

Source: Center for Marine Conservation, Washington, DC. Used with permission.

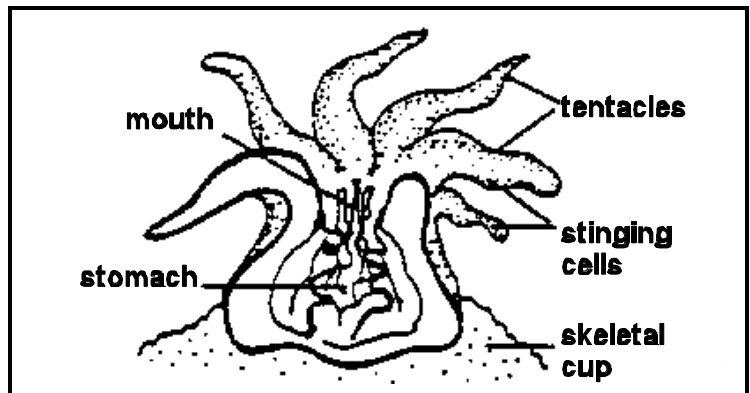
1. CORAL REEFS: A FACT SHEET

Why are they important?

Coral reefs have often been described as “underwater gardens.” Their beautiful colors, intricate shapes and exotic creatures remind us of the diversity and splendor of tropical rainforests. Like rain forests, reefs are valuable resources and important parts of the global ecosystem. Coral polyps, because of their unique ability to grow in nutrient-poor water, are responsible for incredible communities of fish and other marine life in waters that might otherwise have been barren. People all over the world depend on reefs for food and protection from waves; many tropical islands and beaches are constructed completely of coral fragments. Despite the ecological significance and beauty of reefs, they are being threatened around the globe by human activities such as boat groundings, overfishing, and pollution. As in the case of rain forests, it will be up to humans to stop the damage and learn how to protect coral reefs for future generations.

What is coral?

Coral reefs can be made up of hundreds of different species of coral. There are two main types: “hard” coral with an outer skeleton of calcium carbonate (CaCO_3) and “soft” corals that embed bits of CaCO_3 inside their bodies. Although it comes in many shapes and sizes, all coral is composed of tiny individual **polyps**. A polyp is a tiny animal that looks like an upside-down jellyfish. In soft corals, each polyp contains little spikes of CaCO_3 that help hold many polyps together in structures that look like fans or whips. In hard corals, polyps sit inside little cups which they build out of calcium carbonate. Many of these cups are cemented together to make up a coral colony. Reefs are formed when hundreds of hard coral colonies grow next to and on top of each other. Since most species of coral polyps stay deep within their calcium carbonate cups during the day, the casual observer may think of coral as inanimate rocks. At night, however, the polyps emerge, and wave their tiny stinging tentacles in the water to catch microscopic organisms called **plankton**.



What makes coral polyps so unique is that plankton is only part of their diet. Each polyp harbors within its body special algae called **zooxanthellae**. These one-celled plants use sunlight and carbon dioxide to conduct **photosynthesis**, a process that produces oxygen ... and other nutrients needed by the polyps. In return, the algae get protection and a constant supply of carbon dioxide and other raw materials they need for photosynthesis. Such a mutually beneficial relationship is called **symbiosis**. Without this special relationship, it is likely that there would be far fewer animals in clear, tropical waters since they typically cannot support life. It is important to realize that the fish, crabs, snails, worms and other reef creatures depend on the health and growth of the coral reef for their existence.

How do coral reefs form?

To start a new reef, coral polyps can reproduce sexually, using sperm and eggs. Male polyps send sperm into the water where it enters female polyps and fertilizes the eggs within. [Fertilization is internal in corals known as “brooders.” “Broadcasters” shed their eggs and sperm into the water, and fertilization is external.] Baby corals [called planulae] develop and leave the polyps, floating on the current until they reach a suitable surface where they can attach and begin to grow into new coral polyps. Sexual reproduction allows corals to distribute themselves. To simply add onto an existing colony, polyps undergo asexual reproduction in which new polyps “bud” off the parents and form their own CaCO_3 cup right beside the older polyp. Polyps formed this way are exact copies of each other, creating entire colonies of coral with exactly the same genes.

How fast do reefs grow?

Some reef corals are capable of growing 15 centimeters (6 inches) in a year. [Massive corals such as star coral and brain coral grow considerably slower, typically only 1/8 inch to 3/4 inch per year.] As old corals die, new ones usually settle and grow over the dead skeletons. Many generations of settlement, competition, growth and death result in structures like the Great Barrier Reef in Australia, which is hundreds of feet thick and millions of years old.

Where do coral reefs form?

True reef-building corals can only grow where the water is clear, warm and shallow. Average water temperatures typically do not fall below 20 degrees Centigrade (68 degrees Fahrenheit) and it is generally no deeper than 100 meters (325 feet). [Most corals grow in depths of less than 40 meters.] These conditions are met in tropical waters near the equator, on the eastern sides of continents and around oceanic islands.

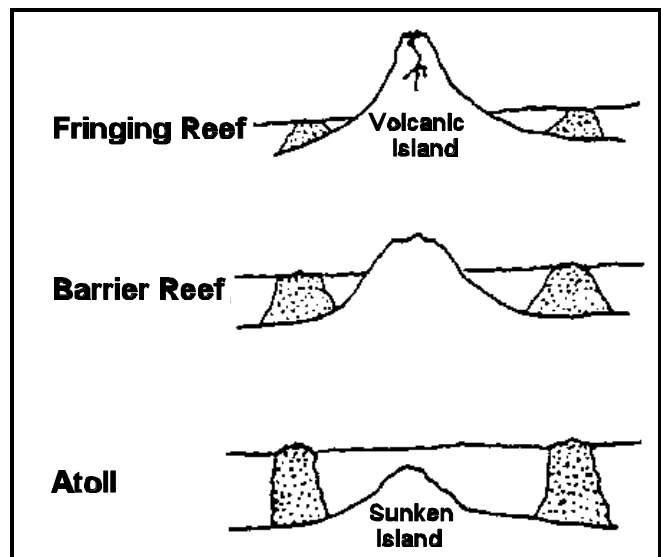
When a reef forms close to shore it is a **fringing reef**. As the reef matures, the oldest corals near the shore may die and the reef will become an offshore **barrier reef** with a lagoon in between it and the shore. When corals grow around a volcanic island an **atoll** results as the island gradually subsides, leaving only a ring of coral visible near the sea surface.

Changes in sea level can also expose pieces of a fringing or barrier reef, turning them into small coral islands like the Florida Keys.

What threatens reefs?

Natural threats

Both hard and soft corals are vulnerable to unusually strong waves (e.g., those formed by a hurricane) as well as dramatic changes in the temperature and saltiness of the water. Predation by fish, snails, worms, crabs, shrimp and starfish, and overgrowth by fleshy algae can also kill corals. Parrotfish, for example, have strong teeth with which they break through the CaCO_3 cup to the polyp inside. Corals also compete against each other for light and space. The faster growing corals usually dominate. However, slow growers like brain coral are better at surviving physical disturbances such as storms.



Over thousands of years, corals have evolved ways to defend against the natural threats they face. Extending polyps only at night, using toxic chemicals (fire coral is an example) and producing huge numbers of larvae all help corals survive and prosper. Unfortunately, these adaptations may be of little use when it comes to threats from humans.

Human activities

We are capable of damaging and destroying reefs in a variety of ways, including pollution, deforestation, fishing and collecting.

Pollution

There are basically two kinds of pollution that damage a reef. One is the introduction of any substance into the water that increases its cloudiness. Zooxanthellae must have absolutely clear water in order to get enough sunlight and still remain embedded in the tissues of the polyp. Sediments stirred up by boaters and swimmers, washed off land by rain or expelled by oil drilling rigs can kill a reef by depriving it of light. (Polyps can also be smothered by blankets of sediment.) The other type of pollution is chemical. Fertilizer runoff and sewage discharge fill the water with nutrients that allow algae to grow faster than the corals, overgrowing and smothering the polyps. In addition, reef organisms are poisoned by heavy metals, pesticides and oil. Even low levels of oil can slow down reproduction by making it difficult for microscopic larvae to swim and settle. Slower reproduction means that reefs cannot repair damage as quickly as usual.

Power plants

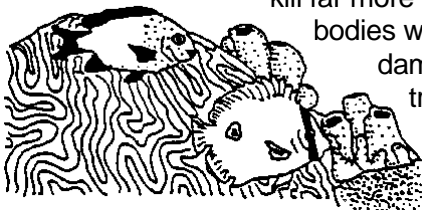
Many power and desalination plants draw huge quantities of seawater into their machinery. The filters through which this water passes often become clogged with the bodies of fish that were attracted to the intake pipes. Microscopic plankton that travel through the filter screens are killed by excessive heat inside the pipes. Hot water discharged from plants can be as lethal as any poison to organisms accustomed to the stable temperatures of tropical seas. The location of such plants near coral reefs upsets the normal balance of the reef ecosystem by serving as a huge, indiscriminate predator and a source of constant disturbance.

Deforestation

Extensive logging results in erosion of soil into rivers that carry it out to sea, increasing the cloudiness and nutrient content of water. Another effect of deforestation is the possible rise of global temperatures due to the increase in carbon dioxide from the burning of trees (and fossil fuels). Changes in sea level and water temperature brought on by global warming could affect reefs by making shallow water too warm for polyps. There is evidence that suggests higher than normal temperatures have already affected corals around the world by causing polyps to eject their zooxanthellae. This phenomenon, known as "bleaching" [since the algae within corals gives them color], significantly weakens the ability of reefs to grow, repair themselves and combat disease.

Fishing and Collecting

In many parts of the world reef fishes are a significant source of food. Fishing with a simple hook and line is usually not harmful to coral reefs, but blasting with dynamite, setting traps and using poisons such as cyanide can cause irreparable damage. Besides the obvious physical destruction of the coral, underwater explosions stir up sediment that prevents sunlight from penetrating to the polyps. Traps and poisons often kill far more animals than the fishers can use and fill the area with decomposing bodies which use up dissolved oxygen. Recreational fishermen can also cause damage by running aground on coral, breaking coral with anchors, dumping trash into the water, and taking too many fish to allow populations to maintain their numbers. Some reefs are overwhelmed with divers and snorkelers who stand on and break off coral, collect indiscriminately and stir up sediment with their fins.



Correlation to National Standards from McREL (<http://www.mcrel.org>) :

Life Sciences

5. Understands the structure and function of cells and organisms
6. Understands relationships among organisms and their physical environment

Geography

8. Understands the characteristics of ecosystems on Earth's surface
14. Understands how human actions modify the physical environment