



THE INSECT HEAD

AND

ITS APPENDAGES

TAGMOSIS-Segmentation

- Insect body is divided into a series of segments, which in primitive arthropods are known as “somites” or “metameres”.
- During the process of evolution, these somites get fused with each other in different ways forming the body parts of the existing arthropods.
- embryonic stage -primary segmentation & adult insects -secondary segmentation sclerotized membranous inter-segmental region.
- Three regions or tagmata namely head, thorax and abdomen.
- This grouping of body segments into regions is known as tagmosis.

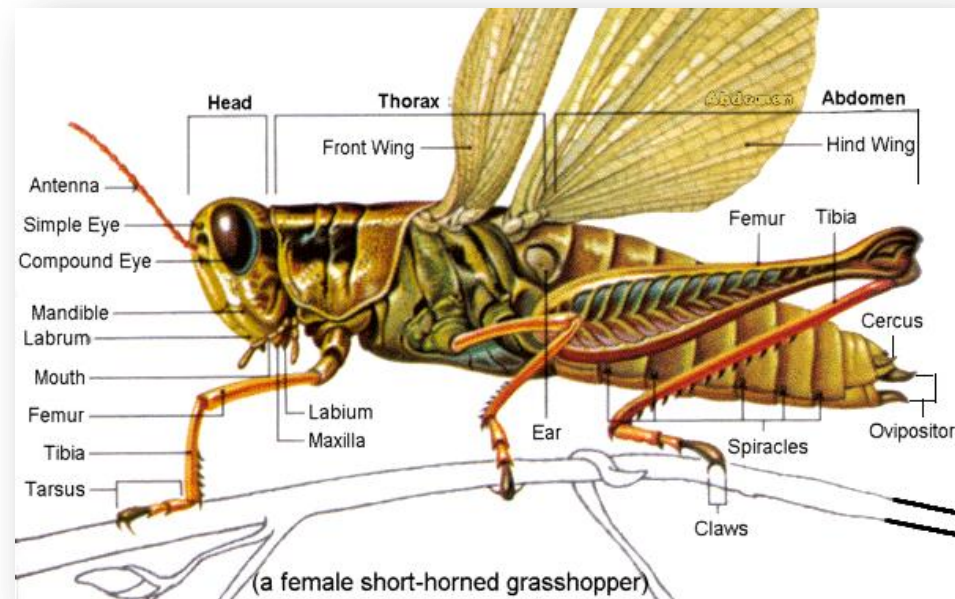
Head-mouthparts, compound eyes, simple eyes (ocelli) and a pair of antennae.

Thorax -3 segments i.e. prothorax, mesothorax and metathorax

Meso+metathorax= pterothorax.

All the three thoracic segments possess a pair of legs and meso and meta thorax possess one pair of wings

Abdomen has 7-11 segments with genital appendages on 8th and 9th segments.

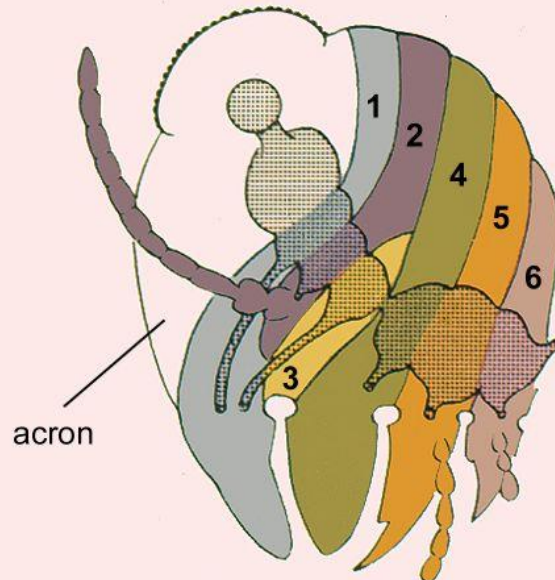


Insect head

- Hard and highly sclerotized
- 6 segments form a head capsule
- can be divided into 2 regions i.e.
 1. Procephalon
 2. gnathocephalon (mouth).

S. No.	Segment	Region	Appendages
1	Pre Antennary	Procephalon	No
2	Antennary		Antennae
3	Intercalary		No
4	Mandibular	Gnathocephalon	Mandibles
5	Maxillary		Maxillae
6	Labial		Labium

INSECT HEAD SEGMENTATION

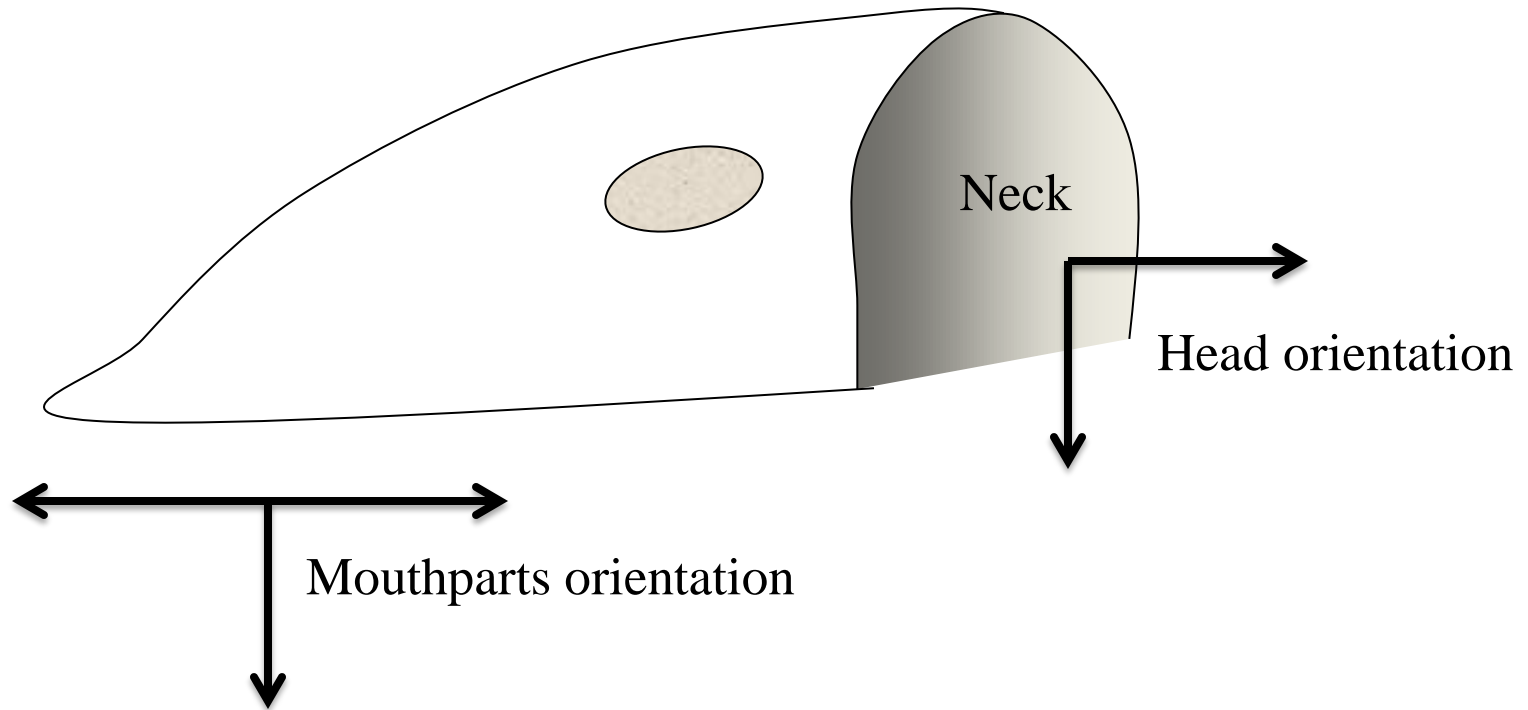


HEAD OF INSECT

Acron + 6 segments

- 1 - labral
- 2 - antennal
- 3 - intercalary
- 4 - mandibular
- 5 - maxillary
- 6 - labial

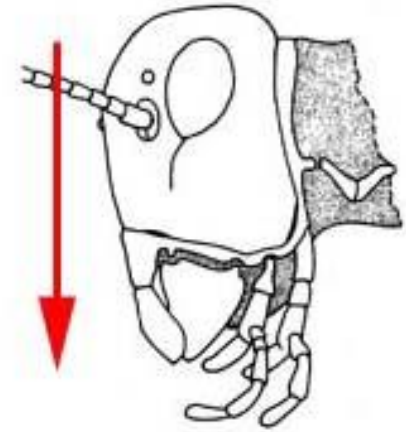
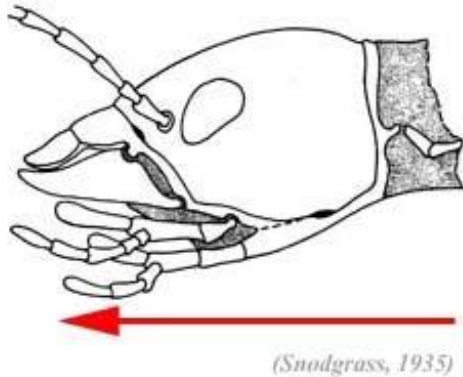
Head Capsule



Types of head

According to the position /projection of mouth parts, the Insect head can be classified as

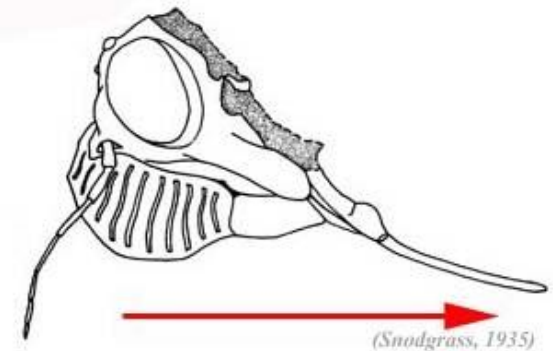
(a) Hypognathous (Hypo – Below: Gnathous – Jaw)
head is vertical and at right angle to the long axis of body
mouth parts are ventrally placed and projected downwards
This is also known as Orthopteroid type
Eg: Grass hopper, Cockroach



(Snodgrass, 1935)

(b) Prognathous : (Pro – in front: Gnathous – Jaw)
head remains in the same axis to body
mouth parts are projected forward
This is also known as Coleopteroid type
Eg: beetles

(c) Opisthognathous : (Opistho – behind: Gnathous – Jaw)
Head orientation is same as prognathous
mouthparts are directed back ward held in b/w the fore legs
Hemipteroid or Opisthorhynchous type
Eg: bugs



(Snodgrass, 1935)

Sclerites and sutures of head

- Head capsule is formed by the union of number of cuticular plates i.e. sclerites
- Sclerites are joined together by cuticular lines or ridges known as sutures
- Sutures provide mechanical support to the cranial wall.

Sclerites

1. Labrum: small sclerite forms the upper lip of the mouth cavity

It is freely attached or suspended from the lower margin of the clypeus

2. Clypeus: It is situated above the labrum

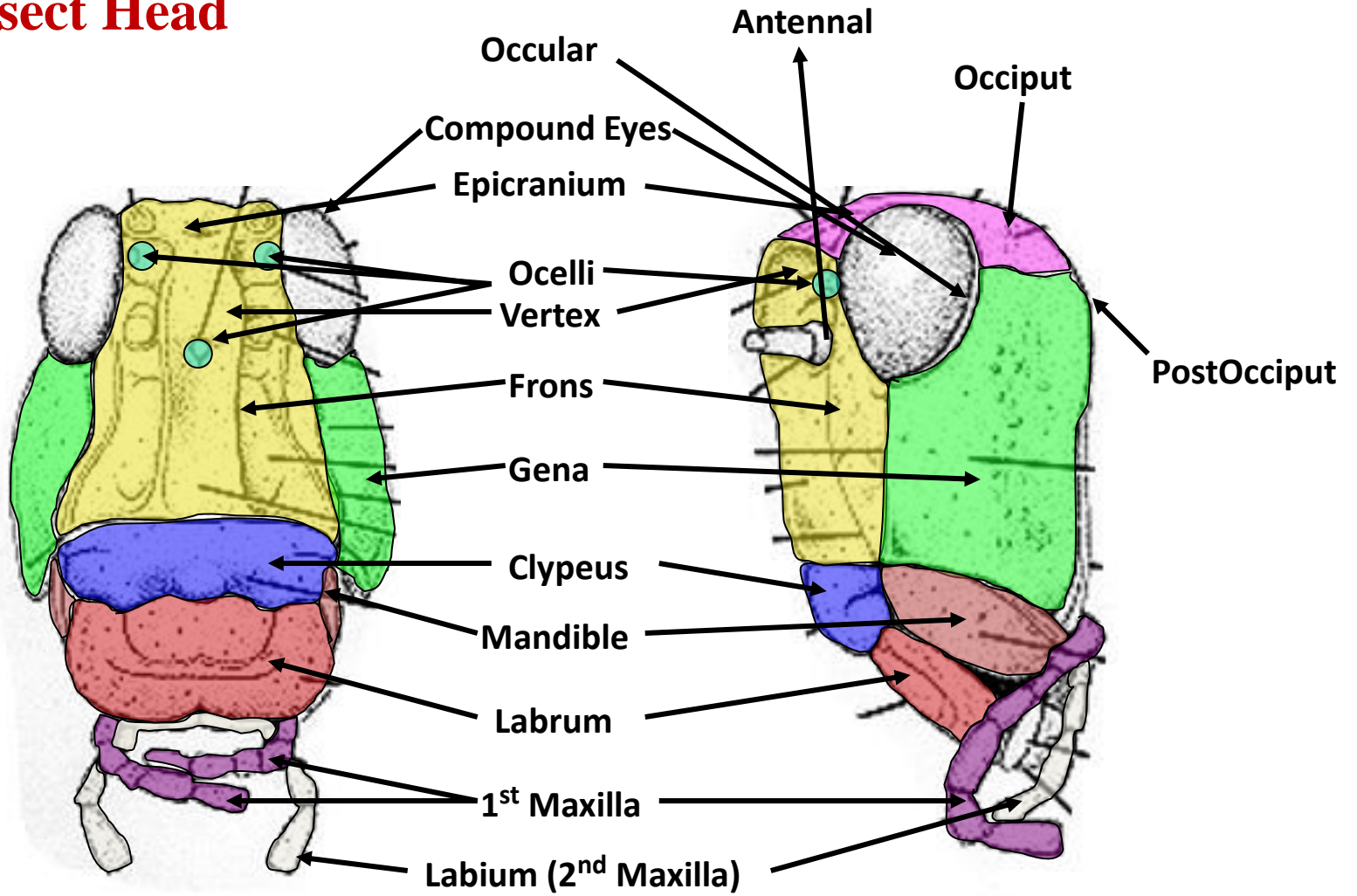
divided into anterior ante-clypeus and posterior post-clypeus.

3. Frons: It is the facial part of the insect consisting of median ocellus.

4. Vertex: It is the top portion of the head behind the frons or the area between the two compound eyes.

5. Epicranium: It is the upper part of the head extending from vertex to occipital suture.

Insect Head



6. Occiput: It is an inverted “U” shaped structure representing the area between the epicranium and post occiput

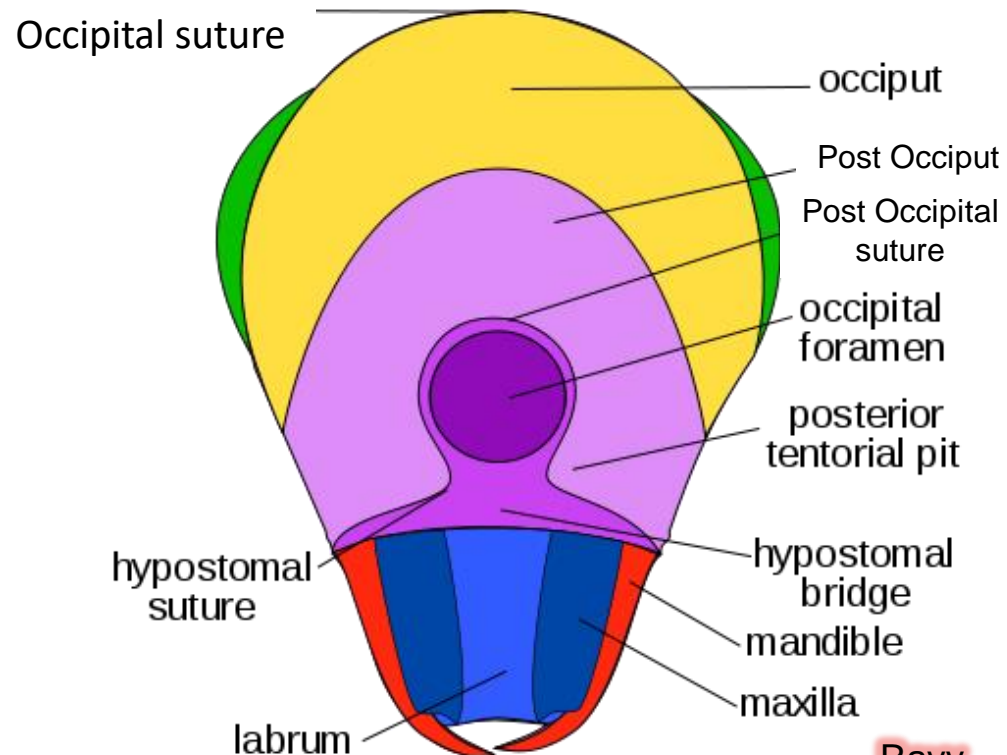
7. Post occiput : It is the extreme posterior part of the insect head that remains before the neck region.

8. Gena: It is the area extending below the compound eyes to just above mandibles

9. Ocular sclerites: cuticular ring like structures around each compound eye

10. Antennal sclerites: These form the basis for the antennae and present around the scape which are well developed in Plecoptera (stone flies)

All the above sclerites gets attached through cuticular ridges or sutures to provide the attachment for the muscles inside.



Sutures

1. **Clypeolabral suture** : It is the suture present between clypeus and labrum. It remains in the lower margin of the clypeus from which the labrum hangs down
2. **Clypeofrontal suture or epistomal suture:** The suture present between clypeus and frons
3. **Epicranial:** It is an inverted 'Y' shaped suture distributed above the facial region extending up to the epicranial part of the head. Two arms 1.frontal suture occupying the frons and stem called as coronal suture.

It also known as line of weakness or ecdysial suture because the exuvial membrane splits along this suture during the process of ecdysis.

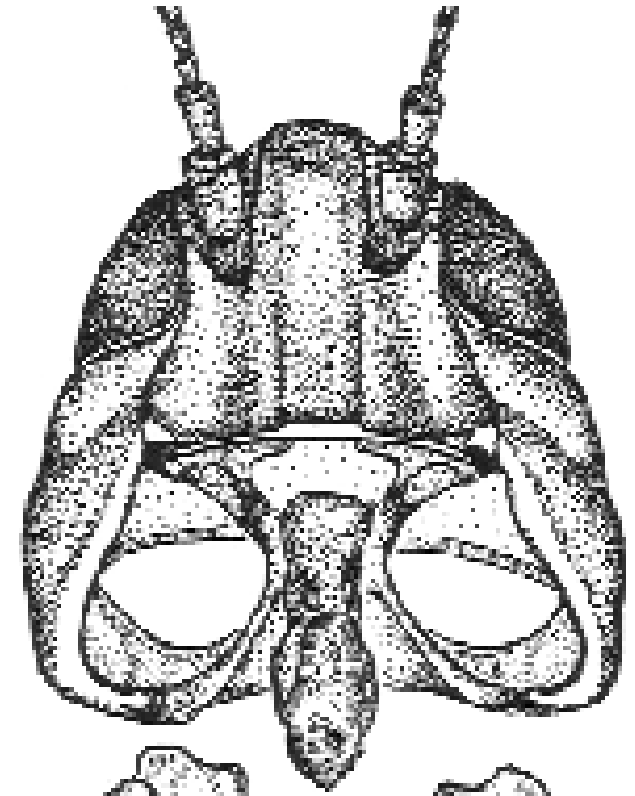
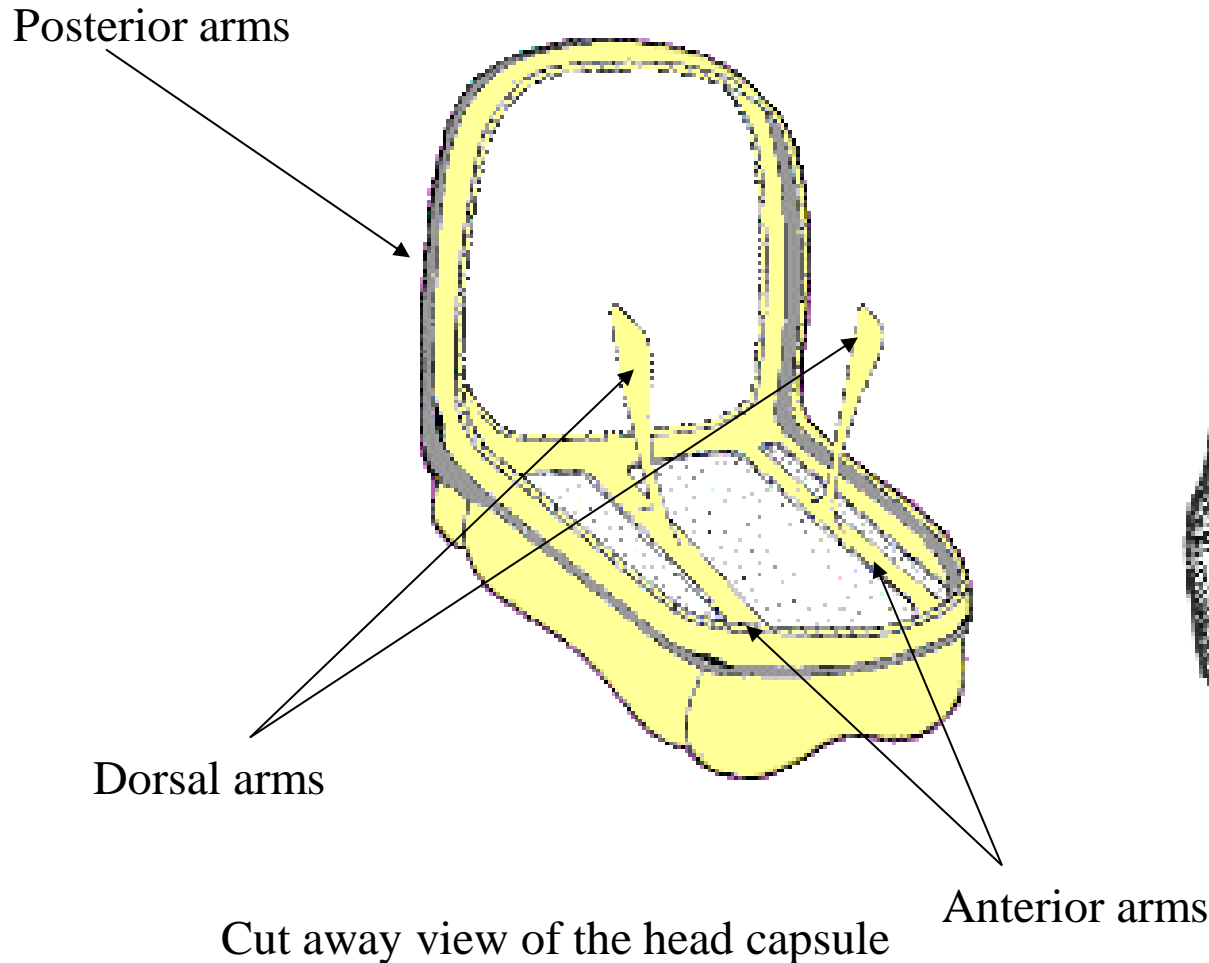
4. **Occipital** : It is 'U' shaped or horseshoe shaped suture between epicranium and occiput.
5. **Post occipital:** It is the only real suture in insect head.

Posterior end of the head is marked by this suture to which the sclerites are attached.

As this suture separates the head from the neck, hence named as real suture.

6. **Genal:** It is the sutures present on the lateral side of the head i.e. gena.
7. **Ocular suture:** It is circular suture present around each compound eye.
8. **Antennal suture:** It is a marginal depressed ring around the antennal socket.

Tentorium (plural **tentoria**) is a term used to refer to the framework of internal supports within an arthropod head. The tentorium is formed by ingrowths of the exoskeleton, called apophyses, which fuse in various ways to provide rigid support for the muscles of the head.



3. Gula (Fig.3.12). It is a ventral sclerotic plate of the head capsule separating the foramen magnum from the base of labium. It is well developed in the insects having prognathous head in order to place the mouth parts in forward direction. The gula is separated from the laterally expanded postgenae by the gular sutures. The gular sutures are in fact modified post-occipital sutures. The gula varies in length and width in different species of Coleoptera and Neuroptera.

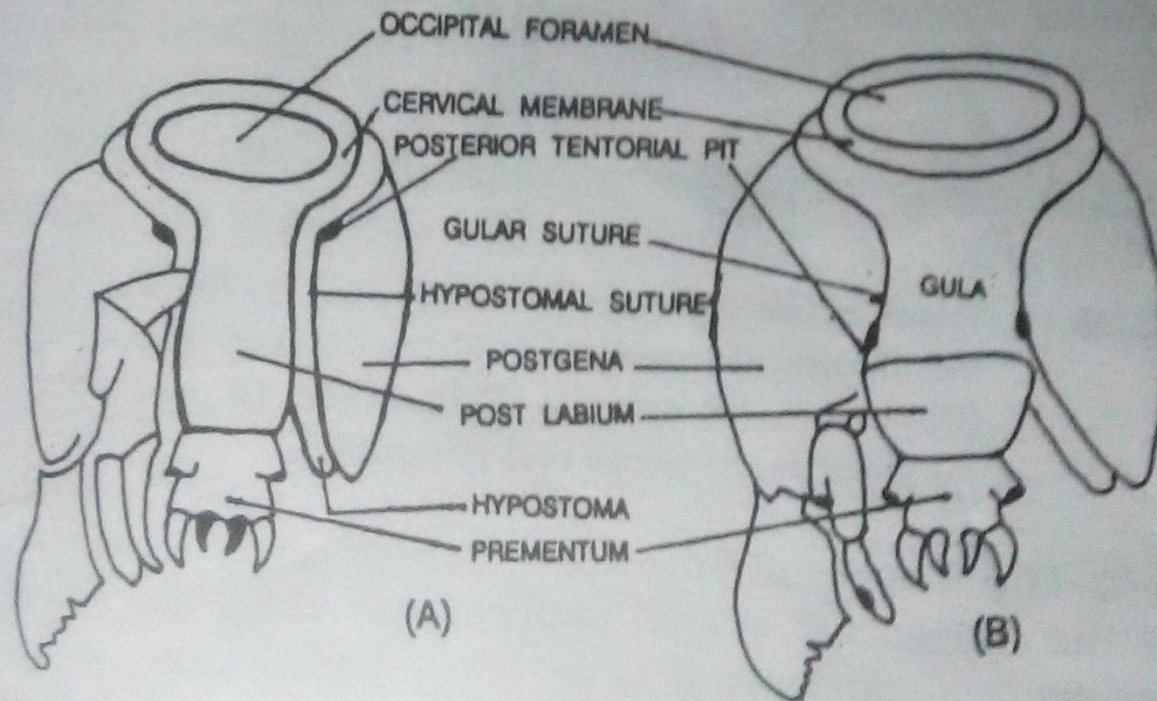
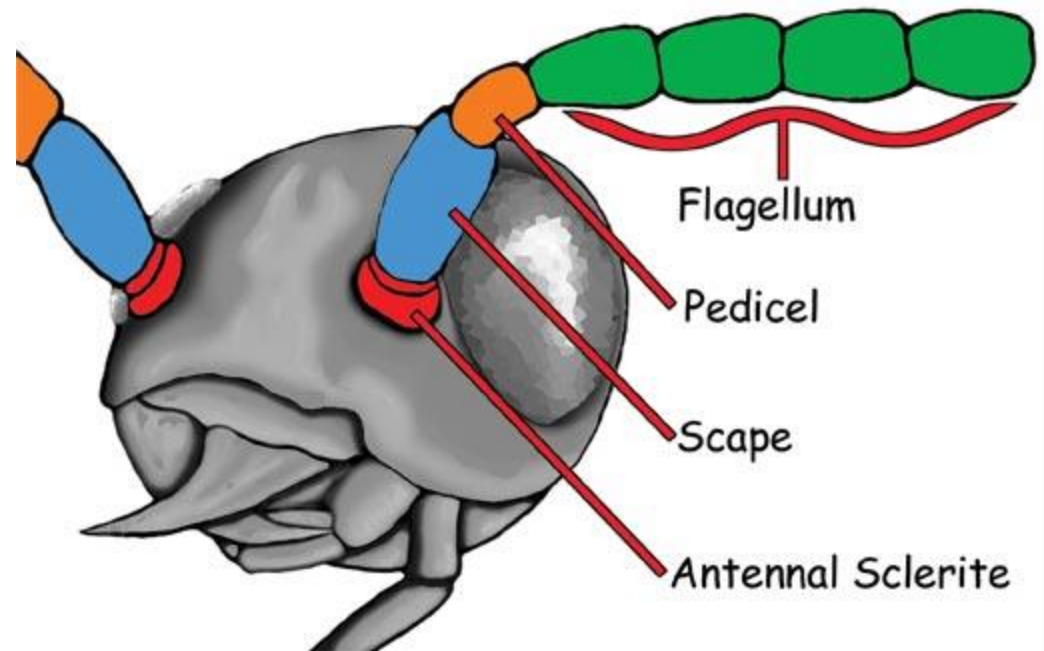


FIG. 3.12. Ventral view of the head - (A) without gula (orthopteroid Insect) and (B) with gula (a beetle).

Insect Antenna & its Modifications



- ❖ uniramous (unbranched), segmented and mobile structures
- ❖ basally fixed in to deep antennal socket (antennifer)
- ❖ Antennal socket is provided with an antennal suture
- ❖ The base of socket is connected to the edge of the socket by an articulatory membrane For free movement of antennae

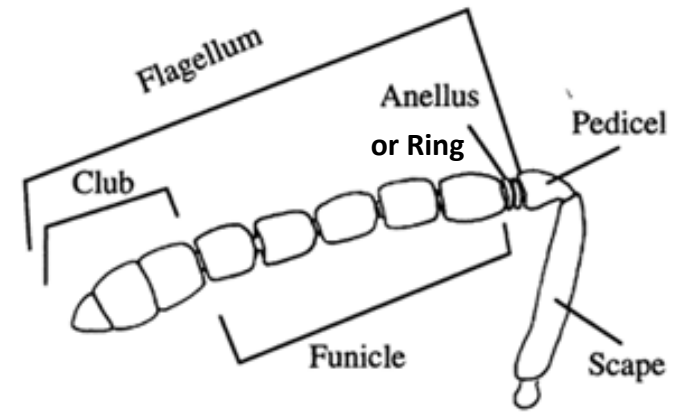


Exceptions

- ❖ Absent in Protura and Class Arachnida and 2 Pairs in Crustacea
- ❖ In Chalcidoids, Flagellum is divided into basal Ring, middle Funicle and upper Club
- ❖ In Collembola & Diplura, Antennae are muscular, Hence Segmented type
- ❖ Johnstons organs are absent in Collembola & Diplura

Functions

- ❖ sense organ responding to touch, smell, odour, humidity, temperature & air currents or wind speed.
- ❖ Jhonston's organ on pedicel -auditory organ responding to sound and measuring the speed of air currents.
- ❖ Help the mandibles for holding prey and for mastication of food material
- ❖ Helps in sexual dimorphism
- ❖ Useful for clasping the female during copulation
- ❖ Aid in respiration by forming an air funnel in aquatic insects.



FILIFORM (thread-like)



The segments of flagellum are of same thickness and thread-like.

Example :

Grass hopper

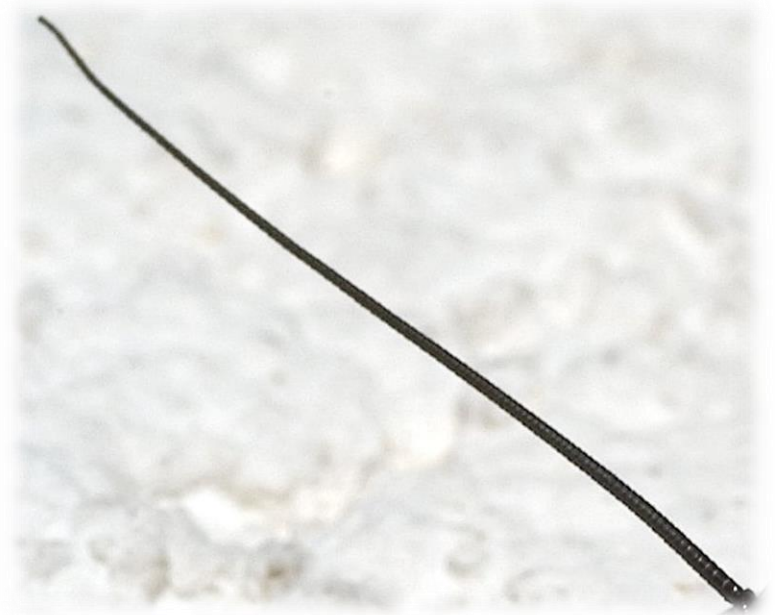


SETACEOUS (whip-like)



The segments of flagellum are taper towards apex.

Example : Dragon fly, Cockroach



MONILIFORM (bead-like)



The segments of flagellum are globular and bead-like with clear constrictions.

Example : Termites



PECTINATE (comb)



The segments of flagellum have long stiff projections on one side.

Example :

Female Arctiid moths



BIPECTINATE (Double comb)



The segments of flagellum have long stiff projections on both sides.

Example : Male Lymantrids, Mulberry silk moth



SERRATE OR DENTATE (tooth-like)

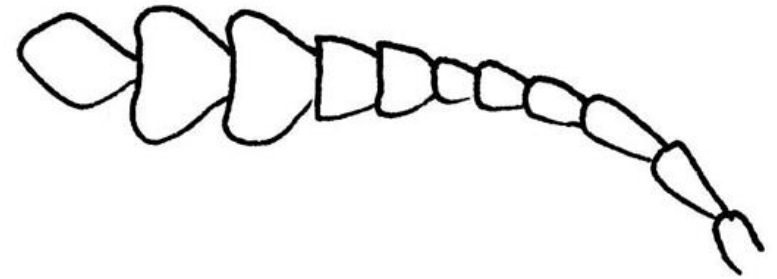


The segments of flagellum have tooth-like projections on one side.

Example : Pulse Beetles



CLAVATE (club-like)

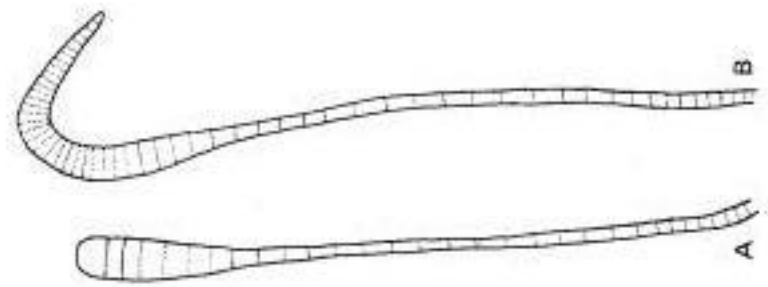


The segments of flagellum are gradually broaden towards apex.

Example :Butterfly



Clavate with Hook



The segments of flagellum are gradually broaden towards apex structure with a terminal hook like curve

Example : Skipper Butterfly



CAPITATE (knob-like)

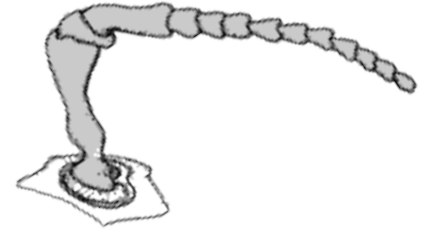


The segments of flagellum Suddenly thickened to form a knob-like structure.

Example : Red Flour Beetle



GENICULATE (elbow-like)

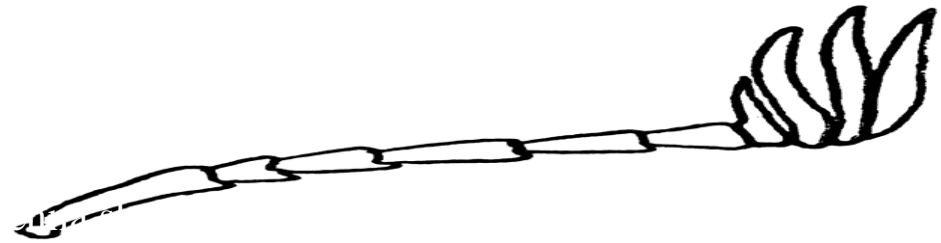


In these the scape is very long and flagellum forms a sharp bend like a flexed arm.

Example : Ant, Honey bee



LAMMELLATE (Plate-like)



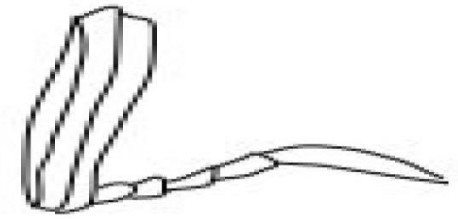
The terminal segment of flagellum are extended into leaf-like plates on one side.

Example : Rhinoceros beetle

Dung roller



FLABELLATE (tongue-like)



The segments of flagellum are produced into long and thick tongue-like projections.

Example : Male stylopid



PLUMOSE (feather-like)



The segments of flagellum have thick whorls of long hairs.

Example : Male mosquito



Male (Plumose)



PILOSE (hairy)



The segments of flagellum have very thin whorls of hairs .

Example :Female mosquito



Female (Pilose)



ARISTATE (arista-like)

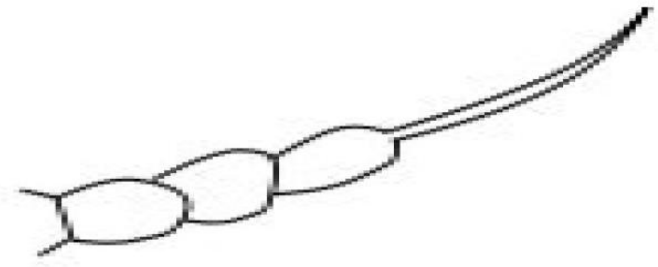


The segments of flagellum form an arista or bristle like structure on dorsal surface

Example : House fly

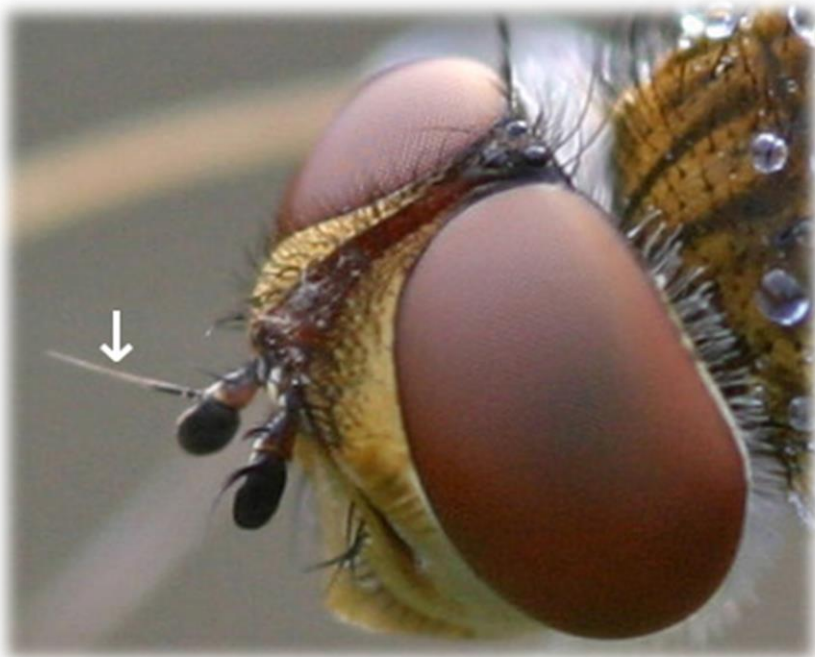


STYLATE (styliform)



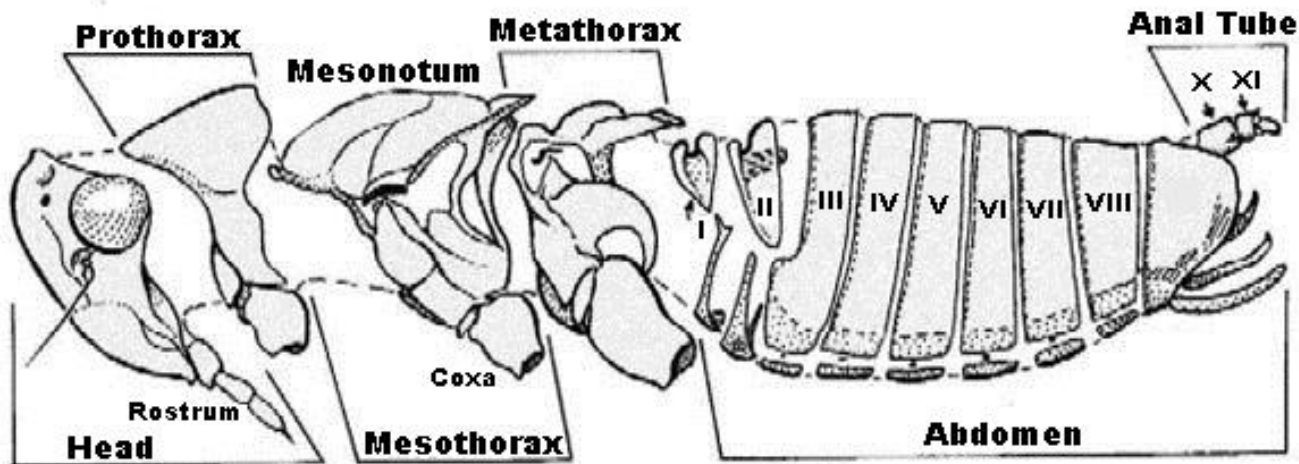
The flagellum forms a long unsegmented , terminal hair.

Example : Robber fly



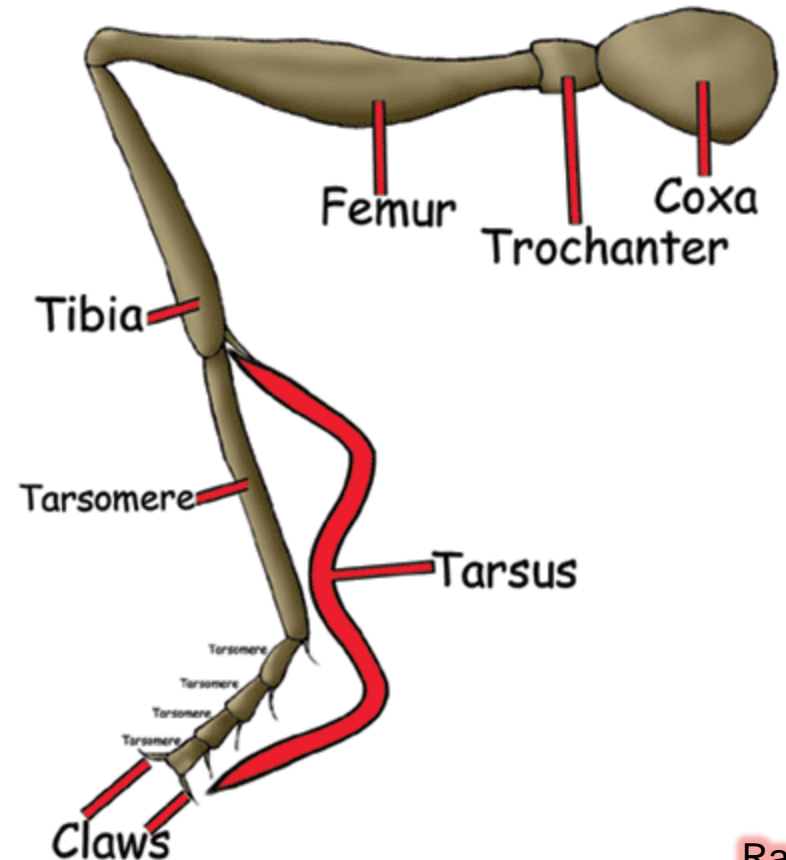
Thorax

- consisting of three segments, Prothorax, Mesothorax and Metathorax
- Each possess a pair of legs and a pair of wings on meso and meta thoracic segment
- Meso and meta thoracic segments together known as **pterothorax**
- Sclerite of dorsal region of thorax is **tergum or notum**
- ventral region is called sternum and lateral region is called **pleuron**



Insect Leg and its Modifications

- All the three thoracic segments of an insect possess a pair of legs - **hexapods** and class insecta as **hexapoda**
- Insect leg consists of 5 parts viz. **Coxa, Trochanter, Femur, Tibia and Tarsus**.
- In primitive insects, a small sclerite known as **subcoxa** occur before the coxa which form the true basal segment



1. Coxa: It is the functional basal segment rigidly fixed to thorax or weakly articulated
 2. Trochanter : It is very small is articulated with coxa and more or less fixed to femur
 3. Femur : It is the largest, strongest segment and is articulated with the tibia
 4. Tibia : It is equal or more than the length of the femur, articulated with tarsus
 5. Tarsus : largest segment of the leg divided into **tarsomeres**, no. vary from 1-5 and are movable one on the other
- 1st segment is large, big or broad in size known as **basitarsus**
 - Tarsus at it's end consists of **pretarsus** with a pair of claws and cushion like **pulvilli**
 - In between the claws, if there is lobe like structure, it is known as "**aroleum**" as in **Orthoptera** and if it is bristle like, it is called "**embodium**" as in **Diptera**

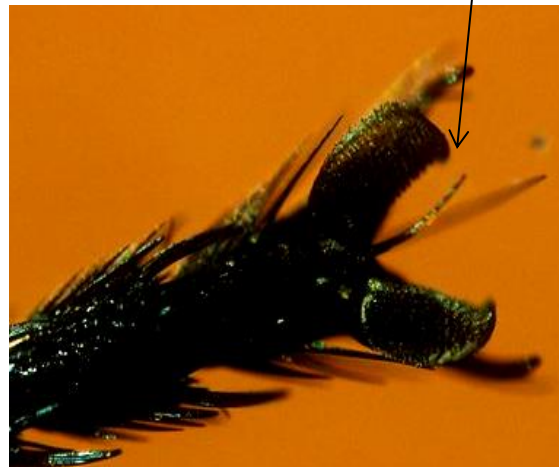
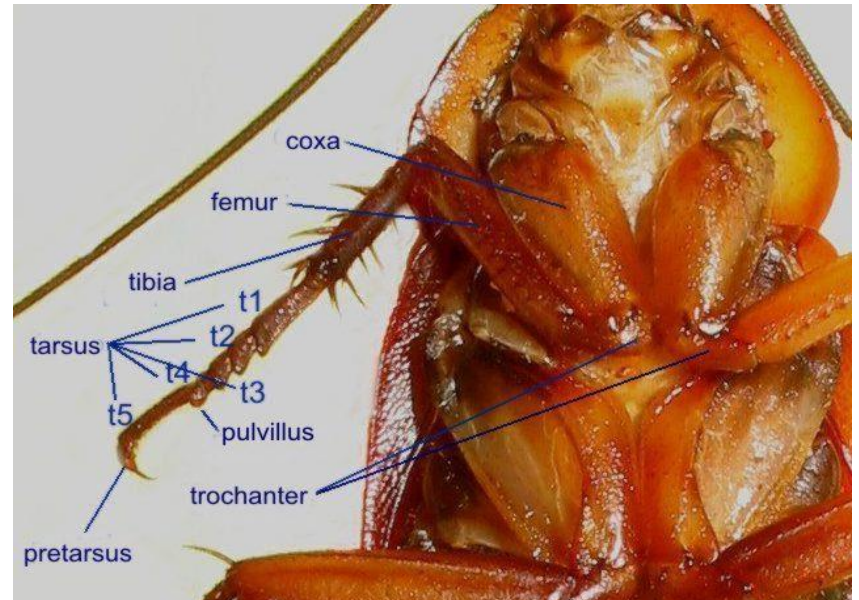


Photo: jreal

- In some insects, the ventral surface of pretarsus consist of a median circular plate between the claws known as **unguitractor** where as the claws are known as **ungues**

Modifications of Leg

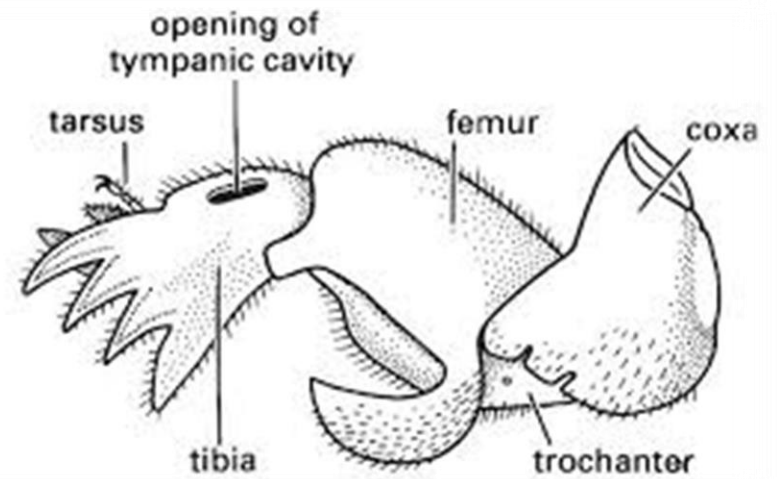
Type	Leg modified	Example	purpose	Modification
Cursorial	All legs	Blister beetle, wasp	Walking	All the legs uniformly well developed without any special modification
Ambulatory	All legs	Cockroach	Running	All legs are normal. coxa widely separated
Saltatorial	Hind legs	Grasshopper , gryllids	Leaping & jumping	Femur and tibia elongated
Fossorial	Front legs	Mole crickets, dung rollers	Digging	Tibia and tarsus short and broad with teeth like projections



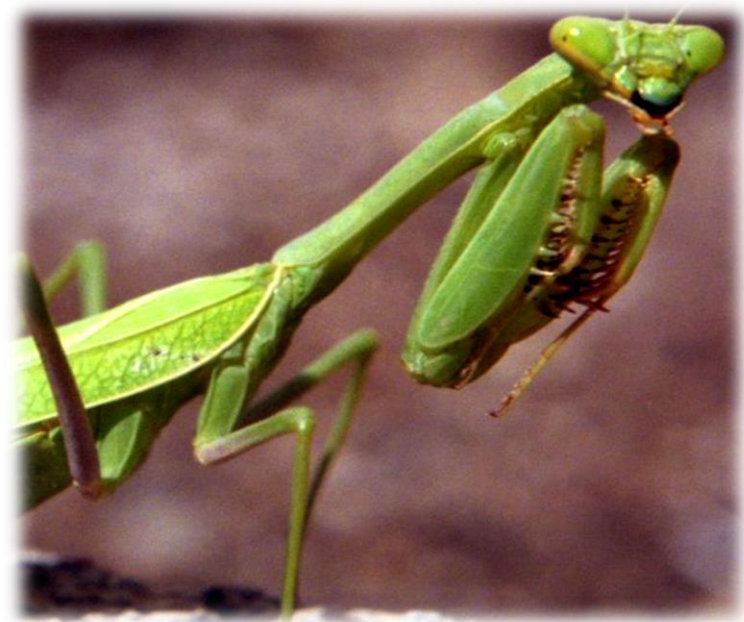
Saltatorial



Fossorial

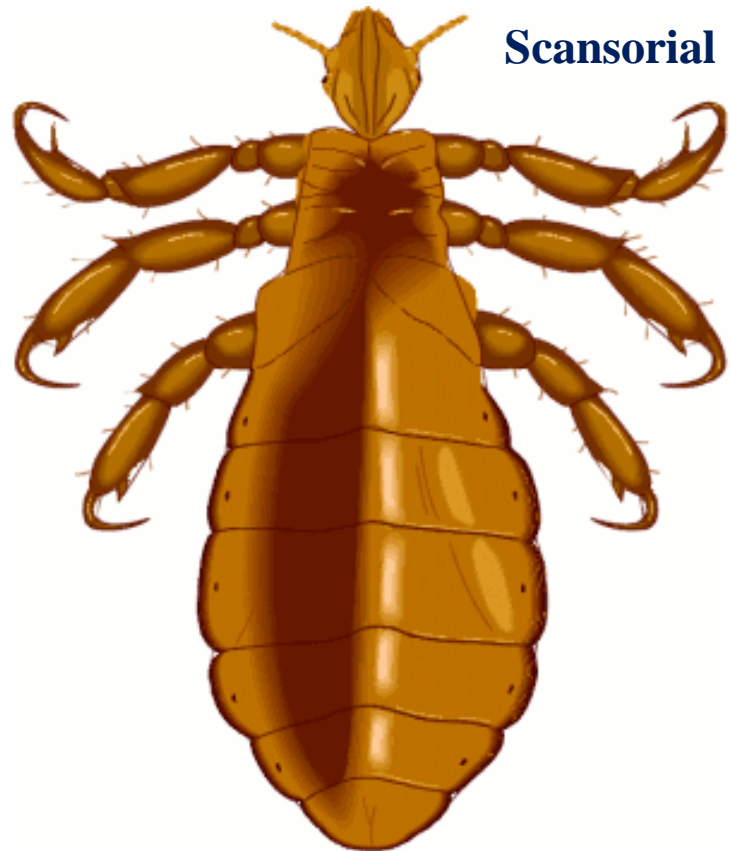


Type	Leg modified	Example	purpose	Modification
Raptorial (grasping)	Front legs	Preying mantids	Preying	femur spinose and possess a central longitudinal groove. Tibia narrow, blade like spinose and fits into the groove of femur
Natatorial	Hind legs	Water beetle, water bugs	Swimming	Hind legs pad like. Tibia and tarsus short and broad having dense long marginal hairs.
Scansorial	All legs	Head louse	clinging	Tibia possess tibial thumb. Tarsus single segmented and pretarsus with a single long curved claw





Natatorial



Scansorial

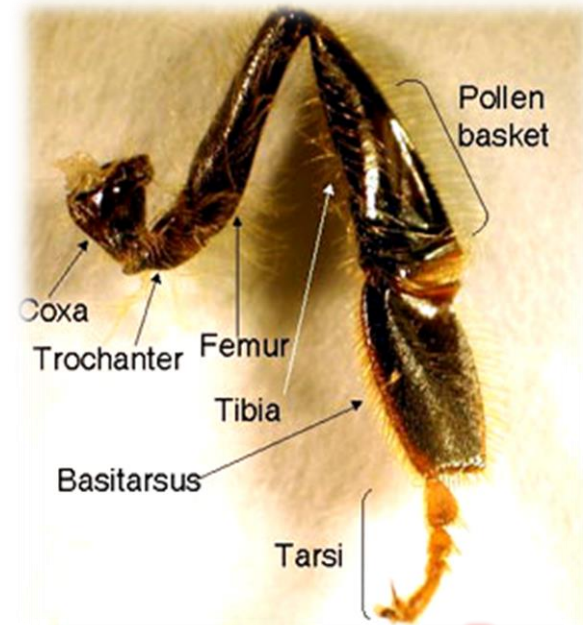
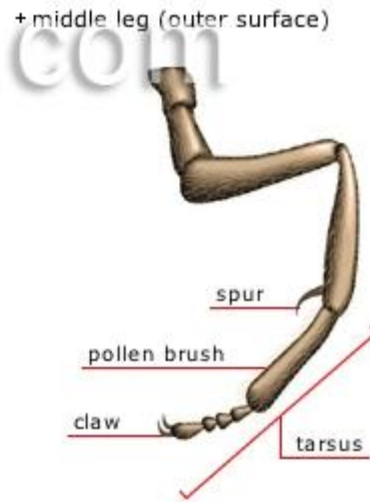
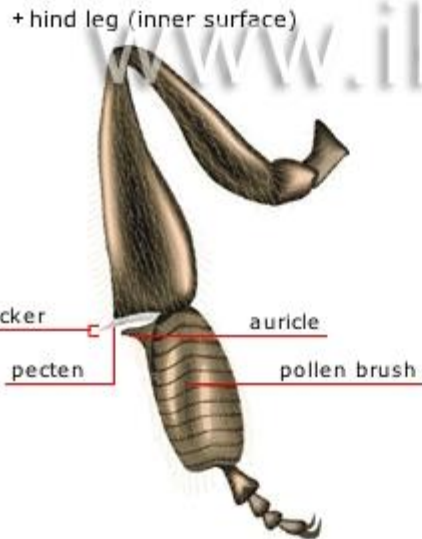
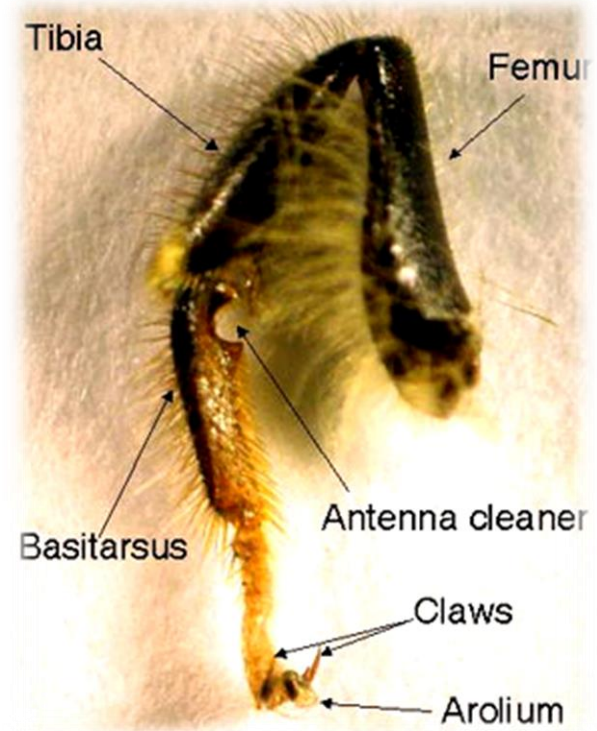
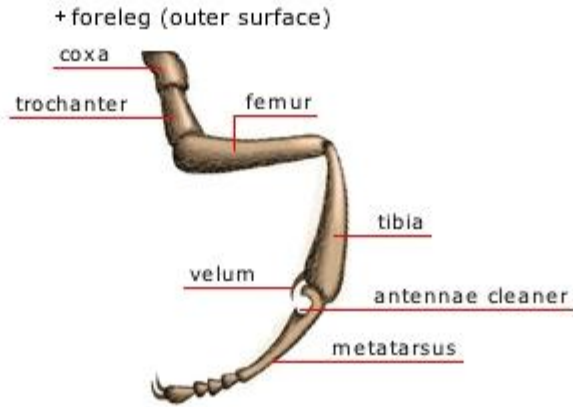


Type	Leg modified	Example	purpose	Modification
Prehensile	All legs together	Dragon flies	Catching prey, basket forming type	Thoracic segments obliquely arranged . Tergal plates are pulled backwards and Sternal plates pushed forward, resulting that all the legs pushed forward and seen below the head, together from a basket like structure useful for catching the prey even in flight



Type	Leg	Example	purpose	Modification
Antennal cleaning legs	Front legs	Honey bee	For cleaning antennae	Tibia possess a movable spine, and the first tarsal segment with a semicircular notch
Wax pick type	Middle legs	Honey bee	For picking wax plates	Tibia possess a spine called wax pick for removing the wax plates from the ventral side of the abdomen
Pollen basket and brush type	Hind legs	Honey bee	For collecting pollen and cleaning the body	Inner surface of large tibia has a groove and is used as pollen basket or 'Corbicula' for temporary storage of pollen grains. First tarsal segment enlarged and possess short stiff hairs 'Pecten' all over the surface called pollen brush.





Legs of immature stages

The immature stage of exopterygotes i.e. nymph consist of only thoracic legs similar to its adult
The endopterygote i.e. larva possess two types of legs. 1.Thoracic legs or true legs: Jointed, on 3 thoracic segments

2.Abdominal/prolegs: Unjointed sucker like legs, having flat, fleshy surfaced tip known as **Planta**.

Planta consists of hook like structures known as **Crochets** ,used for clinging to the substrate

The number of prolegs vary from 1-5 pairs distributed on 3rd, 4th, 5th, 6th and 10th abdominal segments

For example, sawfly larva has 6-8 pairs of abdominal prolegs. In some insects leg are degenerated e.g.: Coccidae; Endoparasitic hymenopterans.

