INSECTS: A BASIC BACKGROUND

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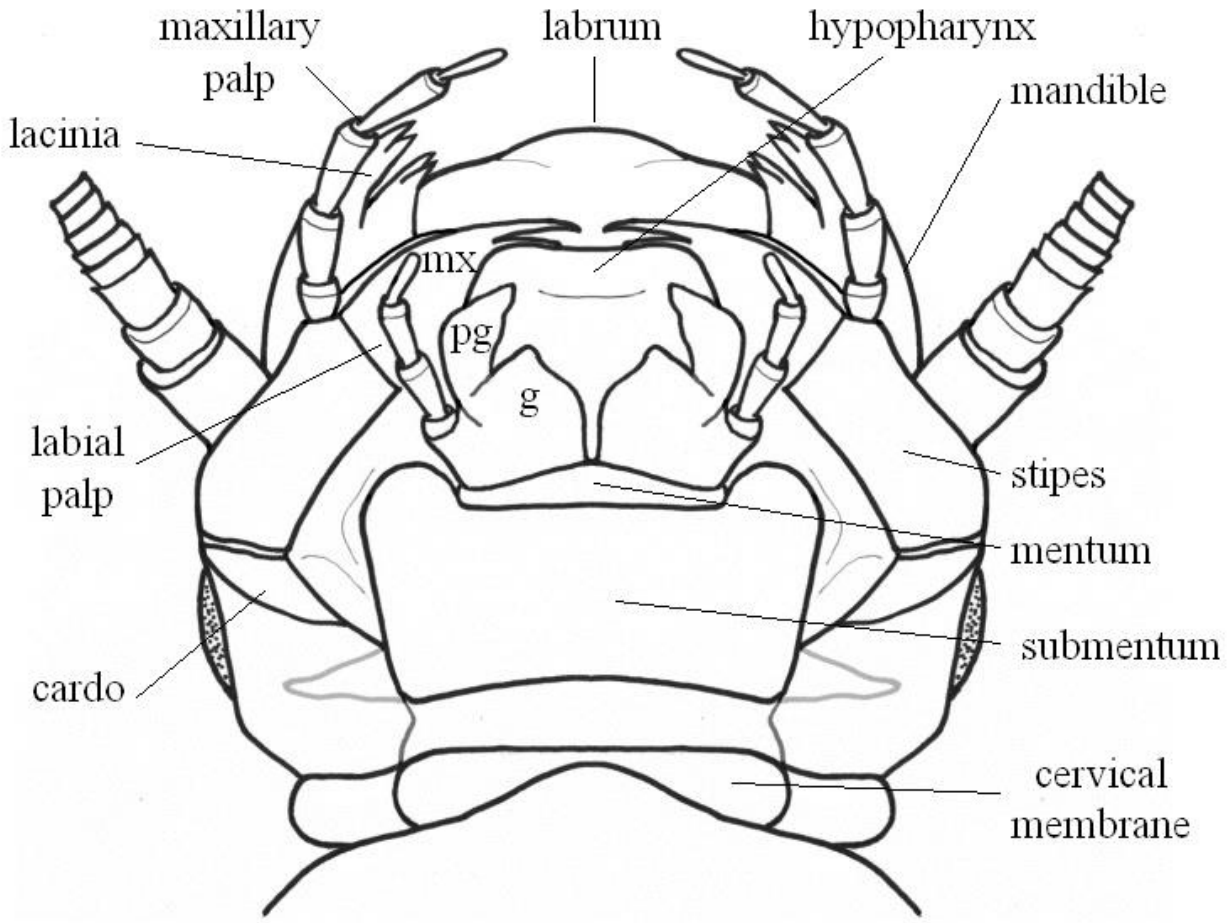
Insect Morphology

- Mouthparts
  - Labrum – Top Lip
  - Mandible – Jaw
  - Maxilla – Fork and Spoon
  - Labium – Bottom Lip
- Types of Mouthparts
  - Chewing, Piercing-sucking, Rasping-sucking, Sponging

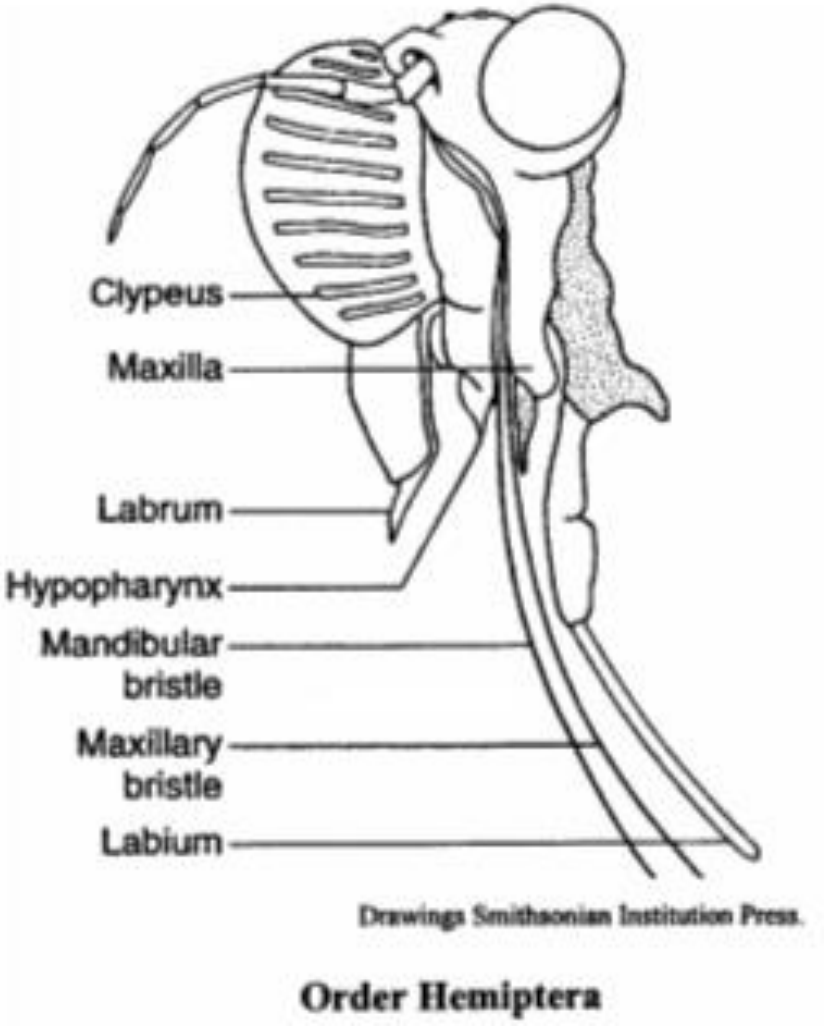
Insect Morphology

- Chewing



Insect Morphology

- Piercing-sucking

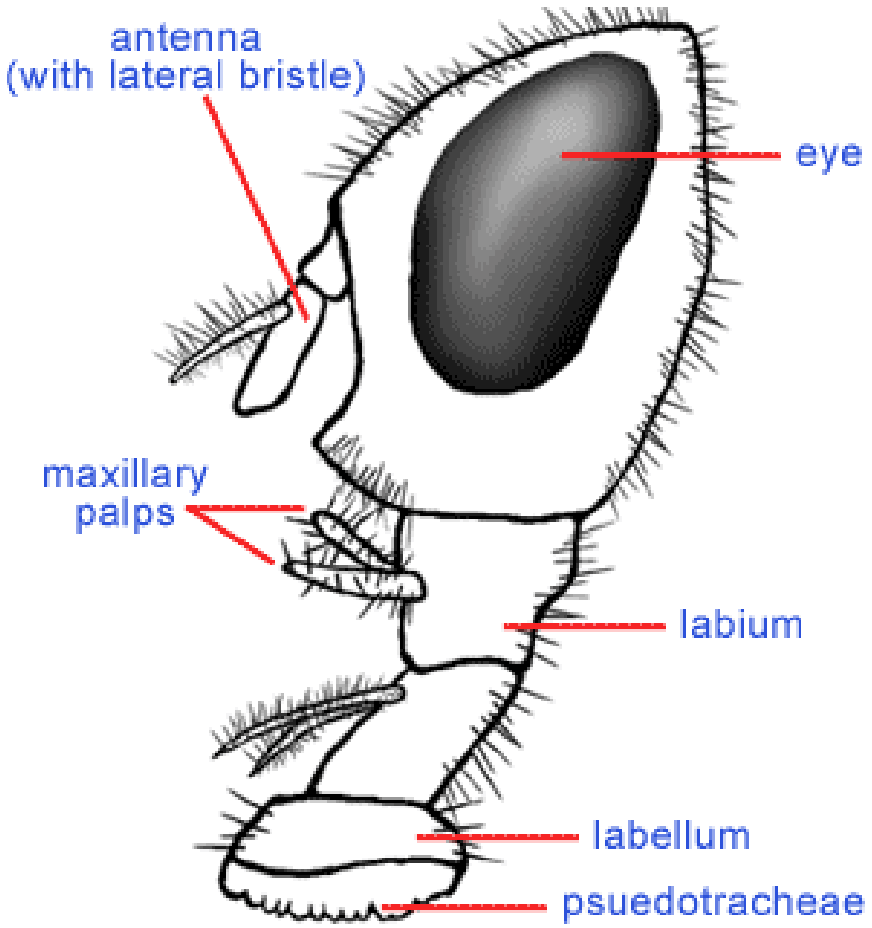


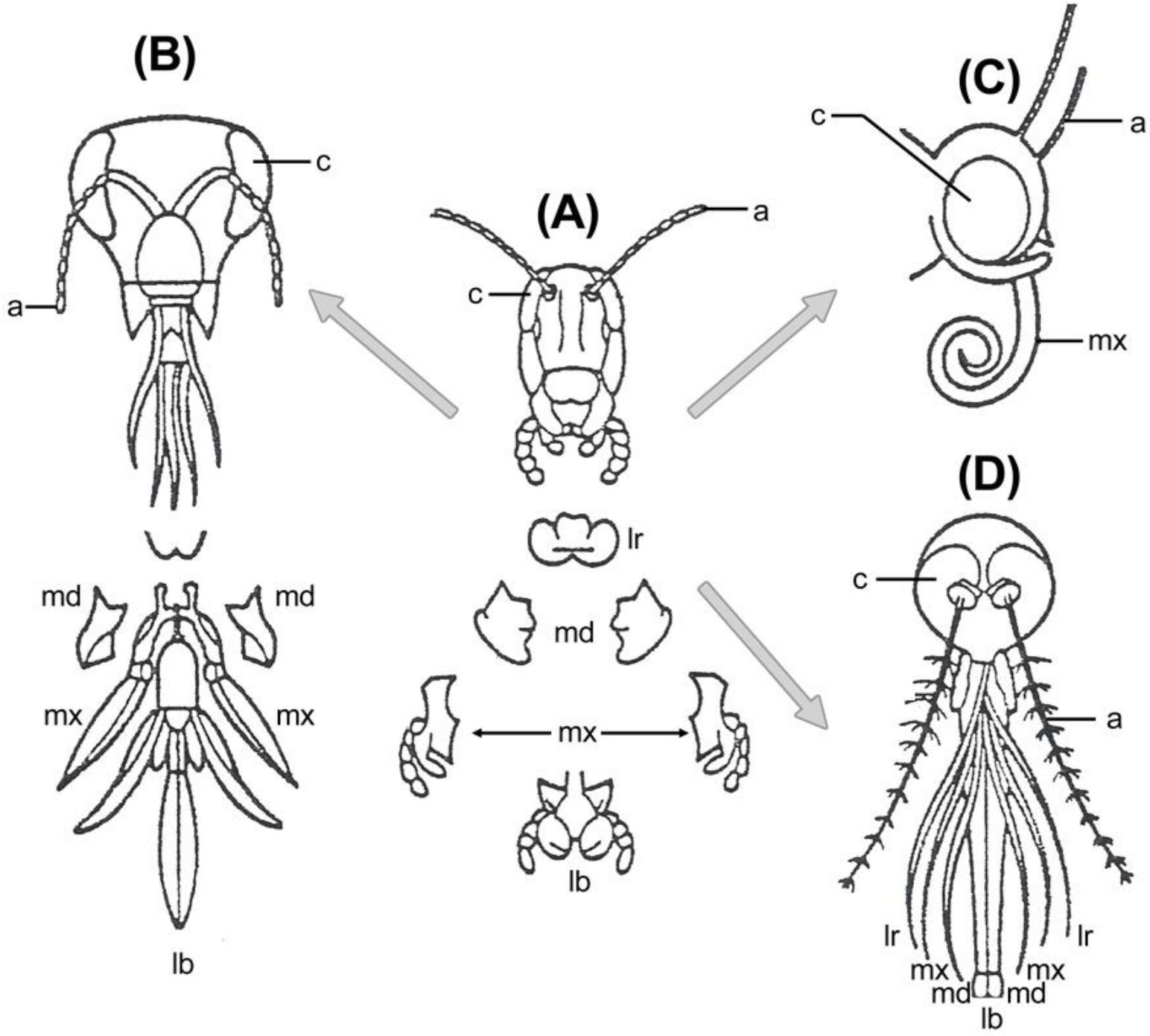
Insect Morphology

- Rasping-sucking

Insect Morphology

- Sponging

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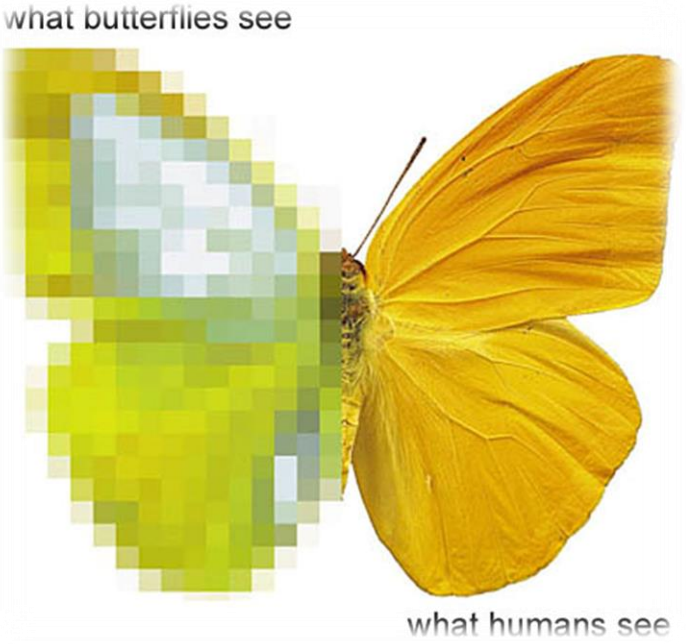
Insect Morphology

- Eyes
  - Simple (Ocelli) – Usually in a set of 3 and detect light and dark.

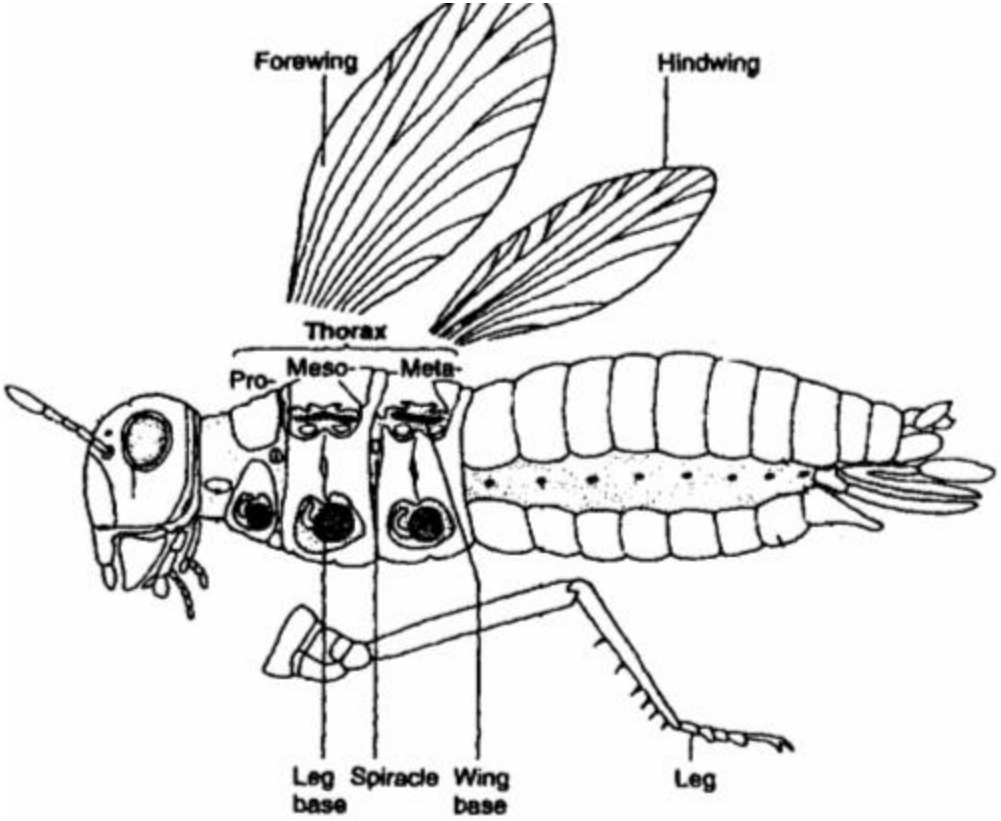
Insect Morphology

- Eyes
  - Compound – Comprised of multiple facets that create a pixilated image.



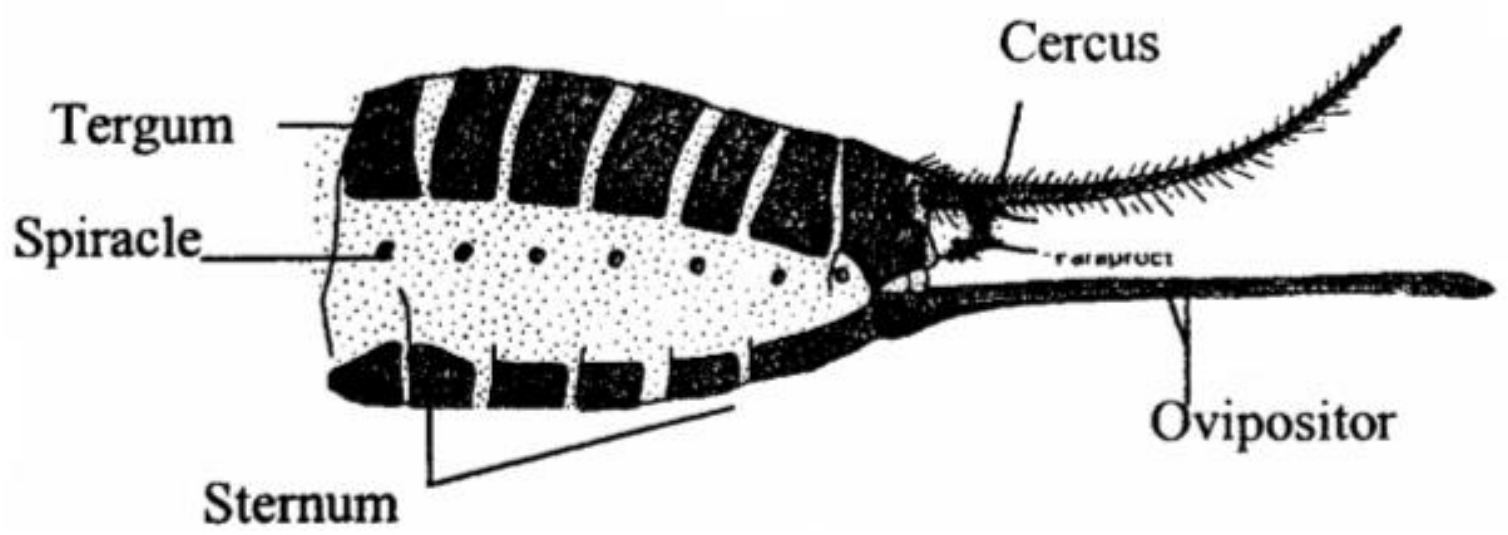
Insect Morphology

- Thorax – The middle region of the body that bears the legs and wings – if wings are present.



Insect Morphology

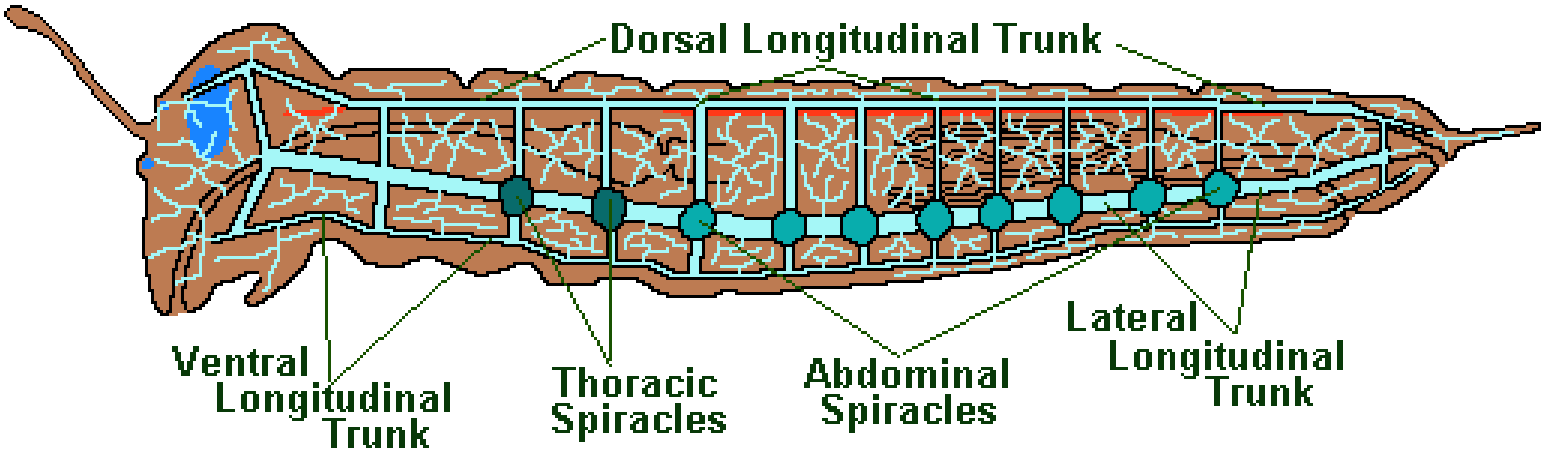
- Abdomen – The abdomen contains the reproductive organs and the majority of the organ systems.



Insect Physiology

- Respiration
  - Insects do not have lungs.
  - Insects do not transport oxygen through their circulatory systems.
  - Insects transport oxygen throughout their bodies with tracheal tubes.
  - Valves on their exteriors called spiracles allow oxygen in.

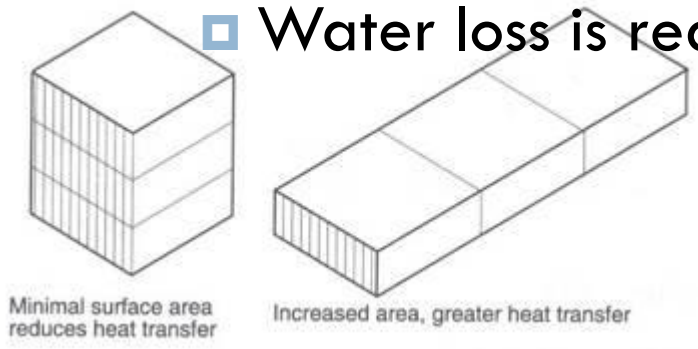
Diagramatic Representation of the Insect Tracheal System




JUSTNEEM
NEEM CURE

Insect Physiology

- Respiration
  - Insects only breathe when they have to because O2 and CO2 can diffuse through their bodies.
  - Pressure Differential – Some insects can "hold their breath" for long periods which increases the partial pressure differentials between the outside and inside of their bodies. This allows for a more rapid gas exchange.
  - Water loss is reduced by keeping the spiracles closed.



Insect Physiology

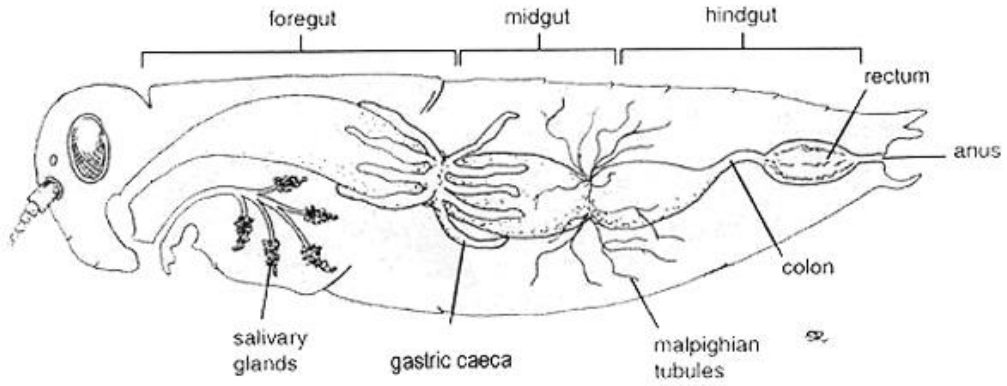
- Reproduction
  - Female
    - Ovipositor – Egg laying apparatus
    - Stinger – A modified ovipositor
    - Spermatheca – Sperm storage
    - The female can control how many eggs are fertilized.
    - Fertilized eggs become females and unfertilized eggs become males.

Insect Physiology

- Reproduction
  - Male
    - Spermatophore – A ball (packet) of sperm that moves around the spematheca as a unit. The spematophore is difficult to pass (kidney stone).

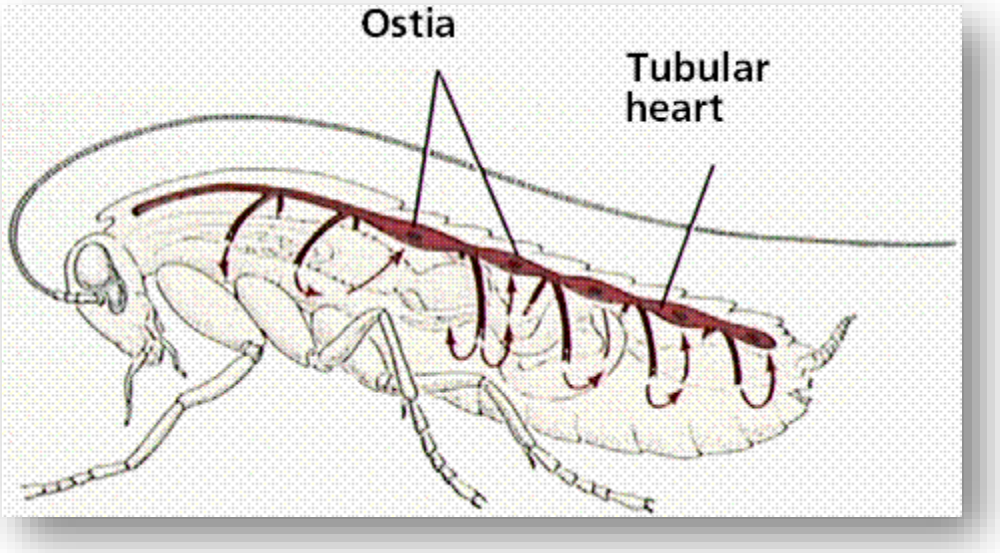
Insect Physiology

- Digestion
  - Foregut – Ingestion, Storage, Gringrinding
  - Midgut – Biochemical breakdown (secretion of enzymes) and nutrient uptake
  - Hindgut – Absorbtion of water, salt, and other nutrients + elimination of frass
  - The foregut and hindgut are lined with chitin.



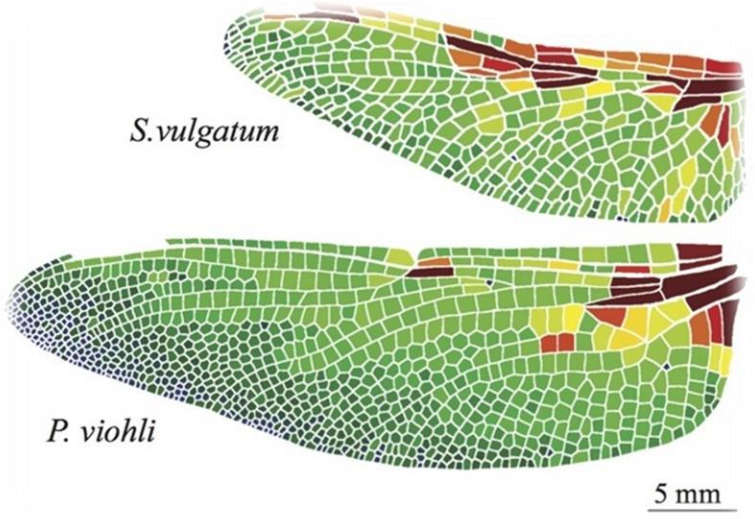
Insect Physiology

- Circulatory System
  - Insects have an open circulatory system.
  - "Blood" is pumped by the heart throughout the body, but not through veins and arteries.
  - No gas is exchanged and there is no need for hemoglobin.



Insect Physiology

- Circulatory System
  - Blood is used for the dissemination of hormones, nutrients, and defense compounds.
  - Blood inflates the wings, which act as “solar panels” to transfer heat.
  - Blood inflates the body and promotes molting.



Insect Physiology

- Nervous System
  - Impulse Transmission – Impulses travel from neuron to neuron via chemical transmission.
  - The primary chemical messenger is acetylcholine (ACH).
  - Acetylcholine – Travels from synaptic sites and docks at receptors.
  - Acetylcholinesterase (ACHE) – Degrades ACH. The insect becomes overstimulated if ACHE does not degrade ACH.

Insect Physiology

- Acetylcholinesterase Inhibitors
  - Organophosphates
    - Diazinon
    - Malithion
    - Lorsban (Chlorpyrifos)
  - Carbamates
    - Sevin (Carbaryl)
    - Temik (Aldicarb)

Insect Physiology

- Acetylcholine Receptor Antagonists
  - Neonicotinoids
    - Merit (Imidacloprid)
    - Safari (Dinotefuran)
    - Arena (Clothianidin)
- Sodium Channel Modulators
  - Pyrethroids
    - Talstar (Bifenthrin)
    - Optimate (Cyhalothrin)

Metamorphosis

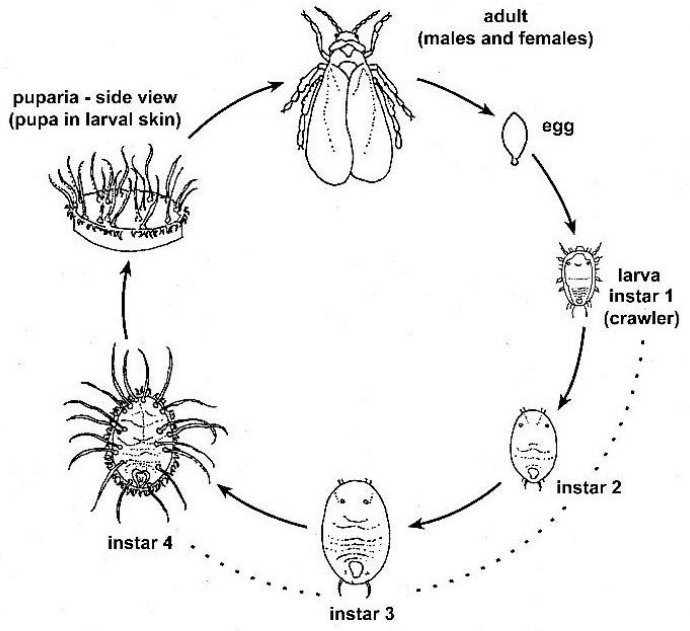
- Change in Form
  - Metamorphosis ranges from none (babies like adults except reproductive structures) to complete (babies nothing like adults).
  - Complete Metamorphosis – Advanced; immatures and adults often do not compete for same food source or habitat.

Metamorphosis

- Ametabolous
  - Immatures look like adults.
  - 3 Stages – Egg, Immature, and Adult
  - Immature still molts multiple times as it grows.
  - Insects between molts are referred to as instars.

Metamorphosis

- Hemimetabolous
  - Insects with an incomplete metamorphosis.
  - Nymphs (Immature) – Look like adults, but have no wings or reproductive organs.
  - The last instar nymph has wingpads (nubs).
  - 3 Growth Stages – Egg, Nymph, and Adult



Metamorphosis

- Holometabolous
  - Insects with a complete metamorphosis.
  - Adults look completely different from immatures.
    - Allows for different feeding habits – Caterpillar (leaves) and Butterfly (nectar).
  - 4 Growth Stages – Egg, Larva, Pupa, and Adult
  - The pupa is the resting stage of the larva.

Metamorphosis

- Molting is a function dictated by a hormone concentration change.
  - Ecdysone – Molting hormone that elicits action.
  - Juvenile Hormone (JH) – Keeps the insect in its immature stage.
- Insecticides that mimic these hormones are referred to as Insect Growth Regulators (IGRs).

Metamorphosis

- Ecdysone Mimic – A growth action occurs whether the insect is ready or not.
  - Mach 2 (Halofenozide)
  - Intrepid (Methoxyfenozide)
  - Confirm (Tebufenozide)

Metamorphosis

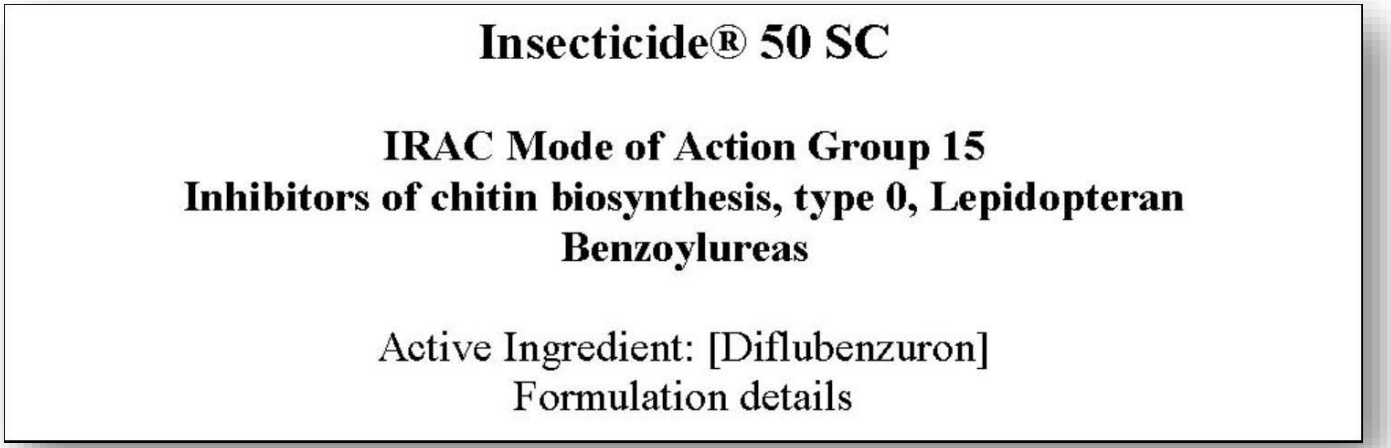
- JH Mimic – Forces the insect to stay in the larval stage.
  - Pros – Prevents adult damage and reduces risk of resistance.
  - Con – Insect continues to feed in immature stage, which is oftentimes more economically damaging.
- Gencore (Hydroprene)
- Enstar II (Kinoprene)
- Apex (Methoprene)

Insecticide Mode of Action

- IRAC – Insecticide Resistance Action Committee
  - Responsible for the classification of insecticide and acaricide mode of action.
  - A partnership between the US, Brazil, South Africa, Spain, India, and Australia.
  - Resistance – An inheritable change in the sensitivity of a pest population reflected by repeated product failure to achieve expected control for a pest species.

Insecticide Mode of Action

- Insecticides and acaricides are categorized by:
  - Group
  - Subgroup
  - Primary Target Site of Action
  - Chemical Subgroup
  - Active Ingredient



Questions?