

PHYLUM: ARTHROPODA

Arthropoda is the largest phylum with about nine lakh species. They may be aquatic, terrestrial or even parasitic. They have jointed appendages and a chitinous exoskeleton.

This phylum includes several large classes and contains the class Insecta which itself represents a major portion of the animal species in the world. They possess the ability to survive in every habitat.

Arthropoda Characteristics

The arthropoda characteristics are mentioned below:

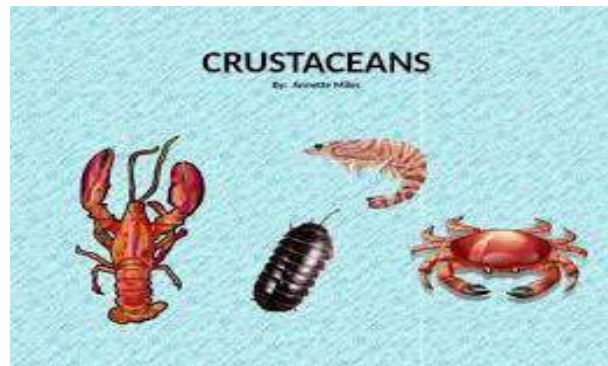
1. The body is triploblastic, segmented, and bilaterally symmetrical.
2. They exhibit organ system level of organization.
3. The body is divided into head, thorax, and abdomen.
4. Their body has jointed appendages which help in locomotion.
5. The coelomic cavity is filled with blood.
6. They have an open circulatory system.
7. The head bears a pair of compound eyes.
8. The exoskeleton is made of chitin.
9. The terrestrial Arthropods excrete through Malpighian tubules while the aquatic ones excrete through green glands or coxal glands.
10. They are unisexual and fertilization is either external or internal.
11. They have a well-developed digestive system.
12. They respire through the general body surface or trachea.
13. They contain sensory organs like hairs, antennae, simple and compound eyes, auditory organs, and statocysts.

Classification of Phylum Arthropoda

The classification of phylum arthropoda are as follows:

Class:Crustacea

- **Chitinous cuticle** covers the body which is divisible into **cephalothorax** and **abdomen**.
- Cephalothorax is covered by a carapace which bears spiny rostrum.
- A cephalothorax bear two pairs of antennae, two pairs of maxillae, one pair of mandibles, generally a median eye and a pair of compound eyes.
- They are **ammonotelic** and excretion is by **green glands** or **antennary gland**.
- The appendages are modified for swimming, respiration and reproduction.
- Respiration is carried out either by **body surface** or by **gills**.
- Heart is arterial, i.e only oxygenated blood is present.
- Sexes are usually separate with sexual dimorphism.
- Development is indirect with **Zoea larva**.
- Most of them are edible, constitute the food for aquatic or terrestrial life.
- e.g. *Palaemon* (prawn), *Cancer* (crab)



Class:Myriapoda

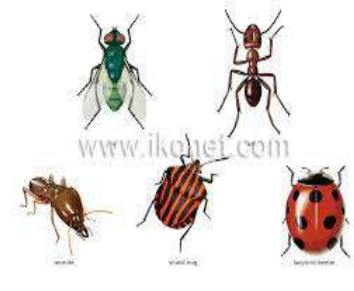
- They are mostly terrestrial.
- Body is long and divisible into **head** and **trunk**.

- Head consists a pair of antennae, a pair of simple eyes and two to three pairs of jaws.
- Trunk consists of many segments with each segment having one to two pairs of legs.
- Respiration occurs with the help of **trachea**.
- Excretion takes place by **malpighian tubules**.
- Development is direct.
- e.g. *Scolopendra* (Centipede), *Julus* (Millipede)



Class:Insecta

- They are mostly terrestrial.few are aquatic
- Body is bilaterally symmetrical and segmented. It is divided into **head, thorax** and abdomen
- Head bears a pair of compound eyes, a pair of antennae and different types of mouth parts (chewing and biting, piercing and sucking).
- Thorax consists of three segments (**prothorax, mesothorax** and **metathorax**).
- Wings arise from meso- and metathorax while legs arise from each thoracic segment. Abdomen neither consists of legs nor wings.
- Respiration takes place by trachea or gills.
- Heart is tubular and divided into chambers (in cockroach- 13 chambered).
- Malpighian tubules help in excretion and are uricotelic.
- Sexes are separate.
- e.g. *Periplaneta* (Cockroach), Butterfly, Mantis, Housefly etc.



Class:Merostomata

- They are exclusively marine forms.
- Body is divided into **prosoma** (cephalothorax) and **opisthosoma** (abdomen).
- Cephalothorax is covered by a **carapace** and bears a pair of simple eyes, a pair of large compound eyes, a pair of **chelicerae**, a pair of **pedipalp** (mouth parts) and five pairs of appendages (legs).
- The anus ends in a sharp telson.
- Respiration occurs by book gills and development is indirect.
- e.g. *Limulus* (King crab)



Class:Onychophora

- It is a **connecting link** between annelids and arthropods and are mostly terrestrial.
- Body is without external segmentation.
- **Annelidan characteristics:**
 - The integument is thin, soft and **without exoskeleton**.
 - **Parapodia** like appendages are present which are unjointed.
 - Excretory organs are **nephridia**.
- **Arthropodan characteristics:**

- **Tracheal gills** are present for respiration.
- Appendages terminate into **claws**.
- They have salivary gland and their coelom is reduced.
- Head has a pair of simple eyes, a pair of antennae, a pair of oral papillae and a pair of jaws.
- e.g. *Peripatus*

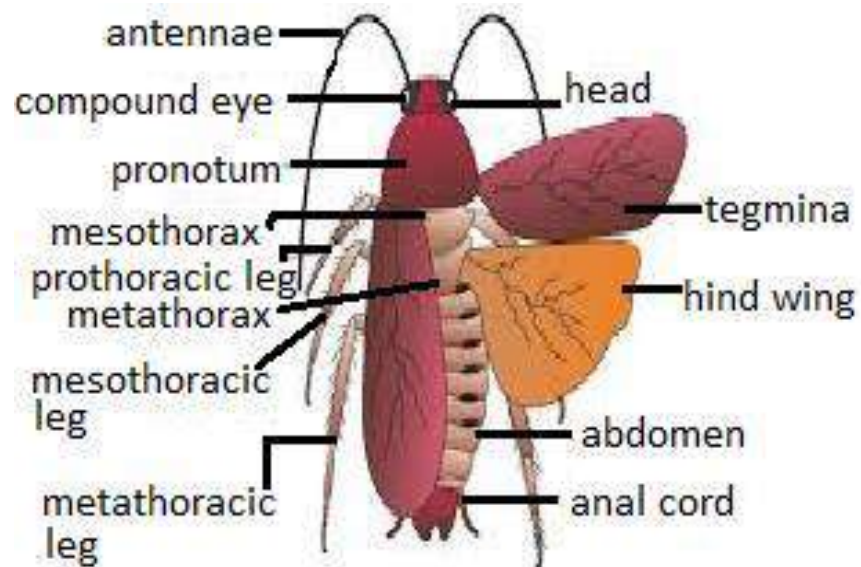


Class: Arachnida

- They are mostly terrestrial and rarely aquatic.
- Body is divisible into **prosoma** (cephalothorax) and **opisthosoma** (abdomena).
- Prosoma bears simple eyes, one pair of chelicerae, one pair of pedipalp and four pairs of legs.
- **Antennae** and true jaws are **absent**. Opisthosoma is usually without appendages.
- Respiration takes place by **book lungs**.
- They are unisexual and usually without sexual dimorphism.
- Development is generally direct.
- e.g. *Aranea* (Spider), *Palamnaeus* (Scorpion)



COCKROACH- MORPHOLOGY



As an arthropod, the body of a cockroach is divisible into three distinct regions. They are the head, thorax, and abdomen. There is a hard exoskeleton that is brown in color, made of chitin. The hardened plates of the exoskeleton are called the sclerites. A cockroach is a dioecious animal, with separate male and female sexes. The male species are longer in length while the females are slightly smaller than the males.

The head of the cockroach has a distinct triangular shape. It is formed by the fusion of six segments. The head shows great mobility due to the presence of a flexible neck. A pair of compound eyes is present on the head. In front of the eyes, membranous sockets are present, out of which two antennae protrude out.

Body is covered by brown chitinous exoskeleton. Exoskeleton is thick and hard and is made up of calcareous plates called **sclerites**. There are ten segments are present on dorsal side which is called **tergum** and ventral side is known as **sternum**.

The antennae monitor the surrounding environment with the help of the sensory receptors. The head also has appendages that bear similarity to the mouthparts, such as labrum, a pair of mandibles, a pair of maxillae and a labium. There is also flexible lobe called the hypopharynx that acts as a tongue.

The thorax is further divided into prothorax, mesothorax, and metathorax. Each segment of the thorax has a pair of walking legs. The fore wings called the **tegmina or elytra** comes out from the mesothorax and the hind wings comes out from the metathorax. The tegmina are dark and cover the hind wings. The hind wings are membranous, transparent and used in flight.

Abdomen: In both male and female ten segments are present. The seventh sternum is boat shaped in females and together with eighth and ninth sterna makes a broad genital pouch. The tenth segment bears two jointed filamentous structure which are called as anal cerci. The ninth segment bears a pair of short thread like style which lies ventral to anal cerci. Anal system is not found in female cockroach.

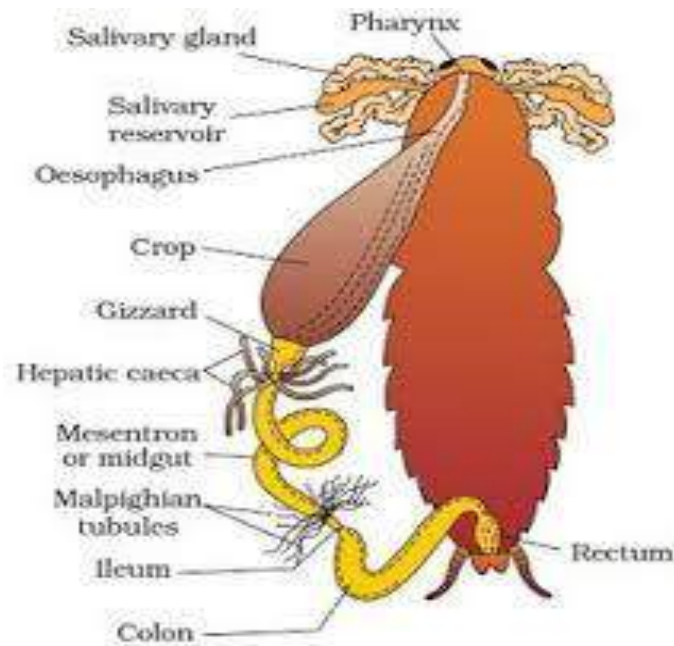
Digestive system

The three parts into which the alimentary canal is divided are the foregut, midgut, and hindgut. The mouth leads into a pharynx which leads into a narrow passage called the oesophagus. The oesophagus opens into a sac-like structure called the crop that stores food.

The gizzard is the next structure that is present after the crop. It is also called the proventriculus. It helps in grinding the food particles due to the presence of six chitinous plates called teeth. A cuticle lines the entire foregut. At the junction of the

foregut and midgut, there is a ring of tubules called the gastric caecae, which secrete digestive juice.

Another ring of 100-150 yellow coloured thin filamentous Malpighian tubules is present at the junction of the midgut and hindgut. These Malpighian tubules help in the removal of excretory products. The hindgut opens outside through the anus.



Blood Vascular System

An open blood vascular system is found in a cockroach as the blood vessels are poorly developed. There is an open space called the hemocoel into which the visceral organs are located.

These visceral organs are bathed in hemolymph which is the blood of a cockroach. The hemolymph is made of a colorless plasma and hemocytes. An elongated tube with a muscular wall regulates the blood in the hemocoel. This elongated tube which is the heart of the cockroach has many funnel-shaped chambers and lies mid-dorsally in the abdomen and thorax.

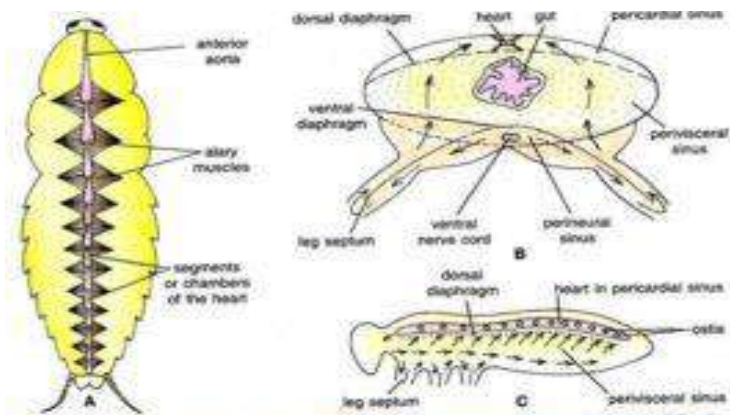


Fig. 73.18. Periplaneta. A—Heart in dorsal view; B—Course of circulation of blood in T.S. of thoracic segment; C—Course of circulation of blood in L.S. of body.

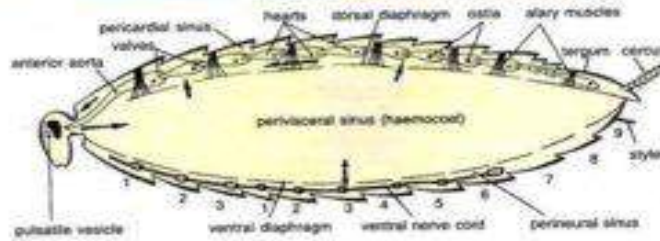
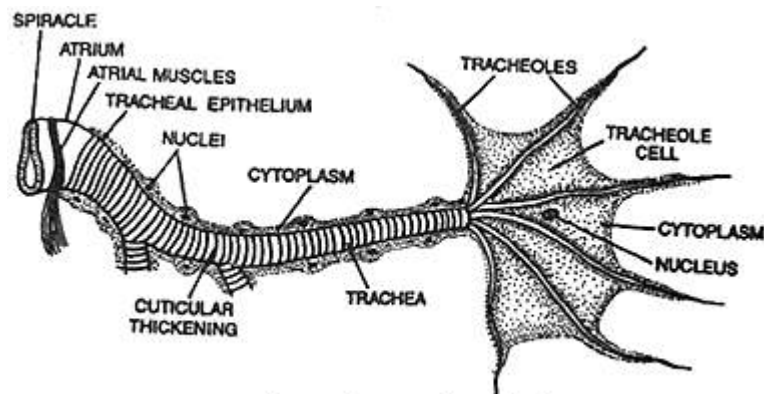


Fig. 73.19. Periplaneta. Blood vascular system.

Respiratory System

In cockroach, the respiratory system has a network of the trachea. They open through 10 pairs of spiracles that are present on the lateral side of the body. Thin tubes carry oxygen from the air to all the parts of the body. The spiracles are regulated by the sphincters. Exchange of gases takes place by diffusion.



Spiracle tracheae and tracheoles

Nervous System

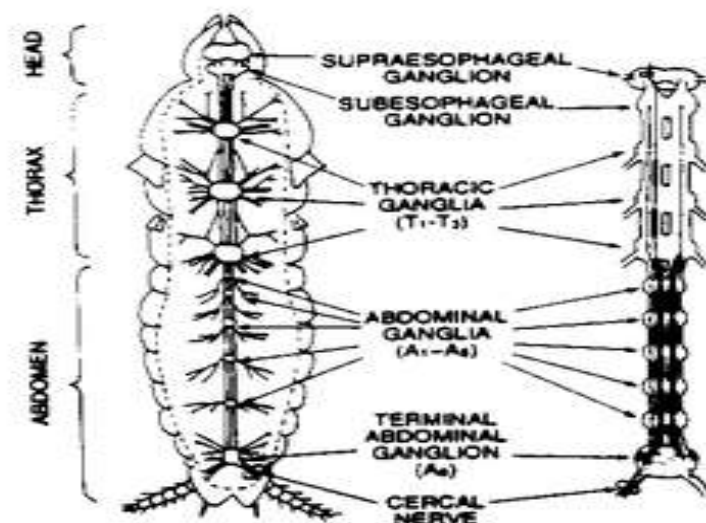
Fused ganglia that are segmentally arranged make up the nervous system of this insect. The thorax region has three ganglia and the abdomen has six ganglia. In a cockroach, the nervous system is spread throughout the body.

It consists of three system: Central nervous system, peripheral system, sympathetic or visceral system.

Central nervous system consists of Brain or supra oesophageal ganglion. Brain gives off a pair of short, stout cords, the circumoesophageal connective, that encircle the oesophagus and passes downwards or backward over the suboesophageal ganglion situated below oesophagus. From the suboesophageal ganglion passes backwards into the thorax and double central nerve cord which bears three ganglia in the thorax and six in the abdomen.

Peripheral nervous system consists of nerves, which are given off from the ganglia so as to innervate all parts of the body.

Sympathetic or somatogastric or visceral nervous system consists of frontal a ganglion which is situated on the dorsal side of the oesophagus in the head. From this ganglion, a median unpaired recurrent nerve reaches the visceral ganglion situated on the crop. Various nerve branches are given off from visceral ganglion. Frontal ganglion is jointed with the CNS by nerves which connect the circumoesophageal commissures.



Excretory System

The Malpighian tubules perform the excretion in a cockroach. There are glandular and ciliated cells that are present lining each tubule, which absorb the nitrogenous waste products. These are converted into uric acid and excreted out through the hindgut. This is the reason why a cockroach is called a uricotelic.

Reproductive System

Male reproductive system is divided into following

I. **Testes:** There is a pair of three lobed testes lying dorsoventrally in the 4th and 5th abdominal segments. Testes become non-functional and reduced in old adults while well developed and elaborate structure in young cockroach.

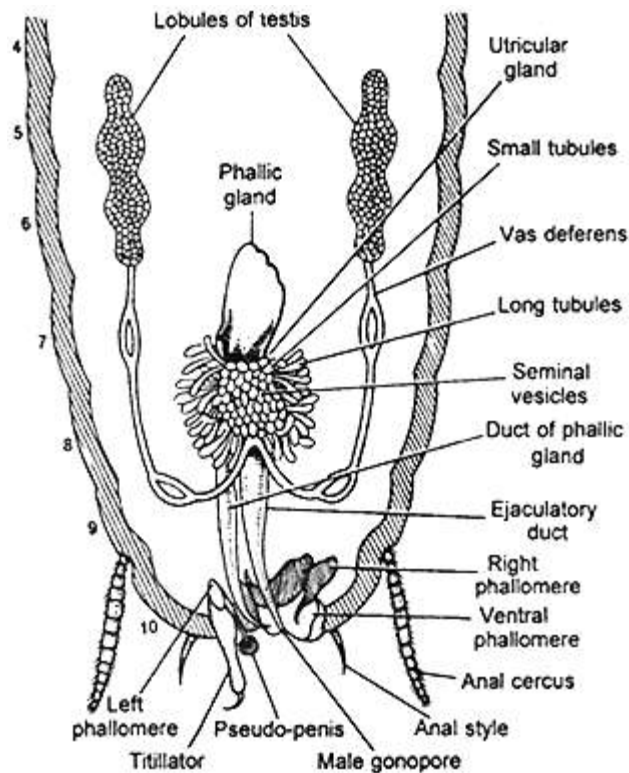
II. **Vasa deferentia:** From each testes arises a thin thread like white vasa deferens. Both vasa deferentia pass backwards almost to the posterior end of abdomen and then bend forwards to meet in the middle and open into an ejaculatory duct.

III. **Ejaculatory duct:** It is an elongated white median duct which runs backwards in the abdomen and opens out by male gonopore situated ventral to anus.

IV. **Utriculus or Mushroom shaped gland:** It is a large accessory reproductive gland, whitish in color and situated at the junction of vasa deferentia with the ejaculatory duct. It has mass of glandular tubules of three kinds; Peripheral long tubules or utriculus majors, central tubules are small short tubules.

V. **Phallic or Conglobate gland:** It is a long club shaped accessory gland. Its anterior broader end lies in the 6th segment slightly to the right of nerve cord. It narrows posteriorly into a tubular structure and finally tapers to open by a separate aperture located close to the male gonopore at the hind end of the body.

VI. **External genitalia:** Some chitinous asymmetrical structures are found surrounding the male gonopore at the end of the abdomen. These are three phellomeres or male gonapophysis which constitute the external genitalia. These are left phellomere (largest), ventral phellomere (smallest) and right phellomere.



Reproductive System of Cockroach - Male

Female:

Female reproductive system of cockroach consists of following organs:

I. **Ovaries:** There are two large, light yellow coloured ovaries lying laterally to the segments 4th, 5th, 6th embedded in the fat body. Each ovary is a group of eight ovarion tubules or ovarioles containing a chain of developing ova. Oviduct is a stalk of all eight ovarioles on one side join to form an oviduct which is lateral, small and with muscular wall.

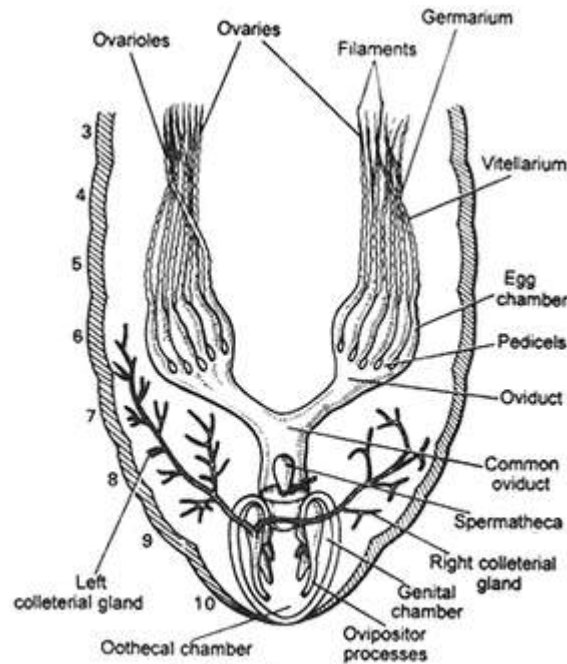
II. **Vagina:** Both the lateral oviducts unite to form a brown median common oviduct called vagina. It opens by female gonopore into genital chambers.

III. **Genital pouch:** It is large boat shaped structure where floor is formed by the seventh sternites, roof and sides are formed by the 5th and 9th sternites.

IV. **Collateral glands:** There is a pair of white much branched collateral glands, left is much larger than the right. Both these glands continue as collateral ducts which join to form a common duct which opens into the dorsal side of the genital chamber.

V. **Spermathecae:** These are a pair of club shaped; unequal sized one spermathecae being larger than the other structure. Both the spermathecae unite to form a short common duct which pens into the genital chamber on a small spermathecal papilla.

VI. **External genitalia of female:** It consists of an ovipositor formed by two gonapophyses. The ovipositor lies above and behind the gonopore, it is short and has three pairs of elongated process, a pair of long thick arms lying dorsally and enclosing two pairs of slender tapering arms.



Periplaneta americana
Female reproductive organs in dorsal view

Mouth Parts of Insects

Insects are the largest group of animals that occupy every type of habitat available on earth with the possible exception of sea. They also feed on a variety of food in different habitat condition. They are plant feeding, predators, parasitic and decomposers, for which they must possess different types of feeding apparatus. When the insects evolved, they had biting and chewing type of mouth parts to feed on the plant material available on land but as their food choices changed with time, these mouth parts modified to suit the type of food eaten.

Biting and chewing type:

These type of mouh parts are found in Cockroach & grasshopper. It is the primitive type of mouth part and consists of the following parts.

i. Labrum : (Upper lip)

It is flap like, bilobed and attached to the clypeus by an articular membrane. It is movable. It covers the mouth cavity from above. It helps to pull the food into the mouth. It holds the food in position so that mandibles can act on it. It forms the roof of the pre oral food cavity.

ii. Labrum-epipharynx:

Inner surface of the labrum is referred to as epipharynx. It is frequently membranous and continuous with the dorsal wall of pharnyx. It is an organ of taste.

iii. Mandibles:

There is a pair of mandibles. They are the first pair of jaws. They are also called as primary jaws or true jaws. Mandibles articulate with the cranium at two points. They are heavily sclerotised. They are toothed on their inner border.

There are two types of teeth. Distal are sharply pointed and are called incisor or cutting teeth and proximal teeth are called molar or grinding teeth. They act transversely to bite and grind the food into small fragments.

iv. Maxillae:

They are paired and more complicated than mandibles. They are called secondary jaws or accessory jaws. At proximal end the first sclerite cardo joins the maxilla to head.

The second sclerite is called stipes which articulates with cardo. Stipes carries a lateral sclerite called palpifer which bears a five segmented antenna like maxillary palp.

On the distal end of the stipes, there are two lobes. The outer lobe is called galea and inner lobe is lacinia which is toothed. Maxille direct the food into the mouth.

They hold the food in place when the mandibles are in action. They act as auxiliary jaws and assist in mastication of food. Sense organs connected with the perception of touch, smell and taste are abundantly found in palpi.

v. Hypopharynx :

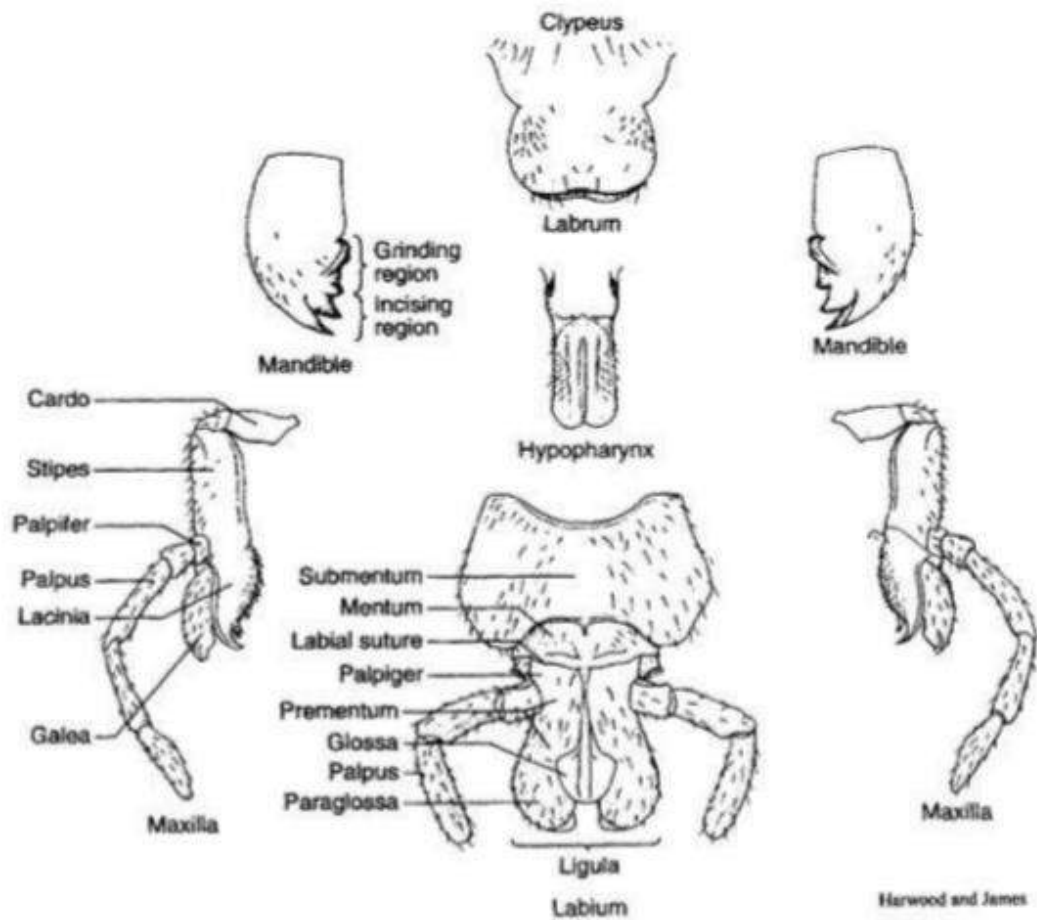
It is a tongue like organ. It is located centrally in the preoral cavity. Salivary gland duct opens through it.

vi. Labium /lower lip:

It is a composite structure formed by the fusion of two primitive segmented appendages. It bounds the mouth cavity from below or behind. It forms the base of the preoral cavity.

It consists of three median sclerites viz., submentum (large basalsclerite), mentum (middle sclerite) and prementum (apical sclerite). On the lateral side of the prementum there are two small lateral sclerites called palpiger bearing three segmented labial palpi.

Distally prementum bears two pairs of lobes. The other pair of lobes is called paraglossae and inner pair of lobes, glossae. Both pairs when fused are called ligula.



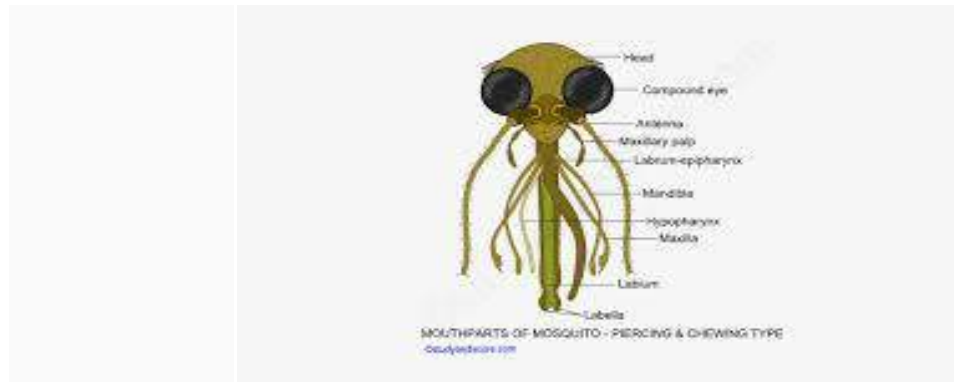
Piercing and sucking type

These type of mouth parts are found in mosquitoes. Mouthparts of female mosquito consists of an elongate labium which is grooved forming a gutter which encloses six stylets.

The stylets are composed of labrum - epipharynx (enclosing the food canal), the hypopharynx (containing the salivary canal), two maxillae and two mandibles.

Both the ends of maxillary stylets and mandibular stylets are saw like and suited piercing flesh. The stylets are inserted into host's skin by a strong downward and forward thrust of body.

Both mandibles and maxillae are reduced in male and they feed on plant nectar and juices of decaying fruits. Female pierces the skin of human beings into which it injects saliva containing an anticoagulant and and sucks up the blood. Labium does not pierce but folds up or back as stylets pierce. Maxillary palpi are present.

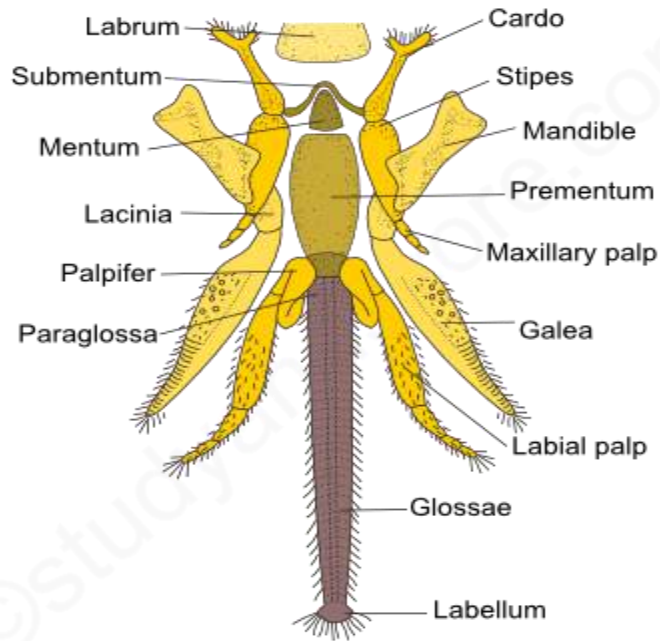


Chewing and lapping type :

These type of mouth parts are found in honey bee. Labrum and mandibles are as in biting and chewing type of mouth parts. But mandibles are blunt and not toothed.

They are useful to crush and shape wax for comb building; ingest pollen grains and other manipulative functions. Maxillolabial structures are modified to form the lapping tongue.

The tongue unit consists of two galea of maxillae, two labial palpi and elongated flexible hairy glossa of labium. The glossa terminates into a small circular spoon shaped lobe called spoon or bouton or flabellum which is useful to lick the nectar.



MOUTHPARTS OF HONEY BEE - CHEWING & LAPPING TYPE
 ©studyandscore.com

Sponging type :

These type of mouth parts are found in House fly. The proboscis is fleshy, elbowed, retractile and projects downwards from head. The proboscis can be differentiated into basal rostrum and distal haustellum.

The proboscis consists of labium which is grooved on its anterior surface. Within this groove lie the labrum-epipharynx (enclosing the food canal) and slender hypopharynx (containing the salivary canal).

Mandibles are absent. Maxillae are represented by single segmented maxillary palpi. The end of the proboscis is enlarged, sponge like and two lobed which acts as suction pads. They are called oral discs or labella.

The surfaces of labella are traversed by capillary canals called pseudotracheae which collect the liquid food and convey it to the canal. Labella function as sponging organs and are capable of taking exposed fluids. These insects often spit enzyme containing saliva onto solid foods to liquify them.

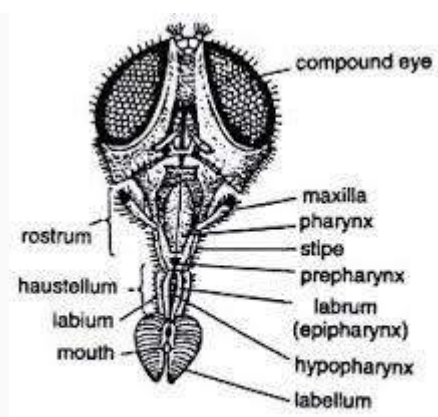


Fig. 2B.16 : Musca sp. (House fly). Mouth parts

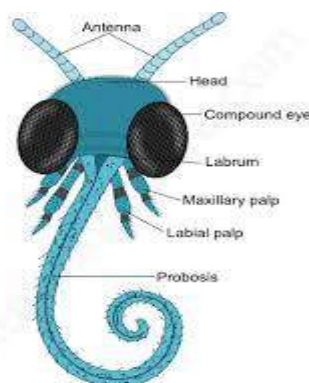
Siphoning type :

These type of mouth parts are found in Moths and butterflies. Mouth parts consists of elongate sucking tube or proboscis. It is formed by two greatly elongated galeae of maxillae which are zippered together by interlocking spines and hooks.

Galeae are grooved on their inner surface and when they are fitting together closely they form a suctorial food canal through which the nectar is sucked up.

The proboscis is coiled up like watch spring and kept beneath the head when it is not in use. By pumping of blood into galeae, the proboscis is extended.

The other mouth parts are reduced or absent except the labial palpi and smaller maxillary palpi.



MOUTHPARTS OF BUTTERFLY - SIPHONING TYPE
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Larval forms of Crustaceae and their significance

Introduction

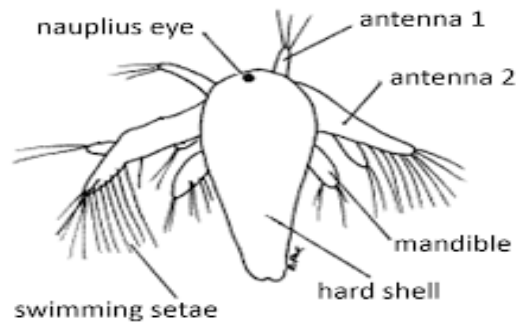
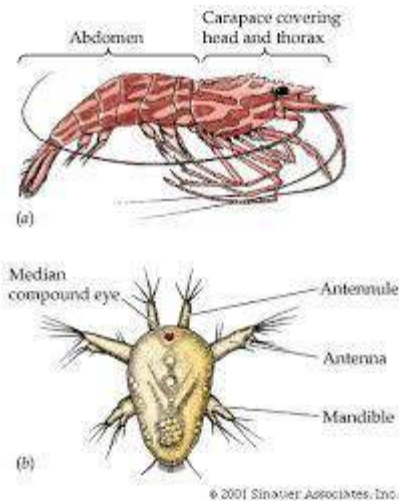
The animals belonging to class Crustacea shows both direct and indirect development. In the direct development, the egg hatches into young one resembling adult in general structure. Progressive growth and differentiation transforms the young ones into adult.

Whereas indirect development includes larval stages which later become adults. These larval stages are different from the adult in form and structure.

The larval stages achieve adulthood through the process of metamorphosis. The following is the detailed explanation of each of the larval forms of crustaceans.

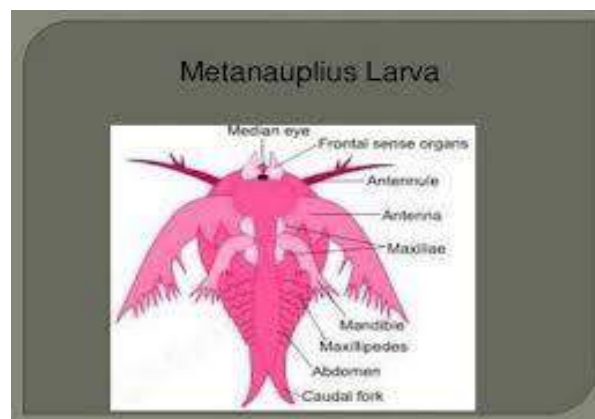
Nauplius larva

- It is the first larvae hatched from egg in most of the crustaceans.
- It is free swimming larvae.
- It is minute and microscopic.
- The body has indistinct regions like a simple median eye also called as nauplius eye, three pair of jointed appendages (uniramous antennule, biramous antennae and mandible).
- Mandibles along with antennae are helpful in food collection.
- In some forms nauplius larva develops straight away into adult, but in many other crustacean forms it gives rise to other intermediate larval forms like metanauplius, protozoaea, zoea, crypsis, mysis, megalopa, phyllosoma, alima .



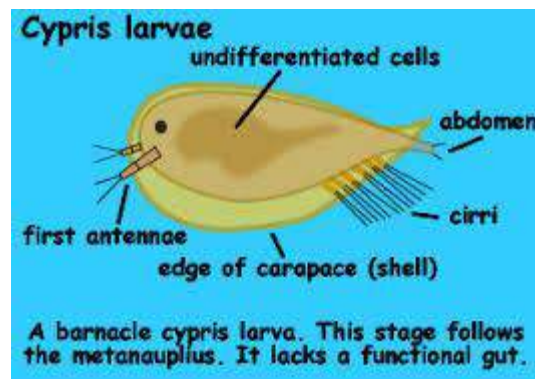
Metanauplius larva

- It is the second larva of prawn
- It develops from the nauplius larva.
- The body has an anterior oval cephalothorax, an elongated trunk-region and an abdomen terminating in a caudal fork provided with setae.
- The anterior end has a pair of frontal sense organs and median eye.
- Dorsal shield of the head grows back to form carapace.
- The larvae has three pair of appendages just as in nauplius, it also develops the rudiments of 4 pairs of appendages, which later become the maxillae and 2 pairs of maxillipedes of the adults.



Cypris larva

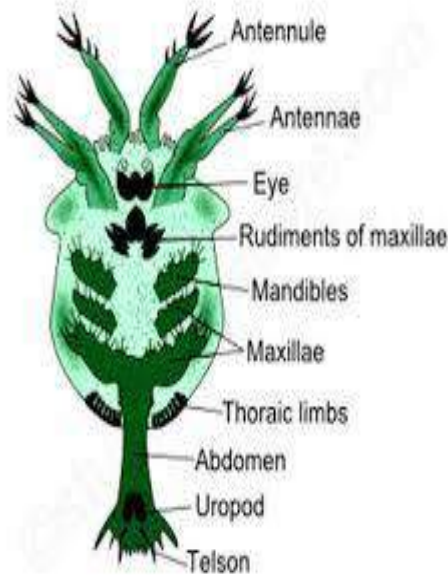
- It is the larvae of Sacculina, Balanus and Lepas.
- It develops from nauplius
- It is a free swimming larva.
- It is triangular in shape with bivalved shell.
- The larva has seven pairs of appendages, namely a pair of antennules and six pair of thoracic appendages.
- A median eye is present.
- The larva contains a mass of germ cells.
- It undergoes a remarkable series of metamorphoses to become the sessile adult form.



Protozoa larva

- The metanauplius larva is succeeded by the protozoa stage
- It is divisible into broad segmented cephalothorax covered with a small carapace and a slender abdomen which is unsegmented.
- Abdomen terminates in a forked telson.
- The carapace becomes enlarged and covers the dorsal surface anteriorly.
- The 7 pairs of appendages present in the metanauplius become well-developed and capable of movements.
- The rudiments of paired lateral eye begin to appear near the median eye.

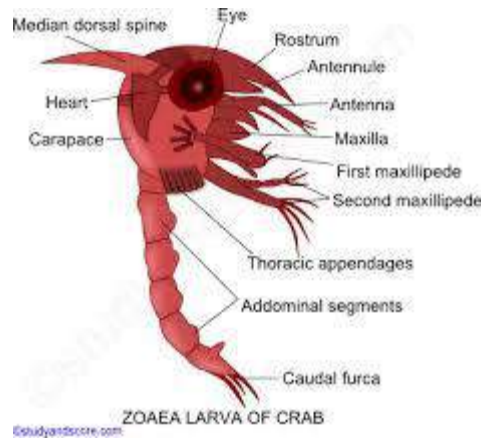
- The rudiments of the remaining posterior six thoracic segments are also marked off, but the abdomen is still unsegmented and without limbs.
- The protozoaea swims by antennae.
- Marine prawns, *Penaeus* hatch in to protozoaea larva.



Zoea larva

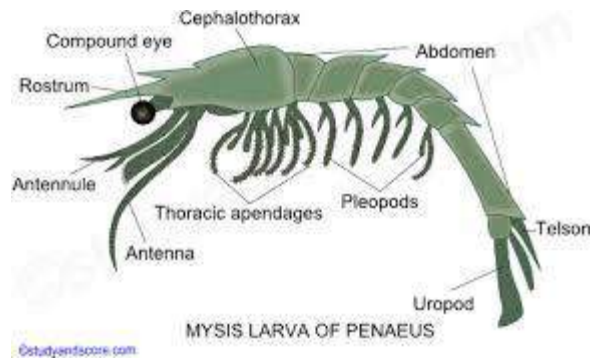
- Zoea is the second important larvae of the Crustacea, after the nauplius larva.
- Protozoaea stage is succeeded by the zoea stage.
- The zoea is characterized by a distinct cephalothorax and abdomen, 8 pair of appendages and buds of 6 more, and resembles the adult Cyclops.
- The cephalothorax is immensely developed and covered by a helmet-like carapace, which is produced into two long spines, an anterior median rostral and a posterior median dorsal.
- Two lateral spines are also present.

- The paired lateral and stalked compound eyes become well-formed and but remaining 6 pair of thoracic appendages appears in the form of bud.
- The long abdomen is distinctly made of 6 segments, and terminates in a caudal furca and still lacking in appendages.
- Zoea swims by means of thoracic limbs.



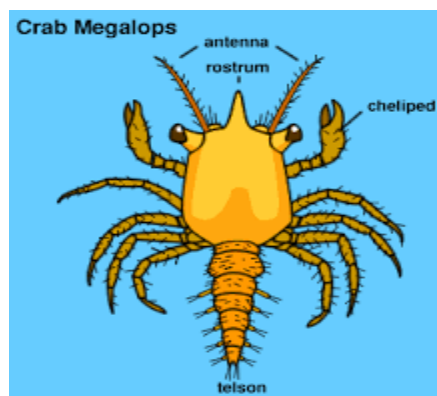
Mysis larva

- In *Penaeus*, the zoea larva, instead of converting into the megalopa stage, moults into the post larval mysis larva.
- It has 19 pairs of appendages. All the thoracic appendages are biramous. Even the 5 pairs of posterior thoracic legs are biramous with flagellar exopodites which take up the locomotory function.
- The abdomen develops similar to that of the adult form, with 5 pairs of biramous pleopods and a pair of uropods and a telson.
- The mysis larva metamorphosis into the adult prawn by the loss of the exopodites on the thoracic leg.



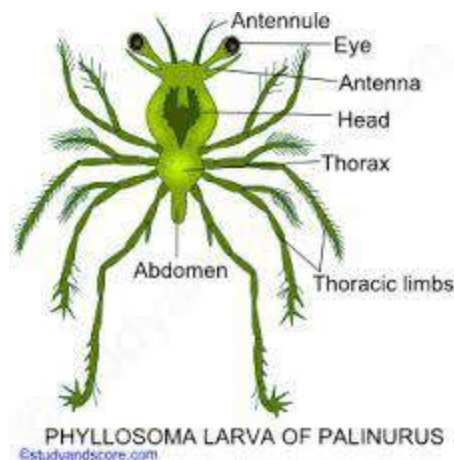
Megalopa larva

- In true crabs, the zoea larva or metazoea larva passes through successive moults into the post larval megalopa stage.
- It has a broad and crab-like unsegmented cephalothorax.
- The carapace is produced anteriorly into a median spine.
- The eyes are large, stalked and compound.
- All the thoracic appendages are well formed of which the last 5 pairs are uniramous.
- The abdomen is also well formed, straight and bears biramous pleopods.



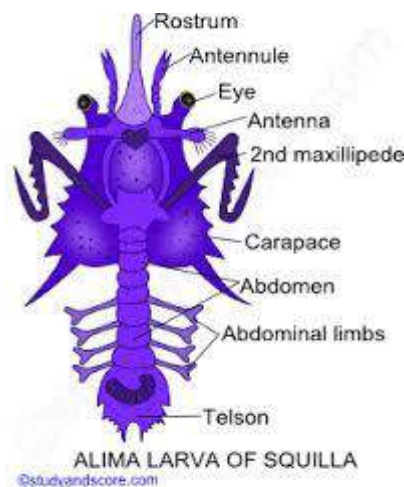
Phyllosoma larva

- In the rock- lobster (Palinurus), the newly hatched larva is called the phyllosoma larva or glass- crab
- It is a greatly modified mysis stage.
- It is remarkable for its large size, extremely flattened and leaf- like delicate form and glassy transparency.
- A narrow constriction demarcates the head from thorax.
- A large oval carapace covers the head and the first two thoracic segments.
- The eyes are compound and borne by large stalks.
- Only anterior 6 pairs of thoracic appendages are present in the newly hatched larva.
- The first thoracic appendages or maxillipedes are rudimentary (Palinurus) or absent (Scyllarus) and the second are uniramous; succeed by 4 pairs of very long and biramous legs with exopodites.
- Last two pairs of thoracic appendages are usually absent.
- Abdomen, though indistinctly segmented is very small and limbless.
- Phyllosoma undergoes several moults before reaching the adult form.



Alima larva

- The so-called alima larva of *Squilla* hatches out from the egg directly
- It is a modified zoea larva form.
- It is a peagic larva, having a glass-like transparency and occurring in large numbers in the plankton. It has a slender form, and a sort and broad carapace. All the head appendages are present. But only is 6-segmented, having 4 or 5 pairs of pleopods. The alima larva differs from the zoea larva in the armature of the telson and a very large raptorial second maxillipedes.



Importance of Larval Stages:

1. They help in wide dispersal of the species.
2. The larval stages help in establishing relationships between various groups.
3. Occurrence of nauplius stage in all crustaceans connects the different representatives of this class together. As referred to, the nauplius establishes relationship of some obscure animals like *Sacculina* where adult has lost the characters of the class and even the phylum.

In fact, it is the presence of nauplius stage in its life history that connects *Sacculina* to class Crustacea and further the presence of cypris stage relates it to subclass Cirripedia.

4. If Haeckel's law of recapitulation (which states that every organism during its development, i.e., ontogeny, repeats its evolutionary history, i.e., phylogeny) is considered true then it can be said that the nauplius stage represents the ancestral form of crustaceans because all crustaceans invariably pass through nauplius stage during their development.

Hence, it can be concluded that present day crustaceans have evolved through nauplius stage.