What You’ll Learn

- You will compare and contrast the characteristics of sponges, cnidarians, flatworms, and roundworms.
- You will describe how sponges, cnidarians, flatworms, and roundworms are adapted to their habitats.

Why It’s Important

Sponges and cnidarians are two major groups of animals that are important to aquatic biomes. Flatworms and roundworms include many species that cause diseases that affect both plants and animals.

Reading Biology

Make a list of new vocabulary words that appear in the section previews. For any unfamiliar words, try to determine their origin. As you read, note how the words are used in the context of biology.

Biology Online

To find out more about sponges, cnidarians, flatworms, and roundworms, visit the Glencoe Science Web site.

science.glencoe.com

The sea anemone and the sponge (inset) share common traits. Both are invertebrates with simple body plans.
**26.1 Sponges**

*Is this red organism a plant or an animal? At first glance, it may look like a plant because it is colorful and doesn’t move from place to place, but it is an animal. How do you know this organism is an animal? Like snakes, spiders, and you, this organism is eukaryotic, multicellular, and heterotrophic—characteristics that place it in the animal kingdom. This sessile animal is a sponge that filters water through many small pores on the outside of its body.*

**What Is a Sponge?**

Sponges are asymmetrical aquatic animals that have a variety of colors, shapes, and sizes. Many are bright shades of red, orange, yellow, and green. Some sponges are ball shaped; others have many branches. Sponges can be as small as a quarter or as large as a door. Although sponges do not resemble more familiar animals, they carry on the same life processes as all animals. *Figure 26.1* shows a natural sponge harvested from the ocean.

**Sponges are pore-bearers**

Sponges are classified in the invertebrate phylum Porifera, which means *pore-bearer*. Of the 5000 described species of sponges, most live in the ocean; only 100 species can be found in freshwater environments.

No matter where sponges live, they are mainly sessile organisms. Because most adult sponges are sessile, they can’t travel in search of food. Sponges get their food by *filter feeding*, a method in which an organism feeds by filtering small particles of food from water as it passes by or through some part of the organism. How does a sponge get rid of its wastes? Find out by reading the *Inside Story.*

**Figure 26.1**

This heavy bath sponge is dark brown or black in its natural habitat. After harvest, it is washed and dried in the sun. When the process is complete, only a pale, lightweight skeleton remains.
A Sponge

Sponges have no tissues, organs, or organ systems. The body plan of a sponge is simple, being made up of only two layers of cells with no body cavity. Between these two layers is a jellylike substance that contains other cells as well as the components of the sponge’s internal support system. Sponges have four types of cells that perform all the functions necessary to keep them alive.

**Critical Thinking** Why are sponges classified as animals?

1. **Osculum** Water and wastes are expelled through the osculum, the large opening at the top of the sponge. A sponge no bigger than a pen can move more than 20 L of water through its body per day.

2. **Pore cell** Surrounding each pore is a single pore cell. Pore cells bring water carrying food and oxygen into the sponge’s body.

3. **Epithelial cell** Epithelial cells are thin and flat. They contract in response to touch or to irritating chemicals, and in so doing, close up pores in the sponge.

4. **Collar cell** Lining the interior of sponges are collar cells. Each collar cell has a flagellum that whips back and forth, drawing water through the pores of the sponge.

5. **Amoebocytes** Amoebocytes, located between the two cell layers of a sponge, carry nutrients to other cells, aid in reproduction, and produce chemicals that help make up the spicules of sponges.

6. **Spicules** Spicules are structures produced by other cells that form the hard support systems of sponges. Spicules are small, needlelike structures located between the cell layers of a sponge.
Cell organization in sponges

Like all animals, sponges are multicellular. Sponges have different types of cells that perform functions that help the animal survive. Read the Problem-Solving Lab on this page to find out how sponges survive in different environments. The activities of the different types of cells are coordinated in a sponge, but sponges do not have tissues like those found in other animals. Tissues are groups of cells that are derived from the ectoderm, endoderm, and mesoderm in the embryo. Sponge embryos do not develop endoderm or mesoderm, so they do not have cells organized into tissues.

However, the cells of a sponge are organized. If you took a living sponge and put it through a sieve, you would witness a rather remarkable event. Not only would you see the sponge’s many cells alive and separated out, but you also would be able to see these same cells coming together to form a whole sponge once again. It may take several weeks for the sponge’s cells to reorganize themselves.

Many biologists hypothesize that sponges evolved directly from colonial, flagellated protists, such as Volvox. More importantly, however, sponges demonstrate what appears to have been a major step in the evolution of animals—the change from a unicellular life to a division of labor among groups of organized cells.

Reproduction in sponges

Sponges reproduce both sexually and asexually. They reproduce asexually when fragments break off from the parent animal and form new sponges, or by forming external buds. Buds may break off, float away, and eventually settle and become separate animals. Sometimes the buds remain attached to the parents, forming a colony of sponges. You can see a colony in Figure 26.2.

Problem-Solving Lab 26-1

Why are there more species of marine sponges than freshwater sponges? Most sponges are marine. They live in a saltwater environment. Is there an advantage for sponges to live in a marine environment rather than in a freshwater environment? A series of statements is provided below. Read them over and then answer the questions that follow.

Analysis

A. The internal tissues of marine organisms are isotonic with their surroundings.
B. Oceans do not have problems with rapid changes in velocity (rate of flow) of water.
C. Young marine animals often spend the early part of their life cycles as free-floating organisms.

Thinking Critically

1. Using statement A, how might a freshwater environment vary? How might this be a disadvantage for freshwater sponges?
2. Using statement B, how might a freshwater environment vary? How might this be a disadvantage for freshwater sponges?
3. Using your collective answers, explain why few sponge species are found in freshwater environments.

Figure 26.2

Sponge colonies are the result of asexual reproduction. How would these sponges compare genetically? Could they be considered clones?
Most sponges reproduce sexually. Some sponges have separate sexes, but most sponges are hermaphrodites. A hermaphrodite (hur MAHF ruh dite) is an individual animal that can produce both eggs and sperm. Hermaphroditism increases the likelihood of fertilization in sessile or slow-moving animals. Eggs and sperm are formed from amoebocytes. During reproduction, sperm released from one sponge can be carried by water currents to another sponge, where fertilization may occur.

Fertilization in sponges may be either external or internal. A few sponges have external fertilization, in which the eggs and sperm are both released into the water; fertilization occurs outside the animal’s body. Most sponges have internal fertilization, in which eggs remain inside the animal’s body, and sperm are carried to the eggs in the flow of water. In sponges, the collar cells collect the sperm and transfer them to amoebocytes. The amoebocytes then transport the sperm to ripe eggs. Most sponges reproduce sexually through internal fertilization. The result is the development of free-swimming, flagellated larvae, shown in Figure 26.3.

Some freshwater sponges that live in temperate waters produce seedlike particles, called gemmules, in the fall. The adult sponges die over the winter, but the gemmules survive and grow into new sponges in the spring.

Figure 26.3
Sponges reproduce sexually when sperm from one sponge fertilize the eggs of another sponge.
Support and defense systems in sponges

Sponges are soft-bodied invertebrates, yet they can be found in waters as deep as 8500 m. You might think that the water pressure at such depths would flatten sponges, yet they all have an internal support system that enables them to withstand such pressure. Some sponges have sharp, hard spicules located between the cell layers. Spicules may be made of glasslike material or of calcium carbonate. Some species, such as the river sponge shown in Figure 26.4, have thousands of tiny, sharp, needle-like spicules that make them hard for animals to eat. Other sponges have an internal skeleton made of silica or of spongin, a fibrous proteinlike material. Sponges can be classified according to their spicules and/or skeletons.

Besides sharp spicules, some sponges may have other methods of defense. Some tropical sponges contain chemicals that are toxic to fishes and to other predators. Many sponges produce toxins that are poisonous to sharks. Scientists are studying sponge toxins to identify those that possibly could be used as medicines.

**Figure 26.4**
The spicules of freshwater sponges, such as this lake sponge, protect it from predators (a). Spicules of the deep-water glass sponges form a rigid skeleton (b).

---

**Understanding Main Ideas**

1. How does a sponge obtain food?
2. Explain how epithelial cells control filter feeding in sponges.
3. Describe the steps involved in the sexual reproduction of sponges.
4. What are the functions of amoebocytes in sponges?

**Thinking Critically**

5. What advantages for obtaining food do multicellular organisms such as sponges have over unicellular organisms? Explain.

**Skill Review**

6. **Making and Using Tables** Make a table listing the cell types and other structures of sponges along with their functions. For more help, refer to *Organizing Information* in the Skill Handbook.
What Is a Cnidarian?

Cnidarians (ni DARE ee uns) are a group of marine invertebrates made up of more than 9000 species of jellyfishes, corals, sea anemones, and hydras. Cnidarians can be found worldwide, but coral species generally prefer the warmer oceans of the South Pacific and the Caribbean.

Cnidarians have radial symmetry

Though cnidarians are a diverse group, all possess the same basic body structure, which supports the theory that they had a single origin. All cnidarians have radial symmetry.

A cnidarian’s body is made up of two cell layers with one body opening. The cell layers of cnidarians are organized into separate tissues with specific functions. Cnidarians have a simple nervous system, and both cell layers have cells that can contract as though they were muscles. The two cell layers of a cnidarian are derived from the ectoderm and endoderm of the embryo. The ectoderm of the cnidarian embryo develops into a protective outer layer of cells, and the endoderm is internal and adapted mainly to assist in digestion.

Cnidarians display only two basic body forms, which occur at different
stages of their life cycles. These two forms are the polyp and medusa, *Figure 26.5*. A **polyp** (PAHL up) is the stage with a tube-shaped body and a mouth surrounded by tentacles. A **medusa** (mih DEW suh) is the stage with a body shaped like an umbrella with tentacles hanging downward. The hydra has a typical polyp body form. How do hydras capture their food? You can find out by reading the *Inside Story* on the next page.

In cnidarians, one body form may be more conspicuous than the other. In jellyfishes, for example, the medusa stage is the dominant body form. The polyp stage of a jellyfish is small and not very noticeable. In hydras, the polyp stage is dominant, with a small and delicate medusa stage. The corals and sea anemones have only the polyp stage.

**Digestion in cnidarians**

Cnidarians are predators that capture or poison their prey with nematocysts. A **nematocyst** (nih MAT uh sihst) is a capsule that contains a coiled, threadlike tube. The tube may be sticky or barbed, and it may contain toxic substances. Nematocysts, located in stinging cells, are discharged like toy popguns, but much faster, in response to touch or chemicals in the environment. Prey organisms are then taken in for digestion.

In cnidarians, you can see the origins of a digestive process similar to that of animals that evolved later. Once captured by nematocysts on the ends of tentacles, prey is brought to the mouth by contraction of the tentacles. The inner cell layer of cnidarians surrounds a space called a **gastrovascular cavity** (gas troh VAS kyuh lur) in which digestion takes place. Cells adapted for digestion line the gastrovascular cavity and release enzymes over the newly captured prey. Any undigested materials are ejected back out through the mouth. You can observe a cnidarian feeding in the *MiniLab* on this page.

**MiniLab 26-1 Observing**

**Watching Hydra Feed** Hydras are freshwater cnidarians. They show the typical polyp body plan and symmetry associated with all members of this phylum. Observe how they capture their food.

**Procedure**

1. Use a dropper to place a hydra into a watch glass filled with water. Wait several minutes for the animal to adapt to its new surroundings. **CAUTION: Use caution when working with a microscope and glassware.**
2. Observe the hydra under low-power magnification.
3. Formulate a hypothesis as to how this animal obtains its food and/or catches its prey.
4. Place brine shrimp in a culture dish of freshwater to avoid introducing salt into the watch glass.
5. Add a drop of brine shrimp to the watch glass while continuing to observe the hydra through the microscope.
6. Note which structures the hydra uses to capture food.

**Analysis**

1. Describe how the hydra captures food.
2. Was your hypothesis supported or rejected?
3. Sequence the events that take place when a hydra captures and feeds upon its prey.
4. Explain how your observations support the fact that hydras have both nervous and muscular systems.

**Figure 26.5** The two basic forms of cnidarians are the polyp form (a), and the medusa form (b).
A Cnidarian

Cnidarians display a remarkable variety of colors, shapes and sizes. Some can be as small as the tip of a pencil. The flowerlike forms of sea anemones are often brilliant shades of red, purple, and blue. Most cnidarians go through both the polyp and medusa stages at some point in their life cycles.

Critical Thinking  How is having poisonous stinging cells an advantage for a sessile organism?

**Tentacles**  Surrounding the mouth of a cnidarian is a ring of flexible, tubelike tentacles. Tentacles can be long as in some jellyfishes, or short as in sea anemones and corals, but all are used for capturing food. Some jellyfishes have mouth arms that help direct food from the tentacles to the animal's mouth.

**Polyp**  A polyp is the sessile form of a cnidarian. Polyps have mouths that are directed upward. Examples of polyps include sea anemones, corals, and hydras.

**Medusa**  A medusa is the free-swimming form of a cnidarian. It possesses an umbrella-shaped, floating body with the mouth pointing down.

**Bud**  All cnidarians can reproduce both sexually and asexually. A polyp such as hydra reproduces asexually by budding. Genetically, a bud is a clone of its parent.

**Nematocysts**  Located primarily at the tips of the tentacles are stinging cells that contain nematocysts. When prey touches the tentacles, the stinging cells release nematocysts, coiled tubes that capture or paralyze the prey.
Cnidarians are classified into groups partly based on whether or not there are divisions within the gastrovascular cavity, and if there are, how many divisions are present.

**Oxygen enters cells directly**

Because of a cnidarian’s simple, two-cell-layer body plan, as shown in the Inside Story, no cell in its body is ever far from water. Oxygen dissolved in water diffuses directly into the body cells, and carbon dioxide and other wastes diffuse out of the cells directly into the surrounding water.

**Nervous regulation in cnidarians**

Cnidarians have a simple nervous system called a nerve net. A nerve net conducts nerve impulses from all parts of the cnidarian’s body, but there is no control center such as the brain found in other animals. The impulses from the nerve net bring about contractions of muscularike cells in the tentacles and body of a cnidarian. For example, when touched, a hydra reacts by contracting its muscularike cells.

**Reproduction in cnidarians**

All cnidarians have the ability to reproduce sexually and asexually. Sexual reproduction occurs in only one phase of the life cycle, usually the medusa stage, unless there is no medusa stage. Asexual reproduction may occur in either the polyp or medusa stage. Cnidarians that remain in the polyp stage, such as hydras, corals, and sea anemones, can reproduce sexually as polyps. Polyps reproduce asexually by a process known as budding, as shown in Figure 26.6.

The most common form of reproduction in cnidarians can be illustrated by the life cycle of a jellyfish, shown in Figure 26.7 on the next page. As you can see, the sexual medusa stage alternates with the asexual polyp stage, from generation to generation. Male medusae release sperm and female medusae release eggs into the water, where fertilization occurs. The resulting zygote develops into an embryo, and then into a larva. Recall that a larva is an intermediate stage in animal development. The free-swimming larva eventually settles and grows into a polyp, which, in turn, reproduces asexually to form new medusae. Even though these two stages alternate in a cnidarian life cycle, this form of reproduction is not alternation of generations as seen in plants because cnidarians are diploid animals in both medusa and polyp stages.

**Figure 26.6**
The main form of reproduction in polyps is budding. During this process, small buds grow as extensions of the body wall (a). In some species, such as corals, a colony develops as the buds break away and settle nearby (b).
Diversity of Cnidarians

Most of the 9000 described species of cnidarians belong to one of three classes: Hydrozoa, Scyphozoa, and Anthozoa.

Most hydrozoans form colonies

The class Hydrozoa includes two groups—the hydroids, such as hydra, and the siphonophores, including the Portuguese man-of-war. Most hydroids consist of branching polyp colonies that have formed by budding. The siphonophores include floating colonies that drift about on the ocean’s surface as well as colonies that form swimming medusae. Hydrozoans have open gastrovascular cavities with no internal divisions.

It’s difficult to understand how the organism shown in Figure 26.8 could be a closely associated group of individual animals. The Portuguese man-of-war, Physalia, is an example of a siphonophore hydrozoan colony. Each individual in a Physalia colony has a different function that helps the entire organism survive. For example, just one individual forms a large, blue, gas-filled float. Regulation of the gas in the float...
allows the colony to dive to lower depths or rise to the surface. Other polyps hanging from the float have different functions, such as reproduction and feeding. The polyps all function together for the survival of the colony.

**Scyphozoans are the jellyfishes**

Have you ever seen a jellyfish like the one shown in Figure 26.9? Some jellyfishes are transparent, but others are pink, blue, or orange. The medusa stage is dominant in this class. Like other cnidarians, scyphozoans have musclelike cells in their outer cell layer that can contract. When these cells contract together, the medusa contracts, which propels the animal through the water. The fragile and sometimes luminescent bodies of jellyfishes can be beautiful, but most people know about jellyfishes more by their painful stings. Jellyfishes can be found everywhere in the oceans, from arctic to tropical waters, and have been seen as deep as 1000 m. The gastrovascular cavity of scyphozoans has four internal divisions.

**Most anthozoans build coral reefs**

Anthozoans are cnidarians that exhibit only the polyp form. All anthozoans have many divisions in their gastrovascular cavities.

Sea anemones are anthozoans that live as individual animals. Sea anemones are thought to live for centuries. Some tropical sea anemones may have a diameter of more than a meter. Sea anemones can be found in tropical, temperate, and arctic seas.

Corals are anthozoans that live in colonies of polyps in warm ocean waters around the world. They secrete cuplike calcium carbonate (limestone) shelters around their soft bodies for protection. Colonies of many coral species build the beautiful coral reefs that provide food and shelter for many other marine species. When a coral polyp dies, the limestone skeleton it leaves behind adds a tiny piece to the structure of the reef. The living portion of a coral reef is a thin, fragile layer that grows on top of the skeletons left behind by...
previous generations. Coral reefs grow very slowly, about 2 mm per year. It took centuries to form the reefs found today in tropical and subtropical oceans. Find out more about the fragility of coral reefs by reading the Biology & Society feature at the end of this chapter. Corals that form reefs are known as hard corals. Other corals are known as soft corals because they do not build such structures.

A coral polyp extends its tentacles to feed, as shown in Figure 26.10. Although coral reefs are often found in relatively shallow, nutrient-poor waters, the corals thrive because they form a symbiotic relationship with tiny organisms called zooxanthellae, photosynthetic protists. The zooxanthellae (zoh oh zan THEH lee) supply oxygen and food to the corals while using carbon dioxide and waste materials produced by the corals. These protists are primarily responsible for the bright colors found in coral reefs. Because the zooxanthellae are free-swimming, they sometimes leave the corals. Corals without these protists often die. You can find out how corals respond to changing environmental conditions in the Problem-Solving Lab.

**Problem-Solving Lab 26-2**

**What ocean conditions limit the number of coral species?** All corals that build reefs have a mutualistic symbiotic relationship with zooxanthellae. Zooxanthellae within the coral carry on photosynthesis and provide some nutrients to the coral. Animals caught by the coral provide some nutrients to these protists.

**Analysis**

Graph A shows the number of species present in coral reefs at certain depths. Graph B shows the number of species present at different temperatures. All reef-building coral species have zooxanthellae. The effects of abiotic factors on organisms are usually related. For example, temperature and levels of illumination in an ocean vary with depth.

**Thinking Critically**

1. Identify the abiotic and biotic factors being studied in this ocean environment.

2. In Graph A, what seems to be the correlation between number of coral species present and depth? Use actual numbers from the graph in your answers.

3. In Graph B, what seems to be the correlation between number of species present and the temperature? Use actual numbers from the graph in your answer.

4. Bleaching occurs when coral polyps expel their zooxanthellae. Bleaching has been observed when water temperature exceeds 35°C. How might depth of coral be related to bleaching?

**Figure 26.10**

Corals feed by extending their tentacles outside their limestone cups (a), but if they are threatened, they can retreat back into the cups (b) until danger has passed.
Origins of Sponges and Cnidarians

As shown in Figure 26.11, sponges represent an old animal phylum. The earliest fossil evidence for sponges dates this group to the Paleozoic Era, about 700 million years ago. Scientists infer that sponges may have evolved directly from a group of flagellated protists that today resemble the collar cells of sponges.

The earliest known cnidarians date to the Precambrian Era, about 630 million years ago. Because cnidarians are soft-bodied animals, they do not preserve well as fossils, and their origins are not well understood. The earliest coral species were not reef builders, so reefs cannot be used to date early cnidarians. The larval form of cnidarians resembles protists, and because of this, scientists consider cnidarians to have evolved from protists.
Imagine the ultimate couch potato among living organisms—a worm that never has to move using its own power, is always carried by another organism, is surrounded by food that is already digested, and never has to expend much energy. This describes a parasite called a tapeworm. The parasitic way of life has many advantages.

**What Is a Flatworm?**

To most people, the word worm describes a long, spaghetti-shaped animal. Many animals have this general appearance, but now it is understood that many wormlike animals can be classified into different phyla.

The least complex worms belong to the phylum Platyhelminthes, Figure 26.12. These flatworms are acoelomates with thin, solid bodies. The most well-known members of this phylum are the parasitic tapeworms (class Cestoda) and flukes (class Trematoda), which cause...
diseases in other animals, among them frogs and humans. The most commonly studied flatworms in biology classes are the free-living planarians (class Turbellaria). You can learn about the evolutionary relationships among these classes of flatworms in the Problem-Solving Lab on this page. Flatworms range in size from 1 mm up to several meters. There are approximately 14,500 species of flatworms found in marine and freshwater environments and in moist habitats on land.

**Feeding and digestion in planarians**

A planarian feeds on dead or slow-moving organisms. It extends a tube-like, muscular organ, called the pharynx (FAH rinx), out of its mouth. Enzymes released by the pharynx begin digesting food outside the animal’s body. Then food is sucked into the gastrovascular cavity, where food particles are broken up. Cells lining the digestive tract obtain food by phagocytosis. Food is thus digested in individual cells.

**Nervous control in planarians**

Some flatworms have a nerve net, and others have the beginnings of a central nervous system. A planarian has a nervous system that includes two nerve cords that run the length of its body, as you can see in Figure 26.13, sensory pits that detect chemicals and movement in water, and eyespots that detect light and dark. At the anterior end of the nerve cord is a small swelling called a ganglion. Located in the head, the ganglion receives messages from the eyespots and sensory pits, then communicates with the rest of the body along the nerve cords. Messages from the nerve cords trigger responses in a planarian’s muscle cells. The nervous system enables a planarian to respond to the stimuli in its environment. Most of a planarian’s nervous system is located in its head—a feature common to other bilaterally symmetrical animals.

**Problem-Solving Lab 26-3 Predicting**

*Which Came First?* There are three classes of flatworms. Two classes are parasitic and the third is free-living. Free-living flatworms are grouped in the class Turbellaria. Trematoda and Cestoda are parasitic classes. These two classes often have humans or some other mammal as one of their hosts.

**Analysis**

Diagrams A, B, and C show a possible evolutionary relationship among the three classes. The class at the bottom of each diagram can be assumed to have evolved first.

![Diagram](image)

**Thinking Critically**

One of the three evolutionary patterns is correct. Pick the one that you consider to be correct. Defend your answer by explaining your reasoning. Include in your answer why the other two could not be correct.

![Figure 26.13](image)
A Planarian

If you’ve ever waded in a shallow stream and turned over some rocks, you may have found tiny, black organisms stuck to the bottom of the rocks. These organisms were most likely planarians. Planarians have many characteristics common to all species of flatworms. The bodies of planarians are flat, with both a dorsal and a ventral surface. All flatworms have bilateral symmetry.

Critical Thinking Why is having a head an advantage to a swimming animal?

1 Head Flatworms have a clearly defined head. The head senses and responds to changes in the environment.

2 Eyespots Eyespots are sensitive to light and enable the animal to respond to the amount of light present.

3 Sensory pits Located on the sides of the head, sensory pits are used to detect food, chemicals, and movements in the environment.

4 Flame cells Excess water is removed from the planarian’s body by a system of flame cells. The water from flame cells collects in tubules and leaves the body through pores on the body surface. Flame cells are so named because the constant movement of the cilia inside flame cells resembles the flickering of a candle’s flame.

5 Cilia Hairlike cilia are located on the ventral surface of planarians. Cilia help the worm to pull itself along.

6 Pharynx The pharynx is a muscular tube that can be extended outside the animal’s body through its mouth. It is used to suck food into the planarian’s gastrovascular cavity. Note that the mouth is a body opening located in the midsection of the planarian.
Reproduction in planarians

Study the body of a planarian in the Inside Story. How does a planarian reproduce? Like many of the organisms studied in this chapter, most flatworms are hermaphrodites. During sexual reproduction, individual planarians exchange sperm, which travel along special tubes to reach the eggs. Fertilization occurs internally. The zygotes are released in capsules into the water, where they hatch into tiny planarians.

Planarians can also reproduce asexually. When a planarian is damaged, it has the ability to regenerate, or regrow, new body parts. **Regeneration** is the replacement or regrowth of missing body parts. Missing body parts are replaced through mitosis. If a planarian is cut horizontally, the section containing the head will grow a new tail, and the tail section will grow a new head. Thus, a planarian that is damaged or cut into two pieces may grow into two new organisms—a form of asexual reproduction. Go to the BioLab at the end of this chapter to observe regeneration in planarians.

Feeding and digestion in parasitic flatworms

Although the basic structure of a parasitic flatworm is similar to that of a planarian, it is adapted to obtaining nutrients from inside the bodies of one or two hosts. Recall that a parasite is an organism that lives on or in another organism and depends upon that host organism for its food. Parasitic flatworms have mouthparts with hooks that keep the worm firmly attached to the insides of its host. Parasitic flatworms do not have complex nervous or muscular tissue. Because they are surrounded by nutrients, they do not need to move to seek out or find food.

Diversity of Flatworms

Planarians are free-living flatworms. Tapeworms and flukes are parasitic flatworms. These parasites live in the bodies of many vertebrates including dogs, cats, cattle, monkeys, and people.

Tapeworm bodies have sections

Some adult tapeworms that live in animal intestines can grow to more than 10 m in length. The body of a tapeworm is made up of a head and individual repeating sections called proglottids, shown in Figure 26.14. The knob-shaped head of a tapeworm is called a **scolex** (SKOH leks). A **proglottid** (proh GLAH tihd) is a detachable section of a tapeworm that contains muscles, nerves, flame cells, and male and female reproductive organs. Each proglottid may contain up to 100 000 eggs, and some tapeworms consist of 2000 proglottids.

**Figure 26.14**
The scolex is covered with hooks and suckers that attach to the intestinal lining of the host (a). Mature proglottids full of fertilized eggs are shed (b). Eggs hatch when they are eaten by a secondary host.

---

**WORD**

**scolex**

From the Greek word *skolek*, meaning “worm.” A scolex is the knob-shaped head of a tapeworm.
The life cycle of a fluke

A fluke is a parasitic flatworm that invades the internal organs of a vertebrate such as a human or a sheep. It obtains its nutrition by embedding itself in organs where it feeds on cells, blood, and other fluids of the host organism. Flukes have a complex life cycle that may include one, two, or more hosts.

Blood flukes of the genus *Schistosoma*, shown in Figure 26.15, cause a disease in humans known as schistosomiasis. Schistosomiasis is common in countries where farmers grow rice. Farmers must work in standing water in rice fields during planting and harvesting. Blood flukes are common where the secondary host, snails, also are found.
What Is a Roundworm?

Roundworms belong to the phylum Nematoda. They are widely distributed, living in soil, animals, and both freshwater and saltwater environments. More than 12,000 species of roundworms are known to scientists. Most roundworm species are free-living, but many are parasitic, including those shown in Figure 26.16. In fact, virtually all plant and animal species are affected by parasitic roundworms.

Roundworms are tapered at both ends. They have a thick outer covering that protects them from being eaten. However, they are not immune to predators, and some species have evolved mechanisms to escaped predators. For example, some roundworms can release a cloud of mucus that obscures their location, making it difficult for predators to find them.

Figure 26.16
Parasitic roundworms include Ascaris (a), Trichinella (b), hookworms (c), pinworms (d), and nematodes (e) that affect plants.
Roundworms are parasites in most organisms on Earth. Approximately half of the described roundworm species are parasites, and about 50 species infect humans.

**Roundworm parasites invade humans through a variety of methods**

*Ascaris* mainly infects children who swallow eggs when they put their soiled hands into their mouths or eat vegetables that have not been washed. The eggs hatch in the intestines, move to the bloodstream, and then to the lungs, where they are coughed up and swallowed to begin the cycle again.

Hookworms commonly infect humans in warm climates where people walk on contaminated soil in bare feet. Hookworms cause people to feel weak and tired due to blood loss.

Pinworms are the most common parasites in children. Pinworms invade the intestinal tract when children eat something that has come in contact with contaminated soil. Female pinworms lay eggs near the anus, and reinfection is common because the worms cause itching.

*Trichinella* worms cause a disease called trichinosis. These worms enter the body in undercooked pork. Find out what these roundworms look like in the *MiniLab* on this page. Trichinosis is not as common in the United States as it once was because of stricter meat inspection standards. However, *Trichinella* worms are microscopic and may not be seen during a visual inspection. Trichinosis can be controlled by cooking pork long enough to kill any worms that may be present. You can learn more about controlling trichinosis in the *Problem-Solving Lab* on the next page.

---

**MiniLab 26-2 Observing**

**Observing the Larval Stage of a Pork Worm** You can observe the larval stage of a pork worm (*Trichinella spiralis*) embedded within the muscle tissue of its host. It will look like a curled up hot dog surrounded by muscle tissue.

**Procedure**

1. Examine a prepared slide of pork worm larvae under the low-power magnification of your microscope.
2. Locate several larvae by looking for “spiral worms enclosed in a sac.” All other tissue is muscle.
3. Estimate the size of the larva in µm.
4. Diagram one larva. Indicate its size on the diagram.

**Analysis**

1. Describe the appearance of a pork worm larva.
2. Why might it be difficult to find larva embedded in muscle when meat inspectors use visual checking methods in packing houses to screen for pork worm contamination?
Roundworm parasites of other organisms

Nematodes can infect and kill pine trees, cereal crops, and food plants such as potatoes. They are particularly attracted to plant roots. About 1200 species of nematodes cause diseases in plants. They also infect fungi and form symbiotic associations with bacteria. Soil nematodes invade roots of plants grown for food, as you can see in Figure 26.17, and cause a slow decline of the plant.

Figure 26.17
Roundworms that are plant parasites usually enter the roots, forming cysts that affect the plant’s ability to absorb water.

Problem-Solving Lab 26-4
Interpreting Scientific Illustrations

How can the pork worm parasite be controlled?
*Trichinella spiralis*, the pork worm, is contracted when humans eat raw or undercooked pork products.

Analysis
This diagram shows the life cycle of the pork worm. A cyst is a protective covering that encloses the dormant larval stage.

Life Cycle of a Pork Worm

<table>
<thead>
<tr>
<th>Events in Pigs</th>
<th>Events in Humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pig is slaughtered</td>
<td>6. Humans eat pork with cysts.</td>
</tr>
<tr>
<td>2. Uncooked pig scraps with larvae are fed to pigs.</td>
<td>7. Larvae are released from cysts during digestion.</td>
</tr>
<tr>
<td>3. Larvae are released from cysts during digestion.</td>
<td>8. Larvae mature, mate, and produce thousands of new larvae.</td>
</tr>
<tr>
<td>4. Larvae mature, mate, and produce thousands of new larvae.</td>
<td>9. Larvae travel in blood stream to muscles and form cysts.</td>
</tr>
<tr>
<td>5. Larvae travel in blood stream to muscles and form cysts.</td>
<td></td>
</tr>
</tbody>
</table>

Thinking Critically
1. Would it be practical or impractical to disrupt the pork worm life cycle: At step 2? At step 4? At step 6? At step 9? Explain your answers.
2. Why doesn’t the arrow return to the top of the diagram after step 9 as it does after step 5?

Section Assessment

Understanding Main Ideas
1. Compare the body structures of roundworms and flatworms.
2. Why do parents teach children to wash their hands before eating?
3. Describe the method of infection of one human roundworm parasite.
4. Compare how *Ascaris* and *Trichinella* are contracted.

Thinking Critically
5. An infection of pinworms is spreading to children who attend the same preschool.

Make a list of precautions that could be taken to help prevent its continued spread.

Skill Review
6. Making and Using Tables  Make a table of the characteristics of four roundworm parasites, indicating the name of the worm, how it is contracted, the action of the parasite in the body, and means of prevention. For more help, refer to Organizing Information in the Skill Handbook.
Certain animals have the ability to replace lost body parts through regeneration. In regeneration, organisms regrow parts that were lost. This process occurs in a number of different phyla throughout the animal kingdom. Examples of animals that can regenerate include sponges, hydra, mudworms, sea stars, and reptiles. In this activity, you will observe regeneration in planarians. Planarians are able to form two new animals when one has been cut in half.

**Problem**
How can you determine if the flatworm *Dugesia* is capable of regeneration?

**Objectives**
*In this BioLab, you will:*
- **Observe** the flatworm, *Dugesia*.
- **Conduct** an experiment to determine if planarians are capable of regeneration.

**Materials**
- planarians
- petri dish
- springwater
- camel hair brush
- chilled glass slide
- binocular microscope
- marking pencil or labels
- single-edged razor blade

**Safety Precautions**
Always wear goggles in the lab. Use extreme caution when cutting with a razor blade. Wash your hands both before and after working with planarians.

**Skill Handbook**
Use the *Skill Handbook* if you need additional help with this lab.

**Preparation**

1. Obtain a planarian and place it in a petri dish containing a small amount of springwater. You can pick up a planarian easily with a small camel hair brush.
2. Use a binocular microscope to observe the planarian. Locate the animal’s head and tail region and its “eyes.” Use diagram A as a guide.
3. Place the animal on a chilled glass slide. This will cause it to stretch out.
4. Place the slide onto the microscope stage. While observing the worm through the microscope, use a single-edged razor to cut the animal in half across the midsection. Use diagram B as a guide.
5. Remove the head end and place it in a petri dish filled with spring-water. Label the dish with the date, your name, and the word “head.”

6. Add the tail section to a different petri dish and label it as in step 5, marking this dish “tail.”

7. Repeat steps 3-6 with a second flatworm and add the correct pieces to the proper petri dishes.

8. Place the petri dishes in an area designated by your teacher.

9. Prepare a data table that will allow you to record the appearance of your flatworms every other day for two weeks. Include diagrams and the number of days since starting the experiment in your data table.

10. Observe your animals under a binocular microscope and record observations and diagrams in your data table.

**ANALYZE AND CONCLUDE**

1. Knowledge To what phylum do flatworms belong? Are planarians free living or parasitic? What is your evidence?

2. Observing What new part did each original head piece regenerate? What new part did each original tail piece regenerate?

3. Observing Which section, head or tail, regenerated new parts faster?

4. Interpreting Are planarians able to regenerate new parts? Would regeneration be by mitosis or meiosis? Explain.

5. Thinking Critically What might be the advantage for an animal that can grow new body parts through regeneration?

6. Thinking Critically Would the term “clone” be suitable in reference to the newly formed planarians? Explain your answer.

**Going Further**

**Project** Design and carry out an experiment that would test this hypothesis: If regenerating planarians are placed in a warmer environment, then the time needed for new parts to form would decrease.

**Online** To find out more about regeneration, visit the Glencoe Science Web site.

science.glencoe.com
Coral reefs protect nearby shore areas from erosion by breaking up the energy of incoming waves. But worldwide, coral reefs are increasingly being damaged and destroyed.

**Physical Damage to Coral Reefs**  Hurricanes cause serious damage to coral reefs, as do large ships that run aground on reefs. Coral reefs lie close to the water’s surface, and make attractive anchoring sites for boats. But when an anchor is pulled up, it may rip away a piece of the reef. In some parts of the world, explosives are used to mine coral limestone for building materials and fertilizers. Tropical aquarium fishes are sometimes collected by poisoning with cyanide, which stuns fishes and makes them easier to collect, but also kills corals. Collectors take pieces of coral for jewelry and souvenirs.

**Damage from Disease**  In the 1970s, marine scientists began to realize that the world’s coral reefs were being attacked by diseases no one had seen before.

Black-band disease is caused by several species of cyanobacteria that combine to form a band of black filaments. This invading community slowly moves across the coral. White-band disease causes the living tissue of a coral to peel away from its skeleton; this may be caused by bacteria. Rapid-wasting disease, possibly caused by a fungus, forms white patches that consume not only the living tissue but also the top layers of the coral skeleton.

Many of the world’s coral reefs are losing their beautiful colors in a process called bleaching. The corals become gray or white in color. Some scientists hypothesize that coral bleaching is the result of a loss of zooxanthellae, the symbiotic protists that live in coral and give it much of its color as well as nutrients.

**Different Viewpoints**

It is not easy to tell whether microorganisms are causing the diseases or are attacking already damaged or ailing corals that have lost their natural defenses. Most researchers hypothesize that coral diseases are on the increase because environmental changes, such as pollution in coastal runoff, higher water levels, or changes in ocean temperatures, make corals more vulnerable to opportunistic diseases.
## Chapter 26 Assessment

### SUMMARY

#### Section 26.1 Sponges

**Main Ideas**
- A sponge is an aquatic, sessile, asymmetrical, filter-feeding invertebrate.
- Sponges are made of four types of cells. Each cell type contributes to the survival of the organism.
- Most sponges are hermaphroditic with free-swimming larvae.

**Vocabulary**
- external fertilization (p. 716)
- filter feeding (p. 713)
- hermaphrodite (p. 716)
- internal fertilization (p. 716)

#### Section 26.2 Cnidarians

**Main Ideas**
- All cnidarians are radially symmetrical, aquatic invertebrates that display two basic forms: medusa and polyp.
- Cnidarians feed by stinging or entangling their prey with cells called nematocysts, usually located at the ends of their tentacles.
- The three primary classes of cnidarians include the hydrozoans, hydras; scyphozoans, jellyfishes; and anthozoans, corals and anemones.

**Vocabulary**
- gastrovascular cavity (p. 719)
- medusa (p. 719)
- nematocyst (p. 719)
- nerve net (p. 721)
- polyp (p. 719)

#### Section 26.3 Flatworms

**Main Ideas**
- Flatworms are acoelomates with thin, solid bodies belonging to the phylum Platyhelminthes. They are grouped into three classes: free-living planarians, parasitic flukes, and tapeworms.
- Planarians have well-developed nervous and muscular systems. These systems are reduced in parasitic flatworms. Flukes and tapeworms have other structures adapted to their parasitic existence.

**Vocabulary**
- pharynx (p. 727)
- proglottid (p. 729)
- regeneration (p. 729)
- scolex (p. 729)

#### Section 26.4 Roundworms

**Main Ideas**
- Roundworms are pseudocoelomate, cylindrical worms with lengthwise muscles, relatively complex digestive systems, and two body openings.
- Roundworm parasites include parasites of plants, fungi, and animals, including humans. *Ascaris*, hookworms, *Trichinella*, and pinworms are roundworm parasites of humans.

**Vocabulary**
- none
1. Which of these is a type of cell found in sponges?
   a. epithelial cell  
   b. flame cell  
   c. stinging cell  
   d. nematocyst

2. An individual sponge is a hermaphrodite because it ________.
   a. reproduces by budding  
   b. can regenerate lost body parts  
   c. can produce both eggs and sperm  
   d. has both pore cells and stinging cells

3. Which of the following organisms obtain food by filter feeding?
   a. jellyfish  
   b. sponge  
   c. pinworm  
   d. tapeworm

4. To what phylum do marine invertebrates with radial symmetry and two body layers belong?
   a. Porifera  
   b. Platyhelminthes  
   c. Cnidaria  
   d. Cestoda

5. Both sponges and planarians have ________ larvae.
   a. sessile  
   b. polyp  
   c. free-swimming  
   d. budding

6. In cnidarians, medusae reproduce sexually to produce polyps, which in turn reproduce asexually to form ________.
   a. buds  
   b. larvae  
   c. hermaphroditic  
   d. new medusae

7. Sea anemones exhibit only the ________ type of body form.
   a. polyp  
   b. medusa  
   c. bud  
   d. colony

8. Two basic body forms are found in ________.
   a. sponges  
   b. flatworms  
   c. roundworms  
   d. cnidarians

9. Acoelomate worms called ________ have thin, solid bodies.
   a. roundworms  
   b. flatworms  
   c. nematodes  
   d. hookworms

10. Of the following, which is a pseudocoelomate animal?
    a. fluke  
    b. roundworm  
    c. tapeworm  
    d. planarian

11. Examine the diagram. The cell labeled ________ forms eggs and sperm.

12. A ________ is an organism that has both male and female reproductive organs.

13. Unlike sponges and cnidarians, flatworms have a clearly defined ________.

14. Parasitic worms have mouthparts with ________.

15. A ________ is a parasitic worm that uses a snail as an intermediate host and has a larval stage that can bore through the skin of humans.

16. Examine the diagram. The structure labeled ________ is used to detect food, chemicals, and movement in the environment.

17. Hydrozoans and anthozoans are classes of ________.

18. ________, located on the head of a ________, are sensitive to light.

19. If a(n) ________ is cut accidentally, it can ________ lost tissue.

20. In ________, eggs and sperm meet inside an animal’s body.
21. In what ways are cnidarians more complex than sponges?

22. You are examining a wormlike animal found in the intestine of a sheep. It has a head with tiny hooks. What kind of worm is it?

23. Of what advantage is hermaphroditism to a sessile animal?

24. Describe the features that would be important for a predator of jellyfishes.

25. Observing and Inferring While examining soil from the bottom of a pond, you notice tiny red worms wriggling aimlessly in your petri dish. What kind of worms are they?

26. Recognizing Cause and Effect At what points could the life cycle of a blood fluke be interrupted so that disease would be prevented?

27. Observing and Inferring Why is the phylogeny of cnidarians so little understood?

28. Comparing and Contrasting Both sponges and hydras are sessile organisms that cannot pursue prey. Compare their methods of obtaining food.

29. Concept Mapping Complete the concept map by using the following vocabulary terms: medusa, nematocyst, polyp.

**CD-ROM**

For additional review, use the assessment options for this chapter found on the Biology: The Dynamics of Life Interactive CD-ROM and on the Glencoe Science Web site.

**Interpreting Scientific Illustrations**

Use the diagram to answer the following questions.

1. Which part of the life cycle for a beef tapeworm is missing?
   - a. infection of the cow
   - b. infection of the grass
   - c. infection of the human host
   - d. infection of the tapeworm

2. How do the tapeworm eggs get into the grass?
   - a. from rainwater
   - b. from feces of infected cattle
   - c. from snails
   - d. from dead cows

3. Beef tapeworm larvae get into human hosts when humans ________.
   - a. eat beef
   - b. eat pork
   - c. walk barefoot
   - d. go swimming

4. Completing a Diagram By making a diagram similar to the tapeworm life cycle on this page, trace the steps of a Trichinella infection.