MORPHOLOGY OF ANIMALS
COCKROACH

- Cockroaches are brown or black bodied animals that are included in class Insectaof phylum Arthropoda
- Bright yellow, red and green coloured cockroaches have also ben reported in tropical region.
- These size= 1/4 inches to 3 inches [0.6-7.6cm]

PERIPLANETA AMERICANA

Periplaneta americana (American Cockroach)

Phylum - Arthropoda

Class - Insecta

Order - Orthoptera

Family - Blattidae

Genus - Periplaneta

Species - Americana

Blatta Orientalis - Indian Cockroach

•Cockroach is a) nocturnal (active during night)

b) omnivorous

c) cursorial (fast running)

d) cosmopolitant (world wide distribution)

e) live in damp places (slightly wet)

• Cockroach is a pest and vector which can transmit a variety of bacterial diseases by contaminating food.

• Cockroach exhibit external segmentation.

• It's body is divided into 3 regions

1) HEAD - composed of 6 embryonic segments

2) THORAX - composed of 3 segments

3) ABDOMEN - composed of 10 segments

Total segments → Embryonic life - 19 segments

→ In adult - 13 segments

• Their body is externally covered by chitinous exoskeleton.

• SCLERITES - These are chitinous plate in cockroach.

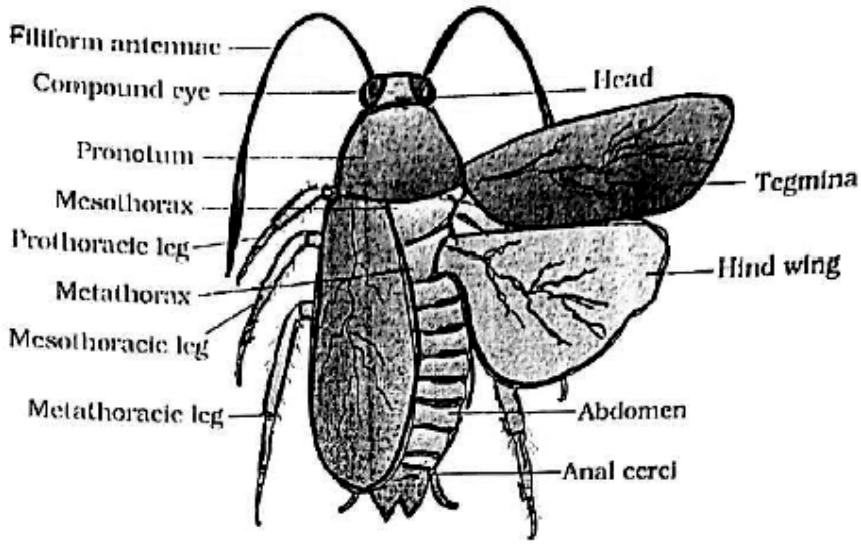
• It is of three types:

1. Tergites - These are dorsal skeletal plate / sclerites

2. Sternites - These are ventral skeletal plate.

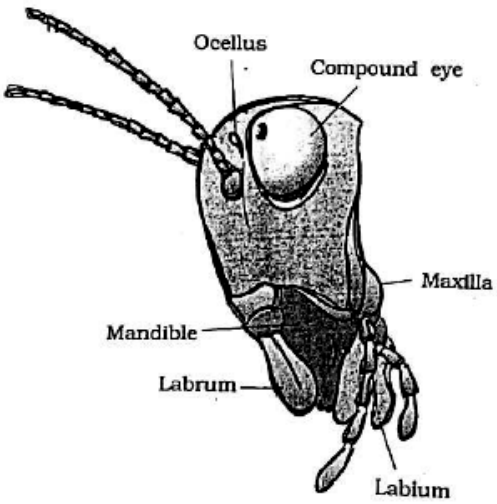
3. Pleurites - These are lateral skeletal plate.

• Arthrodial Membrane : These are thin and flexible membrane that connect adjacent sclerites.



I. HEAD

• Cockroach head is hypognathus i.e mouth parts are pointing downwards.



The head bears :

1) A pair of antennae : These are thread like structure arise from membraneous sockets lying in front of eyes

→ Antennae have sensory receptors that help in monitoring the environment

2) A pair of compound eyes - for vision

A compound eye bears :

i) Ommatidia - Each compound eye has about 2000 visual units called ommatidia .

ii) Rhabdome - It is the part of a light sensitive receptors in compound eye.

iii) Mosaic vision / nocturnal vision / apposition vision : In compound eyes, the images are formed in many units or many pieces with less resolution and more sensitivity. Such vision is called mosaic vision.

3) A pair of ocelli / simple eyes : It contains photo sensitive cells.

→ Simple eyes are considered as vestigial organ.

4) Mouth : Its mouth is biting and chewing type or mandibulate type.

→ Its mouth parts include :

1. Single labrum → Upper lip

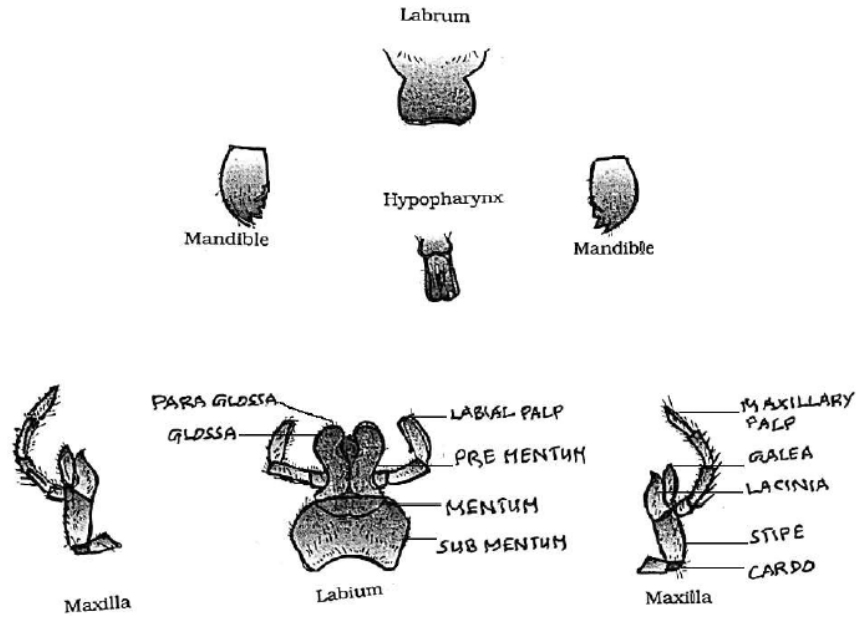
2. A pair of mandibles → Hard chitinous structures found below the labrum and it grind up food particles

3. A pair of maxilla → Present below the mandibles that pick up the food particles and push them into the mouth

4. Single Hypopharynx [Tongue] → _ A median flexible lobe, acting as tongue, lies within the cavity enclosed by the mouth parts.

→ The duct of salivary gland opens at the base of the tongue

5. Single labrum → Lower lip - prevent food from falling out



II. THORAX

Thorax has three segments like

1. PROTHORAX

2. MESOTHORAX

3. METATHORAX

• Its thorax bears :

A. WINGS $\rightarrow$ Two types

• Wings external beyond the tip of the abdomen in males.

• They have two pairs of wings, each pair arises from mesothorax and metathorax respectively:

1) ELYTRA or TEGMINA or FORE WINGS or MESOTHORACIC WINGS

• These are one pair of wings arises from Mesothorax

• Tegmina are opaque, dark and leathery and cover the hind wings when at rest

2) HIND WINGS or METATHORACIC WINGS

• These are one pair of wings arise from metathorax

• The hind wings are transparent, membraneous and are used in flight

B. WALKING LEGS : Three pairs

• They have three pairs of legs, each pair arises from the segments prothorax, mesothorax and metathorax

• Each walking leg has five segments like

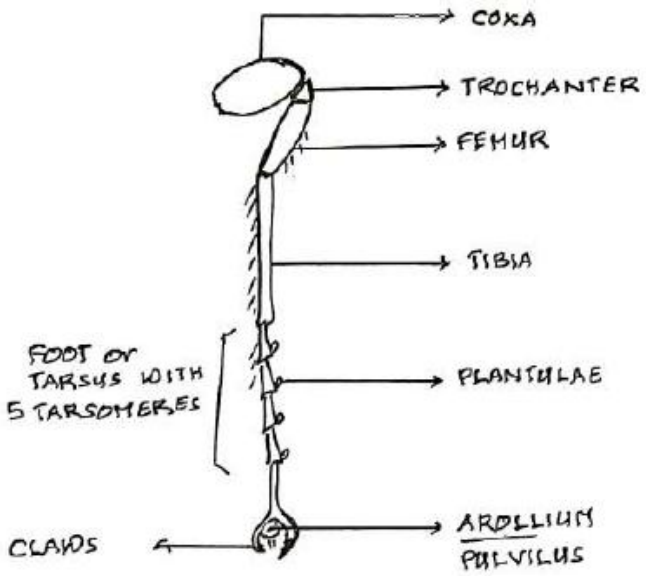
1) COXA : It is the short, broad part which is attached to pleuron (Thorax)

2) TROCHANTER : It is a small, triangular plate that connect coxa to the femur

3) FEMUR : It is the strongest part

4) TIBIA : It is the longest part in leg

5) FOOT or TARSUS: made of very short five movable podomeres or tarsomeres



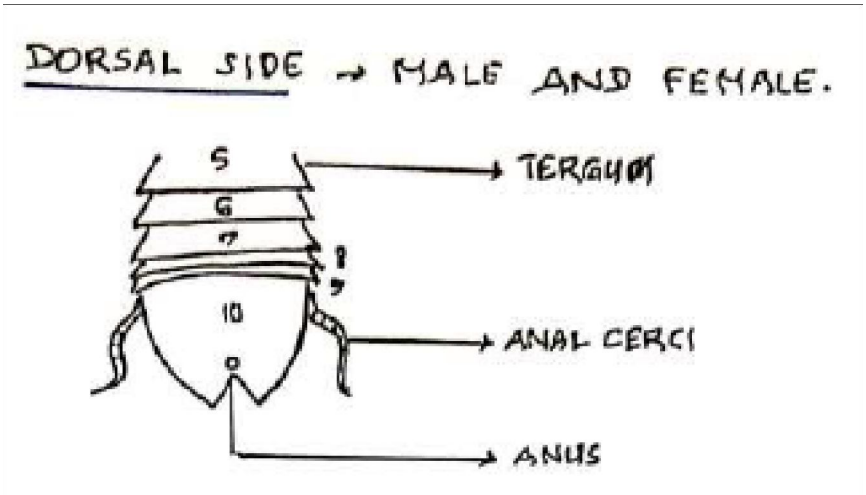
• PLANTULAE - These are soft adhesive pads on first four tarsomeres

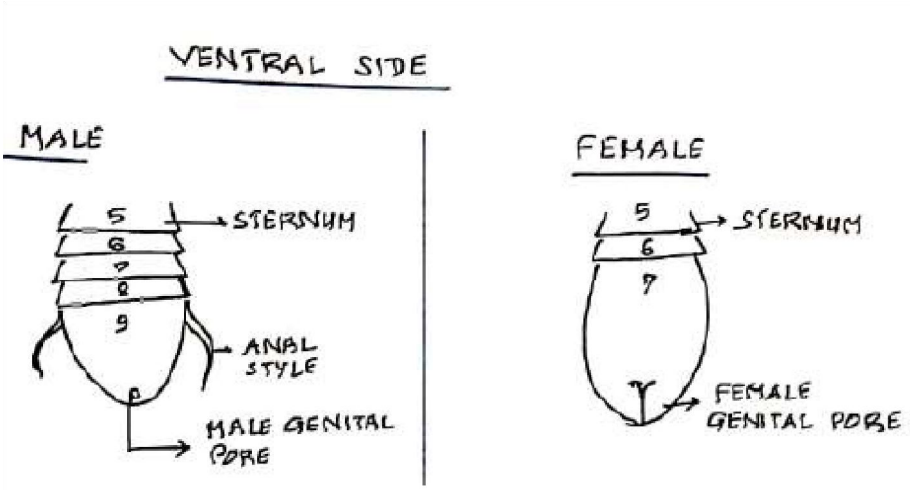
• AROLIUM/ PULVILUS: These are hair covered porous pads present in between the two claws, which prevent from slipping.

III. ABDOMEN - 10 Segments

• Anal cerci - In male and female, the 10th tergum - bears a pair of many segmented structures which are helpful in detecting sound and other vibrations [Auditory receptors]

• Anal style or Caudal style : In male, the 9th sternum bears, a pair of processes which helps in copulation.





MALE GENITAL CHAMBER

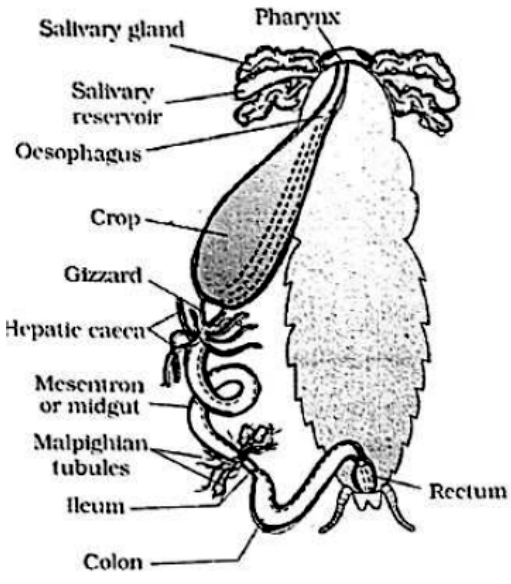
- It is present at the posterior end of abdomen bounded dorsally by 9th & 10th terga and ventrally by 9th sternum.

FEMALE GENITAL CHAMBER / BROOD POUCH

- In female 7th sternum is boat shaped and together with 8th & 9th sternum forms brood pouch
- Anus is present in 10th tergum

STING GLAND : It is present in between 5th and 6th abdominal tergite which secrete foul smell to avoid predators

I. DIGESTIVE SYSTEM



Alimentary canal of cockroach

- Cockroach is omnivorous
- It's digestive system has three regions.

  1) FORE GUT / STOMODIUM - It has parts like:

  • Buccal cavity

  • Pharynx

  • Oesophagus

  • Crop

  • Gizzard
- The entire foreguts is lined by cuticle.
- **Crop** : It is a sac like structure used for storing food.
- **Gizzard / proventriculus** - It is a small thick walled muscular structure which helps in grinding the food particles.
- **Teeth / Armerium** - Gizzard internally contains six chitinous plates called armerium
- **Salivary Glands** : These are a pair of bilobed glands present on the anterior region of crop.

  2) **MIDGUT OR MESENTERON**: It is the main organ of digestion and absorption.

  3) **HINDGUT/ PROCTODEUM** : It includes Ileum, colon and rectum
- Hindgut is broader than midgut
- **Hepatic caeca / Gastric caeca / Enteric Caeca:**

  These are 6 - 8 finger like structures present at the junction of foregut and midgut (around gizzard).

  It secrete enzymes like amylase, lipase etc. (digestive juice).
- **Malpighian Tubules :**

  These are 100 - 150 yellow coloured thin, filamentous structures present at the junction of midgut and hindgut which helps in excretion.

II. EXCRETORY SYSTEM

$\rightarrow$ Cockroach is uricotelic

- **Major excretory organ is Malpighian Tubules:**

  These are 100 - 150 microtubules present at the junction of midgut and hindgut (around ileum)

  Each malpighian tubule is lined by glandular and ciliated cells.

  Malpighian tubules absorb nitrogenous waste products and convert them into uric acid which is excreted out through the hindgut.
- **Accessory excretory organs:**

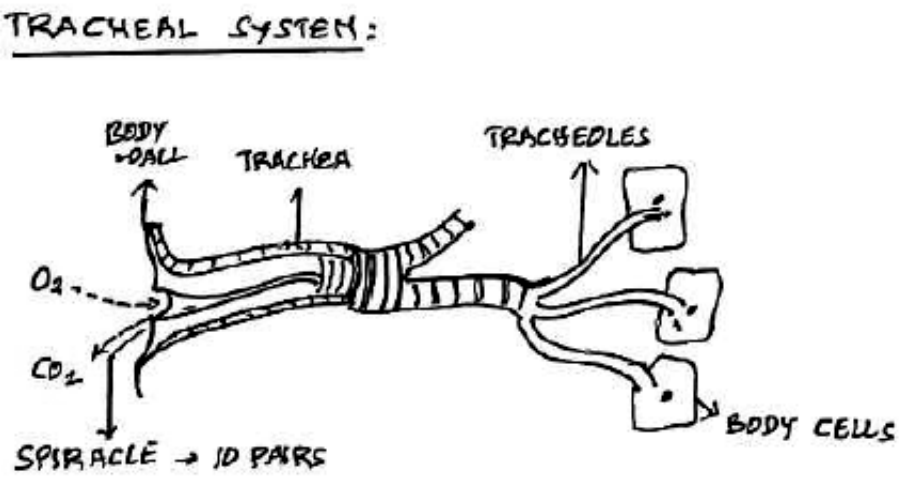
  1) Cuticle

  2) Fat body

  3) Nephrocyte

  4) Uricose Gland

III. RESPIRATORY SYSTEM



Their respiratory system consists of tracheal system

- Tracheal system includes;

  a) 10 pairs of spiracle : 2 pairs in thorax and 8 pairs in Abdomen.

- **Two pairs of thoracic spiracles** - First pair between pleuron of prothorax and meso thorax.

  Second pair between mesothorax by metathorax.

- **Eight pairs of abdominal spiracles** - First pair of abdominal spiracles on tergum of first segment and remaining 7 pairs of spiracles present on pleuron.

- The opening of spiracles is regulated by sphincter muscle.

- First and 3rd pair of spiracles [1st thoracic and first abdominal) always remain open while remaining

  8 pairs open only during respiration.

  b) Trachea : The tubes leading from spiracles.

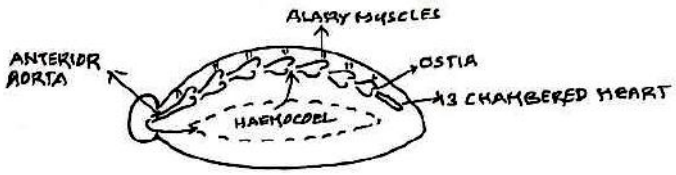
  c) Tracheoles : Microscopic tubules from trachea and it end in cells.

  This elaborate tracheal system carries oxygen directly to body cells.

Respiration:

- Respiration is by the action of tergo-sternal muscle.
- Due to the contraction of tergo - sternal muscle expiration take place and its relaxation leads to inspiration.
- Inspiration is a passive process about expiration is an active process.

IV. CIRCULATORY SYSTEM



- Cockroach has open type of circulation.
- Its circulatory system includes;

  a) **Haemolymph** → It is the colourless blood containing colourless plasma and haemocyte.

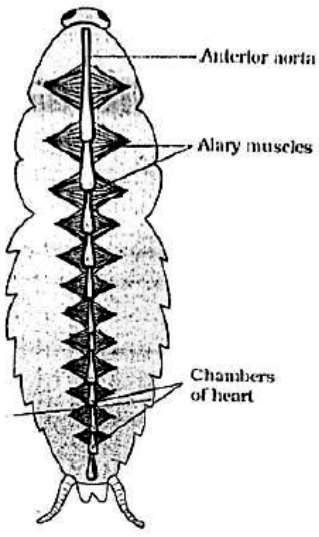
  b) **Haemocyte** → These are phagocytic cells.

  c) **Haemocoel** → It is the blood filled body cavity.
- It's haemocoel contains three sinuses.
- **Pericardial sinus** → present around the heart and Aorta.
- **Perivisceral sinus** → present around alimentary canal.
- **Perineural sinus** → present around the nerve cord.

  d) 13 chambered dorsal neurogenic heart. [under the control of nervous tissue].
- **Ostia** : It is a pair of opening present at the posterior end of each chamber.
- Ostia allow the flow of blood from haemocoel to heart.
- **Alary muscles** : These muscles connect heart to dorsal body wall or tergum.
- Blood vessels are poorly developed and open into space [HAEMOCOEL]

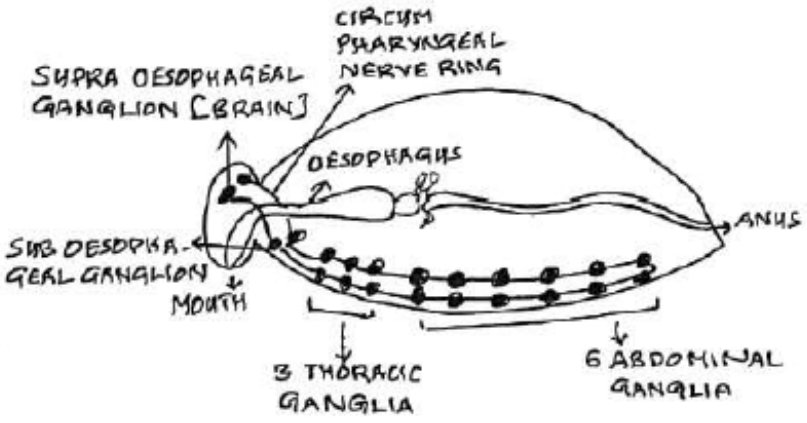
CIRCULATION

- Blood from sinuses enter the heart through ostia and is pumped anterior to sinus again.



Open circulatory system of cockroach

V. NERVOUS SYSTEM



Its nervous system consists of double ventral venous cord with:

A) Supra oesophageal ganglion $\rightarrow$ Present in head region which supplies nerve to antennae and compound eyes

B) Circum oesophageal ring / Nerve Ring / Brian Ring

C) Sub oesophageal ganglion

D) 9 segmental ganglia , i.e, 3 in thorax and 6 in abdomen.

Its head bears a bit of nervous system and the major part present in the ventral part of the body.

If the head of the cockroach is cut off, it will still live for as long as one weak.

- **SENSE ORGANS:**

Its major sense organs are:

a) A pair of antennae

b) A pair of compound eyes

c) A pair of simple eyes / ocelli

d) A pair of labial palp

e) A pair of maxillary palp

f) A pair of anal cerci

VI. ENDOCRINE SYSTEM (3 glands)

Endocrine system make their first appearance in arthropoda.

Its endocrine system includes 3 glands like;

a) **Corpora Cardiaca** : Its hormones regulate metabolism respiration, heartbeat etc.

b) **Corpora Allata** : It secrete Juvenile hormone or neotinin

This helps to maintain juvenile characters and prevent moulting.

c) **Prothoracic glands**: To secrete moulting hormone or ecdysone or growth hormones.

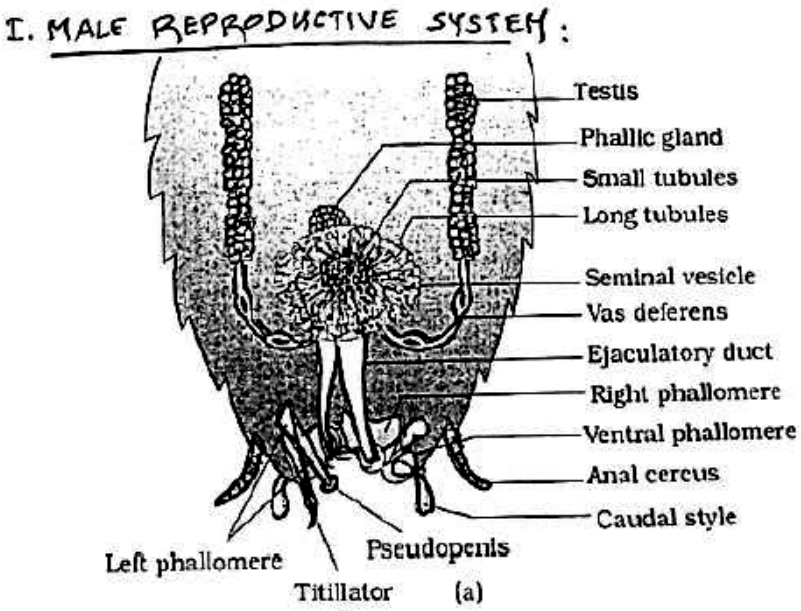
It control ecdysis or moulting which is primarily meant for growth.

PHEROMONES

These are ectohormones released into the environment by an insect.

In cockroach, pheromone is helpful in attracting opposite sex.

VII. REPRODUCTIVE SYSTEM



- Male reproductive system includes:

a) A pair of trilobed testis „_ present in segment 4 to 6

b) A pair of vas deferens „_ these are thin ducts each arising from a testis.

c) A pair of seminal vesicle → each vas deferens posteriorly dilated to form seminal vesicles.

→ They temporarily store spermatophore (bundle of sperms).

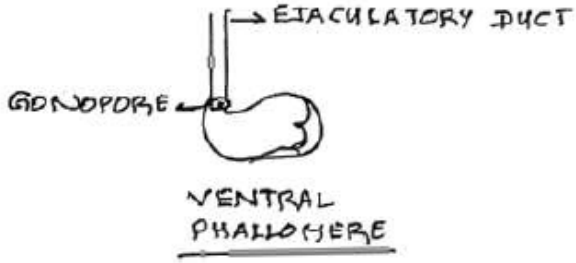
d) Ejaculatory duct → It is a median muscular tube into which two seminal vesicles open.

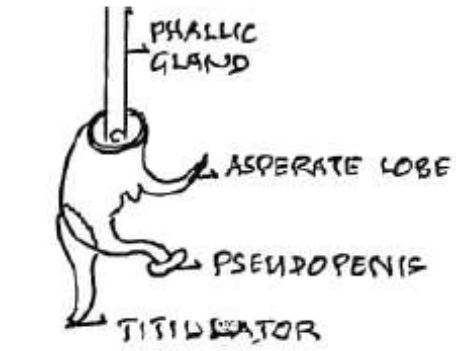
→ This ejaculatory duct opens into male genital chamber through male genital pore.

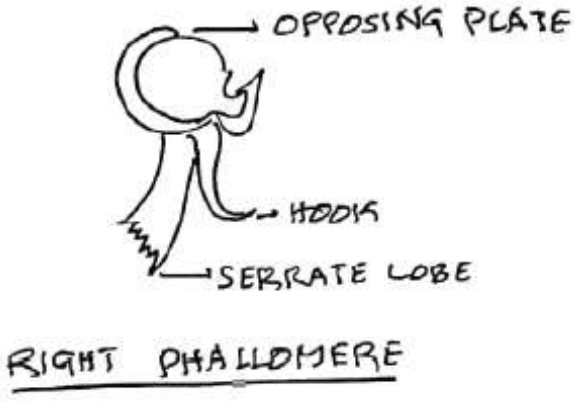
Male Gonapophysis / Phallomeres

→ These are three pairs of irregular chitinous structures present around the genital pore.

→ Phallomeres help in copulation







- Right phallomere contains opposing plate and serrate lobe.
- Pseudopenis, Aspirate lobe and Titillator together constitute the left phallomere
- **<u>Male Reproductive Glands</u>**

  Male Reproductive Glands of two types

  1. **Mushroom Gland or Utricular Gland or Uricose Gland**:

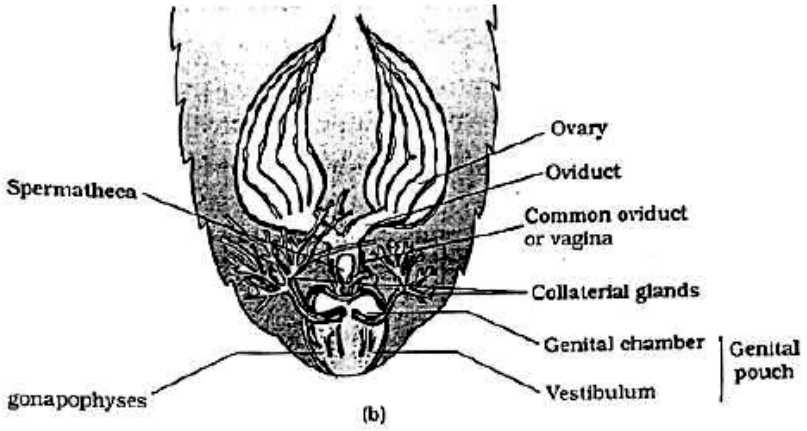
  Present in segments 6 & 7

  It helps in the formation of spermatophore.

  2. **Phallic gland or Conglobate Gland:**

  It helps in the formation of covering of spermatophore.

II. Female Reproductive System



Female reproductive system consists of

1) A pair of large ovaries → present in 2- 6th segment

• Each ovary is made up of ovarioles, containing a chain of developing egg.

2) A pair of oviducts → Posteriorly the ovarioles unite to form a short and wide duct.

3) Common oviduct / Uterus / Vagina → Two oviducts unite to form a very short median duct that opens into brood pouch.

4) A pair of spermatheca → Present in 6th segment.

• Spermatheca store spermatophore from male cockroach.

5) Gonapophysis / Ovipositor : These are 3 pairs of irregular chitinous structure present around the brood pouch.

• It helps to deposit ootheca in a safe position. So it's called ovipositor.

FEMALE REPRODUCTIVE GLANDS

A pair of branched collaterial glands : It secrete ootheca [Egg case]

FERTILISATION AND DEVELOPMENT

- Fertilisation in cockroach is internal and it take place within the brood pouch.
- Each ovary produces eight eggs at a time.
- Cockroach egg is centrolecithal (yolk is present at the centre) and macrolecithal (large quantity of yolk.)
- On an average female cockroach produce 9 - 10 ootheca.
- Each ootheca contains 14 - 16 fertilised egg.
- Their development is paurometabolous, i.e. gradual development through 13 nymphal stages.
- The next to last nymphal stage has wing pads, but only adult cockroach has wings.sss