

# INSECT APPENDAGES

These are the outgrowths of body wall, movable and connected with it by membranes.

## Appendages of Head

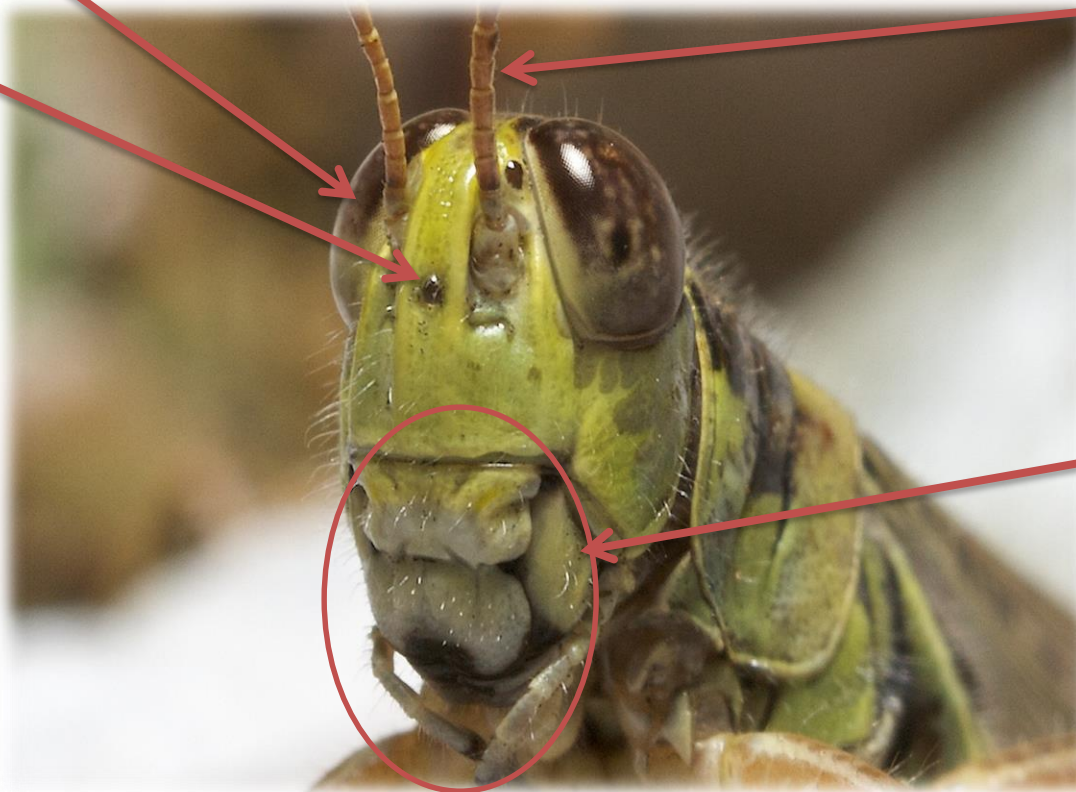
Compound eyes composed of ommatidia (may be up to 30,000)

Less resolution than the vertebrate eye but an acute perception of movement

Compound eyes and  
Ocelli (either 2/3)

Antennae

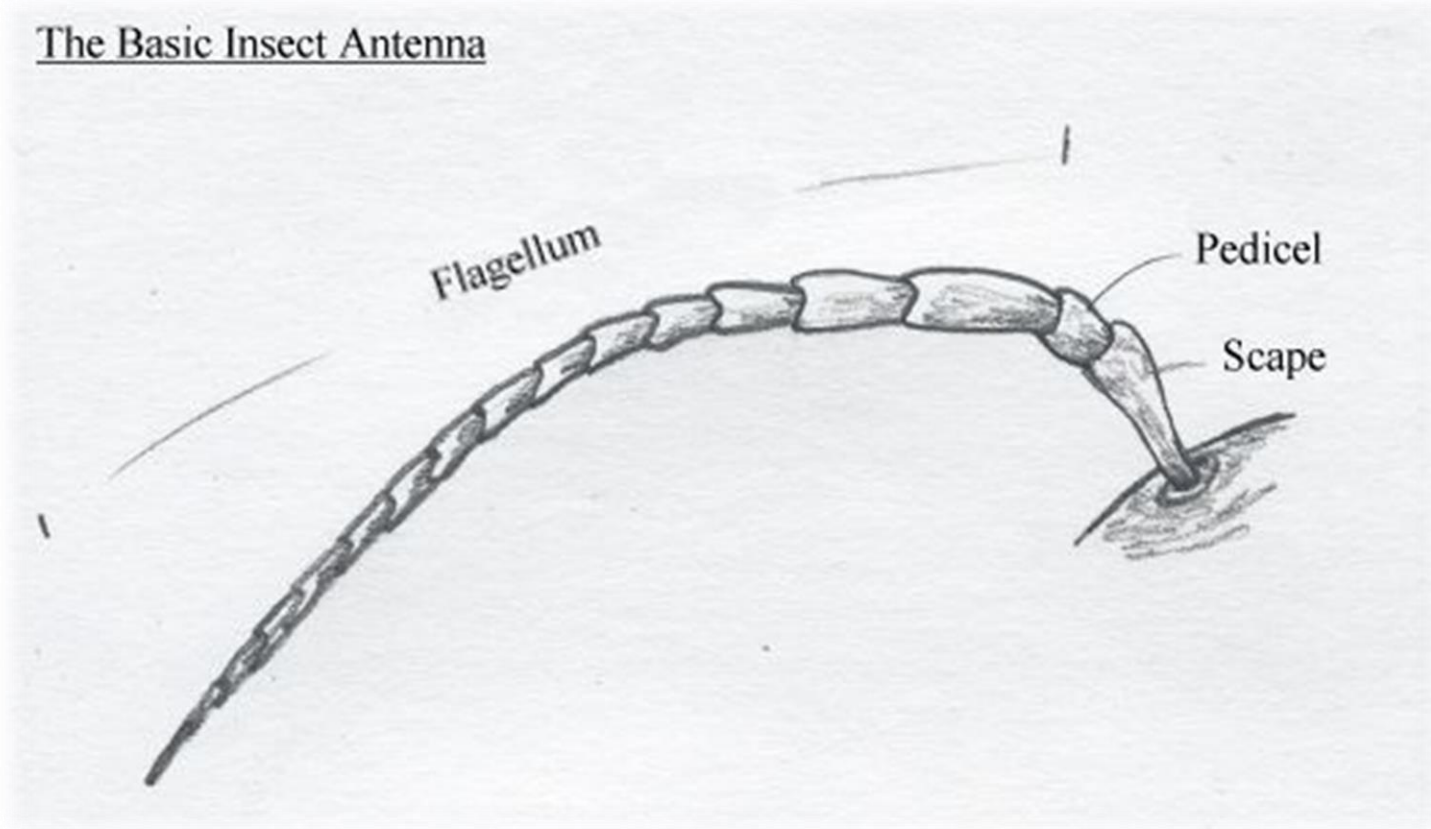
Mouthparts



# Head Appendages - Antenna

- Paired
  - Jointed
  - Primarily sensory appendages
  - Between or below the compound eyes
  - Feelers
  - absent in the insect order Protura
- Parts of Antenna
    - Scape (basal segment, longer & thicker)
    - Pedicel ( second segment, generally small)
    - Flagellum (All the remaining segments)
  - Types of Antennal segments
    - Ring segments (very small and ring-like)
    - Funicle segments (ordinary segments)
    - Club segments (swollen segments)

The Basic Insect Antenna



# Head Appendages - Antenna

## Types of antennae

Based on variations in shape of flagellum

1. Setaceous

2. Filiform

3. Moniliform

4. Serrate or dentate

5. Pectinate

6. Plumose

7. Pilose

8. Clavate

9. Capitate

10. Lamellate

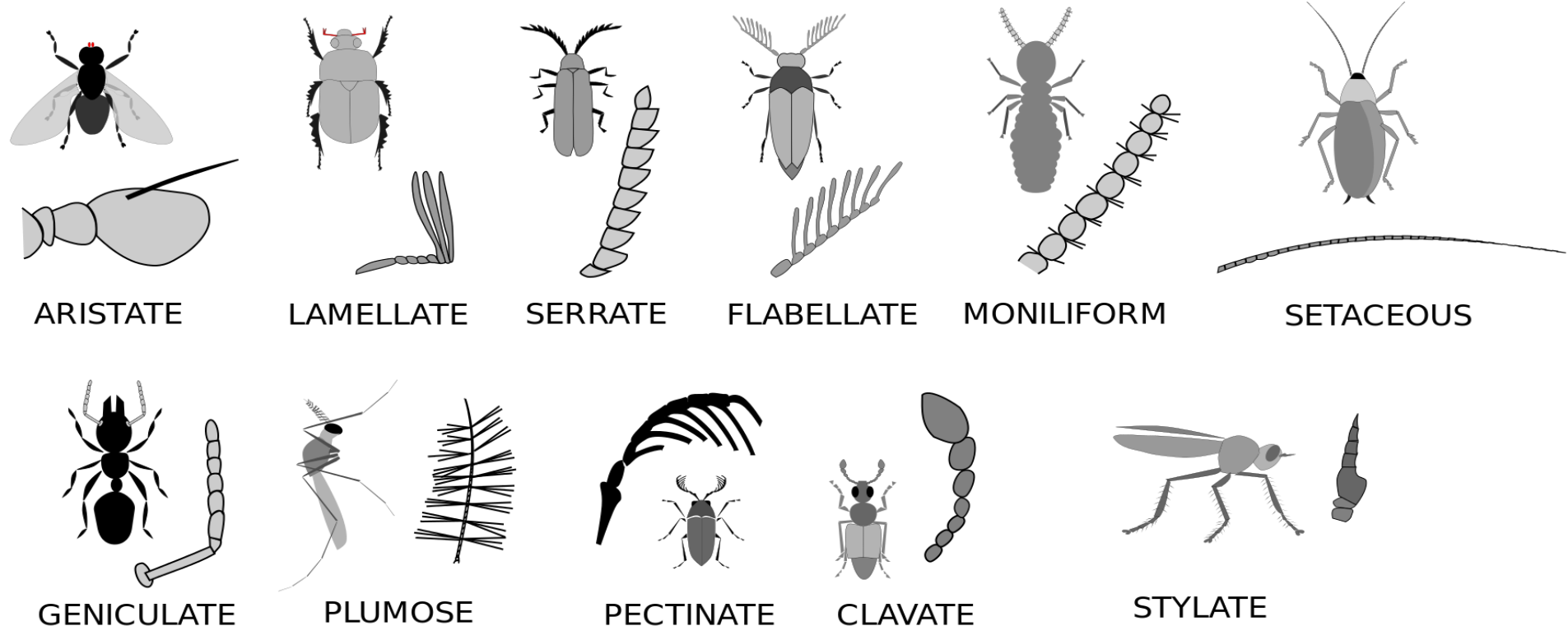
11. Flabellate

12. Geniculate

13. Aristate

14. Styletate

15. Ensiform

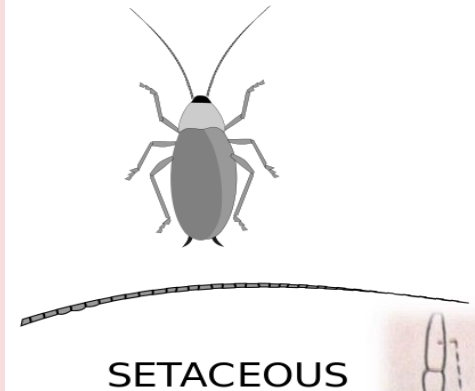
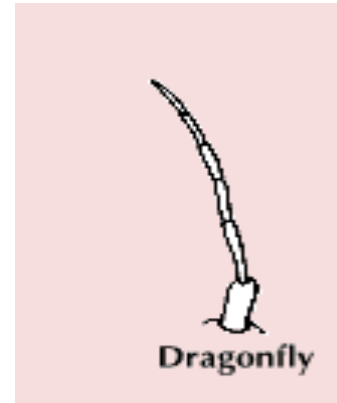


# Head Appendages - Antenna

## Types of antennae

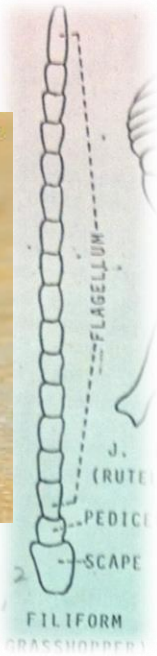
### Setaceous (bristle-like)

The segments of flagellum gradually taper or narrow towards apex like a hair, e.g. dragonflies, damselflies, stoneflies, silverfish and cockroaches.



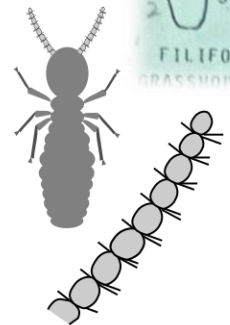
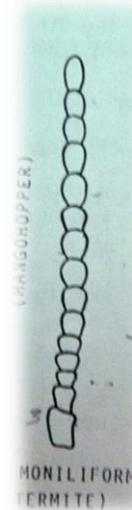
### Filiform (thread-like)

The segments of flagellum are almost cylindrical and of same thickness like a thread, e.g., grasshopper, locust, red cotton bug, earwigs and shield bug etc.



### Moniliform (bead-like)

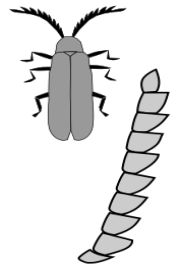
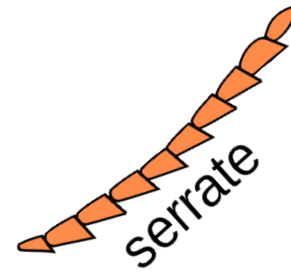
The segments of flagellum are more or less globular like a bead, e.g. termites, doubletails, beaded lacewings and wrinkled bark beetles.



# Head Appendages - Antenna

## Serrate or dentate (Saw-like or tooth-like)

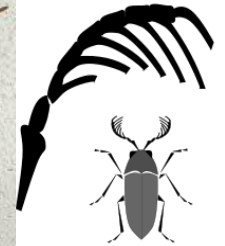
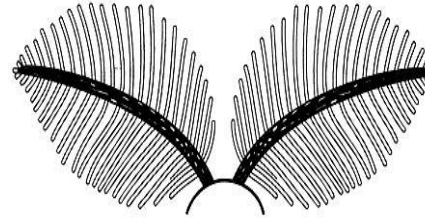
The segments or flagellum have short triangular or tooth-like projections on one side, e.g. pulse beetles and most click beetle.



SERRATE

## Pectinate (comb-like)

The segments of flagellum have long, slender and stiff projections on one side like the teeth of a comb, e.g., cardinal beetle.



PECTINATE

When these projections are on both sides, the antenna is called **bepectinate** e.g., silkworm moth, saturnid moths, some noctuid moths and sphingid moths



## Plumose (feather-like or densely hairy)

The segments of flagellum (except the distal ones) have thick whorls of long hair on them, e.g., male mosquitoes.

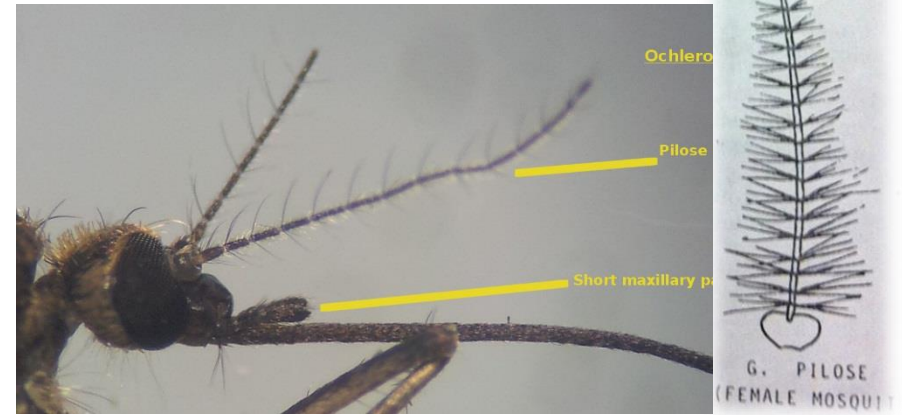


PLUMOSE

# Head Appendages - Antenna

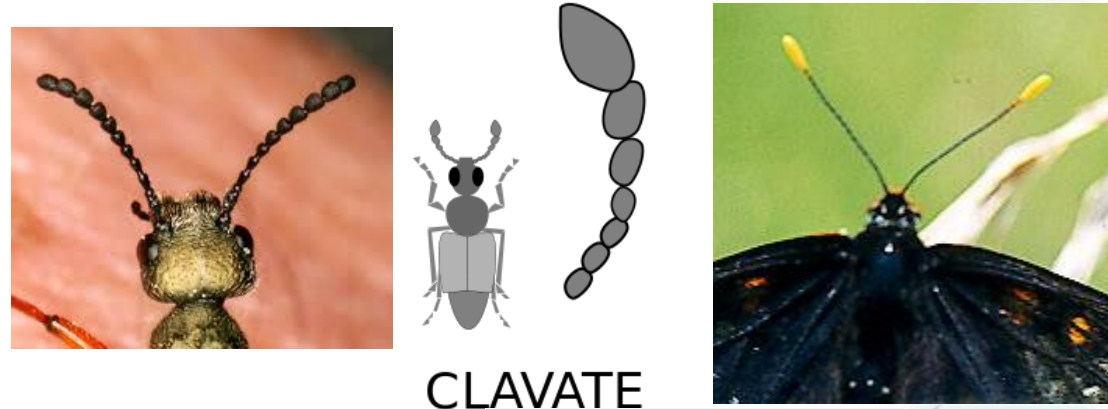
## Pilose (sparsely hair)

The segments of flagellum (except the distal ones) have very thin whorls of short hair on them. e.g., female mosquitoes.



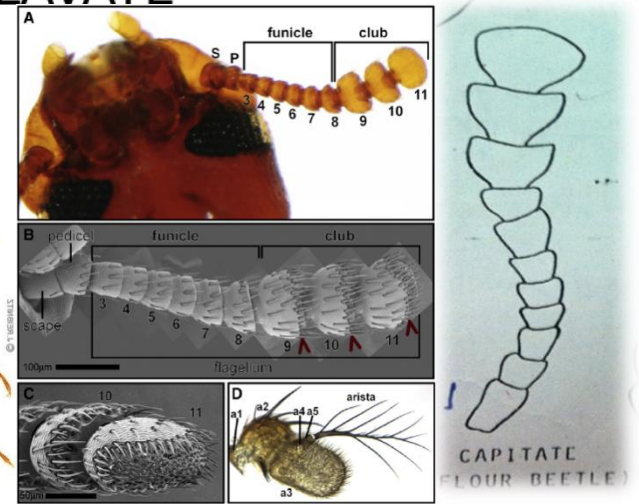
## Clavate (Club-shaped)

The segments of flagellum gradually broaden towards apex, e.g., butterflies, antlions, trogossitid beetles and some darkling beetles.



## Capitate (knob-like or head-like)

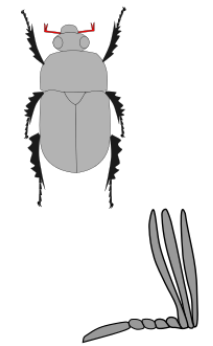
One or a few terminal segments of flagellum are suddenly thickened to form a head-like structure, e.g., red flour beetle, powder post beetles, nitidulid beetles and amblyceran biting lice.



# Head Appendages - Antenna

## Lamellate (Leaf-like)

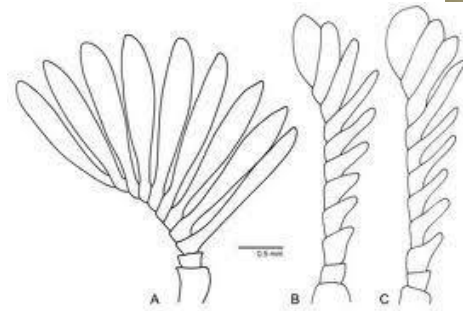
The terminal segments of flagellum are expanded into long, broad leaf-like plates on one side, e.g., rutelid beetles, rhinoceros beetles and dung rollers.



LAMELLATE

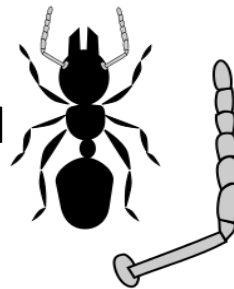
## Flabellate (tongue-like)

Resemblance to lamellate antenna. But in this type one or more segments of flagellum are produced into long, thick, tongue-like processes slightly broadening towards apices, e.g., male stylopids and sandaled beetles.



## Geniculate (elbow-like)

In this antenna, the scape is very long and forms a sharp bend with the remaining segments like a flexed arm, e.g., weevils, honeybees, chalcid wasps and stag beetles.



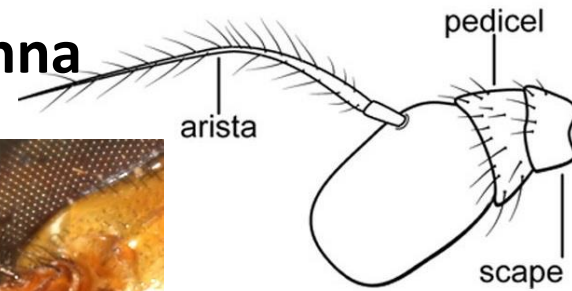
GENICULATE



# Head Appendages - Antenna

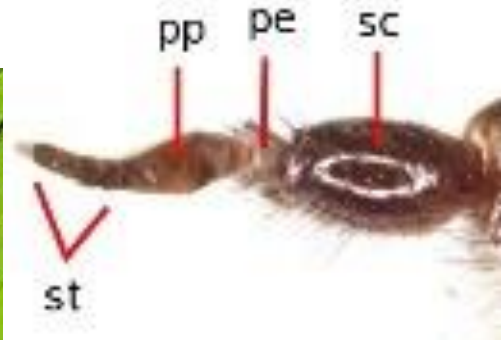
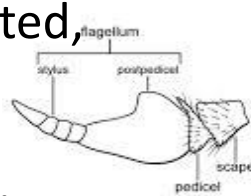
## Aristate (arista-like)

The scape is very small while the pedicel is large and triangular. The first segment of flagellum is greatly enlarged, where as the remaining segments are modified into a large hairy bristle, the arista, e.g., house flies, fruit flies, syrphid flies, etc.



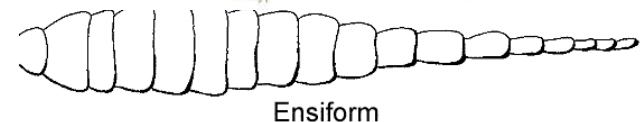
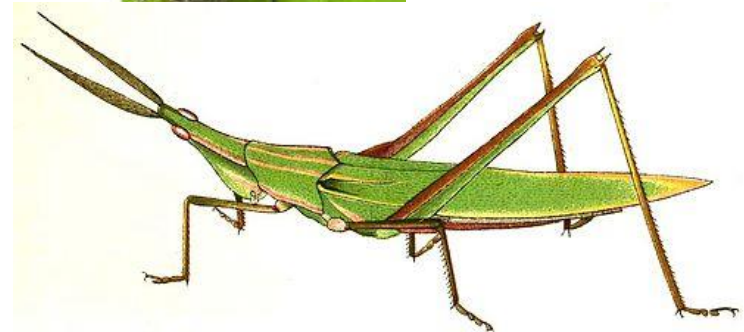
## Stylate (styliform or setiform)

The flagellum forms a long, unsegmented, terminal hair, e.g., mango hoppers (leafhoppers), plant hoppers, cicadas, robber flies, delphacid bugs and mayflies.



## Ensiform (Sword-like)

The segments of flagellum are thin, flattened and gradually taper toward apex like a leaf-blade or a sword, e.g., green grasshoppers (Acrida Species).

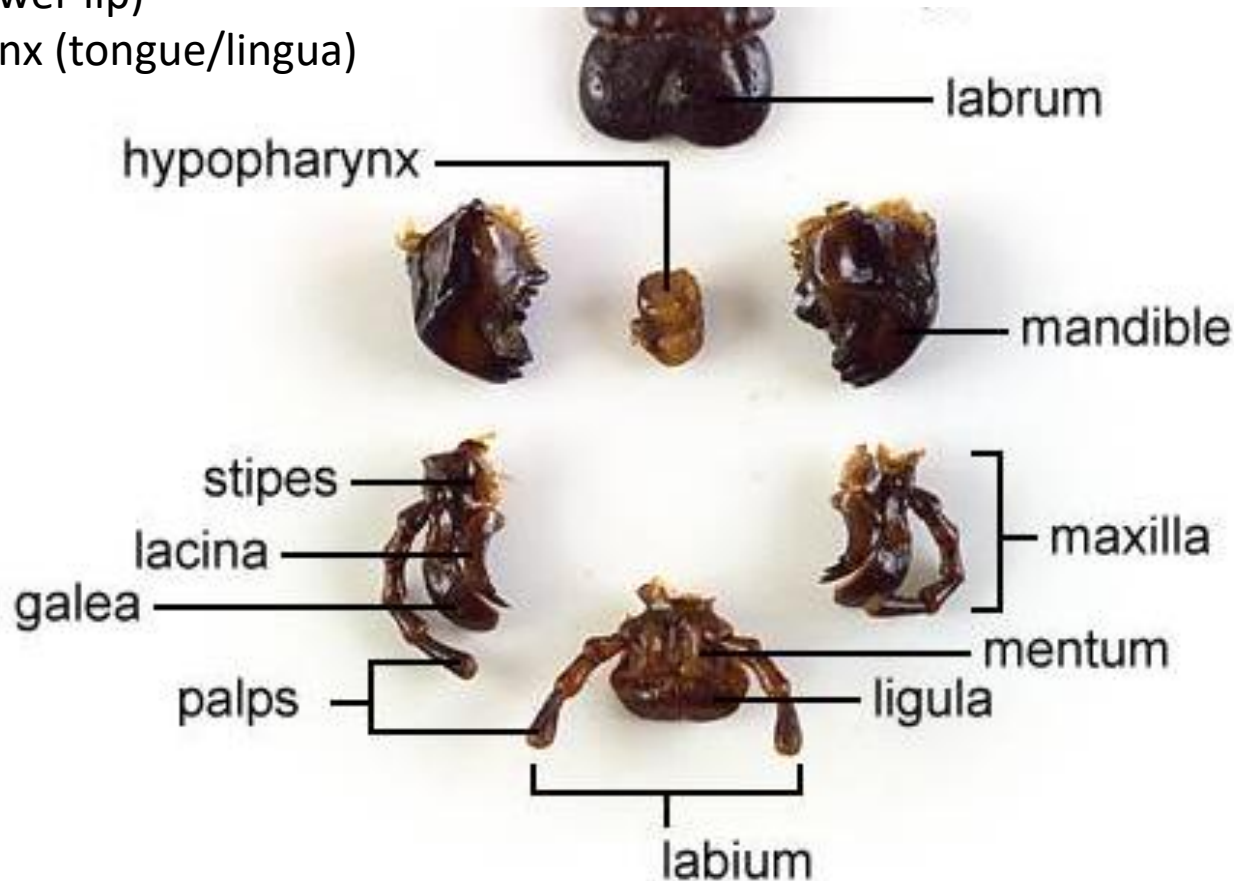


Ensiform

# Head Appendages - Mouthparts

## Typical Insect Mouthparts

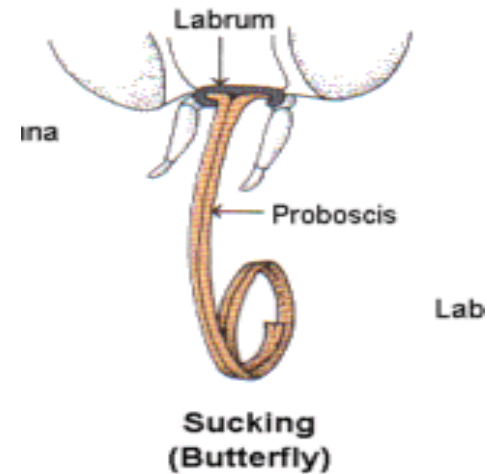
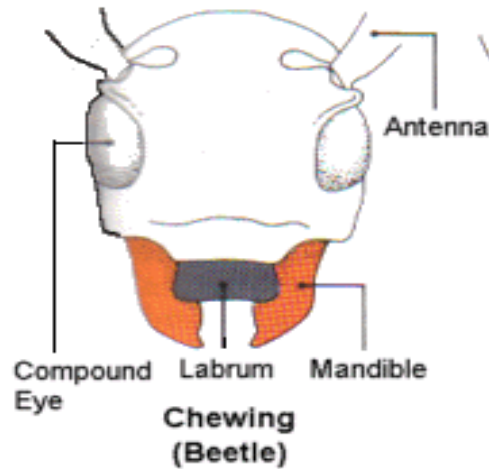
1. Labrum (Upper lip)
2. Mandibles (Upper jaw)
3. Maxillae (Lower jaw)
4. Labium (Lower lip)
5. Hypopharynx (tongue/lingua)



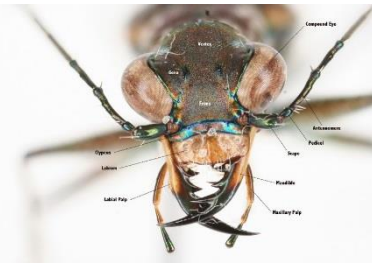
# Head Appendages - Mouthparts

## General Types of Mouthparts

- **Chewing** (mandibulate)
- Strong mandibles to cut & chew
- **Sucking** (haustellate)
- Long proboscis to suck

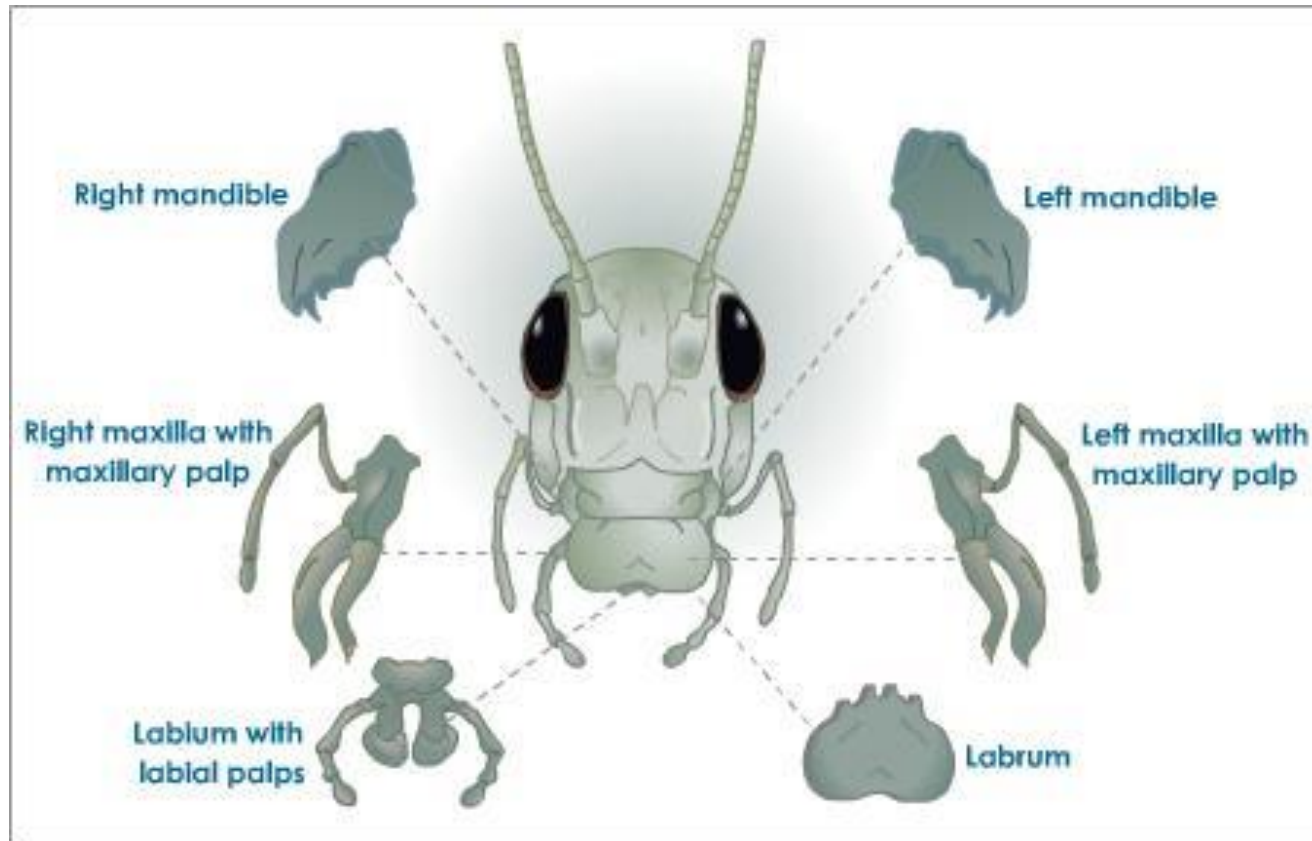


- **Ectognathous**
- Not hidden within the head
- e.g., bristletails, grasshoppers, bugs and butterflies etc.
- **Entognathous**
- Hidden within the head
- e.g. doubletails, telsontails and springtails etc.



# Head Appendages - Mouthparts

Chewing/biting Mouthparts (Ak Grasshopper)



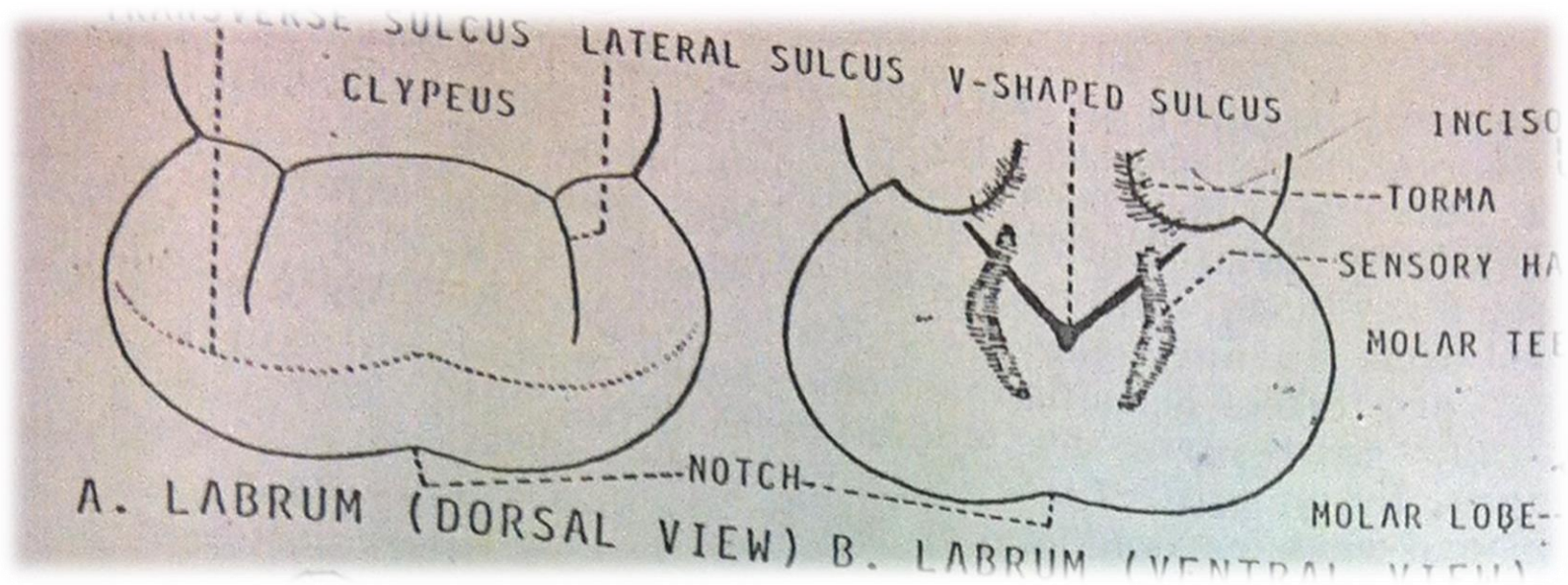
# Head Appendages - Mouthparts

## Chewing/biting Mouthparts (Ak Grasshopper)



### Labrum

- Broad flap-like sclerite attached to clypeus
- Capable of up and down movement.
- Roof of the mouth cavity.
- Anterior border has a slight notch.
- Two short lateral sulci on upper surface
- It has also an ill-defined transverse sulcus.
- Lower surface is lined with a membrane, the epipharynx.
- V-shaped sulcus in its posterior part.
- Two median curved bands of sensory hair.
- The posterior angles of labrum have two sickle-shaped sclerotized bars, the tormae.



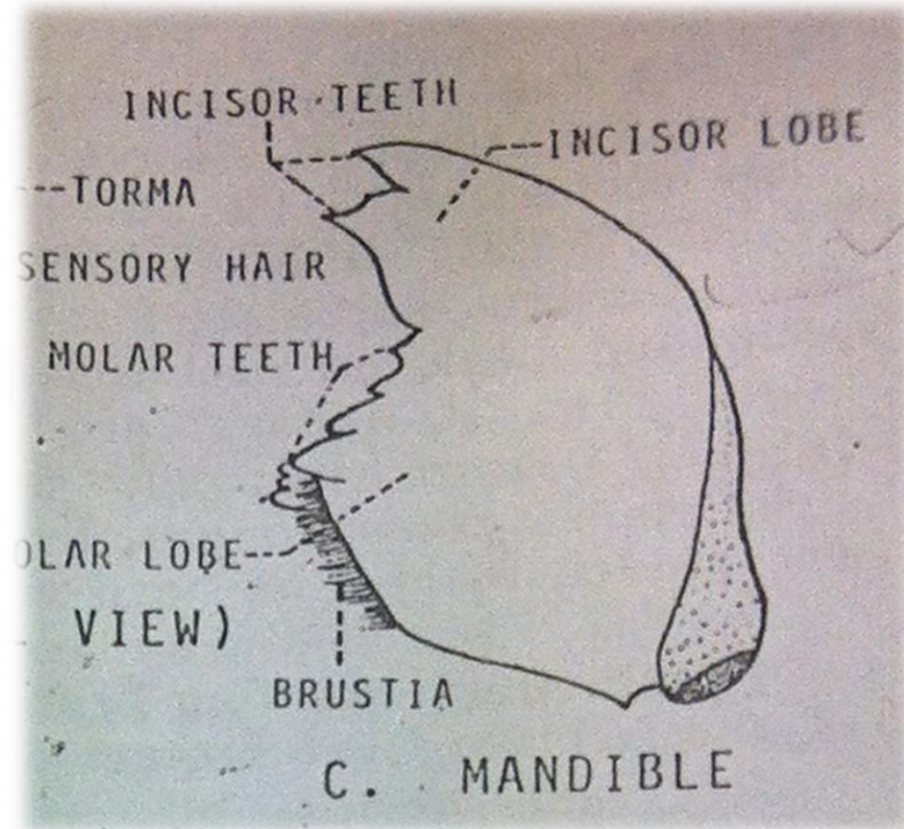
# Head Appendages - Mouthparts

## Chewing/biting Mouthparts (Ak Grasshopper)

### Mandibles



- Paired, triangular and asymmetrical
- Lying below labrum
- Strongly sclerotized but hollow jaws
- Move sideways
- Biting surface has two lobes
  - the molar lobe
  - the incisor lobe
- Molar lobe is near the base of the mandible
- Molar lobe has a group of short and blunt molar teeth which form the grinding area.
- Incisor lobe has a group of longer and acute incisor teeth which cut the food.
- The inner edge, between the molar teeth and the base of the mandible, has a row of short hairs called bristia.



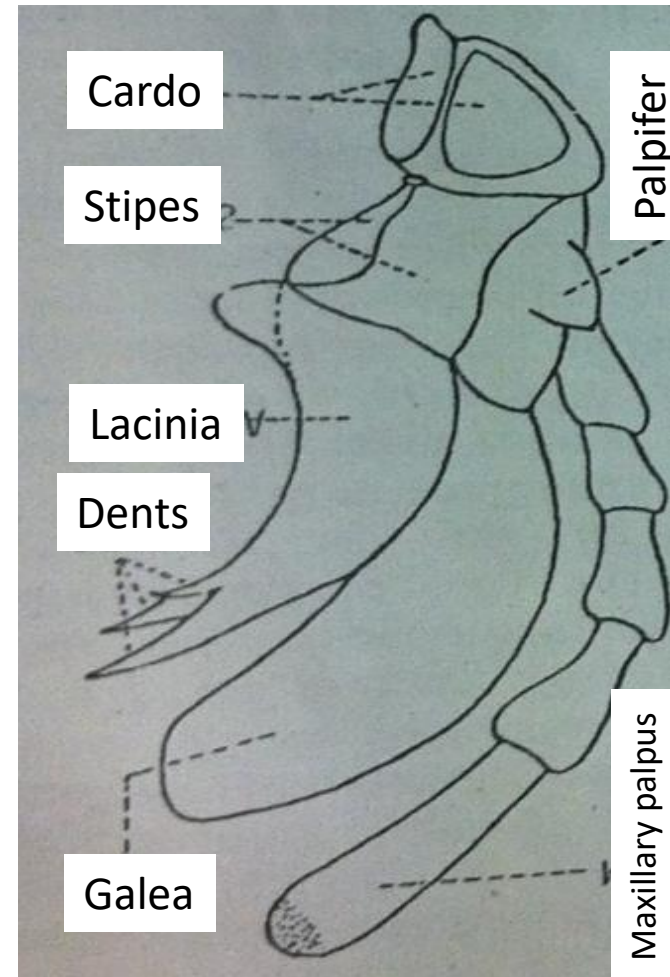
# Head Appendages - Mouthparts

## Chewing/biting Mouthparts (Ak Grasshopper)



### Maxillae

- Paired structures lying below the mandibles.
- Move sideways just like mandibles.
- Each maxilla consists of a basal sclerite, the **cardo**.
- On apex of cardo is another sclerite, the **stipes**.
- The cardo and stipes has further two parts
  - outer broad
  - inner long and narrow.
- On outer side of stipes has a small process called palpifer.
- Palpifer bears an antenna-like 5 segmented structure, the maxillary palpus.
- Stipes on its apex bears two lobes-like structures.
  - The outer one is broad, elongate and called **galea**
  - The inner one is basally broad but tapering anteriorly and known as the **lacinia**.
- Lacinia is strongly sclerotised and has three black pointed dents at its apex.
- When galea and lacinia on the stipes fused to form a single structure, mala.



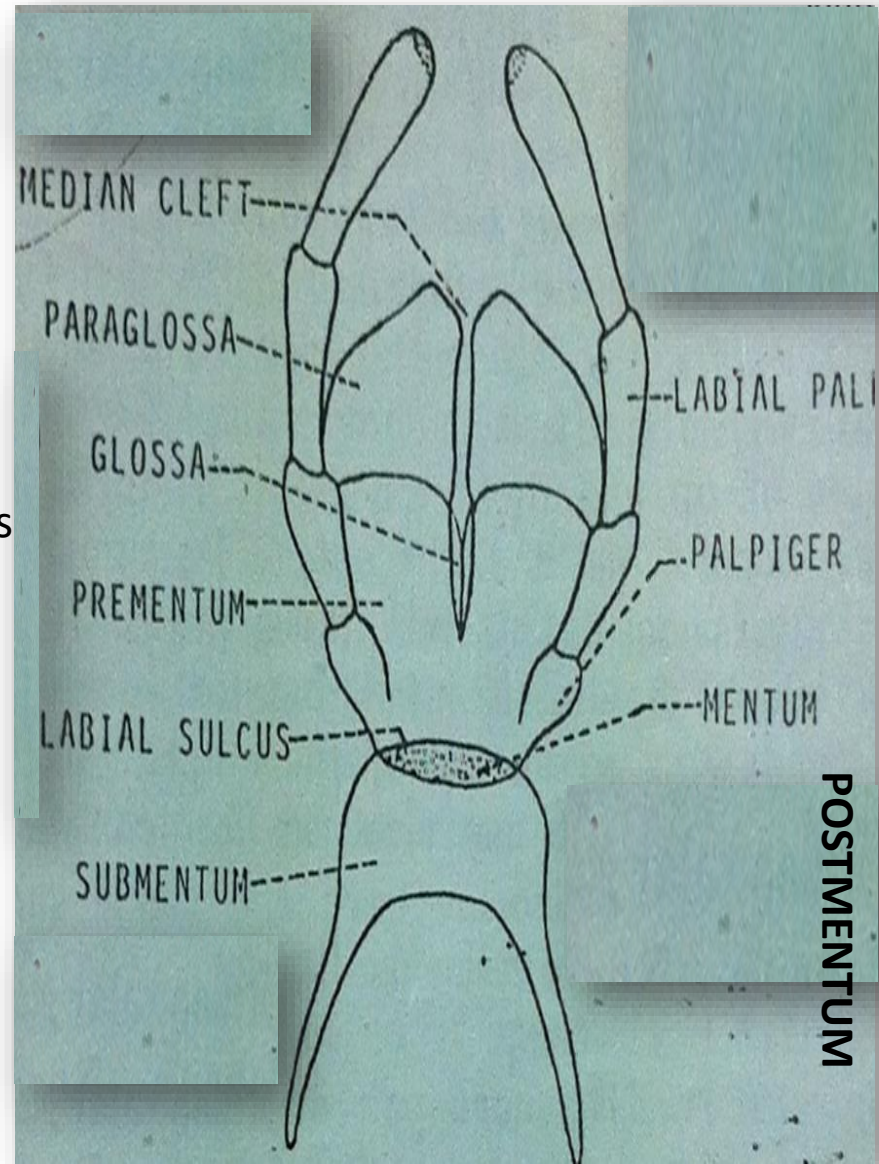
# Head Appendages - Mouthparts

## Chewing/biting Mouthparts (Ak Grasshopper)



### Labium

- Single structure lying below the maxillae.
- Closes the mouth from the lower side.
- It is divided by an ill-defined transverse **labial sulcus** into two main parts
  - Posterior one, **postmentum**
  - Anterior one, **prementum**
- The postmentum is further divided into
  - lower very large is the **submentum**
  - upper very small is the **mentum**
- The prementum contains three pairs of structures
  - At apex two large triangular lobes of **paraglossae** which are separated by a deep **median cleft**.
  - At the base of the cleft are two small the narrow lobes, the **glossae**.
  - On basal sides small processes, fused with prementum, called **palpiger**. Each palpiger bears on it an antenna-like 3-segmented structures, the **labial palpus**.



# Head Appendages - Mouthparts

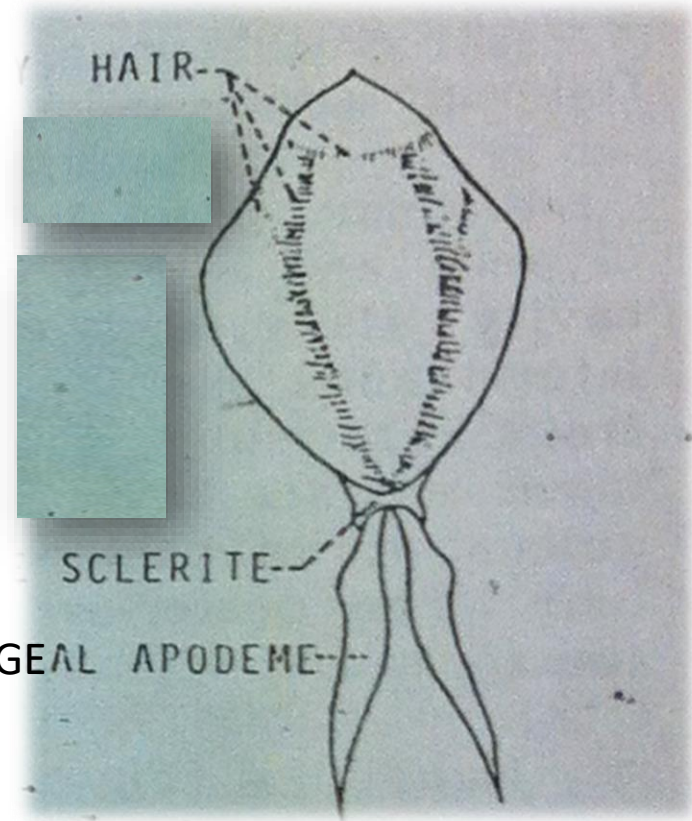
## Chewing/biting Mouthparts (Ak Grasshopper)

### Hypopharynx



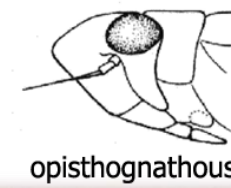
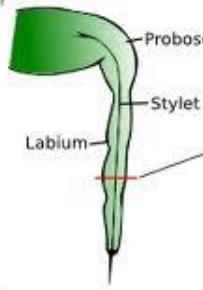
- A large median fleshy lobe in the mouth cavity.
- It is attached to the base of the labium.
- The hypopharynx is broad form the middle and tapers anteriorly as well as posteriorly.
- It anterior end looks like a triangular lobe.
- Its dorsal side bears two slightly curved longitudinal rows and one transverse row of sensory **hairs**.
- The hypopharynx has also a posterior transverse **sclerite**.
- Two hypopharyngeal apodemes arise from sclerite for the attachment of muscles.

HYPOPHARYNGEAL APODEME---



# Head Appendages - Mouthparts

## Piercing-Sucking Type Mouthparts (Red Cotton Bug)



- The mouthparts are greatly modified to form of a long, slender beak or proboscis.
- Opisthognathous head and mouthparts

### Labrum:

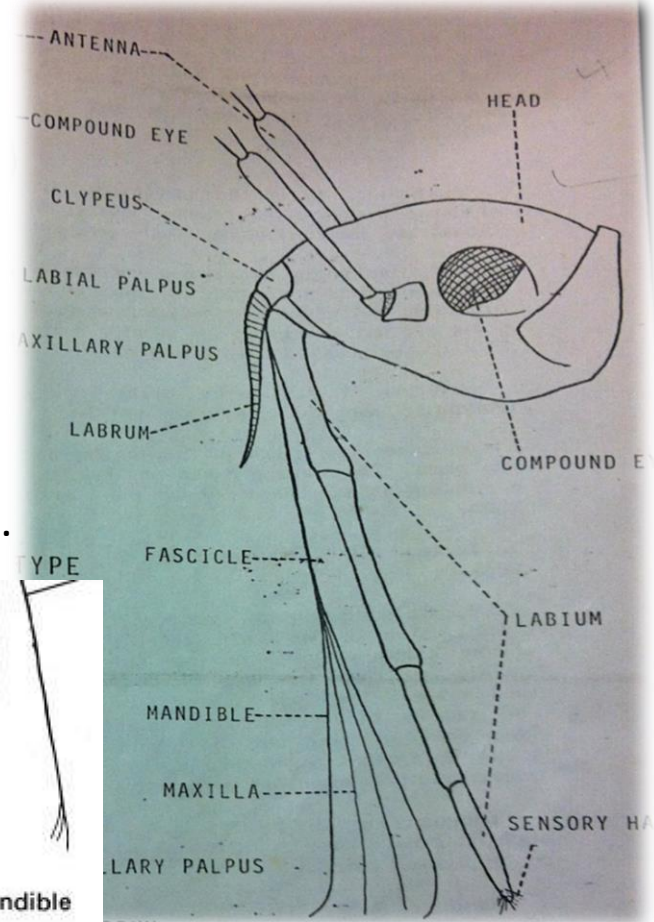
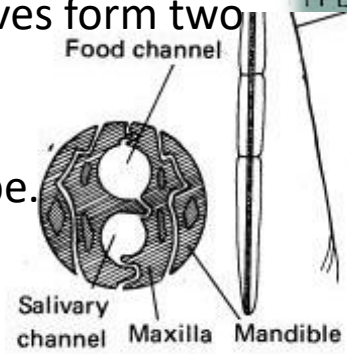
- A short structure, broad at base narrow towards apex.
- Attached to the clypeus and covers the grooves of the labium up to the end of its first segment.
- It keeps the needles in the groove of the labium.

### Mandible:

- Paired, long, hair-like needles called stylets.
- Their tips are slightly curved and serrated for piercing the plant.
- They form the outer pair.

### Maxillae:

- Paired, long, hair-like called stylets.
- Each maxillary stylet has a double groove along its inner side.
- When the two maxillae fit together, their grooves form two tubes or channels
  - The upper food channel or suction tube
  - The lower salivary channel or ejection tube.
- They form the inner pair.



# Head Appendages - Mouthparts

## Piercing-Sucking Type Mouthparts (Red Cotton Bug)

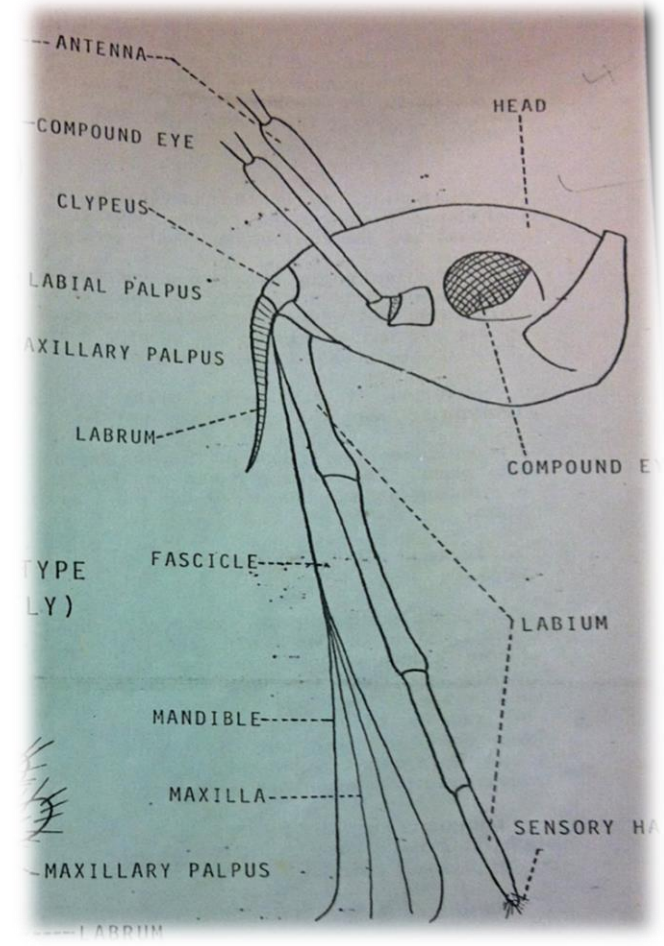
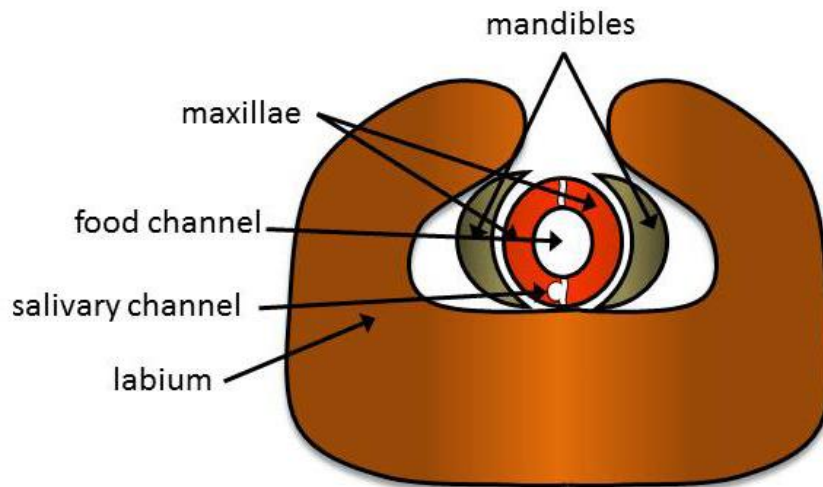


### Fascicle:

- The stylets of mandibles and maxillae cling together to form a single structure, the fascicle.
- It lies in the grooves of the labium.

### Labium:

- Principal structure modified to form an antenna like 4-segmented proboscis.
- It has a dorsal groove to accommodate the fascicle.
- Its tip is provided with small sensory hair.
- It does not penetrate into the plant.



# Head Appendages - Mouthparts

## Sponging type (house fly)



The mouthparts are greatly modified to form a short, thick elbow-shaped fleshy proboscis on the lower side of the head.

### Rostrum:

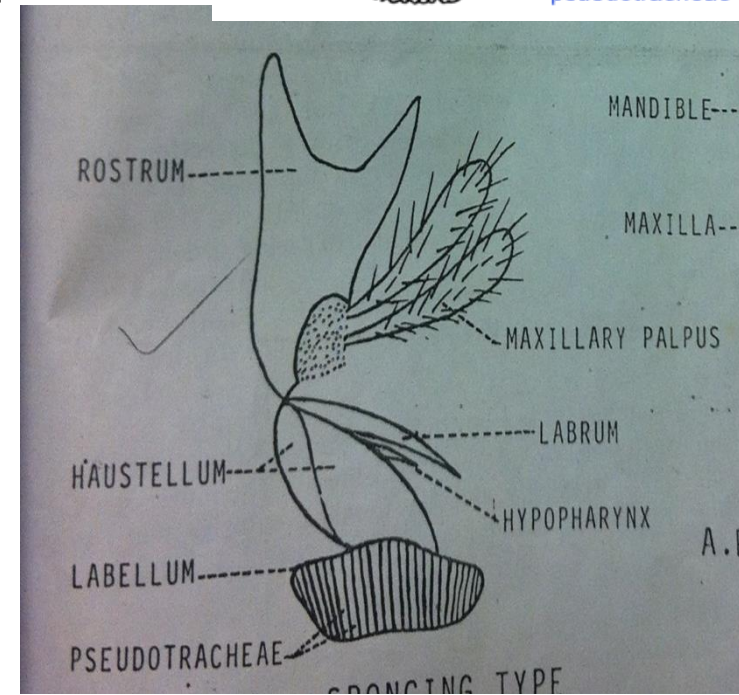
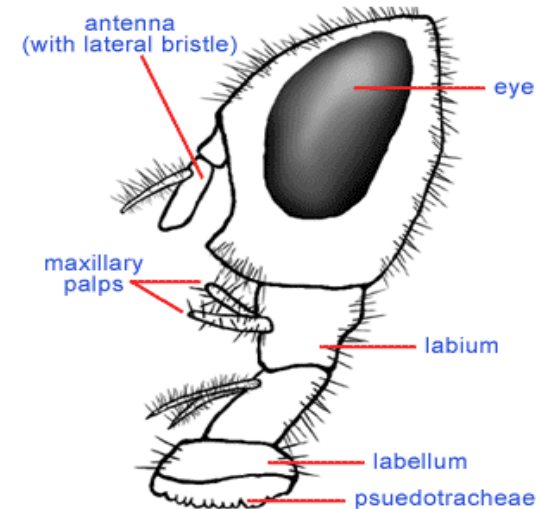
- It is the basal cone-shaped portion of the proboscis. A pair of unsegmented, club-shaped, hair maxillary palpi are present on its distal end.

### Haustellum:

- The part of the proboscis between maxillary palpi and labellum.
- It has a groove on its dorsal side which contains a pair of needle-like structures, the **hypopharynx** and **labrum**.
- **Hypopharynx** lies at the bottom of the groove and forms the salivary channel.
- **Labrum** is ventrally grooved from below by the hypopharynx to make food channel.

### Labellum:

- Terminal portion of the proboscis which has a pair of large, sponge-like, fleshy lobes, the **labella**.
- They contain numerous fine tubes, the **pseudotracheae** which open outside.



# Head Appendages - Mouthparts

## Siphoning Type Mouthparts (Butterfly)



Modified to a long but coiled proboscis below the head. It is straightened only at the time of feeding. Many parts are either absent or greatly reduced and thus not visible.

### Labrum:

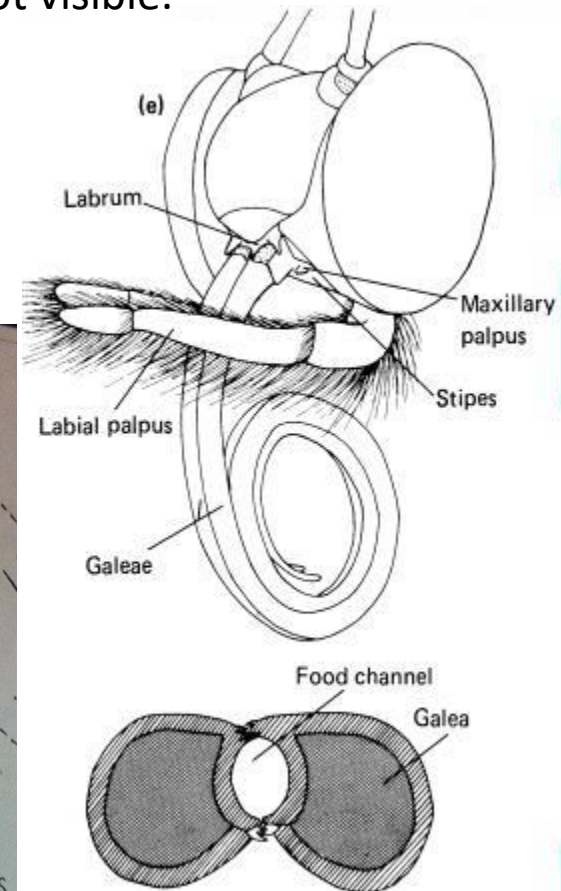
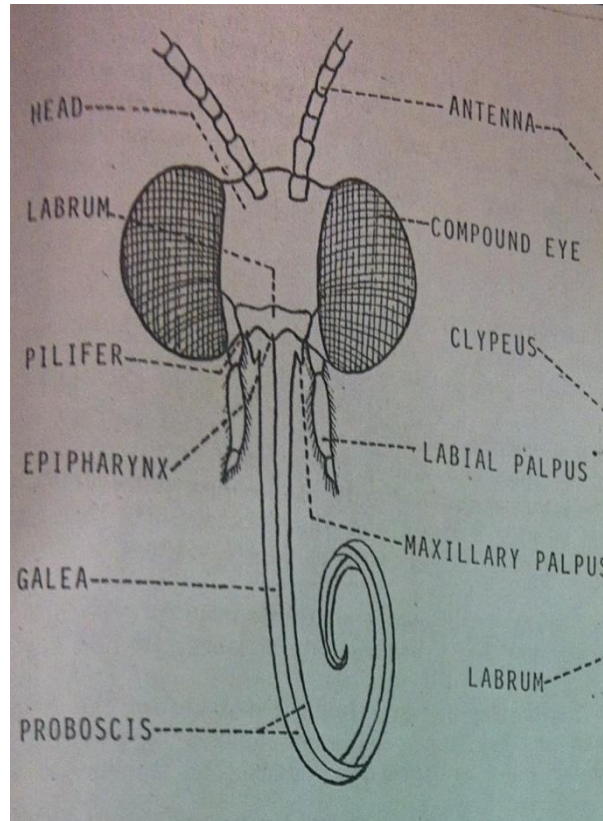
- Narrow, transverse sclerite which is provided with a median proboscis.

### Maxillae:

- Galea are elongated proboscis.
- They are grooved on their inner sides and hooked together to form a sucking tube.
- The maxillary palpi are greatly reduced and appear as small knobs.

### Labium:

Consists of only large, 3-segmented, hairy labial palpi.



# Head Appendages - Mouthparts

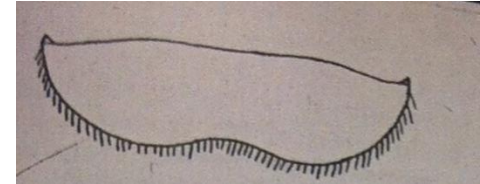
## Chewing-lapping Type Mouthparts (Honey bee)



Combination of two types: Labrum and mandibles are similar to those of the chewing type labium and maxillae are greatly elongated and modified to form the lapping proboscis.

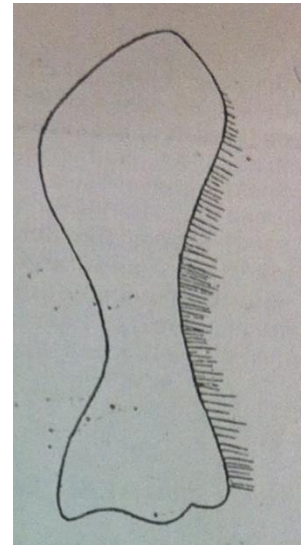
### Labrum:

- is a narrow, transverse flap.
- Anterior border slightly excavated.
- Base is attached to the clypeus.
- Free border contains small hairs.



### Mandibles:

- paired, dumb-bell-shaped sclerotised structures lying on sides.
- partly concealed in labrum.
- Outer surface has long hairs which gradually shorten towards anterior end.
- Not used for feeding but for moulding wax into hexagonal cells in the hive.



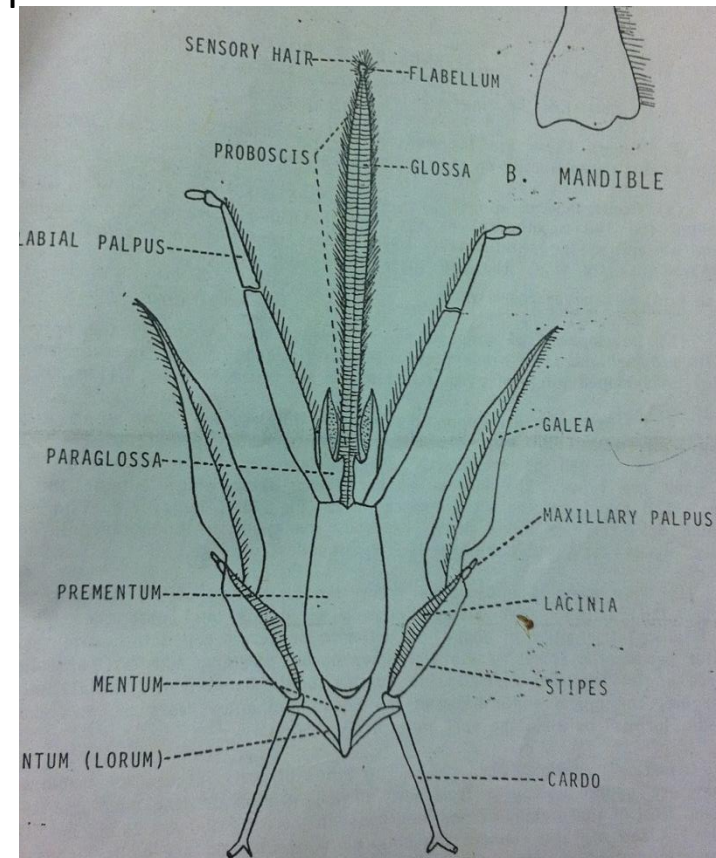
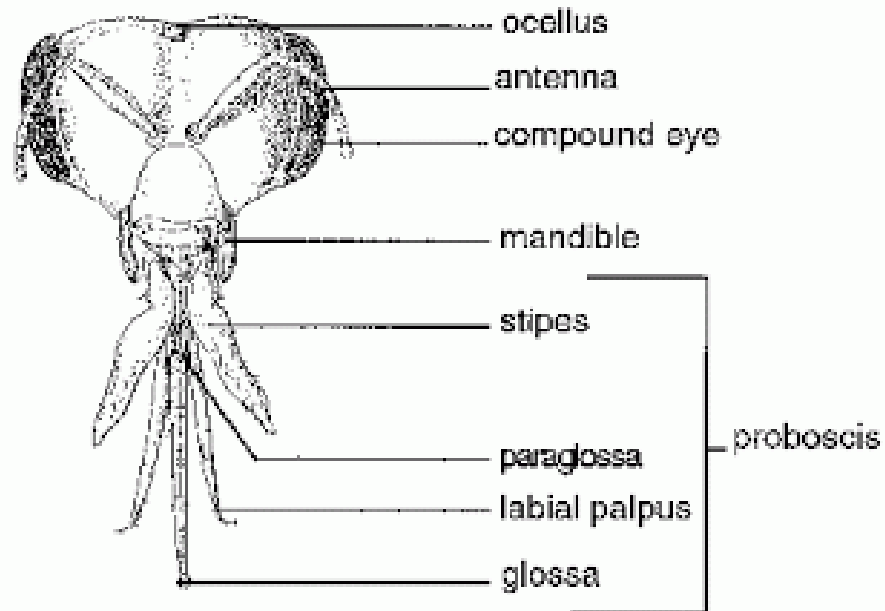
# Head Appendages - Mouthparts

## Chewing-lapping Type Mouthparts (Honey bee)



### Maxillae:

- Paired lateral structures lying below mandibles.
- Each maxilla consists of a long, narrow, basal sclerite, the **cardo**.
- Cardo contains on it an elongate and broad sclerite, the **stipes**.
- Stipes bears three structure
  - a minute peg like 2-segmented **maxillary palpus** on the outer side of its apex,
  - a very large blade like **galea** on the inner side of its apex
  - a reduced, narrow **lacinia** on its inner side.



# Head Appendages - Mouthparts

## Chewing-lapping Type Mouthparts (Honey bee)



### Labium:

- It lies below the maxillae on the lower side of the mouth.
- It consists of a flexible, V-shaped, basal sclerite, the **submentum (lorum)**.
- In middle articulates a small triangular sclerite, the **mentum**.
- Mentum carries on it a large sclerotised **prementum**.
- On each side of the apex of the prementum, two small lobes the **paraglossae** arises.
- Each paraglossa is apically divided into two processes the inner very small and the outer large and spoon-shaped.
- Between the paralossae lies an elongate spindle-shaped flexible **proboscis** which is formed by the fusion of two **glossae**.
- Proboscis has transverse ridges and long hair on it.
- Proboscis is expanded at apex to form a small knob-like lobe the **flabellum**.

