Section 24.3

SB5b. Explain the history of life in terms of biodiversity, ancestry, and the rates of evolution.
Also covers: SCSh1a, SCSh2a–b, SCSh3a–f, SCSh4a, SB1d, SB3b–c

Objectives

- **Distinguish** structure and function in sponges and cnidarians.
- **Describe** the diversity of sponges and cnidarians.
- **Evaluate** the ecology and importance of sponges and cnidarians.

Review Vocabulary

diploid: cell with two of each kind of chromosome

New Vocabulary

filter feeder
sessile
cnidocytes
nematocyst
gastrovascular cavity
nerve net
polyp
medusa

Sponges and Cnidarians

MAIN Idea **Sponges and cnidarians were the first animals to evolve from a multicellular ancestor.**

Real-World Reading Link Have you ever double-bagged your groceries? If so, you have an idea of what a sponge is like—a layer, or sac, of cells within another sac of cells. These sacs of cells are among the first animals to evolve from the common ancestor of all animals.

Sponges

If you examine a living sponge, you might wonder how these animals do so much with so little. They have no tissues, no organs, and most have no symmetry. You can break apart a sponge into its individual cells and those cells will come together again to form a sponge. Other animals cannot do this.

Locate sponges on the evolutionary tree in **Figure 24.14.** They are in the phylum Porifera (po RIF uh ruh), which contains between 5000 and 10,000 members. Most live in marine environments. Biologists hypothesize that sponges evolved from the colonial choanoflagellates because sponges have cells that look similar to these protist cells.

Body structure Notice the asymmetrical appearance and bright colors of the sponge in **Figure 24.14.** It is difficult to think that these are animals, especially if you see one washed up on a beach where it might appear as a black blob. Recall that tissues form from ectoderm, endoderm, and mesoderm in a developing embryo. Sponge embryos do not develop endoderm or mesoderm, and, therefore, sponges do not develop tissues. How does a sponge's body function without tissues?

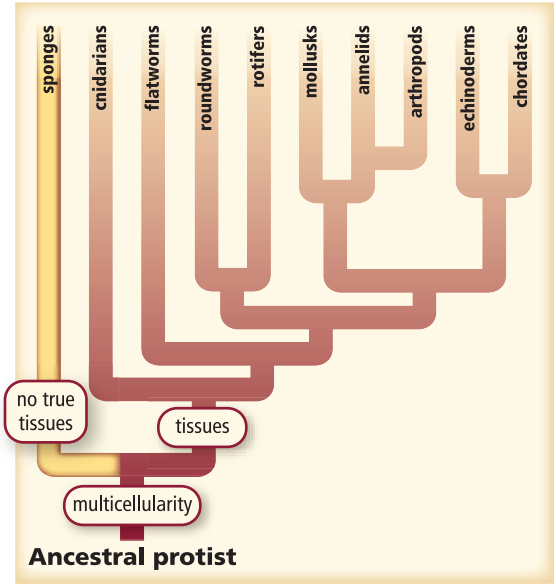


Figure 24.14 It might be hard to believe that the sponges on the right are animals that take in and digest food, grow, and reproduce.

Therisa Stack/Tom Stack & Associates

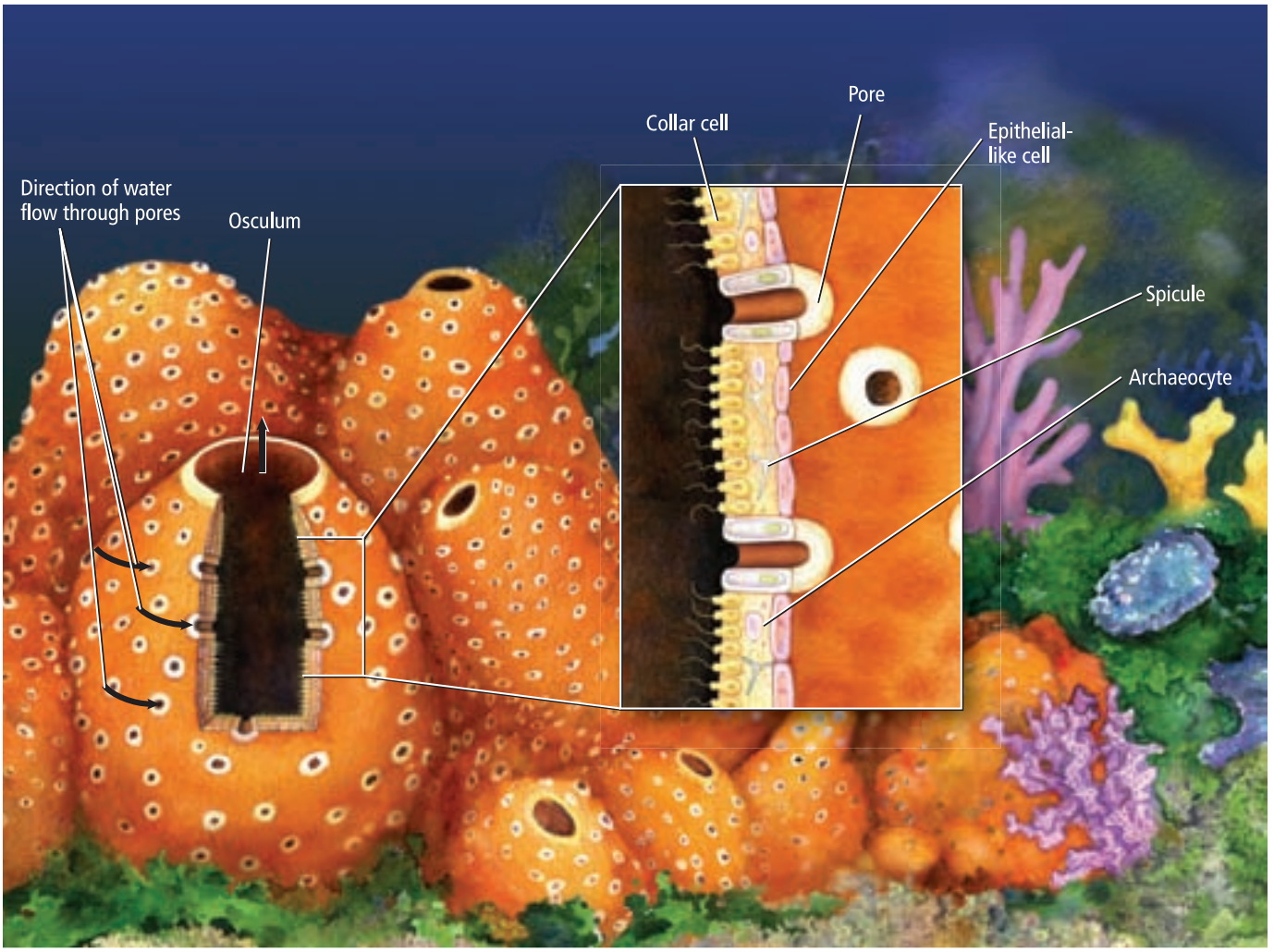


Figure 24.15 Sponges have no tissues or organs and have a body made of two layers of cells.

Interactive Figure To see details of the anatomy of a sponge, visit biologygmh.com.

Two layers of independent cells with a jellylike substance between the layers accomplish all of the life functions of sponges. As illustrated in **Figure 24.15,** epithelial-like cells cover the sponge and protect it. Collar cells with flagella line the inside of the sponge. As collar-cell flagella whip back and forth, water is drawn into the body of the sponge through pores. These pores give sponges their phylum name Porifera, which means "pore-bearer." Water and waste materials are expelled from the sponge through the osculum (AHS kyuh lum), which is the mouthlike opening at the top of the sponge.

Feeding and digestion When an organism such as a sponge gets its food by filtering small particles from water, it is called a **filter feeder.** Even though this might sound like a process that is not very active, consider that a sponge only 10 cm tall can filter as much as 100 L of water each day. Although sponges have free-swimming larvae, the adults move very little. Adaptations for filter-feeding are common in animals that are **sessile** (SES sul)—meaning they are attached to and stay in one place. As nutrients and oxygen dissolved in water enter through the pores in a sponge's body, food particles cling to the cells. Digestion of nutrients takes place within each cell.

Reading Check Infer Why is filter feeding an adaptive advantage for sponges?

Study Tip

Think Aloud Read the text and captions aloud. As you read, say aloud your questions and comments. For instance, when you come to the mention of **Figure 24.15,** look at the figure to say how it relates to the text.

(tl) Lawson Wood/CORBIS, (tr) CORBIS

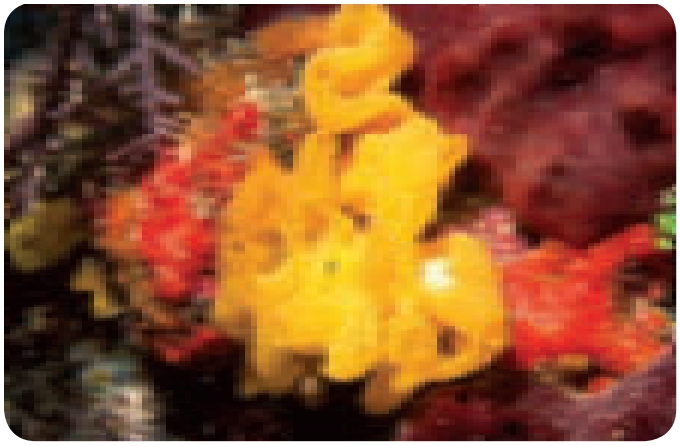
Demosponge

■ **Figure 24.16** Bath sponges are harvested from the sea and processed for human use.

Support Within the jellylike material that lies between the two cell layers of a sponge are amoeba-like cells—cells that can move and change shape. These amoeba-like cells are called archaeocytes (ar kee OH sites) and are illustrated in **Figure 24.15.** These cells are involved in digestion, production of eggs and sperm, and excretion. Archaeocytes also can become specialized cells that secrete spicules (SPIH kyuhls)—the support structures of sponges. Spicules are small, needlelike structures made of calcium carbonate, silica, or a tough fibrous protein called spongin.

Sponge diversity Biologists place sponges into three classes based on the type of support system they have. Most sponges belong to class Demospongiae (deh muh SPUN jee uh), the demosponges, and have spicules composed of spongin fibers, silica, or both. Natural bath sponges, like the ones in **Figure 24.16,** have spongin support. Class Calcarea (kal KER ee uh) consists of sponges with spicules composed of calcium carbonate. Calcareous sponges, like the one in **Figure 24.17,** often have a rough texture because the calcium carbonate spicules can extend through the outer covering of the sponge. The sponges in class Hexactinellida (heks AK tuh nuh LEE duh) are called glass sponges and have spicules composed of silica. These spicules join together to form a netlike skeleton that often looks like spun glass, as illustrated in **Figure 24.17.**

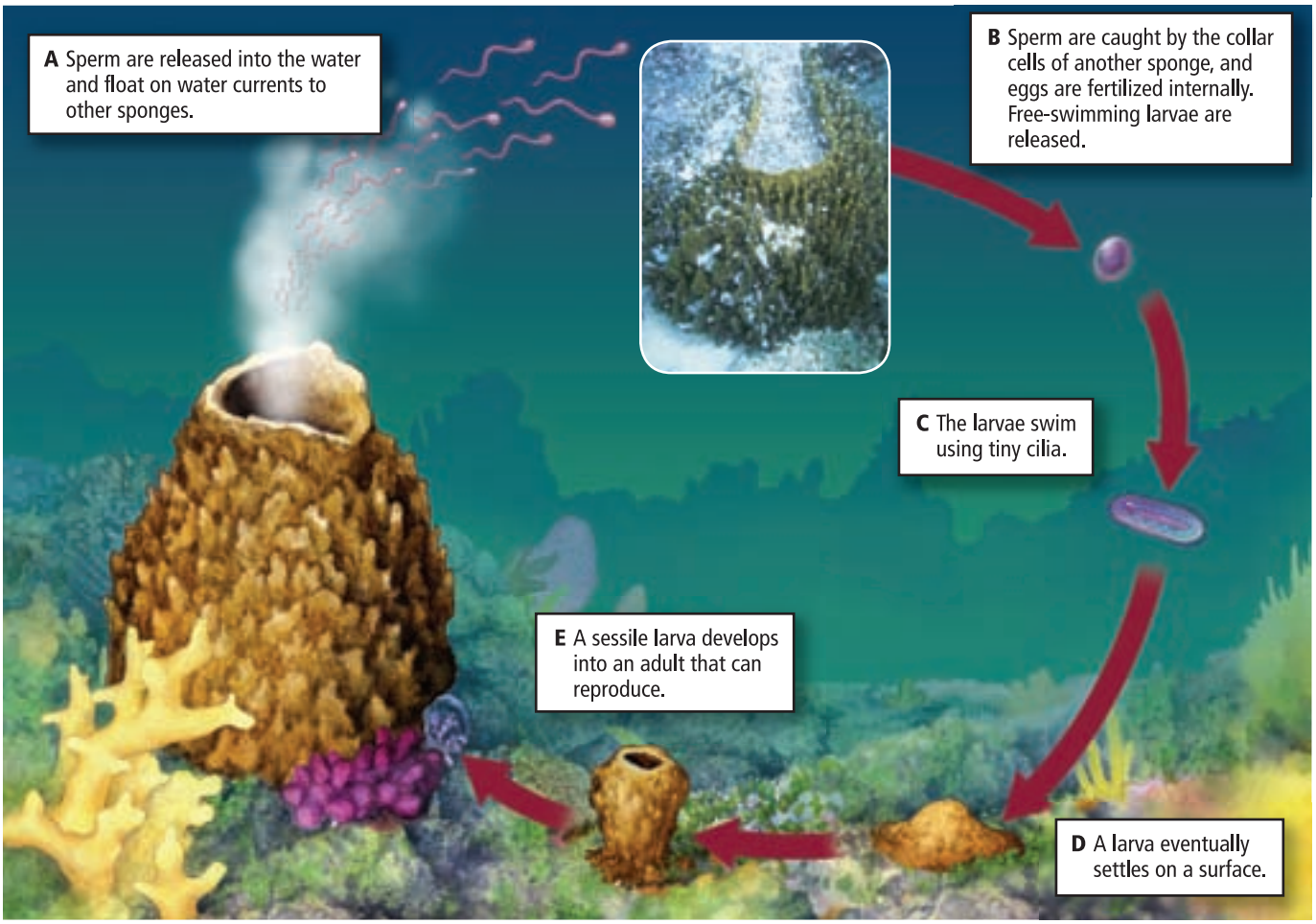
■ **Figure 24.17** Calcareous sponges are small and have a rough texture. The skeletons of glass sponges look like brittle spun glass.



Calcareous sponge

Glass sponge skeleton

(bl) Tom Stack/Tom Stack & Associates, (br) Patti Murray/Animals Animals



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■ **Figure 24.18** Sexual reproduction in sponges requires water currents to carry sperm from one sponge to another.

Evaluate ***Is fertilization internal or external in sponge sexual reproduction?***

Response to stimuli A sponge does not have a nervous system. They do have epithelial-like cells that detect external stimuli, such as touch or chemical signals, and respond by closing their pores to stop water flow.

Reproduction Sponges can reproduce asexually by fragmentation, through budding, or by producing gemmules (JEM yewlz). In fragmentation, a piece of sponge that is broken off due to a storm or other event develops into a new adult sponge. In budding, a small growth, called a bud, forms on a sponge, drops off, and settles in a spot where it grows into a new sponge. Some freshwater sponges form seedlike particles called gemmules during adverse conditions like droughts or freezing temperatures. Gemmules contain sponge cells protected by spicules that will survive and grow again when favorable conditions occur.

Most sponges reproduce sexually, illustrated in **Figure 24.18.** Some sponges have separate sexes, but most sponges are hermaphrodites. Recall that a hermaphrodite is an animal that can produce both eggs and sperm. During reproduction, eggs remain within a sponge, while sperm are released into the water. Sperm released from one sponge can be carried by water currents to the collar cells of another sponge. The collar cells then change into specialized cells that carry the sperm to an egg. After fertilization occurs, the zygote develops into a larva that is free-swimming and has flagella. The larva eventually attaches to a surface, then develops into an adult.

Reading Check **Describe** the methods by which sponges reproduce.

VOCABULARY

ACADEMIC VOCABULARY

Survive:
to remain alive.
Sponge gemmules survive despite adverse conditions.

(t) Chris McLaughlin/Animals Animals

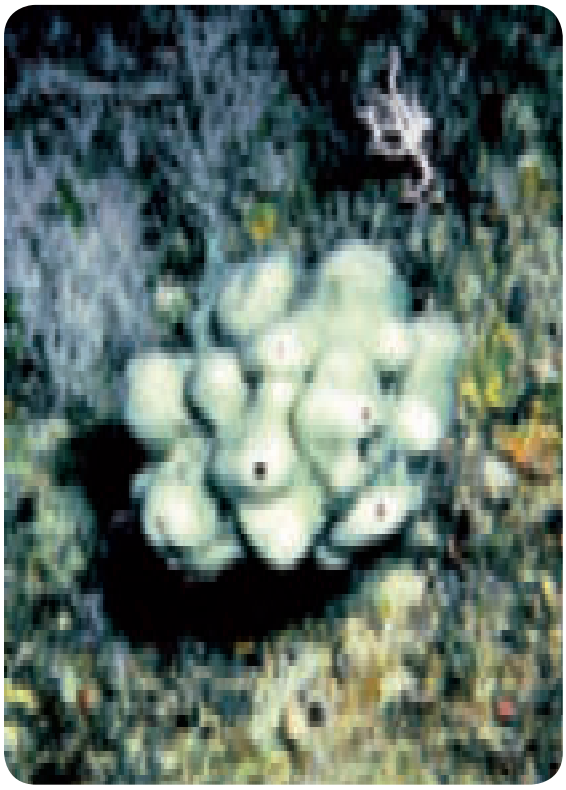
Sponge ecology Although spicules and toxic or distasteful compounds in sponges discourage most potential predators, sponges are food for some tropical fishes and turtles. Sponges also are common habitats for a variety of worms, fishes, shrimp, and colonies of symbiotic green algae. Some sponges even live on and provide camouflage for mollusks, as shown in **Figure 24.19.**

Sponges also are beneficial to humans. Sponges with spicules made of spongin fibers often are used for household scrubbing purposes. Medical research is focusing on sponge chemicals that appear to discourage prey and prevent infection. Ongoing studies of these sponge chemicals as possible pharmaceutical agents have shown that they might have antibiotic, anti-inflamatory, or antitumor possibilities. They also might have potential importance as respiratory, cardiovascular, and gastrointestinal medicines.

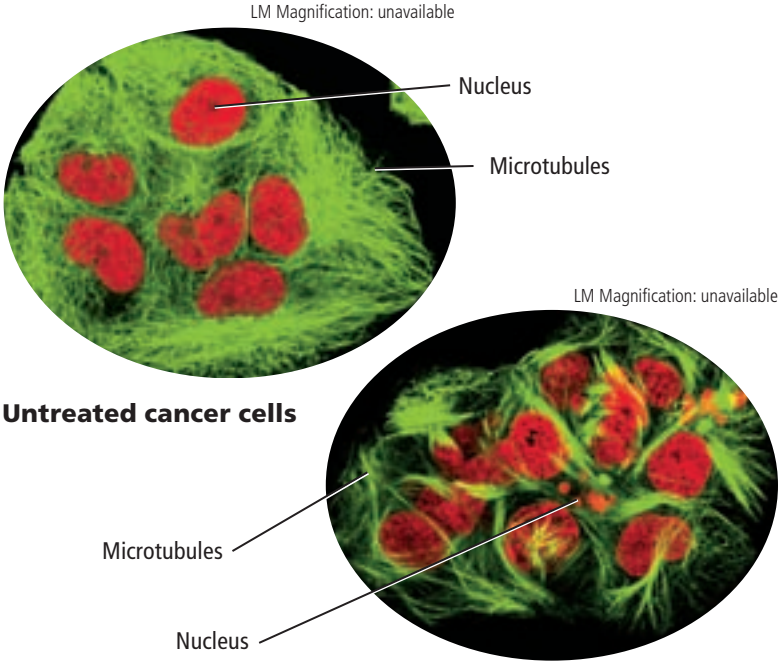
Connection to Health For example, researchers discovered a powerful antitumor substance in the deep water sponge shown in **Figure 24.20.** This substance, discodermolide (disk uh DER muh lide), stops cancer cells from dividing by breaking down the nucleus and rearranging the microtubule network. Recall from Chapter 7 that microtubules are part of a cell's skeleton and help the cell maintain its shape. Note the differences in the nuclei and microtubules between the untreated and treated cancer cells in **Figure 24.20.**

■ **Figure 24.19** This crab hides from predators by carrying a living sponge on its back. The crab uses two pairs of legs to hold the sponge in place.

■ **Figure 24.20** Discodermolide, a substance taken from the sponge *Discodermia dissoluta,* breaks down the nucleus in a cancer cell and rearranges its microtublules.



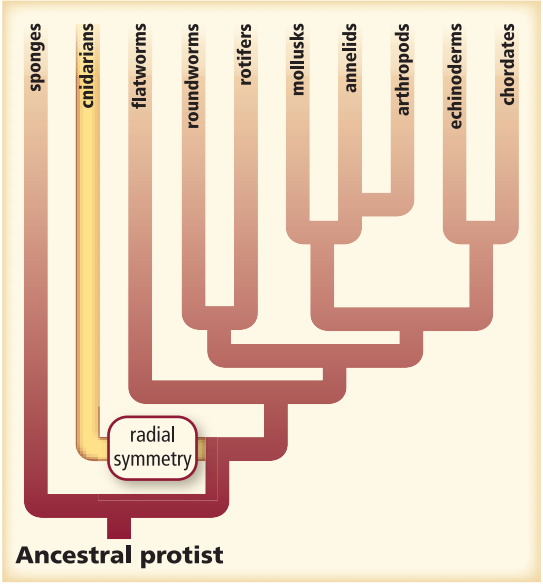
Discodermia dissoluta



Untreated cancer cells

Treated cancer cells

(b) Harbor Branch Oceanographic Institution, (b) Harbor Branch Oceanographic Institution, (b) Harbor Branch Oceanographic Institution



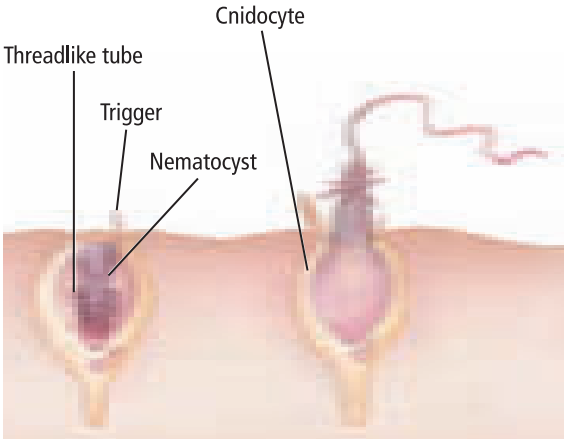
Jellyfish—free floating

Sea anemone—sessile

(l) Brandon D. Cole/CORBIS, (r) CORBIS

■ **Figure 24.21** Cnidarians have radial symmetry and can be free floating or sessile.
Explain *how radial symmetry helps a cnidarian obtain food.*

■ **Figure 24.22** Stinging cells that contain nematocysts are discharged from the tentacles of cnidarians when prey touches them.



Cnidarians

Imagine that you go snorkeling around a coral reef, and you wear a bodysuit to protect yourself from the stings of jellyfishes that float on the water. Later, when you go ashore to visit a tidepool, you might see colorful sea anemones that look somewhat like flowers. The jellyfish and sea anemone in **Figure 24.21** belong to phylum Cnidaria (ni DARE ee uh). This phylum consists of about 10,000 species, most of which are marine.

Body structure Like sponges, cnidarians (ni DARE ee uns) have one body opening and most have two layers of cells. However, in cnidarians, the two cell layers are organized into tissues with specific functions. The outer layer functions in protecting the internal body, while the inner layer functions mainly in digestion. Because cnidarians have tissues, they also have symmetry. As shown in **Figure 24.21,** cnidarian bodies have radial symmetry. Recall that radial symmetry enables slow moving or sessile animals to detect and capture prey from any direction. Cnidarians are adapted to aquatic floating or sessile attachment to surfaces under the water.

Feeding and digestion Cnidarian tentacles are armed with stinging cells called **cnidocytes** (NI duh sites). Cnidarians get their name from these stinging cells. Cnidocytes contain nematocysts, as shown in **Figure 24.22.** A **nematocyst** (nih MA tuh sihst) is a capsule that holds a coiled, threadlike tube containing poison and barbs.

Connection to Physics A nematocyst works like a tiny but very powerful harpoon. Recall from Chapter 7 that osmosis is the diffusion of water through a selectively permeable membrane. The pressure provided by this flow of water is called osmotic pressure. The water inside an undischarged nematocyst is under an osmotic pressure of more than 150 atmospheres. This pressure is about 20 times the pressure in an inflated bicycle tire.

In response to being touched or to a chemical stimulus, the permeability of the nematocyst membrane increases, allowing more water to rush in. As the osmotic pressure increases, the nematocyst discharges forcefully. A barb is capable of penetrating a crab shell.

Nematocyst discharge is one of the fastest cellular processes in nature. It happens so quickly—in just 3/1000ths of a second—that it is impossible to escape after touching these cells. After capture by nematocysts and tentacles, the prey is brought to the mouth of the cnidarian.

The inner cell layer of cnidarians surrounds a space called the **gastrovascular** (gas troh VAS kyuh lur) **cavity,** illustrated in **Figure 24.23.** Cells lining the gastrovascular cavity release digestive enzymes over captured prey. Undigested materials are ejected through the mouth. Recall that digestion occurs within each cell of a sponge. However, in cnidarians, digestion takes place in the gut cavity—a major evolutionary adaptation.

Response to stimuli In addition to cells adapted for digestion, cnidarians have a nervous system consisting of a **nerve net** that conducts impulses to and from all parts of the body. The impulses from the nerve net cause contractions of musclelike cells in the two cell layers. The movement of tentacles during prey capture is the result of contractions of these musclelike cells. Cnidarians have no blood vessels, respiratory systems, or excretory organs. Look at **Table 24.1** to compare the structures and functions of sponges and cnidarians.

Reading Check **Compare** How does a cnidarian's response to stimuli differ from a sponge's response?

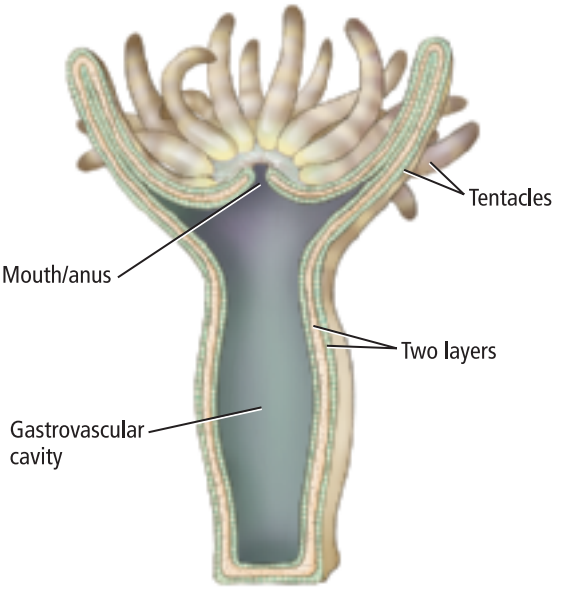


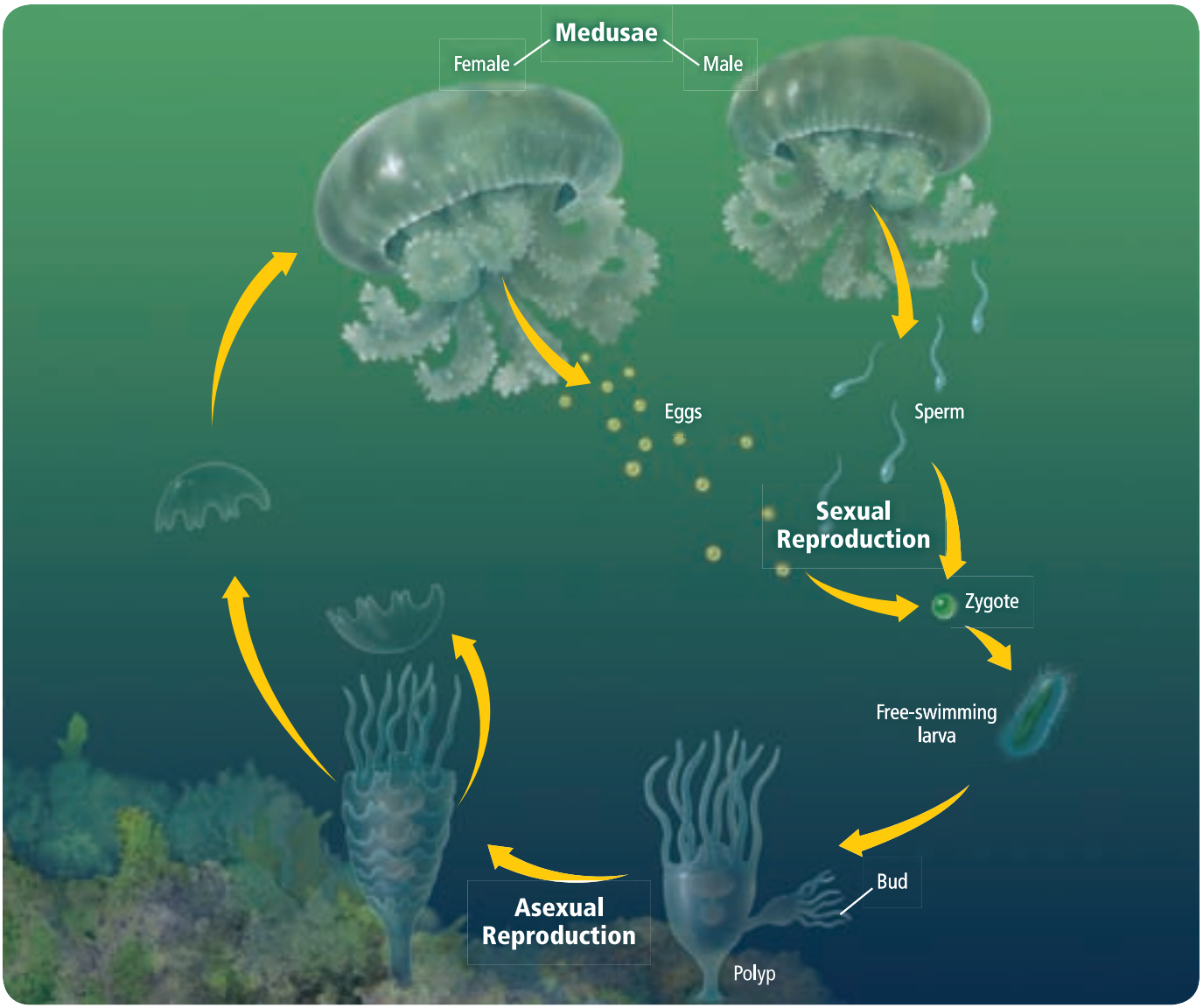
Figure 24.23 A cnidarian's mouth leads directly into its gastrovascular cavity. Because the digestive tract has only one opening, wastes are expelled through the mouth.

Table 24.1 **Comparison of Sponges and Cnidarians**

Concepts in Motion

Interactive Table To explore more about sponges and cnidarians, visit biologygmh.com.

	Sponges	Cnidarians
Example		
Body Plan	• Generally has asymmetry	• Has radial symmetry
Feeding and digestion	• Filter feed • Digestion takes place within individual cells	• Capture prey with nematocysts and tentacles • Digestion takes place in gastrovascular cavity
Movement	• Sessile	• Aquatic floating or sessile
Response to stimuli	• No nervous system • Cells react to stimuli	• Simple nervous system consisting of a nerve net
Reproduction	• Hermaphrodites reproduce sexually • Asexual reproduction by fragmentation, budding, or gemmule production	• Separate sexes reproduce sexually • Polyp stage reproduces asexually by budding



■ **Figure 24.24** Jellyfishes reproduce by alternating sexual and asexual stages of their life cycle.

Interactive Figure To see an animation of the reproductive cycle in cnidarians, visit biologygmh.com.

CAREERS IN BIOLOGY

Marine Ecologist Using submersibles and deep-sea robots, a marine ecologist studies the relationships between marine animals and their environments. For more information on biology careers, visit biologygmh.com.

Reproduction In addition to stinging cells, cnidarians have another adaptation not seen in most animals of recent origin. Most cnidarians have two body forms: a **polyp** (PAH lup) with a tube-shaped body and a mouth surrounded by tentacles, and a **medusa** (mih DEW suh) (plural, medusae) with an umbrella-shaped body and tentacles that hang down. The mouth of a medusa is on the ventral surface between the tentacles.

The two body forms of cnidarians can be observed in the life cycle of jellyfishes, illustrated in **Figure 24.24.** To reproduce, jellyfishes in the medusa stage release eggs and sperm into the water where fertilization occurs. The resulting zygotes eventually develop into free-swimming larvae that settle and grow into polyps. These polyps reproduce asexually to form new medusae. It would be easy to confuse the life cycle of cnidarians with the alternation of generations you studied in plants. However, in plants, one generation is diploid and the other is haploid. In cnidarians, both the medusae and polyps are diploid animals.

Reading Check **Compare** How are the larvae of sponges and cnidarians similar?

(t) Georgette Douwma/Photo Researchers

Cnidarian diversity There are four main classes of cnidarians: Hydrozoa, the hydroids; two classes of jellyfishes—Scyphozoa and Cubozoa (the box jellyfishes); and Anthozoa, the sea anemones and corals.

Hydroids Most of the approximately 2700 species of hydroids have both polyp and medusa stages in their life cycles. Most hydroids form colonies, such as the Portuguese man-of-war in **Figure 24.25.** Another well-known hydroid is the freshwater hydra, which is unusual because it has only a polyp stage.

Jellyfishes There are about 200 species of jellyfishes. They are transparent or translucent in appearance and float near the water's surface. The medusa is the dominant body form, although a polyp stage does exist. They are called jellyfishes because the substance between the outer body covering and the inner body wall is jellylike. The structure of the inner and outer body layers with the jellylike structure between can be compared to a jelly sandwich. The box jellyfishes take their name from the boxlike medusae that are their dominant form. The stings of some box jellyfish species can be fatal to humans.

Sea anemones and corals Generally colorful and inviting, sea anemones and corals still possess stinging cells like all cnidarians. The 6200 species of sea anemones and corals are different from the jellyfishes because the polyp stage is the dominant stage of their life cycles. Recent research indicates that these anthozoans actually might have bilateral symmetry. This would alter the evolutionary tree because this adaptation usually is seen only in animal groups that evolved later than cnidarians.

Sea anemones live as individual animals, while corals live in colonies of polyps. Corals secrete protective calcium carbonate shelters around their soft bodies. The living portion of a coral reef is a thin, fragile layer growing on top of the shelters left behind by previous generations. Coral reefs form from these shelters over thousands of years.

Coral polyps extend their tentacles to feed, as shown in **Figure 24.26.** They also harbor symbiotic photosynthetic protists called zooxanthellae (zoh oh zan THEH lee). The zooxanthellae produce oxygen and food that corals use, while using carbon dioxide and waste materials produced by the corals. These protists are primarily responsible for the bright colors found on healthy coral reefs.

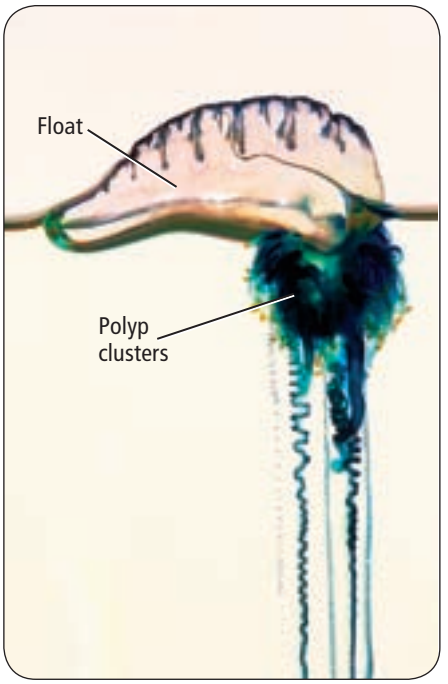
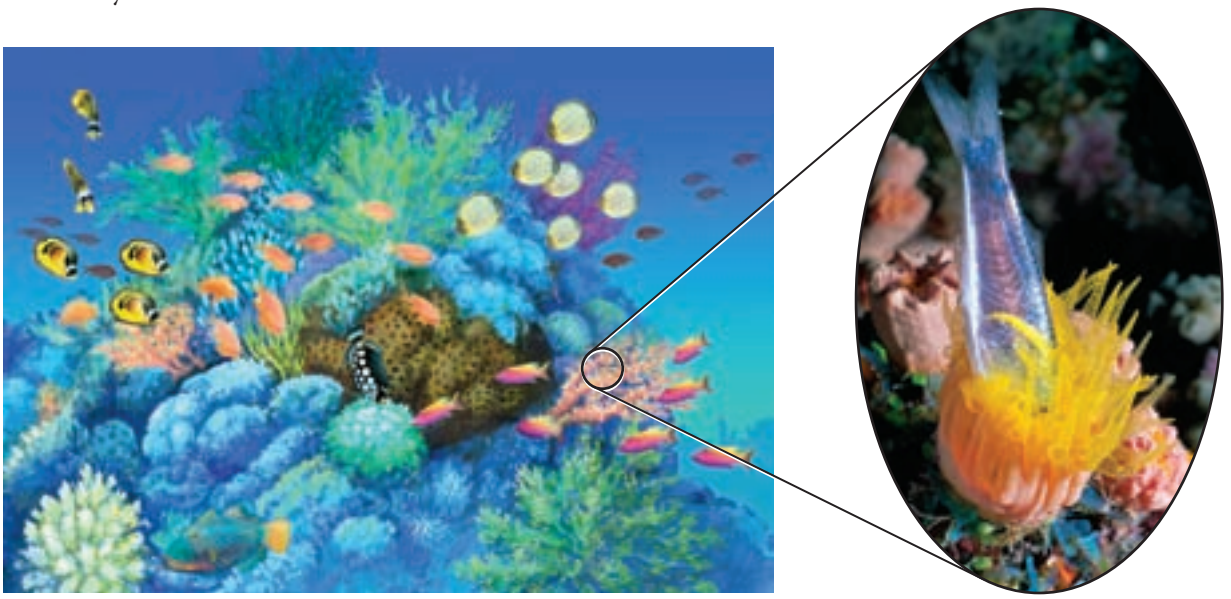
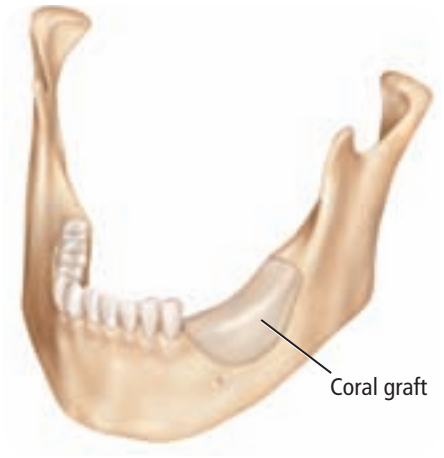


Figure 24.25 This Portuguese man-of-war is composed of a colony of hydroids. One hydroid polyp forms the large float, while other hydroid polyps cluster beneath the float.

Figure 24.26 Coral polyps capture food by extending their tentacles.



(b) Jeff Rotman/Photo Researchers



■ **Figure 24.27** Surgeons use treated hydroxyapatite to make implants for reconstructing facial bones, such as this jaw.

The health of a coral reef depends on proper water temperature, adequate light, and appropriate water depth. If these environmental conditions deteriorate in areas where there are reefs, the health of the reef might also deteriorate. You can examine this problem in **Data Analysis Lab 24.1.**

Cnidarian ecology Mutualism, a relationship in which both organisms benefit, is common in cnidarians. One species of sea anemone wraps itself around hermit crabs' shells; the anemones obtain food scraps and the crabs are protected. Some sea slugs feed on cnidarians and incorporate the unfired nematocysts into their bodies for their own defense. As shown in the photo at the beginning of the chapter, clown fishes are protected by the tentacles of anemones. One theory as to how clown fishes are protected from the tentacles of anemones is that the fish incorporates mucus from an anemone into its own mucous coating, which prevents the nematocysts from discharging.

People benefit from cnidarians in many ways. Some people enjoy visiting a coral reef. In the medical field, some stony coral species are used in surgical procedures. A calcium phosphate mineral in coral called hydroxyapatite (hi DROX ee ap uh TITE) can be treated so that it has the same structure and chemical composition as human bone. Small pieces of coral are implanted as bone grafts, especially in face and jaw reconstruction and in arm and leg surgery. The grafts anchor to the adjacent bone, as shown in **Figure 24.27,** and eventually are replaced by new human bone growth.

DATA ANALYSIS LAB 24.1

Based on Real Data*

Interpret Data

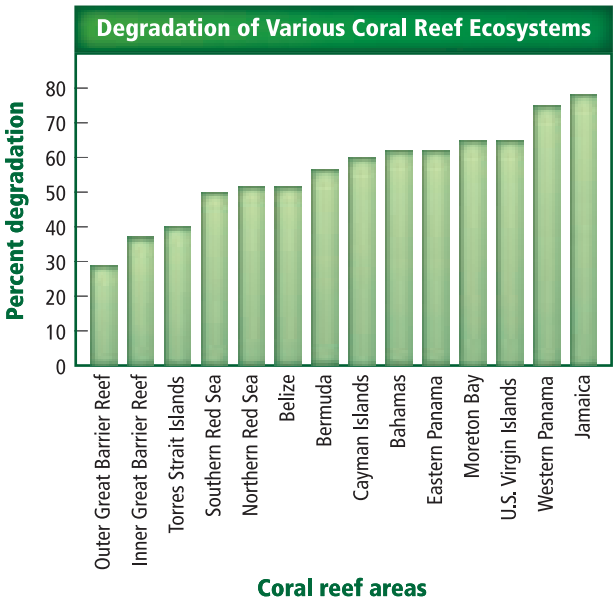
Where are coral reefs being damaged?
Some corals have ejected their symbiotic algae and become bleached, or lost their coloring. Coral reef bleaching is a common response to reef ecosystem damage. However, some corals appear to be recovering from bleaching.

Data and Observations

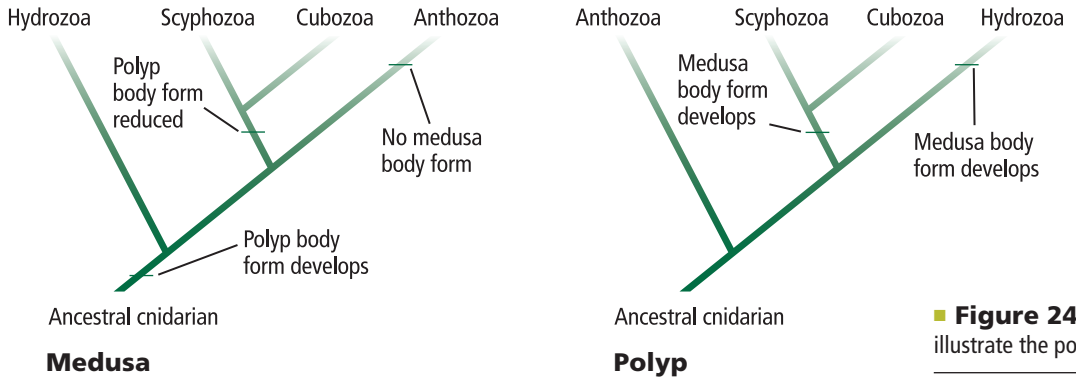
The graph indicates the percentage of the damage that has occurred to specific reefs.

Think Critically

1. **Interpret** What part of the world has suffered the most damage to its coral reefs? What part of the world has suffered the least damage to its reefs?
2. **Model** On a world map, locate the coral reefs noted in the graph. Color code the map based on the percent of degradation.



*Data obtained from: Pandolfi, J.M. et al., 2003. Global trajectories of the long-term decline of coral reef ecosystems. *Science* 301 (5635): 955–958.



■ **Figure 24.28** The two cladograms illustrate the possible phylogeny of cnidarians.

Evolution of cnidarians There are two major interpretations of the phylogeny of cnidarians. The fact that cnidarians have two body forms—medusa and polyp—raises the question of whether the ancestral cnidarian had a medusa or a polyp body form. The cladograms in **Figure 24.28** present both interpretations.

In the cladogram on the left, the ancestral cnidarian has a medusa body form. As cnidarians evolved, a polyp stage developed. The life cycles of hydrozoans have both polyp and medusa stages. As the scyphozoans and cubozoans developed, the medusa stage became the dominant stage in their life cycles. The most highly evolved cnidarians, the anthozoans, have no medusa stage.

In the cladogram on the right, the ancestral cnidarian has a polyp body form. The anthozoans evolved first, and the polyp stage is the dominant stage of their life cycles. The medusa stage evolved independently in hydrozoans and in scyphozoans and cubozoans. As you examine the cladograms, notice how the classes of cnidarians are arranged in each.

Section 24.3 Assessment

Section Summary

- Sponges can be described according to animal features they do not have and according to features they do have.
- Sponges do not have tissues, but carry out the same life functions as other animals.
- Cnidarians have unique features that other animals do not have.
- Cnidarians have more highly evolved body forms and structures than sponges.
- Sponges and cnidarians are important to the ecology of their habitats and to humans.

Understand Main Ideas

1. MAIN Idea **Explain** why sponges and cnidarians were the first animals to evolve.
2. **Describe** the differences between the body plans of sponges and cnidarians.
3. **List** two characteristics that are unique to sponges and two characteristics that are unique to cnidarians.
4. **Demonstrate** your knowledge of cnidarians by describing how they affect other marine organisms.

Think Scientifically

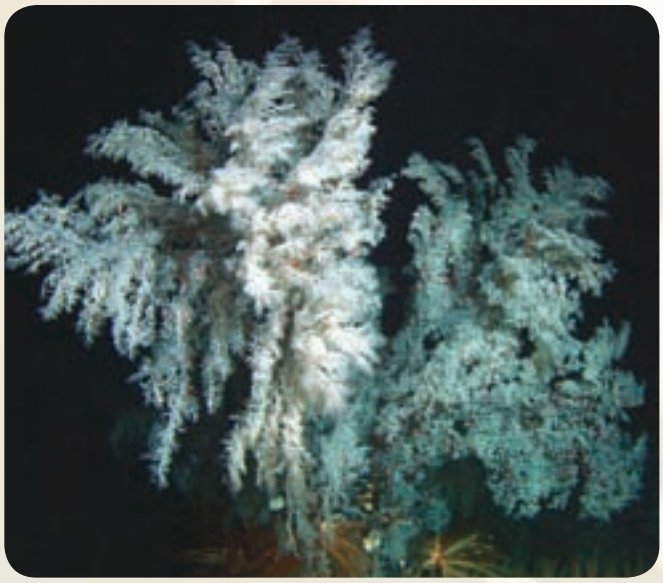
5. *Hypothesize* How are nematocysts an adaptive advantage for cnidarians?
6. MATH in Biology Review the text under the heading *Cnidarian diversity*. Make a circle graph that shows the proportions of each of the three groups of cnidarians to the total numbers of cnidarians. In addition to the groups in this section, there are 900 species of other cnidarians. Analyze this information and hypothesize why one group is so much smaller than the others.

BioDiscoveries

New Species Everywhere

When Wildlife Conservation Society researcher Rob Timmins went to the market, he didn't find a great sale—he found a new species. While in a food market in Ben Lak, Laos, Timmins saw some unusual black- and brown-striped rabbits. DNA analysis of tissue samples confirmed that the rabbit was a new species, now named the Annamite rabbit.

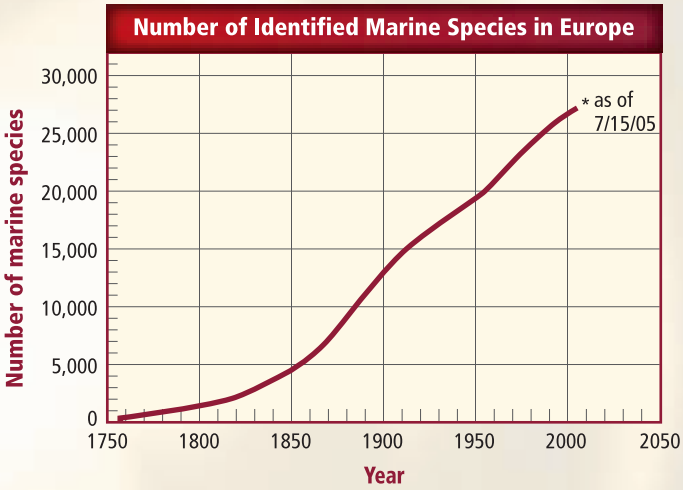
Discovering new species A species is a group of genetically distinct organisms that share common characteristics and are capable of interbreeding. New species—animals that were previously unknown to scientists—are being discovered all the time. Recent finds include the Christmas tree coral—a new species of coral found off the coast of southern California, and the Laotian rock rat—a new family of mammals discovered in Southeast Asia.



This white Christmas tree coral was discovered by researchers Milton Love (UC Santa Barbara) and Mary Yoklavich (NOAA NMFS Santa Cruz) from the mini-submersible *Delta* during surveys on rocky banks off the coast of southern California in 150-m-deep water.

M. Amend, NOAA NMFS

Cataloging species Whether in the Amazon forest or through deep-sea exploration, in-depth cataloging of species is revealing that there are still many species left to identify. The Census of Marine Life (CoML), a multinational project to catalog sea life, found 106 new species of marine fish in their 2004 survey of the world's oceans. That's an average of more than two new species per week.



Future finds? The graph above shows how the number of known marine species in Europe increased in 255 years. CoML plans to continue surveying the world's sea life through 2010, so the trend observed in Europe also should be seen globally. The continuing discovery of new species shows one way science is constantly changing.

WRITING in Biology

Interpret Data Based on the data in the graph above, estimate the number of marine species in Europe that might be identified by 2050. Explain your answer. Then infer why the rate of identifying new marine species might be higher in other parts of the world than in Europe. Visit biologygmh.com to learn more about finding new species.

Matt Meadows

BIOLAB

Design Your Own

FIELD INVESTIGATION: WHAT CHARACTERISTICS DO ANIMALS HAVE?

Background: **A small pond is an ecosystem in which organisms interact to accomplish essential life functions. They exhibit a wide variety of body plans, obtain food in different ways, and use various methods of movement.**

Question: *What kinds of animals live in ponds?*

Materials

wading boots
tweezers
aquarium
Petri dishes
dissecting microscopes
Choose other materials that would be appropriate for this lab.

Safety Precautions

WARNING: ***Handle living animals with care.***

Plan and Perform the Experiment

1. Read and complete the lab safety form.
2. Locate a pond to use for your observations and collections. Make sure you have permission to use the pond.
3. Determine methods to observe and record animals you see at the pond that you do not collect.
4. Design and construct a data table to record your observations.
5. Make sure your teacher approves your plan before you proceed.
6. **Cleanup and Disposal** Wash your hands after handling any live organisms. Return the animals and any pond water to the pond. Wash and return all reusable lab materials and correctly dispose of other materials used in the lab as directed by your teacher.

Analyze and Conclude

1. **Use Scientific Explanations** How were you able to determine if the organisms you observed were animals?
2. **Summarize** the adaptations you observed used for obtaining food. Were any of the adaptations similar to those you observed in **MiniLab 24.1?**
3. **Compare and contrast** the methods of movement used by each of the animals you observed.
4. **Interpret Data** Look at drawings or photographs of the animals you observed. What do these illustrations tell you about the body plan of each organism? What gut type does each animal have?
5. **Error Analysis** What other types of observations could you make to verify your conclusions about each organism?

WRITING in Biology

Make a Booklet Choose one of the animals you observed in your pond study. Develop an illustrated booklet that shows how this animal obtains food, how it reproduces, its body plan, and its stages of development. Share the information with your class. To learn more about animals, visit biologygmh.com.

CHAPTER 24

Study Guide

Download quizzes, key terms, and flash cards from **biologygmh.com.**

FOLDABLES **Compare** all three body plans and consider why the greatest diversity of animals is found among the coelomates. Determine the levels of diversity of the other two body plans and rank them as second and third, respectively. Explain your reasoning.

Vocabulary	Key Concepts
Section 24.1 Animal Characteristics	
• blastula (p. 696) • ectoderm (p. 697) • endoderm (p. 697) • endoskeleton (p. 693) • exoskeleton (p. 693) • external fertilization (p. 695) • gastrula (p. 696) • hermaphrodite (p. 695) • internal fertilization (p. 695) • invertebrate (p. 693) • mesoderm (p. 697) • vertebrate (p. 693) • zygote (p. 695)	**MAIN Idea** Animals are multicellular, eukaryotic heterotrophs that have evolved to live in many different habitats. • Animals must get their nutrients from other organisms. • Animals have diverse means of support and live in diverse habitats. • Animal cells do not have cell walls, and most animals have cells that are organized into tissues. • Most animals undergo sexual reproduction, and most animals can move. • During embryonic development, animal cells become tissue layers, which become organs and systems.
Section 24.2 Animal Body Plans	
• acoelomate (p. 701) • anterior (p. 700) • bilateral symmetry (p. 700) • cephalization (p. 700) • coelom (p. 701) • deuterostome (p. 702) • dorsal (p. 700) • posterior (p. 700) • protostome (p. 702) • pseudocoelom (p. 701) • radial symmetry (p. 700) • symmetry (p. 700) • ventral (p. 700)	**MAIN Idea** Animal phylogeny can be determined, in part, by body plans and the ways animals develop. • Animal phylogeny can be compared to a tree with branches. • The branches of a phylogenetic evolutionary tree show the relationships among animals. • Animal phylogeny can be determined, in part, by the animal's type of body cavity or lack of a body cavity. • After gastrulation, two types of development can occur in coelomate animals. • Segmentation is an important feature in some coelomate animals.
Section 24.3 Sponges and Cnidarians	
• cnidocyte (p. 710) • filter feeder (p. 706) • gastrovascular cavity (p. 711) • medusa (p. 712) • nematocyst (p. 710) • nerve net (p. 711) • polyp (p. 712) • sessile (p. 706)	**MAIN Idea** Sponges and cnidarians were the first animals to evolve from a multicellular ancestor. • Sponges can be described according to animal features they do not have and according to features they do have. • Sponges do not have tissues, but carry out the same life functions as other animals. • Cnidarians have unique features that other animals do not have. • Cnidarians have more highly evolved body forms and structures than sponges. • Sponges and cnidarians are important to the ecology of their habitats and to humans.

CHAPTER 24 Assessment

Section 24.1

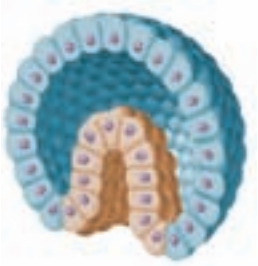
Vocabulary Review

Match the definitions below with the correct vocabulary terms from the Study Guide page.

1. a hard outer covering that provides support
2. a two-layer sac with an opening at one end formed in embryonic development
3. an animal that produces both eggs and sperm

Understand Key Concepts

Use the diagram below to answer question 4.



4. The embryo is in which stage of development?
   A. gastrula **C.** egg cell
   B. blastula **D.** zygote
5. Which material is not found in endoskeletons?
   A. calcium carbonate **C.** silica
   B. bone **D.** cartilage
6. Hox genes are active during which process?
   A. cell differentiation **C.** digestion
   B. movement **D.** neural stimulation

Constructed Response

7. **Open Ended** How are animals different from plants?
8. **Open Ended** Describe the advantages and disadvantages of internal and external fertilization.

Think Critically

9. **Interpret** this statement by Hans Spemann, a biologist who studied embryonic development: "We are standing and walking with parts of our body which could have been used for thinking had they developed in another part of the embryo."
10. **Hypothesize** what might happen to an embryo that suffers damage to some mesoderm cells.

Section 24.2

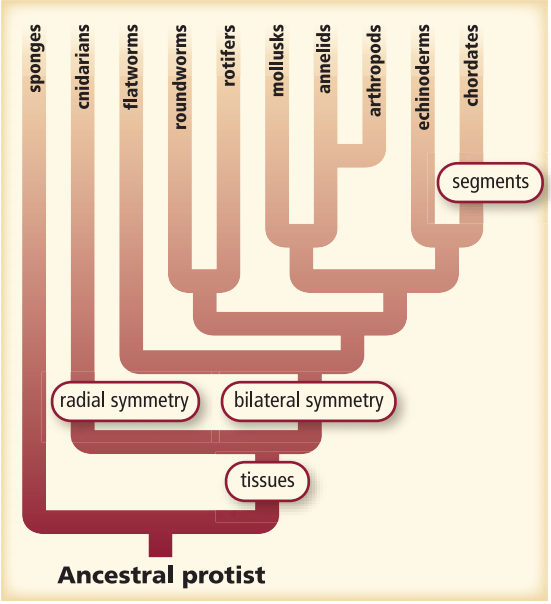
Vocabulary Review

Distinguish between the vocabulary terms in each pair.

11. bilateral symmetry and radial symmetry
12. ventral and dorsal
13. coelom and pseudocoelom

Understand Key Concepts

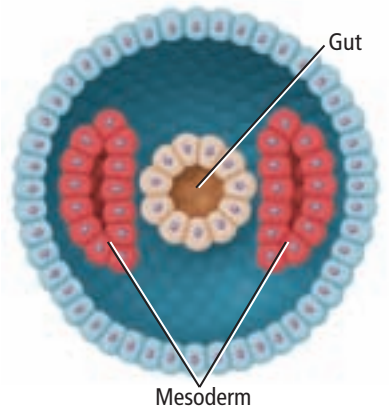
Use the diagram below to answer questions 14 and 15.



14. Based on the evolutionary tree above, which statement is true?
   A. True tissues evolved after bilateral symmetry.
   B. Segments evolved after bilateral symmetry.
   C. The common animal ancestor was a sponge.
   D. Most animals have bilateral symmetry.
15. On the evolutionary tree, which animals are related most closely?
   A. an earthworm and a snail
   B. a flatworm and an earthworm
   C. a roundworm and an earthworm
   D. an earthworm and a sea star

16. **CAREERS IN BIOLOGY** An embryologist, a scientist who studies embryos, discovers a new marine animal. When one cell is removed during its early development, this cell develops into a complete animal. This animal is which of the following?
   A. acoelomate
   B. deuterostome
   C. protostome
   D. pseudocoelomate

Use the diagram below to answer question 17.



17. What does the location of the mesoderm indicate about this embryo?
   A. The cells are directly aligned.
   B. The outcome of each cell can be changed.
   C. The mouth develops from the gastrula opening.
   D. The coelom forms from pouches of mesoderm.

18. The evolution of an internal body cavity had adaptive advantage in all the following areas except for which?
   A. circulation **C.** feeding
   B. movement **D.** muscular system

19. Based on the evolutionary tree in **Figure 24.8,** what characteristics does an earthworm have that a flatworm does not?
   A. a coelom, a body cavity, bilateral symmetry, and no tissues
   B. a coelom and segmentation
   C. a coelom, protostome development, and segmentation
   D. a pseudocoelom, a body cavity, and bilateral symmetry

20. What is the lighter undersurface of a frog called?
   A. dorsal surface **C.** anterior surface
   B. ventral surface **D.** posterior surface

Constructed Response

21. **Open Ended** Construct a working model of cell differentiation using clay, salt dough, or other materials. Make the first stage, then make that stage into the next, and that stage into the next until you have completed the steps.

22. **Open Ended** Describe how you would choreograph a dance or skit that would illustrate symmetry for elementary school children.

Think Critically

23. **Hypothesize** Biologists have recently determined that some sea anemones seem to possess bilateral symmetry. Hypothesize how this changes ideas for how and when bilateral symmetry evolved.

24. **Recognize Cause and Effect** Explain how segmentation and exoskeletons gave some animals an adaptive advantage over those that were not segmented and did not have exoskeletons.

Section 24.3

Vocabulary Review

For each set of terms below, choose the term that does not belong and explain why it does not belong.

25. cnidocyte, nematocyst, cnidarian, spicule

26. pores, gemmule, filter feeder, nematocyst

27. alternation of generations, polyp, spongin, medusa

Understand Key Concepts

Use the diagram below to answer question 28.

28. The animal in the diagram above possesses which characteristic?
   A. cephalization **C.** bilateral symmetry
   B. cnidocytes **D.** asymmetry

Lawson Wood/CORBIS

29. Cnidarians evolved directly from which group?
- **A.** sponges
- **B.** multicellular choanoflagellates
- **C.** flatworms
- **D.** animals with bilateral symmetry

Use the diagram below to answer question 30.

30. How does the animal shown in the diagram reproduce?
- **A.** fragmentation
- **B.** external fertilization
- **C.** internal fertilization
- **D.** regeneration

31. Which is not a characteristic of sponges?
- **A.** filter feeding
- **B.** digestion inside cells
- **C.** asymmetry
- **D.** tissues

32. Which pair of words is mismatched?
- **A.** sponges—filter feeding
- **B.** cnidarians—nematocysts
- **C.** sponges—free swimming larva
- **D.** cnidarians—spicules

Constructed Response

33. Open Ended Examine want ads in the paper to see how they are organized, and then use your knowledge of cnidarians to write a want ad that describes an ideal jellyfish homesite.

Think Critically

34. Calculate Assume that a sponge filters 1.8 mL of water per second. How much water is filtered in one hour? In 12 hours?

35. Create Make a concept map using the following words: coral, polyp, cnidocyte, reef, calcium carbonate, zooxanthellae.

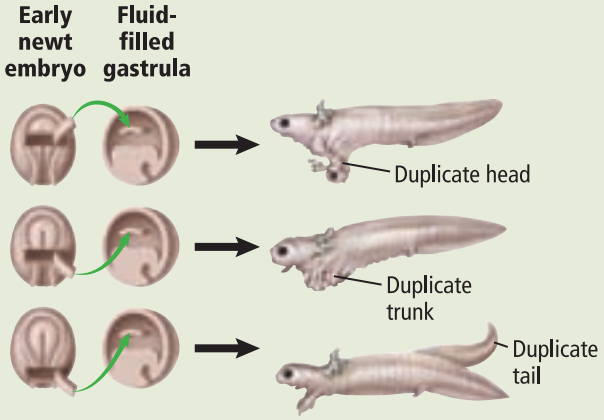
Additional Assessment

36. WRITING in Biology Write an editorial for a newspaper advocating protection for coral reefs. Explain the dangers that corals are facing and make suggestions about what could be done to preserve and protect reefs.

DBQ Document-Based Questions

Transplantation experiments with early embryos of newts show that when tissue responsible for tail development was added into a different fluid-filled gastrula, it caused the effects shown below.

Data obtained from: Niehrs, C. 2003. A tale of tails. *Nature* 424: 375–376.



37. When a section from the top of the area was transplanted, where did the new tissue grow?

38. When a section from the bottom of the area was transplanted, where did the new tissue grow?

39. Make a summary statement that describes where new tissue grew when portions of the embryo responsible for tail development were transferred to fluid in the gastrula.

Cumulative Review

40. Review what you learned about microscopic agents that cause disease. Which of these are considered living and which are not? Explain. **(Chapter 18)**

Standards Practice for the EOCT

Cumulative

Multiple Choice

1. Which color of flower is most likely to attract nocturnal pollinators such as bats and moths?
   A. blue
   B. red
   C. violet
   D. white

Use the illustration below to answer questions 2 and 3.

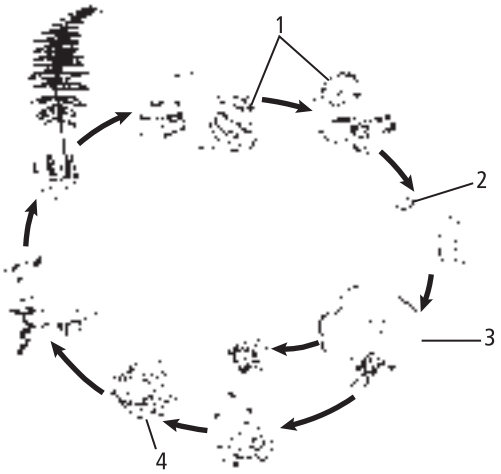
2. How would you describe the body symmetry of the animals shown in the above illustration?
   A. Both have bilateral symmetry.
   B. Both have radial symmetry.
   C. The sea star has bilateral symmetry and the bird has radial symmetry.
   D. The sea star has radial symmetry and the bird has bilateral symmetry.

3. How does the body shape of the sea star help with its survival?
   A. It enables the sea star to capture many kinds of prey.
   B. It enables the sea star to capture prey from many directions.
   C. It enables the sea star to move through the water quickly.
   D. It enables the sea star to move through the water feebly.

4. Which structure in nonvascular plants is similar to roots in vascular plants?
   A. chloroplast
   B. mucilage
   C. rhizoid
   D. sporophyte

5. Which hormone stimulates the ripening of fruit?
   A. auxin
   B. cytokinins
   C. ethylene
   D. gibberellins

Use the diagram below to answer question 6.



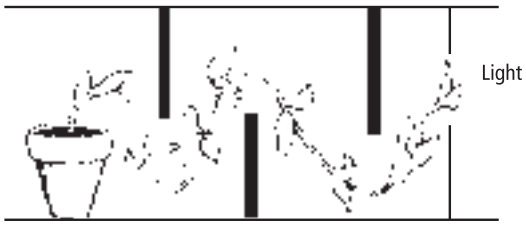
6. At which stage of the fern life cycle does the chromosome number change from haploid to diploid?
   A. 1
   B. 2
   C. 3
   D. 4

7. Which is the role of sclerenchyma cells in plants?
   A. gas exchange
   B. photosynthesis
   C. food storage
   D. support

8. What evidence would help scientists determine that colonial organisms were an early step in the evolution of multicellularity?
   A. similarities in DNA or RNA of early multicellular organisms and colonial unicellular organisms
   B. differences in DNA or RNA of early multicellular organisms and colonial unicellular organisms
   C. similarities of early multicellular organisms and present-day multicellular organisms
   D. differences between early multicellular organisms and present-day multicellular organisms

Short Answer

Use the diagram below to answer question 9.



9. A student conducted an experiment using the above set up. Explain the purpose of this experiment.

10. Which type of fossils would tell a paleontologist the most about the soft tissues of an animal?

11. Explain why most spore-producing plants live in moist areas.

Use the diagram below to answer question 12.

12. How is the age of a tree estimated? What is the approximate age of this tree?

13. Name four flower adaptations that attract insects.

14. What are three kinds of evidence that can be used to confirm whether animals with different body structures are related closely?

Extended Response

15. *Plasmodium* is a sporozoan that causes the disease malaria. Identify the different stages of the sporozoan that occur in mosquitoes. Assess the importance of the stages of the life cycle that occur in mosquitoes.

16. Why does Mendel's law of segregation only apply to organisms that reproduce sexually?

17. Summarize egg development and fertilization in flowering plants.

Essay Question

Pollen analysis, or palynology, is an important tool used in archaeology. Palynologists take samples of soil from archaeological sites and analyze the pollen from different soil layers. By examining the changes in pollen types over time, palynologists can learn about historical land use. The pollen in the soil indicates how the land was used—whether it was cultivated, a forest was cleared, or if it was abandoned.

Using the information in the paragraph above, answer the following question in essay format.

18. Scientists have been trying to find the origin of corn. They know that corn was domesticated from a plant called *teosinte* that grew somewhere in the central valley of Mexico between 12,000 and 6,000 years ago. It often is hard to find intact corncobs because they do not fossilize well. How could a palynologist help determine the origin of corn?

If You Missed Question . . .	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Review Section . . .	23.1	24.2	24.2	21.2	22.3	23.1	22.1	24.1, 24.3	22.3	14.1	23.1	22.2	23.2	24.1	19.2	10.2	23.2	23.3
Georgia Standards	B4f	B3b	B4f	B4e	B3b	B2f	B3b	B5b	B4e	B5c	B1d	B3b	B4a	B5b	B3b	B2c	B3b	B5b

B = Biology Content Standard, S = Characteristics of Science Standard