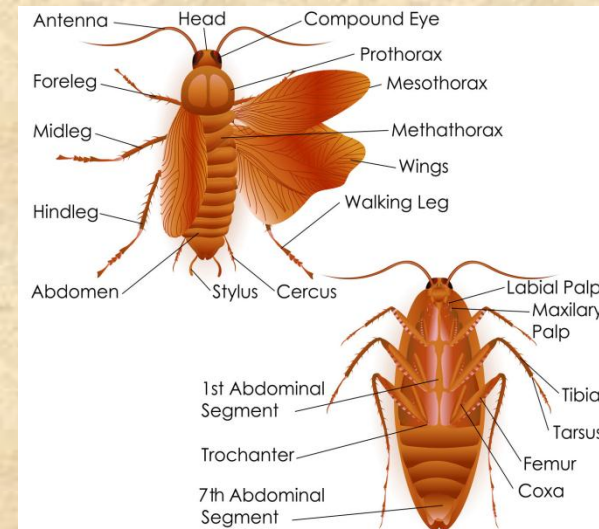
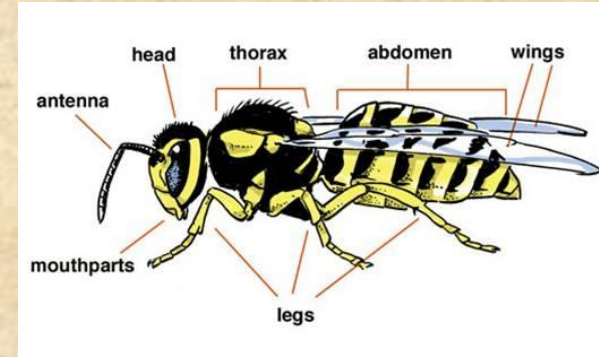


# **Lesson №24**

**PHYLUM ARTHROPODA,  
CLASS INSECTA,  
ORDER DIPTERA**

# General characteristic and taxonomy of class Insecta

The number of species is over 1 million. **Medical significance:** they are vectors or pathogens of diseases (ectoparasites) and toxic animals. There are 3 body regions: the head, thorax and abdomen. There are one pair of antennae (sense organs), mouthparts and compound eyes on the head. The thorax consists of three segments. It carries six segmented legs (per one pair for each segment). There are 1 or 2 pairs of wings on the 2nd and 3rd segments on the dorsal side of the thorax. The abdomen consists of 6–12 segments. The body is covered with chitin, beneath is the hypodermis containing odoriferous glands, wax glands, prothoracic glands and other.



*The muscular system* is differentiated and specialized.

*The digestive system* consists of a foregut, midgut and hindgut. Mouthparts include two mandibles, two maxillae, upper and lower lips and a tongue (hypopharynx).

Types of mouthparts depend of the way of feeding: chewing (bugs), piercing-sucking (mosquitoes, fleas), licking (flies), sucking (butterflies).

*Excretory organs* are Malpighian tubules and a corpus adiposum (fat body).

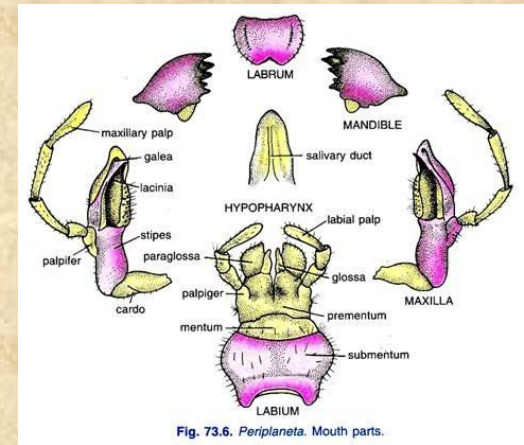
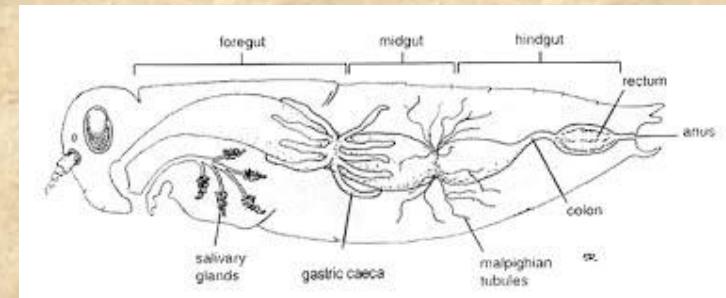
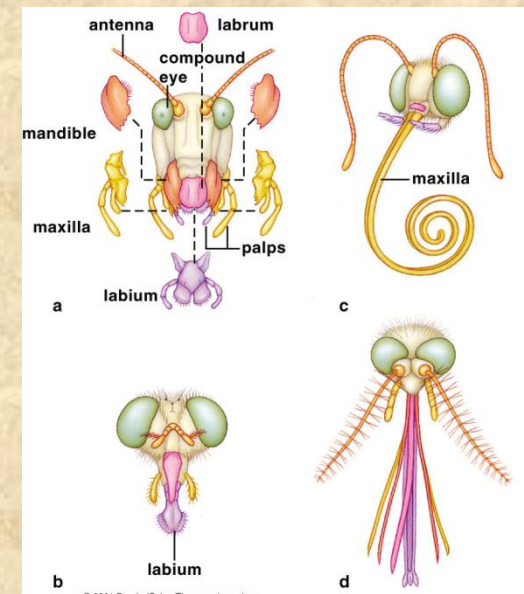


Fig. 73.6. *Periplaneta*. Mouth parts.

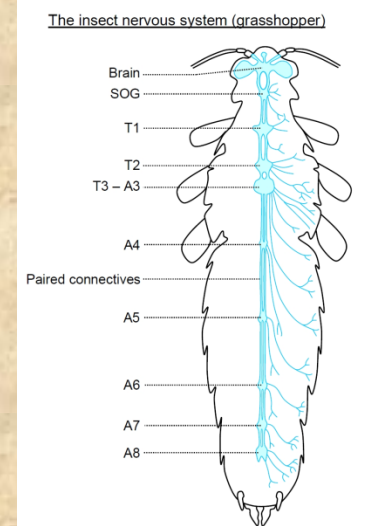
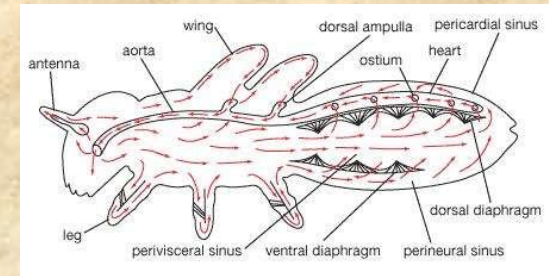
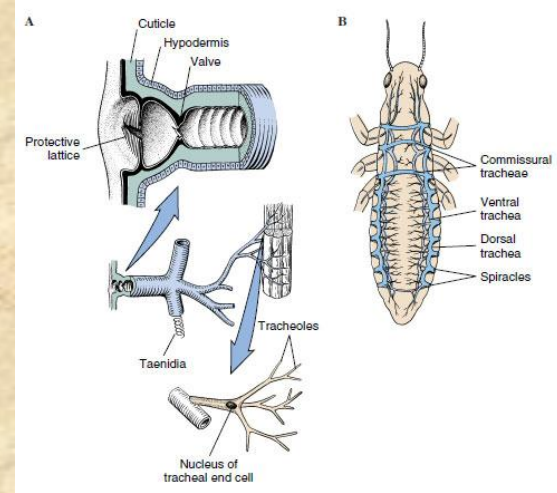




*The respiratory system* of insects is represented by trachea.

*The circulatory system* is poorly developed. A tube-like heart with aorta is located on the dorsal side. The blood of insects is called hemolymph. It transports nutrients and dissimilation products.

*The nervous system* consists of suprapharyngeal ganglion (the brain) having 3 regions — anterior, middle and posterior. Ventral nerve cord has a tendency to confluence of ganglions. *Tactile organs* are sensitive hairs around the body. *Olfactory organs* are located on palps and antennae, on mandibles. *Taste receptors* are located on mouthparts and leg segments. Eyes are simple or compound.



Insects are dioecious, sexual dimorphism is marked. Their reproduction is sexual. Development is direct or indirect (complete or incomplete metamorphosis). The following criteria are used for the division into orders: a type of mouthparts, presence and the number of wings and the type of development.

<b>Order</b>	<b>Metamorphosis</b>	<b>Structure of wings</b>	<b>Mouthparts</b>
<b>Hemiptera</b> (true bugs)	Incomplete	2 pairs: fore wings are partially membranous, hind wings are membranous	Piercing-sucking
<b>Blattoidea</b> (cockroaches)	Incomplete	2 pairs: fore wings are leathery, hind wings are membranous	Chewing
<b>Phthiraptera</b> (lice)	Incomplete	Absent	Piercing-sucking
<b>Siphonaptera</b> (fleas)	Complete	Absent	Piercing-sucking
<b>Diptera</b> (true flies, mosquitoes)	Complete	2 pairs: forewings are membraneous; the back wings are reduced and transformed into halteres	Piercing-sucking, licking



## Morphology and biology of the order Diptera.

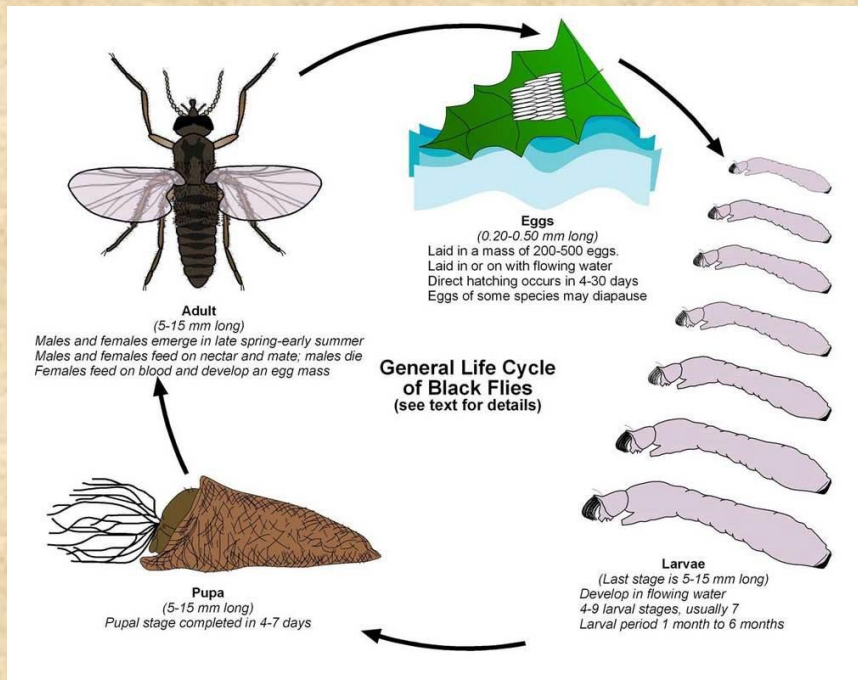
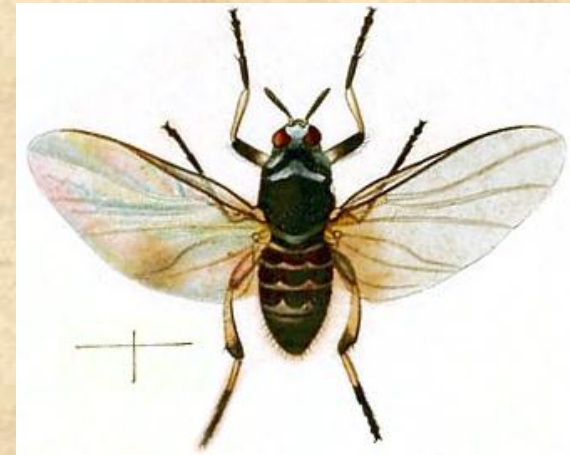
Dipteran insects have 2 wings. One pair is called fore wings and they are membranous, second pair of back wings are reduced and transformed into *halteres*, performing the function of an equilibrium organ. A large head is connected with a thorax by a thin stem that supports its mobility. Big compound eyes are located on the head. Mouthparts are piercing-sucking or licking-sucking. They feed on blood and flower nectar. The development goes with complete metamorphosis.



# Tiny flying insects assembling a gnat (black flies, midges, sand flies, horse-flies, mosquitoes).

**Black flies (family Simuliidae)** look like small flies. Their sizes are about 2–3 mm. Their development occurs in water, females lay eggs on underwater stones and plants. Larvae develop in streaming water. At day time in the open air females

attack animals and humans, bite them and feed on blood.





The saliva of black flies is toxic, bites are painful. Black flies are mechanic vectors of tularemia, anthrax, leprosy. They are intermediate hosts and specific vectors of *onchocerciasis* (river blindness).

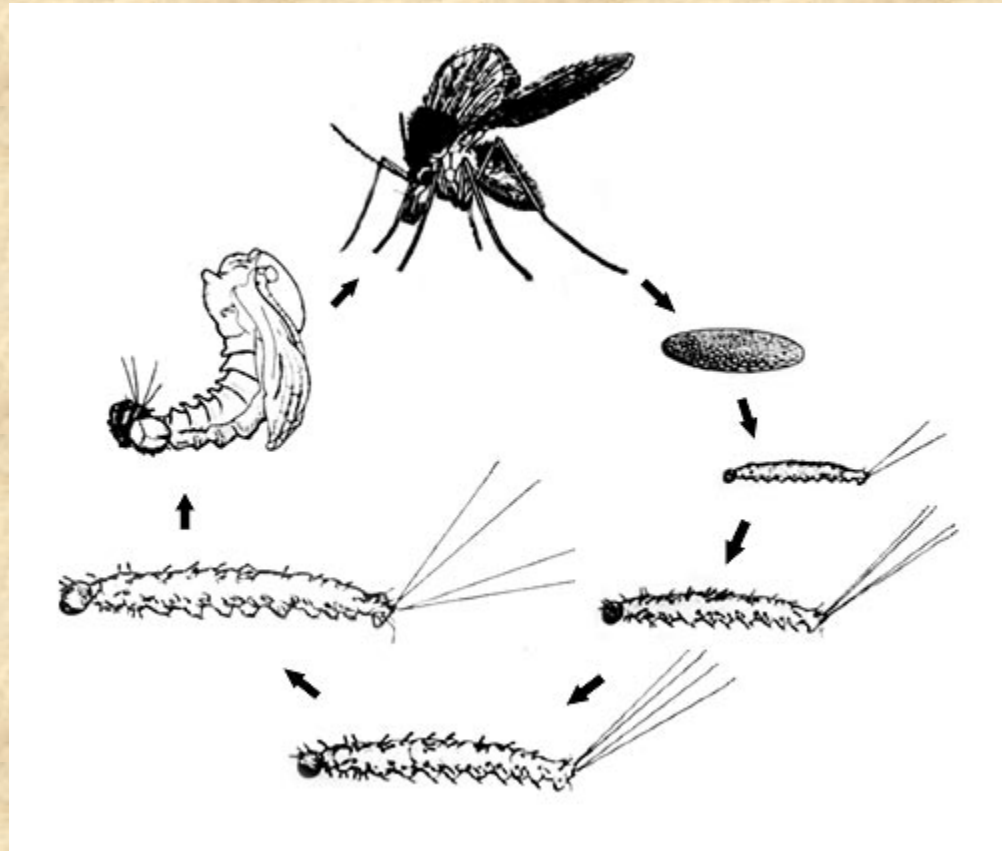




**Sand flies (subfamily Phlebotomidae)** inhabit regions with a warm climate, close to human habitations. Besides they live in caves and holes of rodents. Their sizes are about 1.5–3.5 mm, the body is brown-grey or slightly yellow. The head is small. Mouthparts are piercing-sucking. Legs are long and thin. The body and wings are slightly hairy.



They lay eggs in shadowed places: rodents' holes, caves, in birds' nests, in garbage. Males feed on flower nectar, females feed on blood (in twilight and at night). Their bites are painful and cause itching and scratching. Sand flies are specific vectors of *leishmaniasis* and *pappataci fever*. Transovarial transmission occurs in sand flies.





**Horse-flies (family Tabanidae)** are big true flies (their body length is up to 3 cm). They live in a forest and steppe. Males feed on flower nectar. Females have piercing-sucking mouthparts and feed on blood of animals and humans. They attack more often in hot weather on pasture ground or near water reservoirs. They lay from 200 to 1000 eggs on plants leaves at river banks. Larvae develop in silt on the bottom of reservoirs or in wet soil. Their saliva is toxic, bites are painful and cause itching. They are mechanic vectors of *tularemia*, *anthrax* and *poliomyelitis*, intermediate hosts and specific vectors of *loa loa filariasis*.



**Protective measures against gnat:** insecticide treatment of human habitations, putting nets on windows and using repellents.



How to Get Rid of Midges





# Mosquitoes (family Culicidae). Genera Culex, Anopheles and Aedes.

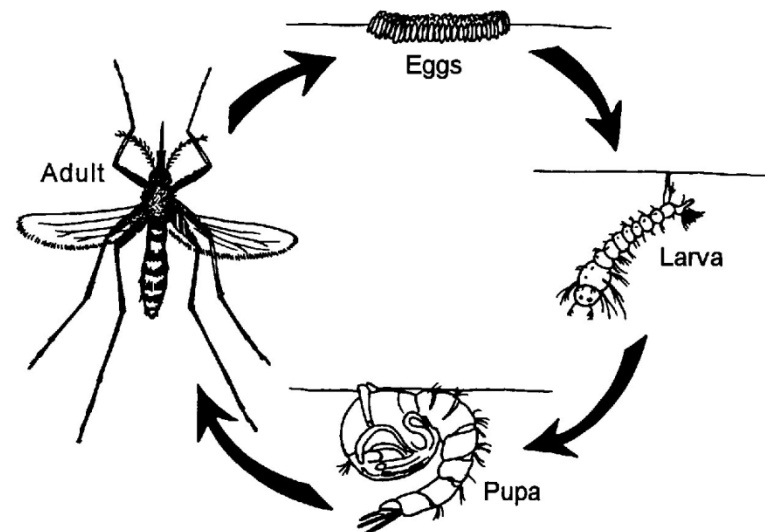
**Morphology:** mature mosquitoes have a slender stretched body and small sizes. There are large compound eyes, palps and mouthparts on the head. Females have piercing-sucking mouthparts and feed on blood. Males have sucking mouthparts. They feed flower nectar. Segmented palps are on the sides of the mouthparts. A pair of translucent wings is attached to the thorax. The abdomen has 10 segments, the last two of them are modified into sexual appendices.



**Life cycle:** mosquitoes go through four stages in their life cycles: egg, larva, chrysalid, and adult or imago. A new generation of mosquitoes undergoes a period of physiological maturation lasting about 4 days. During this time they stay near water reservoirs and feed on nectar. In twilight males form a swarm, females fly into it, fertilization occurs, and then females must obligatorily feed on blood to provide development of eggs. During blood digestion maturation of eggs occurs (**gonotrophic cycle**).

When the eggs mature, females get to a water reservoir and lay about 350–450 eggs on its surface. Larvae come out of eggs. A minimal term of their development is 15 days in an optimal temperature (25 °C).

**Life Cycle of the Mosquito**





Fertilized females (Anopheles, Culex) and eggs (Aedes) pass the winter. When autumn colds come males fertilize females and die.

**Eggs.** Aedes mosquitoes lay eggs by one into temporary reservoirs: in puddles or tree hollows. Eggs are oval-shaped without air chambers.

Culex mosquitoes lay eggs on the surface of stagnant water stucked in a form of a raft. Eggs are V-shaped without air chambers.

Anopheles mosquitoes lay eggs in stagnant or slowly running clean water. Eggs have floats with air chambers on their sides and swim separately.



# Larvae

Larvae of *Culex* and *Aedes* mosquitoes have a respiratory siphon in the shape of narrow tube on penultimate segment. Such larvae form an angle with the water surface.

Larvae of *Anopheles* mosquitoes have no siphon and are located parallel with water surface.

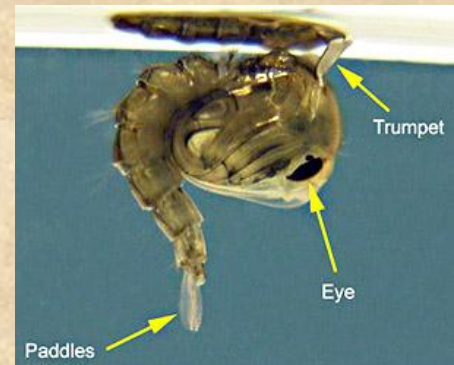
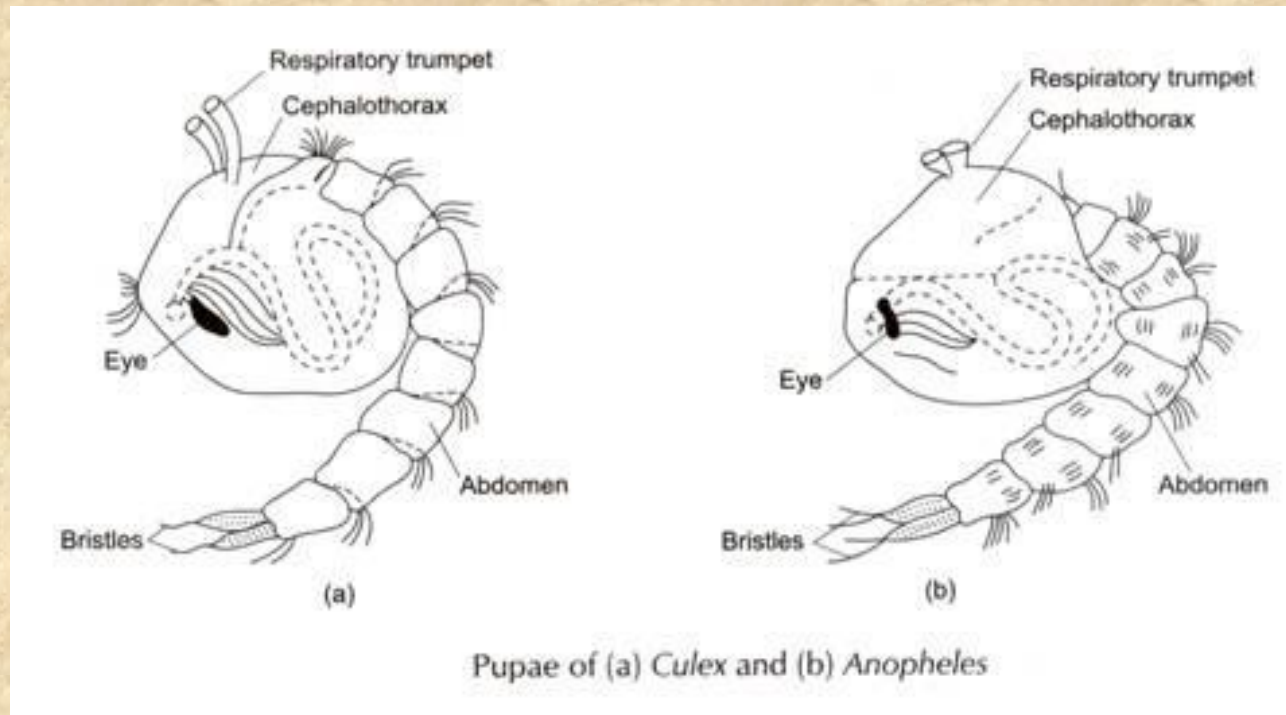




**Chrysalides** are comma shaped. They breathe through a pair of respiratory siphons on the dorsal side of cephalothorax. So they swim on water surface.

Culex and Aedes chrysalides have a cylinder shape siphons.

Anopheles chrysalides have a funnel shape (conic) siphons.



**Mature forms (imagos)** differ by their body position, wing pattern and the structure of mouthparts. The abdomen of *Culex* and *Aedes* mosquitoes is located parallel with the surface where they sit.



Posterior end of *Anopheles* mosquitoes abdomen is elevated.



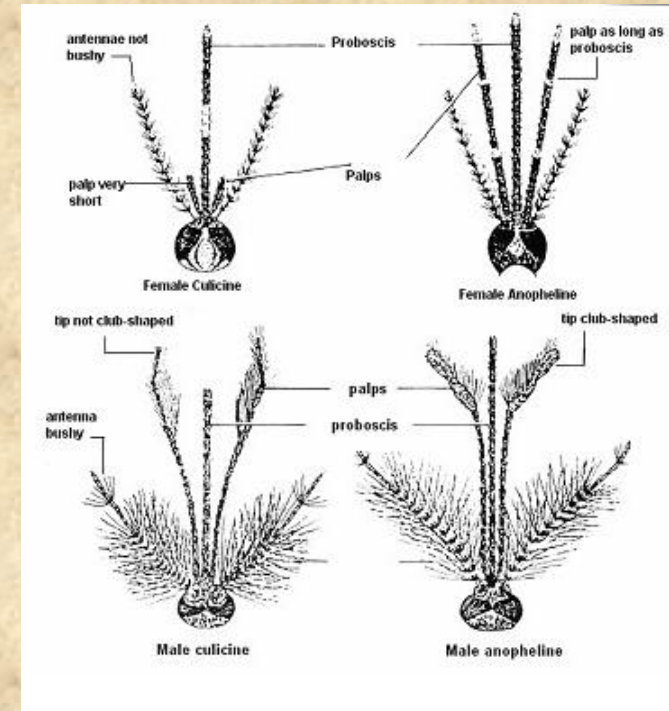
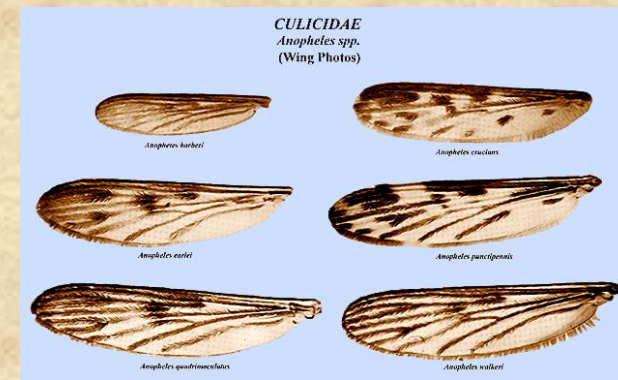


There are dark spots on the wings of some Anopheles mosquitoes, on the wings of Culex and Aedes mosquitoes they are absent.

Antennae of males are hairy, antennae of females are hairy much less.

Palps of Anopheles females are equal in length to the proboscis, palps of Culex and Aedes females comprise 1/3–1/4 of the proboscis length.

Palps of Anopheles males are equal in length to the proboscis and have club-shaped thickenings, palps of Culex and Aedes are usually longer than the proboscis and have no thickenings.



# ANOPHELINES

# CULICINES

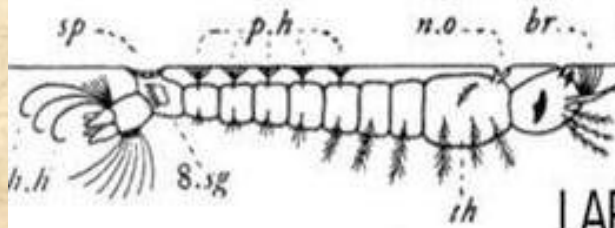
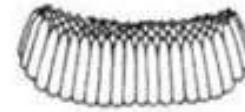
## Anopheles

## Aedes

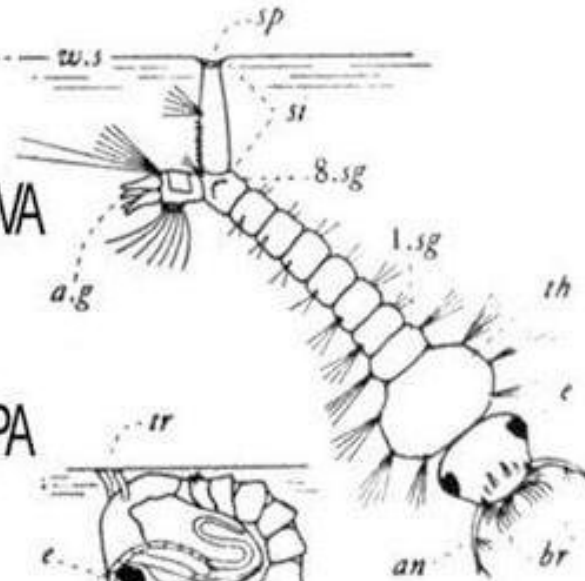
## Culex



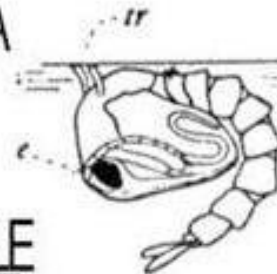
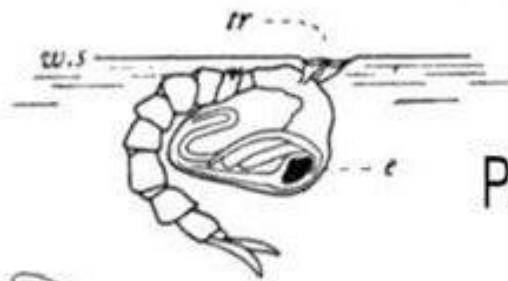
EGGS



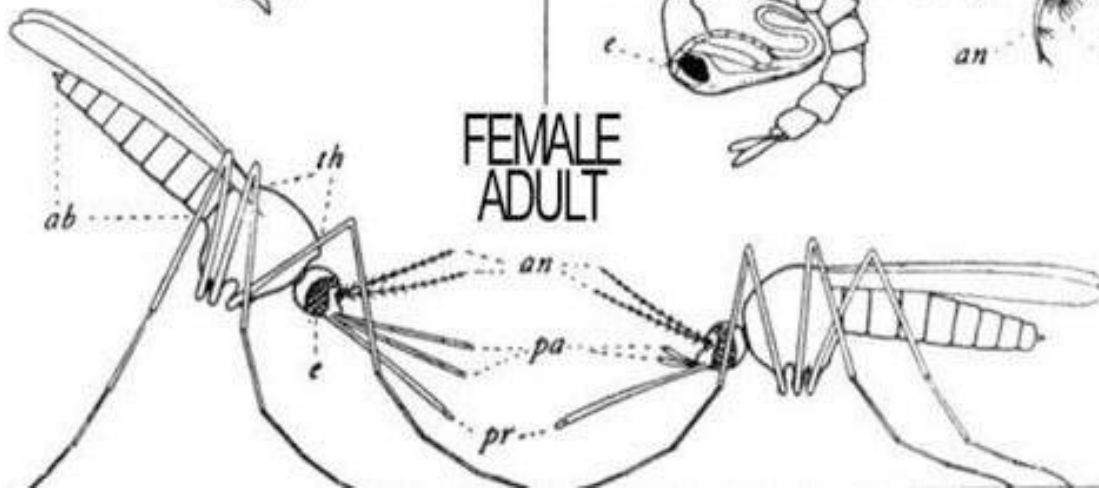
LARVA



PUPA



FEMALE ADULT





**Medical significance:** mosquitoes are temporary ectoparasites.

Anopheles mosquitoes are specific vectors and principal hosts of *malaria parasites*, specific vectors and intermediate hosts of *wuchereria bancrofti* and *brugia malayi*.

Aedes mosquitoes are specific vectors of *Japanese encephalitis*, *yellow fever*, *dengue fever*, *lymphocytic choriomeningitis*, *anthrax*, *tularemia*, *wuchereria bancrofti* and *brugia malayi*.

Culex mosquitoes are specific vectors of *Japanese encephalitis*, *tularemia* and *brugia malayi*.

## Flies (Muscidae family)

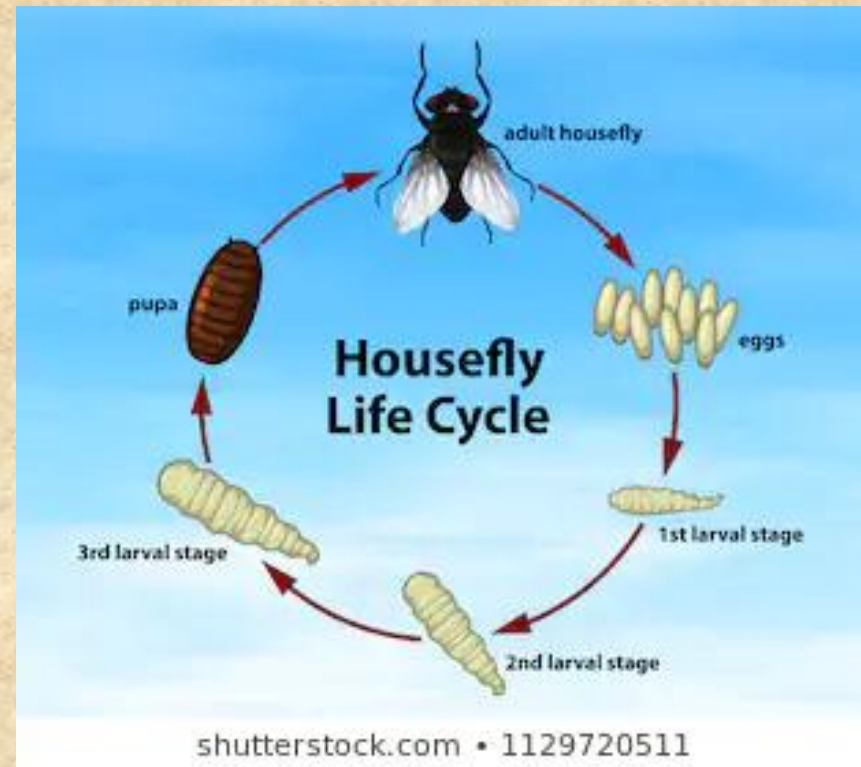
**House fly (*Musca domestica*)** is common everywhere. Adult flies have grey or black slightly hairy body and can reach up to 7.5 mm in length.

There are claws and sticky pads on the legs, due to them flies can move on any surfaces. Flies have licking mouthparts. The saliva contains mucolytic enzymes for digestion of organic substances which flies lick after. They feed on food particles and decaying organic leftovers.





**Life cycle:** if the temperature is not lower than 17–18 °C females lay up to 150 eggs in 4–8 days after crossing on decaying organic matter such as garbage, carrion or human feces. If the temperature is about 35–45 °C larvae come out of eggs in 1 day, they pupate in soil in 1–2 weeks if the temperature is not higher than 25 °C. A new generation of flies appears in a month. Their life span is about 1 month.



**Medical significance:** flies are mechanic vectors of enteric infections (*cholera, typhoid fever, paratyphus, dysentery*), *tuberculosis, diphtheria, helminthes eggs and protozoans' cysts*. There are more than 6 million bacteria on the fly's body, and up to 28 million bacteria in the intestine.

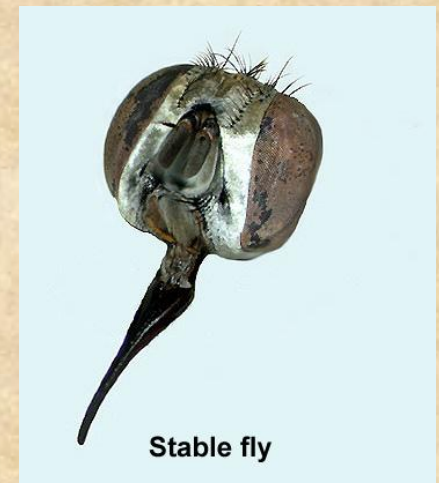
## Protective measures against house flies.

Insecticides, adhesive tapes, baits with poisons are used as protection form from house flies, they are also can be eliminated mechanically.



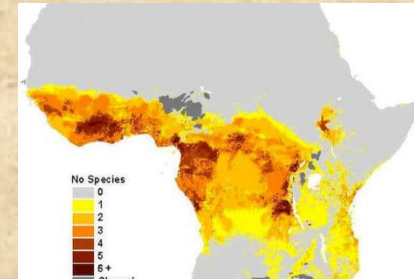


**Stable fly (*Stomoxys calcitrans*).** Adult flies can reach 5–6 mm in length. The body is grey with dark stripes on the thorax and spots on the abdomen. The adults of both sexes feed blood of warm-blooded animals during the day-time. With the help of its proboscis stable flies scrape off skin epidermis and lick off blood. The saliva contains toxic substances causing a severe itch. Bites are painful. The population of flies reaches its maximum in August–September. The female lives about 20 days. Stable flies are mechanic vectors of *anthrax*. **Protective measures against stable flies** are the same as against the house flies.



**Tsetse fly (*Glossina palpalis*)** is large dark brown biting fly that inhabit much of midcontinental Africa. It lives near human habitations along river banks and lakes. They have large sizes (up to 13 mm), the proboscis is strongly chitinized, protrudes forward. Females are viviparous, they lay only one larva into the soil surface. The larva develops in pupa into the soil, than in 3–4 weeks an imago comes out. During the whole life (3–6 months) females lay about 6–12 larvae. Tsetse flies feed on blood of animals and humans, they are specific vector of *African trypanosomiasis*.

**Protective measures against tsetse fly:** cutting down bushes and trees along river banks near human habitations and along roads. Insecticides are used against mature flies.





**Spotted flesh fly (Wohlfahrtia magnifica)** is common in countries with a moderate and hot climate. The body is light-grey, the adults are about 9–13 mm in length and there are 3 dark longitudinal stripes on the thorax. Mature flies feed nectar. Females lay about 120–150 larvae in human open cavities (nasal cavity, in eyes, in ears), in the wounds and ulcers of the human or animal body, sometimes in human open cavities during a sleep in the open air. Larvae live in ears, nasal cavity, frontal sinuses and eyes. Larvae destroy tissues and reach bones. Parasitizing larvae cause *myiasis*. Myiasis may complicate by necrosis. In 5–7 days larvae fall out in the soil and pupate. Preventive measures are defense from flies attacks.



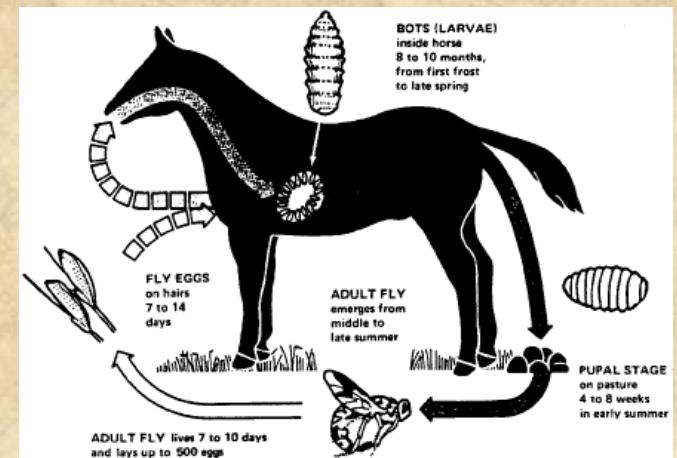
Figure 1. Parasitizing photograph of *Wohlfahrtia magnifica*.



## Medical significance of bot-flies (Oestridae family)

Bot-flies are common everywhere. Mature bot-flies live several days and do not eat. They lay eggs or produce living larvae that cause *myiasis*.

**Horse bot-fly (*Gasterophilus intestinalis*)** lays eggs on the hair of horses. Larvae penetrate into the skin and cause itching. During scratching itching sites with teeth horses swallow larvae. Larvae get into the soil with horse feces and pupate. Sometimes a female horse bot-fly lays eggs on the human hair. Larvae permeate into the skin of face or chest, where they make passages 3–5 cm long and parasitize about 1 or 2 months.





**Warble fly (*Hypoderma bovis*)** lays eggs on the hair of animals, sometimes on human hair. Then larvae develop and migrate into tissues to complete their development in the subcutaneous adipose tissue on the back, arms and face. Pupation occurs in soil.

**Sheep bot-fly (*Oestrus ovis*)** and **Russian bot-fly (*Rhinoestrus purpureus*)**. Females are viviparous, they throw out a stream of fluid containing larvae into nostrils or eyes of animals or humans. The development of larvae occurs in nasal cavities, sinuses, in eyes or in the cranial cavity. They leave the host through nostrils before pupation and enter the environment. Larvae of horse-flies in the human body can be removed surgically.



# Protective measures against Diptera insects

*Direct protection from insects attack* are wearing closed clothes, putting nets on windows; using insecticides and repellents; *zooprophyllaxis* — the use of biological barriers (cattle farms) between hatching places of insects and human habitations; swamp drainage, using chemicals in wintering places of insects.



Write down in your drawing book classification of **black flies, sand flies, horse-flies, genera Culex, Anopheles and Aedes, Stable fly, Tsetse fly, Spotted flesh fly, bot-flies.**

You must draw in your drawing book

1. Larvae of black flies,
2. Larvae of Culex,
3. Larvae of Anopheles
4. Heads of females of Culex and Anopheles
5. Heads of house fly
6. Heads of Stable fly

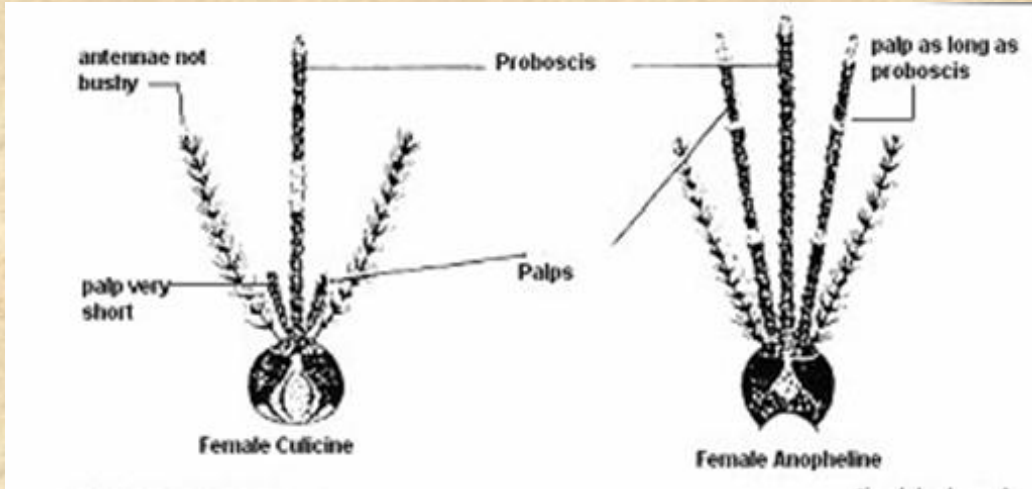
1



2,3



4



5



6

