

Subphylum Crustacean

Chapter 20

NEW CRUSTACEAN SPECIES FROM THE PHILIPPINES



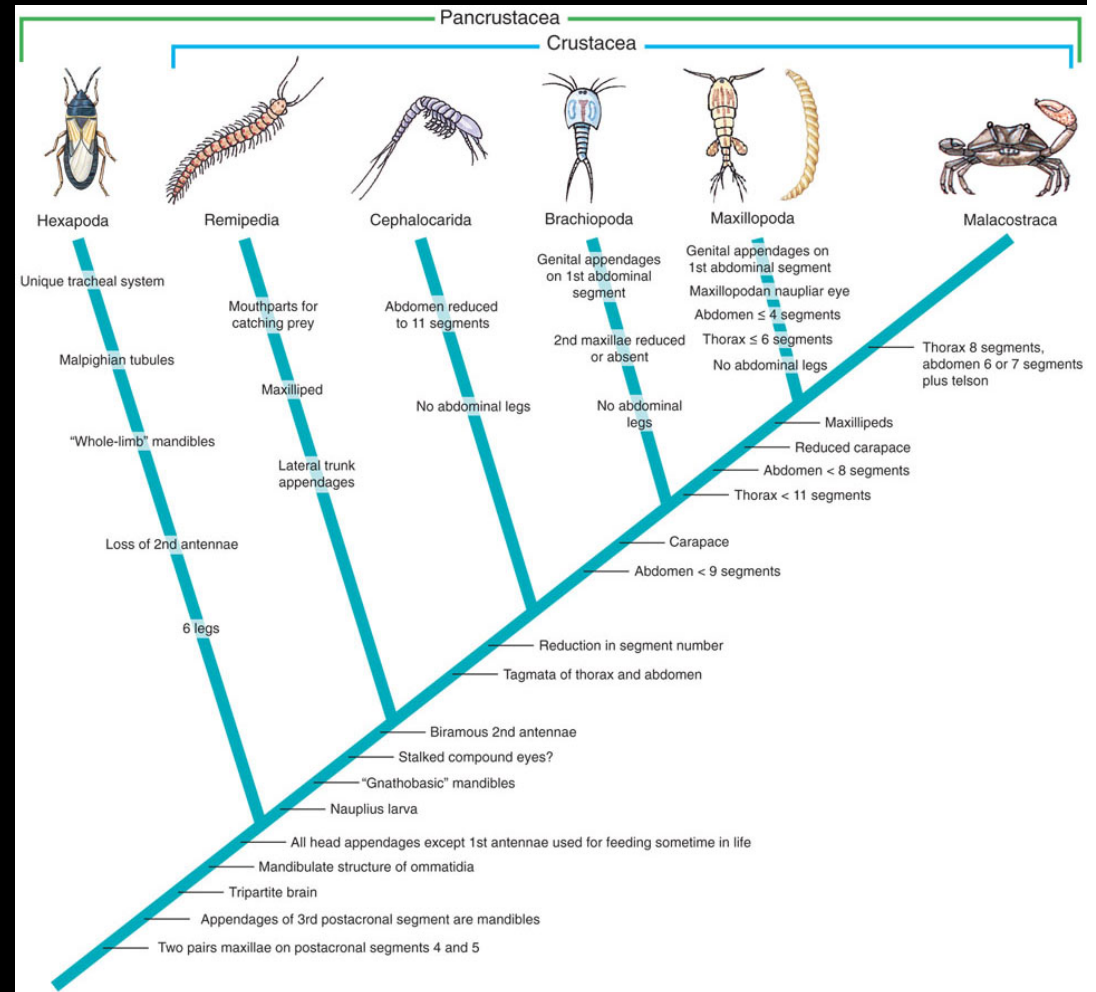
Subphylum Crustacea

- Crustaceans, **are mainly marine, with many freshwater, and a few terrestrial species**



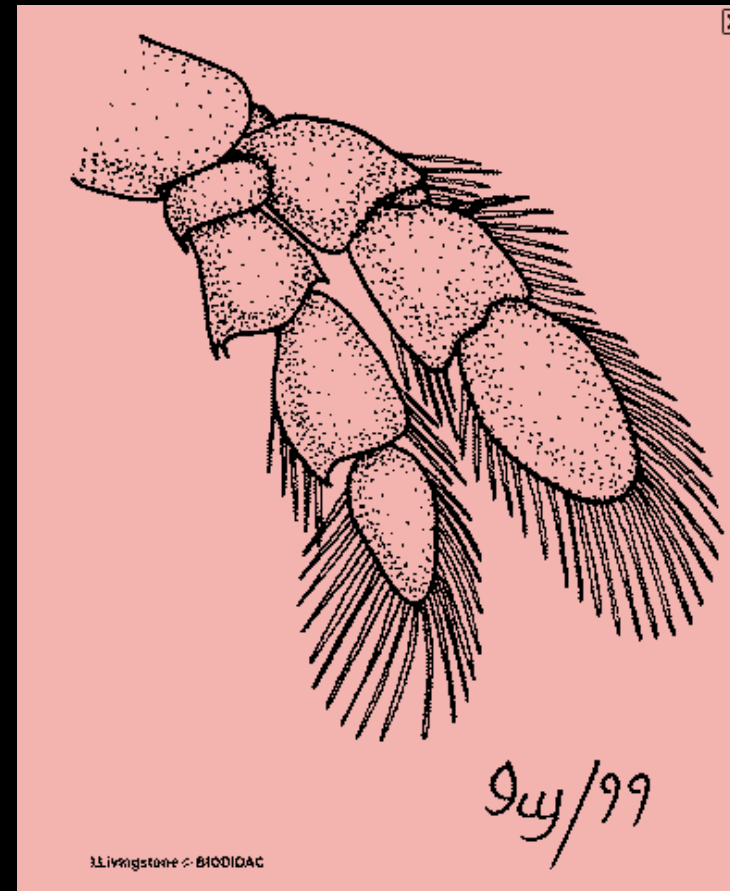
Subphylum Crustacea

- Crustacea is divided into 5 classes.
 - Current molecular phylogenies do not support the monophyly of all classes.



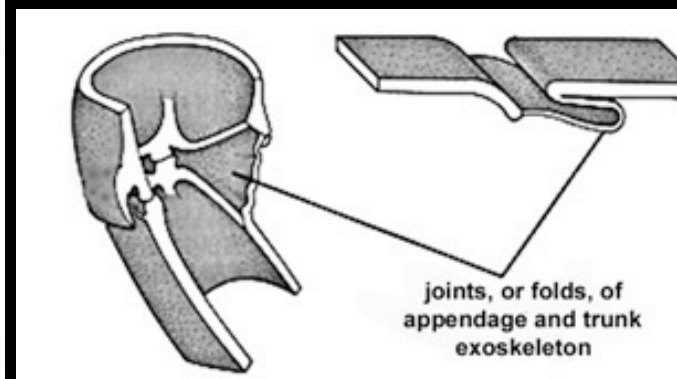
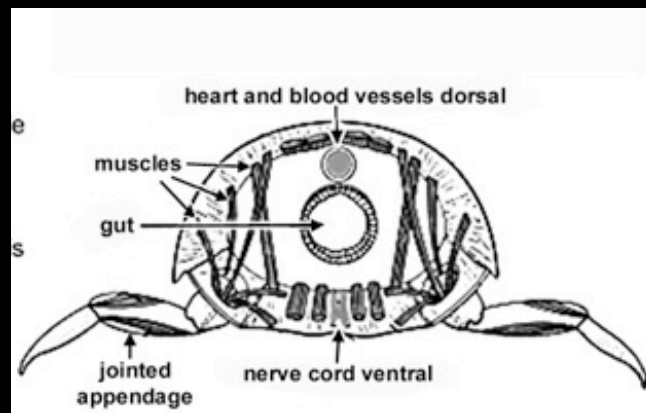
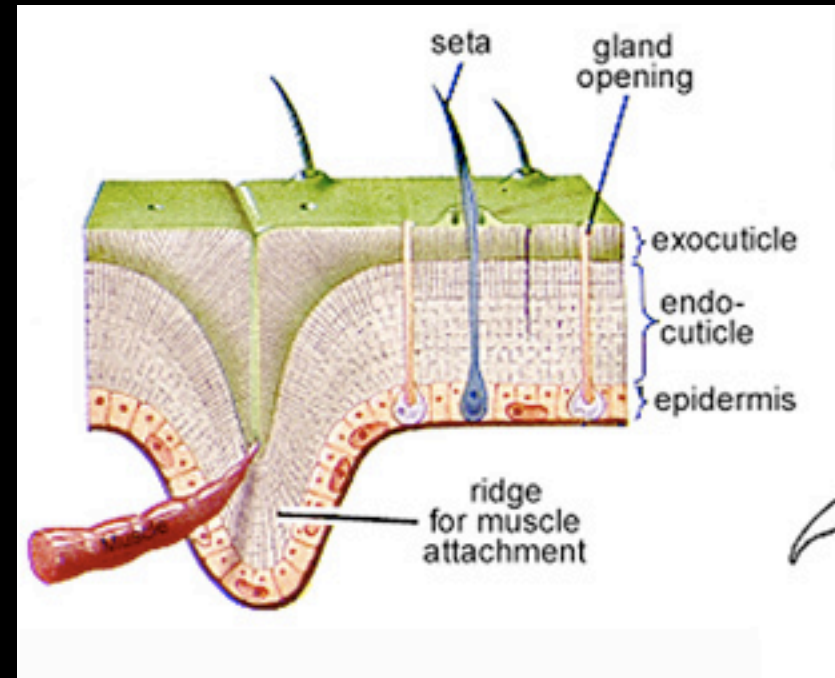
Characteristics

- Crustaceans, typically have **biramous**, branched, appendages that are extensively specialized for feeding and locomotion.



Characteristics

- Secreted cuticle is made of chitin, protein, and calcareous material.
- Heavy plates have more calcareous deposits - joints are soft and thin, allowing flexibility.



Characteristics

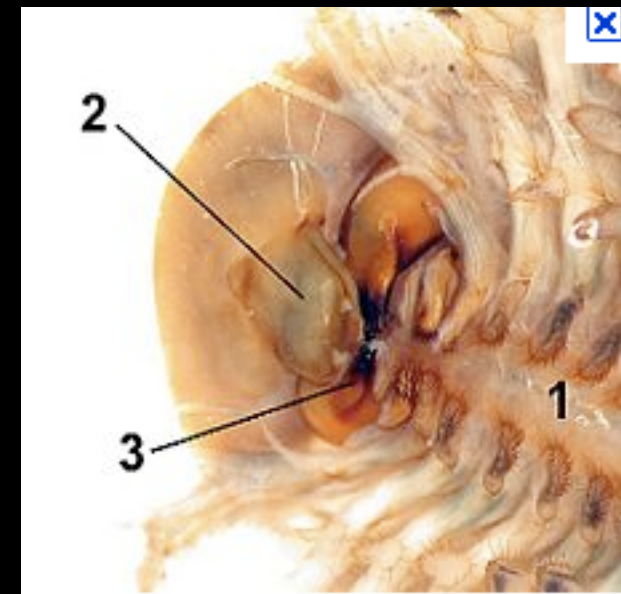
- **Telson** is not a somite - bears anus.
- The telson last segment has the uropods which form a tail for reverse movements and to protect eggs and young



Uropodos

Characteritics

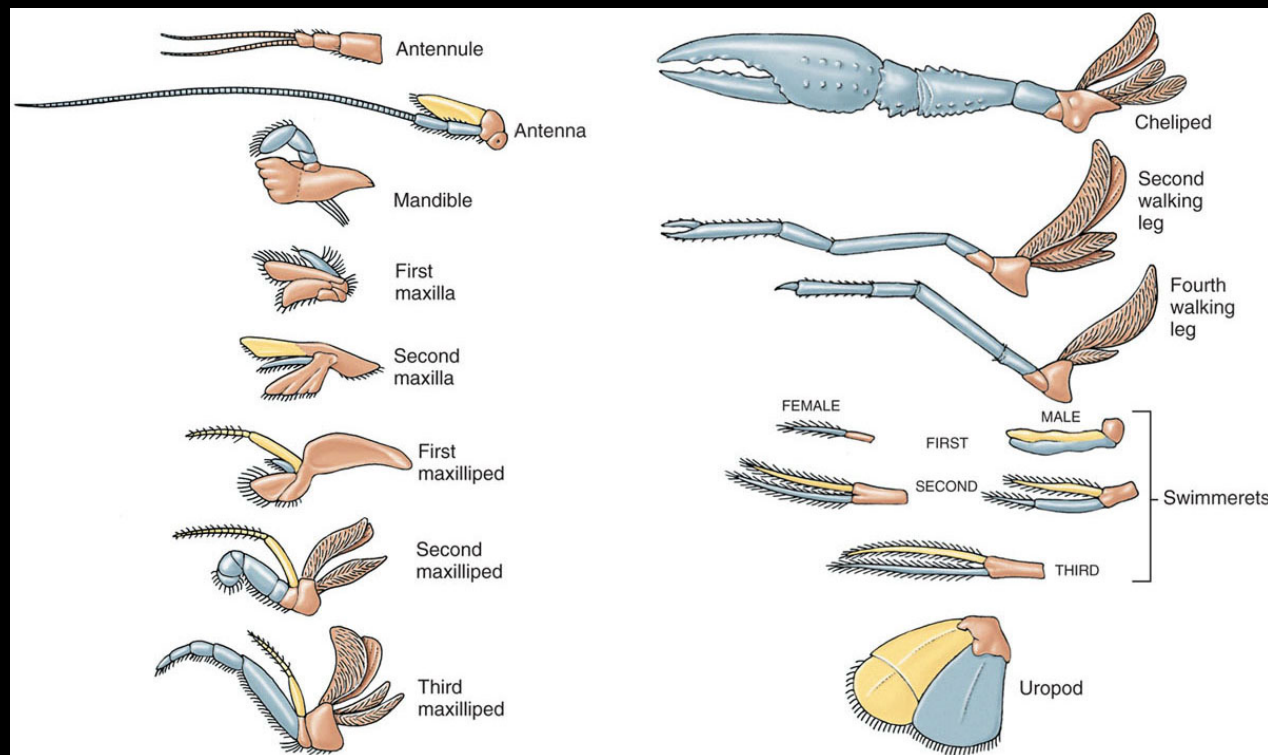
- Crustaceans are the only arthropods that have **two pairs of antennae**.
- They also have a pair of **mandibles** (jaw-like appendages) and two pairs of **maxillae** on the head.



2: labrum, 3: mandibles

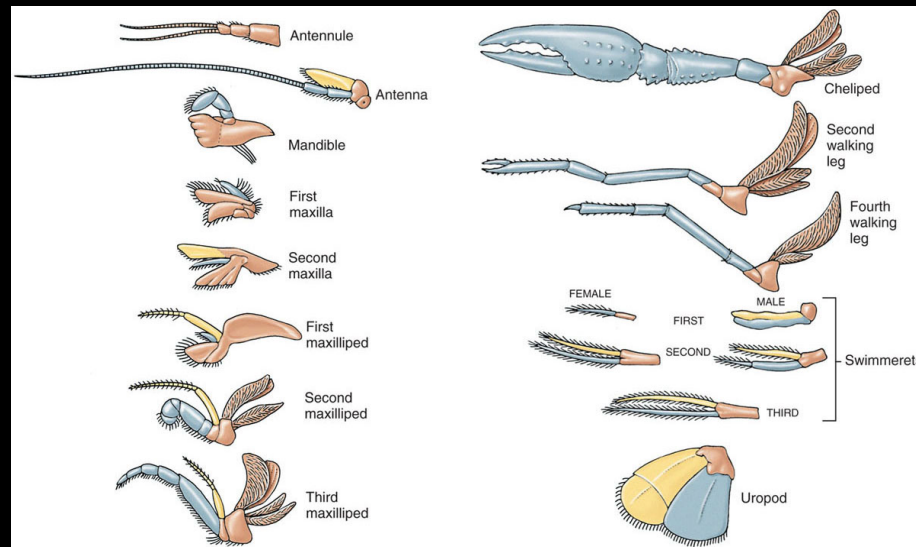
Appendages

- Appendages have become specialized by evolving into a wide variety of walking legs, mouthparts, swimmerets, etc. from modification of the basic biramous appendage.



Appendages

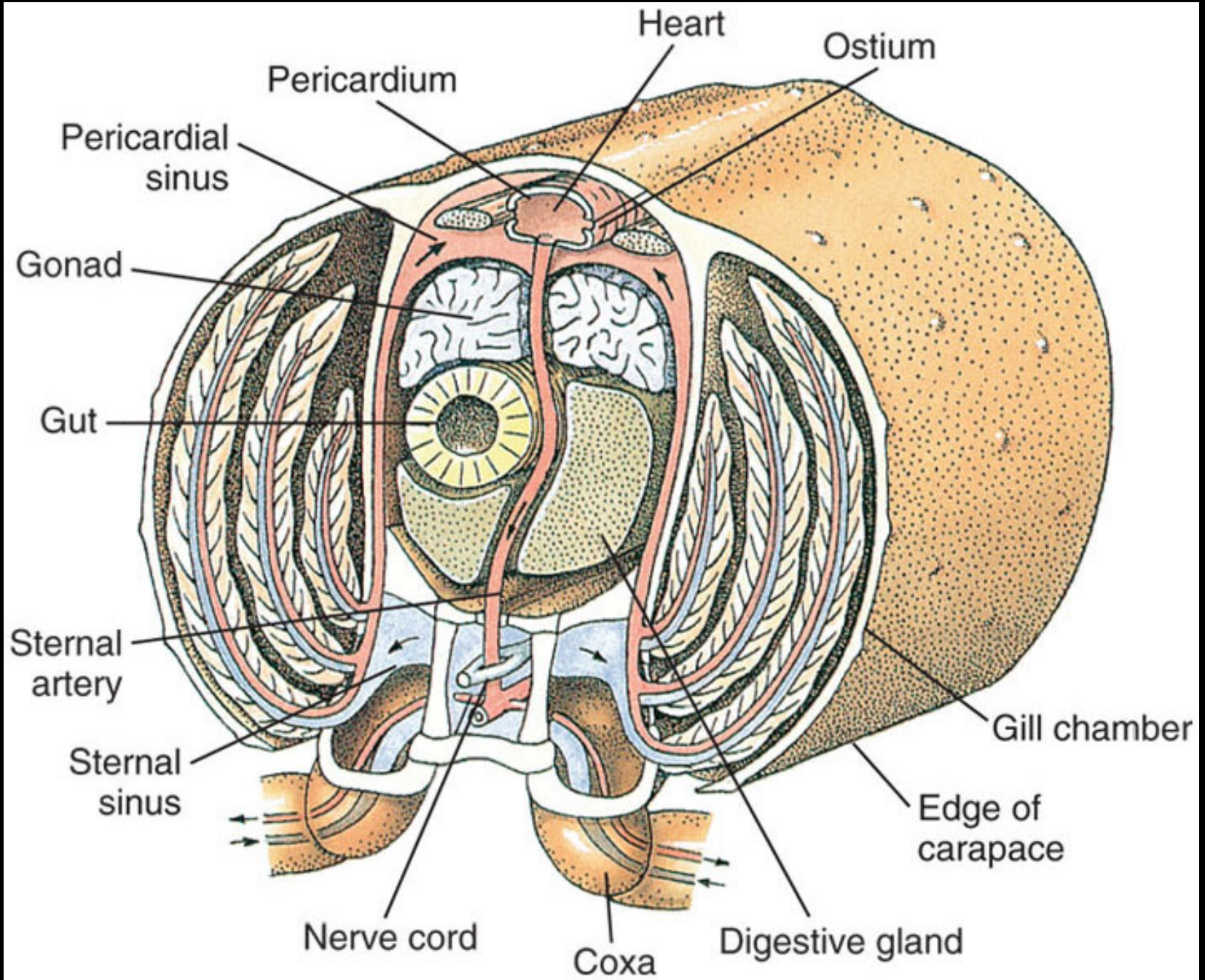
- Since all these appendages have evolved from a common biramous appendage they are all homologous to each other a condition called- **serial homology**



Circulation

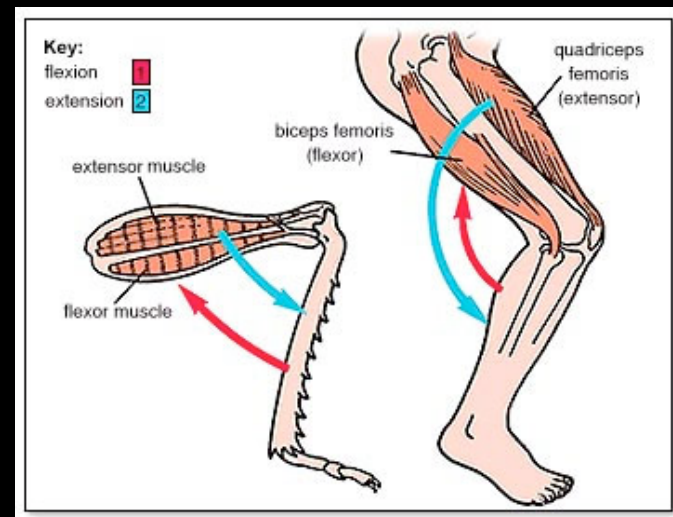
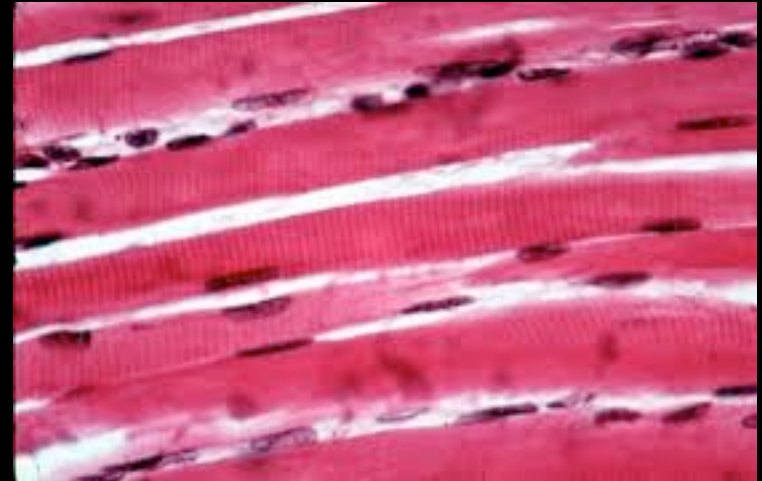
- **Hemocoel** - persistent blastocoel that becomes filled with blood.
 - Open circulatory system
 - No veins, the heart pumps blood to body tissues through arteries
 - Arteries empty into tissue sinuses
 - Returning blood enters sternal sinus, then go through gills for gas exchange, then back to pericardial sinus

Hemolymph may be colorless, **reddish**, or **bluish**. **Hemocyanin (blue)** and/or **hemoglobin (red)** are respiratory pigments. Contains ameboid cells that may help prevent clotting.



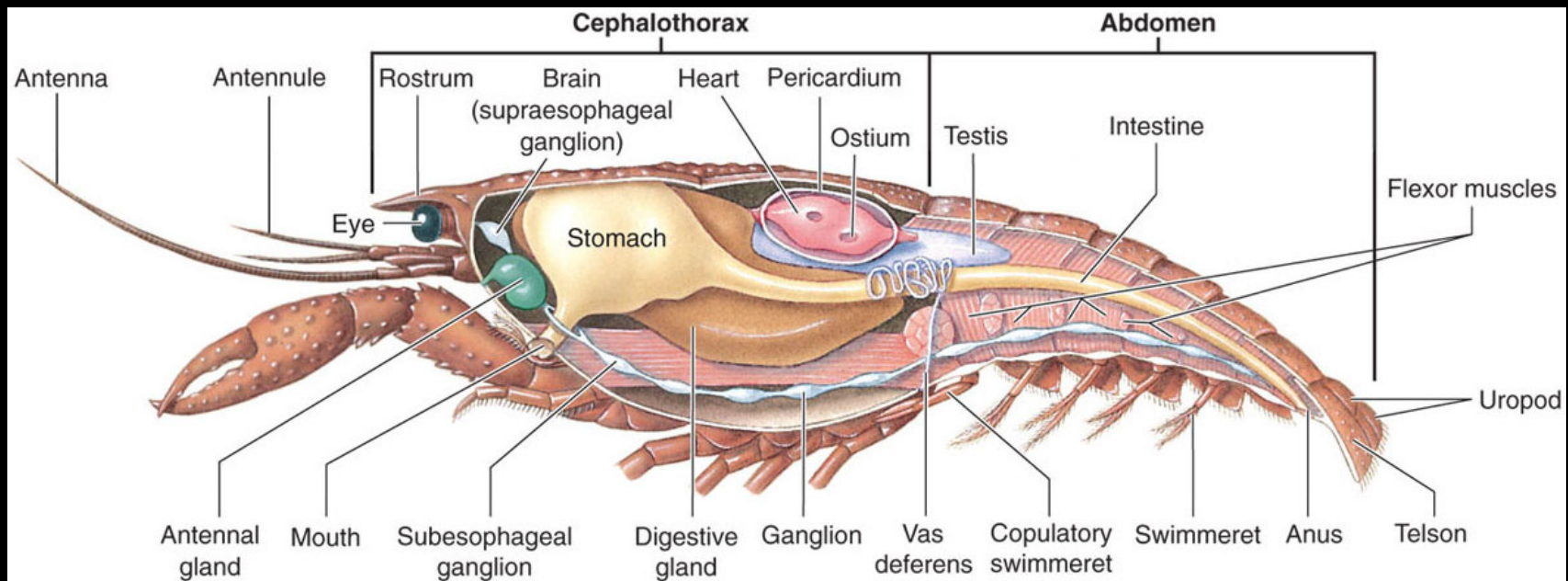
Muscular System

- **Striated muscles** make up a major portion of crustacean body.
- Most muscles arranged as antagonistic groups.
 - Flexors draw a limb toward the body and extensors straighten a limb out.



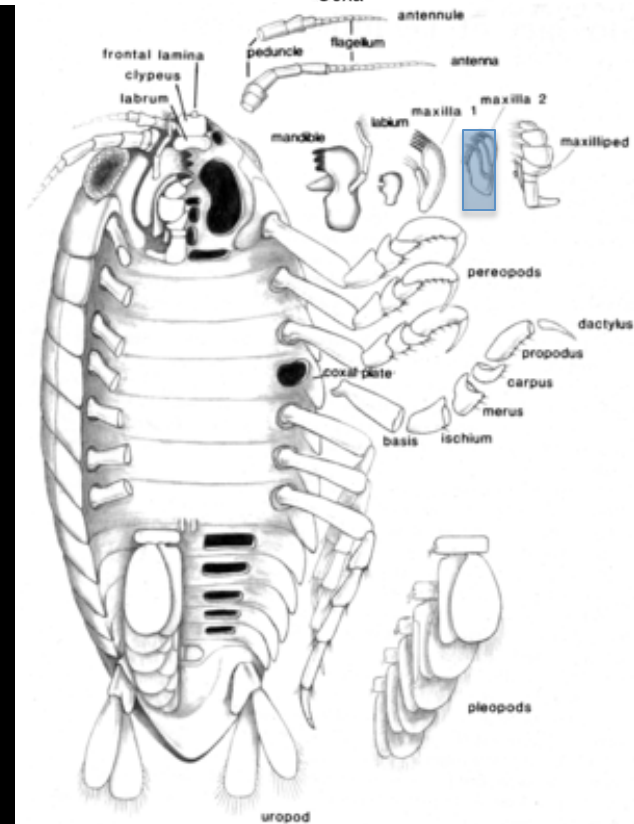
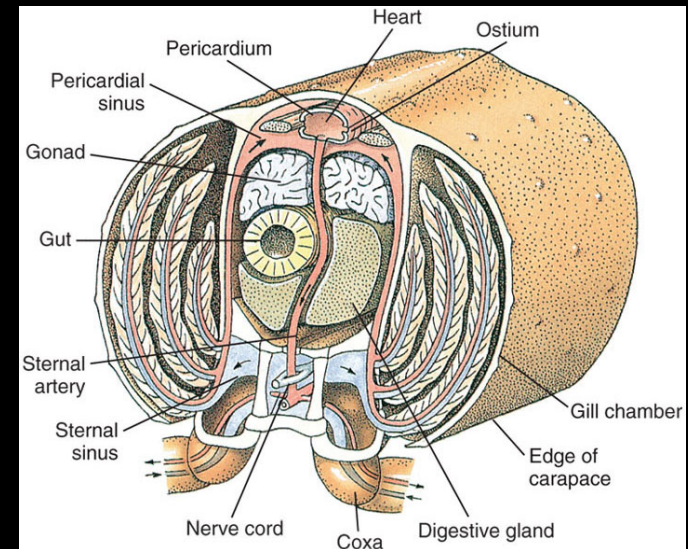
Muscular System

- Abdominal flexors of a crayfish allow it to swim backward.
- Strong muscles located on each side of stomach control the mandibles.



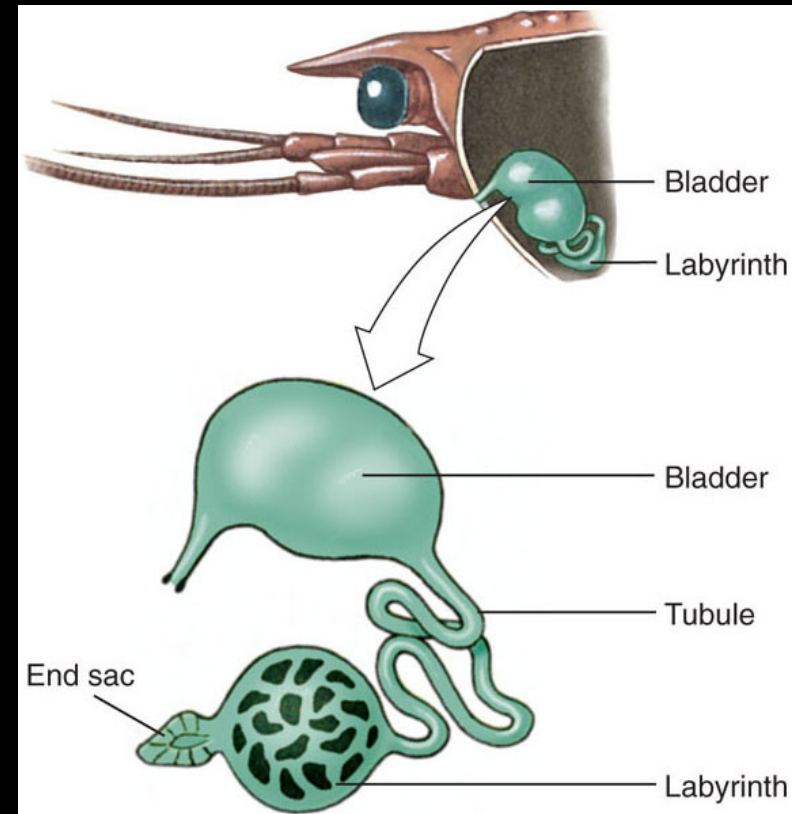
Respiratory System

- Smaller crustaceans may exchange gases across thinner areas of cuticle.
-
- Larger crustaceans use featherlike gills for gas exchange.
- 2nd maxilla draws water over gill filaments.



Excretory System

- **Antennal or maxillary glands** are called **green glands** in decapods.
- End sac of antennal gland has a small vesicle and a spongy labyrinth.
- **Labyrinth connects by an excretory tubule to dorsal bladder that opens to exterior pore.**
- Resorption of salts and amino acids occurs as the filtrate passes the excretory tubule and bladder.
 - **Mainly regulates the ionic and osmotic composition of body fluids.**

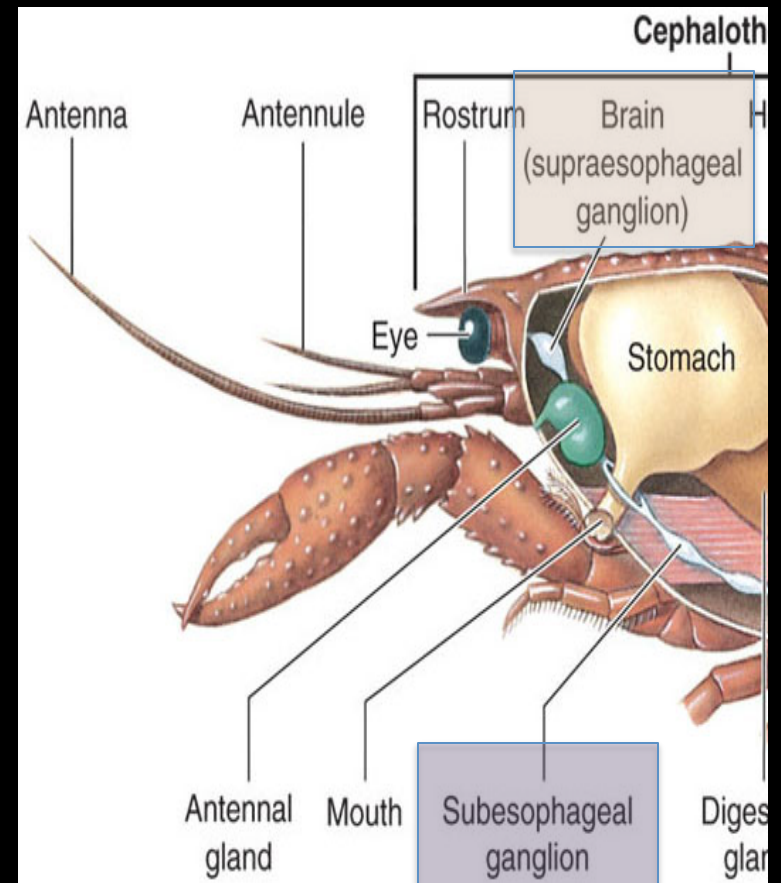


Excretory System

- Nitrogenous wastes are excreted across thin areas of cuticle in the gills.
- Freshwater crustaceans constantly threatened by over-dilution with water.
 - Gills must actively absorb Na^+ and Cl^- .
- Marine crustaceans have urine that is isosmotic with the hemolymph.

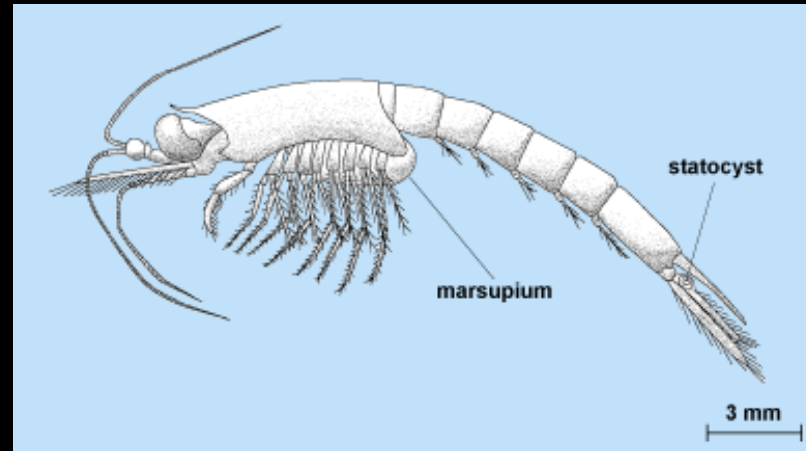
Nervous System

- Pair of **supra-esophageal ganglia** connects to eyes and two pairs of antennae.
- Neuron connectives join this brain to the **subesophageal ganglion**.
 - Supplies nerves to mouth, appendages, esophagus, and antennal glands.
- Double ventral nerve cord has a pair of ganglia for each somite to control appendages



Sensory System

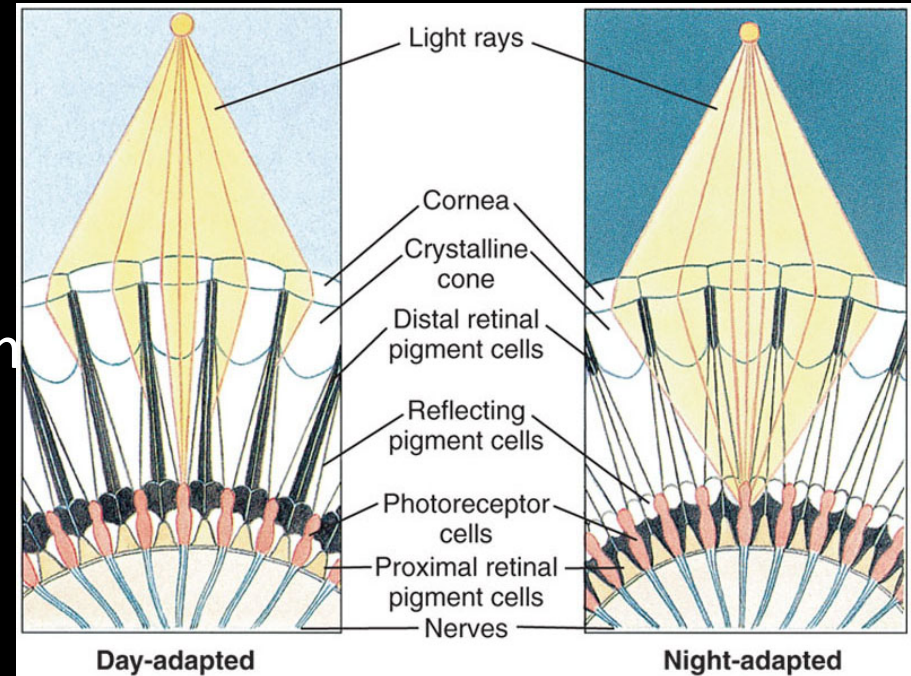
- Eyes and statocysts are the largest sensory organs.
 - **Statocyst** opens at base of first antenna in crayfish. In others are at the back end of the body



- Tactile hairs occur on the body, especially on chelae, mouthparts and telson.
- Chemical sensing of taste and smell occurs in hairs on antennae and mouth.

Sensory System

- **Compound eyes** are made of many units called **ommatidia**.
- Cornea focuses light down the columnar ommatidium.
- Distal retinal, proximal retinal, and reflecting pigment cells form a sleeve around each ommatidium.
- Each ommatidium detects a restricted area of objects, a mosaic, in bright light.
- In dim light, the distal and proximal pigments separate and produce a continuous image.



<http://www.youtube.com/watch?v=TU6bgQnTi18&feature=related>

Diversity of Reproduction

- Most have sex separate and have various specializations for copulation.
- Barnacles (Order Cirripedia) are monoecious but generally cross-fertilize.
- In some ostracods and copepods, males are scarce and reproduction is by **parthenogenesis**.



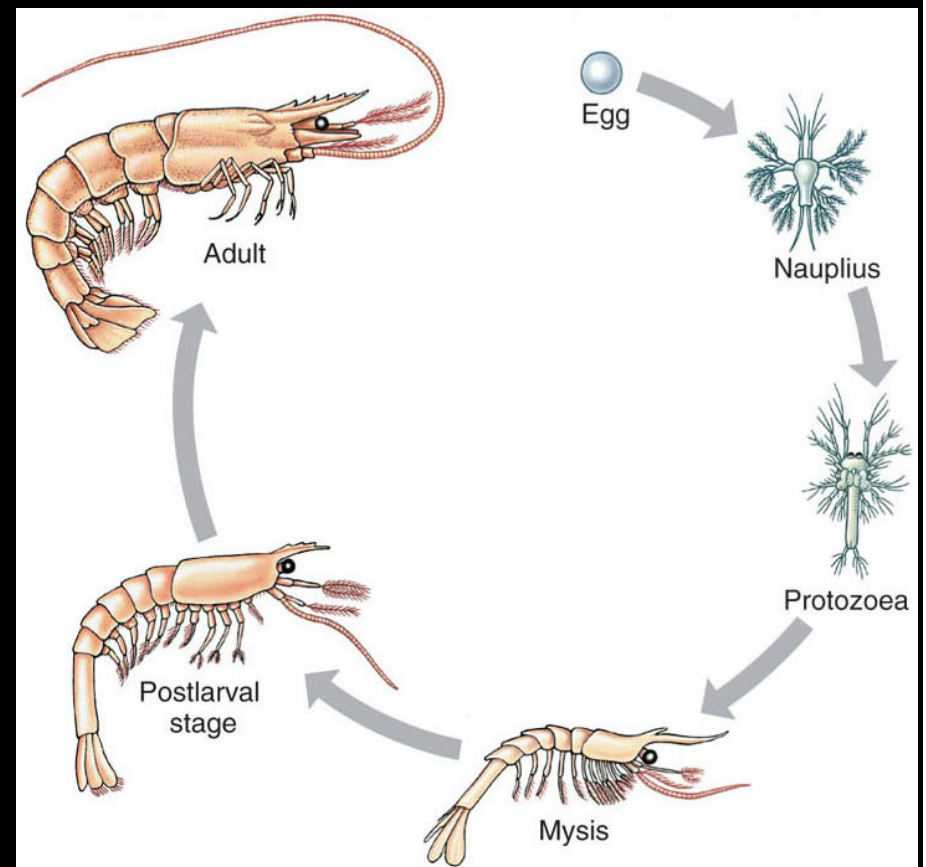
Diversity of Reproduction

- Most crustaceans brood eggs in **brood chambers**, in brood sacs attached to the abdomen, or attached to abdominal appendages.



Diversity of Reproduction

- Crayfish has direct development without larval stages
- Development is indirect for most crustaceans have a larva unlike the adult in form, and undergo **metamorphosis**.
 - Nauplius larvae



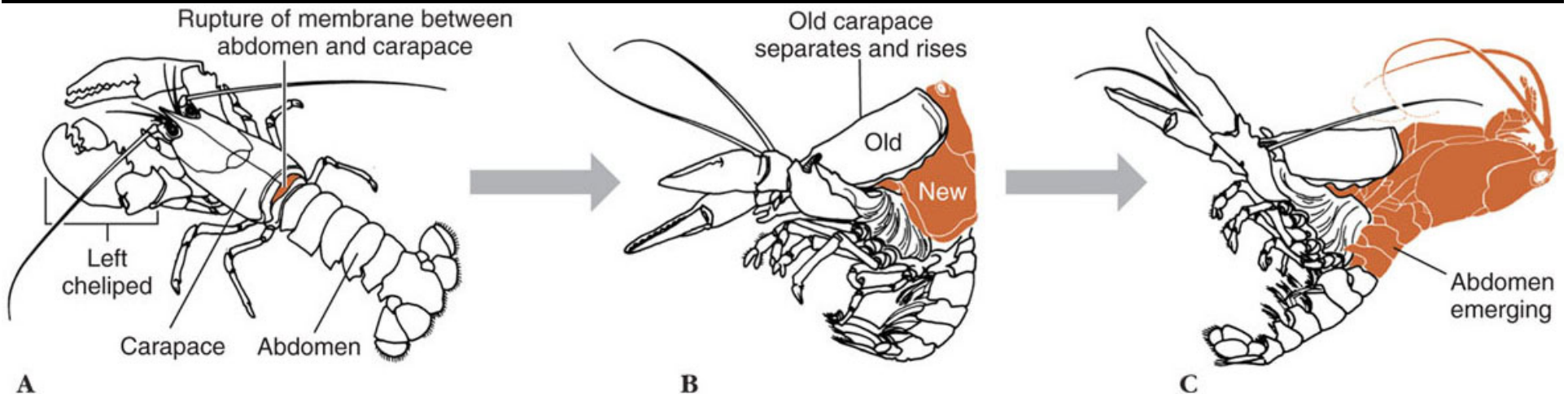
Diversity of Reproduction

- The **nauplius** is a common larval form with uniramous first antennae, and biramous second antennae and mandibles that all aid in swimming.
 - Appendages and somites are added in a series of molts.



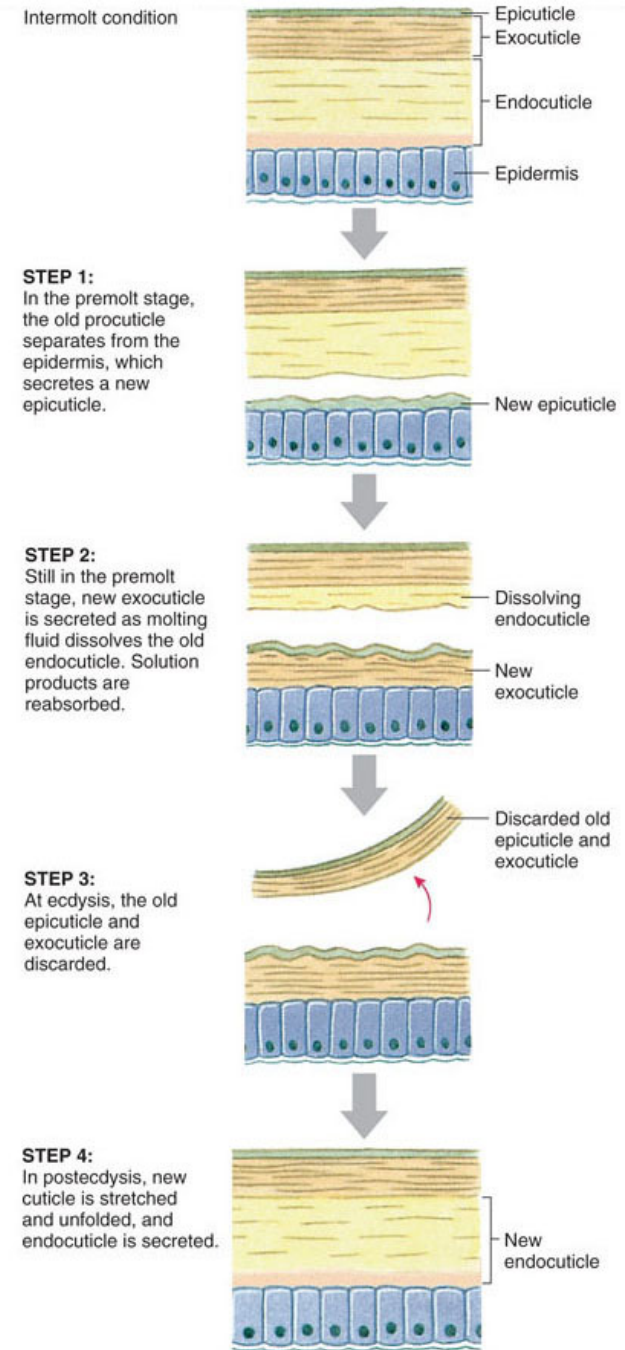
Ecdysis

- Molting animals grow in the **intermolt phases, or instars**.
- Soft tissue increases in size until there is no space within the cuticle.
- **When body fills the cuticle, animal is in the premolt phase.**
- Molting occurs often in young animals and may cease in adults.



Ecdysis

- **Ecdysis** is necessary for a crustacean to increase in size – the exoskeleton does not grow.
- Physiology of molting affects reproduction, behavior, and many metabolic processes.
- Underlying epidermis secretes cuticle.



Ecdysis

- Hormonal Control of Ecdysis:
 - Temperature, day length, or other stimuli trigger central nervous system to begin ecdysis.
 - Central nervous system decreases production of molt-inhibiting hormone by the X-organ.
 - Promotes release of molting hormone from the Y-organs which promotes ecdysis.

Feeding Habits

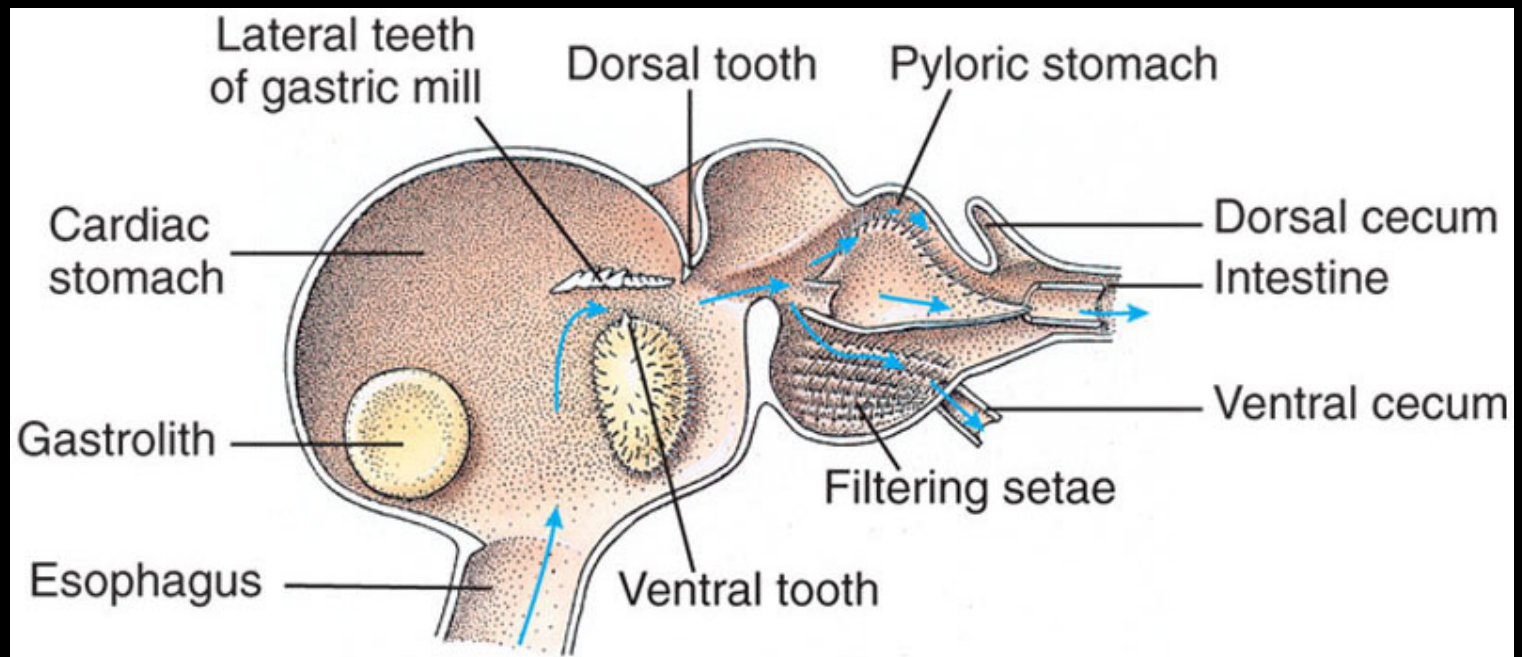
- Same fundamental mouthparts in various crustaceans are adapted to a wide array of feeding habits.
 - Suspension feeders generate water currents in order to feed on plankton, detritus, and bacteria.
 - Predators consume larvae, worms, crustaceans, snails, and fishes.
 - Scavengers eat dead animal and plant matter.



Carnivore crab

Feeding Habits

- Crayfishes have a two-part stomach.
 - The cardiac stomach contains the gastric mill (little teeth) grinds up food and stores it. The pyloric produces most of the digestive enzymes



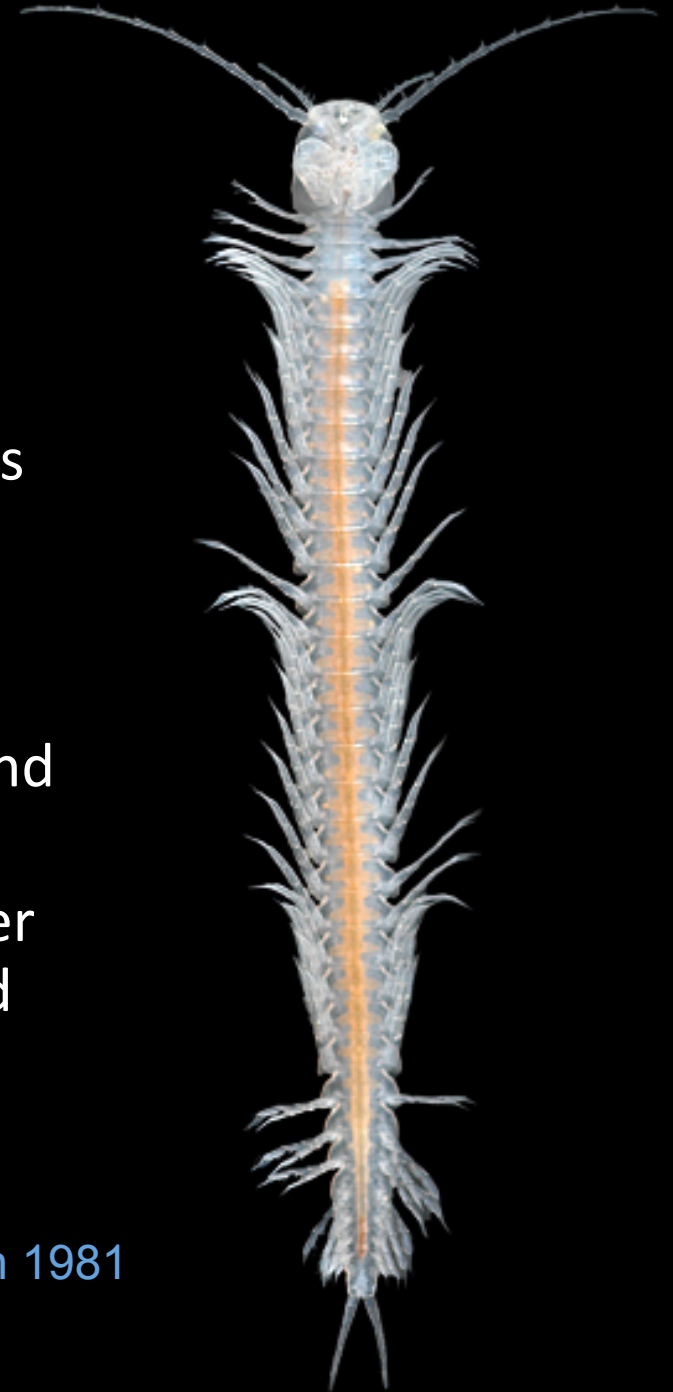
Cool and strange crustaceans!



Class Remipedia

- Only 10 described species
- All found in caves connected to the sea.
- Primitive features include 25–38 segments with similar, paired, biramous, swimming appendages.
- Antennules also biramous.
- Maxillae and maxillipeds are prehensile and specialized for feeding.
- Swimming legs are directed laterally rather than ventrally as is found in copepods and cephalocarids.

Remipedes were first discovered in 1981 and are still poorly understood.



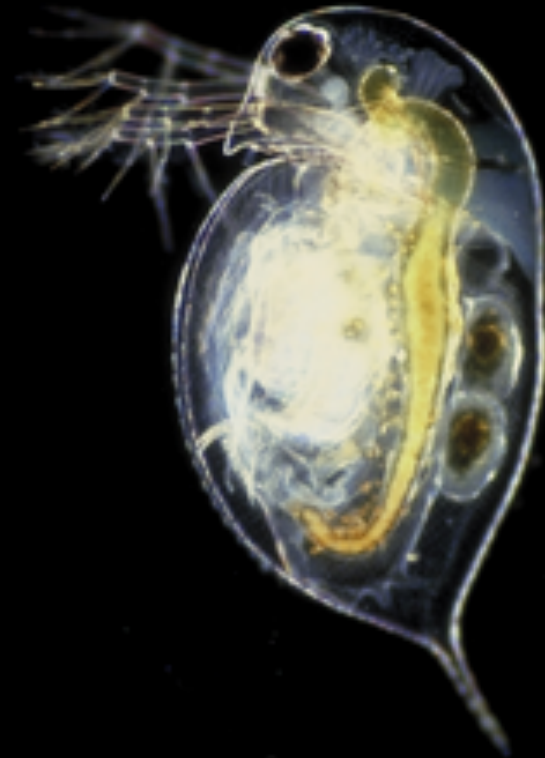
Class Cephalocarida

- Only 9 species described in
- Live in coastal bottom sediments from intertidal zones to 300 meters depth.
- Thoracic limbs and 2nd maxillae are very similar.
- Lack eyes, a carapace, and abdominal appendages.
- True hermaphrodites and unique in discharging eggs and sperm through same duct.



Class Branchiopoda

- Includes the fairy shrimps and *water fleas*
- Water fleas (like *Daphnia*) produce females parthenogenetically in summer.
- Males are produced when unfavorable conditions arise and overwintering fertilized eggs are produced that are resistant to cold and desiccation.



Order Cladocera

Class Maxillopoda

- Include ostracods, copepods, barnacles
- The **nauplius** of maxillopods has a **maxillopodan eye** – unique to this group.



Class Maxillopoda

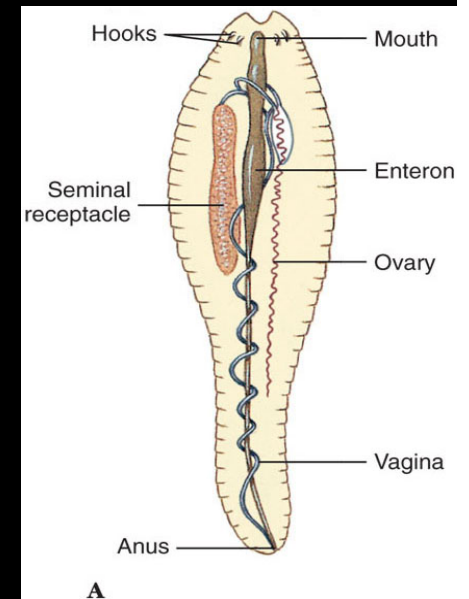
- Members of the subclass Branchiura lack gills.
- Most are ectoparasites of marine and freshwater fish.
- 5–10 mm long.
- Development is direct.



Nope is not an alien!

Class Maxillopoda

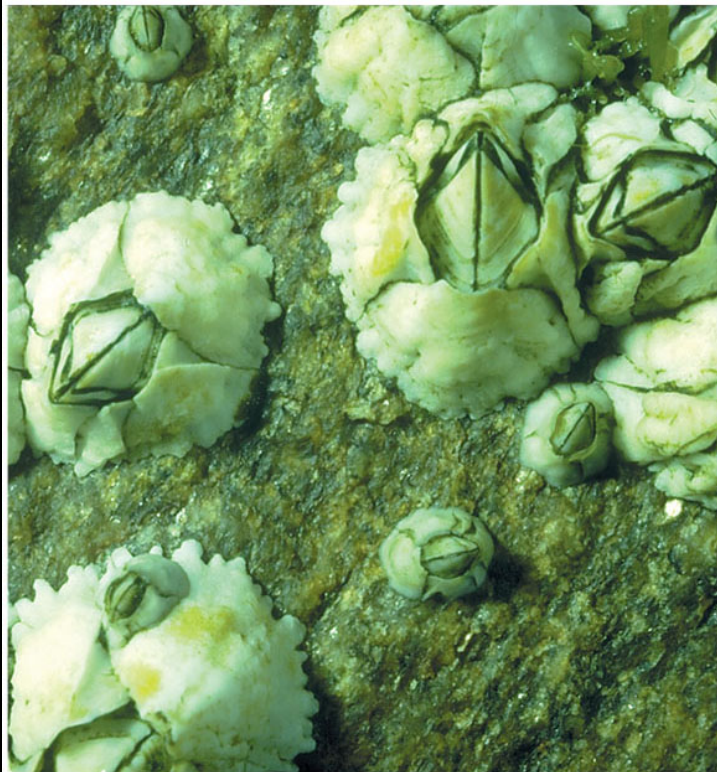
- Subclass Pentastomida - tongue worms.
- Consist of about 90 species of parasites of vertebrate respiratory systems.
 - Most infect reptile lungs, a few infect air sacs of birds or mammals.
- Range from 1 to 13 cm in length.
- Chitinous cuticle regularly molted.



Yeap this is a crustacean!

Class Maxillopoda – Subclass Cirripedia

- **Barnacles** – **subclass cirripedia** – are a group of mostly sessile crustaceans whose cuticle is hardened into a shell.



A



B

A: © William C. Ober, B: © R. Harbo

Class Malacostraca

- Largest and most diverse class of Crustacea with over 20,000 species.
- Contains three subclasses, 14 orders, and many suborders.

Lobsters, crabs, crayfish, shrimps, etc



Class Malacostraca – Order Isopoda

- **Order Isopoda** – including pill bugs.
 - Only truly terrestrial crustaceans.
 - Also have marine and freshwater forms.
 - Dorsoventrally flattened, lack a carapace, and have sessile compound eyes.
 - Compressed dorsoventrally.



Larry S. Roberts

Class Malacostraca – Order Amphipoda

- **Order Amphipoda** – many marine, terrestrial & freshwater forms.
- Amphipods resemble isopods
- However, they are compressed laterally.
- Development is direct.



A



B



C

A: © Kjell Sandved/Visuals Unlimited; B,C: © Kjell Sandved

Class Malacostraca – Order Euphausiacea

- **Order Euphausiacea** contains approximately 90 species.
- Includes important ocean plankton called **krill**.
- Most are bioluminescent with a light-producing organ called a **photophore**.
- Form a major component of the diet of baleen whales and of many fishes.
- Eggs hatch as nauplii.



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Adaptive Diversification

- Crustaceans are unquestionably the dominant arthropod in marine environments.
- They also share dominance in freshwater environments with the insects.
- The class Malacostraca is most diverse