CULEX AND ANOPHELES: THE MOSQUITOES

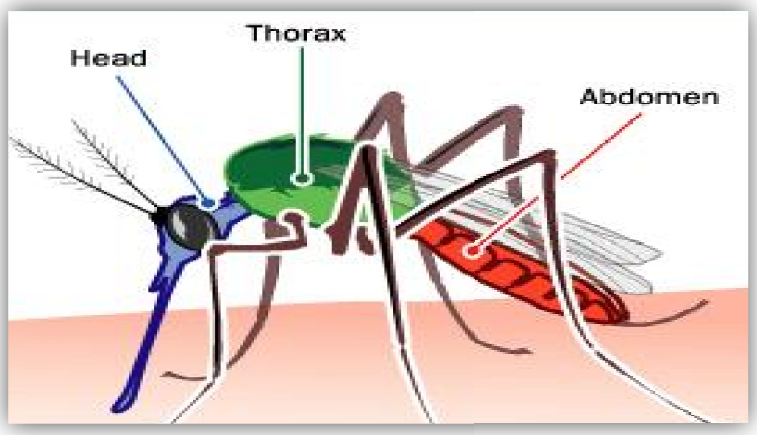
NOTES BY ANUPAM SIR

- Everyone is familiar with mosquitoes because of their painful and irritating bites, especially at night.
- Like houseflies, mosquitoes also belong to the order **Diptera of class Insecta**.
- However, they differ from flies in having a shorter body, longer legs, piercing and sucking mouth parts and many-segmented antennae.
- Important genera are **Anopheles (fam. Anophelidae) and Culex and Aedes (fam. Culicidae**).

CULEX AND ANOPHELES

Systematic Position

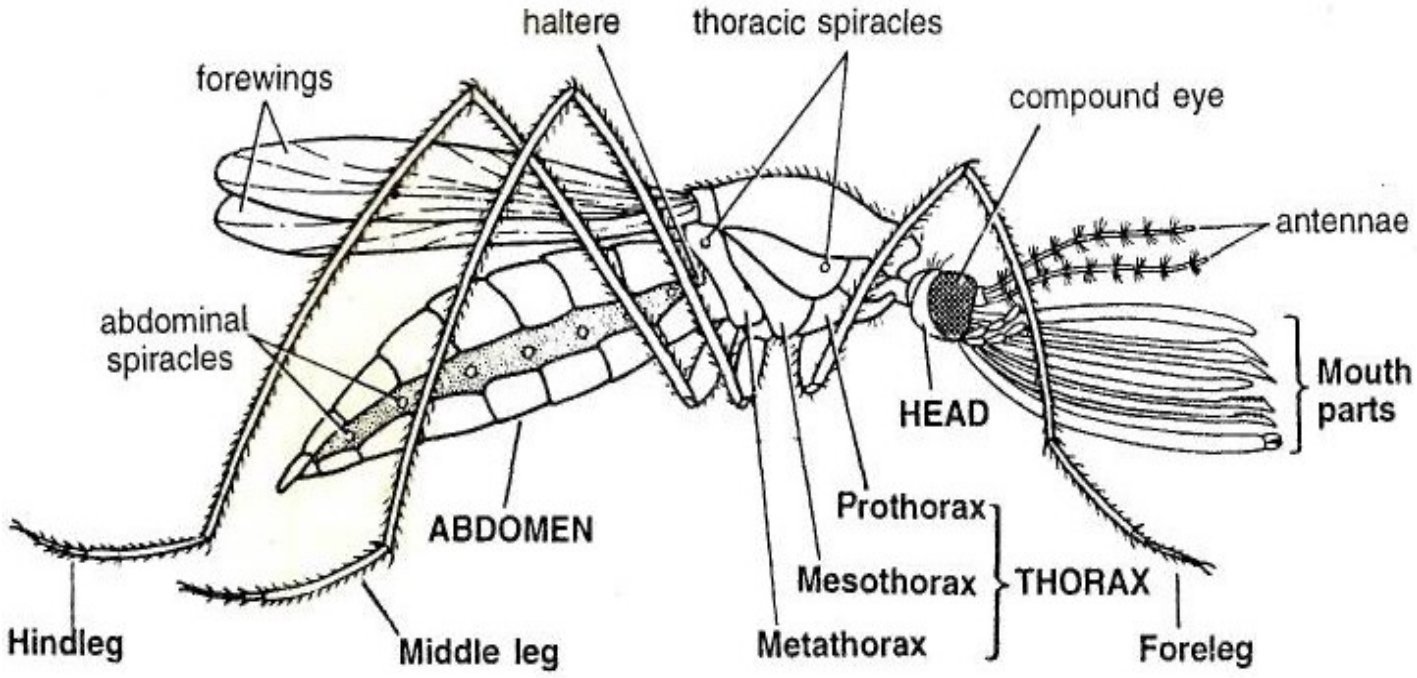
Phylum	Arthropoda
Class	Insecta
Subclass	Pterygota
Division	Endopteiygota
Order	Diptera
Genus	*Culex* or



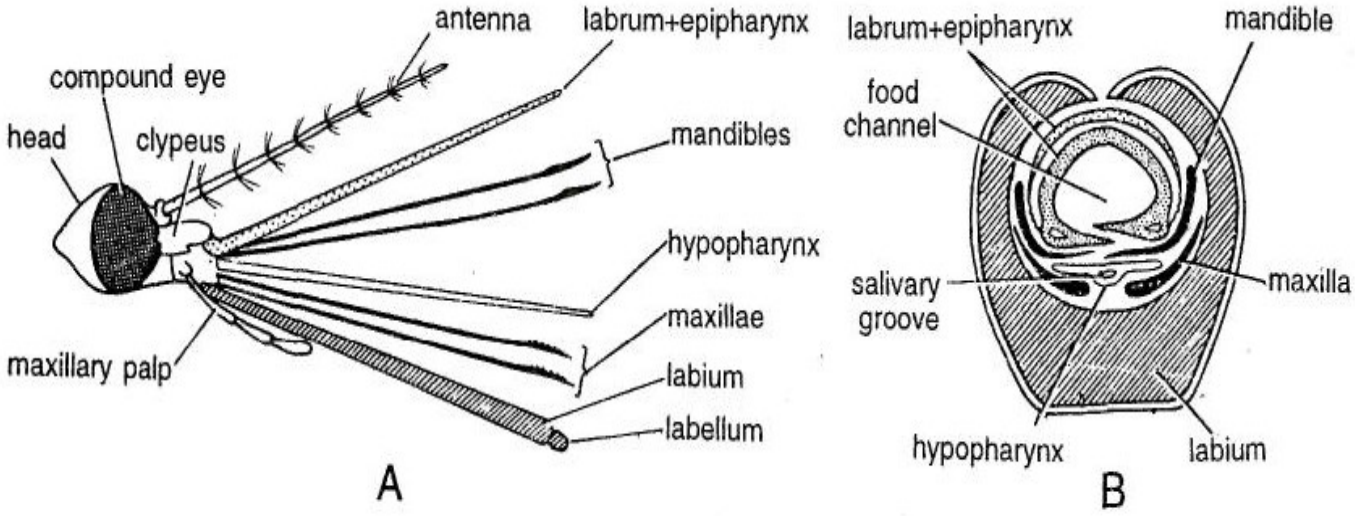
Habits and Habitat

- Mosquitoes are found in damp and marshy localities.
- They are abundant in tropics and subtropics.
- They are **nocturnal** in feeding habit.
- **Females feed on blood** (**sanguivorous**) of man and large animals, while **males suck juices** of flowers and fruits.
- **Because of their blood-sucking adaptation, females are medically important as carriers of viral, bacterial and protozoan infections**.
- **Anopheles caries malaria.**
- **Culex caries dengue and elephantiasis.**
- **Aedes caries yellow fever.**
- Adult mosquitoes fly well and can cover great distances.
- They are able to fly without rest **for 2 or 3 hours** and easily cover 20 to 30 kilometers in a night.
- Females become aggressive after copulation.
- They lay eggs in water where development of larvae and pupae takes place.
- Two common mosquito genera, (**Anopheles and Culex**) can be easily identified by their **sitting postures**.

- When sitting, the abdomen of Anopheles is always held at an angle to the surface while that of **Culex** is held parallel to the surface.



Culex. Female in lateral view.



Culex. Head and mouth parts of female. A-In lateral view, B-In T.S.

External Morphology

[I]Shape, size and colouration

- Body of mosquito is small, soft, slender and covered with scales.
- It measures **3 to 6 mm** in length.
- Body colour is greyish black.
- Wings of Anopheles carry dark spots.
- Aedes has a black and white striped body.

[II] Divisions of body

- Body is segmented and like other insects, divided into 3 distinct parts: **head, thorax and abdomen**.

1. Head.

- Small and almost spherical head is connected with thorax by a short, narrow neck.
- It bears the following parts —

(a) Compound eyes.

- These are two enormous, **kidney-shaped structures** almost touching each other.

(b) Antennae.

- Below eyes, in front of head, a triangular plate, called clypeus, projects much forward and bears a pair of **long, many-jointed and feathery antennae, bearing** delicate hair arranged in several whorls.
- Antennae of male are densely clothed with long hair (**plumose antennae**) while those of female are with only a few short hair (**pilose antennae**).

(c) Mouth parts.

Mouth parts form a long piercing and sucking tubular proboscis.

(i) Labium.

- In female mosquito, labium forms the proboscis-sheath.
- It ends in a pair of white**, pointed lobes, the labellae**, bearing tactile hair.
- It bears a dorsal groove, which lodges all the other mouth parts modified into six **needle-shaped piercing stylets**, meant for puncturing the host skin.

(ii) Labrum-epipharynx.

- A long, pointed and stiff rod is called labrum- epipharynx.
- It is formed by the fusion of labrum or upper lip and epipharynx, a projection from the roof of mouth.
- Ventral surface of labrum-epiphayrnx bears a longitudinal groove or food channel.

(iii) Hypopharynx.

- Food channel is closed below by a long pointed and flattened plate like a double edged sword, called hypopharynx.
- It is traversed by a minute median salivary channel, down which flows the secretion of salivary glands.

(iv) Mandibles and maxillae.

- Within proboscis also lie paired mandibles and maxillae (galeae), forming long and needle-shaped stylets.
- Mandibles end in sharp tiny blades while maxillae into saw-like blades bearing teeth.
- A pair of long and segmented maxillary **palps,** bearing tactile hair, project from sides at the base of proboscis.
- In male mosquito, the piercing organs are reduced.
- Mandibles and maxillae are absent and **hypopharynx** fused with labium.
- Male and female sexes of mosquitoes can easily be determined by the form of their antennae and maxillary palps.
- In Anopheles, palps are nearly as long as proboscis in both sexes, but in male, their ends are club-shaped.
- In Culex, palps are much shorter than proboscis in female, but slightly longer in male.

Feeding.

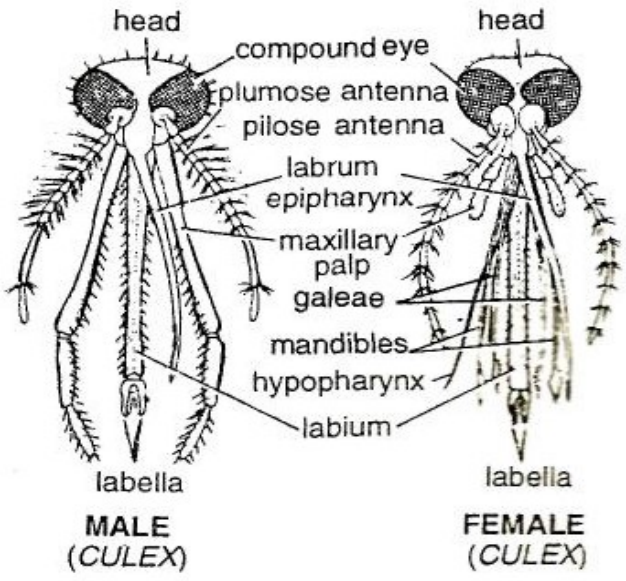
- To feed upon **bjood meal**, the female presses the **labellae** of proboscis against the skin of man.
- Maxillae and mandibles pierce deep into skin in order to puncture the **blood capillaries**.
- Saliva, acting as an anticoagulant, is injected down the hypopharynx into the wound.
- Labrum-epipharynx and hypophayrnx form a feeding tube to suck up blood.
- Pharyngeal suction force is believed to be responsible for sucking of blood.

2. Thorax.

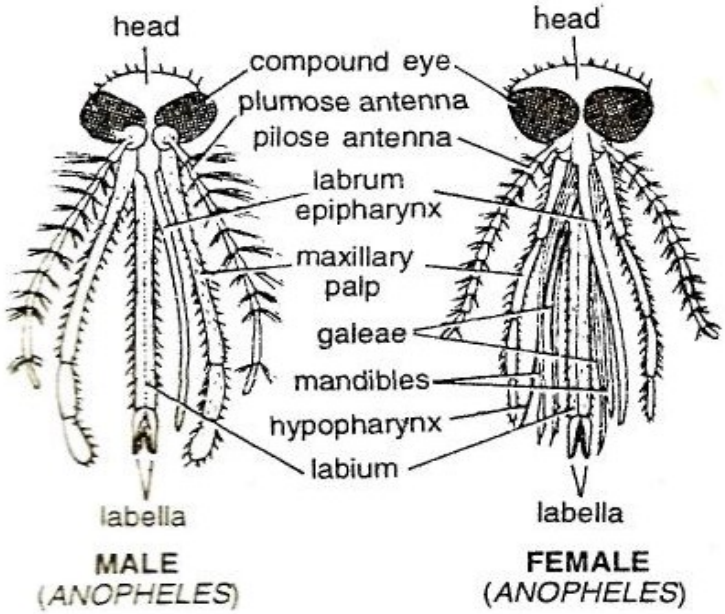
- Thorax is made of a very small.
- prothorax, a very large.
- mesothorax and a small metathorax.,
- each bearing ventro- laterally a single pair of long, slender and jointed legs.
- A single pair of wings are attached dorso-laterally to mesothorax.
- These are narrow, membranous and covered with scales in a characteristic manner that differs from species to species.
- Metathorax bears a pair of small drumstick-shaped or club-shaped processes, called halteres or balancers.
- These represent the rudimentary hindwings, useless for flight and probably sensory in function.
- These are supposed to produce characteristic sound.

3. Abdomen.

- The abdomen is **slender and 9 segmented**
- . It bears anus on **8th segment and a genital pore on 9th segment**.



Culex. Head and mouthparts.



Anopheles. Head and mouthparts.

Internal Anatomy

- The alimentaiy canal is constructed on the typical plan as **described for cockroach**.
- Crop has the capacity of absorbing water and thus concentrating blood.
- Gizzard or proventriculus has no cuticular teeth.

- Internal lining of midgut does not secrete peritrophic membrane.
- As in other insects, the organ for blood circulation, respiration and excretion are the segmented heart, tracheae and Malpighian tubules, respectively.
- The compound eyes are very much prominent and other sensory structures are well developed.
- All mosquitoes are dioecious.
- Male and female reproductive organs resemble those of cockroach.

Life History of Culex

1. Copulation.

- The two sexes copulate during the flight.
- Female takes a meal of blood before mating.
- Male gets attached to the female by her high pitched whine.
- Female mates only once in her life time which is enough for **laying eggs 4-5 times** of her remaining life for a month or two.

2. Oviposition.

- Female takes a meal of blood before laying eggs.
- Before laying, she fertilizes her eggs with the spermatozoa stored in her **spermatheca**.
- She lays nearly **200 to 400 eggs** in a cluster, in standing polluted **water of ponds,** , marshes, street gutters or **water barrels**.
- By her hindlegs, she arranges the eggs, which are cemented together to form a small floating raft.

3. Eggs.

- Eggs are white, elongated and cigar-shaped.
- They are pointed at their upper ends and broad and rounded at the base.
- Air bubbles, entangled among the upper narrowed ends, assist in floating.
- After some time the eggs become dark grey.

4. Larva.

- Eggs hatch within **2 to 3 days**,
- and a small transparent larva, measuring about 1 mm,
- emerges from the lower end of each egg-Aquatic larva of mosquito is popularly known as the **wriggler**, as it swims actively in water by wriggling movements.
- Its body is distinctly divided into: **head, thorax and abdomen**.

(a) Head.

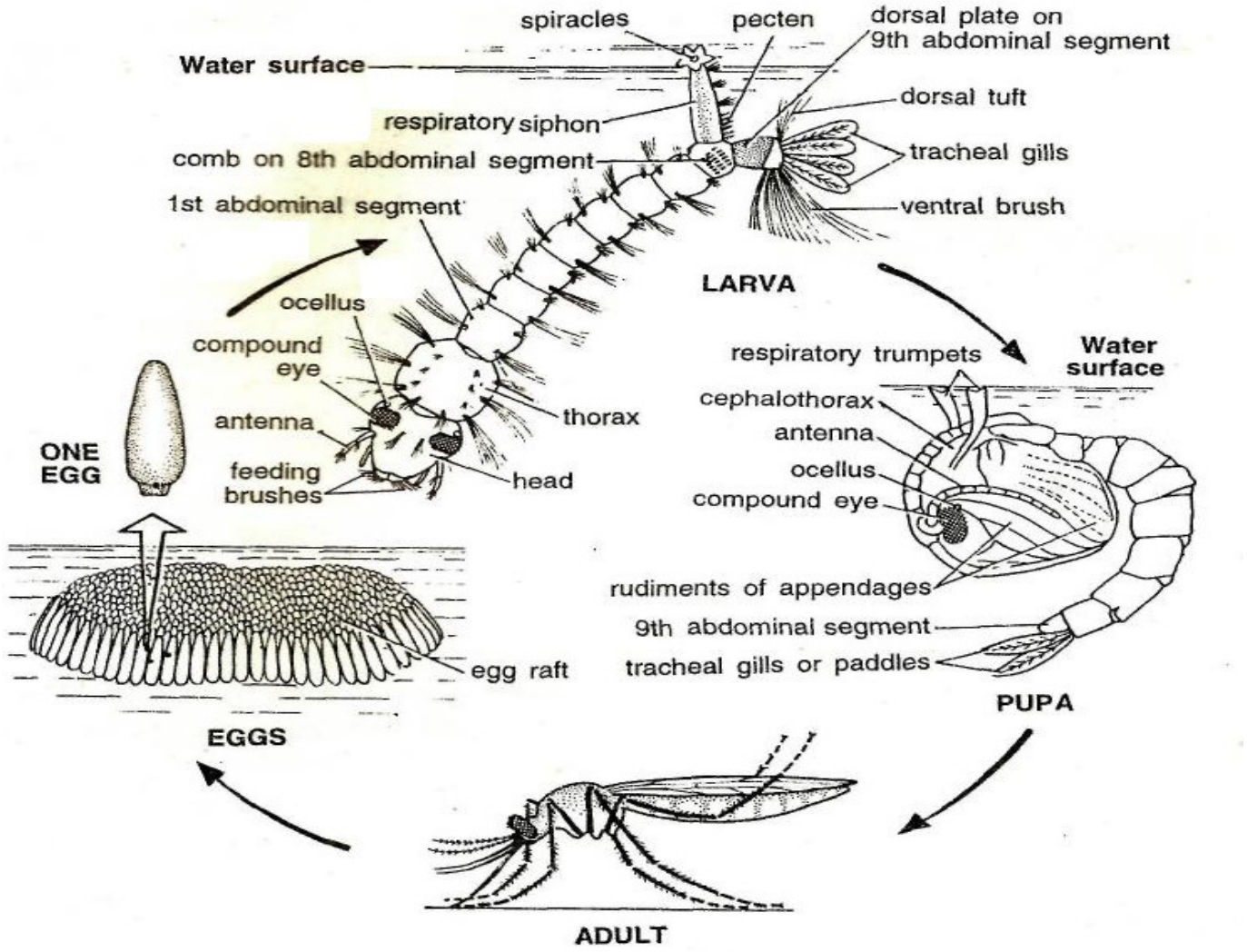
- The large head of larva bears a pair of compound eyes, a pair of ocelli, a pair of two- jointed antennae and chewing mouthparts.
- Larva feeds upon minute aquatic plants and animals.
- In front of mouth, a pair of special branches of hair, the feeding brushes, move rapidly to set up a current of **water, carrying small particles of food into** mouth.
- Mouth has a pair of mandibles and a pair of maxillae.

(b) Thorax.

- Thorax is slightly broader than head,
- unsegmented and limbless,
- but bears **3 pairs of lateral tufts** of hair,
- each tuft springing from a small tubercle.

(c) **Abdomen.**

- Abdomen **consists of 9 segments**, each bearing lateral tufts of bristles.
- Dorsally, upon the 8th abdominal segment is located a long respiratory tube or siphon.
- Tracheal system of body opens on outside through a pair of spiracles, placed at the tip of this siphon.
- Spiracles can be closed by 5 terminal flaps.
- Larva thrusts its respiratory siphon above the water' surface at intervals to breathe.
- Besides, 4 small leaf-like tracheal gills are attached to the last abdominal segment, surrounding the anus.
- These tracheal gills contain tracheae and probably take oxygen dissolved in water.
- 9th abdominal segment also bears two tufts of bristles, ventral brush and a dorsal brush, which help in swimming.
- When at rest, the larva hangs with its head downwards at an angle in water with the top of its **respiratory siphon projecting** above the **surface of water**.



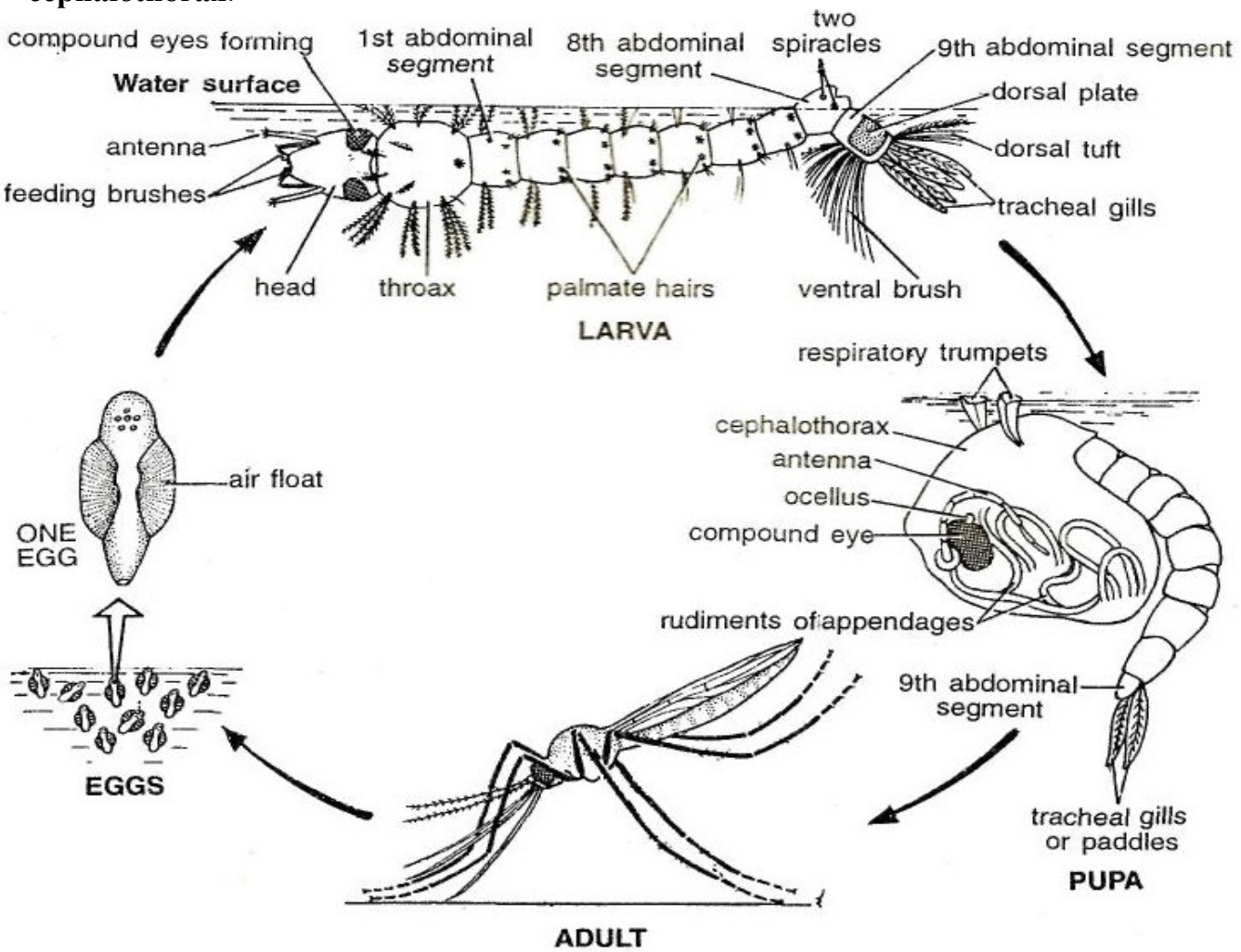
Culex. Stages of life cycle.

- In a fortnight or so, the **larva moults for the 3rd or 4th** time and measures **1.25 mm in** length.
- At the last **moult**, it changes into **pupa**.

5. Pupa.

- Aquatic pupa of mosquito is commonly known as tumbler.

- Unlike most insect pupae, it is quite active.
- But like them, it does not feed.
- It has a comma-shaped body,
- consisting of a swollen unsegmented cephalothorax (head + thorax) and a slender, depressed 9-segmented abdomen under **cephalothorax**.
- 8th abdominal segment bears a pair of large paddles, used in swimming.
- Pupa clings to the surface film with its head upwards.
- If disturbed, it at once darts downwards with a tumbling motion and rises to the surface again after some time.
- Pupa respires with air through a pair of small, trumpet-like tubes or respiratory trumpets, located dorsally on cephalothorax.
- These trumpets are connected with the tracheae of body.
- Pupa does not feed as there is no mouth or anus, but active changes of metamorphosis are going on internally.
- Certain phagocytotic cells cause histolysis of larval organs, which break down and degenerate into a milky pulp.
- At the same time, certain other cells, called imaginal discs, carry out histogenesis by producing organs of the adult from the pulpy mass.
- Transformation of internal organs can be observed through pulpal skin, which encloses the **cephalothorax**.



Anopheles. Stages of life cycle.

6. Imago.

- Pupal stage lasts for a short duration, usually of **2 or 3 days**.
- After completion of metamorphosis, pupa is transformed into the perfect adult insect, called **imago**.
- **Pupal** skin now splits along the back between the two **respiratory trumpets**.
- The imago emerges out with well-developed wings and after a few moments flies away.
- Complete life cycle, from egg to adult, takes 10 to 15 days.
- The female lives for one month or more and the male for about a week.
- Differences in the stages of life cycles of Culex and Anopheles have been given in Table.

MOSQUITO-BORNE DISEASES

1. Malaria.

- Caused by species of Plasmodium carried by female Anopheles.
- Symptoms include recurrence of fever every third or fourth day.

2. Elephantiasis.

- Caused by a parasitic roundworm,
- Wuchereria bancrofti, carried by Culex fatigans.
- Symptoms include enlargement of limbs, scrotum or mammae.

3. Dengue fever.

- Caused by a virus and carried by Culex fatigans and Aedes.
- Symptoms include aching limbs, high temperature and minute rash.

4. Yellow fever.

- Caused by a virus and carried by Aedes.
- Symptoms include high fever, internal bleeding, anaemia and destruction of liver cells.

5. Encephalitis.

- Caused by a virus and spread by various species of **Culex and Aides**.
- It can kill its victim or cause serious brain damage.

6. Leprosy.

- Thought to be spread only by contact, it can be spread by Indian mosquitoes also, according to the scientists at the **Jawaharlal Nehru Institute for Postgraduate Education and Research (JIPMER) at Pondicherry.**

MOSQUITO CONTROL

- In order to prevent and **control malaria** and other diseases **caused by mosquitoes**, the following methods for the destruction of mosquitoes must be adopted.

1. Elimination of breeding places.

- Mosquito larvae and pupae develop in water; therefore, elimination of breeding places is of primary importance.
- Swampy areas and stagnant water should be drained out.
- Water should also be prevented from standing in gutters, drains and depressions.
- Domestic species can be largely controlled by eliminating receptacles that hold water such as **tin-cans, buckets, cisterns, barrels**, etc.

- If possible the **breeding grounds may be filled** up.
- The bushes and **shrubs should be cleared** off.

2.Destruction of larvae and pupae.

- Wherever it is not possible to fill up or drain out swamps or lakes and ponds, the larvae and pupae may be **killed** by covering or spraying the surface of water with **petroleum**, **paraffin oil**.
- **crude oil or kerosine** oil.
- These substances produce a **thin film of oil** on the **surface**, so that the larvae and pupae die due to **suffocation or lack of respiration**.
- Oil also enters the spiracles, blocks the tracheae, and **poisons the body**.
- Oil Solutions or emulsions of **DDT, DDD** and **Benzene hexachloride** are effective larvicides.
- Dusts containing Paris green.
- **DDT or BHC are** effective in the control of surface feeding Anopheles larvae.
- Larvicidal fishes like sticklebacks, minnows, trouts etc., should be introduced in the ornamental **fountains, ditches, ponds, lakes, canals, tanks,** etc.
- Aquatic nymphs and adult insects (dragon-flies), which are natural enemies of mosquitoes, should be encouraged.
- Keeping the lakes, reservoirs and streams free of aquatic vegetation and other floating material provides the top-**feeding minnows** (**Gambusia**) better opportunities to search out and feed upon the larvae and pupae.

3.Destruction of adult mosquitoes.

- Adult mosquitoes are most effectively combated in dwellings.
- Mosquitoes shouid be driven out of the houses or killed by fumigation with pyrethrum, sulphur, etc.
- Occasionally spraying of houses and adjoining lands with DDT, flit, pyrethrum and other insecticides proves useful.
- Residual sprays of **DDT may remain effective for several months**.

4.Defence against mosquito bite.

- Houses in mosquito-infested areas should be made mosquito- proof by screening ail the doors and windows.
- While sleeping, mosquito nets should be used to keep away the mosquitoes.
- Exposed parts of body may be protected by the use of veils, gloves and boots or by the application of repellents, such as **antimosquito** creams, mustard oil, mixture of **kerosine** oil and eucalyptus oil or **citrinella** and cocoanut oil, and **dimethyl phthalate or dimethyl carbate**, etc.