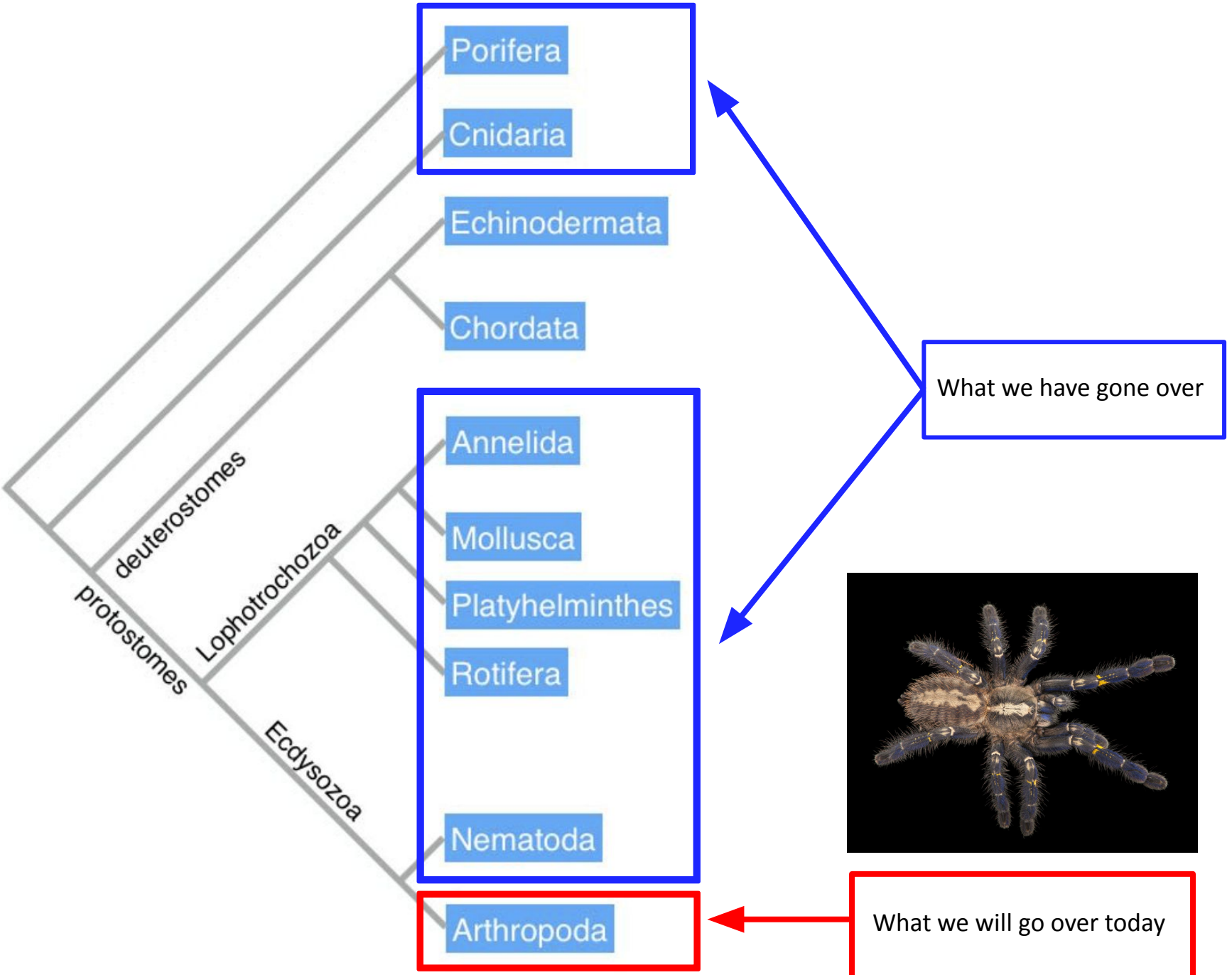
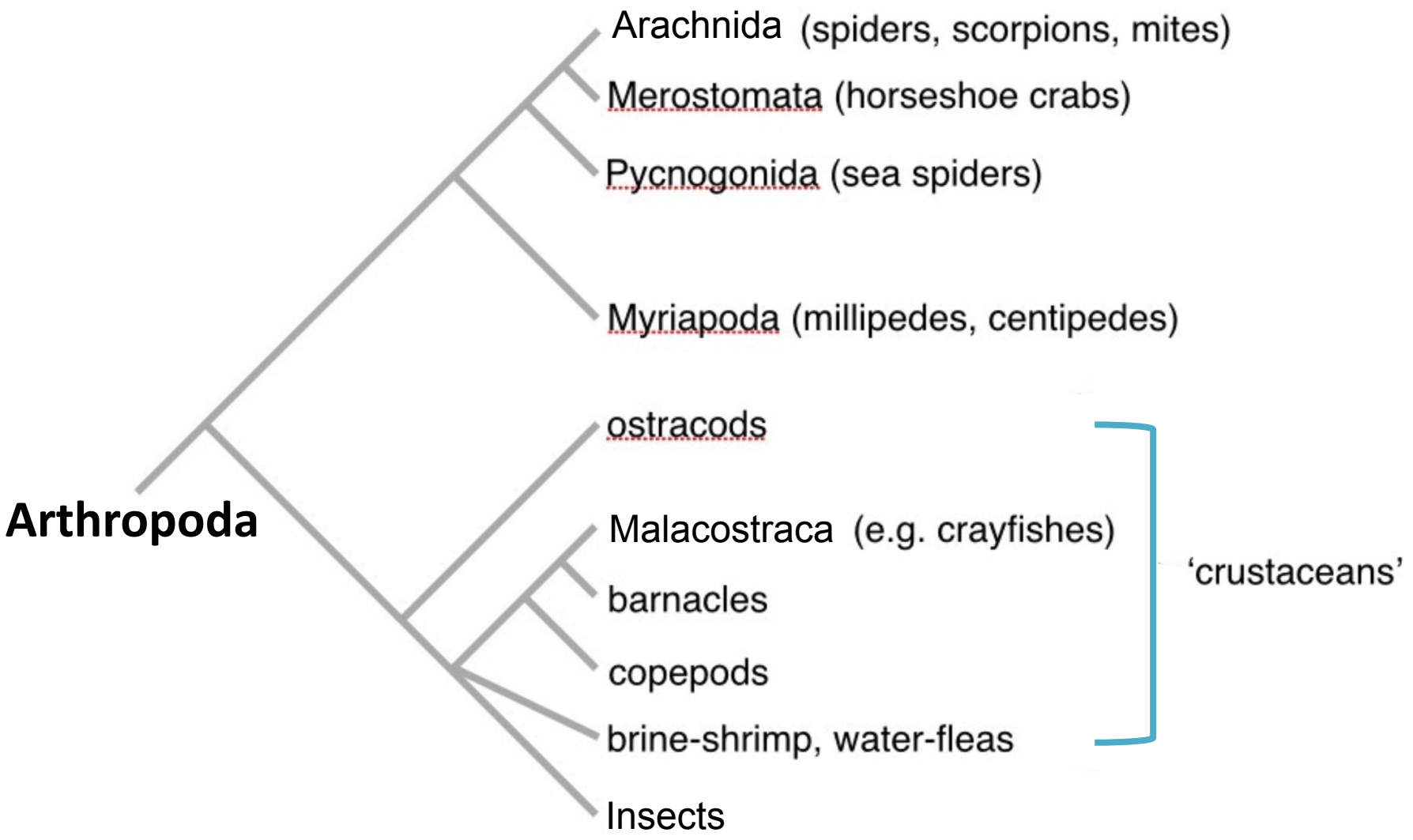
Week 11: *Drosophila*

Reading:

- Read lab manual chapter 11
  - Pages 312-348

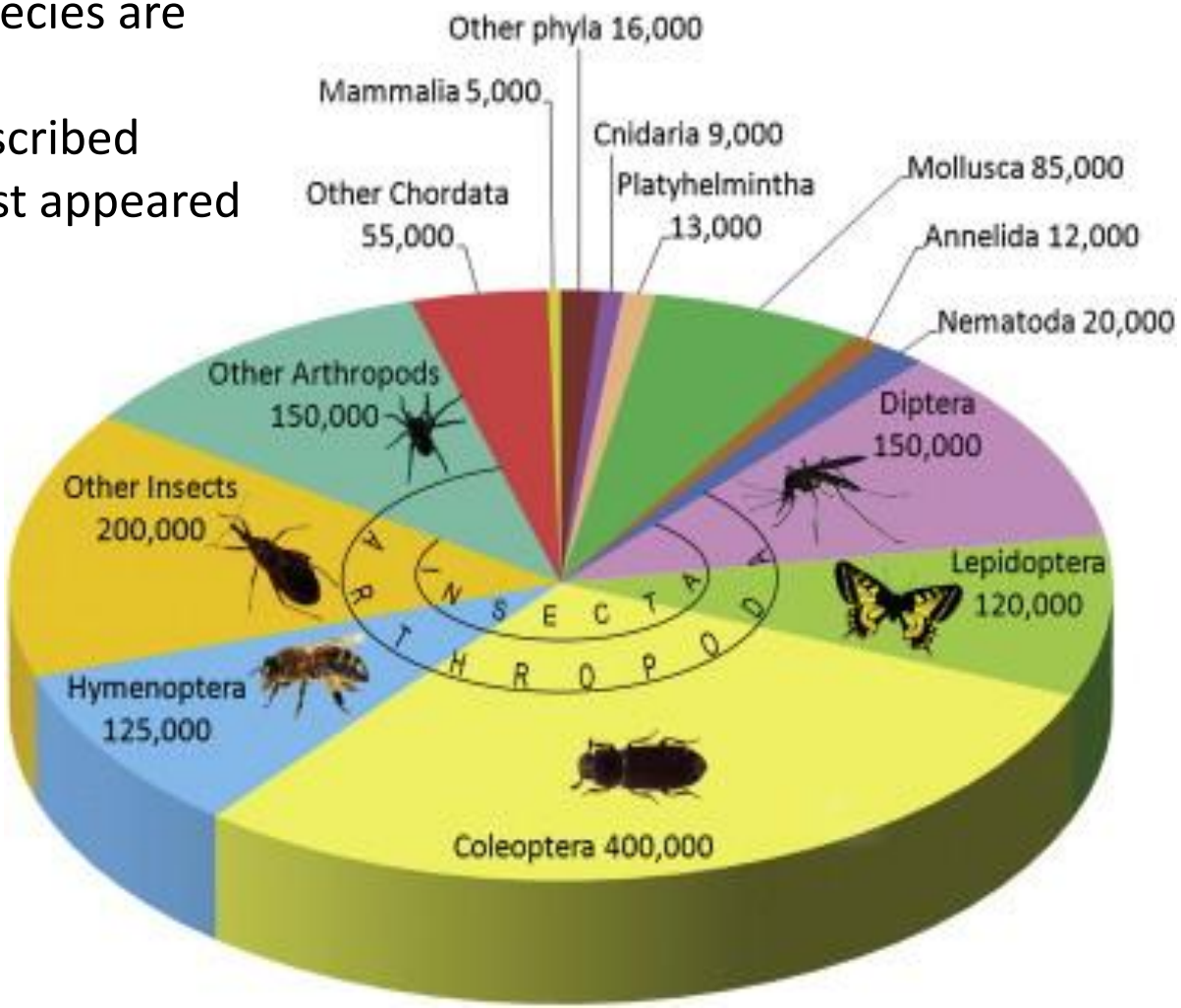

Porifera
Cnidaria
Echinodermata
Chordata
Annelida
Mollusca
Platyhelminthes
Rotifera
Nematoda
Arthropoda
deuterostomes
protostomes
Lophotrochozoa
Ecdysozoa
What we have gone over
What we will go over today

Arthropod Phylogenic Tree



THE ARTHROPODS

- Most abundant and diverse animals on Earth
- Insects: over 1 million species are described
  - With more to be described
- Very ancient animals- first appeared ~375 million years ago



Importance of Arthropods

- Easy model organisms to study genetics, ecology, and evolution
  - Short life cycle
  - High reproduction rate
  - Observable traits (phenotypes)
- Ecosystem engineers: any organism that creates, significantly modifies, maintains or destroys a habitat
  - These organisms can have a large impact on the species richness and landscape-level heterogeneity of an area (e.g. leafcutter ants)

Importance of Arthropods

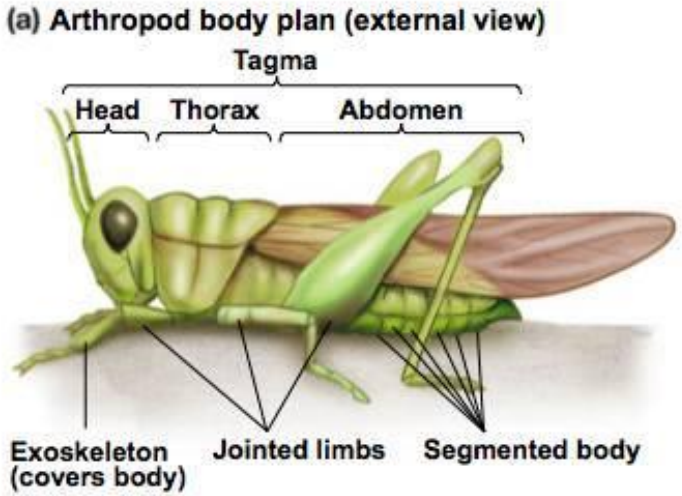
We are able to eat the fruits and vegetables we do now due to our reliance on arthropods (thanks, bees!)

Importance of Arthropods

- They serve as a good source of protein
- As we move away from using cattle and pork as sources of protein, more sustainable options will become crickets and mealworms in the future

The Arthropod Body Plan

1. Exoskeleton made of **chitin**
   - **Sclerites –** the hardened plates that protect the body
   - **Ecdysis (page 325)** – the molting (shedding) of the exoskeleton (like *C. elegans*!)
2. Segmentation & tagmatization
   - Body divided into segments, or **metameres** with specific roles
   - Segments can be fused into groups called **tagmata** (head, thorax, abdomen in insects)

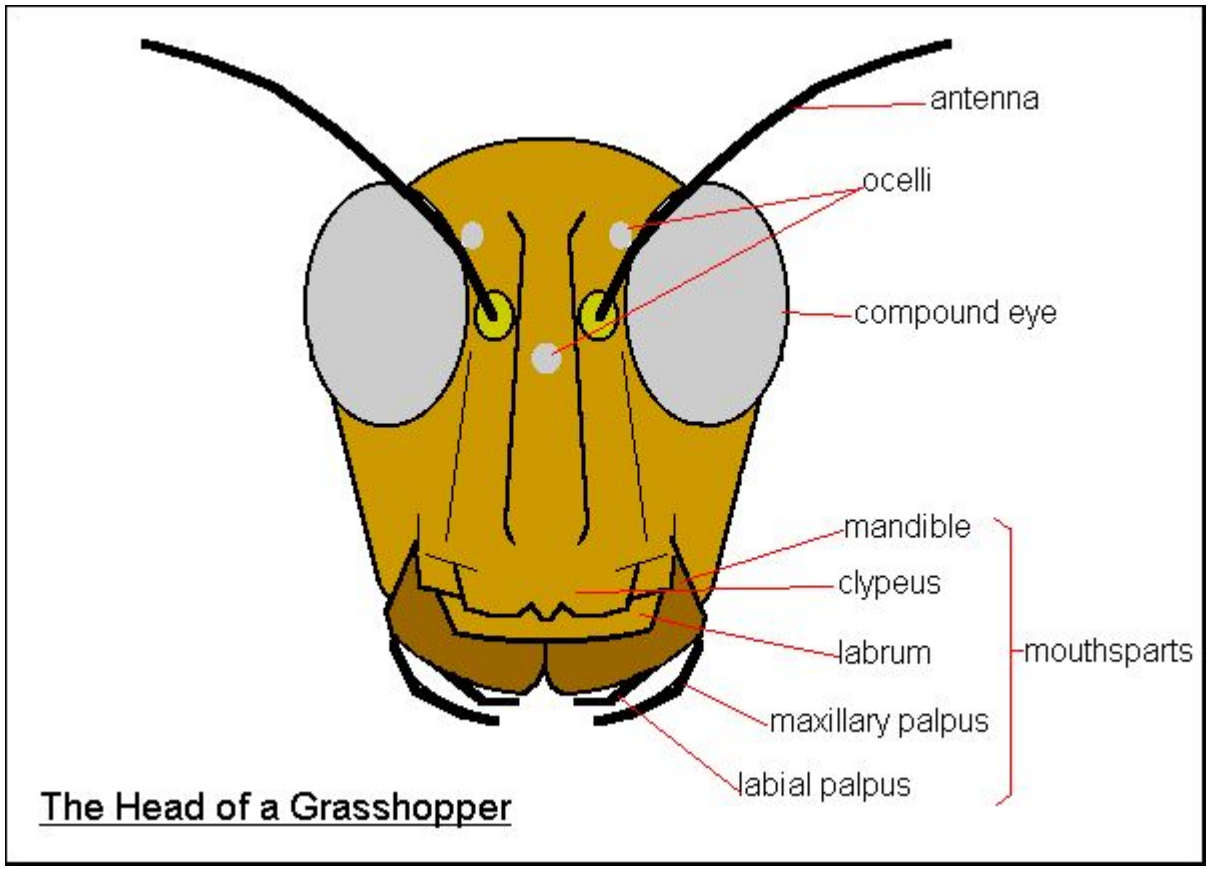


- Body appendages & movement
  - arthropod = “jointed leg”
  - Muscles are within the skeleton
- Nervous system & sense organs
  - Cephalization
  - Antennae, simple eyes (ocelli), compound eyes

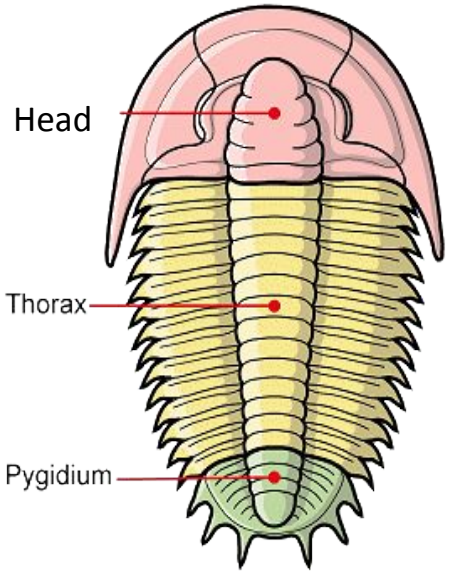
Molting

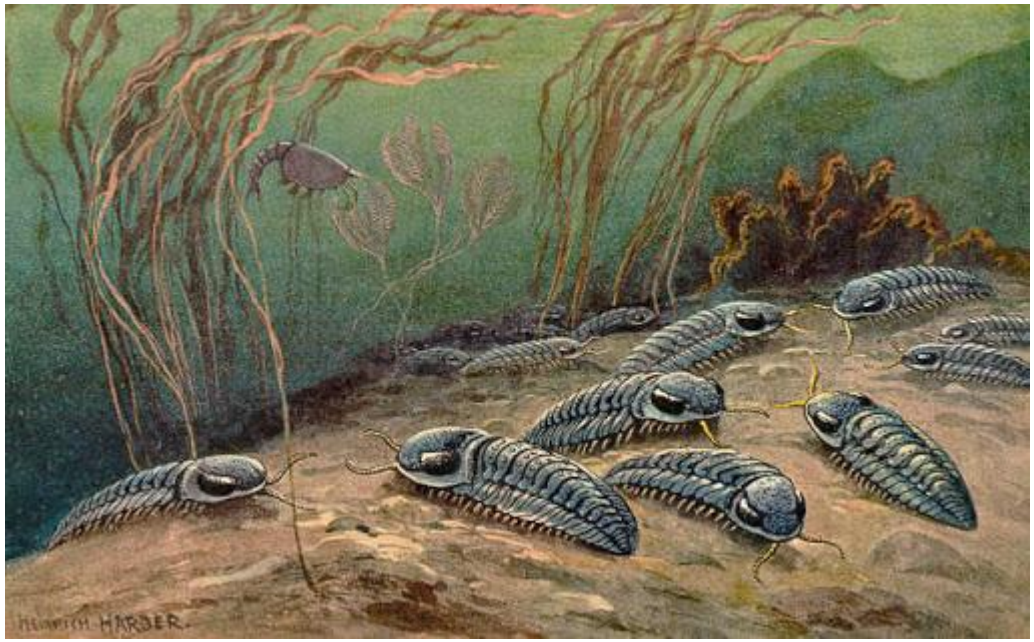
Arthropods undergo **ecdysis (page 325)** – the molting (shedding) of the exoskeleton (like *C. elegans*!)

Cephalization highly developed



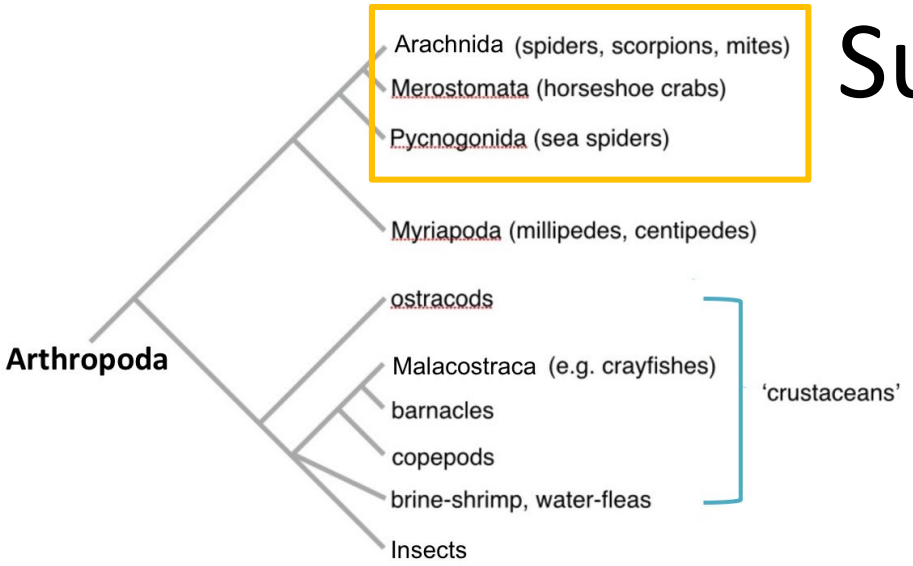
Ancient arthropods: Trilobita

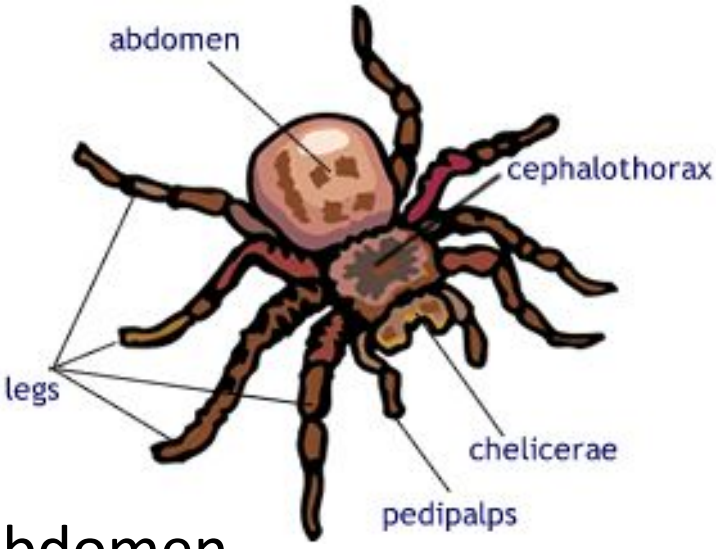




- Extinct, common 500-250 mya
- Most ancient of arthropods
- Marine - probably benthic dwellers

Subphylum Chelicerata





- Two tagmata: cephalothorax and abdomen
- Chelicerae: claws or fangs for feeding or defense
- Pedipalps: sensory or locomotion

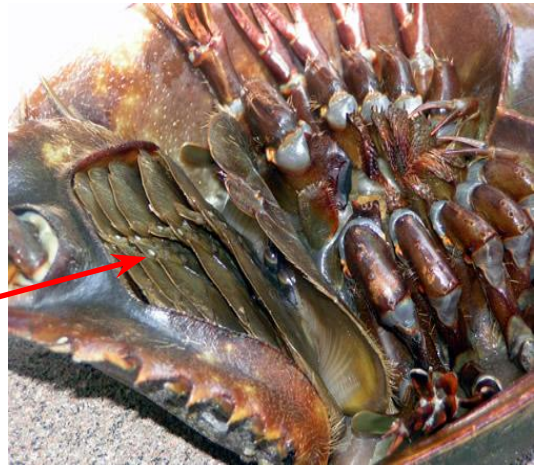
Two classes:

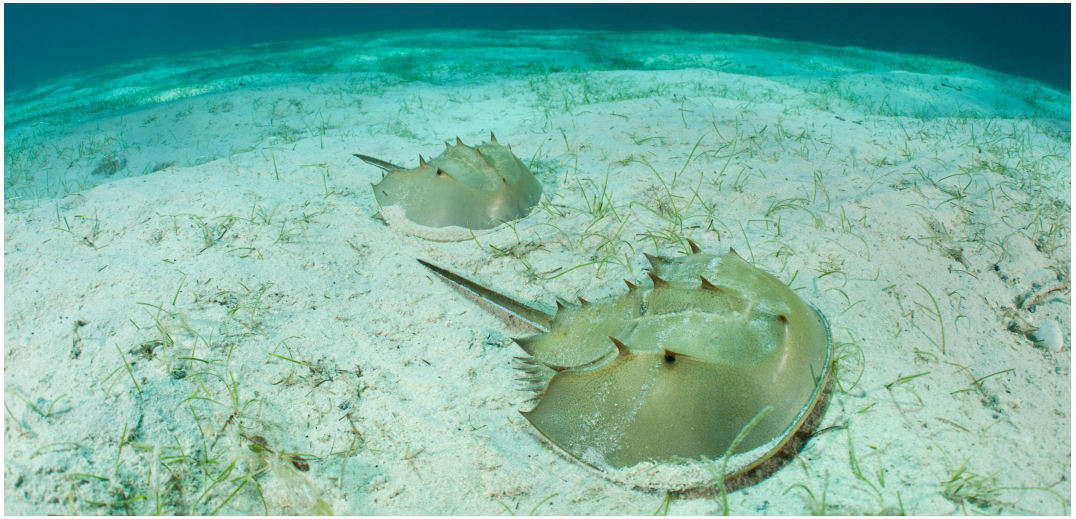
1. **Class Merostomata** (horseshoe crabs)
2. **Class Arachnida** (spiders, scorpions, mites, ticks)

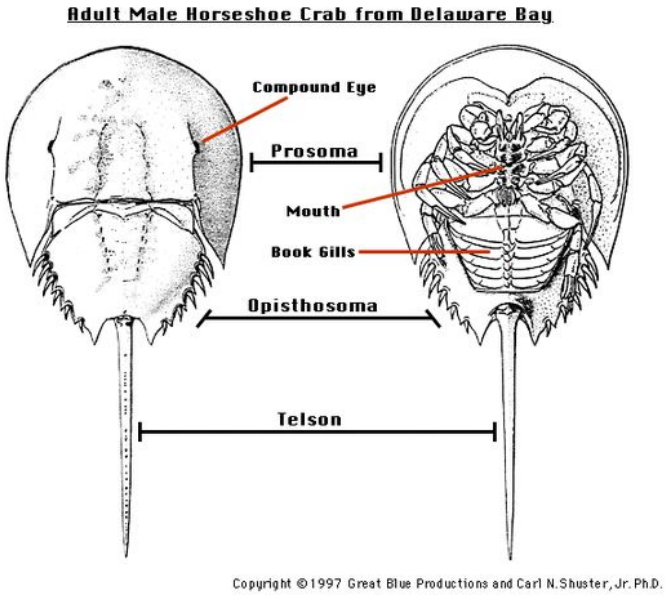
Class Merostomata: Horseshoe crabs

Ex: *Limulus polyphemus*

Book gills



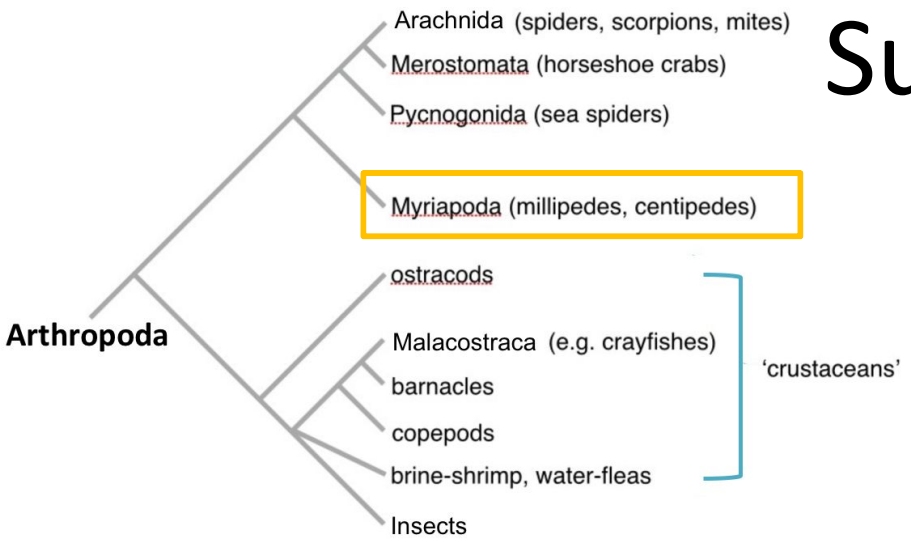




Telson

Class Arachnida

- Spiders, scorpions, mites, ticks, and Harvestmen
- Order Aranaea (spiders)
  - 35,000 species
- Order Scorpiones (scorpions)



Subphylum Myriapoda

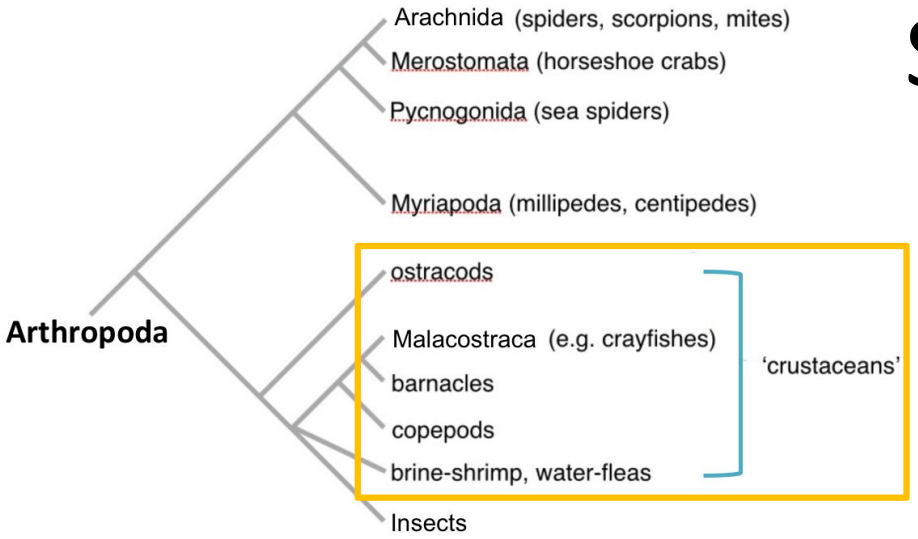
Multiple appendages on almost every segment

- **Class Chilopoda** – centipedes
  - Predatory (eat other arthropods)
  - Venomous
- **Class Diplopoda** – millipedes
  - Feed on decaying vegetation (great composters!)
  - Many secrete chemicals when threatened
    - Ex: Hydrogen cyanide

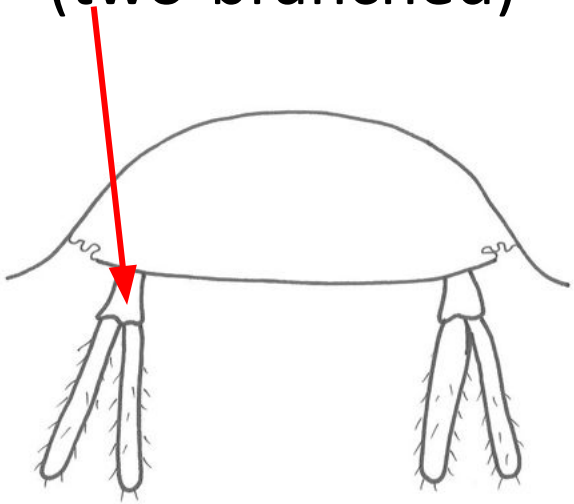
Centipedes Verses Millipedes

Subphylum ‘Crustacea’

Paraphyletic-excludes insects



- Mostly marine
- Biramous: forked (two-branched)



‘Crustaceans’

Class Malacostraca – crabs, lobsters, shrimp, isopods, amphipods

Class Cirripedia – barnacles

Larval stages similar to other arthropods

Class Branchiopoda – fairy shrimp, brine shrimp, water fleas

Classes Copepoda (marine copepods) and **Ostracoda** (freshwater ostracods)

Subphylum Hexopoda: Class Insecta

- Dominant animal on earth!
- Uniramous (not forked) appendages
- 3 tagmata
- 3 possible developmental modes:
  - **Ametabolous** – born as mini-adults
  - **Hemimetabolous** – born lacking some adult structures, but develop them with each molt
  - **Holometabolous** – larva is unlike adult; larva undergoes a pupal stage

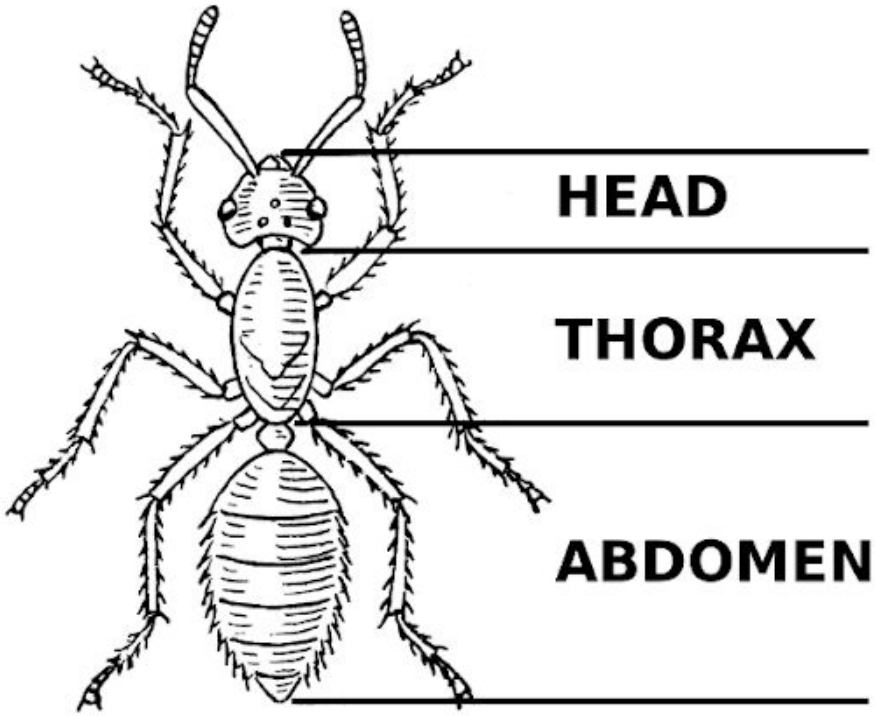
Look in lab manual on page 336 to learn external anatomy

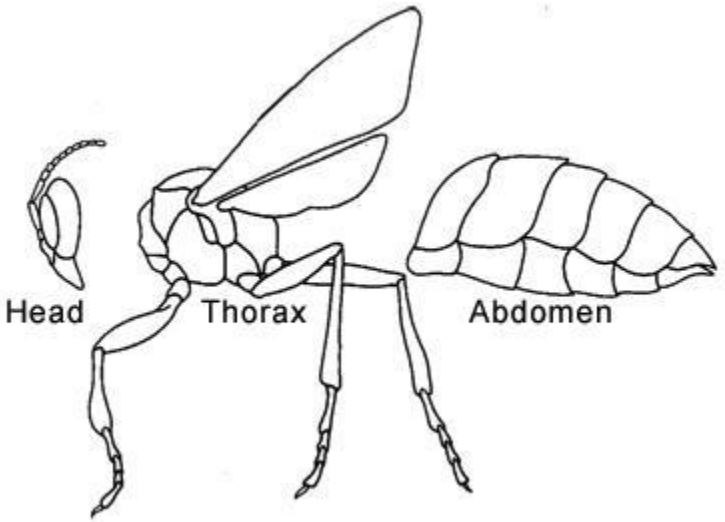
Most abundant animals on Earth

- There are over **1,000,000,000,000,000,000** (a quintillion) individuals on Earth
- The world holds 300 pounds of insects for every pound of humans

Insects have 3 tagmata

Segments can be fused into functional groups called **tagmata** (head, thorax, abdomen in insects)





Insect Orders

1. Order Coleoptera – beetles
2. Order Lepidoptera – butterflies and moths
3. Order Diptera – Flies, mosquitoes
4. Order Hymenoptera – bees, ants, wasps
5. Order Hemiptera – true bugs
6. Order Dermaptera – earwigs
7. Order Odonata – dragonflies and damselflies
8. Order Orthoptera – grasshoppers, katydids, crickets
9. Order Mantodea – mantids (ex: praying mantis)
10. Order Blattaria – cockroaches and termites
11. Order Neuroptera – lacewings and antlions
12. Order Siphonaptera – fleas

Know the insect orders highlighted in red for the practical!

Insect Dichotomous Key

- Page 345-346 in iBook lab manual
- Be able to identify insects to **order** based on anatomical features
  - You may think you have a fly, only to find out it's a bee! They are in completely different orders. This is why the key is important.
- Let's take a look at an example

Insect Dichotomous Key

We'll use this critter as our example specimen

Insect Dichotomous Key

Key to the common insect orders

1. Wings absent 2
1. Wings present 3

[Wings may be difficult to identify. The forewings of some insects are hard or leathery, scarcely wing-like; such wings may cover and conceal the more typical membranous hind-wings.]

2. Body compressed laterally; hind-legs for jumping; abdomen broadly joined to thorax; size small (< 3 mm) ..... Order Siphonaptera
2' Body not compressed laterally; abdomen joined to thorax by narrow constriction; antennae often elbowed ..... Order Hymenoptera

3. With one pair of wings ..... Order Diptera
3' With two pairs of wings 4

4. All wings membranous, either translucent or thin and covered in scales 5
4' Front pair of wings wholly or partly hardened or leathery, always obviously more opaque than hind-wings 9

5. Wings opaque, covered with scales, often brightly colored; mouthparts usually a long coiled tube ..... Order Lepidoptera
5' Wings ± clear, not scale-covered 6

6. Abdomen joined to thorax by narrow constriction; hind wings smaller than front wings; wings with relatively few veins ..... Order Hymenoptera
6' Abdomen broadly joined to thorax; hind wings similar in size to front wings; wings with many veins 7

7. Wings held roof-like over the body; mouthparts forming an elongate beak for sucking fluids ..... Order Hemiptera, subgroup Homoptera
7' Mouthparts not an elongate beak, mandibles adapted for chewing 8

Insect Dichotomous Key

Start at #1. Are the wings absent or present? Based on those orange wings, we can say the wings are present, and choose 1' (there is a typo there-the bottom #1 should have an apostrophe,) which leads us to #3.

Key to the common insect orders

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Insect Dichotomous Key

Now we have been led to #3. Are there one pair or two pairs of wings? We can see that there are two pairs, 4 wings total. Two front wings and two hind wings. This means we will take 3', which directs us to #4.

Key to the common insect orders

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Insect Dichotomous Key

#4 can be tricky, especially without in-person specimens to look at. However, you can tell from the photo that the wings are not leathery or hardened; they look pretty translucent. Therefore, we should go with 4, not 4'. That takes us to #5.

Key to the common insect orders

1. Wings absent 2
1. Wings present 3

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Insect Dichotomous Key

Now we're at #5. Again, this one can be hard to tell in a photo, but these wings look pretty clear and not covered in scales the way butterfly and moth wings are (those usually look powdery rather than smooth). We should go with 5', which takes us to #6.

Key to the common insect orders

1. Wings absent 2
1. Wings present 3

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Insect Dichotomous Key

You can see the narrow constriction better in this photo

Now we're at #6. This one is hard to tell from the original photo, so I added another one on the far right to show a better angle of the thorax and abdomen. You can see the narrow constriction. The hind wings are also smaller than the front wings. There are few veins, relative to other insect wings (look at photo below on left for an example of many veins). Therefore, we need to choose 6, and that takes us to the order Hymenoptera!

Key to the common insect orders

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Hymenoptera

Tarantula Hawk Wasp

- Good job, you identified the insect to order!
- It is in the order Hymenoptera: the bees, ants, and wasps
- This is a Tarantula Hawk Wasp, found in California
- Fun fact: **It has one of the most painful insect stings in the world**
- However, they are not highly aggressive and will leave you alone if you leave them alone. They don't want to waste their venom on you when they could use it to lay eggs inside a tarantula spider ☺️

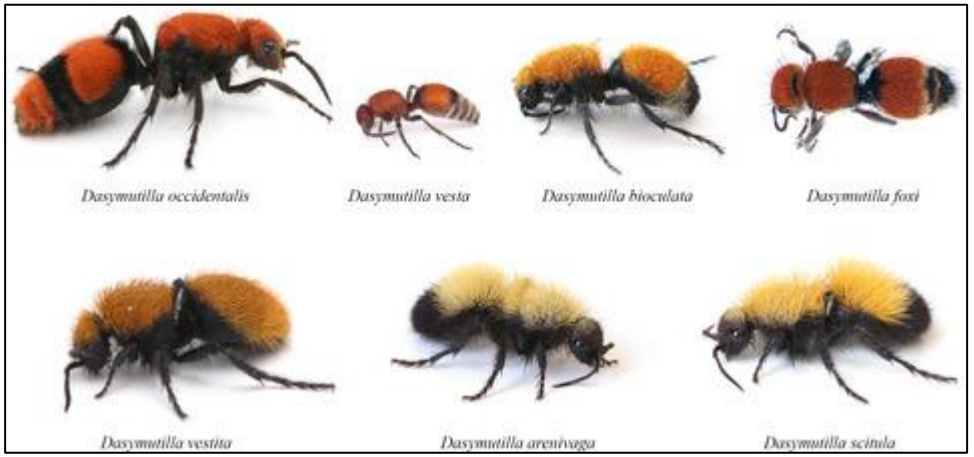
Crypsis in insects

Colors and patterns that allow an organism to blend in with the surrounding environment

Can you spot the insect?

Batesian mimicry

Mimics the warning signals of a harmful species



Müllerian mimicry

Two or more poisonous or venomous species have come to mimic each other's warning signals (often common predator)

Poisonous vs. Venomous Video
https://www.youtube.com/watch?v=ZraPJCwod3I

Venomous Mammals (a tangent)

Male platypus (Australia)

Southern short-tailed shrew (eastern US)

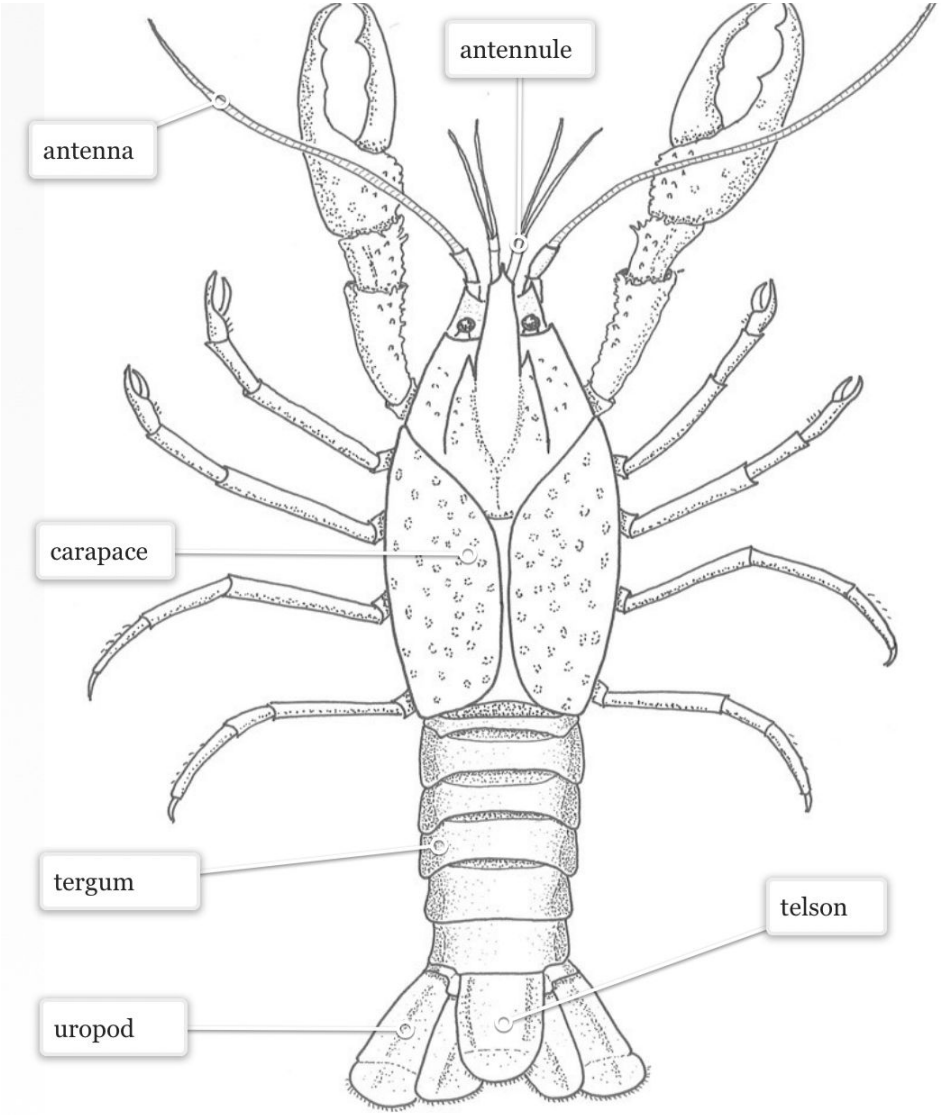
Slow Loris (Asia)

Crayfish Dissection

Watch videos on Canvas

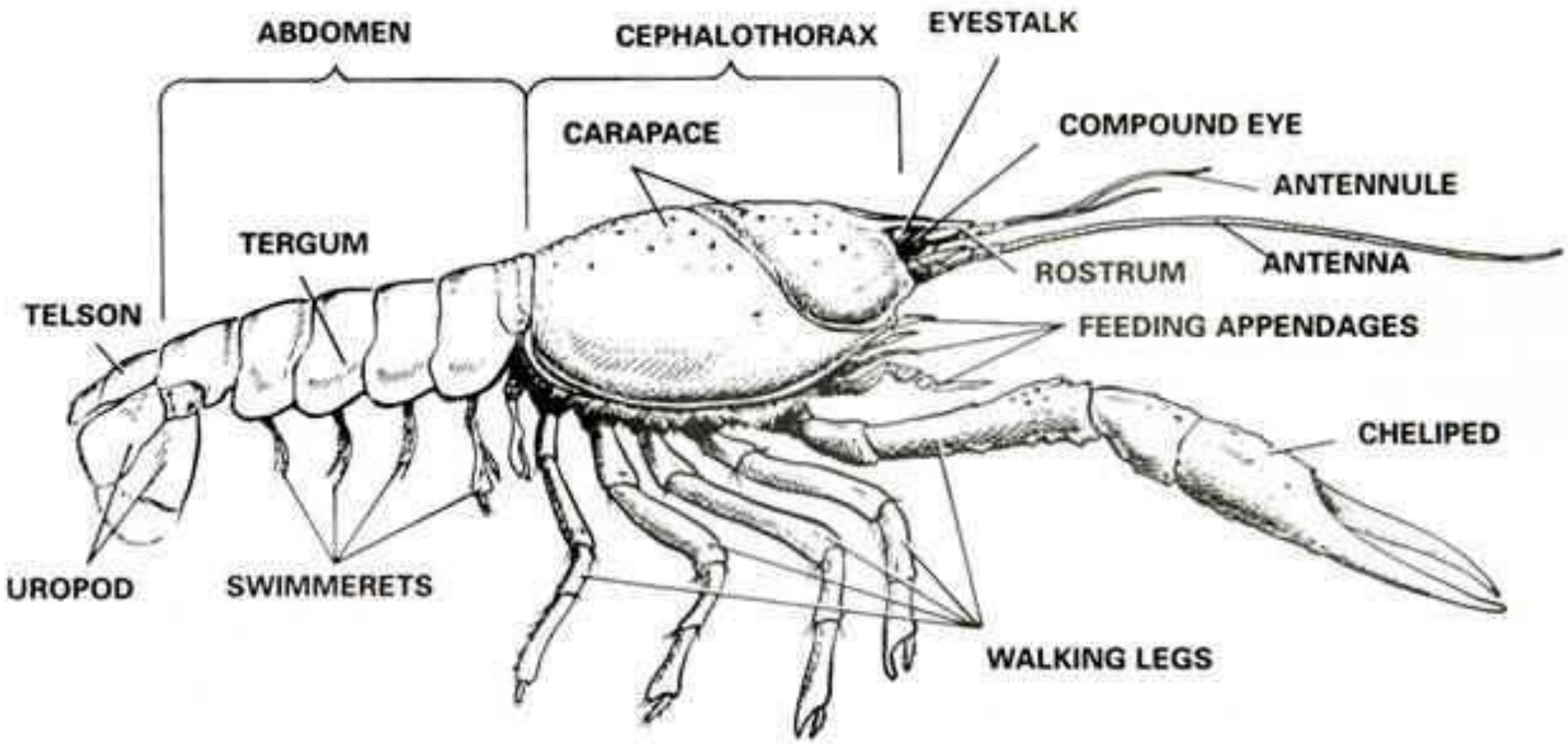
Crayfish Dissection

Read lab manual starting on page 314, and watch videos on Canvas!



Crayfish Dissection

Read lab manual starting on page 314, and watch videos on Canvas!



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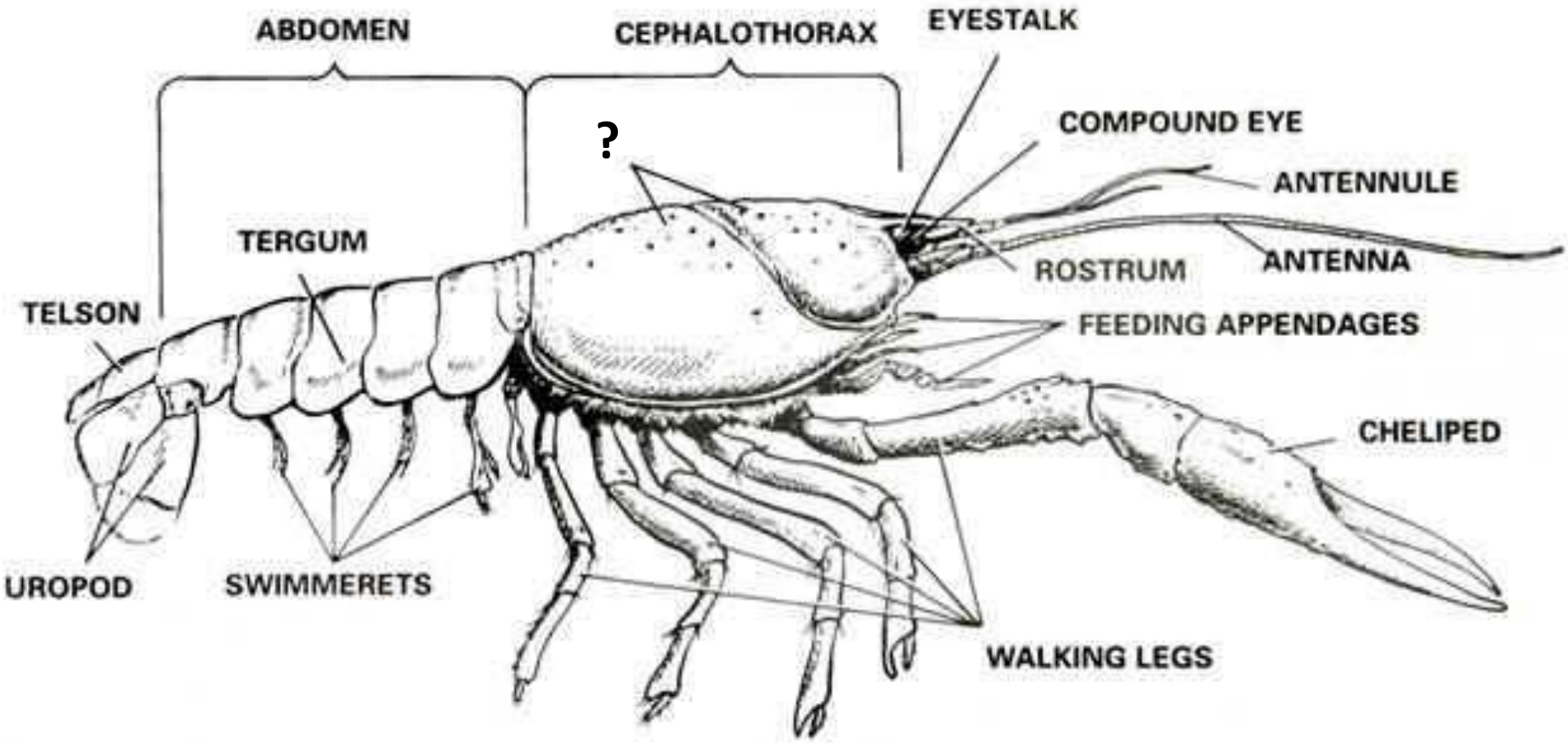

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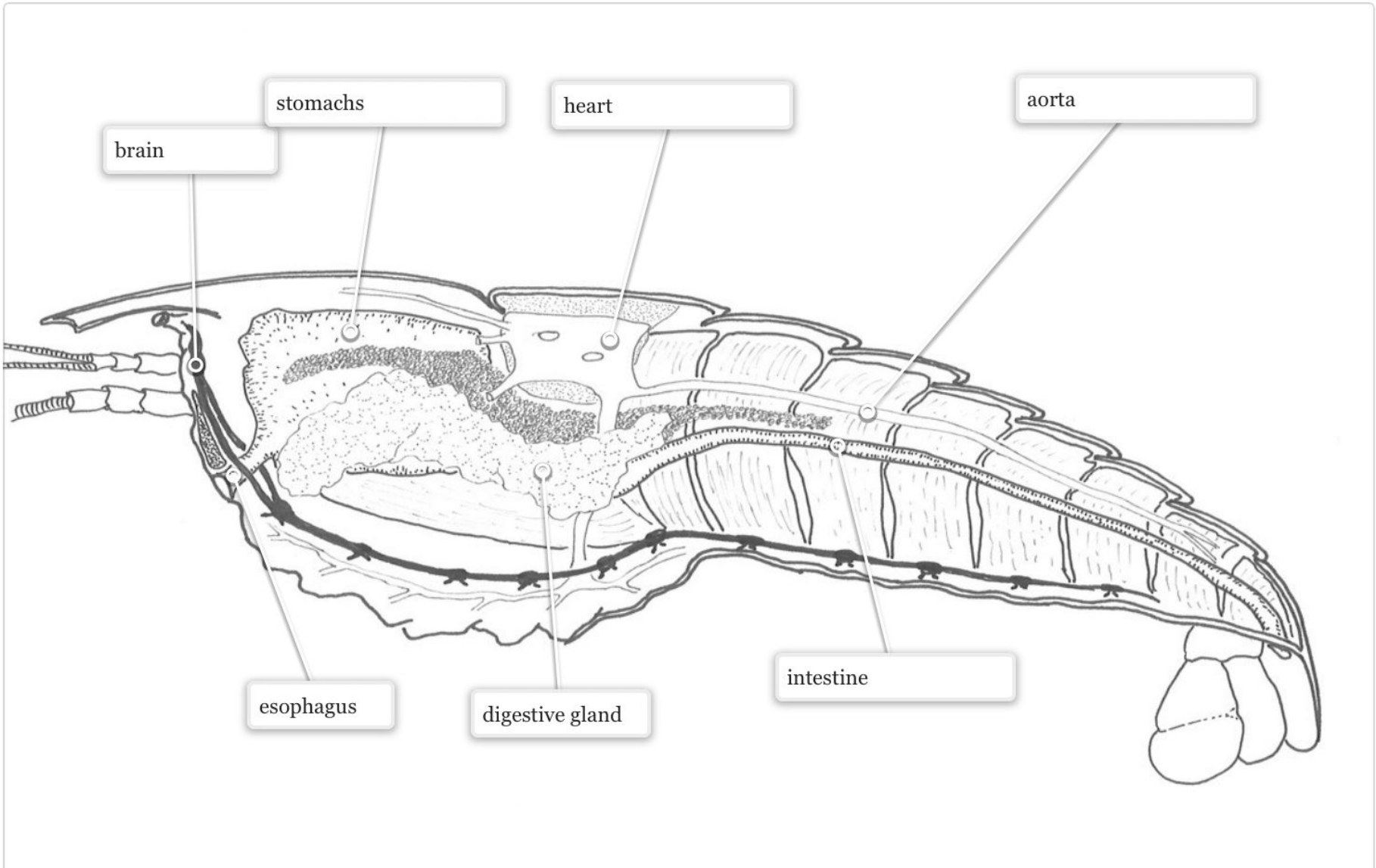
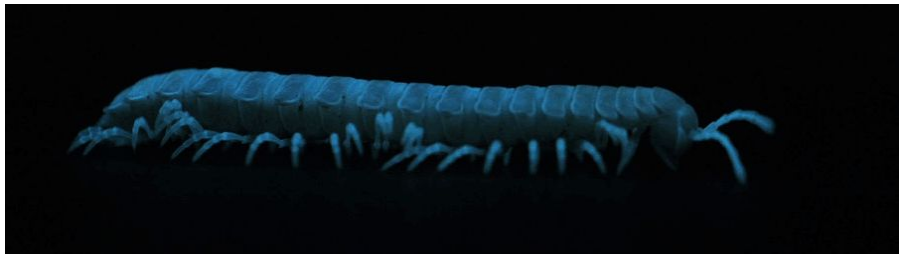


- Crayfish dissection
- Ecdysis observation
- Horseshoe crab external anatomy
- Spider and scorpion external anatomy
- Centipede and millipede observation
- Malacostraca observation
- Barnacle observation
- Branchiopoda observation
- Copepoda observation
- Ostracoda observation
- Grasshopper external anatomy
- Insect development
- Keying

Chapter 11 specimens/activities



Thanks for watching!