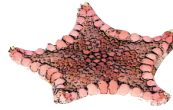
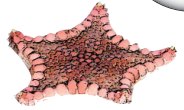


## Activity #3

# Coral Construction



## Cool Fact



Many **corals** at the Flower Garden Banks participate in **mass spawning**. During this event, the corals release millions of reproductive cells into the water at the same time.

Mass spawning at the Flower Garden Banks takes place just once a year, about a week after the August full moon.



© FGBNMS/Hickerson

## Cool Words

### Corals

Small, soft-bodied animals that often live in large groups called colonies

### Mass spawning

Event in which corals (and some other organisms) release millions of reproductive cells into the water at the same time

### Coral larvae

Very young corals that have not yet attached themselves to a hard surface

### Zooxanthellae

One-celled, plant-like organisms that live inside the cells of some corals

### Salt dome

A mound of salt that has pushed up through layers of rock

### Calcium carbonate

A white, chalky mineral

### Coralline algae

Tiny, plant-like organisms that make calcium carbonate

### ROV

A remotely operated vehicle; a type of robot controlled from a distance



The beautiful coral reefs of the Flower Garden Banks have not always been there. Scientists believe that **coral larvae** (LAR vee) first came to the banks about 10,000 to 15,000 years ago. Coral larvae are very young corals that have not yet attached themselves to a hard surface. The larvae likely came from reefs off the coast of Mexico. Water currents carried the larvae to the Flower Garden Banks.

Hard corals can survive only under certain conditions. They need to be attached to a hard surface. They also need shallow, clear water so that sunlight can reach the **zooxanthellae** (zoh zan THEL ee) living in their cells. Without sunlight, zooxanthellae cannot make food for themselves or their coral hosts. Temperature is another important factor. For hard corals to survive, the water temperature must be 64 to 86 degrees F (18 to 30 degrees C).

The Flower Garden Banks have everything that hard corals need. When coral larvae began to arrive, they attached themselves to the rocky surface of the **salt domes** that form the banks. As the corals grew, they laid down **calcium carbonate** and began to build reefs. Over time, the corals reproduced and the reefs got bigger.

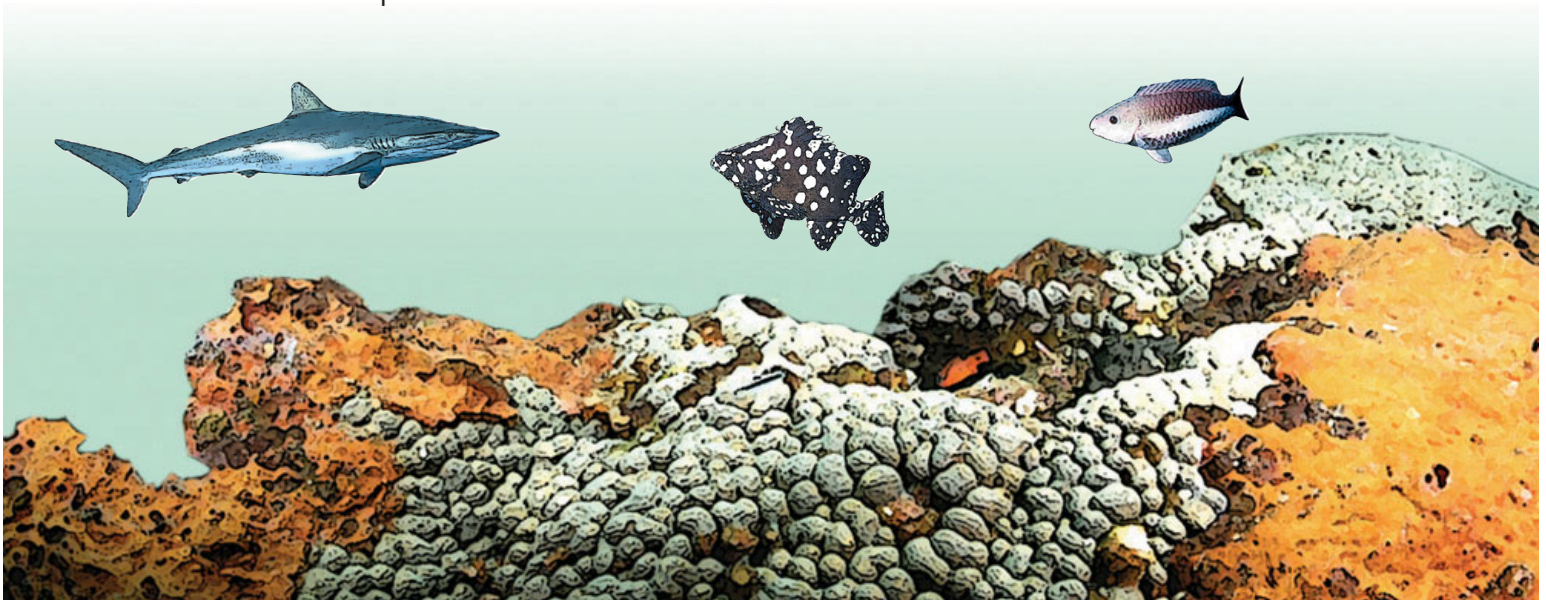
The Flower Garden Banks have changed over the past 10,000 years. As sea levels have gone up and down, plants and animals have adapted by forming different types of communities. Today, scientists divide the Flower Garden Banks into seven zones: coral reef, coral community, **coralline algae** (KOR uh lin • AL jee), deep coral, soft bottom, brine seep, and mud volcano.

The coral reef zone is 60 to 170 ft (18 to 52 m) below the surface of the water. More than 20 species of hard corals help to build the reef in this zone. Coralline algae—tiny, plant-like organisms that make calcium carbonate—also help to build the reef.



Researcher Emma Hickerson uses a waterproof video camera to film the coral reef zone at the East Flower Garden Bank.

© Ed Enns



The coral reef zone supports a huge variety of organisms. It is the most well-known part of the Flower Garden Banks because it is shallow enough for scuba divers to explore.

In deeper water, there is less sunlight and fewer hard corals can survive. The coral community and coralline algae zones have some hard corals. But they have more coralline algae, sponges, and soft corals. Soft corals do not build reefs.

Very little sunlight reaches the deep coral zone, which is more than 290 ft (88 m) deep. In this zone, soft corals rule! Many types of fish and other creatures live in this zone, too. The deep coral zone is the least well-known zone because it is too deep for scuba divers. But it is not too deep for remotely operated vehicles (**ROVs**). One goal of the *Secrets of the Gulf* expedition was to use the ROV *Argus* to find out more about the geology and biology of the deep coral zone. *Argus* shot video, took pictures, and made maps of the area.



This soft coral colony is 253 ft (77 m) below the surface of the water. The colony is about 4 in. (10 cm) across.

© FGBNMS/NURC-UNCW

*Argus* also had a chance to explore the fascinating soft bottom, brine seep, and mud volcano zones. You will learn more about these zones in later activities.












**Now that you know a little more about the history of the Flower Garden Banks, follow the steps on the next page to see the history in action!**



## Activity

In this activity, you will model the beginning of reef formation at the Flower Garden Banks.

## Materials

-  Flower Garden Banks Map
-  11.4 qt (10.7 L) plastic dishpan tub
-  0.5 lb (225 g) modeling clay
-  ruler
-  3 colored pipe cleaners
-  scissors
-  3 to 4 qt (3 to 4 L) water
-  1 c (240 mL) sand
-  *optional:* yarn or string

## Ready to Begin?

### Steps

#### *Part 1: Make the Banks*

- 1.** First you will make models of the East Flower Garden Bank and the West Flower Garden Bank.
- 2.** Divide your modeling clay into two balls. With the first ball, form a mound on top of the East Flower Garden Bank on the Flower Garden Banks Map. The mound should be about 2 in. (5 cm) high.
- 3.** With the second clay ball, form a mound on top of the West Flower Garden Bank on the Flower Garden Banks Map. This mound should also be about 2 in. (5 cm) high.

- 4.** Look at the Flower Garden Banks Map. It is divided into four large rectangles. Each of these rectangles represents part of the Flower Garden Banks area. Now look at the dishpan tub. Picture the same four rectangles dividing the bottom of the tub into four zones. Move the two clay mounds to the bottom of the dishpan tub. Place the mounds in the same position on the bottom of the tub as they are on the map. Press down on the mounds to securely attach them to the bottom of the tub.
- 5.** Pour water into the dishpan tub until the tops of both clay mounds are just covered.
- 6.** Sprinkle 1 c (240 mL) sand into the dishpan tub so that a thin layer covers the entire bottom.

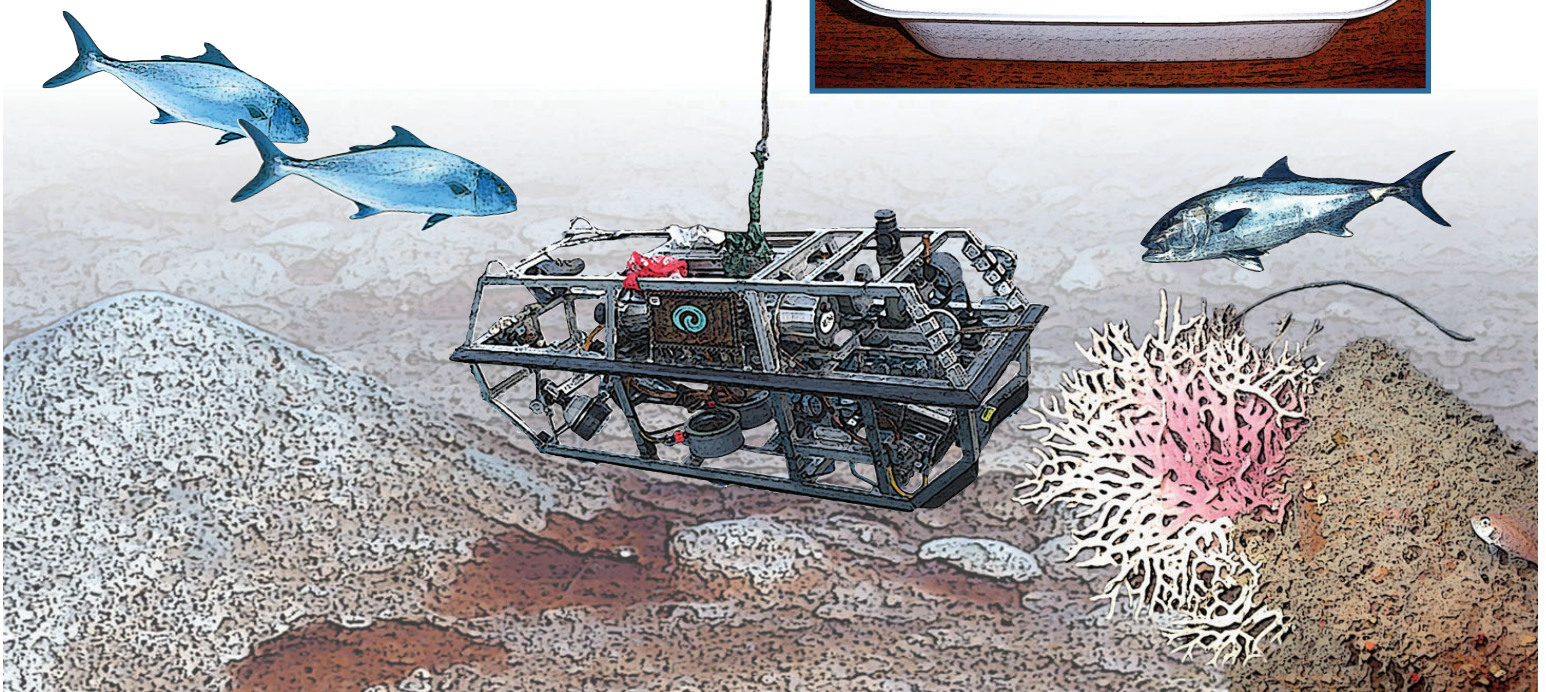




## Part 2: Bring On the Coral Larvae

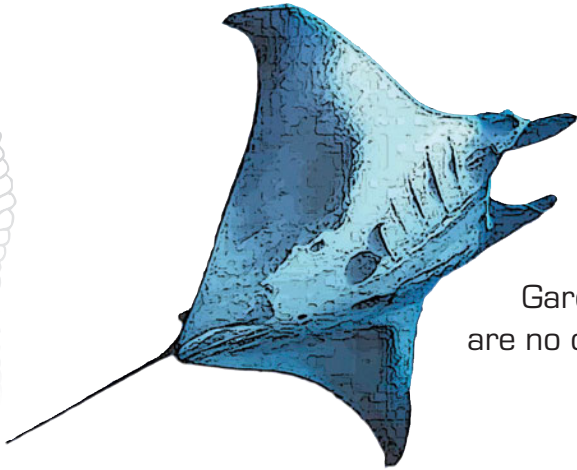
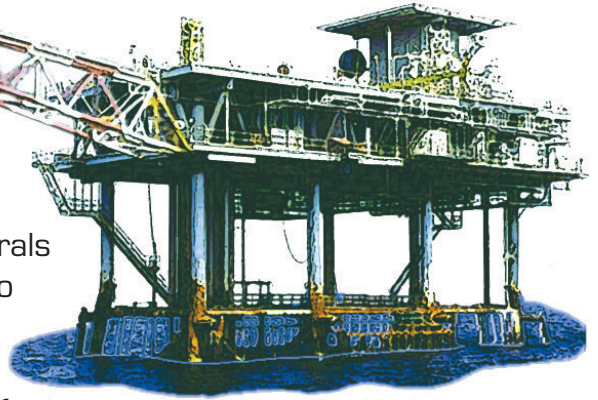
1. Now you will model what happened when the coral larvae began to arrive at the Flower Garden Banks.
2. Cut three colored pipe cleaners into segments that are each about 0.5 in. (1.25 cm) long. The pipe cleaner segments will represent coral larvae. Later they will represent adult corals, too.
3. Look again at the four large rectangles on the Flower Garden Banks Map. Picture the same four rectangles dividing the bottom of the tub into four zones. Two of the zones should be mostly sand. Two of the zones should have a clay mound.
4. Plant one pipe cleaner segment in each of the four zones. For the sand zones, try to make the pipe cleaner segment stand upright in the sand. For the clay mound zones, push the end of the pipe cleaner segment into any part of the mound. Planting the pipe cleaner segments represents the coral larvae trying to attach themselves to a surface.

5. Now hold two sides of the dishpan tub and gently swish the water back and forth. This represents currents moving through the area. Observe what happens to the coral larvae in the sand.
6. Plant another pipe cleaner segment next to each coral larva that remained upright after step 5. This represents the larvae growing into adult corals and beginning to reproduce.
7. Repeat steps 4–6 until you run out of pipe cleaner segments. Remember to add another pipe cleaner segment next to every pipe cleaner segment that is still standing after step 5. By the time you run out of pipe cleaner segments, you should see two thriving coral reefs!



## Taking It Further Activity: Sea Level Ups and Downs

Over the years, the sea level around the Flower Garden Banks has changed a lot. Add 2 qt (2 L) water to your dishpan tub. This represents a rise in sea level. Hard corals near the bottom of the clay mounds are now too deep to survive. They will die, but they will leave behind their calcium carbonate skeletons. To show this, pull out all of the colored pipe cleaner segments on the bottom half of each mound, and replace them with white pipe cleaner segments. What would happen if the sea level rose even more? What would happen if the sea level then sunk so low that the tops of the mounds were above the surface of the water?



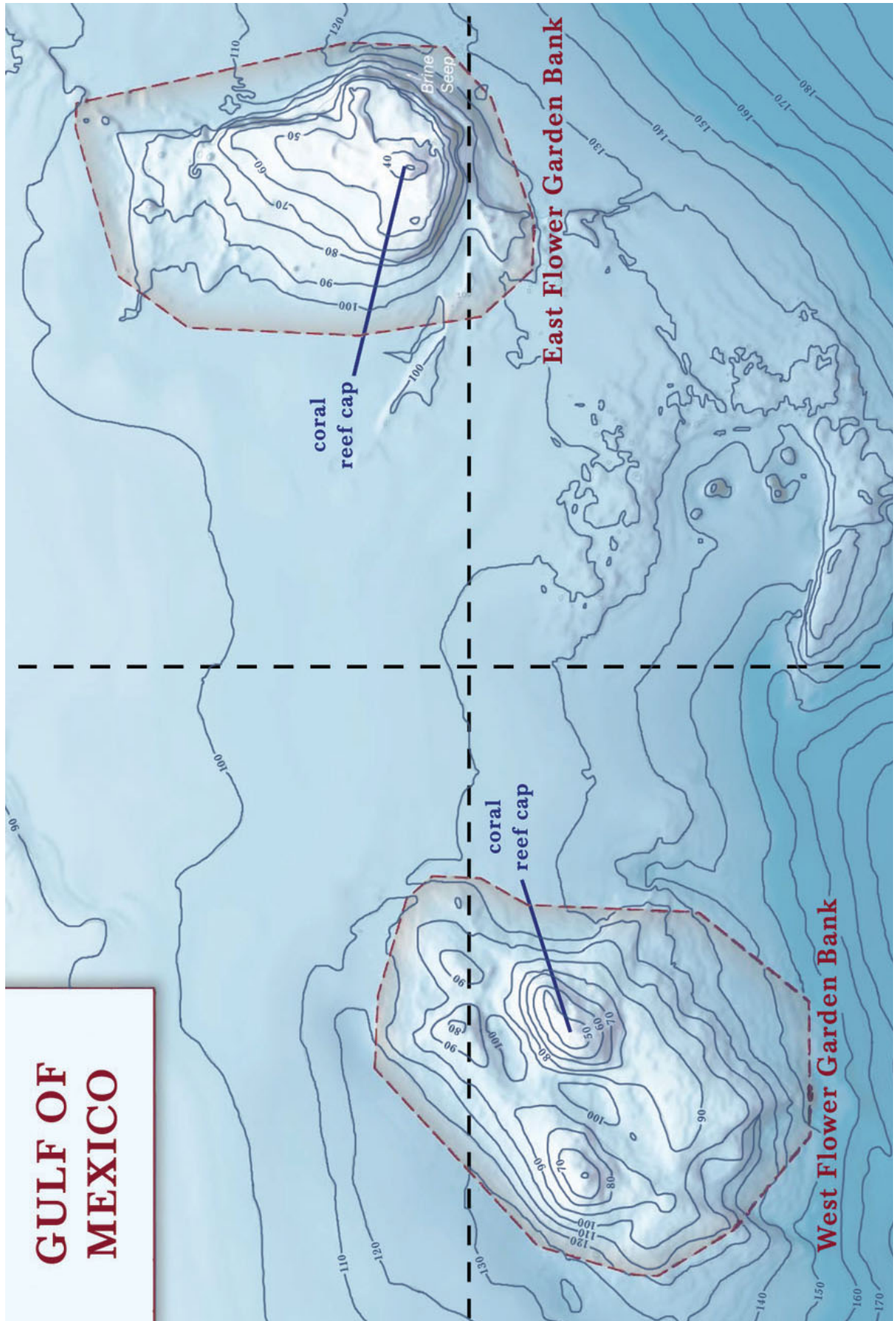
## Think About It

Stetson Bank is a salt dome formation that was added to the Flower Garden Banks National Marine Sanctuary in 1996. It is about 40 mi (64 km) northwest of the Flower Garden Banks. There are corals at Stetson Bank, but there are no coral reefs. Why not?



## Flower Garden Banks Map

This bathymetric (bath uh MEH trik) map shows the area around the East and West Flower Garden Banks. A bathymetric map shows the depths of the water in an area. Bathymetric maps include underwater contour lines, which are lines that connect points of equal depth. The numbers on the contour lines in this map tell how many meters each contour is below sea level.



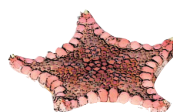




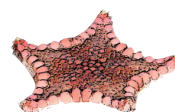


## Activity #3

# Coral Construction



## Summary



In this activity, participants model the beginning of reef formation at the Flower Garden Banks.

**Difficulty:** Medium to Hard

**Suggested Group Size:** 2 to 4

**Time:** 45 to 60 minutes

### Goals

Participants will:

- A. learn about the history of coral reef formation at the Flower Garden Banks
- B. identify several conditions that must be present for hard corals to survive
- C. name the seven different biological zones at the Flower Garden Banks
- D. model the beginning of coral reef formation at the Flower Garden Banks

### Materials

*For each group:*

- Flower Garden Banks Map
- 11.4 qt (10.7 L) plastic dishpan tub
- 0.5 lb (225 g) modeling clay
- ruler
- 3 colored pipe cleaners
- scissors
- 3 to 4 qt (3 to 4 L) water
- 1 c (240 mL) sand

*Optional:*

- yarn or string
- buckets or empty 2-L plastic bottles
- towels

*For the Taking It Further Activity, per group:*

- 1 to 2 white pipe cleaners
- scissors
- 2 qt (2 L) water

### Cool Words

#### Corals

Small, soft-bodied animals that often live in large groups called colonies

#### Mass spawning

Event in which corals (and some other organisms) release millions of reproductive cells into the water at the same time

#### Coral larvae

Very young corals that have not yet attached themselves to a hard surface

#### Zooxanthellae

One-celled, plant-like organisms that live inside the cells of some corals

### Salt dome

A mound of salt that has pushed up through layers of rock

### Calcium carbonate

A white, chalky mineral

### Coralline algae

Tiny, plant-like organisms that make calcium carbonate

### ROV

A remotely operated vehicle; a type of robot controlled from a distance

## Think About It

Stetson Bank is a salt dome formation that was added to the Flower Garden Banks National Marine Sanctuary in 1996. It is about 40 mi [64 km] northwest of the Flower Garden Banks. There are corals at Stetson Bank, but there are no coral reefs. Why not?

*Although Stetson Bank is just 40 mi (64 km) northwest of the Flower Garden Banks, average winter temperatures there are several degrees cooler. These winter temperatures fall outside of the range necessary for hard corals to thrive. So the corals at Stetson Bank do not build reefs. Instead, they exist as individuals and isolated colonies.*

## Set-Up

Make a copy of the Flower Garden Banks Map for each group. Also gather the rest of the necessary supplies.

Non-toxic modeling clay is commonly available in drugstores and arts and crafts stores. This kind of clay is often sold in 1-lb

boxes. Each box contains four sticks of colored clay—enough for two groups. Do not use Play-Doh® or similar clays since these kinds of clay dissolve in water.

Pipe cleaners are available at arts and crafts stores and teacher supply stores.

Any kind of clean sand will work for this activity. You can purchase sand at home improvement stores, garden stores, pet stores, and arts and crafts stores. Use sand from the outdoors only if it is clean and free of debris.

Consider having a few towels on hand in case there are any water spills during the activity. To minimize spills, do not have participants carry their dishpan tubs back and forth to a sink. Supply them with buckets of water or 2-L plastic bottles that they can refill with water.

## Working With Groups

This activity works well in groups of two to four. Have each group member do at least one round of steps 4–6 in Part 2 of the activity.

## Activity Notes

Participants do not need to make their mounds very precisely for this activity to work. However, if participants would like to learn how to use bathymetric data to make more accurate mounds, help them do the optional activity at the end of this section.

Some participants might have trouble picturing the four zones on the bottom of their dishpan tub. They might find it helpful to use yarn or string to mark the zones.

They should cut one piece of string to fit along the length of the tub and one piece of string to fit along the width. Then they should cross the pieces of string on the bottom of the tub to form the four zones shown on the Flower Garden Banks Map.

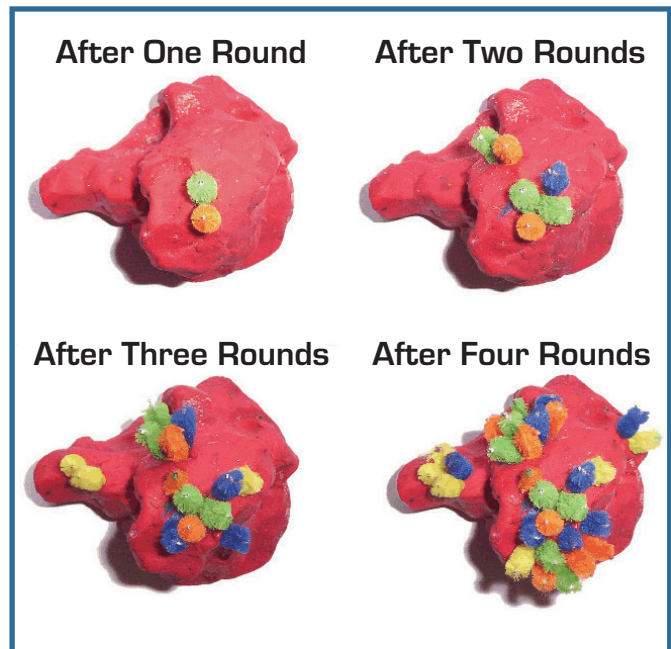
Stress to participants that they should make sure the mounds are firmly stuck to the bottom of the dishpan tub before they add the water and sand. If a mound becomes loose during the activity, participants should remove it from the water. They should use a finger to rake the bottom of the mound to remove any sand and to rough up the surface of the clay. Then they should stick the mound back to the bottom of the dishpan tub.

You might want to demonstrate for participants how to gently shake the dishpan tub in step 5. Water should not spill over the sides of the tub. You do not need to create very much movement in the water to knock down the coral larvae in the sand.

As participants begin to repeat steps 4–6, remind them to add a pipe cleaner segment next to every pipe cleaner segment that is still standing after step 5 (including ones from previous rounds). Groups should run out of pipe cleaner pieces after three to four rounds. See the photos to the right for an example of how this should work.

*Optional:* Supply each participant with a copy of the Flower Garden Banks Map. Explain to participants that the map is a bathymetric map, which means that it shows the depths of the water in the area. Bathymetric maps include underwater contour lines, which are lines that connect points of equal depth.


The numbers on the contour lines indicate how many meters each contour is below sea level. Ask participants to use the numbers to figure out the approximate depth of the sea floor around the Flower Garden Banks (about 100 m). Tell them that the very top of each mound is about 20 m below sea level. Then show participants how to use the contour lines to figure out the approximate depth of the major features of each mound. If they make each mound 2 in. (5 cm) tall, they can use a scale of 0.25 in. = 10 m (6 mm = 10 m). Have participants use the contour lines and a ruler to mold each major feature to scale. Remind participants that the pipe cleaner segments are not to scale. They are more than 1,000 times larger than real coral larvae would be at this scale!




## Taking It Further Activity


Before participants begin the activity, have them cut a white pipe cleaner into 0.5-in. (1.25-cm) segments. These segments will represent the calcium carbonate skeletons left behind by hard corals that die when the sea level rises. If participants have a lot of colored pipe cleaner segments on the bottom half of each of their mounds, they might need more than one white pipe cleaner. Have extra white pipe cleaners on hand for this situation. Discuss with participants what would happen if the sea level rose even more. (Less sunlight would reach the deeper hard corals and more of them would die.) Discuss what would happen if the sea level then sunk so low that the tops of the mounds were above the surface of the water. (New reefs might form on lower parts of the banks. Reefs on the very tops of the banks would die.)


## Discussion Questions


 When and how did coral reefs begin at the Flower Garden Banks? *[Coral reefs first started forming at the Flower Garden Banks about 10,000 to 15,000 years ago. The first coral larvae were likely carried by currents from reefs off the coast of Mexico. The larvae settled on the rocky surface of the salt domes, grew into adult corals, and began to build coral reefs.]*

 What are some of the conditions that need to be present for hard corals to be able to survive? *[Hard corals need a hard surface onto which they can attach themselves. They also need shallow, clear*

*water. The temperature of the water must be 64 to 86 degrees F (18 to 30 degrees C). Parts of the Flower Garden Banks meet all of these conditions.]*

 Name the seven biological zones at the Flower Garden Banks. *[The seven zones are coral reef, coral community, coralline algae, deep coral, soft bottom, brine seep, and mud volcano.]*

 During the activity, why didn't the coral larvae that you planted in the sand survive? How is this similar to or different from what really happens (or happened) at the Flower Garden Banks? *[The coral larvae in the sand fell over when the dishpan tub "sea" was shaken gently. Both in the activity and in reality, coral larvae cannot attach themselves to loose sand because it is not a hard surface. The sea floor around the Flower Garden Banks is mostly made up of sand and mud, which is not a suitable living surface for corals.]*

 How could you find out if the present coral community zone at the Flower Garden Banks had more hard corals in the past? *[You could look for calcium carbonate skeletons that hard corals might have left behind when they died. Because sea levels have changed many times over the past 15,000 years, parts of the reef that are now too deep to allow hard corals to thrive might have been shallower in the past. Hard corals are more likely to thrive in shallower, sunnier waters.]*

## Additional Information

### Books

*Corals: A Quick Reference Guide*, by Julian Sprung.

*Creatures of the Sea: Coral*, by Kris Hirschmann.

### Videos

*The Blue Planet: Seas of Life (Part 3): Coral Seas*, produced by BBC Warner.

*Coral Reef Adventure*, produced by MacGillivray Freeman Films.

*Finding Nemo DVD Extra: Exploring the Reef*, produced by Disney/Buena Vista.

### Web Sites

Flower Garden Banks National Marine Sanctuary Web site

Immersion Presents Web site

NOAA National Ocean Service's *Welcome to Corals* Web page

NOAA's *Coral Reef Tip Sheet (August 11, 1997 – Week 32): Reef Romance: Coral Spawning Coming Up August 18-26* Web page

U-Haul SuperGraphics' *Texas Flower Gardens* Web site

USGS's *Texture, Carbonate Content, and Preliminary Maps of Surficial Sediments, Flower Garden Banks Area, Northwest Gulf of Mexico Outer Shelf, USGS Open-File Report 03-002: Figures* Web page

**Note:** Links to all Web resources can be found at [www.immersionpresents.org/gulf/links.html](http://www.immersionpresents.org/gulf/links.html).