Applied Entomology andParasitology

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511 Zoo

Definition of Applied Entomology

Applied entomology is the study of insects that have huge impact on agriculture, forestry, stored products and the insects of medical and veterinary importance.

THE INSECTS

- Fossil records indicate insects on land more than 300 million years ago.

Introduction to Taxonomy

- In biology, the naming of organisms is referred to as nomenclature, and ordering them into a hierarchy of categories is known as classification.
- A related science, taxonomy, involves the theoretical basis for classification and the study of classification schemes.
- Specialists working in these areas usually are referred to as Systematists; their overall activity, systematics, is the study of the diversity and classification of organisms.

- **Great stuides have been made in understanding insect diversity. some experts estimate that nearly 7,000 species new to science are discovered, named, and classified each year!**
- **we formulate predictions about relationships, including those with both evolutionary and ecological meaning. For instance, members of the same species are expected to behave similarly in their food habits, tolerances to environmental extremes, developmental patterns.**

- **A group of similar species, put together in a higher category called a genus, also could be predicted to share somewhat similar ecologies and to have evolved from the same ancestor.**
- **Moving to higher and higher groupings in classification, we expect more and more diversity within the grouping.**

- **A major application of classifications is in identification of insect specimens.**
- **Identifications of major groups such as insect orders can usually be made at a glance; however, finer identifications often require the use of keys.**
- **Most keys comprise a sequence of paired statements and questions that allow the user to eliminate alternative options and eventually associate the unknown specimen with a name.**
- **Many keys exist for orders and families of insects. Some of the most useful are those written by D. J. Borrer,**

- **Correct identification is the first step and probably the most important one in dealing with a Pest.**
- **It allows us to retrieve the information required for insect pest management. Without identification, we have no basis for predicting injury and advising action**

- **The classification of organisms is based on a hierarchy of categories, with the most inclusive occurring at the top and the least inclusive at the bottom.**
- **The major categories used in animal classification are phylum, class, order, family, genus, and species. But for added distinction in large, diverse groups, many other categories fall between these major ones.**
- **For example, a subclass category is commonly present below the class category and a superfamily category above the family category.**

Introduction to insect morphology

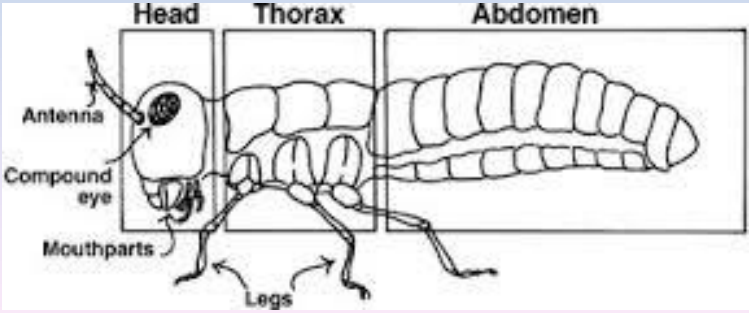
- **Insects are in the phylum Arthropoda. A single insect bears:**

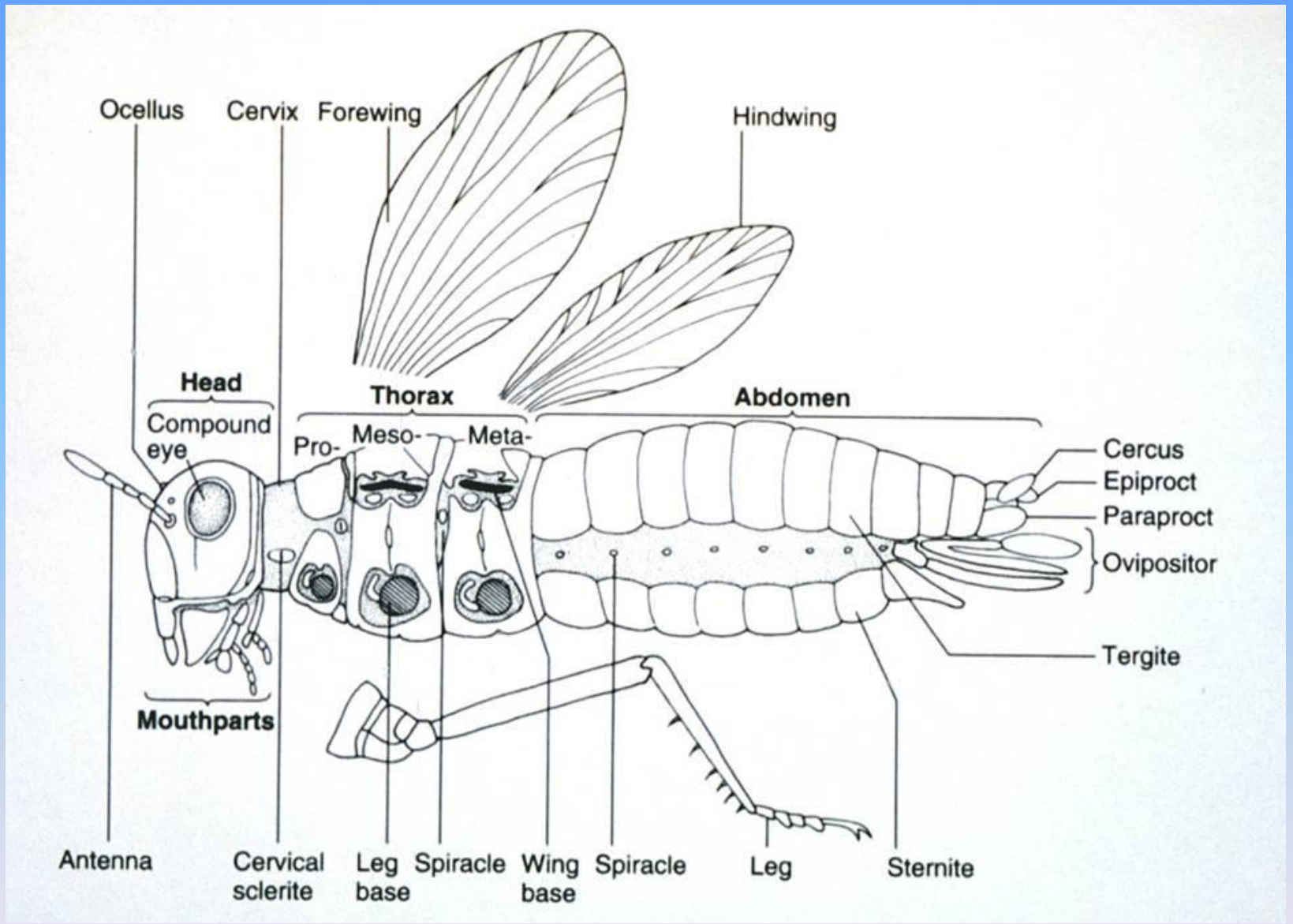
  - 3 body parts (head, thorax and abdomen).

  - The head bears compound eyes, simple eyes and 2 antennae

  - The thorax of adults bears 3 pairs of legs and 2 pairs of wings .

  - Exoskeleton which provides tremendous strength.

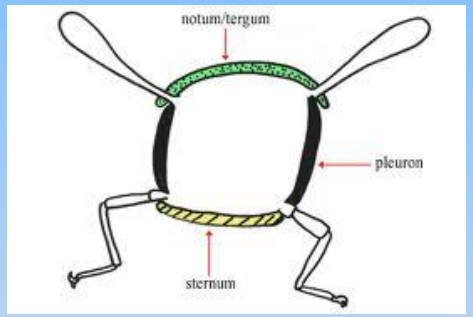



Ocellus
Cervix
Forewing
Hindwing
Head
Thorax
Abdomen
Compound eye
Pro-
Meso-
Meta-
Cercus
Epiproct
Paraproct
Ovipositor
Tergite
Mouthparts
Antenna
Cervical sclerite
Leg base
Spiracle
Wing base
Spiracle
Leg
Sternite

- **The exoskeleton is comprised of sclerites: hardened plates**

  - Tergites: Dorsal plates

  - Sternites: Ventral plates



  - Pleuron: Lateral area, often membranous

- **The integument (body covering) is comprised of multiple layers:**

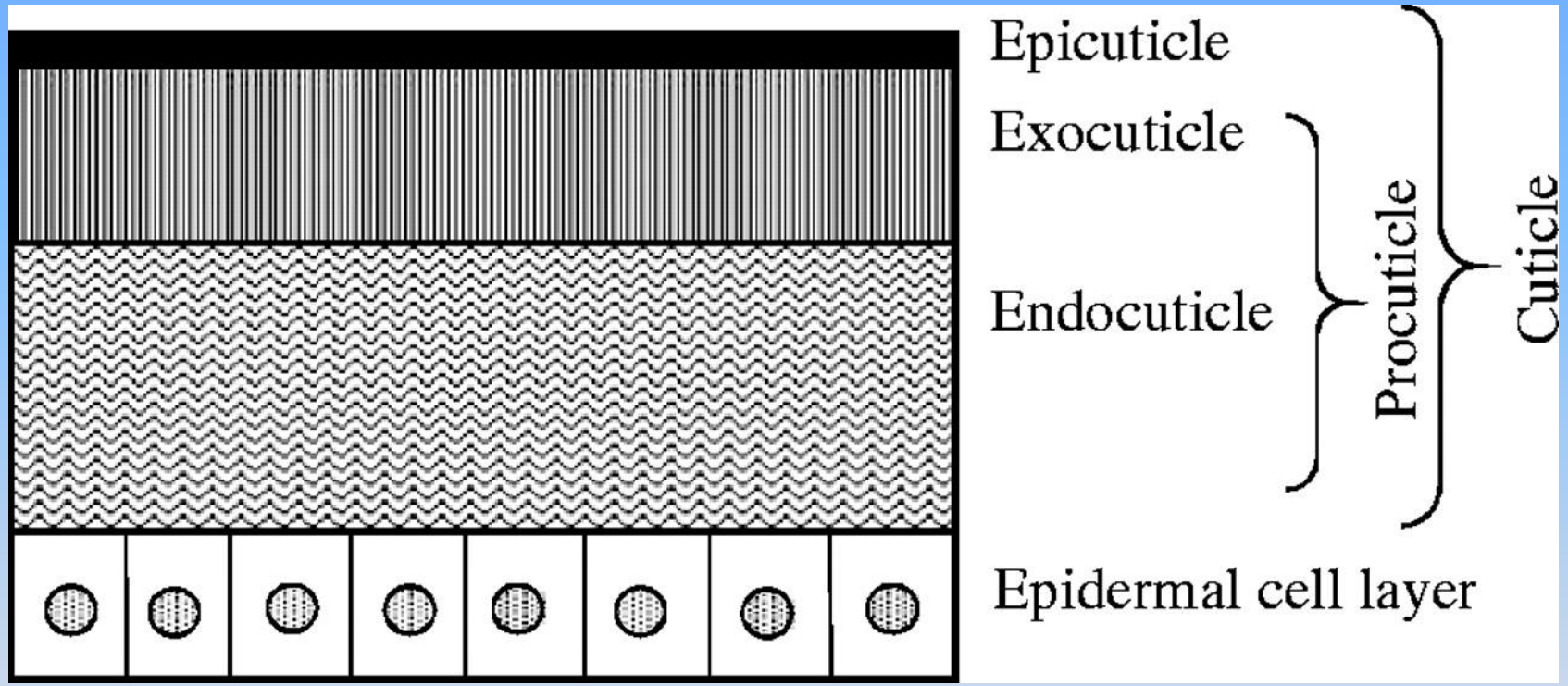
- **The cuticle is the outermost layer, covering the entire outer body surface, it also lines the air tubes (tracheae, etc.), salivary glands, foregut, and hindgut.**

- **Strength and resilience (not hardness) are provided by chitin, a nitrogen-containing polymer common to the arthropods.**

- The cuticle is secreted by the epidermis and covers the whole of the outside of the body as well as lining ectodermal invagination such as stomodum and proctodum and trachea.
- It is differentiated into two main regions:

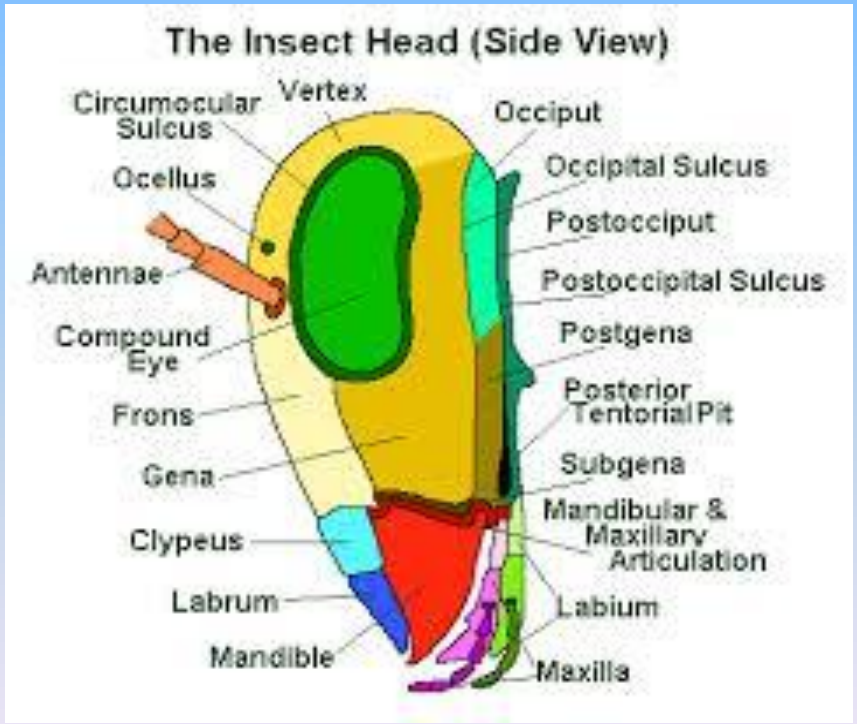
1- Inner region, characterized by the presence of chitin and forming the block of the cuticle.

2- Outer thin epicuticel, which does not contain chitin.


Epicuticle
Exocuticle
Endocuticle
Procuticle
Cuticle
Epidermal cell layer

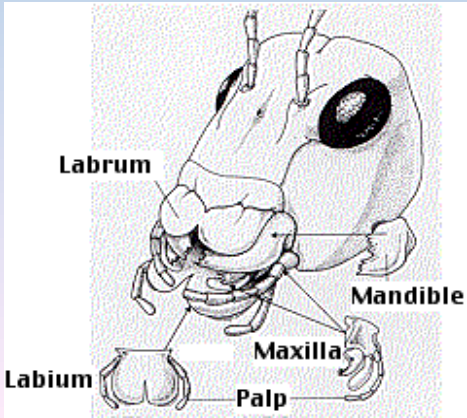
Insect Head

- The insect head bears:
  - Mouthparts
  - Eyes
  - Antennae

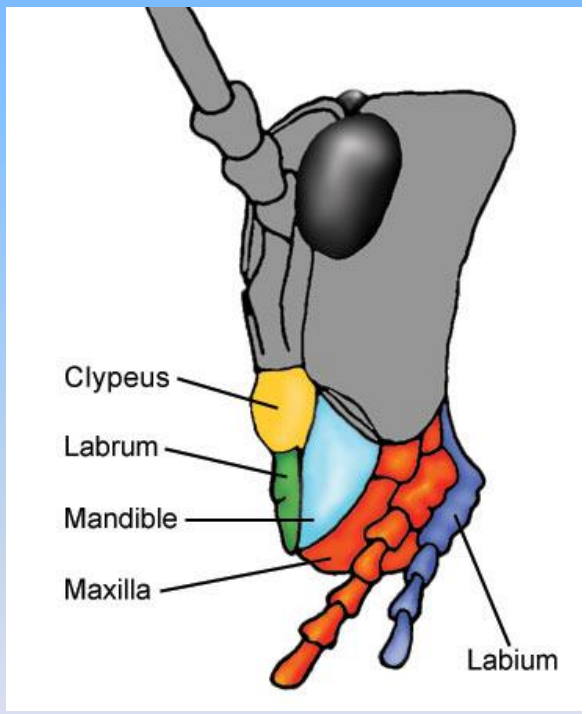


Mouth parts in typical insect

- Mouthparts: consists of different parts including:
- Labrum (1) (Upper lip)
- Mandibles (2) (Jaws)
- Maxillae (2) (More jaws)
- Labium (1) (Lower lip)
- Hypopharynx (1) (Tongue-like, bears openings of salivary ducts)
- Labrum-epipharynx (1) (Fleshy inner surface of labrum - sensory)



Mouth Parts modifications



Insect Mouthparts

Chewing

Grasshopper

Sucking/Mouth Hooks

Maggot

Chewing/Lapping

Bee

Piercing/Sponging

Biting Fly

Rasping/Sucking

Thrips

Siphoning

Moth

Piercing/Sucking

Mosquito

Chewing

Beetle

Piercing/Sucking

Cicada

Sponging

House Fly

Piercing/Sucking

Flea

Chewing/Raptorial

Dragonfly

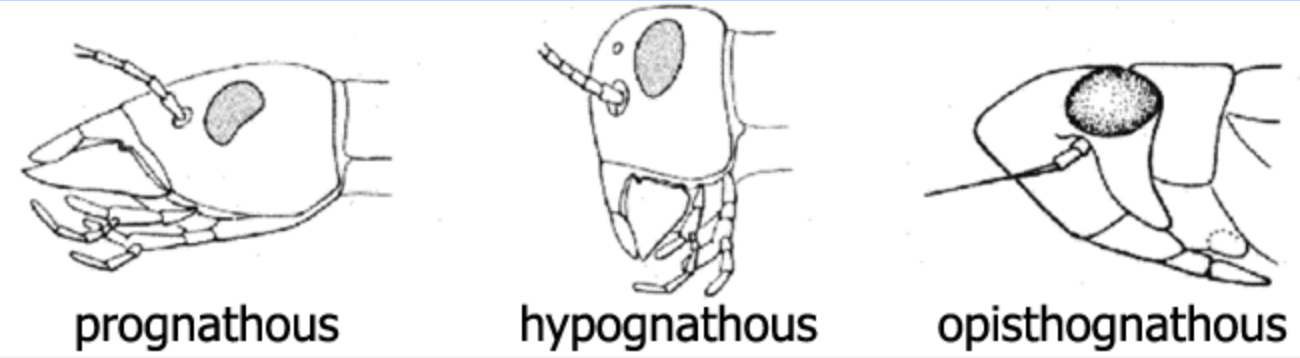
Mouthparts Orientation

- The orientation of the mouthparts on the head may differ, and they may be described as:

  - **Prognathous**: projecting forward (horizontal)

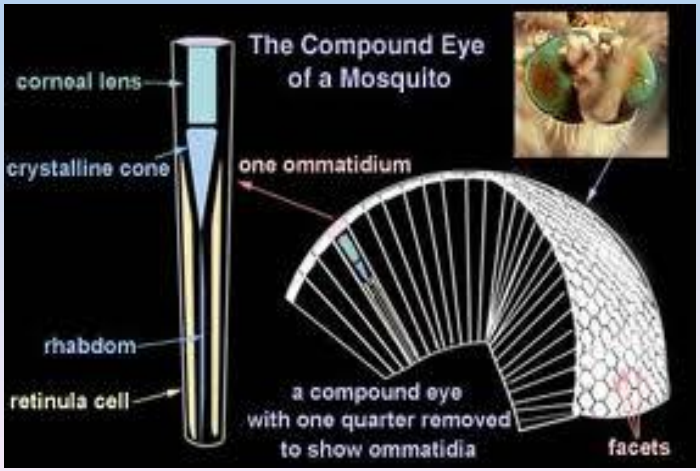
  - **Hypognathous**: projecting downward

  - **Opisthognathous**: projecting obliquely or posteriorly



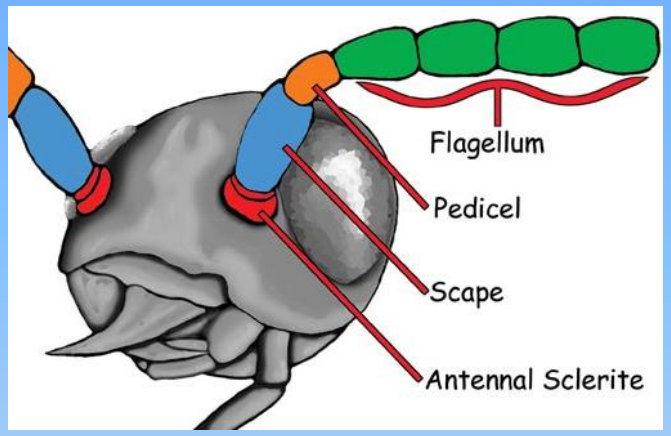
Insect Eyes

- Compound eyes: Individual units are facets or ommatidia. 28,000 ommatidia comprise a single compound eye in dragonflies.
- Oellus (Ocelli), or simple eyes: small, usually a single lens

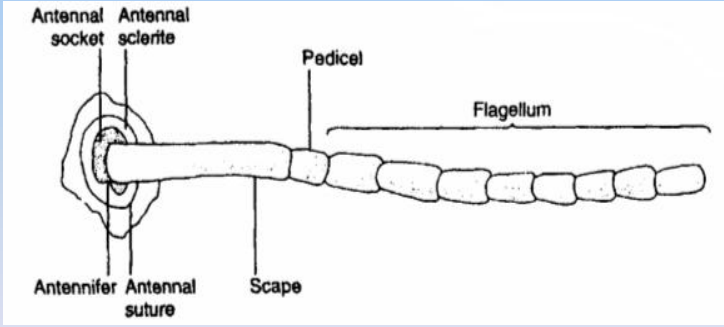


Insect Antennae

- 2 basal segments are the scape & pedicel



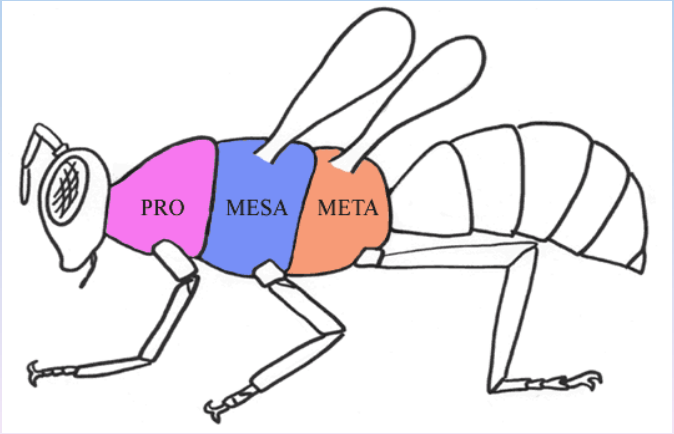
- The filament is comprised of several segments (actually pseudo-segments lacking independent musculature)



Aristate antennae Shore fly		**Setaceous** antennae Damsel fly	
Capitate antennae Speckled wood butterfly		**Lamellate** or clubbed antennae	
Clavate antennae Carrion beetle		**Moniliform** antennae Termite	
Plumose antennae Male mosquito		**Serrate** antennae Click beetle	
Filiform antennae Longhorn beetle		**Pectinate** antennae Firefly	

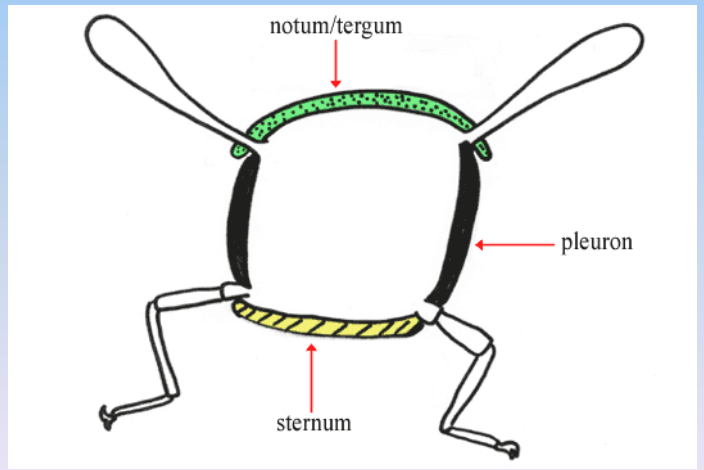
Insect thorax

- **Prothorax:** Bears 1 pair of legs
- **Mesothorax:** Bears 1 pair of legs, 1 pair of wings
- **Metathorax:** Bears 1 pair of legs, 1 pair of wings



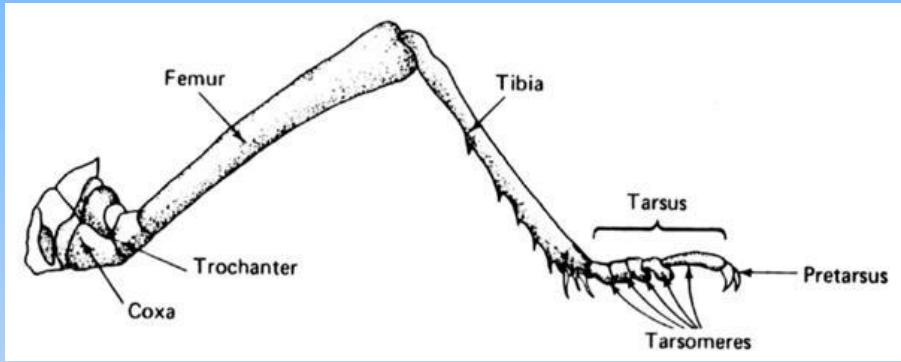
Insect thorax Con…

- Sclerites that comprise the thorax are given specific names; each may be preceded by the prefixes pro-, meso-, or meta-.
- **Notum:** Dorsal plate. The pronotum is the dorsal sclerite on the prothorax.
- **Pleuron**: Lateral plate
- **Sternum**: Ventral plate



Insect legs

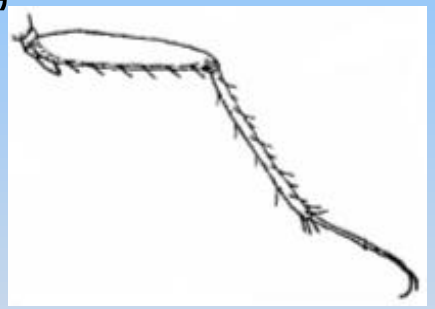
- Legs are segmented. The names for each segment are (in order, beginning at the body and progressing outward.



- ✓ **coxa**
- ✓ **trochanter**
- ✓ **femur**
- ✓ **tibia**
- ✓ **Tarsus** The tarsus may be comprised of multiple segments (not really true segments; more accurately called tarsomeres); the terminal segment usually bears claws.

Insect legs modifications

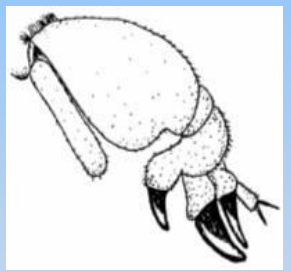
- Legs may be modified for specific purposes:
- Jumping: grasshoppers, fleas
- Running (or walking): ground beetles, cockroaches.
- Clinging: lice.



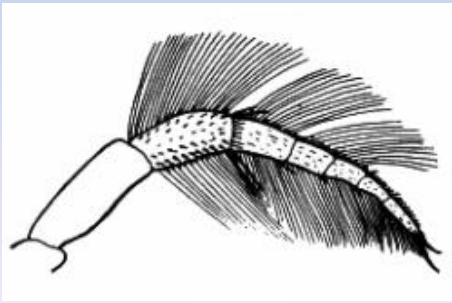
Insect legs modifications Con…

- Grasping (holding prey): raptorial -- mantids, giant water bugs

- Digging: fossorial -- cicada nymphs, mole crickets



- Swimming: natatorial -- water scavenger beetle, backswimmer



Insect Wings

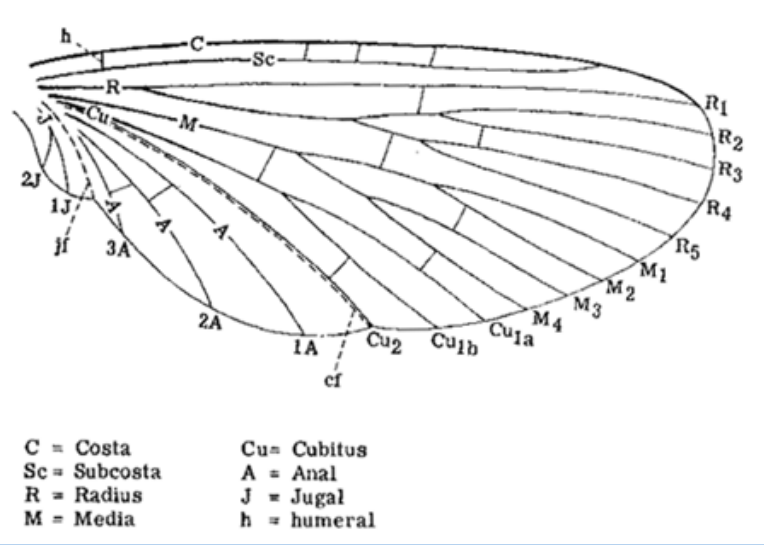
- **Apterygota** – adults like immature without wings
- **Pterygota** – adults have wings

  Exopterygota -the wings develop externally on the nymph body

  Endopterygote – wings develop inside of body in immature insects and not visible until adult immerges from pupa

Wings

- Mesothoracic wing = forewing
- Metathoracic wing = hindwing
- Wing veins and cells between veins are named according to the standard system



Wing modifications

- **Halters (Halter):** Knob-like reduced hind wings of Diptera

- **Elytra (Elytron):** Hardened, protective forewings of Coleoptera

- **Hemelytra:** Half-hardened, half-membranous forewings of Hemiptera (Heteroptera)

Wing modifications Con…

- **Fringed wings:** Modified wing structure of the Thysanoptera (Thrips)

- **Scaly wings:** Lepidoptera, Trichoptera, some Diptera

The insect abdomen

- Insect abdomen is comprised of 6 to 10 segments. Terminal structures include:

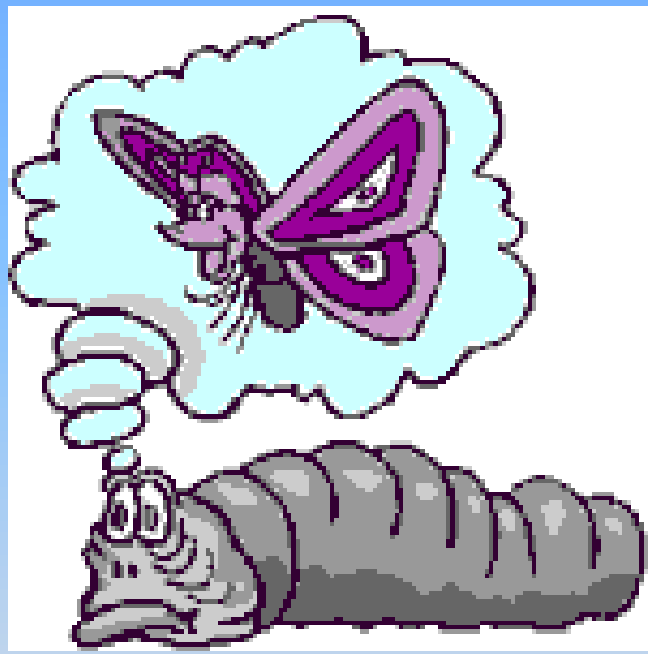
  - **Cerci:** Paired sensory projections from the terminal abdominal segment

  - **Ovipositor:** Egg-laying apparatus (may be modified for other purposes)

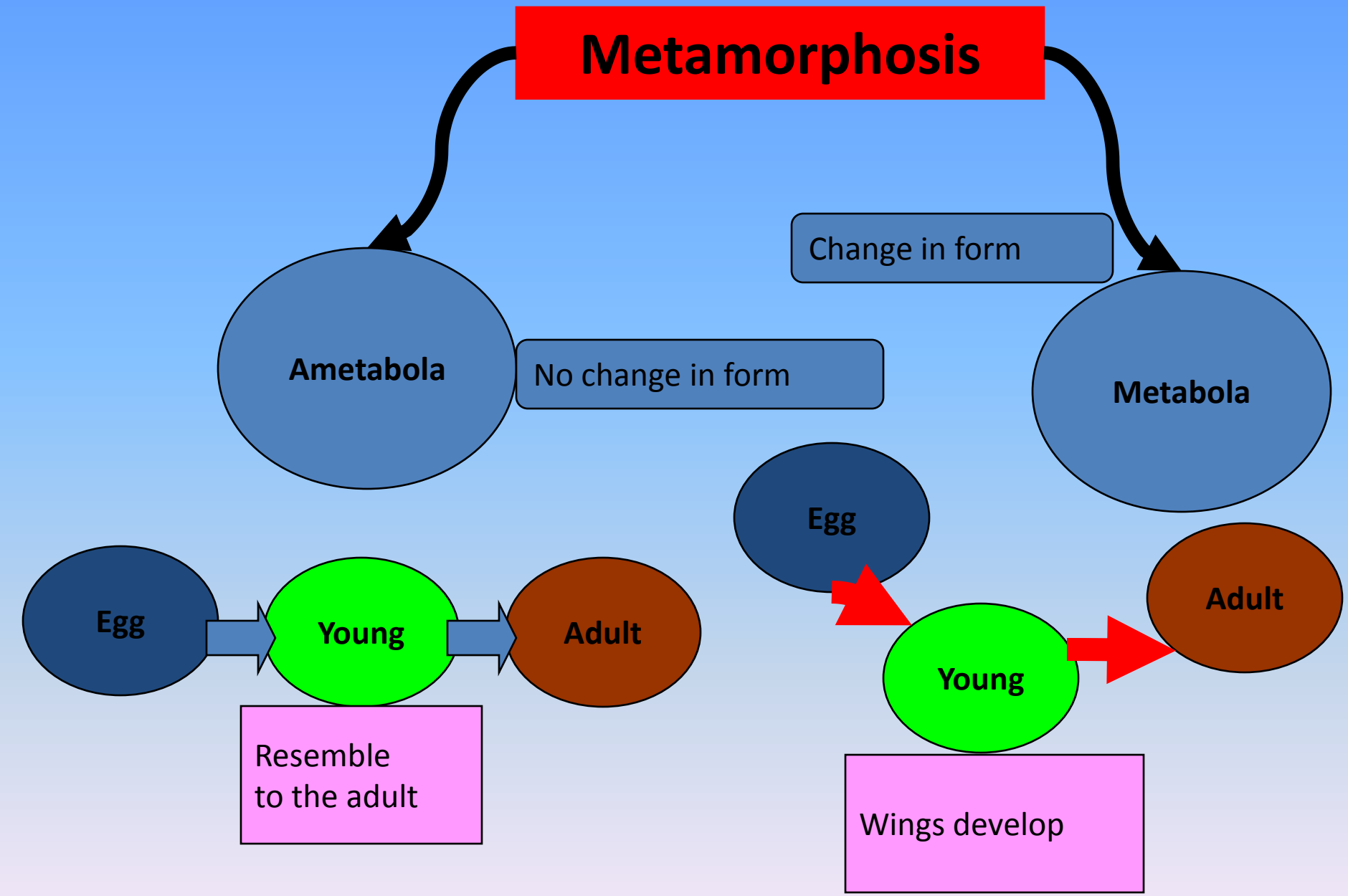
  - **Aedeagus:** Male copulatory organ, analogous to the penis in vertebrates

Insects development

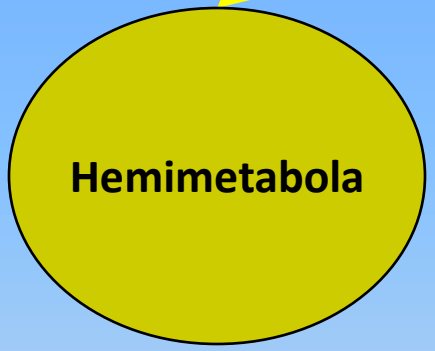
- The physical transformation of an insect from one stage of its life cycle to another is called metamorphosis.

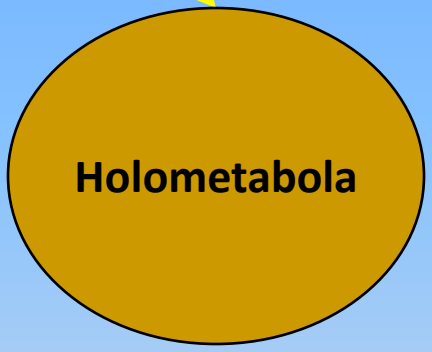


- With a few odd exceptions, all insect life begins as an egg. After leaving the egg, an insect must grow and transform until reaching adulthood. Only the adult insect can mate and reproduce


Metamorphosis
Change in form
Ametabola
No change in form
Metabola
Egg
Young
Adult
Resemble
to the adult
Egg
Young
Adult
Wings develop

Metabola



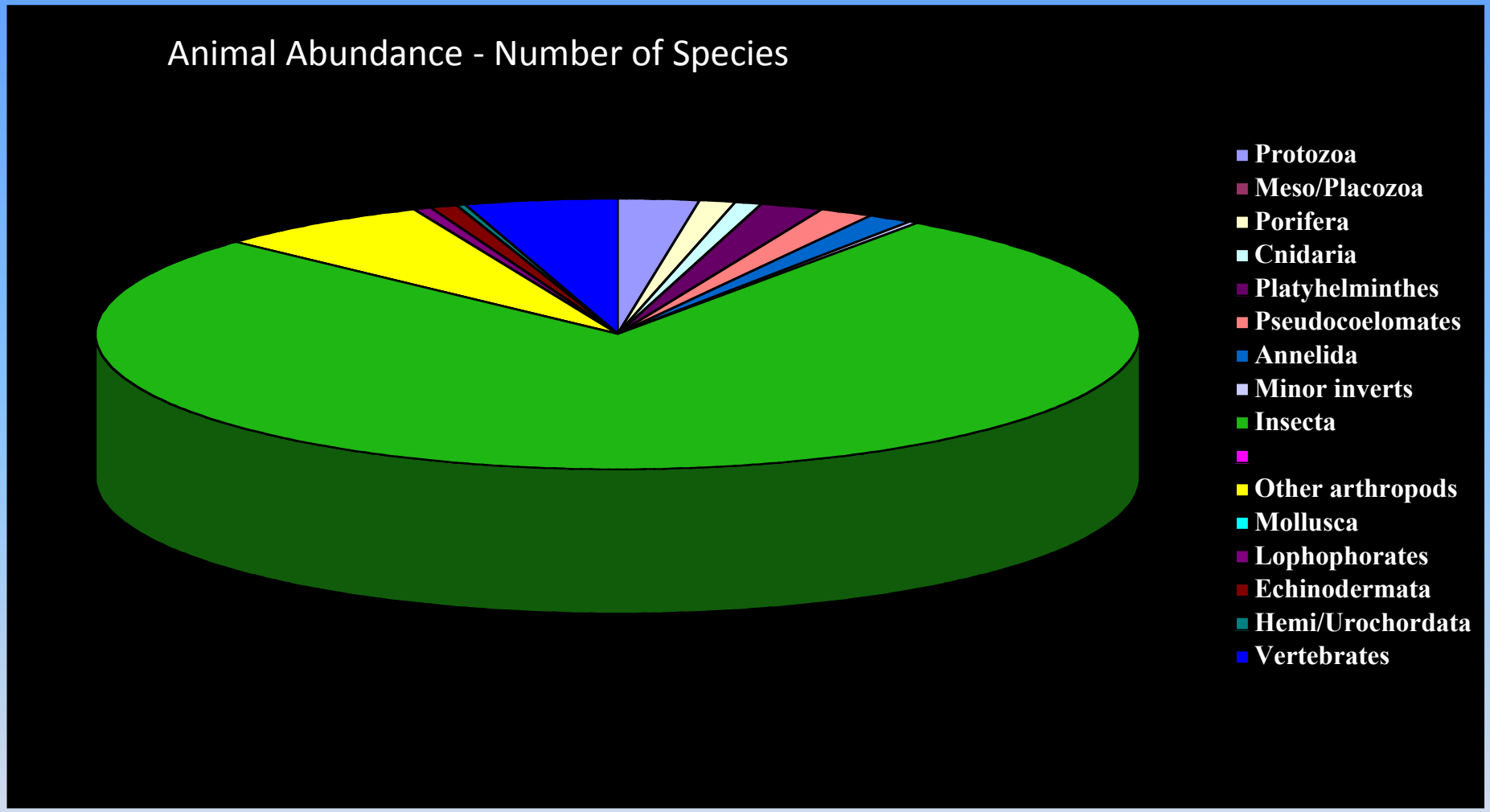


- Incomplete change
- Direct change
- Simple change
- Egg – nymph - adult

- Complete change
- Indirect change
- Complex change
- Egg – larva – pupa - adult

Insects as Pests

- Pests, by definition, are organisms that come into conflict with humans.
- Over 1 million species of insects
- Over half of all living species are insects
- Over 75 percent of all animal species are insects
- Less than 3 percent of all insect species are pests (even by a loose definition)


Animal Abundance - Number of Species
Protozoa
Meso/Placozoa
Porifera
Cnidaria
Platyhelminthes
Pseudocoelomates
Annelida
Minor inverts
Insecta
Other arthropods
Mollusca
Lophophorates
Echinodermata
Hemi/Urochordata
Vertebrates

WHY ARE INSECTS SO SUCCESSFUL?

1. Ability to fly
2. Reproductive capacity & adaptability
3. Resist drying - exoskeleton
4. Small size
5. Metamorphosis

Insects as pests

- Pests have no particular ecological significance.
- Insects become pests when they conflict with human welfare, aesthetics or profits.
- They may be pests either directly through disease transmission, or indirectly by affecting our domestic animals, cultivated plants or timber reserves.

How serious are insects as pests?

- Life threatening
  - **Vectors of disease** (mosquitoes that transmit malaria, fleas that carry plague, lice that carry epidemic typhus)
  - **Crop destruction and famine** (locusts, boll weevil, Rocky Mountain locust, Colorado potato beetle)

How serious are insects as pests?

- **Economically damaging**

  – Many crop pests, termites, etc.

- **Displeasing to our sense of aesthetics; cosmetic or just annoying**

  – Common densities of house flies, cockroaches.

  – Feeding scars on the surface of fruits and vegetables

- So, how serious?

Why we care about insects?

1. Annoyance

Why we care about insects?

2. Disease

Why we care about insects?

3. Competition

Why we care about insects?

4. Providers

Why we care about insects?

5. Fascination


any questions?


Thank You