

## Chapter 6: Classification of insects

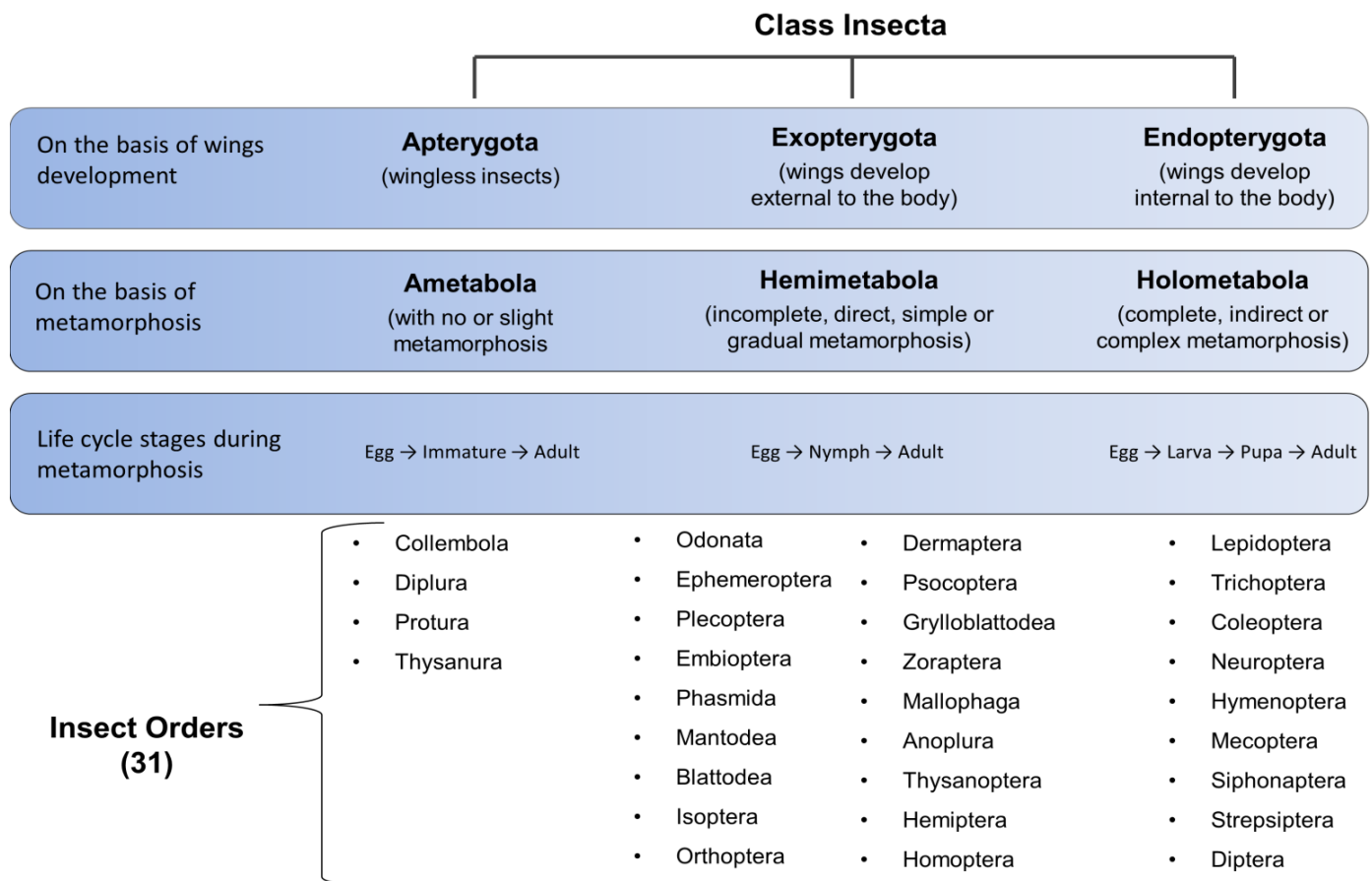
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Insects are invertebrates (organisms without a vertebral column or backbone) and belong to the class 'Insecta' of the subphylum 'Hexapoda' of the phylum 'Arthropoda' of the Kingdom 'Animalia' as lined out below;

**Kingdom:** Animalia → **Phylum:** Arthropoda → **Subphylum:** Hexapoda

Class insect includes the most conspicuous insect groups including ants, bees, beetles, butterflies, cockroaches, flies, grasshoppers, mosquitoes, moths, termites. On the planet earth, there are approximately 1.2 million described species of insects to date representing more than 90% forms of animal life.

On the basis of evolution, the class 'Insecta' is further divided into thirty one (31) insect orders as detailed below;



## Metamorphic groups of insect orders

### Ametabola (apterygota) insects:

#### 1. Collembola (4000 described species)

**Etiology (origin) of name:** “coll” mean stick or glue “embola” mean peg or wedge (refers to adhesive organ “collophore” on ventral side of abdomen).

**General habitat:** Moist and damp places, under leaf litter, plant pots etc.

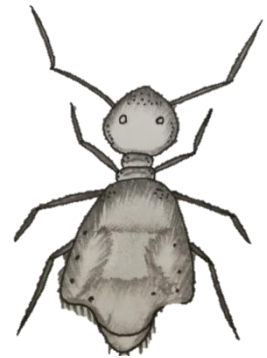
**Mouthpart types:** Chewing or piercing-sucking but entognathous.

**Salient identification features:**

- Minute insects (with body length about 6 mm)
- Abdomen 6-segmented
- Collophore on ventral side of 1<sup>st</sup> abdominal segment
- A forked jumping organ, ‘furcula’ present on ventral side of 4<sup>th</sup> abdominal segment

**Major families:** Sminthuridae, Entomobryidae, Isotomidae

**Examples:** Springtails, Lucerne Flea etc.



Lucerne Flea

#### 2. Diplura (800 described species)

**Etiology (origin) of name:** “Di” mean two and “ura” mean tail (refers to insects with two long fringe like tails or appendages at end of abdomen)

**General habitat:** Within or under moist soil, leaf litter or humus

**Mouthpart types:** Chewing but entognathous

**Salient identification features:**

- 2-5mm long body
- Antennae long and moniliform
- No compound or simple eyes
- Two long filaments or forceps-like appendages at abdominal end

**Major families:** Campodeidae, Japygidae

**Examples:** Diplurans or Doubletails, Campodeids Japygids



Doubletails

#### 3. Protura (800 described species)

**Etiology (origin) of name:** “Pro” mean first and “ura” mean tail (refers to insects before tail evolution in class insect or in other words primitive insects)

**General habitat:** Moist and damp soil surfaces

**Mouthpart types:** Piercing-sucking but entognathous

**Salient identification features:**

- Body length less than 3 mm (minute insects)
- No antennae and eyes
- Pro-legs project forwardly and function as antennae
- Last abdominal segment is called ‘a telson’ or tail
- Anamorphosis (addition of 3 abdominal segments during postembryonic developments)



Telsontail

**Major families:** Protentomidae, Eosentomidae

**Examples:** Proturans or Telsontails

#### 4. **Thysanura** (also called as Zygentoma) (500 described species)

**Etiology (origin) of name:** “thysan” mean fringe and “ura” mean tail (refers to long fringe or bristle-like tails at abdominal end)

**General habitat:** Damp places with polysaccharides including books, clothes, carpet, fabrics etc.

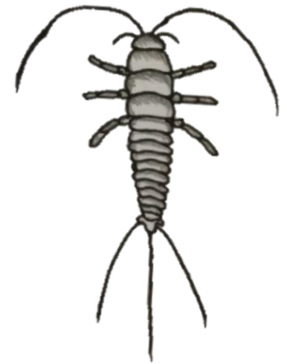
**Mouthpart types:** Chewing but ectognathus

**Salient identification features:**

- 15-25mm body length
- Body covered with fine grey or silver scales
- Antenna very long and setaceous
- Three long caudal filaments at abdominal end

**Major families:** Lepismatidae, Machilidae

**Examples:** Silverfishes and firebrats, Jumping bristletails, (*Lepisma saccharina*, a common silverfish found in old books)



Silverfish

### **Hemimetabola (exopterygota) insects**

#### 5. **Odonata** (6,000 described species)

**Etiology (origin) of name:** “odon” means tooth (literarily refers to insects with teeth on mandibles)

**General habitat:** Near water bodies (canals, river streams, water springs) because nymphs of these insects are aquatic or semi-aquatic

**Mouthpart types:** Chewing or mandibulate (Predacious insects)

**Salient identification features:**

- Compound eyes very large and prominent
- Wings almost equal and greatly veined with nodus and stigma (black spots along anterior margin of fore-wing).
- Nymphs aquatic (naiads) with spoon-shaped labium for catching prey



Dragonfly

**Major families:** Suborder: Anisoptera (Dragonflies), Libellulidae, Aeshnidae, Suborder: Zygoptera (Damselflies), Agrionidae

**Examples:** Dragonflies and Damselflies

#### 6. **Ephemeroptera** (3,000 described species)

**Etiology (origin) of name:** “ephemeron” mean brief or short (refers to very short life cycle of these insects)

**General habitat:** Near water bodies (canals, river streams, water springs) because nymphs of these insects are aquatic or semi-aquatic

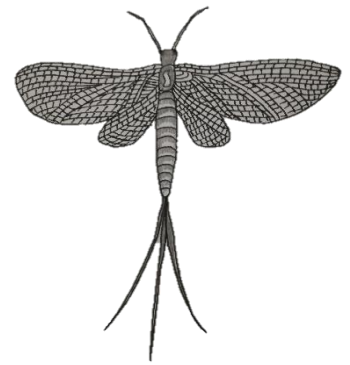
**Mouthpart types:** Chewing or mandibulate, (vestigial (nonfunctional) in adults)

**Salient identification features:**

- Very delicate and slender body
- Antennae short and setaceous
- Fore wings large and hind wings greatly reduced (both are membranous)
- Abdomen with 2 or 3 long caudal filaments
- Nymphs aquatic (naiads)

**Major families:** Ephemeridae, Ephemerellidae, Baetidae, Caenidae

**Examples:** Mayflies



Mayfly

## 7. Plecoptera (3,300 described species)

**Etymology (origin) of name:** “pleco” mean folded and “ptera” mean wings (refers to the hind wings pleated under forewings during insect resting position)

**General habitat:** On stones, rocks and vegetation etc. near water bodies (canals, river streams, waterfalls and springs) because nymphs of these insects are aquatic or semi-aquatic

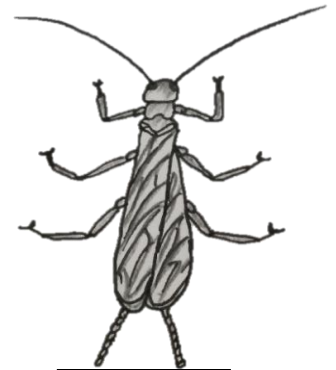
**Mouthpart types:** Chewing or mandibulate (vestigial in adults)

**Salient identification features:**

- Antennae long and setaceous
- Hind wings larger than fore wings
- Long paired cerci (singular cercus) at abdominal end
- Prominent round black compound eyes
- Nymphs aquatic (naiads)

**Major families:** Perlidae, Nemouridae

**Examples:** Stoneflies



Stonefly

## 8. Embioptera (750 described species)

**Etymology (origin) of name:** “embios” mean lively and “ptera” mean wings (refers to their brisk flying capacity both forwardly and backwardly)

**General habitat:** Damp places with polysaccharides including books, clothes, carpet, fabrics etc.

**Mouthpart types:** Chewing

**Salient identification features:**

- 15-20mm long brown or black cylindrical body
- Sexual dimorphism (♂ & ♀ different from each other)
- Tarsi 3-segmented, 1<sup>st</sup> segment of front tarsi greatly swollen to contain silk gland
- Paired short 2-segmented cerci

**Major families:** Embiidae, Oligotomidae

**Examples:** Embiids or Webspinners



Webspinner

## 9. Phasmida (Phasmatodea) (2,500 described species)

**Etymology (origin) of name:** “phasm” means phantom or ghost or shade (refers to fantastic camouflage of these insects with their background)

**General habitat:** Trees and shrubs foliage and canopies, grasses, leaf-litter

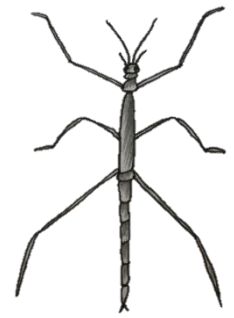
**Mouthpart types:** Chewing or mandibulate (Herbivores)

**Salient identification features:**

- Winged or wingless insects with elongated (stick like) or flattened (leaf like) body
- Similar long and slender legs

**Major families:** Phasmidae (stick insects), Phylliidae (leaf insects)

**Examples:** Stick-insects (also called as walking-sticks) and Leaf-insects



Stick Insect

## 10. Mantodea (Superorder: Dictyoptera (2,500 described species))

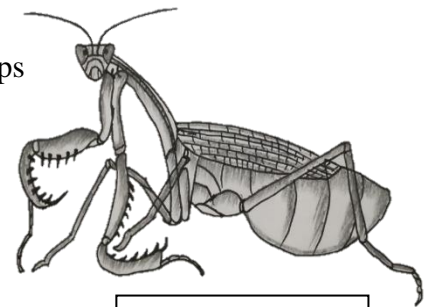
**Etiology (origin) of name:** “mantis” mean diviner or soothsayer (refers to ancient Greeks’ belief of these insects having spiritual powers)

**General habitat:** Tree canopies, grasses, shrubs, herbs, agricultural crops

**Mouthpart types:** Chewing or mandibulate (predacious)

**Salient identification features:**

- Elongated body with triangular head having bulging eyes
- Forelegs are raptorial (modified for capturing prey)



Praying mantid

**Major families:** Mantidae

**Examples:** Mantids or praying mantid

## 11. Blattodea (Superorder: Dictyoptera) (4,500 described species)

**Etiology (origin) of name:** “blatta” mean cockroach

**General habitat:** Ubiquitously present in human dwellings, under leaf litter, sewerage system etc.

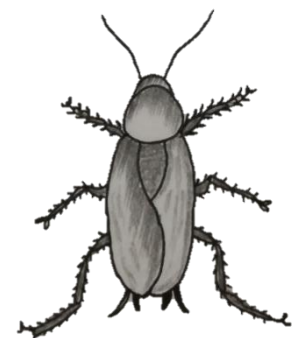
**Mouthpart types:** Chewing or mandibulate

**Salient identification features:**

- Antennae long and setaceous
- Body flattened with prothorax forming a prothoracic shield
- Two short unsegmented cerci at abdominal end
- Males with leathery wings and females wingless

**Major families:** Blattidae

**Examples:** Cockroaches: American cockroach (*Periplaneta americana*), German cockroach, Oriental cockroach



American Cockroach

## 12. Isoptera (Superorder: Dictyoptera) (3,500 described species)

**Etiology (origin) of name:** “iso” mean similar and “ptera” mean wings (refers to very identical pair of wings)

**General habitat:** Decaying wood, leaf litter, soil sub-surface, dry wood logs, plant roots, damp wooden infrastructures

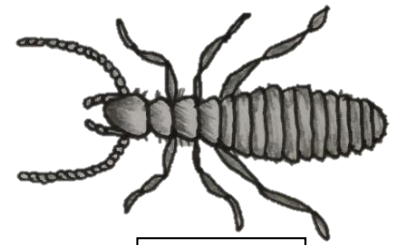
**Mouthpart types:** Chewing

**Salient identification features:**

- 5-20 mm soft-bodied social insects
- Live in colonies containing queen, workers, soldiers etc.
- Antennae moniliform
- Wings membranous and similar in shape
- Cerci short segmented.

**Major families:** Termitidae (odontotermes species), Rhinotermitidae (coptotermes species)

**Examples:** Termites also called as white-ants



Termite

**13. Orthoptera** (27,500 described species)

**Etiology (origin) of name:** “ortho” means strait and “ptera” means wings

**General habitat:** Tree canopies, shrubs and weeds foliage, grasses, leaf-litter, crops, human-dwellings

**Mouthpart types:** Chewing or mandibulate (Herbivores)

**Salient identification features:**

- Winged, brachypterous or apterous insects with elongated and cylindrical body
- Hind legs with developed femur for jumping (saltatorial type of leg)
- Forewings narrow and leathery (tegmina) and hindwings broad and membranous
- Paired short and unsegmented cerci



Grasshopper

**Major families:** Tettigoniidae (katydids), Gryllidae (crickets), Acrididae (grasshoppers and locusts)

**Examples:** Grasshoppers (ak grasshopper, *Poekilocerus pictus*), Crickets (house cricket, *Acheta domestica*), Katydids (maize katydid)

**14. Dermaptera** (2,000 described species)

**Etiology (origin) of name:** “derma” mean skin and “ptera” mean wings (refers to folding of membranous hind wings under rarely used short forewings when rest)

**General habitat:** Cracks and cervices, soil subsurface, under tree bark, leaf-litter etc. (nocturnal (active in night) insects)

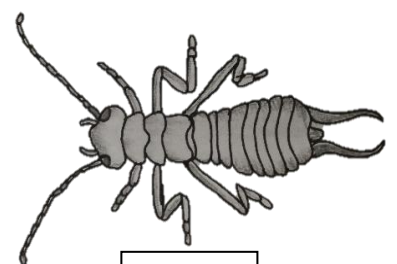
**Mouthpart types:** Chewing or mandibulate (predacious, herbivores, scavengers)

**Salient identification features:**

- Elongated body with short stout forewings and broad membranous hindwings which remain folded under forewings when not in use
- Forceps like pincers or cerci at abdominal end

**Major families:** Foreficulidae

**Examples:** Earwigs (refers so as their membranous hind wing shape is like human ears)



Earwig



## 15. Psocoptera (5,000 described species)

**Etiology (origin) of name:** “psocos” mean gnawing and “ptera” mean wings (refers to small winged insects which gnaw while feeding)

**General habitat:** Old books (booklice) and under tree bark (barklice)

**Mouthpart types:** Chewing or mandibulate (scavengers, mycophagous)

**Salient identification features:**

- Few millimeter-long minute soft-bodied insects
- Two pairs of small membranous wings
- Antennae usually long and setaceous

**Major families:** Psocidae

**Examples:** Psocids (booklice and barklice)



Psocids

## 16. Grylloblattodea (45 described species)

**Etiology (origin) of name:** “gryllo” mean cricket “blatta” mean cockroach

**General habitat:** Inside dark caves and rocks cracks and crevices

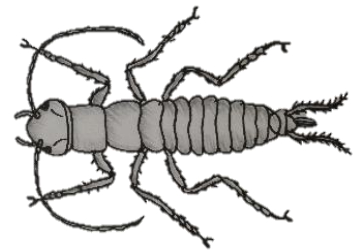
**Mouthpart types:** Chewing

**Salient identification features:**

- Apterous cricket like insects
- Antennae long and filiform
- Long 8-segmented cerci

**Major families:** Grylloblattidae

**Examples:** Rock-crawlers



Rock-crawlers

## 17. Zoraptera (45 described species)

**Etiology (origin) of name:** “zor” means pure and “aptera” means wingless

**General habitat:** Under tree bark or leaf litter or decaying wood

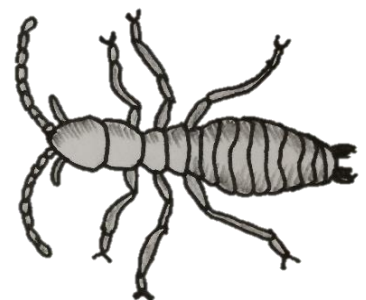
**Mouthpart types:** Chewing or mandibulate, (Herbivores)

**Salient identification features:**

- Soft-bodied minute (few mm long) wingless (rarely winged) insects
- Nine segmented moniliform antennae

**Major families:** Zorotypidae

**Examples:** Zorapterans



Zorapterans

## 18. Mallophaga, (Superorder: Phthiraptera) (3,000 described species)

**Etiology (origin) of name:** “mallo” mean wool or feather and “phaga” mean to eat. (refers to feeding behavior of these lice on dead epidermal skin, hairs and feather)

**General habitat:** External parasites in feathers of wild and domestic birds and on skin of some mammals

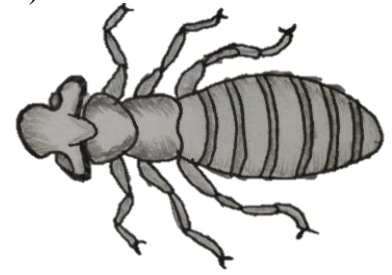
**Mouthpart types:** Chewing or mandibulate, (carnivores/hematophagous)

**Salient identification features:**

- Minute wingless insects with flattened body
- Head broader than thorax
- Ecto-parasites of birds and mammals
- Legs clinging type

**Major families:** Philopteridae (chicken and duck lice)

**Examples:** Chicken louse, Duck louse, Horse louse



Chicken louse

**19. Anoplura** (previously known as Siphunculata), (Superorder: Phthiraptera) (500 described species)

**Etiology (origin) of name:** “anoplos” mean unarmed and “ura” mean tail (may be referring to their round-tipped abdomen without cerci)

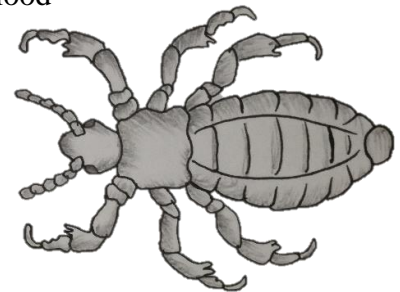
**General habitat:** Skin of mammals including humans sucking on blood

**Mouthpart types:** Piercing-sucking (carnivores/hematophagous)

**Salient identification features:**

- Minute wingless insects with flattened body
- Head narrow than prothorax and cone-shaped
- Ecto-parasites of humans
- Legs clinging type

**Major families:** Pediculidae



Human louse

**Examples:** Human lice, (*Pediculus humanus*)

**20. Thysanoptera** (6,000 described species)

**Etiology (origin) of name:** “thysano” mean fringe and “ptera” mean wings (refers to rod-shaped fringed wings)

**General habitat:** On plant foliage

**Mouthpart types:** Scrapping-sucking or piercing-sucking, (herbivores)

**Salient identification features:**

- Minute (1 mm) insects with elongated slender body
- Wings long narrow and rod-like fringed with long hairs
- Abdominal end cone-shaped

**Major families:** Thripidae

**Examples:** Onion thrips, Cotton thrips (*Thrips tabaci*)



Onion thrips

**21. Hemiptera** (Superorder: Heteroptera) (5500 described species)

**Etiology (origin) of name:** “hemi” means half and “ptera” means wings (refers to heme-elytra type forewings of these insects)

**General habitat:** Plant foliage (leaves, young sprouts) twigs, stems, tree trunks etc.

**Mouthpart types:** Piercing-sucking (Herbivores, some species are predatory or hematophagous)

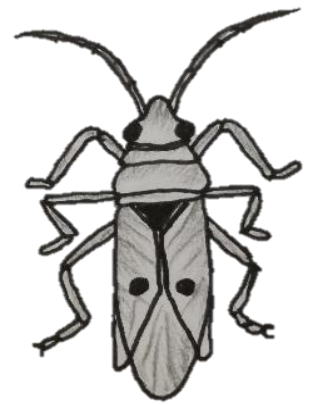


**Salient identification features:**

- Antennae long generally filiform
- Forewing modified into hemelytra with basal portion membranous and apical portion membranous
- Hind wing membranous
- Labium modified into sucking proboscis arising from front of head

**Major families:** Pentatomide (painted bugs), Lygaeidae (dusky cotton bug), Reduviidae (Assassin bugs), Belostomatidae (giant water bug)

**Examples:** Potato bug, (*Nazara viridula*), Green shield bugs, Red cotton bug, Dusky cotton bug, Bed bug



Red Cotton Bug

## 22. Homoptera, (Superorder: Heteroptera) (40,000 described species)

**Etiology (origin) of name:** “homo” mean similar or uniform and “ptera” mean wings (refers to uniform texture of their forewings)

**General habitat:** Plant foliage (leaves, young sprouts) twigs, stems etc.

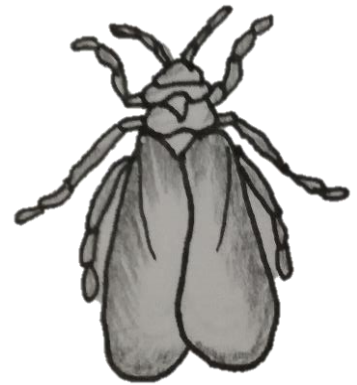
**Mouthpart types:** Piercing-sucking, (Herbivores)

**Salient identification features:**

- Small insects with piercing-sucking mouthparts
- Labium modified into sucking proboscis, arising from postero-ventral side of head and between front legs bases
- Antennae very short and setaceous

**Major families:** Cicadidae, (treehopper), Delphacidae, (white-backed plant hoppers, Lophoidae, (sugarcane pyrilla) Margarodidae, (mango mealybug) Pseudococcidae, (citrus mealybug)

**Examples:** Mango mealy bug, Citrus mealybug, Cotton whitefly, Cotton aphid, Rice leaf hoppers, Sugarcane pyrilla (hopper), Cotton jassids.



Cotton whitefly

## Holometabola (endopterygota) insects:

### 23. Lepidoptera (182,000 described species)

**Etiology (origin) of name:** “lepto” means scale and “ptera” means wings, (refers to bodies and wings of these insects covered with fine powdery scales)

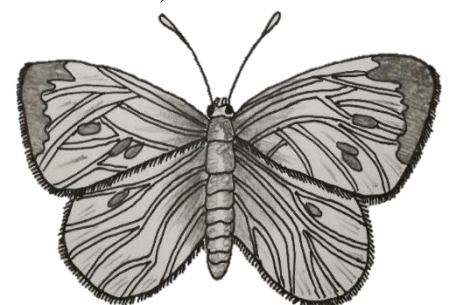
**General habitat:** Adults free livings and larvae can be found on or near plants or vegetation

**Mouthpart types:** Adults with siphoning mouthparts (feed on plant nectarines etc.). Larvae with chewing or mandibulate mouthparts (feed on plant parts)

**Salient identification features:**

- Winged insects with scales coving all their body, wings and legs
- Wings membranous with few cross veins
- Long coiled sucking proboscis in adults

**Major families:** Pieridae (cabbage butterfly, Papilionidae (lemon butterfly), Danaidae (AK butterfly, Noctuidae (cotton bollworms or moths), Sphingidae (hawk moths)



Cabbage Butterfly

**Examples:** Monarch or AK butterfly, Citrus butterfly, Cabbage butterfly, American bollworm, Spotted bollworm, Pink bollworm, Armyworm.

## **24. Trichoptera** (7,000 described species)

**Etiology (origin) of name:** “tricho” mean hair and “ptera” mean wings

**General habitat:** Within or around water bodies (water streams, waterfalls, rivers, lakes)

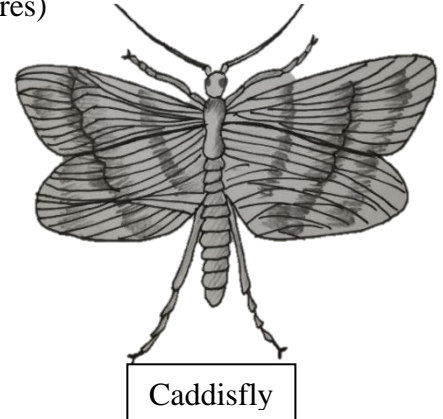
**Mouthpart types:** Chewing or mandibulate, (predacious, herbivores)

**Salient identification features:**

- Moth-like insects with no of scales on body
- Antennae long and setaceous,
- Wings hairy with very few cross veins
- Larvae aquatic, usually construct cocoons or cases with debris, twigs and sand particles

**Major families:** Hydroptilidae

**Examples:** Caddisflies



## **25. Coleoptera** (400,000 described species) (largest insect order: 40% of described insect species)

**Etiology (origin) of name:** “coleo” mean sheath and “ptera” mean wings, (refers to hard forewings (elytra) of these insects)

**General habitat:** Diverse habitats including plants foliage, roots, post-harvest produce, water, soil surfaces, leaf litter etc.

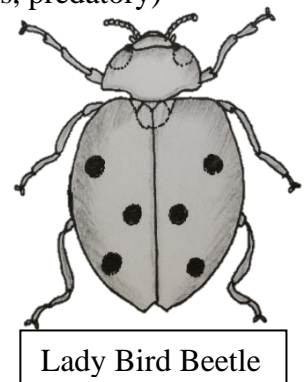
**Mouthpart types:** Chewing or mandibulate, (herbivores, carnivores, scavengers, predatory)

**Salient identification features:**

- Forewings modified into hard and thickened elytra meeting in a straight line on back
- Hind wings usually membranous and concealed under forewings at rest

**Major families:** Curculionidae, Tenebrionidae, Staphylinidae, Coccinellidae, Carabiadae, Scarabaeidae

**Examples:** Beetles and Weevils



## **26. Neuroptera** (6,100 described species)

**Etiology (origin) of name:** “neuro” mean nerve or net and “ptera” mean wings, (refers to transparent wings with a prominent wing venation)

**General habitat:** Free living (near water bodies, in soil, plant foliage etc.)

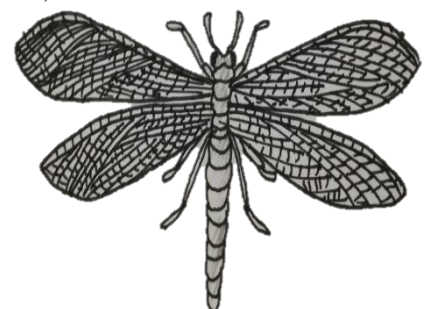
**Mouthpart types:** Chewing or mandibulate (Predacious insects)

**Salient identification features:**

- Transparent elongate wings with numerous cross-veins
- Predacious insects with long antennae

**Major families:** Chrysopidae, Mantispidae, Myrmeleontidae

**Examples:** Aphid-lions (green lacewing), Mantidflies, Ant-lions



## 27. Hymenoptera (150,500 described species)

**Etiology (origin) of name:** “hymen” means strait and “ptera” means wings

**General habitat:** Diverse habitats

**Mouthpart types:** Chewing-mandibulate or Chewing-lapping), (herbivores, carnivores, omnivores, scavengers)

**Salient identification features:**

- Winged usually membranous and hind pair bear coupling hooks at their anterior margins
- Usually have a narrow-constricted waist (petiole) between thorax and abdomen
- Antennae usually long and elbow-shaped (geniculate)

**Major families:** Tenthredinidae, Vespidae, Trichogrammatidae, Apidae, Formicidae

**Examples:** Wasps, Ants, Bees, Sawflies



Honey Bee

## 28. Mecoptera (600 described species)

**Etiology (origin) of name:** “meco” mean long and “ptera” mean wings, (refers to long identical fore and hind wigs of these insects)

**General habitat:** Moist and damp places such as under leaf litter in tropical and temperate forests

**Mouthpart types:** Chewing or mandibulate (scavengers)

**Salient identification features:**

- Head prolonged ventrally to form a thick beak-like structure
- Antennae long and filiform
- Wings long, narrow and similar
- Adnominal end resembles scorpion tail with two short cerci

**Major families:** Panorpidae

**Examples:** Scorpionflies



Scorpionfly

## 29. Siphonaptera (2,500 described species)

**Etiology (origin) of name:** “siphon” mean gnawing and “ptera” mean wings, (refers to small winged insects which gnaw while feeding)

**General habitat:** External parasites of humans, mammals, birds etc.

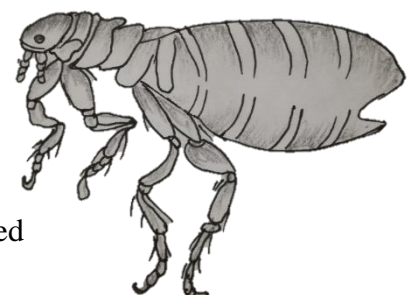
**Mouthpart types:** Piercing-sucking (hematophagous)

**Salient identification features:**

- Up to 3 mm long wingless insects
- External (ecto) parasites of humans, mammal and birds
- Body strongly depressed or flattened with backwardly directed hairs or spines in rows

**Major families:** Pulicidae (Human fleas)

**Examples:** Human flea, Rat flea, Bird flea



Bird flea

### 30. Strepsiptera (600 described species)

**Etymology (origin) of name:** “strep” mean twisted or folded” and “ptera” mean wings, (refers to their twisted or foldable hind wings)

**General habitat:** Inside bodies of their hosts (bees, wasps and leafhoppers)

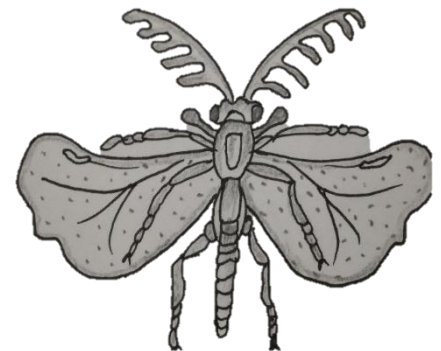
**Mouthpart types:** Chewing or mandibulate (parasitic)

**Salient identification features:**

- Wasp-like insects with hind wings twisted when at rest
- Forewings reduced in to halteres
- Antennae long and filiform
- Long 8-segmented cerci

**Major families:** Stylopidae (parasitic stylopids)

**Examples:** Stylopids



Stylopids

### 31. Diptera (127,000 described species)

**Etymology (origin) of name:** “Di” means two and “ptera” means wings, (refers to only one prominent pair of forewings while hind wings are extremely reduced in halteres)

**General habitat:** Diverse

**Mouthpart types:** Piercing-sucking Or Sponging type (Omnivores, herbivores, carnivores, scavengers, hematophagous etc.)

**Salient identification features:**

- Insects with one prominent pair of wings (forewings)
- Hind wings reduced in to halteres (knobbed structures)

**Major families:** Culicidae (mosquitos), Asilidae (robber fly), Tephritidae (fruit flies), Muscidae (house flies), Chironomidae (midges)

**Examples:** Mosquitos, House fly, Robber fly, Fruit fly, Horse fly, Crane fly, Midges.



House fly