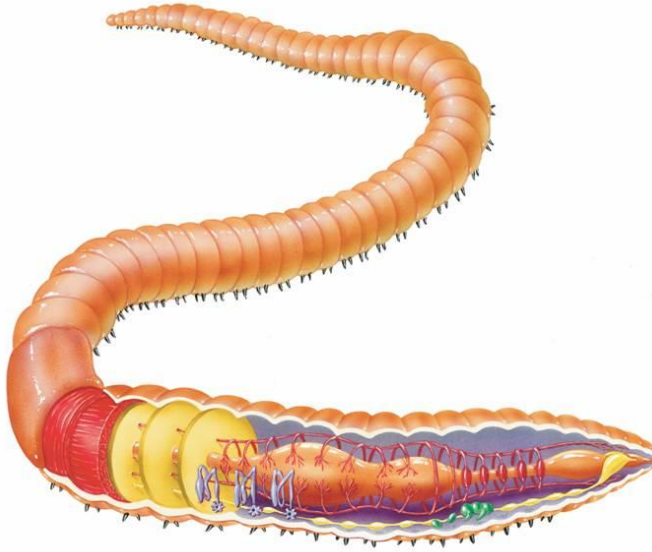


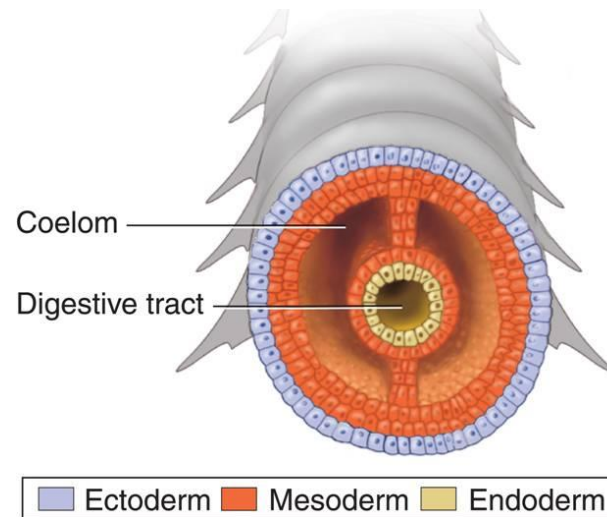
What Is an Annelid?

Phylum: Annelidae



Annelids are worms with segmented bodies. They have a true coelom that is lined with tissue derived from mesoderm.

Three Germ Layers of an Annelid



The body of an annelid is divided into segments. Each segment is separated by **septum**, which are internal walls between each segment.

Body segments may carry eyes, antennae, other sense organs, or be specialized for functions such as respiration.

Bristles called **setae** may be attached to each segment.

Annelids have a tube-within-a-tube digestive tract that food passes through from the mouth to the anus.

Form and Function in Annelids

Annelids have complex organ systems.

Many of these systems are unique because of the segmented body plan of this group.

Feeding and Digestion

In carnivorous species, the pharynx usually holds two or more sharp jaws that are used to attack prey.

Annelids that feed on decaying vegetation have a pharynx covered with sticky mucus.

Other annelids obtain nutrients by filter feeding.

In earthworms, the pharynx pumps food and soil into the esophagus.

The food then moves through the crop, where it can be stored.

It then moves through the **gizzard**, where it is ground into smaller pieces.

The food is absorbed farther along in the digestive tract in the intestine.

Circulation

- Annelids typically have a closed circulatory system, in which blood is contained within a network of blood vessels.

Blood in the dorsal (top) vessel moves toward the head of the worm.

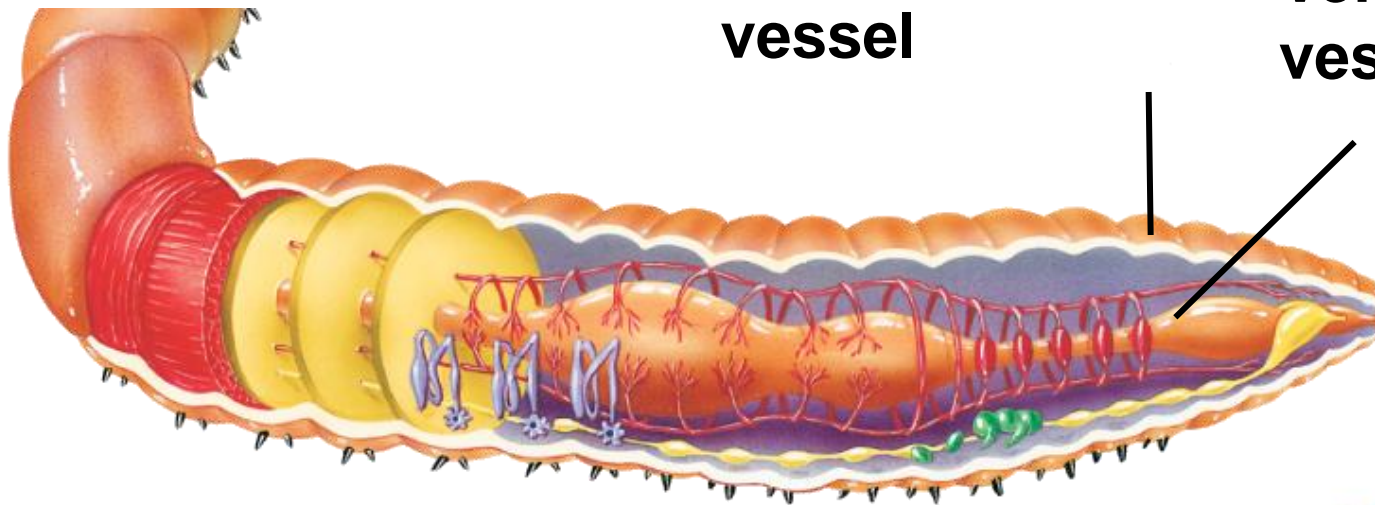
The dorsal blood vessel functions like a heart because it contracts rhythmically and helps pump blood.

Blood in the ventral (bottom) vessel runs from head to tail.

In each body segment, a pair of smaller blood vessels connect the dorsal and ventral blood vessels and supply blood to the internal organs.

Dorsal blood vessel

Ventral blood vessel



Respiration

Aquatic annelids often breathe through gills.

A gill is an organ specialized for the exchange of gases underwater.

Land-dwelling annelids take in oxygen and give off carbon dioxide through their moist skin.

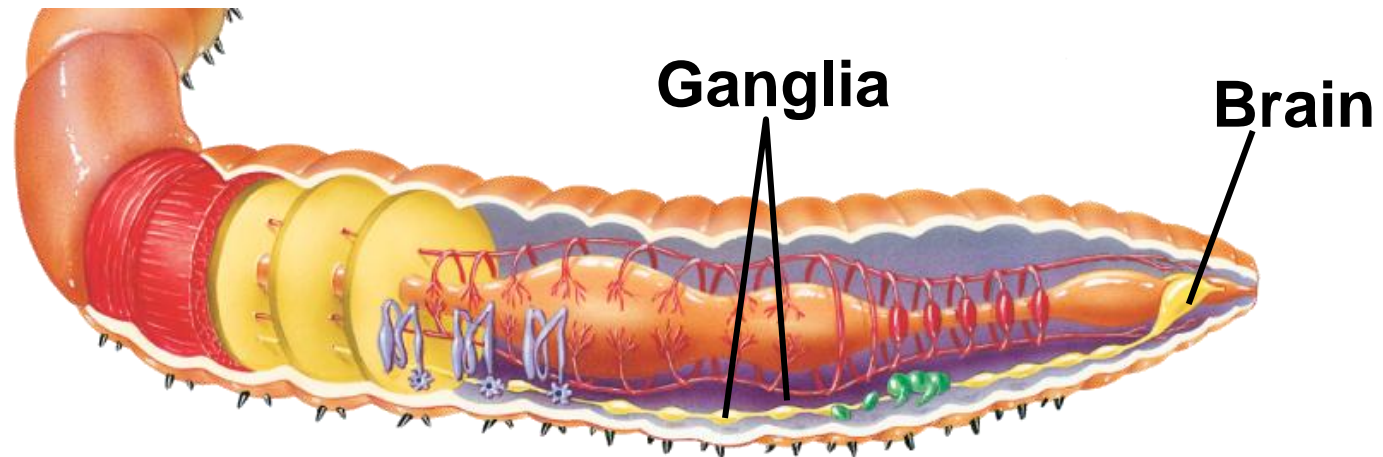
Excretion

Digestive waste passes out through the anus.

Cellular waste containing nitrogen is eliminated by nephridia - organs that filter fluid in the coelom

Response

Most annelids have a well-developed nervous system consisting of a brain and several nerve cords.



Movement

Annelids have two groups of body muscles that function as part of a hydrostatic skeleton. Longitudinal muscles run from the front of the worm to the rear and can contract to make the worm shorter and fatter.

Circular muscles wrap around each body segment and can contract to make the worm longer and thinner.

The earthworm moves by alternately contracting these two sets of muscles.

Reproduction

- Most annelids reproduce sexually.
- Some species use external fertilization and have separate sexes.
- Other annelids are hermaphrodites. Two worms attach to each other, exchange sperm, and then store the sperm in special sacs.

Groups of Annelids

Annelids are divided into three classes

- Oligochaetes - earthworms and their relatives
- Hirudinea - the leeches
- Polychaetes - sandworms, bloodworms, and their relatives.

Ecology of Annelids

Earthworms and many other annelids spend their lives burrowing through soil, aerating and mixing it. Earthworms help plant matter decompose. Earthworm castings are rich in nitrogen, phosphorus, potassium, micronutrients, and beneficial bacteria.

Phylum: Molluska



What Is a Mollusk?

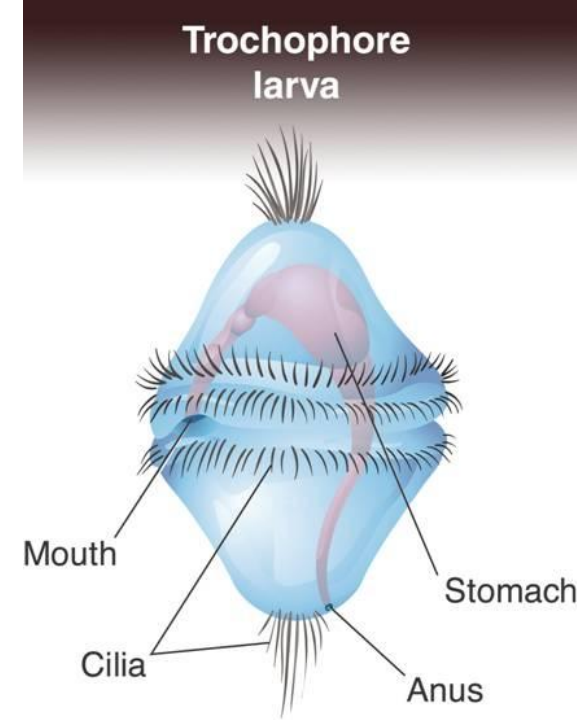
Mollusks are soft-bodied animals that usually have an internal or external shell.

Mollusks include snails, slugs, clams, squids, and octopi.

Many mollusks share similar developmental stages.

Many aquatic mollusks have a free-swimming larval stage called a **trochophore**.

The trochophore larva is also characteristic of annelids, indicating that these two groups may be closely related.



Form and Function in Mollusks

Mollusks have true coeloms surrounded by mesoderm tissue.

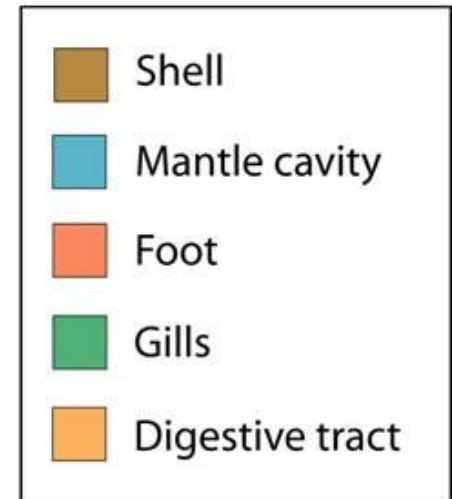
They have complex, interrelated organ systems that function together to maintain the body as a

whole Body Plan

The body plan of most mollusks has four parts: foot, mantle, shell, and visceral mass.

The muscular **foot** takes many forms

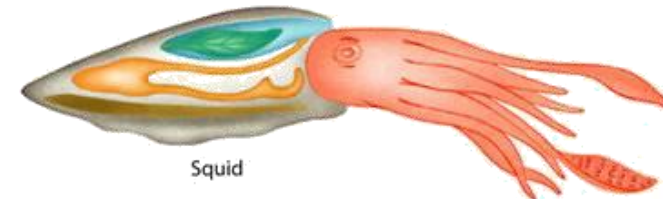
- flat structures for crawling
- spade-shaped structures for burrowing
- tentacles for capturing prey



Snail



Clam



Squid

The **mantle** is a thin layer of tissue that covers most of the mollusk's body.

The shell is made by glands in the mantle that secrete calcium carbonate.

Just beneath the mantle is the **visceral mass**, which contains the internal organs.

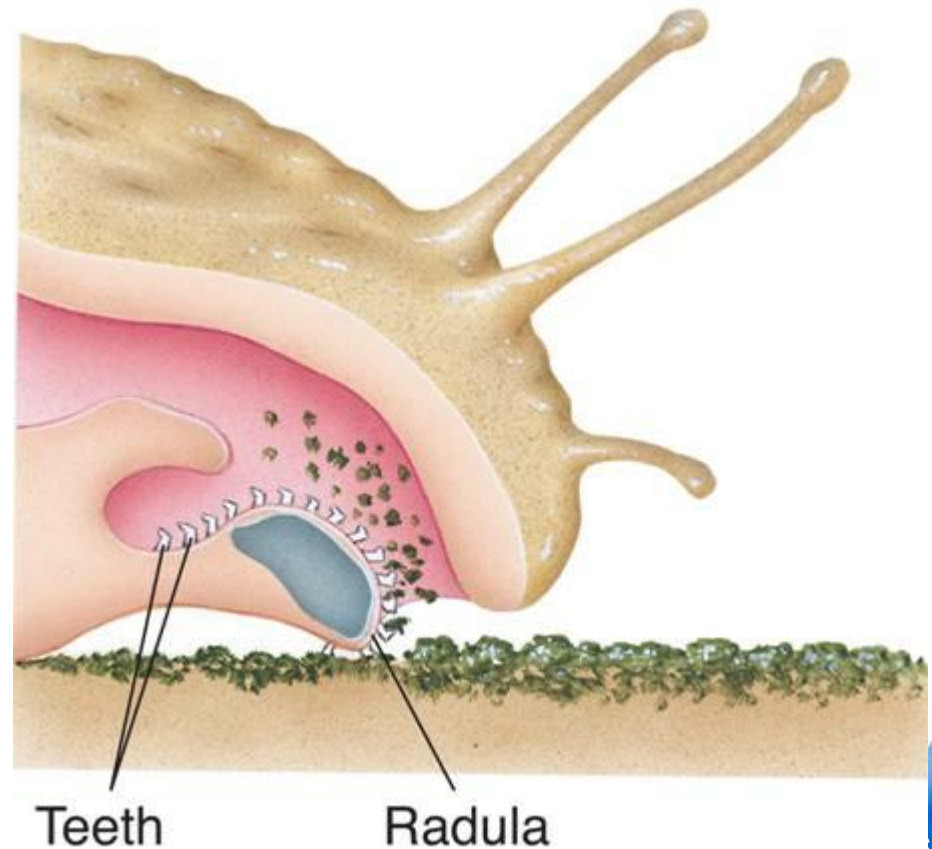
Feeding

Mollusks can be herbivores, carnivores, filter feeders, detritivores, or parasites.

Snails and slugs feed using a flexible, tongue-shaped structure known as a **radula**.

Hundreds of tiny teeth are attached to the radula.

The radula is used to scrape algae off rocks or to eat the soft tissues of plants.

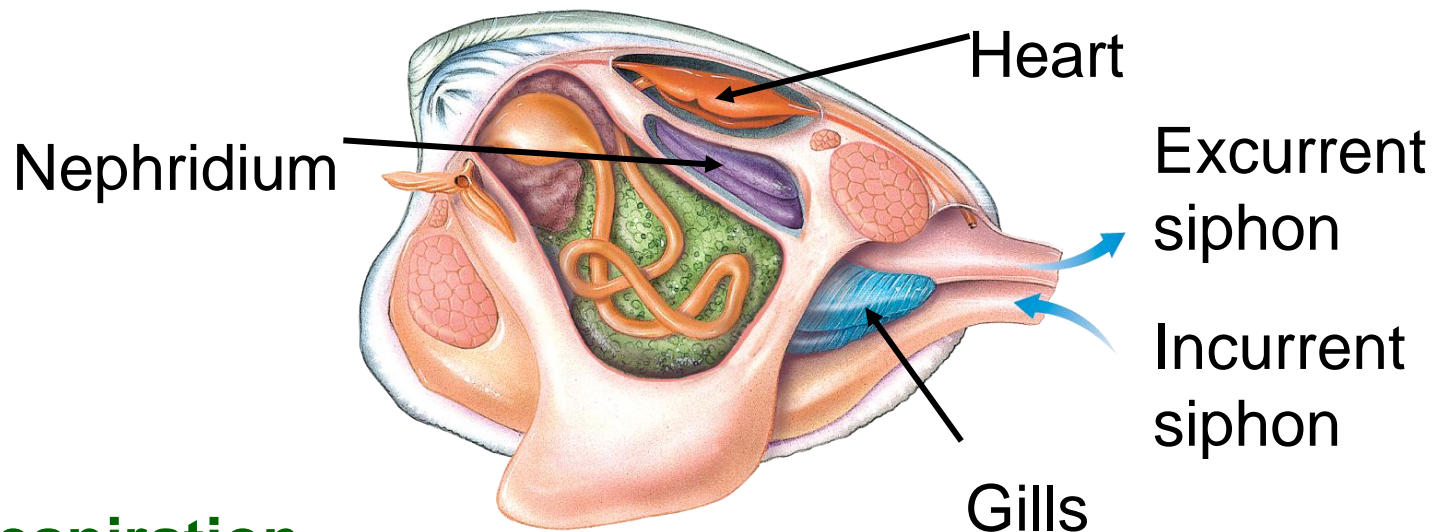


Clams, oysters, and scallops use gills.

Food is carried by water, which enters the incurrent siphon.

A siphon is a tubelike structure through which water enters and leaves the body.

The water flows over the gills and leaves by the excurrent siphon.



Respiration

Aquatic mollusks breathe using gills inside their mantle cavity.

As water passes through the mantle cavity, oxygen in the water moves into blood flowing through the gills.

At the same time, carbon dioxide moves in the opposite direction.

Land snails and slugs respire using a mantle cavity that has a large surface area lined with blood vessels.

Circulation

Some mollusks have open circulatory systems (no vessels); other mollusks have closed circulatory systems (blood vessels).

Blood leaves the vessels and works its way through different sinuses.

Blood passes from the sinuses to the gills, where oxygen and carbon dioxide are exchanged. Blood is then pumped back to the heart.

Slow-moving mollusks often have open circulatory systems.

Faster-moving mollusks have a closed circulatory system.

A closed circulatory system can transport blood through an animal's body much more quickly than an open circulatory system.

Excretion

Cells of the body release nitrogen-containing waste into the blood in the form of ammonia – through nephridia.

Response

The complexity of the nervous system and the ability to respond to environmental conditions varies among mollusks.

Two-shelled mollusks have a simple nervous system.

Octopi and their relatives have the most highly developed nervous system of all invertebrates.

Well-developed brains in these animals allows them to remember things for long periods.

Movement

Snails secrete mucus along the base of the foot, and then move over surfaces using a rippling motion of the foot.

The octopus draws water into the mantle cavity and then forces the water out through a siphon.

Water leaving the body propels the octopus in the opposite direction.

Reproduction

Some mollusks reproduce sexually by external fertilization.

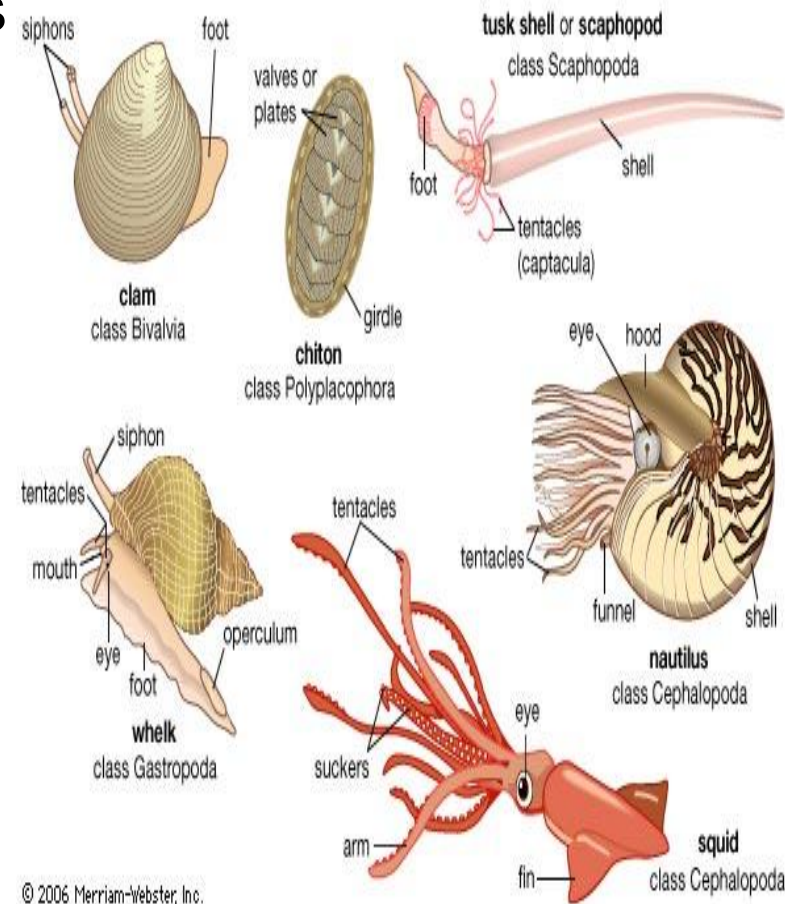
In other mollusks, fertilization takes place inside the body of the female.

Some mollusks are hermaphrodites and usually fertilize eggs from another individual.

Groups of Mollusks

The three major classes of mollusks are

- **Gastropods** - shell-less or single-shelled mollusks that move by using a muscular foot located on the ventral side.
- **Bivalves** - two shells that are held together by one or two powerful muscles
- **Cephalopods** - soft-bodied mollusks in which the head is attached to a single foot – with foot is divided into tentacles or arms



Fossilized Trilobites

Evolution of Arthropods



A typical primitive arthropod was composed of many identical segments, each carrying a pair of appendages.

This early body plan was modified gradually. Body segments were lost or fused over time.

The evolution of arthropods has led to fewer body segments and highly specialized appendages for feeding, movement, and other functions.

Phylum: Arthropoda

What Is an Arthropod?

Arthropods have a segmented body, a tough exoskeleton, and jointed appendages.

Arthropods include insects, crabs, centipedes, and spiders.

Arthropods are surrounded by a tough external covering, or exoskeleton.

The exoskeleton is made from protein and chitin. Chitin is a carbohydrate.

All arthropods have jointed appendages.

Appendages (legs and antennae) are structures that extend from the body wall.



Form and Function in Arthropods

Arthropods use complex organ systems to carry out different essential functions.

Organ systems are interrelated; the functioning of one system depends on that of other systems.

5 Main groups of Arthropods:

Arachnida (spiders, ticks, mites)

Chilopoda (centipedes)

Diplopoda (millipedes)

Crustacea (shrimp, crabs, lobsters)

Hexapoda (insects)

Feeding

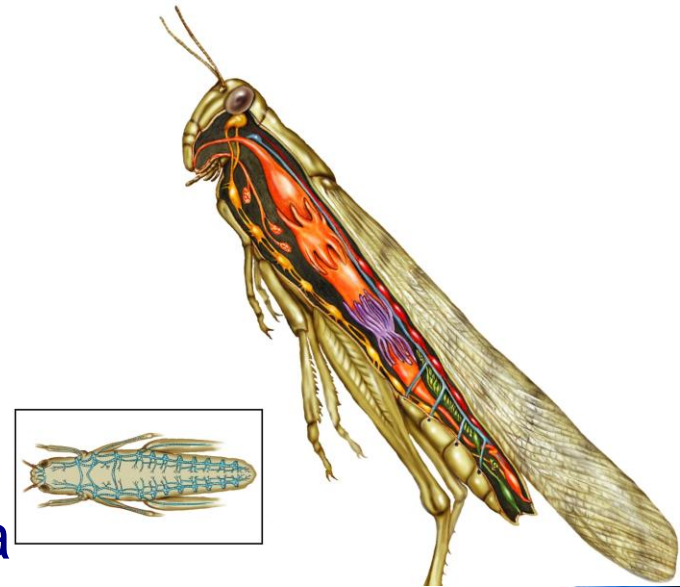
Arthropods include herbivores, carnivores, and omnivores. There are filter feeders, detritivores, and parasites.

The mouthparts of arthropods are adapted to the type of food the arthropod eats.

Respiration

Most terrestrial arthropods breathe through a network of branching **tracheal tubes** that extend throughout the body.

Air enters and leaves the trachea tubes through spiracles, which are small openings located along the side of the body.



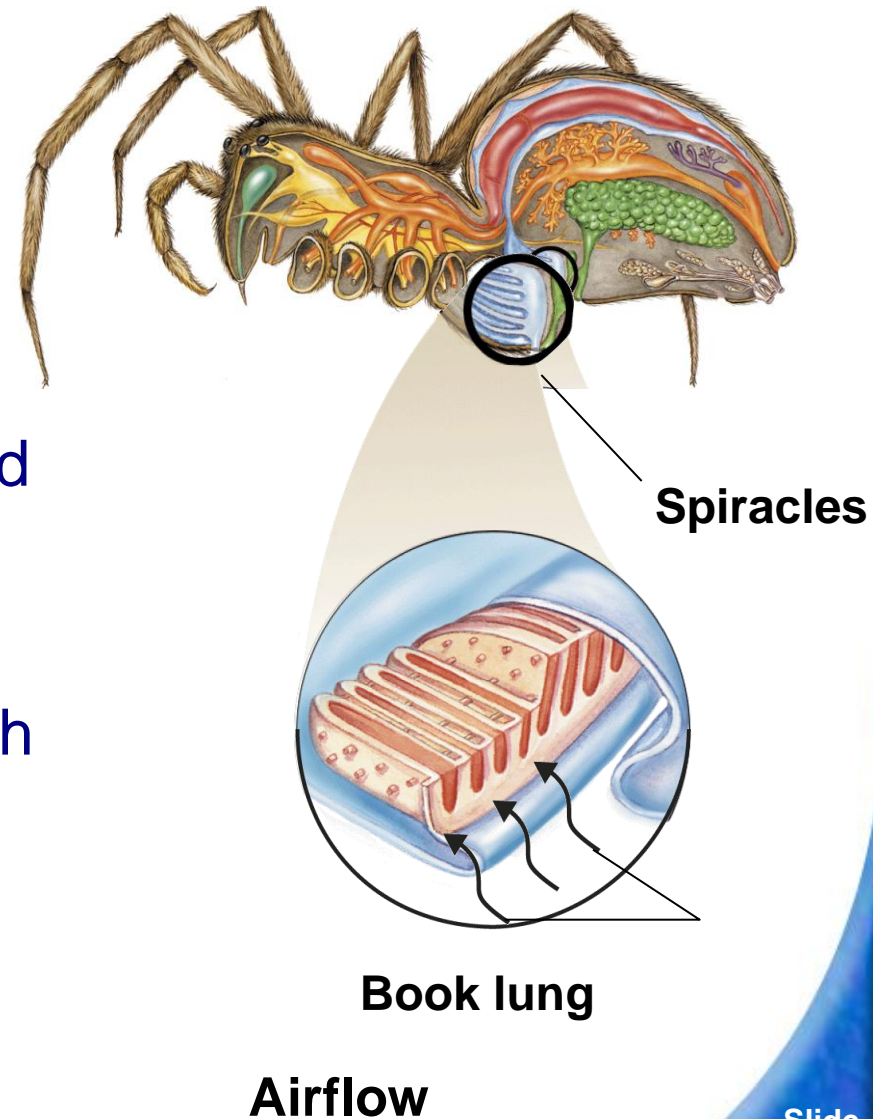
27-3 Annelids → Form and Function in Arthropods

Other terrestrial arthropods, such as spiders, respire using book lungs.

Book lungs are organs that have layers of respiratory tissue stacked like pages of a book.

Most aquatic arthropods, such as lobsters and crabs, respire through featherlike gills.

Horseshoe crabs respire through book gills.



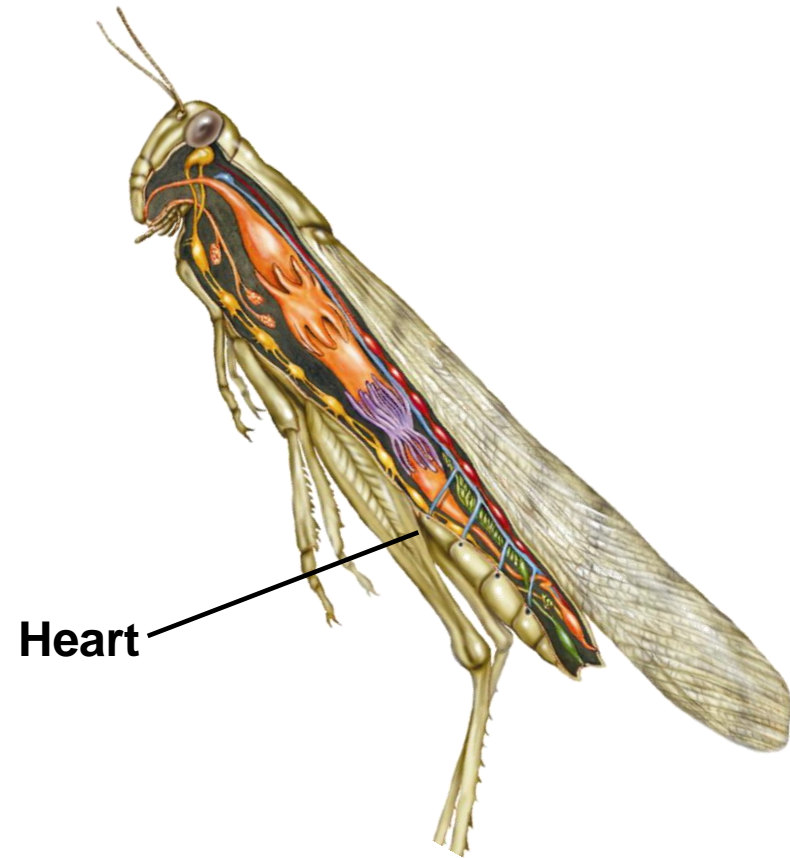
Circulation

Arthropods have an open circulatory system.

The heart pumps blood through arteries that branch and enter the tissues.

Blood leaves the blood vessels and moves through sinuses, or cavities.

Blood collects in a large sinus surrounding the heart and re-enters the heart.



Excretion

Most terrestrial arthropods dispose of nitrogenous wastes using Malpighian tubules.

Malpighian tubules are saclike organs that extract wastes from the blood and then add them to digestive wastes.

In aquatic arthropods, diffusion moves wastes from the body into the surrounding water.

Response

Most arthropods have a well-developed nervous system.

All arthropods have a brain.

Most arthropods have sophisticated sense organs such as compound eyes.

Compound eyes may have more than 2000 separate lenses and can detect color and motion very well.

Movement

Arthropods move using well-developed groups of muscles that are coordinated and controlled by the nervous system.

Muscles generate force by contracting and then pulling on the exoskeleton.

Reproduction

Terrestrial arthropods have internal fertilization.

In some species, males deposit sperm inside females.

In other species, the males deposit a sperm packet that is picked up by the females.

Aquatic arthropods may have internal or external fertilization.

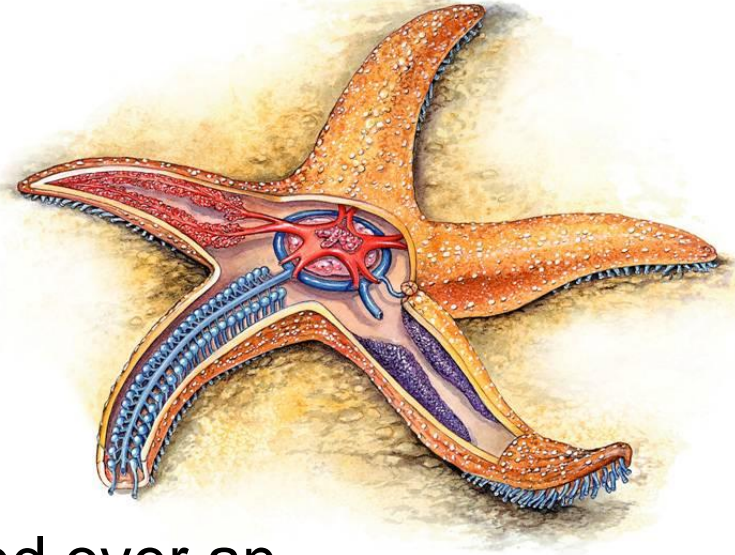
Growth and Development in Arthropods

When they outgrow their exoskeletons, arthropods undergo periods of molting.

During **molting**, an arthropod sheds its entire exoskeleton and manufactures a larger one to take its place.

Echinoderms are characterized by spiny skin, an internal skeleton, a water vascular system, and suction-cuplike structures called tube feet. Most adult echinoderms exhibit five-part radial symmetry.

Phylum: Echinodermata



What Is an Echinoderm?

The skin of echinoderms is stretched over an **endoskeleton** that is formed of hardened plates of calcium carbonate.

Adult echinoderms typically have no anterior or posterior end and lack cephalization.

The side in which the mouth is located is called the oral surface, and the opposite side is called the aboral surface.

What Is an Echinoderm?

Echinoderms are deuterostomes, animals in which the blastopore develops into an anus.

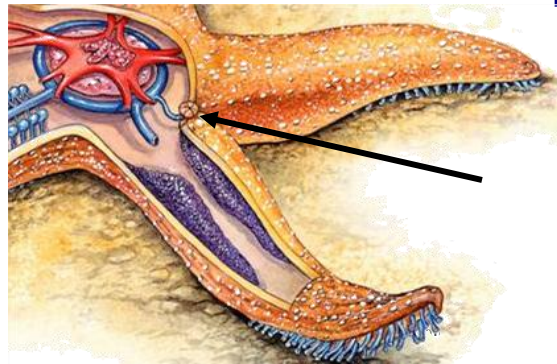
Sea stars, sea urchins, and sand dollars are all echinoderms.

Form and Function in Echinoderms

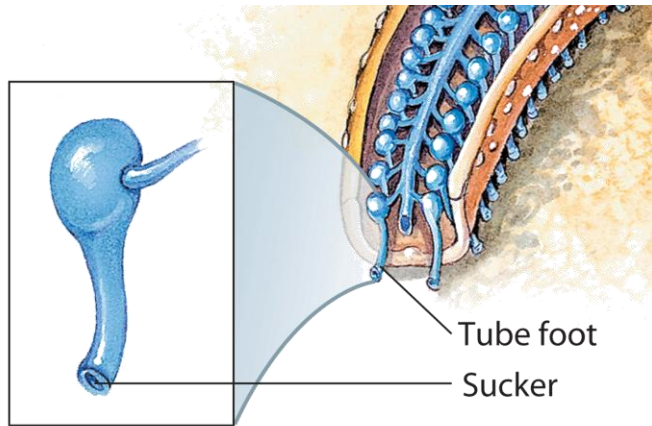
Echinoderms have a system of internal tubes called a water vascular system.

The water vascular system carries out many essential body functions, including respiration, circulation, and movement.

The water vascular system opens to the outside through a sieve-like structure called a madreporite.



A tube foot is attached to each radial canal.



Tube feet act together to create enormous force allowing echinoderms to “walk,” and pull open shelled prey.

Feeding

Echinoderms have several methods of feeding.

Sea urchins use five-part jawlike structures to scrape algae from rocks.

Sea lilies use tube feet along their arms to capture floating plankton.

Sea cucumbers move across the ocean floor, taking in sand and detritus.

Sea stars usually feed on mollusks such as clams and mussels.



The sea star starts digesting the mollusk in its own shell. The sea star pulls its stomach and the partially digested prey into its mouth.

Respiration and Circulation

In most echinoderms, the thin-walled tissue of the tube feet provides the main surface for respiration.

In some species, small outgrowths called skin gills also function in gas exchange.

Circulation of needed materials and wastes takes place throughout the water vascular system.

Excretion

In most echinoderms, digestive wastes are released as feces through the anus.

Nitrogen-containing cellular wastes are excreted primarily in the form of ammonia.

This waste is passed into surrounding water through the thin walled tissues of tube feet and skin gills.

Response

Most echinoderms have a nerve ring that surrounds the mouth, and radial nerves that connect the ring with the body sections.

Most echinoderms have scattered sensory cells that detect light, gravity, and chemicals released by potential prey.

Movement

Most echinoderms move using tube feet.

Sand dollars and sea urchins have movable spines attached to the endoskeleton.

Sea stars and brittle stars use their arms for locomotion.

Sea cucumbers crawl by using both tube feet and the muscles of their body wall.

Reproduction

Echinoderms reproduce by external fertilization.

Both sperm and eggs are shed into open water, where fertilization takes place.

The larvae swim around for some time.

Larvae then swim to the ocean bottom and develop into adults.

Groups of Echinoderms

Classes of echinoderms include

sea urchins and sand dollars

brittle stars

sea cucumbers

sea stars

sea lilies and feather stars.

