CORAL RESTORATION FOUNDATION™

# Appetizing Acropora

*with Science, Art, Math, and Language Arts Extensions*

ADAPTED FROM CALIFORNIA ACADEMY OF SCIENCE: BUILD A CORAL

## Objective

*Students will be introduced to the parts of a coral polyp by creating an edible model.*

## Overview

This interdisciplinary activity encourages students to think about what is a coral, how coral reefs are formed, and the relationship between zooxanthellae and their host. This activity has the ability to have a long-term impact on both corals and ocean stewardship at large, giving the students understanding of this organism and a chance to help save our reefs. This activity can be adapted to a single day or longer, with the inclusion compare / contrast of other Cnidarians, math, and language art extensions.

## Background Information

What is a polyp? A polyp, when it comes to Zoology, is one of the two forms found within the members of the phylum *Cnidaria*. Polyps are sessile, meaning that they do not have locomotion. Their shape is usually cylindrical, with the tentacles and mouth facing upwards. This includes corals, anemones, and hydras. The other form is the medusa, which are free-swimming, tentacles and mouth facing downward, and includes jellyfish.

## Materials

- Round Crackers (3 per student)
- Banana (two-inch piece per student)
- Toothpicks (1 per student)
- Licorice (6 one-inch strips per student)
- Green sprinkles
- Straw (two-inch piece per student)
- Plate
- Jam

## Vocabulary

- Coral
- Polyp
- Colony
- Coral Reef
- Corallite
- Zooxanthellae
- Symbiosis
- Coral Bleaching
- Ocean Acidification
- Greenhouse gases

## Standards

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|---|---|---|---|---|
| SC.K.L.14 | SC.3.L.14 | SC.5.L.14 | SC.6.L.15 | SC.912.E.7 |
| SC.1.L.14 | SC.3.L.15 | SC.5.L.15 | SC.7.E.6 | SC.912.L.14 |
| SC.1.L.17 | SC.3.L.17 | SC.5.L.17 | SC.7.L.15 | SC.912.L.15 |
| SC.2.L.14 | SC.4.L.17 | SC.6.E.7 | SC.7.L.17 | SC.912.L.17 |
| SC.2.L.17 | SC.5.E.7 | SC.6.L.14 | SC.8.L.18 | SC.912.L.18 |

# Preliminary Phase

*Find out what the students already know.*

Teacher displays pictures of coral reefs.

**Teacher talk:**

- *Have you ever seen a coral reef before?*
- *What lives in a coral reef?*
- *What is coral? Is it an animal? Is it a plant? Is it a mineral?*

At this point, depending on the age of the students, Teacher might have to explain the differences between animals, plants, and minerals are. Teacher makes a table on the board, and students vote and their votes are placed on the board for all to see.

**Teacher talk:**

- *If you answered animal, you are 100% correct. If you answered vegetable or mineral, you are not 100% wrong though. Corals are animals that may have a special relationship with a microscopic plant (or vegetable) and that can make an external limestone (or mineral) skeleton.*

# Focus Phase

*The students explore examples of the concept.*

Teacher shows picture of Staghorn Coral (image 1)

**Teacher talk:**

- *Here is a picture of some Staghorn Coral. This is one of the types of coral that the Coral Restoration Foundation grows and out plants. Now, this may look like just one coral, but actually there are hundreds of corals in this one picture. See, coral is a colonial animal, which means that lots of individual animals live together. Lets zoom in and see one of these individuals.*

Teacher shows picture of zoomed-in coral polyp (image 2)

**Teacher talk:**

- *These are the individual animals that make up a coral colony. They are called* ***polyps****. They look like little sea anemones, and for good reason! They are closely related to sea anemones, along with jellyfish, within the phylum* ***Cnidaria.***

## Exploration Phase

*The students exchange, debate, and test ideas.*

**Teacher talk:**

- *So what characteristics do you think link together sea anemones, jellyfish and corals?*

Teacher works with the class to make a list of characteristics. Teacher should lead them to focus not only what they have in common, but also what they do not have.

## Application Phase

*The students apply their rules to new situations.*

Teacher then displays pictures of different Cnidarian animals, including Box Jellies, Hydras, Corals, Anemones, Jellyfish, Stalked Jellies, etc. as well as animals that are not Cnidarian, such as sponges, sea slugs, starfish, comb jellies, etc. The students will then use their list of characteristics to see if they can decide if each is or isn't a Cnidarian. Teacher will update their characteristics as they make discoveries.

## Challenge Phase

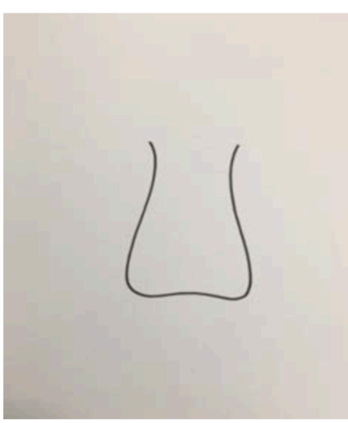
*The students take their application to a real-world situation*

**Teacher talk:**

- *Now that we all agree what it means to be a* Cnidarian, *let's make an edible one!*

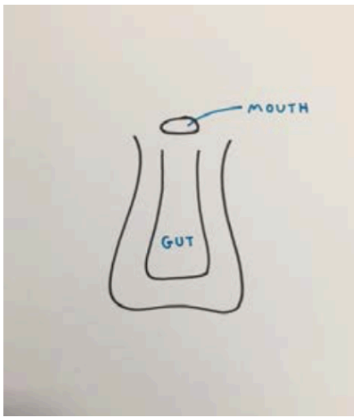
**Step 1:**

- Draw the basic coral **polyp** shape on the board.
- Explain that the banana will represent the living tissue of the coral polyp.
- Tell students to peel their section of banana and stand it up on the center of their paper plate.



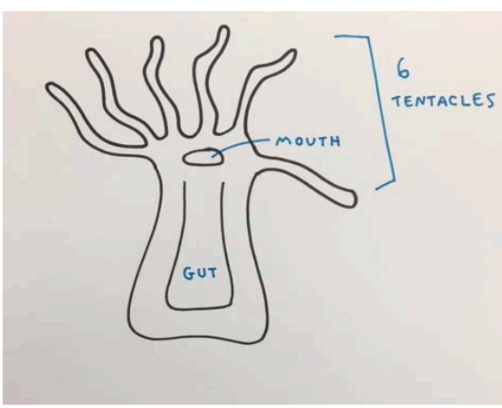
**Step 2:**

- Draw the **mouth** and **gut** inside the polyp and label each.
- Explain that corals have a mouth and a "blind gut." This means that both food and waste enter and exit the polyp through the mouth.
- Tell students to use their straw to poke a hole into the center of the banana. Be careful not to go all the way through the banana, as coral polyps have just one hole, not two.



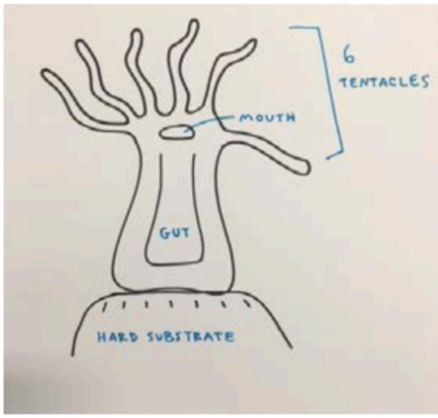

**Step 3:**

- Draw six **tentacles** surrounding the mouth of the polyp and label them.
- Explain that students will be building a coral with six tentacles; these are **hexacorals**. There are also corals with eight tentacles; these are **octocorals**. The coral polyp uses its tentacles to capture food (plankton) that is floating by in the water.
- Tell students to use a toothpick to poke six holes into the banana surrounding the central mouth.
- Insert six Twizzlers or pretzels to the holes. These represent the tentacles.



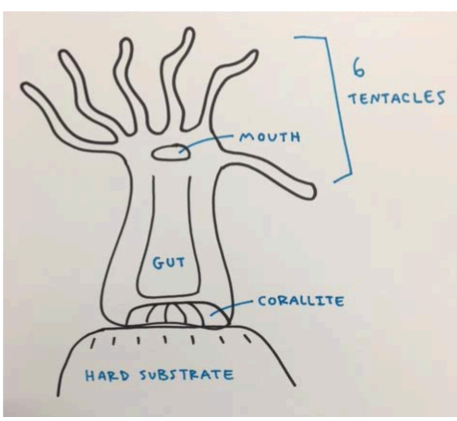

**Step 4:**

- Draw the **hard substrate** below the polyp and label it.
- Explain that when the polyp settles on a hard substrate, like a rock or the skeleton of another coral reef, the polyp secretes a sticky substance to help is attach. This sticky substance is represented by the jam.
- Tell students to place the jam onto a Ritz cracker.



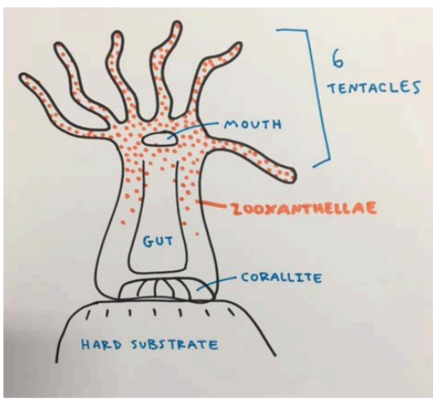

**Step 5:**

- Draw the **corallite** below the blind gut, inside of the polyp, and label it.
- Explain that the coral polyp makes its own hard, internal skeleton made of **calcium carbonate**. This is called the corallite. The living tissue of the polyp lives in the corallite. The polyp pulls itself into the corallite for protection from predators.
- Tell students to carefully break apart two Ritz crackers into large chunks and surround the banana with these pieces. This represents the corallite skeleton.




**Step 6:**

- Use a different color marker to draw **zooxanthellae** 'dots' on the polyp and label them.
- Explain that some corals contain tiny algae within their tissue. These tiny algae are called zooxanthellae. Zooxanthellae that live in corals have a mutually beneficial **symbiotic relationship** with their host. This means that both the coral and the alga benefit from being in the relationship. The zooxanthellae photosynthesize within their coral host and produce sugars that provide nutrition to both the zooxanthellae and the coral. In return, the coral provides protection and assists the growth of the zooxanthellae by passing on nutrients. Approximately 98% of coral's energy comes from zooxanthellae. The zooxanthellae contribute to the bright colors that corals often display.
- Tell students to add sprinkles to their banana to represent the zooxanthellae.




# Synthesis Phase

*The students take their overall understanding to the next level.*

### Teacher talk:

- *What would happen to the coral if the zooxanthellae left? Well, that is happening across our oceans. This is called **coral bleaching**. Instead of being a yellow color, they turn bright white. Without their symbiont friend, coral can't feed themselves enough, and they starve.*
- ***Coral reef ecosystems support important commercial, recreational, and subsistence fishery resources** in the U.S and its territories.*
- *Fishing also plays a central social and cultural role in many island and coastal communities, where it is often a critical source of food and income. **The impacts from unsustainable fishing on coral reef areas can lead to the depletion of key reef species** in many locations. Such losses often have a ripple effect, not just on the coral reef ecosystems themselves, but also on the local economies that depend on them.*
- *Additionally**,** certain types of fishing gear can inflict serious physical damage to coral reefs, seagrass beds, and other important marine habitats. Coral reef fisheries, though often relatively small in scale, may have disproportionately large impacts on the ecosystem if conducted unsustainably.*
- *Rapid human population growth, increased demand, use of more efficient fishery technologies, and inadequate management and enforcement have led to the depletion of key reef species and habitat damage in many locations.*
- *Scientific evidence now clearly indicates that the **Earth's atmosphere and ocean are warming**, and that these changes are **primarily due to greenhouse gases** derived from human activities. **As temperatures rise, mass coral bleaching events and infectious disease outbreaks are becoming more frequent.***
- *Additionally, carbon dioxide absorbed into the ocean from the atmosphere has already begun to reduce calcification rates in reef-building and reef-associated organisms by altering seawater chemistry through decreases in pH. This process is called **ocean acidification**.*
- ***Climate change will affect coral reef ecosystems, through sea level rise, changes to the frequency and intensity of tropical storms, and altered ocean circulation patterns**. When combined, all of these impacts dramatically alter ecosystem function, as well as the goods and services coral reef ecosystems provide to people around the globe.*

- ***Impacts from land-based sources of pollution****—including coastal development, deforestation, agricultural runoff, and oil and chemical spills—****can impede coral growth and reproduction, disrupt overall ecological function, and cause disease and mortality in sensitive species.***
- *It is now well accepted that* ***many serious coral reef ecosystem stressors originate from land-based sources****, most notably toxicants, sediments, and nutrients.*
- *Coral reef ecosystems are highly impacted by watershed alteration, runoff, and coastal development. On U.S. islands in the Pacific and Caribbean, significant changes in the drainage basins due to agriculture, deforestation, grazing of feral animals, fires, road building, and urbanization have increased the volume of land-based pollution released to adjacent coral reef ecosystems.*
- *Many of these issues are made worse because of the geographic and climatic characteristics found in tropical island areas. Together they create unique management challenges.*

# Extension 1 – Bitter Bleaching (SCIENCE)

ADAPTED FROM PEGGY KOENIG: CORAL BLEACHING DEMONSTRATION

## Materials

- Rubber glove (thick)
- Freezer
- Bowl
- Whipped cream
- Green sprinkles

**Before class begins:** Teacher fills the rubber glove with water and ties it shut. Hang upside down in the freezer overnight or until completely frozen.

Teacher removes ice hand from glove, and places it down on the bowl, fingers upward. Then, Teacher carefully covers palm and back of hand with whipping cream (not fingers) and covers the whipping cream with green sprinkles.

### Teacher talk:

- *Here is a coral polyp model. Let's see if we can name the different parts of the coral!*

Teacher leads the class to identify the frozen hand as the coral polyp, the fingers as the tentacles, the bowl as the limestone cup, whipped cream as the limestone skeleton, and the sprinkles as the zooxanthellae.

As the class continues, have students observe what happens to the coral polyp model. As the temperature rises, the sprinkles should fall off.

### Teacher talk:

- *What you have just witnessed is an example of **coral bleaching**. Warmer water temperatures can result in coral bleaching.*
- ***When water is too warm, corals will expel the algae (zooxanthellae) living in their tissues causing the coral to turn completely white**. This is called coral bleaching.*
- *When a coral bleaches, it is not dead. **Corals can survive a bleaching event**, but they are under more stress and are subject to mortality.*

- *In 2005, the U.S. lost half of its coral reefs in the Caribbean in one year due to a massive bleaching event. The warm waters centered around the northern Antilles near the Virgin Islands and Puerto Rico expanded southward. Comparison of satellite data from the previous 20 years confirmed that thermal stress from the 2005 event was greater than the previous 20 years combined.*
- ***Not all bleaching events are due to warm water*.**
- *In January 2010, cold water temperatures in the Florida Keys caused a coral bleaching event that resulted in some coral death. Water temperatures dropped 12.06°F lower than the typical temperatures observed at this time of year. Researchers will evaluate if this cold-stress event will make corals more susceptible to disease in the same way that warmer waters impact corals.*

# Extension 2 – Jubilant Jellyfish (ART)

ADAPTED FROM PAMEBOLTA: Χάρτινες θαλάσσιες μέδουσες

## Materials

- Paper bowls OR cupcake liner
- Tissue paper
- Poster paint
- Scissors
- White glue
- Thin string
- Paperclips

## Instructions:

1. Punch a small hole at the center of a paper bowl or cupcake liner using a pencil or pen.
2. Paint the outside of the paper bowl with poster paint. Allow your painted bowl to dry completely.
3. Cut string to a length of about 6 inches or more and insert the string through the hole on your paper bowl.
4. Tie the end of the string to a paper clip and glue or tape it down to the inside of your bowl.
5. Cut at least 6 tissue paper to make the jellyfish tentacles. You can also add pipe cleaners for different length tentacles.
6. Glue the ends of a tissue paper strips onto the center of your paper bowl in a radial pattern.
7. Once the glue has dried, unveil your jellyfish by gently turning your paper bowl upside down and holding your jellyfish by the string.

# Extension 3 – Amazing Anemone (ART)

ADAPTED FROM MARCIA MURPHY: SEA ANEMONES

## Materials

- Recycled toilet paper roll
- Tissue paper
- Scissors
- Glue

## Instructions:

1. Use a full toilet paper roll or cut a roll into halves or thirds.
2. Cut a piece of tissue paper so that it wraps around the roll several times and is approximately twice as long as the roll.
3. Place the roll on one edge of the paper and add a little glue.
4. Completely wrap the paper around the roll.
5. Glue the end.
6. Use the scissors to make thin slits in the top section of the paper (that is longer than the roll).

# Extension 4 – Carton Corals (ART)

ADAPTED FROM ALEXANDER GOLDOWSKY: EGG CARTON CORALS

## Materials

- Recycled cardboard egg carton
- Paper
- Scissors
- Tape
- Markers

## Instructions:

1. Begin by cutting the top half and the closing flap off an egg carton, leaving just the section with the twelve egg cups. Place this upside down on a table and punch a hole in the bottom of each egg cup with scissors. To shorten the activity, cut the egg cup tray into thirds, giving each student a section of 4 egg cups rather than all twelve.
2. Cut a sheet of paper into three strips horizontally. Each strip will become a coral polyp. Roll each strip into a tube about the diameter of your finger. Tape the tube to keep it from unrolling and tape the bottom of the tube shut.
3. To make the tentacles of the polyp, make several cuts from the top of the tube, . of the way to the bottom of the tube. Get the tentacles to bend/curl by running each fringe over the blade of a scissor or a metal ruler.
4. Insert one polyp tube in each egg cup, pulling it partway through the hole. Tentacles should be on the top of the egg carton.
5. Using markers you can add small dots on the polyp to symbolize the zooxanthellae. Although they all have chlorophyll, like other plants, zooxanthellae can have a variety of other pigments giving them different overall colors. It is the zooxanthellae that give reef building corals their color; the calcium carbonate skeleton is white, and the coral polyp itself is largely colorless.

# Extension 5 – Tentacle Total (MATH)

An easy math extension is using the idea that each hexacoral polyp has a multiple of 6 tentacles and each octacoral polyp has a multiple of 8 tentacles.

**Example Easy Math Questions:**

1. How many tentacles do two 6-tentacle hexacorals have combined?
2. There was a total of 20 tentacles. I take away one 8-tentacle octacoral polyp. How many tentacles are left?
3. A small branch of Staghorn coral has 100 polyps. If staghorn is a hexacoral with 12-tentacle polyps, how many tentacles are on the branch?

**Example Hard Math Questions:**

1. If there are 16 6-tentacle hexacoral polyps and 19 8-tentacle octacoral polyps, but a parrotfish ate 3 polyps, what is the range of the total number of tentacles?
2. There are 34 tentacles in a total of 5 polyps. How many are 8-tentacle octacorals?

# Extension 6 – Dear Zoox (LANGUAGE ARTS)

After students learn the importance of the relationship between Zooxanthellae and Coral, have the students write a love letter from coral to the symbiotic algae, begging them not to leave. Have them include what they learned from this lesson, or make them do more research on how important Zooxanthellae is to coral, and causes of bleaching. This can become a multiple day assignment.

## PICTURE 1

## PICTURE 2