

Section 25.2



SB3b. Compare how structures and function vary between the six kingdoms (archaeobacteria, eubacteria, protists, fungi, plants, and animals). **Also covers:** SCSH9b, d, SB1d

Objectives

- ▶ **Compare** the features of roundworms to the features of flatworms.
- ▶ **Identify** roundworms based on movement.
- ▶ **Evaluate** the risk of contracting roundworm parasites.

Review Vocabulary

cilia: short, numerous projections that look like hairs

New Vocabulary

hydrostatic skeleton
trichinosis

Roundworms and Rotifers

MAIN Idea Roundworms and rotifers have a more highly evolved gut than flatworms derived from a pseudocoelomate body plan.

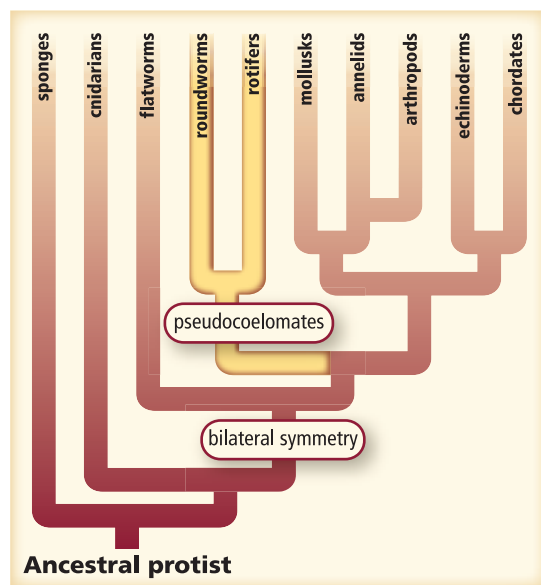
Real-World Reading Link If you were to guess what animal is one of the most common in the world, what animal would you choose? Would you guess a roundworm? With 20,000 species of roundworms known, scientists estimate that there might be 100 times as many more kinds of roundworms still undiscovered.

Body Structure of Roundworms

Roundworms are in phylum Nematoda (ne muh TOH duh) and often are called nematodes. Locate roundworms on the evolutionary tree in **Figure 25.7**. Notice that they have a body cavity in the form of a pseudocoelom. Roundworms have bilateral symmetry and are cylindrical, unsegmented worms that are tapered at both ends. Roundworms come in many sizes, as shown in **Figure 25.7**. Most are less than 1 mm long. However, the longest known roundworm, living in certain whales, can grow to 9 m in length.

Roundworms are found in both marine and freshwater habitats and on land. Some are parasites on plants and animals. A spadeful of garden soil might contain one million roundworms. One study revealed that a rotting apple contained 1074 roundworms! Dogs and cats can be plagued by roundworms if they are not wormed when they are young and at regular intervals during adulthood. Roundworms have adaptations that enable them to live in many places.

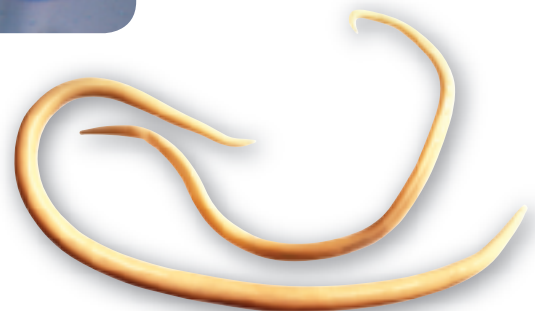
■ **Figure 25.7** Roundworms are pseudocoelomates with bilateral symmetry.



LM Magnification: 50×



Vinegar eel
(2 mm in length)



Ascarid worms (10-35 cm in length)

CAREERS IN BIOLOGY

Veterinary Parasitologist As scientists who keep parasites out of the food supply, veterinary parasitologists are responsible for the health of farm and domesticated animals. They determine ways to control and prevent parasites in animals such as cows, pigs, and chickens. For more information on biology careers, visit biologygmh.com.

Feeding and digestion Most roundworms are free-living, but some are parasites. Some free-living roundworms are predators of other tiny invertebrates, while others feed on decaying plant and animal matter. Free-living forms have a key evolutionary adaptation in their digestive systems. Recall from Chapter 24 that in the course of evolution, pseudocoelomate animals were the first to have a body cavity. The pseudocoelom of a nematode separates the endoderm-lined gut from the rest of the body. The movement of food through the gut, or digestive tract, is one-way—food enters through the mouth, and undigested food leaves through an opening at the end of the digestive tract called the anus.

Respiration, circulation, excretion, and response to stimuli Like flatworms, roundworms have no circulatory organs or respiratory organs, and they depend on diffusion to move nutrients and gases throughout their bodies. Most roundworms exchange gases and excrete metabolic wastes through their moist outer body coverings. More complex forms have excretory ducts that enable them to conserve water for living on land, while others have flame cells.

Ganglia and associated nerve cords coordinate nematode responses. Nematodes are sensitive to touch and to chemicals. Some have structures that might detect differences between light and dark.

Movement Roundworms have muscles that run the length of their bodies. These muscles cause their bodies to move in a thrashing manner as one muscle contracts and another relaxes. These muscles also pull against the outside body wall and the pseudocoelom. The pseudocoelom acts as a **hydrostatic skeleton**—fluid within a closed space that provides rigid support for muscles to work against. If you were to observe a roundworm moving, it might resemble a tiny piece of wriggling thread. Learn more about worm movement in **Data Analysis Lab 25.1**.

DATA ANALYSIS LAB 25.1

Based on Real Data*

Interpret the Diagram

How does a nematode move? A nematode alternately contracts and relaxes muscles running lengthwise on each side of its body, which moves it forward in successive stages.

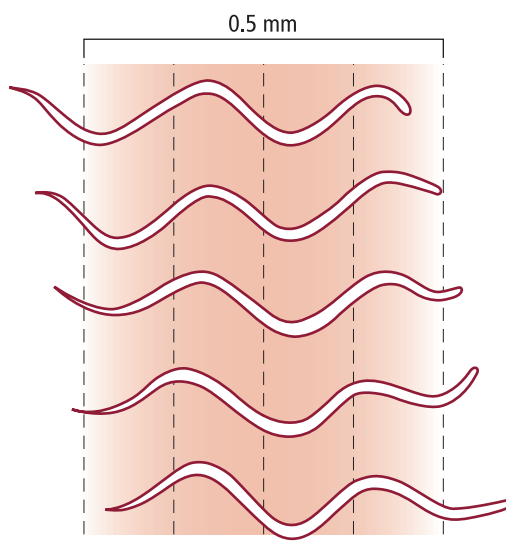
Data and Observations

Look at the diagram and observe how a nematode moves.

Think Critically


- 1. Interpret** About how long did it take the worm to move to its final location?
- 2. Calculate** How far could the worm move in 10 min?
- 3. Infer** How might worm movement differ if muscles on one side of its body were damaged?

*Data obtained from: Gray, J. and H.W. Lissmann. 1964. The locomotion of nematodes. *Journal of Experimental Biology* 41:135–154.



Reproduction Roundworms reproduce sexually. The females produce eggs, and the males, which often are smaller than the females, produce sperm. Fertilization is internal. In free-living roundworms, larvae hatch from the fertilized eggs, then grow into adults. In parasitic roundworms, development often is more complicated, involving one or more hosts or different locations in the host's body.

The adult roundworm *Caenorhabditis elegans* (*C. elegans*), shown in **Figure 25.8**, contains only 959 cells; zygotes mature to adults in just three days. These characteristics make it an extremely important subject of research on development, aging, and genetics. *C. elegans* was the first multicellular organism to have its entire genome sequenced. The *C. elegans* genome contains 97 million DNA bases encoding over 19,000 different genes. See the BioDiscoveries feature at the end of this chapter to learn more about *C. elegans*.

 **Reading Check Explain** why the features of *C. elegans* make it a good subject for research.

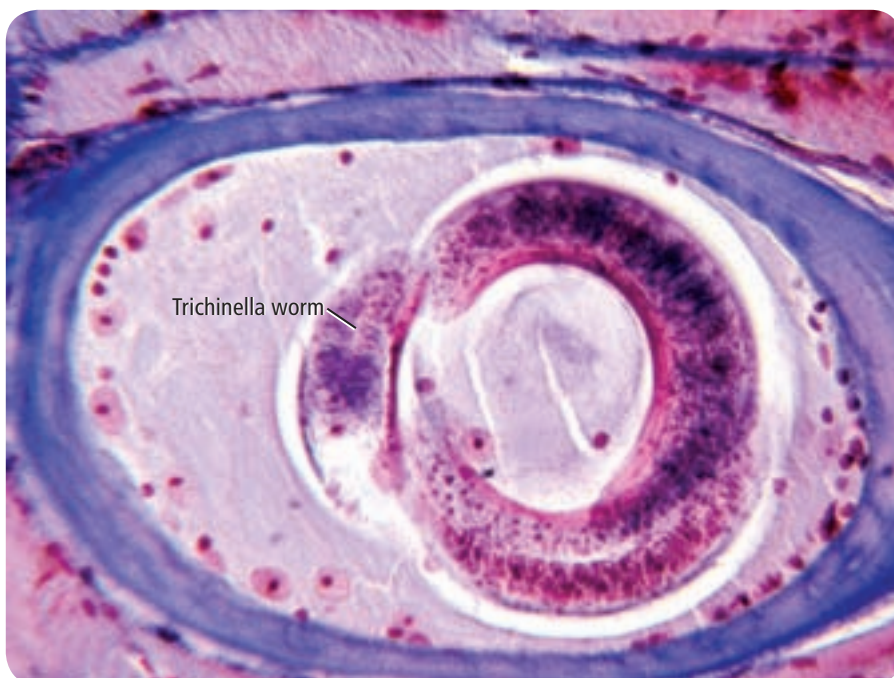
Diversity of Roundworms

Of the 20,000 known roundworm species, approximately half are parasites. These parasitic roundworms cause a variety of diseases in plants and animals, including humans. Many of these diseases in humans are the result of carelessness, a lack of personal hygiene, or poor sanitation.

Trichinella worms A disease called **trichinosis** (trih keh NOH sis) can be contracted by eating raw or undercooked pork and pork products, or wild game infected with the larvae of *Trichinella*, like the one shown in **Figure 25.9**. After ingestion by a host organism, the worms mature in one to two days. Female worms with fertilized eggs burrow into the intestinal walls of humans, pigs, and other mammals. After the eggs hatch, the larvae burrow into muscles where they form cysts, causing muscle pain. Trichinosis can be prevented by cooking meat properly.



■ **Figure 25.8** *C. elegans* is the subject of much genetic research. With comparatively few cells and rapid development, scientists can easily research developmental changes.



LM Magnification: 400×

■ **Figure 25.9** A trichinella worm larva is seen curled up inside of a cyst (purple) in pig muscle.

Infer A person with trichinosis might have what kind of physical symptoms?



Hookworms



Ascarid worms



Pinworm

LM Magnification: 2.5X


(left) Centers for Disease Control, (center) Sinclair Stammers/SPL/Photo Researchers, (right) Lester V. Bergman/CORBIS

■ **Figure 25.10** Hookworms, ascarid worms, and pinworms all might be contracted from contaminated soil.

Identify What feature can you see in the photos that all of these worms share?

Hookworms Hookworm infections are common in warm climates when people go barefoot on contaminated soil. When a hookworm, shown in **Figure 25.10**, contacts bare human skin, it cuts its way inside, travels in the bloodstream to the lungs, and then to the windpipe, or esophagus, where it is coughed up and swallowed. The parasite then moves to the small intestine, where it attaches to intestinal walls and feeds on blood and other tissue. Hookworm infection can be prevented by wearing shoes.

Ascarid worms The most common worm infection in humans is ascariasis (AS kuh RI uh sus), which is caused by ascarid (AS kuh rid) worms like the ones shown in **Figure 25.10**. Eggs of ascarid worms are found in soil in subtropical and tropical areas. They enter the human body through the mouth and live in the intestine. Infection can result when unwashed vegetables from contaminated soil are eaten or when hands contaminated with infected soil are put in the mouth, as young children are likely to do. Infection by ascarid worms can be controlled by carefully washing vegetables and hands.

 **Reading Check Explain** how humans can prevent infection from hookworms and ascarid worms.

Pinworms **Figure 25.10** shows a pinworm—the most common nematode parasite in humans in the United States. The highest incidence of infection occurs in children. At night, female pinworms living in the intestine move out of the anus and lay eggs on nearby skin. When the skin is scratched because of the itching caused by pinworm activity, the eggs are transferred to hands and then to any surface that is touched. These eggs can survive for up to two weeks on surfaces and are ready to hatch if another person ingests them. This infection can spread quickly among children who put toys and other objects in their mouths.

VOCABULARY

WORD ORIGIN


Nematode

nemato—prefix; from Greek—meaning *thread*

—*ode* suffix; from the Greek word *oeides*, meaning *similar to*.

Filarial worms Elephantiasis (el uh fun TI uh sus) is a disease caused by filarial (fuh LER ee uhl) worms—roundworm parasites that live in tropical areas. A mosquito is the intermediate host of filarial worms. When a mosquito sucks blood from a person who is infected with this roundworm, worm embryos are passed into the insect’s bloodstream. The embryos grow into larvae, which then are passed to another person when the mosquito bites again. Adult worms accumulate in the lymphatic system and obstruct the flow of lymph—the tissue fluid in the spaces between cells. This fluid builds up in tissue, causing legs and other body regions to enlarge. Controlling mosquitoes and using mosquito netting at night can aid in preventing this disease.

Another disease caused by a filarial worm—heartworm—is found in dogs and cats throughout the United States. Heartworms are transmitted to dogs and cats through mosquito bites. Once in the bloodstream, the worms travel to the heart and block the flow of blood. Regular doses of oral medications prevent heartworm in dogs and cats.

 **Reading Check Identify** In what parts of the human body do pinworms and filarial worms live?

Nematodes in plants Some species of roundworms cause diseases in plants. Nematodes can infect and kill pine trees, soybean crops, and food plants such as tomatoes. When they infect plant roots, as shown in **Figure 25.11**, they damage the plant.

Most species of nematodes are either harmless or beneficial to plants. Certain nematodes are used to control the spread of cabbage worm caterpillars, Japanese beetle grubs, and many other pests of crop plants. Spraying a solution of nematodes and water on areas that are infested with crop pests is most effective when the targeted pest is at the stage in its life cycle when it lives in the soil.

Connection to Health In addition to treating plant pests, nematodes are used to control pests of humans and animals. Nematodes eat flea larvae, controlling the flea population in yards. This reduces or eliminates exposure of humans and animals to traditional chemicals used to treat flea infestations.

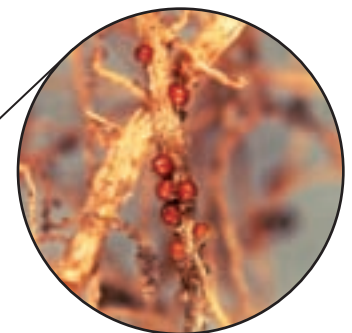
■ **Figure 25.11** The growth of the vascular system of plants can be slowed down when nematodes move into the roots and form cysts.



Potato plant without nematodes



Potato plant with nematodes



Nematode cysts on roots

LM Magnification: 100×



■ **Figure 25.12** Rotifers have two rings of cilia at their anterior end.

Rotifers

Rotifers are tiny animals only about 0.1 mm to 0.5 mm in length. The phylum Rotifera, meaning *wheel-bearer*, gets its name from the rings of cilia around the mouths of the animals. About 1800 species of rotifers have been studied, mostly from freshwater habitats including ponds, streams, and lakes. It would not be unusual to find 40 to 500 rotifers in a liter of pond water. A few species are marine. Refer back to the evolutionary tree in **Figure 25.7** and see that, although rotifers and roundworms occupy separate branches, both are pseudocoelomates.

Rotifer features and movement Rotifers are similar to roundworms because they have bilateral symmetry and are pseudocoelomates with a gut open at both ends. Unlike roundworms, rotifers move through the water by means of their ciliated wheel-like structures, which are shown in **Figure 25.12**. The posterior end of a rotifer generally has “toes” and glands that secrete an adhesive material that enables a rotifer to attach itself to a surface in the water.

Organ systems of rotifers Rotifers feed by using cilia to gather protists and organic materials into a complete digestive tract, which includes a mouth and an anus. Like other pseudocoelomates, rotifers exchange gases and excrete metabolic wastes by diffusion through body walls. Sensory structures include sensory bristles and eyespots on the head. Some rotifers reproduce sexually, while others have complex life cycles involving diploid eggs producing diploid females and haploid eggs producing haploid males. These life cycles are dependent on environmental conditions, such as spring rains, frost, or the presence of stagnant water.

John Walsh/Photo Researchers

Section 25.2 Assessment

Section Review

- ▶ Roundworms are closely related to flatworms, but roundworms have an evolutionary adaptation related to their gut.
- ▶ Roundworms, like flatworms, have a limited number of organs and systems.
- ▶ Roundworms are either free-living or parasitic.
- ▶ Roundworms cause many human and plant diseases.
- ▶ Rotifers are pseudocoelomates that appear on a different branch of the evolutionary tree than roundworms.

Understand Main Ideas

1. **MAIN Idea** Describe the evolutionary adaptation of the digestive tract of roundworms.
2. **Compare and contrast** the features of flatworms and roundworms.
3. **Explain** how roundworms make their distinctive thrashing movements.
4. **Compare and contrast** the various ways humans might risk contracting roundworm parasites.

Think Scientifically

5. **Hypothesize** Imagine that you are digging in your garden and find some tiny threadlike animals making thrashing movements. Make a hypothesis about what these animals might be. Explain your answer.
6. **MATH in Biology** Make a circle graph that shows the number of roundworm species known compared to the estimated number of roundworm species that might actually exist.