TOPIC: INSECTS
CLASS: SENIOR TWO

Aim:

To study about the common insects

LEARNING OUTCOMES

In this unit, you will learn about,

- the general characteristics of insects
- main characteristics common to all insects
- economic importance of common insects
- Classification, common structures such as head, wings, legs etc, and life cycle of insects; cockroach, butterflies, moth, houseflies and mosquitoes
- construct a dichotomous key of common insects

General characteristics include:

- 3 main body parts
- 2 pairs of wings
- 3 pairs of jointed limbs
- 1 pair of antenna
- Have spiracles on the thorax and abdomen for breathing
- Have a tracheal system for gaseous exchange
- Have a pair of compound eyes
- Have three thoracic segments

Characteristics common to all insects

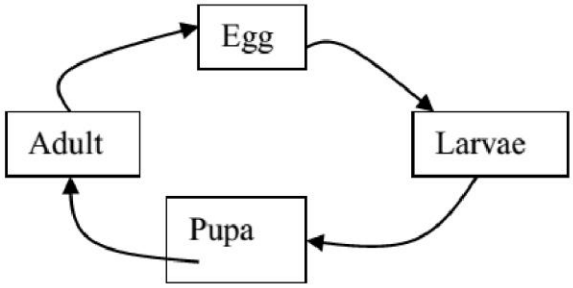
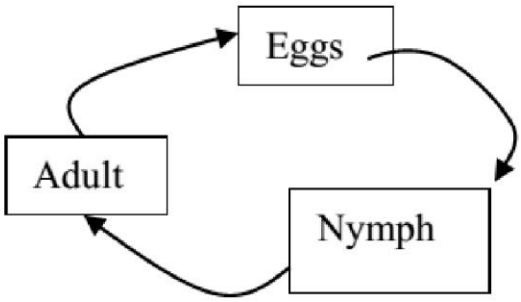
Insects have three main characteristics which are common to all insects and forms the basis for their classification;

1. They have 3 main body parts
2. They have 3 pairs of jointed legs
3. The thorax is divided into three main divisions i.e. pro thorax, meso thorax and meta thorax

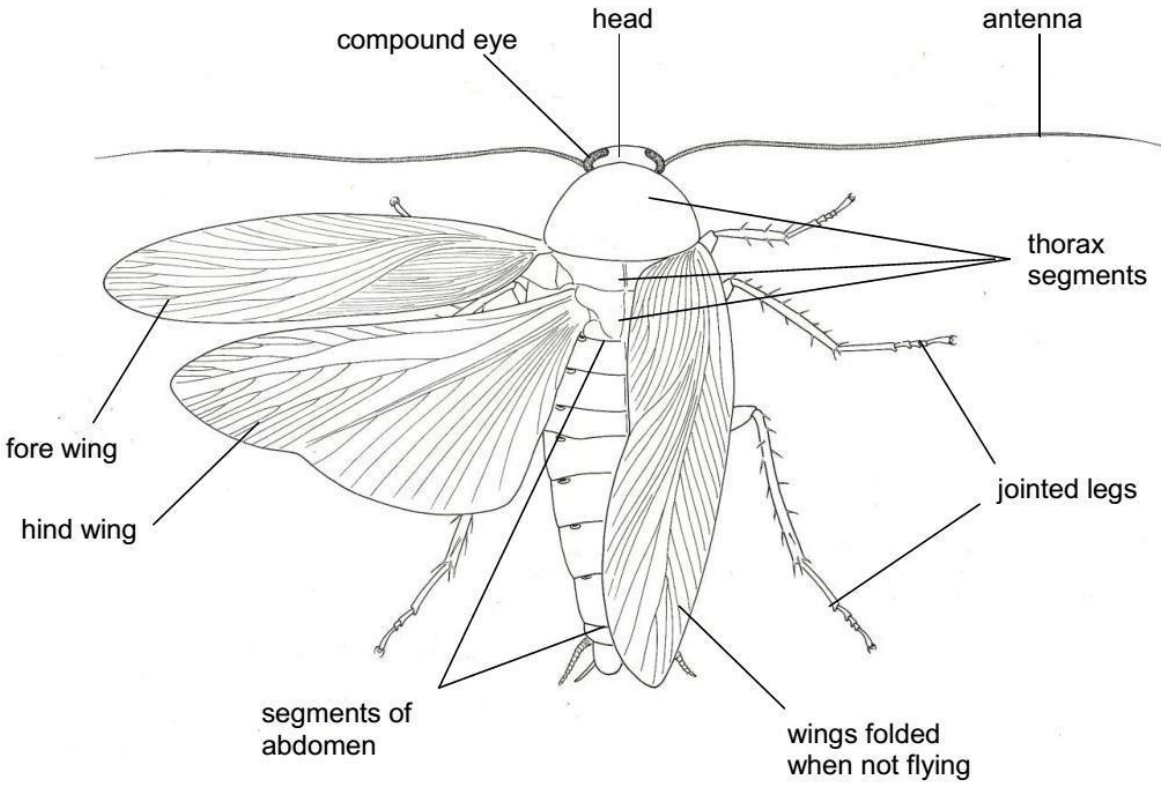
From each segment of the thorax is borne a pair of limbs. In most insects, wings originate from the meta and meso-thorax. The abdomen has several segments which vary in number from insect to insect.

In their growth and development, from egg to adult, insects undergo changes in form and structure. If the changes include all four stages of egg, larva, pupa and imago, they are considered a complete metamorphosis. For incomplete metamorphosis the insect does not go through the pupal stage, and the larvae look like adults but without wings. These intermediate forms in the life cycle are called nymphs.

INSECT METAMORPHOSIS: Metamorphosis is the gradual developmental change from the eggs to the adult stage. It occurs in insects and amphibians. Insect metamorphosis is divided into two types

Complete metamorphosis	**Incomplete metamorphosis**
This is a gradual development change where the eggs hatch into larvae and the larvae change into pupa and finally the pupa change into an adult. It involves four stages. Insects, which undergo complete metamorphosis, include butterflies, mosquitoes, houseflies, tsetse flies, bees, wasps, and beetles. 	This is the gradual developmental change where an insect undergoes only 3 stages, when eggs hatch, they give rise to adult-like nymphs which latter change into adults. Insects showing this include locusts, grasshoppers, bedbugs, cockroaches 

THE COCKROACH



Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Order: Dictyoptera
Genus: Periplaneta
Species: P. *Americana*

The head and mouthparts of a cockroach

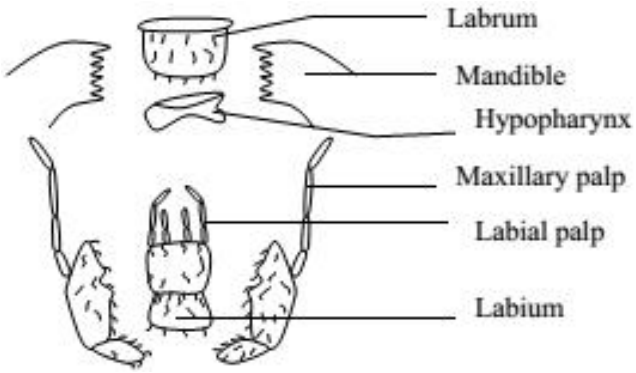
Is small and round. It bears a pair of compound eyes which are sensitive to movements/light/for sight; a pair of jointed, tapering, long and hairy antennae for sensing. The antennae are jointed for flexibility, hairy to increase sensitivity, long to sense around the body.

It bears a pair of biting and chewing mandibles. The mandibles are serrated, curved and strong for biting and chewing food.

Has a pair of hairy maxillae that bear jointed maxillary palps used for holding and manipulating food into the mouth.

The labium and labrum cover the other mouth parts.

Parts on the Head region



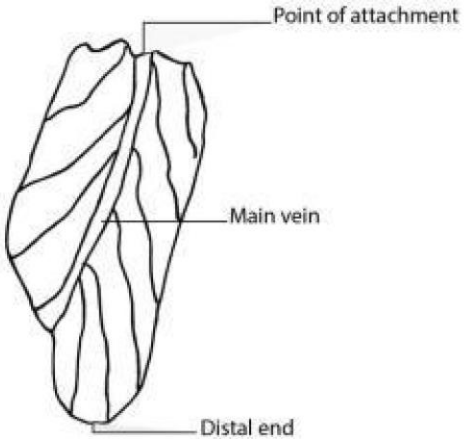
Thorax

Wings

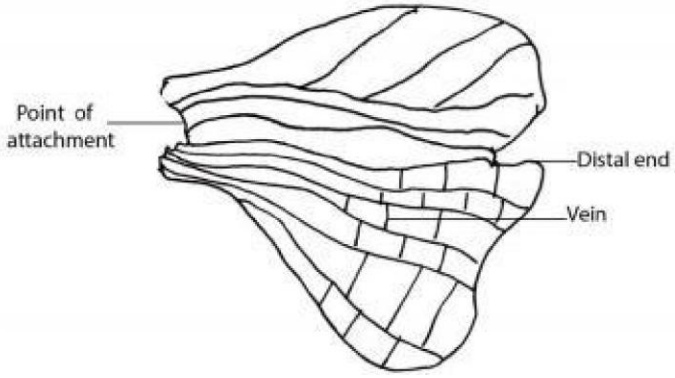
The mesothorax and metathorax each bears a pair of wings

The outer wings are hard/stiff, narrow, long, opague, curved and veined. They protect the hind wings. They also provide support during flight.

The hind wings are broad, membranous, veined and flexible. They are used for flight. They are broad to provide a large surface area for flight. They are membranous of flexible for easy flight.



Drawing of fore wing



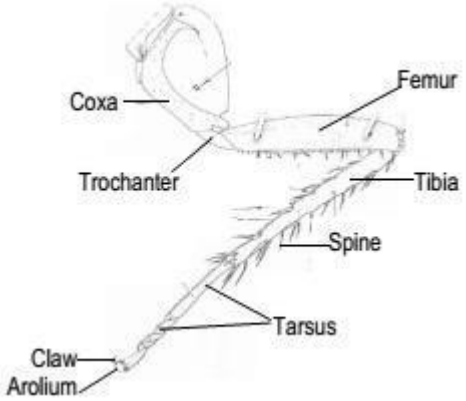
drawing of hind wing

Legs

Each of the thoracic segments possesses a pair of jointed z- shaped legs. The legs are long for takeoff, Z- shaped for fast and swift movement, jointed for flexibility during movement.

The legs end in a pair of curved and pointed claws which are used for grasping onto rough surfaces. In between the claws is arolium which secretes an adhesive substance that enables the cockroach to walk over smooth surfaces.

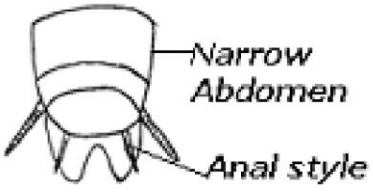
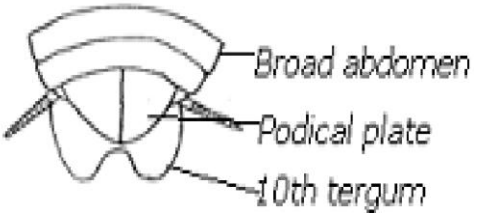
On the legs are spines which are used for defense.



Abdomen

The abdomen has 10 segments and each segment bears a pair of spiracles. In females the 9^{th} segment has a podical plate for holding ootheca i.e. egg case. In males the 9^{th} segment has a pair of anal styles used to hold or manipulate the female during copulation. The 10^{th} segment in both male and female possess a pair of anal cerci which are sensitive to changes/disturbances in the surrounding; i.e. it has a sensory function

Differences between a male and female cockroach

Male	**Female**
Has a narrow abdomen	Has a broader abdomen
Lack ootheca	Has ootheca which develops after fertilization.
Has rod-shaped structures called styles on the 9_{th} abdominal segments.	No styles on the 9_{th} abdominal segment.
No podical plates.	Has podical plate for carrying eggs.
	

Mode of life.

Cockroaches dislike light, live in dark places and move out at night. They fly over short distances but move very fast by using legs. They feed on paper, wood, cloth etc.

Life cycle

Undergoes an incomplete metamorphosis i.e. eggs hatch into nymphs, the nymphs moult several times and finally gives rise to an adult.

After mating with the male, the sperms are stored in a special sac in the female. When the eggs are released from the ovary, they are fertilized by stored sperms and are enclosed in an egg case called ootheca

Egg

The eggs are deposited in warm, dry, dark crevices. In 6-7 days, the eggs hatch into nymphs.

Nymphs.

The nymphs moult 6-7 times as they grow to reach adult size in 11-14 days

Adult

The adult has a lifespan of 12 month

Economic importance of cockroaches

- They are vectors for diseases like dysentery, cholera, plague
- They destroy property e.g. paper, wood and cloth
- They contaminate food
- They make household property become dirty

Practical task

- Classify the insect giving reasons for the class and ***order***
- Study structure of cockroach and define parts of the head, thorax and abdomen. State the number of each structure.
- Draw and label the head showing mouthparts and appendages of cockroach.
- Draw and label the last 4 segments of the abdomen (discuss how features on the abdomen distinguish the male and female cockroach/grasshopper)
- Deflect the wings and pin the insect with the dorsal view facing you/up. Draw
- Pin the insect with the ventral view up. Draw what you observe.
- Carefully cut off the hind limb. Draw and label

. Carefully cut off the fore wing and the[6] hind wing. Draw

BUTTERFLIES AND MOTHS

Similarities

- They have wings covered with scales and thus belong to group **lepidoptera**.
- They both have 4 wings.
- They both undergo complete metamorphosis

Differences

Butterfly	**Moth**
Wings held upright at rest	Wings held horizontally at rest
Antenna is club shaped	Antennae pointed at the tip
Slender body	Thicker body
Brightly coloured body	Dull coloured body

Classification of butterfly

Kingdom: Animalia

Phylum: arthropoda

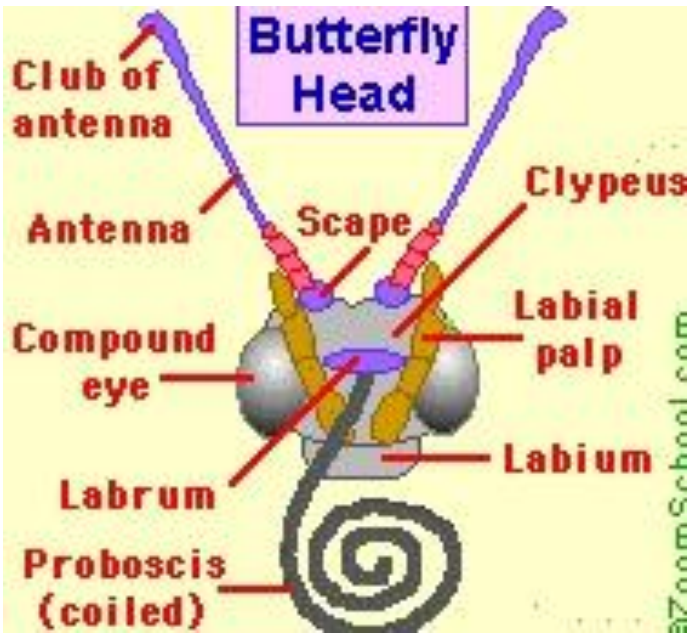
Class: insecta

Order: Lepidoptera

Genus: Papilio

Species: *P. demodocus*

Structure of the head of a butterfly



Head

The head is small and is covered with hair.

It bears;

- A pair of large compound eyes
- A pair of long, jointed, club shaped antennae
- A long proboscis that is coiled when not in use. Proboscis is used for sucking nectar from flowers
- Two simple eyes called ocelli situated behind the compound eyes

Thorax

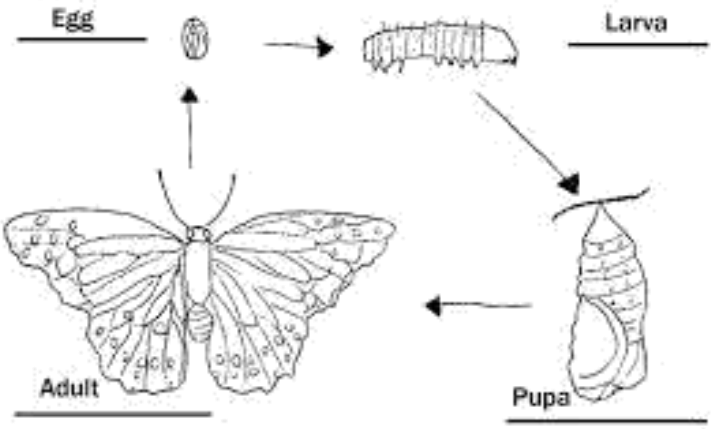
- Has two pairs of wings covered with scales
- A pair of slender, jointed, long legs on each thoracic segment

Abdomen

- It is made up of 10 segments. The last abdominal segment bears external genitalia

Life Cycle

- An adult female lays eggs on the underside of leaves.
- Within 4 days the eggs hatch into caterpillars.
- The caterpillars move and feed constantly on leaves and moult several times as it quickly grows.
- After 4 days the caterpillar changes into a pupa known as Chrysalis.
- The dormant chrysalis does not feed but it undergoes internal re-organisation and tissue development.
- After 4days the imago emerges.
- At first the wings of the imago are small and crumpled (folded), but in one hour they expand and harden and it is able to fly away.



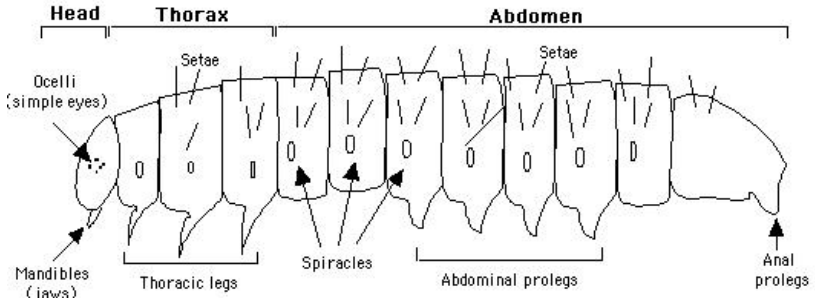
Caterpillar/larva

- Has 13 segments, 3 thoracic and 10 abdominal
- Has 8 pairs of legs i.e. 3 pairs of true legs on the thorax and 5 pairs of prolegs on the abdominal segments. These are used for locomotion
- Has a prominent head with chewing mouth parts (mandibles). It feeds on plant leaves
- Has a pair of claspers on the last abdominal segment for support
- It has spiracles for breathing

Differences between Butterflies and Moths

Butterflies	Moths
Diurnal	Nocturnal
Clubbed antennae	Pointed antennae
Long antennae	Short antennae
At rest, wings lie folded vertically	At rest, wings lie stretched horizontally
Herbivorous	Omnivorous
Complete metamorphosis	Incomplete metamorphosis

Labeled drawing of a caterpillar



Economic importance of butterflies and moths

- Pollination of flowers
- Caterpillars are pests to crops
- Some pupae produce silk for making cloth
- The scales on the wings of butterflies cause respiratory problems/allergies when inhaled
- Caterpillars have hairs that cause irritation to the skin
- Used for biological study purposes
- Some larvae feed on insects hence used as biological control agent of pests.

Practical task 2

Classify the butterfly giving reasons for the class and *order*. Study the head of a butterfly. Draw and label parts

Draw one antenna of the moth and butterfly

Describe mouth parts of the butterfly and suggest it diet

Stretch out one wing of butterfly and moth, describe the appearance and draw. Suggest how these wings suit the butterfly for survival in its habitat.

HOUSEFLY

Kingdom: Animalia

Phylum: Arthropoda

Class: insecta

Order: diptera

Family: muscidae

Genus: Musca

Species: Musca domestica

Head

Bears:

- A pair of prominent compound eyes which are larger in males than in females
- A pair of short jointed, feathery antennae between the compound eyes. Antennae has three joints
- A proboscis, expanded at the end. The proboscis is used to suck food. When not in use the proboscis is drawn up beneath the head.
- Three simple eyes (ocelli) on top of the head.

- A pair of short maxillary palps

Structure of the head of housefly

Thorax

Bears:

- A pair of transparent, veined, membranous (flexible) wings used for flight. One pair of wings originate from the second thoracic segment. The inner pair of wings is on the 3rd thoracic segment and its reduced into vestigial structures called halteres for balance.
- Three pairs of hairy, segmented legs. Each leg ends in a pair of claws between which glandular pad which secretes a sticky substance which enables the fly to walk on smooth surfaces. The claws are used to cling onto rough surfaces.
- A pair of small vestigial wings called halt ares which are used for balancing.
- The thorax is hairy with prominent black strips running on the back.

Abdomen

The abdomen is segmented, hairy and only four segments can clearly be seen.

Each segment bears a pair of spiracles used for gaseous exchange

Feeding in a housefly

The mouthparts consist of a proboscis by which the fly sucks liquid food. Its mouthpart cannot penetrate tissue, but the enlarged proboscis terminates in two pads whose surface

is channeled by grooves called pseudotracheae. If the food is semi-solid, the fly applies this foot/proboscis to the food and pumps saliva along the channels onto the food. The saliva dissolves the soluble parts of the food and may contain enzymes which digest the insoluble matter. The nutrient liquid formed is then absorbed along the pseudotrachea and pumped into the alimentary canal.

Did you know: When not in use, the proboscis is drawn up beneath the head?

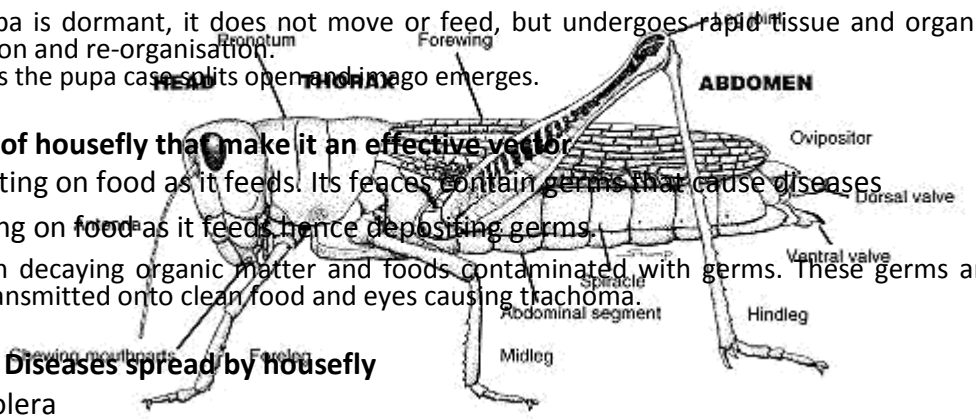
Life cycle

The adult female housefly lays eggs in batches in warm moist areas e.g. in decomposing organic matter.

In 1 day the eggs hatch into maggots(larvae). This is a very active stage which feeds and grows rapidly.

days after egg laying the maggot moves to a dry dark spot to pupate. A puparium/pupa case is formed

The pupa is dormant, it does not move or feed, but undergoes rapid tissue and organ formation and re-organisation.
In 4 days the pupa case splits open and imago emerges.



Habits of housefly that make it an effective vector

Defecating on food as it feeds. Its feaces contain germs that cause diseases

Vomiting on food as it feeds hence depositing germs.

Feed on decaying organic matter and foods contaminated with germs. These germs are later transmitted onto clean food and eyes causing trachoma.

Diseases spread by housefly

- Cholera
- Dysentery
- Typhoid fever and paratyphoid (enteric) feveri9
- Trachoma

Disease control

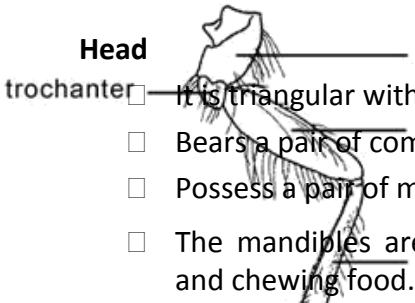
- Cover food to prevent flies from getting in contact with it.
- Proper disporsal of feaces to prevent access to pick germs
- Proper disporsal of waste foods by burning or burying
- Cover latrins to prevent flies from picking germs
- Prompt treatment of infected individuals to reduce chances of contamination
- Proper washing of hands after toilet and before handling food to prevent contamination
- Spray with insecticide to kill flies.

GRASS HOPPERS

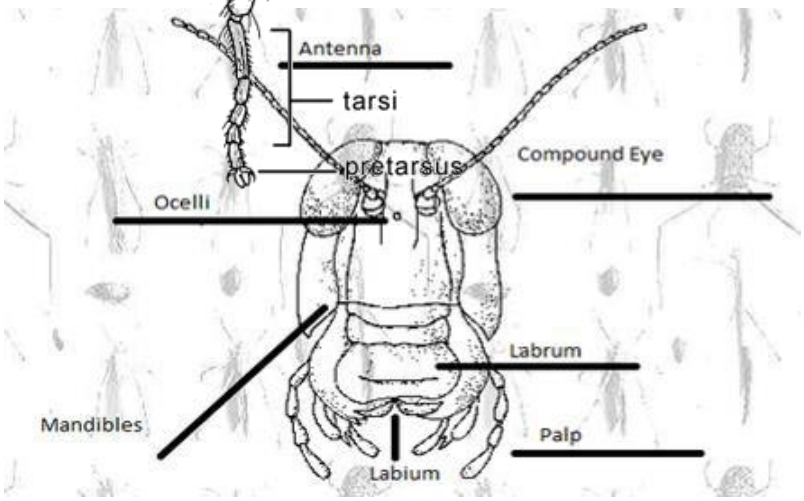
They belong to the same order, **orthoptera,** together with crickets and locusts.

Drawing of a grass hopper

Head



- It is triangular with a pair of short antennae
- Bears a pair of compound eyes between which is simple eyes
- Possess a pair of mandibles, maxillae, libs labium and labrum
- The mandibles are strong, slightly curved and toothed for cutting and chewing food.



Thorax

- ♠ The prothorax is large and overlaps part of the mesothorax dorsally
- ♠ The fore and middle legs are shorter than the hind legs. The hind legs are enlarged and elongated for jumping. The spines on the legs are for defense and offense.
- ♠ The fore wings are hardened and narrow. They overlap and protect the hind wings. The hind wings are broader and membranous and are used for flight

Drawing showing leg of a grasshopper

Abdomen

- The abdomen has upto 11 segments
- On each side of the first abdominal segments lies a circular typmpanum which is sensitive to sound vibrations.
- The last segment bears a pair of cerci
- The 9^{th} , 10^{th} and 11^{th} sterna in the males is modified into claspers and an aedeagus or penis. The claspers are used for gripping the end of the female abdomen during mating. The male introduces the sperms into the females abdomen through the aedeagus
- The end of sterna of the female is modified into the ovipositor which enables the female to dig a hole in the ground for egg laying
- There are two pairs of spiracles in the thorax and eight pairs on the first eight abdominal segments

Life cycle

Grasshoppers undergo an incomplete metamorphosis.

The female lays eggs in the ground

The eggs hatch into nymphs which moult 5 times to become adults

Economic importance

- They destroy crops
- They are used for study purposes
- They are used as a source of food

SOCIAL INSECTS

These are groups of insects where there is division of labour. Each individual carries a specific role in the community. They include termites, honey bees, ants, etc. they live in groups called colonies. Each colony is made up of castes

TERMITES

Classifications

Kingdom: Animalia
Phylum: Arthropoda
Class: insecta
Order: isoptera
Family: macrotermes
Genus: M. *belicocus*

Structure

Termites possess comparatively large head, chewing and biting mouth parts.

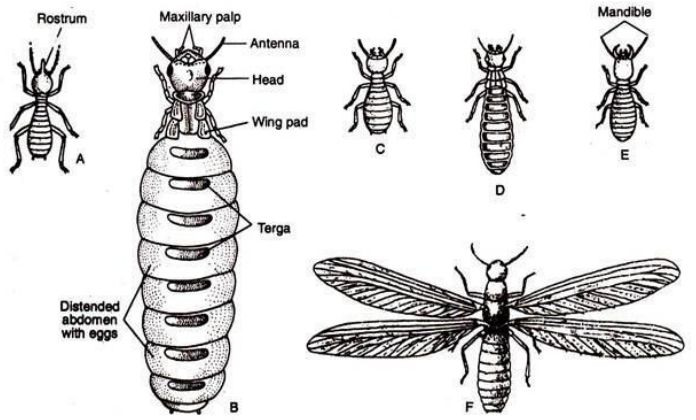


Fig. 18.91: Different forms in a termite colony. A. Nasute, B. Queen or female. C. Worker. D. Male. E. Soldier. F. Winged male.

Workers:

- They are sterile of both sexes and developed from the fertilized eggs. They constitute major numbers in a colony and occupy 80%-90% of the total number. They are small-sized individuals which bear chewing mandibles and usually lack of eyes.
- They have no wings (apterous). They feed upon the wood or fungus products.
- They take care of the eggs and young,

- undertake the labours of food gathering, food storage and feed the nymphs, king and queens.
- They take part in the building of
- They also maintain the moisture in the interior of a nest of a colony. They perform defense duties in some species and also clean the other castes.

Soldiers

- Have a brown head and soft abdomen
- Have two powerful jaws for biting
- Have no wings and no eyes

Queen

6. The reproductive female in the colony (termitarium)
7. Has no wings and has one short antenna
8. Has a small compound eyes
9. Abdomen is slightly broad, and elongated

King

- The reproductive male that fertilizes the queen

Note: The white ants are female winged termites

Economic importance of termites

4. They improve on soil aeration by making tunnels through soil which allow air circulation
5. Cause decomposition of dead leaves, wood as they feed them hence enriching the humus to the soil
6. Cause serious damage to wooden fabric of buildings and furniture
7. They also damage man's crops e.g. maize, sugar cane etc.
8. A source of food to man

THE BEE- worker bee

Kingdom: Animalia
Phylum: Arthropoda
Class: insecta
Order: hymenoptera
Genus: Apis
Species: A. *melifera*

General features

- Have biting or sucking mouth parts
- Have a hairy body
- Have two membranous wings
- 4. They exist in three different groups called castes in the same honey comb.

The queen

- This is the egg laying female
- It has a long pointed abdomen which extends beyond the wings

- ♠ It is fed by the workers

The drone

- ♠ This is the male bee which is larger than the worker bee

Workers

- ♠ They are underdeveloped females and are sterile
- ♠ They are the smallest caste in size
- ♠ They are many in number within a hive
- ♠ They perform a variety of work and are the busiest bees in a hive
- ♠ They build the hive where bees live
- ♠ They collect food for all the castes
- ♠ They feed the queen, drones and larvae
- ♠ They guard the hive by sending away intruders
- ♠ Clean the cells of the comb where eggs are laid
- ♠ They build the cells of the comb where eggs are laid

Structure of worker bee

Features on the head

- Bears 1 pair of uniformly segmented antennae
- Mouth parts are composed of proboscis which is used for sucking up nectar from flowers, and blunted mandibles used for moulding wax
- It has three simple eyes which can easily be seen

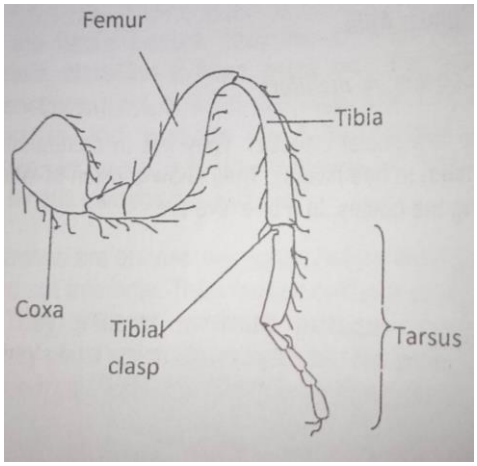
Features on the thorax

- ♠ The thorax is large and strong because of the presence of powerful muscles which operate the legs and wings
- ♠ It has four body segments which are almost fused together
- ♠ It carries two pairs of wings. Fore wings are larger than the hind wings
- ♠ It has 3 pairs of legs, which are modified for performing different functions.

Fore legs

They possess a pollen comb located at the end of the tibia. This is used for cleaning off the pollen from the head

Drawing of fore leg of worker bee



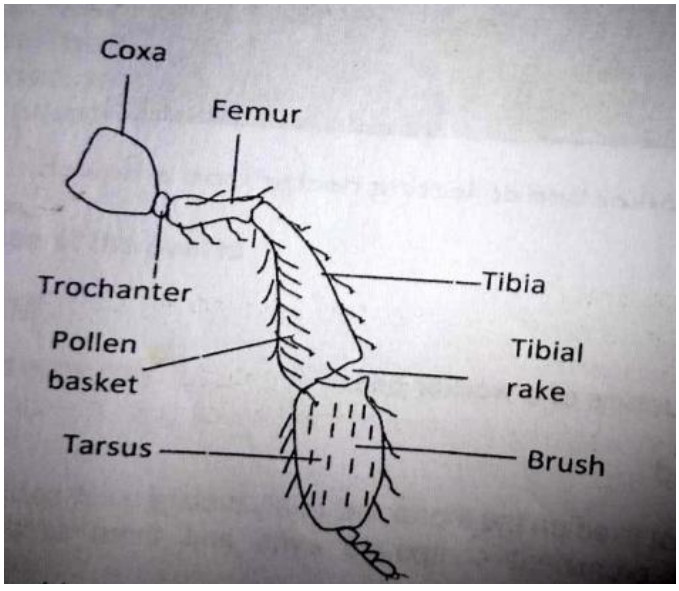
Middle leg

Possess a hair like structure called prong at the distal end of the tibia. The prong is used for scooping pollen out of the pollen basket of the hind leg

Hind leg

These have pollen baskets on their tibia which are used for carrying the collected pollen from flowers to the hive. They also posses tufts of hair on the tarsus called pollen brush which are used for cleaning pollen off the body into the pollen basket on the other leg

Drawing of hind leg of worker bee



Features on the abdomen

- The first abdominal segment is fused with metathorax
- The abdomen has six segments
- The underside of four of these segments have wax glands
- The last segment usually possesses a sting used in offence and defense
- **Life cycle**
- Bees undergo complete metamorphosis.
- The queen lays eggs in the comb which hatch into tiny white larvae/grubs within 3 days.
- The larvae have no eyes and legs. They are fed on by workers by bee milk/royal jelly which the workers regurgitate from their digestive systems for 2-3 days, followed by a mixture of honey and pollen for the next 3- 4 days. In about 7 days an adult worker bee emerges.
- Larvae fed on royal jelly throughout develops into the queen.
- Larvae fed on royal jelly for only 3 days and later on a mixture of honey and pollen for 6 days develop into drones.
- The larvae moults 5 times and then spin a cocoon and a pupa emerges.
- The pupa undergoes complete reorgnisation of tissues. In next 11-12 days it grows into a worker bee
- Drones develop from unfertilized eggs. They take 24 days from egg laying time to emerge as adults. The new queen flies out in the nuptial flight with a number of drones, mates once and then returns to the hive.
- **Economic importance of bees**
- They pollinate flowers
- They produce honey which is used as food and medicine
- They are used as biological specimens for study
- They produce wax used for making candles

END