

Insect Classification

Insect Classification

I. Elements of Classification

- Taxonomy- science of classifying organisms
 - Father of taxonomy- Linnaeus in 1758
 - Proposed system of binomial nomenclature
 - Every organism can be assigned a specific name using a two name system
 - Binomial name made up of genus and species name.
 - e.g. *Papilio glaucus* Linnaeus (Lepidoptera: Papilionidae)
 - *Leptinotarsa decemlineata* (Say) (Coleoptera: Chrysomelidae)

Insect Classification

- Classification- Ordering into a hierarchy of categories
- The Taxonomic Hierarchy- most inclusive to least
 - Phylum: Arthropoda
 - Class : Insecta
 - Order
 - Family:
 - Genus:
 - Species:
 - Each can be sub-grouped- i.e. Super or Sub e.g. Superfamily, subspecies

Insect Classification

- Systematics- study of diversity and classification
- Classification of Insects
 - A. 28 orders of insects
 - B. 7 of the 28 are the most diverse and cause the most problems

Insect Classification

II. C. How they Evolved

- **Class Insecta**
- **Subclass Apterygota:** Wingless Insects (Ametabolous or No metamorphosis)
- **Subclass Pterygota :** Wings in adult stage or lost
 - Infraclass Paleoptera:** Lack ability to flex wings on abdomen, Hemimetabolous or simple metamorphosis
 - Division Exopterygota:** Wings develop externally
 - Infraclass Neoptera:** Ability to flex wings over abdomen
 - Division Exopterygota :** Wings develop externally, Hemimetabolous or simple metamorphosis
 - Division Endopterygota:** Wings develop internally, Holometabolous or complete metamorphosis

Insect Classification

Subclass Apterygota

- Wingless Insects
- No Metamorphosis
- Entognathous Mouthparts- Inside head, not exposed
- Rest of Insects- ectognathous

Insect Classification

d. The Orders

i. Protura (170 spp.)

- Small (0.6-20 mm), whitish
- Stylet mandibles
- No eyes or antennae
- Anametamorphosis-
 - young have 9 segments, and 12 segments as adult
- Live in soil and feed on decayed matter
- Feed on organic debris and fungal spores

Insect Classification

ii. Diplura (675 spp.)

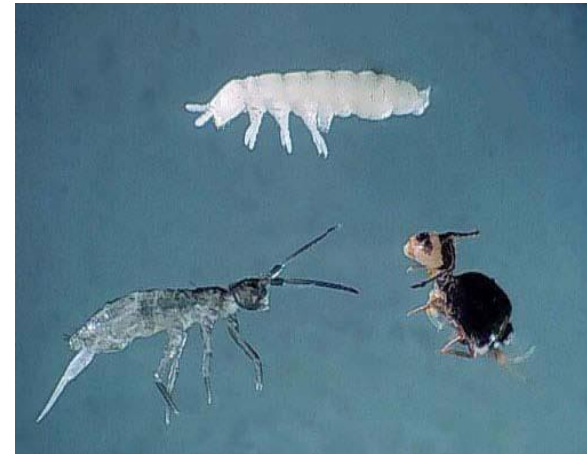
- Small <7 mm
- Blind
- Chewing mouthparts
- Live in soil and surface debris



Insect Classification

iii. Collembola- Springtails (2,000 spp.)

- 0.2- 10 mm in length
- Chewing mouthparts
- Eyes are ommatidia or eye spots
- Collophore- suction cup on 1st abdominal segment
- Furculum- tail apparatus, connects into tenaculum
- Moist environments
- Feed fleshly fungi, some on plants



Insect Classification

iv. Thysanura- Bristletails, Firebrats, Silverfish (330 spp.)

- 7-9 mm
- Flattened body
- May have small compound eyes
- Chewing mouthparts
- 2 long cerci and one caudal filament
- Eat starchy substances
- Some will eat wallpaper paste, book bindings, starched clothes



Insect Classification

2. Subclass Pterygota

- Wings in the adult stage
- Present
- Lost secondarily

Insect Classification

Infraclass Paleoptera

- Ancient in origin
- Lack ability to flex wings over abdomen
- 2 orders- Dragonflies/Damselflies & Mayflies
- **Division Exopterygota**
- Simple Development
- Wings develop externally in nymphs/larvae

Insect Classification

- v. **Ephemeroptera** (2,139 spp.)
- Mayflies
 - Large & most ancient group
 - Triangular, non-flexed wings, 3 tails
 - Simple development- egg, naiad, subimago, imago/adult
 - Larvae are aquatic, external abdominal gills
 - Predominantly stream dwellers
 - Larvae eat algae and decaying matter
 - Adults don't feed



Insect Classification

vi. **Odonata** (5,000 spp.)

- Dragonflies and damselflies
- Large, highly-coloured, elongated non-flexed wings
- Simple development- egg, naiad, adult
- Adults feed on insects
- Aquatic larvae eat insects or small animals
- Two Suborders

Insect Classification

I. **Anisoptera**- dragonflies

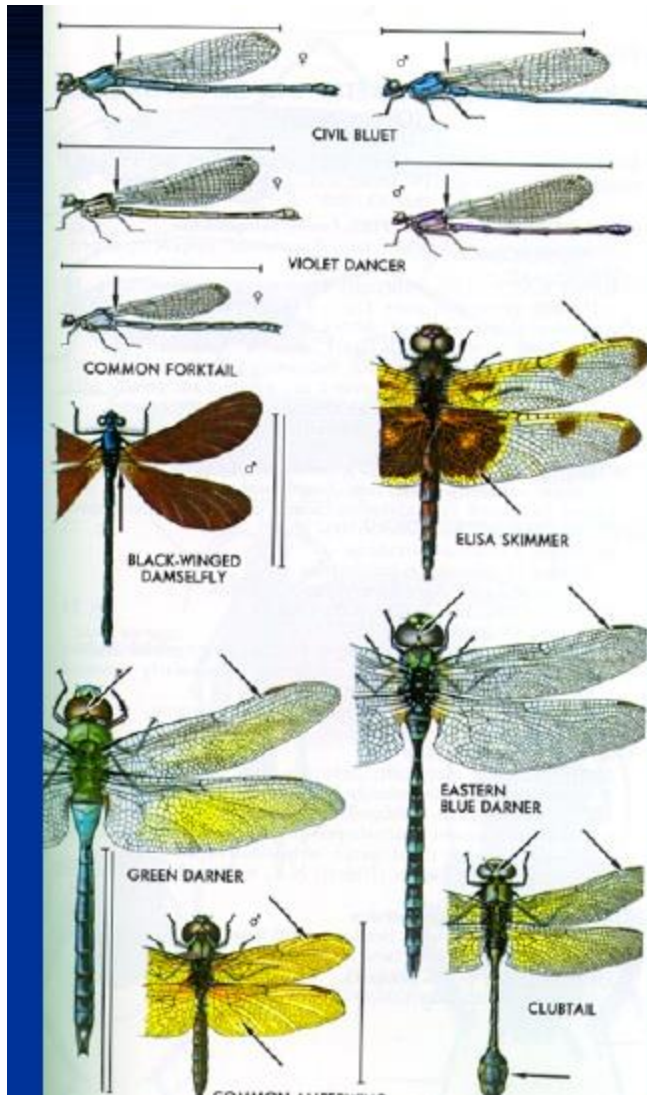
Strong fliers

Predacious

Larvae live in pond and
lake mud

Robust body, internal
rectal gills





Order Odonata



Larval Forms

Insect Classification

II. **Zygoptera**- damselflies

- Weak fliers
- Smaller than dragonflies
- Larvae slender, 3 external gills on abdomen
- Predacious
- Submerged vegetation in lakes and ponds



Insect Classification

c. Infraclass Neoptera

More recent in origin

Ability to flex wings over abdomen

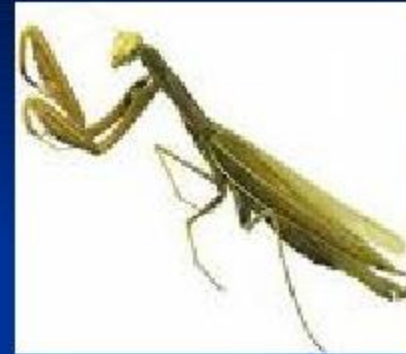
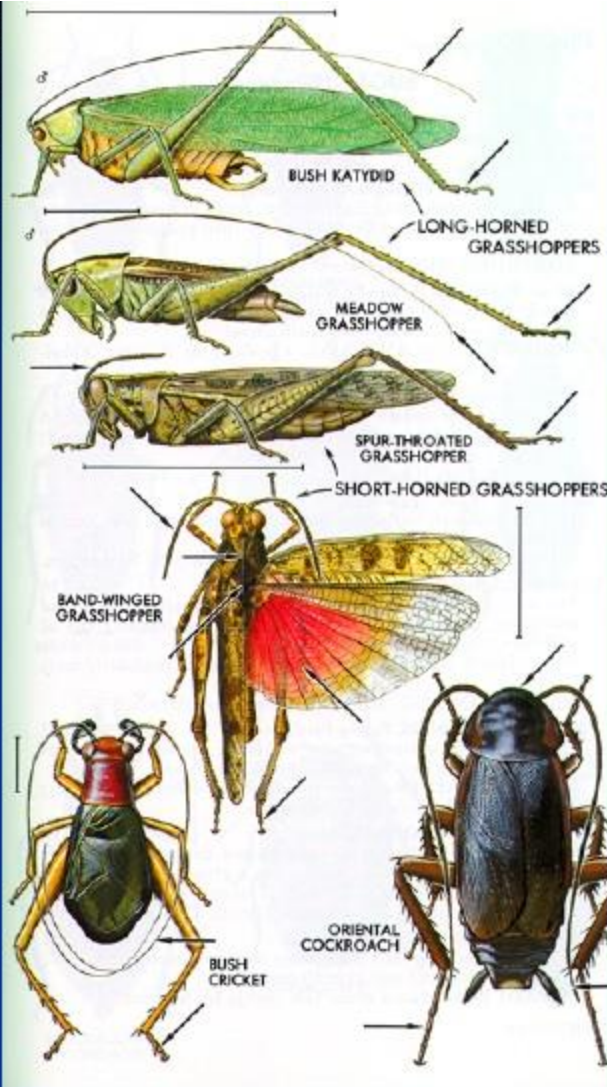
Includes all other orders

Division Exopterygota

Insect Classification

- v. **Orthoptera**- Roaches, grasshoppers, etc (30,000 spp.)
 - Chewing mouthparts
 - Simple development- egg, nymph, adult
 - Mesothoracic wings leathery covers- tegmina
 - Metathoracic wings fanlike
 - Wings folded over abdomen
 - Find mates through sound- stridulation

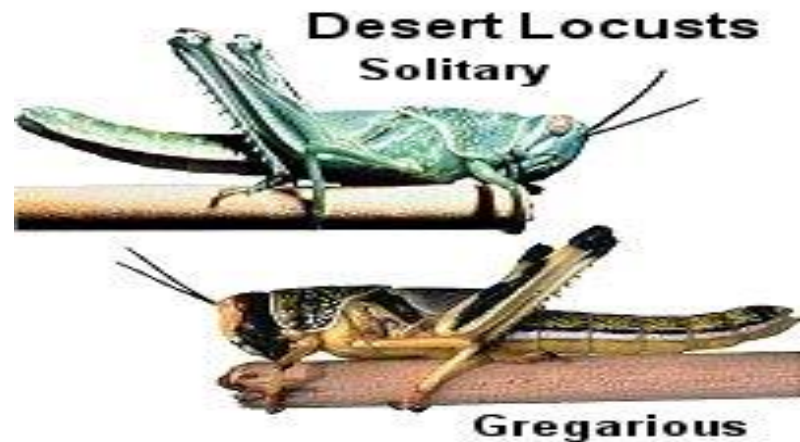
Order Orthoptera



Insect Classification

v. Orthoptera-

- Major Families
 - a. Short-horned grasshoppers :
Acrididae



Insect Classification

v. Orthoptera-

- Major Families

b. Long-horned
grasshoppers:
Tettigoniidae

- Katydid



Insect Classification

v. Orthoptera-

- Major Family
 - c. Crickets:
Gryllidae

Mole Cricket



Tree Cricket

Insect Classification

v. Orthoptera-

- Major Families
 - d. Walking sticks:
Phasmida



Insect Classification

v. Orthoptera-

- Major Families

e. Mantids:

Mantodae



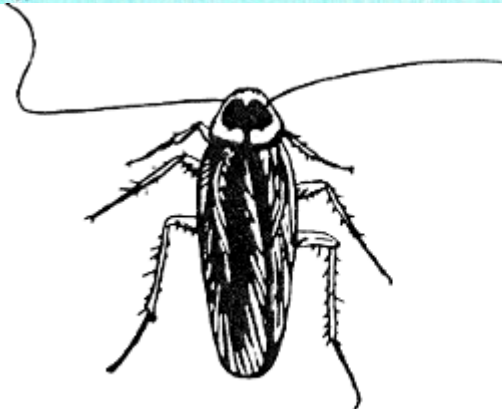
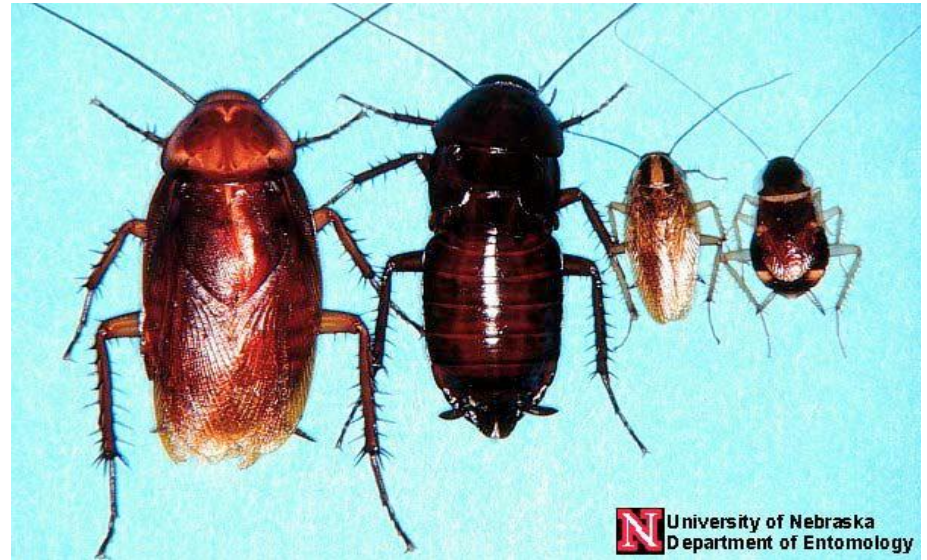
Insect Classification

v. Dictyoptera-

- Major Family

Blattoidea-

cockroaches



Adult

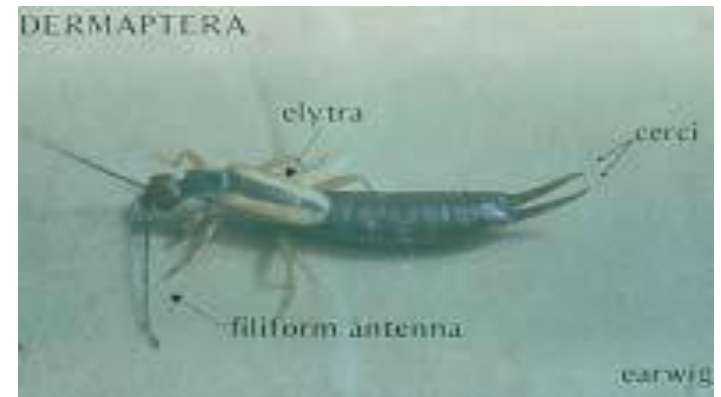


Nymph

Insect Classification

vi. **Dermaptera**- earwigs (1,200 spp.)

- 13 mm in length
- Pincer-like cerci on abdomen
- Winged or wingless
- Chewing mouthparts
- Simple metamorphosis-
egg, nymph, adult
- Eat decaying matter



Insect Classification

Isoptera: Termites (1,200 spp.)

- All forms feed on wood
- Wings equal in size
- Wide waist
- Caste system
- Simple metamorphosis
- Symbiotic dinoflagellates
- Mating system



Insect Classification

vii. **Isoptera**- Termites

- Major Families

- a. Kalotermitidae- drywood

- b. Rhinotermitidae- subterranean

Order Isoptera

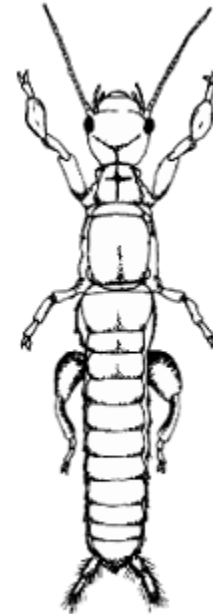


Termite Queen



Insect Classification

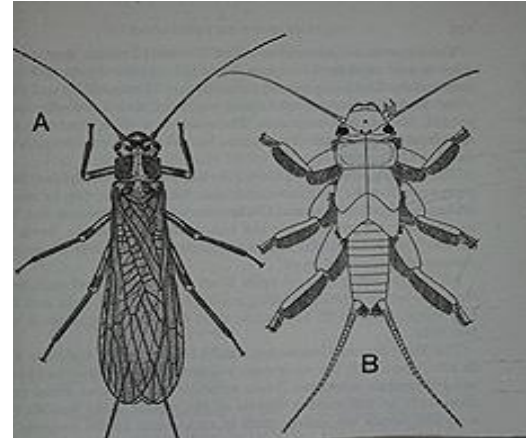
- viii. **Embioptera**- web spinners (149 spp.)
- 4-7 mm in length
 - Winged (M) or wingless (M, F)
 - Simple development
 - Chewing mouthparts
 - Eat decaying matter, fungi
 - Build silk tunnels under rocks
 - Not common- subtropical, tropical



Insect Classification

ix. **Plecoptera**- stoneflies (1,600 spp.)

- Two pairs of wings, folded back
- Two abdominal cerci
- Simple development- **egg, naiad, adult**
- Chewing mouthparts
- Larvae eat plants or predacious
- Streams and lakes



Insect Classification

x. **Zoraptera**- Zorapterans (24 spp.)

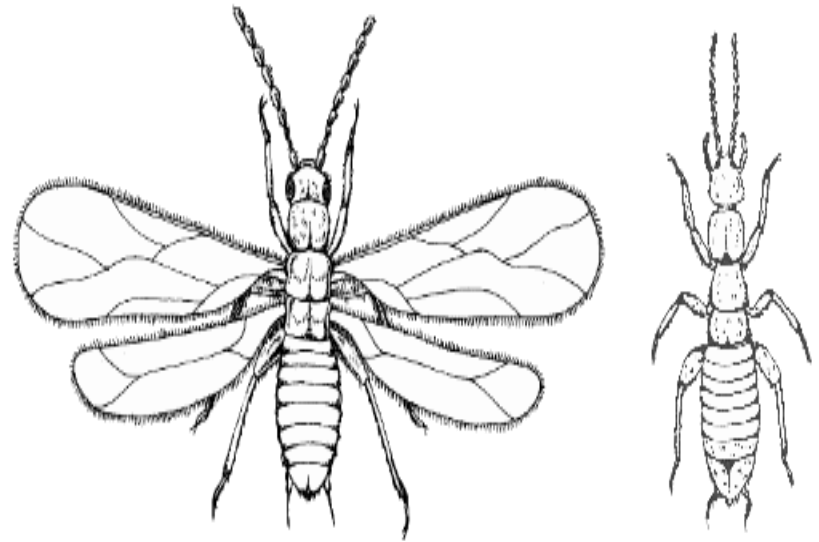
Rare, 3 mm in length

Resemble termites

Winged or wingless

Chewing mouthparts

Decaying logs , under bark
and in sawdust piles



Insect Classification

xi. **Psocoptera**- barklice,
book lice (1,647 spp.)

6 mm in length

Simple development

Chewing mouthparts

Eat pollen, fungi, starchy
substances



Insect Classification

xii. **Mallophaga**- chewing lice (2,675 spp.)

- Ectoparasites of mammals and birds
- Simple development
- Chewing mouthparts
- Feed on hair, skin, feathers, blood clots
- No wings, flat body, head wider than body
- Pests of domestic animals



Insect Classification

xiii. **Anoplura**- sucking lice (500 spp.)

- Ectoparasites of mammals
- Simple development
- Sucking mouthparts
- Feed on blood
- No wings, flattened body, head smaller than body

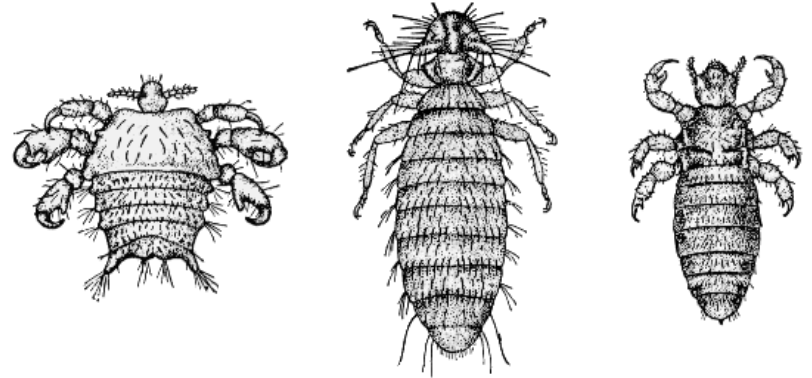
Insect Classification

xiii. Anoplura-

Major Families

a. **Pediculidae**- head and body lice

b. **Pthiridae**- crab lice



Insect Classification

xiv. **Thysanoptera**- thrips
(4,700 spp.)

2-3 mm in length

Simple development- **egg,**
nymph, adult

2 pairs of hairy wings

Rasping sucking mouthparts

Plant feeding or predacious

Pests of vegetables, flowers,
citrus, etc



Insect Classification

xv. Hemiptera- true bugs (23,500 spp.)

- Various sizes
- Simple development
- Sucking mouthparts
- Plants, predacious, blood feeders
- Can inflict a painful bite
- Wings- **mesothoracic-hemelytra**



BOXELDER BUG



FOUR-LINED PLANT BUG



AMBUSH BUG



SMALL MILKWEED BUG



SOUTHERN GREEN STINK BUG



COTTON STAINER



BLOODSUCKING CONE-NOSE

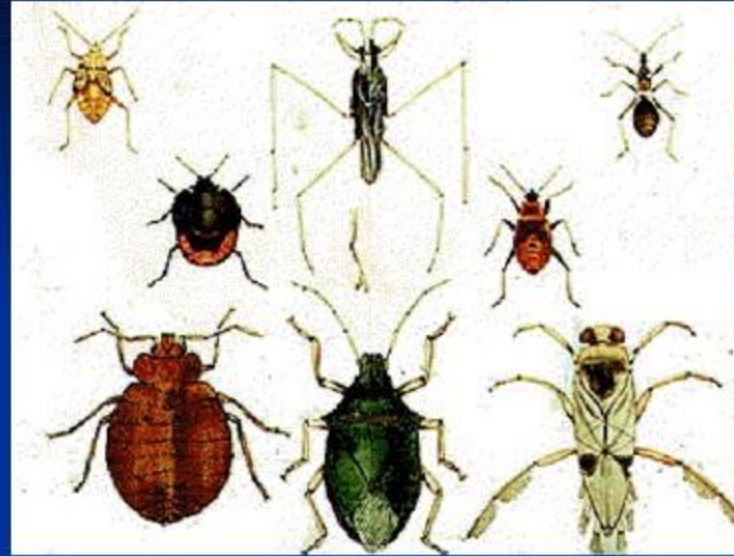


HARLEQUIN BUG



SQUASH BUG

Order Hemiptera



The Kissing Bug, transmits the deadly Chagas disease!



Insect Classification

xv. Hemiptera-

Major families

- a. Stink bugs: **Pentatomidae**
- b. Seed bugs: **Lygaeidae**
- c. Damsel bugs: **Nabidae**
- d. Minute pirate bugs: **Anthocoridae**
- e. Plant bugs: **Miridae**
- f. Assassin bugs: **Reduviidae**



Insect Classification

xv. Hemiptera-

Major families

b. Seed bugs: **Lygaeidae**



Insect Classification

xv. Hemiptera-

Major families

c. Damsel bugs:

Nabidae

d. Minute pirate bugs:

Anthocoridae



Insect Classification

xv. Hemiptera-

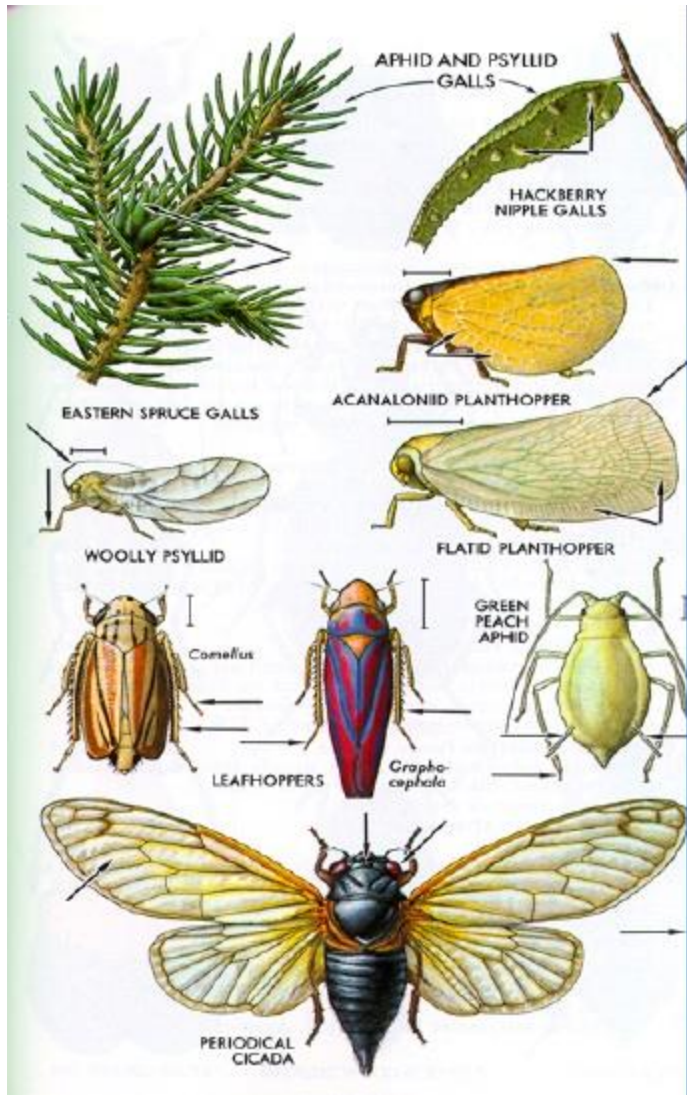
Major families

e. Plant bugs: **Miridae**





Insect Classification

xv. **Homoptera**- Aphids, leafhoppers, etc (33,000 spp.)

- Various sizes
- Simple development
- Sucking mouthparts- front of head
- Feed on plants
- Winged or wingless, may be reduced
- Male scales have 1 pair of wings



Order Homoptera

Molted skin

Insect Classification

xv. Homoptera-

- Major Families
 - a. Cicadas: **Cicadidae**
 - b. Aphids: **Aphididae**
 - c. Leafhoppers: **Cicadellidae**
 - d. Whiteflies : **Aleyrodidae**
 - e. Scales: **Coccoidae**

Insect Classification

xv. Homoptera-

- Major Families

a. Cicadas: **Cicadidae**



b. Aphids: **Aphididae**



Cicada Songs



- Many of these are from the Southeast Asia areas, but there are cicadas that are quite loud around here.

Insect Classification

xv. Homoptera-

- Major Families

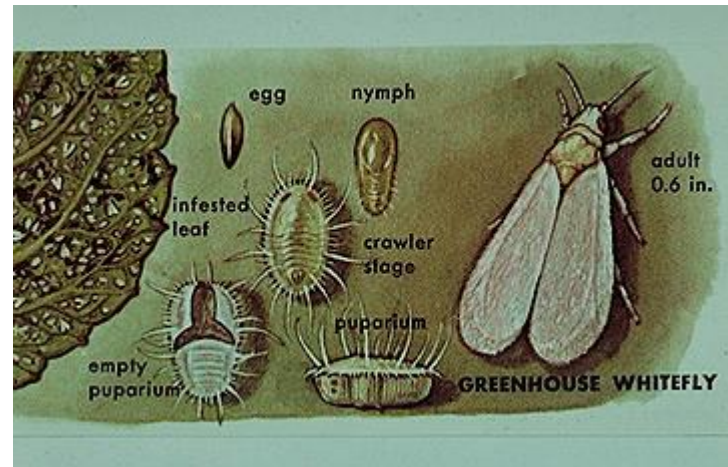
c. Leafhoppers:

Cicadellidae

d. Whiteflies :

Aleyrodidae

e. Scales: **Coccoidae**



Insect Classification

xvi. Division Endopterygota- Complex
Development

- Wings develop internally- Beetles, Bees, etc

Insect Classification

xvii. **Neuroptera**- Nerve-winged insects (4,700 spp.)

- Medium to large
- Many veined wings
- Chewing mouthparts
- Complex development
- Predacious
- Lacewings, alderflies, dobsonflies, antlions

Insect Classification

xvii. **Neuroptera**- Nerve-winged insects (4,700 spp.)

- Major Families:

- Lacewings: **Chrysopidae**

- Chrysopidae



Insect Classification

xvii. **Neuroptera**- Nerve-winged insects (4,700 sps)

- Major Families:
 - Dobsonflies :
Corydalidae



Insect Classification

xvii. **Neuroptera**- Nerve-winged insects (4,700 spp.)

- Major Families:
 - Antlions:
Myrmeleontidae



Insect Classification

xviii. **Coleoptera**- beetles (300,000 spp.)

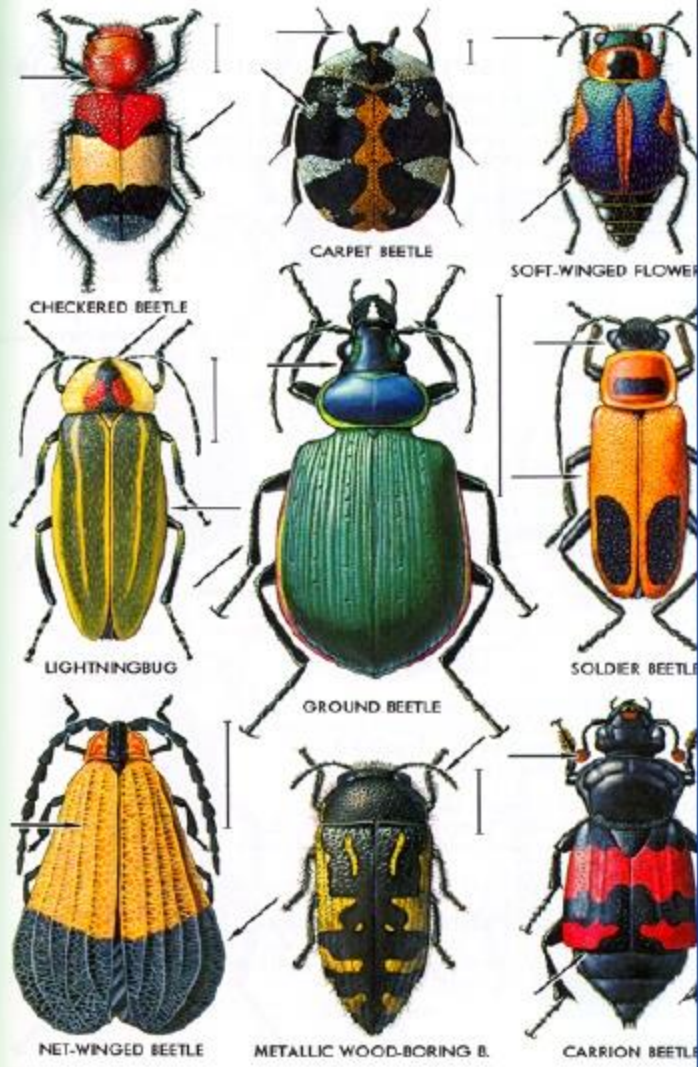
- Largest order
- Various sizes (N.A.- 1-75 mm)
- Complex development
- Chewing mouthparts
- Various food sources
- **Mesothoracic wings- elytra**

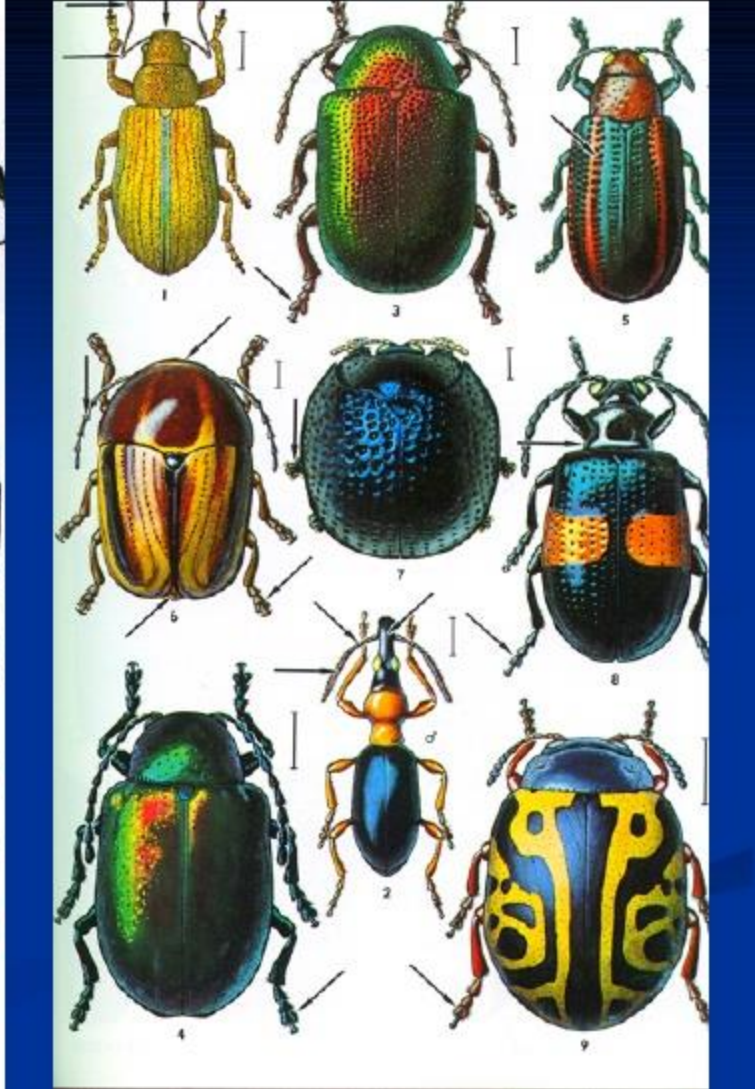
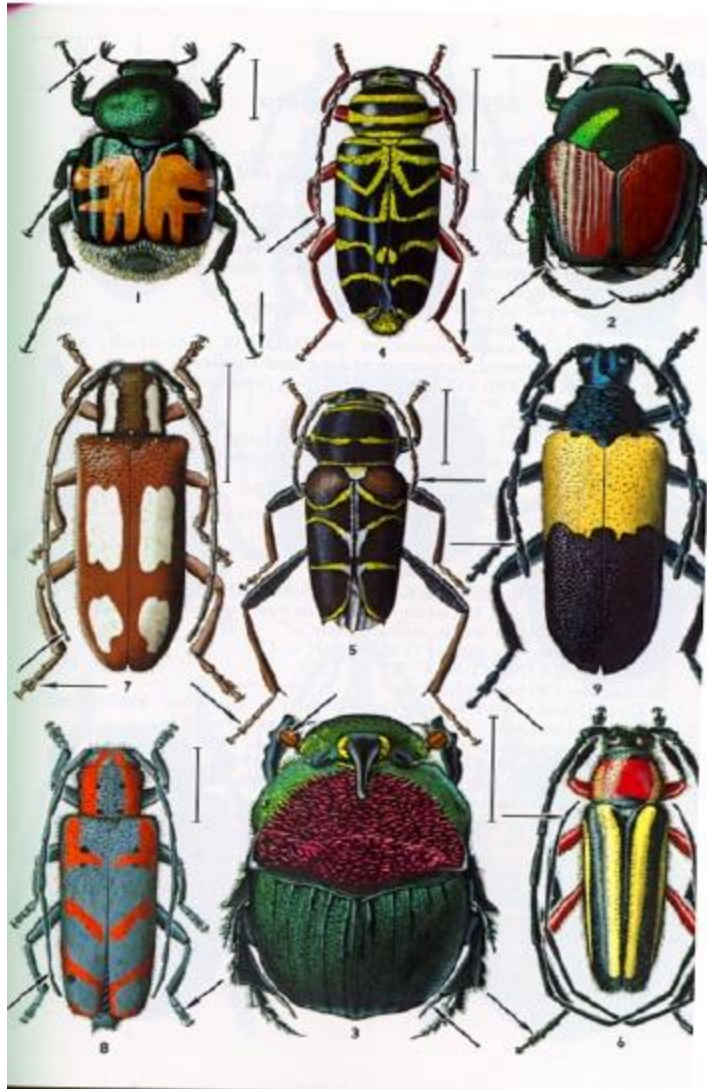
Order Coleoptera



Larval Beetle
Forms







Insect Classification

xviii. **Coleoptera-**

- Major Families
 - a. Ground Beetles: **Carabidae**
 - b. Leaf Beetles: **Chrysomelidae**
 - c. Skin Beetles : **Dermestidae**
 - d. Lady Bird Beetles: **Coccinellidae**
 - e. Weevils : **Curculionidae**
 - f. Long Horn Beetles: **Cerambycidae**
 - g. Bark Beetles: **Scolytinae**
 - h. Scarabs : **Scarabeidae**
 - i. Metallic wood boring Bettles: **Buprestidae**
 - j. Tiger Beetles : **Cicindelinae**

Insect Classification

xviii. Coleoptera-

- Major Families

a. Ground Beetles:

Carabidae

b. Leaf Beetles:

Chrysomelidae

c. Skin Beetles :

Dermeestidae



Insect Classification

xviii. **Coleoptera-**

- Major Families
- d. Lady Bird Beetles:
Coccinellidae



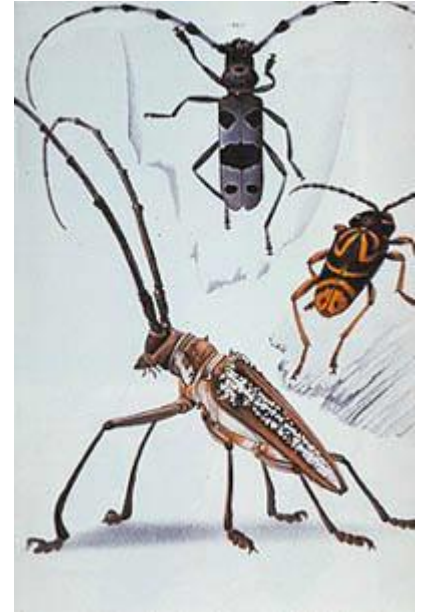
e. Weevils : **Curculionidae**



Insect Classification

xviii. **Coleoptera-**

- Major Families
 - f. Long Horn Beetles:
Cerambycidae



- g. Bark Beetles:
Scolytinae



Insect Classification

xviii. Coleoptera-

- Major Families

h. Scarabs : **Scarabeidae**



Insect Classification

xviii. **Coleoptera-**

- Major Families

i. Metallic wood boring
Beetles: **Buprestidae**



Insect Classification

xviii. **Coleoptera-**

- Major Families

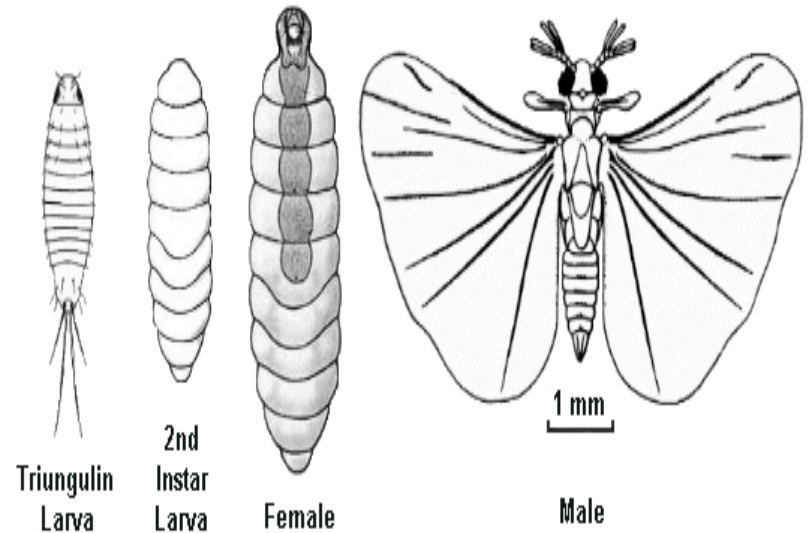
j. Tiger Beetles :
Cicindelinae



Insect Classification

xix. **Strepsiptera**- Twisted winged parasites (300 spp.)

- 3 mm in length
- Males- hind wings only, front- paddle-like
- Females- no wings, may not have legs, eyes or antennae, live in host
- Parasitize insects



Insect Classification

xx. Mecoptera- scorpionflies (400 spp.)

- Rare, 18-25 mm in length
- Chewing mouthparts
- Pincer-like copulatory organs
- Scavengers
- Complex development

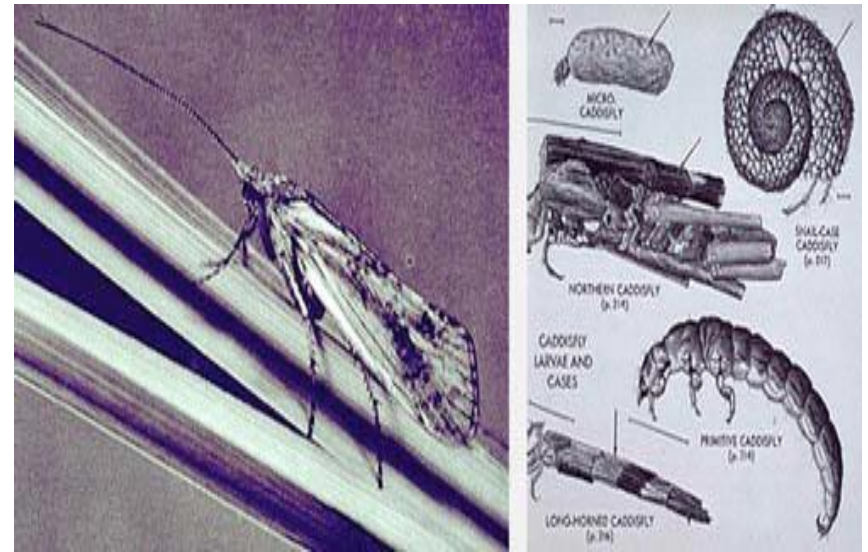


Insect Classification

xxi. Trichoptera-

Caddisflies (5,000 spp.)

- Mothlike and hairy
- Complex development
- Larvae- many feed forms
- Larvae in streams



Insect Classification

xxii. **Lepidoptera**- Moths and Butterflies (113,000 spp.)

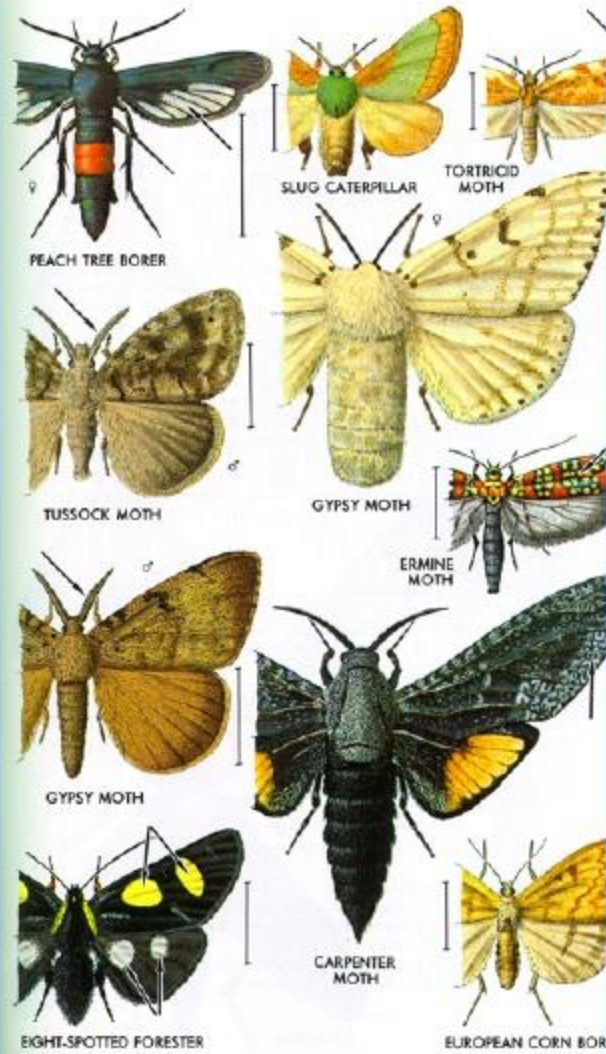
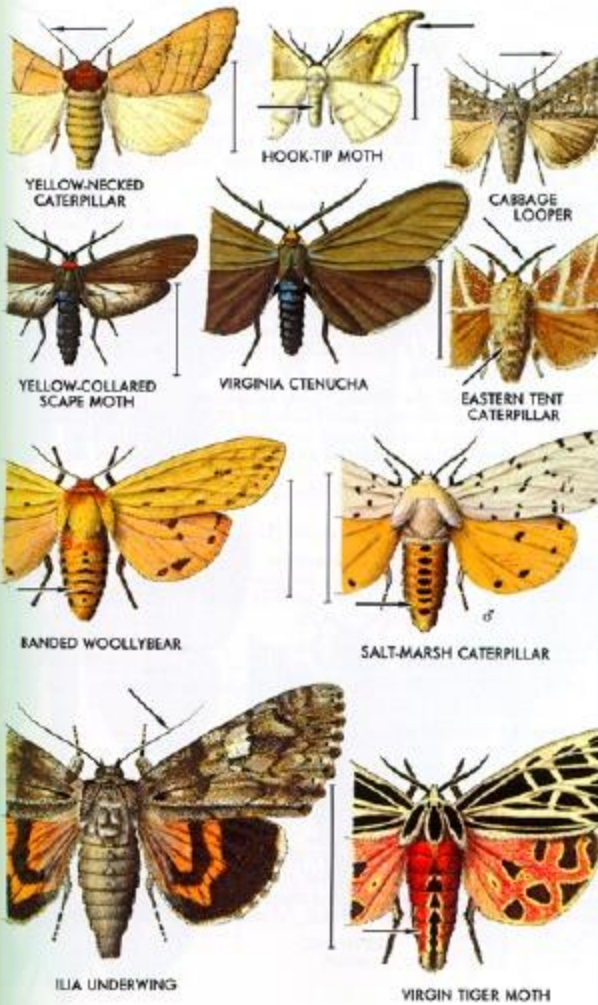
- Various sizes
- Complex development
- Adults have scaly large wings
- Chewing mouthparts in Larvae, Siphoning in Adults that is coiled like a watch spring
- Larvae feed on plants, clothing, scavengers
- Adults feed on nectar, fruit
- Larval structure- 3 legs, prolegs on abdomen
- Silk glands

Insect Classification

xxii. **Lepidoptera**- Moths and Butterflies (113,000 spp.)

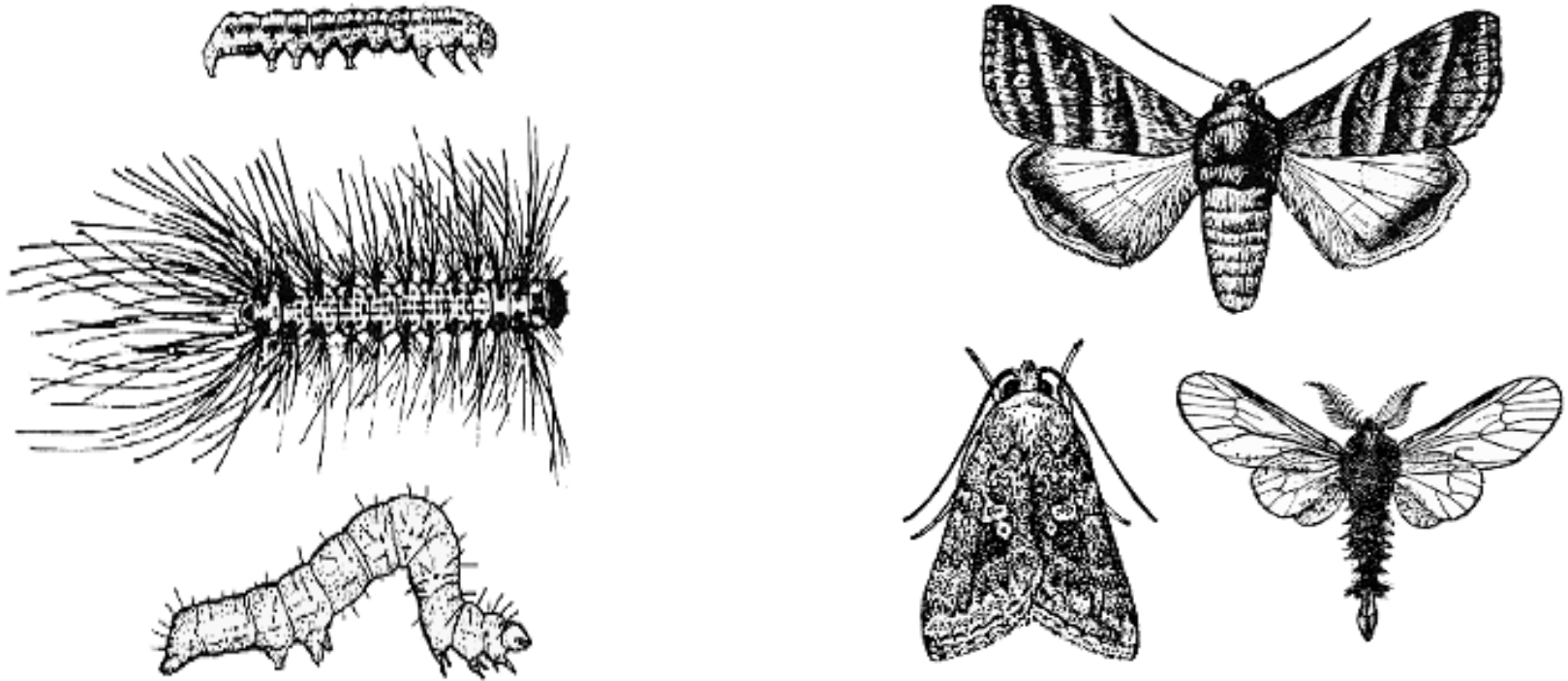
- Comprises Butterflies and Moths.
- **Butterflies are diurnal**, brightly coloured and have **knobs or hooks** at the tip of the antennae. At rest wings are held vertically over the body.
- **Moths are nocturnal**. They are typically drab in appearance, and have **thread-like, spindle-like, or comb-like antennae**. At rest, their wings are held horizontally against the substrate, folded flat over the back, or curled around the body.





Insect Classification

xxii. Lepidoptera



Insect Classification

xxii. **Lepidoptera**

- Major Families : Moths
- Armyworms, Borers, loopers : **Noctuidae**
- European cornborer: **Pyralidae**
- Winter moth, Cankerworm: **Geometridae**
- Clothes moths: **Tineidae**
- Codling moth : **Tortricidae**
- Swallowtails: **Papilionidae**
- Sphinx moth: **Sphingidae**
- Silkworm moth: **Saturniidae**
- Clearwing Moth: **Sessidae**
- Gypsy Moth: **Lymantriidae**

Insect Classification

xxii. **Lepidoptera**

- Major Families : Butterflies
- Brush footed Butterflies : **Nymphalidae**
- Swallowtails: **Papilionidae**
- Whites and sulphurs: **Pieridae**
- Milkweed Butterflies : **Danaidae**
- Skippers : **Hesperiidae**

Insect Classification

xxii. **Lepidoptera**

- Major Families : Moths
- Armyworms, Borers, loopers : **Noctuidae**
- European corn borer: **Pyralidae**



Insect Classification

xxii. **Lepidoptera**

- Major Families : Moths
- Codling moth :
Tortricidae
- Silkworm moth:
Saturniidae



Insect Classification

xxii. **Lepidoptera**

- Major Families : Moths
- Clearwing Moth:
Sessidae



- Gypsy Moth:
Lymantriidae



Insect Classification

xxii. **Lepidoptera**

- Major Families :
Butterflies
- Brush footed Butterflies
: **Nymphalidae**



Insect Classification

xxii. **Lepidoptera**

- Major Families :
Butterflies
- Swallowtails:
Papilionidae



Insect Classification

xxii. **Lepidoptera**

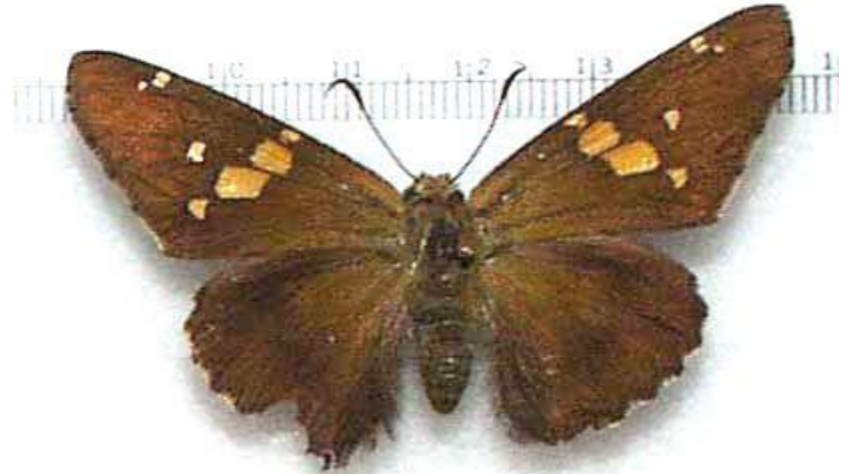
- Major Families :
Butterflies
- Whites and sulphurs:
Pieridae



Insect Classification

xxii. **Lepidoptera**

- Major Families :
Butterflies
- Skippers : **Hesperiidae**

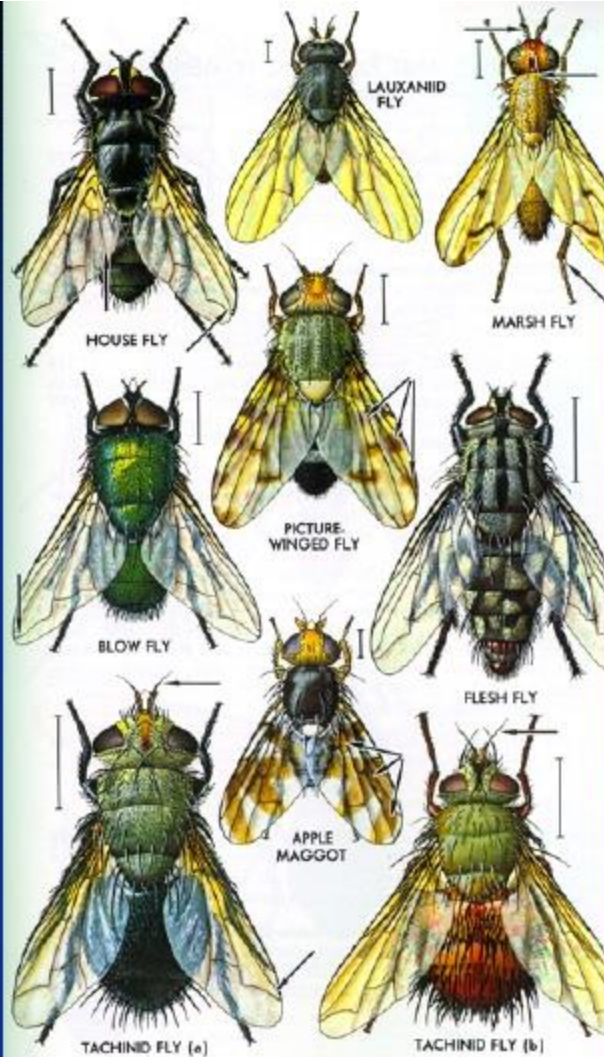


Insect Classification

xxiii. **Diptera**- Flies (120,000 spp.)

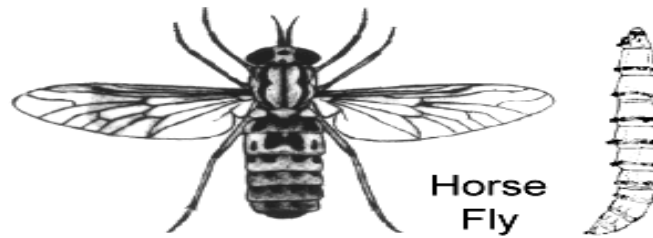
- Various sizes
- Complex development
- 2 wings plus halteres
- Feed on many items
- Piercing, sponging, cutting sponging mouthparts

Order Diptera



Insect Classification

xxiii. Diptera-



Insect Classification

xxiii. **Diptera-**

- Major Families: Biting flies
 - Mosquitoes: **Culicidae**
 - Horse and deer flies: **Tabanidae**
 - House, Stable, Face, Horn flies : **Muscidae**
 - Black flies: **Simulidae**
 - Moth flies: **Psychodidae**

Insect Classification

xxiii. **Diptera-**

- Major Families: Herbivores
 - Gall midges: **Cecidomyiidae**
 - Fruit flies : **Teplitidae**
 - Root and Seed maggots : **Anthomyiidae**
 - Leaf miners : **Agromyzidae**

Insect Classification

xxiii. **Diptera-**

- Major Families: Scavengers
 - Pomace flies : **Drosophilidae**
 - Crane flies : **Tipulidae**
 - Blow flies : **Calliphoridae**
 - Midges : **Chironomidae**
 - Flesh flies : **Sarcophagidae**

Insect Classification

xxiii. **Diptera-**

- Major Families: Predators
 - Robber flies : **Asilidae**
 - Bee flies : **Bombyliidae**
 - Dance flies : **Empididae**
 - Flower flies : **Syrphidae**

Insect Classification

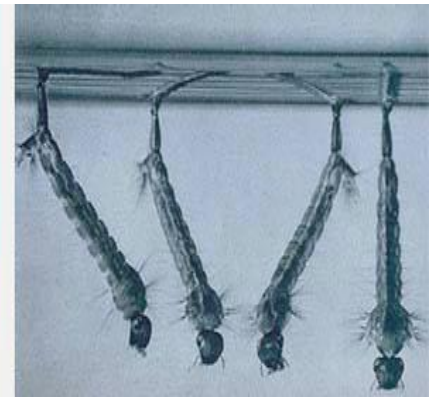
xxiii. **Diptera-**

- Major Families: Parasites
 - Marsh flies : **Sciomyzidae**
 - Bot / Warble flies : **Oestridae**
 - Louse flies : **Hippoboscidae**
 - : **Tachinidae**

Insect Classification

xxiii. **Diptera-**

- Major Families: Biting flies
 - Mosquitoes: **Culicidae**
 - Horse and deer flies: **Tabanidae**



Insect Classification

xxiii. **Diptera-**

- Major Families: Biting flies
 - House, Stable, Face, Horn flies : **Muscidae**
 - Black flies: **Simuliidae**
 - Moth flies: **Psychodidae**



Insect Classification

xxiii. **Diptera-**

- Major Families:
Herbivores

- Gall midges :
Cecidomyiidae



- Fruit flies : **Tephritidae**



Insect Classification

xxiii. **Diptera-**

- Major Families:
Scavengers
 - Crane flies : **Tipulidae**

 - Midges : **Chironomidae**



Insect Classification

xxiv. **Siphonaptera**- fleas (1,600 spp.)

- Small
- Secondarily lost wings
- Piercing mouthparts (A)
- Chewing in larvae
- Complex development

Insect Classification



Insect Classification

xxv. **Hymenoptera**- Ants, bees, wasps (108,000 spp.)

- Various sizes
- Complex development
- Various forms of social behaviour
- Feed in various ways

Insect Classification

xxv. **Hymenoptera-**

Two suborders

Symphyla- broad petiole

i. Horntails

ii. Sawflies

Aprocrita- thin petiole

i. Braconidae

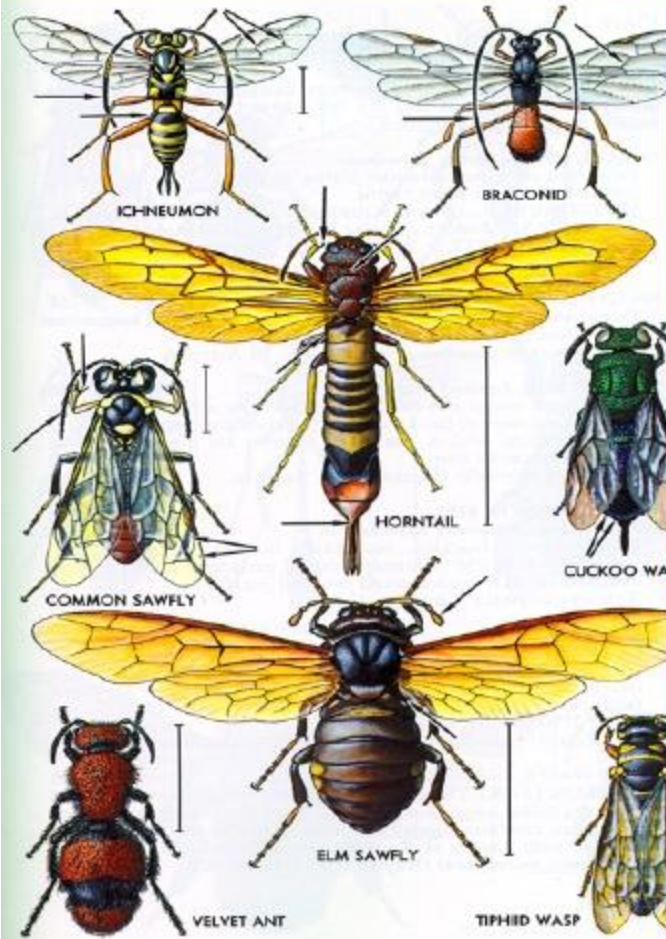
ii. Ichneumonidae

iii. Trichogrammatidae

iv. Formacidae

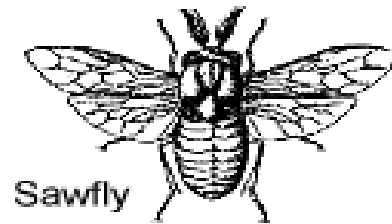
v. Apidae

Order Hymenoptera

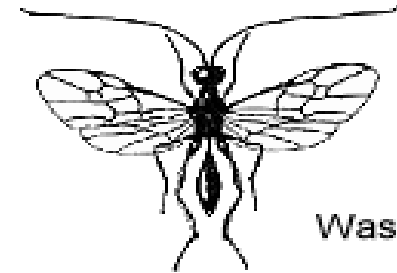


Insect Classification

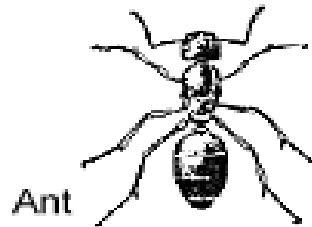
xxv. Hymenoptera-



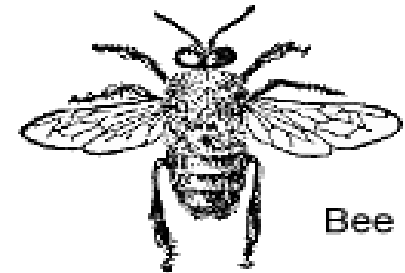
Sawfly



Wasp



Ant



Bee

Insect Classification

- Sawflies: Larvae feed on foliage or burrow into plant tissues.
 - **Diprionidae** -- Conifer sawflies
 - **Tenthredinidae** -- Common sawflies
 - **Cepidae** -- Stem sawflies
- Horntails: Larvae are wood borers.
 - **Siricidae**

Insect Classification

- Parasitic Wasps: Larvae are parasitoids of other insects.
- [Ichneumonidae](#) -- largest family of the Hymenoptera; parasitoids of other holometabolous insects (or spiders)
- **Braconidae** -- mostly parasitoids of lepidopterous larvae
- **Encyrtidae** -- mostly parasitoids of aphids and scale insects
- **Eulophidae** -- parasitoids of beetles, moths, and other insects
- **Trichogrammatidae** -- egg parasites



Insect Classification



Insect Classification

- Gall Wasps: Larvae are herbivores. They induce the formation of plant galls and live in or on these tissues.
 - **Cynipidae** -- most species live on oak trees

Insect Classification

- Predatory Wasps: Adults provision nest sites with prey that they catch and paralyze by stinging.
 - Sphecidae (digger wasps) -- prey on caterpillars and spiders
 - **Pompilidae** (spider wasps) -- prey on spiders
 - **Tiphiidae** (tiphiid wasps) -- prey on beetle larvae
 - Scoliidae (scoliid wasps) -- prey on beetle larvae
 - Vespidae (potter wasps) -- prey on caterpillars

Insect Classification

- Social Wasps: True social insects. Paper-like nests are tended by sterile female workers.
- Vespidae -- yellowjackets, hornets, paper wasps



Insect Classification

- Ants: True social insects. Wingless workers (sterile females) forage for provisions (vegetation, seeds, or other insects)
- [Formicidae](#) --- Ants



Insect Classification

- Solitary Bees: Adults construct individual nests and provision them with plant materials (usually nectar or pollen).
- Halictidae -- sweat bees
- **Megachilidae** -- leafcutting bees
- **Anthophoridae** -- carpenter bees

Insect Classification

- Social Bees: True social insects. Communal nests are built in the soil (bumble bees) or in cavities (honey bees). Workers (sterile females) forage for nectar and pollen.
 - Apidae -- bumble bees and honey bees



