Sight ID

- Phylum Arthropoda
- Subphylum- Chelicerata
- Class Arachnida
- *Loxoscles reclusa* – Brown Recluse
- Distribution in TN: Statewide
- Distribution in US: Southeast

ID Marks

- Fiddle on cephalothorax w/ neck of fiddle toward abdomen
- Abdomen has no spots or stripes
- Legs are a single color

Target Objectives for Arthropods

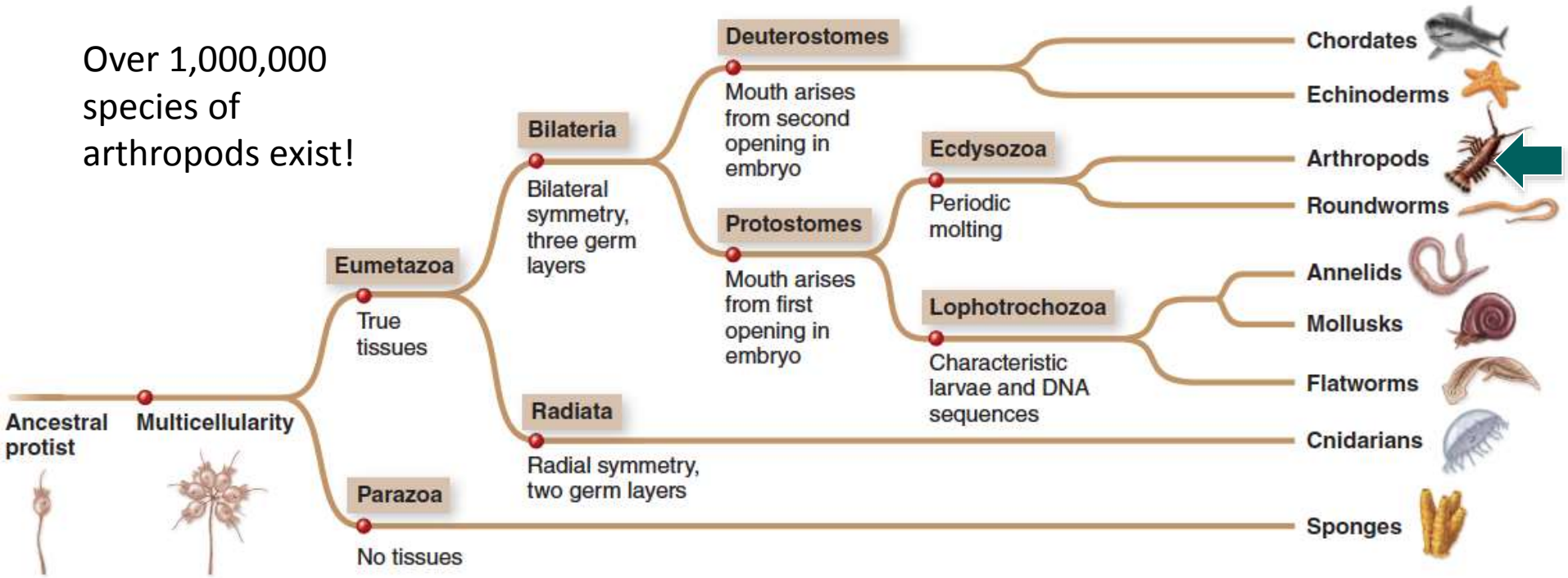
- Describe the characteristics of arthropods.
- Explain the main adaptations contributing to arthropod success.
- List the four main groups of arthropods and describe the features of each.


Phylum Arthropoda
Corbis.com

Arthropods Have Jointed Appendages

Phylum Arthropoda:
Trilobites, chelicerates, myriapods, crustaceans, and insects

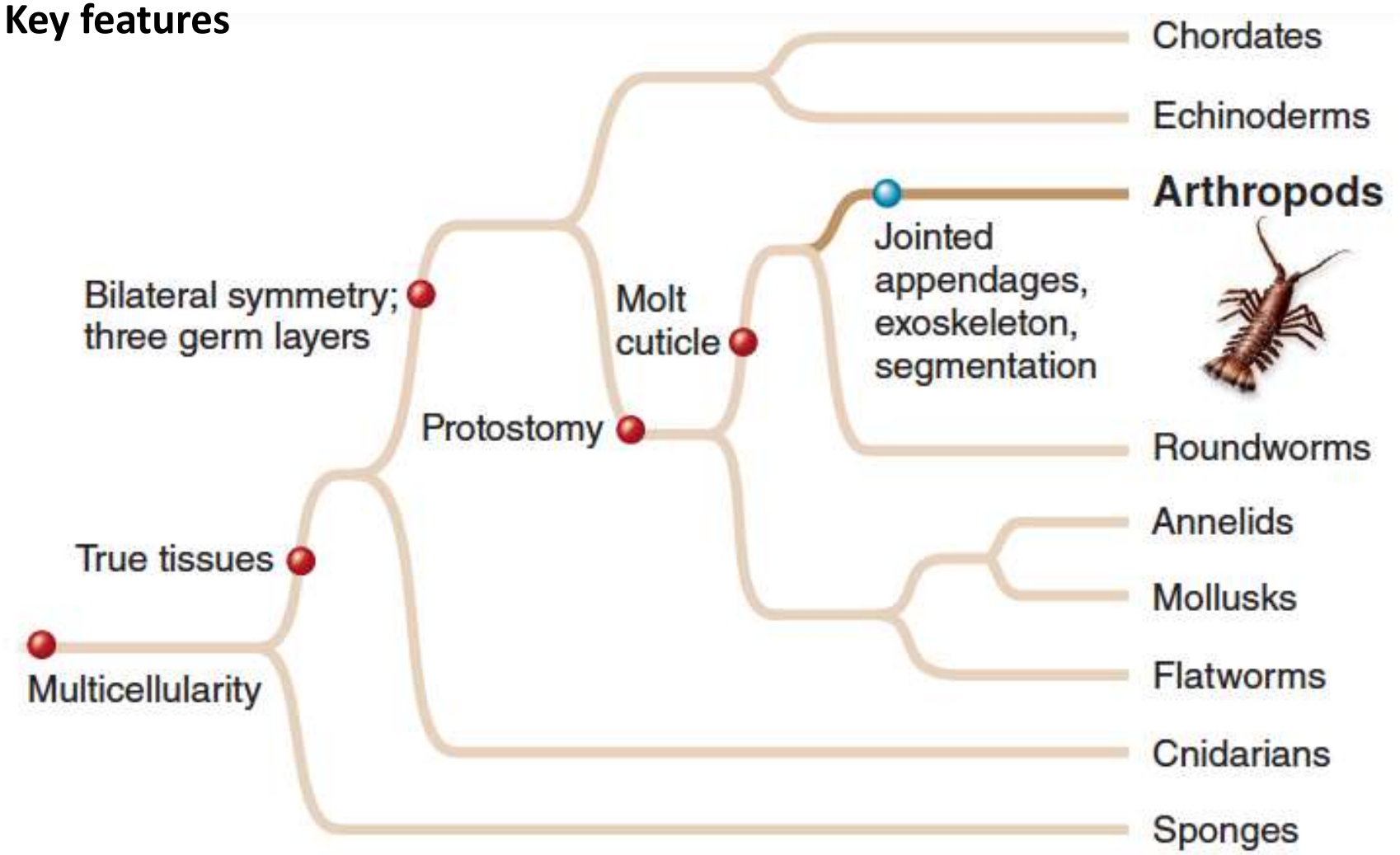
Over 1,000,000 species of arthropods exist!



Section 21.8

Figure 21.2

Arthropods Have Jointed Appendages

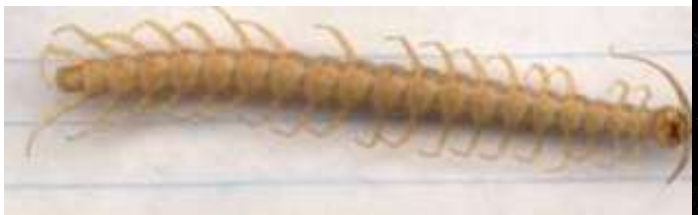


Section 21.8

Figure 21.18

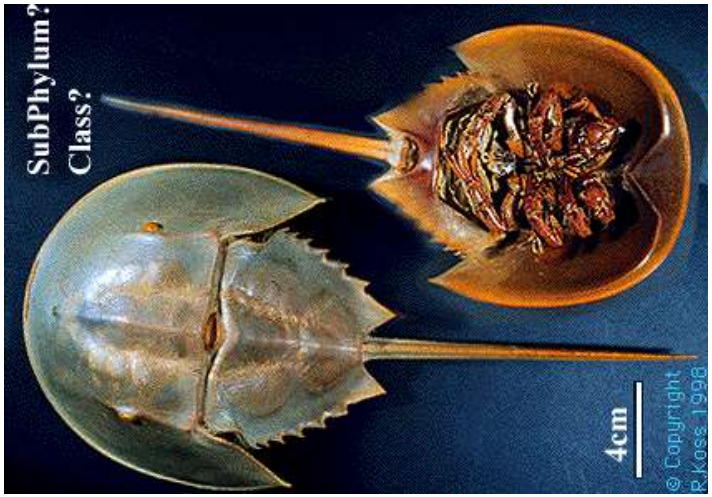
Phylum Arthropoda

- "jointed foot"
- Largest phylum
- 900,000 species
  - 75% of all known species
- Insects, spiders, crustaceans, millipedes, scorpions, ticks, etc.



Phylum Arthropoda (cont'd)

- Most successful phylum
  - Ecologically diverse
  - Present in all regions of the earth
    - Adapted to air, land, freshwater, marine, other organisms



Arthropod Origins

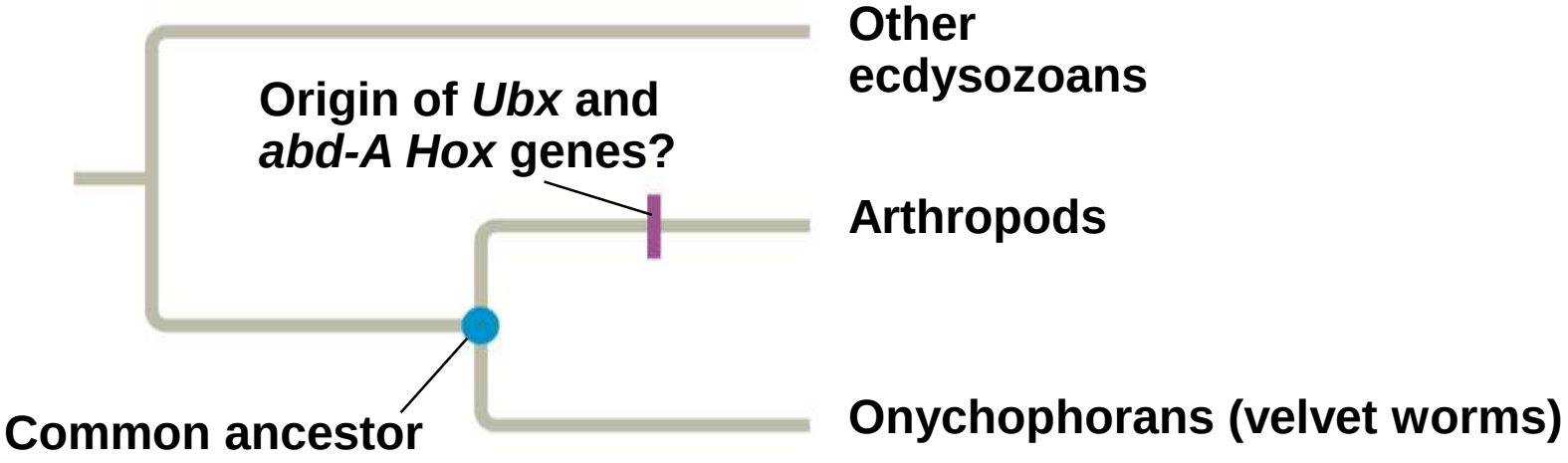
- The arthropod body plan consists of a segmented body, hard exoskeleton, and jointed appendages
- This body plan dates to the Cambrian explosion (535–525 million years ago)
- Early arthropods show little variation from segment to segment

Figure 33.28

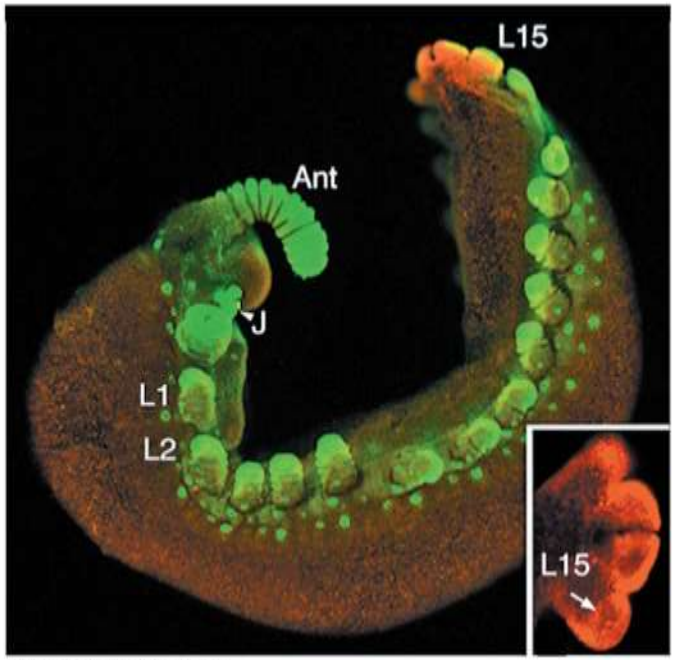
- Arthropod evolution is characterized by a decrease in the number of segments and an increase in appendage specialization
- These changes may have been caused by changes in *Hox* gene sequence or regulation

Figure

EXPERIMENT



RESULTS



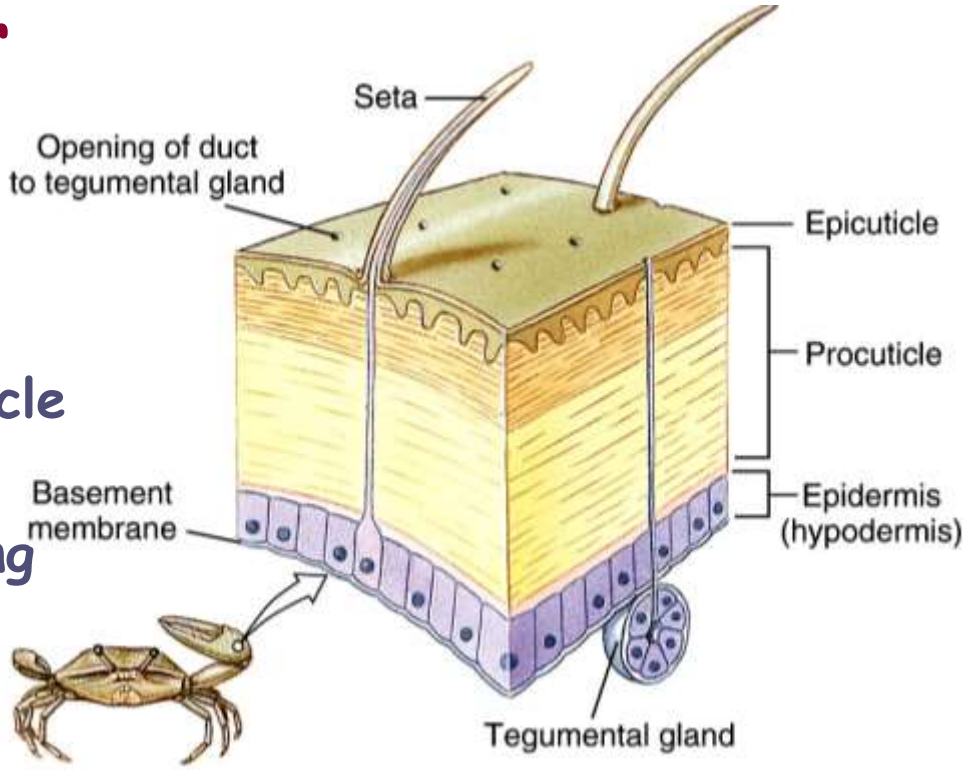
Ant = antenna
J = jaws
L1–L15 = body segments

Reasons for success

1. Versatile exoskeleton
2. Efficient locomotion
3. Air piped directly to cells (terrestrial)
4. Highly developed sensory organs
5. Complex behavior
6. Metamorphosis

1. Exoskeleton

- External: not enveloped by living tissue
- Protection
- Secreted by underlying epidermis
  - Waterproof barrier
  - Chitin +/- calcium, lipoproteins
  - Modifications
    - Can be site for muscle attachment
    - Energy stores- flying
    - Sensory receptors
    - Gas exchange
    - bristles

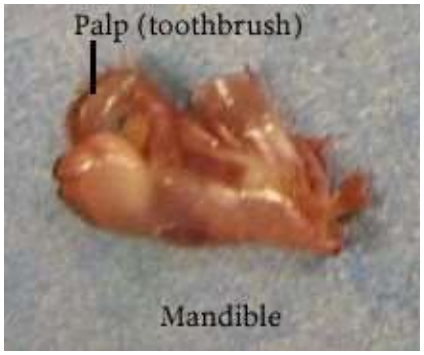


1. Exoskeleton (cont'd)

- Varies from soft and permeable to hard, impermeable
- Between segments of body/appendages= thin + flexible
- Must be shed (ecdysis= molting) to allow growth
- Relatively heavy
  - Limits size

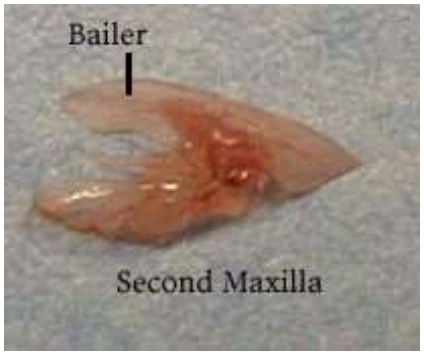
2. Efficient locomotion

- Tagmatization, more specialized than annelids
  - Regions= tagma/tagmata
  - Jointed appendages



Crushing food

Food handling



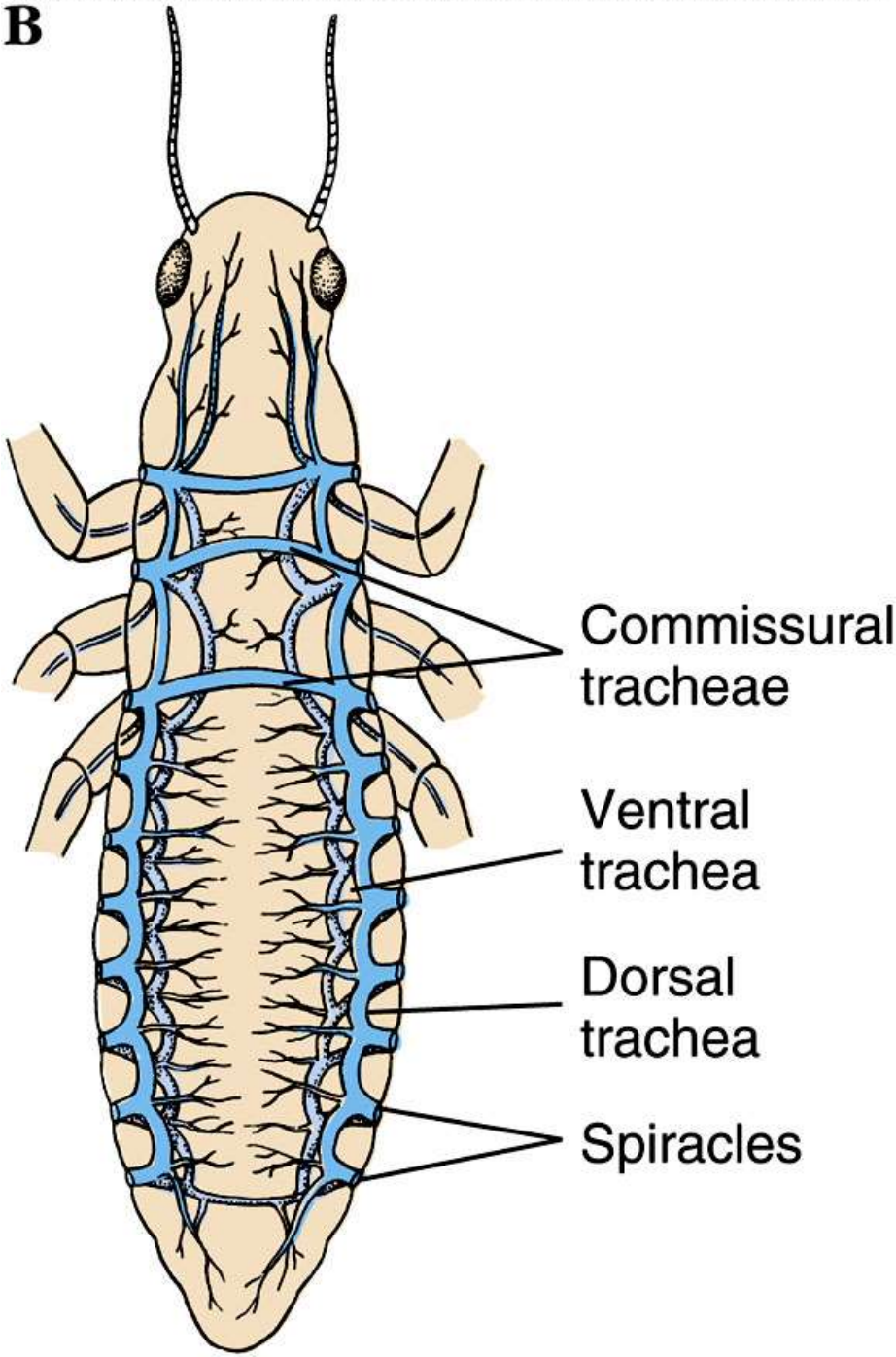
Drawing water into gills

Touch, taste, food handling

Crayfish mouthparts

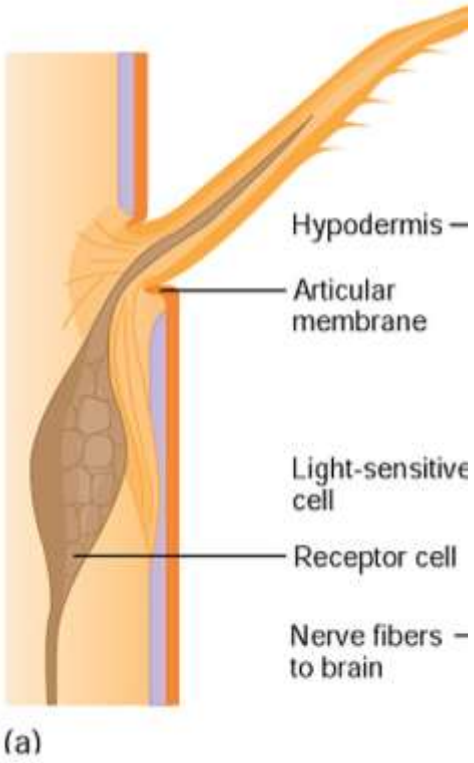
3. Air piped directly to cells

- More efficient than most other invertebrates
- Most have efficient tracheal system of air tubes; some breathe by gills
- Limits size

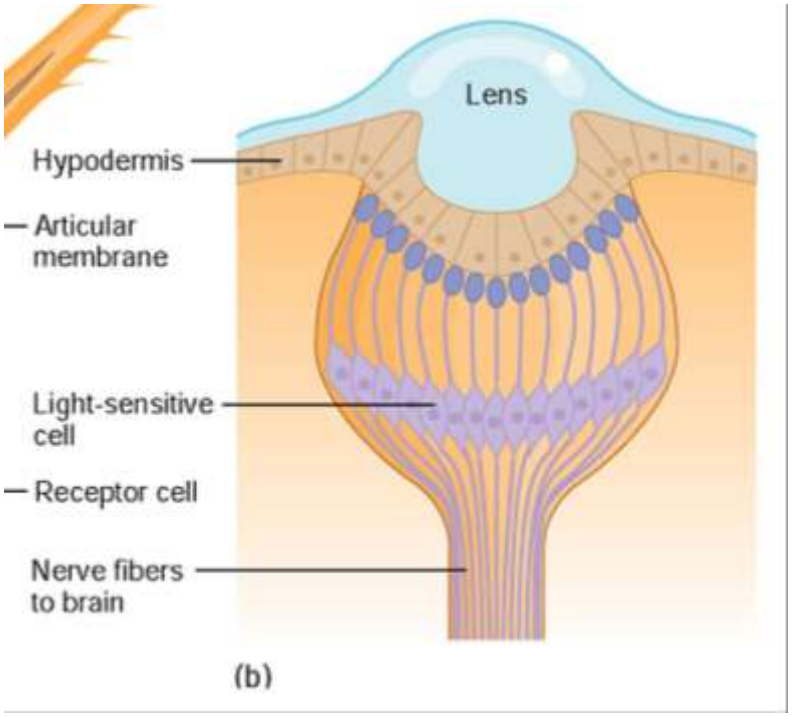


4. Highly developed sense organs

- Sight, touch, smell, hearing, balance, chemical reception



Displacement of seta initiates a nerve impulse in a receptor cell at its base



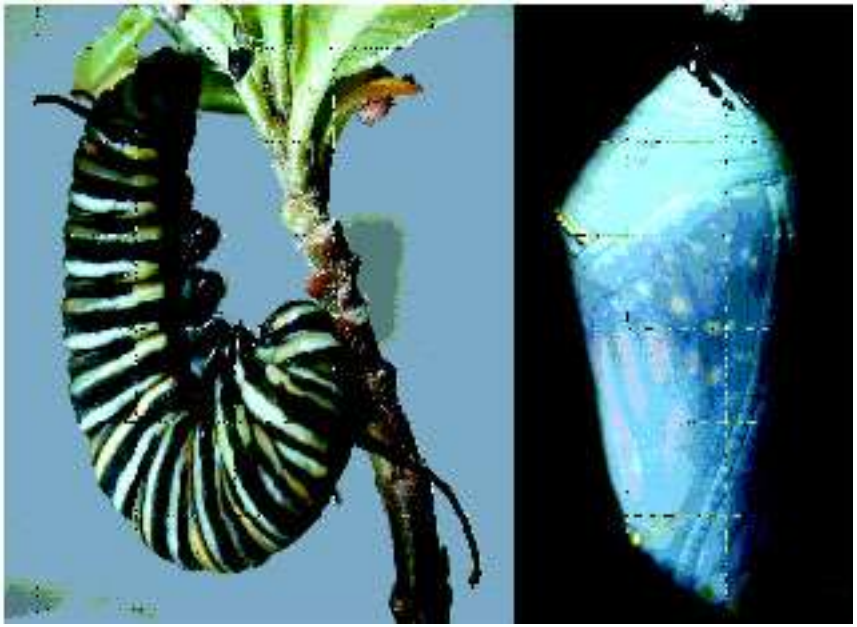
Eyes convert light energy into nerve impulses

5. Complex behavior patterns

- Complex, organized activities
- May be innate (unlearned) or learned

6. Limited intraspecific competition

- Many arthropods undergo metamorphosis
  - meta= between/after; morphē= form; osis= state of
- Different stages (ie. larva, adult) have different nutrition/habitats
  ∴ no competition



Research questions

- What is metamorphosis and why has it contributed to arthropod success?

- What phylum is most closely related to Phylum Arthropoda?

Arthropod Groups

1. Subphylum Trilobita
   - extinct trilobites
2. Subphylum Chelicerata
   - horseshoe crabs, spiders, ticks, mites, and some extinct groups
3. Subphylum Myriapoda
   - centipedes, millipedes
4. Subphylum Crustacea
   - crabs, lobsters, shrimps, barnacles
5. Subphylum Hexapoda
   - Insects

Subphylum Trilobita

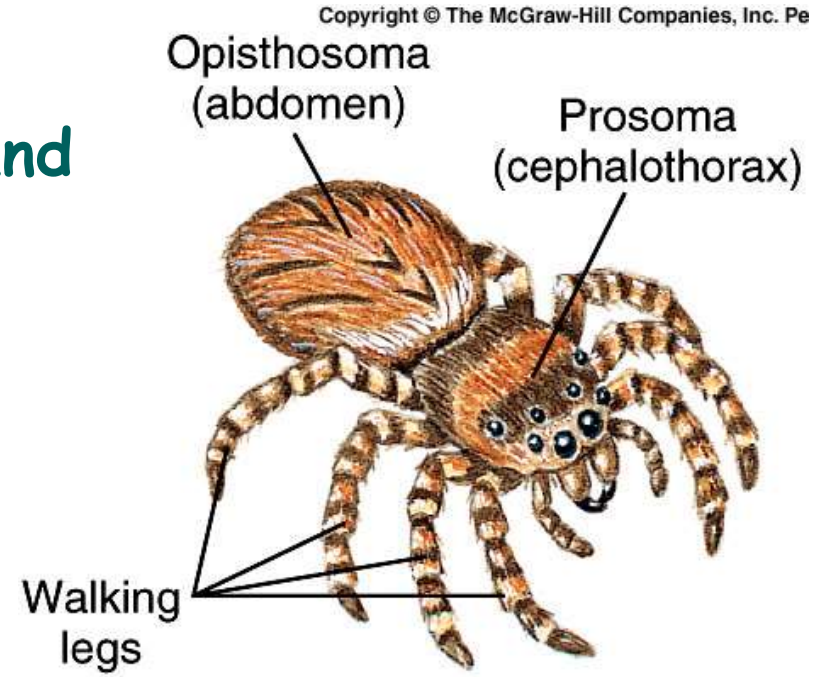
- tri= three; lobos= lobes
- Divided into 3 longitudinal regions
- Extinct
- Oval, flattened

Subphylum Chelicerata

- Named for claw-like feeding appendage called chelicerae
- Horseshoe crabs, spiders, ticks, mites, scorpions

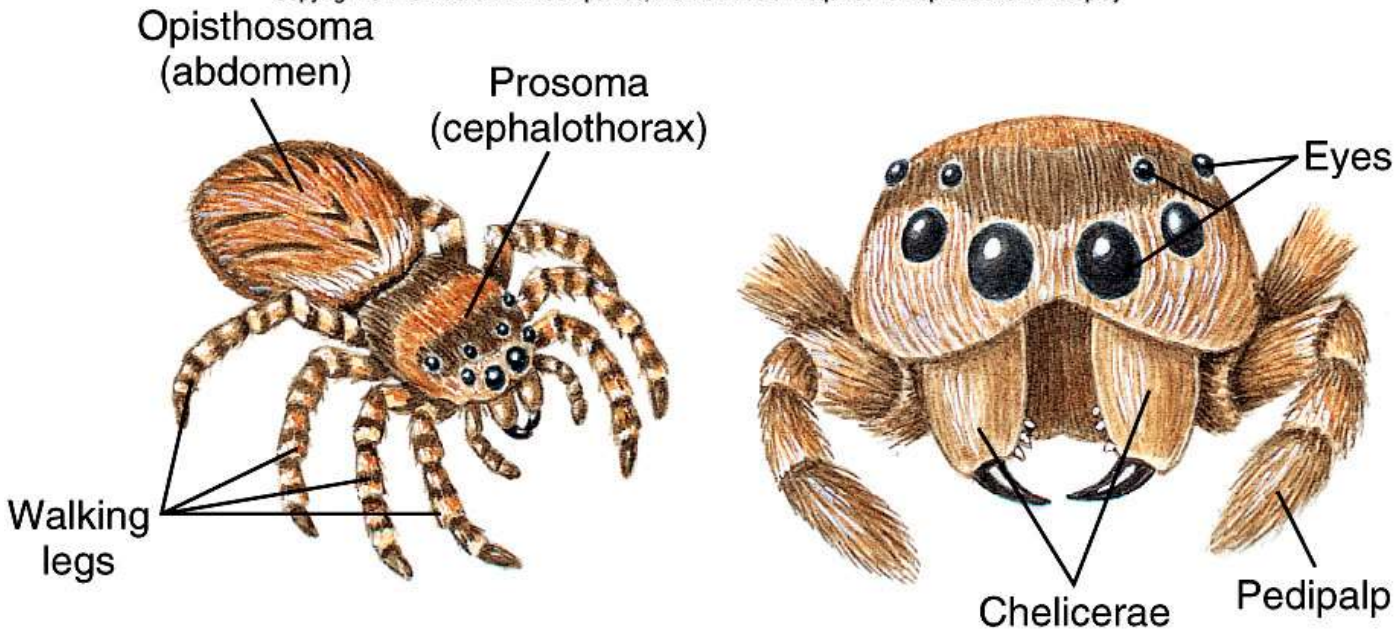
Subphylum Chelicerata (cont'd)

- **Cephalothorax**
  - Fused head and thoracic region
  - 6 pairs of appendages
- **Abdomen**
  - contains digestive, reproductive, excretory, and respiratory organs



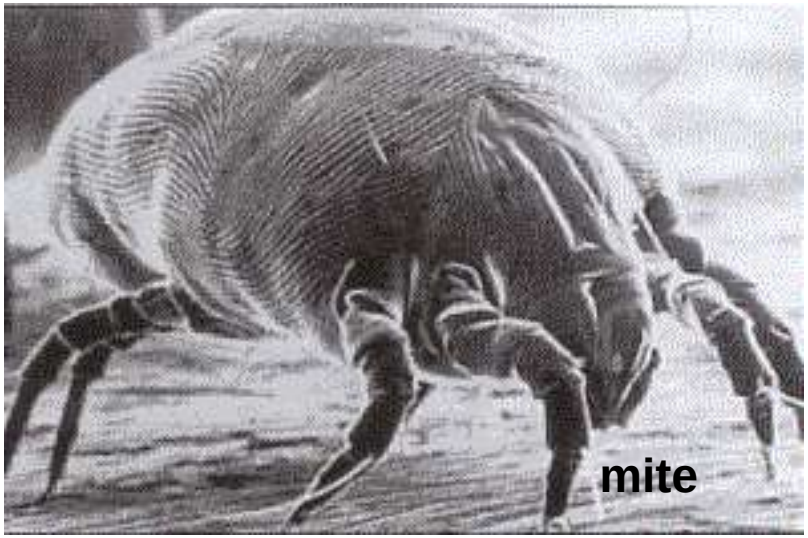
Subphylum Chelicerata (cont'd)

- **Appendages attached to cephalothorax**
  - Pair of chelicerae (clawlike feeding appendages)
  - Pair of pedipalps (usually sensing or feeding)
  - four pairs of legs (5 in horseshoe crabs)



Subphylum Chelicerata (cont'd)

- No antennae
- Most suck liquid food from prey



Class Arachnida

- Spiders, ticks, scorpions
- Most are predaceous

Class Arachnida (cont'd)

- Most are harmless/beneficial to humans
- Some spiders (ie. black widow, brown recluse spider) give painful, dangerous bites

Brown recluse

Black widow

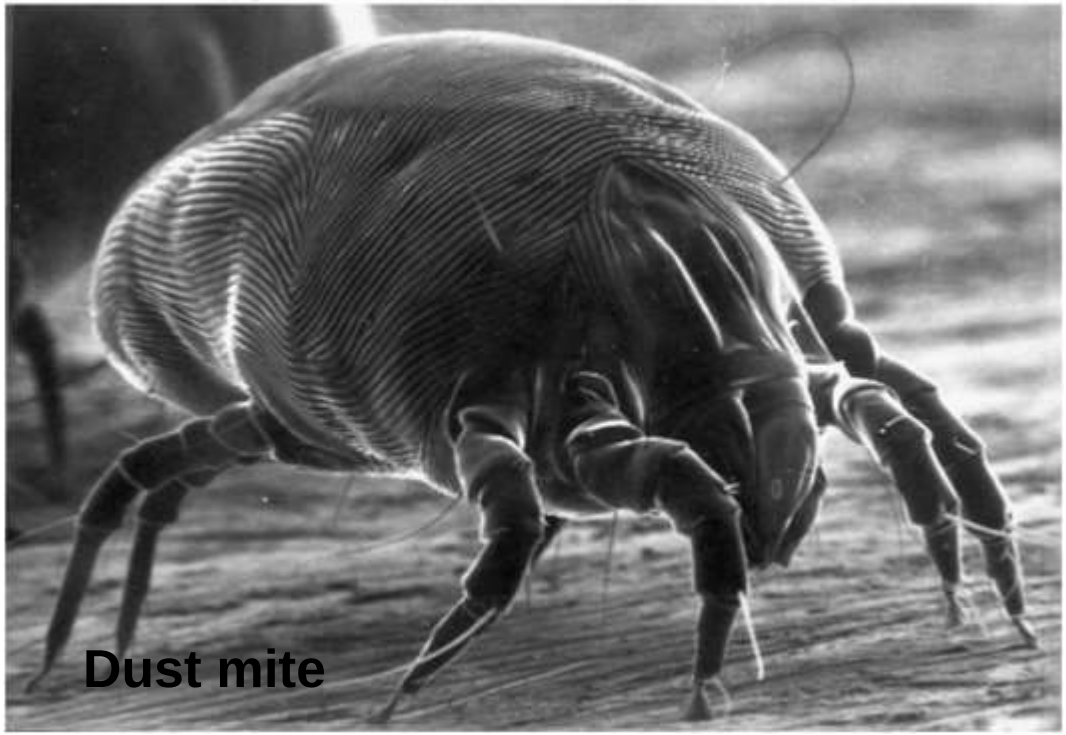
Class Arachnida (cont'd)

- Scorpion sting can be painful, dangerous

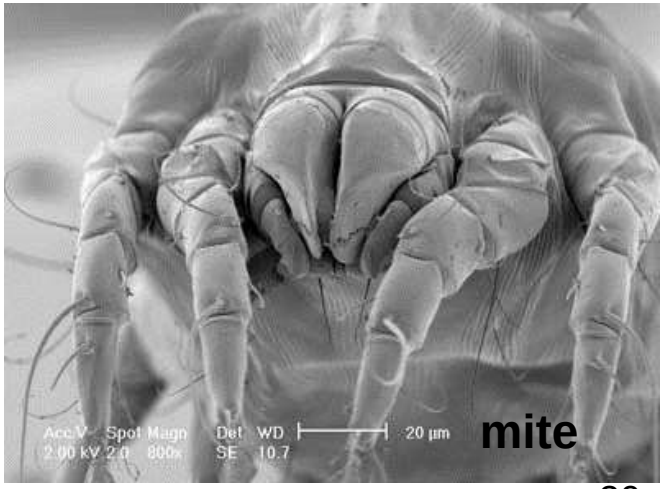
Scorpion

Class Arachnida (cont'd)

- Some ticks and mites spread disease, cause irritation



Dust mite



mite

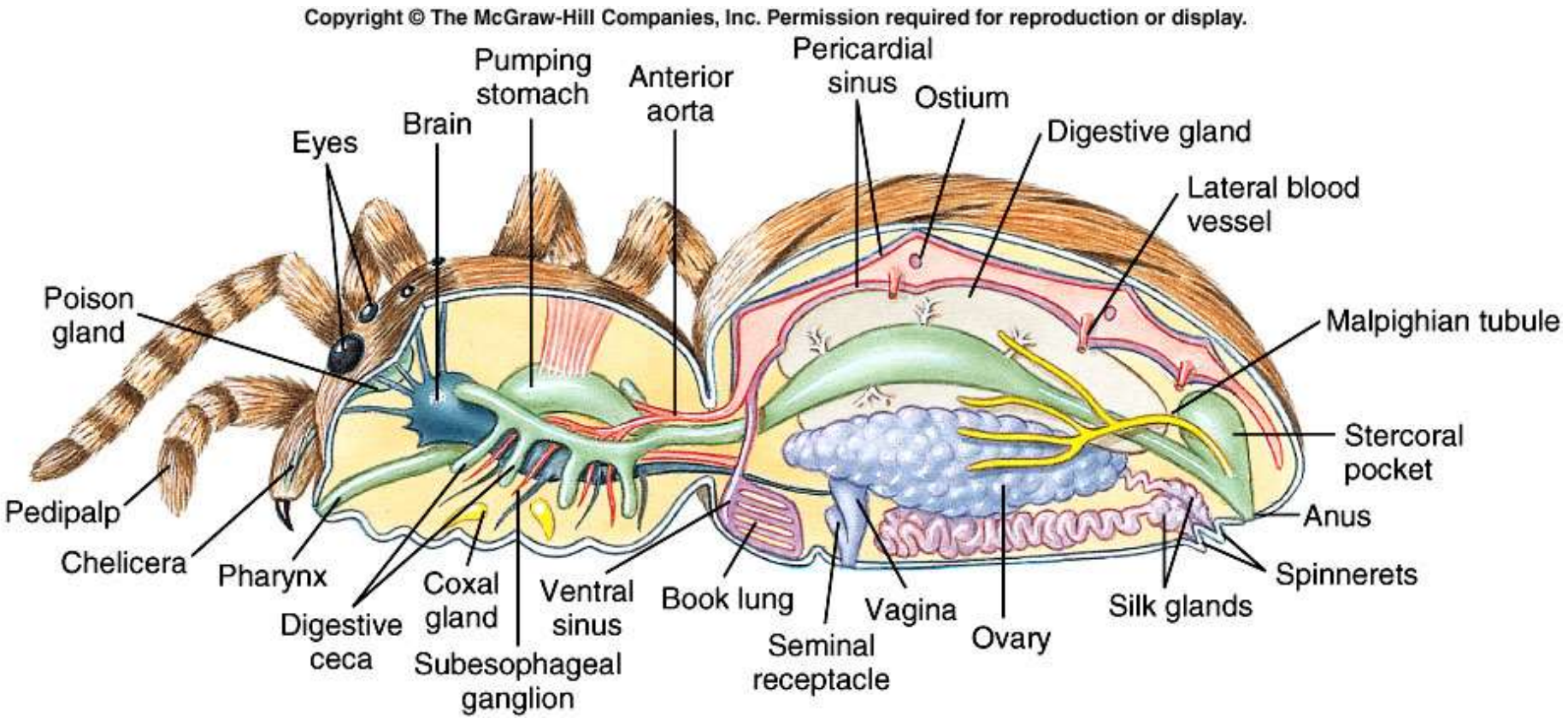
Class Arachnida (cont'd)

- Lyme disease
  - Caused by tick

More on spiders……
Order Araneae

Spiders

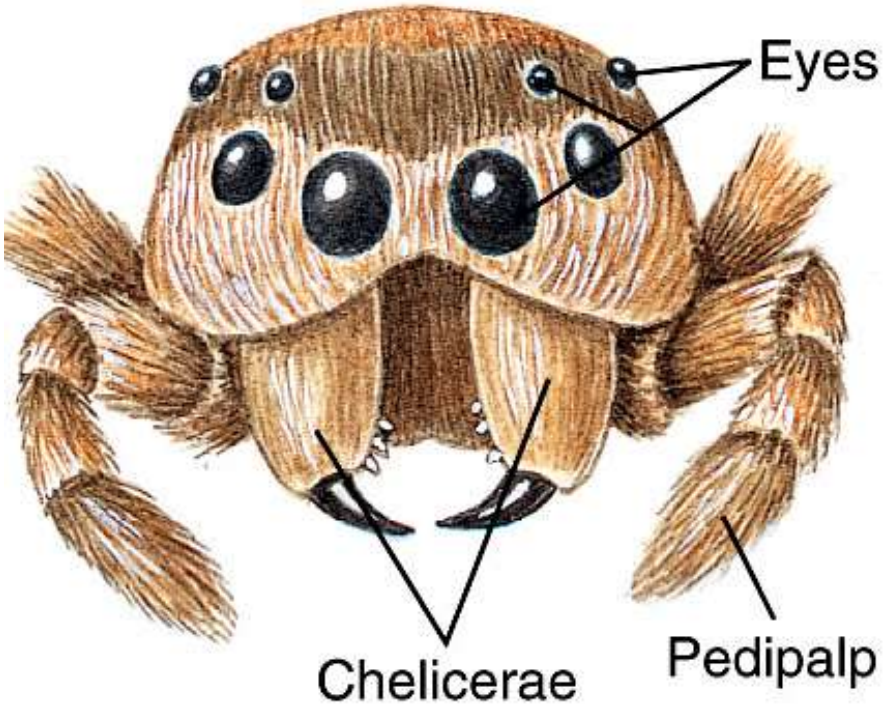
- cephalothorax and abdomen shows no external segmentation



Spiders (cont'd)

- All predaceous
  - Mostly insects
- Chelicerae have fangs

ssion required for reproduction or display.



Spider Urban legends

Debunked!

- MYTH: Daddy longlegs (Harvestmen) are one of the most poisonous spiders but their fangs are too short to bite humans: MYTH (!!!!!!!)
- Daddy longlegs: Order Opilionid
- Spiders: Order Araneae
- One basic body segment (no pedicel)
- Don't produce silk
- No venom, fangs

daddy longlegs

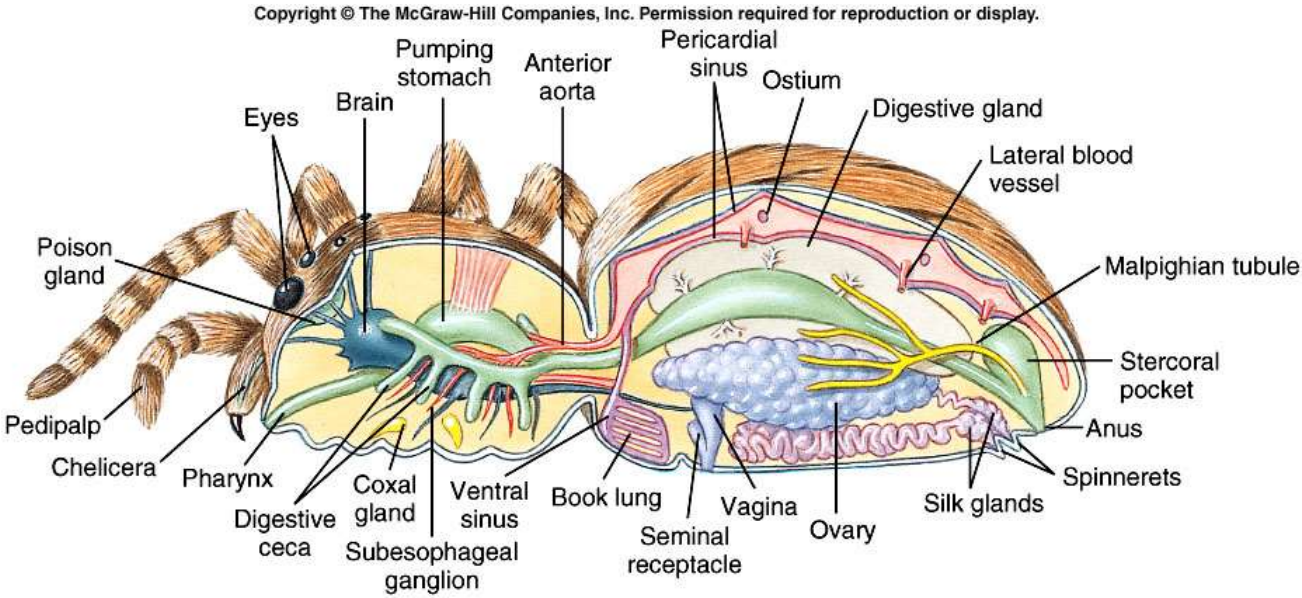
Spiders: Class Araneae

Spider love…..

- Spiders, like most arthropods, are dioecious
- Mating habits
  - Pheromones- chemicals that elicit behavioral change
  - Rituals- males pluck female's web (pattern is species-specific)

Spiders: Class Araneae

- Male builds small web, deposits sperm
  - Collects sperm in cavities of pedipalps
  - Pedipalps have ejaculatory duct
  - inserts pedipalps into female genital opening



Spiders: Class Araneae

- Eggs laid in silk case
  - Carried, attach to web, bury

Wolf spider preparing egg sac


A lycosid (wolf spider) preparing egg sac
M. C. Barnhart


M. C. Barnhart


M. C. Barnhart


M. C. Barnhart

Wolf spider parental care- after the eggs hatch, the young ride on mom for several days.

Brown recluse

- Violin-shaped stripe on back
- Necrotoxin
  - hemolytic

Loxosceles reclusa

- Necrosis of tissue

Day 3

Day 4

Day 5

Day 6

Day 9

Day 10

Myriapods

- Subphylum Myriapoda includes millipedes and centipedes
- Myriapods are terrestrial, and have jaw-like **mandibles**
- Millipedes eat decaying leaves and plant matter
- Millipedes have many legs, with two pairs per trunk segment

- Centipedes are carnivores
- Centipedes have one pair of legs per trunk segment

Figure 33.34b

(b) Centipede

Figure 33.34

(a) Millipede

(b) Centipede

Target Objectives for Arthropods

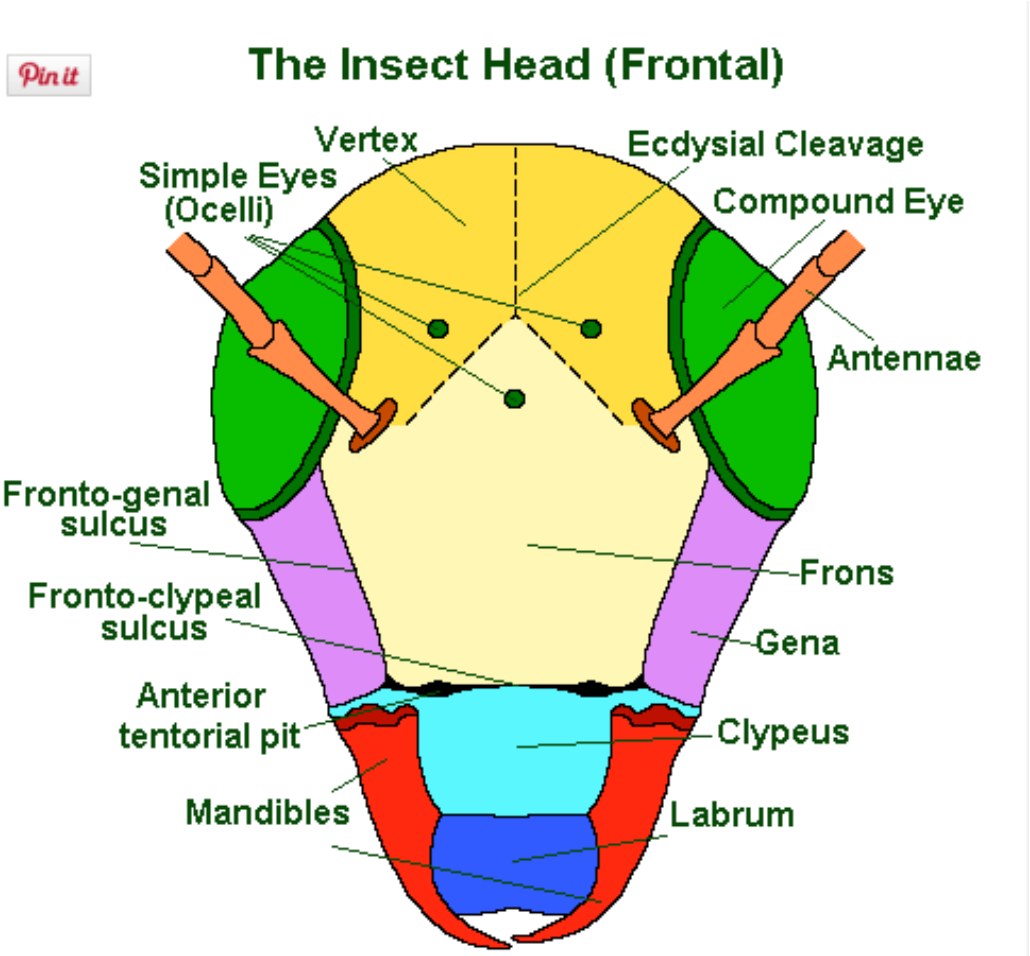
- Describe the characteristics of arthropods.
- Explain the main adaptations contributing to arthropod success.
- List the four main groups of arthropods and describe the features of each.

Insecta

- Subphylum Hexapoda, insects and relatives, has more species than all other forms of life combined
- They live in almost every terrestrial habitat and in fresh water
- The internal anatomy of an insect includes several complex organ systems

Grasshopper External Anatomy

- Head
  - Clypeus
  - Labrum
  - Mandible
  - Maxilla
  - Labium (lower jaw)
  - Frons
  - Gena (cheeks)



Grasshopper External Anatomy

- Head
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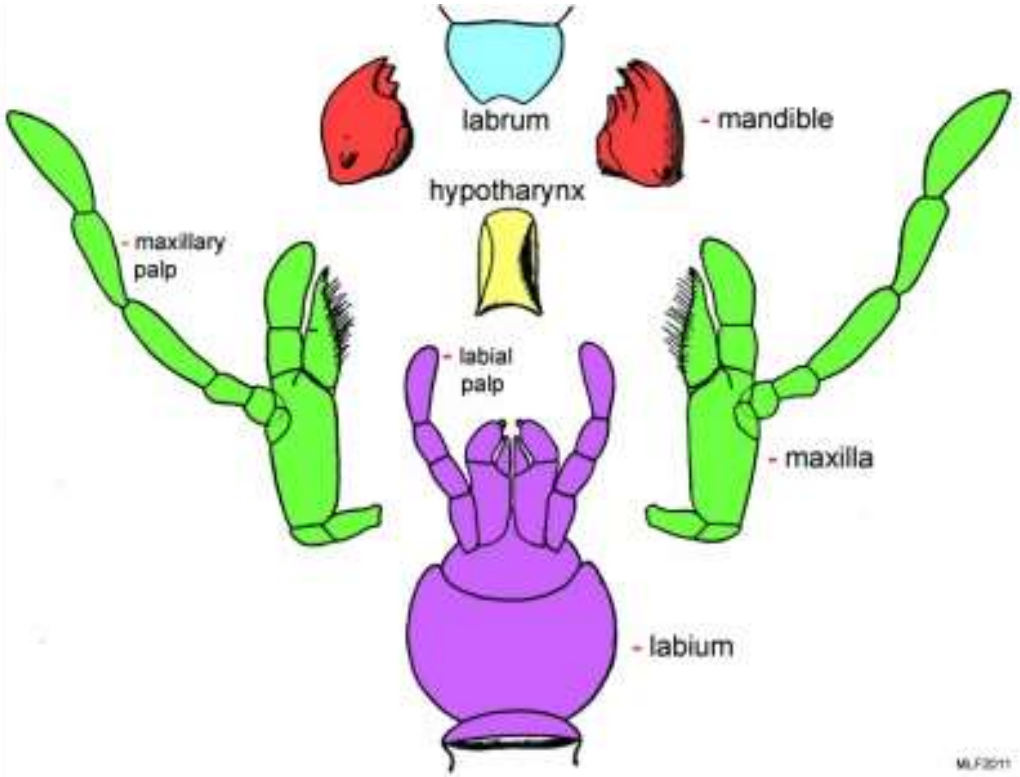
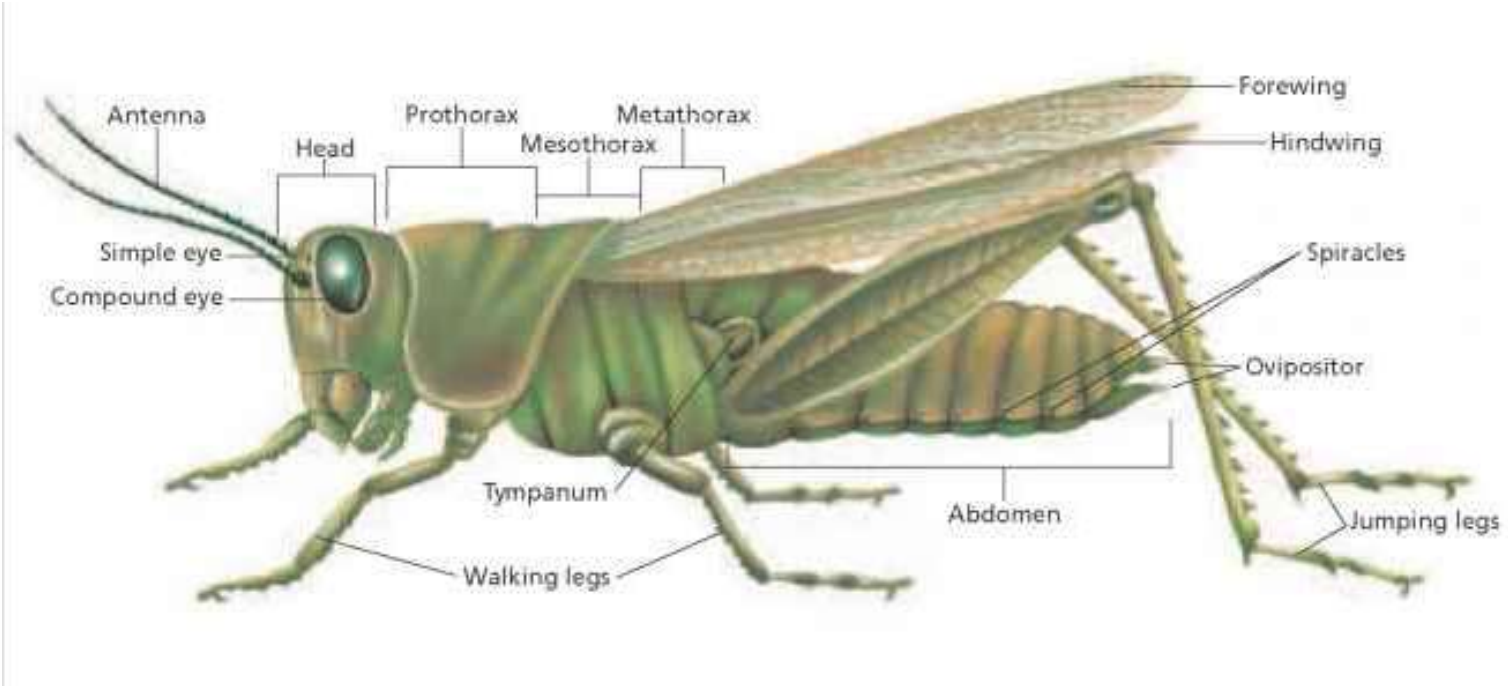


Grasshopper External Anatomy

- Body
  - Thorax
    - Prothorax
    - Mesothorax
    - Metathorax

-Head
-Abdomen
-Antenna
-Eye
-Forewing
-Hindwing
-Spiracles
-Ovipositor
-Tympanum
-Leg



Grasshopper External Anatomy

- Leg
  - Claws
  - Coxa
  - Femur
  - Tibia
  - Tibial Spurs
  - Trochanter
  - Tarsus

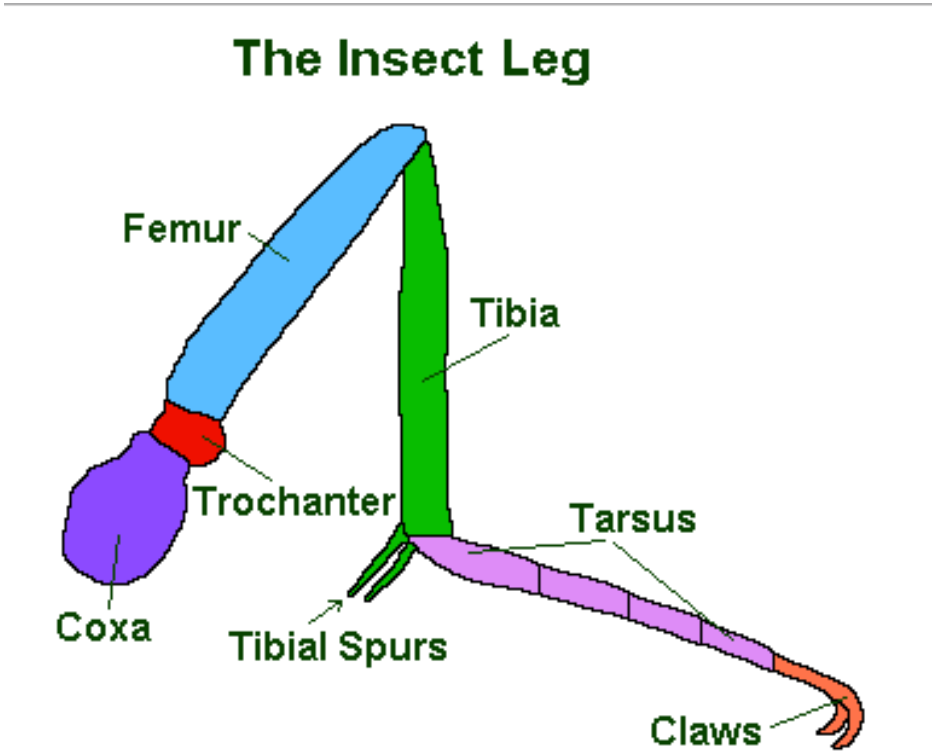
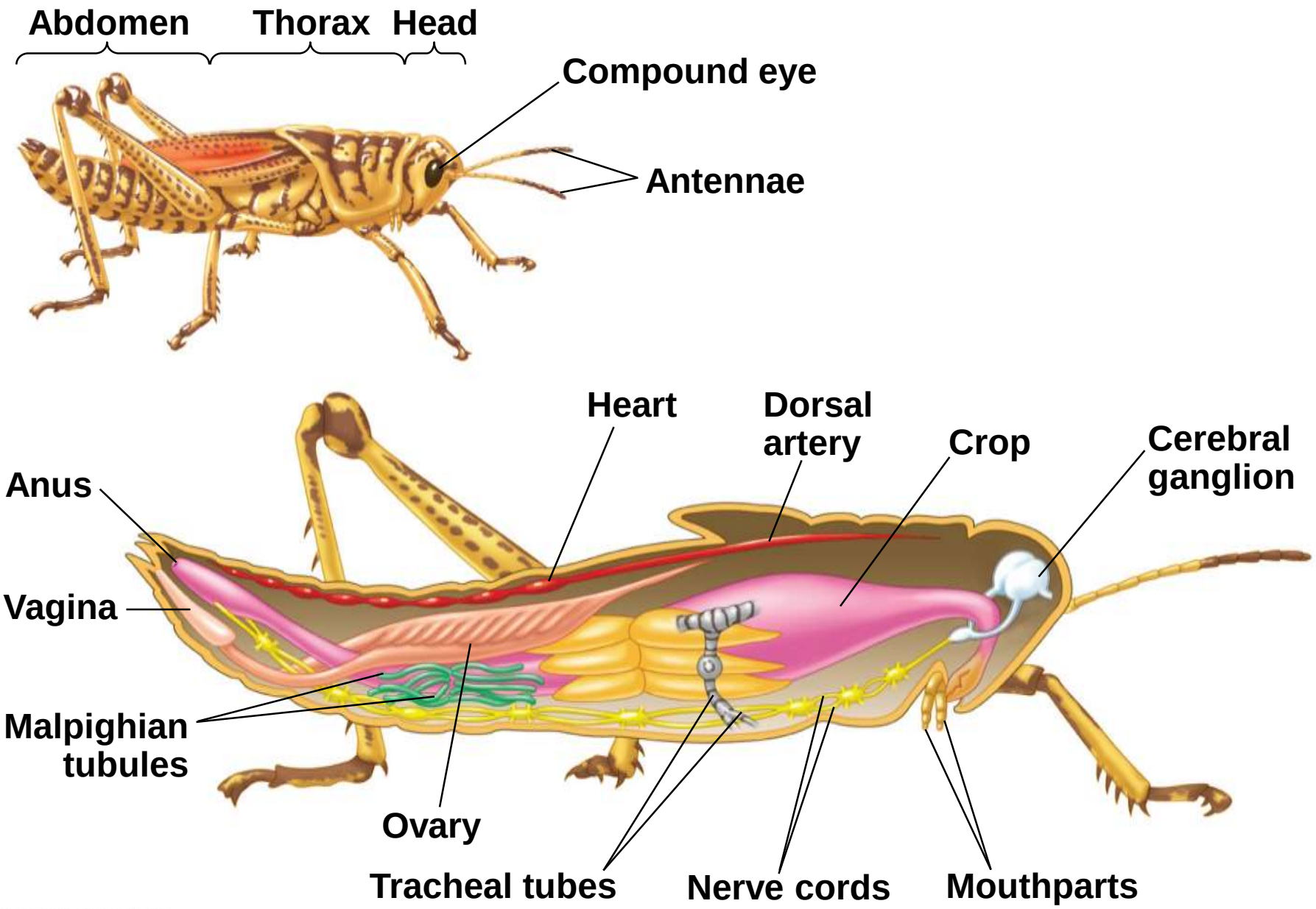


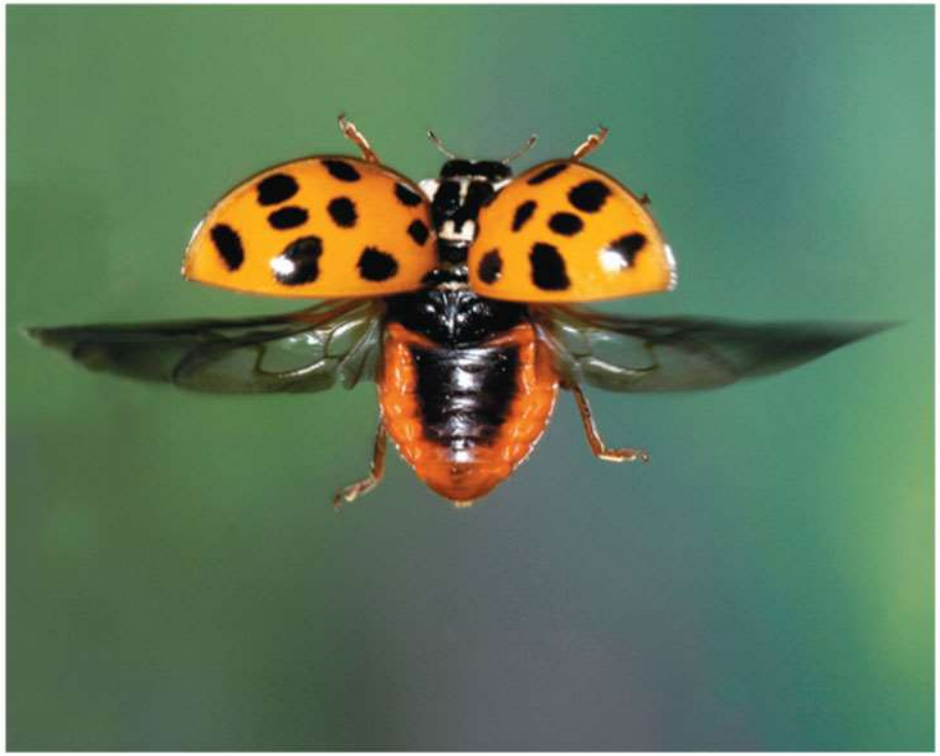
Figure 33.35



- Insects diversified several times following the evolution of flight, adaptation to feeding on gymnosperms, and the expansion of angiosperms
- Insect and plant diversity declined during the Cretaceous extinction, but has been increasing in the 65 million years since

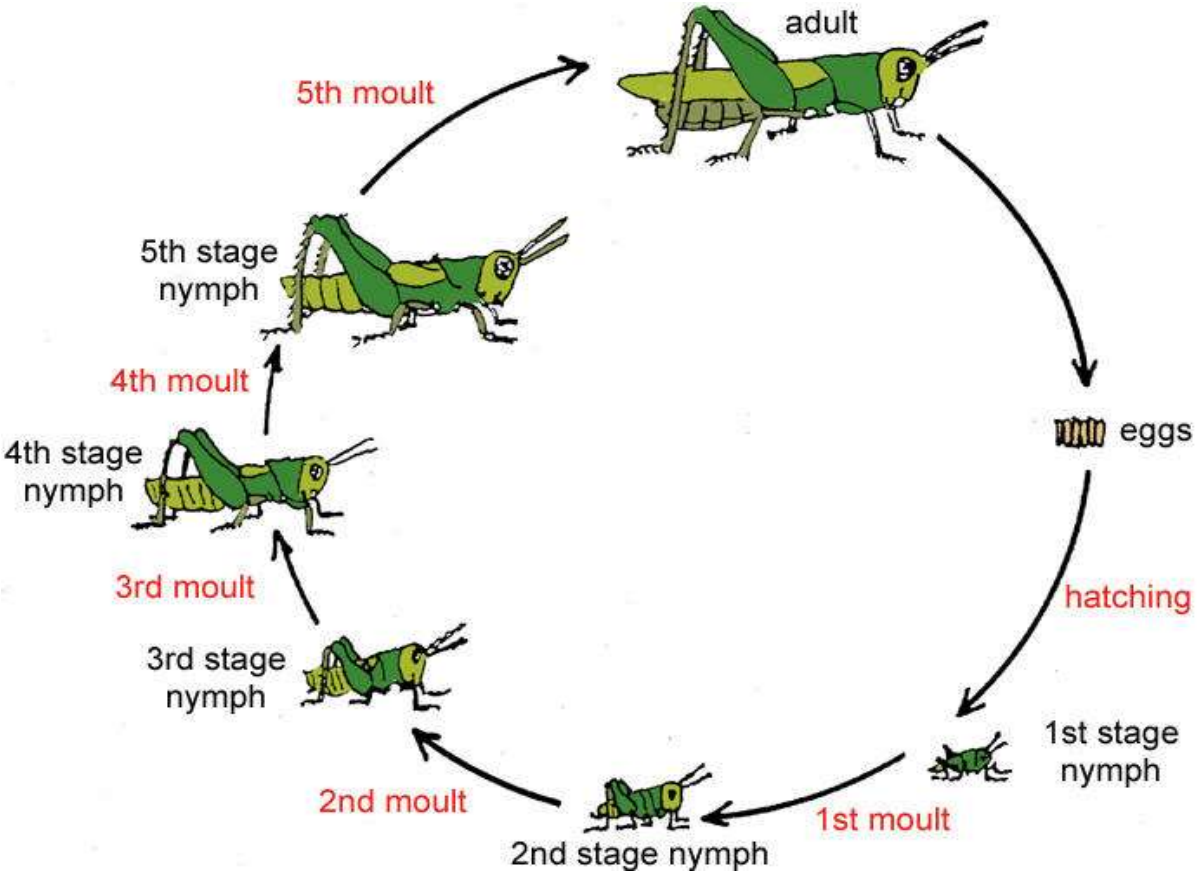
- Flight is one key to the great success of insects
- An animal that can fly can escape predators, find food, and disperse to new habitats much faster than organisms that can only crawl

Figure 33.36



- Many insects undergo metamorphosis during their development
- In **incomplete metamorphosis**, the young, called nymphs, resemble adults but are smaller and go through a series of molts until they reach full size

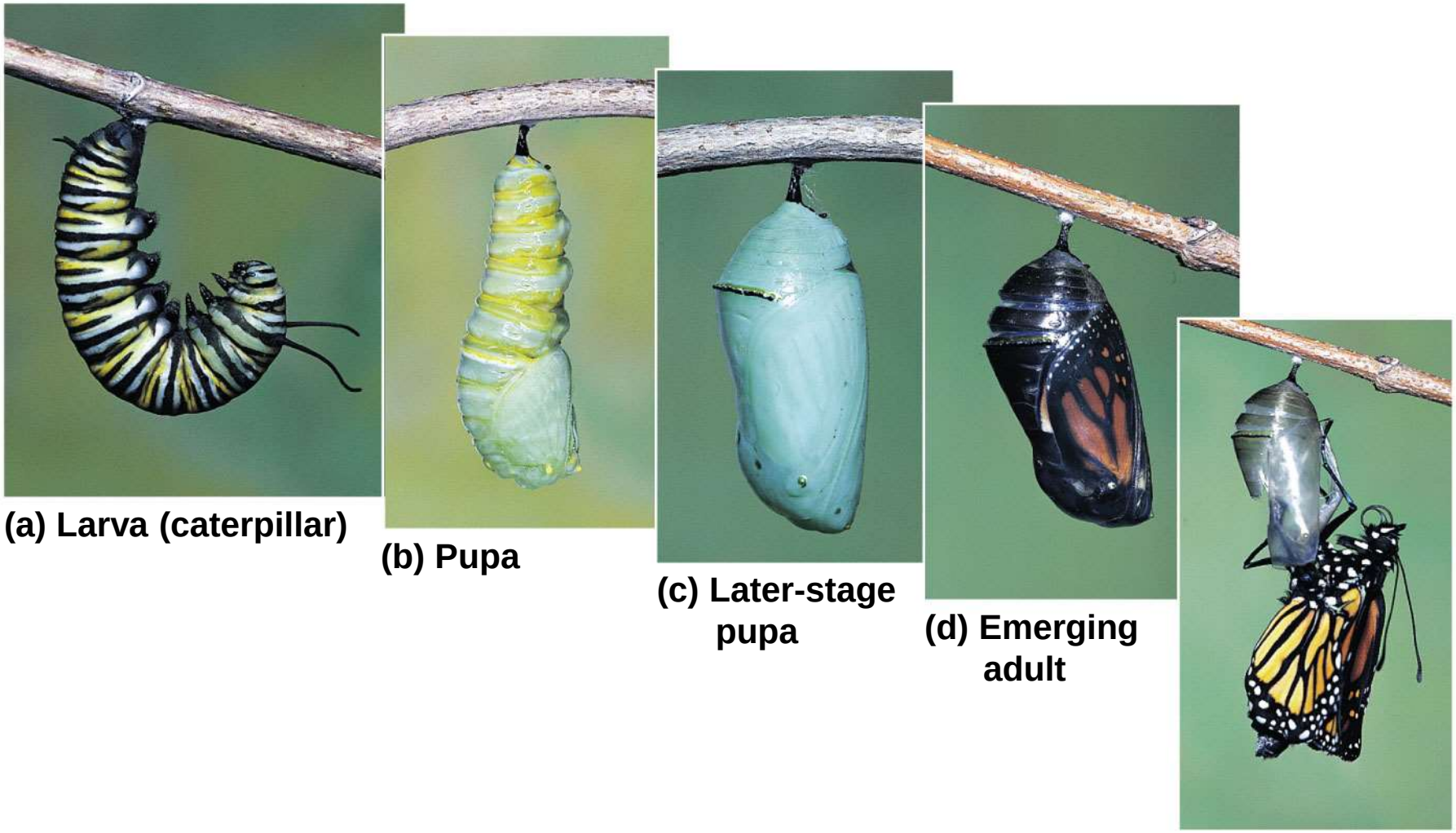
Life Cycle



Simple Metamorphosis

- Insects with **complete metamorphosis** have larval stages known by such names as maggot, grub, or caterpillar
- The larval stage looks entirely different from the adult stage

Figure 33.37



(a) Larva (caterpillar)

(b) Pupa

(c) Later-stage pupa

(d) Emerging adult

(e) Adult

- Most insects have separate males and females and reproduce sexually
- Individuals find and recognize members of their own species by bright colors, sound, or odors
- Some insects are beneficial as pollinators, while others are harmful as carriers of diseases, or pests of crops
- Insects are classified into more than 30 orders

Figure 33.38

Archaeognatha (bristletails; 350 species)

Thysanura (silverfish; 450 species)

Winged insects (many orders)

Complete metamorphosis

Coleoptera (beetles; 410,000 species)

Diptera (151,000 species)

Hymenoptera (125,000 species)

Lepidoptera (120,000 species)

Incomplete metamorphosis

Hemiptera (85,000 species)

Orthoptera (13,000 species)

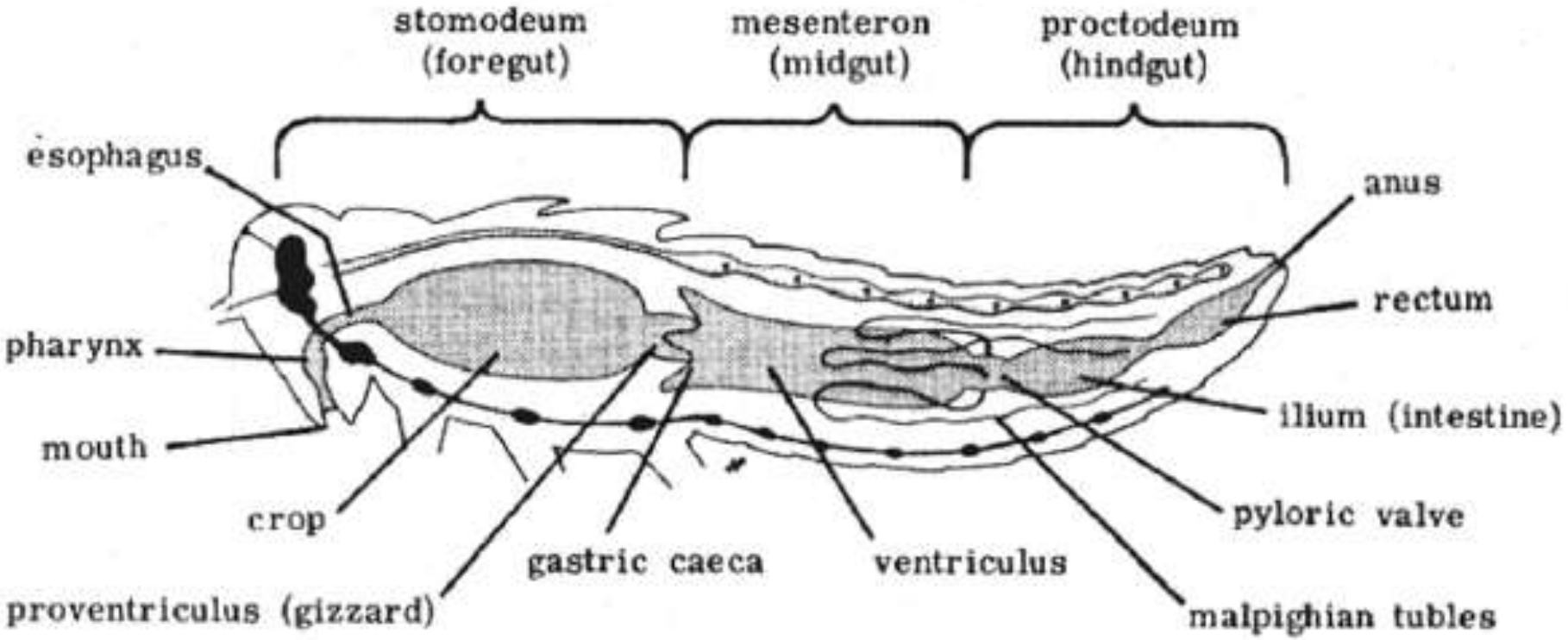
Orders to know

The Grasshopper: the digestive system

- Grasshoppers feed on plants so their mouthparts are modified for cutting & chewing plant materials
- The **labrum** & **labium** are mouthparts that function as upper & lower lips
- They hold the food in place so the sharp **mandibles** & **maxillae** can cut it
- The food is moistened by saliva, passes through the **esophagus** & into the **crop** for temporary storage

The digestive system…

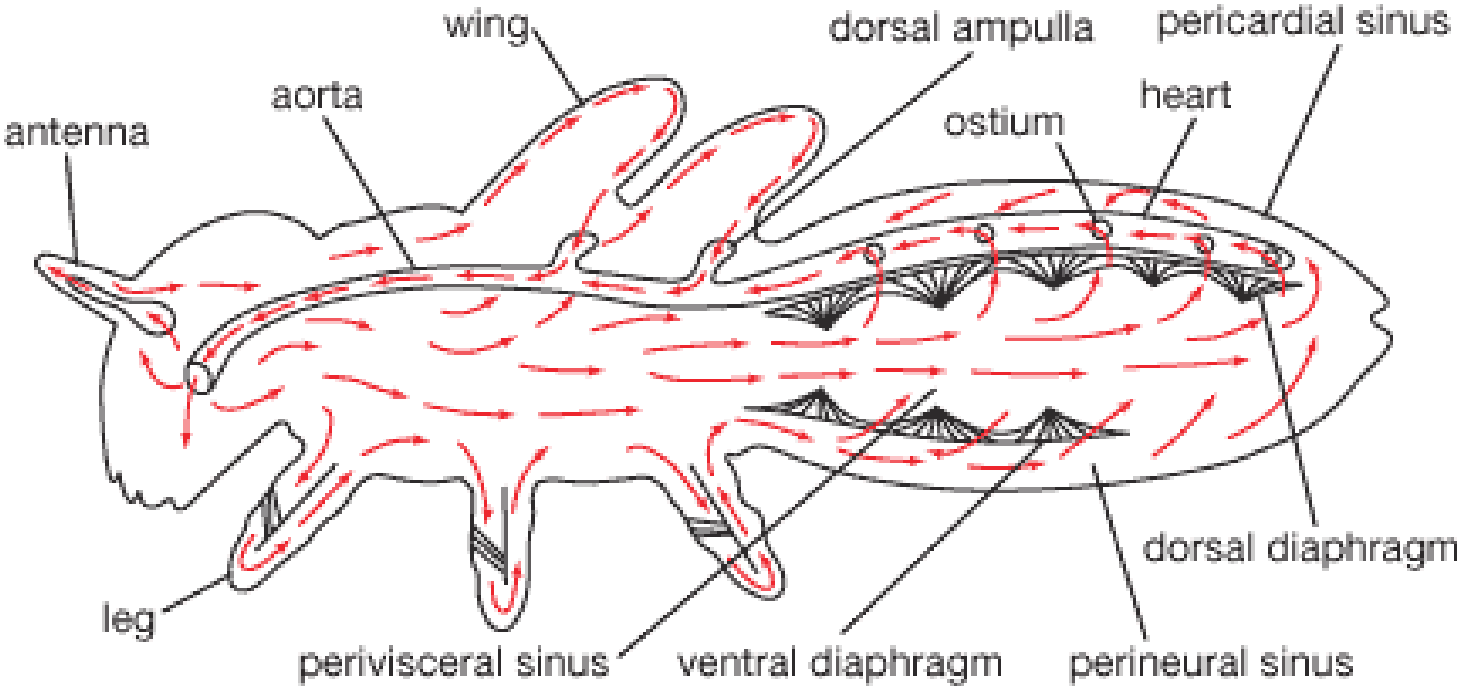
- The food then pass into the **gizzard** where it is ground & shredded & is pushed into the **midgut**
- In the midgut, enzymes are released to digest the food & nutrients are absorbed
- Undigested matter enters the **hindgut** & leaves the body



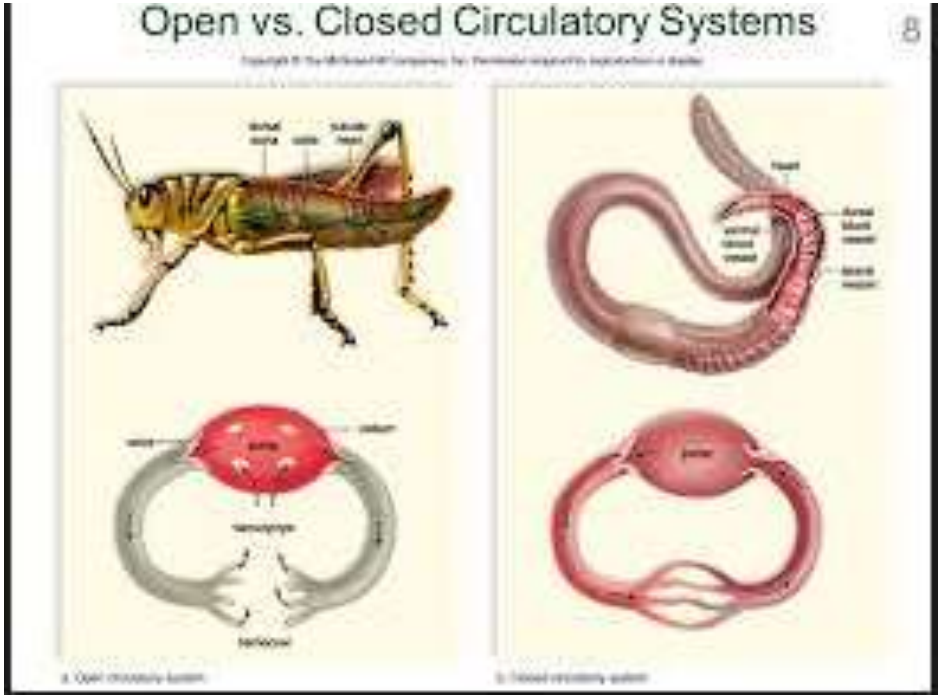
The "generalized" digestive system of insects.

The Grasshopper: Circulatory system

- Nutrients are transported through the body of a grasshopper by an **open circulatory system**
- **Hemolymph** (blood) flows through a large dorsal vessel called the **aorta**
- The heart is located in the abdomen & thorax pumps the hemolymph towards the head where it slowly moves through a sieve like structure called a **coelom**
- The hemolymph then slowly makes its way back to the heart to be recirculated



How do circulatory systems compare?



The Grasshopper: nervous system

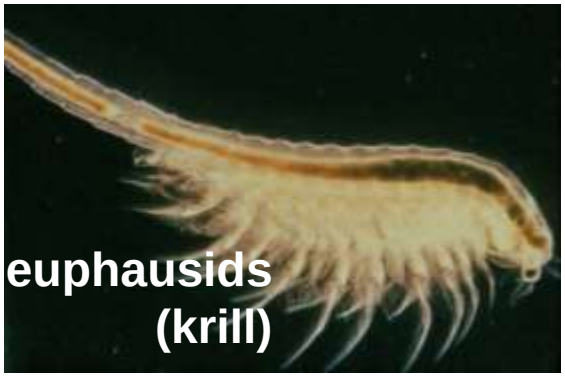
- The central nervous system consists of a **brain** & a **ventral nerve cord** with ganglia located in each body segment
- **Ganglia** are small nerve centers that control each segment & boost signals from the brain
- In the head, nerves extend from the brain to the sensory organs:
  - **Antennae:** touch & smell
  - **Simple eyes**: measure light intensity
  - **Compound eyes**: composed of hundreds of lenses provide a wide field of vision & detect motion

- Other nerves extend from the segment ganglia to the muscles
- The abdominal ganglia connects to a sound sensing organ called the **tympanum**
  - It is an oval window found on the first abdominal segment which is hollow & full of air
  - Sounds cause the tympanum to vibrate, sending a signal to the nearby nerves that are interpreted as sound


Crustaceans
Corbis.com

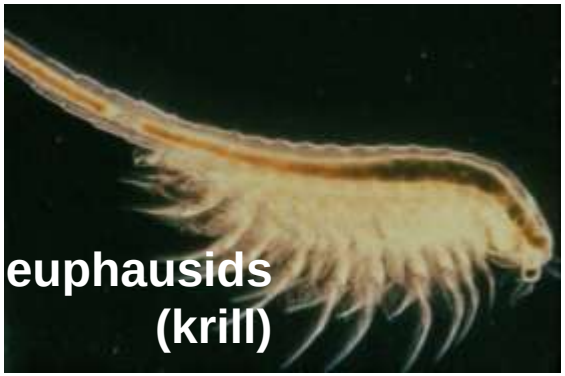
The Crustaceans

- Phylum Arthropoda
  - Subphylum Crustacea
    - crusta= shell
- Lobster, crayfish, shrimp, crab, water flea, barnacles

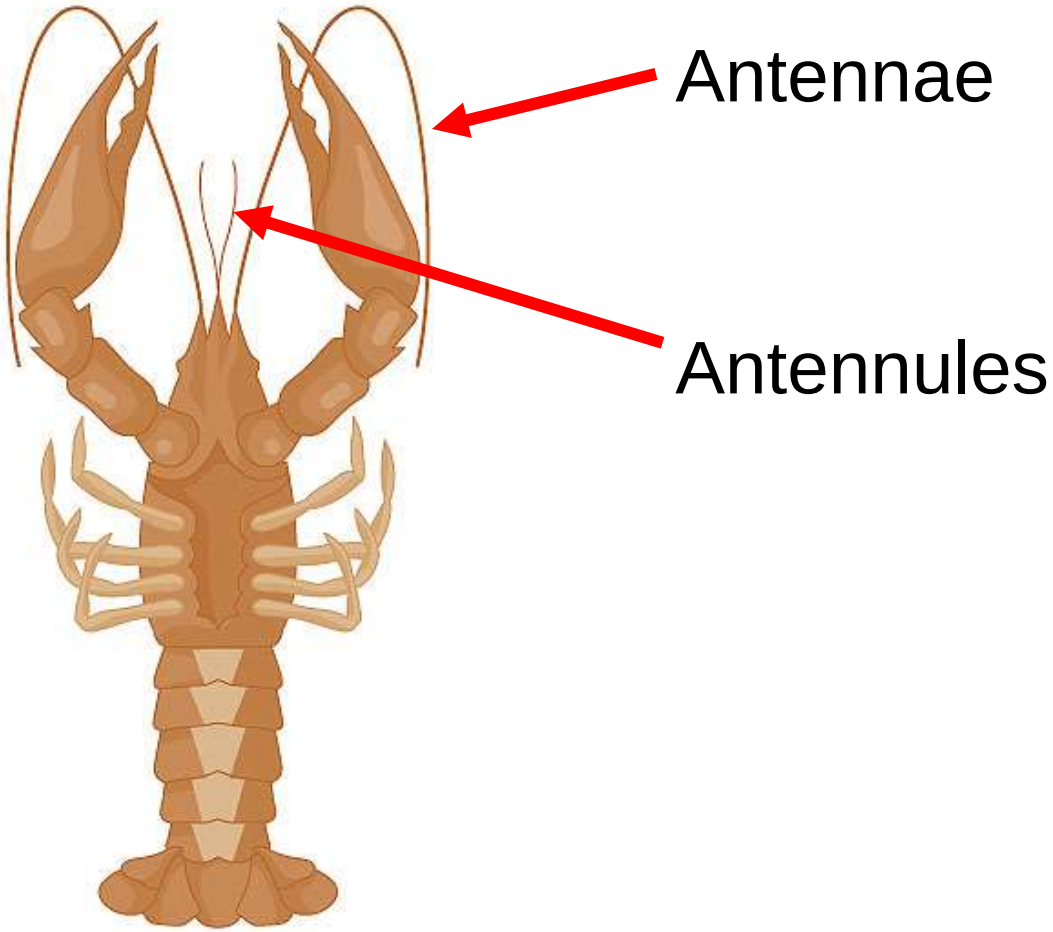


The Crustaceans (cont'd)

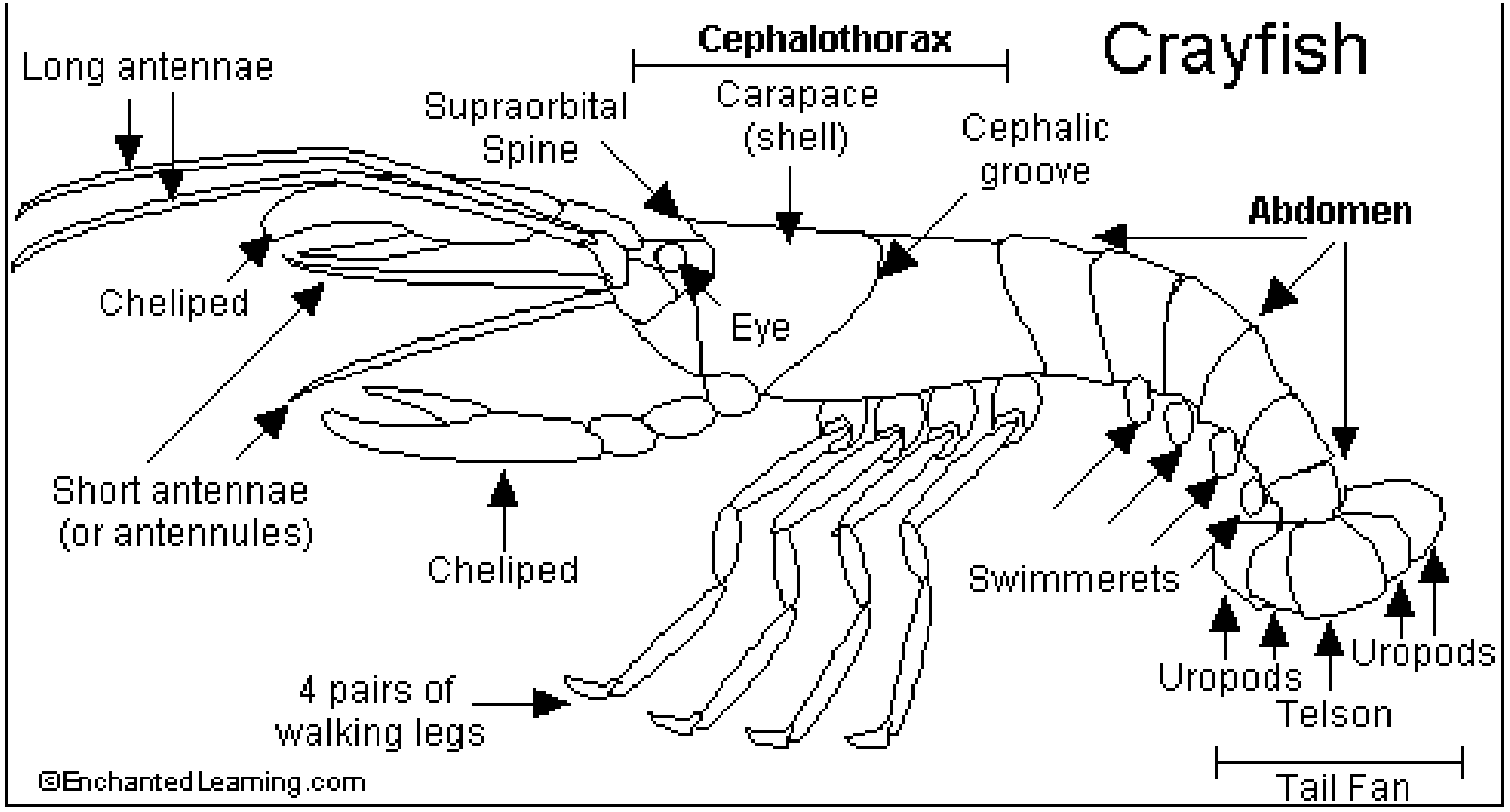
- Aquatic (mostly marine)
  - a few terrestrial forms
- Major ecological and economical importance.



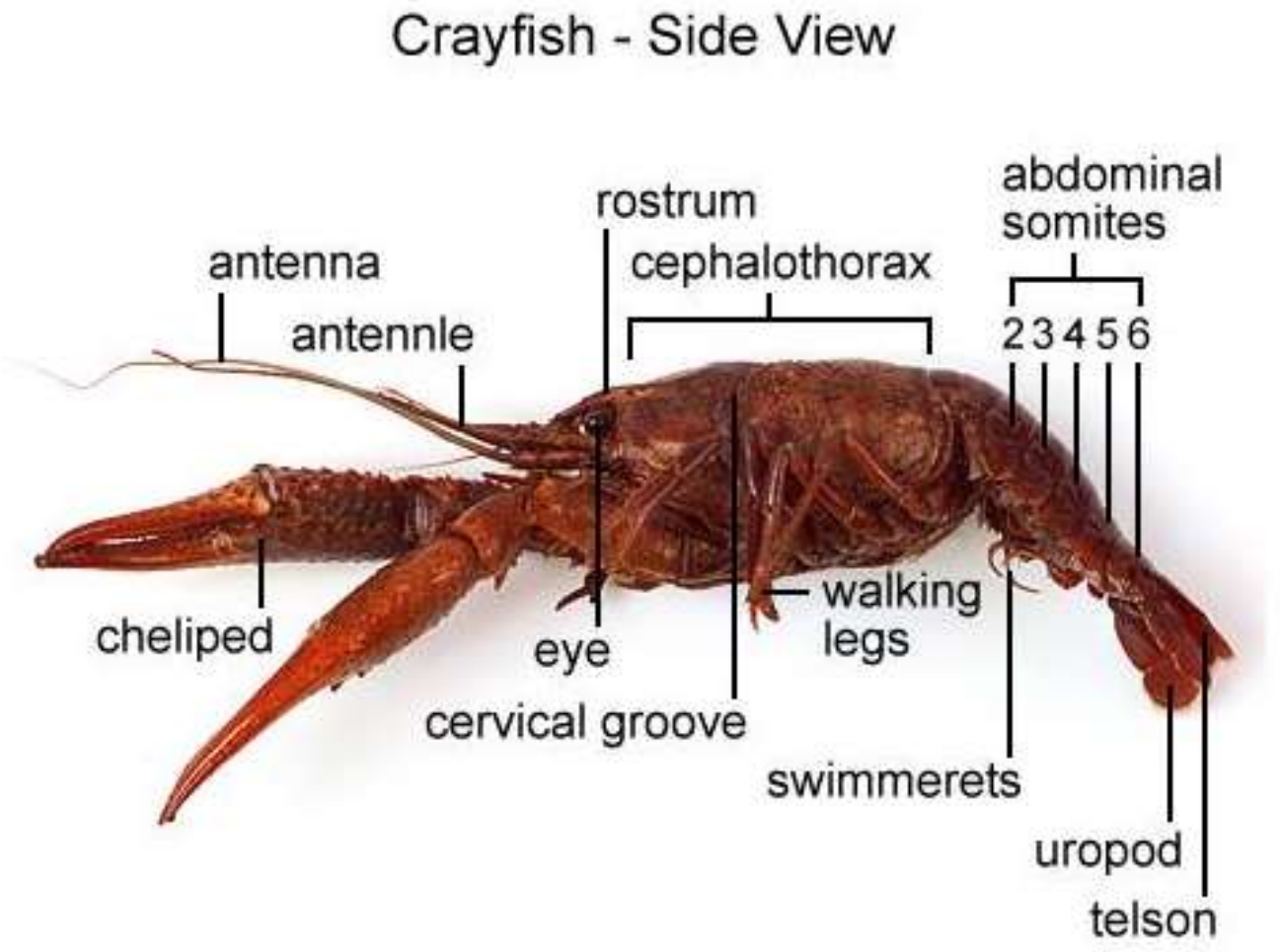
- **Only arthropods with 2 pairs of antennae**



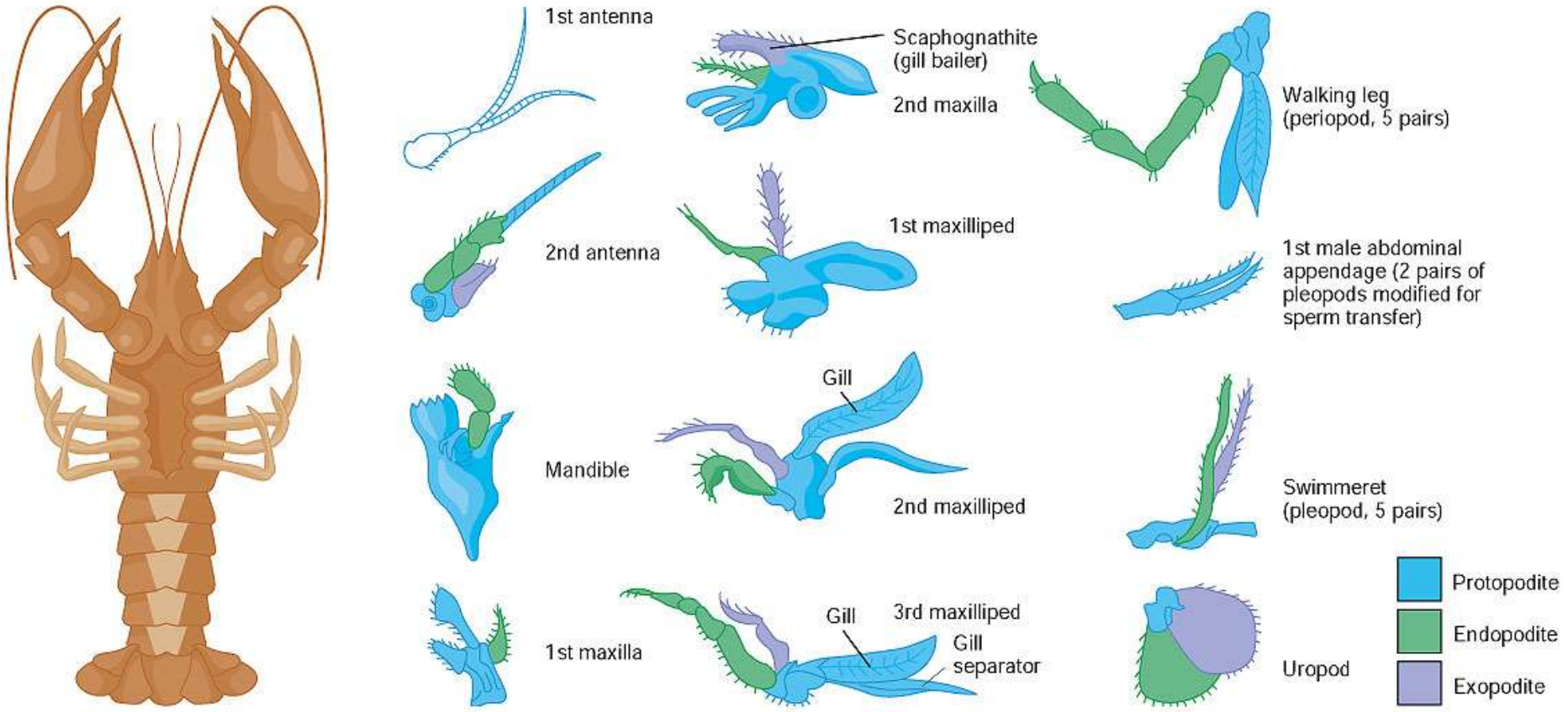
Crayfish External Anatomy



Crayfish External Anatomy



- **Great specialization of appendages**
  - Mouthparts chewing, grinding, handling



- appendages strengthened for walking or protection (chelipeds, pincer-like claws)

Digestive

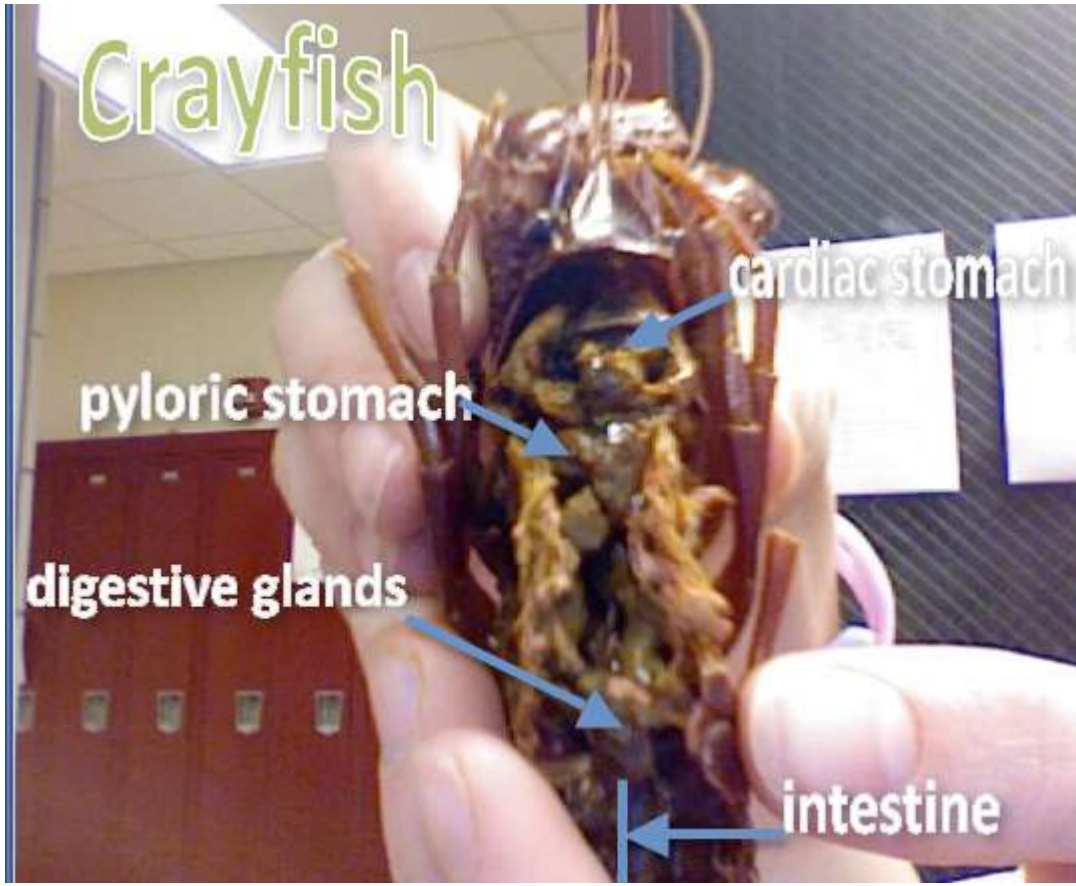
- The cardiac stomach has 3 teeth that grind food called the gastric mill

Digestive

- Crayfish also have a liver that produces digestive enzymes and enters the midgut through ducts (nearly identical to ours)

Digestive

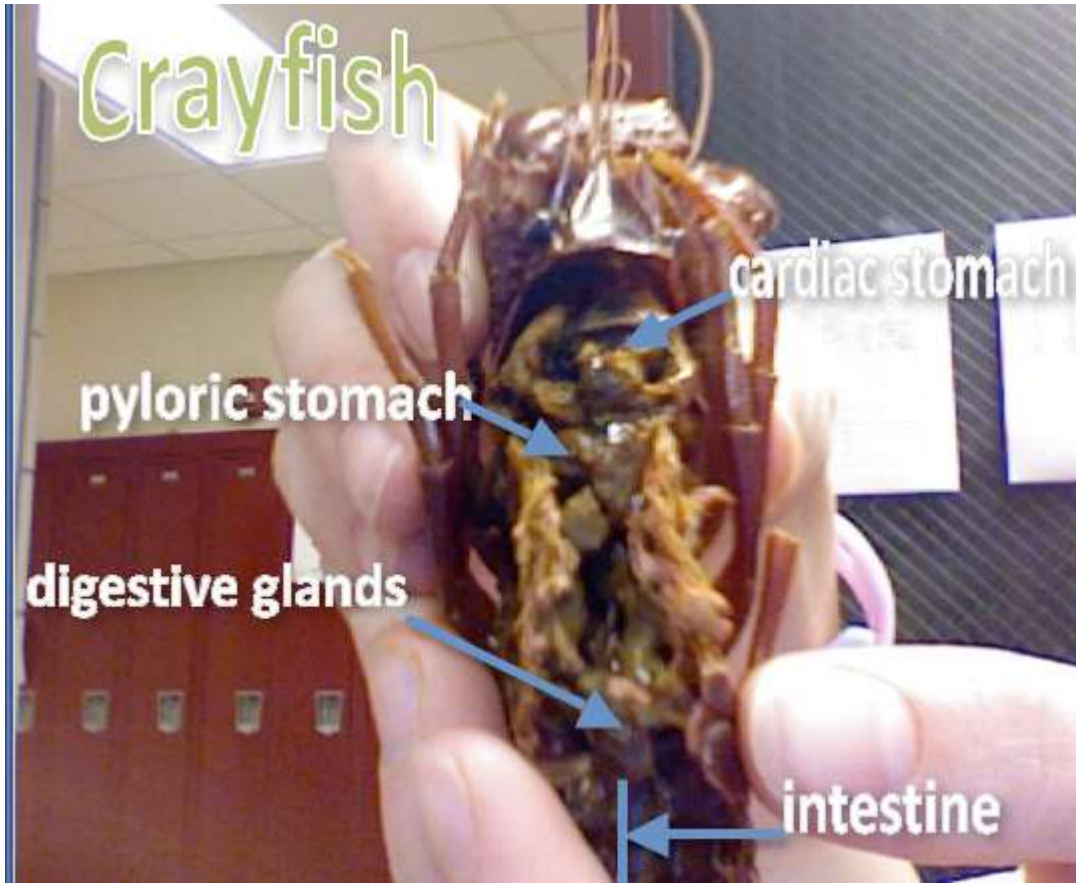
- Crayfish eat snails, tadpoles, insects, larvae, decaying matter
- Mostly Nocturnal



Digestive

- Digestive Pathway:

Mouth-Esophagus-Cardiac stomach-pyloric stomach, midgut, intestine, anus



Circulatory

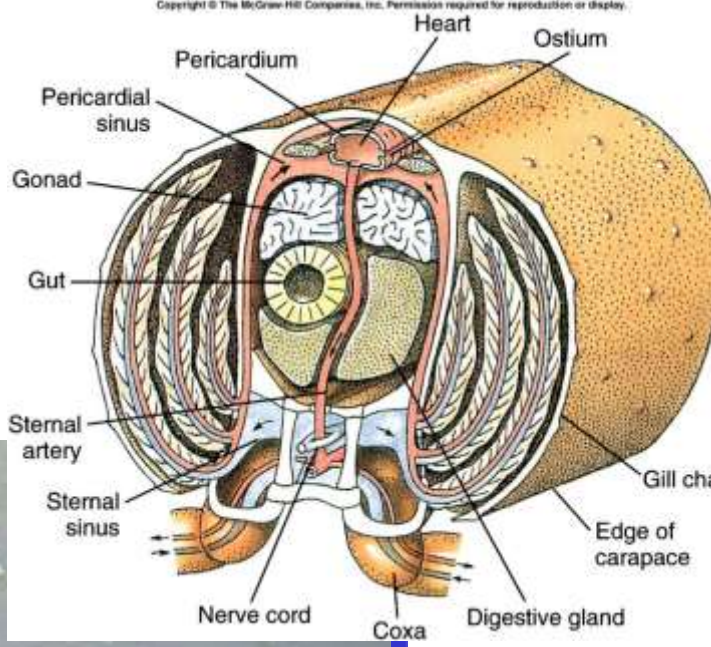
- Similar to worm, but is open so NO VEINS
  - System Includes
  - Heart
  - Seven arteries carry blood to body
  - Sinuses to return blood
  - Large pericardial sinus surrounding heart
  - Blood nearly colorless contains hemocyanin, a copper containing respiratory pigment
  - Can clot

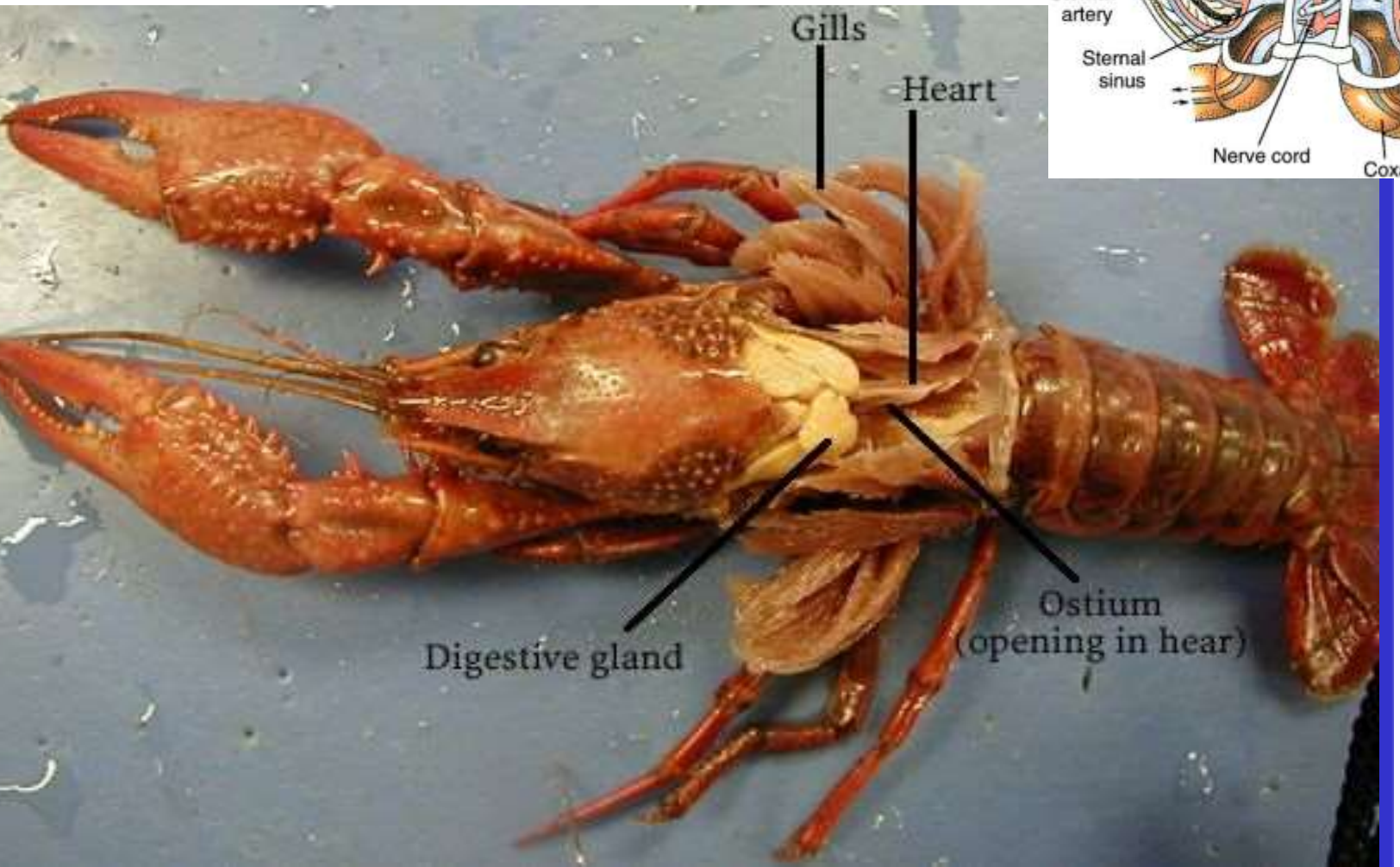
Respiratory System

- Gills are very prominent during dissection

Respiration

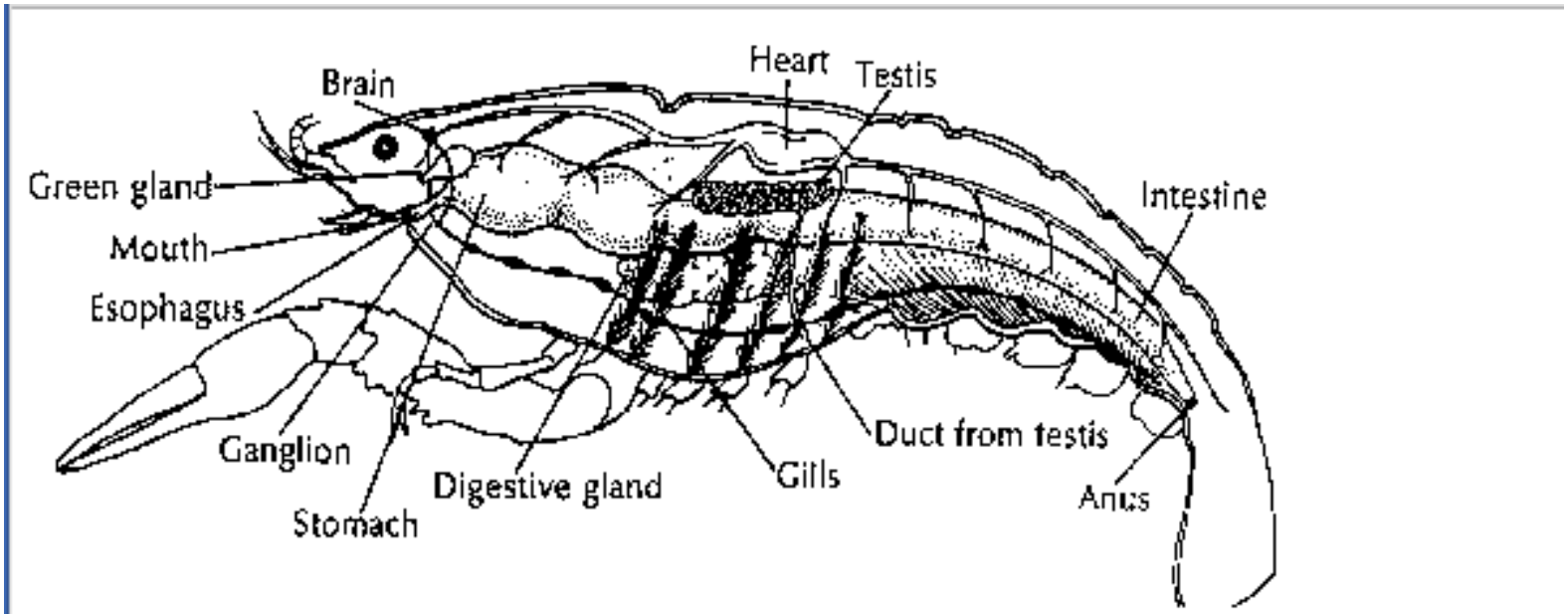
- gills (usually)





Excretory system

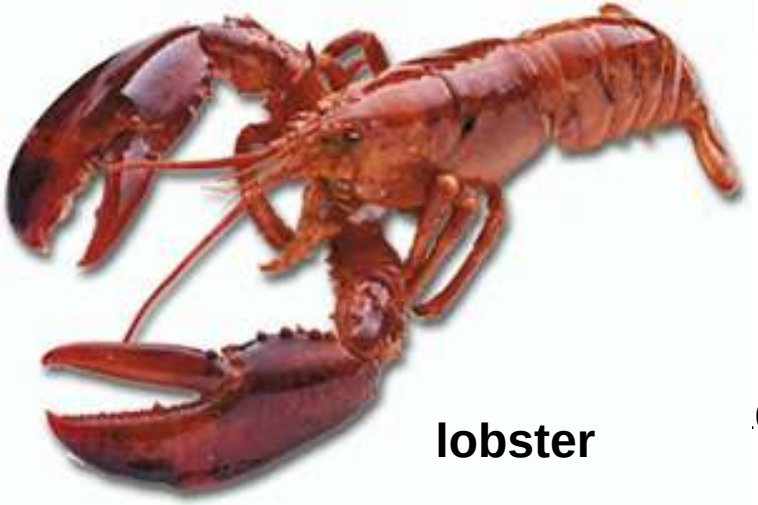
- Excretory organs area pair of green glands (similar to our kidneys)
- Green gland consists of a glandular portion, a thin walled bladder, and a duct leading to the renal pore that opens to outside and is just behind the eye



What's the difference between a crayfish and a lobster?

- Same Order, but different families
- Lobsters are bigger
- Lobsters are marine; crayfish live in freshwater creeks, ditches, or lakes

crayfish



lobster

Next Class

- Read in Chapter 20 the section over Echinoderms before Thursday class
- Quiz over Grasshopper Anatomy both internal and external
- Echinodermata notes

Target Objectives for Arthropods

- Describe the characteristics of arthropods.
- Explain the main adaptations contributing to arthropod success.
- List the four main groups of arthropods and describe the features of each.