Section 1 Sponges

Objectives

- **Summarize** the general features of sponges. 8C TAKS 2
- **Describe** how sponge cells receive nutrients. 10A TAKS 2
- **Describe** how a sponge's body is structurally supported. 10A TAKS 2
- **Distinguish** between sexual and asexual reproduction in sponges. 10A TAKS 2

Key Terms

ostia
oscula
sessile
choanocyte
amoebocyte
spongin
spicule
gemmule

The Simplest Animals

Sponges are so unlike other animals that early naturalists classified them as plants. It wasn't until the mid-1800s that scientists using improved microscope technology began studying sponges closely. Scientists then realized that sponges are animals. The bodies of most sponges completely lack symmetry and consist of little more than masses of specialized cells embedded in a gel-like substance called mesohyl *(MEHZ oh hil)*. You could say that a sponge's body is somewhat like chopped fruit in gelatin. The chopped fruit represents the specialized cells, and the gelatin represents the mesohyl.

Sponge cells are not organized into tissues and organs. However, they do have a key property of all animal cells—cell recognition. A simple lab experiment can demonstrate that sponge cells can recognize other sponge cells. A living sponge can be passed through a fine silk mesh, causing the individual cells to separate. On the other side of the mesh, the individual sponge cells will recombine to form a new sponge.

Sponges have a body wall penetrated by tiny openings, or pores, called **ostia** *(AHS tee uh)*, through which water enters. The name of the phylum, Porifera, refers to this system of pores. Sponges also have larger openings, or **oscula,** through which water exits. You can see the many oscula of the sponge shown in **Figure 1.** Sponges are also **sessile** *(SEHS uhl)*. Early in their lives, sponges attach themselves firmly to the sea bottom or some other submerged surface, like a rock or coral reef. They remain there for life. Sponges can have a diameter as small as 1 cm (0.4 in.) or as large as 2 m (6.6 ft). 1

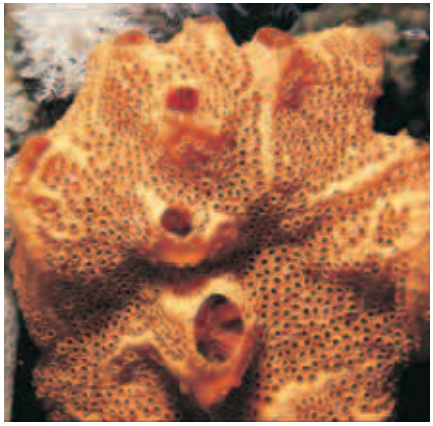


Figure 1 Sponge. The small openings in this sponge's body are ostia. The larger openings are oscula.

Most sponges are bag-shaped and have a large internal cavity. One or more oscula (singular, osculum) are located in the top of

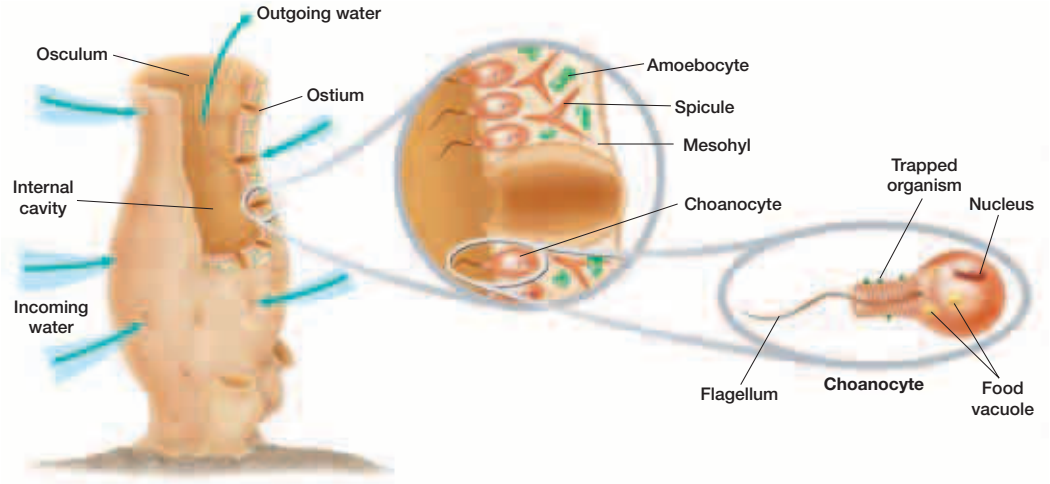
Evolutionary Milestone

1 Multicellularity

The bodies of all animals, including sponges (phylum Porifera), are multicellular—made of many cells. Although the sponge is composed of several different cell types, these cells show only a small degree of coordination with each other.

Figure 2 Sponge interior

Water enters the sponge through many small pores (ostia) in its body wall and exits through the osculum, an opening at the top of the sponge.



the body wall, as shown in **Figure 2.** Lining the internal cavity of a sponge is a layer of flagellated cells called **choanocytes** *(koh AN oh siets),* or collar cells. The flagella of these cells extend into the body cavity. As the flagella beat, water is drawn in through the pores in the body wall. The water is driven through the body cavity before it exits through the osculum.

As sea water passes through the sponge's body cavity, the collar cells function as sieves. These cells trap plankton and other tiny organisms in the small hairlike projections on the collar. The trapped organisms are then pulled into the interior of the collar cells, where they are digested intracellularly (within the cell). As sea water leaves the sponge, wastes are carried away in it. 1

How do the other sponge cells, such as those in the body wall, survive if the collar cells take in all of the food? The collar cells release nutrients into the mesohyl where other specialized cells, called *amoebocytes (uh MEE boh siets),* pick up the nutrients. **Amoebocytes** are sponge cells that have irregular amoeba-like shapes. They move about the mesohyl, supplying the rest of the sponge's cells with nutrients and carrying away their wastes. 1

Protistan Ancestors

The choanocytes of sponges very closely resemble a kind of protist called a choanoflagellate, shown in **Figure 3.** Ancient choanoflagellates are thought by many scientists to be the ancestors of sponges. Other free-swimming colonial flagellates closely resemble sponge larvae, however, and some scientists believe organisms similar to these other flagellates were the true ancestors of sponges. 2

Figure 3 Choanoflagellate. Ancient choanoflagellates similar to the one shown above may be the ancestors of sponges.

Real Life

What is a luffa sponge? A luffa sponge really isn't a sponge at all but a gourd. When dried, the fibrous material found in the gourd forms a "skeleton" similar to that of some sponges, and it can be used for many of the same purposes.

Comparing Structures *Obtain a natural sponge and a luffa sponge, and compare the nature of their "skeletons."* 8B

Sponge Diversity

As any snorkeler can tell you, brilliantly colored sponges abound in warm, shallow sea waters. Other marine sponges live at great depths, and a few species even live in fresh water. Rather than being a simple baglike shape, the body wall of some sponges, such as the azure vase sponge on the first page of this chapter, may contain hundreds of folds that are sometimes visible as fingerlike projections. These folds increase a sponge's size and surface area. 1 2

Sponge Skeletons

To prevent the sponge from collapsing in on itself, the sponge body is supported by a skeleton. A sponge's skeleton, however, does not have a fixed framework like a human skeleton does. Instead, the skeletons of most sponges are composed of a resilient, flexible protein fiber called **spongin**. A few sponges have skeletons composed of spicules. A **spicule** is a tiny needle composed of silica or calcium carbonate. Some sponges contain both spongin and spicules. These supporting structures are found throughout the mesohyl. 2

Taxonomists group sponges into three types based on the composition of their skeletons. Calcareous sponges have spicules composed of calcium carbonate. Glass sponges have spicules made of silica. Demosponges contain spongin. In some species the spongin is reinforced with spicules of silica. The three classes of sponges are shown in **Figure 4.** 2 3 4

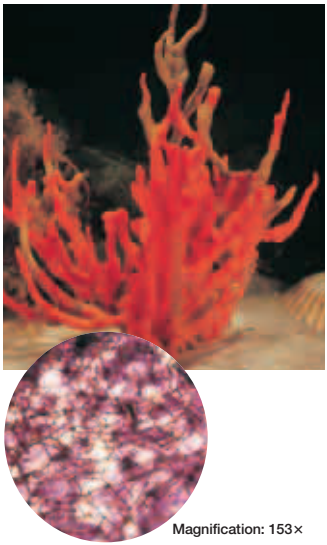
Figure 4 **Three types of sponges**

Sponges have skeletons made of spicules, spongin, or both.

Calcareous sponge

Glass sponge

Demosponge



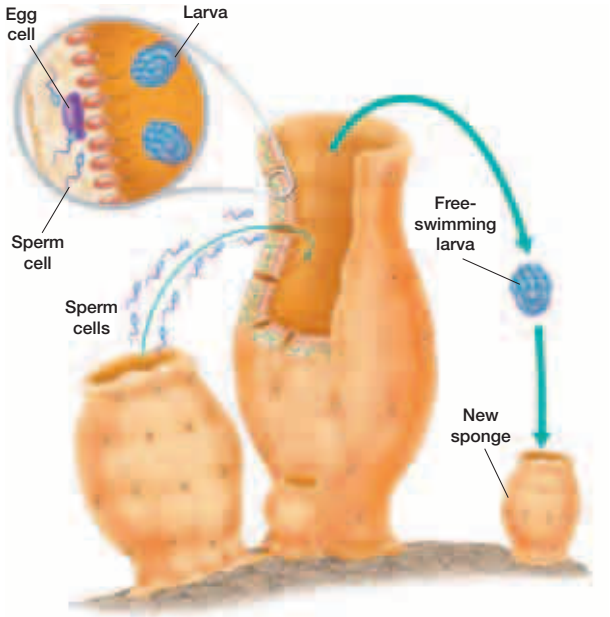
Reproduction

Sponges can reproduce asexually. A remarkable property of sponges is that they regenerate when they are cut into pieces. Each bit of sponge, however small, will grow into a complete new sponge. As you might suspect, sponges frequently reproduce by shedding fragments, each of which develops into a new individual. Sponges also reproduce by budding. A third form of asexual reproduction occurs in some freshwater sponges. When living conditions become harsh (cold or very dry), some freshwater sponges form **gemmules** *(JEHM yools)*, clusters of amoebocytes encased in protective coats. Sealed in with ample food, the cells survive even if the rest of the sponge dies. When conditions improve, the cells grow into a new sponge. 2 4

Sexual reproduction is also common among sponges. Most sponges are hermaphrodites, meaning they produce both eggs and sperm. Since eggs and sperm are produced at different times, self-fertilization is avoided. In most species of sponges, sperm cells from one sponge enter another sponge through its pores, as shown in **Figure 5.** Collar cells on the receiving sponge's interior pass the sperm into the mesohyl, where the egg cells reside, and fertilization occurs. The fertilized eggs develop into larvae and leave the sponge. After a brief free-swimming stage, the larvae attach themselves to an object and develop into new sponges. 2 4

Figure 5 Sexual reproduction in sponges

In most species of sponges, sperm from one sponge fertilize eggs from another sponge.



Section 1 Review

1. **Draw** a simple sketch of a sponge body plan, and label all the parts you include. 2C 3E 8C
2. **Summarize** how a sponge feeds and distributes nutrients. 10A
3. **Describe** the three types of sponge skeletons. 6D 10A
4. **Compare** asexual and sexual reproduction in sponges. 10A
5. **Critical Thinking Forming Hypotheses** What advantage might there be to a free-swimming larval stage in sponges? 7B
6. **Critical Thinking Determining Factual Accuracy** Evaluate this statement: Sponges have two cell layers, mesoglea and collar cells. 5B
7. TAKS Test Prep What is one function of choanocytes in a sponge? 10A

A supporting the body **C** distributing nutrients
B fertilizing eggs **D** circulating water