MEDICAL ENTOMOLOGY

A. Arthropods as vectors of pathogens

(Disease transmitters)

Methods of transmission:

I. Mechanical transmission: When the arthropods transport the various pathogens in or on their body legs, hair, wings and drop them unchanged on human food, drinks or tissues.

Types of mechanical transmission:

a) Direct mechanical: *Stomoxys* in the transmission of blood disease.

b) Indirect mechanical: *Musca* in the transmission of typhoid, amoeba, cholera and viral hepatitis.

II. Biological transmission: This type of transmission occurs when the arthropod takes an important role in the life cycle of the transmitted organism.

a) Propagative	The organism multiplies in the vector without any cyclical development, e.g. multiplication of bacterial, rickettsial and viral diseases.
b) Cyclo-developmental	The organism undergoes developmental or morphological changes only without multiplication in the arthropod, e.g. development of microfilaria in the female *Culex* mosquito
c) Cyclo-propagative	The organism undergoes both developmental changes and multiplication in the arthropod as in protozoal diseases, e.g. malaria in female *Anopheles.*

B. Arthropods as etiological agents of disease

(Causing disease)

Arthropods play a significant part as disease producing organisms.

1. Specific parasites: Certain arthropods produce lesions in the human tissue, e.g. flies causing myiasis, and *Sarcoptes scabiei* producing tunnels in the skin of man and severe itching.

2. Through toxins and venoms: Certain ticks produce fatal paralysis in some individuals due to toxins in their secretions. Venoms introduced into the skin by the bite of the spider and scorpion.

3. Allergic reactions: These may be provoked by fleas and lice bites and by blood sucking flies when depositing droplets of saliva on the skin. House dust mites may cause rhinitis or asthma by serving directly as allergens.

4. Entomophobia: The fear of arthropods can be extremely important as a cause of severe neurosis.

Phylum: Arthropoda

This is the largest phylum of the animal kingdom.

Classification of phylum arthropoda: Arthropoda is classified into many classes; the following are those of medical importance:

I. Class insecta, which is characterized by:
   a) The body consists of head, thorax and abdomen.
   b) One pair of antennae.
   c) Three pairs of legs.
   d) Four wings (sometimes 2 wings).

II. Class arachnida, which is characterized by:
   a) Body is composed of cephalothorax and abdomen.
   b) No antennae.
   c) Four pairs of legs.
   d) No wings.

III. Class crustacea, which is characterized by:
   a) The body is formed of cephalothorax and abdomen.
   b) Two pairs of antennae.
   c) Four pairs of bifid legs.
   d) No wings.

Metamorphosis in arthropods: It is a series of developmental changes that occur in the immature stages to reach the mature adult stage of the insect. There are three types of metamorphosis:

1. **Complete metamorphosis:** in which development to the adult stage passes through (egg - larva – pupa - adult), e.g. mosquitoes, flies, fleas.
2. **Incomplete metamorphosis:** in which development to the adult stages passes through (egg - nymph - adult), e.g. *Cimex lectularis* (Bed bug), *Triatoma* (Winged bug), *Pediculous* (Lice).
3. **Gradual metamorphosis:** in which development to the adult stages passes through (egg - larva - nymph - adult), e.g. ticks.

Class: Insecta

This is the largest and most important class of arthropods. The insect's body is distinctly divided into head, thorax and abdomen.

A) Head: is globular, carries the eyes, antennae and mouth parts.

1. **The eyes:** may be simple or compound. Both may be present or absent.
2. **Mouth parts:** vary in shape may be suitable for piercing skin and sucking blood as in mosquitoes, or soft and spongy suitable for lapping and sucking as in *Musca*.
3. **A pair of long or short antennae:** mobile and segmented.

B) Thorax: is made up of three segments; prothorax, mesothorax, and metathorax. A

pair of legs is attached to the ventral side of each thoracic segment. The wings if present are attached to the mesothorax.

C) Abdomen: is divided into segments, only 4-8 segments are visible. The abdomen contains the different systems.

-The class insecta contains four order of medical importance:
1. Order diptera (Mosquitoes and Flies).
2. Order siphonaptera (Fleas).
3. Order hemiptera (Bugs).
4. Order anoplura (Lice).

Order: Diptera

Family: Culicidae (Mosquitoes)

Mosquitoes have a worldwide distribution, more common in tropical and temperate countries. They are slender diptera with elongated proboscis, antennae, and legs. Wings are covered by scales. Larvae and pupae are aquatic.

Morphology:
I. Adult:
-Size: 4 -12 mm.

-The body is consisting of head, thorax and abdomen.

A) Head: More or less globular carries:
1. Two compound eyes.
2. A pair of long antennae (14-15 segments). The antennae of male are covered by long and dense hairs (**plumose**), while in female, the antennae are covered by short scanty hairs (**pilose**).
3. The proboscis or mouth parts are adapted for piercing skin and sucking blood in the **female**, while it is sucking plant juice in **male.**
4. The maxillary palp is composed of 4-5 segments, and may be as long as the proboscis or short and this difference help in species identification.

B) Thorax:
1. The thorax is made of pro-, meso- and metathoracic segments.
2. The mesothorax carries the wings and the metathorax carries the halters.

C) Abdomen: is long slender, consists of 10 segments, covered by scales. The external genitalia are at the tips of the abdomen.

II. Larva: is made up of head, thorax and abdomen.
A) Head: carries a pair of eyes, a pair of thickly haired mouth brushes, a pair of short antennae and the mouth which is adapted for eating organic matter that are suspended or floating in water.

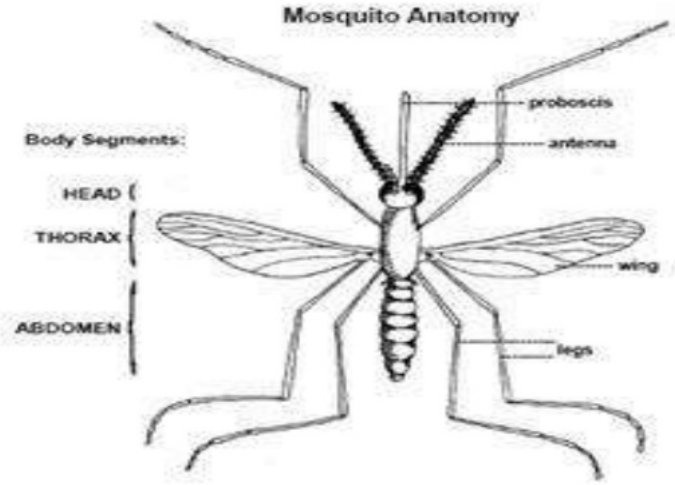
B) Thorax: The three thoracic segments are fused in one segment.

C) Abdomen:

1. It is made up of 10 segments.
2. The eighth segment carries the opening of the tracheal tubes (respiratory spiracles). These spiracles may be present directly on the dorsal surface of the eighth segment or carried on the tip of a tube called **siphon** attached to the eighth segment. The shape of the siphon varies and helps in identification.
3. Larvae without siphon are provided with certain hair (**palmate hairs**) on the dorso-lateral sides of the abdominal segments to help the larva to float.

III. Pupa: is capable of jerky movement in water but it does not feed. It is comma-shaped, with the body consists of a cephalothorax and abdomen. The cephalothorax carries on its convex top one pair of respiratory trumpets.

Morphology of mosquito



Life cycle:

- The fertilized female mosquito needs blood meals to help eggs to develop. Then it chooses some suitable collection of water for egg laying.

- Eggs are laid singly or in groups.

- According to the environmental condition, eggs hatch and larvae come out, moult three times and then pupa comes out.

Diseases transmission by mosquitoes:

Only the female mosquito can suck blood and transmit diseases.

I. Anophelines as vectors of human diseases:

1. Malaria: In Egypt there are number of recorded anophelines species, of these *Anopheles sergenti,* followed by *Anopheles pharoensis* acts as malaria vectors.

In order to be an efficient malaria vector, the **female *Anopheles* must possess four characteristics**:

a) It must feed frequently on human blood (**anthropophilic**).

b) It must be susceptible to gametocytes i.e. parasite development can occur in it.

c) It must live long enough for the *Plasmodium* parasite to complete its development.

d) *Plasmodium* parasites must be present in adequate numbers to maintain transmission.

***Anopheles gambiae*:**

This is a famous malaria transmitter in the tropics, because it fulfills almost all the criteria as an efficient malaria vector. It can breed in any type of water. It invaded Egypt in 1941 and there is always the possibility of re-invasion with this mosquito as it can breed in Lake Nasser. It transmits malignant malaria.

2. Filarial worms: When the infected mosquito bites man, the larvae of *Wuchereria bancrofti* and *Brugia malayi* are attracted by the warmth of his body, where they enter through the puncture wound made by the bite.

3. Arbo-viruses (Arthropod-borne viruses): These are discharged with the salivary secretion into the tissues, e.g. Eastern equine encephalomyelitis (EEE), Western equine encephalomyelitis (WEE), and Venezuelan equine encephalomyelitis (VEE)

II. *Culex as* vector of human disease: It is the most common mosquito in Egypt. It transmits:

1. Arbo-viruses.

2. *Wuchereria bancrofti* and ***Brugia malayi***.

3. Bird malaria.

4. Rift-valley fever virus.

III. *Aedes* as vector of human diseases:

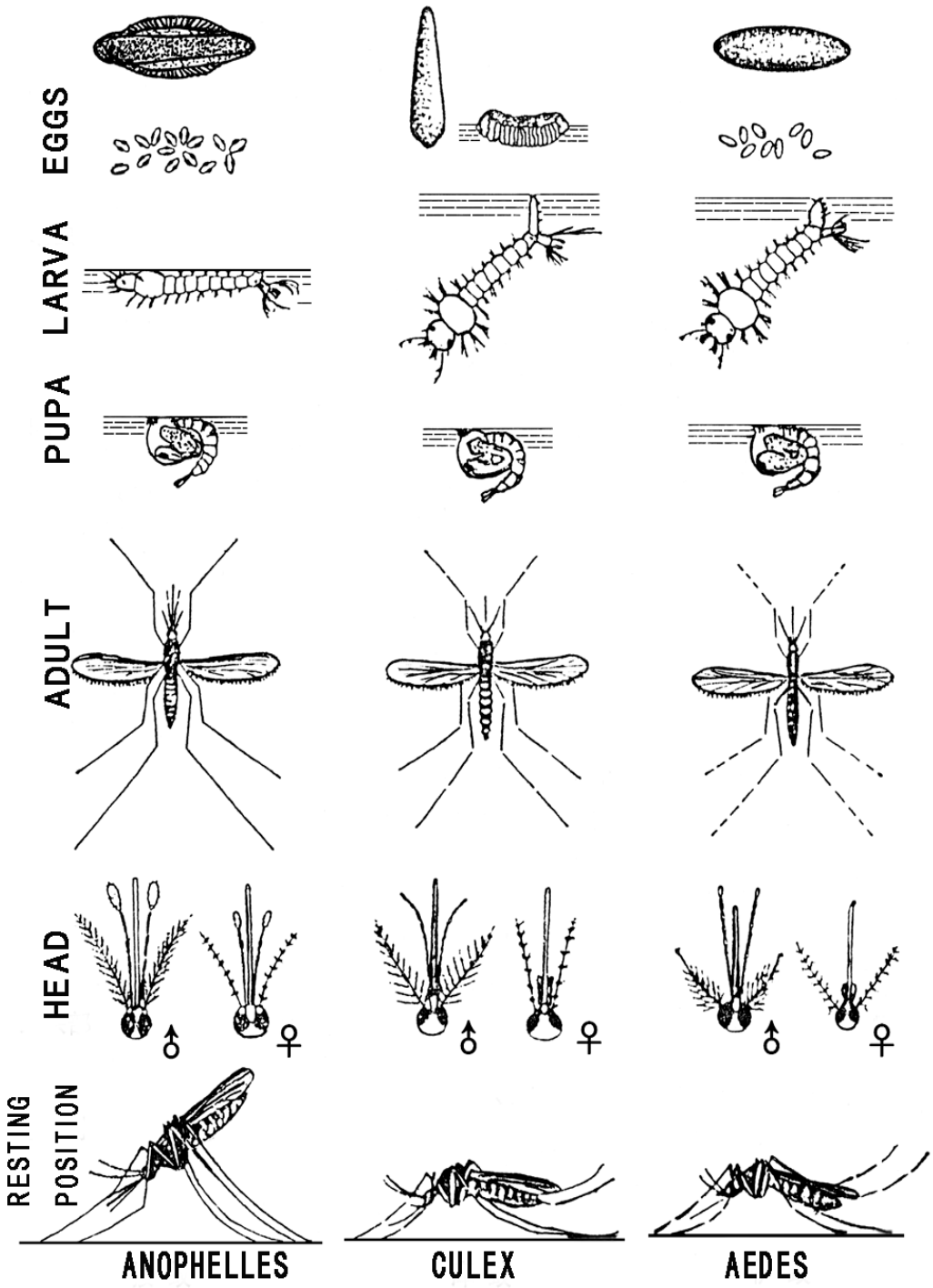
1. Yellow fever: This is an acute febrile disease caused by the yellow fever virus. It is transmitted chiefly to man through the bite of the domestic mosquito, *Aedes aegypti*. The virus is present in most tissues of mosquito and transmitted to man through its salivary secretions. Yellow fever virus is primarily **viscerotropic**. The liver is the main target organ where necrosis occurs.

2. Dengue fever (Break Bone Fever): This is a viral infection transmitted by the salivary secretions of the *Aedes* mosquito. The mosquito takes infection during the first 3 days of the patients' illness and becomes infective to man only after 11 days, and remains infective for life, where the virus is found in all its tissues.

3. Arbo-viruses.

4. Filarial worms: *Wuchereria bancrofti.*

5. Bacterial diseases: Mechanical transmission of **tularemia** caused by *Francisella tulariensis.*



Stages of life cycle in different mosquito species.

Morphological criteria of different mosquito species.

	Anopheles	*Culex*	*Aedes*
1. Adults Maxillary palps	-As long as the proboscis in both sexes -In males, they are club-shaped distally	-As long as the proboscis in males -In females, they are very short	-Same as *Culex*.
Wings	Spotted	Not spotted	Not spotted
Colour of scales	Yellowish brown	Yellowish brown	-Black and silvery white -2 white straight lines on the thorax give **Lyre design**
Resting position	Adults stand in an inclined position of the resting surface (45°)	Adults stand parallel to the resting surface	Same as *Culex*
2. Eggs	Laid singly, dark brown with air float cells on either side.	Laid in batches of 50 to 100, called egg rafts.	Laid singly, black and elliptical with sculptured shells.
3. Larvae Palmate bristles	On the dorsolateral sides of abdominal segments	Absent	Absent
Respiratory siphon	Absent, replaced by two respiratory spiracles	Present long with more than one pair of hair tufts (1-3)	Present, barrel-shaped with one pair of hair tufts
Position in water	Parallel to the surface of water and are surface feeders	Lie in an inclined position of 45° and are deep feeders	Same as *Culex*
4. Pupae Respiratory trumpets	Short and pyramidal	Long and cylindrical	Same as *Culex*

Control of mosquitoes:

The following are general rules to be followed in the control of mosquitoes:

A) Physical control (Natural control):

I. Measures against aquatic larval stage:

1. Elimination of breeding places
   - Swamps and small collections of water should be filled with earth.
   - Pumping of water collections is helpful in reducing the breeding places.
2. Efforts should be made to render the water collection unsuitable for mosquitoes breeding in the locality (i.e., making the water turbid instead of clear, fast running instead of slow, clean instead of polluted water and so on).

II. Measures against adult stage:

1. Avoid the entrance of mosquitoes by screening all inlets and outlets of houses with wire screens (27 mesh/square inch).
2. Use head nets, long sleeves and long pants.
3. Stay indoors at sunrise, sunset when mosquitoes are most active.

B) Biological control:

I. Measures against aquatic larval stage:

Use of natural enemies for the aquatic stages of mosquitoes as: frogs, ducks, fish of various species especially *Gambusia affinis*.

Bacterial larvicides: The toxins and spores produced by the bacteria interfere with digestion and paralyze the gut of the larvae, then, they die of starvation.

Examples: *Bacillus Thuringiensis Israelensis, Bacillus Sphaericus*.

II. Measures against adult stage:

Use of *Dragon* flies which feeds on adult mosquitoes.

C) Chemical control:

I. Measures against aquatic larval stage (Larvicides):

These chemicals even the safest of them are poisonous and have a varying degree of toxicity to man, animals, fish and plants. These include:

1. Petroleum oil or non volatile oils when applied on the surface of water makes a film which prevents the larvae and pupae from breathing and suffocate them.
2. Paris green which is a copper arsenical compound. It is a food poison which is sprayed on water collections and when eaten by the larvae eventually kill them. It is diluted with some light material as road dust, talc powder or even dust to make a 1 % mixture and is sprayed on the surface of water.

II. Control of adult (Adulticides):

1. Repellents are chemical substances that mosquitoes and arthropods avoid. Of these repellents are: Oil of Citronella, Dimethyl Phthalate, Dibutyl Phthalate, Indalone and Rutgers. These are applied on the exposed part of the body (face and legs) in the form of non greasy cream.
2. Insecticides: Spraying the insecticides in suitable dilutions is an efficient method of control for adult mosquitoes. Some insecticides as Pyrethrum has no residual actions, while D.D.T. (dichlorodiphenyltrichloroethane) and Gammaxane have a residual action (keep their toxic effect for several weeks).

D) Genetic control:

Sterile Insect Technique (SIT): Introduced a gene into the mosquitoes which stops other mosquito genes being expressed correctly. As a result, the mosquitoes can't develop properly and die before becoming adults.

Family: Psychodidae

Phlebotomus papatasii (Sand fly)

Geographical distribution: Cosmopolitan (Mediterranean areas, Africa, Middle- and Far-East).

Morphology:

- Small, hairy insect, 1.5-2.3 mm, light brown (sand) in colour, can pass through ordinary mosquitoes net.

- Body is made of head, thorax and abdomen.

Head: Carries proboscis adapted for piercing and sucking in female, while male feeds only on plant juice, 2 long antennae each formed of 16 segments, a pair of 5 segmented maxillary palps, and a pair of dark big compound eyes.

Thorax: Consists of 3 segments and makes a hump with the rest of the body. It carries six long slender legs.

- A pair of long lanceolate pointed end wings is attached to mesothorax. They form an angle of 45° with the body when the insect is at rest.

- Body and wings are heavily covered with hairs.

Abdomen: Male abdomen ends in claspers, while that of female ends in a pair of cerci. These are the accessory sex organs.

Life cycle:

- The female lays about 50 eggs once in its life time. It lays eggs under the stones in dark humid places which hatch into larva then pupa before attaining the adult stage.

- The life cycle is completed in 4-8 weeks.

- The female sucks blood before laying eggs. It bites at night, but it cannot fly a long distance or rise more than few feet above the ground.

Medical importance:

Only female sand fly can suck blood, transmit and cause the following diseases**:**

1. **Leishmaniasis:** As it carries:

   a) *Leishmania tropica, L. major and L. aethiopica,* causing **old world cutaneous leishmaniasis**.

   b) *Leishmania donovani* and *L. infantum,* causing **visceral leishmaniasis**.

2. **Sand fly fever or papatasii fever or 3 days fever**: It is caused by virus.

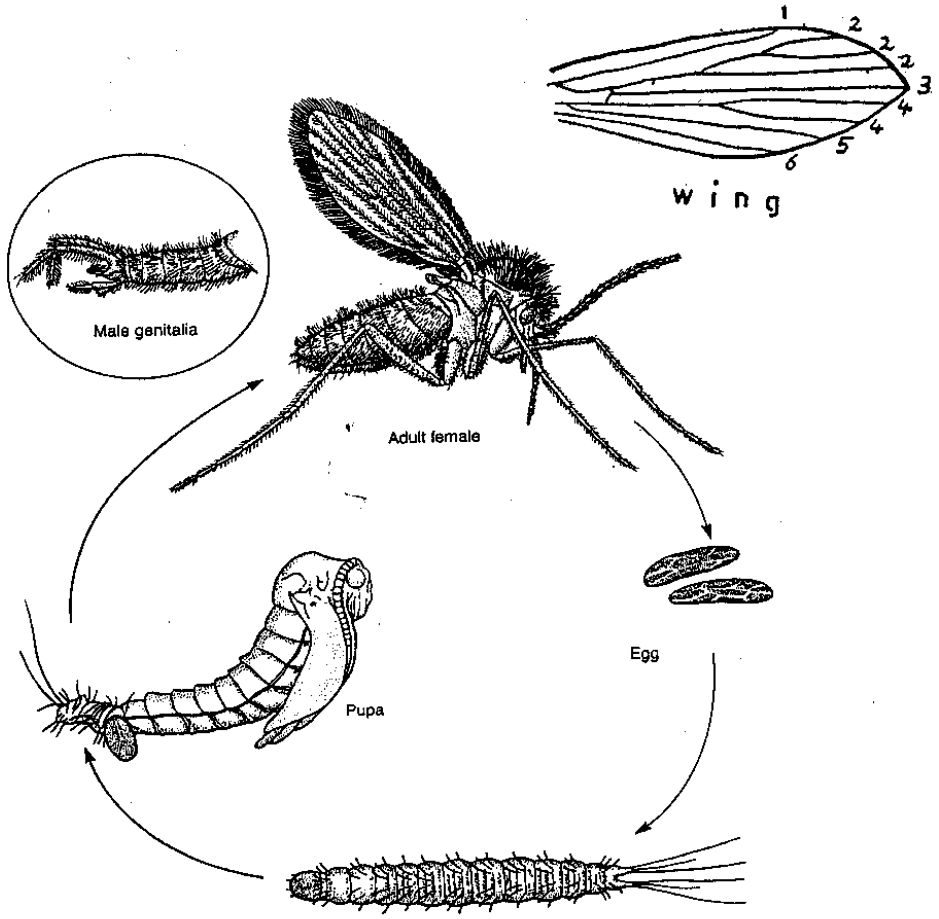
3. **Oroya fever:** It is caused by *Barttonella bacilliformis* (**Carrion's disease**).

4. **Harara:** Sand flies cause a sharp painful bite with a severe allergic reaction, high temperature, nausea and malaise.

Control:

1. Screening doors and windows by wire nets with narrow meshes (40 mesh/square inch).
2. Sleeping under mosquito nets with narrow meshes.
3. Spraying insecticides like D.D.T. inside houses and in the breeding places.

Phlebotomus papatasi (sand fly)



The structure and life cycle of a sand-fly.

Family: Simulidae

Some species of *Simulium* transmit the filarial parasite *Onchocerca volvulus*. They are sometimes known as the black flies, or buffalo gnats or coffee flies. They breed in fast running streams of water.

Family: Ceratopogonidae

Some species of culicoides transmit the filarial parasite *Acanthocheilonema perstans* and *Mansonella ozardi*. *Culicoides* are minute insects, night feeders and so a source of light can protect against their bites.

Family: Muscidae

Musca domestica

(The house fly)

Geographical distribution: Cosmopolitan, indoors and outdoors.

Morphology:

-The fly is about 1 cm in length and grey in colour with longitudinal black strips on the thorax.

-The body consists of head, thorax and abdomen.

-<u>Head</u>: carries 2 compound eyes and 3 simple eyes between them. Antennae are 3 segments; 2 small segments and 1 terminal big segment, which carries a stiff bristle called **arista** covered by simple hairs on both sides up to the tip.

-<u>Proboscis</u>: The mouth parts are soft retractile and adapted for sucking fluids.

-<u>Thorax</u>: consists of pro-, meso- and metathorax. It has 4 longitudinal dark strips.

-<u>Abdomen:</u> It is grey in colour, consists of 4 visible segments and has 4 dorsal longitudinal dark strips.

Life cycle:

- **Breeding places:** Female lays eggs in batches (50-100 at a time), on decaying organic matter, manure and household refuse.
- **Egg:** is creamy white in colour, banana-shaped, about 1 mm with one end broader and with 2 ridges along its length.

-In 6-10 hours (in optimum conditions), the egg hatches and a larva comes out.

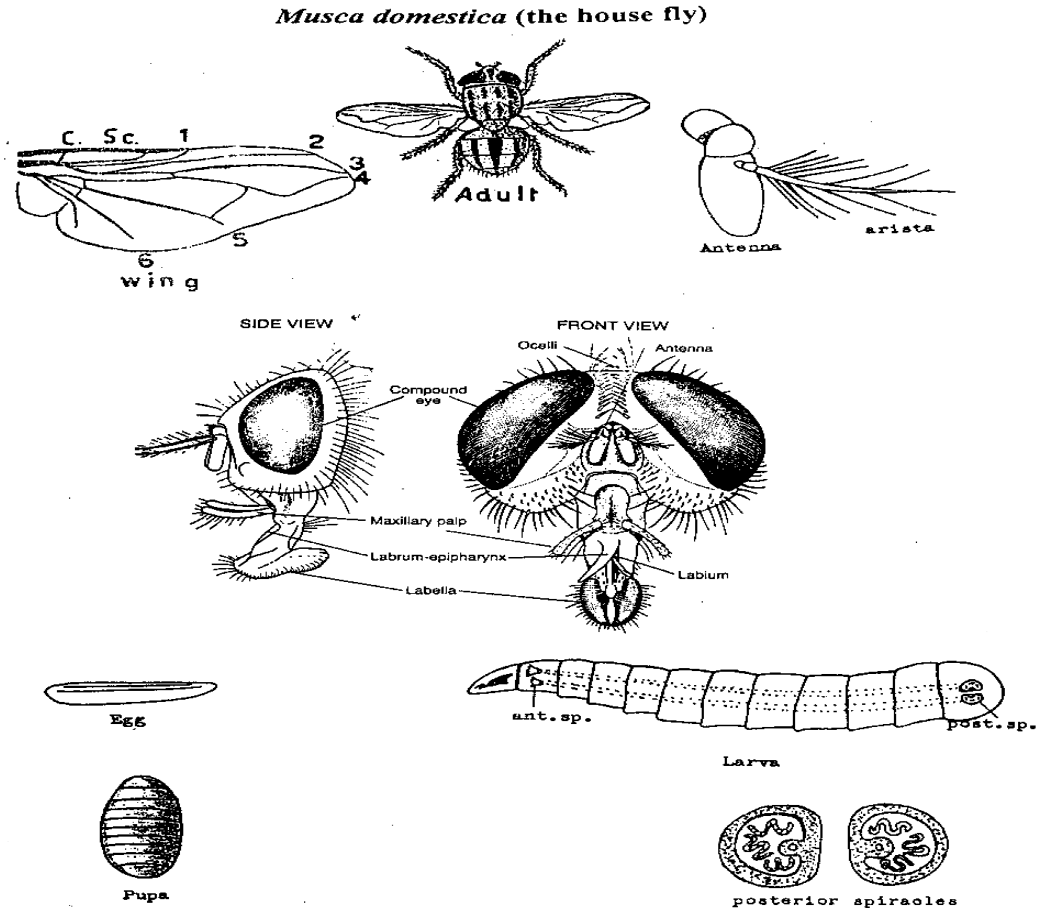
- **Larva:** is worm-like in appearance with 12 segments. The mouth is provided with 2 strong chitinized hooks of unequal size, and continues posteriorly with the highly chitinized cephalopharyngeal skeleton.

-Two tracheal tubes run along the length of larva and open anteriorly at the 2nd segment by anterior spiracles which are crown-shaped. At the posterior surface of last abdominal segment, they open by closed **D-shaped posterior respiratory spiracles containing three m-shaped slits and a medial raised chitinized area** (button).

-The larva feeds on organic matter and grows in size by moulting twice.

-The 3rd stage larva dips itself in the earth and pupate.

- **Pupa:** is dark brown in colour, barrel shaped and does not feed.



Medical importance:

1. House flies are capable of mechanically transmit pathogens causing diseases: on their hairs, mouth parts, legs, faeces and vomitus.

a) Parasites: Cysts of protozoa e.g. *E. histolytica, G. lamblia* and eggs of helminths as *A. lumbricoides, T. trichiura, H. nana, E. vermicularis.*

b) Bacteria: Typhoid, cholera, dysentery, pyogenic cocci, etc.

c) Viruses: Enteroviruses, poliomyelitis, hepatitis,....etc.

2. They cause accidental myiasis.

Control:

1. Adults:

- Wire screening of houses and fly nets over the food.
- Fly papers and fly traps.
- Insecticides as D.D.T.

2. Breeding places:

- Elimination of breeding places.
- Health education
- Sanitary disposal of excreta.
- Insecticides especially for heaps of manure, garbage, animal stables and slaughter houses.

Stomoxys calcitrans

(The biting stable fly)

Adults are found in stables, farms, yards and neglected gardens. They are diurnal biters and their bites are very painful. In Egypt their seasonal prevalence is between May and June.

Morphology:

The adults resemble the house flies. But they differ in the following features:

-The mouth parts are adapted for piercing skin and sucking blood. So the proboscis is always protruded needle-like with proximal gradually swollen bulb, and the maxillary palps are short. The labium is provided with toothed labellae.

-The arista carries simple hairs on the dorsal side only.

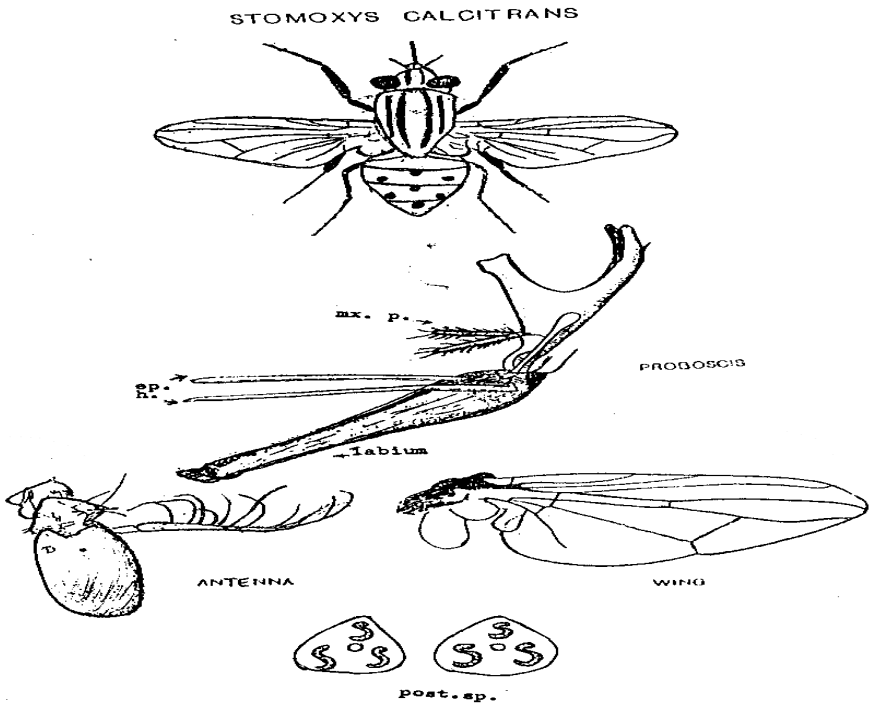
-The abdomen is broader and marked with four black rounded spots.

Life cycle:

-Females lay their eggs on horse or donkey manure mixed with hay or decaying garden refuse.

-The larvae hatch in few days and moult twice. They can be differentiated from *Musca* larvae by their **round posterior spiracles containing three S-shaped spiracular slits**.

-The pupal stage lasts for one week.



***Stomoxys* as vector of disease:**

It mechanically transmits animal diseases such as: animal trypanosomes, anthrax, and tetanus (direct mechanical).

Control: By spraying stables and animal houses by residual insecticides.

Glossina species

(Tsetse fly)

Geographical distribution: Equatorial Africa (a belt region in the middle of Africa).

Morphology:
It is larger than *Musca* (10-15 mm). The colour of the fly varies according to species. *Glossina palpalis* is dark or blackish, while *Glossina moristans* is brownish.

It is similar to *Musca* but differs in:

A) Head:

1. **Arista:** with branching hairs on the dorsal side only.
2. **Proboscis (mouth):** piercing and sucking blood **in both male and female**.
3. **The maxillary palps:** are single segmented, as long as the labium.
4. **The labellae:** are small and toothed.

B) Thorax: formed of 3segments.
C) Abdomen: formed of 8 segments.
Life cycle:

- **Breeding places:** They are diurnal biters, following animals and man and prefer human blood. They bred in shady trees along the banks of rivers and lakes.
- **Metamorphosis:** Complete.
- **Adults:** are relatively long lived (2-3 months) and fly for considerable distances. Female *Glossina* is **larviparous**, it gives larvae which are laid singly at intervals of 10-15 days. The larvae burrow in the soil in a depth of about 5 cm and changed into pupa after one hour.
- **Larva**: is rounded, yellowish white in colour with 2 large posterior lobes.
- **Pupa**: is black, barrel shape with the 2 posterior lobes still present. The adult merges after about one month.

Disease transmission:

a) *Glossina palpalis* and *Glossina tachinoides* transmit *Trypansoma gambiense*, which causes chronic sleeping sickness.

b) *Glossina moristans* transmits *Trypanosoma rhodsiense*, which causes acute sleeping sickness.

Control:

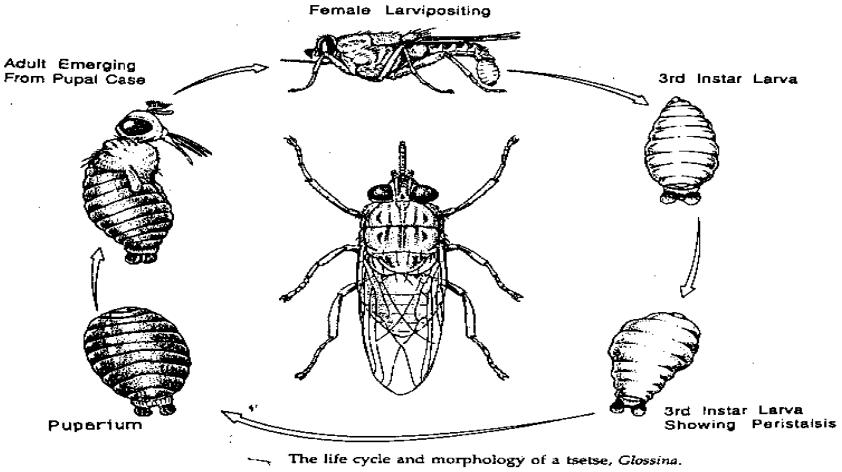
***-Glossina palpalis*:**

1. Periodic clearing of riverine vegetation around villages.
2. Selective spraying of vegetation on which the flies rest.
3. Hand catching of larvae and pupae in breeding places.
4. Mass survey and treatment of human cases to eradicate trypanosomes.

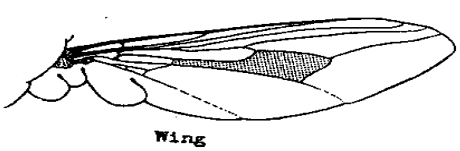
-Glossina morsitans*:* Its control is more difficult.

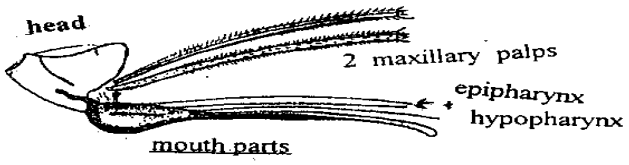
1. Elimination of animals near human habitations.

2. Animals traps to attract the insects that can be sprayed with insecticides.
3. Spray or paint the animals with insecticides.
4. Slaughter of wild animals
5. Insecticides sprayed on forest by planes.



The life cycle and morphology of a tsetse, *Glossina*.





GLOSSİNA

Family: Calliphoridae

They are flies of metallic coloration, just larger than *Musca*, and their larvae feed on dead animals. Less frequently, they find their way to wounds or ulcers causing myiasis. Some are facultative or obligatory parasites. They are:

•***Calliphora*** (**Blue bottle flies**):

Similar to *Musca* but differ in:

- They are larger than *Musca*. The body is blue in colour with metallic luster and the eyes are red.

- Larvae develop on meat, decaying matters and on ulcers.

- The larva can be identified by the posterior spiracles which are **pear-shaped with three straight slits and closed peritreme**.

•***Lucilia*** **(Green bottle flies):**

- Similar to *Musca* but differ in: Adults are metallic green in colour with a

large bristles on the thorax.
- Larvae are similar to *Calliphora.*

• ***Chrysomia*** **(Blow fly)**:
-Metallic green as *Lucilia* but no noticeable large bristles on the thorax, and the abdomen is provided with 2 transverse dark strips.

• ***Sarcophaga****:*
-These are big flies, grey with **chess board pattern** of the abdomen.

-They are **flesh flies**, their larvae feed on animal excrement and decaying flesh.
-Arista has a bare terminal third otherwise it resembles *Musca* in all respects.

-Female is **larviparous**. The larva has **rounded posterior spiracle with incomplete peritreme, medial button and three straight slits**.

•***Wohlfahrtia*****:**
-They resemble *Sarcophaga* except the abdomen has permanent **9 black spots**.

-They are **larviparous** and larvae are capable of penetrating unbroken skin.

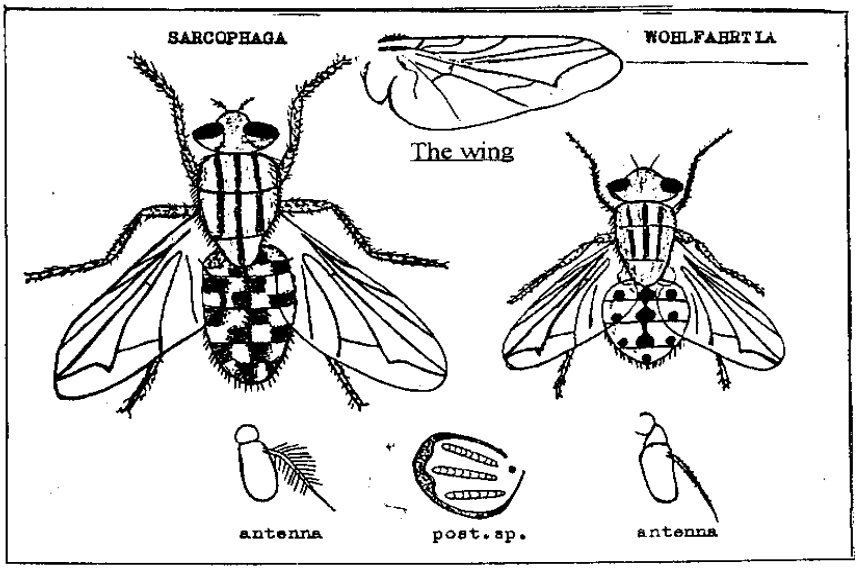
-The arista is bare with scarce hairs.

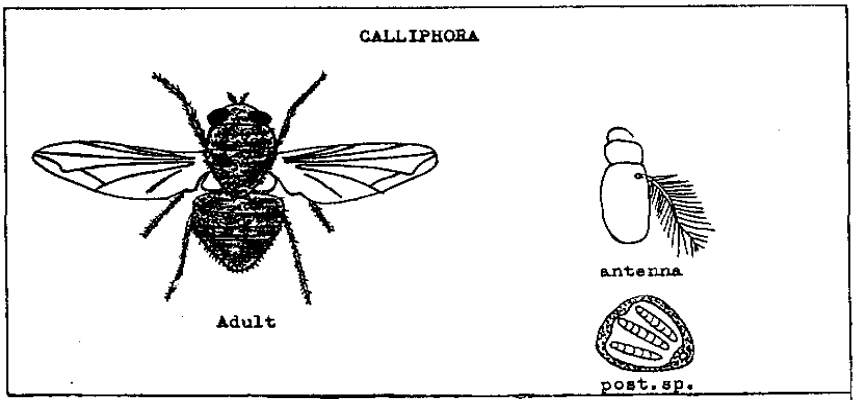
Medical importance of calliphoridae: all calliphoridae species cause myiasis in man

Control of calliphoridae: like *Musca*.

Family: Oestridae

This family includes large hairy bee-like flies. They do not feed in the adult stage. Their larvae are essentially parasitic. They cannot live on dead matter. They parasitize animals in their larval stage causing great damage to them. Accidentally they find their way to man causing various kinds of myiasis. Examples are *Oestrus, Rhinoestrus, Hypoderma, Gastrophilus* and *Dermatobia.* The larvae find their way to healthy tissue, and when ready to pupate, they fall down to the ground and the adults finally emerge.





MYIASIS

- Myiasis means invasion of the tissues of man or animals by the larval stages of some flies.

- In man, myiasis frequently occurs in rural regions where people live in close contact with domestic animals.

- Myiasis is common in domestic and wild mammals all over the world.

Classification of myiasis

A) According to the site of tissue invaded:

I. Internal myiasis

1. Intestinal
2. Gastric
3. Urogenital

II. External myiasis

1. Cutaneous myiasis:
   a. Traumatic cutaneous
   b. Creeping eruption
2. Ocular and nasopharyngeal
3. Aural

I. Internal myiasis

1. Intestinal myiasis:

- Several flies may deposit their eggs or larvae on human food or on the anus (particularly in rural children), during sleep or defecation in open places. Larvae find their way to the intestine and may cause nausea, vomiting, abdominal discomfort or pain with diarrhea.

- Living and dead larvae appear in stools or vomitus and can be diagnosed by their shape and posterior spiracles, e.g. larvae of *Calliphora*, *Lucilia*, *Musca, Sarcophaga,* and *Fannia* (latrine fly).

2. Gastric myiasis:

- It is uncommon in man, the larvae of *Eristalis* fly may find their way to stomach. This larva is commonly called rat-tailed larva.

- Usually these larvae either pass to intestine causing intestinal myiasis or die or get vomited.

3. Urogenital myiasis:

- Caused by*: Fannia, Musca, Calliphora* and *Sarcophaga* species.

- Larvae may enter through urinary or genital orifices or through lesions on orifices during urination in open places.

- They may cause obstruction to the urine flow with pain if larvae are in the urinary tract or inflammation with pus, mucus and blood in urine. Maggots passed in urine are used for diagnosis.

II. External myiasis

1. Cutaneous myiasis:

a. **Traumatic cutaneous myiasis:** This occurs when wounds or ulcers are invaded by flies' larvae. These larvae may cause serious damage e.g. *Wohlfarthia, Chrysomia, Cordylobia* and *Dermatobia.*

b. **Creeping eruption:** The larvae of *Hypoderma* and *Gasterophilus* parasitize some animals but accidentally may find their way to the skin of man and wander in the skin causing papules and pustules along its path leading to creeping eruption.

2. Ocular and nasopharyngeal myiasis:

Larvae of some flies are attracted to the discharge coming from the eye or the nose, find their way to the conjunctiva or the nose and may reach the brain. Severe pain in the eye is the first complaint in ocular myiasis e.g. Larvae of *Oestrus*, *Calliphora, Sarcophaga, Gasterophilus* and *Hypoderma.*

3. Aural myiasis:

Purulent exudates discharged from running ears attract some flies where they lay their eggs or larvae. Larvae invade middle ear, inner ear or even mastoid sinuses or the brain tissue in extreme cases, for example, *Wohlfahrtia, Sarcophaga, Lucilia* and *Chrysomia.*

B) According to the biological habits of the fly:

I. Specific myiasis:

The fly larvae can **invade only living tissues** e.g. *Hypoderma* and *Dermatobia.* Their larvae invade the skin causing boil like swellings. *Wohlfahrtia* and *Oestrus* larvae invade the eyes, nose and external ears, and cause conjunctivitis and corneal ulcers, nasal obstruction and persistent bloody purulent discharge, and external otitis, respectively.

II. Semispecific myiasis:

Flies which habitually oviposit or larviposit on **dead tissues** of man or animals, can be attracted by the offensive discharges coming from neglected wounds, or inflamed ears and eyes and thus deposit their larvae or eggs in such tissues. Examples of such flies are: *Sarcophaga, Lucilia, Calliphora, Wohlfahrtia* and *Chrysomia.* The presence of larvae prevent healing and induce sepsis.

III. Accidental myiasis:

When the fly eggs or larvae are deposited on food material, e.g. cheese and vegetables and then they are accidentally ingested, they lead to intestinal myiasis. Also, when the eggs are deposited around the anal canal or urogenital orifice, the larvae can travel up these passages leading to intestinal or urogenital myiasis, respectively. Example of such flies are: *Piophila* in cheese, *Drosophila* in fruits and *Fannia* the latrine fly.

Diagnosis of myiasis:

1. Diagnosis of myiasis can be made only upon **finding the larvae**, which should be removed and kept for identification. The shape of the larvae and pattern of spiracles are characteristics of different groups of flies.
2. Sometimes larvae are breed in the laboratory to diagnose the adult fly.

Treatment:

1. Treatment consists essentially of destroying and removing the larvae and then treating the lesions.
2. Removal is easy in open wounds, but difficult if deep seated or in internal mucous membranes or frontal sinuses.
3. If deep seated and large an attempt must be made to remove the larvae and the wound should be packed with an antibiotic.

Prevention:

1. If an obligatory parasite, destroy the larvae in the living host and prevent further development of the larvae which have escaped.
2. Protect open lesions of the skin and mucous membranes by gauze or wool dressings.
3. Use nets or screens, repellants to protect humans.
4. Control of adult flies in their breeding places with insecticides.
5. Protection of food from flies.

Case study:

A 11-year-old boy was presented to Ear, Nose and Throat (E.N.T.) specialist suffering from earache, with foul-smelling discharge from his right ear, for 15 days. He was diagnosed as right otitis media. He was prescribed several types of antibiotics with no response. After one month, his mother observed some small worm-like structures coming out of his infected ear, with purulent aural discharge.

These worm-like structures were sent to the laboratory and submitted for parasitological examination. The diagnosis was then made and the child was properly treated.

Questions:

1. Which insects cause this patient's symptoms?
2. How can you confirm the diagnosis?
3. What is the specific treatment?
4. How can you prevent this infection?
5. Can you classify myiasis according to parasitism and according to the type of tissue invaded? How?

Order: Siphonaptera (Fleas)

General characters:

- Small, 2-3 mm, brown in colour.
- Bilaterally compressed.
- Strong legs for jumping.
- Complete metamorphosis.
- Formed of head, thorax and abdomen, but with no wings.

Head:

- Rounded or angular, has 2 simple eyes which may be absent.
- Mouth is piercing and sucking **in both male and female**.
- Has short antenna (3 segments).

Thorax: Formed of 3 segments.

- Three pairs of strong legs.
- May have pronotal comb on the posterior border of the first thoracic segment.
- Has no wings.

Abdomen: Is formed of 10 segments.

-Male: has spring-like aedaegous.

-Female: has comma-shape spermathica.

Life cycle:

-Breeding places: on the ground.

- Female deposits eggs after blood meal.

- The egg is oval and white and the larva hatches after 3-10 days under suitable temperature and humidity. It is very active, slender formed of 14 segments, after 2-12 days changes into pupa then adult that can live for a year or more.

Types of fleas (Classification)

According the comb

Non Combed fleas **Combed fleas**

1- *Pulex irritans* (Human flea)

- Mainly present on humans.
- Rounded head.
- Cosmopolitan in distribution.

2-*Xenopsylla cheopis* (Rat flea)

- Mainly present on rats.
- Rounded head.
- Has mesopleural suture.

3-*Tunga pentrans* (Sand flea)

- Angular head, larger than the thorax.
- No hair in the head.
- It presents in tropical America, India and Pakistan.
- The thoracic segments are compressed.

- Differences between *Xenopsylla cheopis* and *Pulex. irritans*

	Xenopsylla cheopis	***Pulex irritans***
Ocular bristle	In front and above the eye	In front and below the eye
Post-cephalic bristles	Several bristles	Only one bristle
Mesopleural suture	Present	Absent

Combed fleas

One comb

***Ceratophyllus fascitaus* (Rat flea)**

- Only one comb; pronotal comb.
- No genal comb.

Two combs

***Ctenocephalus canis* (Dog flea)**

- Genal and pronotal comb.
- Cosmopolitan in distribution on humans, dogs and cats.

Medical importance:

Fleas transmit and cause the following diseases**:**

1. Plague:

It is an acute infectious disease; causative organism is *Pasteurella pestis.*

Blocked flea:

After taking an infected blood meal, multiplying organisms + blood clot + fibrin net block the stomach of flea. So, it cannot take another blood meal and remains hungry, nervous, and irritable trying to take blood meal from many persons.

Xenopsylla is the flea which is commonly blocked due to its narrow stomach.

2. Endemic typhus fever (murine typhus):

It is caused by *Rickettsia mooseri*. The *Rickettsia* pass in the stool of the flea and enter to the patient through bite wound or any abrasion in the skin, conjunctiva, or mucous membrane of the nose or mouth.

3. Fleas act as intermediate host of *Dipylidium caniunm* (*Ctenocephalis canis*)

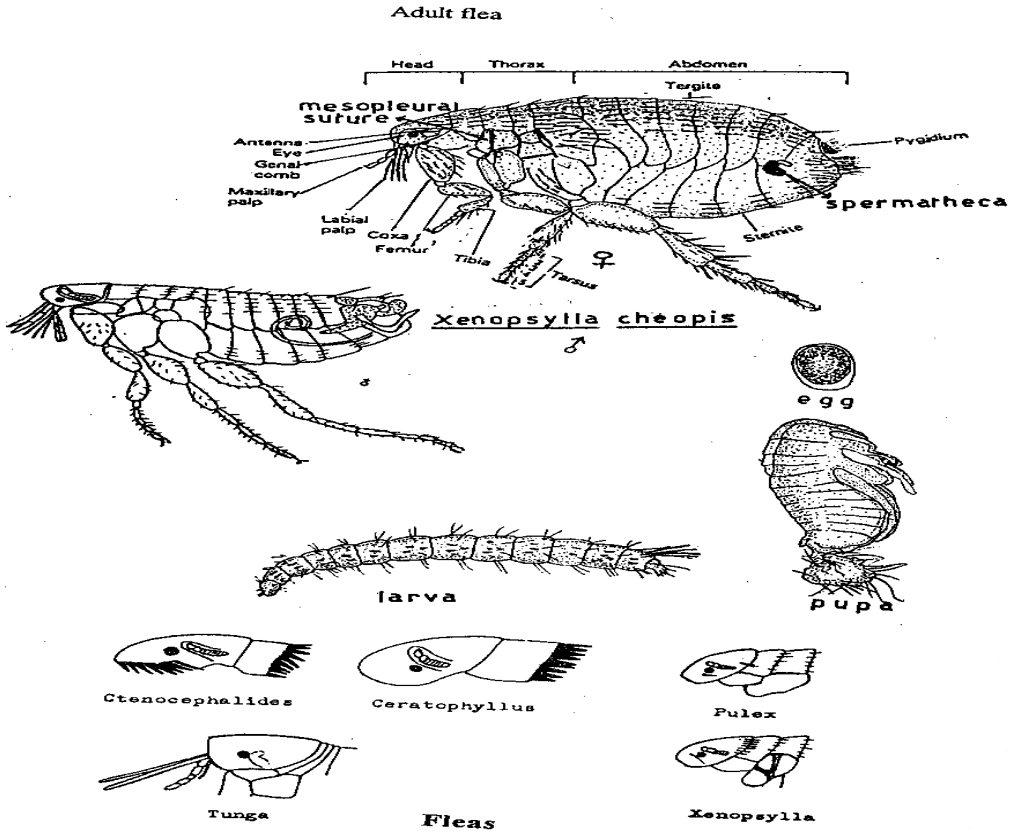
4. Fleas act as intermediate host of *Hymenolepis diminuta* (*Xenopsylla cheopis* and *Ceratophyllus fasciatus*).

5. Flea dermatitis: Itching due to biting followed by 2ry bacterial infection.

6. Tungiasis (previously known as **Jiggers disease**): Female *Tunga* penetrates the skin between toes to deposit eggs leading to 2ry bacterial infection and cellulites.

Control:

1. The adult and the larval stages are sprayed with insecticides.
2. Infected dogs and cats are treated by 1 or 4% rotenone.
3. Floors, rugs, carpets and pillows and other domestic articles in which fleas may breed should be sprayed with kerosene.



Order: Hemiptera

Cimex lectularis

(Bed bugs)

- Flat dorsoventrally, reddish brown and covered with small hairs.
- Wings rudimentary or no wings.
- Its size is about 5-6 mm in length and 4 mm in breadth.
- It is composed of head, thorax and abdomen:

Head:

- Pentagonal in shape, with 2 big compound black eyes.
- Antennae (5 segments).
- The mouth is adapted for piercing and sucking, **in both male and female**.

Thorax:

-Three segments with 3 pairs of legs and rudimentary wings.

Abdomen: formed of 8 segments.

Male: posterior end is tapering (v- shaped), spring like aedegous.

Female: posterior end is broadly rounded.

Life cycle:
Breeding place: wall cracks and bed linings.

Metamorphosis: incomplete.

Egg: Female deposits eggs in masses.

- Dirty white, 1 mm, operculated, like egg plant. After one week nymph hatches.

Nymph: Similar to adult but smaller, translucent, with no genitalia. After 2 month it changes into adult.

Medical importance: Irritation, irritability, urticarial rashes and insomnia.

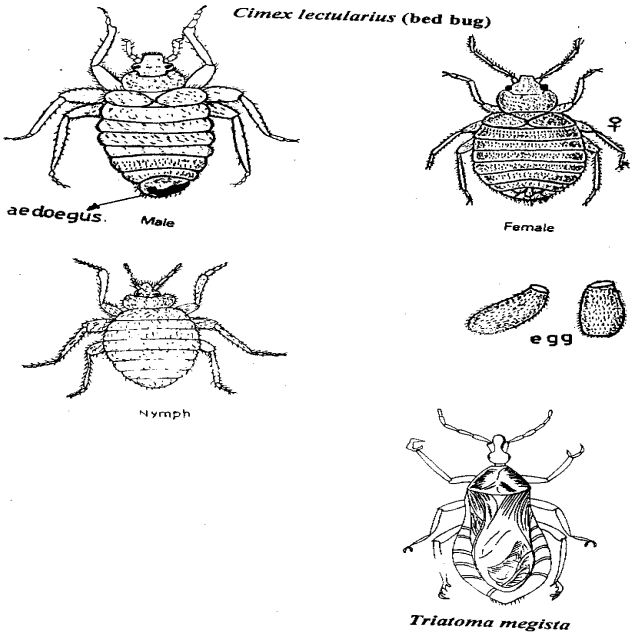
Control:
1. Application of insecticides as 1% malathian to the hiding places.
2. Infected beds are sprayed by 5% D.D.T.

Triatoma

(Winged bug, Kissing bug)

Geographical Distribution: It is not present in Egypt. Commonly found in Brazil and South America.

Morphology:
1. It is large, bee like, black with red markings on the wings, thorax and abdomen.
2. Head: has mouth adapted for piercing and sucking and bent under the body.
3. Thorax: contains 2 pairs of wings, the mesothoracic pair (chitinous) and the metathoracic pair (membranous).
4. Abdomen: has sharp edges and covered with many wings.



Life cycle:

- The adults live in huts where people live, hiding during daytime in cracks and feeding during night on their hosts. They attack the face (so they called kissing bugs).
- Eggs are deposited in hiding places, and hatch into wingless nymph.
- Nymph is changed into adult after one year.

Medical importance:

Triatoma transmits ***Trypanosoma cruzi*** that causes Chagas' disease.

Control: Insecticides are applied to the hiding places.

Order: Anoplura (Lice)

- Ectoparasite of man.
- Small, flat dorsoventrally, and has short antenna (5 segments).
- Mouth part is adapted for piercing and sucking.
- No wings.
- Legs are short, provided with claws adapted for clinging.
- **Metamorphosis is incomplete**.

Types:

1. *Pediculus humanus capitis* (head louse)
2. *Pediculus humanus corporis* (body louse)
3. *Phthirus pubis* (pubic louse).

Pediculus humanus capitis

Geographical distribution: Worldwide, common in poor crowded areas.

Morphology:

- Small in size, about 3-4 mm, brown in colour.
- The body is composed of head, thorax and abdomen.

Head: has 2 simple eyes, 2 short antennae and the mouth is adapted for piercing and sucking.

Thorax: formed of 3 segments fused together and it has 3 pairs of legs. The legs are short and end in a single big claw. The first pair of legs is stronger than the other 2 pairs.

Abdomen: formed of 7 segments, the upper 6 segments each has 2 respiratory spiracles on the sides of the segments. The abdomen of male ends with a pointed protruding spine-like aedeagus, while in female ends in an inverted V-shaped slit (Notch), surrounded by 2 processes called gonopods on either side of the vagina.

Life cycle:

- *Pediculus humanus* is **permanent ectoparasite** of man.

-The female deposits the eggs (nits) that stuck to the hair by cement substance.

Egg: is oval in shape with operculum (crown like appearance) and white in colour. The egg hatches after one week, the nymph comes out through the operculum.

Nymph: is similar to the adult but smaller, translucent, sexually immature. It feeds by sucking blood. It moults 3 times before becoming adult in about one week.

- Head lice are not known to transmit any disease. Itching is the most common symptom of head lice infestation that is caused by an allergic reaction to louse bites. Head sores caused by scratching can sometimes become infected with bacteria normally found on a human's skin.

Pediculus humanus corporis

(Body Louse)

It is similar to *Pediculus humanus capitis* but differs in:

- Bigger in size, paler, longer antennae.

- It is present on the body only.

- Life cycle similar to that of head louse.

Medical importance:

Body lice transmit and cause the following diseases**:**

1. **Epidemic typhus:**
   Causative organisms: *Rickettsia prowazekii*.
   Mode of transmission: When the louse takes blood meal from a patient, it takes the *Rickettsia* with the blood which multiplies in the cells lining the louse gut, causing rupture of these cells, liberating the organisms into the lumen of the gut which then pass with the stool of the louse. *Rickettsia* contaminates any abrasions in the skin, conjunctiva, and mucous membranes of the mouth or nose. Infection can occur by inhalation after crushing the louse on the skin.
2. **Epidemic relapsing fever:**
   Causative organism: *Borrelia recurrentis*.
   Mode of transmission: When the louse takes blood meal from a patient, it takes the *Borrelia* with the blood which passes from the gut to the body cavity and multiplies. It is transmitted by crushing the infected louse. *Borrelia* contaminates the bite wound, skin wound or skin abrasion, also by contamination of mucous membranes of the mouth or nose.
3. **Trench fever:**
   Causative organism: *Rickettsia quintana*.
   Clinical picture and the method of transmission are similar to epidemic typhus.

4. Pediculosis (Vagabond´s disease): It is very common among poor crowded area, in prisoners and among soldiers. It is due to long lasting, heavy infection with body lice, which leads to severe itching, irritation, dermatitis, scratching of the skin with secondary bacterial infection and causes pustule formation and lastly deep pigmentation of the skin.

Treatment:

Head louse:

-1% Lindane or gamma lindane is rubbed in the infected areas.

- By using Benzanyl lotion or cream.

Body louse: Dusting the skin with insecticides powder.

Phthirus pubis

(Pubic louse)

It is similar to *Pediculus humanus* but differs in that it lives attached to pubic hair, axillary hair, chest hair, moustache, eye lashes and eye brows.

Morphology:

1. The head: is shorter, and present in a depression in the thorax.
2. Thorax: is larger than the abdomen.
3. The legs: first pair is less developed than the others.
4. The abdomen: is formed of 5 segments and has 3 pairs of respiratory spiracles on the first abdominal segment. The abdomen has lateral processes (4 pairs in male and 2 pairs in female).

Life cycle:

It is transmitted by sexual intercourse. The eggs are similar to that of *Pediculus.* The egg hatches and then nymph comes out that feeds on blood, moults 3 times and finally becomes an adult.

Medical Importance:

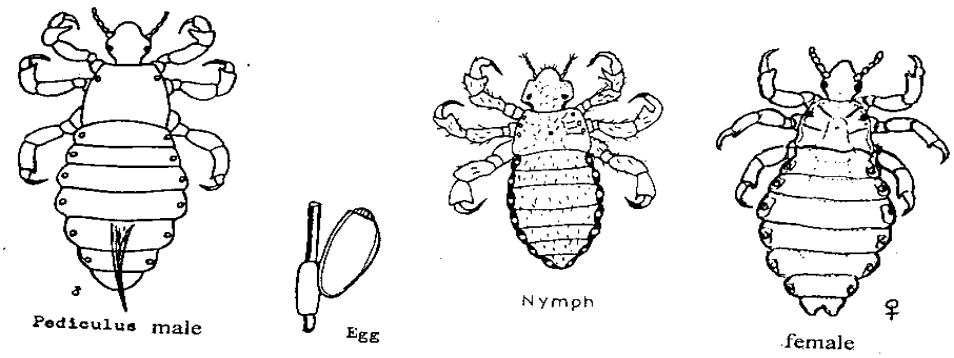
No disease is transmitted by *Phthirus*, it causes severe itching, irritation and dermatitis.

Control: Delousing consists of bathing and cleaning clothes by laundering, dry heat, dusting with a powder containing 5-10% D.D.T or Gammaxane.

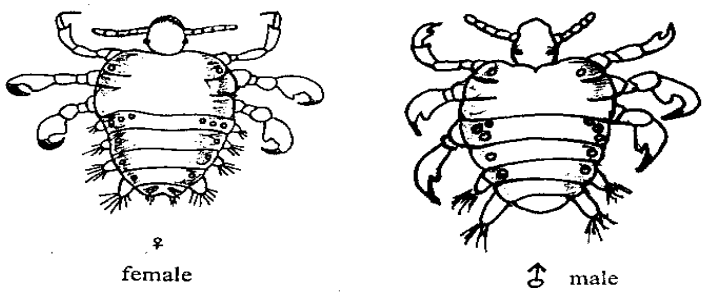
Differences between *Pediculus* and *Phthirus*.

	Pediculus	***Phthirus***
Head	-Not impacted	-Impacted on the thorax
Legs	-First pair is well developed	-First pair is less developed
Abdomen	-Not compressed -Consists of 7 segments with 6 pairs of respiratory spiracles	-The thorax and abdomen are compressed -Consists of 5 segments, with 3 pairs of respiratory spiracles -It shows lateral processes
Habitat	-Head and body	-Pubic hair, axillary hair and eye lashes
Medical importance	1-Epidemic typhus 2-Trench fever 3-Epidemic relapsing fever 4- Pediculosis N.B. Head lice cause itching but don´t transmit any disease	-No disease transmission, only causes itching, irritation and dermatitis

Pediculus humanus **(Lice)**



Phthirus pubis **(pubic louse or crab louse**



Class: Arachnida

Ticks

General characters:

1. The body is one mass sac like.
2. The head is lacking, but the **capitulum** (mouth), which is adapted for piercing and sucking may be seen.
3. The body of the tick has dorsal surface and ventral surface.
4. On the dorsal surface, hard chitinous plate called **scutum** may be present. It may cover the dorsal surface either completely or partially.
5. Metamorphosis is gradual (egg —> larva —> Nymph —> Adult).
6. The adult and nymph have 4 pairs of legs, while the larva has 3 pairs.

Types of Ticks: Ticks are classified into 2 families:

1. Ixodidae (hard ticks).
2. Argasidae (soft ticks).

Life cycle:

Breeding places: Females deposit eggs on the ground. The deposition of eggs terminates their life.

- Egg hatches into **larva** which has 3 pairs of legs, smaller than the adult, paler, its anterior part is covered partially by the scutum and it is sexually immature. The larva changes into **nymph** with 4 pairs of legs, it is similar to the adult but smaller and sexually immature then changes into adult. It may live from 6 weeks to 2 years.

Medical importance of ticks:

A. Diseases transmitted and caused by hard ticks (*Dermacentor andersoni*):

1. Rocky mountain spotted fever: It is also named tick-bite fever or black fever.

Causative organism: *Rickettsia rickettsii*.

Mode of transmission: The tick takes the *Rickettsia* with blood meal, it multiplies inside the gut cells of the tick which finally ruptured, liberating the *Rickettsia* in the faeces and in the body cavity. Infection occurs by biting of the tick or by contamination of any wound by the faeces of the infected tick.

Clinical picture: The incubation period is 2-5 days.

The most characteristic symptom is rash which appears on the wrists, ankles, then on the back and later spreading to all parts of the body.

2. Q-fever:

Causative organism: *Coxiella burnetti.*

Mode of transmission: Bite of the tick.

Clinical picture: Similar to brucellosis, influenza and atypical pneumonia**.**

3. Boutonneuse fever: caused by *Rickettsia conorii*.

4. Tick bite fever: caused by *Rickettsia pijperi.*

5. Meningoencephalitis fever: caused by a virus.

6. **Colorado fever:** caused by a virus.
7. **Lyme disease:** caused by *Borrelia bergidorfini*.
8. **Tularaemia:** caused by *Pasteurella tularensis*.
9. **Texas cattle fever and babesiosis:** caused by *Babesia*.
10. **Tick paralysis:** It is produced by some toxins in the saliva of the tick; which produce a blockage of the neuro-muscular junctions and probably some of the synapses of the spinal cord. Paralysis disappears after removal of the causative tick.

B. Diseases transmitted by soft ticks (Argasidae):

Two types of soft ticks:

***Argas*:** It does not transmit diseases.

***Ornithodrous*:**

Only transmits and causes the following diseases:

1. **Endemic relapsing fever:**

   The causative organism is *Borrelia duttoni*. It is characterized by headache, body ache, vomiting, abdominal pain, high fever, increasing pulse rate, hot skin, congested eye and dyspnea. The fever lasts 2 days then drops and fresh attack occurs.

2. **Q-fever:** caused by *R. burnetti*.
3. **Tick paralysis**.

Mechanisms of disease transmission by ticks:

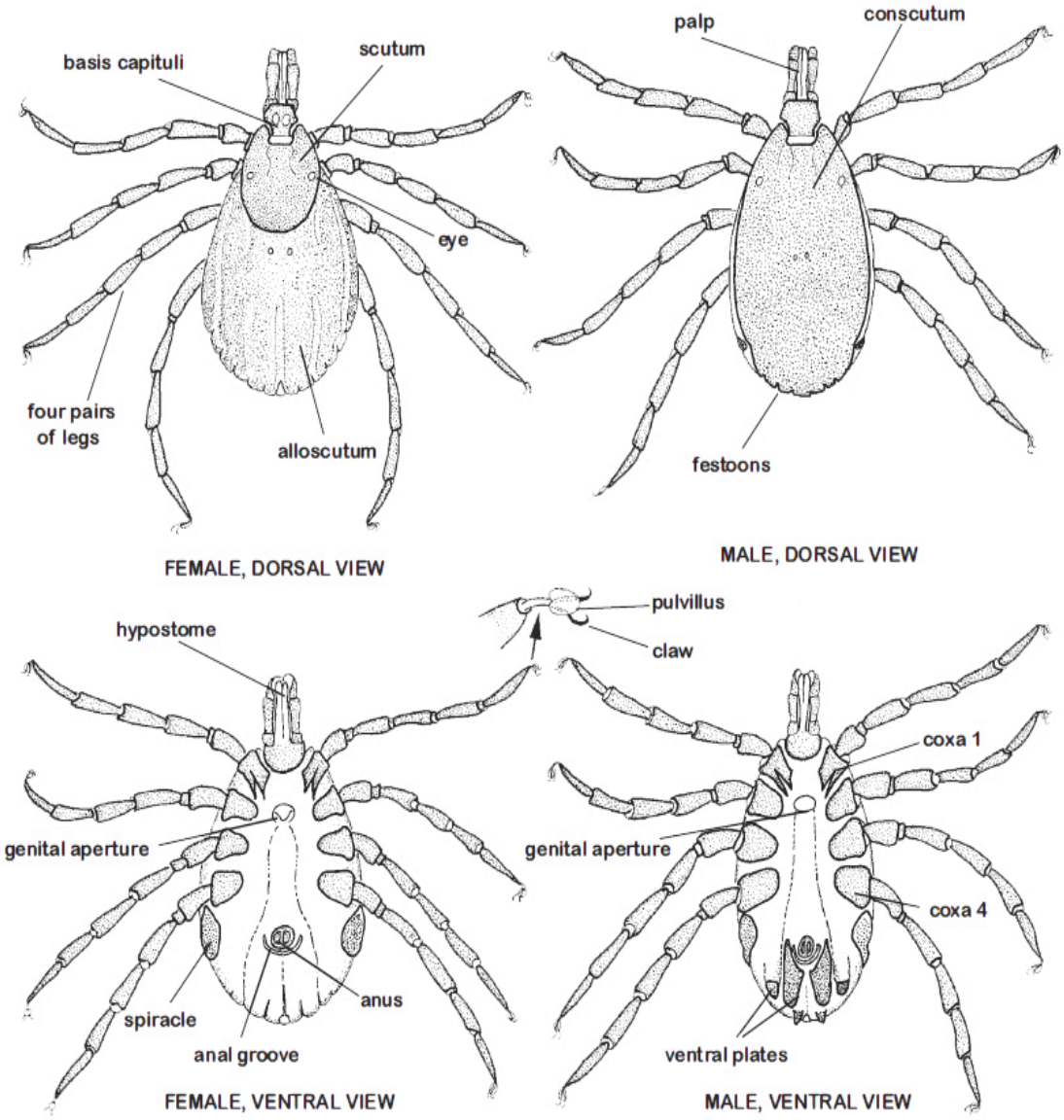
1. Through bites of ticks in case of rickettesial and viral diseases.
2. By faeces contaminating the puncture wound and skin abrasions.
3. By coxal fluid.
4. Transovarian (Progeny).

Treatment:

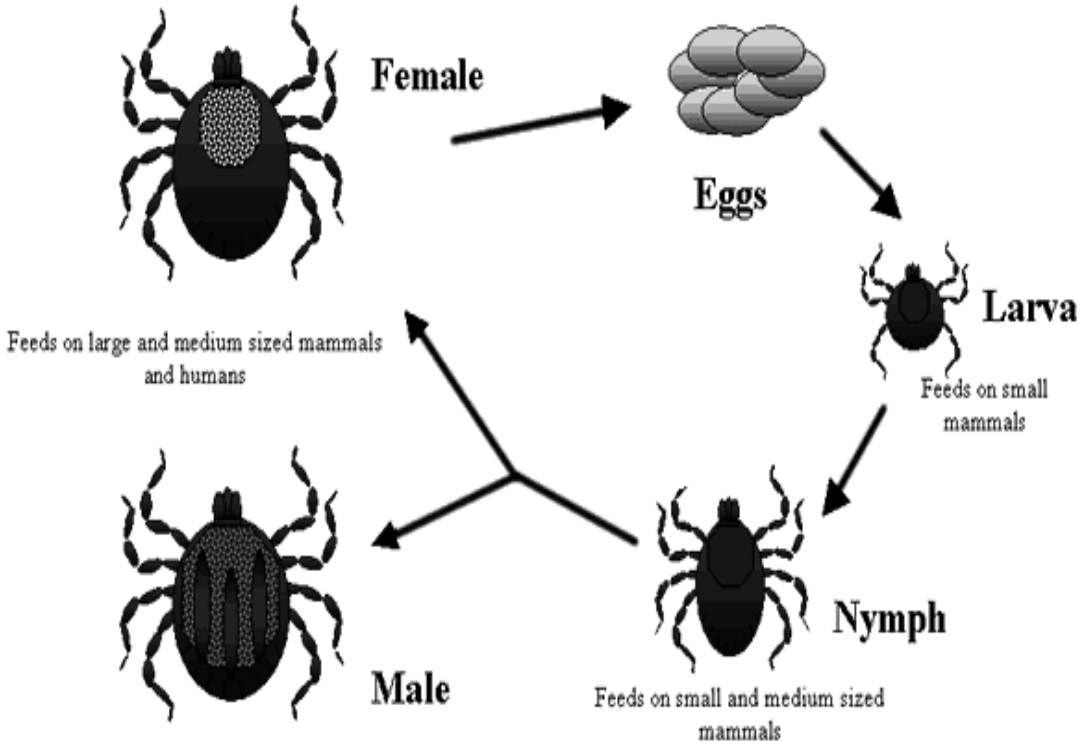
By the removal of tick, it is better to anaesthetize the tick with ether or to suffocate it with gasoline oil, glycerin or kerosene.

Control:

Depends mainly on spraying insecticides on the floors, in cracks in the walls and places where ticks are hide. Also, disinfestations of animals by dipping them in solutions of insecticides.

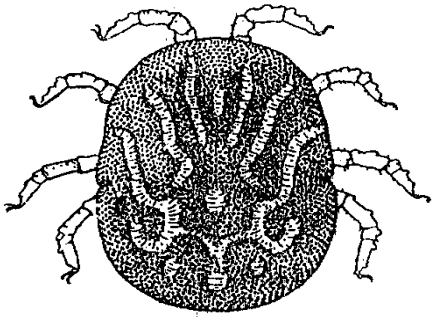


Hard tick morphology.

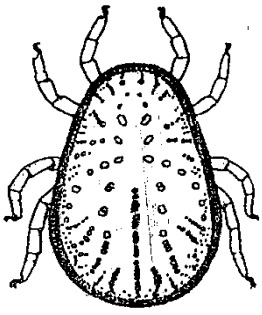


Hard tick life cycle.

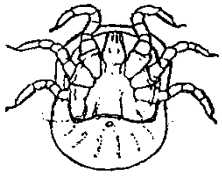
soft ticks



Ornithodorus moubata



Argas persicus



larva

Differences between Ixodidae and Argasidae.

	Ixodidae (Hard tick)	**Argasidae (soft tick)**
Adult: Capitulum (mouth)	Can be seen from dorsal surface	Can be seen from ventral surface
Sex	Can be differentiated into male and female	Not differentiated
Scutum	Present, covers all the dorsal surface of male but cover only the anterior half of female	Not present
-Festoons on the posterior margin -Respiratory spiracles -Relation to the host	-Present -Lie behind the 4^{th} leg -Permanent	-Absent -Between the3^{rd}and4^{th} leg -Temporary
-Life span	-Short lived, male dies after mating and female dies after oviposition	-Long lived
Larvae -Scutum	-Present and cover small part anteriorly	-Not present
-Festoon (in posterior margin)	-Present	-Absent

Differences between *Ornithodorous* and *Argas*.

	Ornithodorous	***Argas***
Shape **Margins** **Dorsal surface**	Oval Thick Mamillated	Triangular Sharp Smooth

Mites

These are small acarines, the important members causing diseases to man are:
1. *Sarcoptes scabiei*.
2. *Demodex folliculorum*.
3. *Trombicula akamushi*.
4. House dust mites (HDMs).

Sarcoptes scabiei

(The itch mite)

Geographical distribution: Cosmopolitan; the disease is common among overcrowded, poor and dirty classes of populations.

Morphology:
1. It is a small mite, about 400-500x 200-250 μ, grey in colour, and oval in shape.
2. It is one mass.
3. Mouth is adapted for tearing the tissues.
4. It has 4 pairs of legs. The anterior two pairs in both male and female end by suckers. While the posterior two pairs end by bristles in female. In male, its 3rd pair ends by bristle, while the 4th pair ends by suckers.

Life cycle:

Habitat: in intracutaneous tunnels between fingers, toes, ulnar surface of the arm, elbows, axillae, groin, breast, umbilicus, shoulder, back and buttocks.

-The head and neck are not affected.

-The fertilized female adheres to the skin by the suckers on its tarsi. The female burrows tortuous tunnels in the epidermis and deposits eggs at 2 to 3 days intervals for a period of 2 days. The eggs are large and oval (150 x 100μ). The female remains in the burrow for its life time.

-The larvae hatch from eggs, move freely over the skin and change into nymphs, both larvae and nymphs are found in hair follicles.

-Maturity occurs after 2 weeks from eggs deposition **(metamorphosis is gradual).**

Mode of infection: It takes place by contact with an infected person or by using his internal clothes.

Pathogenesis and clinical picture:
Scabies is called **seven years itching.** The activity of mites usually occurs during **night**. It is activated by the warmth of the affected part. Mites produce black tortuous tunnels due to their toxics secretions and excretions. Severe itching occurs that interferes with sleep (insomnia). Scratching and secondary bacterial infection occur on top, resulting in vesicles and pustules.

Diagnosis:

I. Clinically: By the severe itching during night, its sites distribution in the skin, and by finding the scratches, vesicles and pustules.

II. Laboratory: By finding the adult mite or its stages in the tunnels after opening with a needle under a magnifying lens.

Treatment:

1. Bathing every day with sulphur soap for 5 days.
2. Change the internal clothes and bed lining.
3. Using sulphur ointment 10-15% on the affected areas or benzyl benzoate 25% emulsion painted on body.

Prevention and control:

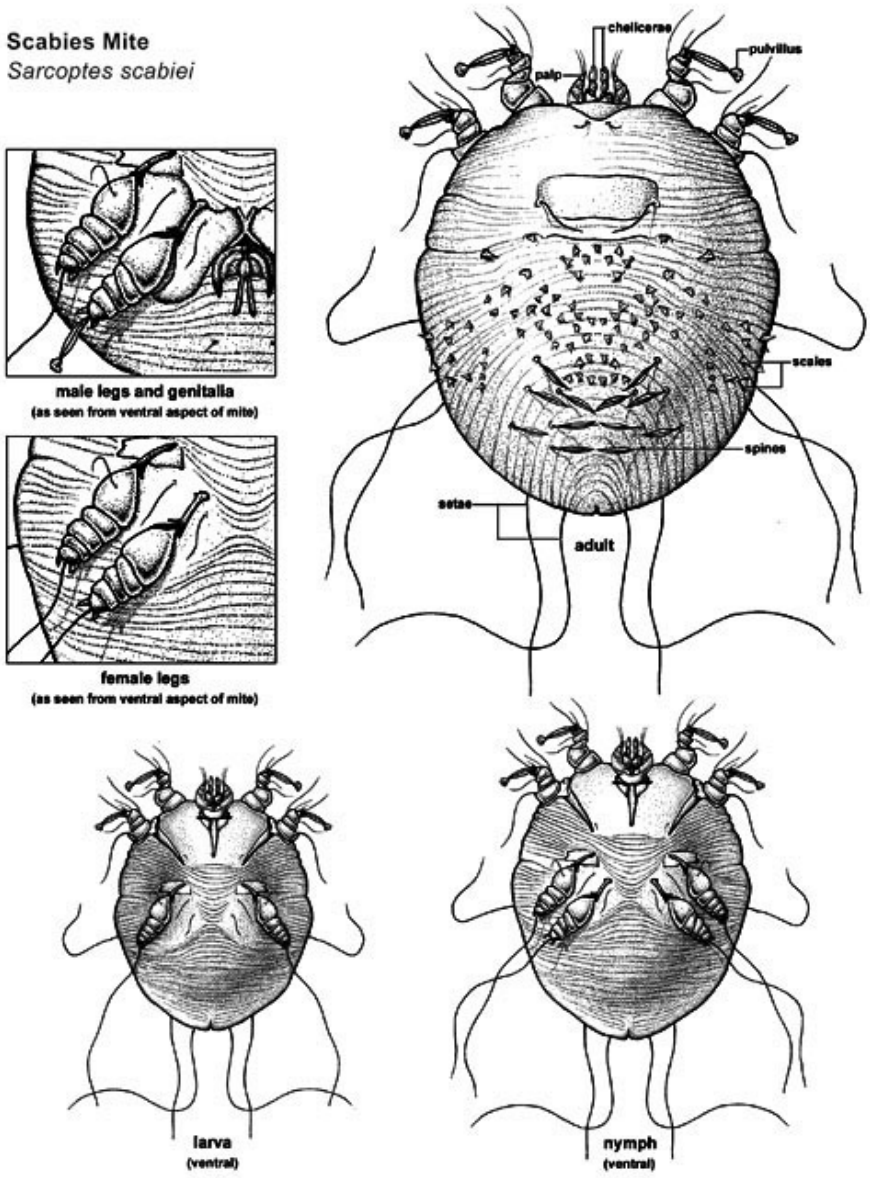
1. Personal hygiene by regular bathing.
2. Avoid contact with patients.

Case study:

A 11-year-old child was presented to the dermatologist suffering from severe nocturnal itching in the groin, lower abdomen, elbows and neck. Clinical examination revealed multiple scratches, elevated red tracks in the skin with small papular lesions in the affected areas. Skin specimens of the affected areas were collected and sent to the laboratory for examination.

Questions:

1. Do you think that the patient's illness may be a result of parasitic infection?
2. Name the insect that may cause this patient's illness.
3. Name the disease caused by this insect.
4. How is this infection acquired?
5. Describe the life cycle and pathogenicity of this insect.
6. Is this disease opportunistic?
7. How is the diagnosis of this infection made?
8. How is this infection treated?
9. What are the precautions to be followed during treatment of this infection?
10. How can you prevent and control this disease?



Demodex folliculorum

(The hair follicle mite)

Geographical distribution: Worldwide distribution.

Morphology:

1. It is very minute, about 300-400x 40 μ, and elongated.
2. It is formed of cephalothorax, which has 4 pairs of legs and transversely striated abdomen.

Life cycle:

Habitat: in the hair follicles and sebaceous glands particularly around the nose, eyelids, mouth and face.

- The female deposits eggs, which change into larvae then nymphs and lastly adults, are produced. The larva has 3 pairs of legs. The larva and nymph are present with the

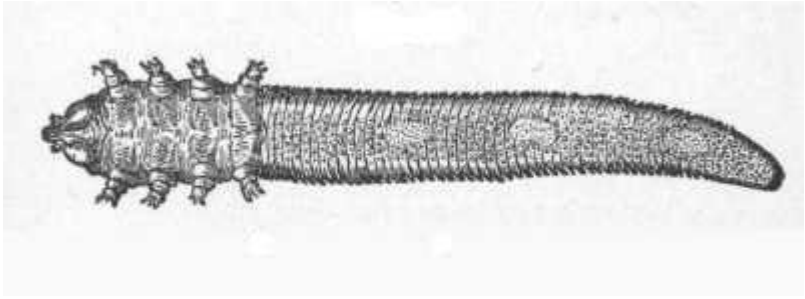
adult in the same follicles or glands. Many parasites are present also in the same follicles.

Mode of infection: By direct contact with the patient or by using the polluted towels.

Pathogenicity: It causes acne, black heads and dermatitis.

Diagnosis: Squeeze out the contents of the black head or sebaceous gland and examine under the microscope for the adult and its stages.

Treatment: Sulphur ointment 15% or Benzyl benzoate 25%.



***Demodex folliculorum* adult**

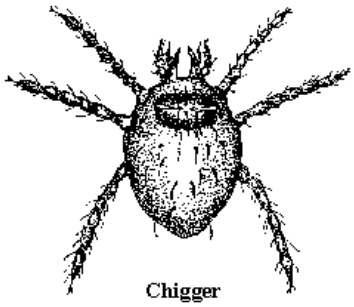
Trombicula akamushi

(The harvest mite, red bug, chigger)

Geographical distribution: Cosmopolitan.

Morphology: They are small in size, 0.5-1.0 mm, red in colour, and the cephalothorax is well demarcated from the rest of the body.

-The adult stage lives freely on the ground.



Chigger

Medical importance:

1. Scrub typhus:

Causative organism: *Orientia tsutsugamushi* (*Rickettsia tsutsugamushi*).

Mode of transmission: By the bite of larva. *Rickettsia* is transmitted transovarially from the adult stage.

Clinical picture: This is an acute exanthematous rickettsial disease characterized by a primary lesion in the form of punched out ulcer covered by

an eschar at the site of attachment of the trombiculid larva. A red maculopapular rash appears on the trunk and extremities and then fades away.

Treatment: Azithromycin has been used successfully in the treatment.

2. Chigger dermatitis (Scrub itch, trombiculid dermatitis):

Mites attach themselves to the skin or to the base of hairs follicles; they secrete salivary juice producing severe dermatitis. The lesion first appears as minute red elevation on the skin, accompanied by intense painful pruritis; a wheel then develops and the surrounding skin becomes excoriated as a result of scratching and serious exudates and frequently a pustule develops. The regions commonly affected are the ankles, legs, external genitalia, and groin and waist line.

Prevention and control:

1. Using repellants against larvae.
2. Eradication of rodents.

House dust mites

House dust often contains allergenic mites. These are found in dust on the floors, furniture, mattresses and beds. The most common is "*Dermatophagoides farinae*".

Medical importance:

They contain dust allergens and produce allergic reactions in humans, as allergic rhinitis, conjunctivitis and bronchial asthma.

Prevention and control:

1. Exclusion of dust from bedrooms and furniture of sensitive individuals.
2. Thorough cleaning beds and furniture using a vacuum cleaner.

House dust mite

Scorpion

Morphology:

- Scorpions are moderately large, elongated, yellowish brown or black in colour, about 15 cm in length.
- The body is composed of a cephalothorax and a long segmented abdomen.
- The cephalothorax carries anteriorly a pair of strong pincer used for picking up and crushing small insects and spiders. It has 4 pairs of legs which are adapted for walking.
- The abdomen is formed from 12 segments. The first 7 segments are broad, while the posterior 5 are narrow and are called a tail. At the last segment, appendage called telson which is swollen, ending by a sharp curved needle called the stinger, where the venom glands are present.

Life cycle:

- The female is **viviparous** and carries the newly born ones over its back for the first week. It feeds on insects and does not drink.

Medical importance:

Scorpions when attack man, inject the poison in his body. In children, the injected dose is fatal. Death occurs due to cardiac and respiratory failure.

Treatment:

1. A tourniquet is applied proximal to the site of sting to prevent dissemination.
2. The wound is incised and sucked.
3. Potassium permanganate is put on the wound to oxidize the venom.
4. Adrenocorticotropic hormone (ACTH) and antitoxin.

Control: Spraying insecticides, e.g. 10% D.D.T. and 0.2% pyrethrum in kerosene.

Scorpion morphology

Class: Crustacea

Cyclops

Geographical distribution: Cosmopolitan, living in fresh water of wells and canals.

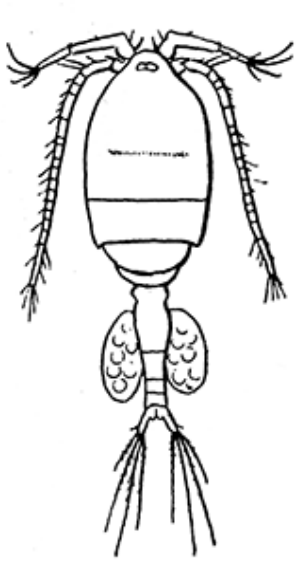
Morphology: It is pear-shaped, formed of cephalothorax and abdomen.

- **Cepholothorax:** its anterior end is broad, has one single median eye, 2 pairs of antennae, and 5 pairs of bifid legs.
- **Abdomen:** is formed of 5 segments in male and 4 segments in female with two egg sacs on its side. It ends posteriorly by 2 bristles.

Life cycle:
Eggs are laid by female inside the two egg sacs until they maturate and the larvae hatch and moult several times to become adult stage.

Medical importance:
Cyclops acts as intermediate host for:
1. *Diphyllobothrium latum.*
2. *Diphyllobothrium mansoni*.
3. *Diphyllobothrium proliferum*.
4. *Dracunculus medinensis*.

Control:
Eradication of cyclops in wells and fresh water by using super heated steam or quick lime which raises the temperature of water causing death of cyclops.



Cyclops female morphology