Chapter 11

Diversity of Life 2

11.2 Animals Part 1: Sponges and Cnidarians

Animals include organisms as varied as starfish, beetles, coral, and antelope. **Animals** are multicellular, heterotrophic eukaryotes that obtain nutrients by eating other organisms. What are some other characteristics of animals? Animals *ingest* food, taking it into their bodies for digestion. Most animals reproduce sexually and are diploid during most of their life cycle. The gametes—sperm and eggs—are the only haploid stage. Many animals go through a juvenile period as a *larva* that is markedly different from the adult in form and ecology; examples are butterfly caterpillars and frog tadpoles. Most animals also have muscles for moving, sense organs for collecting information from their environments, and nervous systems for controlling their actions. The evolutionary tree in Figure 11.4 shows a tentative hypothesis of the relationships among the major groups of animals.

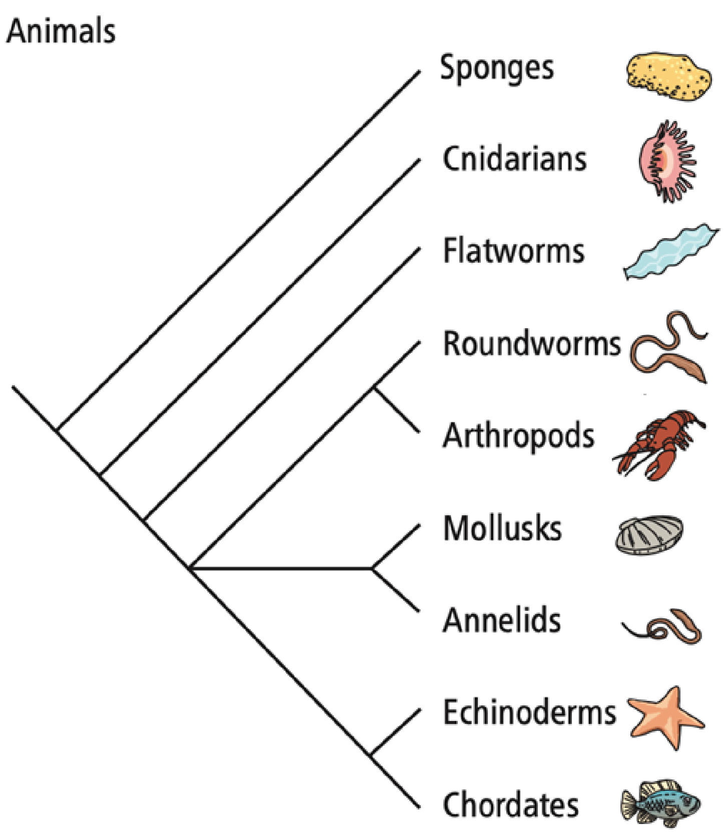


FIGURE 11.4

This evolutionary tree shows how the major groups of animals are related to one another.

Sponges

Sponges are sedentary marine animals (Figure 11.5). Most sponges have a tubelike shape with a large central cavity. Special cells in the sponge beat their flagella to produce a constant flow of water through the animal. Water enters through numerous pores, flows into the sponge's central cavity, and goes out the top. This constant current allows the sponge to catch food. Sponge cells trap bacteria from the water, digest them, and then distribute the nutrients to other cells.

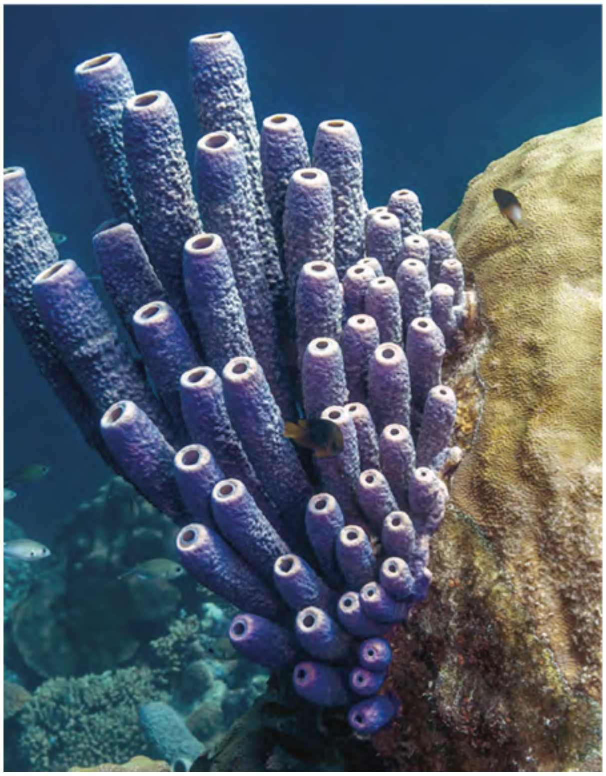


FIGURE 11.5
This is a purple tube sponge.

Sponges are the only animals that lack tissues, groups of similar cells that perform a certain function. This allows sponges to do unusual things—for example, if you separate a sponge's cells by passing it through a sieve, the cells will reassemble on the other side, forming a new sponge. No other animals can do that.

Cnidarians

Cnidarians ("nye-DARE-ee-uhns") include animals such as jellyfish, sea anemones, and corals. Unlike sponges, cnidarians have two distinct tissue layers: an outer layer that protects the body and an inner layer that digests food. These layers are separated by a jellylike middle layer.

Cnidarians use tentacles armed with barbed stinging cells to catch prey. In many species, the stinging cells release powerful toxins. (This is why jellyfish can be a danger to ocean swimmers.)

Prey are digested in a *gastrovascular cavity* that has a single opening that serves as both mouth and anus. Many cnidarians alternate between a sedentary polyp stage and a mobile, bell-shaped, medusa stage. Cnidarians such as sea anemones and corals spend most of their lives as polyps. Cnidarians such as jellyfish spend most of their lives as medusas (Figure 11.6). One important group of cnidarians are the corals.

FIGURE 11.6
These are moon jellyfish, a species found in coastal waters all over the world. The moon jellyfish is a cnidarian in its medusa form.

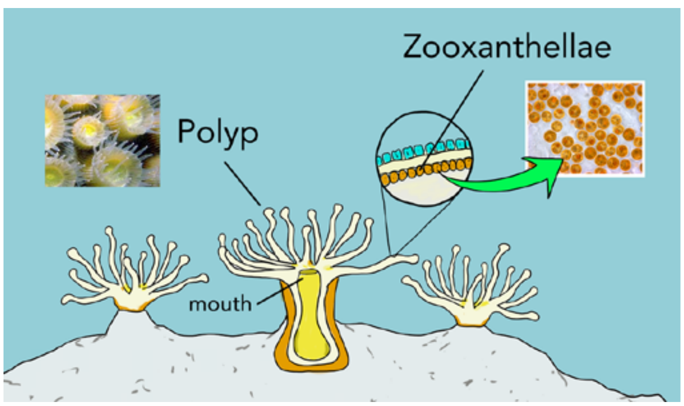
Coral reefs are found in tropical oceans, in clear, shallow waters with temperatures between 20°C and 28°C (68°F and 82°F). Coral reefs are among the most diverse ecosystems in the world. Numerous marine species, including commercially important fish, spend all or part of their lives in coral reefs. Reefs also help protect shorelines from ocean waves. But, as humans burn more and more fossil fuels, the amount of carbon dioxide in Earth's atmosphere has increased, resulting in global warming and more acidic oceans. How has this affected corals and other marine species?

Corals live in colonies of tiny polyps, each wrapped in a calcium carbonate skeleton. Unlike many other cnidarians, however, corals are not hunters.

They obtain most of their nutrients from photosynthesizing dinoflagellates known as zooxanthellae that live within their cells, as shown in Figure 11.7a. (We discussed dinoflagellates, a group of Protists, in Chapter 10.)

Coral bleaching occurs when environmental conditions cause corals to kick out their zooxanthellae. The corals literally turn white, because it is their dinoflagellates that give them their colors (Figure 11.7b). Coral bleaching is most often triggered by an increase in seawater temperature. High temperatures interfere with photosynthesis in dinoflagellates, causing toxic molecules to build up in them. This in turn causes the corals to eject them. Corals can survive for a short time without their dinoflagellates. If water temperatures decrease again, dinoflagellates move back into bleached corals, and the corals survive. But, if warm temperatures continue for too long, the corals starve to death.

FIGURE 11.7
(a) Coral polyps tend to be tiny, but they live in huge colonies. Corals receive as much as 98% of their nutrients from the photosynthesis occurring within the colorful zooxanthellae living within their tentacles. (b) These bleached corals have kicked out their zooxanthellae dinoflagellates.



(a)


(b)

Mass coral bleaching has become common in recent years due to the high water temperatures associated with global warming. In 2016, an estimated 29% of corals in Australia's Great Barrier Reef—the largest coral reef in the world—died. Bleaching was worst in the northern part of the reef, where over 70% of corals died. A second bleaching event occurred in 2017, this time striking the middle part of the reef. This event caused another 20% of the corals to die. Overall, about 90% of the reef has been affected. Unfortunately, as temperatures continue to rise, bleaching is likely to become more widespread and more severe.

Will coral reefs disappear? Corals do vary in their preferred temperatures and in their susceptibility to bleaching. For example, certain corals have special fluorescent pigments that they use, like sunscreen, to shield their dinoflagellates. These fluorescent corals have survived mass bleaching episodes better than nonfluorescent corals. But, it is uncertain how much warming coral reefs can stand.

High carbon dioxide levels also lead to ocean acidification. Atmospheric carbon dioxide (CO_2) is absorbed by the ocean, where it reacts with water to form carbonic acid (H_2CO_3). This lowers the pH of the ocean while also transforming carbonate minerals, such as calcium carbonate ($CaCO_3$), into bicarbonate compounds:

CO_2	+	H_2O	→	H_2CO_3
Carbon dioxide	+	Water	→	Carbonic acid

H_2CO_3	+	$CaCO_3$	→	$Ca(HCO_3)_2$
Carbonic acid	+	Calcium carbonate	→	Calcium bicarbonate

Many marine animals—including corals, echinoderms, crustaceans, and mollusks—need calcium carbonate to build their shells. In addition, acidified seawater increases the rate of dissolution of their shells. For these reasons, ocean acidification causes shelled animals to grow more slowly and to have weaker shells. Scientists have observed that coral growth slows in acidified waters and that the larvae of bivalves such as oysters and mussels are smaller. Some plankton, including certain photosynthetic species, also have calcium carbonate shells. As seawater becomes more acidified, plankton mass decreases. Because photosynthetic plankton form a crucial part of marine food chains, the consequences could extend across entire marine communities.

READING CHECK

1. **Global warming also causes sea levels to rise, mainly because seawater expands as its temperature increases. How do rising sea levels affect corals?**
2. **As global warming continues, how might the species composition of coral reefs change?**

CHECK YOUR ANSWERS

1. Corals are found only in clear, shallow waters, where there is enough sunlight for their dinoflagellates to photosynthesize. Rising sea levels will require corals to shift to shallower ground or to grow upward quickly. Whether corals can find appropriate habitat and keep pace with sea- level changes remains to be seen.
2. Corals that are adapted to warmer temperatures may spread as global warming continues. In addition, coral reefs may come to be dominated by corals that are more resistant to bleaching. For example, species that have fluorescent pigments may survive, whereas species that lack these sunscreens may die out.

Visit these sites to learn more about the dire problem of coral bleaching and what can be done about it:

https://www.chasingcoral.com/

https://www.worldwildlife.org/pages/everything-you-need-to-know-about-coral-bleaching-and-how-we-can-stop-it

For more on sponges, check out:

http://tolweb.org/treehouses/?treehouse_id=4291

To read more about cnidarians, go to:

https://ucmp.berkeley.edu/cnidaria/cnidaria.html