PANARTHROPODA

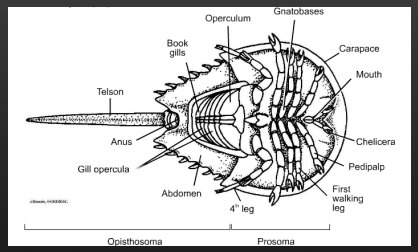
uniramia? biramia?

VELVET WORMS

- **PHYLUM ONYCHOPHORA**
  - Have characters similar to annelids and arthropods
    - however, not closely related to annelids! closely related to arthropods!
  - Have segments with no septa, unjointed limbs, antennae, mandibles, chitin, exoskeleton
  - Use metanephridia for excretion, one in each segment
  - Use tracheal system with spiracles for respiration
  - Have hydrostatic skeleton, move like worms
  - Lay eggs (no larval stage)

ARTHROPODS

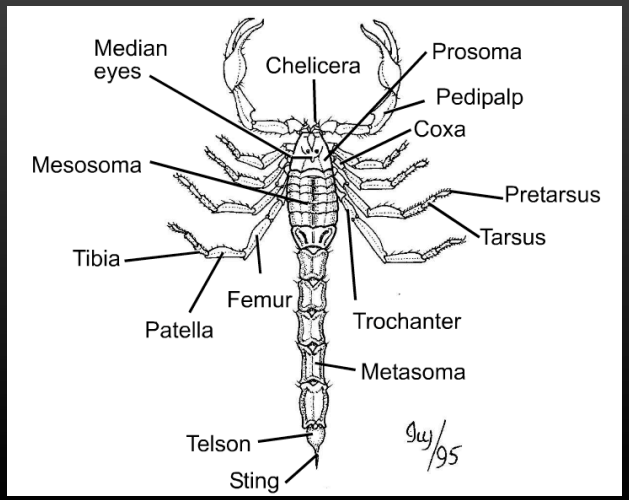
- **PHYLUM ARTHROPODA**
  - Hard, chitinous exoskeleton
  - Segmented, jointed appendages
  - Extensive tagmatization
- **SUBPHYLUM TRILOBITA**
  - All extinct, among oldest complex
  - animal fossils found
- **SUBPHYLUM CHELICERATA**
  - Two main body regions (tagma)
    - prosoma – cephalothorax
    - opisthosoma – abdomen



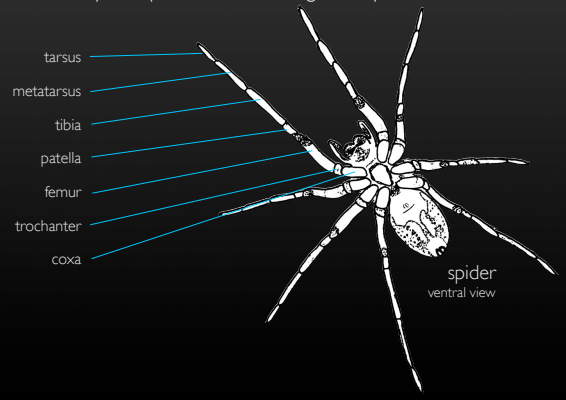
  - No antennae, compound and simple eyes (ocelli), chemosensory organs
  - Six pairs of limbs: 1st 2 are mouthparts: chelicerae and pedipalps
  - Next four are walking limbs (i.e. spiders have eight legs)
  - book gills or book lungs are respiratory structures
  - Some species have tracheal system as well or exclusively

- CLASS MEROSTOMATA (HORSESHOE CRABS)
  - Marine with book gills, chelicerae manipulate food, pedipalps not well-defined
  - Telson modified into long spike
  - Antibiotic blood
- CLASS ARACHNIDA (SCORPIONS, SPIDERS, TICKS, AND MITES)
  - ORDER SCORPIONIDA (scorpions)
    - Book lungs, chelicerae tear up food, pedipalps modified into pincers
    - Pre-abdomen and post abdomen (tail)
    - Pectines (belly combs) - mechano and chemo reception
      - females use this structure to pick up sperm packet for reproduction
    - Telson is modified as stinger (bulb = vesicle, barb = aculus), contains neurotoxic venom

Scorpion anatomy

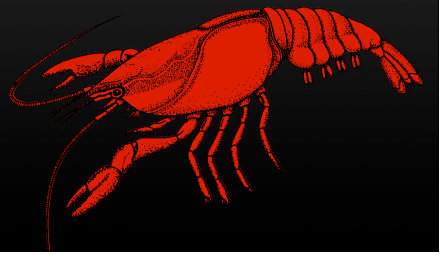


- ORDER ARANEAE (spiders)
  - Book lungs with tracheal system as well
  - Chelicerae with "fangs" (cheliceral teeth), pedipalps used in reproduction (males – bulbous, females – small and straight)
  - Spinnerets produce webs (very strong substances, modified for many uses)
- ORDER ACARI (ticks and mites)
  - No lungs, just tracheal system, parasitic with sucking mouthparts

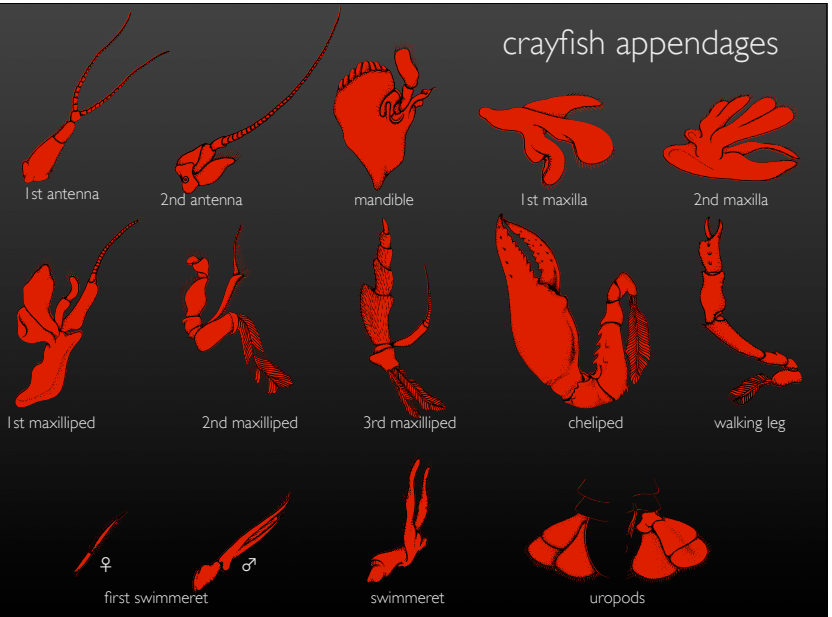


CRUSTACEANS

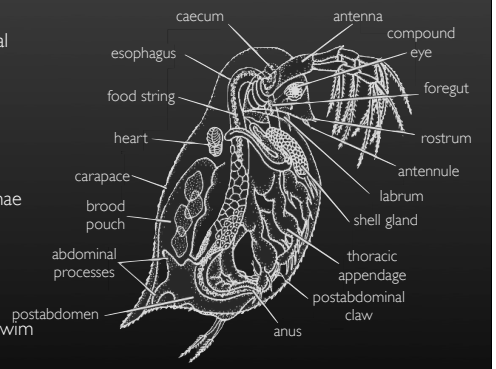
- **PHYLUM ARTHROPODA - SUBPHYLUM CRUSTACEA**
  - Mostly aquatic, some terrestrial
  - 3 body regions – head, thorax, and abdomen
  - Stalked compound eyes
  - Biramous limbs – outer part=exopodite, inner part=endopodite, used to walk, swim, feed, fight, respire, clean gills, etc.
  - branchiostegite gills - derived from appendages
  - Two antennae
  - tough chitinous exoskeleton with calcium carbonate
  - Mandibles, maxillae, and maxillipeds



crayfish appendages

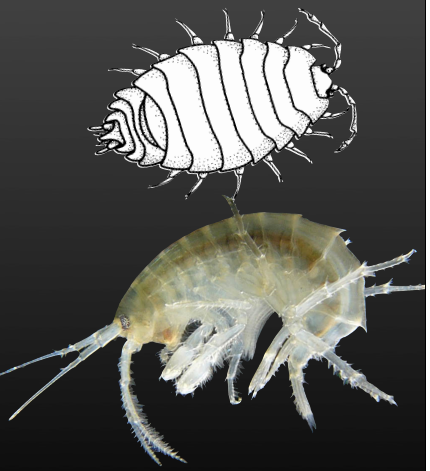


- CLASS BRANCHIOPODA
  - Filter feeders, planktonic
  - ORDER ANOSTRACA
    - Fairy shrimp, no abdominal limbs
    - Carapace like a shell
    - Nauplius larval stage
  - ORDER CLADOCERA (DAPHNIA)
    - Bivalve, 2nd pair of antennae used for swimming
- CLASS OSTRACODA (OSTRACODS)
  - Bivalve, benthic animals
  - Use 1st pair of antennae to swim



- CLASS MAXILLOPODA
  - ORDER COPEPODA (COPEPODS)
    - Dorsally flattened
    - Use 1st pair of antennae to swim
    - most species retain nauplius eye – single, median simple eye
  - ORDER CIRRIPEDIA (BARNACLES)
    - Sessile, shell made totally of calcium carbonate
    - Planktonic larvae
    - Filter feeders

- CLASS MALACOSTRACA
  - ORDER ISOPODA
    - Isopods (rolly pollies), terrestrial crustaceans
  - ORDER AMPHIPODA
    - Some terrestrial, most aquatic
    - Have ancestral 19 segments with 19 pairs of limbs
    - No larval stage, brood eggs
  - ORDER DECAPODA (LOBSTERS, SHRIMP, CRAYFISH, CRABS)
    - Many larval stages
    - Chelipeds (pincers) – even in shrimp – Boxing shrimp that kills with chelipeds
    - Variable levels of tagmatization



MYRIAPODS

- **SUBPHYLUM MYRIAPODA**
  - CLASS CHILOPODA (CENTIPEDES)
    - Relatively untagmatized, 1 pair of limbs and spiracles per segment, simple eyes (some with compound eyes, some with no eyes)
    - Maxillipeds modified into fangs to inject venom (1st pair of limbs)
    - Secrete waste in form of ammonia, body is made of head capsule and trunk regions
    - Flattened when compared to millipedes, very successful predators
  - CLASS DIPLOPODA (MILLIPEDES)
    - Diplosomatic
      - Each segment now has 2 pairs of limbs and spiracles
    - Simples eyes, detritivores, excrete ammonia, exoskeleton has $CaCO_3$ like crustaceans

HEXAPODS

- **SUBPHYLUM HEXAPODA**
  - General characteristics of arthropods, plus:
    - unbranched limbs (uniramous)
    - distinct head
      - 1 pair of antennae
      - 1 pair of mandibles
      - 1 or 2 pairs of maxillae (2nd pair fused to form labium)
    - breathe via spiracles / tracheal system (some have "air pumps" in wing musculature)
    - malphigian tubules to excrete uric acid (conserves water)
  - CLASS INSECTA (HEXAPODA)
    - Body divided into head, thorax, and abdomen (3 tagmata)
    - Thorax: 3 segments: 1st- pronotum with no wings, 2nd – mesonotum with 1 pair of wings, 3rd – metanotum with 2nd pair of wings
    - Wings can be highly modified in different species (grasshopper, beetle, fly)
    - 3 pairs of walking limbs
    - Abdomen has 11 segments ancestrally (no limbs on abdomen)

- Types of metamorphosis stages:
  - Hemimetabolous – gradual metamorphosis from larval to adult body forms
  - Holometabolous – major changes in larval forms: larvae-pupae-adult (seen in butterflies, bees, etc.)
  - ametabolous -- no metamorphosis (silverfish, ear wigs, etc.)