Insect Structure and Function

PG 1

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The Taxonomic Hierarchy is:

Kingdom ----- Animal

Phylum ----- Arthropoda

Class ----- Insecta

Order ----- Coleoptera

Family

Genus

Species

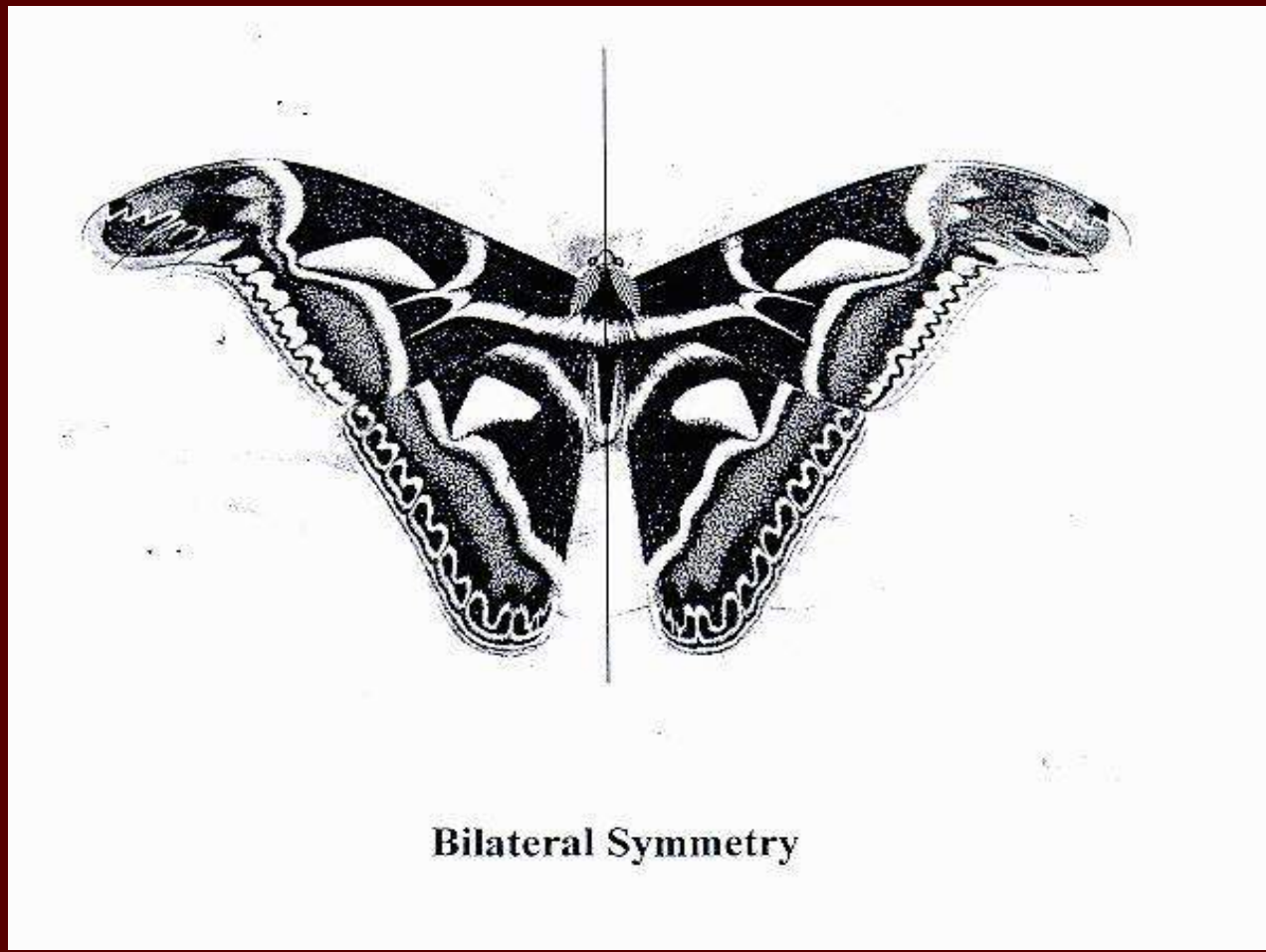
All Arthropods Have Several Common Structural Characteristics:

1) A chitinous exoskeleton

The suit of armor of this knight is somewhat analogous to the insect exoskeleton

All arthropods have:

2) Bilateral Symmetry



Bilateral Symmetry

All arthropods have:

3) Jointed Appendages

All arthropods have:

4) Segmented Bodies

All arthropods *also* have:

- A tubular digestive tract
- A dorsal tubular circulatory system
- A ventral nervous system

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- A dorsal tubular circulatory system
- A ventral nervous system

Chelicerata include some members important to foresters, including

Scorpions, spiders, and ticks.

Class Arachnida

Characteristics of Chelicerata include:

•All those of general arthropods

and

•2 body regions
•No antennae
•4 pair of walking legs

Mandibulata include:

Lobsters – Class Crustacea

Centipedes –
Class Chilopoda

Millipedes – Class Dipl

Mandibulata also include:
The Class Insecta:

Why Study?

- **An understanding of the external structure of the insect is necessary…**

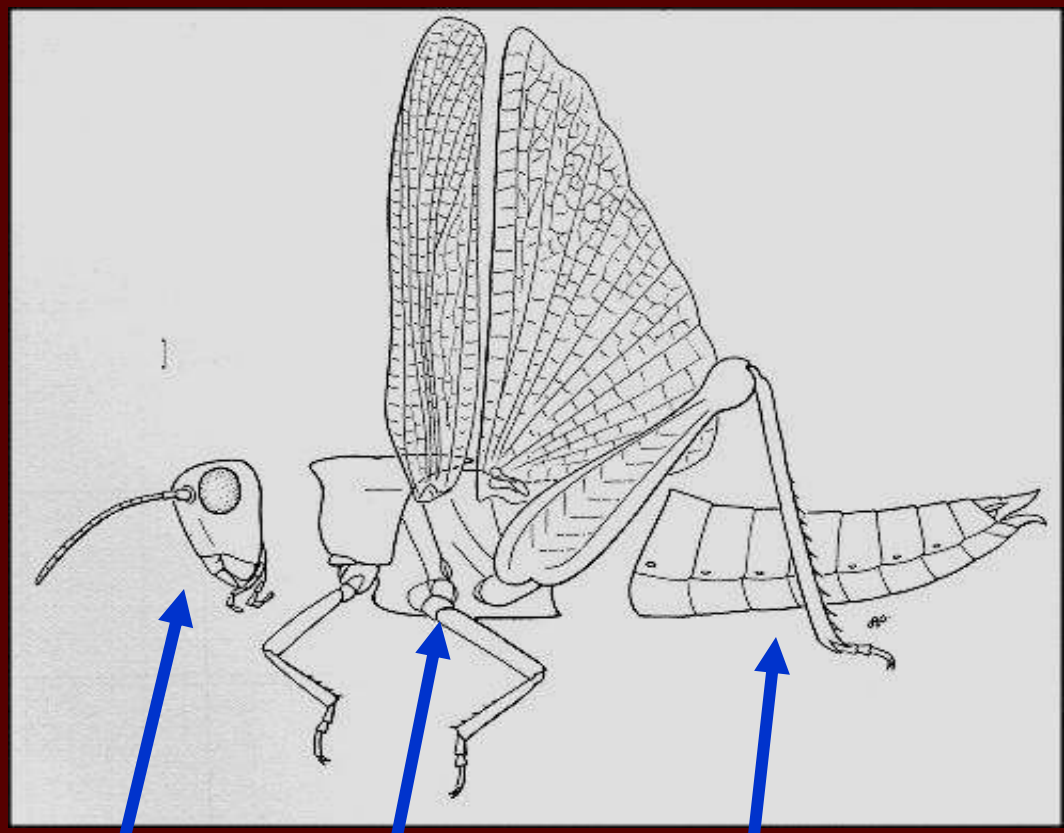
  - to allow the identification of insects and other arthropods

  - to understand their biology and control

Insects within the Class Insecta have all the characteristics of Arthropods

and

- **3 body regions**

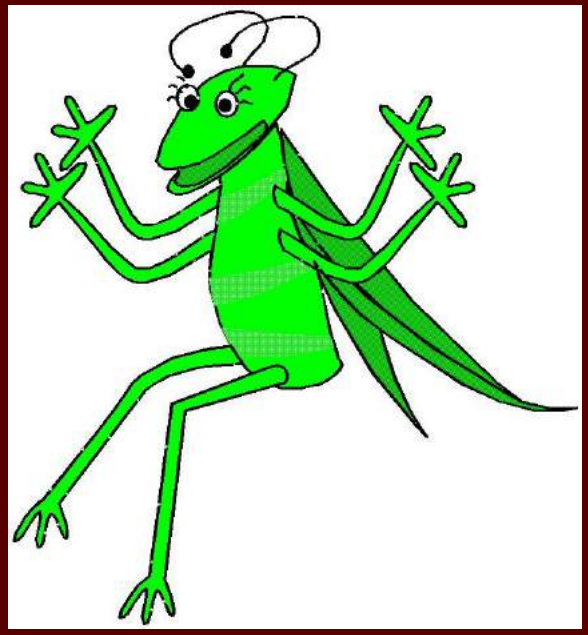


Head Thorax Abdomen

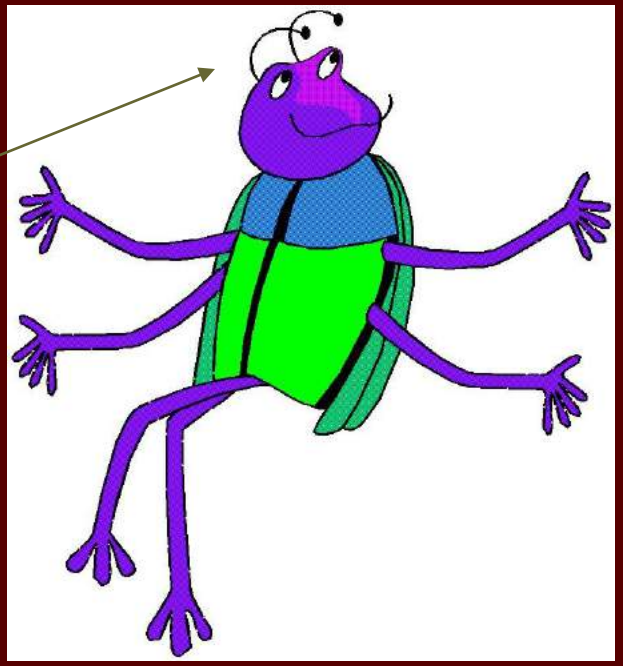
Insects also have:

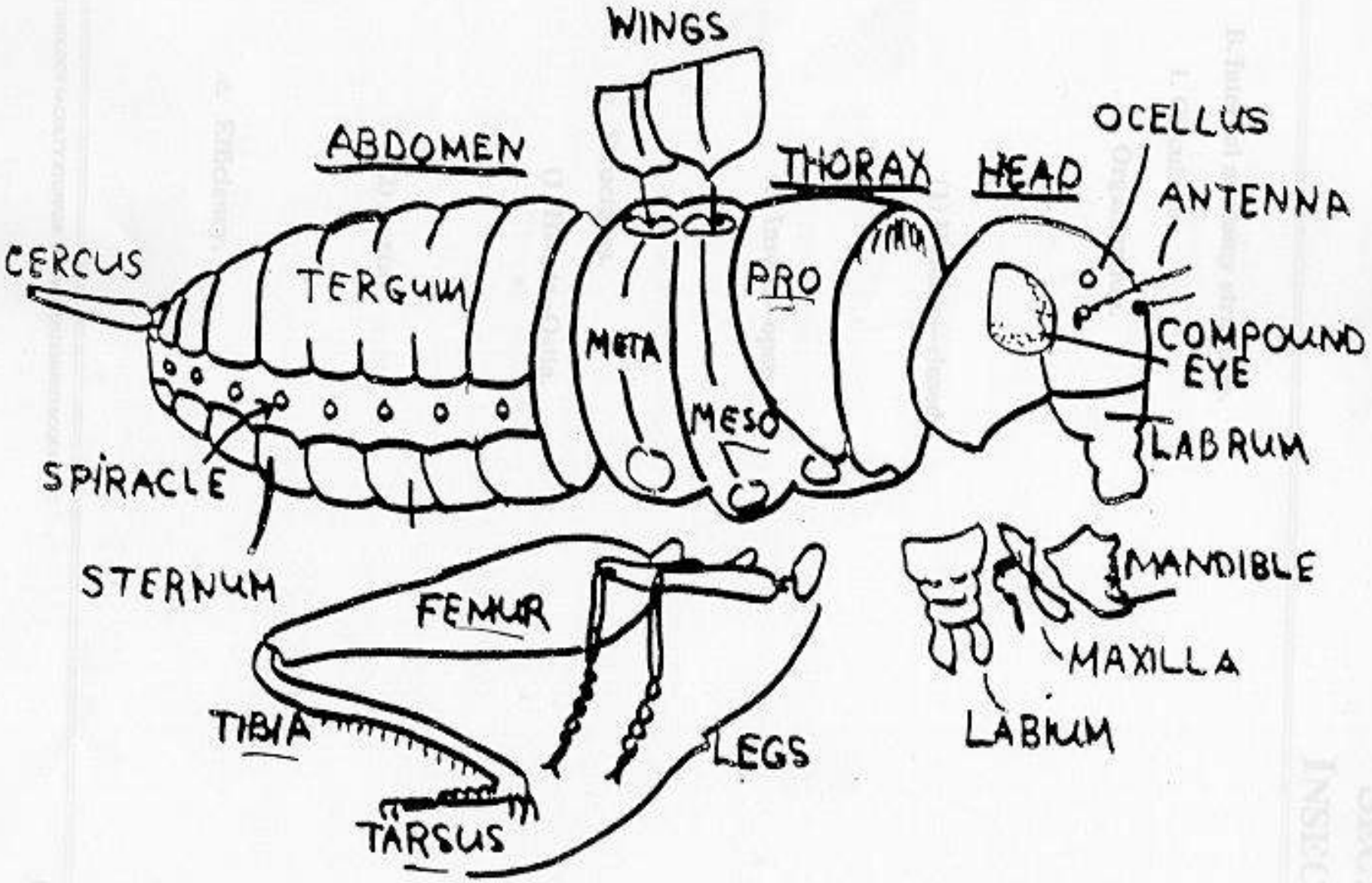
•3 pairs of legs

(not two in spite of what you may see in some movies)



•1 pair of antennae

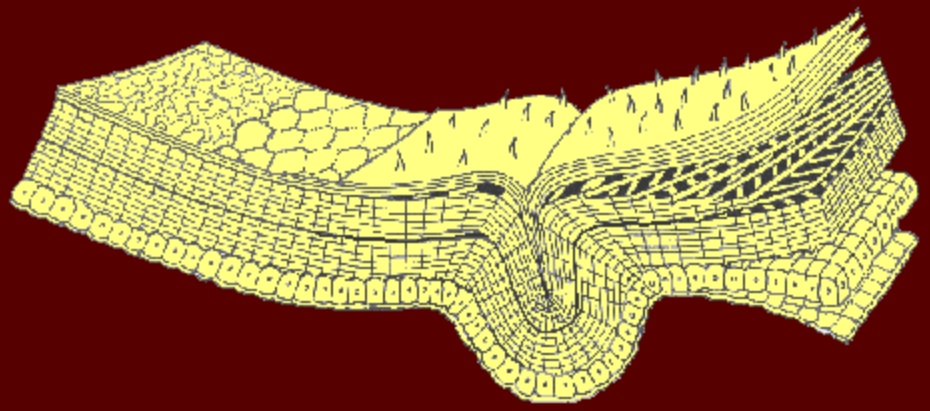



WINGS
ABDOMEN
THORAX
HEAD
OCELLUS
ANTENNA
CERCUS
TERGUM
PRO
META
MESO
COMPOUND EYE
LABRUM
SPIRACLE
STERNUM
FEMUR
MANDIBLE
MAXILLA
TIBIA
LEGS
TARSUS
LABIUM

Tagmata

Exoskeleton

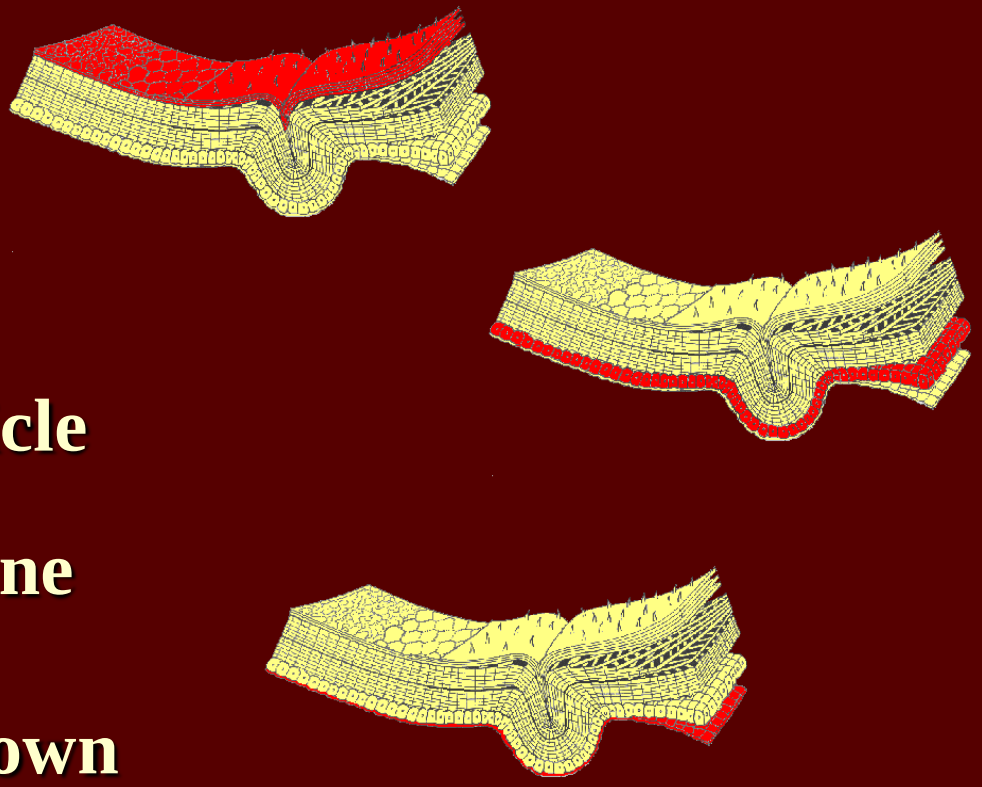
- Outer layer or “skin”



- Functions:
  - Protection of soft parts
  - Muscle attachment
  - Support
  - Site for sensory organs
  - Helps prevent desiccation
  - Reduces pathogen entry

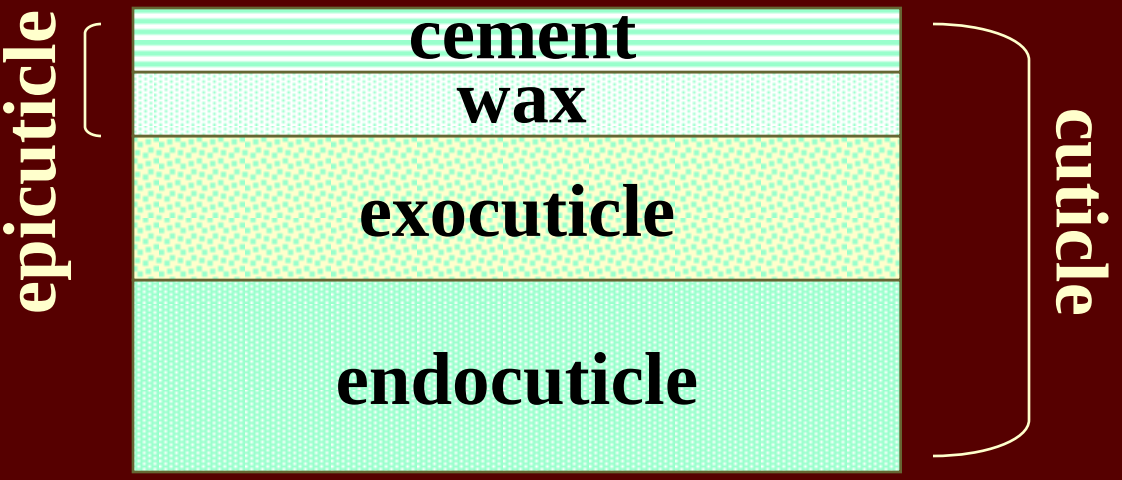
Components of the Exoskeleton

- Cuticle
  - non-living
- Epidermis
  - living
  - secretes the cuticle
- Basement membrane
  - non-living
  - function not known



Cuticle

- Key contributor to the success of insects
  - barrier between living tissue/environment
  - restriction of water loss
  - abrasion protection



Body Structure

- 3 body regions

- 1 pair of antennae
- 3 pair of legs on the thorax

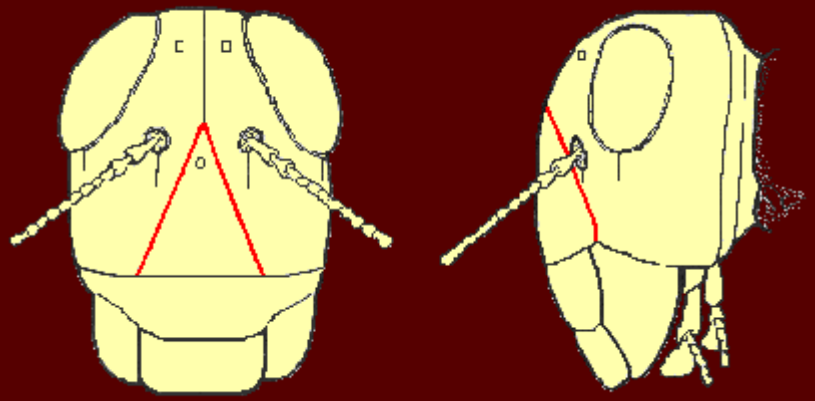
Head

- **Functions:**

  - Mouthparts (feeding appendages)

  - Sensory organs (interaction with nature)
    - photoreceptors/vision
    - receptors on antennae

  - Houses the brain

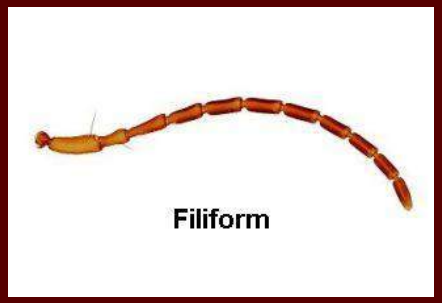


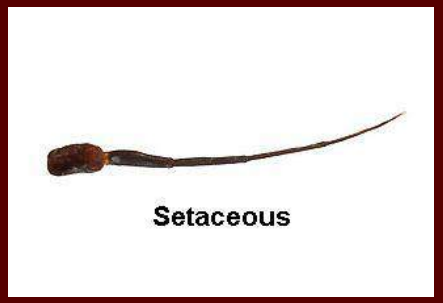
Antennae

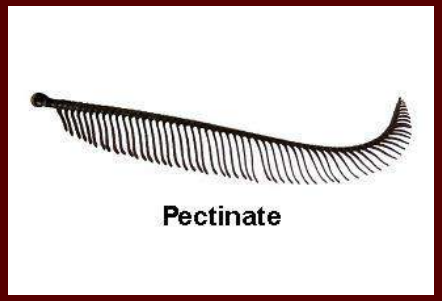
- Single pair
- Located between and in front of eyes
- Sensory function
  - touch
  - smell
  - humidity
  - sound

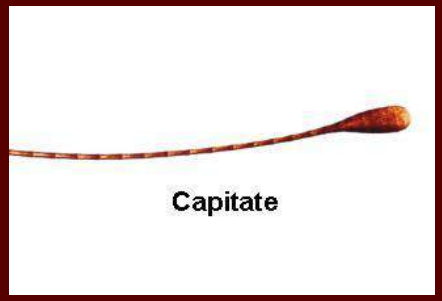
Antennae

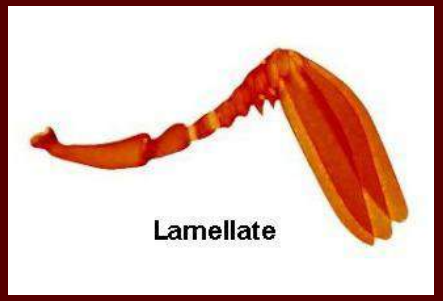
- **Types**



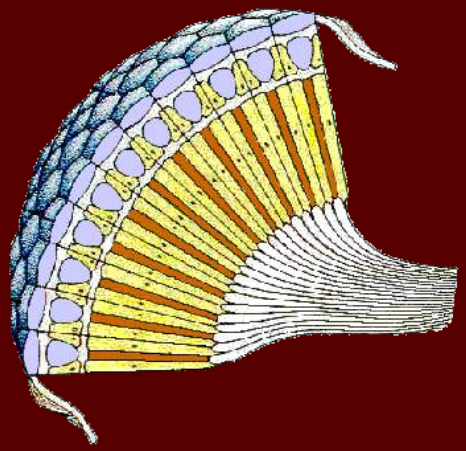








Vision



- Compound eyes
  - main organ of vision
- Composed of individual units - ommatidia
  - each registers a portion of a mosaic image
  - number vary (>25,000 for dragonflies)
  - surface of eye is protected with a cuticle
- Resolution of image varies
  - dragonfly: several meters away
  - other insects: only a meter or so away

How do insects perceive the world?

- Many can see color (but many blind to red)
- Others see colors we can not - Ultraviolet
- Some only detect degrees of light and no image
- Others are totally blind

Nectar Guides

- Many insect-pollinated flowers have nectar guides
- Serve as visual guides to direct insects to nectar source
- Nectar guides absorb UV light
- Rest of flower reflects UV light

Mouthparts

- **Basic types:**

  - chewing
  - piercing-sucking
  - rasping-sucking
  - sponging
  - siphoning
  - chewing-lapping

- **Important for insect identification**

- **Provides information on feeding habits and types of damage**

Chewing Type

- Simplest type
- Used to chew holes in leaves, bore in stems
- Examples: grasshoppers, crickets, caterpillars, beetles

Piercing-Sucking Type

- Common and important type
- Greatly modified for puncturing plants and animals
- Mouthpart components form needle-like stylets
- Capable of transmitting viruses
- Toxic saliva
- Examples: mosquitoes, stink bugs, etc.

Rasping-Sucking Type

- Combination of chewing and piercing-sucking
- Rasp (scrap) surfaces of leave, suck up sap
- Example: thrips

Sponging Type

- **Modified for liquids or solid foods**
  - solid foods must be dissolved by salivary secretions

- **Example: house fly**

Siphoning Type

- Mouthparts form a sucking tube (proboscis)
  - modified for uptake of nectar/liquids
- Coiled beneath head when not in use
- Examples: butterflies and moths

Chewing-Lapping Type

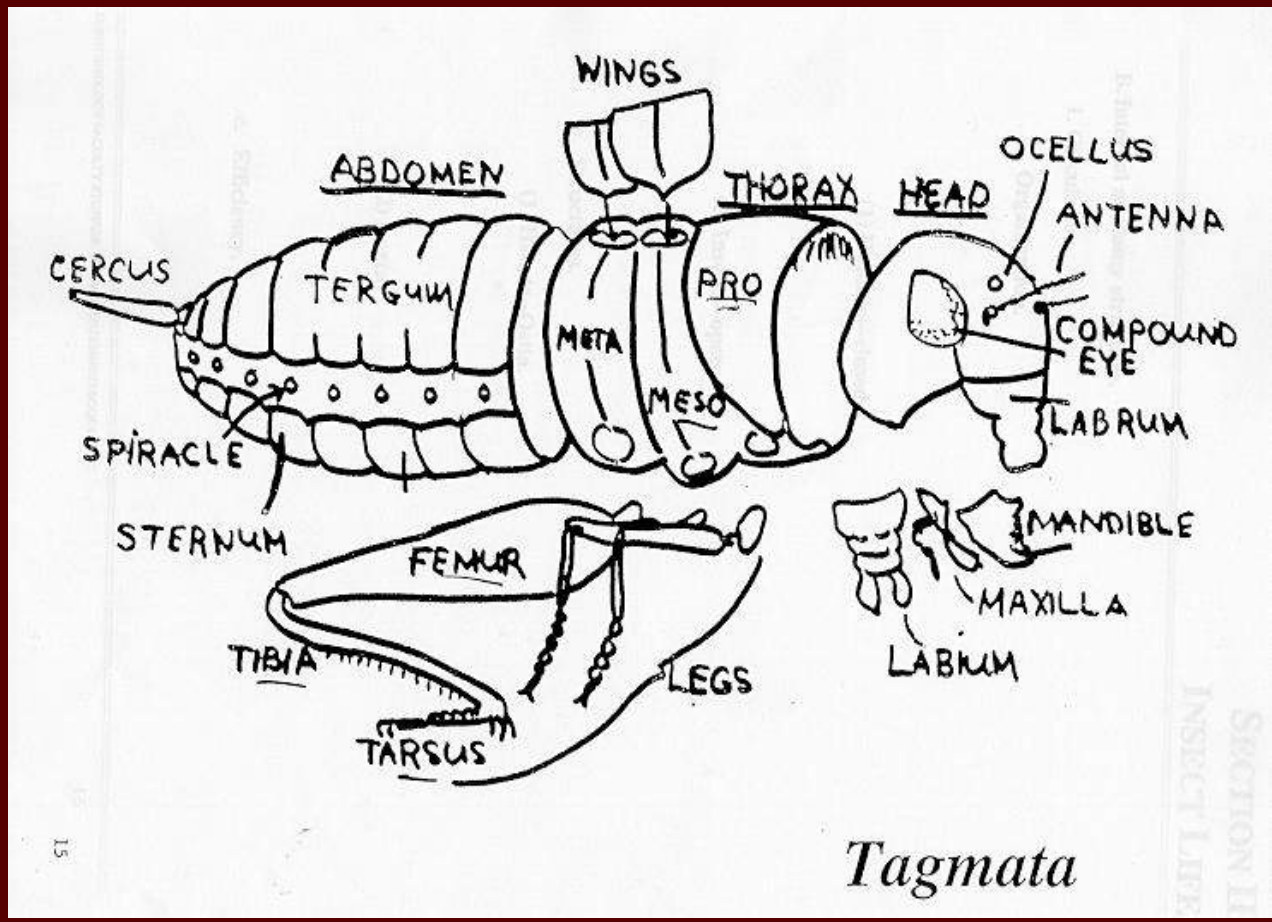
- Modified to use liquid or semi-liquid foods
- Some mouthpart components function for chewing
  - mold wax
  - grasping prey
  - cutting flowers
- Other components form the proboscis
  - ‘lapping’ surface
- Examples: honey bee, bumble bee

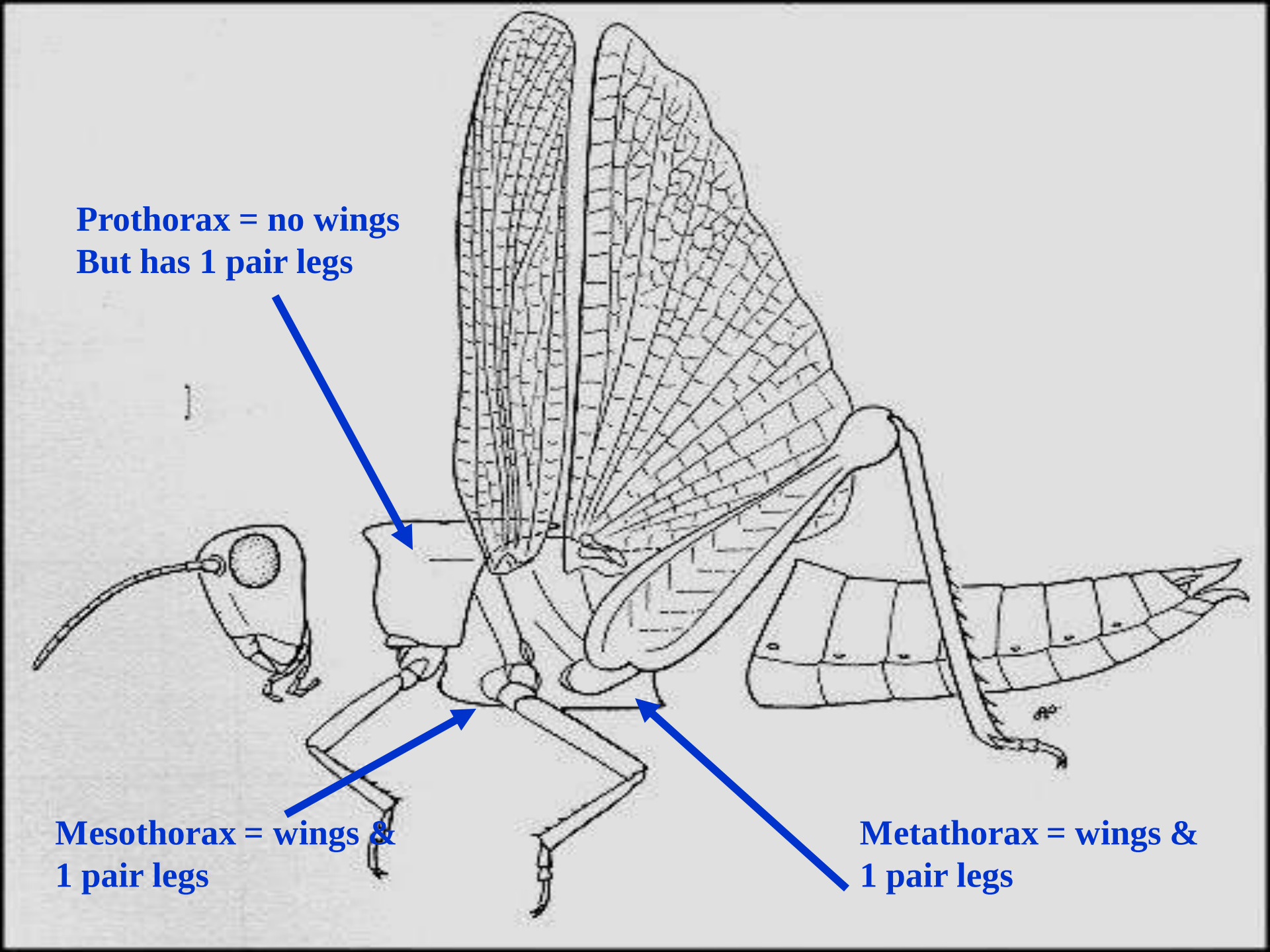
The **Thorax** consists of three segments:

1) Prothorax

2) Mesothorax

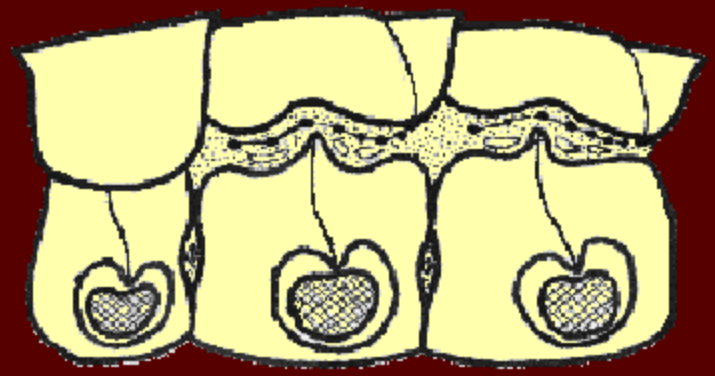
3) Metathorax




Prothorax = no wings
But has 1 pair legs
Mesothorax = wings &
1 pair legs
Metathorax = wings &
1 pair legs

Thorax

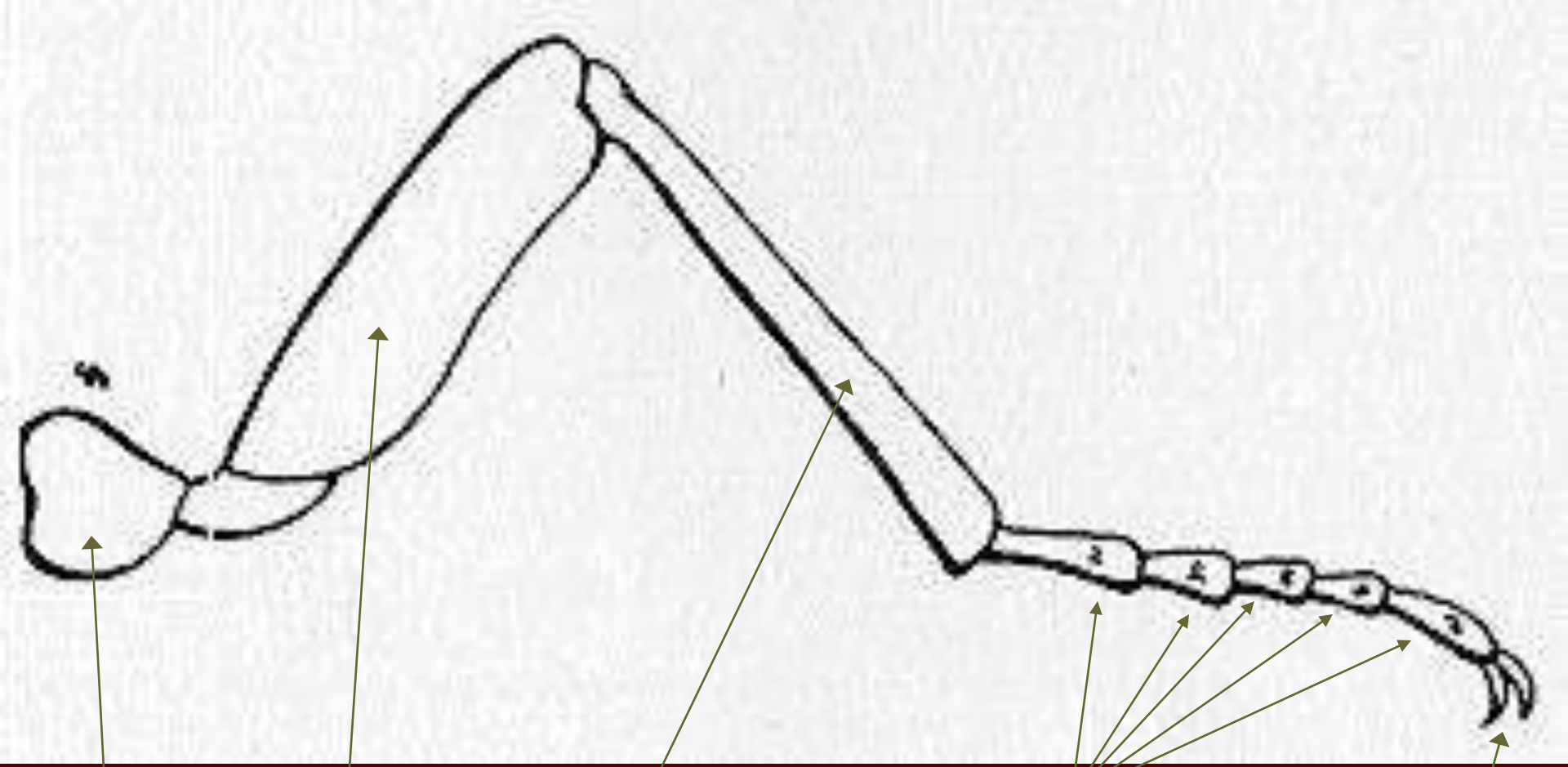
- Divided into 3 regions
  - prothorax
  - mesothorax
  - metathorax
- Main function: locomotion
  - walking/running
  - jumping
  - swimming
  - flying



Legs

- Three pairs of true legs
- 6 basic segments of the leg
  - coxa
  - trochanter
  - femur
  - tibia
  - tarsus
  - pretarsus

- Adapted for various functions


Coxa
Femur
Tibia
Tarsal segments
Tarsal claws

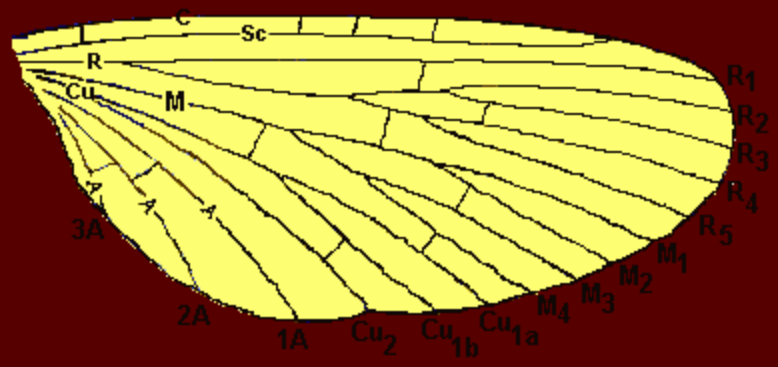
Types of Legs

- Cursorial – running
- Fossorial – digging
- Raptorial – predaceous
- Saltatorial – jumping
- Natatorial - swimming

Wings

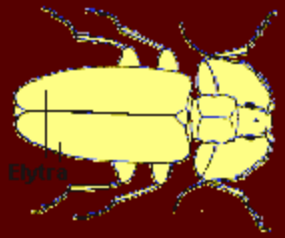
- Number of wings varies by species
  - 2 pairs
  - 1 pair on the mesothorax
  - absent

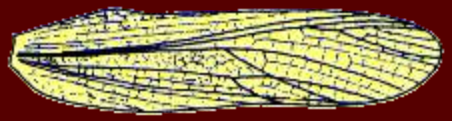
- Functions
  - locomotion
  - protection
  - camaflouge

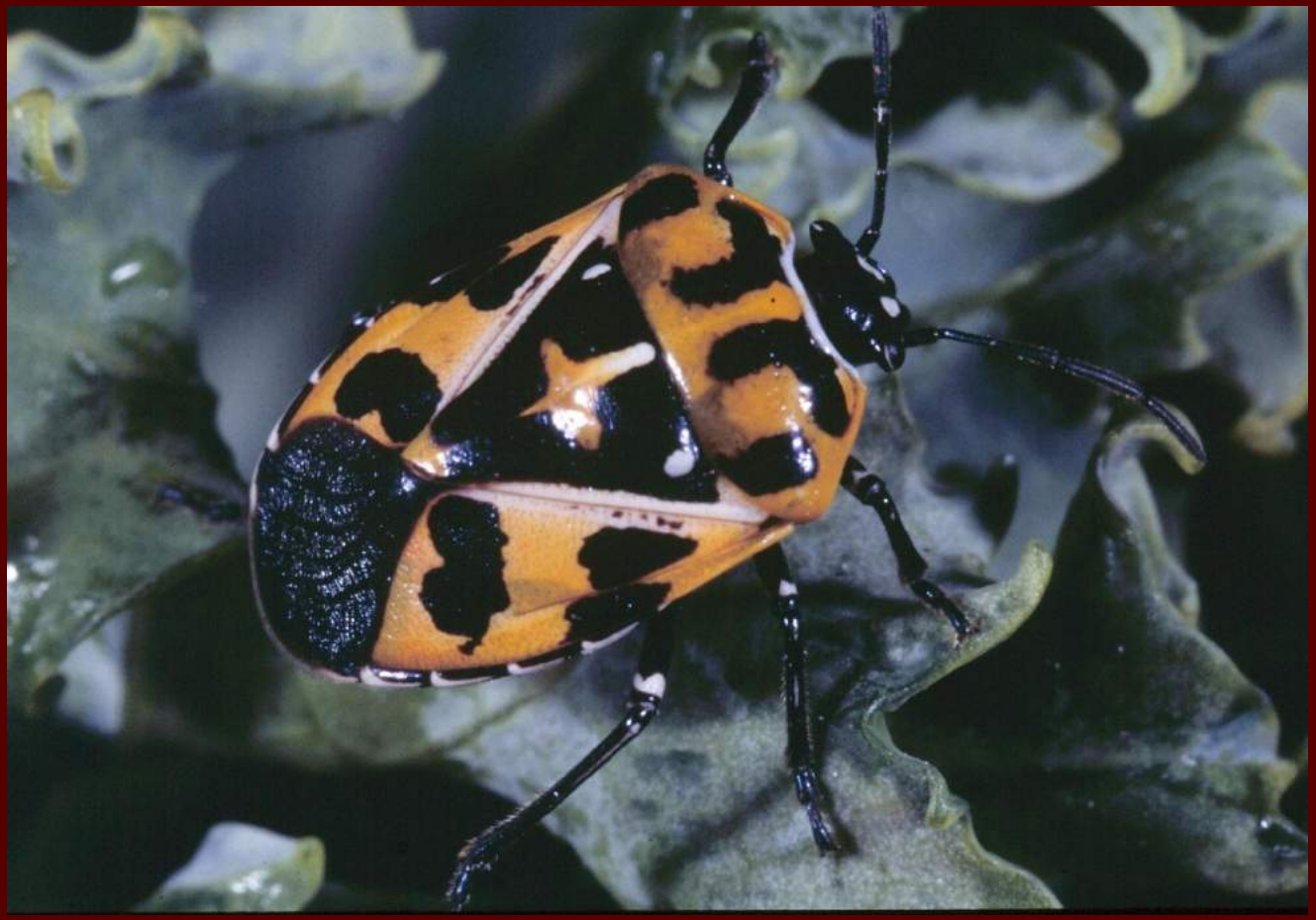


Types of Wings

- **Membranous**
- **Elytra -** hardened, front wings that serve as protective covers for membranous hind wings
- **Hemelytra -** front wings that are leathery or parchment-like at the base and membranous near the tip
- **Halteres -** small, club-like hind wings that serve as gyroscopic stabilizers during flight
- **Scales**
- **Tegmina -** front wings that are completely leathery or parchment-like in texture

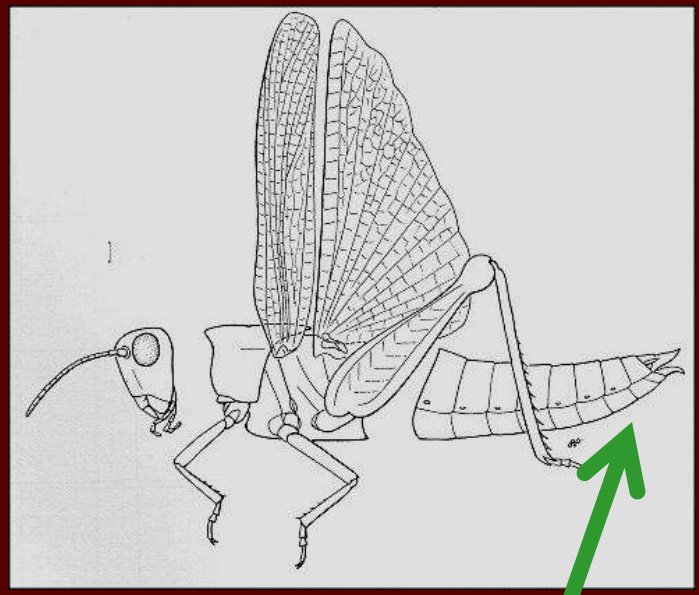


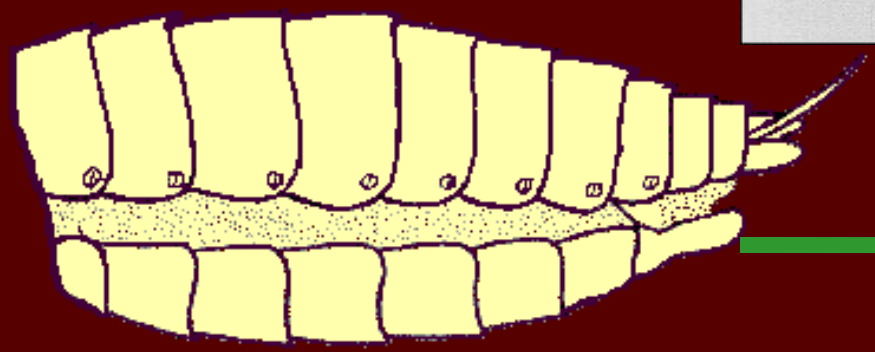




Abdomen

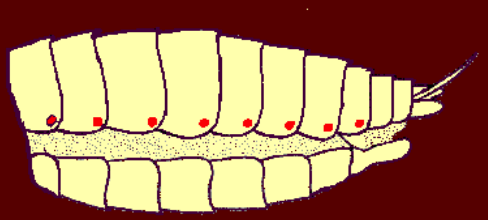
- **Functions:**
  - **respiration**
  - **excretion**
  - **reproduction**





Abdomen

- Spiracles
  - openings involved in respiration
  - located on each side of abdomen



- Cerci
  - sensory organs

- Ovipositor
  - egg-laying structure
  - stingers (modified ovipositor found in some females)

That's All!!!