27–2 Roundworms

Members of the phylum Nematoda, also known as roundworms, are among the most numerous of all animals. It is difficult to imagine how many live around us. A single rotting apple can contain as many as 90,000 roundworms. A cubic meter of garden soil can be home to more than a million!

What Is a Roundworm?

Roundworms are slender, unsegmented worms with tapering ends. They range in size from microscopic to a meter in length. Most species of roundworms are free-living, inhabiting soil, salt flats, aquatic sediments, and water, from polar regions to the tropics. Many others are parasitic and live in hosts that include almost every kind of plant and animal.

Like flatworms, roundworms develop from three germ layers. However, roundworms have a body cavity between the endoderm and mesoderm tissues. Because this cavity is lined only partially with tissue derived from the mesoderm, it is called a **pseudocoelom** (soo-doh-SEE-lum), which means "false coelom." Observe the pseudocoelom in **Figure 27–7.**

Also, unlike most flatworms, roundworms have a digestive tract with two openings. This body plan is often called a tube-within-a-tube. The inner tube is the digestive tract, and the outer tube is the body wall. This arrangement makes digestion in roundworms very different from that in flatworms because food moves in one direction through the digestive tract. Any material in the food that cannot be digested leaves through the anus. The **anus** is the posterior opening of the digestive tract.

Roundworms are unsegmented worms that have pseudocoeloms and digestive systems with two openings—a mouth and an anus.

Guide for Reading

Key Concepts
- What are the defining features of roundworms?
- What roundworms are important in human disease?

Vocabulary
pseudocoelom
anus

Reading Strategy: Using Visuals As you read, write a statement explaining how each illustration or photograph reinforces or enhances the content of the section.

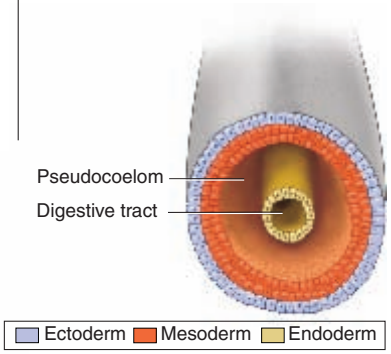

Figure 27–7 **Roundworms such as hookworms are unsegmented worms that have a pseudocoelom and a digestive system with a mouth and an anus.** Roundworms develop from three germ layers, and a pseudocoelom forms between the endoderm and mesoderm layers.

SECTION RESOURCES

Print:
- ***Teaching Resources,*** Lesson Plan 27–2, Adapted Section Summary 27–2, Section Summary 27–2, Worksheets 27–2, Section Review 27–2
- ***Reading and Study Workbook A,*** Section 27–2

Technology:
- ***iText,*** Section 27–2
- ***Transparencies Plus,*** Section 27–2

Section 27–2

1 FOCUS

Objectives

27.2.1 ***Describe*** the defining features of roundworms.
27.2.2 ***Describe*** form and function in roundworms.
27.2.3 ***Identify*** roundworms that are important in human disease.

Guide for Reading

Vocabulary Preview

Have students write the Vocabulary words, dividing each into its separate syllables as best they can. Remind students that each syllable usually has only one vowel sound. The correct syllabications are pseu•do•coe•lom and a•nus.

Reading Strategy

Before students read, have them skim the section to find the boldface Key Concepts. Ask students to copy the sentences onto separate sheets of paper. Then, as they read, they should make notes of details that support each Key Concept.

2 INSTRUCT

What Is a Roundworm?

Use Visuals

Figure 27–7 Direct students' attention to the cross section of a roundworm. Then, have them compare this cross section with the one shown in Figure 27–1 on page 683. Ask: **What is the main difference between the body plan of a flatworm and the body plan of the roundworm?** *(In a flatworm, there is no space between the endoderm tissue and the mesoderm tissue. In the roundworm, there is a space between those two tissues.)* Point out that this space, or body cavity, is the pseudocoelom of the roundworm. Ask: **What is "false" about a pseudocoelom?** *(A pseudocoelom is "false" because it is only partially lined with mesoderm tissue.)* **What part of the pseudocoelom is not lined with mesoderm tissue?** *(The inner boundary of the cavity)* L2 L3

Form and Function in Roundworms

Build Science Skills

Comparing and Contrasting Set up a classroom display of live flatworms and roundworms so that students can observe and compare the two groups of animals. An appropriate flatworm is a planarian; vinegar eels are roundworms that make excellent subjects for observation. Place several planarians in a small amount of pond water or aquarium water in a petri dish. Have students use a hand lens or a stereo microscope to observe these animals move. Place a few drops of vinegar eel culture in a depression slide or on a plain microscope slide. Do not use a coverslip. Have students observe the slide under low power. Then, ask: **How would you describe the movement of the planarians?** *(They glide through the water or along the surface of the petri dish.)* **How would you describe the movement of the roundworms?** *(They move with a rapid, jerky motion.)* L2

Roundworms and Human Disease

Build Science Skills

Comparing and Contrasting Have students make a compare/contrast table to organize the information they learn about roundworms and human disease. Column heads should include Parasite, Disease, and Characteristics. L2

Figure 27–8 **Parasitic roundworms include trichinosis-causing *Trichinella* worms (top) and hookworms (inset).** *Trichinella* worms reproduce in the intestines of their host and then form cysts in the muscle tissue. Hookworms affect as many as one quarter of the world's population. They suck the host's blood from inside the intestines, weakening the host.

Form and Function in Roundworms

Roundworms have specialized tissues and organ systems that carry out essential physiological functions. In general, the body systems of free-living roundworms tend to be more complex than those of parasitic forms.

Feeding Many free-living roundworms are predators that use grasping mouthparts and spines to catch and eat other small animals. Some soil-dwelling and aquatic forms eat algae, fungi, or pieces of decaying organic matter. Others digest the bacteria and fungi that break down dead animals and plants.

Respiration, Circulation, and Excretion Like flatworms, roundworms exchange gases and excrete metabolic waste through their body walls. They have no internal transport system. Therefore, they depend on diffusion to carry nutrients and waste through their bodies.

Response Roundworms have simple nervous systems, consisting of several ganglia. Several nerves extend from ganglia in the head and run the length of the body. These nerves transmit sensory information and control movement. Roundworms have several types of sense organs. Some include simple structures that detect chemicals given off by prey or hosts.

Movement The muscles of roundworms extend the length of their bodies. Together with the fluid in the pseudocoelom, these muscles function as a hydrostatic skeleton. Aquatic roundworms contract these muscles to move like snakes through the water. Soil-dwelling roundworms simply push their way through the soil by thrashing around.

Reproduction Roundworms reproduce sexually, and most species have separate sexes—an individual is either male or female. Roundworms reproduce using internal fertilization. Usually, the male deposits sperm inside the female's reproductive tract. Parasitic roundworms often have life cycles that involve two or three different hosts or several organs within a single host.

CHECKPOINT *How do free-living roundworms that are predators obtain their food?*

Roundworms and Human Disease

Although most roundworms are free-living, the phylum is better known for species that parasitize their hosts, including humans. Parasitic roundworms, such as those in **Figure 27–8,** have been evolving relationships with other organisms for hundreds of millions of years. Unfortunately, this process has produced worms that cause a great deal of pain and suffering in humans. **Parasitic roundworms include trichinosis-causing worms, filarial worms, ascarid worms, and hookworms.**

UNIVERSAL ACCESS

Less Proficient Readers
Have students skim the subsection Roundworms and Human Disease. Then, ask them to begin a concept map about the topic by using the subsection heading as the first level and the subheadings as the second level. As they read, they should add a third level with details about the diseases. L1 L2

English Language Learners
Explain that the prefix *pseudo-* is used in a word students might come across in literature class: *pseudonym*, or "false name." Point out that authors sometimes publish under a pseudonym to protect their real identity. L1 L2

Advanced Learners
Encourage students to find out from a veterinarian whether the nematode *Dirofilaria immitis*, or dog heartworm, is a threat to dogs in your area. This parasite is spread by mosquitoes and then matures in the hearts of dogs and other animals. If untreated, infection is lethal. L3

Careers in Biology

Meat Inspector

Job Description: work with farms and meat-processing plants to ensure that all meat and poultry products use healthy animals, are processed in a sanitary manner, and are labeled truthfully with no harmful ingredients added; enforce government regulations to ensure that proper safety, sanitation, preservation, disposal, and packaging procedures are followed

Education: college courses in sanitation and public health; USDA certification

Skills: knowledge of food-borne illnesses, proper sanitation practices, and regulations; public relations skills for dealing with different people in the industry; patience and communication skills for educating the public; ability to work independently and with a team

Highlights: You help protect the safety of the public by working to eliminate food-borne illnesses. You inspect farms to make sure that sanitary procedures are followed.

Go Online PHSchool.com
For: Career links
Visit: PHSchool.com
Web Code: cbb-8272

Trichinosis-Causing Worms Trichinosis (trik-ih-NOH-sis) is a terrible disease caused by the roundworm *Trichinella*. Adult worms live and mate in the intestines of their hosts. Female worms carrying fertilized eggs burrow into the intestinal wall and then release larvae. These larvae travel through the bloodstream and burrow into organs and tissues, causing terrible pain for the host. The larvae form cysts and become inactive in the host's muscle tissue.

Trichinella completes its life cycle only when another animal eats muscle tissue containing these cysts. Two common hosts for *Trichinella* are rats and pigs. Humans get trichinosis almost exclusively by eating raw or incompletely cooked pork.

Filarial Worms Filarial worms, which are found primarily in tropical regions of Asia, are threadlike worms that live in the blood and lymph vessels of birds and mammals, including humans. They are transmitted from one primary host to another through biting insects, especially mosquitoes. In severe infections, large numbers of filarial worms may block the passage of fluids within the lymph vessels. This causes elephantiasis, shown in **Figure 27–9**, a condition in which the affected part of the body swells enormously.

CHECKPOINT *Describe the cause of elephantiasis.*

▲ **Figure 27–9** **Filarial worms are one kind of parasitic roundworm.** Elephantiasis, shown here in an advanced stage, is a disease caused by filarial worms.

Careers in Biology

- The occupational outlook handbook for a meat inspector suggests a BA/BS in agricultural science.
- Inspections of meat and enforcement of regulations help prevent trichinosis and other diseases caused by roundworms and other organisms. L2

Resources Have students who want additional information on this career contact the U.S. Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS), which has the responsibility for ensuring that meat, poultry, and egg products are safe, wholesome, and accurately labeled.

Go Online PHSchool.com

You can have students write a more extensive job description as well as list the educational requirements for a career in this field.

TEACHER TO TEACHER

I ask a local veterinarian to come into class and talk about parasitic roundworms and flatworms found in pets and local agricultural animals. The students are more interested in roundworms and flatworms when they are discussed in terms of their parasitic impact on mammals. You might also have students examine prepared slides of parasitic worms. These slides can be obtained from a biological supply house.

—*Steve Ferguson*
Biology Teacher
Lee's Summit High School
Lee's Summit, MO

Answers to . . .

CHECKPOINT *Free-living flatworms that are predators use grasping mouthparts and spines to catch and eat small animals.*

CHECKPOINT *Elephantiasis occurs when large numbers of filarial worms block the passage of fluids within the lymph vessels of a part of the body.*

27–2 (continued)

Use Visuals

Figure 27–10 Direct students' attention to the life cycle of the ascarid worm, and ask a student to read the annotations aloud. Then, ask: **Why is this worm classified as a parasite?** *(It takes nourishment and lives at the expense of its host, such as a human. The host gains nothing from the relationship.)* **In what part of the body does the parasite do the most damage?** *(In the small intestine)* L2

Use Community Resources

Invite a representative from a local health agency to address the class about some of the diseases caused by parasitic roundworms. A public health nurse could be asked to speak about human diseases caused by roundworms. A veterinarian, or a vet student, could be asked to talk about roundworms that cause diseases in domestic animals, including pets. Before the speaker arrives, have interested students research the topic and prepare a list of questions to ask. L2 L3

Research on *C. elegans*

Use Visuals

Figure 27–11 To help students understand the significance of the research on *C. elegans*, review such basics as the composition of DNA and the definitions of *genome, chromosome,* and *base pair*. Then, ask: **What does it mean to "sequence completely" the genome of this roundworm?** *(It means to determine the exact sequence of base pairs that make up each chromosome of the roundworm's DNA.)* Point out that the photo to the right in the figure shows a method by which biochemists study that sequence. L1

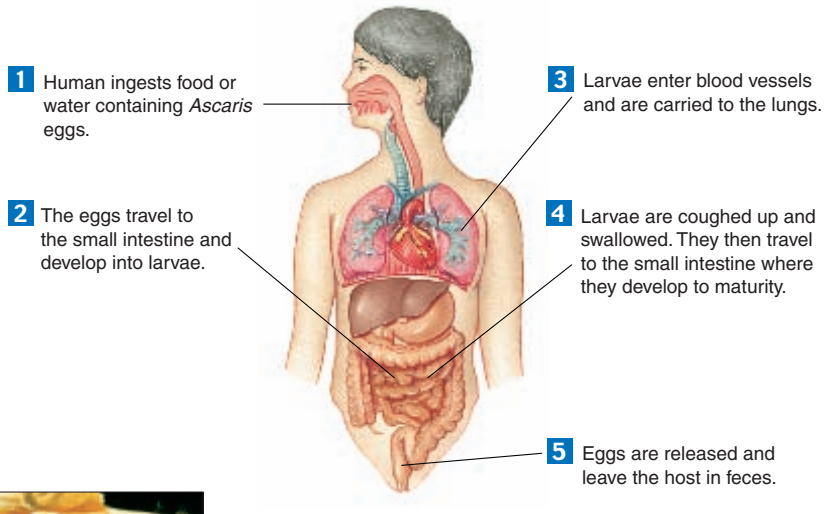

Figure 27–10 *Ascaris lumbricoides* fill the host's intestine. These worms absorb the host's digested food and can cause severe malnutrition. Blockage of the intestine can be severe enough, as shown in a pig intestine in the photograph, that it causes death. **Interpreting Graphics** ***What is the sequence of organs that* Ascaris *travels through in humans?***

Ascarid Worms *Ascaris lumbricoides* is a serious parasite of humans and many other vertebrate animals. It causes malnutrition in more than 1 billion people worldwide. It does this by absorbing digested food from the host's small intestine. *Ascaris lumbricoides* is commonly spread by eating vegetables or other foods that are not washed properly.

The life cycle of *Ascaris* is summarized in **Figure 27–10** above. *Ascaris* matures in the intestines of its host, such as a human, and can reach a length of almost 50 cm. In the intestine, the ascarid worms produce a large number of fertilized eggs, which leave the body in the feces. If food or water contaminated with these feces is eaten by another host, then the eggs hatch in the small intestine of the new host. The young worms burrow into the walls of the intestines and enter the surrounding blood vessels. The worms are carried in the blood until they reach the lungs. There, they spread into air passages and into the throat, where they are swallowed. Carried back into the intestines, they mature, and the cycle repeats itself.

Species that are closely related to *Ascaris* affect horses, cattle, pigs, chickens, dogs, cats, and many other animals. *Ascaris* and its relatives, which are collectively known as ascarids, have life cycles that are similar to one another. One of the reasons puppies are wormed while they are young is to rid them of the ascarid worms that affect dogs.

Hookworms Today, as many as one quarter of the people in the world are infected with hookworms. Hookworm eggs hatch outside the body of the host and develop in the soil. If they find an unprotected foot, they use sharp toothlike plates and hooks to burrow into the skin and enter the bloodstream. Hookworms travel through the blood of their host to the lungs and down to the intestines. There, they suck the host's blood, causing weakness and poor growth.

BIO INSIGHTS

FACTS AND FIGURES

A great lab animal

Caenorhabditis elegans has become such a well-established laboratory animal that more is known about its biology than that of almost any other organism. Because it is only 1 mm long when mature, *C. elegans* can be raised in small laboratory dishes. It takes only 12 hours from fertilization of the egg to hatching of the juvenile worm. In that time, successive cell divisions produce 671 cells, of which 113 are programmed to die, leaving 558 in the worm that hatches. This "programmed-to-die" characteristic is valuable to researchers studying the aging process. The precise number of 959 cells in the mature worm is adequate for studying the development of complex organ systems, but not so many that it is impossible to track the divisions of each cell. The pattern and number of cell divisions in *C. elegans* are unvarying, making it possible to study the effects of a single genetic mutation.

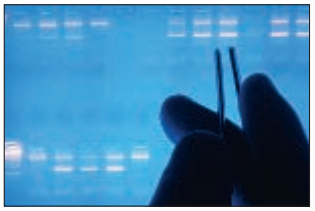

Figure 27–11 The DNA of *C. elegans,* a free-living roundworm, was the first genome of any multicellular animal to be sequenced completely. Biologists used techniques such as gel electrophoresis, shown above, to determine the exact sequence of base pairs in each chromosome. **Predicting** ***How might these results be important to our understanding of human development?***

Research on *C. elegans*

Roundworms have recently been making headlines in scientific research. The free-living roundworm *Caenorhabditis elegans*, or *C. elegans*, is shown in **Figure 27–11**, above left. This worm lives a modest existence feeding on rotting vegetation. However, this species is extraordinary because its DNA was the first of any multicellular animal's to be sequenced completely.

Scientists now have the sequence of all 97 million base pairs of *C. elegans* DNA. This is roughly one thirtieth the number of base pairs in human DNA. They have also traced the differentiation and development of each body cell of *C. elegans*, starting from a single fertilized egg. Researchers are still learning how this differentiation is controlled by the animal's DNA. This research will lead to a better understanding of how eukaryotes became multicellular. Information from *C. elegans* may also shed light on how genes make multicellular organisms both similar to and different from one another.

27–2 Section Assessment

1. **Key Concept** What is a roundworm?
2. **Key Concept** What are the parasitic roundworms?
3. Describe how humans become infected with the parasitic roundworm *Ascaris lumbricoides*.
4. How do hookworms enter the human body?
5. What have scientists already learned about *Caenorhabditis elegans*? What do they hope to learn in the future?
6. **Critical Thinking** **Problem Solving** What steps might individual people and governments take to reduce the spread of elephantiasis?

Thinking Visually

Creating a Poster
Choose a type of roundworm that can cause disease in humans. Design an educational poster that promotes prevention of the disease. Be sure to include information about how the roundworm infects humans.

27–2 Section Assessment

1. A roundworm is an unsegmented worm that has a pseudocoelom and a digestive system with two openings—a mouth and an anus.
2. Parasitic roundworms include trichinosis-causing worms, filarial worms, ascarid worms, and hookworms.
3. A human becomes infected by ingesting food or water containing *Ascaris* eggs.
4. Hookworms enter the human body by burrowing into the skin of a foot.
5. Students should mention basic features of the species as well as its DNA sequence. In the future, scientists hope to learn how that sequence controls differentiation.
6. Individuals could wear protective clothing and use insect repellant. Governments could implement strategies to reduce the numbers of biting insects.

3 ASSESS

Evaluate Understanding

Ask students to write a comparison of flatworms and roundworms. Tell them that they should compare both form and function, beginning with whether or not each type of invertebrate has a coelom.

Reteach

Have students write an article that might be published in the local newspaper about a person who has contracted trichinosis. Explain that they should describe the disease and how it was contracted, as well as the organism that causes the disease.

Thinking Visually

Discuss what makes an effective poster, and have students determine who their audience is, as well as the poster's objective. Posters should explain how one type of roundworm spreads to humans and how infection can be prevented.

Interactive Textbook

If your class subscribes to the iText, use it to review the Key Concepts in Section 27–2.

Answers to . . .

Figure 27–10 *Mouth, small intestine, blood vessels, lungs, throat, small intestine*

Figure 27–11 *Information from* C. elegans *may shed light on how an animal's DNA controls the animal's development from a single fertilized egg to a complex multicellular organism.*