Section 26–2

1 FOCUS

Objectives

26.2.1 ***Explain*** what a sponge is.
26.2.2 ***Describe*** how sponges carry out essential functions.
26.2.3 ***Describe*** the ecology of sponges.

Guide for Reading

Vocabulary Preview

Have students write the Vocabulary terms, 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 cho•a•no•cyte, os•cu•lum, spic•ule, arch•ae•o•cyte, in•ter•nal fer•til•i•za•tion, lar•va, gem•mule.

Reading Strategy

Before students read the section, have them draw a line down the center of a piece of paper. Explain that as they read through the section, they should write down the main topics of the section on the left side of the line. On the right side, they should make notes of supporting details and examples.

2 INSTRUCT

What Is a Sponge?

Build Science Skills

Observing Divide the class into small groups, and give each group a natural sponge and a hand lens. Explain that they will be observing the nonliving part of a sponge; the living material was removed during processing. Ask students to observe the sponge with the hand lens and make drawings of what they see. Then, have students use a microscope to observe prepared slides of sections of a sponge. Have them make drawings of what they observe. L2

26–2 Sponges

Guide for Reading

Key Concepts
- Why are sponges classified as animals?
- How do sponges carry out essential functions?

Vocabulary
choanocyte
osculum
spicule
archaeocyte
internal fertilization
larva
gemmule

Reading Strategy: Using Visuals Before you read, preview **Figure 26–8** and **Figure 26–9.** For each figure, write a brief statement that summarizes the content of the illustration. Once you have read the section, explain how each illustration reinforces or enhances the content of the section.

Sponges are the simplest and probably the most unusual animals. Living on Earth for at least 540 million years, sponges are also the most ancient animals. Today, most sponges live in the ocean, from the Arctic and Antarctic regions to the tropics, and from shallow water to depths of several hundred meters. To humans, however, they are probably best known in their dried form—the natural sponges used for bathing.

What Is a Sponge?

Sponges are placed in the phylum Porifera (poh-RIF-ur-uh), which means "pore-bearers." This name is appropriate because sponges have tiny openings, or pores, all over their bodies, as shown in **Figure 26–7.** Sponges are sessile, meaning that they live their entire adult life attached to a single spot.

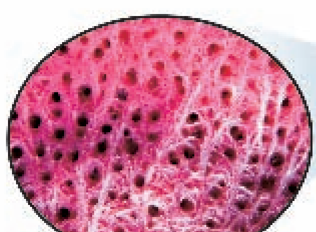
Given these unusual features, why are sponges considered animals? **Sponges are classified as animals because they are multicellular, heterotrophic, have no cell walls, and contain a few specialized cells.** Because sponges are so different from other animals, some scientists think that they evolved independently from all other animals. Other evidence suggests that sponges share a common ancestor with other animals but that they separated from this ancestor long before the other groups did.

CHECKPOINT *Why is the phylum name Porifera appropriate for sponges?*

Form and Function in Sponges

Sponges have nothing resembling a mouth or gut, and they have no tissues or organ systems. Simple physiological processes are carried out by a few specialized cells.

Figure 26–7 **Sponges are animals because they are heterotrophic and have specialized cells.** Sponges are probably the least typical of what we think of as animals. They grow in irregular shapes and live attached to the floor of oceans and freshwater bodies. Water enters the body of a sponge through small holes called pores (inset photo).

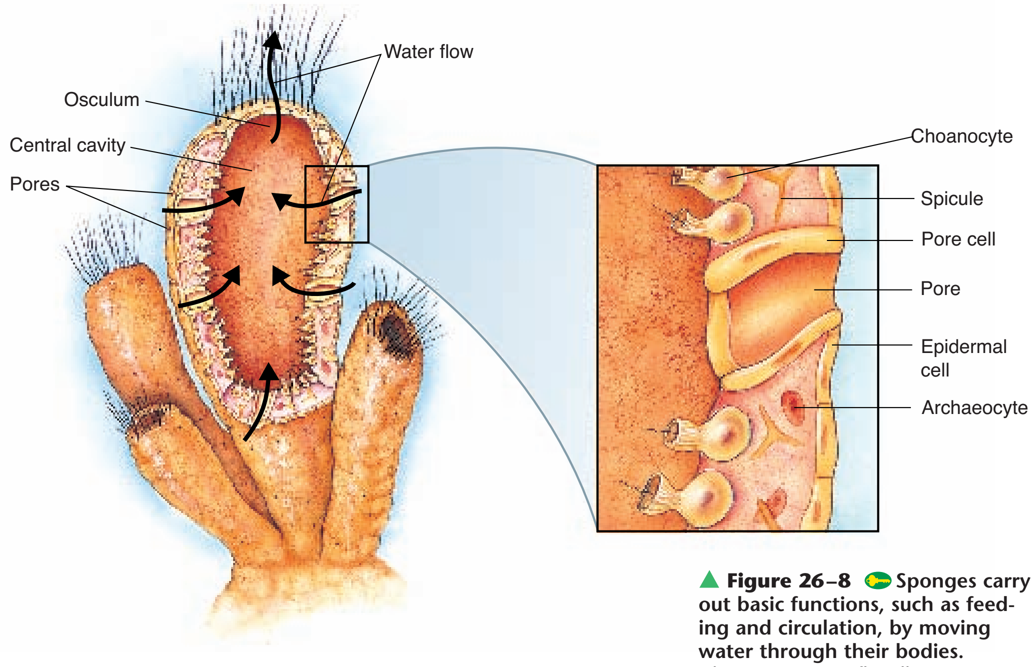


SECTION RESOURCES

TIME SAVER

Print:
- ***Teaching Resources,*** Lesson Plan 26–2, Adapted Section Summary 26–2, Adapted Worksheets 26–2, Section Summary 26–2, Worksheets 26–2, Section Review 26–2
- ***Reading and Study Workbook A,*** Section 26–2
- ***Adapted Reading and Study Workbook B,*** Section 26–2

Technology:
- ***iText,*** Section 26–2
- ***Presentation Assistant Plus,*** Section 26–2



▲ **Figure 26–8 Sponges carry out basic functions, such as feeding and circulation, by moving water through their bodies.** Choanocytes use flagella to move water through pores in the wall of the sponge and out through the osculum. As water moves through the sponge, food particles are filtered from the water, and wastes are removed from the sponge.

Body Plan Sponges are asymmetrical; they have no front or back ends, and no left or right sides. A sponge can be thought of as a large, cylindrical water pump. The body of a sponge, shown in **Figure 26–8**, forms a wall around a large central cavity through which water is circulated continually. **Choanocytes** (koh-AN-uh-sytz) are specialized cells that use flagella to move a steady current of water through the sponge. This water enters through pores located in the body wall. Water then leaves through the **osculum** (AHS-kyoo-lum), a large hole at the top of the sponge. **The movement of water through the sponge provides a simple mechanism for feeding, respiration, circulation, and excretion.**

Sponges have a simple skeleton. In harder sponges, the skeleton is made of spiny spicules. A **spicule** is a spike-shaped structure made of chalklike calcium carbonate or glasslike silica. Spicules are made by **archaeocytes** (ARK-ee-uh-sytz), which are specialized cells that move around within the walls of the sponge. Softer sponges have an internal skeleton made of spongin, a network of flexible protein fibers. These are the sponges that are harvested and used as natural bath sponges.

Feeding Sponges are filter feeders that sift microscopic food particles from the water. Digestion is intracellular, meaning that it takes place inside cells. As water moves through the sponge, food particles are trapped and engulfed by choanocytes that line the body cavity. These particles are then digested or passed on to archaeocytes. The archaeocytes complete the digestive process and transport digested food throughout the sponge.

Go Online
active art
For: Structure of a Sponge activity
Visit: PHSchool.com
Web Code: cbp-8262

Form and Function in Sponges

Address Misconceptions

Students may have the misconception that a simple or primitive body plan is inferior or less than optimal. Point out that sponges and other so-called primitive animals evolved hundreds of millions of years ago and have persisted through cataclysmic environmental changes until today. Ask: **What does the longevity of the sponge say about its body plan in terms of adaptability to its environment?** *(The longevity of the sponge is evidence that it is extremely well adapted to its environment.)* L1 L2

Use Visuals

Figure 26–8 Ask: **Does this sponge exhibit symmetry?** *(It doesn't exhibit symmetry; almost all sponges are asymmetrical.)* **Through what structures does water enter a sponge?** *(Pores)* **What do choanocytes use to move a current of water through a sponge?** *(Flagella)* **Through what structure does water leave the sponge?** *(The osculum)* **Is this sponge a harder or softer sponge?** *(It is a harder sponge, because it has spicules.)* L1 L2

Go Online
active art
For: Structure of a Sponge activity
Visit: PHSchool.com
Web Code: cbe-8269
Students learn about the structure of a sponge.

UNIVERSAL ACCESS

Inclusion/Special Needs

Display a natural sponge in its natural form. Then, have students compare it with the labeled drawing of a sponge in Figure 26–8. Call on students to relate what they see in the figure to what they observe in the natural sponge. Have students point to the osculum, central cavity, and pores in both the figure and the natural sponge. Then, touch the relevant parts of the natural sponge as you explain how water flows through it. L1

English Language Learners

Help students understand the meaning of the Vocabulary term *osculum* by explaining that the Latin word for "mouth" is *os* and that in Latin *osculum* means "little mouth." Explain that in English "to osculate" is a fancy way of saying "to kiss." Call on students to compare and contrast the form and function of a sponge's osculum with their own mouths. L1 L2

Answer to . . .

CHECKPOINT Porifera *means "pore-bearers," and sponges have pores all over their bodies.*

26–2 (continued)

Demonstration

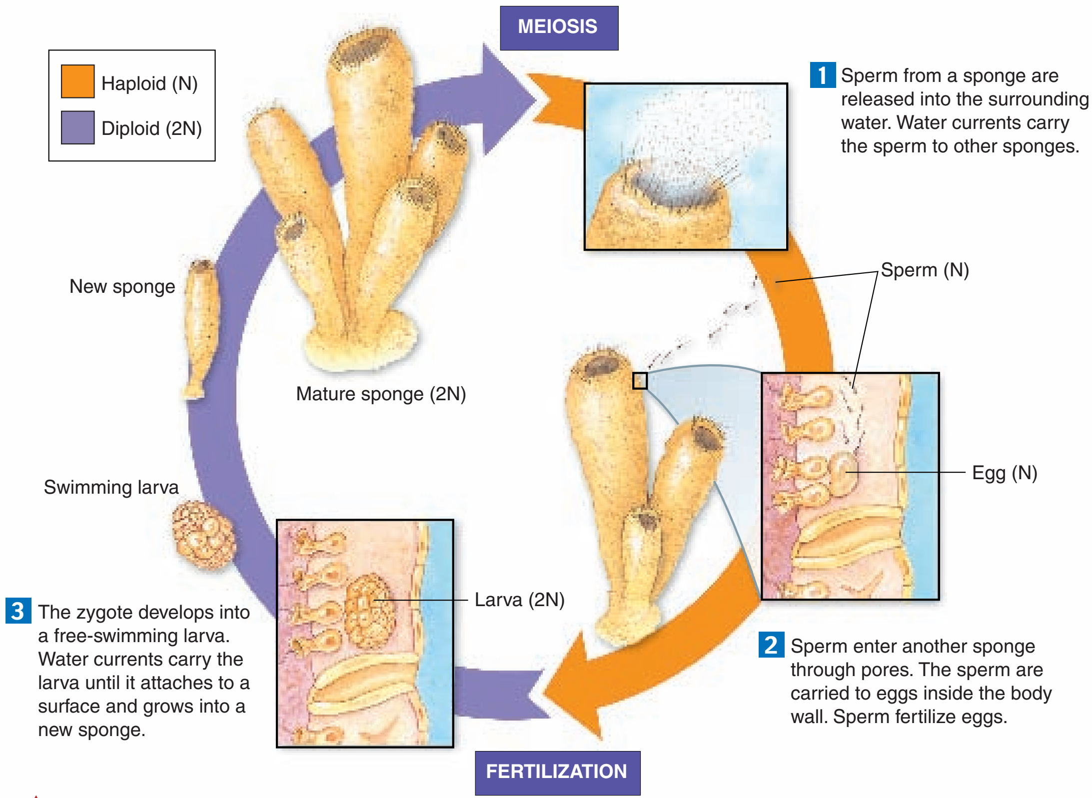
Emphasize that sponges rely on the movement of water through their bodies for the essential functions of feeding, respiration, circulation, and excretion. Demonstrate how much water a sponge can hold by comparing the water-holding capacity of a natural sponge and a synthetic sponge of about the same mass. Measure the mass of each sponge on a scale, and record the masses on the board. Then, soak each sponge in water, and measure and record their masses again. Students should observe that the natural sponge holds more water than the synthetic sponge. L2

Build Science Skills

Applying Concepts Help students understand respiration and excretion in sponges by having them recall what they have learned about diffusion. Ask: **What is diffusion?** *(It is a process by which molecules spread through a medium—liquid, gas, or solid—from regions of high concentration to regions of low concentration.)* Reinforce the idea that diffusion occurs across cell membranes. Then, ask: **How would you describe the process of diffusion in sponge respiration?** *(Oxygen diffuses into a cell through the cell membrane from the water circulating through the sponge, because the concentration of oxygen in the water is greater than that inside the cell.)* Explain that the opposite occurs with wastes in the process of excretion. L2

Use Visuals

Figure 26–9 After students have studied the illustration of sexual reproduction in a sponge, ask: **Is a mature sponge haploid or diploid?** *(Diploid)* **What cellular process produces sperm and egg cells?** *(Meiosis)* **How do sperm reach eggs, and where does fertilization occur?** *(Sperm are released into the water, and currents carry them into the pores of other sponges. Fertilization occurs in the wall of a sponge.)* **What is the immature stage of a sponge called?** *(A larva)* L2



▲ **Figure 26–9** Most sponges reproduce sexually, and many have internal fertilization. **Interpreting Graphics** ***Is an adult sponge haploid or diploid?***

Respiration, Circulation, and Excretion Sponges rely on the movement of water through their bodies to carry out body functions. As water moves through the body cavity, oxygen dissolved in the water diffuses into the surrounding cells. At the same time, carbon dioxide and other wastes, such as ammonia, diffuse into the water and are carried away.

Response Sponges do not have nervous systems that would allow them to respond to changes in their environment. However, many sponges protect themselves by producing toxins that make them unpalatable or poisonous to potential predators.

Reproduction Sponges can reproduce either sexually or asexually. The steps in sexual reproduction are diagrammed in **Figure 26–9.** In most sponge species, a single sponge forms both eggs and sperm by meiosis. The eggs are fertilized inside the sponge's body, in a process called **internal fertilization.** Sperm are released from one sponge and are carried by water currents until they enter the pores of another sponge. Archaeocytes carry the sperm to an egg. After fertilization, the zygote develops into a larva. A **larva** is an immature stage of an organism that looks different from the adult form. The larvae of sponges are motile and are usually carried by currents before they settle to the sea floor.

BIO INSIGHTS HISTORY OF SCIENCE

Plant or animal?

Because sponges are sessile and asymmetric, most common observers might think that a living sponge is some kind of a plant. In fact, sponges have traditionally been thought of as plants, which is how the ancient Greeks classified them. It wasn't until naturalists in the late 1700s described the flow of water through sponges that these organisms were recognized as some kind of animal.

Throughout the 1800s, most naturalists thought sponges were related to corals and other members of the cnidarian class Anthozoa. It was thought that sponges, like anthozoans, had only a polyp stage in their life cycle. Early in the twentieth century, sponges became generally accepted as constituting a phylum of their own, separate from all other animals. Phylum Porifera now includes about 5,000 recognized species in three classes.

Sponges can reproduce asexually by budding or by producing gemmules. In budding, part of a sponge breaks off of the parent sponge, settles to the sea floor, and grows into a new sponge. When faced with difficult environmental conditions, some sponges produce **gemmules** (JEM-yoolz), which are groups of archaeocytes surrounded by a tough layer of spicules. Gemmules can survive freezing temperatures and drought. When conditions become favorable, a gemmule grows into a new sponge.

Sexual reproduction—in sponges and other organisms—involves the joining of haploid gametes that have been produced by meiosis. Since the zygote contains genes from both parents, the new sponge is not genetically identical to either parent. Asexual reproduction, in contrast, does not involve meiosis or the joining of haploid gametes. Instead, the cells of the bud or gemmule, which are diploid, divide repeatedly by mitosis, producing growth. Asexual reproduction produces offspring that are genetically identical to the parent.

Ecology of Sponges

Sponges are important in aquatic ecology. Sponges have irregular shapes and many are large. Therefore, they provide habitats for marine animals such as snails, sea stars, and the shrimp in **Figure 26–10.** These are examples of commensalism. Sponges also form partnerships with photosynthetic bacteria, algae, and plantlike protists. These photosynthetic organisms provide food and oxygen to the sponge, while the sponge provides a protected area where these organisms can thrive. This relationship is an example of mutualism, since both partners benefit. Sponges containing photosynthetic organisms play an important role in the ecology and primary productivity of coral reefs.

Sponges usually live attached to the sea floor, where they often receive only low levels of filtered sunlight. Recently, scientists have found clues to the mystery of how organisms within the sponge get enough light to carry out photosynthesis. The spicules of some sponges look like cross-shaped antennae. Like a lens or magnifying glass, they focus and direct incoming sunlight to cells lying below the surface of the sponge—where symbiotic organisms carry out photosynthesis. This adaptation may allow sponges to survive in a wider range of habitats.

▲ **Figure 26–10** Sponges often provide habitats for other organisms. Observe how the sponge provides shelter for this snapping shrimp. **Inferring** *How might the sponge protect the shrimp from predators?*

26–2 Section Assessment

1. **Key Concept** What features do sponges share with all other animals?
2. **Key Concept** How do sponges use water to carry out essential functions?
3. Describe the different types of sponge skeletons.
4. **Critical Thinking** **Drawing Conclusions** Why would sponges be unable to live on land?

Focus on the BIG Idea

Interdependence in Nature
In Chapter 4, you learned about mutualism, commensalism, and other symbiotic relationships. Compare and contrast mutualism and commensalism, and explain how each is important in the life of a sponge.

26–2 Section Assessment

1. Sponges are heterotrophic, have no cell walls, and contain specialized cells.
2. The movement of water through the sponge carries needed materials, such as food and oxygen, and carries wastes away. Water also carries sperm to eggs.
3. The skeleton of many sponges is made of spiny spicules. Softer sponges have a skeleton made of flexible spongin.
4. Sponges depend on the movement of water for most functions, including feeding, respiration, circulation, excretion, and reproduction.

Ecology of Sponges

Using Visuals

Figure 26–10 Direct students' attention to the shrimp inside the sponge, and ask: **In what part of the sponge is the shrimp taking shelter?** *(The osculum)* **How does the sponge benefit from the shrimp's presence?** *(The sponge doesn't benefit.)* **Is the sponge hurt by the shrimp's presence?** *(The sponge is probably not hurt in any way.)* **What kind of symbiotic relationship is represented here?** *(Commensalism)* L2

3 ASSESS

Evaluate Understanding

Call on students at random to explain why sponges are considered animals and how sponges carry out the seven essential animal functions.

Reteach

Have students make their own drawing of Figure 26–8. Help them define each term in the labels and explain how each part of the sponge aids the organism in one of the seven essential functions.

Focus on the BIG Idea

In mutualism both species in the relationship benefit, whereas in commensalism one member benefits and the other is neither helped nor harmed. The symbiotic relationship between a sponge and an alga is an example of mutualism, in which the sponge receives food and oxygen. The symbiotic relationship between a sponge and a snapping shrimp is commensalism, in which the sponge does not benefit.

Interactive Textbook

If your class subscribes to the iText, use it to review the Key Concepts in Section 26–2.

Answers to . . .

Figure 26–9 *Diploid*

Figure 26–10 *By providing a place of concealment*

TECHNOLOGY & SOCIETY

After students have read this feature, you might want to discuss one or more of the following:

- Ask students to think about how corals evolved in a way that they contain a chemical that protects them from the sun. Students should apply their knowledge of natural selection to this example.
- Have students explain why it is important that a way to produce Sunscreen 855 in the laboratory was developed. Students should infer that biologists don't want to harvest corals to extract the chemical, because coral reefs are already under high threat worldwide.
- Discuss with students the importance of bioprospecting, as well as how the prospect of products from plants and animals argues for the continued maintenance of biodiversity. Students could brainstorm a list of products they think could be derived from other animals in the wild. Suggest that they think about adaptations animals have evolved that could be exploited for helpful products.

Research and Decide

For things that the product should do, students might mention protecting against a severe sunburn and preventing skin cancer. For things that the product should not do, students might mention that the sunscreen should not cause a skin rash and should not cause some kind of systemic allergic reaction or disease. For testing the different claims, students might suggest first carrying out experiments in which animals are tested with the sunscreen and then, if there are no evident harmful effects, devising controlled studies with human volunteers.

Go Online PHSchool.com

Students can research Sunscreen 855 on the site developed by authors Ken Miller and Joe Levine.

TECHNOLOGY & SOCIETY

Using Nature to Produce Sunscreen

One way of generating new medicines is to look for them in nature. Organisms of all kinds have been battling one another and their physical environment since life began. So, researchers can search for molecules that have been assembled and tested by the oldest process for generating new compounds on Earth—natural selection.

Natural UV Protection in Corals

One of these "new" molecules may be the world's first naturally produced sunscreen. Known as Sunscreen 855, this compound was discovered by researchers studying corals that live in shallow waters along Australia's Great Barrier Reef. During the low tide, these corals are exposed to the air and full sunlight. Investigators reasoned that these corals might have evolved some sort of protection against the damaging ultraviolet (UV) radiation of intense sunlight. Sure enough, their search turned up a UV-blocking compound in the tissues of these corals.

From Natural to Synthetic

After isolating and analyzing the compound in Sunscreen 855, the researchers learned that it was structurally different from the compounds used in synthetic sunscreens. They devised a way to produce it in the laboratory so that corals would not need to be harvested to make the sunscreen. Preliminary tests have shown that the sunscreen is highly efficient in absorbing radiation in the damaging UV-B region of the spectrum.

Sunscreen 855 is not sold in any drugstore—nor will it be for several years. Researchers are working with investors, lawyers, and businesspeople to test the new product for safety and effectiveness. If it passes final tests, Sunscreen 855 could be the best—and most natural—protection yet against the harmful effects of the sun.

Research and Decide

Use library or Internet resources to learn more about Sunscreen 855. Then, suppose that Sunscreen 855 were made into a product that people could buy. Make a list of things that the product should do. Make another list of things it should not do (such as harmful side effects it might cause). Describe how you would test these different claims.

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BIO INSIGHTS

FACTS AND FIGURES

Sunscreens and UV-B radiation

UV radiation makes up that part of the electromagnetic spectrum with wavelengths just shorter than those of visible light. People need some exposure to UV radiation for the production of vitamin D, which promotes healthy bones and teeth. But, excessive exposure causes skin damage and even cancer. UV radiation is divided into two regions: UV-A radiation has longer wavelengths than UV-B radiation. UV-B radiation is much more harmful, and most commercial suntan and sunscreen products absorb UV-B radiation. Sunscreen 855 has proven to be very efficient in absorbing and dissipating UV-B radiation. The development of this product is an example of bioprospecting, or biodiversity prospecting, which is the exploration of wild plants and animals for commercially valuable genetic and biochemical resources.