

Subject	Adv. Insect structure
Lect. No.	3
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The Head and its appendages

Three physical features separate insects from other arthropods: they have a body divided into three regions (called tagmata) (head, thorax, and abdomen), three pairs of legs, and mouthparts located outside of the head capsule. This position of the mouthparts divides them from their closest relatives. The head is specialized for sensory input and food intake. The head capsule bears most of the sensory organs, including the antennae, ocelli, and compound eyes, along with the mouthparts.

The characteristic feature of arthropods, including the insects, is a hard, jointed exoskeleton or cuticle. This consists of a series of hard plates, these sclerites, which may simply be jointed to each other by membranes giving flexibility or may be closely articulated together so as to give a more precise movement of one sclerite on the next.

The head is derived from a strongly sclerotized capsule jointed to the thorax by a flexible membranous neck.

The head takes the form of a heavily sclerotized capsule, and the anterior tagma, bears the major sense organs (pair of compound eyes, typically three ocelli and a pair of antenna) and the mouthparts.

The insect head is consisting from six segments; the first preoral segment is called the protocerebral segment. The second preoral (antennal/deutocerebral) segment bears the antennae, which are therefore true segmental appendages.

The third preoral (intercalary/tritocerebral) segment, Segments 4 to 6 are postoral and named the mandibular, maxillary, and labial, respectively.

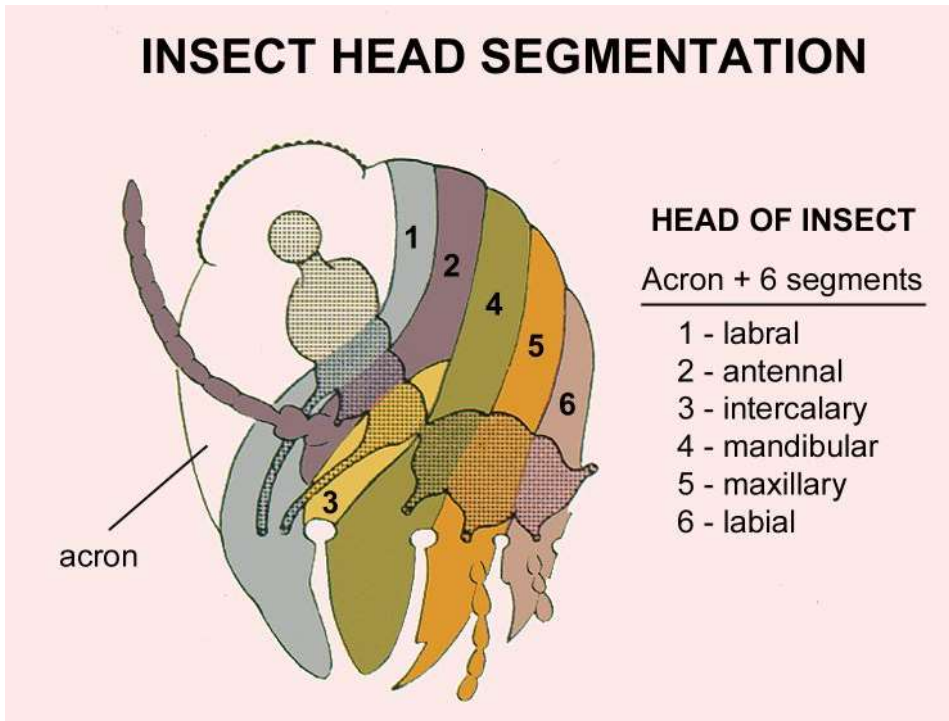


Fig. Head segmentation

Head Orientation

The orientation of the head with respect to the rest of the body varies. There are three types of the orientation:

- 1- **The prognathous:** the mouthparts point forewards and this is found in carnivorous species with actively pursue their prey, and in larvae, particularly coleopteran, which use their mandibles for burrowing.
e.g., Broad-nosed weevils, *Polydrusus fimosus*



Fig. Broad-nosed weevils, *Polydrusus fimosus*

- 2- **The hypognathous:** the mouthparts in a continuous series with the legs are probably primitive. This orientation occurs mostly in vegetarian species living in open habitats. this is found in Orthoptera , Grasshoppers, Desert locust, *Schistocerca gregaria* .

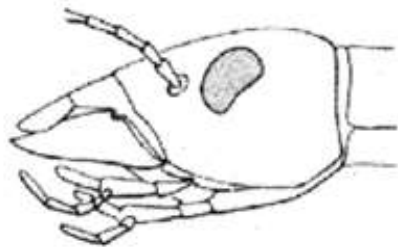


3- Fig. Desert locust , *Schistocerca gregaria* .

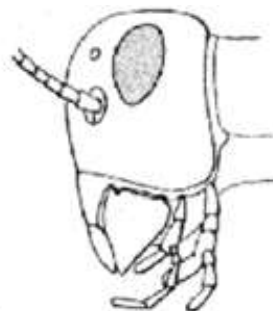
- 4- **The Opisthognathous:** the elongated proboscis slopes backwards between the front legs, this is found in heteroptera and homoptera. e.g., Oleander aphid, *Aphis nerii*



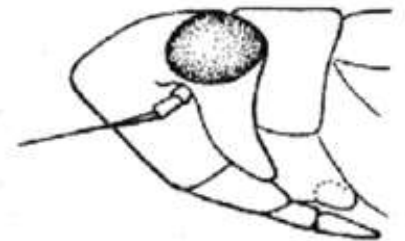
Fig. Oleander aphid, *Aphis nerii*



prognathous



hypognathous



opisthognathous

Head Sutures

The head is a continuously sclerotised capsule without outward appearance of segmentation, but it's marked by a number of grooves, commonly all the groups are called sutures. The head consists of various kinds of sutures:

1. **Ecdysial cleavage** or (**sulcus**) or (**suture**) is variably developed among insects. Depending on the insect, the ecdysial cleavage may be shaped like a Y, a U, or a V. Some of these complexes of sutures are used by insects to emerge from the old integument during molting.
2. **Epistomal (fronta-clypeal) suture**: acts as a brace between the anterior mandibular articulations.
3. **Circumocular suture**: is strengthen the rim of the eye and may develop into a deep flange, protecting the inner side of the eyes.
4. **Circumantennal suture**: is strengthening the head at the point of insertion of the antenna.
5. **Occipital suture**: this is running across the back of the head, behind the compound eyes.
6. **Subgenal suture**: is a lateral groove in the cranial wall running slightly above the mouthpart articulations. That part of the subgenal sulcus lying directly above the mandible
7. **pleurostomal sulcus**; That part of the subgenal sulcus lying directly above the mandible
8. **Clypo-labral suture**
9. **Fronto-genal suture**

Areas of the Head

The different areas of the head defined by the sutures are given names for description purposes. Since the sutures are variable position, so there are many areas.

The front of the head is divided by the fronto-clypeal suture into the **frons** (is that area of the face below the vertex) and **clypeus** (is that area of the face immediately below the frons). Dorsally the frons continues into the **vertex** and posteriorly this is separated from the **occiput** by the occipital suture. The vertex is the apex or dorsal region of the head between the compound eyes, in this area ocelli are usually located.

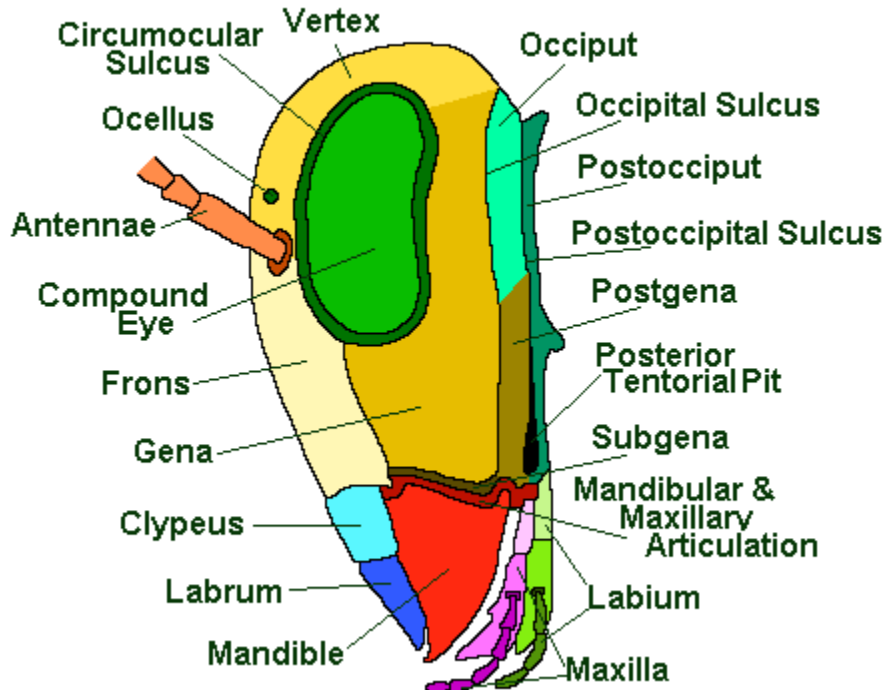
The occiput is divided from the postocciput behind it by the postoccipital suture. The area below the compound eye on both sides of the head is called **the gena** from which the **subgena** is cut off below by the **subgenal suture** and the postgena behind by the occipital suture. Gena separated from frons by frontogenal suture

The clypeus is that area of the face immediately below the frons (with which it may be fused in the absence of the fronto-clypeal sulcus). It supports the cibarial dilator muscles.

Under the clypeus is **the labrum** that equivalent to the insect's upper lip and is generally moveable, it articulates with the clypeus by means of the **clypeolabral sulcus**.

The mandibles and **maxillae** take up the lateral region of the labrum and the base of the **labium** lies transversely below the foramen magnum.

The Insect Head (Side View)



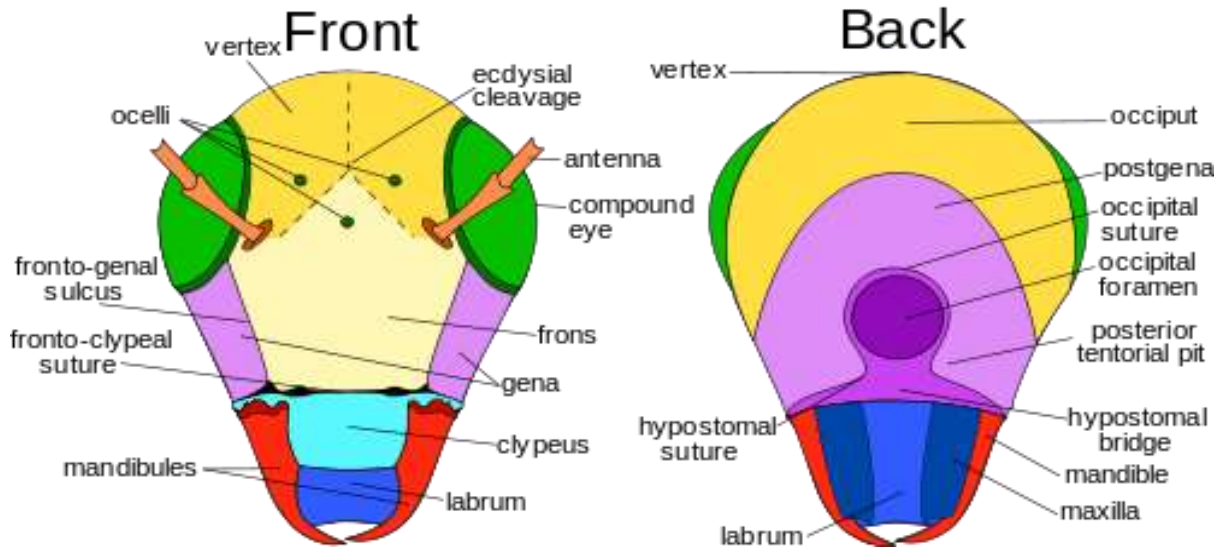


Fig. Head a. Dorsal

b. Ventral

Compound eyes and ocelli

In most insects there is one pair of large, prominent compound eyes composed of units called ommatidia. There may be up to 30,000 ommatidia in a compound eye. This type of eye gives less resolution than the vertebrate eye, but it gives acute perception of movement. When present, ocelli (either 2 or 3), detect low light or small changes in light intensity.



Fig. *Chrysomya megacephala* Male

Female

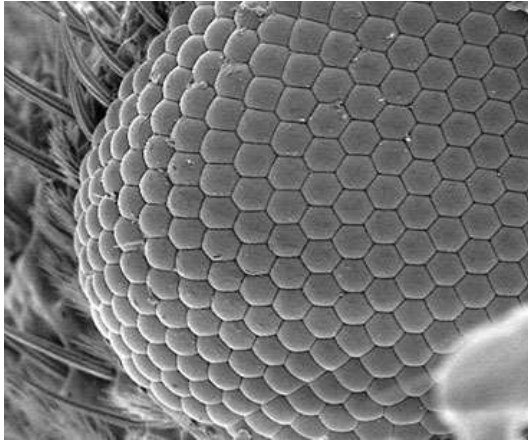


Fig. a. Ommatidia

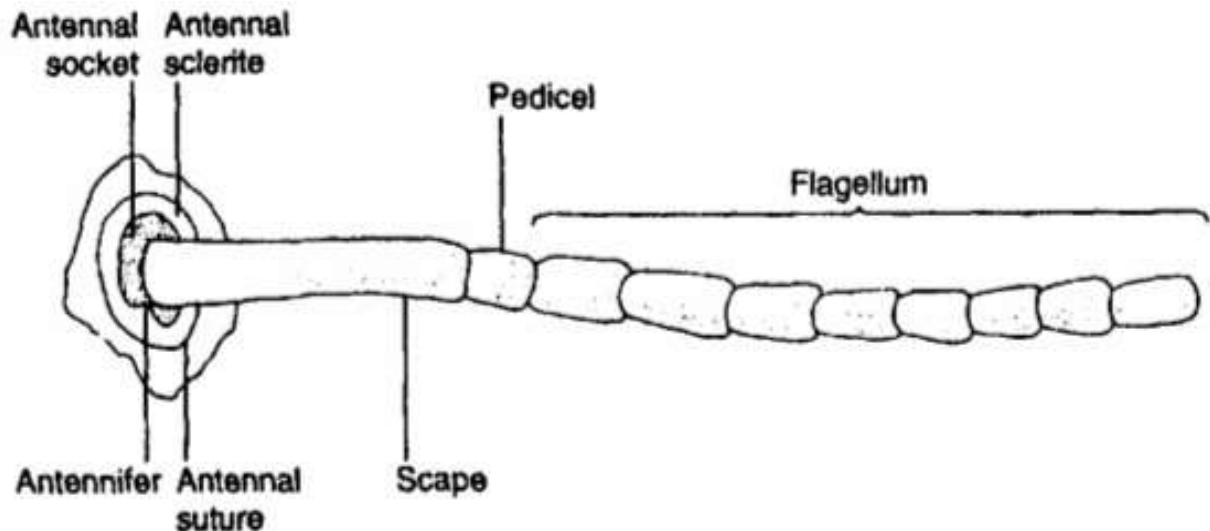
b. Ocelli

Antennae

Antennae, sometimes called "feelers", are flexible appendages located on the insect's head which are used for sensing the environment. Insects *can* feel with their antennae because of the fine hairs (setae) that cover them.

A pair of antennae is found on the head of the pterygote insects and the apterygote groups with the exception of the Protura. However, in the larvae of many higher Hymenoptera and Diptera they are reduced to a slight swelling or disc.

In a typical antenna, there are three principal components: the basal **scape** by which the antenna is attached to the head, the **pedicel** containing Johnston's organ and the **flagellum**, which is usually long and annulated.



The scape is set in a membranous socket and surrounded by the antennal sclerite on which a single articulation may occur. In the majority of insects movement of the whole antenna is effected by muscles inserted on the scape and attached to the cranium or tentorium. However, in Collembola there is no Johnston's organ and each antennal segment is moved by a muscle inserted in the previous segment. Although retaining the basic structure outlined above, the antennae take on a wide variety of forms related to their varied functions.

Antennal Functions

The functions of antennae include touching, temperature and humidity perception, grasping prey, and holding on to the female during mating. For taxonomists, this variety of form may be an important diagnostic feature. Generally, it is the flagellum that is modified. For example, in some male moths and beetles the flagellum is plumose and flabellate, respectively, providing a large surface area for the numerous chemosensilla that give these insects their remarkable sense of smell. By contrast, the plumose nature of the antennae of male mosquitoes makes them highly sensitive to the sounds generated by the beating of the female's wings.

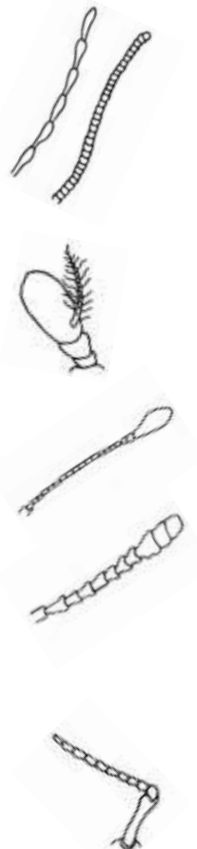
Types of Antennae

1-Filiform: Segments are usually cylindrical. Thickness of segments remains same or reduced. e.g. Grasshopper,

2- Aristate: The terminal segment is enlarged. It bears a conspicuous dorsal bristle called arista. e.g. Houseflies.

3- Capitate: Terminal segments become enlarged suddenly e.g. butterfly

4- Clavate: Antenna enlarges gradually towards the tip. e.g. Blister beetle

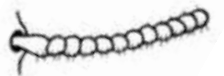


5- Genuiculate: Scape is long, remaining segments are small and are arranged at an angle to the scape resembling an elbow joint. e.g. Ant, wasps and honey bee.

6-Lamellate (Plate like): Antennal tip is expanded laterally on one side to form flat plates e.g. Scarab beetles.



7-Moniliform: have a beadlike shape. e.g. Termites (White Ant).



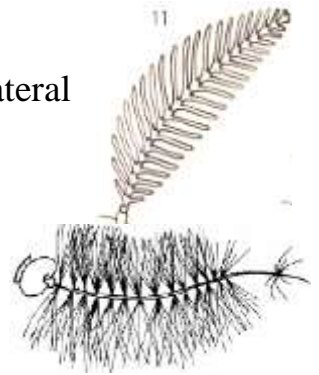
8-Bipectinate: (Double comb like) Segments with long slender lateral processes on both the sides e.g. Moth

9-Plumose: (Feathery) Segments with long whorls of hairs e.g. male mosquito

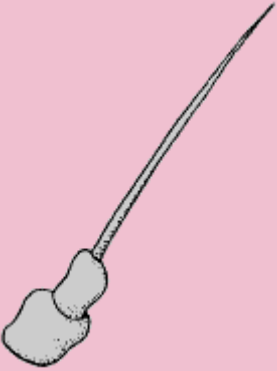

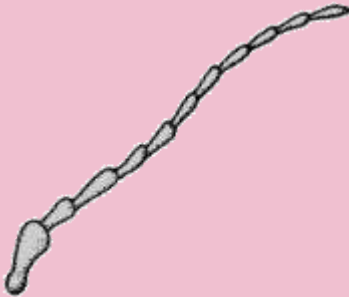



10-Pilose: (Hairy) Antenna is less feathery with few hairs at the junction of flagellomeres. e.g. Female mosquito.

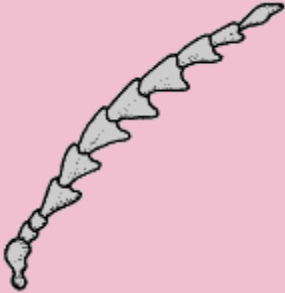

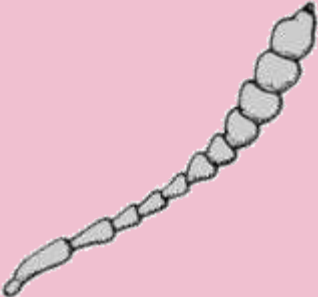



11- Setaceous: (Bristle like) Size of the segments decreases from base to apex. e.g., Dragonfly, Damselfly.

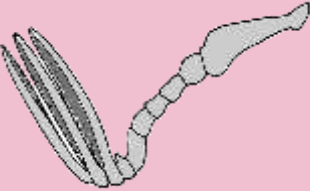




12- Serrate: (Saw like) Segments have short triangular projections on one side e.g. Click beetles.


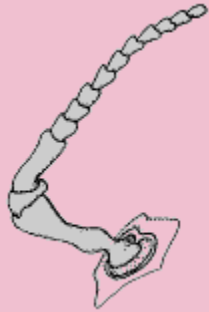

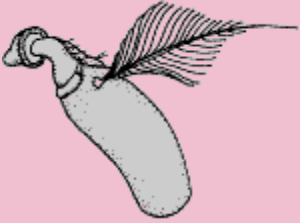


Types of Antennae:

Name	Appearance	Example(s)
<p>Setaceous -- bristle-like</p>		<p>Dragonflies</p> 
<p>Filiform -- thread-like</p>		<p>Ground beetles and Cockroaches</p> 
<p>Moniliform -- bead-like</p>		<p>Termites</p> 

<p>Serrate -- sawtoothed</p>		<p>Click beetles</p> 
<p>Clavate -- gradually clubbed</p>		<p>Carrion beetles</p> 
<p>Capitate -- abruptly clubbed</p>		<p>glaphyridae beetle</p> 

<p>Lamellate -- nested plates</p>		<p>Scarab beetles</p> 
<p>Pectinate -- comb-like</p>		<p>Fire-colored beetles and Male glow-worms</p> 
<p>Plumose -- brush-like And Pilose</p>		<p>Mosquitoes</p>

		
<p>Geniculate - - elbowed</p>		<p>Weevils , Honey bee and Ants</p> 
<p>Aristate -- pouch-like with lateral bristle</p>		<p>House flies</p> 