PRACTICAL MANUAL

Insect Taxonomy

APE- 503 3(1+2)

For

M.Sc. (Ag.) Entomology

2023

Department of Entomology

Rani Lakshmi Bai Central Agricultural University,

Jhansi, UP, India- 284003

PRACTICAL MANUAL

Insect Taxonomy

APE- 503 3(1+2)

M.Sc. (Ag.) Entomology

Vijay Kumar Mishra
Usha
M. Soniya Devi
Sundarpal
Yogendra Kumar Mishra

2023

Department of Entomology

Rani Lakshmi Bai Central Agricultural University,

Jhansi, UP, India- 284003

Index

Practical No. 1

Objective: Identify the insect based on taxonomic keys

Insects represent one **Class** of animals within the **Phylum *Arthropoda***. If you do not immediately recognize an insect you may need to identify some arthropods to first determine if they are in fact insects before proceeding further. Biologists have adopted the use of *dichotomous keys* to identify organisms.

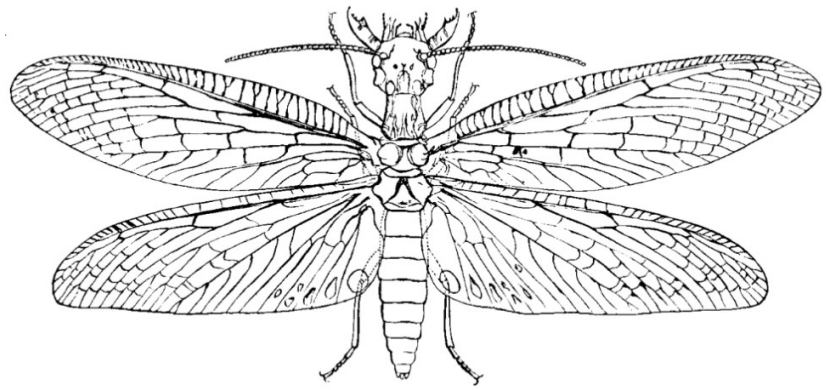
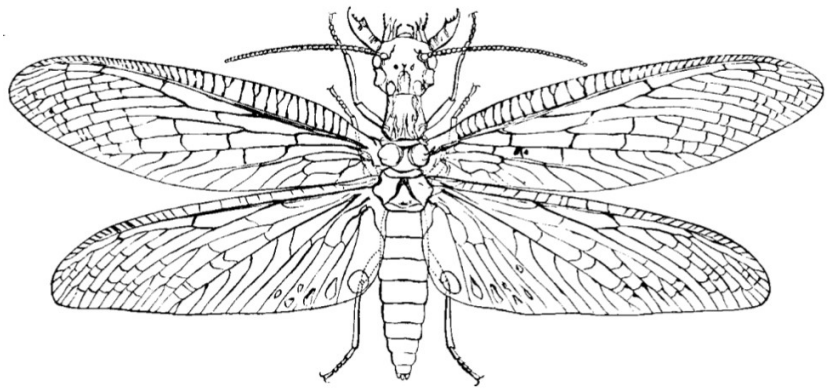


Fig.1

1. With 1-2 pair of obvious, visible, usually transparent wings (Fig. 1). (If it's not a bird or a bat then it is



an insect) ..... Insecta

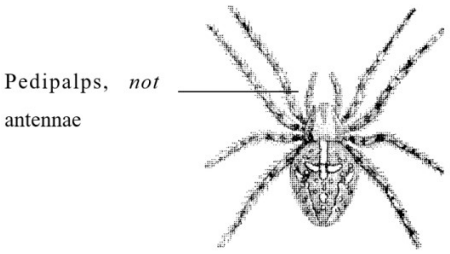


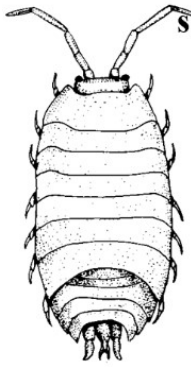
Fig. 2. Spider

_Without obvious wings.....2

2. With 1 or 2 pairs of antennae ("segmented feelers") of various shapes (see Figs. 1, 3-5) inserted on front of head, usually between the eyes. Antennae may be inconspicuous, hidden beneath head when viewed from above, or small and more bristle like than typical segmented structure. Note: some non-insects carry their front legs or modified mouthparts (pedipalps, Fig. 2) in a manner resembling antennae 3

- Lacking segmented antennae and always lacking any suggestion of wings. .....8 3. With 2 pairs of antennae (one pair may be smaller than the other; 2nd pair is vestigial in terrestrial Isopoda (pillbugs, sowbugs); body usually with 2 distinct regions (Figs. 3-4), cephalothorax and abdomen; variable number of legs on cephalothorax, abdomen with or without appendages which when present are not leg-like; (amphipods, sowbugs, lobsters, crayfish) ..... Crustacea

Fig. 3. sowbug



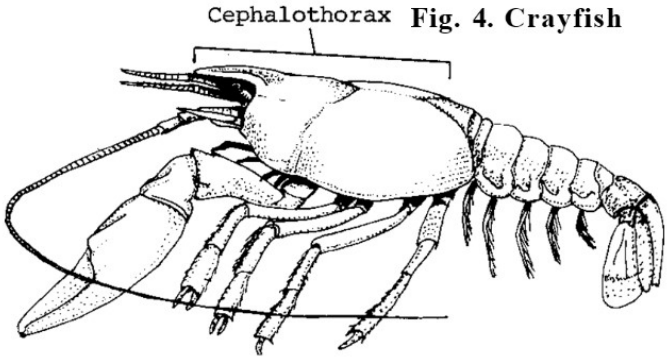


Fig. 4. Crayfish

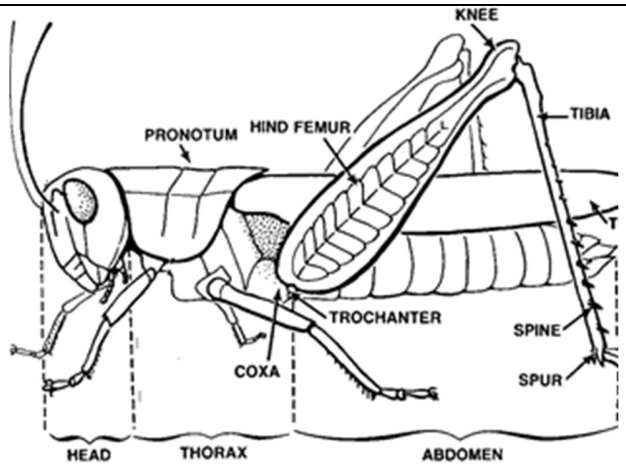


Fig 5

4. With only 3 pairs of legs and often with 1-2 pairs of wings; 3 body regions (Fig. 5). Abdomen without segmented legs but may have appendages; body shape variable .Insecta

- With 9 or more pairs of legs (Figs. 6-7) which are on most segments posterior to head; head distinct; wings absent; body elongate and wormlike……5

5. Legs evenly spaced along body, usually 1 pair of legs per segment 6

- Legs arranged in pairs, 2 pair per segment (Fig. 6)(millipedes) .....Diplopoda

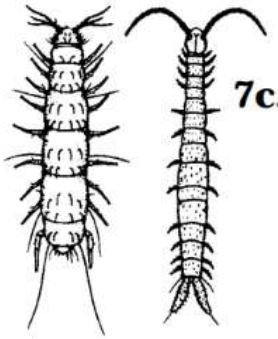
6. Body flattened, with 15 or more pairs of legs; size variable but usually longer than 25mm.(Fig. 7a)(centipedes) ..... Chilopoda

– Body cylindrical; minute forms with 9-12 pairs of legs 7

7. Antennae branched (Fig. 7b); 9 pairs of legs..... Pauropoda

- Antennae not branched; 10-12 pairs of legs (Fig. 7c)..... Symphyl

7b. Pauropod



7c. Symphylan

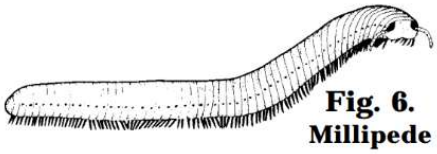


Fig. 6.
Millipede

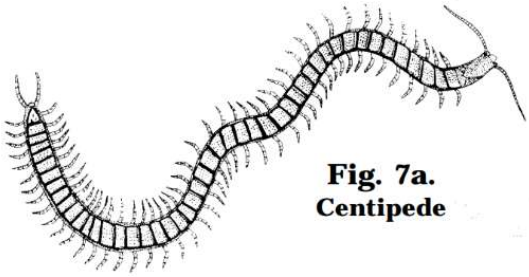


Fig. 7a.
Centipede

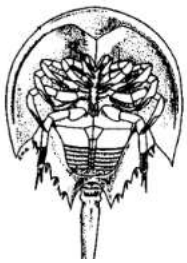
8. Usually 7 pairs of appendages, 5 pairs of legs; marine organisms only; abdomen rudimentary ....Pycnogonida

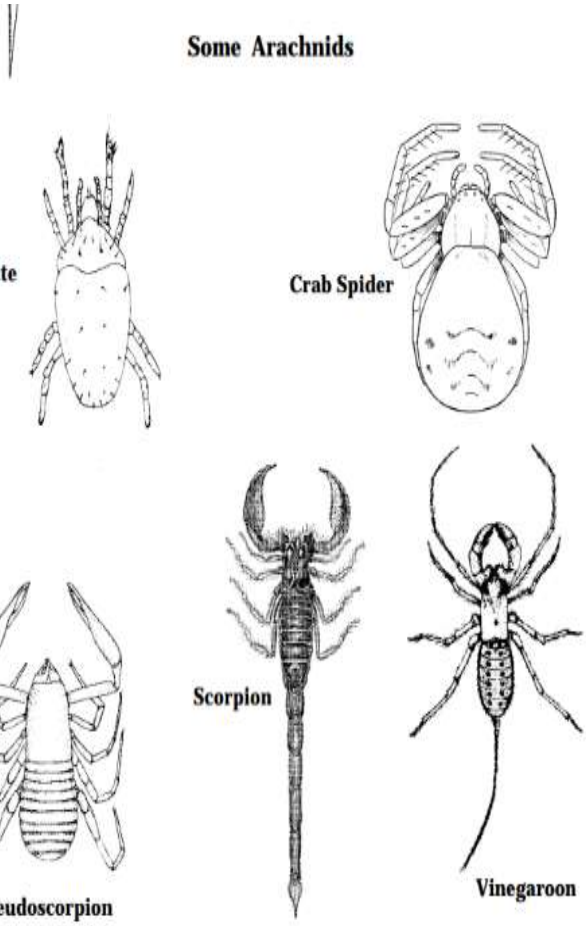
- Six (rarely fewer) pairs of appendages, with 4 (-5) pairs of legs; abdomen well developed 9

9. Large marine forms up to 460mm in length; body oval, covered with hard shell; long spinelike tail present. (Horseshoe crabs. Fig. 7d) ....Xiphosura

- Smaller forms, less than 75mm in length; body without hard shell and without spinelike tail; See below. (spiders, ticks, mites, whip scorpions, windscorpions, scorpions) ..... Arachnida

7d. Horseshoe crab





Key to the orders of insects normally found in insect collections: An insect key is a tool used to determine the species of a given insect. Typically, insect keys are designed as dichotomous, or paired, couplets. A couplet is a choice between 2 options based on a description of a particular feature. Example: Insect size, antennae shape. A user or students chooses which option best matches the insect being identified. This choice leads to another couplet. The process continues until the user reaches a final couplet that identifies the insects .

1. Wings present (wings may be hidden under external elytra (p. 10-11), hemelytra (Fig. 8), or tegmina (Fig. 9) such that "wings" do not appear to be present).....22

   — Wings absent or reduced to small pads; many abdominal segments visible from above 2

   2. Antennae absent; body slender and whitish in color. Very small (Fig. 10) (1mm.) .....Protura — Antennae present (may be difficult to see) 3

   3. Usually with forked spring (furcula - Fig. 11)onabdomen. Size small, 2-4mm. Always lacking apical abdominal cerci. If furcula absent, size and body shape are characteristic of order ..Collembola

   -Furcula always absent. Body size larger, shape various

Fig. 10. Protura

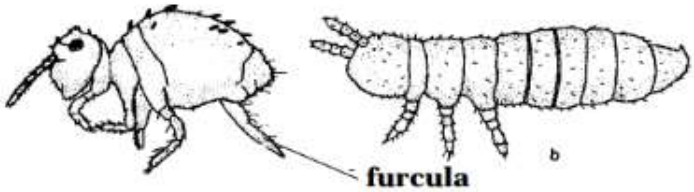


Fig. 11. Collembola

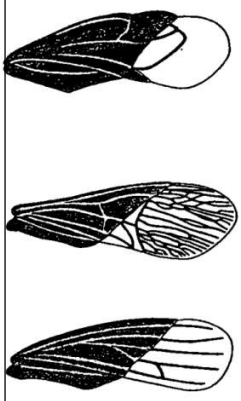


Fig. 8. Hemelytra

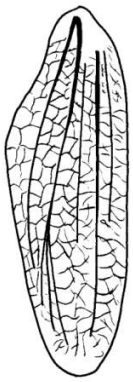


Fig. 9. Tegmen

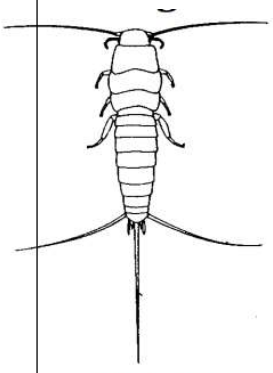


Fig. 13. Thysanura

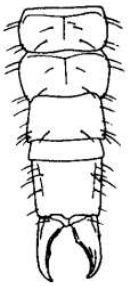


Fig. 12. Diplura

Fig. 14. Homoptera

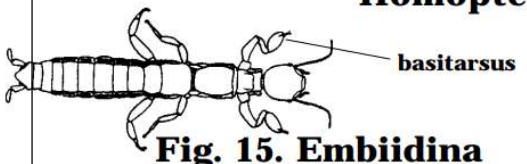


Fig. 15. Embiidina

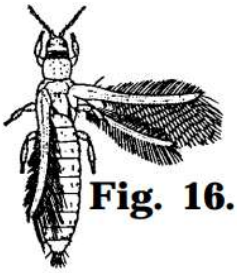


Fig. 16. Thysanoptera

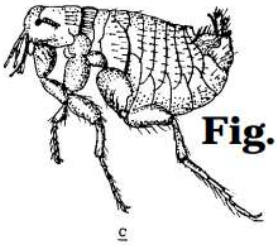


Fig. 17. Siphonaptera

1. Apex of abdomen with long cerci (Fig. 13) and lacking ventral abdominal styliform appendages, or if ventral styliform appendages present, cerci are short 5

— Cerci short or lacking; abdominal styliform appendages always absent 6

2. Apex of abdomen with 3 filamentous cerci (silverfish) .....Thysanura

— Apex of abdomen with 2 cerci, either forceps-like (Fig. 12) or short and segmented .....Diplura

3. Large unsegmented forceps-like structures at apex of abdomen(earwigs) ..... Dermaptera

4. — Cerci (when present) neither forceps-like nor unsegmented 7

5. Large insects, usually > 25mm in length; antennae frequently very long and slender 8

— Small insects, usually < 12mm in length 9

8. 4-segmented tarsi .....Orthoptera — 5

-segmented tarsi .....Phasmida

9. Tube-like structures (cornicles) (Fig. 14)protruding posteriorly from 4th to last abdominal segment; OR body covered with waxy filaments or a scale ..... Homoptera

— Cornicles absent AND no scale or waxy filaments covering body 10

10. Abdomen constricted to narrow waist where it joins thorax (bees, wasps, ants, sawflies) .... Hymenoptera

— Abdomen not constricted into narrow waist 11

11. Front legs with enlarged first segment (Fig. 15) (basitarsus), which is modified for production of silk (webspinners) .....Embiidina

— First tarsal segment not enlarged 12

12. Mouthparts (rasping-sucking) contained in a short, cone-like beak; wings when present often with fringe of hairs (Fig. 16); size ; size <3mm; abdomen often pointed at apex (thrips) .. Thysanoptera

— Mouthparts other than rasping-sucking; may be in form of elongate beak which extends ventrally and posteriorly beneath head; 13

13. Body flattened laterally, with numerous backwardprojecting spines and bristles; legs long, with greatly enlarged coxae modified for jumping (fleas) (Fig. 17) .....Siphonaptera

— Body not flattened laterally; may have hairs or spines but these are not backwards projecting; if legs aremodified for jumping, femora are enlarged 14

14. Mouthparts elongated into piercing-sucking beak ... .15

— Mouthparts not elongated into long piercing beak; head may be prolonged 16

15. Antennae hidden in grooves in head .....Diptera

— Antennae long and easily seen (Fig. 18)Heteroptera

16. Body covered with dense hair .....Lepidoptera

— Body lacking dense hair 17

17. Antennae moniliform (segments beadlike); short cerci present (Fig. 19)(termites) ..... Isoptera

— Antennae not moniliform; cerci absent 18

18. Antennae long and slender 19

— Antennae short 20

19. Head prolonged and beak-like (Fig. 20); males of some species have scorpion-like abdomen (scorpionflies) .....Mecoptera

— Head not prolonged and beak-like .....Psocoptera

20. Tarsi with 4-5 segments .....Diptera

— Tarsi with 1-3 segment (lice) - Phthiraptera 21

21. Chewing mouthparts; head usually broader than long (Fig. 21a) .....Mallophaga

— Piercing-sucking mouthparts retracted into head; head usually longer than broad; legs greatly enlarged for grasping (body lice)(Fig. 21b) .... Anoplura

22. Abdomen with large unsegmented forceps-like cerci (Fig. 24)..... Dermaptera

— Cerci appearing segmented when present, not forcepslike, or absent 23

23. Cerci filamentous, longer than last 3 abdominal segments combined 24

— Cerci shorter than last 3 abdominal segments combined, not filamentous, or totally absent.....28

24. Wings folded upright and parallel to body length; antennae setaceous (Fig. 22. mayflies) ....Ephemeroptera

— Wings various but not held upright above body; antennae elongate and filiform 25

25. Front pair of legs shaped differently than mid and hind pair, modified for digging (Fig. 23a) (fossorial) or grasping (Fig. 23b) (raptorial) .... Orthoptera

— Front pair of legs similiar to middle pair 26

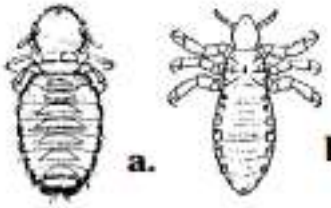
26. Hind pairs of legs enlarged for jumping (Fig. 23c).... .....Orthoptera

— Hind pair of legs similar to middle pair 27

Fig. 18. Heteroptera

Fig. 19. Isoptera

Fig. 20. Mecoptera



a. b.

Fig. 21

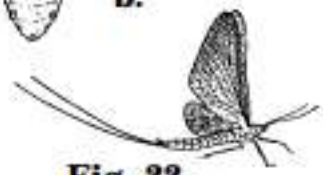


Fig. 22. Ephemeroptera

a. fossorial

b. raptorial

c. jumping

Fig. 23. Orthoptera leg types

Fig. 24. Dermaptera

Fig. 25. Odonata wing

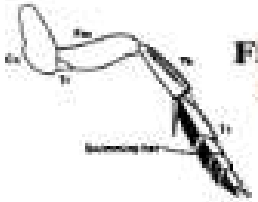


Fig. 26. Aquatic Heteroptera

Fig. 27. Heteropter

Scutellum

Hemelytron

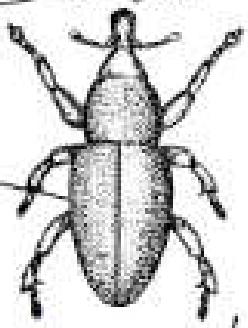


Fig. 28. Coleoptera

Elytron

Tegmen

Fig. 29. Orthoptera

Siphon

Fig. 30. Lepidoptera

27. Tarsi 3-segmented; cerci long or short, not forceps-like; many segmented .....Plecoptera

— Tarsi variable (4-5 segments). Includes large, bulky insects, frequently with well developedwings 31

28. Cerci present, shorter than last 3 abdominal segments combined 29

— Cerci absent (do not be confused by genitalia) 33

29. Small, delicate insects; wings transparent, uniform shape and size 30

— Body shape varied; wings in form of elytra, tegmina, or hemelytra 31

30. Front basitarsi (1st tarsomere) enlarged and dilated to form a webspinningorgan .....Embiidina

— Front basitarsi not enlarged and dilated, appearing of normal proportions (termites) .....Isoptera

31. Tarsi 4-segmented .....Orthoptera

— Tarsi 5 segmented 32

32. Prothorax much longer than mesothorax; front legs modified for grasping .....Mantodea

— Prothorax not greatly lengthened; front legs not modified for grasping .....Blattaria

33. Large insects with 2 pairs of wings; wings usually transparent, each wing with an anterior node (Fig. 25)or notch (dragonflies, damselflies) ....Odonata

— Wings variable but lacking anterior node 34

34. One pair of wings; halterespresent .....Diptera

— Two pairs of wings; halteres absent 35

35. Mouthparts in the form of a piercing-sucking, elongate beak which is mostly held beneath and behind the head; palpi absent 36

— Mouthparts other than above; palpi present 38

36. Hind leg without tarsal claws; adapted for swimming (Fig. 26)..... Heteroptera

— Hind leg with tarsal claws 37

37. Beak arises from anterior part of head; forewings usually as hemelytra (Fig. 27) ....Heteroptera

— Beak appears to originate from between front pair of legs; forewings of uniform texture..... .....Homoptera

38. Rasping-sucking mouthparts in form of cone-like beak; wings fringed with long hairs ....Thysanoptera

— Not as above 39

39. Front pair of wings hardened, of different texture than rear flight wings 40

— Front wings not thickened or hardened to form cover for flight wings.....41

40. Front pair of wings thickened and usually hard, without crossveins, meeting along midline (meson) of the body to form elytra (Fig. 28); many forms with elytra shortened, exposing one or more abdominal segment from above (beetles); hind legs usually not modified for jumping .... Coleoptera

— Front pair of wings with obvious crossveins and veins (Fig. 29, tegmen), overlapping one another at least partially; hind legs often enlarged for jumping (grasshoppers, crickets, Katydids) .... Orthoptera

41. Front basitarsi (1st segment) enlarged to form silkproducing glands (Fig. 15) (webspinners) ....Embiidina

— Front basitarsi not any more enlarged than remaining segments 42

42. All wings equal in size; (termites) .....Isoptera

— Hind wings usually smaller than front pair of wings; 43

43. Mouthparts in the form of a coiled siphon (Fig. 30); wings and body usually covered with scales (butterflies and moths) .....Lepidoptera

— Mouthparts not in the form of a coiled siphon; body scales absent or few in number, restricted to wings and wing veins 44

44. Many crossveins in wings (Fig. 31), particularly at anterior edge; if few crossveins, wings covered with waxy coating and insect very small ....Neuroptera — Few crossveins in wings; body and wings lacking waxy coating 45

45. Mouth reduced, vestigial; only palpi obvious; hairs often present on wings (caddisflies) ....Trichoptera

— Mouthparts not reduced or vestigial; chewing or chewing-lapping types 46

46. Chewing mouthparts elongated into a beaklike structure. Some males with scorpion-like abdomen (scorpion flies) .....Mecoptera

— Chewing mouthparts not elongated into beak; or with chewing-lapping mouthparts 47

47. Tarsi 4- or 5-segmented; wings folded flat over body (Fig. 32) (bees, wasps, ants, sawflies) .... Hymenoptera

— Tarsi 2- or 3-segmented; wings folded roof-like over body (Fig. 33) (treelice, booklice) .... Psocoptera

Fig. 31. Neuroptera, including Megaloptera

Fig. 32. Hymenoptera

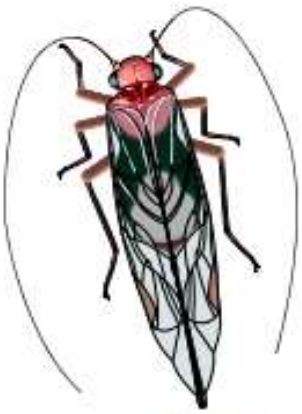
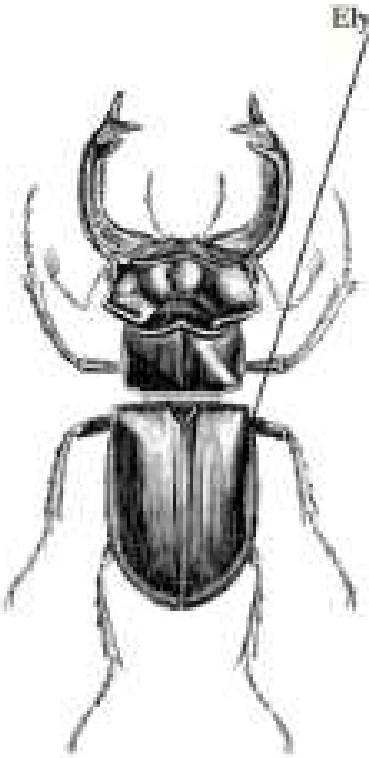
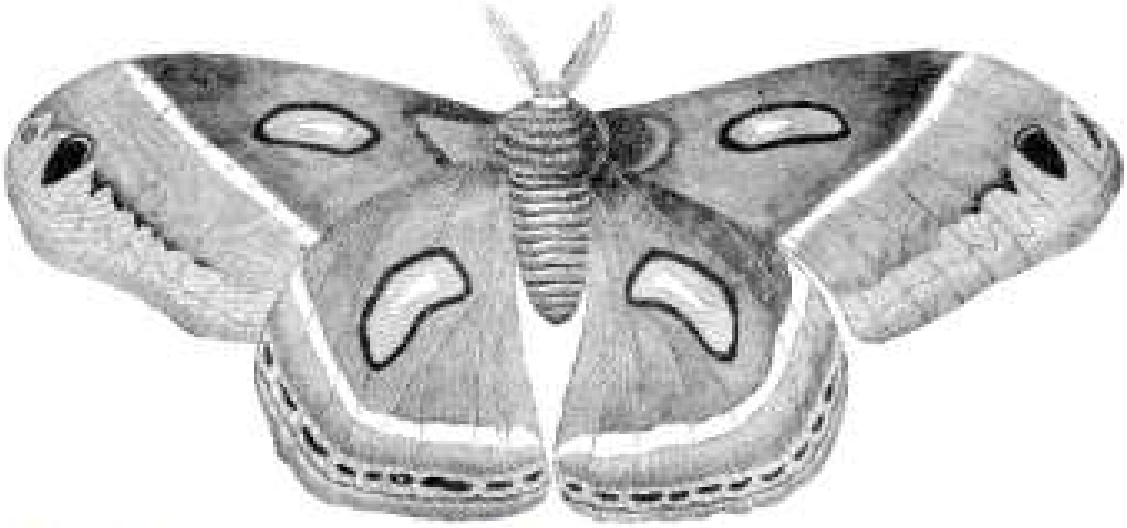


Fig. 33. Psocoptera

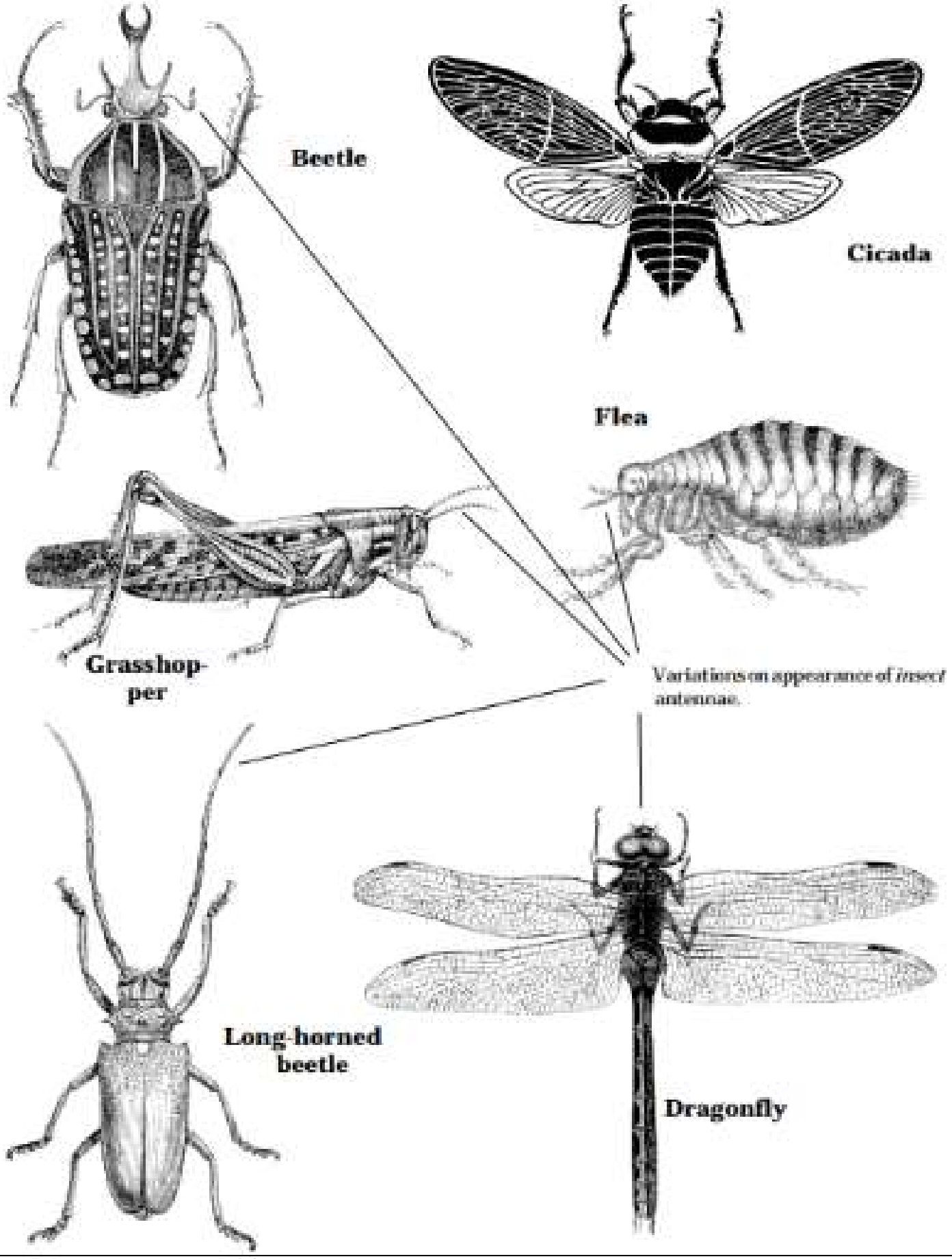


Stag Beetle (Coleoptera: Lucanidae) with elytra closed, appearing to lack "typical" wings.

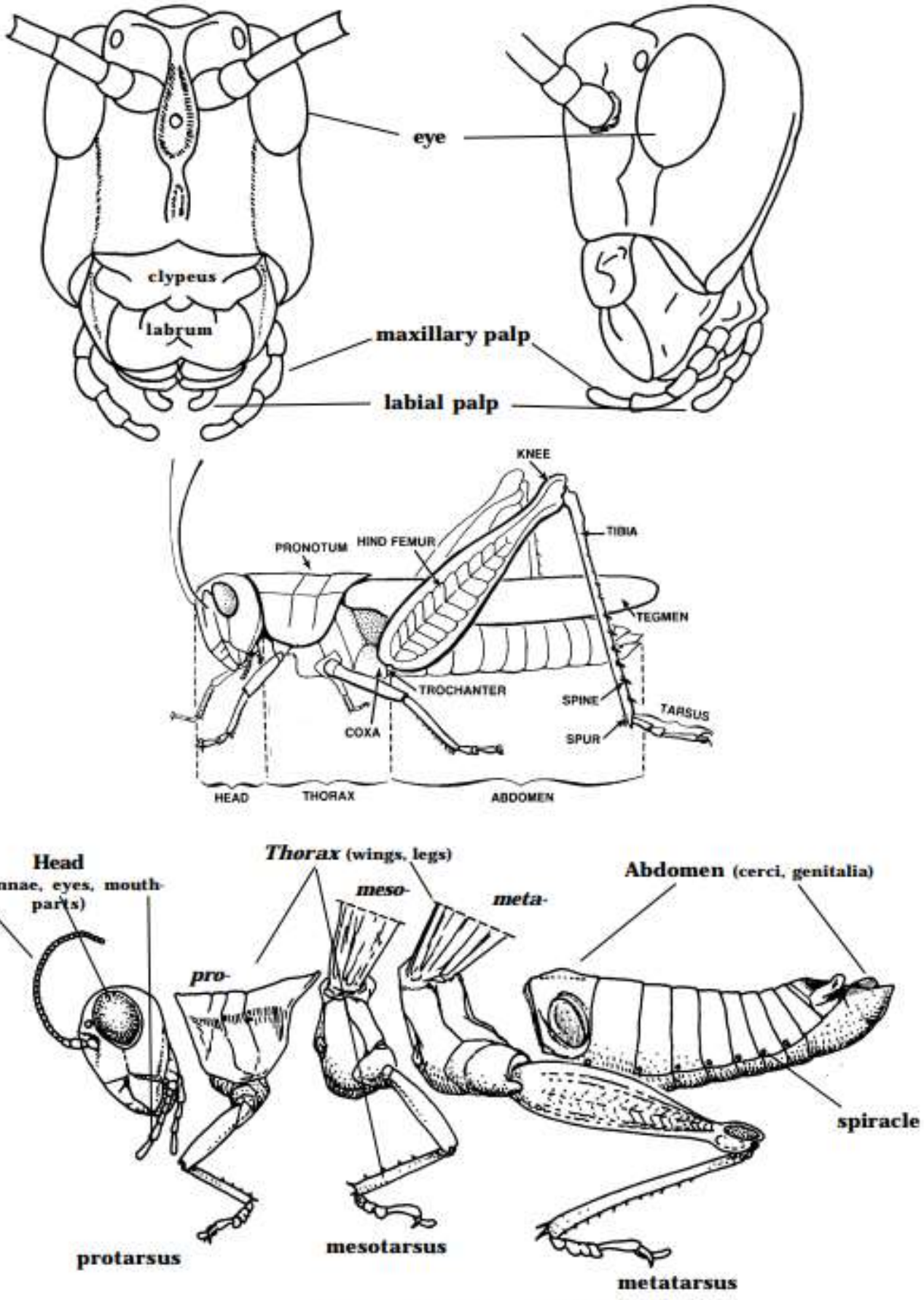
Stag Beetle (Coleoptera: Lucanidae) with elytra opened, preparing to take flight. Note visible "flight" wings.



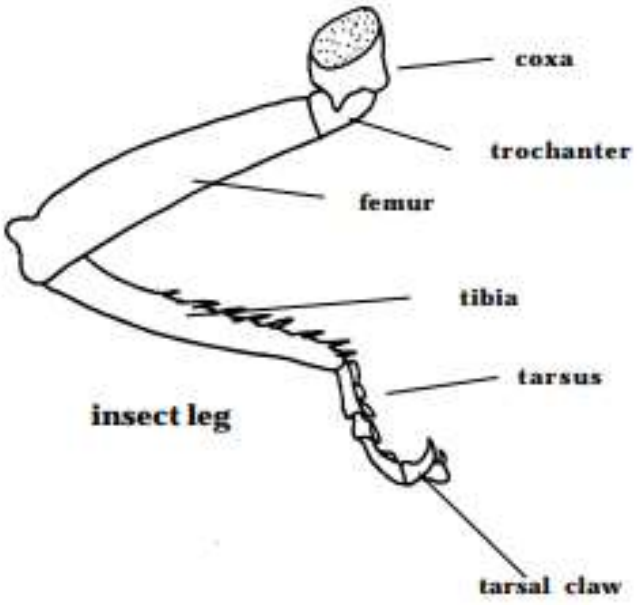
Note "feathery" antennae of this male moth (Lepidoptera).



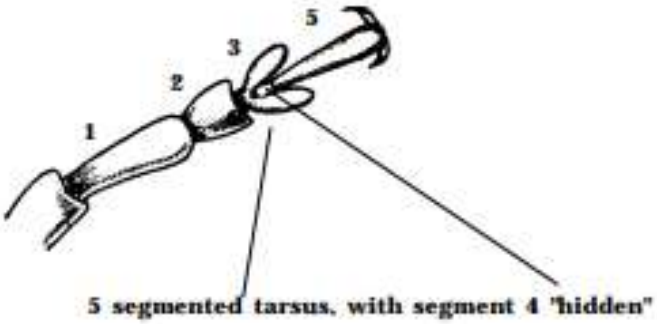
Variations on appearance of *insect* antennae.



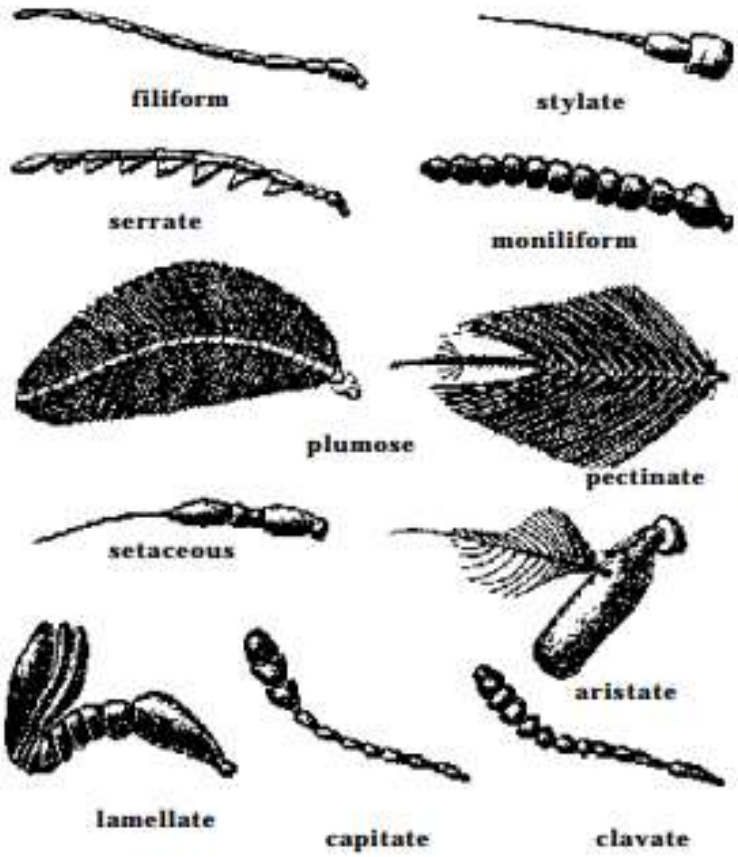
Body regions of grasshopper



insect leg



5 segmented tarsus, with segment 4 "hidden"



A few antennal types

Activity:

1. To study about the lepidopteran insect based on key.
2. To study about the coleopteran insect based on key

Practical No.2

Objective: Collection and preservation of insects including immature stages

(A) COLLECTION

The purpose of insect collection are:

1. To know the occurrence of particular insect in the particular locality.
2. Taxonomic study of insects.
3. Identification of insects.
4. To study the bionomics and rearing of insects for various entomological experiments.
5. To develop the insect repository etc.

I). Instruments required:

1. Insect collection net
2. Aspirator (pooster)
3. Vials (specimen tubes) of various size
4. Forceps and hand lens
5. Hair brush
6. Insect killing bottle
7. Setting board
8. Insect store box
9. Insect rearing cage
10. Insect killing and preservation media

II). Methods of insect collection:

i. Hand picking:

Insects are picked up by hand and placed in containers. This method is suitable for large insects like: beetles, bug and grasshoppers. It's a tedious method. This method is unsuitable for some insects that inflict painful bite and sting.

ii. Insect net or sweep net:

It is made up of three parts: hoop (30-40 cm dia), handle (100 cm) and porous cloth bag made up of mosquito netting material. The diameter of hoop and depth of bag should be in the proportion

of 1:2. Ordinary net is useful for catching the active flier Examples: moths butterfly, dragonfly, wasps *etc*. whilesweep net (muslin cloth bag) useful for leafhopper, grasshopper and other small insects.

iii. Aspirator (pooster):

It consist of a bottle fitted with rubber cork having two holes for installment of two tubes one is bent at one end and other straight glass tube attached to a rubber tube (suction tube). A cloth piece is placed between glass and rubber tube to avoid the entry of insect into mouth. By sucking at the rubber tube, small insects can be drawn into the bottle from net or directly from tree trunk or wall without damaging the specimens.

iv. Berlese funnel:

This device is useful for collecting soil dwelling insects.

v. Beating:

This method is useful for crawling insects from plant parts. It can be done by placing beating Tray or inverted umbrella and beat the plant part and collect the insects

vi. Traps:

Different traps used for collecting the different insect.

Light trap	-	Positively phototaxis insect
Food lure trap	-	Flies
Sticky trap	-	Aphids and whiteflies
Water trap	-	Brown plant hopper
Suction trap	-	White flies
Sex lure	-	Moths

a. Light trap:

It consists of a light source (usually mercury vapour lamp), baffle plates, hopper and collectioncontainer. It is effective for nocturnal habit insect with positive phototaxis movement.

b. Sticky colour trap:

It consists of sticky coloured chart paper: (yellow for aphid and white flies, green for green leafhopper, blue for thrips), Greece and stand.

c. Water trap:

It consists of shallow tray about 12 X 20 cm with water. Add 2 – 3 drops of detergent to reduce thesurface tension of water. The insect sink into the bottom and avoid escape.

d. Pitfall trap:

The pitfall trap consists of a container or jar or rectangular trough either open or provided with a lid with large central hole. It can be put in the soil in such a manner that lid or upper portion should be up side. It is useful against crawling and running insect.

e. Baits:

The concept of bait is insect attractant (sweet fermenting baits, decaying and over ripe fruits, honey, sugar syrup for flower visitor insects and decaying meat and fish for house flies) + poison substanceplaced in a container so that insect attract and due to poison killed.

vii. Pond net: It is made up of fine nylon netting usually smaller then aerial with long handle. The loop should be square or semi circular. The net deep into water at various depth and pulled out quickly. Thewater drains out but aquatic insects are retained in the net.

(B) KILLING

It is done immediately after capture by potassium cyanide, ethyl acetate, carbon tetra chloride andchloroform.

i. Potassium cyanide killing bottle:

Take a wide mouthed strong bottle with tight fitting lid. Place ¼ inch thick layer of potassium cyanide at the bottom of the bottle. Cover it with ½ inch thick layer of dry plaster of Paris. Pour ½ inch thick wet plaster of Paris over the dry layer. Tap the bottle on table lightly to eliminate the bubbles and smoothen the top. Leave the lid off for the day in a dark and ventilated room to let the plaster dry. Also keep the circular piece of blotting paper inside the bottle to insure dryness and avoid condensation of water droplets.

ii. Ethyl acetate killing bottle:

Pour ½ inch layer of wet plaster of Paris at the bottom of the bottle and allow it to dry thoroughly.

Then saturate the media with ethyl acetate.

Precautions :

1. The bottle must be labeled with "POISON" in english and vernacular language along with skulland cross bone symbol.
2. Killing bottle should never left open because it leaves poisonous hydrocyanic acid gas.
3. Broken killing bottle should carefully buried into soil.

iii. Killing with alcohol:

Some insects can be killed by the exposure of to 70 to 90 % ethyl alcohol or isopropyl alcohol.

iv. Pinching on thorax: Moth and butterflies can be immobilize and killed by sharp pinching on thorax.

(C) Mounting:

Setting board (spreading board):

It's a wooden frame with centrally grooved. The either side of groove provided with foam sheet toenable pinning.

Relaxing container: The collected dead specimen becomes stiff and brittle. Stiffness can be removed by keeping the specimen in relaxation chamber. A wide mouthed air tight container filled with moist sand (for high humidity) covered with blotting paper along with the few drops of carbolic acid (prevent mould development). This chamber permits water to be reintroduced into the specimen make them flexible.

(D) PRESEVATION

a. Materials required:

Killing bottle, entomological pins, setting board, insect boxes, drying chamber etc.

b. Methods of preservation

i. Paper fold (paper envelope): The triangular envelope made from absorbent paper sheet and cut into rectangle with the side proportion of 3:5. Bring the opposite corners together diagonally to leave two projecting flap. Data regarding collection should be write on outer side of projecting flap and put the insect between two overlapping triangles then fold the flaps as triangular envelope. It is suitable for temporary preservation and storage for large winged insects.

ii. Pinning: It is done using entomological pins which are very thin, slender, delicate, headless, rust resistant, made up of mixture of brass and nickel. Pinning should be at specific point of the body with1/3rd portion of pin must be above the insect body and 2/3rd portion must be below.

Insects group	Pining region
Orthoptera(Grasshopper,Cricket) Dictyoptera(Praying mantid,Cockroach)	Pronotum
Hemiptera (Bug)	Scutellum
Coleoptera (Bettle,Weevil)	Right elytra
Lepidoptera,(Moth and butterfly), Hymenoptera(Bees,Wasp,Ant),Neuroptera (Lace wing),Odonata (Dragonfly,Damselfly)	Thorax

i. Double mounting:

This method is used for smaller insects because pinning is troublesome. Methods for doublemounting are:

Staging or micro pinning: The small insect can be pinned in narrow rectangular piece of pith or cork stage using micropin andthen stage is pined in store box with a bigger pin later.

Carding:The small specimen is stick directly instead of pining in 5 X 8 mm or 5 X 12 mm rectangular andthen this card placed in store box with the help of glue.

Pointing or triangular carding: The specimen is glued at down ward bend tip of triangular card (10 mm x 5 mm) and thenplaced the card into store box using bigger pin.

iii. Liquid preservation:

The immature stages or soft bodied insects can be preserved by placing them into a screw cap vialfilled with 70 % alcohol and 4 % formalin. The stopper should be seal with the paraffin wax and replace the liquid after one year because preservative are highly volatile.

iv. Setting:

It is done by using setting board for the study of wing characters. Wings should be set on either side in moth, butterflies, dragonfly and damselfly while one side wing in case of grasshopper before thespecimen become stiff.

v. Blowing soft bodied larva: Removed the internal content of soft bodied insect and inflating it like a balloon to its natural sizeand then drying in blowing apparatus.

vi. Labeling:

It is the information regarding insect, common name, scientific name, place and date of collectionand name of collector

Common Name : Gram Pod Borer

Scientific Name : *Helicoverpa armigera*

Order : Lepidoptera

Family : Noctuidae

Place of collection :RLBCAU,Jhansi

Date of collection : 0 5/ 05/2023

Name of collector : Gopal Shinde

(vii) Display:

Insect collection box

The common, light weight, air tight, moisture proof wooden box of 45 X 30 X 15 cm with fittedhinge. Cork sheet are glued inside at the bottom of box that facilitate pinning while top portion fitted with transparent glass for display preserved specimen.

Preservatives:

Preserved specimens are attacked by various microbes and other store pests. Naphthalene ballplaced inside the boxes by pin. Heating the head of pin in flame and pressed against the ball and hold fewsecond for drying.

Riker mount:

American botanist discovered it hence the name. It's a flat container with a glass or transparentcover and cotton wool at bottom.

Insect collection box

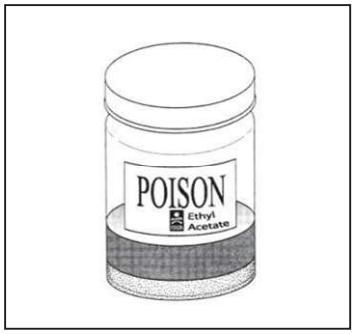
Sweep net

Aspirator

Hand lens

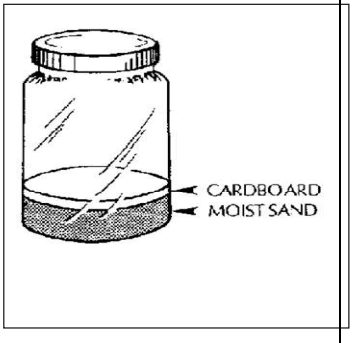
Forceps

Vial

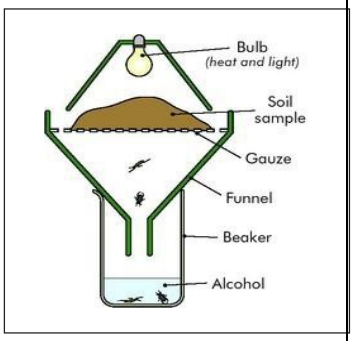


Killing bottle

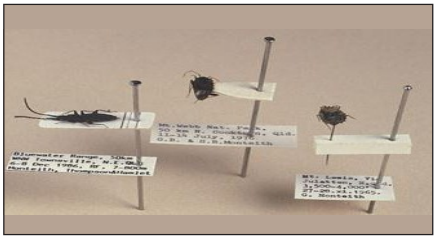
Stretching board



Display box Camel brush Pond net Relaxation chamber



Liquid preservation Light trap Pit fall trap Berlese funnel



Water trap Yellow sticky trap Carding

Activity:

1.Draw the neat labeled diagram insect collecting material, specimen insect label

2. Practice different methods of collection, killing, speading of butterfly,cockroach, grasshopper wings and preservation of different Insects.

Practical No. 3

Objective: Classification of insects based on wing basis

INSECT CLASSIFICATION

Classification of insects is basically adopted by A.D. Imms (1957), according to him class Insecta or Hexapoda is divided into two sub classes-

Sub Class 1- Apterygota – Apterous insects, the wingless condition presumed to be primitive, metamorphosis slight or absent. Adult with one or more pair of pregenital abdominal appendages. Adult mandible usually articulating with the head capsule at a single point. This sub class is divided into following four orders-

1. Thysaneura → Example Silver fish
2. Diplura → Example Japygids
3. Protura → Example Telson tails or proturans
4. Collembola → Example spring tails

Sub Class – Pterygota – winged or secondarily wingless insects, metamorphosis varied, Adults without pregentital abdominal appendages. Adult mandible usually articulating with the head capsule at two points. This subclass is divided into following two divisions -

Division I - Exopterygota – Wings develop externally. Metamorphosis simple, pupal stage rarely present. Immature stages are called nymphs which are similar to adults in structure and habit. In this division following orders are present -

5. Ephemeroptera→ Eg- Mayflies
6. Odonata → Eg- Dragon flies
7. Plecoptera → Eg- Stone flies
8. Grylloblatoidea → Eg- Gryloblatta
9. Orthoptera → Eg- Grasshoppers & crickets
10. Phasmida → Eg- Phasmids
11. Dermaptera → Eg- Earwings
12. Embioptera → Eg- Embiids
13. Dictyoptera → Eg- Cockroaches & Mantids
14. Isoptera → Eg- Termites
15. Zoraptera → Eg- Zorapterans
16. Procoptera → Eg- Booklice
17. Mallophaga → Eg- Birdlice
18. Siphunculata → Eg- Sucking lice
19. Hemiptera → Eg- Plantbugs, Aphids, Whiteflies, mealy bugs etc.
20. Thysanoptera → Eg- Thrips
21. Mantophasmatodea – Eg- Mantophasmatids (New order discovered in 2002)

Devision II –Endopterygota – Wings develop internally meteramorphesis complex, pupal instar present immature stages are called larvae which differ from adults in structure and habits. It is divided into following order –

Order –22. Neuroptera – Eg - Lace wings, Alderflies, snake flies etc.

23. Mecoptera – Eg – Scorpion flies
24. Lapidoptera – Eg – Butterflies and moths
25. Trichoptera – Eg – Caddish flies
26. Diptera - Eg – Two winged flies or true flies
27. Siphonoptera- Eg- Fleas
28. Hymenoptera –Eg- Ant, Bees, Wasp etc.
29. Coleoptera – Eg- Beetles and weevils
30. Strepsiptera – Eg – Stylops

Activity:

1.Identify and collect insect insect species of apterygote and pterygote

2.Observe the exopterygote and endopterygote insects

Practical No. 4

Objective: Taxonomic characters of order Orthoptera and its classification

Observation:

Order – Orthoptera (orthos = straight, pteron = wing)

Grasshoppers, crickets and locusts

Characters -

1. Winged or brachypterous or apterous.
2. Month parts biting and chewing type (Mandibulate type)
3. Hind leg usually enlarged and modified for grouping.
4. Two pair's wings, sometimes absent or vestigial, following straight, thickened called Tegmina, hind pair of wing membranous.
5. Gradual metamorphosis, the nymphs resemble the adults in all essential features and habits.
6. A pair of unsegmented short cerci is present.

Order is divided into two sub orders

Suborder- 1 – Ensifera:

1. Antennal are longer than their body length and many segmented.
2. Tympanal organs (auditory organs) are located on the tibia of the leg.

Example – Long horned gross hoppers and crickets.

Suborder- 2 – Caelifera:

1. Antennae are shorter than their body length with less than thirty segments.
2. The Tympanal organs are located at the sides of 1st abdominal segment.

Example- Short horned gross hoppers and locusts.

Family – Acrididae

1. These are moderately long insects with prominent head begs.
2. Diurnal in habit.
3. The antennae are always much shorter than the body length.
4. The auditory organs are located on the sides of the Ist abdominal segment.
5. There are usually one generation in a year.

Example- Kharif grass hopper, *Hieroglyphus banian, H. Nigroreplatus,* Desert locust, *Schistocerca gregarea,* Migratory locust, *Locusta migratoria*

Activity:

1. Draw neat labeled diagrams of representative insects from the insect orders Orthoptera

2.Collect the listed insects and observe them for different key family characters

Practical No. 5

Objective: Taxonomic characters of order isopteran and its classification

Order – Isoptera (Iso = equal, ptera = wing) Termites

Taxonomic characters -

1. Moderate sized, thin skinned, social insects, consisting of several castes such as winged king and queen, wingless king and queen, workless and soldiers.
2. Metamorphosis simple.
3. Mouth parts of the typical biting and chewing type.
4. The wings are equal in size, long, narrow, membranous, some what opaque.
5. Workers and soldiers of both the sexes are wing less and sterile forms.

Family 1. Masto termitidae eg.- *Masto termes* spp.

Family 2. Kalotermitidae eg.- *Kalotermes* spp.

Family 3. Rhinotermitidae eg.- *Rhinotermes* spp.

Family 4. Hodotermitidae eg.- *Hodotermes* spp.

Family - Termitidae:

Characters:-

1. Members are mostly subterranean and form a termitarium.
2. Wings only slightly reticulate, wing membrane and margin more or less hairy.
3. Pronotum of workers and soldiers narrow.
4. The queen attains enormous proportions, the increase effecting only in the abdomen and not the head and thorax. This obesity is known as Physagastory.

Example- Termite- *Odontotermes obesus /microtermes obesi*

Activity:

1. Collect and identify the isopteran insect species

2.Draw the neat label diagrams of different cast of termite

Practical No.6

Objective: Habit, habitat and taxonomic character of order Thysanoptera and their families

ORDER: THYSANOPTERA

Thysano: fringed, Ptera: Wings, Fringed-winged Insects (THRIPS)

Habitat	Terrestrial, commonly found in flowers
Habit	Phytophagous
Size	Minute to small, thin, slender elongated bodied insects

Taxonomic characters:

Antennae	6-10 segmented with sensorial (cone like structure) on 3rd or 4th segment
Compound eyes	Conspicuous with 3-4 ommatidia in apterous forms, up to 150 in winged forms. 3 ocelli in winged forms.
Mouth parts	Asymmetrical mouth parts. Right mandible is absent. Lacerating or Rasping and sucking type with three stylets. Mouth cone is formed by labrum, labium and the maxillae and extends ventrally, between the fore coxae
Wings	Winged/wingless. Flight-capable thrips have two pairs of similar, strap-like wings with a ciliated fringe on margins with long hairs, from which the order derives its name. Wings when fully developed are long and narrow with highly reduced venation (with 1-2 veins).
Legs	Legs usually end in two tarsal segments with a bladder-like structure known as an arolium at the pretarsus.
Abdomen	Elongate with 10-11 segments, usually tapering posteriorly.
Anal cerci	Absent
Metamorphosis	Intermediate between simple and complex, in which 1st and 2nd instar larvae are active, resemble adults (called nymphs) where as 3rd and 4th instar consists of inactive pre-pupal and pupal like stages.

Parthenogenesis This type of reproduction is very common, and in many species males are rarely seen.

FAMILY : THRIPIDAE

Chilli thrips : *Scirtothrips dorsalis*

Onion thrips : *Thrips tabaci*

Grapevine thrips : *Rhapiphorothrips cruentatus*

- Largest, most important and most injurious family in thysanoptera.
- Antennae 6-9 segmented, 3rd and 4th antennal segments are conical with sense cones or sensoria, antennae with 1-2 segmented apical style, 4th segment is usually enlarged
- Winged or wingless forms. If winged, wings are narrow, pointed at the tip and fringed with hairs on the margins
- They can be distinguished from other thrips by a saw-like ovipositor curving downwards
- 1st and 2nd segments of tarsi consists of claw like appendage.

Activity:

1. Collect the listed insects and observe them for different taxonomic characters

2.Draw the neat label diagram of thrips

Practical No.7

Objective: Key characters of order neuroptera and its families

Order:Neuroptera

Neuro : Nerve, Ptera: Wings,Wings with net like patterns of veins

Lacewings, Aphid Ions, Ant Lions, Alder Flies, SnakeFlies

- Neuroptera have two pairs of similar size membranous wings with a complex, net-like pattern of veins.
- They are rather fragile insects and weak fliers
- Antennae filiform, with or without terminal club
- Adults and larva have chewing mouthparts; larva with very strong elongatedmandibles, but some larval mouthparts is modified for piercing and sucking.
- Larva is compodiform and predaceous.
- Lacewings and their immature forms, known as *aphid lions*, are the most common insects in this order, and both adults and larvae feed on aphids. Immature *antlions* are called "doodlebugs." They form pits in dry, dusty soil.
- Adult green lacewings can be found throughout the year. They are considered beneficial because they feed on other insects.
- Six out of eight malpighian tubuls are modified as silk glands
- Larvae spin cocoons through anal spinneret, and pupation takes place in silken cocoon.

FAMILY: CHRYSOPIDAE

GREEN LACEWINGS, APHID LIONS, GOLDEN EYES

- Body is pale green in color
- *Eggs are mounted on stalks* to avoid predation and cannibalism
- Larvae prey on soft bodied insects, especially aphids, often carry layer ofdebris on its body which provides camouflage
- They emit a stinking fluid when alarmed, from prothoracic stink glands
- They are mass multipled and released in field for control of a

Activity:

1.Draw neat labeled diagrams of green lacewing

2.Collect the listed insects and observe them for different key characters

Practical No.8

Objective: Taxonomic characters and classification of order coleoptera.

Observation:

Order – Coleoptera (Coleos = sheath, Pteron = wing**) Beetles and weevils**

Taxonomic characters:

1. Two pairs of wing, fore wing thickened (hard & sclerotized) called elytra, hind wing membranous and protected by fore wing.
2. Both larvae and adult have biting and chewing type of mouth parts.
3. Metamorphosis complete.
4. Larvae of beetles are commonly known as grub. Snout beetle (weevils) grubs are leg less (apodous).

This order is divided into following two suborders

Suborder 1. Adephaga

Characters – 1. Beetles mostly predatory in habit, they feed on other, insects.

2. Antennae generally filiform.
3. Notopleural suture is present.
4. The Ist visible abdominal sternum is divided by the hind coxae and the posterior margin of this sternum does not extend completely across the abdomen.

Followings are the important families –

Family 1. Cicindellidae

Example – Tiger beetle, *Cicindella sexpunctata*

Family 2. Carabidae

Examples- 1. Carabid beetle, *Anthia sexguttata*

2. Carabid beetle, *Chlaenius bioculatus*
3. Carabid beetle, *Calosoma indica*

Suborder 2. Polyphaga Characters:

1. The Ist visible abdominal sternum is not divided by the hind coxae and the posterior margin of this sternum extends completely across the abdomen.
2. Hind trochanters are small.
3. Notopleural suture is absent. Followings are the important

families – **Family 1. Dermestidae**

Example – Khapra beetle, *Trogoderma granarium*

Family 2. Curculionidae (curculioni = weevils or snout beetles) Examples – 1. Rice weevil, *Sitophilus oryzae*

2. Gujhia weevil, *Tanymecus indicus*
3. Sweet potato weevil, *Cylas formicarius*

Family 3. Bruchidae

Example – Pulse beetle, *Callosobruchus chinensis*

Family 4. Chrysomelidae

Example - 1. Red pumpkin beetle, *Raphidopalpa foveicollis*

2. Rice hispa, *Decladispa armigera*
3. Singhara beetle, *Galerucella bermanica*

Family 5. Tenebrionidae

Example – Rust red flour beetle, *Triboliuam castaneuam*

Family 6. Coccinellidae

Sub family – Coccinellinae lady bird beetles

Example – 1. Lady bird beetle, *Coccinella septempunctata*

Family 7. Melolonthidae (Scarabaeidae)

Example **–** White grub, *Holotrichia consanguinea*

Activity:

1.Draw neat labeled diagrams of different insects under Sub-order adephaga and polyphaga

2.Collect and identify the beetle and weevil

Practical No.9

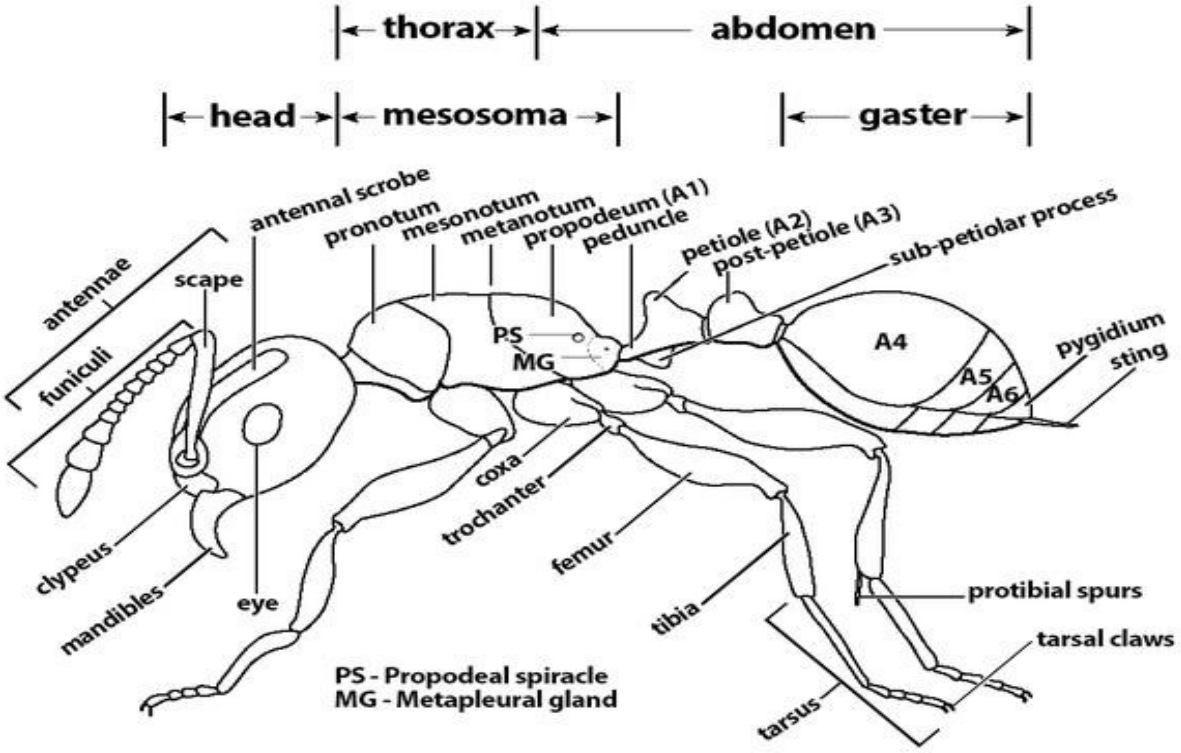
Objective: Key taxonomic characters of order Hymenoptera and agriculturally important families

Hymenoptera is one of the highly diversified assemblages of insects. (Etymology: **Hymen** means **membrane** or **Hymeno** means **God of marriage** and **ptera** means **wings)**

Taxonomic character:

1.The mouthparts are **mandibulate** and the basal sections of the labium and maxilla lie closely attached side by side and have a sharp transverse fold near the basal third. In bees, labium and maxillae are integrated to form **lapping tongue** (Chewing and lapping type of mouth part).

2. Thorax modified for efficient flight. **Pronotum** is **collar like**; **mesothorax is enlarged** and metathorax is small. Both prothorax and metathorax are fused with mesothorax.



3.Two pairs of **membranous wings**. Forewings are larger than hind wings; the membranes not obscured by scales or dense hairs.

4.Wing venation is reduced. Both forewings and hind wings are coupled by a row of hooklets **(hamuli)** present on the leading edge of hind wing.

5.Base of the forewing is covered by a small roundish sclerite, the **tegula**.

10.Abdomen is basally constricted. The first abdominal segment is called **propodeum**. It is fused with metathorax. The second segment is called **pedicel** which connects thorax to abdomen. Abdomen beyond the pedicel is called **gaster or metasoma**

11.A true primitive **ovipositor** with three pairs of valves occurs in the female and is sometimes plainly visible ventrally or apically. It is variously modified for oviposition or stinging or piercing plant tissues.

12. **Complete metamorphosis**. Often the grub is apodous and eucephalous (Apocrita). But in case of Symphyta, the larvae are caterpillar like. But Symphyta larvae have atleast 5 pairs of prolegs, on abdominal segments 2-6 but lepidopteran caterpillar have only 4 pairs of abdominal prolegs on abdominal segments 3-6.

13Pupa is **exarate**, frequently enclosed in a silken cocoon secreted from labial glands.

Sex is determined by fertilization of eggs. Fertilized eggs develop into females and males are produced from unfertilized eggs. **Males are haploid and females are diploid**

Agriculturally important families

Family Ichneumonidae

- Fore wing venation is characteristic with discoidal and submarginal cells confluent and with two m-cu veins.
- The ovipositor is often long, sometimes longer than body.

  Eg. *Campoletis chlorideae* on *Helicoverpa armigera* and *Isotima javensis* on sugarcane borers

Family Braconidae

- They resemble ichneumonids, but differ in that they have no more than one m-cu cross vein or none.
- Usually the second and third abdominal tergites are fused together.
- Polyembryony is observed in many species.
- Eg. *Bracon brevicornis* for the control of coconut black headed caterpillar.

Family Trichogrammatidae

- Three segmented tarsi.
- Antennae are 5-9 segmented; male antennae normally with whorls of long setae and female antennae with short setae.
- Eg. *Trichogramma s*pp. *h*ave a wide host range and attacks the eggs of many species.

Family Eulophidae

- Brilliant metallic colour.
- Four segmented tarsi.
- Eg. *Tetrastichus israelli* is a gregarious pupal parasitoid of coconut black headed caterpillar; *Diglyphus* spp. are parasitoids of leaf miners.

Family Platygasteridae

- Minute shiny black insects.
- Antennae are 10 segmented; attached very low on the face.
- Eg. *Platygaster oryzae i*s a very important parasitoid of rice gall midge, *Orseolia oryzae*

. **Family Apidae**

- **Honey bees**
- Body covered with plumose hairs.
- Chewing and lapping type of mouthparts.
- Legs are specialized for pollen collection.
- Scopa (pollen basket) present on hind tibia.
- Social insects; three castes – queen , drone and workers; temporal separation of duties is noticed among workers.
- ***Eg. Apis dorsata***

Family Tenthredinidae: Abdomen broadly joined to the thorax; ovipositor is saw toothed; eruciform larva; it has one pair of ocelli and papillae (reduced antenna); possess 6-8 pairs of prolegs in abdomen without crochets. Eg. **Mustard saw fly,** Athalia lugens proxima is a defoliator of mustard and cruciferous vegetables

Activity:

1.Collect the listed insects and observe them for different identical family characters

2.Collect and identify the bee species with well label diagram

Practical No.10

Objective: Key identical character of Symphyta and Apocrita

SYMPHYTA	APOCRITA
Abdomen is broadly joined to the thorax	Abdomen is petiolated
Larva is a caterpillar and belongs to eruciform type	Larva is a grub and it belongs to apodous eucephalous type
Stemmata are present	Stemmata are absent
Both thoracic and abdominal legs present	Legs are absent
Ovipositor is saw like and suited for piercing the plant tissue	Ovipositor is not saw like and suited for stinging
Behavioral sophistication is less	Behavioral sophistication is more
They are phytophagous	They are generally parasitic
Athalia lugens proxima belonging to sub order Symphyta	*Campoletis chlorideae, Bracon brevicornis, Trichogramma spp* belonging to sub order Apocrita

Activity:

1. Draw neat labeled diagrams of different insects under Sub-order apocrita and symphyta

Practical No.11

Objective: Key characters of order lepidoptera and agriculturally important families

Lepido: Scales, Ptera: Wings, Scaly winged Insects

Butterflies and Moths

Key character

1. Body, wings, appendages, are densely clothed with overlapping scales, which give colour, rigidity and strength. They insulate the body and smoothen air flow over the body. Mouthparts in adults are of siphoning type. Mandibles are absent. The galeae of maxillae are greatly elongated and are held together by interlocking hooks and spines. The suctorial proboscis is coiled up like a watch spring and kept beneath the head when not in use.

2. Wings are membranous and are covered with overlapping pigmented scales. Forewings are larger than hind wings. Cross veins are few. Wings are coupled by either frenate or amplexiform type ofwing coupling . Larvae are polypod-eruciform type.

3. Mouthparts are adapted for chewing with strong mandibles. A group of lateral ocelli is found on either side of the head. The antenna is short and three segmented. There are three pairs of five segmented thoracic legs ending in claws. Two to five pairs of fleshy unsegmented prolegs are found in the abdomen. At the bottom of the proleg, crochets are present. Pupa is generally obtect. It is either naked or enclosed in a cocoon made out of soil, frass, silk or larval hairs

Agriculturally important families

1.Nymphalidae: (Brush footed or four footed butterflies)

2.Lycaenidae: (Blues, Coppers, Hair streaks)

3.Papilionidae: (Swallow tails)

4.Pieridae: (whites and Sulphurs)

5.Satyridae: (Browns, Meadow – browns)

6.Arctiida : (Tiger moths)

7.Bombycidae: (Silk worm moths)

8.Cochlididae: (Slug caterpillar)

9.Crambidae : (Grass moths)

10.Gelechiidae: (Paddy moth)

11.Geometridae: (Loopers)

12.Lymantridae: (Tussock moths)

13.Noctuidae: (Noctua moths)

14.Pyraustidae: (Grass borers)

15.Saturniidae: (Moon months, giant silk worm moths)

16.Sphingidae : (Hawk moths, Sphinx moths, Horn worms)

17.Hesperiidae (Skipper)

Activity:

1.Collect and identify the butterfly and moth with suitable diagram.

2.Identify the economically important family

Practical No.12

Objective: Key identical characters of order diptera and agriculturally important families

Order – Diptera (Di = two, pteron = wing)

True flies, Houseflies mosquitoes etc.

Characters:

1. Insects with single pair of membranous wings, hind pair of wings modified into halteres.
2. Mouth parts piercing and sucking or sponging type.
3. Prothorax and metathorax small and fused with well-developed mesothorax.
4. Metamorphoses complete.
5. Larvae are apodous (legless) called maggots which have biting and chewing type of mouth parts.
6. Pupa are generally free or enclosed in a puparium.

Family 1. Culicidae: Mosquitoes Example-1. *Anopheles* spp.
2.*Culex fattigaus*

Family 2. Cicidomyiidae: Gall midge

Example- 1. Rice gall midge, *Orseolia oryzae*
2. Mango gall midge, *Dasyneura mangiferae*
3. Linseed gall midge, *Dasyneura lini*

Family 1. Tabanidae: Horse flies
Example – Horse flies, *Tabanus maculicornis*

Family 2. Asilidae: Robber flies
Example – Robber flies, *Philonicus albiceps*

Family 3. Bombyllidae: Bee flies
Example – Bee flies, *Bombylius major*

Family 1. Tephritidae: (Fruit flies)
Example – Melon fruit flies, *Bactrocera cucurbitae*

Activity:

1.Draw neat labeled diagrams of different insects of Diptera

2.Collect the listed insects and observe them for different key family characters

Practical No.13

Objective: Taxonomic characters of Heteroptera and homoptera

Character	**Heteroptera**	**Homoptera**
Examples	True Bugs	Jassids, Leaf hoppers, Aphids, whiteflies, Scales, Mealybugs
Basic character	Hetero : Different wings Hemi-Elytra	Homo : Same/uniform/alike Uniform wings
Size	Comparatively large	Comparatively small
Head	Proganthous	Hypognathous / Opisthognathous
Antenna	4-5 segmented	3-10 segmented
Rostrum	Rostrum arises from front part ofthe head and head base does not touch anterior coxa	Rostrum arises from posterior part of the head and head base extends between anterior coxa
Pronotum	Pronotum Large, while meso- and meta-notum are relatively small	Pro-notum Small, collar-like, large meso-notum, and small meta-notum
Forewings	Hemi-elytra Forewings which are hard and	Uniform in consistence The forewings are entirely
Wings position	Wings held flat over the body atrest	Wings are held roof like / tentlike over the body at rest
Tarsi	3 segmented	1-3 segmented
Sound Production	No sound producing organs	Many can produce sounds Sound production due to *tymbal organs* in first two abdomenal segments (Cicadas)
Glands	Odoriferous glands (Scent Glands) present, opens at hindcoxae, gives off characteristic odour	Wax glands present on the entirebody
Life History	Parthenogenesis is present insome insects	In most species, the life history is very complex involving sexual and parthenogenetic generations, winged and wingless individuals
ImportantFamilies	*Cimicidae:* Bed bugs *Pentatomidae* : Stink /Shield Bugs *Lygaeidae :* Seed bugs, Chinch Bugs *Miridae :* Mirid bugs	*Cicadellidae:* Leaf Hoppers, Jassids *Delphacidae ;* Plant hoppers *Aphididae:* Aphids or Plant Lice *Pseudococcidae :* Mealy bugs

	*Pyrrhocoreidae :*Cotton bugs/stainers *Coridae:* Leaf-footed bugs	*Coccidae:* Scale insects *Aleurodidae:* Whiteflies *Lophodidae :* Aeroplane bugs

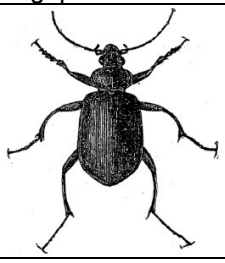
Activity:

1. Draw neat labeled diagrams of different insects of heteroptera and homoptera

2.Identify the economically important family of homopteran insect

Practical No.14

Objective: Taxonomic characters of Beetles and Weevil with suitable example

S.No.	Beetle	Weevil
1.	Mouth parts typically chewing type.	Mouth parts chewing type but modified into snout like structure.
2.	Both pairs of wings present, fore wing elytrate, which at rest in straight suture when at rest.	Hind wing absent, fore wing elytrate, immovably united.
3.	Antennae capitate/serrate/tameilate	Antennae clavate.
4.	Tarsi 3 to 5 segmented	Tarsi 4 segmented.
5.	Larvae oligopod	Larvae apodous
		

Activity:

1.Collect and identify the beetle and weevil with specific character

Practical No.15

Objective: Key characters of moth and butterfly with suitable example

Character	Butterflies	Moths
Shape and structure of an antenna	Most of the butterflies have a thin filamentous antennae which are club shaped at the end	Moths have comb like feathery antennae or filamentous or club shaped antennae
Wing coupling mechanism	Amplexiform type of wing coupling mechanism	Many of the moths have frenulam which is filamentarising from the hind wing and coupling with the barbs on the forewing .some moths have a lobe on the forewing called jugum that helps in coupling with the hind wing
pupae	Most of them form an exposed pupae also known as chrysalis	Pupa is enclosed in a cocoon or shell
Coloration of the wings	Wings are brightly coloured	They are usually brown grey white or black and often with the obscuring patterns of zigzags swirls help in camouflage
Structure of the body	Possess fie scales and have slender ,smoother abdomens	They tend to be stout and hairy or furry looking bodies and scales on their wings which make them look more dense and fluffy
Behavioral difference	Diurinal	Nocturnal
Resting posture	They freaquently fold their wings on the back above the abdomen when they are perched	They usually rest with their wings spread out to their sides
Economic importance	Most of them are pollinators in the adult stage and weed killers in larval stage	The larval stages feeds on the cultivated crop and thus become important pest
Example	Blue butterfly	Fruit sucking moth

Activity:

1.Draw neat labeled diagrams butterfly and moth with key identical character

Practical No.16

Objective :Taxonomic characters of Megaloptera and Planipennia

Character	Megaloptera	Planipennia
1. Body size	Large	Small
2. Antennae	Filiform, short	Very long, many segmented filiform, monoliform, pectinate.
3. Wings	Without Pterostigma	With pterostigma and net like venation branched at margin.
4. Hind wings	With large anal fold,	Piercing, suctorial mouthparts without large and fold.
5. Veins	Unbranched at margin	Braches or veins bifurcated
6. Ovipositor	Long but not exerted	Plough- like
7. Larval mouth parts	Biting mouthparts Sickle-like mandibles;	Suctorial mouthparts
8. Larval habitat	Aquatic	Rarely aquatic (Sisyridae)

Activity:

1.Draw neat label diagrams megaloptera and planipennia with key identical character

Practical No.17

Objective: Taxonomic characters of Terebrantia and Tubilifera

Suborder- Terebrantia

Taxonomic character

1. Female bearing saw- like serrated ovipositor.
2. Female with conical abdominal apex while male with blunt and round abdominal apex.
3. Forewings large with a least one complete longitudinal vein.

Family-Thripidae: Ovipositor curved downwards; wings narrow and pointed; antennae 6-9 segmented.6th antennal sesgment is the largest one. Last abdominal segment of female is conical. Segments 9 and 10 smooth, It included about 160 genera**, e.g. –** Thrips, Heliothirps, Physothrips, Limothrips, Kakothirps.

Suborder – Tubilifera

Taxonomic character

1. Female without ovipositor.
2. 10th abdominal segment is tubular.
3. Fore and hind wings are similar, no veins or with one vestigial vein.
4. No longitudinal veins runs full length of a wing. Wings without hairs (microtrichia)

Family phlaeothripidae: Antennae with 7-8 segments, 3rd antenna! Segment is the largest one. Head rounded. Maxillary paip-2 segmented. It included about 300 genera. E.g., Phlaeothirps, Liothrips, Liothirps, Zygoathrips, Haplothirps.

Activity:

1.Collect and identify the tubilifera and terebrantia insect species

Practical No.18

Objective: Key characters of Nematocera and Brachycera

Characters	Nematocera	Brachycera
I Larvae		
1.Head	1. Eucephalous,fully developed except in cecidomyidae and Tipulidaess	1. Hemicephalous, reduced represented by only low capsule
2.Antennae	2. 1-6 segment well- developed,	
	3. well developed ,mandible articulate transversely.	2. Reduced, papillae- like well developed, mandibles articulate vertically.
3. mouth parts		
	4. Short – straight	
	5. 4,(exception-6 in simulidae)	3. Slightly convolulated
	6. obtect	4. 5-8
4. Alimentary Canal		
5. Instars	7.Longer than body, filiform	5. Obtect
II. **pupa**		
6.Type		6. 3 segment, stylet type
III. Adult		
7.Antennae	8.4 or 5 segment, pendulous	7. 1 or 2- segmented porrect, 1 – segmented
	9.4 or 5 segemented, pendulous straight, exception- psychodidae	
8. palpi	10.Absent	8. 1 or 2- segmented porrect twice bent (exc.- Acroceridae)
9.Pleural suture of mesothorax	11.Widely open	9. Present
	12.Stylet- like, piercing type, only in female	10. Closed
		11. Blade like piercing
10.wing discal ccell	13.Tubular, trilobed, thoracic	12. Type only in femal
11. cubital cell		
12. mouthparts		
		13.Tubular running upto some length of abdomen
13.salivary glands		

Activity:1.Draw neat labeled diagrams of representative insects from the insect suborder viz., Nematocera

Practical no.19

Objective: Key characters order Mantophasmotodea and its families

Key character

Mantophasmatodea is the smallest insect orde

Mantophasmatodea is an amalgamation of the order names for praying mantids (Mantodea) and walkingsticks (Phasmatodea)

The consistently wingless Mantophasmatodea have a very uniform body shape, which superficially resembles that of certain grasshoppers or stick insects.

The body length (without the antennae) ranges from 0.35 to 0.94 in (9–24 mm), males usually being somewhat smaller than females

The basic color of the body is brown, gray, green, or yellow; different tints of these colors, a whitish component of varied extent, and— in some species—black dots form a pattern of mottles and/or longitudinal stripes

Coloration varies between and also within species. Nymphs resemble the adults in appearance

The compound eyes are well developed, albeit of varied size, but ocelli are lacking.

The chewing mouthparts are generalized and directed downward

The abdomen consists of 10 well-developed segments and a reduced eleventh segment

Major Family

Mantophasmatidae is the only family in this order. It contains three genera

Activity:

1. Collect the listed insects and observe them for taxonomic characters

Practical No.20

Objective:Identify the locust and grasshopper on the basis of marphometric and behavior characters

Locust

The short-horned grasshoppers are called locusts. Locusts are a type of grasshoppers that change their color and behavior when at its high population density. They are also called **short-horned grasshoppers** and they belong to the family Acrididae. Generally, locusts are solitary. When they increase in number, they change their behavior as well as the habitat, becoming gregarious. The gregarious phase is called the **swarming phase**. Gregarious locusts change their coloration, form, physiology, behavior, and fertility.

Fig. Locust

Grasshopper The long-horned grasshoppers are called grasshopper. Grasshopper is a plant-eating insect with long hind legs used for jumping. Grasshopper is a medium sized insect in 1-7 cm. The color combination is brown, grey or green. These colors help them to merge with the environment. This is called camouflage. Males may have bright colors to attract females.

Fig. Grasshopper

Similarities between locust and grasshopper

1.Locust and grasshopper are herbivorous insects.

2.Both locust and grasshopper belong to the order Orthoptera.

3.Both are bugs that have large, compound eyes and a pair of short antennae. Their mouth consists of strong mandibles.

4.They have elongated hind legs for jumping.

5.Both have two front wings and two membranous wings in the back.

6.They undergo incomplete metamorphosis.

Activity:

1.Collect and identify the morphometric and behavior character of locust and grasshopper

Practical No.21

Objective: Taxonomic characters of order dictyoptera

ORDER	**: DICTYOPTERA** Dictyo: Net, Ptera: Wings, Netted winged Insects
Examples	**: Cockroach and Praying Mantis**
Habitat	Terrestrial, tropical and subtropical insects.
Food Habit	Cockroaches are omnivorous, while Mantis is predacious on otherinsects and small animals
Size	Variable, Large to Medium sized
Shape	Dorso-ventrally flattened, depressed, oval shape in cockroaches orvery long bodied, stick like in some mantis.
Taxonomic characters:	
Head	Usually Hypognathous
Antennae	Long, may be longer than the body. Filiform (Mantis) or Setaceous (Cockroaches), usually long, thin,composed of many segments
Mouthparts	Mandibulate (Chewing and biting type)
Wings	Have two pairs of wings, held flat over the body (roof shaped) when at rest. Fore wings modified into leathery tegmina with marginal costal vein. Hind wings are membranous with a large anal lobe folded in a fan like fashion.
Legs	Cursorial (running in cockroach) or Raptorial forelegs (Mantis) with 5 tarsal segments. All three pairs are similar in Blattidae (cockroaches) useful for running, while in Mantidae (praying mantis), forelegs are modified for grasping the prey (Raptorial),and middle and hind legs are normal used for running. In Mantids, fore legs coxa is very long, femur is spiny. A tarsus is 5 segmented in both Blattids, and Mantis.

Anal cerci	A pair of many segmented anal cerci is present, they are visible,and hairs on anal cerci in cockroach are very sensitive to air movements, and hence it is very difficult to catch them.
Eggs	laid in ootheca. The female lays eggs in groups, and then encases them in foam (polystyrene-secreted by female accessory glands) which hardens into a protective capsule, or ootheca.

Activity:

1.Draw neat labeled diagrams of representative insects from the insect orders dictyoptera

2.Collect and identify the dictyopteran insect

Practical No.22

Objective: Key characters of family mantidae

Taxonomic characters of family mantidae

- Most are tropical, sub-tropical.
- Mostly *predacious*. Nymphs and adults are predators on other insects, small animals.
- They usually exhibit cryptic colorations, simulating with the background (*mimicry*). Uniformly coloured insects.
- Long body, abdomen flattened.
- *Head is triangular deflected.*
- Three ocelli present.
- Antenna: filiform, long, many segmented.
- *Prothorax greatly elongated*, meso- and meta-thoracic segments are short.
- Characterized by *raptorial type of front legs*, *with long coxa, tibia and femur bearing prominent spines*.
- Anal cerci short and segmented.
- No specialised stridulatory organs are present though *some mantids do have a single ear on the metathorax* which allows them to hear the sonar of bats.
- Eggs are laid in a water tight *egg case/ootheca which is fixed to plants*. The case is formed from a frothy gum (polystyrene) secreted by collateral glands of females. After exposure to air, the case hardens.
- *Nymphs emerging from ootheca resemble ants*.
- Greenhouse mantis: *Mantis religiosa*
  Common Indian mantis : *Gongylus gongyloides*

Activity:

1. Collect and identify the taxonomic character of mantid insects

Practical No.23

Objective:Taxonomic characters of family blatidae

Taxonomic character

- Nocturnal, Omni vorous (feed on food stuff, clothes, paper etc.). Impart foulsmell to food by contaminating with excreta.
- Body dorsoventrally flattened, depressed and oval shaped
- Body heavily pigmented body
- Head is not mobile in all directions, and *head is hidden by pronotum*
- *Pronotum large plate like / shield like* covering the head
- *Degenerated Ocelli (sensitive to light) called fenestrae*
- Antennae setaceous (whip like), long with many segments.
- Legs: All thre pairs similar, *cursorial (running) type*.
- Wings: Two pairs of wings, both are functional, used for flying. *Forewings modified as tegmina*, *hind wings membranous* with large anal area.
- Eggs : arranged in double row and are enclosed in sac called *ootheca* which is formed by the secretions (polystyrene) of collateral glands (modified accessory glands of females)

- Example: American cockroach: *Periplanata americana*

Activity:

1. Collect and identify the taxonomic character of cockroach

Practical No.24

Objective: Taxonomic characters of family pentatomidae

Taxonomic character

- Medium to large sized, broad shied like Stink / Shield Bugs
- *Body medium sized, shield like and brightly coloured*
- Ocelli present
- The lateral margins of head conceals the bases of antenna
- *Antenna : 5 segmented*
- *Pronotum: Broad and Shield shaped,* scutellum of mesonotum is large, triangular,sometimes extends posteriolry to the extent of covering wings entirely.
- Forewings : Hemi-Elytra, corium large, membranous, with many longitudinalveins arising from a vein parallel to the apical margin of the corium
- Tarsi : 2-3 segmented, claws with pulvilli
- They produce highly disagreeable odours. A pair of *odoriferous glands* opens at hind conxae, and in addition, *4 pairs of odoriferous glands present on the dorsumof the abdomen of nymphs*
- Eggs : usually barrel shaped with spines on the upper end.
  - Green Stink Bug: *Nezara viridula*
  - Red Pumpkin Bug : *Aspongopus (Coridius) janus*
  - Cabbage Painted Bug: *Bagrada cruciferarum*

Activity:

1. Collect and identify the taxonomic character of pantid bug and green stink bug

Practical No.25

Objective: Key characters of family cicadellidae

Key characters

- Economically very important family
- These are *vectors of important plant diseases*
- *Cause plant injury by injecting toxins*, causing *hopper burns*
- They are usually small in size, slender, usually *tapering posteriorly, Wedgeshaped* insects during rest
- They jump/ leap several feet when disturbed, both nymphs and adults havecharacteristic habit of *running sidewise or diagonally*
- Antennae minute, bristle like, 3 segmented
- Forewings are somewhat thickened, often brightly coloured
- Fore wing anal veins usually separate from base to anal margin (Anal veins 1Aand 2A do not unite to form Y shaped vein)
- *1 or 2 rows of small spines are present on hind tibia*
- Ovipositor well developed and adopted for lacerating plant tissues for egg laying
- Many *excrete honey dew through anus*, over which sooty mould (black) developsand hampers photosynthesis ability of the plant
  - Cotton Leaf Hopper : *Amrasca biguttula biguttula*
  - Paddy Leaf Hopper : *Nephotettix virescens*
  - Mango Leaf Hopper : *Idioscopus clypealis, Amritodus atkinsoni*
  - Bhendi Leaf Hopper : *Amrasca biguttula biguttula*

Activity:

1.Collect the listed insects and observe them for different key family characters

Practical No.26

Objective: Key characters of family aphididae

Key characters

- Economically very important family; polyphagous; Some act as vectors of plant diseases, and some even feed on roots.
- Pear shaped, small and soft bodied insects, usually found in large numbers /colonies, sucking as from various parts of plants.
- Rostrum usually long and well developed
- Antenna fairly long.
- A pair of cornicles on dorsal surface of 5^{th} and 6^{th} abdominal segments (cornicles produce wax substance to protect from other insects) is the characteristic feature of insects belongs to this family.
- Alary polymorphism (winged/wingless forms, normally wingless forms are predominant. In winged forms, hind wings are much smaller with fewer veins)
- At rest, the wings are generally held vertically (like tent) above the body
- Tarsus 3 segmented with pair of claws
- Excrete honeydew through anus (honey dew consists of excess sap, excess sugars and waste materials), to which ants are attracted. The transportation of aphids through ants is called poracy.
- The reproduction can be through parthenogenesis, oviparity, viviparity, in the occurance of generations the sexes are unequally developed, males often being rare.
    - Cotton Aphid: *Aphis gossypii*
    - Bean Aphid: *Aphis craccivora*
    - Apple Aphid: *Eriosoma lanigerum*

Activity:

1. Collect and identify the taxonomic character of cotton aphid and bean aphid

Practical No.27

Objective: Key identical characters of family aleurodidae

Key characters

- Minute insects, 1-3mm, resemble tiny moths with opaque body
- Adults have two pairs of wings with reduced venation and *covered by a finewhitish dust or powdery wax giving white colour*
- Antenna fully developed, 7 segmented
- Reniform compound eyes, 2 ocelli
- Rostrum 3 segmented
- Tarsi nearly with two equal segments with paired claws and with empodium
- *Vasiform Orifice (honey dew excreting organ) on dorsal surface of last abdominal segment* in both nymphs and adults, *through which honeydew excretes*. It is the characteristic feature of the family.
- Metamorphosis is complex. *The 1st instar young ones are active (crawlers) but subsequent immature stages are sessile and look like scales*. The scale like covering is a waxy secretion of the insect. The wings develop internally during metamorphosis and the early instars are called larvae. The next to the last instar is quiescent stage called pupa. The wings are given out at the moult of last larval instar.
- The *eggs are very characteristic being provided with pedicel which sometimes exceeds the length of the egg*.
- Sexual reproduction is common, but parthenogenesis is also seen.
- They are *Vectors of Plant Diseases* (Mosaic Viruses)
- Cotton Whitefly : *Bemisia tabaci*
  Citrus Whitefly : *Dialeurodes disperses* Sugarcane
  Whitefly : *Aleurolobes barodensis*

Activity:

1.Collect the listed insects and observe them for different key family characters

Practical No.28

Objective: Taxonomic characters of Pscocptera and Malophaga

Identical character of Pscocptera

- Adult usually has two pair of membranous, separately veined wings that are held roof like over the body.
- Head has a distinct 'y' shaped epicranial suture.
- Two or three segmented tarsi.
- Chewing type mouthparts.
- Forewings are larger than hind wings.
- Dorsal pair of labial glands are modified in to silk glands.
- Importance: they feed on paper paste of book binding, fragments of animal and vegetable matter and stored products. They are also damage dry preserve insects and herbarium specimens.

Identical character of Malophaga

- Chewing lice are parasite of both birds and mammals.
- Wingless insect and have large head.
- Body is dorsoventrally flattened.
- Compound eyes are reduced.
- Prothorax is invariable free and not fused with pterothorax. Meso and metathorax may be free or fused.
- The tarsus is either unsegmented or two segmented.
- Eggs are called nits and are cemented to the feathers.
- Importance : They are obligate parasites on birds and less frequently on mammals. They severely infest the poultry bird, Affected birds will become restless and peck at one another continuously, leading to loss of plumage.

Activity:

1. Draw neat labeled diagrams of psocoptera and malophaga insects with specific character

Practical No.29

Objective: Identify the orthopteroid and hemipteroid groups on the basis of taxonomic charachers

S.No.	**Orthopteroid groups**	**Hemipteroid groups**
1.	Nymphs with ocelli	Nymphs lack ocelli
2.	Chewing mouth parts, gular region well developed	Chewing mouthparts in primitive groups, gradual development of mouth parts.
3.	Hind wing dominant in flight	Forewing dominant in flight
4,	Antennae long, multiarticulate	Reduction in antennal segments
5.	Tarsomere number variable	With 3 or fewer tarsomeres
6.	Malphigian tubules numerous	Malphigian tubules 4 or 6 number
7.	CNS with separate ganglia in thorax and abdomen	CNS strongly concentrated in thorax
8.	Herbiorous, predators, very few parasite, some social and sub-social	Herbivorous, predators, parasite, non-social, few sub social

Activity:

1. Collect and identify the orthopteroid and hemipteroid insect

Practical No.30

Objective: Habit, habitat and key characters of dermaptera

- **Habit and Habitat:** They are terrestrial but mostly nocturnal insects and are often attracted to light. They cannot fly (exception Labia minor). During day time, they hide away under stones, hollow stems or bark, vegetation or in the crackes of soil. They may live together in colonies . Female guards her eggs showing unique parental care. Some are parasitic (Hemimeus, Arixenia). They are omnivorous

Key character

- Head: Prognathous, clypeus is differentiated into sclerotized postclypeus and membranous anteclypeus.
- Epicranium with Y-shaped suture.
- Compound eyes: well developed.
- Ocelli: Often absent or vestigial.
- Mouthparts: Large biting-chewing type, maxillary palp-5 segmented, ligula and superlinguae bilobed.
- Thorax: With large prothorax, metanotum fused with first abdominal segment. Metasterna with distinct apophysialpits
- Wings Greatly reduced or absent (e.g., Anisolabis,Hemimerus, Arixenia etc. The forewings are modified into truncated, leathery, veinless, very short tegmina about half of the length of an abdomen.
- The hindwings are membranous, semicircular, mostly formed from greatly extended anal lobe, while preanal part of wings is highly sclerotized, short and with reduced radial and cubital veins. The rest of part of wings is provided with radially arranged, secondarily developed veins. They are folded longitudinally in a fan-like fashion along with two transverse folds and at rest, are concealed under the tegmina
- Legs: Equal in size, short, with 3-segmented tarsi.
- Abdomen: Eleven - segmented, last segment modified into an epiproct and a pair of paraprocts. firsttergum is fused with the metathorax. The 8th and 9th segments are reduced or overlapped by the 7th segment, particularly in the females.
- The Ovipositor: It is absent or reduced (Forficulina) consisting two pairs of valves.
- The Male Genitalia: There are two penes in Pygidicranidae, Carcinophoridae and Labiduridae or only one in other families.

- The Cerci: Modified into unjointed forceps (Forficulina), In female they are short, straight and undented while in male they are long, forked and armed (Forficula). Cerci serve defensive, prehensile and copulatory functions.
- Four to five nymphal instars can be seen in insect in one season and show parental care for eggs

Activity:

1.Collect the listed insects and observe them for different key characters(Dermaptera)

Practical No.31

Objective: Habit, habitat and key characters of order Embioptera

- **Habit and Habitat:** The Embioptera are small, fragile, soft bodied, weakly flying, brown or yellowish-brown coloured insects. They live under stones barks and avoid the light but males are generally attracted by light. They show sexual dimorphism as the the males being winged while the females remain apterous. Strikingly, they construct silken tunnels for inhabitation and can run forward as well as backward with equal efficiency. They form a colony by living in a series of superimposed tunnels communicating with each other. Males are carnivorous, while females are herbivorous. Females show parental care for their offsprings.

Key character

- Head: Prognathous, freely movable, with a ventral gula.
- Compound Eyes: Elliptical in shape, smaller in female.
- Ocelli: Absent.
- Antennae :Filiform, short even than head.
- Mouthparts: Well developed orthopteroid type. Mandibles are slender in male, broad in female. Maxillary palps are 5-segmented. Labial palps are 3-segmented.
- Thorax: Prothorax is smaller than meso and metathorax. It is divided into anterior and posterior divisions by a transverse suture in male while in female it is elongate and narrow.
- Wings: Only in males; Identical, flexible, membranous, covered with hairs; Radial vein is enclosing blood sinus: other veins are reduced, wing membrane is smoky in colour with longitudinal interveinal hyaline areas.
- Legs: Mostly equal in length, fore and hind femora are A large due to deposition of depressor tibial muscles. Tarsi are 3-segmented,. Metatarsus of forelegs is swollen and possess the spinning gland. They run very fast in both forward and backward direction .
- Abdomen:- 10 segmented well evident, 11 segment is represented by a pair of asymmetrical cerci . terga of 10^{th} segment is divided into 2 asymmetrical plates or hemitergites in the males .
- Cerci:- 2 segmented, asymmetrical in males .
- Tracheal system is 2 thorasic and 8 abdomenal spiracles
- 4 nymphal instars are found in these insect order .

Activity: 1.Collect the listed insects and observe them for different key characters (Dermaptera)

Practical No.32

Objective: Key characters of arctiidae and acrididae family in insect

Arctiidae	Acrididae
• It comes under order Lepidoptera • Metamorphosis is complete • Common name is tiger moth • Wings are conspicuously spotted or banded • They are nocturnal and attracted to light • Larvae is either sparsely hairy or densly haired (wooly bear) • Example: *Amscata moorei* (red hairy caterpillar)	• It comes under orthoptera • Incomplete metamorphosis • Common name is grasshopper • Tarsi is 3 segmented • Ovipositor is short and horny • Tympanum is located on one or either side of the first abdominal segments • Larvae resemble adults morphology except for the genital organs • Example : rice grasshopper *(Heigroglephus banian)*

Activity:

1. Collect and observe the morphometric character of red hairy caterpillar and grasshopper

Practical NO. 33

Objective:Identify the endopterygota order and their present status with respect to sister groups

- Endopterygota comprise insects with immature (larval) instars that are very different from their respective adults.
- The adult wings and genitalia are internalized in their preadult expression, developing in imaginal discs that are evaginated at the penultimate molt. Larvae lack true ocelli. The "resting stage" or pupa is nonfeeding and precedes an often active pharate ("cloaked" in pupal cuticle) adult.
- Two or three groups currently are proposed among the endopterygotes, of which one of the strongest is a sister group relationship termed amphiesmenoptera between the trichoptera (caddisflies) and Lepidoptera (butterflies and moths).
- A plausible scenario of an ancestral amphiesmenopteran taxon has a larva living in damp soil among liverworts and mosses followed by radiation into water (trichoptera) or into terrestriality and phytophagy (lepidoptera).
- A second (usually) strongly supported relationship is between order neuroptera and sister group coleoptera.
- A third, postulated relationship antliophora, unites diptera (true flies), siphonaptera(fleas), and mecoptera (scorpionflies and hanging flies).
- Debate continues about the relationships of these taxa, particularly concerning the relationships of siphonaptera.
- Fleas were considered sister to diptera, but molecular and novel anatomical evidence increasingly points to a relationship with a curious looking mecopteran.
- Strepsiptera is phylogenetically enigmatic, but resemblance of their first-instar larvae (called triungulins) to certain coleoptera, notably parasitic rhipiphoridae, and some wing base features have been cited as indicative of relationship.
- This placement is becoming less likely, as molecular evidence (and haltere development) suggests a link between Strepsiptera and Diptera.
- The long-isolated evolution of the genome can create a problem known as "long- branch attraction", in which nucleotide sequences may converge by chance events alone with those of an unrelated taxon with a similarly long evolution, for the strepsipteran notably with diptera. The issue remains unresolved.
- Several positions have been proposed for coleoptera but current evidence derived from female genitalia and ambivalent evidence from eye structure supports a sister group relationship to neuropterida

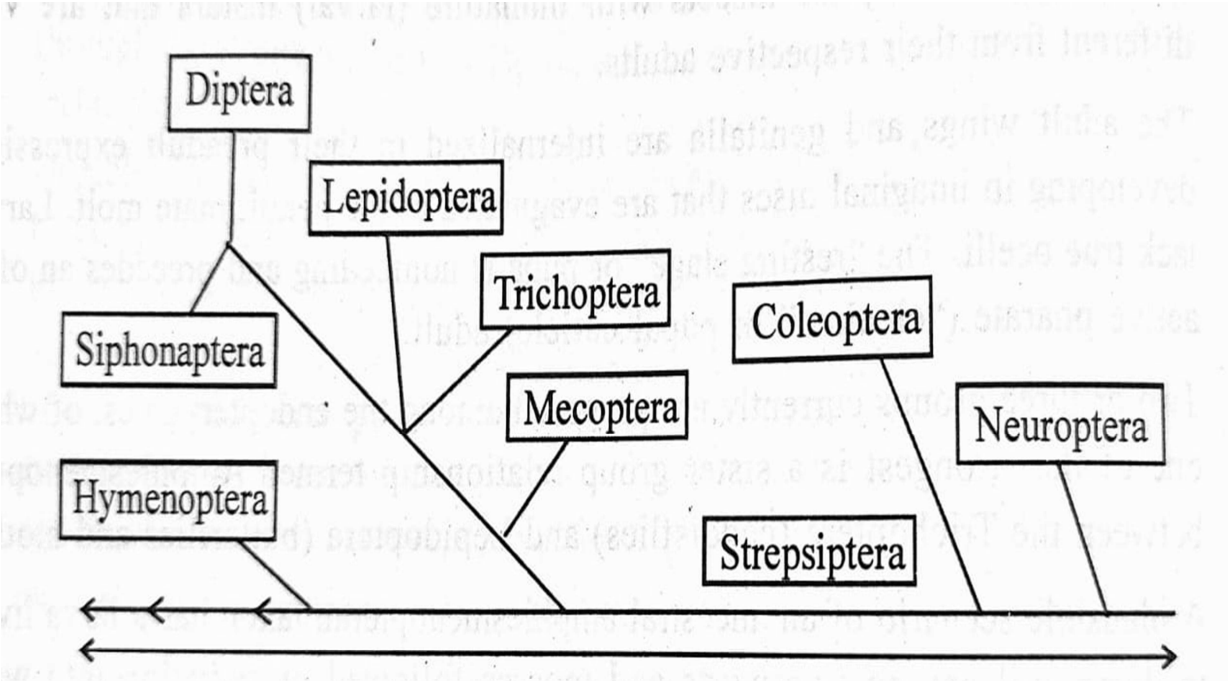


Fig. Sister group of endopterygote

Activity:

1.Collect and identify the endopterygote insect with sister group

Practical No.34

Objective: Taxonomic characters of order strepsiptera and mecoptera

Taxonomic character Strepsiptera

- Strepsiptera form an enigmatic order of nearly 400 species of highly modified endoparasites, most commonly of Hemiptera and Hymenoptera, and show extreme sexual dimorphism.
- The male has a large head with bulging eyes comprising few large facets and lacks ocelli.
- The antennae are flabellate or branched, with 4 to 7 segments.
- The forewings are stubby and lack veins, whereas the hind wings are broadly fanshaped, with few radiating veins; the legs lack trochanters and often also claws.
- Females are either coccoid-like or larvi form, wingless, and usually retained in a pharate (cloaked) state, protruding from the host.
- The first instar is a triungulin, without antennae and mandibles, but with three pairs of thoracic legs; subsequent instars are maggot-like, lacking mouthparts or appendages.

Taxonomic character Mecoptera

- Mecopterans are holometabolous insects comprising about 500 known species in nine families, with common names associated with the two largest families Bittacidae (hanging flies) and Panorpidae (scorpion flies).
- Adults have an elongate ventrally projecting rostrum, containing elongate, slendermandibles and maxillae, and an elongate labium.
- The eyes are large and separated, the antennae filiform and multi segmented.

- The fore- and hind wings are narrow, similar in size, shape, and venation, but often are reduced or absent.
- The legs may be modified for predation.
- Larvae have a heavily sclerotized head capsule, are mandibulate, and may have compound eyes comprising 3 to 30 ocelli.
- The thoracic segments are about equal and have short thoracic legs with fused tibia and tarsus and a single claw. The pupa is immobile, mandibulate, and with appendages free.

Activity:1. Collect and observe the morphometric character of strepsipteran and mecopteran

Practical No.35

Objective: Taxonomic characters of order siphonptera and trichoptera

Taxonomic character siphonaptera

- Siphonaptera is a highly modified order of holometabolous insects, comprising some 2400 species, all of which are bilaterally compressed,apterous ectoparasites.
- The mouthparts are specialized for piercing and sucking, lack mandibles, but have an upaired labral stylet and two elongate serrate, lacinialstylets that together lie within a maxillary sheath.
- A salivary pump injects saliva into the wound, and cibarial and pharyngeal pumps suck up the blood meal.
- Fleas lack compound eyes and the antennae lie in deep lateral grooves.
- The metathorax houses very large muscles associated with the long and strong hind legs which are used to power the prodigious leaps made by these insects

Taxonomic character Trichoptera

- Trichoptera contains about 45 extant families containing some 10,000 described species, with estimates of undescribed (mostly Southeast Asian) species diversity some four to fivefold higher.
- Trichoptera are holometabolous; the moth like adult has reduced mouthparts lacking any proboscis, but with three- to five segmented maxillary palps and three segmented labial palps.
- The antennae are multi segmented and filiform and often as long as the wings. The compound eyes are large, and there are two or three ocelli.
- The wings are haired or less often scaled and differentiated from all but the most basal Lepidoptera by the looped anal veins in the forewing and absence of a discal cell.
- The larva is aquatic, has fully developed mouthparts, has three pairs of thoracic legs (each with at least five segments), and lacks the ventral prolegs characteristic of lepidopteran larvae.
- The abdomen terminates in hook bearing prolegs.
- The pupa is also aquatic, enclosed in a retreat often made of silk, and possesses functional mandibles to aid in emergence from the sealed case.

Activity:

1. Collect and observe the taxonomic character of siphonopteran and trichopteran insect

Practical No. 36

Objective : Identify agriculturally important insects order with some identical l characters

Agriculturally important insect orders

1.Lepidoptera:-

This includes all moths and butterflies, characterized by scaly wings that are either darkly coloured or brightly coloured respectively .catterpillars are the damaging stage

2.Diptera :-

Includes all the true flies .appears to have a single pair of wings because hind wings are very much redused to a balancing organ called halters . maggots (larval stage) are the damaging stages. Consume liquids only through sucking mouthparts. Complete metamorphosis - a change in physical form from earlier stages in life to adulthood, includes 4 stages.

3.Coleoptera

Includes all the beetles and weevils characterized by the presence of heavily sclerotized fore wings boths grubs and adults are the damaging stages .undergo complete metamorphosis

4.Orthoptera

Includes all thegrasshoppers .theymaybe either solitary or in gregarious form . usually short horn grasshoppers turns to gregarious form commonly called locusts . generally cylindrical body, with elongated hindlegs and musculature adapted for jumping. They have mandibulate mouthparts for biting and chewing and large compound eyes, and may or may not have ocelli, depending on the species.

5.Thysanoptera

Includesthripssoft bodied minute insect barely visible to naked eyes ,some species may attain a length of 12 mm, causes curling of leaves with a streaks on the leaf surface . larval and adult stages are damaging stages .The compound eyes usually have large facets,ocelli are present in winged adults only. Another curious feature of thrips is that the right mandible is absent.

6.Isoptera

Includes termites.he compound eyes are frequently reduced, the antennae are long and multisegmented, and the fore wings and hind wings are generally similar, membranous, and have restricted venation they resemble ants in their structure they are soft bodied insects and prefer dry humid conditions their damage is more prevalent in unmanaged farms

7.Neuropteran

Includes green lace wing bugs .they are beneficial insects found to be a predator of many crop damaging insects Neuropterans are soft-bodied insects with relatively few specialized features. They have large lateral compound eyes, and may or may not also have ocelli. Their mouthparts have strong mandibles suitable for chewing, and lack the various adaptations found in most other endopterygote insect groups

8.Hemiptera

Includes all the bugs ,aphids , whiteflies ,leafhoppers . they are the sucking pest . sucks the sap from plant surface and cause stunting of plant. The true bugs have forewings that are hardened at the base and membranous at the tips. They sit flat over the abdomen hiding the membranous hind wings. The head and proboscis can flex forward. The hoppers have forewings that are uniform in texture and are held like a tent over the abdomen

9.Hymenoptera

Includes insets like wasps bees and sawflies .most of them are beneficial they serve as parasitoids . some of the insects like honeybees helps in production of products which are utilized by humans since ages. Hymenopterans are chiefly small to medium-sized insects, usually with four membranous wings and a narrow waist that sets off the abdomen from the thorax, or middle region of the body. The mouthparts may be either of the biting type or of the chewing and lapping type.

Activity:

1.Collect and identify the agriculturally important insect on the basis of taxonomic character