

CORAL REEFS

Not all corals build coral reefs. Those that do not are called soft corals and often live at great depths in cold seawater. Stony corals are reef-building species. Coral reefs are built as calcium carbonate exoskeletons of one generation of stony corals are secreted on the exoskeletons of preceding generations. It requires millions of years for massive reefs, such as those found in warm, shallow waters of the Indian Ocean, the south Pacific Ocean, and the Caribbean Sea, to develop. Reef formation requires constantly warm (20° C), shallow (less than 90 m) water and constant salinity near 3.5%.

Most reef-building activities are the result of stony corals living in a mutualistic relationship (*see chapter 8*) with a group of dinoflagellate protists called **zooxanthellae** (*see figure 9.20*). Stony corals depend on photosynthetic activities of zooxanthellae as a principal source of carbohydrates. Predatory activities are mainly a source of protein for polyps. Zooxanthellae also promote exceptionally high rates of calcium deposition. As zooxanthellae carry on photosynthesis, they remove carbon dioxide (CO₂) from the polyp's environment. Associated pH changes induce the precipitation of dissolved CaCO₃ as aragonite (coral limestone). The 90 m depth limit for reef building is believed to correspond to the limits to which sufficient light penetrates to support dinoflagellate photosynthesis.

Certain algae, called **coralline algae**, live outside the coral organisms and create their own calcium carbonate masses. These algae contribute to the reef by cementing together larger coral formations.

Reefs can extend hundreds of meters below the ocean's surface; however, only the upper and outer layer includes coral animals and algae. Most of the reef formation consists of exoskeletons of previous generations of stony corals. (The depth of the reef mass is evidence of changing oceanic levels during glacial periods and of the subsidence of the ocean floor.) In addition to the outer layer of photosynthetic and cnidarian life-forms, the reef supports a host of other organisms, including fishes, molluscs, arthropods, echinoderms, soft corals, and sponges. The exceptionally high productivity of reef communities depends on the ability of reef organisms to recycle nutrients rather than to lose them to the ocean floor.

There are three types of coral reefs: (1) Fringing reefs are built up from the sea bottom so close to a shoreline that no navigable channel exists between the shoreline and the reef. This reef formation frequently creates a narrow, shallow lagoon between the reef and the shore. Surging water creates frequent breaks and irregular channels through these reefs. (2) Barrier reefs are separated from shore by wide, deep channels. The Great Barrier Reef of Australia is 1,700 km long with a channel 20 to 50 m deep and up to 48 km wide. (The Great Barrier Reef actually consists of a number of different reef forms, including barrier reefs.) (3) Atolls are circular reefs that enclose a lagoon in the open ocean. One hypothesis regarding their origin, first described by Charles Darwin, is that atolls built up around islands that later sank.