

Arthropods




Most diverse group of animals

- Over 1 million spp.

Single Phylum (Arthropoda)

3 large subphyla

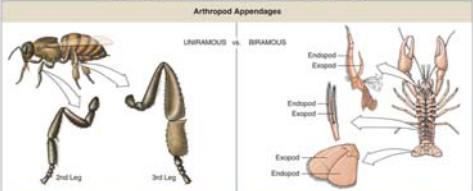
- Chelicerata (spiders, scorpions, ticks)
- Crustacea (crabs, shrimp, lobsters)
- Hexapoda (insects)



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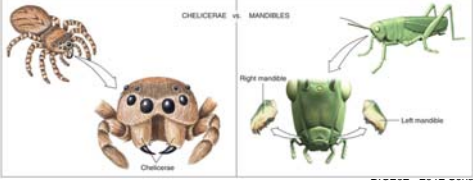
Arthropod Appendages

UNIRAMOUS vs. BIRAMOUS



Arthropod Mouthparts



CHELICERAE vs. MANDIBLES



Arthropods

Defining traits of Arthropoda

- Segments form groups (**tagmata**)
- Jointed** appendages
- Exoskeleton (proteins, chitin)
- Complex muscles, rapid movement
- Reduced coelom (**hemocoel**)
- Respiration advanced with **trachea** or **gills**
- Advanced sensory systems



Arthropods

Subphylum Chelicerata

- Have **six** pairs of appendages
 - 4 pairs walking legs
 - 1 pair **chelicerae**
 - 1 pair **pedipalps**
- No mandibles or **antennae**
- **Predigest** food before consuming



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Arthropods

Subphylum Chelicerata

Class Merostomata

- extinct subclass of large aquatic scorpions (**Eurypterida**)
- living horseshoe crabs

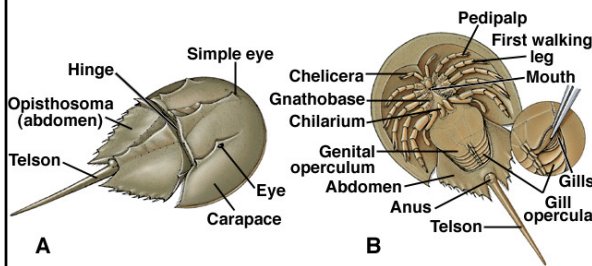
Horseshoe crabs

- since Cambrian
- hard dorsal **carapace** and long **telson**
- opercular flaps on abdomen to cover **book gills**
- benthic feeder
- spring spawning aggregations



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A horseshoe crab (Xiphosura)




Arthropods

Subphylum Chelicerata

Class Arachnida

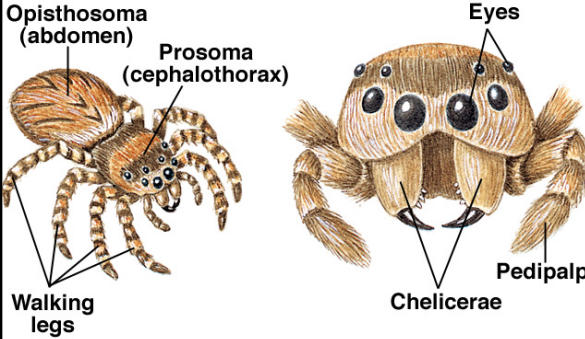
- > Spiders, scorpions, ticks, and mites
- > Dry climates
- > Cephalothorax and abdomen
- > Predatory with fangs, stingers, and poison glands



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Anatomy of a jumping spider



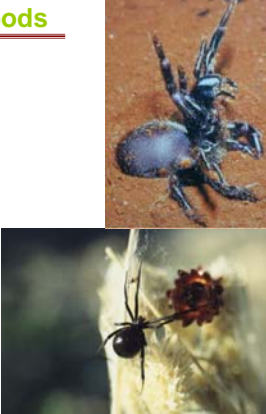
Opisthosoma (abdomen)
Prosoma (cephalothorax)
Eyes
Pedipalp
Chelicerae
Walking legs

Arthropods

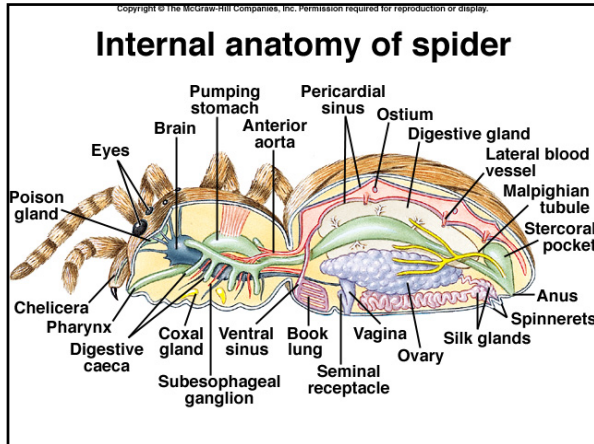
Subphylum Chelicerata

Spiders

- > All carnivorous, using poison
- > Most ambush or use web
- > Predigest food, some with teeth
- > Unique book lungs
- > Excretory tubules (Malpighian) aid in water retention



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Arthropods

Subphylum Chelicerata

Spiders

- Eight eyes sense movement
- Hairlike **setae** with sensory function
- **Silk glands** and **spinnerets** for web-building
- Liquid protein hardens, very strong
- Silk also for reproduction, prey storage, trip lines

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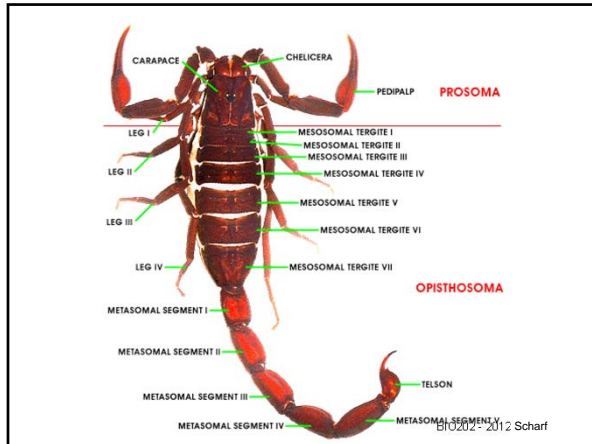
Arthropods

Subphylum Chelicerata

Scorpions

- Mostly tropical and secretive
- Short cephalothorax, preabdomen and **postabdomen** (tail) with stinger
- **Pedipalps** form large pincers
- Ventral surface organs = **pectines**

(c) Jeff Dawson 2000





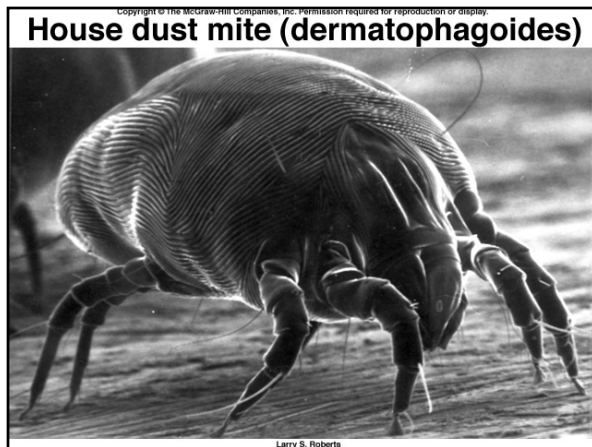
Arthropods

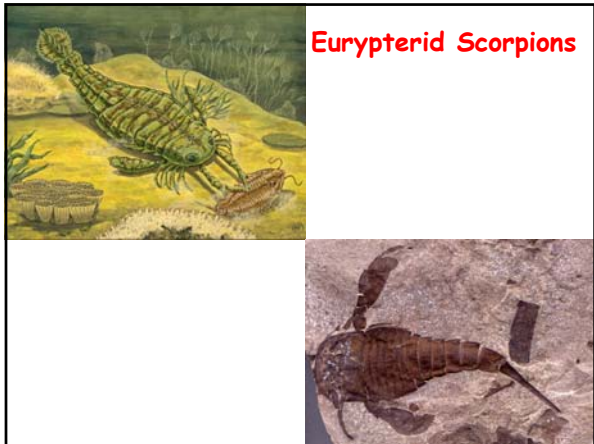
Subphylum Chelicerata

Ticks and mites

- Maybe up to 1 million spp (only 30,000 known)
- Cephalothorax and abdomen fused
- Mouthparts (chelicerae, pedipalps) carried on **capitulum**
- Important effects on human food and health
 - Dust mites – allergies
 - Agricultural pests
 - Disease transmission by ticks





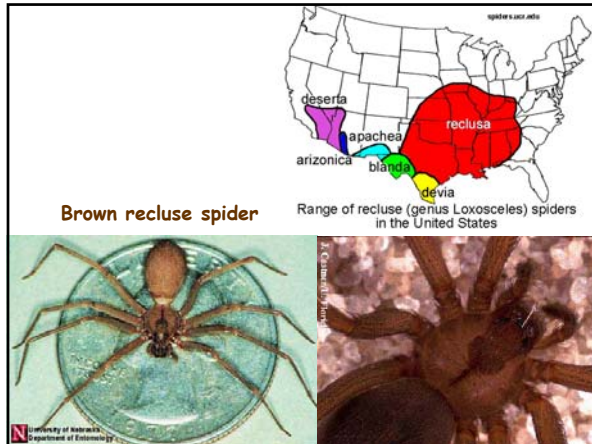















Arthropods

Subphylum Crustacea

- Includes lobsters, shrimp, crabs, plus.....
- Mostly marine
- Cuticle exoskeleton high in calcium
- Possess mandibles
- Appendages not limited to cephalothorax

Fiddler crab (*Uca pugnax*)

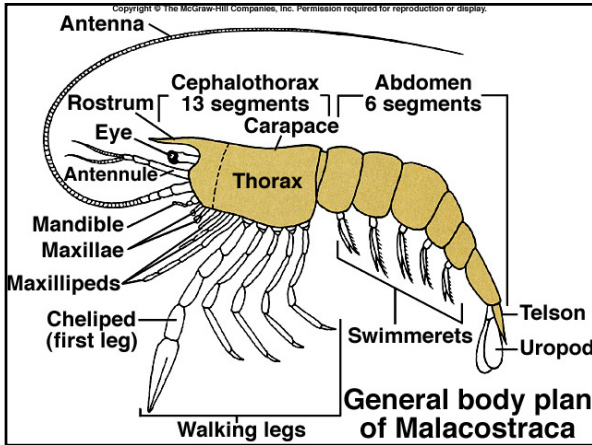
Arthropods

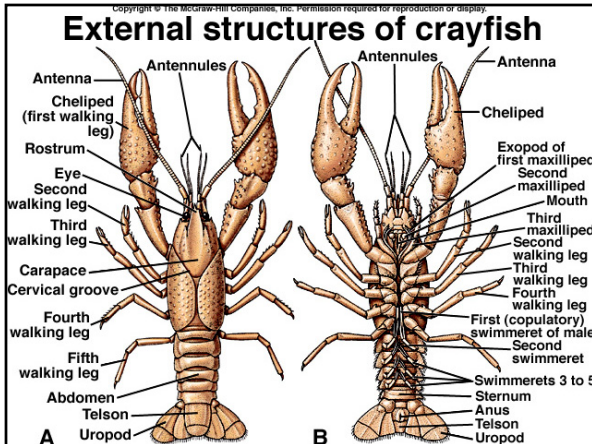


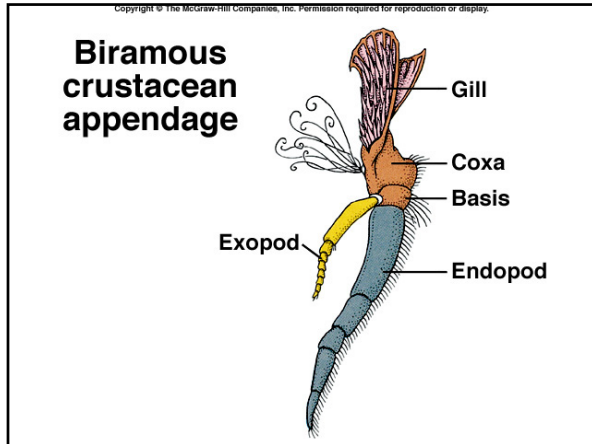
Regional specialization of Crustacean appendages

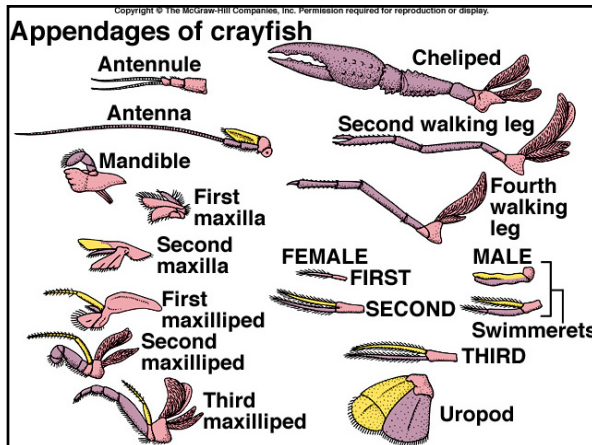
- Two pairs of antennae
- 5 pairs of appendages on head (2 pairs of antennae, 1 pair of mandibles, and 2 pairs of maxillae)
- Thorax and abdomen with 1 pair of appendages per segment
- Dorsal cuticle often forms hard carapace

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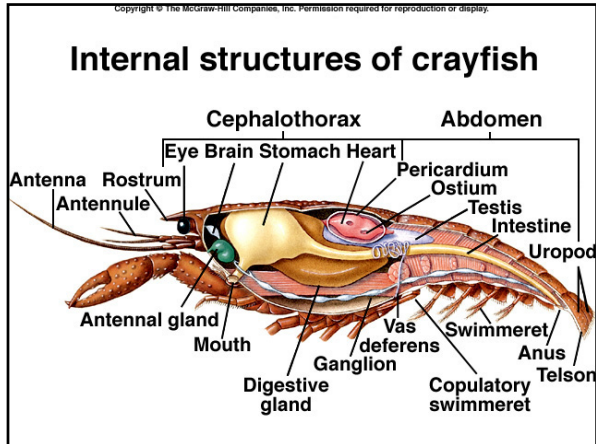


Arthropods

Crustaceans

- Internal cavity is hemocoel
- Open circulation
- Complex flexor and extender muscles
- Gills originate at base of appendages
- Antennal or maxillary glands for osmotic balance
- Tactile hairs for chemoreception

The first photograph shows a person's hand holding a large crayfish, highlighting its size and color. The second photograph shows a crayfish in its natural habitat, surrounded by rocks and water.

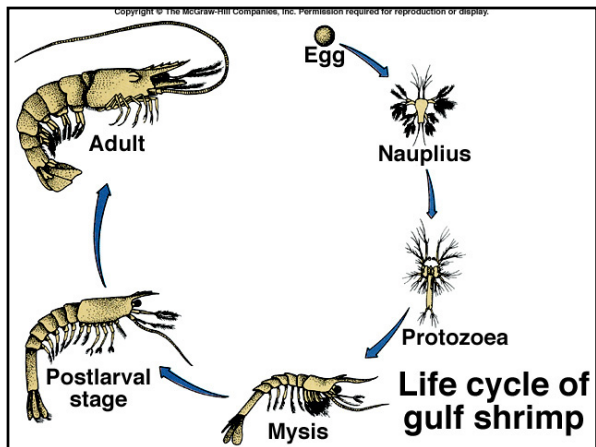


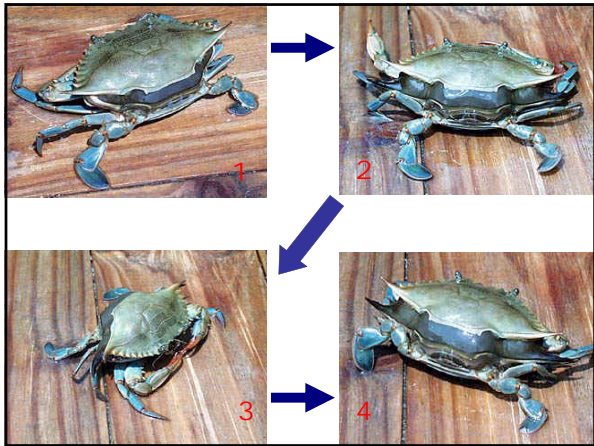
Arthropods

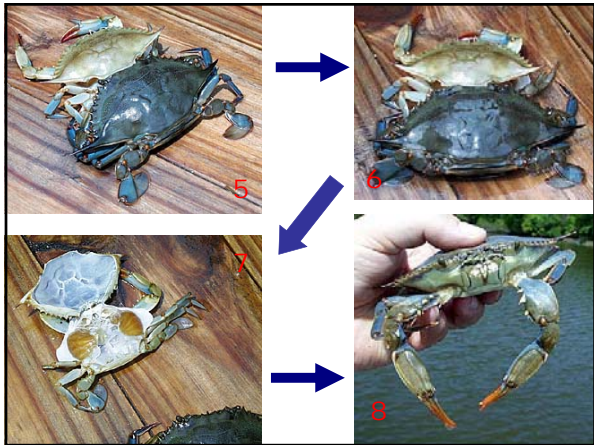
Crustacean reproduction and molting

- Mostly separate sexes
- Specialized egg brooding
- Indirect development in most (**metamorphosis**)
- Molting (**ecdysis**) required to grow
- Break down old cuticle layers and secrete new ones
- Take in **water** to swell body and split old cuticle
- **Hormonal** control

Crustacean reproduction and molting









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Arthropods


Crustacean Taxa

Branchiopods

- Brine shrimp and water fleas
- Important component of freshwater zooplankton

Copepods

- Large number of species
- Most abundant marine zooplankton (genus *Calanus*)



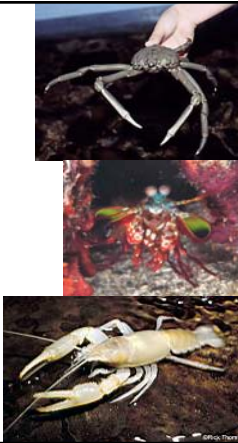
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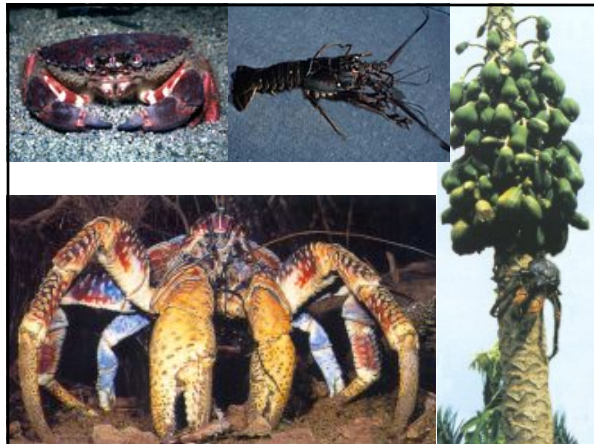
Crustacean Taxa

Class **Malacostraca** is largest class

Includes several Orders:

- Isopoda
- Amphipoda
- Euphausiacea (krill)
- Decapoda** (Crayfish, crabs, lobsters, true shrimp)





Arthropods

Subphylum Hexapoda

Class Insecta

- Most diverse and abundant arthropod
- Estimated 10 million spp.
- Economic importance

Arthropods

Class Insecta General Traits

- 3 tagmata = head, thorax, abdomen
- One pair of antennae and 3 pairs of walking legs
- Appendages uniramous
- Wings (0,1, or 2 pairs)
- Respiratory tracheae
- Scleroproteins in exoskeleton
- Specialized food habits


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Gross anatomy of a grasshopper

Arthropods

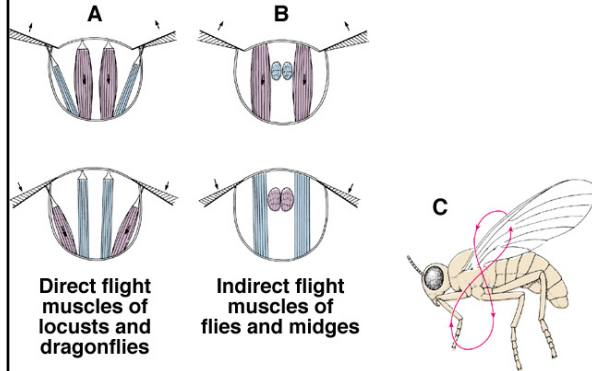
Insect Flight

- Wings composed of **cuticle**
- Most with 2 pairs
- **Direct** and **Indirect** flight muscles
- Synchronous or asynchronous control
- Various speeds and migratory distances



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Flight muscles of insects



A **B**

C

Direct flight muscles of locusts and dragonflies


Indirect flight muscles of flies and midges

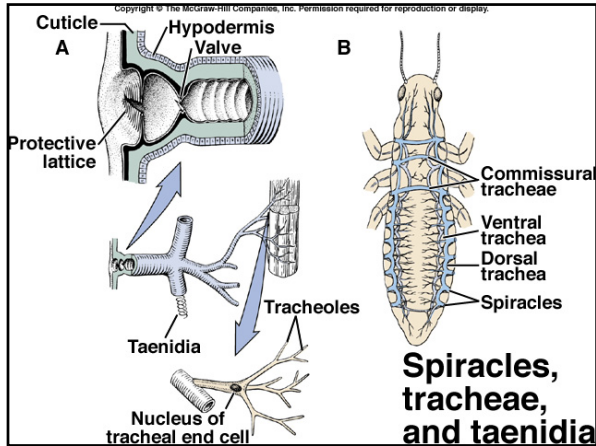
Arthropods

Insect Form and Function

Tracheal system

- Network of thin tubes
- Main trunks open to outside via **spiracles**
- Deliver oxygen directly to cells
- Gas exchange mainly by **diffusion**

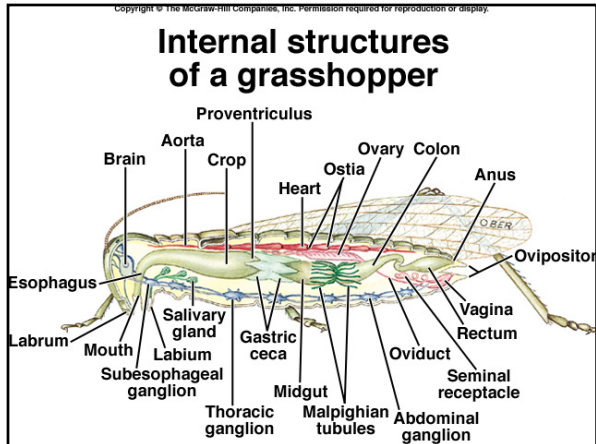


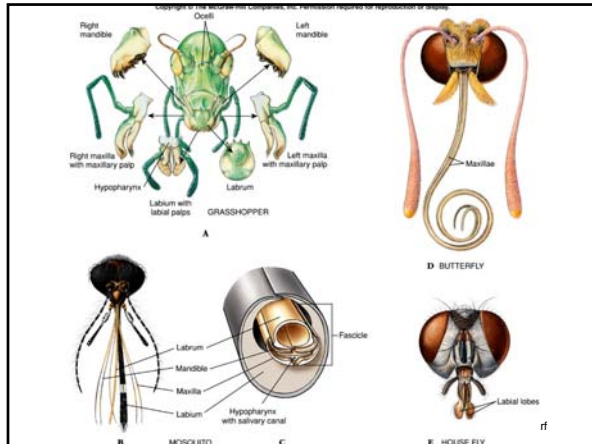


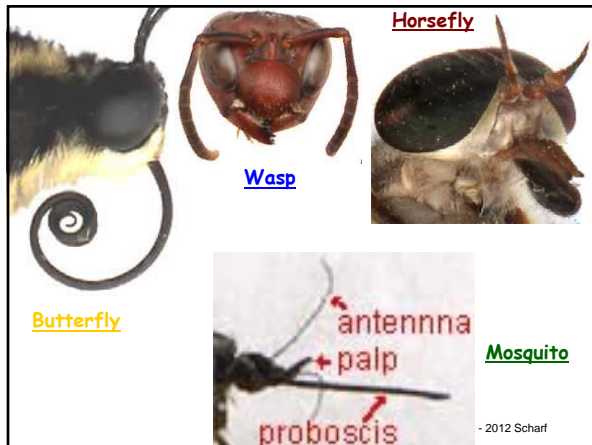
Arthropods

Insect Form and Function

- Complete digestive system with foregut, midgut, and hindgut
- Food habits vary widely
 - Herbivores
 - Scavengers
 - Carnivores
 - Parasites
 - Parasitoids
- Mouth part morphology tied to diet







Arthropods

Insect Form and Function

- Malpighian tubules for excretion
- Well-developed sense organs
 - Mechanoreception with **sensilla**
 - Auditory reception
 - Chemoreception is critical
 - Vision with **compound eyes**

Arthropods

Insect Form and Function

Reproduction

- Separate sexes in most
- Egg number and parental care vary
- **Dramatic metamorphosis**
 - Holometabolous
 - Hemimetabolous
- Seasonal dormancy called **diapause**

