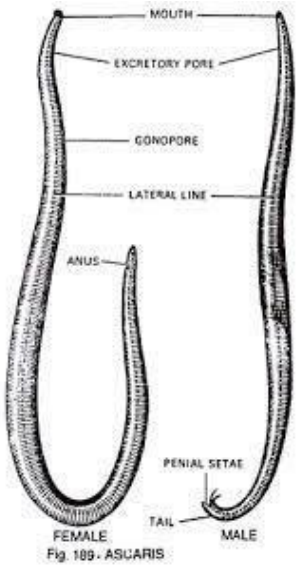


Fig. 189. ASCARIS

Lifecycle:

- These parasites don't have intermediate hosts.
- The main host is man.
- The adult parasite lives in the lumen of the small intestine of man.
- It feeds on the semi-digested food content of the gut and in some conditions it can bite the intestinal mucous membrane and feed on blood and tissue fluids.
- The female parasites can laying 2million eggs daily.

Stages in life cycle:

StageI:Eggs in feces:

- Sexually mature female releases eggs in the small intestine, which are shed along with thefeces.

Stage-II:Development insoil:

- These eggs becomeas embryos at optimum temperature(20-25C).
- Infective larvae developed with in the egg about3-6weeks.

Stage-III:Humaninfectionandliberationoflarvae:

- Embryonated eggs infected to the host(man) through contaminates oil,foodand water

- In the man intestine,the embryo hatches out into**Rhabditiform** larvae.

Stage-IV:Extra-intestinal migration:

- Larvae penetrate the intestinal wall and carried to **liver** through portal circulation.
- Than ittravels via blood to heart and to lungs by pulmonary circulation within4-7 days.
- The larvae molds in twice in lungs,enlarge and breaks into alveoli.

Stage-V:-Re-entry to stomach and small intestine

- From the alveoli, the larvae than pass up through bronchi and into trachea and then swallowed.
- The larvae pass down the esophagus to the stomach and reached into small intestine once again.
- With in the small intestine parasite again molds twice and mature into adult worm
- The life span of parasitesof 12-18months.

PATHOGENECITY OF ASCARIS

a) Symptoms:

During larval stage:

- ❖ Pneumonia with low fever
- ❖ Cough
- ❖ Allergy

During adult stage:

- ➢ Abdominal pain especially in children
- ➢ Blockage of bile tract opening in the intestine
- ➢ Weakness
- ➢ Mal nutrition problems
- ➢ Itching,irritation,allergyetc.,

b) Diagnosis:

- ➢ Stool or fecal examination

c) Treatment:

- Ascariasi can be controlled by drugs like- Albendazole, Mebendazole, Pyrantel Pamoateetc.,

UNIT-IV

PhylumAnnelida

1. General characters and classification upto classes with suitable examples
2. Vermiculture-Scope, significance, earthworm species,processing,Vermicompost,economic importance of vermicompost

PhylumArthropoda

3. Generalcharacters and classification upto classes with suitable examples
4. Vision in Arthropoda
5. Respiration in Arthropoda
6. Metamorphosisin Insects
6. Peripatus-Structure and affinities
7. Social Life in Bees andTermites

1. ANNELIDA-GENERALCHARACTERS&CLASSIFICATION

Annuli-rings
Eiods-form

Generalcharacters:-

- The term Annelida was coined by**Lamark.**
- Annelids ware first identified by **Cuvier.**
- This is the3rdlargest phylum in Invertebrates.
- **This phylum includes approximately7,800**sps.
- These are mostly freeliving forms, some are parasites and few-ectoparasites.
- All are terrestrial and aquatic.
- Some annelids are burrowing forms.
- Bodyis elongated&cylindrical.
- All are triploblastic and bilaterally symmetrical.
- These are true coelomates(Schizocoelomates)
- Segmentation is true&metamerical.
- Suckers are present.
- Body is covered by glandular epithelium.
- Cephalization is initiated in this phylum.
- Head bears sense organs like eyes and tentacles.
- Digestivesystem consists digestive glands.
- Nervoussystem consists nervecords.
- Locomotion is carried by parapodia or setae.
- Respiratory organs are absent. Respiration carried by skin. Hence it is cutaneous respiration(Skin).
- Excretion is performed by nephridia.
- Permanentor temporary clitellum is present.
- All these are mostly hermaphrodites,but a few are unisexuals.
- Development is director indirect.
- Bloodvascularsystem is well developed.
- Blood contains blood cells.
- Blood cells contain hemoglobin.
- Blood vessels and lateral hearts are also present.

Classification

Phylum Annelida was divided in to 4classes based on their locomotory organs and animal body nature. Theyare-

Class1:-Polychaeta
Class2:-Oligochaeta
Class3:-Hirudinea
Class4:-Archiannelida

Class-1Polychaeta

(Poly–many,Chaeta-Setae)

- These are mostly marine,some are fresh water forms.
- Body has true segmentation.
- Body bears distinct head with eyes, tentacles,palps etc.
- Locomotion is carried by setae or parapodia.
- Clitellum is absent absent.
- Mostly unisexuals.
- Development is indirect (Trochophore larva appears in the

  development)Eg**;-Aphrodite, Neries**etc.,

Class-2:-Oligochaeta

(Oligi-afew,chaeta-setae)

- This class includes Earth worms.
- All are aquatic &terrestrial.
- Live in moist places.
- Cephalizationis notclear.
- Eyes are absent

- Body has true segmentation.
- Locomotion is carried by setae.
- Parapodia are absent.
- These are mostly burrowing forms.
- Bodyis covered by glandular epithelium.
- Mostly hermaphrodites.
- Development is direct
- Permanent clitellum is present

Eg;-**Pheretima, Megascoles,Chaetogaster**etc.,

Class-3:Hirudina

(Hirudin-anticoagulant)

- This class includes Leeches.
- These are Aquatic or terrestrial forms.
- Mostly ectoparasites on cattle.
- These are Sanguivores(bloodsucking).
- Body has fixed number of segments (33).
- Parapodia &setae are absent.
- Body bears two suckers (anterior&posterior)
- Coelom is reduced.
- Fertilization is internal.
- Clitellum is temporarily formed duringcopulation.
- Development is direct.

Eg;-**Hirudo,Hirudinaria,Acanthobdella** etc.,

Class-4:-Archiannelida

(**Archios-primitive**)

- This class includes primitive annelids.
- All these are comparatively small animals than remaining classes in Annelida.
- Segmentation is confined to internal.
- Parapodia,setae are absent.
- All are unisexuals.
- Development is indirect.

Eg;-**Polygordius**,**Protodrillus** etc.,

2.VERMICULTURE

vermiculture:

Developing the organisms or increasing the number of organisms by creating natural environment can be called as culture, if it is done with earthworms it is called "Vermiculture. The term 'Vermi' is a latin word which means worm.

Definition:

Vermiculture is a process in which number of worms increase along with vermicompost. It is a process of using the worms to decompose all types of organic degradable wastes into a nutrient-rich material which helps the growth of the plants.

A scope:

Vermicompost or manure:

→ Vermicompost is the excreatory waste material of earthworms which is rich in humans.

→ Earthworms generally eat cow dung, yard manure and other waste materials and convert them into the vermicompost

→ In the Similar manner, the municipal wastes, liquid waste of the industries and household garbage's can also be converted into the vermicompost.

→ Earthworm excreate (vermicompost) can fertilize the soil,l break down organic waste into plant available forms, improves the soil structure, nutrients and water holding quality of soil.

→ In the past 50 years particularly in the villages, due to the we of chemical fertilizers and pesticides have Killed many earthworms and other beneficial organisms leading to poor soil fertility, loss of soil/ structure and soil erosion.

Earthworms eat organic wastes and gives healthy soil and organic fertilizer in return.

B. Significance:

(a) Soil:

→ It improves soil erosion

Enriches soil with micro organisms

worms neutralize PH of the soil

Worms Churn the soil and make it porous to that air, water and solids are Supplied to plants and Crops in required quantities bringing up materials and nutrients

→ Soil fertility and structüre improved

b, Plant growth:

→ It enhances germination, plant growth which

leads to more yield of crop

→ It improves root growth and structure

→ It enriches soil with micro organisms.

C. Environment:

→ It helps to close the metabolic gap through recycling waste on site.

Controls soil and water pollution

→ It's production reduces greenhouse gas emissions such as methane and nitric oxide etc

earthworm species (commercialty):

→ Most ofterly used Earthworm species is red wiggler (Eisenia fetida) (or) (Eisenia anderi), Lumbricus rubellus (or) lumbricus terrestris,
Perionyx excavatur. (Indian blue worm).

Vermiculture processing:

Vermiculture can be done with indoors and out doors.
a, Indoor method (Bin method):

→ the earthworms are cultured in bins.

Location must be selected for the bins

Best places are kitchens, bathrooms, laundry rooms (0r) other sheady places in summer and sheltered from winter by placing garbage (or) keeping hay stacks around the bins.

→There are 5 basic needs for bin method. They are container, Bedding, worms, water, vegetable or waste harvesting collection.

i) Container:

Bin is called the container. It should not be too
large → It may be 2to 4 feet in length and 2 feet in breadth
→ It should be shallow as the worms feed on the surface of the bedding.

Bins are made up of plastic because they are light in weight and can be carried easily.

→ Bins should be covered by a sheet of plastic to conserve the moisture and also to prevent the worms from light

→8-10 holes are to be made at the bottom of the bin to drain off the excess water
Bins should be ventilated sufficiently.

iis Bedding: → fold a section of a newspaper in half
and tear off

length wise in one inch strips.

→Soak these pieces in water for few minutes and squeeze outlike a sponge and add to worm bin over the soil that is present in the bin.

→ The soil should be moist but not soaking.

→ Spread the bedding evenly until it fills three quarters of the bin

→ A couple of handful of soil brought from outside can be sprinkled into the bedding to introduce beneficial micro-organisms which help the worms in digestion process

Earthworms:

→Selected vermicomposting earthworms are introduced into the bin

→The temperature should be maintained between 13 and 27°C

→ Place the worms gently on top of the bed.

Lid of the bin should be kept open till the worms Settle in the bed

→ The amount of worm's depend on the amount of kitchen scrap that is added per day.
(iv) Water:
→ Water is necessary to moisten the bedding so water is added to that extent that the bedding absorbs to the capacity

→ Excess water will run out of the bin through holes

present at the bottom of the bin

→ water should be sprinkled when the bed is drying.

V, Vegetable or food scraps:

The food scraps collected from the kitchen are added

to the bin This includes cut vegetables, potato peels, fruits, used coffee and tea pouda can be added in a thin layer

on the top or that can be kept in a hole that is dug in the bedding and the hole should be closed.
More food is added after a week or ten days
→ Worms may be fed any time of the day

→ food should be added in small quantities in the begining and gradually the amount should be increased.

The bin should be kept in dark places so that worms come to the surface and eat the food materials.

Vi, Harvesting:
→ The food supplied will be eaten by the worms

→ It passes through the digestive system and ejected out through the anus in the form of pellets called worm Castings

→ In about six weeks some worm castings are seen at the surface of the bin
In about 3-4 months bins will be filled with rich, black natural fertiliser comprising of partially decom- ped bedding, food scraps and worm castings. This is called 'Vermicompost'.

Viis Collection:
→ In the first method, the contents of the bin be emptied on to a plastic sheet in the sunlight or strong artificial light

→ scrap the top layer of vermicompost. In 20-30 minute worms will move down ic, away from the light.

→ so vermicompost can be collected after every thirty minutes. Afterwards worms are collected and trans- fered to a fresh bedding.

→ In the second method after some days place the food scraps only on one side of the bedding for some weeks worms migrate to that side.

→ so vermicompost can be collected from the other side. The procedure is repeated on the other side and compost can be collected.

Vill Outdoor method:

→ Pits are dug of 10 feet tong 3 feet wide and 2 feet deep under the shade of tree. Brick walls are constructed above the pit floor.

6 to 8 holes of 10 to 12 cm size are provided in the Walls for acration.
Top of the tank should be covered with plastic Sheet or nylon mosquito net CLoth so that worms do not escape out and moisture is Also conserved.

→Growing vegetables and plant debris should be removed from the surroundings of the bed. The bed is filled with partially decomposed dung upto 3 to 4 cm.

→ Then a layer of litter of same size 'is added. Raw straw can also be added. This process is repeated upto one foot

→After 15 days the temperature of the bed reaches 35%. The moisture content is maitained at 60 to 70% by sprinkling the water often.

→Then the composting worms are introduced into the pit. (About 500 grams of worms for Im^3 bed).

E. Economic importance:
→ Worms neutralize the pH of the soil.

→ Worms stimulate the microbial population

→ Root discases of plasts are reduced

→ Various essential nutrients like N, S, Ca, K, Mg, P, fe, Cu, Mn, Zn etc. are available for plants

→ various significant bacteria, are present in the worm castings

3. ARTHROPODA

[Arthros - joints , Podas – Foot or leg

]GENERALCHARACTERS

-Ii is largest phylum in the animal kingdom

- 70%animal so animalkingdom is belongs to this phylum

- This phylum includes approximately 9,00,000 species.

- These animals live in all habitats(terrestrial,aquatic,aerial,burrowing)

- These are free living forms but some are parasites

- Hormones are identifiedin Arthropds, which help in moulting,colouration,reproduction&metabolism.

- These are bilaterally symmetrical forms

- All are triploblastic forms

- These are metamerically segmented

- Paired appendages may uniramous or biramous and help in feeding&locomotion

- Bodyis covered by cuticle or chitinous shell

- Bodyis divisible intoHead , Thorax&Abdomen

- Coelomis not true coelom

- Digestivesystem is well developed with digestive glands

- Alimentarycanal is differentiated into fore gut midgut and hind gut

- Respiration is performed Gills,Book gills,book lungs or skin

- Excretion is carried by Malphigian tubules,Antennal glands,greenglands

- Circulation is open type

- Blood contains haemocyanin as respiratory pigment

-Tubular heart is present

- Nervoussystem developed as in Annelids

- Mostly unisexuals but some are bisexuals

- Fertilization is Internal o rExternal

- Devolopment is indirect

CLASSIFICATION

Phylum arthropoda is divided into 5

classesTheyare-

Class-A:Trilobita

-This class includes fossil forms(duringCambrian and Silurian period)

-All are marine forms

- Body is covered by hard cuticle

-Body is divisible into Head,Thorax and Pygidium

-Head bears a pairo f antenna,eyes,4 pairs of appendages

- Biramous appendages are present

Eg;-Trilobite

CLASS-B :Crustaceae

-This class includes prawns, crabs,lobsters,shrimps etc..

- All these are economically and commercially valuable sps.

- Bodyis divisible intohead,thorax and abdomen.

- Bodyis covered by cuticle or shell.

- These are unisexual.

- Head bears uniramous appendages.

- Thorax and abdomen bear biramous appendages.

- Respiration is performed bygills or body wall.

- Excretion is carried by greenglands.

- Developmentis indirect.

Eg;-Prawns,Crabs,Lobsters,Sacculinaetc..

CLASS-C:Miriapoda

- Body is long with many segments.

- Segments bears 1or2pairs of legs

- Headbears a pairof antenna,eyes and2 or3 pairsof jaws

- Respiration is carried by trachea

- Excretion is carries by Malphigiantubules.

-All areMonoecious orbisexuals.

Eg;-Julus,Scolopendra,Polydesmus etc..

CLASS:D-Insecta

- This class includes Isects or Hexapods

- Respirationis byTrachae

- Body is divisible Head,thorax and Abdomen

- Head has 6segments,Thorax has3segments,

- 3 Pairs of legs,2pairs of wings are present

- Salivaryglands are present

- Excretion is byMalphigian tubules

-All Unisexuals

- Metamorphosis is present

Eg;-Cockroach, Grasshopper,Locust,Housefly,Honeybee,Butterfly

CLASS ;E-ARACHNIDA

- Body is covered by Cuticle
- Body is divisible into Prosoma (6 Seg.), opisthosoma (13 Seg.)
- 6 Pairs Appendages are present
- Respiration is performed by Book gills and Book lungs
- These Monoeciousor Bisexuals
- Development is indirect

Eg;-Limulus,Buthus,Eraniaetc..

4.PERIPATUS- STRUCTUREANDAFFINITIES

Peripatus-External features

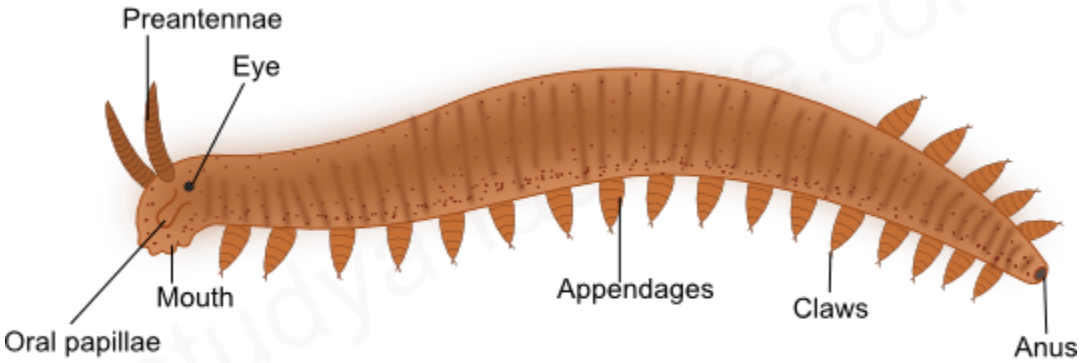
- It is belongs to special phylum Onycophora
- Body is soft and cylindrical in shape
- Body is bilaterally symmetrical
- Segmentation is pseudo segmantation
- It is measures about 3to5cm long
- Body bears 14-41pairsoflegs
- Legs are unjointed
- Legs-are tubular and hollow with claws
- Body bears many small tubericles
- Head is indistinct (notclear)
- Head bears a pair of pre-antenna, eyes,salivarypapillae and jaws

Habit&Habitat:

- It lives in moistplaces likeunder stones,logs,barks,rocksetc..
- It is a nocturnal animal

Shape:-

- Body is elongated and spindle shape
- Body is externally covered by cuticular epidermis and chitinous sheath



EXTERNAL FEATURES OF PERIPATUS

Colour;

- It is velvety and live greenish in colour

Morphology:

- Bodywall
- hascircularandlongitudinalmusclesDigestivesyst
- em is welldeveloped
  Gastricglands are present in the stomach
- Respiration is carried by tracheal
- system(arthropods)Excretion is carried by nephridia
  (Annelida)
- Nervoussystem is well developed as in Annelids&Arthropods
- Gonads occupied mostpart ofthe bodycavity
  is unisexual
- animal Fertilization
  is internal
- Circulatory system is present without blood
- vesselsHeart is tubular and valvular

AFFINITIES

- It was first discovered by Guilding.
- Guilding included this inMolluscs dueto its sluggishness.
  - Later,in 1874Mosely included this in Arthropods due to its tracheal system.
  - Hence itis interlink between Annelids and Arthropods.

A. Affinities with Annelids(Similarities)

- Body is covered by cuticle.
- Un-stripedmuscles arepresent.
- Eyes are simple and sessile.
- Legs are resemble to parapodia of Annelids.
- Reproductive tracts are ciliated.
- Bodyis worm like(Vermi form).
- Pairednephridia are present.

B. AffinitieswithArthropoda:

- Bodyis covered bychitinous sheath.
- Jawsarepresent.
- Bodycavityact as haemocoel.
- Respiratorysystemconsiststrachea.
- Circulatorysystemconsistsdorsaltubularheartandpericardialsinusus
- Apair ofsalivaryglandsarepresent
- Nephridia aredirectlyopeninto haemocoel(arthropods)
- Arrangementsof gonadsissameasinarthropods
- Developmentissimilar
- Appendagesbearclaws

B.Affinities with Arthropoda:

- Body is covered by chitinous sheath.
- Jaws are present.
- Bodycavity act as haemocoel.
- Respiratorysystem consists trachea.
- Circulatorysystem consists dorsaltubular heart and pericardial sinusus
- Apair of salivaryglands are present
- Nephridia aredirectly open into haemocoel (arthropods)
- Arrangements of gonads is same as in arthropods
- Development is similar
- Appendages bear claws

C.Personal chcracters:

- All the segments are similar inshape
- The skin is velvety
- Body bears tubercles
- Onlyone jaw is present
- External true segments are absent
- Tracheaissimpletype
- Headbears apai r of pre-antenna and oral papilla

UNIT-V

PhylumMollusca

1. Generalcharacters and classification upto classes with suitable examples

PhylumEchinodermata

2. Generalcharacters and classification upto classes with suitable examples

3. Watervascular system instarfish

PhylumHemichordata

4. Generalcharacters and classification up toclasses with suitable examples

5. Balanoglossus-Structure and affinities

1. MOLLUSCA

[Molluscs-soft]

GENERALCHARACTERS

- This is second largest phylumin Invertebtares.
- Shellsofmolluscsareusedas ornamentalpurposes.
- StudyofMolluscs isknownasMalacologyandshells isknown as Concology.
- Theseanimals were first defined byCuvierandnamed byAristotle.
- ThesearеTerrestrialor aquaticforms.
- Allaretriploblastic,coelomates,unsegmented,bilarterallysymmetrical animals.
- Bodyis divisiblein to head,mantle, foot&visceral mass.
- Theseareunivalves orbivalves.
- Digestivesystemiscompletewithdigestive glandsandradula.
- Circulationisclosedtypeandhearthas 1or2 auricles and1ventricle.
- Theblood contains Haemocyanin as respiratorypigment
- Respirationiscarried bygills.
- Theexcretethroughthepairednephridia(kidneys).
- Nervoussystemconsistspairedganglia,connectives,nerves&nerverings.
- Eyes,statocysts,chemoreceptorsetcareactassenseorgans.
- MostlyUnisexualbutsomearehermaphrodites.
- Fertilizationisexternalorinternal.
- Developmentmaydirectorindirect.

CLASSIFICATION

Phylum Mollusca is divided into the following classes.

Class-A:APLACOPHORA:-

- This class includes worm like mollusks.
- Head,foot,mantle,shell,nephridia are absent in these animals.
- Its body is externally covered by Cuticle.
- Mouth and anus is terminal and presentat opposite ends.
- Alimentary canal is straight with radula.
- A middorsal longitudinal crest is present at its dorsal partof the body.
- Mostly hermaphrodites but some are

unisexuals.Eg;-Neomenia, Lepidomenia,

Chaetodermaetc..

Chaetoderma

Class-B:POLY PLACOPHORA

- Body is bilaterally symmetrical and Dorso-ventrallyflattened.
- Body is convex on dorsal and flattened in ventral region.
- Eyes and tentacles are absent in the head.
- Shell has 8series longitudinal calcarious plates.
- Foot is flatand ventralin position.
- Radula bears 18teeth.
- Intestine is coiled.

- All these are unisexual.

Eg-Chiton,Hanleyaetc.

CLASS–C:MONOPLACOPHORA

- Body is Bilaterally symmetrical and unsegmented.
- Shell has single piece or shell.
- Eyes and tentacles are absent in the head.
- Foot is flat and ventral in position.
- Mantle encircles the body.
- Gills are arranged at Externa land serial region.
- All are mostly Unisexuals.

Eg;-Neopilina,galatheaetc..

CLASS-D:GASTROPODA

- All are Marine,freshwater, terrestrial and few ar eparasitic forms.
- Body is unsegmented,Assymmetrical,univalves with spirally coiled shell.
- Head is distinct with tentacles,eyes and mouth.
- Foot isVentral, Flatand muscular and contains operculum.
- Visceral mass is spirally coiled(Torsion)
- Buccal cavity possesses radula
- Digestivesystem has muscular pharynx,oesophagus,stomach and coiled intestine.
- Respiration is carried out by gills(ctenidia)
- Circulation is Open type.
- Heart is covered by pericardium.
- They excrete through the nephridia
- Mostly Unisexuals but afew are bisexuals.
- Development is indirect with Trocophore and veliger

larvae.Eg;-Pila, Patella,Limaxetc..

CLASS-E; SCAPHOPODA

- All are Marine forms.
- Bodyis Bilaterally symmetrical.
- Bodyis elongated,closed,tusk likeand opens at both ends.
- Eyes,tentacles, gills are absent.
- Mouth is tubular.
- Foot reduced is reduced and help indigging(makingborrows).
- Heart is rudimentary.(Undeveloped)

Eg;-Dentalium

CLASS-F;PELICYPODA

- These are aquatic and mostly live in marine waters.
- Body-bilaterally symmetrical,laterally compressed
- Shell has 2lateral valves and hinged by hinge joint.
- Pharynx,jaws,radula and tentacles are absent.
- Foot is muscular and ventral in position.
- Mantleis bilobed.
- These animals can respiretory through the gills or tenidia.
- Alimentarycanalislarge,coiledwithdigestive glands.
- Hearthas2auricles and1ventricle.
- Excretioniscarriedoutbypairednephridiaorkidneys.
- Nervoussystempossesses4pairsof ganglia.
- statocysts,osphridiaarethechiefSenseorgans.
- Allareunisexuals.
- DevelopmentincludesTrochophorelarva.

Eg-;Unio,Mytilus,etc..

CLASS-G:CEPHALOPODA

- AllareMarineforms.

- Bodyis divisible in to head and trunk.
- Headbearslarge eyes, tentaclesandmouth.
- Trunkhasuncoiledvisceralmass.
- Mouthbearsjawandradula.
- 2or4pairs of gillsare present.
- Circulatorysystemisclosedtype.
- Excretioniscarriedbynephridia.
- Allareunisexuals.

Eg;-Sepia,Loligo,Octopusetc..

Octopus

Sepia

3.ECHINODERMATA

Echinos-Spines, Dermas-Skin,Eta-Consist)

Generalcharacters:

-Theterm Echinodermatawas coined by**Jacob**in 1734.

-This phylum includes Starfishes,Brittlestars,Seaurchins,Sea cucumbersandSealilies.

-All these are Marine and spiny skinned forms.

-These animals exhibit various colours.

-Body is radially symmetry and pentamerous in arrangement.

-Body shapeis likestar, discoid,cylindrical or circular with oral and aboral surfaces.

-Segmentation and cephalization are absent.

-All these are triploblastic animals.

-Bodyis covered bydelicate epidermis or calcareous plates.

-Alimentarycana lis coiled and extended between oral and aboral regions.

-The can respire through papulae or peristomial gillsor respiratory trees.

-Circulatorysystem is reduced.

-Excretorysystem has no definiteorgans.

-Nervoussystem is primitivetype.

-Senseorgans are poorly developed

-Mostly unisexual but some are bisexuals.

-Fertilizationisexternal.

-Mostlyoviparousbit afew areviviparous

CLASSIFICATION

CLASS-A;ASTEROIDEA (Aster-star,Eidos-form)

-Thisclassincludes"**Starfishes".**
- Bodyis flattened oro-aborallyand s tarshapedwith centraldiscand5radiatingarms.
- Ambulacralgroovesconsoststubefeet,suckers.
- AnusandMadriporite areataboral region.
- Armsarehollowandaccommodategonads,gut, coelomandvisceralorgans.
- Allarefreelivingand slow creepingscavengers.

Eg;-Asterine,Asterias

CLASS;-OPHIORIODEA

(Ophios–Snake,oura-tail,eiods-form)

-Thisclassincludes"**Brittlestars"**.
- These animals areMarineandlivein deep seawaters.
- All these are freelivingforms.
- Body is flattened and pentamerous with round central disc.
- Oral and aboral regions distinct.

-Anus and alimentarycanal is reduced.
- Arms are five,slender,jointed,solid with muscular flexible.

-Amulacralgroovesareabsent.
-Tubefeetwithoutsuckersandamphulla
-Madriporitepresent at theoral surface
-AllthesеareUnisexuals
-Developmentisindirect withPluteuslarva

Eg;-Ophiothrix,Garganlocephalus

CLASS-C:ECHINOIDEA[Echinos-hedgehog(spines)]

-This class includes"**Seaurchins"**.
-Bodyisspherical, disclike,ovalorheartshapedwithoutarms
-Bodyis externallycoveredbyshell orcalcareousplates.
-Oraland aboralregionsareDistinctwithmouthandanus
-Tubefeetwithsuckers
-AspecialreparatorystructureAristotlelanternis present.
-AllareUnisexuals
-DevelopmentisindirectwithEchinopluteuslarva

eg;-Echinus,Clypeaster etc..

CLASS;-HOLOTHUROIDEA(Holothurian-Seacucumber)

-Thisincludes"**Seacucumbers".**
- Bodyis bilaterallysymmetrical andelongated
- Mouthandanus arepresent atoralandaboralregions,
-Bodyiscoveredbyleatherybodywall.
-Mouthis encircledbytentacles.
-Tubefeetbearsuckers
-Alimentarycanal islong andcoiled
-Respirebyrespiratorytrees
-Noarmsandspines
- Allareunisexuals

Eg;-Holothuria,Cucumaria etc..

Water Vascular System of Starfish

Introduction :- The water vascular system is a modified part of coelom & consists of a system of sea water filled canals having certain corpuscles. It plays most vital role in the locomotion of the animals & comprises madreporite stone canal, ring canal, radial canal, Tiedman's body, lateral canals & tube feet.
(1) Madriporite :- The madreporite is a rounded calcareous plate occurring on the aboral surface of the central disc in inter-radial position. Its surface bears a number of radiating, narrow, straight or wavy grooves or furrows. Each furrow contains many minute pores at its bottom. Each pore leads into a very short, fine, tubular pore-canal. Which passes inward in the substance of the madreporite. There may be about 200 pores and pore-canal. The pore-canals unite to form the collecting canal

Which open into an ampulla beneath the madreporite.

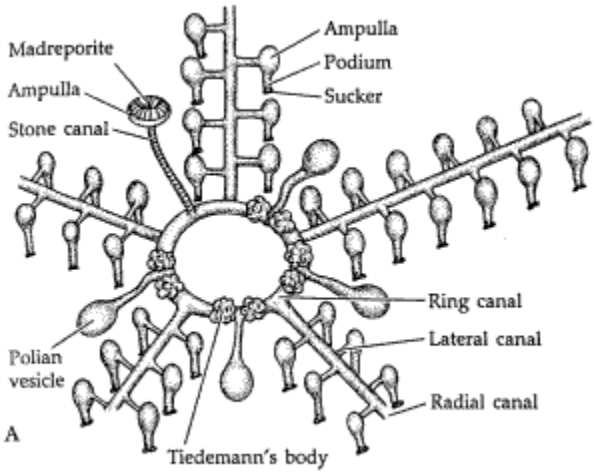


Fig : Water vascular system of Starfish

(2) Stone Canal :- The ampulla opens into a "S" shaped stone canal. The stone canal extends downwards (orally) and opens into a ring canal, around the mouth. The walls of stone canal are supported by a series of calcareous ringd. The lumen of stone canal is lined by very tall flagellated cells. in embryonic stages and young Asterias, the stone canal remains a simple tube but in adult Asterias, lumen of stone canal possesses a prominent ridge with two spirally rolled lamellae.

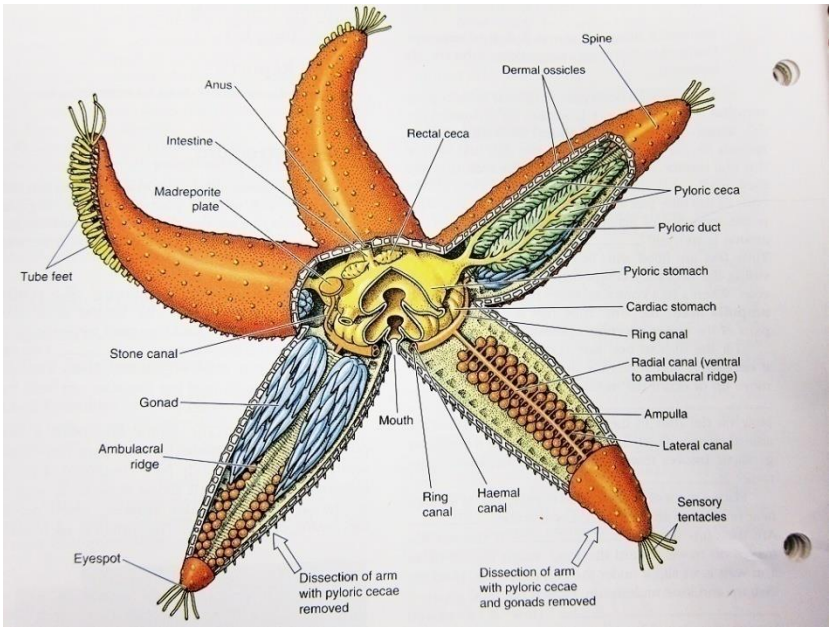


Fig : Diagram of Starfish

(3) Ring Canal :- The Ring canal or water ring is located to the inner side of the peristomial ring of ossicles and directly above (aboral) to the hyponeural ring sinus. It is wide and pentagonal or five sided.

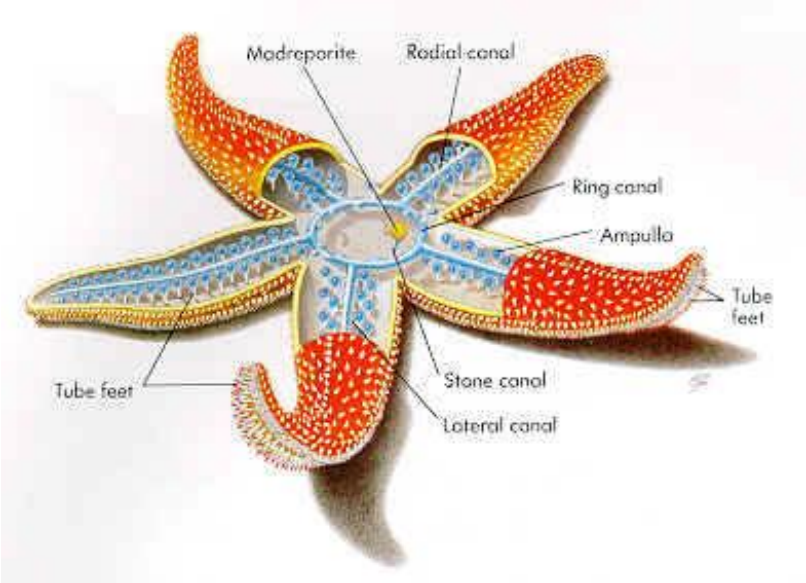


Fig : Star fish

(4) Tiedmann's Bodies :- The ring canal gives out inter radially nine small, yellowish, irregular or rounded glandular bodies called racemose or Tiedmann's bodies from its inner margins. The Tiedmann's body rest upon the peristomial ring of ossicles. The actual function of tiedmann's bodies is still unknown, however they are supposed to be lymphatic glands to manufacture the amoebocytes of the water vascular system.

(5) Pollian Vesicles :- The ring canal gives off on its outer side in the inter radial position one, two or four little, pear shaped, thin walled contractile bladder or reservoirs with long necks called pollian vesicles. They are supposed to regulate pressure inside ambulacral system and to manufacture amoeboid cells of ambulacral system.

(6) Radial Canal :- From its outer surface the ring canal gives off a radial water canal into each arm that runs throughout the length of the arm and terminates as the lumen of terminal tentacle. In the arm the radial water canal runs immediately to the oral side of the ambulacral muscles.
(7) Lateral Canal :- In each arm, the radial canal gives out two series of short, narrow, transverse branches called lateral or podial canals. Each lateral canal is attached to the base of a tube foot and its provided with a valve to prevent backward flow of fluid into the radial canal.

(8) Tube feet :- As already mentioned, there are four rows of tube feet in each ambulacral groove. A tube foot is a hollow. elastic, thin walled, closed cylinder or sac-like structure having an upper sac like ampulla, a middle tubular podium & a lower disc like sucker. The ampulla lies within the arm, projecting into the coelom above the ambulacral pore which is a gap between the adjacent ambulacral ossicles for the passage of the podium. The tube feet are chief locomotory and respiratory organ of Asterias. Function of Water Vascular System :- The water vascular system has three main functions. They are as follows

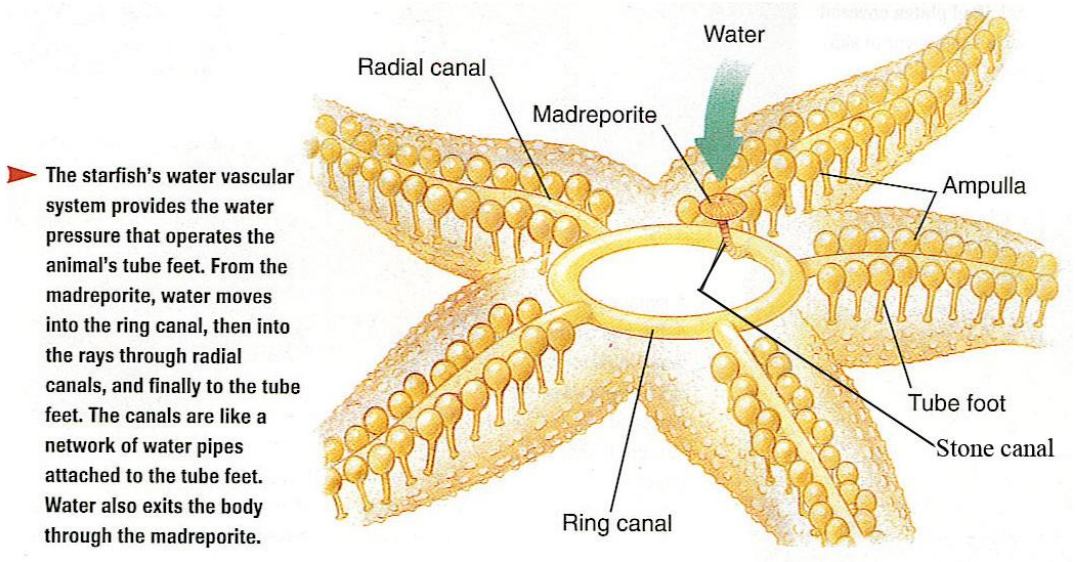


Fig : Function of water vascular system of Star fish

(1) Locomotion :- The water vascular system is used mainly for locomotion. The inner wall of the water vascular canals are provided with cilia. The beating of the cilia causes the seawater to enter through the madreporite. Finally, the seawater reaches the tube feet and their ampullae. The ampullae contract ; the valves at the junction of the lateral canals and tube feet, prevent the flow of water into radial canals. The water is forced into the podia. The podia are elongated and protected out through the ambulacral groove. Then the suckers are applied to the substratum. The tube feet now contract & push the body forward. The water from the tube feet is pushed into the ampulla. Hence, the tube feet shorten. The suckers are released. Then the ampulla contracts & the whole process is repeated.

2) Food Capture :- The tube feet are used to capture the prey. The suckers are used to open the shells of molluscas

3) Attachment :- The Starfish can be attached to the rocks by the tube feet.

6.HEMICHORDATA

GeneralCharacters:

- The phylum Hemichordata was named by**Hyman**in1959
- .
- Thisphylum includes approximately100 species.
-
- Allthesearesolitaryor colonial forms.
-
- Solitaryforms havingwormlikeappearance
- .
- Allaremarineforms livingontheseafloor.
-
- Bodyis divisible into Proboscis,Collar and Trunk.
-
- Bodyis bilaterallysymmetrical.
-
- Thesearetriploblasticforms.
-
- Bodyis covered byciliated epithelium, glandcellsand nerve cells.
-
- Bodywall hasboth longitudinal andcircular muscles.
-
- Coelomisenterocoelom.
-
- Alimentarycanaliscompleteand‘U’shaped.
-
- Buccaldiverticulumisregardedasnotochordpresentintheproboscis.
-
- Animals respiration through the gills or gillslits.
-
- Circulation is opentype with pulsatile heart&2longitudinal bloodvessels.
-
- Excretion by a single gromerulous situated in the proboscis.
- Nervoussystem is primitive type.
-
- Mostly unisexual but a few are bisexuals.
-
- Reproduction mostly sexual.

- Fertilizationisexternal
- .
- Development is indirect with **Tornaria**larva.

CLASSIFICATION

Phylum Hemichordata has been divided into the following classes.

CLASS-A ;ENTEROPNEUSTA

- This class includes Acornworms /Tongueworms.
- These are Solitary and burrowing, wormlike marine animals.
- Body consists of proboscis, collar and trunk.
- Collar without tentaculate darms.
- Alimentarycanal is straight with mouth and anus at opposite ends.
- Numerous pairs of‘U’shaped gill slits are present.
- All are unisexual.
- Gonads numerous and saclike.
- Development is indirect with**Tornaria** larva.

Eg;-**Balanoglossus,Saccoglossus.**

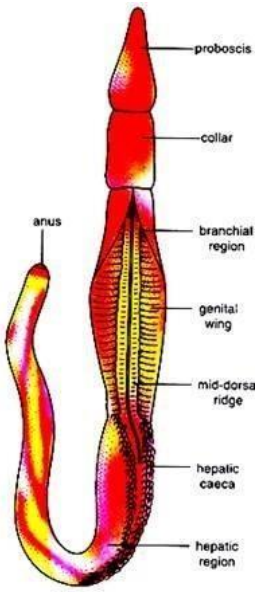
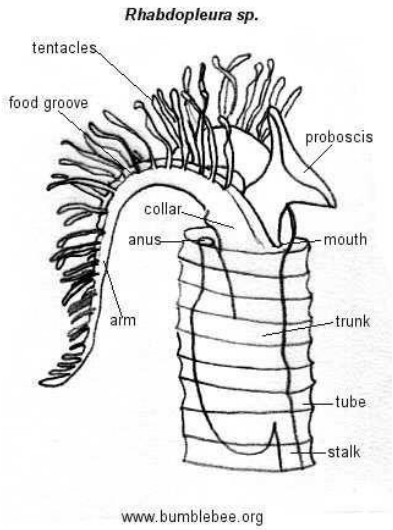


Fig. 88.2. *Balanoglossus*. External features in dorsal view.

CLASS-B;PTEROBRANCHIA

- These are sedentary,colonial tubiculous marine animals.
- Collar is hollow and ciliated.
- Collar with2 or more tentaculated arms bearing tentacles.
- One pairof gill slits is present.
- Alimentary canalis"U"shaped with mouth and anus lie on the same side.
- All are unisexual.
- Single pair of gonads is present.
- Developmen t may direct or indirect.
-

Eg;-Rhabdopleura,Cephalodiscus



7. BALANOGLOSSUS-STRUCTURE&AFFINITIES

I. Structure

A. Habit &Habitat:

- It is commonly called as **Acronworm** or **Tongueworm.**
- It is a marine and World wide in distribution.
- It leads sedentary life in"U"shaped burrows in sand shores between the tide marks in seawaters.
- The burrow has two openings and coils offecal matter are putout of the rear opening.
- The burrow is internally lined with mucus secreted by the body which cements the sandy particles.

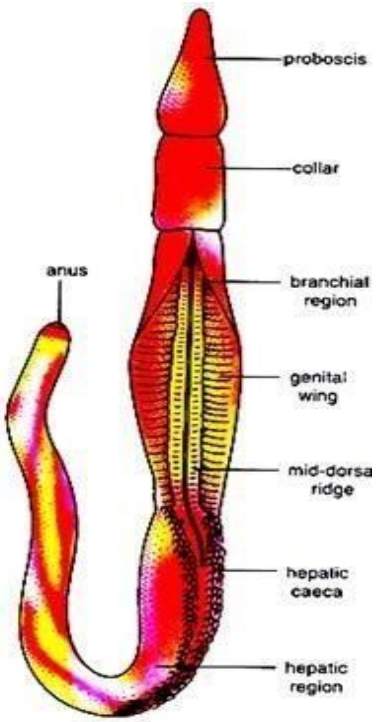


Fig. 88.2. *Balanoglossus.* External features in dorsal view.

B. ExternalFeatures:

a) Shapeandsize:

- Thebodyis worm like, slender, longand uniformlyciliated.
- Thelengthvariesfrom25 mmto 2500mm(25 mmto 25cm).

b) Colour:

- Theproboscisisyellowishandthecollarisorange redwithaposterior whitering.
- Thetrunkhasvarietyofcolours,thebranchialregionisyellowishorange,thehepaticregion isgreenishand thecaudal region is semi-transparent.

c) Odor:

- The odor of Balanoglossus is very offe nsive and irritative odor some what like iodform.

C. Bodydivisions:

The body is clearly divided in to3 regions. Theyare–

1. Proboscis(Prostome)
2. Collar(Mesosome)
3. Trunk(Metasome)

1. Proboscis:

- It is anterior most region of the body,being as rounded or conical structure.
- It narrows posteriorly as a stalk called proboscis stalk.
- On the left side of the proboscis stalk, there is a proboscis pore, through which the proboscis coelom is communicates with the outside.

2. Collar:

- It is a short,cylindrical and forms a next regionof thebody.
- It is produced anteriorly as funnel like expansion ,which embraces the proboscis stalk completely.It is called "**Collarette".**
- Operculum hangs from posterior part of the collar.
- Dorsally the collar bears a pair of collar pores, through which collar coelom opens into the outside.

3. Trunk:

- Trunk forms the longest posterior part of the body.
- All along its length, it possesses a mid-dorsal and mid- ventral ridges to accommodate the corresponding nerves and blood vessels.
- It is further differentiated into3 regions.They are-

a) Branchio-genitalregion:

- It is characterized by the presence of gill slits and genital wings.
- Gill slits or branchial pores are U shaped and lie antero-dorsally in two rows on paired median longitudinal ridges.
- Genital wing sare the lateral expansions of the body which remain curved dorsally,concealing the gill slits.
- They lodge gonads.

b) Hepaticregion:

- Next to the branchio-genital region is the hepatic region characterized in having swellings on either sides due to presence of hepatic partof the intestine.

c) Abdominalregion:

- It is also called as caudalregion or post-hepatic region.
- It gradually apers posteriorly and is superficially annulated through out.
- Posteriorlyit bears a terminal anus.

II. AFFINITIES:

Affinities of Balanoglossus with Chordate&Non chordate phyla areas follows-

A) Affinities with Chordates:

- ✓ The Hemichordates appear to resemble the chordates presenceof notochord,dorsal tubular

Nervecord and pharyngeal gill slits.

a) Notochord:

In Hemochordates thenotochordisin the formof abuccal diverticulumi.e arising from the gut.It is alsoprovided with vacuolated cells as in Chordates.

b) Nervecord:

Dorsalnervecord of Hemichordates resembles because it is also formed from ectoderm.

c) Pharyngealgillslits:

Formation of gillslits in Chordates and Hemichordates is in the same manner. In some members of Hemichordates the gill slits become U shaped because of the development of tongue bars as in Cephalopods.

B) Affinities with Annelids:(Non-Chordates)

- Body is segmented
- Similar mode of feeding and casting exist.
- Intra-epidermal nervoussystem is present.
- Bloodflows from behind in front in the dorsal vessel and in front in the ventralvessal.
- Presence of apical plate with eye spots and gut regioanated into oesophagus, stomach and intestine inTornaria of Balanoglossus and Trochophore of Annelida.

Differences:

- Gill slits are absent in Annelids
- Paired nervecords are present in Annelids.
- In Annelids coelom is Schizocoelom but in Balanoglossus,the coelom is enterocoelom.
- NephridiainTornaria are absent.

C) Affinities with Echinodemates:

- There is evidence of micromeres at vegetal pole of blastula of Balanoglossus like Echinoids.
- Blastopore marks the future posterior end.
- Protocoel and hydrocoellie on the left side.
- Gut is regionated into oesophagus,stomach and intestine.
- Identical course of ciliated band is present.
- Origin coelom is similar.

Differences:

- The eye spot present in Hemichordate larva but it is absent in Echinodermate larva.
- Apicalplate and Telotroch are absent in Bipinnaria and Auricularia but these are present in Tornarialarva.

****