



# Arthropods & Echinoderms

# Introduction to the Arthropods

- Phylum Arthropoda : *arthron* means joint:  
*poda* means foot (jointed foot)
- Insects, crabs, centipedes & spiders
- Have a segmented body, a tough exoskeleton and jointed appendages
- Number of segments vary among arthropods

- **Exoskeleton**- tough external covering
  - like suit of armor to protect the body
  - Made from protein and a carbohydrate called **chitin**
  - Varies among the arthropods

- All arthropods have jointed appendages-structures such as legs and antennae that extend from the body

# Evolution of Arthropods

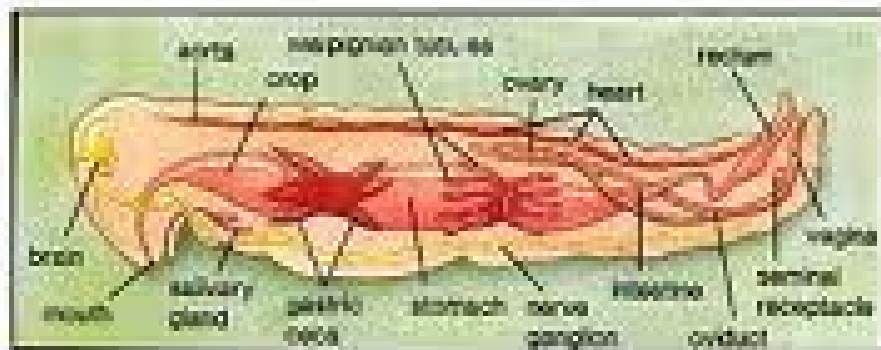
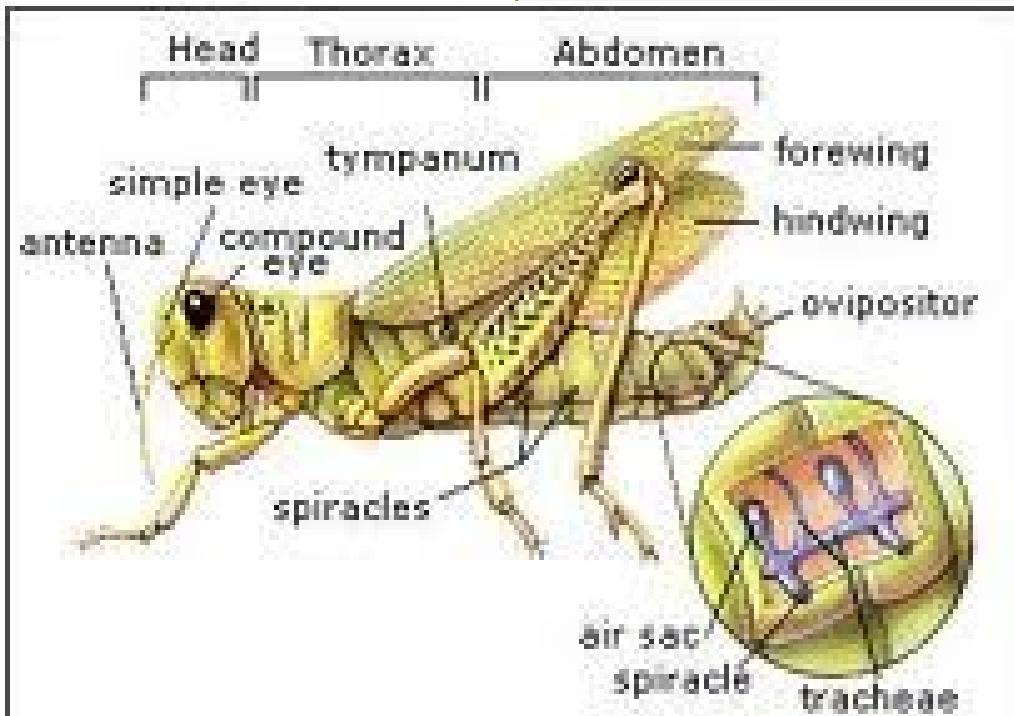
- First arthropods seen in ocean more than 600 million yrs ago
  - Have moved to all areas of sea, freshwater, land and air
- Evolution of arthropods led to fewer segments, highly specialized appendages for feeding, movement

# Feeding

- Varies greatly:
  - Herbivores, carnivores, omnivores
  - Bloodsuckers, filter feeders, detritivores, parasites
- Mouthparts range from pincers or fangs to sickle-shaped jaws

# Respiration

- Aquatic arthropods breath with gills
- Most terrestrial arthropods breath with a network of branching **tracheal tubes** that extend throughout body
- Air enters and leaves through **spiracles** which are small openings located along the side of the body



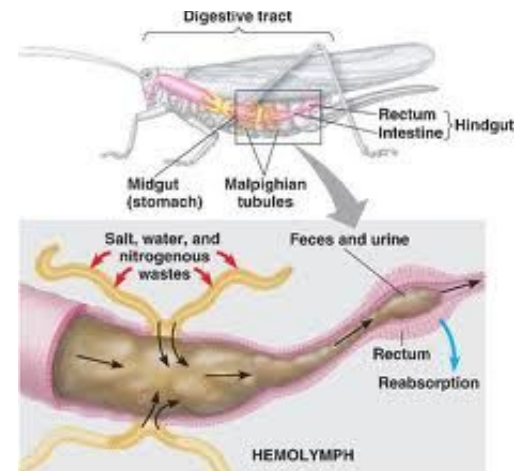


# Circulation

- Open circulatory system
  - Well-developed heart pumps blood through arteries that branch and enter tissues
  - Blood leaves vessels & moves through sinuses
  - Then blood collects in large sinus surrounding the heart where it re-enters the heart and is pumped through body again

# Excretion

- Dispose of nitrogenous wastes using **Malpighian tubules**
- Saclike organs that extract wastes from blood and add them to feces that move through gut

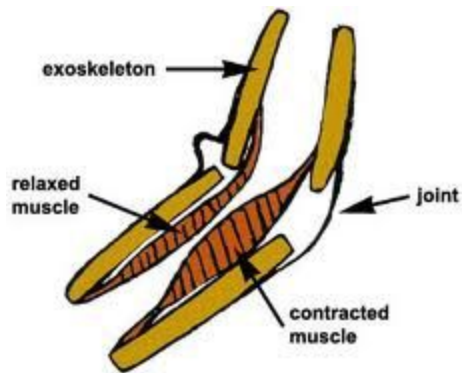


# Response

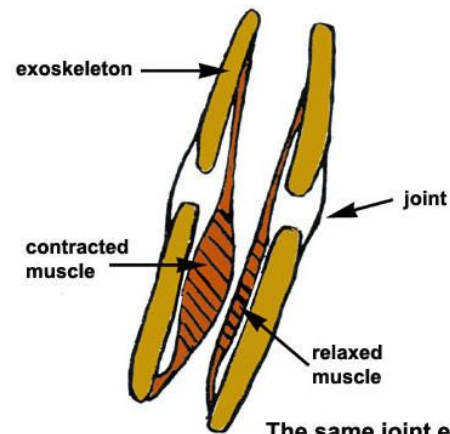
- Most have well-developed nervous system
- All have a brain
- Brain coordinates movements
- Have sophisticated sense organs (eyes, taste receptors)

# Movement

- Use well-developed groups of muscles that are coordinated by nervous system
- Muscles flex or extend the joint



A flexed arthropod joint



The same joint extended

# Reproduction

- Terrestrial arthropods have internal fertilization
- Aquatic arthropods have internal or external fertilization

# Growth and Development

- Exoskeleton does not grow with the animal
  - Arthropods will molt or shed its entire exoskeleton and produce a new one to take its place
  - Skin glands digest inner part of exoskeleton & other glands secrete a new skeleton
  - When new exoskeleton is ready, the animals pulls out of original skeleton



Photo: Mark Berman 1987  
BUGMAN Educational Enterprises  
<http://www.bugs.org>

# Groups of Arthropods

- Classified based on number and structure of their body segments and appendages- particularly their mouthparts

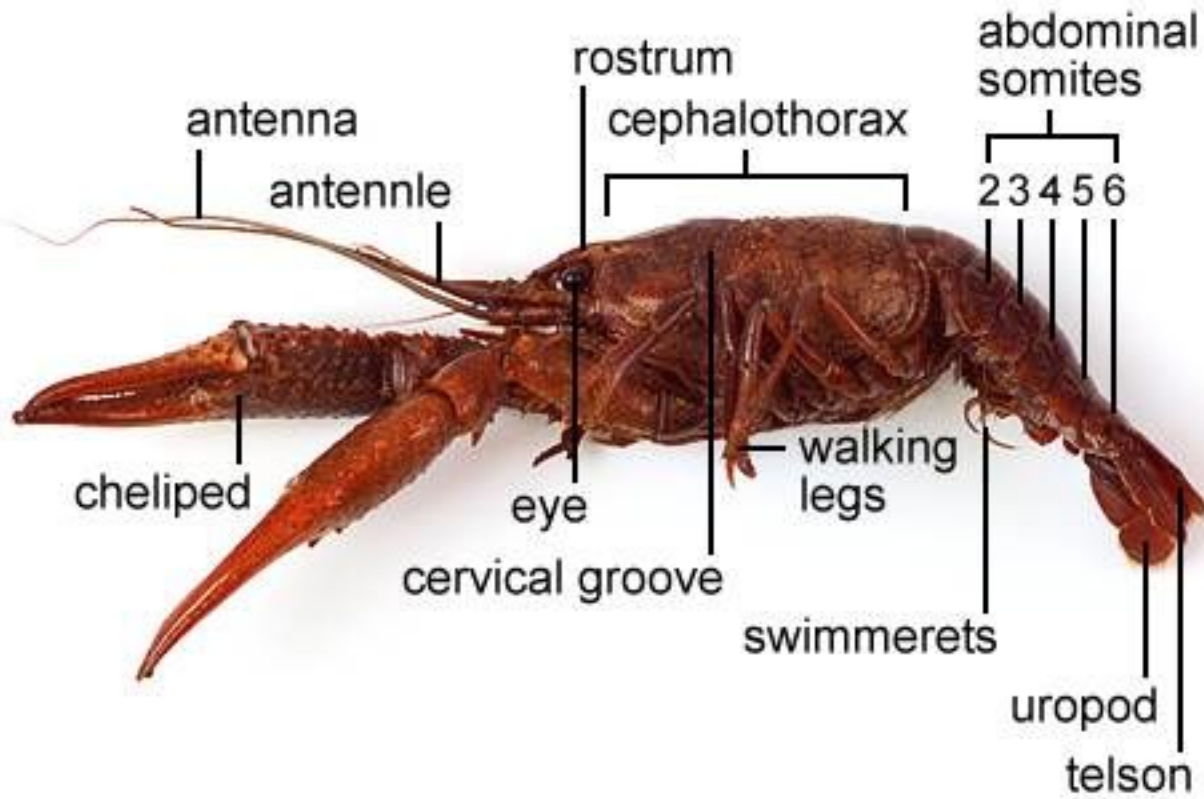


# Crustaceans

- Primarily aquatic
- 2 pairs of branched antennae
- 2 or 3 body segments
- Chewing mouthparts called **mandibles**  
(mouthpart adapted for biting & grinding food)

- Crayfish have 2 sections: abdomen and cephalothorax
- **Cephalothorax:** fusion of head and thorax The carapace is part of exoskeleton that covers the cephalothorax
- Abdomen: posterior of body

## Crayfish - Side View



- Crustacean appendages vary in form and function
  - Antennae: first 2 pairs; have many sensory hairs
  - 3<sup>rd</sup> pair of appendages are the mandibles

- Decapods are the largest group of crustaceans
  - Include the crayfish, lobsters, crabs
  - Have 5 pairs of legs:
    - 1<sup>st</sup> pair have large claws to catch, crush and cut food called **chelipeds**
    - 2<sup>nd</sup>-5<sup>th</sup> pair are walking legs
    - Along the abdomen there are **swimmerets** used for swimming
    - Tail used to move animal backward

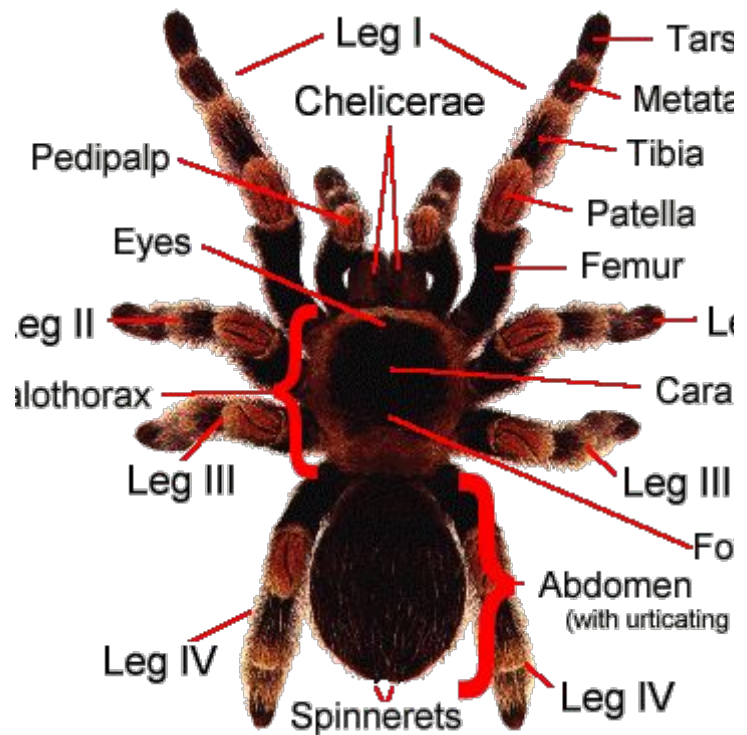
- Barnacles are also crustaceans
  - Sessile
  - No abdominal segment
  - Do not use mandibles
  - Use appendages to capture and bring food particles into mouth



# Class Chelicerata

- Include: spiders, horseshoe crabs, ticks, scorpions, mites
- Have mouthparts called **chelicerae**
- 2 body sections
- Four pairs of walking legs

- Chelicerate Appendages
  - **Chelicerae**- 1<sup>st</sup> pair of append; contain fangs; used to stab & paralyze prey
  - **Pedipalps**- longer than chelicerae; used to grab prey





- Horseshoe Crabs (Family Xiphosura)
  - Breathe with book gills
  - Are chelicerates, not actual crabs
  - Long tail used for movement

- Family Arachnids
  - Include spiders, ticks, mites, scorpions

- Spiders

- Capture prey either by spinning web and catching it in web; pouncing on it as do tarantulas; or lie in wait and grab insects who come nearby
- Must liquefy food to swallow it
  - The chelicerae inject poison into prey to paralyze it
  - Inject digestive enzymes to break down prey's tissues
- Have **spinnerets**, organs that contain silk glands



- Mites & Ticks

- Small arachnids that are usually parasitic
- Chelicerae are specialized for digging into tissue and sucking out blood or fluids
- Can carry disease

- Scorpions
  - Arachnids with pedipalps enlarged into claws
  - Live in warm areas around the world
  - Abdomen has stinger that can kill or paralyze prey
  - Chew prey with chelicerae



# Uniramians

- Includes insects, centipedes, millipedes
- Includes more species than all other groups of animals
- Have jaws, one pair of antennae & unbranched appendages



- Centipedes

- Have a few to more than 100 pairs of legs, depending on the species
- Most body segment has one pair of legs
- Carnivores
- Live beneath rocks or in soil
- Do not have waterproof covering
- Live in humid areas

- Millipedes

- Each segment has 2 pairs of legs!
- Detritivores
- Are timid, unlike centipedes



# Insects

- What is an insect?
  - Has body divided into 3 parts: head, thorax, abdomen
  - Has 3 pairs of legs (6 total) attached to thorax

- Most insects also have:
  - Pair of antennae
  - Pair of compound eyes
  - Two pairs of wings attached to thorax
  - Tracheal tubes for respiration

- Response to Stimuli
  - Compound eyes- many lenses
  - Chemical receptors for taste & smell on their mouthparts and also on antennae & legs



- Adaptations for Feeding

- 3 pairs of appendages used as mouthparts, including mandibles (see Fig 28-16)
- Many insects use saliva to break down food (it contains digestive enzymes)

**Insect mouthparts**

sucking



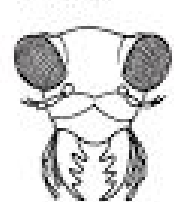
butterfly  
(side view)

lapping

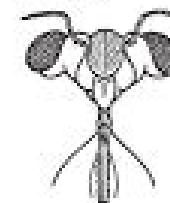


bee  
(front view)

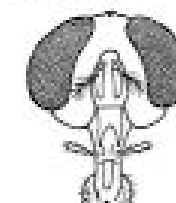
chewing



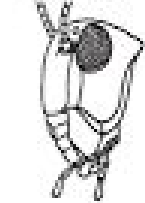
beetle  
(front view)



cicada  
(front view)



housefly  
(front view)



grasshopper  
(side view)



- Movement & Flight

- 3 pairs of legs

- Walk, jump, capture or hold prey

- 2 pairs of wings made of chitin

- Some fly slowly (butterflies), some fly quickly (bees, dragonflies)

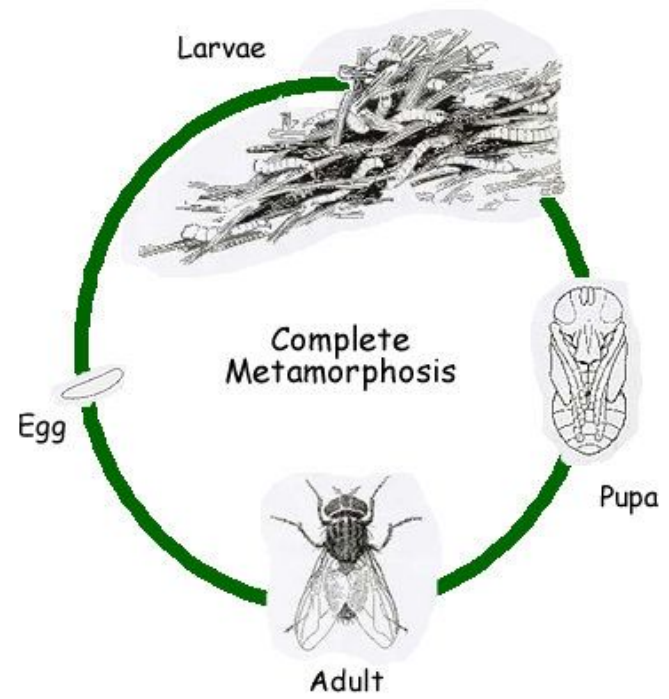
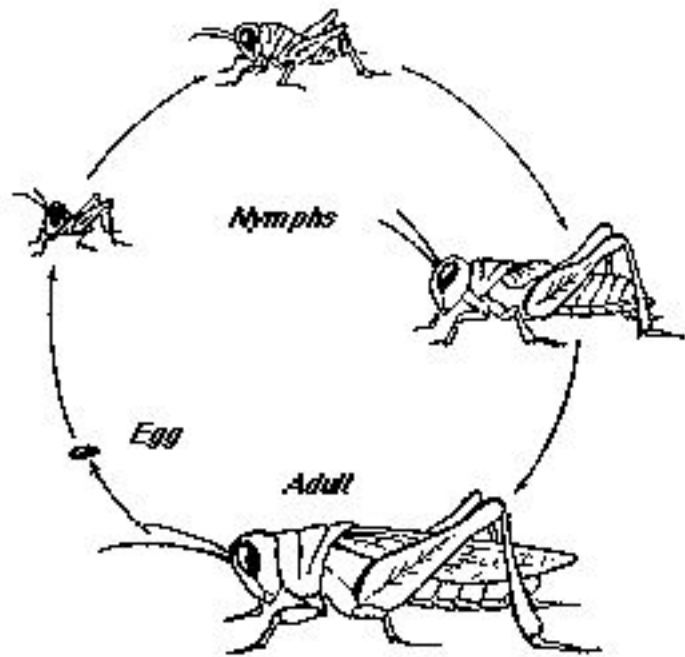
- Metamorphosis

- Process of changing shape or form

- 2 types

1. Incomplete metamorphosis- immature forms, called nymphs, look like the adult form

2. Complete metamorphosis- hatch into larvae that look nothing like parents- become pupa where becomes adult



- Insects & Humans
  - Some have negative effects
    - Termites destroy homes
    - Damage crops
    - Carry disease
  - Many are beneficial
    - Pollinate many crops
    - Silk, wax, honey
    - Delicacies in some countries



- Insect Communication
  - Sound, visual, chemical, other signals
  - Most communication is to find a mate
  - **Pheromones** are chemicals released by insects to find a mate



- Insect Societies

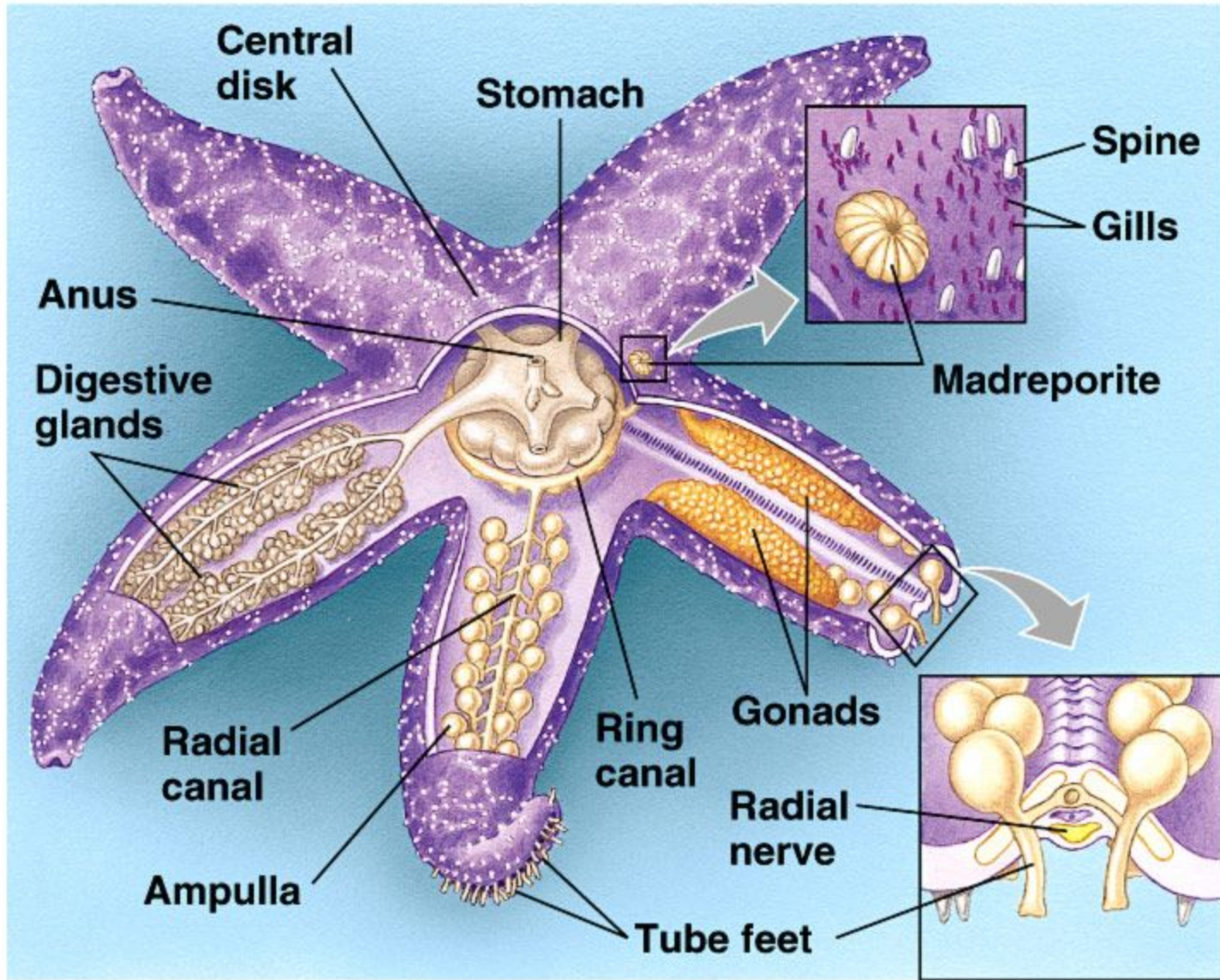
- Group of closely related animals of the same species that work together for the benefit of the whole group
- Ants, bees, termites form societies

- **Castes** are formed by individuals in a society that has a specialized role
  - body form is specialized for castes
  - Queen (lays eggs)
  - Reproductive males
  - Workers

- Communication in Societies
  - Society has its own “language”
  - Visual, touch, sound & chemical signals

# Echinoderms

- Spiny skin
- Internal skeleton called **endoskeleton**
- Water vascular system
- Tube feet
- Radial symmetry



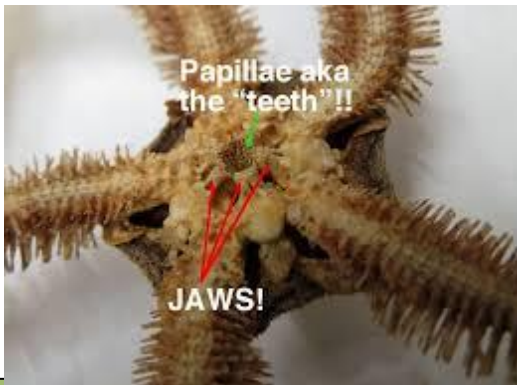
- Water vascular system- filled with fluid, carries out many essential body functions in echinoderms including respiration, circulation, movement
  - Opens to the outside through **madreporite**- sievelike structure
  - Attached to radial canal are **tube feet**



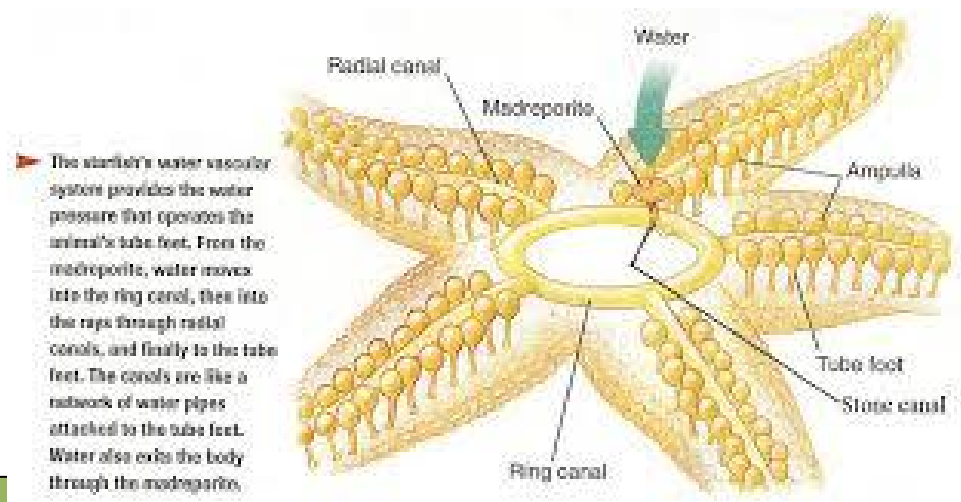




- Feeding
  - Tube feet used for feeding
  - 5-part jaw-like structures
  - Sea stars usually feed on mollusks- use feet to open shell and inject digestive enzymes and pulls prey into mouth

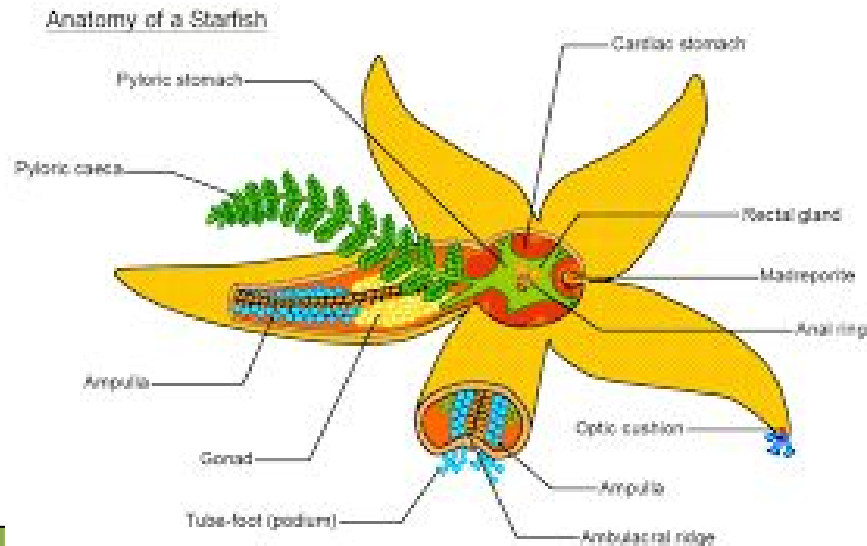


- Respiration & Circulation
  - Water vascular system carries oxygen, food and wastes
  - Thin-walled tissue on the tube feet provide main surface for respiration



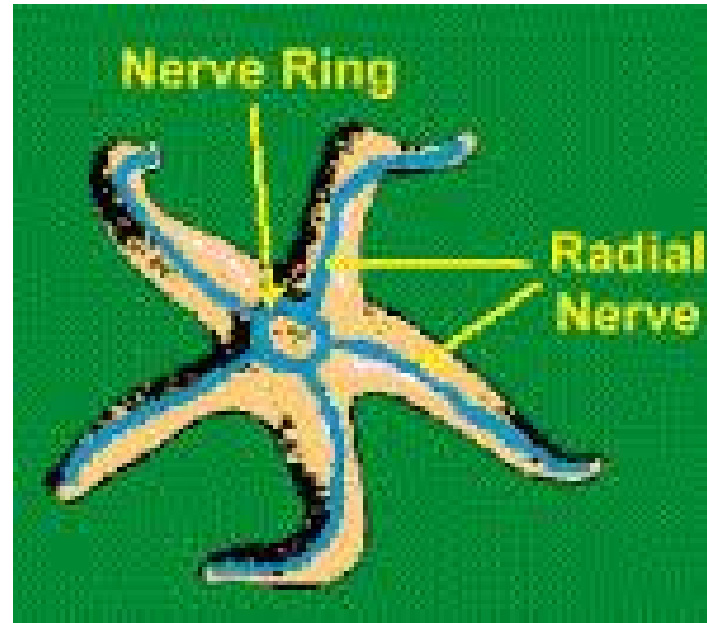
- Excretion

- Solid wastes are excreted as feces through anus
- Cellular wastes excreted through tube feet and skin gills



- Response

- Have no head----no brain
- Sensory cells to detect light, gravity and chemicals



- Movement
  - Use tube feet
  - Muscles attached to the body wall



- Reproduction
  - External fertilization

# Groups of Echinoderms

- Sea Urchins & Sand Dollars
  - Class: Echinoidea
  - Detritivores or grazers
- Brittle Stars
  - Class: Ophiuroidea
  - Slender flexible arms
- Sea cucumbers
  - Class: Holothuroidea
  - Detritus feeders





- Sea stars
  - Class: Asteroidea
  - Creep slowly on ocean floor
- Sea Lilies & Feather Stars
  - Class: Crinoidea
  - Filter feeders

