ARTHROPODA EXTERNAL CHARACTERS

- Phlyum Arthropoda was established by **Von Sicbold.**
- Arthropoda constitute about 80% of the known animal species.
- Insecta constitutes the **largest class** in the animal kingdom.
- They exhibit the greatest adaptive radiation.
- Athropods are the **most successful** of all the known animal groups. it is due to Presence of hard and rigid exoskeleton, which is in the form of chitinous cuticle.
- Presence of jointed legs/appendages which show rapid movement with the help of bundles of striated muscles. **Striated muscles** appeared for the first time in the arthropods among the invertebrates.
- Presence of extensive haemocoel which is a part of open type of blood vascular system.
- **Evolutionary characters of Arthropods:**
- Arthropods arc believed to have evolved from worm like ancestors, hundreds of millions of years ago.
- Arhropods are characterised by true **metamerism,** a heteronomous type of segmentation.
- The segments of the body are differentiated into functional regions called **tagmata.**
- The body is divisible into 3 parts or tagmata - Head. Thorax and Abdomen.
- The body is externally covered by waxy **chitinous exoskeleton.**
- Main function of the cuticle or exoskeleton is to prevent the loss of water.
- In terrestrial organisms **tracheae** are the respiratory organs.

Cockroach

- Cockroach is nocturnal, omnivorous and cursorial animal.
- **Periplaneta Americana** common household Cockroach.
- There are about 2,600 genera of cockroaches.
- **Periplaneta americana and Blatta orientalis** are common in India.
- Periplaneta americana is large in si/.c compared to Blatta.
- Periplaneta is honey in colour, wings are longer than the body in both males and females.
- Its pronotum is oval in shape and has two large brown patches.
- Blatta orientalis—Oriental Cockroach ii) In Blatta wings arc long but do not extend beyond the abdomen in the males.
- Blatta orientalis is snuff in celour. Pronotum is completely black in colour.
- The wings arc reduced and vestigial in female Blatta orientalis.
    1. Blatella germanica-German Cockroach
    2. Blatta australasiae-Australian Cockroach

Segmentation:

- Total no. of segments in adult Cockroach is 19 and in embryo is 20
- The head region is with 6 fused segments, the fusion of segments is also known as
- tagmosis.
- Thoracic region is with 3 segments. Abdominal region is with 10 segments.
- Total number of abdominal segments during the embryonic stage is 11

Head

- The exoskeleton of the head of Cockroach is called head capsule**.**

- The head capsule has both paired and unpaired scleritcs.
- The head capsule is composed of 6 chitinous plates.
- They are - 2 epicranial plates, 1 Frons, 1 clypeus, 2 genae (cheek plates).
- The sclerites in the head are immovably articulated.
- The part of head between eyes is **vertex.**
- The opening on the posterior side of the head is called **occipital foramen.**
- A pair of whitish spots is present close to (lie base of the antennae arc called **fenestrae.**
- Fenestrae in Cockroach arc vestigial ocelli or simple eyes, they arc **photoreceptors.**
- The head of cockroach is called hypognathus.

Appendages of head:

- The first and third segments do not beat- any appendages.
- The second segments bears a pair of antennae.
- Antenna is divisible into 3 parts, large basal segment scape, short pedicel and many jointed flagellum.
- Antennae arc **tactile** and **olfactory** sense organs.
- Fourth segment bears a pair of mandibles.
- Fifth segment bears a pair of first maxillae.
- The sixth segment bears a pair of second maxillae.

MOUTH PARTS

- These are **biting and chewing type.**
- In Cockroach the mouth parts contain — a) Labium or upper lip b) Mandibles c) Hypopharynx or tongue d) First maxillae e) Labium or lower lip or second maxillae
- In Cockroach labium is attached to the clypeus.
- Labium bears **gustatory sensilla** on its inner surface, useful for detecting the taste of food material, it also helps in handling the food
- A pair of triangular, hard, unjoinlcd, stout, chitiniscd structures called mandibles present, one on either side of the mouth behind the labrum.
- Chitinous teeth are present on the inner margin of mandibles.
- Mandibles are moved in the horizontal plane against each other by two pairs of muscles called **adductor** and **abductor muscles.** Each mandible bears a sensory lobe called **prostheca** near its base.
- The first maxilla has two basal segments called cardo and stipes.
- Stipes bears the maxillary palp which is **5** segmented.
- The smaller chitinous lobe present at the base of the maxillary palp is **palpifer.**
- Inner to the palp, attached to the stipes, there are two chitinous lobes. They arc inner **lacinia (pinccr like)** with two terminal denticles and outer **galea** (soft, blunt, hood like).
- The maxillary palps are used for cleaning the antennae and the front pair of legs.

The labium or the lower lip is considered to be formed by the fusion of the second pair of maxillae. Its basal segments is called **postmcnlum** (representative of the two fused cardos). It included two segments, a broad rectangular **subinentum** and a triangular **mentuni. I'rementum** is the small segment in front of the mcntum. It is formed by the fusion of two **stipes.** The labial palp in Cockroach is 3 segmented it is attached to the mcntum by **palpigcr.** In the labium outer paraglossae (comparable to galeae) and inner glossae (comparable to lacineac) arc present at distal end of prcmcmlum. They arc together constitute the **ligula.**

- The hypopharynx (lingua) of cockroach is also known as tongue, hangs into prcoral cavity. It divides the proximal part of the prcoral cavity into a larger anterior **cibarium** and a posterior **salivarium**
- The common salivary duct opens into the salivarium at the base of the hypopharynx

Neck or cervicum

The head is attached to the thorax by cervicum or neck and it is supported by a pair of dorsal and two ventral sclerites called cervical sclerites.

Thorax:

- It is the second tagma of the body cockroch.
- In cockroach thorax consists of 3 segments. They are prothorax, mesothorax and metathorax.
- Each thoracic segment is surrounded by 4 chitinous plates - a tergal plate, a sternal plate and 2 plurae.
- The tergal plates of thorax are pronotum, mesonolum and metanotum.
- The largest tergal plate is **pronotum.**
- Thorax bears two pairs of stigmata, two pairs of wings and three pairs of legs.
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Legs:

- These arc articulated with.the **pleura** and **sterna** of the thoracic segments.
- All the three pans of legs have the same structure and so they arc serially homologous.
- In Cockroach 3 pairs of legs are present.
- Each leg is made up of 5 segments or (MHtimitres vUcv arc coxa, trochanter,
- femur, tibia and tarsus.
- Coxa articulates with the thoracic segment. it is broad and highly muscular.
- The LONGEST PODOMERE in the leg of Cockroach is tibia.
- The **shortest** and triangular podomere is trochanter.
- Long cylidrical lemur, which is the strongest of all.
- The 5 jointed part in the leg is tarsus (with 5 tarsomeres) which is long and thin.
- The last segment of the tarsus is called pretarsus ends with a pair of claws and a
- spongy pad **arolium** or **pulvilus.**
- The tarsomeres of tarsus bear adhesive pads known as **plantulae.**
- Arolium and claws help in locomotion on rough surface. Plantulae are useful in locomotion on smooth surface.

Wings

- The wings in Cockroach arise from the dorsal surface of mesothorax and metathorax.

- In Cockroach 1st pair of wings are thick, leathery and protect the 2nd pair of wings. They are not useful in flight.
- The 1st pair of wings arc called tegmina or elytra.
- The 2nd pair of wings are thin membranous and delicate. They are called hind wings.
- Cockroach flies with the help of 2nd pair of wings.
- The 2nd pair of wings are supported by chitinous nervures or veins.
- WINGS ARE MOVED BY THE tergosternal muscles and longitudinal MUSCLES.

Abdomen:

- The 10th abdominal segment has no sternum.
- There is a pair of triangular, plate like structures at the posterior side of cockroach **below** the 10^{th} tergum. They are called **paraprocts.** Anus lies between them.
- The abdomen bears 8 pairs of stigmata, anus and a pair of anal cerci.
- Anal cerci are developed from junction between 9th and 1 Oth segments on the dorsal side one on each side. Total number of segments present in anal **cercus 15.** They occur in both male and female cockroaches. They are regarded as the appendages of the **vestigial eleventh segment.**
- Anal styles are **unsegmented,** attached to the **9th** abdominal sternum one on either side present in male cockroach.
- In female the sternum of 7th, 8th and 9th segments form a brood pouch or **genital pouch.**
- In female 7th sternal plate bears a pair of gynovalvular plates posteriorly which form floor of the genital pouch on the ventral side. 8th sternum of the female forms the anterior wall of the gential pouch. Female genital aperture is present in the middle of the 8th sternum
- The 9th sternum forms the roof of the genital pouch. The anterior part of the genital pouch is callcd **gynatriuni** and the posterior part is callcd **oothecal chamber.**
- In both male and female genital apertures are surrounded by chitinous structures known as gonapophyses.
- 3 pairs of gonapophyses are present in female and **one pair to 8th** sternum and **two pairs to 9th** sternum.
- Gonapophyses help in copulation, formation of ootheca and oviposition.
- Deposition of eggs in ootheca is oviposition. Gonapophysis which help in oviposition arc called ovipositors.
- The gonapophyses of the male are called phallomeres and they are formed from the **9th sternum.** The male has three phallomeres on the ventral side.
- The left phallomcrc bears a pseudopenis, a titillator and an asperate lobe. The male gential aperture is present at the base of the ventral phallomere.
- The right phallomere bears a hook and a serrate lobe.

Body wall

- In cockroach, body wall consists of 3 distinct layers - cuticle, epidermis and dermis.

Cuticle:

- It is the outer and non-living layer, secreted by epidermal cells.
- Cuticle is 3 layered (i) Epicuticle (ii) Exocuticle, (iii) Endocuticle.
- **Epicuticle** is extremely thin nonchitinous layer present on the entire body surface and consists of the following three parts, but does not contain chitin.

- It consists of outer **lipoprotein cement** layer, **middle wax** layer and **inner layer of polyphenols.**
- **Exocuticle** is the middle layer made up of hard chitin. The rigidness of the scleritcs is due to the polymerisation of chitin and cross - linking of proteins. This process is called sclerotisation.
- Exocuticle is absent in arthrodial membrane. It is pigmented.
- Exocuticle is pigmented layer which contains melanin pigment.
- **Endocuticle** is the inner layer of the cuticle. It consists of several layers of chitin. Endocuticle does not undergo sclctotisation and is **lysed** just before each moulting or ecdysis.

Epidermis:

- Epidermis consists of a row of elongated cells called columnar cells.
- Epidermal cells are of different types.
- Columnar epidermal cells: Most of these cells arc glandular cells, which secrete the cuticle. Some of these cells secrete enzymes that lysc the endocuticle during moulting.
- Trichogen cclls -form movable bristles.
- Tormogcn cells - form the sockets of bristles at their bases.
- Oenocytcs - wax secreting cells.)

Basement membrane:

- Thin layer made up of connective tissue.

ENDOSKELETON

- Cockroach has some cndoskcletal structures for attachment of muscles. The sclerotiscd cuticle is invaginated at several places.
- These invaginations are referred to as **apodemes.** Apodcmes offer rigid surfaces for the attachment of muscles.
- Apodermes in the head fuse together to form an internal protective structure called **Tentorium,** which is a sort of endoskeleton of head.
- It provides the surface for the attachment of muscles and gives support to the head.

STINK GLANDS

- Invaginations of epidermis **between 5th and 6th abdominal terga** from the stink glands, whose secretions have an offensive odour.

BODY CAVITY AND COELOM:

- The body cavity in the adult is filled with blood. So it is called **haemocoel.**
- The haemocoel is divided into three sinuses by Iwo diaphragms. The dorsal is the **pericardial sinus** that encloses heart.
- The middle is the **largest perivisceral** sinus, surrounding the alimentary canal. The ventral is the **smallest perineural** sinus that encloses the nerve cords.
- The **schizocoelom** is restricted to the spaces around the reproductive organs.

FAT BODIES:

- The perivisceral cavty contains many large sized fat bodies. These bodies are called **corpora adiposa.**

- A fat body has many lobules containing four types of cells.
- Trophocytes : Which store food in the form of glycogen, fats and proteins.
- Mycelocytcs : Which contain **symbiotic bacteria** that synthesize amino acids.
- Oenocytes : Secrete lipids and store them.
- Urate cells : Which store uric acid. Fat bodies are thus **analogous to the liver** of the vertebrates.

Locomotion:

Cursorial locomotion:

- Cockroach is a **cursorial** insect and it can run on the ground with the help of legs. During the cursorial locomotion cockroach forms two tripods with its legs.
- Each **tripod** is formed by foreleg and hind leg of one side and middle leg of the other side. In this process the fore leg pulls the body; while the hind leg pushes the body and the middle leg of the opposite side acts as a **pivot.**
- The process is repeated by the other three legs that form the other tripod. Due to the action of these two tripods, the insect moves in a zig zag pattern.

Flying:

- Though cockroach is a cursorial insect, it flies over short distances with the help of its wings.
- While flying the first pair of wings is stretched out at right angles to the body.
- The second pair of wings is moved up and down by the contractions and relaxations of **longitudinal** as well as **tergosternal muscles.**