Insect History

Insects are unmatched in:

- Longevity
- Diversity of adaptations
- Ecological and Economic Significance

Outline

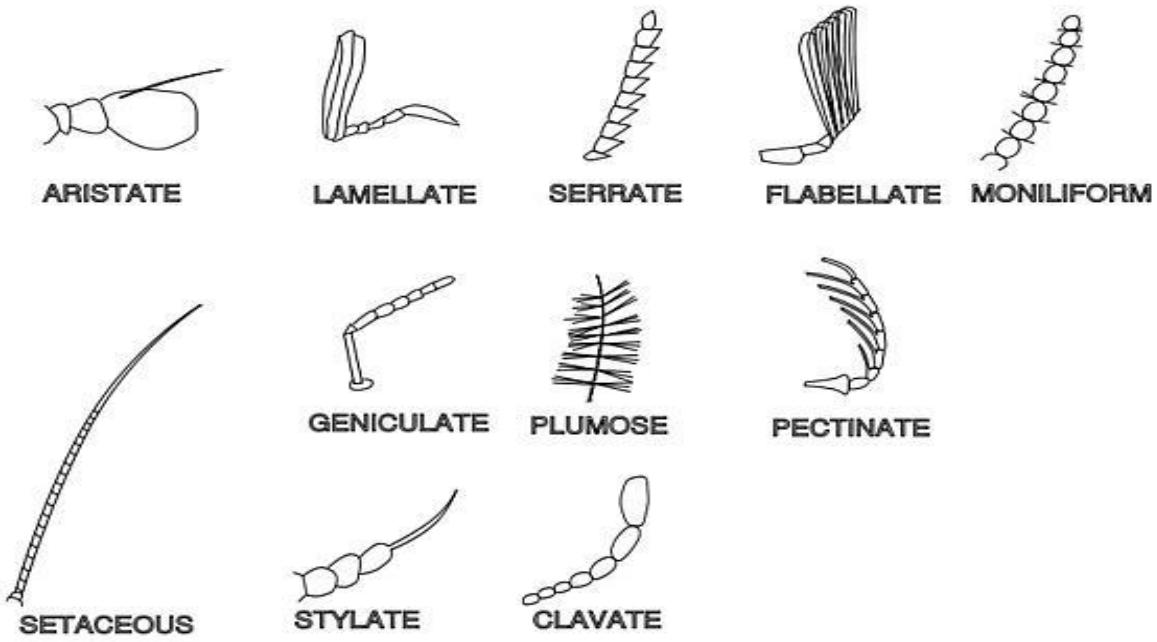
- The Most Successful Animals on Earth: a Brief (Entomological) Journey through Time

- Insect Physiology and Development

Morphology and Development

Morphology: the study of form and structure; homology studied

- *Functional* morphology: What does it do?



Morphology and Development

Morphology: the study of form and structure; homology studied

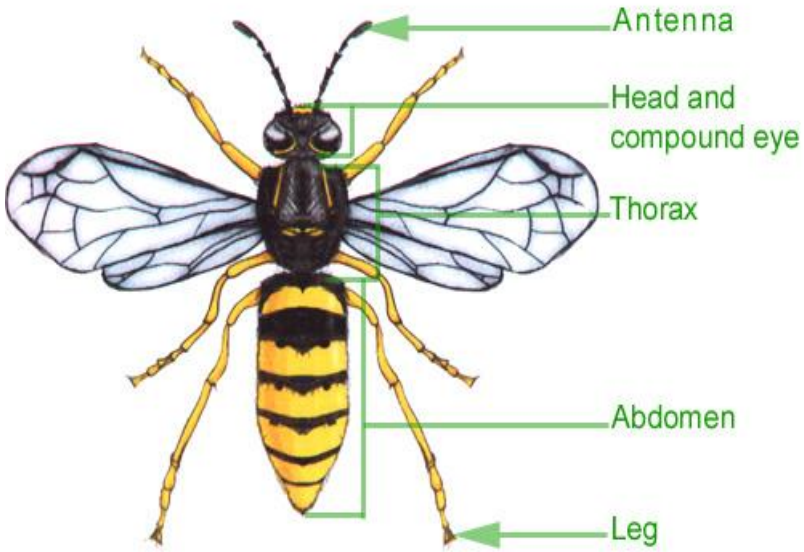
- *Functional* morphology: What does it do?
- *Comparative* morphology: Where did it come from?
  - Functional history of unique events (i.e. origin of wings)
  - Not always testable
  - Some features may be primitive and retained in extinct lineages

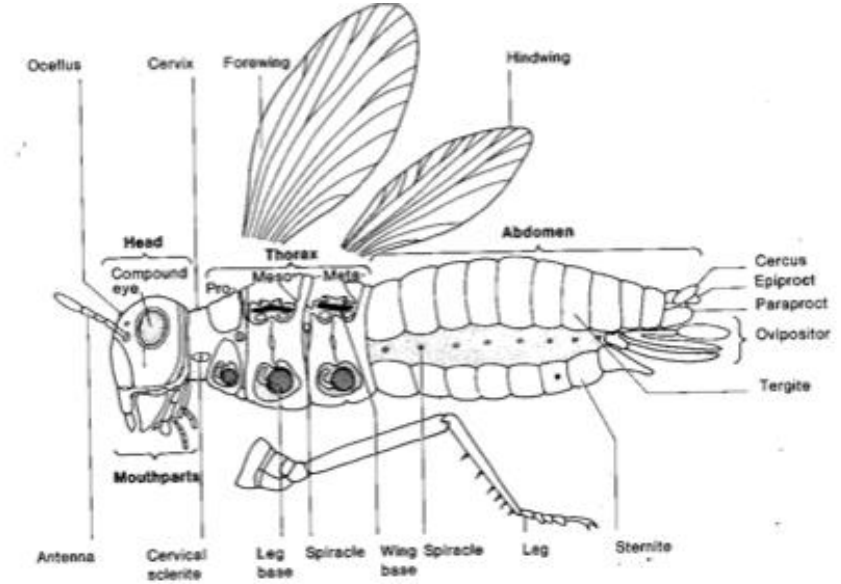
From *Evolution of the Insects,* Grimaldi and Engel, 2005.

Morphology and Development

Insect Morphology

- Are essentially a combination of functional units = *metameres*
  - Specialization occurs and allows for versatility and greater functionality
- Insects have 3 functional *tagmata*
  - Head (sensory input)
  - Thorax (locomotion)
  - Abdomen (visceral functions, mating, some sensory input)





From *The Science of Entomology,* Romoser and Stoffolano, Jr., 1994.

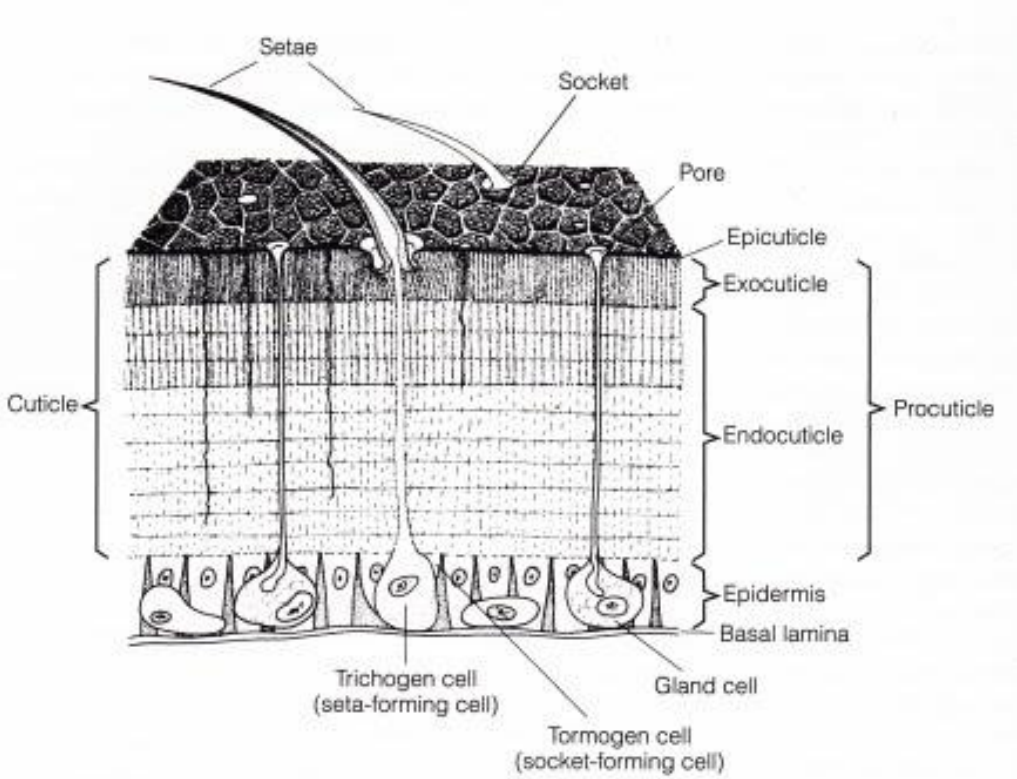
Metamere: identical primary body segments; characteristic of all arthropods

Tagmata: 3 major regions of insects, composed of multiple *metameres*

Morphology and Development

Insect Morphology

- Are essentially a combination of functional units = *metameres*
  - Specialization occurs and allows for versatility and greater functionality
- Insects have 3 functional *tagmata*
  - Head (sensory input)
  - Thorax (locomotion)
  - Abdomen (visceral functions, mating, some sensory input)
- Encased by a chitinized cuticle
  - Provides protection, support, and locomotion
  - Prevents water loss
  - Site for waste deposition
  - Protects from UV radiation
  - Serves communication functions (intra- and interspecifically) via hydrocarbons

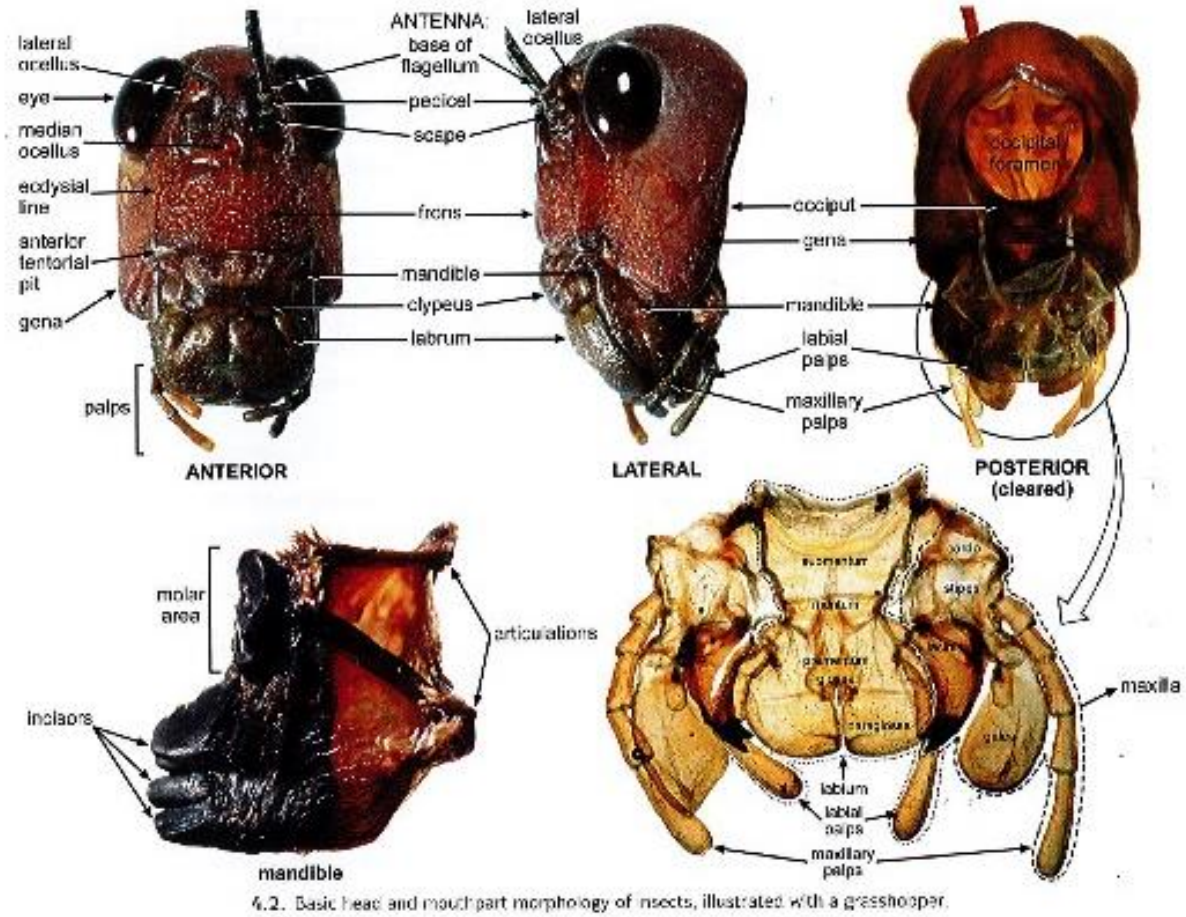


Morphology and Development

Insect Morphology: Head

- Numerous metameres; hyperspecialized structure
  - Mouthparts (ectognathus)
    - *Hypognathus*
    - *Prognathus*

From *Evolution of the Insects,* Grimaldi and Engel, 2005.



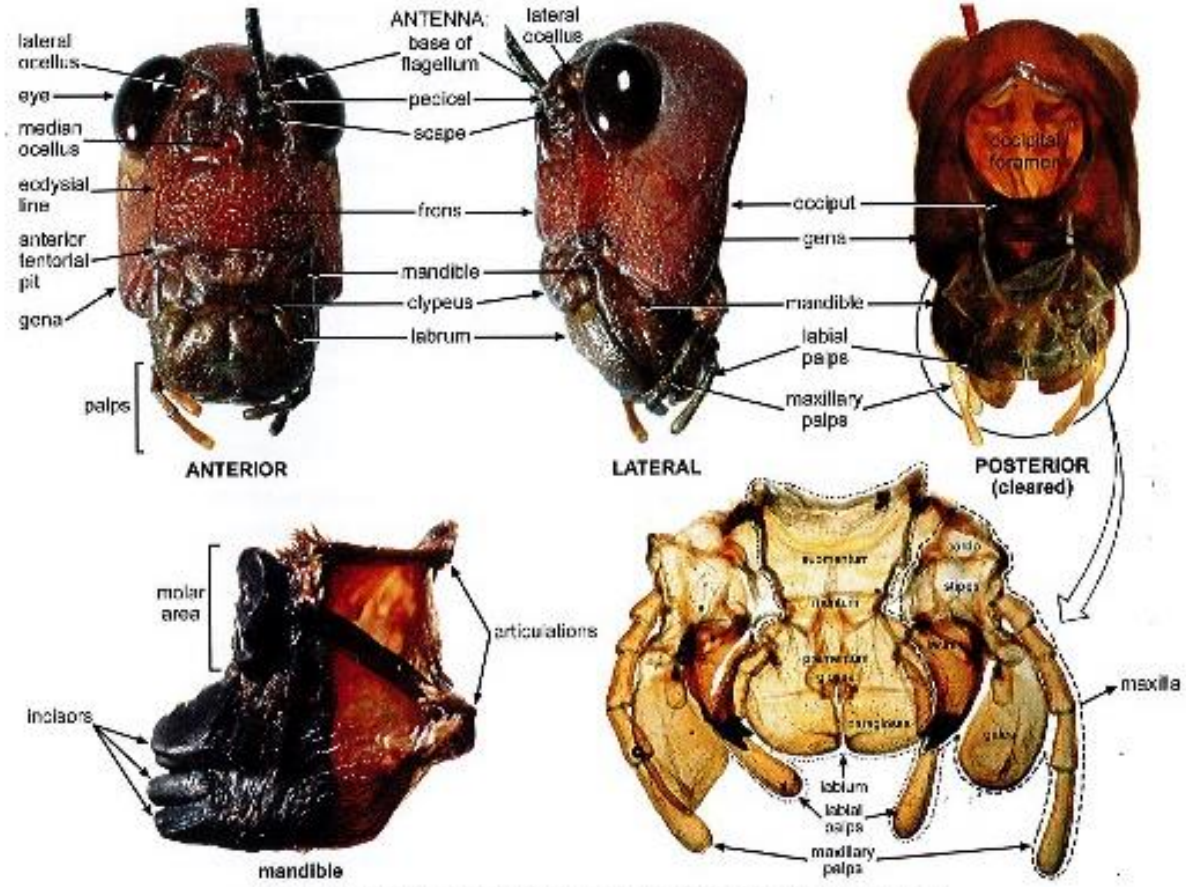
4.2. Basic head and mouthpart morphology of insects, illustrated with a grasshopper.

Morphology and Development

Insect Morphology: Head

- Numerous metameres; hyperspecialized structure
  - Mouthparts (ectognathus)
    - *Hypognathus*
    - *Prognathus*
  - Compound eyes/simple eyes
  - Antennae

From *Evolution of the Insects,* Grimaldi and Engel, 2005.

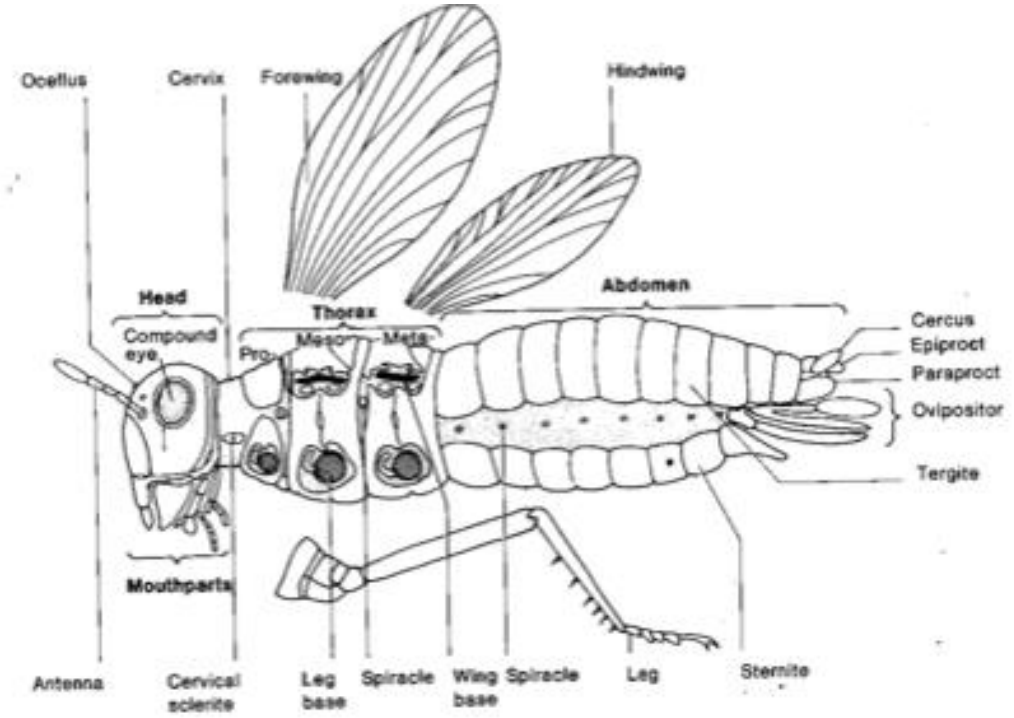


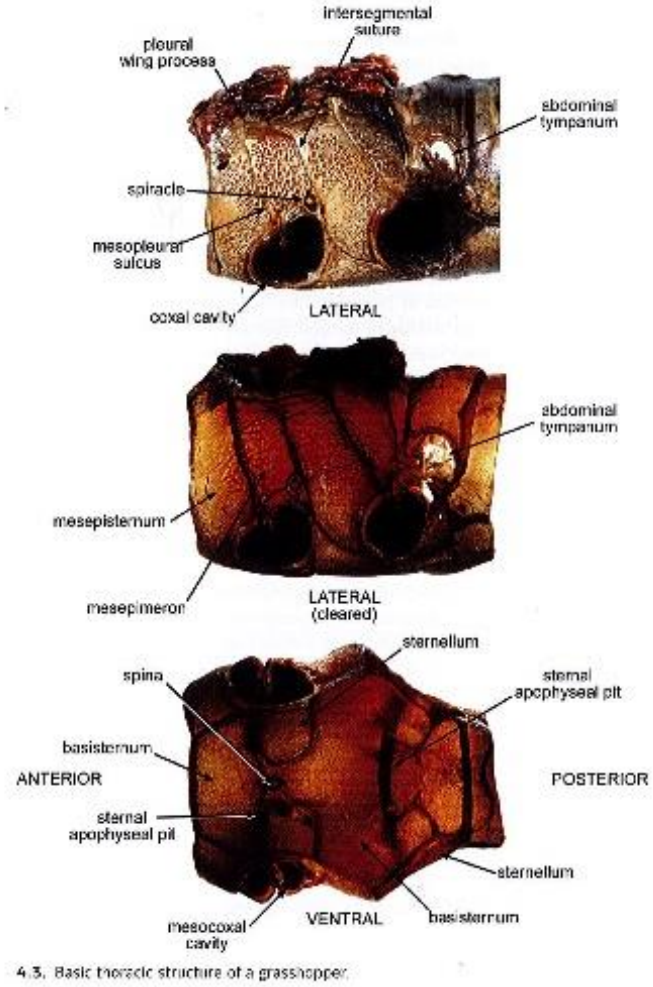
4.2. Basic head and mouthpart morphology of insects, illustrated with a grasshopper.

Morphology and Development

Insect Morphology: Thorax

- Locomotion
  - Wings
  - Legs





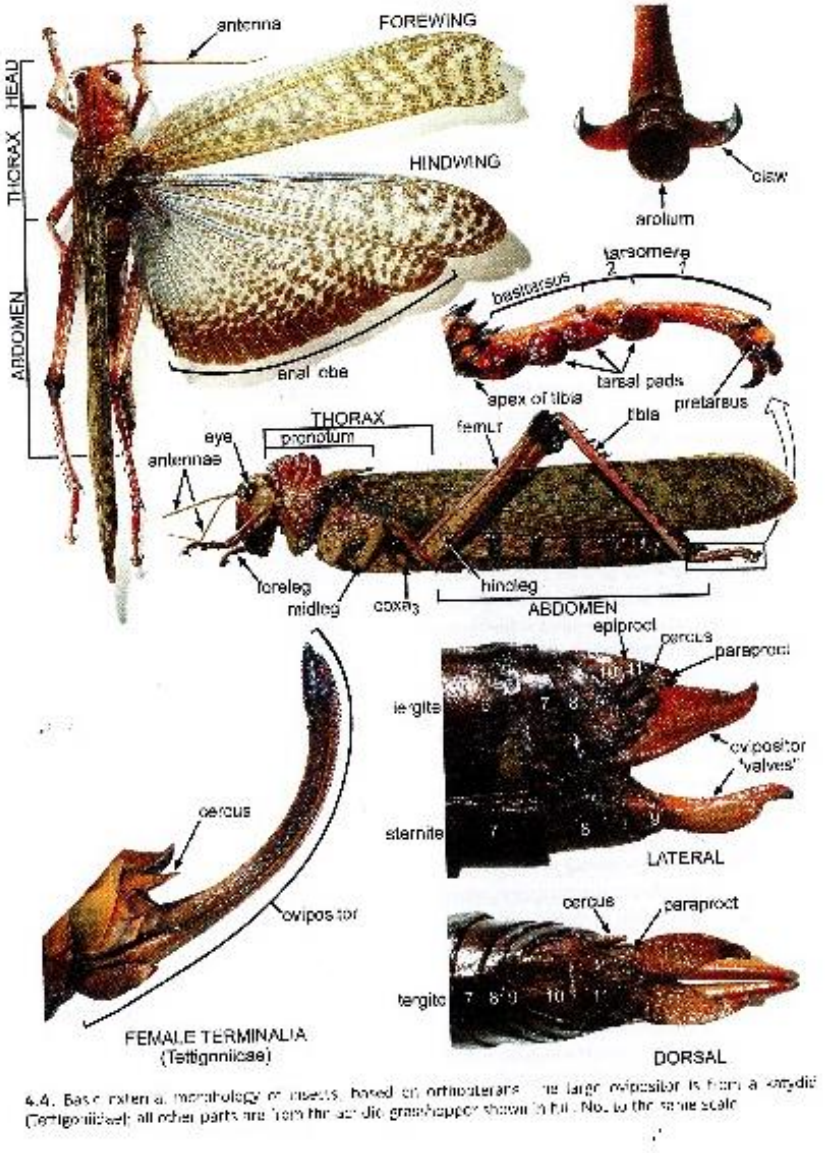
4.3. Basic thoracic structure of a grasshopper.

From *Evolution of the Insects,* Grimaldi and Engel, 2005.

Morphology and Development

Insect Morphology: Abdomen

- Visceral Functions; least modified
  - Waste excretion
  - Mating/copulation
  - Respiration (spiracles)
  - Digestion



From *Evolution of the Insects,* Grimaldi and Engel, 2005.

Spiracle: located along abdominal segments; breathing and communication

Cerci: Located on last abdominal segment; sensory

Morphology and Development

Insect Development: Hemimetabolism (Simple metamorphosis)

Simple Metamorphosis

- 3 main stages: egg, nymph, adult
  - Nymphs molt (usually 5 juvenile stages)
  - Nymphal stage may be confused with beetles

Morphology and Development

Insect Development: Hemimetabolism

Simple Metamorphosis

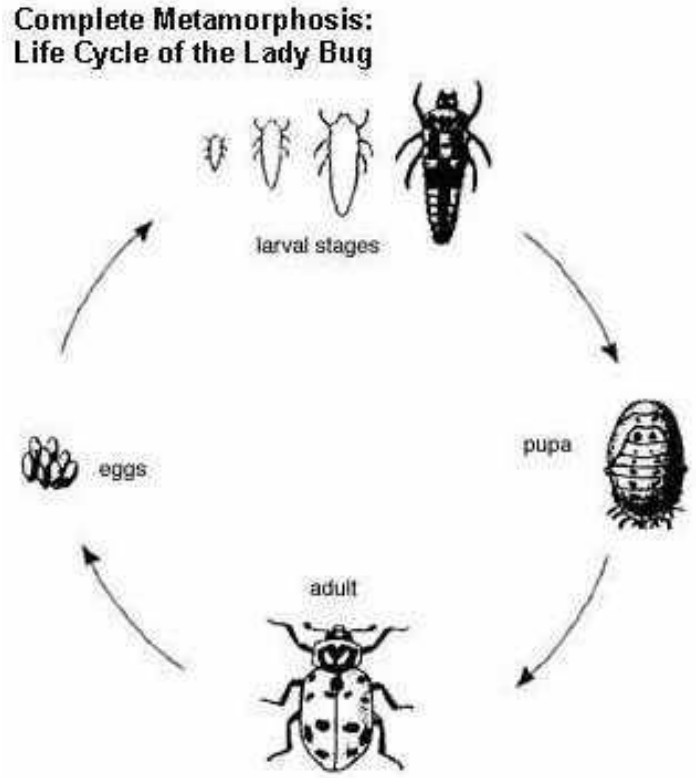
- 3 main stages: egg, nymph, adult
  - Nymphs molt (usually 5 juvenile stages)
  - Nymphal stage may be confused with beetles

Morphology and Development

Insect Development: Holometabolism

Complete Metamorphosis

- 4 main stages: egg, larvae, pupae, adult
  - Adults and larvae feed on different foods (sometimes)



Outline

- The Most Successful Animals on Earth: a Brief (Entomological) Journey through Time
- Insect Physiology and Development
- Common Insects and their Identification

Common Insects: Mayflies

paenvironmentdaily.blogspot.com

Common Insects: Mayflies

Order: Ephemeroptera

- Most basal pterygotes; shortest-lived
- Larval forms are fully aquatic; some families can move to dry land
- Mouthparts are absent or nonfunctional
- Stomachs are simple air sacs that aid in flight
- Common families include:
  - Baetidae
  - Heptageniidae (flat heads)
  - Ephemeridae

Jason Neuswanger

Gunnisoninsects.com

Common Insects: Dragonflies and Damselflies

Common Insects: Dragonflies and Damselflies

Order: Odonata

- An ancient order of extant lineage
- Incomplete metamorphosis
- Adults and larvae predaceous
- Indicators of moderate water
- Males are highly territorial
  - Perchers
  - Fliers

Common Insects: Dragonflies and Damselflies

Common Insects: Dragonflies and Damselflies

Order: Odonata

- Wing muscles move independently of one another
- *Pterostigma* act as ‘weights’ to compensate for increased wingspeed

Pterostigma: group of specialized cells on the outer wings of insects

Common Insects: Dragonflies and Damselflies

Aeshnidae: Darners

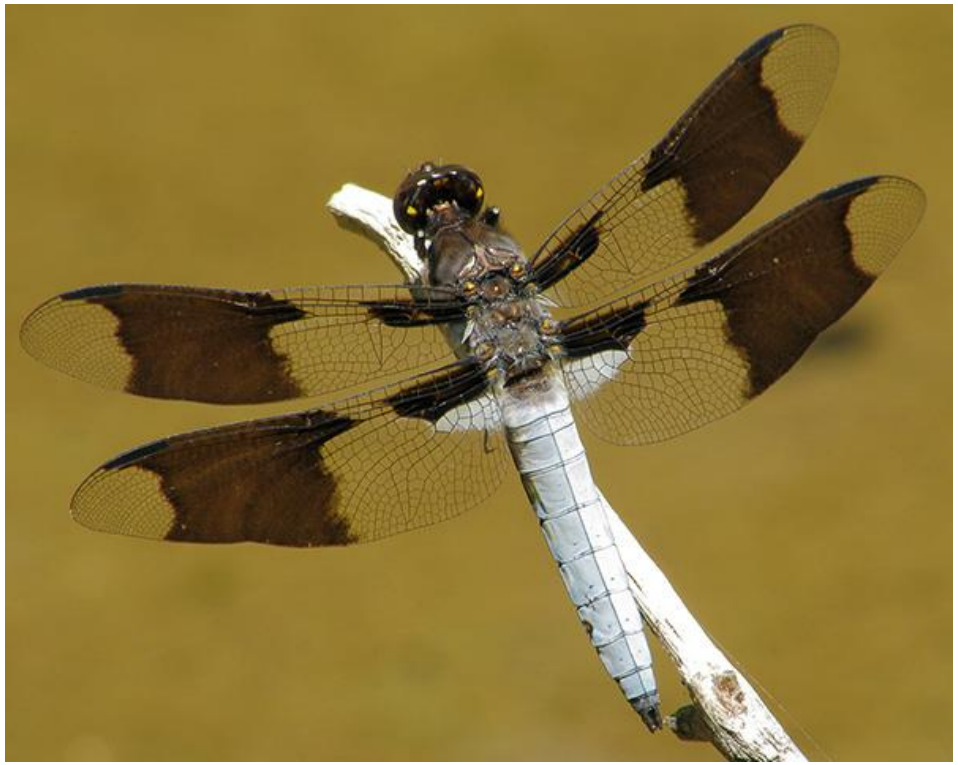
- Largest and most powerful group of dragonflies; up to 116 mm long;
- Green darner most common;
- Exhibit ‘non-contact guarding’ behavior.

Regal darner; common to southeastern swamps and marshes

Common Insects: Dragonflies and Damselflies

Libellulidae: Skimmers

- Frequently encountered group
- Common whitetail in this group
- Common name derives from the way females lay their eggs



Mature Common whitetail; azdragonfly.org

Common Insects: Dragonflies and Damselflies

Libellulidae: Damselflies

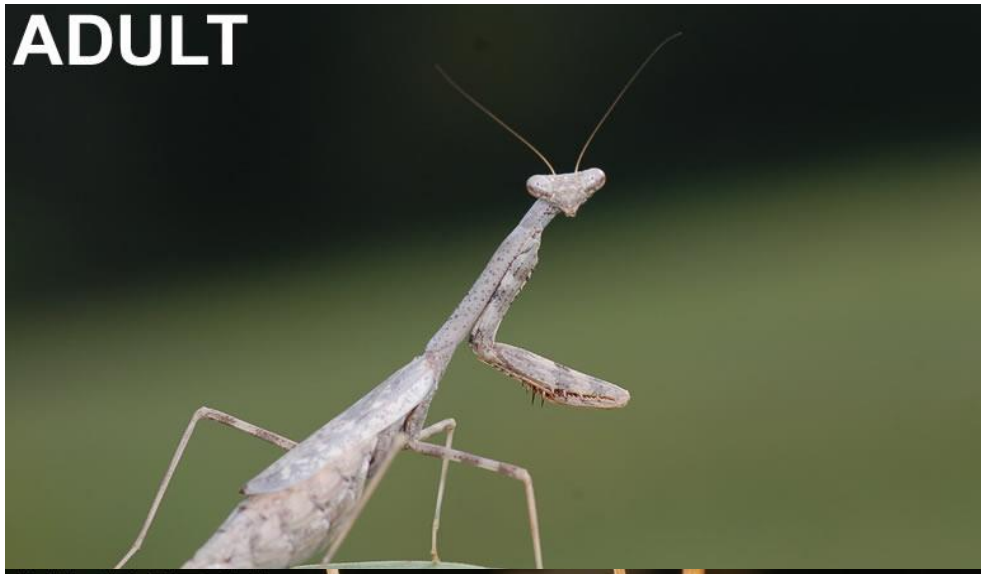
- Males have entirely black wings
- May or may not exhibit territoriality
- Females lay eggs above water, usually on reeds or grasses

Ebony jewel wing

Common Insects: Mantids

Order: Mantodea

- One truly ‘native’ species, the Carolina Mantid
- Mantids in general are closely related to cockroaches
- Usually mottled gray/brown
- Adults are small, ~2 inches



Common Insects: Grasshoppers, Crickets and Katydids

Order: Orthoptera

- 100% are plant feeders;
- Well-camouflaged;
- Field crickets are 2 distinct species

Gryllus pennsylvanicus; bugguide.net

Common Insects: True Bugs

Order: Hemiptera

- Incomplete metamorphosis
- Can be predaceous but are also pests
- Robust group!

Common Insects: True Bugs

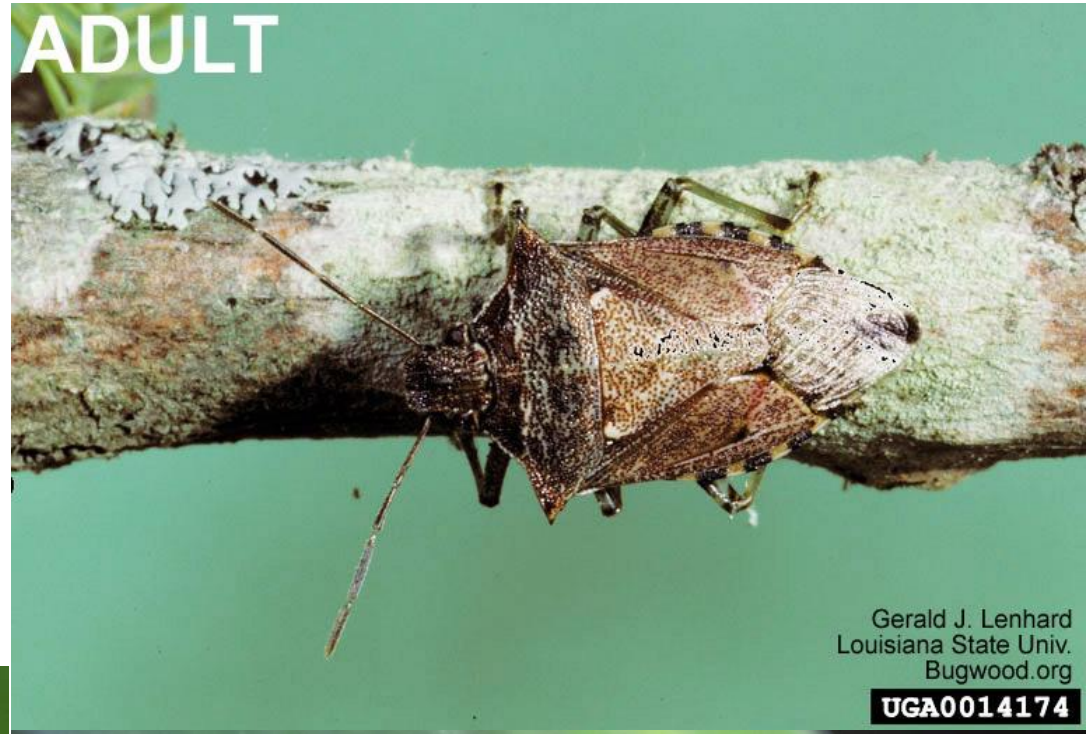
Hemiptera: Reduviidae

- Large group, ~160 spp.
- Beaks twice as thick as antennae
- Can appear spider-like
- Feed on:
  - Caterpillars
  - Other plant-feeding insects

Common Insects: True Bugs

Hemiptera: Pentatomidae

- Large group, ~200 spp
- Spined soldier bug, stinkbugs, etc.



Common Insects: True Bugs

Common Insects: True Bugs

Hemiptera: Belostomatidae

- Giant water bugs; 65-100mm in length;
- Ambush predators, found in ponds and lakes;
- Males exhibit brood care

Common Insects: True Bugs

Hemiptera: Corixidae

- Water boatmen;
- Common in stream and pond edges, brackish pools (infrequent);
- Feed on algae, midge larvae, and other aquatic immatures

Common Insects: True Bugs

Hemiptera: Gerridae

- Water striders
- “Skate” along the surface of water
- Predaceous of other insects that fall into the water