29-2 Form and Function in Invertebrates

How do different invertebrate phyla carry out life functions?

Feeding and Digestion

The simplest animals break down food primarily through intracellular digestion. More complex animals use extracellular digestion.

When food is digested inside cells, this process is known as **intracellular digestion**.

Sponges use intracellular digestion.

In **extracellular digestion**, food is broken down outside the cells in a digestive cavity or tract and then absorbed into the body.

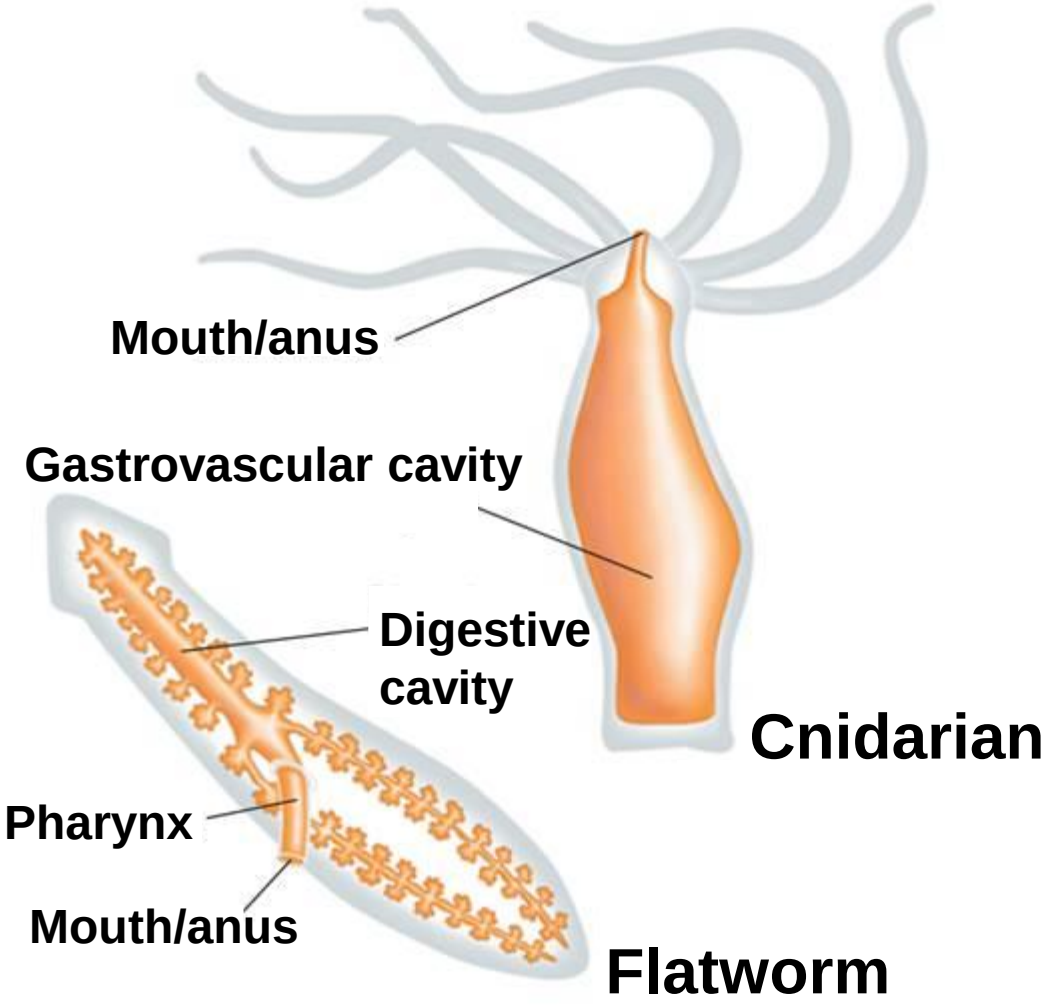
Mollusks, annelids, arthropods, and echinoderms rely almost entirely on extracellular digestion.

Flatworms and cnidarians use both intracellular and extracellular digestion.

Cnidarians and most flatworms ingest food and expel wastes through a single opening.

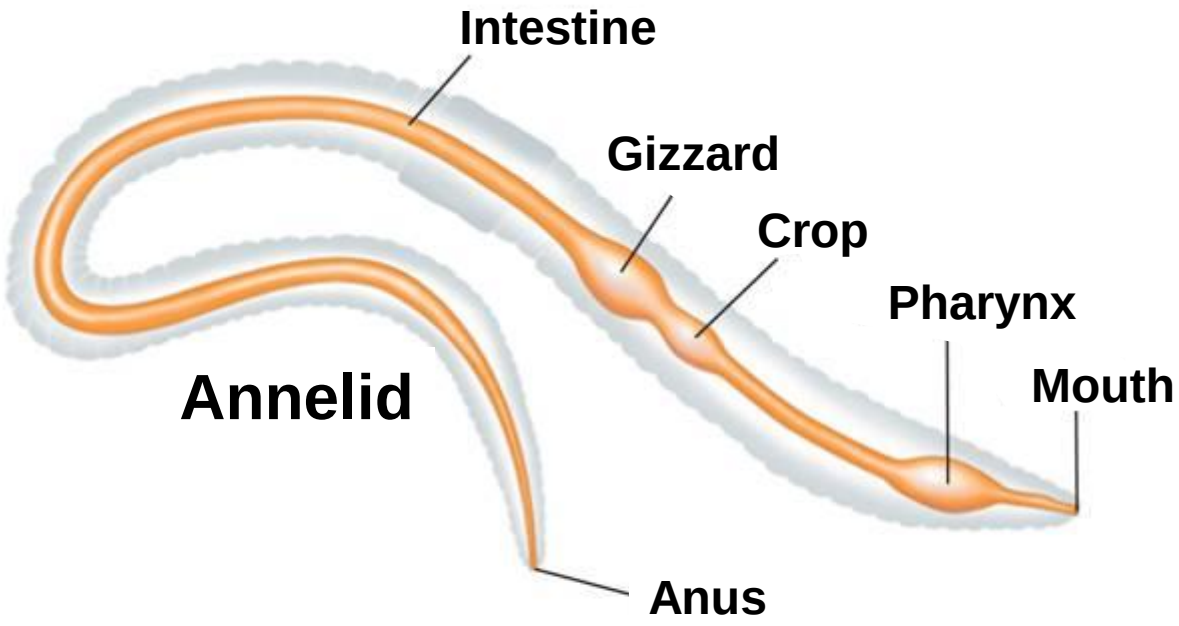
Food is digested in a cavity through both extracellular and intracellular means.

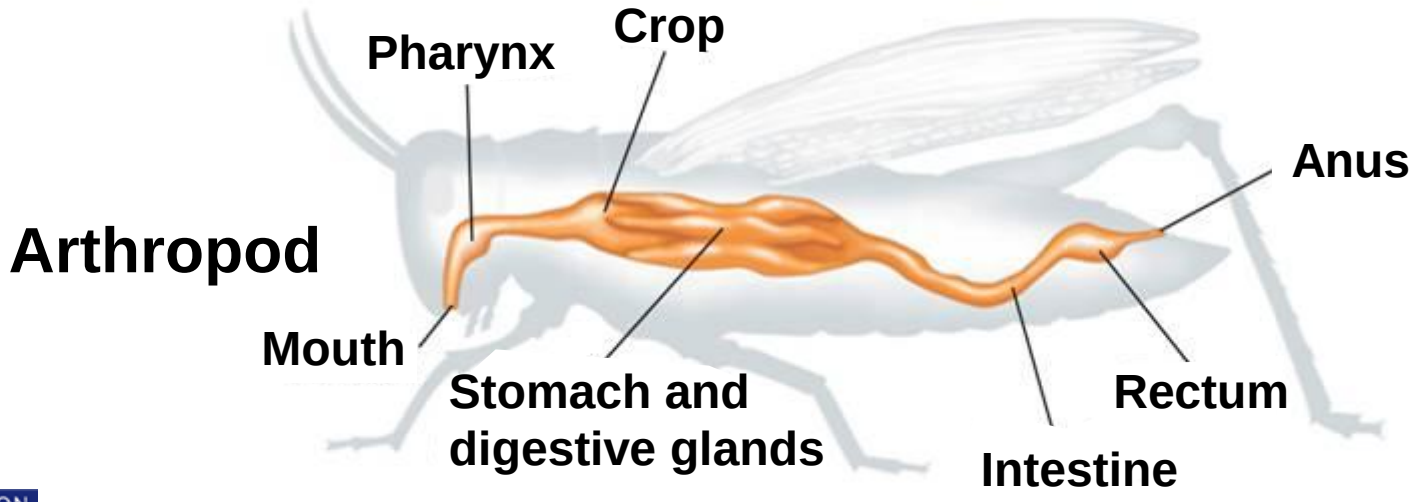
Invertebrate Digestive Systems



In more-complex animals, food enters the mouth and wastes leave through the anus.

A one-way digestive tract often has specialized regions.





Respiration

All respiratory systems have two basic requirements:

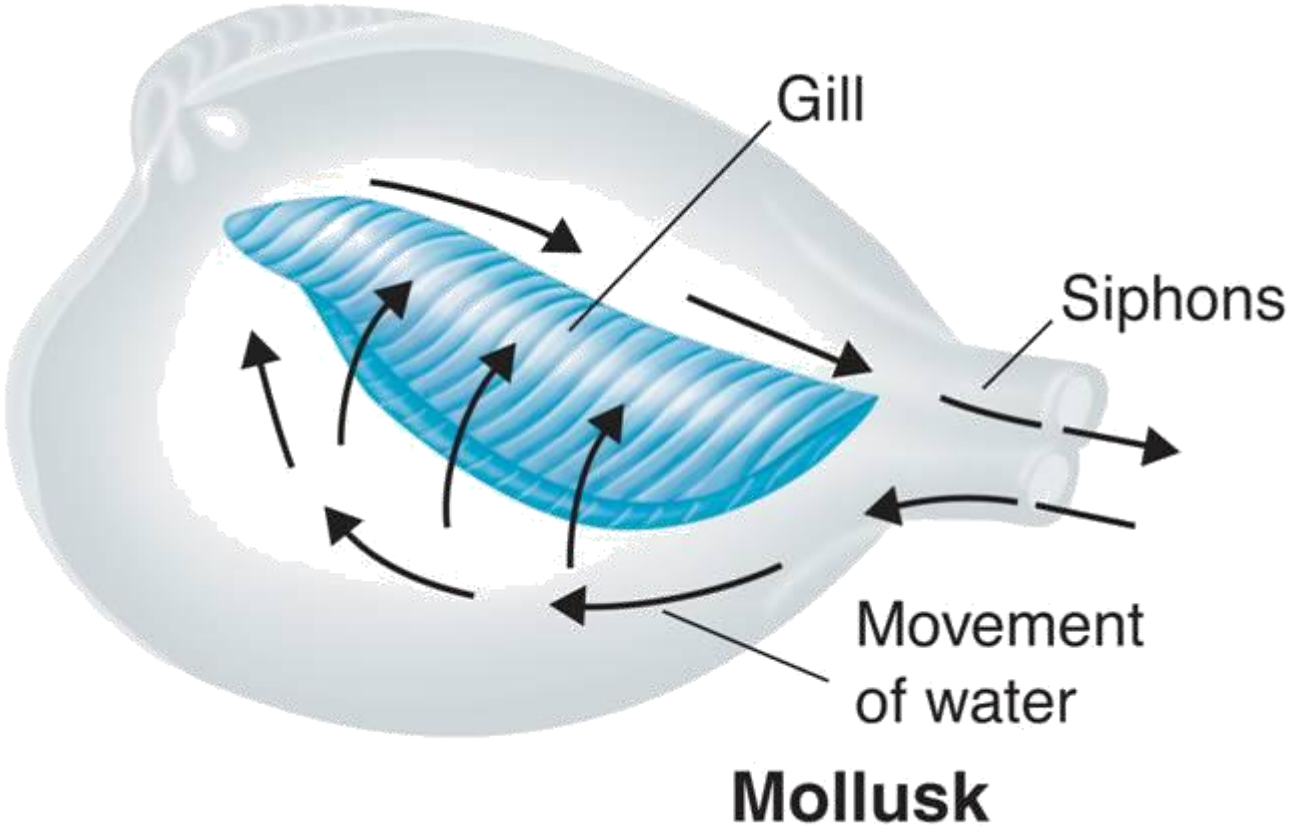
- **a large surface area that is in contact with the air or water**
- **the respiratory surfaces must be moist for diffusion to occur**

Aquatic Invertebrates

Many animals respire through their skin.

Aquatic mollusks, arthropods, and many annelids exchange gases through gills.

Gills are feathery structures that expose a large surface area to the water.

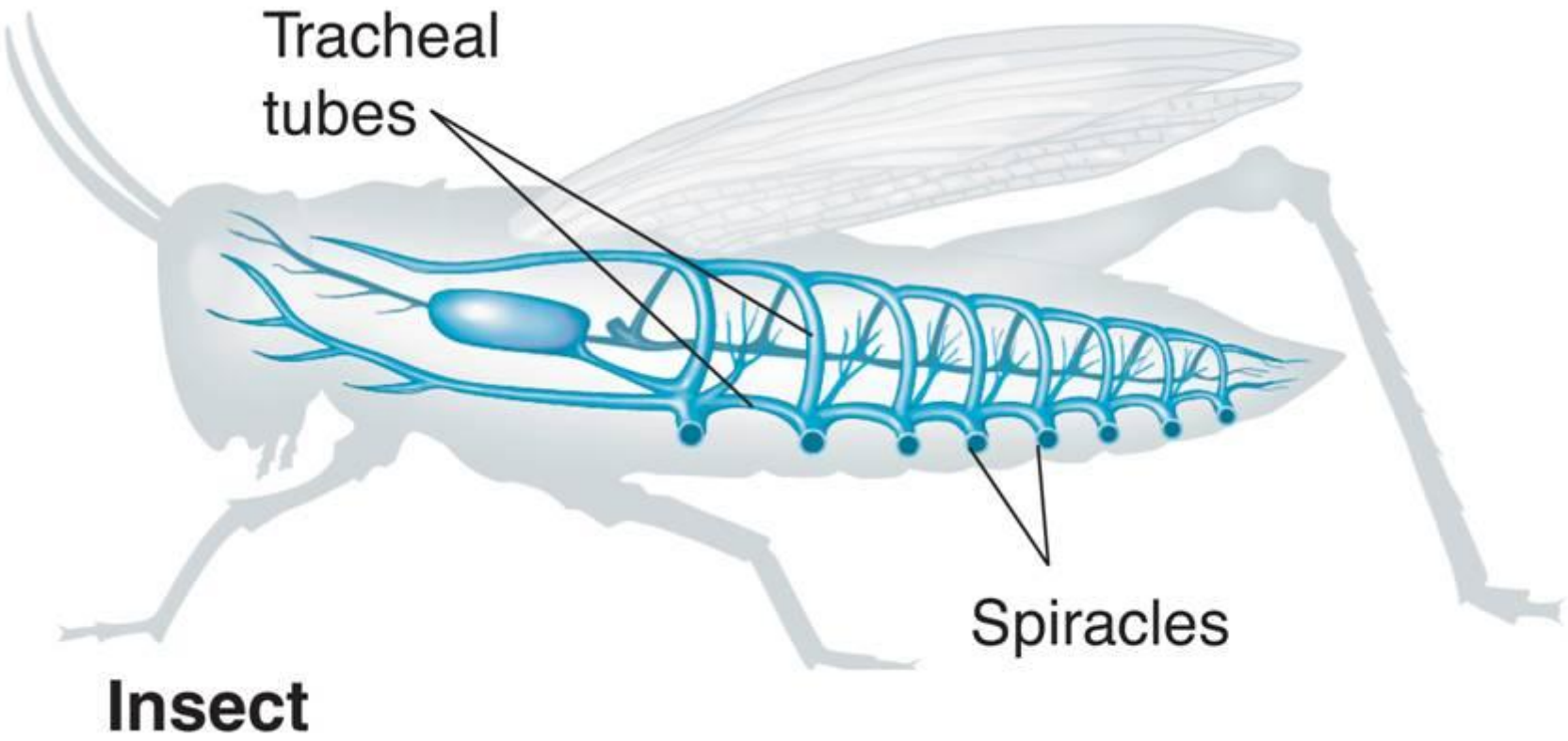


Terrestrial Invertebrates

Terrestrial invertebrates have several types of respiratory surfaces.

Many spiders have book lungs.

Grasshoppers and other insects have spiracles and tracheal tubes.



Circulation

Most complex animals have one or more hearts to move blood through their bodies and either an open or closed circulatory system.

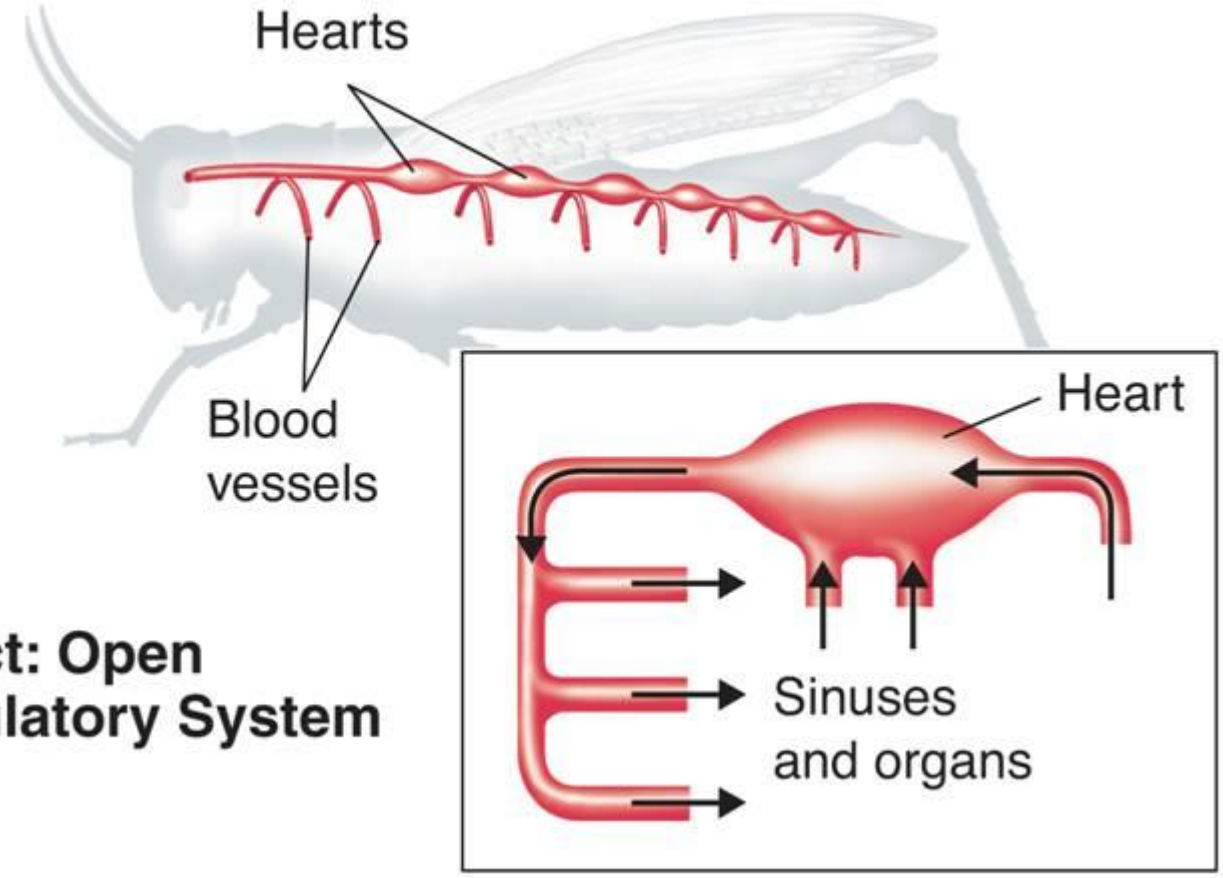
Open Circulatory Systems

In an **open circulatory system**, blood is only partially contained within a system of blood vessels.

One or more hearts or heartlike organs pump blood through blood vessels into a system of sinuses, or spongy cavities.

The blood makes its way back to the heart.

Open circulatory systems are characteristic of arthropods and most mollusks.



Insect: Open Circulatory System

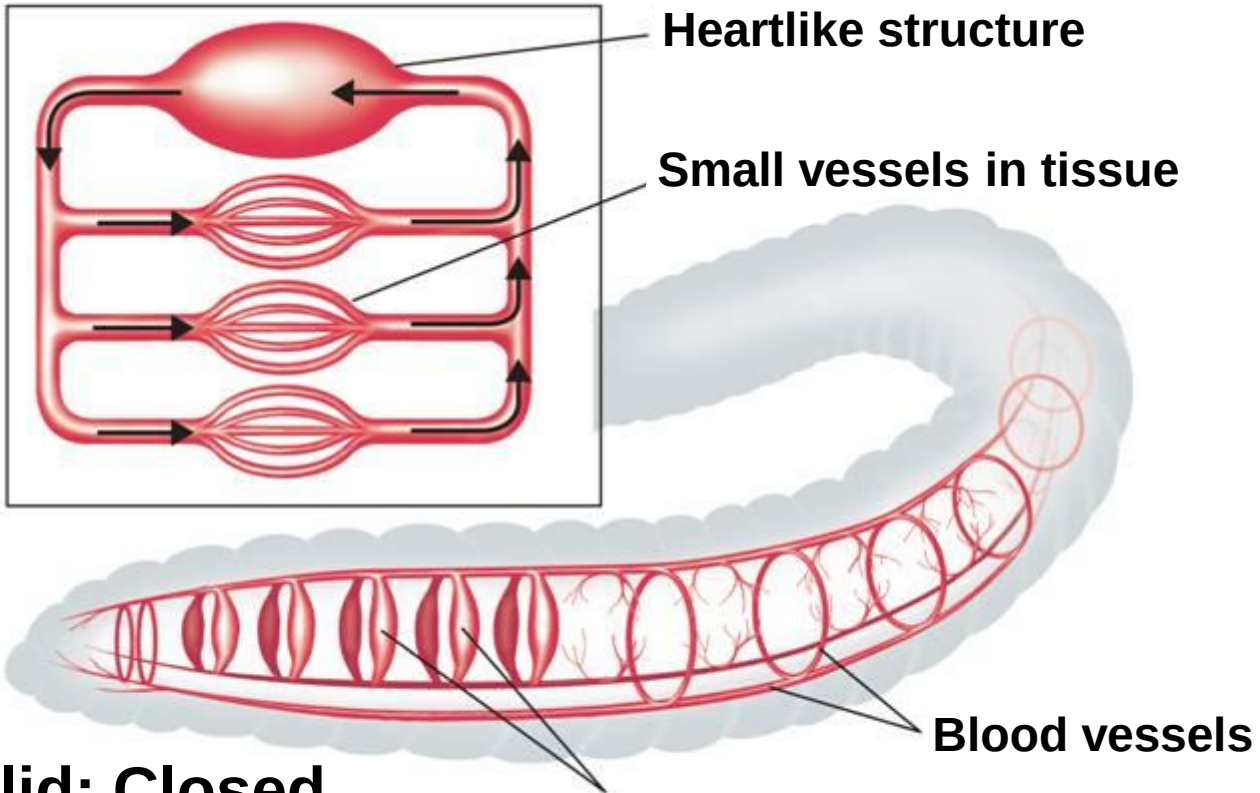
Closed Circulatory Systems

In a **closed circulatory system**, a heart or heartlike organ forces blood through vessels that extend throughout the body.

Materials reach body tissues by diffusing across the walls of the blood vessels.

Closed circulatory systems are characteristic of larger, more active animals.

Among the invertebrates, closed circulatory systems are found in annelids and some mollusks.



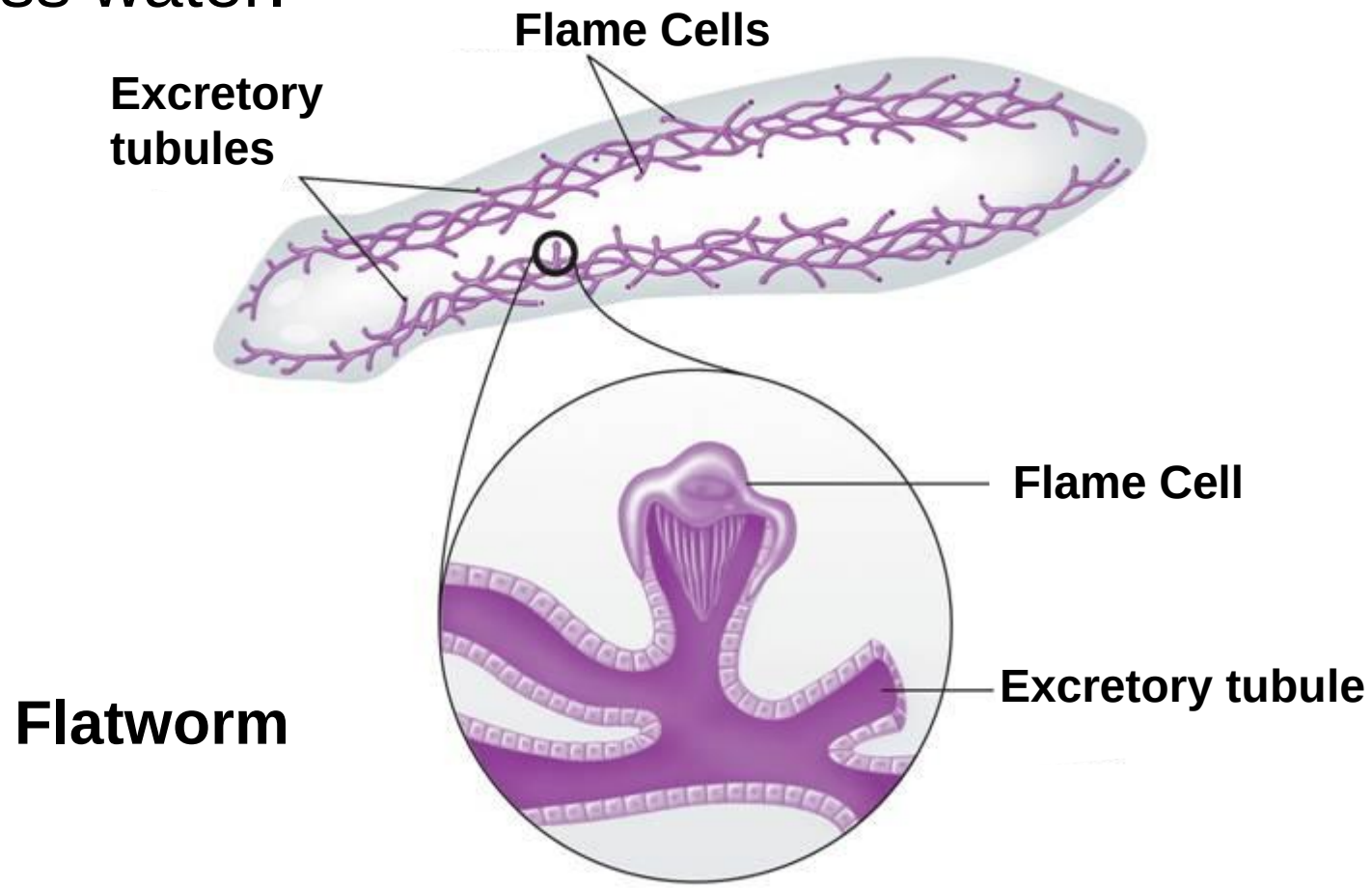
Annelid: Closed Circulatory System

Excretion

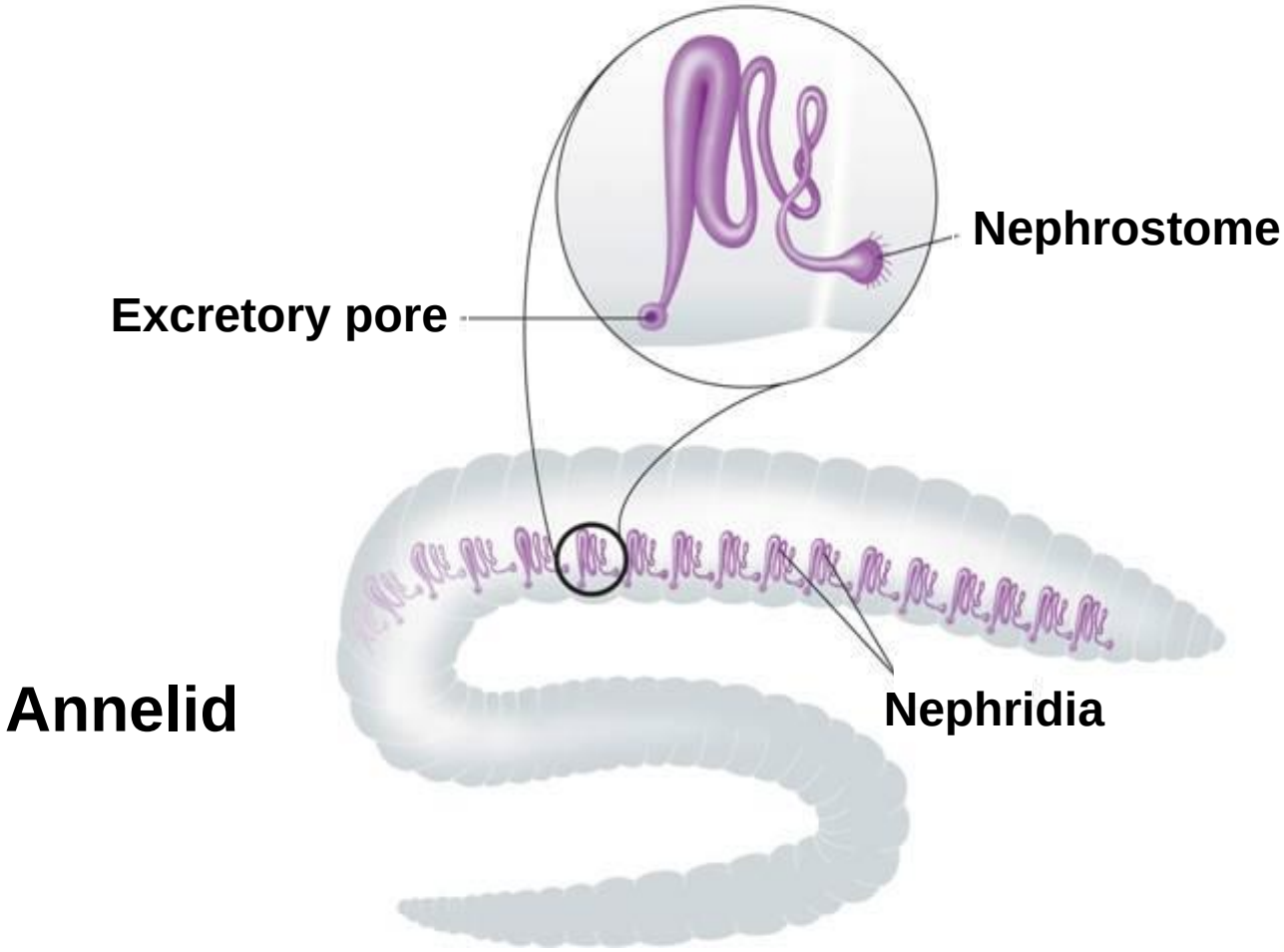
Most animals have an excretory system that rids the body of metabolic wastes while controlling the amount of water in the tissues.

In aquatic invertebrates, ammonia diffuses from their body tissues into the surrounding water.

Flatworms use a network of flame cells to eliminate excess water.



In annelids and mollusks, urine forms in tubelike structures called nephridia.

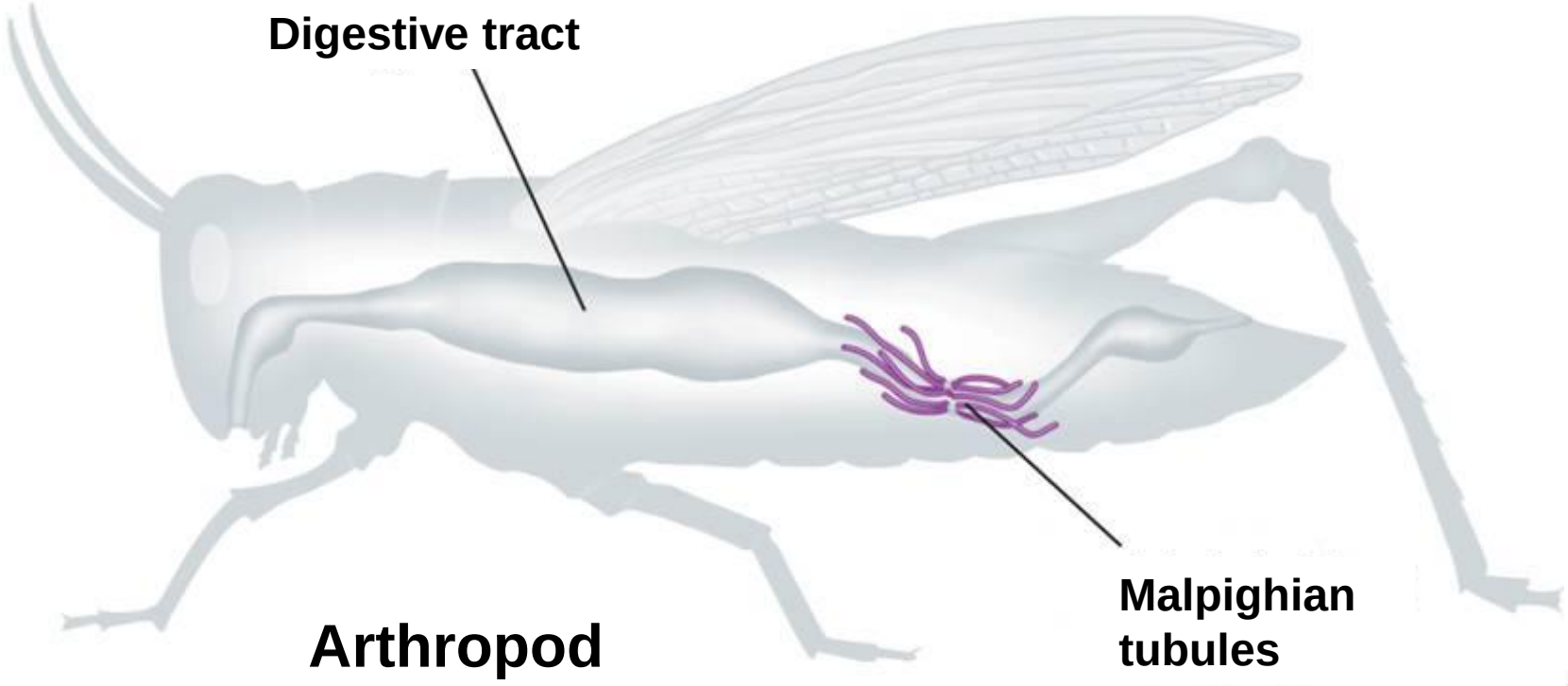


Fluid enters the nephridia through openings called nephrostomes.

Urine leaves the body through excretory pores.

Urine is highly concentrated, so little water is lost.

Some insects and arachnids have Malpighian tubules, saclike organs that convert ammonia into uric acid.



Uric acid and digestive wastes combine to form a thick paste that leaves the body through the rectum.

The paste helps to reduce water loss.

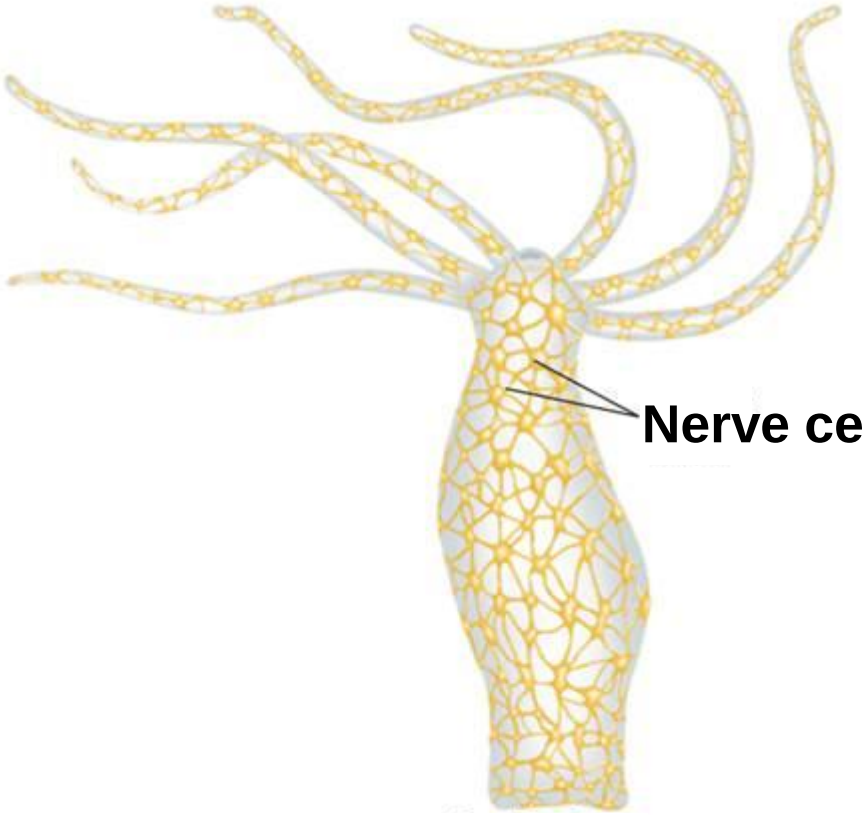
Response

Invertebrates show three trends in the evolution of the nervous system: centralization, cephalization, and specialization.

Centralization and Cephalization

Cephalization is the concentration of nerve tissue and organs in one end of the body.

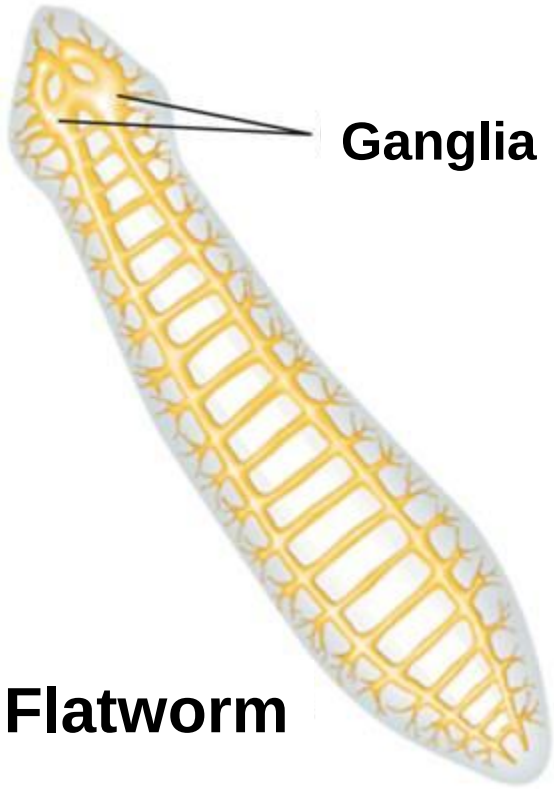
Cnidarians have nerve nets which consist of individual nerve cells that form a netlike arrangement throughout the animal's body.



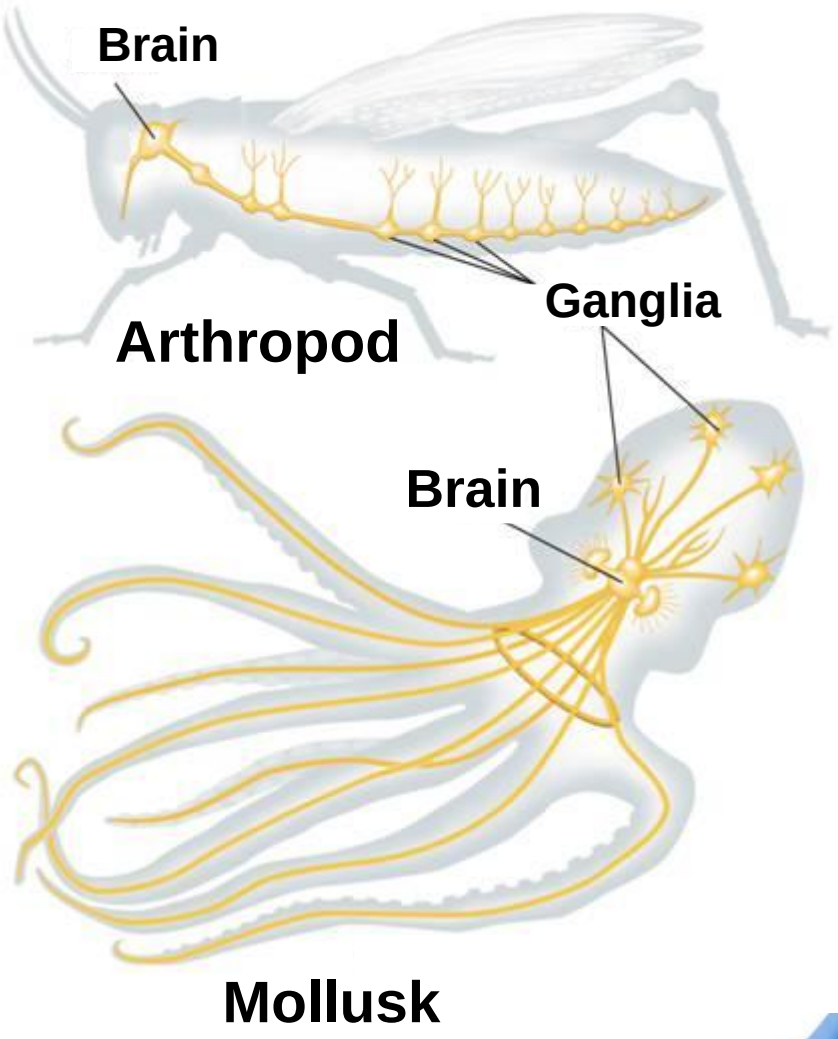
Cnidarian

In flatworms and roundworms, the nerve cells are more centralized.

There are a few clumps of nerve tissue, or ganglia, in the head.



In cephalopod mollusks and arthropods, ganglia are organized into a brain.



Specialization

The more complex an animal's nervous system is, the more developed its sense organs tend to be.

Complex animals may have a variety of specialized sense organs that detect light, sound, chemicals, movement, and electricity.

Movement and Support

Most animals use muscles to move, breathe, pump blood, and perform other life functions.

In most animals, muscles work together with some sort of skeletal system that provides firm support.

Invertebrates have one of three main kinds of skeletal systems: hydrostatic skeletons, exoskeletons, or endoskeletons.

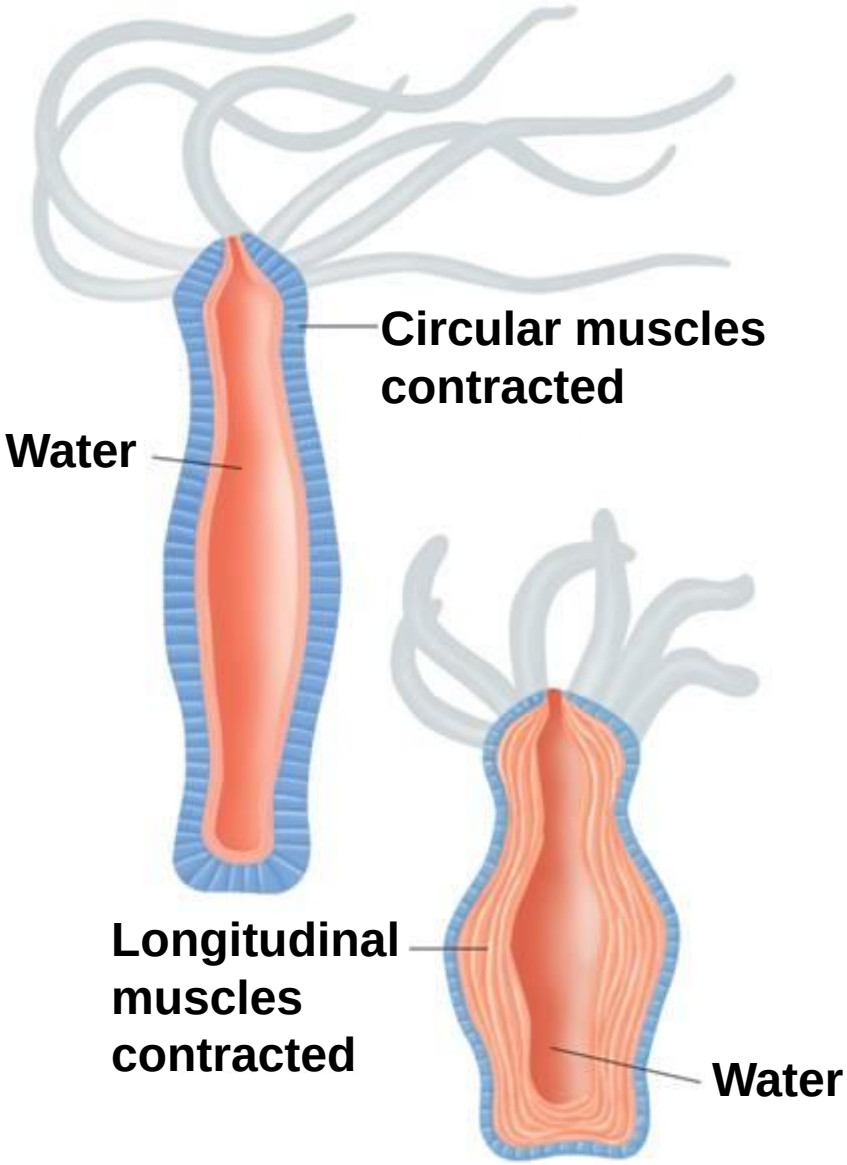
Hydrostatic Skeletons

In a **hydrostatic skeleton**, muscles surround a fluid-filled body cavity that supports the muscles.

When the muscles contract, they push against fluid in the body cavity, causing the body to change shape.

Annelids and certain cnidarians, have hydrostatic skeletons.

Hydrostatic Skeleton



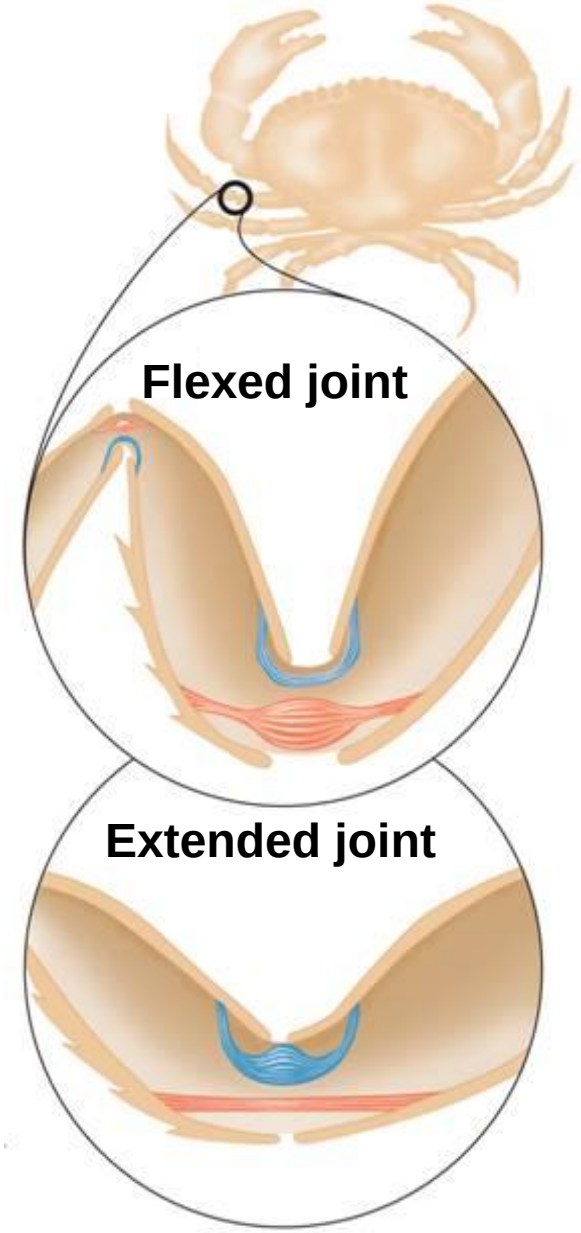
Exoskeletons

An **exoskeleton**, or external skeleton, is a hard body covering made of chitin.

Arthropods have exoskeletons.

Arthropods move by using muscles that are attached to the inside of the exoskeleton.

Exoskeleton

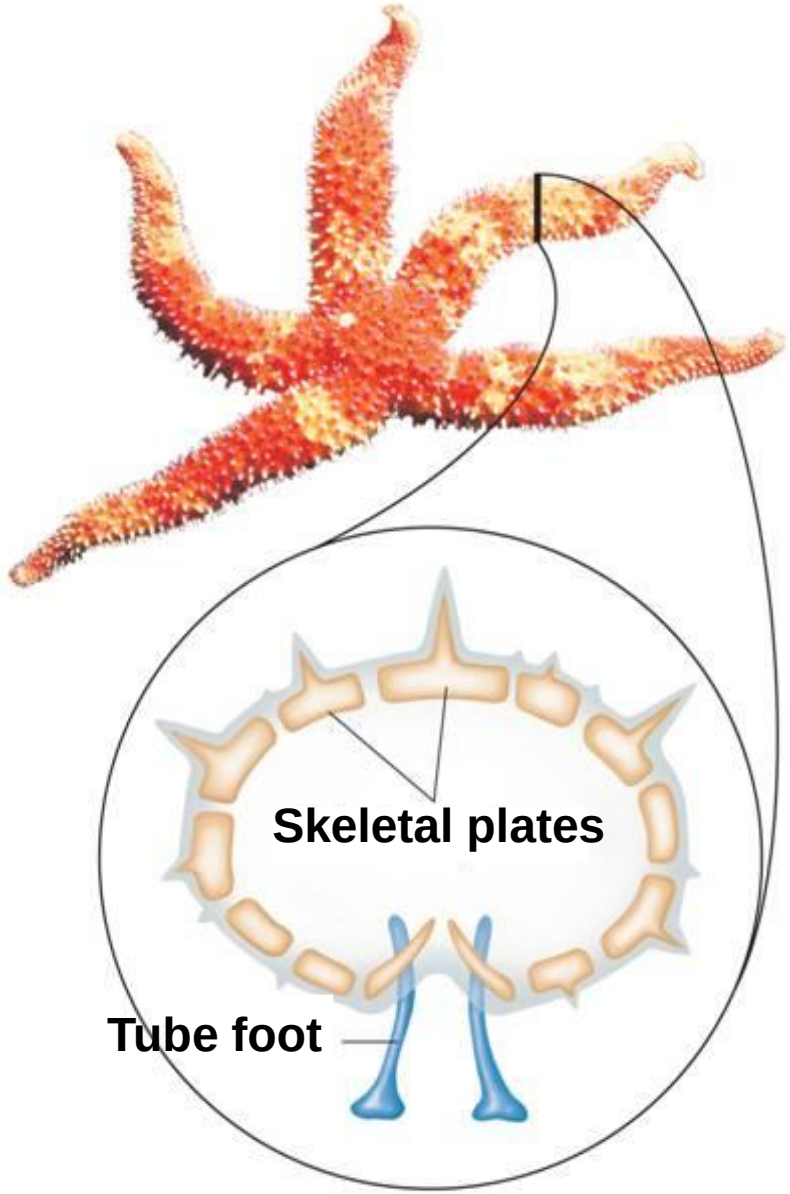


Endoskeletons

An **endoskeleton** is a structural support located inside the body.

Sea stars and other echinoderms have an endoskeleton. Vertebrates also have endoskeletons.

Endoskeleton



Sexual and Asexual Reproduction

Most invertebrates reproduce sexually during at least part of their life cycle. Depending on environmental conditions, however, many invertebrates may also reproduce asexually.

Sexual reproduction maintains genetic diversity in a population.

Asexual reproduction allows animals to reproduce rapidly and take advantage of favorable conditions in the environment.

Sexual reproduction is the production of offspring from the fusion of gametes.

Male and female gametes join to create a zygote.

The zygote grows through mitosis and develops into a multicellular animal.

In most animals, each individual is a single sex.

The individual produces either sperm or eggs.

Some animals are hermaphrodites—individuals that produce both sperm and eggs.

In **external fertilization**, eggs are fertilized outside the female's body.

In **internal fertilization**, eggs are fertilized inside the female's body.

The offspring of asexual reproduction grow into multicellular organisms by mitosis of diploid cells.

Some animals reproduce asexually through budding or by dividing in two.

29-2 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:

1 Flatworms eliminate excess water using a network of

A a. flame cells.

b. Malpighian tubules.

c. nephridia.

d. madrepores.

2 A hydrostatic skeleton is found in the

A a. annelids.

b. echinoderms.

c. arthropods.

d. insects.

3 Complex animals break down food using

a. intracellular digestion.

A b. extracellular digestion.

c. intracellular digestion and extracellular digestion.

d. digestion outside of the body.

4 Which structures are involved in gas exchange in one or more groups of invertebrates?

a. ganglia, brain, and nerve cells

A b. gills, book lung, skin, and tracheal tubes

c. nephridia, flame cells, and nephrostomes

d. pharynx, crop, and intestine

5 Which groups have only one entrance and exit point to the digestive system?

a. annelids and echinoderms

b. arthropods and roundworms

c. mollusks and sponges

A d. flatworms and cnidarians

END OF SECTION