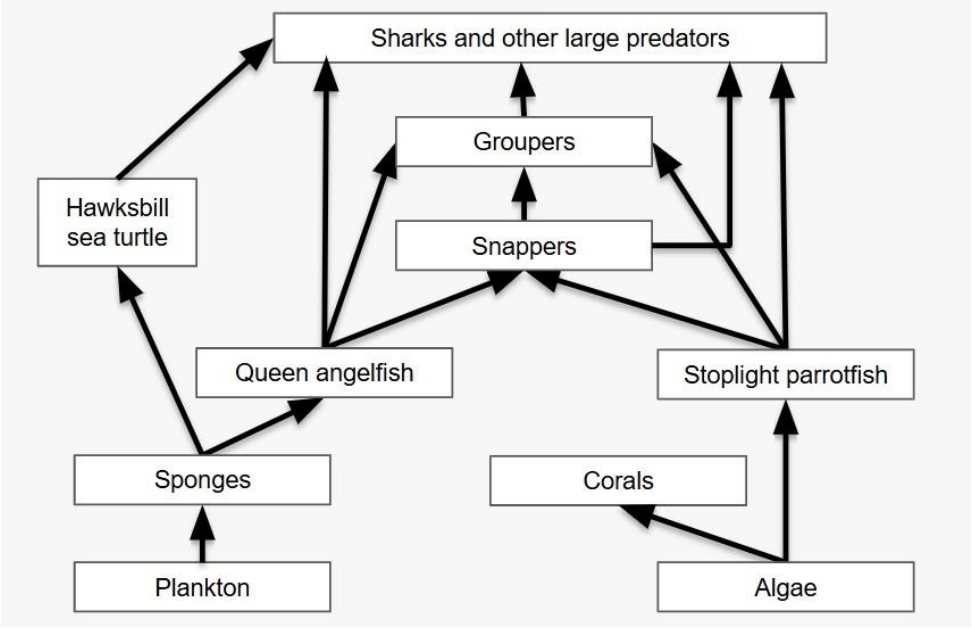
Coral Reef Ecology—Scientific Background

Coral reef ecosystems are known for their biodiversity, or variety of living things. Scientists consider biodiversity an important measure of ecosystem health and stability.

Coral reef organisms that are featured in this Investigation include staghorn and boulder star corals, algae, sponges, hawksbill sea turtles, queen angelfish, stoplight parrotfish, yellowtail snapper, and Nassau grouper. Corals are tiny invertebrates that live in large groups; a single coral organism is called a polyp. Over time, the hard exoskeletons of some types of corals accumulate to form large reefs. The bright colors of a coral reef come from the photosynthetic algae living inside the corals in a type of symbiosis called mutualism, in which both species benefit from living together in a close relationship. Corals provide algae with a place to live, and algae provide energy for corals.

A food web is a diagram that shows how energy is transferred through an ecosystem from one organism to another. It consists of multiple overlapping food chains. Each food chain begins with a producer and consists of a series of interactions in which one organism eats another to obtain energy. In food chains and food webs, arrows show the direction of energy flow.



Sponges are filter feeders that consume plankton suspended in the water. Hawksbill sea turtles are large turtles that feed primarily on sponges. Groupers are large predatory fish that feed on

many reef fish, including snappers, angelfish, and parrotfish. Snappers eat smaller fish, shrimp, crabs, and worms. Queen angelfish mainly eat sponges, while stoplight parrotfish and long-spine sea urchins feed on algae.

Biotic factors are the living things in an ecosystem—like fish, coral, algae, plants, and sponges. Predators and prey are biotic factors. Abiotic factors are the nonliving parts of an ecosystem—like sunlight, water, air, nutrients, sand, temperature, storms, and other environmental conditions. Corals are affected by many environmental factors, including ocean temperature, pH, and storm damage. Increased ocean temperature and other environmental stresses can cause corals to bleach, or expel their symbiotic algae. Bleached corals appear white and cannot survive long without their main food source.

Human activities on land impact coral reef ecosystems. For example, logging and coastal development release sediments into streams, rivers, and the ocean. Sediments are tiny pieces of sand, soil, plants, or wastes from living things. Sediment pollution makes the water more cloudy and adds extra nutrients that increase algae growth. Another source of nutrient pollution is sewage overflows. Large rainstorm events can overwhelm sewer systems, causing untreated sewage to overflow into streams, rivers, and the ocean. Sewage is wastewater that contains everything that people flush down a toilet or pour down a drain. Sewage overflows pollute the water with harmful microorganisms, chemicals, and extra nutrients.

Warmer waters and nutrient pollution from runoff and sewage overflows lead to algae blooms, when algae populations suddenly overgrow. The algae cover corals and block sunlight from reaching their symbiotic algae. Later, bacteria break down dead algae, using up dissolved oxygen in the process. Populations of corals, fish, and other organisms decrease because they cannot breathe.

Another human impact on aquatic ecosystems is overfishing. People tend to catch larger fish, like grouper and snapper, more than smaller ones, like queen angelfish and stoplight parrotfish, but some types of fishing result in bycatch, when other organisms are caught by accident. Overfishing disrupts aquatic food webs, and some types of fishing also damage habitats.

Invasive species can disrupt ecosystems because they have no natural predators. The red lionfish is native to the Pacific Ocean and is a voracious predator of small fish. It has no natural predators in Biscayne Bay, Florida. To reduce red lionfish populations and mitigate disruption to the coral reef food web, people construct habitats to attract, catch, and remove them. Some restaurants offer red lionfish on their menus.