

## Education

# The Changing Coral Reef Community Game



### Grade Level

- 4-6 (Life Sciences)

### Timeframe

- 45-60 minutes, depending upon number of rounds of the game is played and the length and depth of the discussion.

### Materials

- Coral Reef Organism card set
- Scenario card set
- Extra Organism card set
- Table and/or chart for plotting population curves
- Instructions

### Key Words

- Organism
- Population
- Biological Community
- Ecosystem
- Dominant
- Growth
- Reproduction
- Mortality
- Recruitment
- Sponges
- Coral
- Seaweed (macro-algae)



### Activity Summary

Overtime, coral reefs experience shifts in the ecosystem, which changes the type of species that thrive. In this lesson, students will explore the factors that enable specific organisms to survive and live successfully. Students will then track changes in a coral reef community to observe how species diversity, abundance, and interactions change over time. Students will apply scenarios to the corals, sponges and seaweeds on the coral reef in this game, that results in a shift within the ecosystem leading to a change in species composition. Scenarios may be natural or human-induced

### Learning Objectives

Students will be able to:

- Gain an understanding of the living requirements and ecology of three important sessile organisms that inhabit the coral reef: corals, sponges and seaweeds.
- Chart the changes in the population of sponges, corals, and seaweeds over time as the coral reef community experiences environmental changes and other factors that affect the growth, mortality and recruitment of reef organisms.

## Background Information

The **biological community** is the living portion of the **ecosystem** and consists of **populations** of plants and animals that inhabit a particular area. The coral reef experiences environmental conditions that result in the growth, mortality and recruitment of reef organisms. The ability of a specific organism to survive and live successfully in a specific location depends upon many factors: food supply, space and living conditions as well as competition for food and space resources with other organisms.

Over time, the kinds and numbers of organisms on a coral reef may stay basically the same or shifts may take place to favor one species or group of species at the expense of another group. This is especially true for corals and sponges that live attached to the seafloor or substrate because they must have a suitable amount of space in which to live and grow and that suitable space can be very limited in an area like the coral reef.

The **species composition** of a coral reef is determined by the kinds of organisms that form the reef community and their relative abundance to one another. When a species is present in great abundance in a particular place, it may be deemed the **dominant** species. Often, a community is named after the dominant species. In most cases, dominant species are plants, but they can also be corals, sponges, or other organisms.

When a coral reef experiences conditions that cause a shift toward more seaweeds and fewer corals over time, the species composition has changed. If the shift is significant enough, the characteristics and the dominant species for that community may also change. Such changes can affect other organisms at the reef. For example, if seaweeds become the new dominant species in an area, the fish and invertebrates that feed on

seaweeds will be favored, possibly resulting in increases in populations of those species. Predators that feed on the seaweed eaters may also be favored. The way that organisms interact with one another also determines the kinds and numbers of species present in a particular area.

Changes in species composition are influenced by environmental conditions (both natural and human induced) and other factors like disease that affect the **growth, mortality** (death) and **recruitment** (addition of new individuals) of the reef inhabitants. For example, a coral reef can experience the loss (mortality) of corals due to disease or severe environmental conditions. In time, other organisms like sponges may be recruited to the area and grow over the dead corals, changing the nature and characteristics of the biological community from one dominated by corals to one dominated by sponges.

Changes in the populations of organisms on the reef can be visualized by plotting population curves, which reflect the increases or decreases that took place because of certain environmental conditions or other factors. Population curves only measure presence or absence and do not reflect the size or maturity of the organism.



## Vocabulary

**BIOLOGICAL COMMUNITY:** A group of interdependent organisms living and interacting with each other in the same habitat.

**ECOSYSTEMS:** A system that includes all living organisms (biotic factors) in an area as well as its physical environment (abiotic factors) functioning together as a unit.

**POPULATIONS:** A group of organisms of one species that interbreed and live in the same place at the same time.

**SPECIES COMPOSITION:** Species richness, or the number of different species in a given area.

**MORTALITY:** The death rate. The ratio of the total number of deaths to the total population. The ratio of deaths in an area to the population of that area; expressed per 1000 per year.

## Preparation

Print out and cut the cards in the three sets of cards attached to this document: (Coral reef organisms, scenario and extra organism cards).

## Procedure

The object of The Changing Coral Reef Community Game is to observe and track changes in the corals, sponges and seaweeds in a coral reef community through time. A set of 36 organism cards is used to represent the coral reef. Students apply scenarios to the corals, sponges and seaweeds on the coral reef that result in the addition or subtraction of individual, thus showing the changes in the species composition over time. Scenarios may be natural or human-induced. As the scenarios are applied, the students track the population changes in the sponges, corals and seaweeds and create population curves that show the fluctuations over time. Scenario cards describe events and relate concepts that involve mortality, growth, reproduction, recruitment, predation, disease, and species competition.

- 1) Shuffle coral reef organism cards (including blank page cards) and place them face up 6 rows of 6 cards each. These cards will represent the reef at a particular point in time. Before beginning the game, count the individuals at the reef of each species--sponge, coral and seaweed. Record the totals in a table that can be viewed by everyone. The table should have spaces for the total numbers of sponges, corals and seaweeds at various time intervals. These counts will represent the "baseline population" from which all future comparisons will be made. The procedure section explains the activity with step-by-step instructions. Make sure to include information on pre-lesson activities or discussions, during lesson activities, and follow-up questions or discussions.
- 2) Four to 8 players can play at any one time. Shuffle scenario cards. Each player takes a turn drawing a scenario card and applying that scenario to the sponges, corals and seaweeds on the reef. If the scenario card describes the loss of a certain number of corals, sponges or seaweeds, the same number of cards for that kind of organism are turned over face down with their blank sides up to show that these organisms have died, creating an empty space for each organism lost in that scenario.

- 3) If the scenario card calls for the addition of new individuals to the community, the appropriate kind and number of cards from the extra organism set are placed on the empty spaces to represent the added sponges, corals or seaweeds. Only one organism per empty space unless otherwise state.
- 4) If the scenario card calls for the addition of new individuals, but there are no empty spaces available, no changes are applied to the reef community at that time. In some cases, scenarios may be applied that do not result in the loss or gain of individuals to the reef community.

*Note:* If the scenario card calls for the addition or subtraction of individuals in a species greater than the number present at the reef, the highest number available is used. For example, If the scenario card calls for five sponges to die, but there are only 4 sponges at the reef, then 4 sponges die.

- 5) After each player plays a scenario card (one round), the group stops to tally up the number of individuals of each species and records that total in the table. Each round represents a 10-year period of time. Students can plot the number of individuals for each species for the next 50 years by completing five rounds. The game can be played through to any point that is desired.
- 6) Students use the totals for sponges, corals and seaweeds to create population curves that reflect the fluctuating populations of the three groups of organisms at 10-year intervals. After completing the population curves for sponges, corals and seaweeds, a discussion can begin to identify major shifts in the species composition and the factors that

affected those changes and any consequences that accompany those changes (new species being attracted to the area because of changes, etc.). At the beginning of the game, the baseline community was dominated by corals, but is this still the case? If not, what has been the trend over time?

- 7) Students read copies of background materials. Teacher leads class discussion about biological communities, populations, etc., change in an area through time depending upon events and environmental conditions.

## The Bridge Connection

<http://www.vims.edu/bridge/> Click on *Ocean Science Topics*, select *Habitats*, select *Coastal Habitat*, then select *Coral Reefs*.

## Evaluation

Ask students to review the scenario cards and determine whether each scenario describes recruitment, mortality or growth. Have students explain how mortality and recruitment affect populations of reef organisms and give examples of factors that affect coral, sponge and seaweed populations.

## Education Standards

<b>National Education Standards</b>	<p>Science: 5-8 Content Standard C: Life Science</p> <ul style="list-style-type: none"><li>• Structure and function in living systems</li><li>• Regulation and behavior</li><li>• Populations and ecosystems</li></ul>
<b>Ocean Literacy Principles</b>	<ol style="list-style-type: none"><li>1. The Earth has one big ocean with many features. (h)</li><li>5. The ocean supports a great diversity of life and the ecosystem. (f)</li><li>6. The ocean and humans are inextricably interconnected (e)</li><li>7. The ocean is largely unexplored. (c)</li></ol>

### Extension

*Suggestion #1:* Instruct students use the internet or local resources to identify a person who has observed the coral reef community in a certain area over time and interview them to find out what changes they have observed and why they think these changes took place. They should develop a set of questions in advance and then provide the questions and answers.

*Suggestion #2:* Instruct students to read and write an essay on the environmental conditions and other factors that have affected coral reefs in recent years. Specifically, what changes may have taken place due to increased coral disease and/or with the widespread mortality of the long-spined urchin, which in the past kept seaweed populations in check.

### Resources

- This article explains some of the threats facing coral reefs and the changes that have been observed in the last 25 years.  
<http://earthobservatory.nasa.gov/Study/Coral/coral2.html>.
- This Ocean World website provides student information about the biology of corals, coral reefs and the threats facing them.  
<http://oceanworld.tamu.edu/students/coral/index.html>

### Acknowledgment

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