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# A HANDBOOK OF PRACTICAL ZOOLOGY

FOR B. Sc. I (AS PER REVISED SYLLABUS OF SHIVAJI UNIVERSITY, KOLHAPUR)

**Mr. K. J. Adate**

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**Dr. S. A. Vhanalakar**

**Dr. V. M. Deshmukh**



First Edition: 2022

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**(IMPLEMENTED FROM JUNE 2022)**

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## **PREFACE**

*We are very happy to handover this practical handbook to the students of B.Sc. This book is written strictly according to the revised syllabus of Shivaji University, Kolhapur implemented from June 2022. In fact, various reference books have been referred to while preparing this book. Information from the internet has also been collected. For the easy understanding of the student's simple language, large, accurate, and neat labeled diagrams are used.*

*We are thankful to Dr. V. J. Kulkarni Ex. Joint Director of Higher Education, Kolhapur division and Dr. R. N. Kanase, Ex. Head, Department of Zoology, Shivraj College, Gadhinglaj for providing necessary information and encouragement while writing this book.*

*We are specifically thankful to President Prof. K. V. Kurade, Prof. Anil Kurade Secretary of Karmveer Vittal Ramaji Shinde Shikshan Sanstha, Gadhinglaj and Ashokanna charati President Janata education Society Ajara and our management for their continuous and favorable encouragement.*

*We are also very much thankful to Principal Prof. (Dr.) S. M. Kadam, Shivraj College Gadhinglaj and Dr. A. N. Sadale Incharge Principal, Ajara Mahavidyalaya, Ajara for their necessary guidance and encouragement.*

*We hope sincerely that this book will meet the needs and demands of B.Sc. first year Zoology students. We also request the readers to point out any mistakes, typographical errors, and also make suggestions if any. The mistakes will be corrected and worthy suggestions will be incorporated in the next edition.*

**- Mr. K. J. Adate**

**Dr. V. V. Ajagekar**

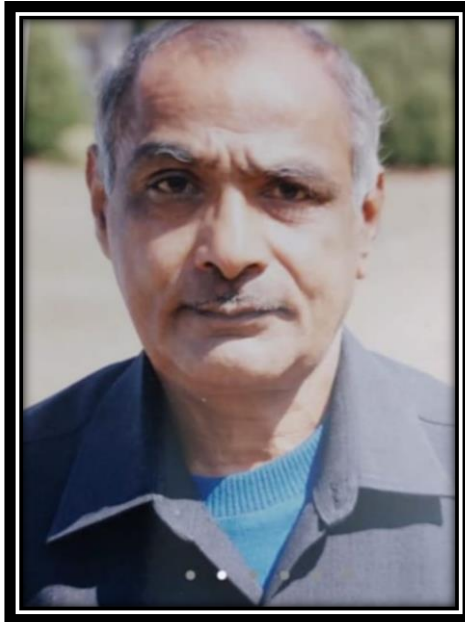
**Dr. S. A. Vhanalakar**

**Dr. V. M. Deshmukh**

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***DEDICATED TO  
OUR BELOVED TEACHER***



**Late. Dr. M. N. Nalavade  
Ex-Professor  
Department of Zoology,  
Shivaji University, Kolhapur**

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**B. Sc. PART – I ZOOLOGY PRACTICALS**

**Marks: 50 (Credits: 02) (DSC– 15A, B and 16 A, B: LAB)**

**1. Study of the following specimens**

- i. Study of Amoeba, Euglena, Plasmodium, Paramecium, w.r.t. classification and locomotion
- ii. Study of Sycon, Hyalonema, and Euplectella, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium, Male And female Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria And Antedon, w.r.t. classification and morphological peculiarities.

**2. Study of the following**

- i. T.S. or L.S. of Sycon,
- ii. Life history of Taenia and Ascaris and their parasitic adaptations.

**3. Preparation of haemin crystals**

**4. Study Tour**

Visit to any suitable place to study animal diversity or any place related to theory syllabus and submission of report.

**5. Preparation of blood smear and identification of ABO and Rh blood groups.**

**6. Cytological Preparations:**

- i. Mitochondria – Stained preparation of mitochondria from onion peeling / Hydrilla leaf / Oral Mucosa by using Janus Green-B.
- ii. Polytene Chromosomes – Stained preparation of polytene chromosomes in Chironomus larvae/Drosophila larva.

**7. Study of fossil evidence from plaster cast models and pictures.**

**8. Demonstration of Rat to study:**

Digestive system, Lungs, Heart, Kidney, Testis, Ovary and Brain of Rat

**9. Study of Mendelian Inheritance and gene interactions (Non-Mendelian Inheritance) using suitable examples. Minimum 10 Examples on: Monohybrid & Dihybrid ratio, Incomplete dominance, Codominance, Multiple alleles, Sex linked inheritance, Linkage, Crossing over and Gene interaction.**

**10. Study of following insect vectors through permanent slides or photographs**

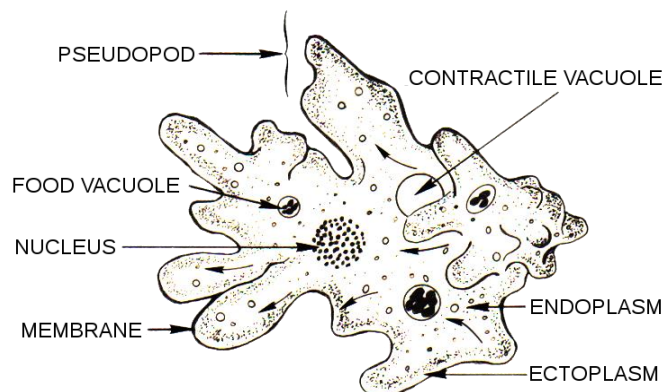
1. Mosquito borne diseases (Causal organism, symptoms and control measures)
  - a. Malaria b. Dengue c. Chikungunya
2. House Fly borne diseases (Causal organism, symptoms and control measures)
  - a. Myiasis
3. Flea borne diseases (Causal organism, symptoms and control measures)
  - a. Plague b. Typhus fever

## **KINGDOM: PROTISTA**

### **GENERAL CHARACTERS OF KINGDOM: PROTISTA**

1. These are microscopic in size, and are found in freshwater, salt water and damp soil, while some are parasitic, symbiotic and commensals.
2. They are called acellular or non cellular and body is made up of a mass of protoplasm with one or many nuclei.
3. Locomotory organs are pseudopodia, cilia or flagella and mode of locomotion in protozoa are Amoeboid movement, flagellar locomotion, Ciliary locomotion and gliding or metaboly by myonemes in Sporozoa like Plasmodium.
4. Nutrition is generally, holozoic or Zootrophic, holophytic or Autotrophic, saprozoic, parasitic, coprozoic or sometimes Mixotrophic.
5. Respiration and excretion occur through general body surface by diffusion.
6. In freshwater osmoregulation by contractile vacuoles.
7. Reproduction sexual or asexual.
8. Sexual reproduction occurs by the methods called syngamy or copulation, Conjugation, Automixis, Endomixis and Hemimixis.
9. Asexual reproduction takes place by Equal or binary fission, multiple fission, Plasmotomy, Budding or gemmation, Parthenogenesis and Regeneration.

### **1) AMOEBA**



## **KINGDOM: PROTISTA**

### **PHYLUM: SARCODINA**

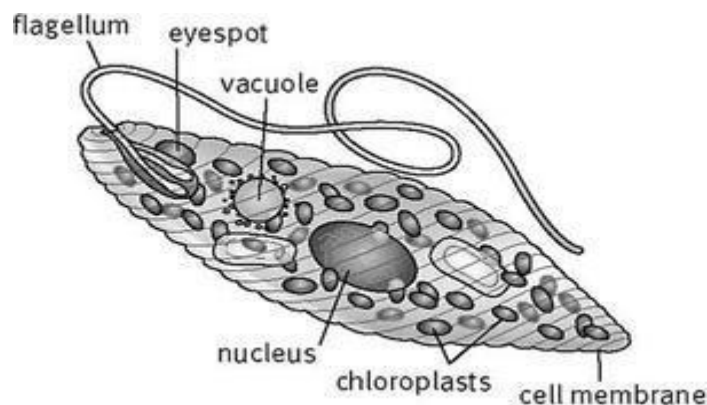
### **CLASS: RHIZOPODA**

1. Amoeba is found in mud, fresh water ponds, streams and ditches in which bacteria and decaying vegetation are rich.
2. Shape of the body is irregular.



3. Body is covered by a very thin and semi-permeable membrane called plasma lemma.
4. Protoplasm is divisible into an outer ectoplasm and an inner endoplasm.
5. The endoplasm has a single nucleus, a large single contractile vacuole and many food vacuoles.
6. Pseudopodia are locomotory organs, which are short and blunt.
7. Nutrition is holozoic.
8. Reproduction is by binary fission.

## 2) EUGLENA



**KINGDOM: PROTISTA**

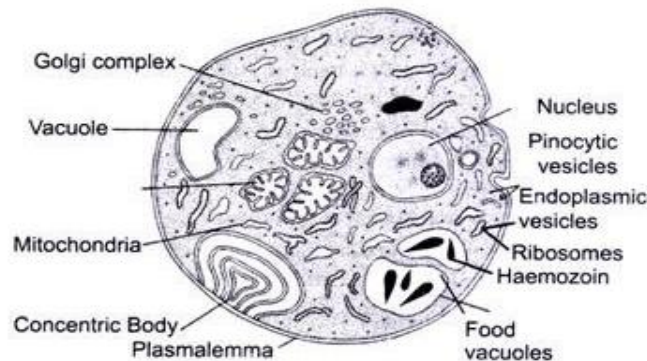
**PHYLUM: ZOOMASTIGINA**

**CLASS: MASTIGOPHORA**

1. Euglena is a freshwater flagellate, found abundantly in ponds, ditches, pools and slow running streams.
2. The body is spindle-shaped, green coloured, measuring about 50-100 microns length.
3. The outer covering is called pellicle. The pellicle is marked by spiral striations.
4. The cytoplasm is divisible into an outer ectoplasm and an inner endoplasm.
5. The endoplasm contains nucleus, chloroplast, paramylum and pyrenoids.
6. The anterior end contains a flask-shaped cytopharynx or gullet.
7. Just below the cytopharynx lies a large contractile vacuole which is surrounded by accessory vacuoles.
8. Just above the contractile vacuole lie stigmata or eye spots which serve as photosensitive organs. They are masses of red hemochrome granules.
9. A long flagellum originating from the blepharoplast projects through the cell gullet.

10. Locomotion is due to the lashing movements of the flagellum, i.e. euglenoid movement.
11. Chloroplast is made up of central pyrenoids enclosed in paramylum.
12. Nutrition is holophytic or saprophytic.
13. Reproduction usually by the binary fission.

### 3) PLASMODIUM



**TROPHOZOITE OF PLASMODIUM VIVAX**

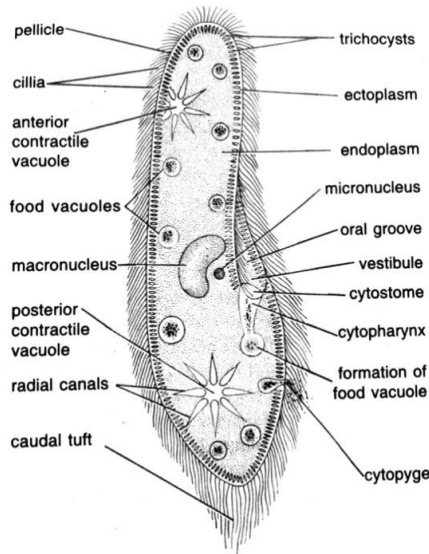
**KINGDOM: PROTISTA**

**PHYLUM: SPOROZOA**

**CLASS: TELOSPOREA**

1. Plasmodium is a malaria parasite.
2. Life cycle of plasmodium is complicated and is completed in two hosts, man and mosquito.
3. Asexual cycle is passed in man in two phases. First phase in liver schizogony and second phase is completed in red blood cells and is known as erythrocytic schizogony.
4. Signet ring stage is a part of the erythrocytic schizogony.
5. After liver schizogony a stage called micro: meta crypto merozoites invades the red blood cells and becomes rounded to form a young trophozoite.
6. As the trophozoite grows in size, a central vacuole is developed.
7. As a result of this the nucleus is pushed to one side into peripheral cytoplasm.
8. This stage is clinically referred to as signet – ring sage.
9. Signet: ring trophozoite secretes digestive enzymes which bring lyses of hemoglobin into protein and haematin.
10. Protein is utilized by the trophozoite and the unused haematin toxic material pigment called hemozoin.

#### 4) PARAMOECIUM



**KINGDOM: PROTISTA**

**PHYLUM: CILIOPHORA**

**CLASS: CILIATA**

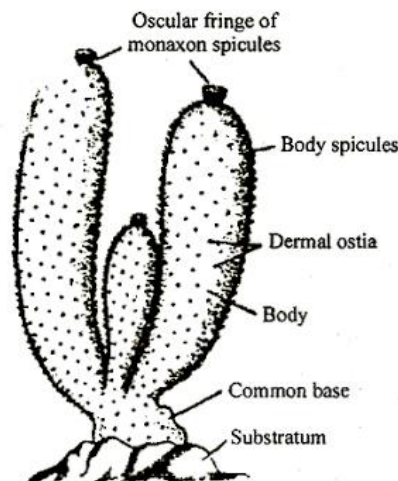
1. Paramecium is found in the mud, fresh water ponds, ditches in which organic matter and decaying vegetation is rich.
2. It is commonly known as slipper animalcule.
3. Body is slipper: shaped covered by the pellicle and cilia.
4. The cilia are arranged uniformly throughout the body, while at the posterior end of the body they are longer.
5. Protoplasm is divisible into an outer ectoplasm and an inner endoplasm.
6. The ectoplasm lies under the pellicle which contains trichocysts.
7. The endoplasm contains two nuclei, i.e. Macronucleus and micronucleus, two contractile vacuoles, i.e. anterior and posterior contractile vacuoles and many food vacuoles containing food material.
8. The oral groove runs backwards and ends into the mouth or cytostome.
9. Cytostome leads into a narrow cytopharynx, at the base of which food vacuoles are developed.
10. Cilia are the locomotory organs.
11. Nutrition is holozoic.
12. Asexual reproduction is by binary fission and sexual reproduction is by conjugation, endomixis, autogamy and hemixis.

## PHYLUM: PORIFERA

### GENERAL CHARACTERS

1. These are strictly aquatic, freshwater or marine.
2. Multicellular body but cells are present in loose aggregation and tissues are not formed.
3. These are diploblastic. The outer layer is ectoderm and inner layer is endoderm. In between these two there is a gelatinous layer called mesoglea.
4. Presence of Ostia, osculum, incurrent pores and excurrent pores.
5. Presence of canal system. Spongin fibers and spicules form a skeleton.
6. Reproduction sexual as well as asexual.
7. Phylum Porifera is divided into following three classes ie class - Calcarea, Hexactinellida and Demospongiae.

### 5) SYCON



## KINGDOM: ANIMALIA

## SUBKINGDOM: PARAZOA

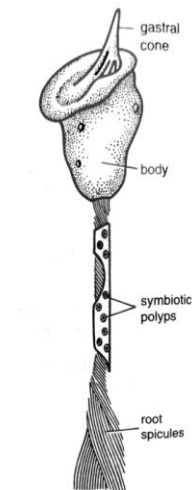
## PHYLUM: PORIFERA

## CLASS: CALCAREA

1. Sycon is a solitary colonial sponge, found attached to the rocks and other substratum in shallow sea water.
2. The body is slender, vase: like or cylindrical.
3. The surface of the body is perforated by numerous pores called ostia.
4. Each cylinder is attached to the substratum by base and opens to the exterior by an opening called an osculum.
5. Osculum is fringed by monaxon spicules.
6. The body wall is made up of the dermal epithelium.

7. Skeleton mainly consists of the calcareous spicules, which project out from the epithelium.
8. Each cylinder has a central large cavity called the spongocoel.
9. The spongocoel opens outside through the osculum.
10. Nutrition, respiration and excretion are performed by the canal system.
11. Reproduction by both asexual and sexual mode.

## 6) HYLONEMA



**KINGDOM: ANIMALIA**

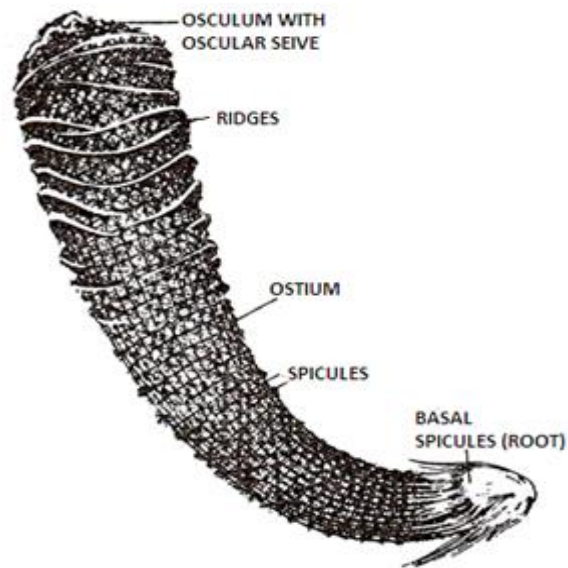
**SUBKINGDOM: PARAZOA**

**PHYLUM: PORIFERA**

**CLASS: HEXACTINELLIDA**

1. It is exclusively marine in habitat found at depths of 100: 150 meters.
2. Body shape is variable, usually rounded or oval.
3. The body looks like a structure of glass wool with projecting tufts of glass spicules.
4. Body is supported by spicules of six – rays and small amphidiscs.
5. Body is raised from the substratum by a stalk – like a root tuft which is twisted like a rope.
6. Root tuft is made up of a bundle of very long anchoring root spicules.
7. Root tuft also traverses the body as an axis or columella and usually projects above as a gastral cone.

## 7) EUPLECTELLA



**KINGDOM: ANIMALIA**

**SUBKINGDOM: PARAZOA**

**PHYLUM: PORIFERA**

**CLASS: HEXACTINELLIDA**

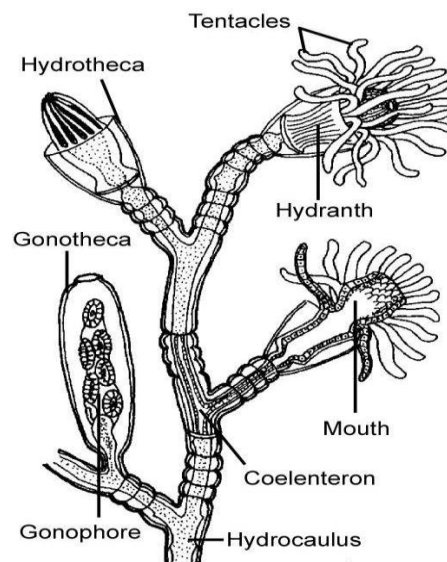
1. It is commonly called the Venus flower basket due to its beautiful elegant glassy shape.
2. The animal measures 15: 30 cm. in diameter.
3. The body is long, rigidly curved and cylindrical.
4. Body is composed of 4 and 6 rayed spicules forming 3 dimensional networks with parietal gaps.
5. The spicules are joined together forming a network.
6. It has a knitted basket shaped body, ostia and osculum sieve plate hence it is Euplectella.

## **PHYLUM: CNIDARIA**

### **GENERAL CHARACTERS**

1. These are aquatic animals; some are fresh water while some are marine water.
2. They may be solitary, colonial, and sedentary or free swimming.
3. They possess a cavity called coelenteron and are diploblastic having non cellular mesoglea.
4. The animals are radially symmetrical and appear in two forms polyp and medusa.
5. Reproduction sexual as well as asexual.
6. Digestion both extracellular and intracellular.
7. Special types of cells i.e. stinging cells are present.
8. This phylum is divided into following three classes
  - a. Hydrozoa, Scyphozoa, and Anthozoa

### **8) OBELIA**



## **KINGDOM: ANIMALIA**

## **SUBKINGDOM: EUMETAZOA**

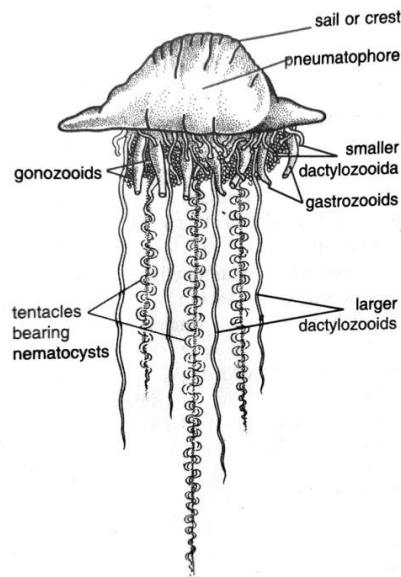
## **PHYLUM: CNIDARIA /COELENTERATA**

## **CLASS: HYDROZOA**

1. Obelia is a colonial, marine, sedentary coelenterate, attached to seaweeds, shell and rocks.
2. The colony of Obelia is made up of the branches and zooids.
3. The colony has an inner, tubular and living part of the coenosarcs.
4. The coenosarcs is surrounded by a tough and non living layer called the perisarc.
5. The coenosarc is continuous with the zooids.

6. The colony of the Obelia is dimorphic i.e. it shows two types of zooids.
7. The zooids are the polyps or hydrants and blastostyles.
8. The polyps or hydrants are nutritive in function and called gastrozooids.
9. The blastostyles are reproductive in function, so called as gonozooids.
10. The perisarc is a yellowish or brown, tough, transparent layer.
11. The perisarc is a protective layer made up of the cuticle.

## 9) PHYSALIA



**PHYLUM: CNIDARIA**

**CLASS: HYDROZOA**

**SCIENTIFIC NAME: PHYSALIA PHYSALIS**

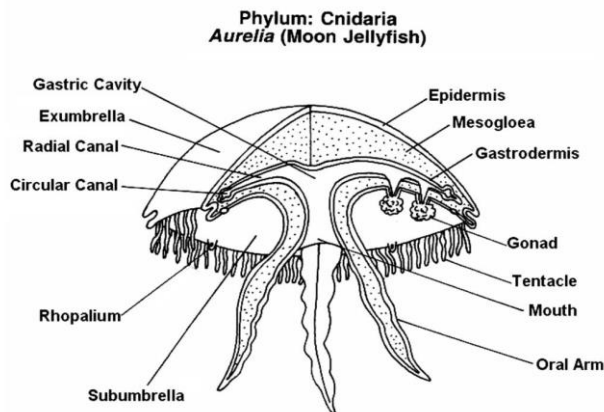
**COMMON NAME: PORTUGUESE MAN O' WAR**

1. The Portuguese man of war is a floating hydrozoan colony consisting of 4 types of polyps.
2. The pneumatophore functions as the float, dactylozooids function as tentacles, gastrozooids function as feeding zooids, and gonozooids produce gametes for reproduction.
3. The Portuguese man of war has two types of stinging cnidocyte cells used to obtain food with the help of the tentacles.
4. Food sources usually consist of fish fry and small adult fish as well as small crustaceans.
5. Sensory cells are numerous and located in the epidermis of the tentacles and the region around the mouth.



6. Movement of the Portuguese man: of: war is done passively with the aid of its gas-filled float.
7. The reproduction of the Portuguese man: of: war is based on the colony of unisexual organisms, with each individual having specific gonozooids.

## 10) AURELIA



**KINGDOM: ANIMALIA**

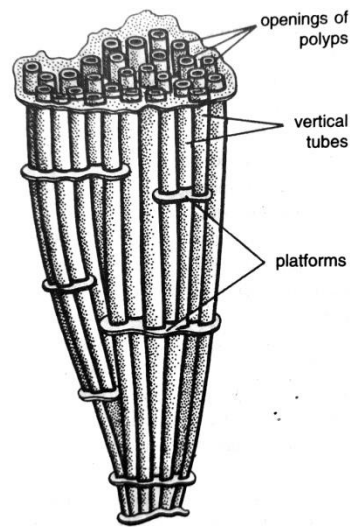
**SUBKINGDOM: EUMETAZOA**

**PHYLUM: CNIDARIA /COELENTERATA**

**CLASS: SCYPHOZOA**

1. It is exclusively marine and commonly known as jellyfish.
2. Body is soft bell or umbrella: shaped, perfectly transparent and bluish in colour.
3. The reddish or pinkish horseshoe: shaped gonads are clearly visible from the surface.
4. The circular body presents a concave oral or subumbrella surface.
5. From the center of the sub - umbrellar surface hangs down a short manubrium.
6. At the free distal end of manubrium a squarish mouth is present.
7. From each corner of the mouth hangs down a long, tapering much - frilled delicate oral arm.
8. Each oral arm has a ventral ciliated groove leading into the mouth. The edges of arms are beset with stinging cells called nematocysts.
9. The circular margin of the umbrella is broken into 8 lobes by notches. In each notch is a sense organ called tentaculocyst.
10. The free edge of the umbrella is base with closely set delicate hollow marginal tentacles.

## 11) TUBIPORA



**PHYLUM: CNIDARIA**

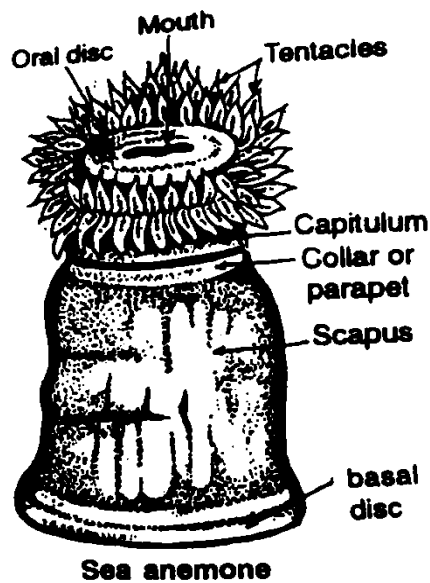
**CLASS: ANTHOZOA**

**SCIENTIFICNAME: *TUBIPORAMUSICA***

**COMMON NAME: ORGAN: PIPE CORAL**

1. The organ pipe coral can be found in the shallow waters of the west Pacific to the south of Japan, west to Africa's east coast, and throughout the Red Sea. They prefer sheltered areas on reef slopes.
2. The organ pipe coral is unlike most corals due to the fact that it lacks colorful polyps, but has a dark red colored skeleton composed of thin tubes that look similar to a pipe organ.
3. Colonies of organ pipe coral polyps can form mounds of up to 50cm in diameter. They also form symbiotic relationships with zooxanthellae to obtain nutritional benefits.
4. In addition, the polyps of the organ pipe coral can use their tentacles to catch plankton and other small microorganisms that happen to float by.
5. The organ pipe coral is an important part of maintaining a balanced reef ecosystem that humans rely on for a number of reasons. It is currently considered near threatened on the IUCN Red List.

## 12) METRIDIUM



**KINGDOM: ANIMALIA**

**SUBKINGDOM: EUMETAZOA**

**PHYLUM: CNIDARIA /COELENTERATA**

**CLASS: ANTHOZOA**

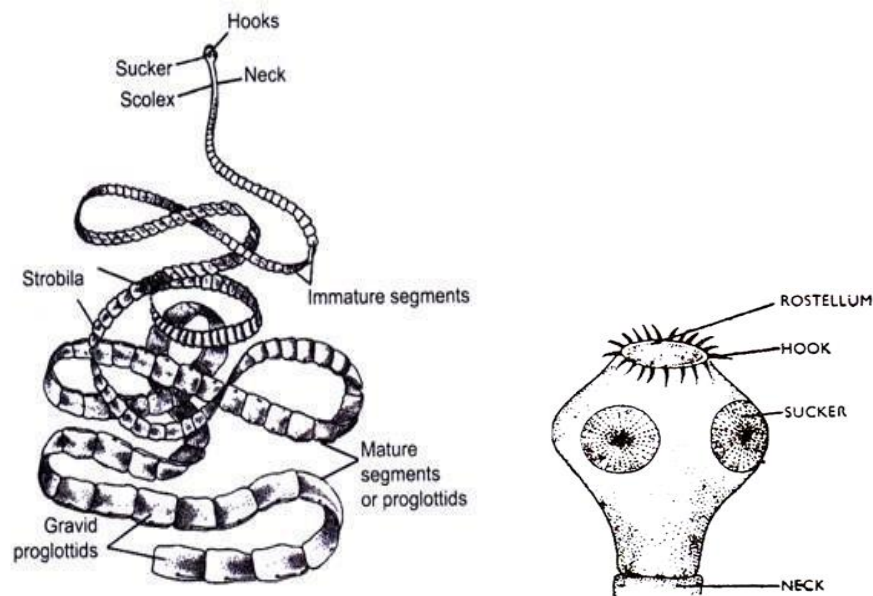
1. Strictly marine, solitary or colonial and are fixed to substratum.
2. These are only polyps; the medusoid stage is absent.
3. Coelenteron is divided and mesoglea contains cells and fibers.
4. Body is short cylindrical and radially symmetrical. It is divided into pedal disc, column and oral disc.
5. Pedal disc is attached to the substratum firmly and the column forms a major part of the body.
6. The column is divided into an upper short thin walled capitulum and lower thick walled scapus.
7. The capitulum and the scapus are separated by a prominent fold called the collar.
8. Oral disc is expanded and crowned with several marginal tentacles around the mouth.
9. It is dioecious animal and asexual reproduction by budding and fragmentation

## PHYLUM: PLATYHELMINTHES

### GENERAL CHARACTERS OF PLATYHELMINTHES

1. Soft bodied, dorsoventrally flattened, free living, triploblastic, coelomate and some are endoparasite.
2. For the first time in the animal kingdom, the head region, definite organ systems like digestive, excretory, nervous and reproductive system is getting formed.
3. Digestive system is incomplete due to absence of anus.
4. Ingestion through the mouth or through the general body surface.
5. Excretory system consists of flame cells. These are mostly bisexual and fertilization is internal.
6. This phylum is divided into following three classes  
Class – Turbellaria, Trematoda and Cestoda

### 13) TAENIA



### SCOLEX

**KINGDOM: ANIMALIA**

**SUBKINGDOM: EUMETAZOA**

**PHYLUM: PLATYHELMINTHES**

**CLASS: CESTODA**

1. It is an endoparasite in the intestine of man.
2. The body is ribbon like, differentiated into scolex, neck and about 700: 900 segments.
3. Scolex contains 4 suckers and a rounded rostellum.

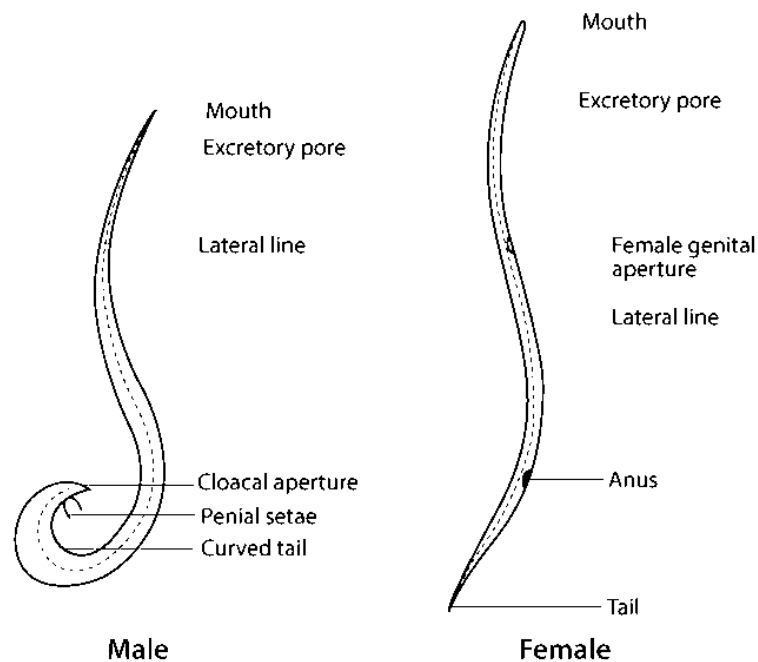
4. Rostellum is crowned at its base by a double row of 28: 32 hooks.
5. Below the scolex there is an area of segmentation called the neck.
6. Neck is followed by a large number of immature, mature and gravid proglottids or segments.
7. Mature segments contain fully developed hermaphroditic genital organs.
8. Male reproductive system consists of testes, vasa efferentia, vas deferens and cirrus.
9. Female system consists of a single bilobed ovary, oviduct, vitellaria and vagina.
10. Ingestion of improperly cooked pork beef leads to the infection.
11. It causes various diseases in man like anemia, eosinophilia, diarrhea, hemorrhage, abdominal pain, nausea etc.

### **PHYLUM: ASCHELMINTHES**

#### **GENERAL CHARACTERS**

1. These are endo: parasites in the small intestine of man.
2. It is commonly known as roundworm.
3. Body is elongated, cylindrical, pointed at both the ends.
4. Body is marked with mid -dorsal, mid: ventral and two lateral lines.
5. Mouth is situated at the anterior end.
6. Posterior end of the male is ventrally curved, having a cloacal aperture.
7. Through the cloacal aperture two spicules project out, known as penial setae.
8. Posterior end of the female is bluntly pointed, having anus.
9. Excretory pore in male and female is situated at the anterior end just below the mouth.
10. Female genital aperture or gonopore lies about 1/3 of the length of the body from the anterior end.
11. Male is smaller than the female.
12. Anus, in the case of male opens into the cloacal aperture.

## 14) MALE AND FEMALE ASCARIS



**KINGDOM: ANIMALIA**

**SUBKINGDOM: EUMETAZOA**

**PHYLUM: ASCHELMINTHES**

**CLASS: NEMATODA**

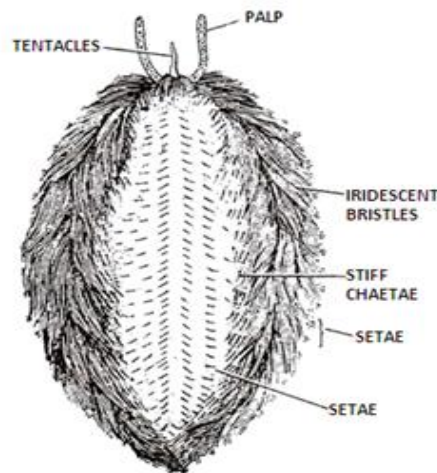
1. Ascaris is a common endo: parasite in the small intestine of man.
2. It is commonly known as roundworm.
3. Body is elongated, cylindrical, pointed at both the ends.
4. Body is marked with mid -dorsal, mid: ventral and two lateral lines.
5. Mouth is situated at the anterior end.
6. Posterior end of the male is ventrally curved, having a cloacal aperture.
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11. Male is smaller than the female.
12. Anus, in the case of male opens into the cloacal aperture.

## **PHYLUM: ANNELIDA**

### **GENERAL CHARACTERS OF PHYLUM ANNELIDA**

1. These are mostly aquatic, freshwater or marine. Some are terrestrial, burrowing, and some are found in moist soil.
2. Body is elongated vermiform, bilaterally symmetrical.
3. The animals are metamerically segmented. External segmentation due to the transverse groove while the internal segmentation is due to the presence of septa.
4. The body wall is composed of longitudinal as well as circular muscles and is covered by cuticles.
5. These are triploblastic and coelomate animals, respiration by general body surface.
6. Circulatory system is well developed and is of closed type. Blood is red in colour due to hemoglobin which is dissolved in plasma.
7. Excretion by nephridia, locomotion by setae, parapodia or suckers.
8. The sexes are separate or united.
9. Phylum annelida is divided into following four classes i.e. classes –
10. Polychaeta, Oligochaeta, Hirudinea and Archiannelida

### **15) APHRODITE**



## **KINGDOM: ANIMALIA**

## **PHYLUM: ANNELIDA**

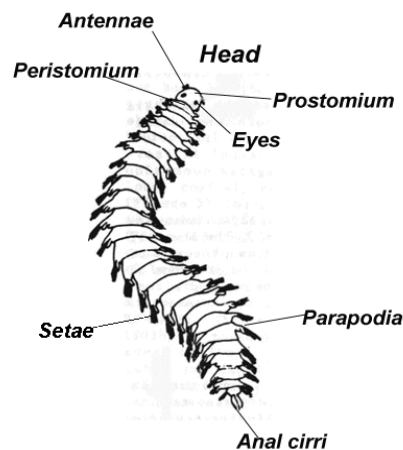
## **CLASS: POLYCHAETA**

## **ORDER: PHYLLODOCIDA**

1. Common Name: Sea mouse
2. Distribution: found in U.S.A.
3. Habit and Habitat: marine and burrowing form.
4. Body: short and broad.

5. Body shape : oval, dorso: ventrally flattened.
6. Length : 7.5 to 12.5 cm with 30: 35 segments.
7. Ventral surface: It is flat and segmented, consists of stiff setae and forms the creeping sole of the body.
8. Dorsal surface: It contains soft notopodium long setae (iridescent, modified) forming a felt like covering on the surface. Dorsal cirri are modified into plate: like structure called Elytra (15 pair).
9. Head: situated anteriorly having a median tentacle and a pair of lateral palps.
10. There are greatly modified parapodia in Aphrodite.
11. There are three types of setae present in notopodia. The organism is identified on the basis of these setae: :
12. Soft setae: These setae forms the creeping sole of the ventral surface.
13. Stiff setae: These soft notopodial setae are modified into the felt like covering of dorsal surface.
14. Iridescent setae.
15. Anus: It is situated posteriorly on the dorsal surface.

## 16) NEREIS



**PHYLUM: ANNELIDA**

**CLASS: POLYCHAETA**

**SCIENTIFICNAME: NEREIS**

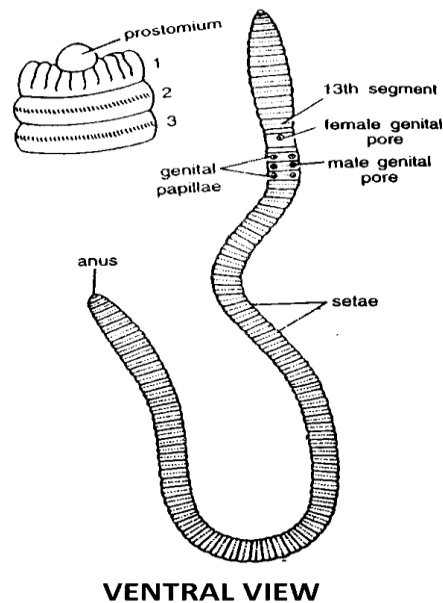
**COMMON NAME: CLAM WORM**

1. Clamworms can be found from Alaska to San Diego as well as the Pacific coast of Russia in the mid to low intertidal zones. They can be found amongst mussels and barnacles, on pilings, sandy mud and algal holdfasts.



2. The Clam Worm is a segmented annelid worm. Its segments are wider than they are long.
3. The prostomium has two antennae and a pair of palps differentiated into two units.
4. The pharynx is delineated into two parts with a pair of stout jaws and conical teeth.
5. There are usually two pairs of eyes present in most species of Clamworms.
6. Coloration is greenish to greenish brown with a slight blue tone. It can grow to a fairly large size at 30cm long and 1.2cm wide.
7. They usually eat algae and have large jaws with an eversible pharynx used to tear their food from hard surfaces.
8. Reproduction is done through the release of body parts called epitokes that make their way to the surface in mating swarms. After spawning, the male and female epitokes die.

## 17) PHERETIMA

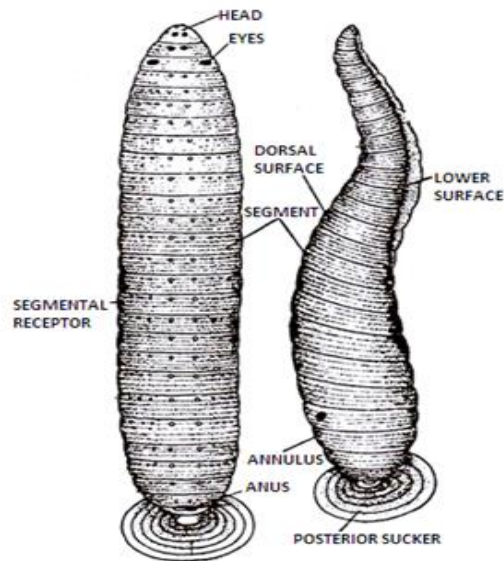


**KINGDOM: ANIMALIA**  
**PHYLUM: ANNELIDA**  
**CLASS: OLIGOCHAETA**  
**GENUS: *PHERETIMA***  
**SPECIES: *POSTHUMA***

1. It is found in moist soil.
2. Body is long cylindrical and brown in color.
3. Anterior end is pointed, while the posterior end is more or less blunt.
4. Each segment of the body except the first and last segment is provided with setae.

5. Mouth is situated antero: ventrally.
6. Clitellum is present in the 14<sup>th</sup>, 15<sup>th</sup> and 16<sup>th</sup> segments.
7. Female genital pore is present midventrally in the 14<sup>th</sup> segment.
8. A pair of male genital pores lies ventrally in the 18<sup>th</sup> segment.
9. Two pairs of genital papillae lie ventrolateral on the 17<sup>th</sup> and 19<sup>th</sup> segment.
10. The anus is present in the last segment.
11. Sexual reproduction.

## 18) HIRUDINEA



**KINGDOM: ANIMALIA**

**SUBKINGDOM: EUMETAZOA**

**PHYLUM: ANNELIDA**

**CLASS: HIRUDINEA**

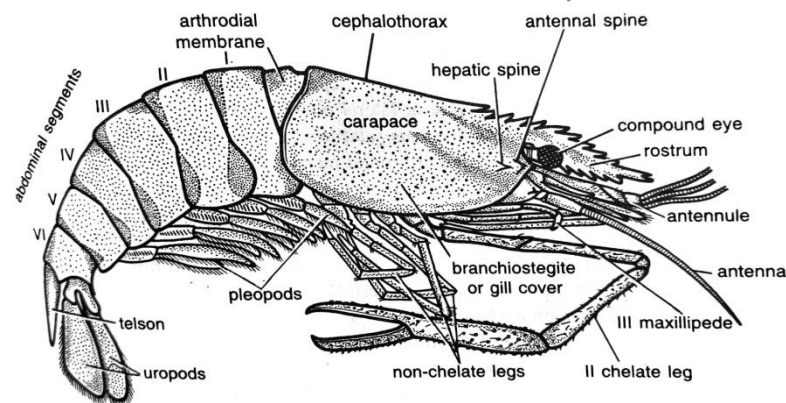
1. It is commonly called as Indian cattle leech found in ponds, marshes and streams.
2. It is ectoparasite.
3. Number of body segments 33. Each segment shows superficial divisions called annuli.
4. Presence of suckers for locomotion and attachment.
5. Indistinct head with five pairs of eyes situated dorsally in the first five segments.
6. Animals are bisexual
7. The male genital pore is situated mid: ventrally in between the 10<sup>th</sup> segment.
8. The female genital pore lies mid: ventrally on the 11<sup>th</sup> segment.
9. The anus lies mid: dorsally on the 26<sup>th</sup> segment.
10. Only a well developed posterior sucker is present. The anterior sucker is reduced.

## **PHYLUM: ARTHROPODA**

### **GENERAL CHARACTERS**

1. They are aquatic, aerial, terrestrial, burrowing and arboreal in habit.
2. Feeding habits: Herbivorous, Carnivorous, Omnivorous or parasitic.
3. They are triploblastic, bilateral symmetrical and metamerically segmented.
4. Generally body is divisible into head, thorax and abdomen or cephalothorax and abdomen or head and trunk.
5. Jointed legs.
6. Digestive tract is complete, simple, and tubular of varying diameters.
7. Exoskeleton with chitinous cuticle.
8. Circulatory system is of open type.
9. Cilia are entirely absent (except Onychophora).
10. Presence of haemocoel.
11. Respiration direct or indirect with gills, trachea or by book lungs.
12. Excretory organs include: Malpighian tubules, coxal glands or green glands.
13. Sexes separate, some are hermaphrodite ex. Balanus.

### **19) PALAEMON**



## **PHYLUM: ARTHROPODA**

### **SUB: PHYLUM: MANDIBULATA**

### **CLAS: CRUSTACEA**

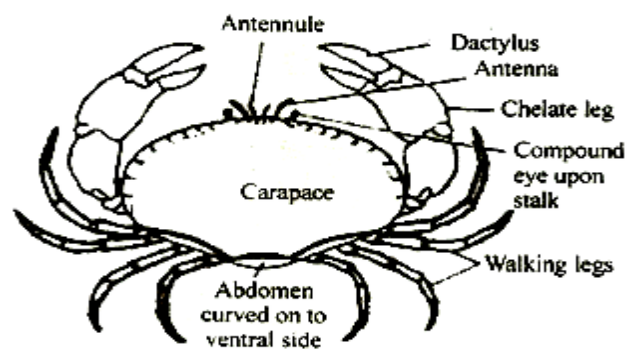
### **SUB: CLASS: MALACOSTRACA**

### **ORDER: DECAPODA**

1. Palaemon is a fresh: water prawn.
2. It remains at the bottom by day, and comes to the surface at night and feeds on algae, moss, small insects and debris.

3. Palaemon shows an elongated body which is spindle: like and shows bilateral symmetry.
4. The entire body is covered by a strong, cuticular exoskeleton.
5. The body is divided into two parts Cephalothorax, and Abdomen.
6. The cephalothorax shows 13 segments. First five appendage bearing segments constitute the head. The remaining eight appendage bearing segments form the thorax.
7. The abdomen bears six pairs of appendages. These are known as the pleopods.

## 20) CANCER



**PHYLUM: ARTHROPODA**

**CLASS : CRUSTACEA**

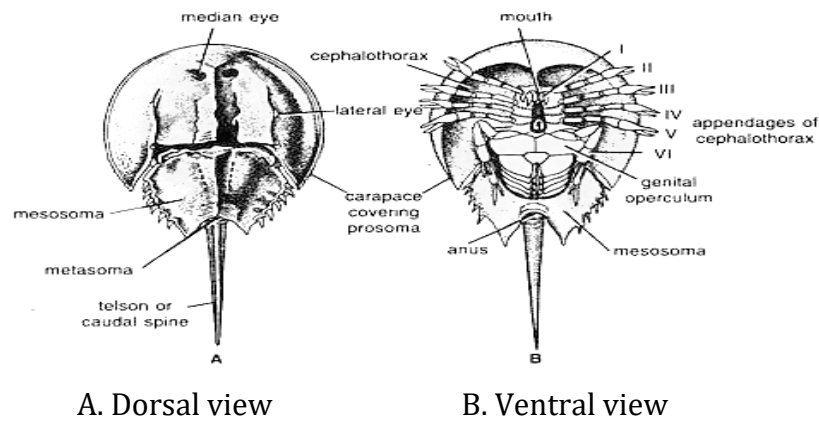
**ORDER : DECAPODA**

**GENUS: BARYTELPHUSA**

**SPECIES: GUERINI**

1. Commonly called rock crab, aquatic in habitat.
2. Body is oval and flattened dorsoventrally.
3. Eye stalks and antennules are contained in the sockets of carapace.
4. Five pairs of thoracic legs are well developed.
5. The first pair of legs modified into chelate for offense and defense.
6. Abdomen is greatly reduced, folded ventral to thorax.
7. Eggs are carried by the female with the help of abdominal biramous pleopods.
8. Metamorphosis comprises zoea and megalopa larva.

## 21) LIMULUS



A. Dorsal view

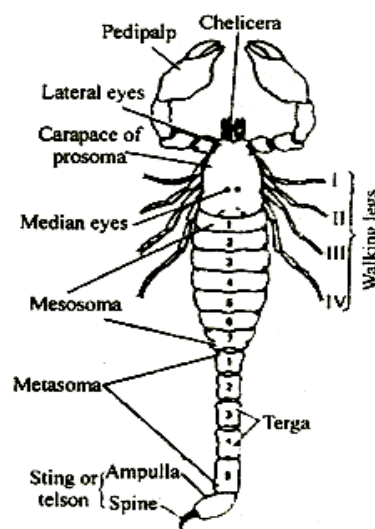
B. Ventral view

### PHYLUM: ARTHROPODA

#### CLASS : CRUSTACEA

1. Marine animal and is nocturnal called horseshoe crab, king crab or limulus.
2. Body is divisible into cephalothorax, abdomen and a caudal spine or telson.
3. Cephalothorax is covered by horse shoe shaped carapace; it has a pair of median eyes and a pair of lateral eyes.
4. On the ventral side of the cephalothorax there is a mouth and seven pairs of appendages.
5. Mesosome contains 6 pairs of movable spines.
6. It is an example of living fossils as they have not changed much in the last 350 to 400 million years.

## 22) PALAMNAEUS

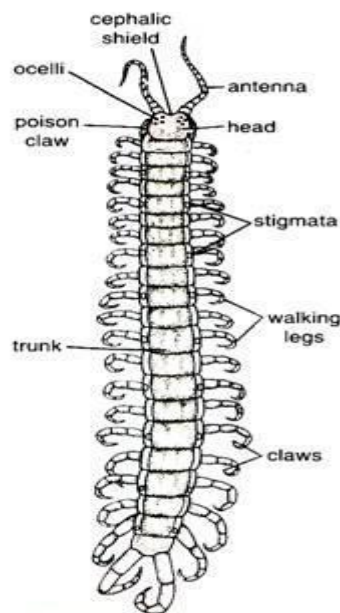


## PHYLUM: ARTHROPODA

### CLASS: ARACHNIDA

1. It is an example of living fossil, nocturnal and strictly carnivorous.
2. Body is dorsoventrally flat, divisible into prosoma or cephalothorax and opisthosoma or abdomen.
3. Opisthosoma is distinguished into two parts a) Mesosome or preabdomen b) Metasoma or post abdomen.
4. Six pairs of appendages, 1: pair of chelicerae, 1: pair of pedipalps and 4: pairs of walking legs.
5. Poisonous, sting with poison gland present at the tip of last segment of metasoma (abdomen).
6. Respiration by 4: pairs of book lungs.
7. Sexes are separate and ovo: viviparous, showing ideal parental care.

## 23) SCOLOPENDRA

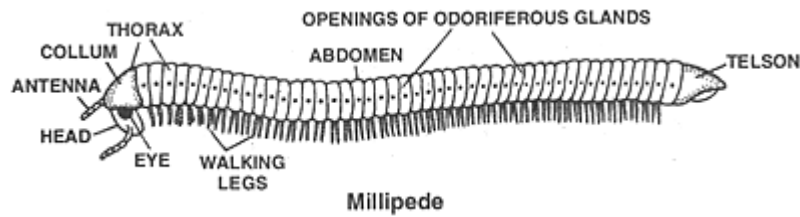


## PHYLUM: ARTHROPODA

### CLASS: MYRIAPODA

1. Found under stones, gaps or in crevices.
2. Body is elongated and dorsoventrally flat, with numerous segments.
3. Each segment bears a pair of legs.
4. First pair of trunk appendages bear sharp paired claws connected to poison glands.
5. Carnivorous, feeds on insects, spiders, worms, slugs etc.
6. Sexes are separate

## 24) JULUS / MILLIPEDE

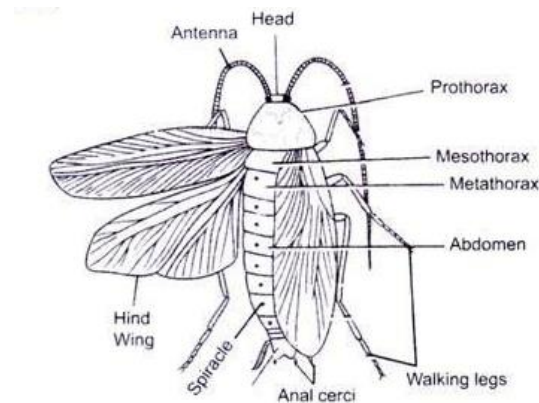


**PHYLUM : ARTHROPODA**

**CLASS: MYRIAPODA**

1. Commonly called as wireworm, herbivorous.
2. Found in dumpy and dark places under stones or below decaying leaves.
3. When disturbed usually rolls up into a tight coil.
4. Body Cylindrical, metamerically segmented and differentiated into head and trunk.
5. In each segment there are so many pairs of legs.
6. Stink glands present along the sides of the body, secreting noxious substances for protection.
7. Respiration by means of tracheae.

## 25) PERIPLANETA



**PHYLUM: ARTHROPODA**

**CLASS: INSECTA**

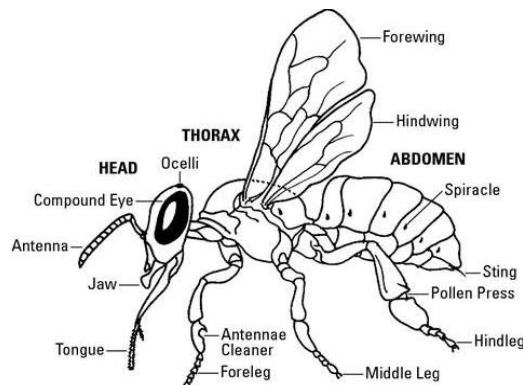
**GENUS: PERIPLANETA**

**SPECIES: AMERICANA**

1. It is nocturnal, hides during day time in crevices, gaps or in holes of kitchen, store rooms, sewage channels where warm, dumpy and plenty of food is available.
2. Dorsally thorax shows two pairs of wings and ventrally three pairs of walking legs.
3. Head with a pair of antennae, a pair of compound eyes and mouth parts.
4. Body is dorso: ventrally flat, divided into head, thorax and abdomen.

5. Body is covered by chitinous cuticular plates. Dorsal tergal plates and ventral sternal plates, joined laterally by pleural membrane.
6. Thorax consists of three segments: Namely prothoracic, mesothoracic and meta thoracic segments, while abdomen is ten segmented.
7. Sexes are separate, fertilization internal, oviparous shows complicated metamorphosis.

## 26) APIS



### PHYLUM: ARTHROPODA

### CLASS: INSECTA

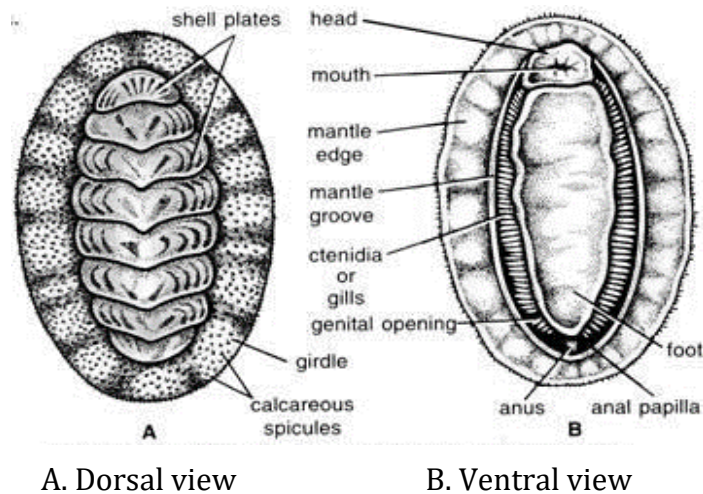
1. Honey bees are social and live in colonies numbering in the thousands. Three types of adult honey bees reside in one colony: the queen, male drones and infertile female workers.
2. The body of the honey bee is segmented: head, three segments of thorax and six visible segments of abdomen.
3. The head of the honey bee consists of the eyes, antennae and feeding structures.
4. The antennae's function is to smell and detect odors and to measure flight speed. The mandible is the bee's jaw, which is used in eating pollen, cutting and shaping wax, feeding larvae and the queen, cleaning the hive, grooming and fighting.
5. The thorax of the bee consists of the wings, legs and the muscles that control their movement. The forewing, which is typically larger than the hind wing, is used for flight and as a cooling mechanism, while the latter is used to fan away heat and cool the hive.
6. The abdomen has six segments including female reproductive organs in the queen, male reproductive organs in the drone and the stinger in both workers and queen.
7. In each colony, there is only one egg: laying queen, but there are thousands of workers. The queen honey bees mate with drones, establish new colonies and lay eggs. Queen bees lay eggs in the cells of the nest, and when they hatch, they become



larvae. Each colony contains only one queen, who is capable of producing 2,000 eggs a day.

8. Adult workers tend the larvae inside the cells and feed them with pollen and honey for approximately three weeks, at which point they become adults. Mature bees chew themselves out of the sealed cells to emerge.
9. Drones, or male bees, are the minority in a colony and serve only one purpose: to mate with virgin honey bee queens. Soon after mating, drones die

## 27) CHITON



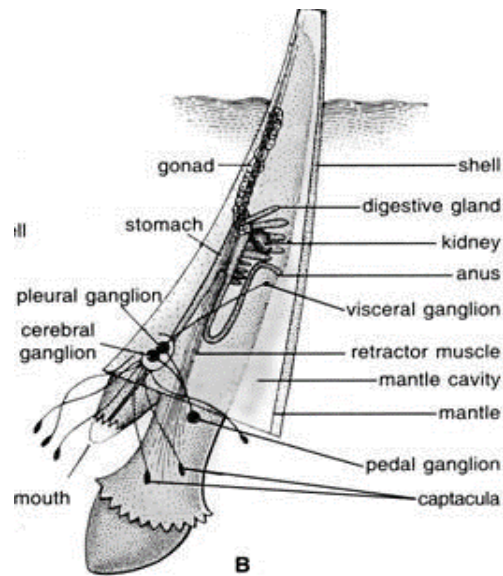
### PHYLUM: MOLLUSCA

### CLASS: AMPHINEURA

### EXAMPLE: CHITON

1. Body is elongated, bilaterally symmetrical and dorsa: ventrally compressed.
2. It consists of shell, foot, mantle and the visceral mass.
3. Shell composed of a series of eight calcareous pieces.
4. Foot is flat and ventral.
5. Mouth and anus are at opposite ends.
6. Head is not distinct. Eyes and tentacles are absent.
7. Mantle covers the main part of the body and covers the shell plates.
8. Foot is ventral, muscular with a flat sole ex whole extending along the length of the body.

## 28) DENTALIUM



### PHYLUM: MOLLUSCA

### CLASS: SCAPHOPODA

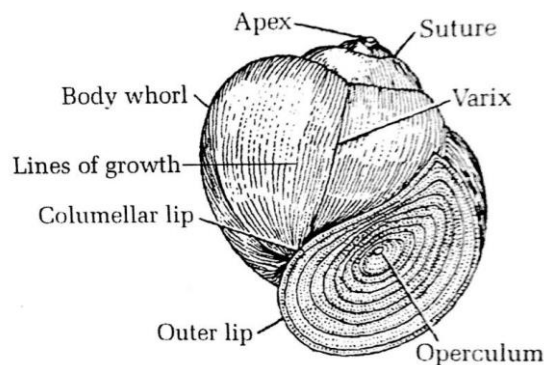
1. Body is bilaterally symmetrical and enclosed in a tubular shell open at both ends.
2. Soft body of the animal is enclosed in a shell.
3. Body consists of head, foot, mantle and visceral mass.
4. Foot is long and conical, protrudes through the anterior opening of the shell and is used in burrowing.
5. Anus lies behind the base of the foot.
6. Radula is well developed. Gills are absent.
7. Vascular system is poorly developed without a distinct head.
8. A pair of nephridia is present.
9. Eyes absent.

## **PHYLUM: MOLLUSCA**

### **GENERAL CHARACTERS OF PHYLUM: MOLLUSCA**

1. Mostly they are aquatic, terrestrial or amphibious life.
2. They are herbivores or plankton feeders.
3. Foot bearing and presence of external or internal hard calcareous shell.
4. Remarkable torsion or distortion present.
5. Respiration both pulmonary (Lung) or by ctenidia (gills).
6. The sexes are usually separate; some are hermaphrodite (e. g. pecten).
7. Fertilization external or Internal. These are mostly oviparous

### **29) PILA**

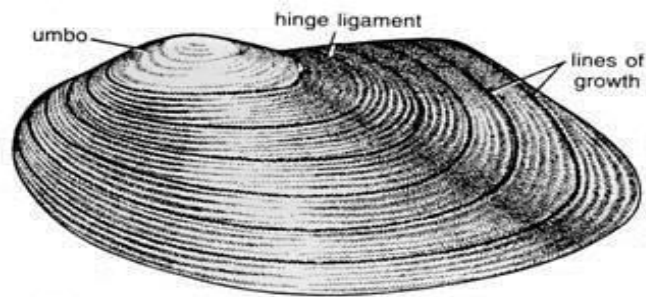


## **PHYLUM: MOLLUSCA**

### **CLASS: GASTROPODA**

1. Pila is a soft body animal enclosed in a spirally coiled shell.
2. Shell is spirally coiled round an axis called the columella and opens outside by the mouth or aperture.
3. Operculum is well developed and closes the aperture or the mouth of the shell.
4. Soft body consists of head, foot and visceral mass.
5. Foot is muscular and flat and serves for creeping.
6. Head lies on the upper side and bears two pairs of contractile tentacles.
7. Visceral mass consists of the main organs of the body.
8. Visceral mass is spirally coiled and covered by mantle to pallium.

### 30) UNIO

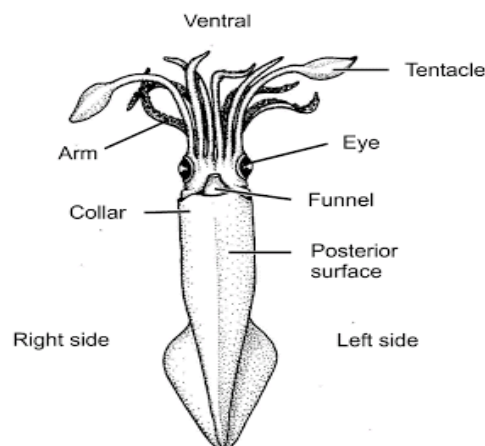


#### PHYLUM: MOLLUSCA

#### CLASS: BIVALVIA

1. Unio is a bivalve mollusc that inhabits freshwater rivers and ponds and lakes.
2. Presence of bivalve shell
3. The chief respiratory organs are a pair of ctenidia and mantle
4. Blood vascular system is open type comprising heart, arteries, veins, lacunae and sinuses. Blood is colorless but in some cases is slightly bluish due to the respiratory pigment haemocyanin.
5. Heart is 3: chambered, with one ventricle and 2 auricles.
6. Excretory organs are a pair of kidneys collectively known as the organ of Bojanus that lies below the pericardial cavity.
7. It is a dioecious animal in which sexes are separate.

### 31) LOLIGO



#### PHYLUM: MOLLUSCA

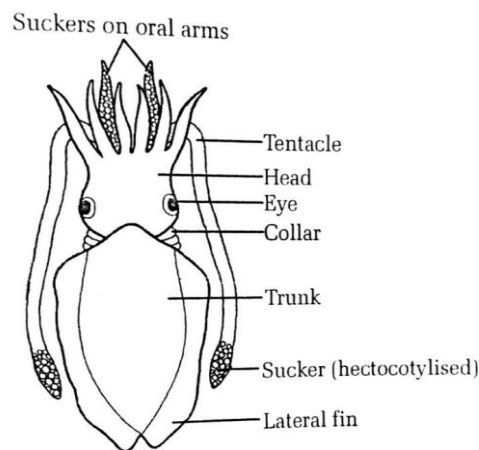
#### CLASS: CEPHALOPODA

#### SPECIES: L.VULGARIS

1. *L. vulgaris* is found throughout the Mediterranean and in the eastern Atlantic Ocean from the North Sea to the Gulf of Guinea.

2. This species can be found at depths from the surface to about 500 m, but it is most abundant between 20 and 250 m (deeper during the winter).
3. The head is relatively small and has large eyes which are covered with a transparent membrane.
4. Like almost all squid, this species has ten limbs surrounding the mouth and beak: eight are relatively short arms, and two, which form the tentacles, are long, as they are used to catch prey. The fourth left arm of males is a hectocotylus.
5. The males are generally bigger than the females and exhibit more rapid rates of growth.

### 32) SEPIA



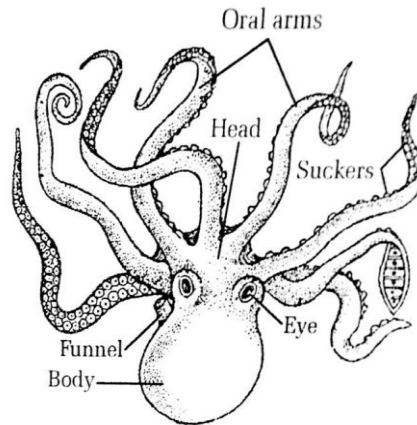
#### PHYLUM: MOLLUSCA

#### CLASS: CEPHALOPODA

1. The sepia is one of the largest and best known cuttlefish species.
2. The body of the common cuttlefish is flattened and broad.
3. It grows to 49 cm in mantle length (ML) and 4 kg in weight.
4. It is known to prey upon a wide variety of animals. These include: bony fish, copepods, crustaceans etc.
5. They have well: developed heads, with large eyes and mouths that feature beak: like jaws.
6. A fin runs around the body from behind the head.
7. Encircling the mouth there are eight 'arms' with suckers, which are used to manipulate prey, there are also two tentacles with flattened paddle: like tips, which can be rapidly extended and are used to catch prey.
8. This species has excellent camouflage; it is able to change its colour to match its surroundings

9. Cuttlefish have an internal shell known as a cuttlebone, which is filled with gas and aids buoyancy; these shells are found washed ashore, and are often given to pet birds as a source of calcium and other minerals.

### **33) OCTOPUS**



#### **PHYLUM: MOLLUSCA**

#### **CLASS: CEPHALOPODA**

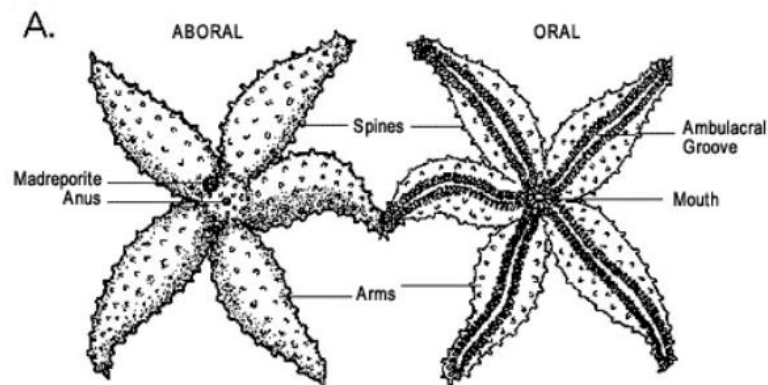
1. Strictly marine and commonly called devil fish.
2. Body is globular.
3. Foot is modified into eight arms with stalked suckers, used for swimming, attachment and capturing the prey.
4. Mantle fold forms a funnel or siphon ventral to the neck.
5. Presence of ink gland for offense and defense.
6. Sexes are separate, oviparous.

## **PHYLUM: ECHINODERMATA**

### **GENERAL CHARACTERS OF PHYLUM ECHINODERMATA**

1. They are exclusively marine animals, shows pentamerous symmetry, skin calcareous or spinney
2. Triploblastic, coelomate without segmentation. Head is absent/ indistinct.
3. The shape of the body may be flattened and star shaped, spherical, globular and discoidal or elongated with distinct oral and aboral surfaces.
4. Having both endoskeleton and exoskeleton.
5. Presence of water vascular or ambulacral system.
6. Locomotory organs are tube feet.
7. Reproduction sexual, Sexes are separate, fertilization is external.

### **34) PENTACEROS**

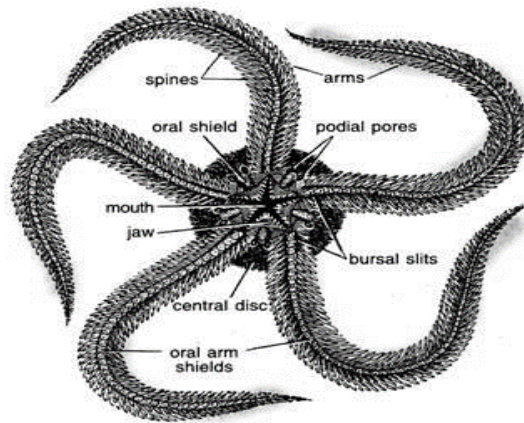


## **PHYLUM: ECHINODERMATA**

### **CLASS: ASTEROIDEA**

1. Asterias has a glittering star: shaped body with penta: radial symmetry; commonly called starfish.
2. They typically have a central disc and five arms.
3. The body is flattened with distinct oral and abdominal surfaces.
4. At the center of the ventral surface, there is a pentagonal aperture called mouth or actinostome.
5. Open ambulacral grooves, tube feet with suckers for locomotion and attachment.
6. Madreporite on the aboral side.
7. Presence of Pedicellariae.
8. Sexual and asexual reproduction with great power of regeneration.

### 35) OPHIURA

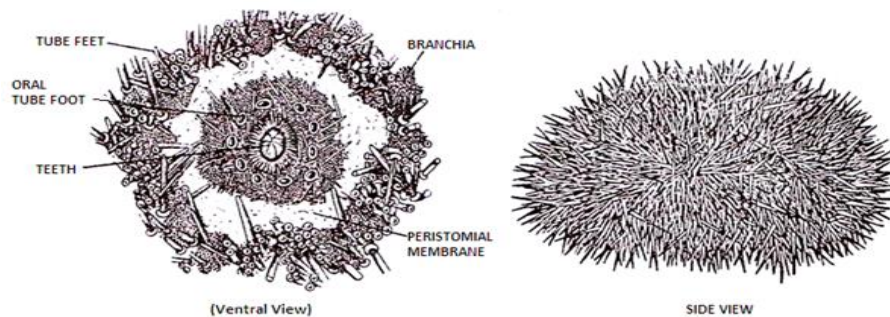


#### PHYLUM: ECHINODERMATA

#### CLASS: OPHIUROIDEA

1. There are some 1,500 species of brittle stars living today, and they commonly are largely found in deep waters more than 500 meters
2. They are flattened, star shaped.
3. Five brittle arms radiating from a distinct central disc.
4. Presence of ambulacral grooves, closed tube feet, without suckers.
5. Madreporite present on oral side.
6. Pedicellariae absent.

### 36) ECHINUS



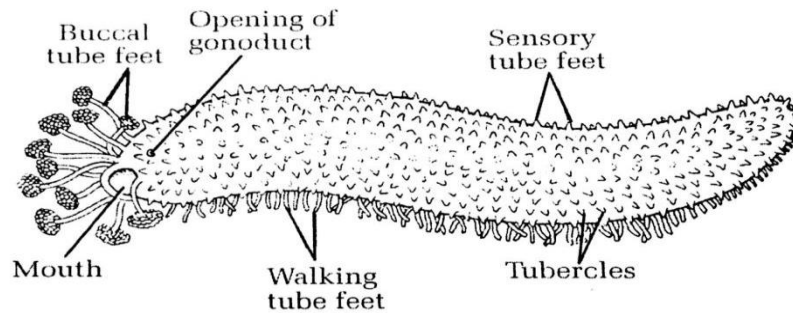
#### PHYLUM: ECHINODERMATA

#### CLASS: ECHINOIDEA

1. Body is globular or semi: circular and without arms.
2. Body with hard / rigid skeleton with strong and stout movable spines for protection.
3. Ambulacral grooves are covered by spines and tube feet with suckers around the mouth.
4. Four types of pedicellariae present, each with three jaws for cutting, holding food and cleaning.



### 37) CUCUMARIA

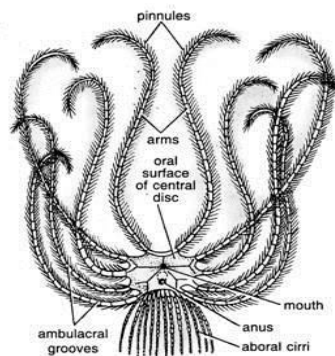


#### PHYLUM: ECHINODERMATA

#### CLASS: HOLOTHUROIDEA

1. Holothurians are also called sea cucumbers. As their name suggests, they are cucumber shaped with an elongated, muscular, flexible body with a mouth at one end and the anus at the other. Around the mouth there is a number of tentacles (modified tube feet) used in food collecting
2. No arms, no spines or no pedicellariae.
3. Endoskeleton reduced and is in the form of microscopic plates embedded in the body wall.
4. The tube feet around the mouth are modified into retractile tentacles.
5. Presence of respiratory tree for protection.

### 38) ANTEDON (FEATHER STAR)



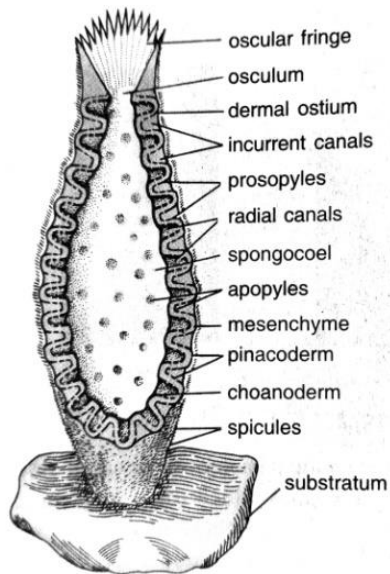
#### PHYLUM: ECHINODERMATA

#### CLASS: CRINOIDEA

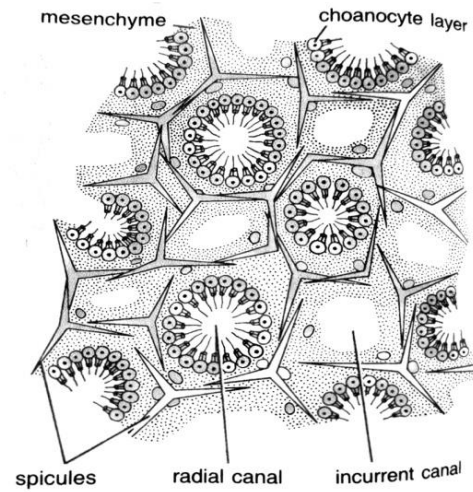
1. Commonly called feather star or sea lily.
2. Generally found in all seas. Remains attached to the rocks by cirri.
3. Generally feeds on microscopic living organism.
4. Body consists of calyx (central part), and arms radiated from the calyx.
5. Calyx differentiated into oral surface and aboral surface.

6. Oral surface contains mouth and anus
7. Aboral surface contains arms and cirri.
8. Cirri: composed of skeletal ossicles.
9. Mouth: present in central, surrounded by sensory podia, but no suckers are present.
10. Ambulacral grooves 10 in number, leading into the arms.
11. Actually arms are 5 in number; each arm is divided into two.
12. Each arm contains pinnules having gonads.
13. Sexes are separate.

## 2. Study of the following permanent slides: T.S. and L.S. of Sycon



**L.S. OF SYCON**



**T.S. OF SYCON**

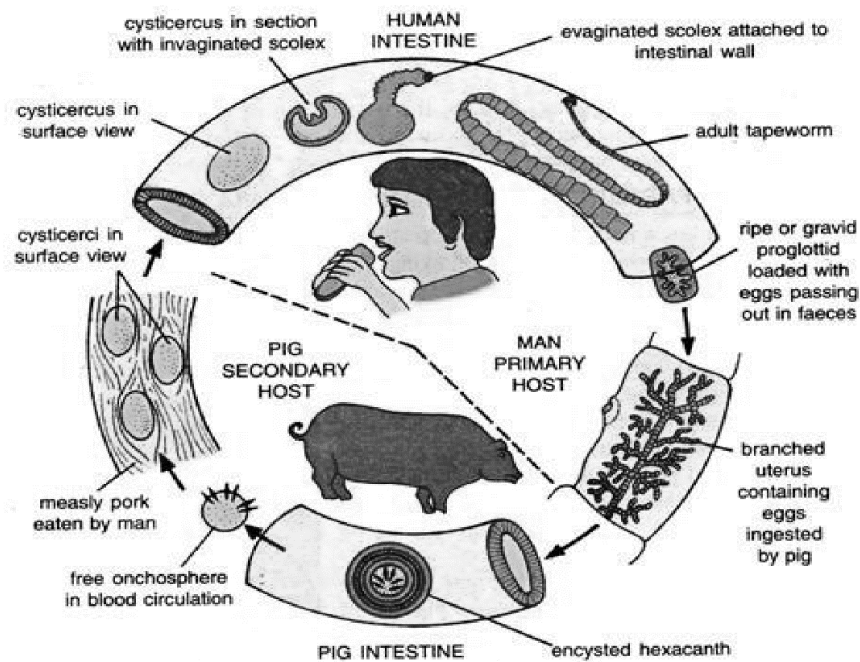
### L.S. OF SYCON

1. Body wall is diploblastic with an outer ectodermal or dermal epithelial layer and inner gastric epithelial layer or endoderm.
2. Non-cellular mesenchyme layer with interspersed monaxon and triaxon spicules is present in between the two layers.
3. The dermal epithelium is made by flat pinacocytes and is perforated by ostia.
4. The ostia lead into incurrent canals which through prosopyles lead into radial canals which are lined with choanocytes.
5. The radial canals lead into small excurrent canals which are lined by pinacocytes.
6. The excurrent canals open into spongocoel.
7. The canal system is of syconoid type.

### T. S. OF SYCON

1. Body wall is diploblastic with an outer dermal layer and inner gastric layer.
2. The gastric layer is made up of mesenchyme with interspersed monaxon and triaxon spicules and is lined internally with flat pinacocytes cells.
3. The dermal layer is also made by flat pinacocytes and is perforated by ostia.
4. The ostia lead into incurrent canals which, through prosopyles, lead into radial canals which are lined with choanocytes.
5. The radial canals lead into small excurrent canals and are lined by pinacocytes.
6. The excurrent canals open into spongocoel.
7. The canal system is of syconoid type.

## STUDY OF LIFE HISTORY STAGES OF TAENIA AND ITS PARASITIC ADAPTATIONS



**TAENIA SOLIUM DIAGRAMATIC LIFE CYCLE**

It is an endoparasite in the intestine of man. The body is ribbon like and differentiated into scolex, neck and about 700: 900 segments. Scolex contains 4 suckers and a rounded rostellum. Rostellum is crowned at its base by a double row of 28: 32 hooks. Below the scolex there is an area of segmentation called the neck. Neck is followed by a large number of immature, mature and gravid proglottids or segments.

1. The life history is digenetic i.e. it completes its life cycle in humans as the definitive host and pigs as intermediate host.
2. Usually self: fertilization occurs but inter proglottid cross: fertilization is of common occurrence.
3. Gravid proglottid packed with egg capsules are detached from the body of the tapeworm (apolysis) and reach to the exterior with the host's (man) feces. Outside the proglottid breaks to release capsules. Capsules are without operculum
4. Development starts after capsule formation in the gravid proglottid.
5. A six – hooked hexacanth larva develops in a capsule; this larva with its protective coat is called oncosphere.
6. The oncospheres are ingested by pigs due to its coprophagous habit.
7. In the intestine of pigs from the oncospheres hexacanthus are released; they bore through the gut wall to reach into the intestinal blood vessels and reach to the

voluntary muscles where they become encysted to form **cysticercus or bladder worms**.

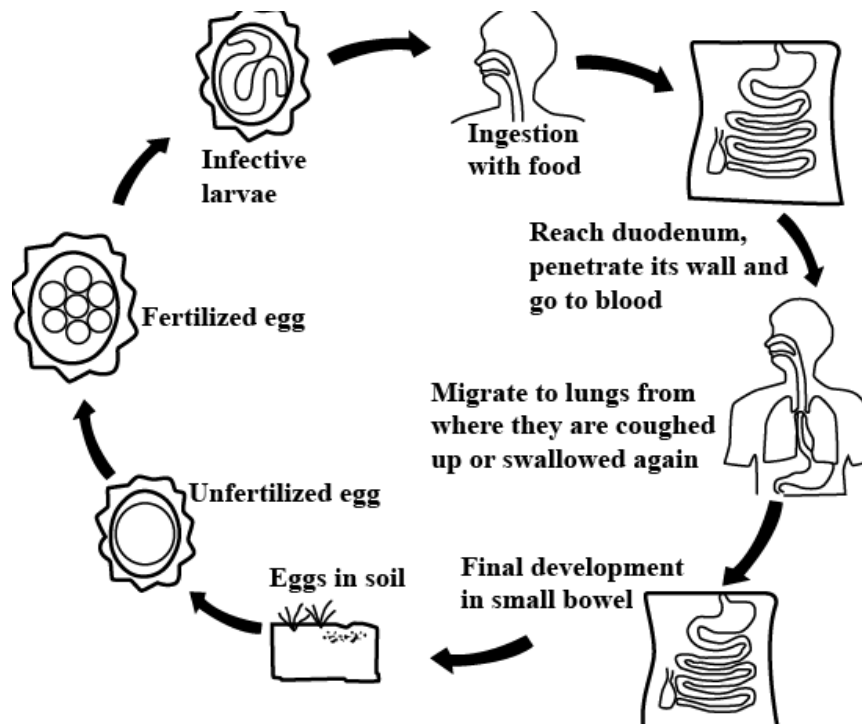
8. Cysticercus does not leave the body of the pig.
9. Man gets infection by eating improperly cooked pork infected with cysticercus i.e. measly pork.
10. Only one tapeworm lives in one host.
11. It is highly pathogenic causing taeniasis. Cysticercosis is also caused by the infection of its larvae cysticerci.

### **PARASITIC ADAPTATIONS OF TAENIA**

Taenia exhibits a number of adaptive features to live comfortably in the intestines of human beings. Some of these are as follows.

1. It has well developed four suckers and hooks to anchor with the intestinal wall the host, which prevents it from being pushed out with food to peristaltic movements of the intestine.
2. Body is externally covered by a tegument which protects it from the host's digestive enzymes.
3. Loss of alimentary canal is compensated by freely permeable tegument for water and nutrients from the digestive food of the host intestine.
4. The power of anaerobic respiration enables us to live in an environment of intestinal content which is oxygen free.
5. The long flattened body provides a larger surface area for its saprozoic mode of nutrition.
6. The sense organs are altogether absent due to its sheltered habit.
7. Huge power of reproduction makes it able to ensure for the transference of at least a few embryos to pig and of larvae from pig to man, to maintain continuity of the race.
8. A tapeworm can survive for more than thirty years and every year it sheds nearly 2500 gravid proglottid containing nearly 30 to 40 thousand onchospheres in each of them.
9. The simplicity of its life cycle lowers the chances of hazards it has to face in transfer from man to pig and pig to man. The pigs being coprophagous in habit automatically approach the human feces containing onchospheres and ingest them to become infective. Man also feeds on pork and hence by ingesting measly pork it becomes infected.

## 2) STUDY OF LIFE HISTORY STAGES OF ASCARIS AND ITS PARASITIC ADAPTATIONS



1. Adult worms live in the lumen of the small intestine. A female may produce approximately 200,000 eggs per day, which are passed with the feces
2. Unfertilized eggs may be ingested but are not infectious. Fertile eggs embryonated and become ineffective after 18 days to several weeks
3. Depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed
4. The larvae hatch, invade the intestinal mucosa, and are carried via the portal system, then systemic circulation to the lungs.
5. The larvae mature further in the lungs (10 to 14 days), penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed.
6. Upon reaching the small intestine, they develop into adult worms.
7. Between 2 and 3 months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live 1 to 2 years.

### **PARASITIC ADAPTATIONS OF ASCARIS LUMBRICOIDES**

1. *Ascaris lumbricoides* is a nematode worm which leads a parasitic life in the intestine of man. Hence it is an endoparasite.
2. Body is long and round so that it can easily fit in the lumen of the intestine.
3. Cuticle covering the body protects the worm from digestive juices secreted in the host's intestine.
4. *Ascaris* also secretes some anti enzymes against digestive enzymes of the host.
5. Papillae present on the lips of the worm help in anchoring to the villi in the intestine.
6. Worms can ingest tissue of the host and suck the blood from the host.
7. Digested food of the host is absorbed by the surface of the body directly from the host's intestine.
8. Worm respire anaerobically in the host's intestine which is devoid of oxygen.
9. Millions of eggs are produced at a time for the benefit of survival.
10. Eggs hatch into juveniles which are present in the environment. Eggs can also be present in the environment.
11. Infection is direct through contaminated food and water.

### 3. PREPARATION OF HAEMIN CRYSTALS

**Aim:** To prepare haemin crystals

**Requirements:** Sterilized needles, cotton, slide, cover slip, glacial acetic acid & spirit lamp.

#### Principle

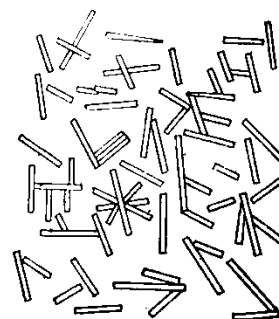
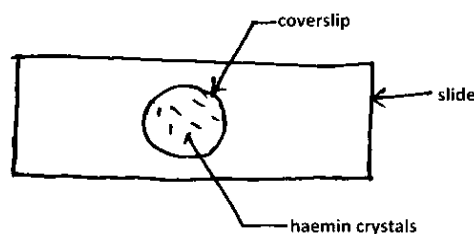
Hemoglobin gives red colour to blood. It is a conjugated protein made up of non: protein pigment haematin and a colourless protein globin. The haematin is made up of a pigment called porphyrin which is combined with iron. A hydrochloride of haematin forms haemin.

#### Procedure

Take a drop of blood on a clean and dry slide. Allow drying and putting a drop of glacial acetic acid over it and cover it with a cover slip. Gently heat on the spirit lamp and after cooling observe under microscope. Dark brown coloured crystals or shining rhombic plates or prisms and star shaped clusters are seen.

#### Applications of haemin crystal test.

1. The Haemin crystal test is used in medico legal work to differentiate fresh or dried blood marks from any other red coloring material.
2. The shape of the haemin crystals are species specific.



**Rhomboidal haemin crystals**

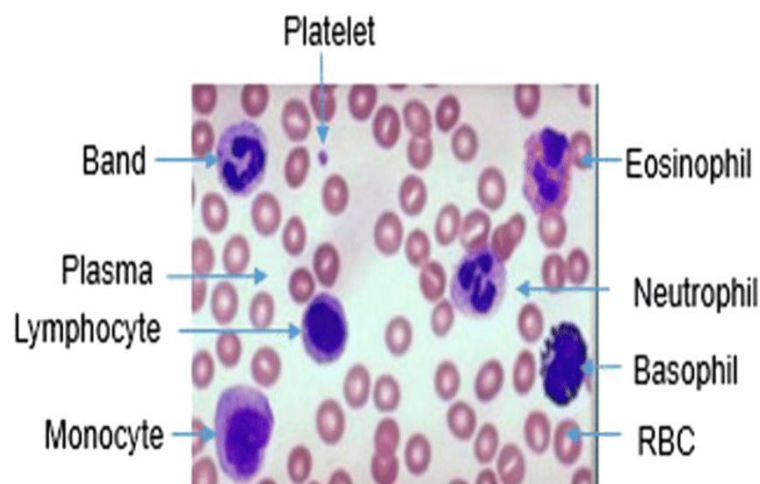


#### 4. PREPARATION OF BLOOD SMEAR

Blood smear remains a vital part of a complete blood count (CBC) in human beings. Its evaluation can help confirm platelet and white blood cell counts, identify infectious agents, and characterize the morphology of all cells ability to detect infectious agents, and certain morphology changes.

##### PROCEDURE

1. Using lens paper, gently wipe two glass slides to remove any dust or glass fragments. Place the glass slide on an even surface.
2. Place a small drop of blood on one end of one glass slide. Hold the bottom (frosted edge) of the slide with the thumb of your non-dominant hand.
3. Using your dominant hand, place the edge of the other slide at an approximately 35:45° angle on the first glass slide, in front of the blood drop. Using gentle pressure, gently pull the second slide back into the blood drop and allow the blood to spread to the edge of the slide.
4. To spread the blood, rapidly but gently push the top slide forward through the remainder of the smear. It is important to keep gentle, equal pressure throughout the whole process, and do not lift the top slide before it reaches the edge of the bottom slide.
5. After preparation, the smear should be labeled and dried (air dryer or waving method).
6. Stain the slide with Leishman stain or Wrights stain and observe under microscope.



## 5. IDENTIFICATION OF ABO AND RH BLOOD GROUPS

Dr. Karl Landsteiner (1900) was the first to discover the presence of two antigens 'A' and 'B' on the RBC coat, which determine A, B, and O (in absence of antigens) blood groups in humans. Later **A.Von Decastello and Sturli** (1902) discovered one more group AB (means both antigens 'A' and 'B' present). Thus the A: B: O blood group system was established. Further in 1940 **Landsteiner and Wiener** discovered one more antigen, anti : D (Rh : factor) on the surface of RBCs of 'Rhesus Monkey'. The persons having Rh factor are called Rh + ve and those lacking D: antigen are called Rh - ve.

**AIM:** To study the A: B: O blood groups in mammalian blood.

### REQUIREMENTS

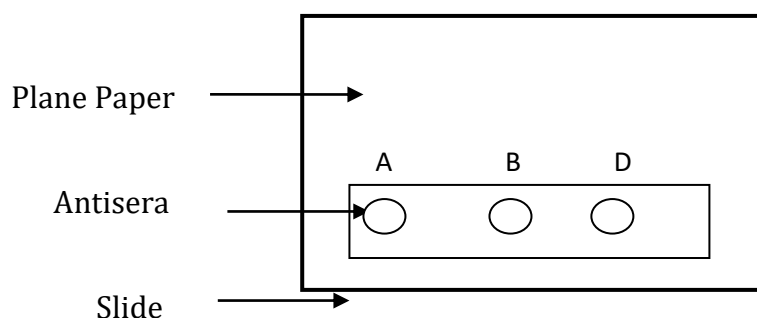
Blood sample, sterilized cotton, antisera, pricking needle or lancet, slide, compound microscope, tooth picks / pins etc.

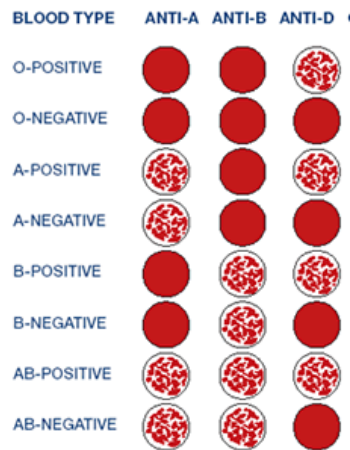
### PRINCIPLE

Blood groups are specified by the presence or absence of specific antigens on the membrane of RBC.

### PROCEDURE

1. Draw the figure of slide on the paper and mark A, B and D as shown in the figure.
2. Place the slide on the paper and place three drops of antisera A, B and D to respective spots.
3. With the help of spirit or alcohol sterilize the tip of the ring finger and prick using a pricking needle/ lancet.
4. Place a drop of blood near the drop of each antiserum (do not touch the finger to the antiserum drop).
5. Mix well antiserum and blood at each spot with the help of separate pins / toothpicks
6. Observe for the agglutination under a microscope.
  - a. Observe for the agglutination under microscope.





## Blood Type Compatibility

Blood Type	Gives	Receives
A+	A+, AB+	A+, A-, O+, O-
O+	O+, A+, B+, AB+	O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+	Everyone
A-	A+, A-, AB+, AB-	A-, O-
O-	Everyone	O-
B-	B+, B-, AB+, AB-	B-, O-
AB-	AB+, AB-	AB-, A-, B-, O-

### OBSERVATIONS

1. Agglutination of RBCs with antiserum indicates +ve test.
2. No agglutination of RBCs with antiserum indicates : ve test.
3. Agglutination of RBCs with antiserum D : indicates Rh +ve test.
4. No agglutination of RBCs with antiserum D: indicates Rh : ve test.

**RESULT: My blood group is \_\_\_\_\_**

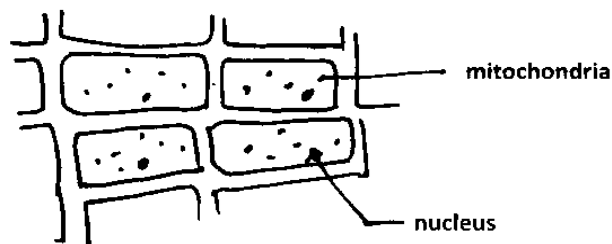
## **CYTOLOGICAL PREPARATIONS: STAINED PREPARATION OF MITOCHONDRIA FROM ONION PEELING**

**Aim:** Preparation of slide of Mitochondria

**Requirement:** Slide, Coverslip, Onion peeling, Janus Green B stain

### **Procedure**

1. Take a smear of oral mucosa or a peel of onion on a clean dry slide.
2. Stain the material with dilute Janus green B stains for five minutes.
3. Observe under microscope, initially under low power and then under high power.
4. Mitochondria appear as bluish green stained granules.



**MITOCHONDRIA OF ONION PEEL**

**Functions of Mitochondria:** It is a powerhouse of the cell and produces biological energy in the form of ATP.

## POLYTENE CHROMOSOME – STAINED PREPARATION OF POLYTENE CHROMOSOME IN CHIRONOMUS LARVA/ DROSOPHILA LARVA

### 6. POLYTENE CHROMOSOME

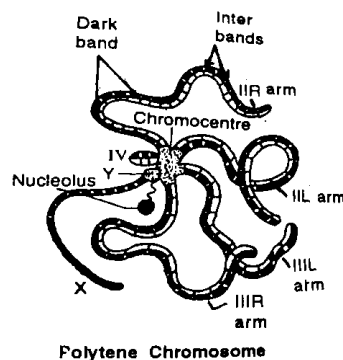
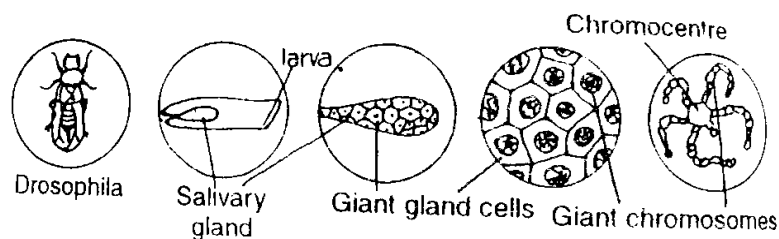
Polytene chromosomes are oversized chromosomes which have developed from standard chromosomes and are commonly found in the salivary glands of *Drosophila melanogaster*. Specialized cells undergo repeated rounds of DNA replication without cell division (endomitosis), to increase cell volume, forming a giant polytene chromosome. Polytene chromosomes form when multiple rounds of replication produce many sister chromatids that remain fused together.

#### Functions of polytene chromosome

In addition to increasing the volume of the cells nuclei and causing cell expansion, polytene cells may also have a metabolic advantage as multiple copies of genes permits a high level of gene expression. In *Drosophila melanogaster*, for example, the chromosomes of the larval salivary glands undergo many rounds of duplication, to produce large amounts of glue before pupation. Another example within the organism itself is the tandem duplication of various polytene bands located near the centromere of the X chromosome which results in the Bar phenotype of kidney: shaped eyes.

#### Procedure

On a slide, take a larva. Hold its body with one BB forceps and with other BB forceps pull out its head. Due to this pulling, the alimentary canal, salivary glands etc also get pulled out with body wall. Locate the salivary glands from this mass. Stain the salivary glands with acetocarmine for about 10 minutes. Put a cover slip, blot excess stain and observe under microscope.



## 7. STUDY OF FOSSIL EVIDENCE FROM PLASTER CAST MODELS AND PICTURES

Fossils are the remains of ancient animals and plants, the traces or impressions of living things from past geologic ages, or the traces of their activities. Fossils have been found on every continent on Earth, maybe even near where you live.

The word fossil comes from the Latin word *fossilis*, which means "dug up." Most fossils are excavated from sedimentary rock layers. Sedimentary rock is rock that has formed from sediment, like sand, mud, small pieces of rocks. Over long periods of time, these small pieces of debris are compressed (squeezed) as they are buried under more and more layers of sediment that piles up on top of it. Eventually, they are compressed into sedimentary rock. The layers that are farther down in the Earth are older than the top layers.

Fossils can be divided into two categories, **fossilized body parts** (bones, claws, teeth, skin, embryos, etc.) and **fossilized traces**, called ichnofossils (which are footprints, nests, dung, tooth marks, etc.), that record the movements and behaviors of the dinosaurs.

The four types of fossils are:

1. **Mold fossils** (a fossilized impression made in the substrate : a negative image of the organism)
2. **Cast fossils** (formed when a mold is filled in)
3. **Trace fossils = ichnofossils** (fossilized nests, gastroliths, burrows, footprints, etc.)
4. **True form fossils** (fossils of the actual animal or animal part).
5. There are six ways that organisms can turn into fossils, including:
6. **Unaltered preservation** (like insects or plant parts trapped in amber, a hardened form of tree sap)
7. **Permineralization=petrification** (in which rock: like minerals seep in slowly and replace the original organic tissues with silica, calcite or pyrite, forming a rock: like fossil : can preserve hard and soft parts : most bone and wood fossils are permineralized)
8. **Replacement** (An organism's hard parts dissolve and are replaced by other minerals, like calcite, silica, pyrite, or iron)
9. **Carbonization=coalification** (in which only the carbon remains in the specimen : other elements, like hydrogen, oxygen, and nitrogen are removed)
10. **Recrystallization** (hard parts either revert to more stable minerals or small crystals turn into larger crystals)
11. **Authigenic preservation** (molds and casts of organisms that have been destroyed or dissolved).



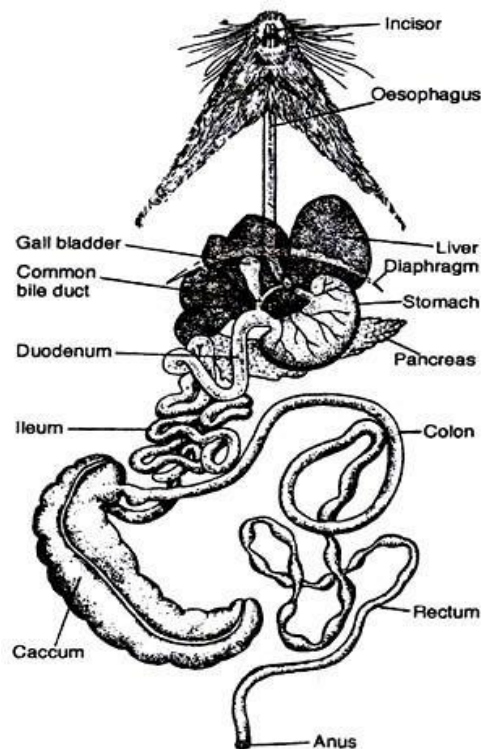
**Mold fossils of Starfish**



**Cast fossils of Bivalve**

## 8. DEMONSTRATION OF RAT

### 1. Digestive System



#### i) Alimentary Canal

It is a long tube starting from mouth to anus.

##### (a) Mouth

The alimentary canal begins from the mouth. It is a transverse aperture and is guarded by two soft and movable lips. The upper lip is provided with a cleft in the middle.

##### (b) Buccal cavity

Mouth leads to the buccal cavity. The roof of the buccal cavity is formed by a palate. The anterior portion of the palate is called hard palate. The palate separates the mouth cavity from the nasal passage. The floor of the buccal cavity houses the tongue. The anterior end of the tongue is free and the posterior end is attached with the floor.

##### (c) Pharynx

Buccal cavity leads to another chamber called the pharynx. The dorsal part of the pharynx is called nasopharynx and the ventral part is called buccopharynx. The buccal pharynx opens into the esophagus through an aperture called gullet.

##### (d) Esophagus

Esophagus is a long tube running along the mid: ventral line of the neck region. It runs through the thoracic region and after passing through the diaphragm opens into the stomach.

### **(e) Stomach**

Stomach is a highly muscular and glandular sac. The inner concave side of the stomach is called lesser curvature and the outer convex surface is called greater curvature. The end of the stomach towards the esophagus is called the cardiac end and its opposite end is called pyloric end.

### **(f) Intestine**

The remaining part of the alimentary canal is known as the intestine. It is divisible into duodenum, ileum and large intestine. The duodenum begins from the pyloric end of the stomach and forms a 'U': shaped loop. Ileum is a much coiled continuation of the duodenum. The coiled loops of the ileum are held in position by folds of mesenteries. Ileum opens into the large intestine and the opening is guarded by an ileocolic valve. The large intestine is wide and is divisible into the proximal colon and distal rectum. The colon is coiled and beaded in parts while the rectum is straight. A large blind sac called caecum is present at the point of opening of the ileum into the colon.

### **(g) Anus**

The terminal part of the alimentary canal is represented by an aperture called anus. The anus is guarded by sphincter muscle.

### **(ii) Digestive Glands**

**The different digestive glands that help the process of digestion are listed below**

#### **(a) Salivary glands**

There are five pairs of salivary glands. Parotid glands, Mandibular glands, Major sublingual glands and Minor sublingual glands.

The secretion of the salivary glands is known as saliva. Saliva helps in moistening food and contains an enzyme called ptyalin.

#### **(b) Liver**

It is a massive gland located beneath the diaphragm and above the stomach. It is a four: lobed structure and remains attached to the diaphragm by a falciform ligament.

The secretion of the liver is bile. Bile is kept temporarily stored in a pyriform gall bladder lodged in the quadrate lobe of the liver. A common bile duct formed by the union of hepatic duct (from liver) and cystic duct (from gallbladder) carries bile to the duodenum.

#### **(c) Pancreas**

It is a whitish, elongated and irregular: shaped gland located between the limbs of the duodenum. The secretion of the pancreas is known as pancreatic juice. The juice is carried to the distal part of the duodenum by a pancreatic duct.



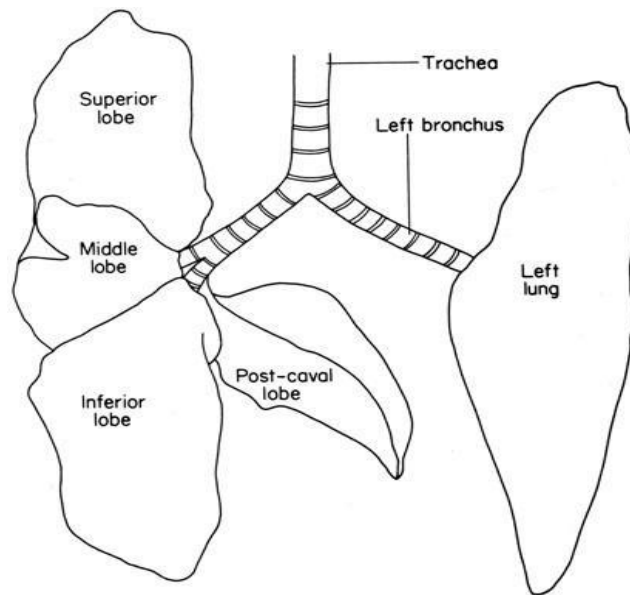
#### **(d) Gastric glands**

Innumerable gastric glands are present along the inner lining of the stomach. The juice produced by these glands is known as gastric juice.

#### **(e) Intestinal glands**

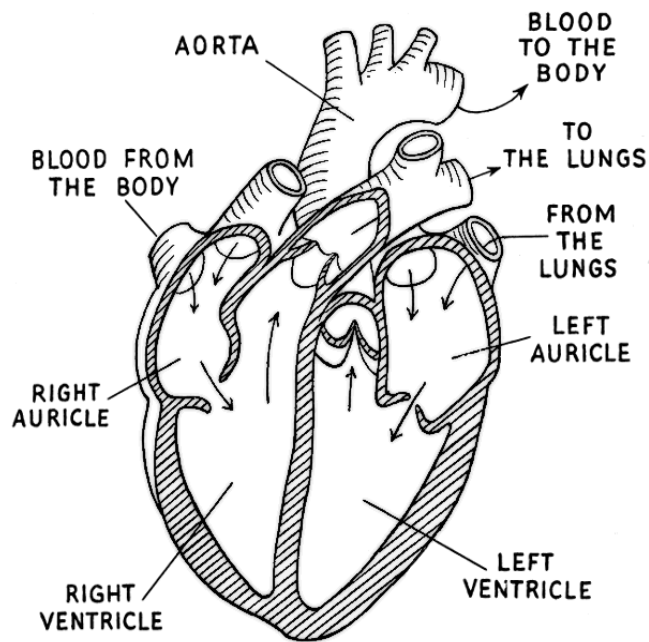
Numerous glands are present in the inner lining of the duodenum and intestine.

## **2. LUNGS**



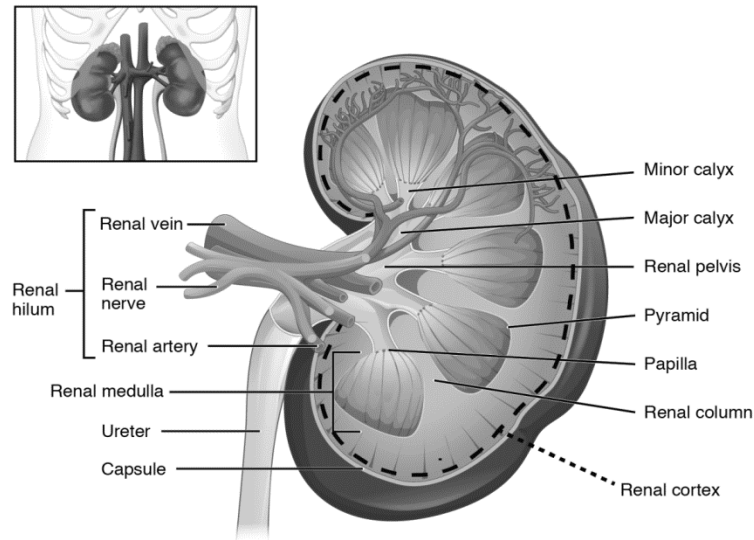
1. In the case of rats lungs are the respiratory organs.
2. Nasal passage opens into the buccal cavity.
3. Buccal cavity then opens into Trachea and trachea opens into the Lung.
4. Trachea is supported by a series of C: shaped hyaline cartilage bands.
5. Lungs are soft, elastic structures, each surrounded by its pleural cavity. Within the lung, bronchi undergoes extensive branching and debranching, ultimately resulting in formation of a large number of lobules or alveoli which form sponging mass.
6. The lungs of the rat, like in humans, lie on each side of the heart in the chest cavity, but rat lungs differ from humans in the division of lobes. The left lung of the rat contains one lobe while the right contains 4 lobes. These are Superior, Inferior Post: caval and middle lobes. In humans the right lung contains three lobes while the left contains two.

## HEART



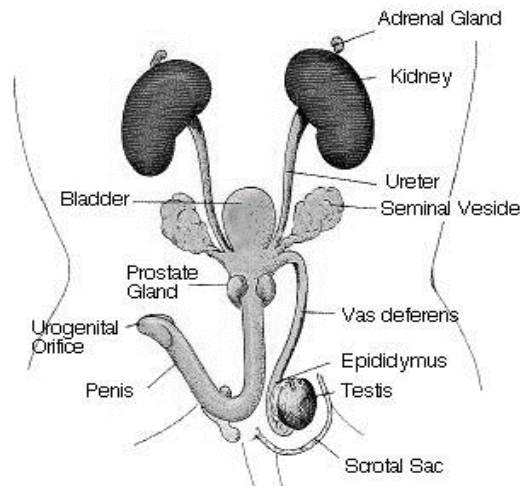
1. The heart of the rat consists of four chambers. There is a right ventricle, and a left ventricle, which are not easy to distinguish externally. Right atrium and left atrium are dark ear-shaped structures on each side of the anterior portion of the heart.
2. Three main blood vessels enter the right atrium which bring the deoxygenated blood back to the heart from all regions of the body. These blood vessels are the right superior vena cava, the left superior vena cava and the inferior vena cava.
3. The inferior vena cava is a large vein running from the diaphragm to the right atrium. The left superior vena cava runs across the 'dorsal surface of the thoracic cavity to enter the right atrium close to the point of entry of the inferior vena cava and the right superior vena cava.
4. The right and left superior venae cavae return deoxygenated blood to the heart from the right and left side of the head and neck. The thoracic cavity is drained by the azygos vein which empties into the left superior vena cava near its entry into the right atrium.
5. The deoxygenated blood in the right atrium is pumped to the right ventricle through an opening guarded by the tricuspid valve.
6. The blood is pumped from the right ventricle through the pulmonary semilunar valve into the pulmonary trunk (usually colourless) which divides into right and left pulmonary arteries going to the lungs. The oxygenated blood returns from the lungs to the left atrium via the right and left pulmonary veins. From the left atrium the blood enters the large muscular left ventricle through the bicuspid valve.

## KIDNEY



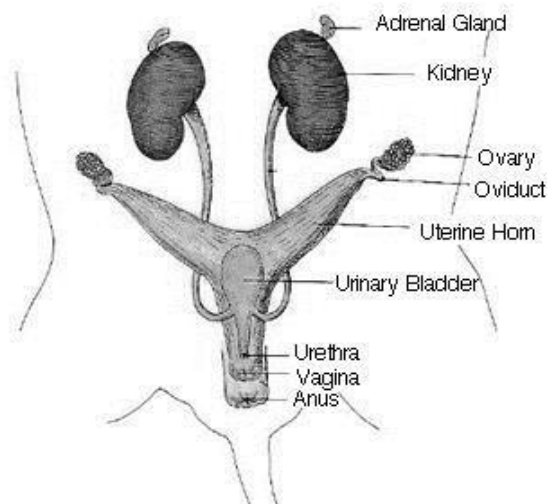
The paired kidneys lie on either side of the spine in the retroperitoneal space between the parietal peritoneum and the posterior abdominal wall, well protected by muscle, fat, and ribs. The left kidney is located at about the T12 to L3 vertebrae, whereas the right is lower due to slight displacement by the liver. Upper portions of the kidneys are somewhat protected by the eleventh and twelfth ribs. Kidneys are directly covered by a fibrous capsule composed of dense, irregular connective tissue that helps to hold their shape and protect them. This capsule is covered by a shock-absorbing layer of adipose tissue called the **renal fat pad**, which in turn is encompassed by a tough renal fascia. The fascia and, to a lesser extent, the overlying peritoneum serve to firmly anchor the kidneys to the posterior abdominal wall in a retroperitoneal position. Each kidney looks like the kidney bean and the renal hilum is the entry and exit site for structures servicing the kidneys: vessels, nerves, lymphatics, and ureters. The medial-facing hilum are tucked into the convex indentation of the kidney.

## TESTES



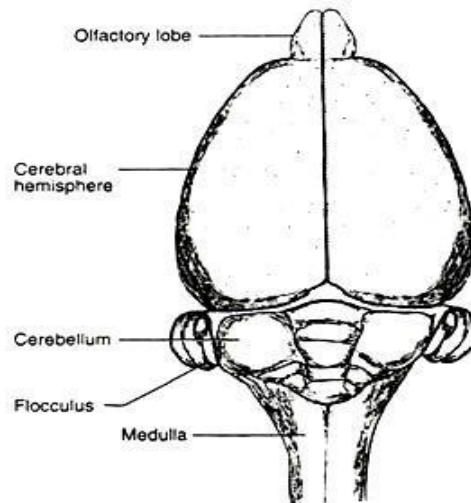
1. The major reproductive organs of the male rat are the **testes** (singular: testis) which are located in the **scrotal sac**. Cut through the sac carefully to reveal the testis. On the surface of the testis is a coiled tube called the **epididymis**, which collects and stores sperm cells. The tubular **vas deferens** moves sperm from the epididymis to the **urethra**, which carries sperm through the penis and out the body. □
2. The lumpy brown glands located to the left and right of the urinary bladder is the **seminal vesicles**. The gland below the bladder is the **prostate gland** and it is partially wrapped around the penis. The seminal vesicles and the prostate gland secrete materials that form the seminal fluid (semen).

## OVARY



1. Ovaries are the female gonad.
2. These are two in number and lie attached to the body wall by mesovarium.
3. These are connected to the uterine horns via **oviducts**.
4. Formation of Ova takes place in the ovary.

## **BRAIN**

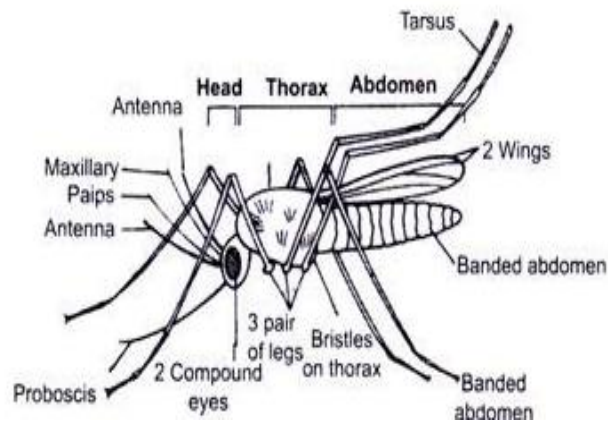


### **Following are the special features of the brain of rat**

1. Meninges or coverings of the brain are three: layered. In: between outer Dura mater and inner Pia mater, there is a distinct middle third layer called arachnoid layer.
2. Size of the brain is large and the cerebral hemispheres and cerebellum are much convoluted so as to increase the area.
3. Olfactory lobes are small and club: shaped.
4. Cerebral hemispheres are much enlarged and cover the diencephalon and mesencephalon. Each hemisphere is subdivided into four lobes—frontal, parietal, temporal and occipital, by grooves.
5. Transverse bands of nerve fibers called corpus callosum connect the two cerebral hemispheres.
6. The ventral side of diencephalon is well: developed and known as hypothalamus. It bears optic chiasma, pituitary body and a pair of small round masses called mammillary bodies. The dorsal side of diencephalon carries a pineal body or epiphysis and a vascularized fold called anterior choroid plexus.
7. Mesencephalon or midbrain is thick and contains four optic lobes called corpora quadrigemina.
8. Cerebellum is enlarged, folded and divided into a median vermis and two lateral lobes. Each lateral lobe is with a short flocculus. A broad band called pons varolii is present on the ventral side of the cerebellum.
9. Medulla oblongata is prominent and carries a vascularized posterior choroid plexus on its non-nervous roof.

## 10. STUDY OF FOLLOWING INSECT VECTORS.

### 1. MOSQUITO BORNE DISEASES (CAUSAL ORGANISM, SYMPTOMS AND CONTROL MEASURES)



#### A) Malaria

##### Causal organism

Malaria is a disease caused by a parasite *plasmodium vivax*. The parasite is spread to humans through the bites of infected mosquitoes.

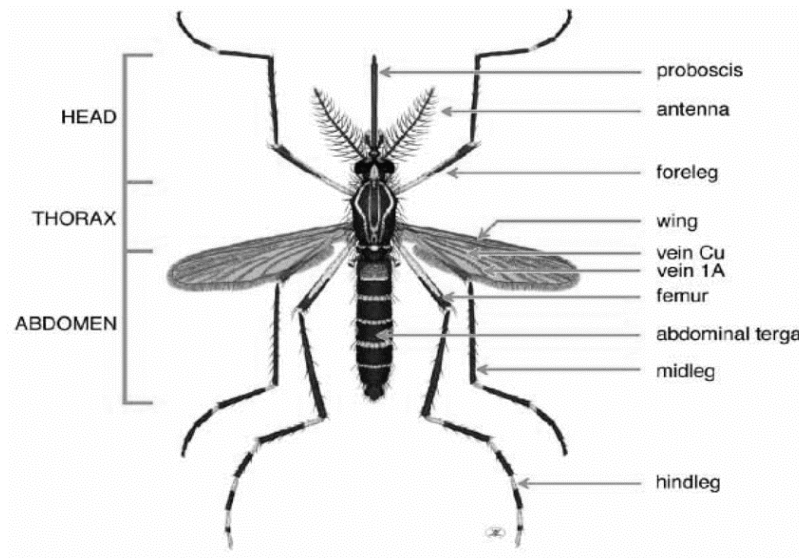
##### Symptoms

People who have malaria usually feel very sick with a high fever and shaking chills. While the disease is uncommon in temperate climates, malaria is still common in tropical and subtropical countries. Each year nearly 290 million people are infected with malaria, and more than 400,000 people die of the disease.

##### Treatment

To reduce malaria infections, world health programs distribute preventive drugs and insecticide: treated bed nets to protect people from mosquito bites. The World Health Organization has recommended a malaria vaccine for use in children who live in countries with high numbers of malaria cases. Protective clothing, bed nets and insecticides can protect you while traveling. You also can take preventive medicine before, during and after a trip to a high: risk area. Many malaria parasites have developed resistance to common drugs used to treat the disease

## B) Dengue



**Female Aedes Mosquito**

### **Causal organism**

Dengue fever is transmitted by the bite of an Aedes mosquito infected with a dengue virus. The mosquito becomes infected when it bites a person with dengue virus in their blood. It can't be spread directly from one person to another person.

### **Symptoms of Dengue Fever**

Symptoms, which usually begin four to six days after infection and last for up to 10 days, may include Sudden, high fever, Severe headaches, Pain behind the eyes, Severe joint and muscle pain, Fatigue, Nausea, Vomiting, Skin rash, which appears two to five days after the onset of fever, Mild bleeding (such a nose bleed, bleeding gums, or easy bruising)

### **Treatment for Dengue Fever**

There is no specific medicine to treat dengue infection. If you think you may have dengue fever, you should use pain relievers with acetaminophen and avoid medicines with aspirin, which could worsen bleeding. You should also rest, drink plenty of fluids, and see your doctor. If you start to feel worse in the first 24 hours after your fever goes down, you should get to a hospital immediately to be checked for complications.

## **C) Chikungunya**

### **Causal organism**

Chikungunya virus can be found in the blood. The virus can be passed from an infected person to a mosquito through mosquito bites. An infected mosquito can then spread the virus to other people.

### **Symptoms**

Most people infected with chikungunya virus will develop some symptoms. Symptoms usually begin 3–7 days after an infected mosquito bites you. The most common symptoms are fever and joint pain. Other symptoms may include headache, muscle pain, joint swelling, or rash. Death from chikungunya is rare. Most patients feel better within a week. However, joint pain can be severe and disabling and may persist for months. People at risk for more severe disease include newborns infected around the time of birth, older adults ( $\geq 65$  years), and people with medical conditions such as high blood pressure, diabetes, or heart disease. Once a person has been infected, he or she is likely to be protected from future infections

### **Diagnosis**

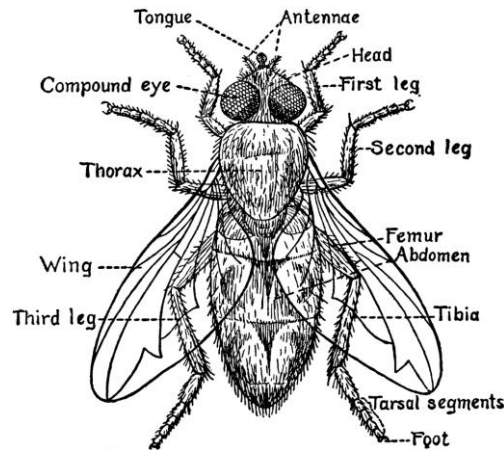
See your healthcare provider if you have visited an area where chikungunya is found and have symptoms described above. Tell your healthcare provider when and where you traveled. Your healthcare provider might order blood tests to look for chikungunya or other similar viruses like dengue and Zika.

### **Treatment**

There is currently no vaccine to prevent or medicine to treat chikungunya. Treat the symptoms: Get plenty of rest. Drink fluids to prevent dehydration. Take medicine such as acetaminophen (Tylenol®) or paracetamol to reduce fever and pain. Do not take aspirin and other non-steroidal anti-inflammatory drugs (NSAIDs) until dengue can be ruled out to reduce the risk of bleeding. If you are taking medicine for another medical condition, talk to your healthcare provider before taking additional medication. If you have chikungunya, prevent mosquito bites for the first week of your illness.



## 2. HOUSE FLY BORNE DISEASES (CAUSAL ORGANISM, SYMPTOMS AND CONTROL MEASURES)



### A) Myiasis

#### Causal organism

**Myiasis**, infestation of the body of humans and other animals with the larvae (maggots) of certain species of flies. Myiasis typically occurs in tropical regions, where flies are particularly abundant. Infestation may be intestinal or superficial.

#### Symptoms

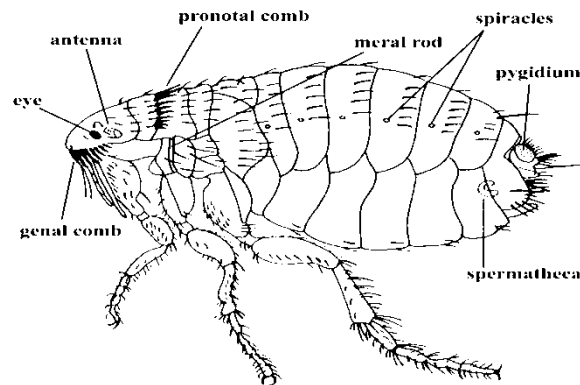
Intestinal myiasis results from ingestion of food contaminated with eggs or larvae of flies and may produce cramps, nausea, vomiting, and diarrhea. Within a short time, however, the organisms are destroyed by gastrointestinal juices and passed in the feces. Superficial myiasis occurs when flies, attracted to open or infected wounds or to odoriferous discharges from the eyes, ears, nose, mouth, or vagina, lay their eggs in these areas. The larvae hatch and feed on the involved tissues, sometimes causing extensive or even fatal damage. Examples of species of flies known to infect open wounds include the housefly (*Musca domestica*) and the New World screwworm (*Cochliomyia hominivorax*); the spotted flesh fly (*Wohlfahrtia magnifica*) may infest the eye, ear, nose, or mouth. The larvae of some species, such as the mango, or tambo, fly (*Cordylobia anthropophaga*), penetrate unbroken skin, especially of infants, producing boil-like lesions or creeping eruptions.

#### Treatment

Treatment of superficial infestation involves removing the larvae by irrigation and mechanical extraction. Because larvae feed on dead tissue and foreign matter in open wounds, they were sometimes deliberately introduced to supplement surgical removal of dead or diseased tissue and to prevent infection.

### 3. FLEA BORNE DISEASES (CAUSAL ORGANISM, SYMPTOMS AND CONTROL MEASURES)

#### A) Plague



RAT FLEA

#### Causal organism

Plague is a serious bacterial infection that's transmitted primarily by fleas. The organism that causes plague, *Yersinia pestis*, lives in small rodents found most commonly in rural and semi rural areas of Africa, Asia and the United States. The organism is transmitted to humans who are bitten by fleas that have fed on infected rodents or by humans handling infected animals.

#### Symptoms

Plague is divided into three main types — bubonic, septicemic and pneumonic — depending on which part of your body is involved. Signs and symptoms vary depending on the type of plague.

#### Bubonic plague

Bubonic plague is the most common variety of the disease. It's named after the swollen lymph nodes (buboes) that typically develop in the first week after you become infected. Buboes may be: Situated in the groin, armpit or neck,,About the size of a chicken egg,Tender and firm to the touch,Other bubonic plague signs and symptoms may include: Sudden onset of fever and chills,Headache,Fatigue or malaise,Muscle aches

#### Septicemic plague

Septicemic plague occurs when plague bacteria multiply in your bloodstream. Signs and symptoms include: Fever and chills,Extreme weakness,Abdominal pain, diarrhea and vomiting,Bleeding from your mouth, nose or rectum, or under your skin, Shock Blackening and death of tissue (gangrene) in your extremities, most commonly your fingers, toes and nose.

## **Pneumonic plague**

Pneumonic plague affects the lungs. It's the least common variety of plague but the most dangerous, because it can be spread from person to person via cough droplets. Signs and symptoms can begin within a few hours after infection, and may include: Cough, with bloody mucus (sputum), Difficulty breathing, Nausea and vomiting, High fever, Headache, Weakness, Chest pain.

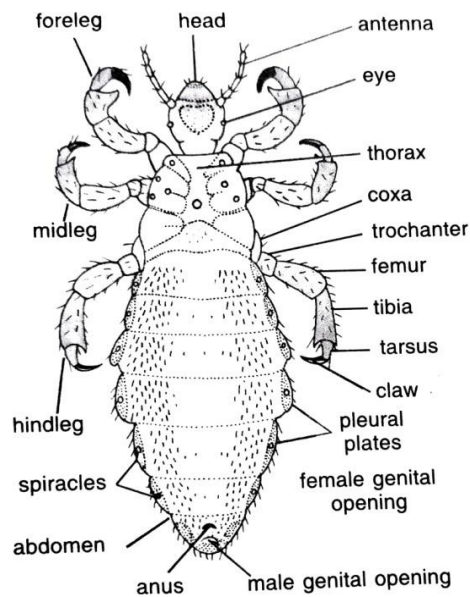
Pneumonic plague progresses rapidly and may cause respiratory failure and shock within two days of infection. Pneumonic plague needs to be treated with antibiotics within a day after signs and symptoms first appear, or the infection is likely to be fatal.

## **Prevention**

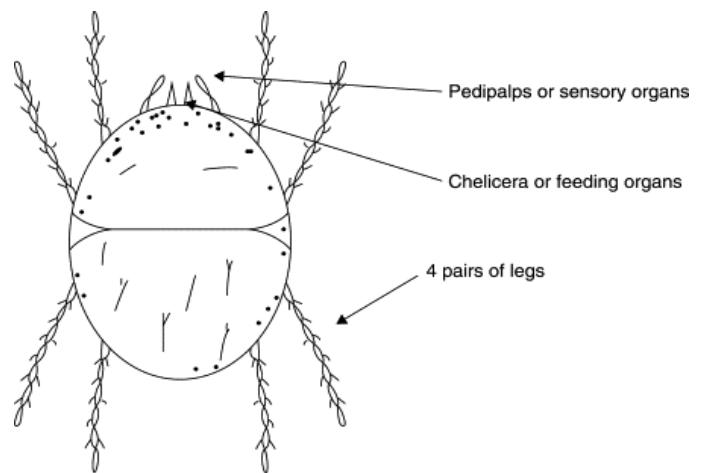
No effective vaccine is available, but scientists are working to develop one. Antibiotics can help prevent infection if you're at risk of or have been exposed to plague. Take the following precautions if you live or spend time in areas where plague outbreaks occur:

- 1. Rodent: proof your home.** Remove potential nesting areas, such as piles of brush, rock, firewood and junk. Don't leave pet food in areas that rodents can easily access. If you become aware of a rodent infestation, take steps to control it.
- 2. Keep your pets free of fleas.** Ask your veterinarian which flea: control products will work best.
- 3. Wear gloves.** When handling potentially infected animals, wear gloves to prevent contact between your skin and harmful bacteria.
- 4. Use insect repellent.** Closely supervise your children and pets when spending time outside in areas with large rodent populations. Use insect repellent.

## B) Typhus fever



**Lice**



**Mites**

### Causal organism

Typhus is a disease caused by rickettsia or orientia bacteria. You can get it from infected mites, fleas, or lice. Modern hygiene has mostly stopped typhus, but it can still happen in places where basic sanitation is bad or if it gets passed on by an infected animal. There are three main kinds of typhus, each caused by different bacteria.

1. **Murine typhus** is passed by fleas to people if the fleas bite infected animals, mainly rats. Most U.S. cases have been reported in California, Hawaii, and Texas.
2. **Epidemic typhus** is a rare variety spread by infected body lice. It's unlikely to happen outside of extremely crowded living conditions. One type of epidemic typhus can be spread by infected flying squirrels. But it, too, is very rare.
3. **Scrub typhus** is spread by infected chiggers, or mites, mainly found in rural parts of Southeast Asia, China, Japan, India, and northern Australia.
4. Doctors can easily treat all three kinds of typhus with antibiotics. But they can cause serious illness, so get treatment right away if you think you might have been exposed to it.

### Typhus Symptoms

With any kind of typhus, you'll start to feel ill about 10 days to 2 weeks after the typhus bacteria gets into your body. You'll likely have: Chills, Fever, Headache, Muscle aches like what you'd have with the flu, A rash several days after the other symptoms start, With murine typhus, you may also have:

Coughing, Loss of appetite, Nausea, Stomach pain, Vomiting, With epidemic typhus, you could notice: Confusion, Coughing, Fast breathing, Nausea, Vomiting, Other symptoms of scrub typhus include: Confusion or other mental impairment, A dark scab on the area where the chigger bite you, Swollen lymph nodes.

### **Typhus Treatment**

The most effective therapy for all three kinds of typhus is the antibiotic doxycycline.

1. A single dose of doxycycline has proved effective against epidemic typhus. Doxycycline also works quickly on other strains of the disease.
2. For the best results, you should take it as soon as possible after your symptoms start.
3. If you're allergic to doxycycline or if it doesn't work, doctors may choose another antibiotic such as ciprofloxacin (Cipro).

**9. Study of Mendelian Inheritance and gene interactions (Non-Mendelian Inheritance) using suitable examples. Minimum 10 Examples on: Monohybrid & Dihybrid ratio, Incomplete dominance, Codominance, Multiple alleles, Sex linked inheritance, Linkage, Crossing over and Gene interaction.**

1. Example based on Monohybrid ratio: In poultry rose comb (R) is dominant over single comb (r). If a homozygous rose comb is crossed with a single comb. What are the genotypes and phenotypes of individuals in F1 and F2 generations?

**Result: Phenotypic ratio 3:1 Genotypic ratio: 1:2:1**

2. Example based on Dihybrid ratio: Homozygous rough black (RRBB) coated guinea pig is crossed with a homozygous smooth, white (rrbb). Then find out the genotypes and phenotypes of F1 & F2 generations.

**Result: in the F1 generation all are rough black coated Guinea pigs.**

**In F2 generation Phenotypic ratio is 9:3:3:1 and**

**Genotypic ratio: 1:2:2:4:1:2:1:2:1**

3. Example based on Incomplete dominance: In Andalusian fowl black and white contrasting characters governing genes controls the feather colour. They are neither completely dominant nor recessive to each other. Presence of both the genes in an individual expresses intermediate character blue (steel gray). If a pure breeding black cock is allowed to breed with white hen; then what will be the genotypes and phenotypes of the individuals in F1 and F2 generations?

**Result: in F1 generation all are steel grays.**

**In F2 generation genotypic and phenotypic ratio is same ie 1:2:1**

4. Example based on Co- dominance: A man and woman both are having blood group AB. List the possible genotypes and phenotypes of their children and then determine the ratio.

Result: possible phenotypes are A-blood group, AB-blood group and

B- blood group. 1:2:1 phenotypic ratio

**Possible genotypes are 1 I<sup>A</sup> I<sup>A</sup> : 2 I<sup>B</sup> I<sup>B</sup> : 1 I<sup>B</sup> I<sup>A</sup> Genotypic ratio 1:2:1**

5. Example based on sex linked inheritance: When a colorblind man marries with a normal vision woman, then they will produce normal vision male and normal but carrier female individuals in F<sub>1</sub>. What will be the nature of vision of the individuals in F<sub>2</sub> when marriage is made between F<sub>1</sub> carrier female with a normal vision male?

(GENOTYPES: Normal female: X<sup>+</sup>X<sup>+</sup> Colourblind male: X<sup>c</sup>Y)

6. Example based on multiple alleles: In Rabbit full color – C<sup>+</sup>, Chinchilla -c<sup>ch</sup> Himalayan c<sup>h</sup> albino – c. are genes governing the coat colour. It shows dominance in descending order.

Phenotype	Genotype
Full colour	$C^+ C^+ / C^+ + C^{ch} / C^+ C^h / C^+ c$
Chinchilla	$c^{ch} c^{ch}$
Light gray	$c^{ch} c^h / c^{ch} c$
Himalayan	$c^h c^h / c^h c$
Albino	$cc$

What will be the appearance of offspring in following crosses?

- |  |   |
|--|---|
| 1) C <sup>+</sup> C X C <sup>+</sup> + c <sup>ch</sup> | 2) c <sup>ch</sup> c <sup>h</sup> X c <sup>ch</sup> c |
| 3) c <sup>ch</sup> c <sup>h</sup> X c <sup>h</sup> c   | 4) c <sup>h</sup> c X c <sup>h</sup> c                |
| 5) C <sup>+</sup> C X c <sup>+</sup> + c               | 6) C <sup>+</sup> c <sup>ch</sup> X c <sup>h</sup> c  |

7. Example based on linkage and crossing over: In Drosophila gray body colour is dominant over Black; long (straight) wing is dominant over arc. From the data below calculate the crossing over value between black and arc.

Gray Straight X Black arc

F1 Female X black arc male

Gray straight 1641    Gray arc 1251

Black straight 1180    Black arc 1532

**(Ans: COV 43.38%)**

8. Example based on linkage and crossing over: Repeated crosses between two hamsters, one of which showed two recessive characters of albino and curly hair gave the following progeny.

Coloured straight 26    Coloured curly 16

Albino straight 12    Albino curly 26

Calculate the linkage value between albino and curly

**(Ans. L.V.65% & COV: 35%)**

9. Example based on supplementary gene interaction: In Rat C represents the gene for the black pigment and A the gene for yellow pigment, combination of two dominant alleles of two different genes one for black and one for yellow results in agouti pattern. While cc genotypes produce cream colour, which appear albino. If a black individual (CCaa) crossed with albino (ccAA) what will be the phenotypes of the F<sub>1</sub> and F<sub>2</sub> generations?

**Result: in f<sub>1</sub> generation all are Agouti and in f<sub>2</sub> generation phenotypic ratio is 9:3:4**

10. Example based on complementary gene interaction: In Indian corn let gene C and P interact to produce purple colour grains. The joint action of these two genes can be explained by the selfing of purple varieties, which are heterozygous for the alleles of the genes C and P (genotypes CcPp X CcPp) absence of either of two results into white. Represent the cross by checkerboard.

**Result: in f<sub>1</sub> generation all are purple and in f<sub>2</sub> generation phenotypic ratio is 9:7**



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