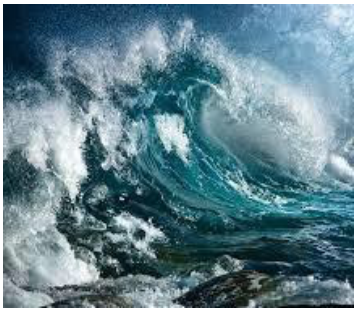
Island STYLE

Coral Structure and Function



SUBJECT:

Science

GRADE LEVEL:

6th

TIMEFRAME:

45 minutes

MATERIALS:

- Demonstration coral
  - Brain
  - Staghorn
  - Elkhorn
- Demonstration elements
  - Graphite
  - Glass of milk
  - Sea shells
  - Egg shells
  - Pearls
  - Limestone
- Reference images of stony coral species
- Clay coral sculpting materials
  - Air dry clay
  - Cardboard circles
  - Clay tools
  - Wire
  - Scissors
  - Acrylic paints
  - Brushes
  - Cups for water
  - Pallets
  - Bucket

ACTIVITY SUMMARY:

Students will learn about the physical makeup of corals, what type of environment stony corals need to thrive, understand some of the challenges coral colonies face for survival. Students will create their own coral clay structure modeled after different species of coral. Coral sculptures will be used in future activity.

LEARNING OBJECTIVES:

- Coral species structure, identification, and function
- Ecosystem requirements for healthy corals
- Threats to coral ecosystems

ALIGNMENT:

TEKS

- 6.5 (A) - Know that an element is a pure substance represented by chemical symbols
- 6.5 (C) - Differentiate between elements and compounds on the most basic level
- 6.6 (C) - Test the properties of minerals including hardness, color, luster, and streak
- 6.12 (C) - Recognize the broadest taxonomic classification of living organisms is divided into recognizable domains
- 6.12 (D) - Identify the basic characteristics of organisms, including prokaryotic or eukaryotic, unicellular or multicellular, autotrophic or heterotrophic, and mode of reproduction that further classify them in the currently recognized kingdoms

Ocean Literacy Principles

- 4 The ocean makes Earth habitable.
- 5 The ocean supports a great diversity of life and ecosystems.

VOCABULARY:

- **Adaptation:** A change or the process by which an organism or species becomes better suited for its environment.
- **Calcium Carbonate:** A material that forms coral skeletons. Occurs in nature as limestone.
- **Coral Colony:** Many coral polyps that are clustered together and are connected to one another.
- **Coral Polyp:** One individual coral animal with a soft, tube-shaped body, and a mouth surrounded by tentacles; grows in colonies to form large reef structures.
- **Nematocyst:** Thread-like stinging cells that contain toxic substances used to capture prey.
- **Photosynthesis:** The process of using energy from the sun to make starches and sugars from carbon dioxide and water.
- **Plankton:** Organisms that are suspended in the water column and transported by tides and currents.
- **Predator:** An animal that hunts and kills other animals for its food.
- **Stony Coral:** An animal with a unique polyp structure that builds a hard, rock-like skeletal base, and hosts symbiotic algae called zooxanthellae.
- **Symbiosis:** A relationship between different species where one, or both, of the organisms benefit from the presence of the other.
- **Tentacle:** A long, slender, and flexible appendage an animal uses for feeling, grasping, or moving.
- **Zooplankton:** Free-floating, microscopic aquatic animals.
- **Zooxanthellae:** Microscopic, single-celled algae that live inside the tissues of corals and produce food for coral through photosynthesis.

BACKGROUND INFORMATION:

- **Classification -**
  - Corals are generally classified as either "hard coral" **(stony)** or "soft coral". There are around 800 known species of hard coral, also known as the "reef building" corals. They live only in the photic zone (above 50 m), the depth to which sufficient sunlight penetrates the water.
- **Feeding -**
  - Corals are animals because they do not make their own food, as plants do. Corals have tiny, tentacle-like arms that they use to capture their food from the water and sweep into their inscrutable mouths.
  - Corals themselves are heterotrophs. However, some species (not all) form a symbiotic relationship with dinoflagellate algae. These algae colonize the corals' bodies and carry out photosynthesis, providing the corals with food in exchange for protection. In some sense the coral/algae partnership can be thought of as an autotrophic compound organism, somewhat similar to lichen. However, this partnership is not necessarily a permanent one. When the corals come under environmental stress, they tend to expel the algae. This is known as "coral bleaching" because the corals are much lighter in color after this occurs. If conditions do not improve to the point where the corals are able to accept the algae again, they eventually die.

- **Habitat -**
  - Coral reefs are among the most important biodiversity hotspots on earth. A quarter of all animals and plants that live in the ocean rely on them for food, nursery areas, and places to hide from predators. Reefs are where many fish species and sea creatures choose to spawn. They also provide a space for feeding and raising babies for some sea mammals. Seagrass meadows next to the reefs act as nurseries for manatees and dugongs.
- **Water Filtration -**
  - Most corals and sponges are filter feeders, which means that they consume particulate matter suspended in the water column. This contributes to the enhanced quality and clarity of our nearshore waters.
- **Polyps -**
  - Each individual coral animal is called a polyp, and most live in groups of hundreds or even thousands of genetically identical polyps that form a "colony". The colony is formed by a reproduction process called budding, which is where the original polyp literally grows copies of itself.
- **Zooxanthellae -**
  - Coral polyps do not photosynthesize but have a symbiotic relationship with microscopic algae, commonly referred to as zooxanthellae.
  - The zooxanthellae also provide much of the color that corals have. When the zooxanthellae are expelled, the colony takes on a stark white appearance, which is commonly described as "coral bleaching."
  - These organisms live within the polyps' tissues and supply the coral with organic products of photosynthesis, including glucose, glycerol, and amino acids. These compounds are utilized by the coral as building blocks in the manufacture of proteins, fats, and carbohydrates, as well as the synthesis of calcium carbonate, used to build a hard, cup-shaped skeleton that protects the soft, delicate body of the polyp. In return, the corals shelter the zooxanthellae and provide a constant supply of the carbon dioxide they need for photosynthesis. Because of this relationship, coral reefs grow much faster in clear water, which admits more sunlight. Without their symbionts, coral growth would be too slow to form significant reef structures.

PREPARATION:

- Gather materials listed above
- Prepare lesson-introduction demonstration materials:
  - Pencils / diamonds, inflated balloon, glass of milk
  - Sea shells, egg shells, pearls, limestone
  - Coral specimens and photo examples
- Prepare clay sculpting activity - ensure enough supplies for each participant + a demonstration model
  - Each participant needs: 1 grapefruit sized ball of clay, 3-5 assortment of clay sculpting tools, 1 cardboard base, 1 paint pallet, 1 paint brush, 1 small cup of water

INTRODUCTION:

QUESTION 1: What are stony corals made of?

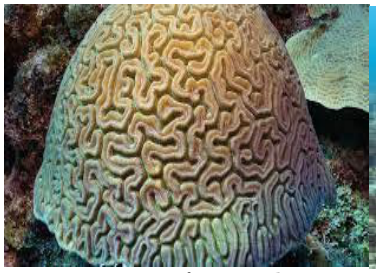
Note: allow students to feel see and feel element examples

- **Carbon** [pencil/diamond] - easily forms with other elements, is found in all living tissues
- **Calcium** [milk] - gives structure, hardness, and strength to bones and teeth
- **Oxygen** [inflated balloon] - the life supporting element in the air we breathe
- **Calcium carbonate** [sea shells, egg shells, pearls, limestone] - see definition below

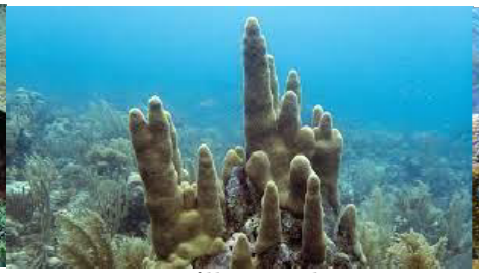
Hard corals tend to secrete **calcium carbonate ($CaCO_3$)** underneath their bodies. This turns into a hard, rock-like structure upon which other coral larvae can settle. Over time, as the calcium carbonate builds up and corals reproduce, the size of a coral reef grows. The skeleton not only gives corals their structure, but also provides the architecture for the coral reef overall!

QUESTION 2: What are the different types of stony corals?

- **Brain coral**
  - Brain-like appearance - grows in shallow, warm water and forms colonies. Can live to be 900 years old. Storm-hardy!
- **Pillar coral**
  - Pillar-like appearance - can grow as tall as 8' high. Pillar corals do not have secondary branches.
- **Staghorn coral**
  - Resembles male deer antlers - branching limbs, can reattach broken pieces to new surface and continue to grow. Fragile!
- **Table coral**
  - Grows in massive flat plates to maximize sun exposure.
- **Cauliflower coral**
  - Resembles cauliflower - often can be found in hues of pink and purple.
- **Elkhorn coral**
  - Similar to staghorn coral - has branching limbs resembling antlers



Brain Coral



Pillar Coral

Staghorn Coral

Table Coral

Cauliflower Coral

Elkhorn Coral

GUIDED PRACTICE:

QUESTION 3: What type of environment do they need to survive?

- **Food**
  - Corals get their food from algae living in their tissues or by capturing and digesting prey. Most reef-building corals have a unique partnership with tiny algae called **zooxanthellae**. The algae live within the coral polyps, using sunlight to make sugar for energy.
- **Water:**
  - Stony corals need **clear, warm (75 degrees F or 24 degrees C), shallow waters** where lots of sunlight filters through their symbiotic algae.
- **Shelter:**
  - Stony corals armor up! Tiny animals called polyps build the coral reefs stonelike structure. They create **hard exoskeletons** around themselves to protect their soft bodies. Coral polyps live in tight colonies, building their exoskeletons — made from the calcium carbonate found in seawater — on top of one another.
- **Oxygen:**
  - The corals and these special cells have a mutualistic relationship. The coral provides the zooxanthellae with a protected environment and compounds they need for photosynthesis. In return, the zooxanthellae produce oxygen and help the coral to remove wastes.

QUESTION 4: What are threats to the survival of corals?

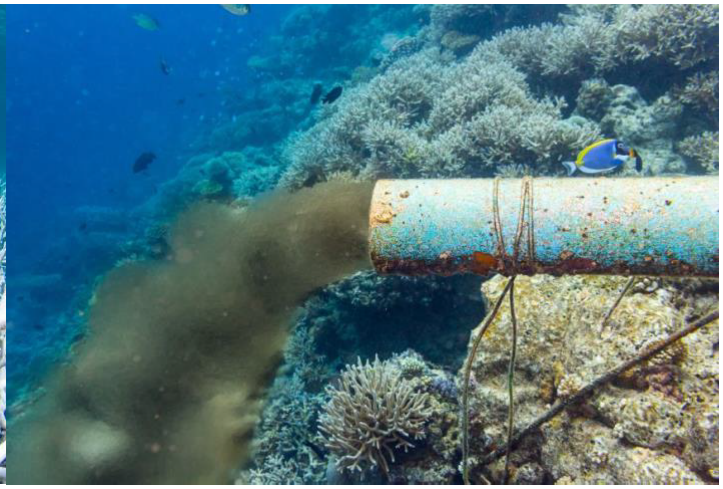
- Global climate change (increased water temperatures)
- Unsustainable over-overfishing
- Land-based pollution

Climate change affects coral reef ecosystems by increasing sea surface temperatures and leads to coral bleaching, disease, sea level rise and storm activity. Additionally, increased carbon dioxide in the atmosphere changes ocean chemistry and harms reef-building corals.

Unsustainable fishing practices in coral reef areas can lead to the loss of ecologically and economically important fish species. 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.

The effects of land-based sources of pollution, such as coastal development and agricultural runoff, can impede coral growth and reproduction, disturb ecological function and cause disease.

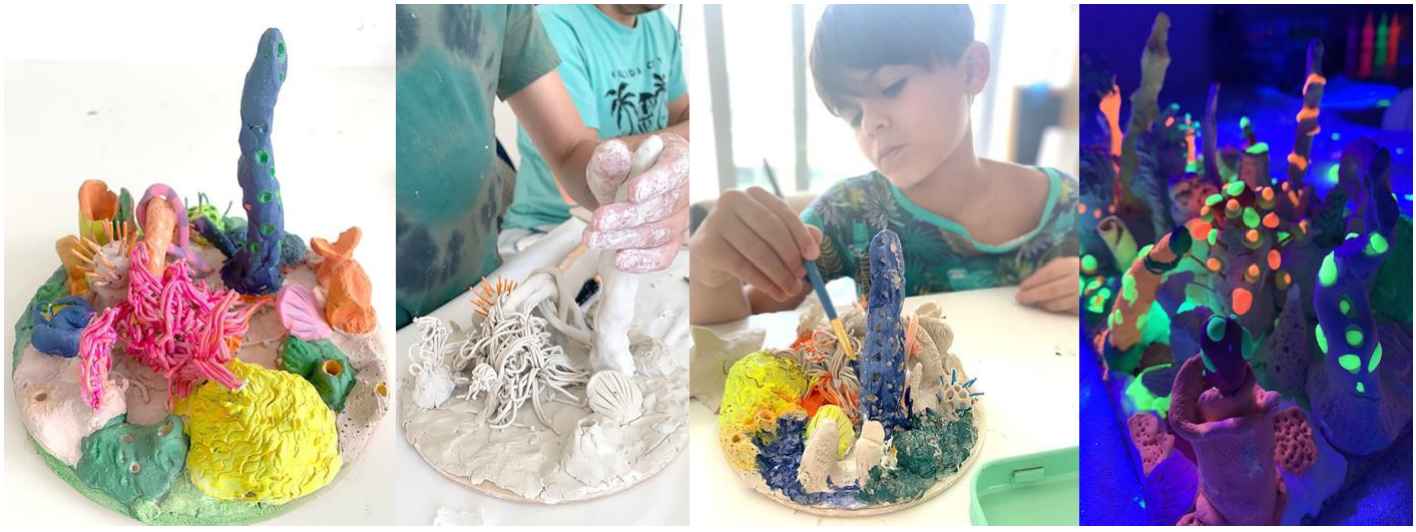
Although some of the biggest threats facing coral reefs are global in nature and require action on a similar scale, addressing local stressors like reducing runoff and promoting sustainable fishing is equally important.



INDEPENDENT / GROUP PRACTICE:

CLAY CORAL SCULPTING ACTIVITY - INSTRUCTIONS

- **Look at Reference Images**
  - Look at varied images of coral reefs. Talk about color, texture, pattern and shape within the context of the corals presented. Look specifically at corals found in the Flower Garden Banks, about 100 nautical miles (190 km) offshore of Galveston. Ask the students to describe the corals, and the kinds of marine life that they see in the images presented.
- **Prep the Cardboard Base**
  - Let each student choose a cardboard base that they want to work off of. They do not all have to be the same shape, but an organic shape will help in the overall look of the final piece. Once bases are chosen, give each of the students a small clump of clay, to start covering their base with. Have them cover the base with clay using their fingers, until the whole base is covered.
- **Create the Clay Corals**
  - Gather students and show them a few examples of what clay corals can look like. Use tools to create similar textures, patterns, and shapes of corals that were seen in reference images. Show students how to use slip and cross-hatching to attach the clay pieces to their base. Send students back to seats with new clumps of clay to begin working on their coral pieces. Have students come up one at a time to use the garlic press, to press through a clump of clay to create long strands of clay that can be used however they like in their reef. (Could be used for an anemone, seagrass, etc.)
- **Make sure Corals are Well-attached and add additional details.**
  - Give students clay tools to poke holes and add in additional texture to the piece. Make sure that all pieces are attached securely.
- **Set pieces to dry**
  - Overnight is best - but if time does not allow, wet clay can be painted (remind students to be gentle). Brief lesson on coral coloration and bioluminescence can be given while clay is drying.
- **Paint Coral Pieces with Acrylic Paint**
  - Once pieces are fairly dry, bring back out to students. Give students tutorial on acrylic painting, showing them several different techniques. Provide students with three different sized paint brushes, and small amounts of paint in paint pallets. Have students completely paint the coral piece, using different colors.
- **Add Glow in the Dark Paint**
  - Have students add glow in the dark paint once they have finished painting the rest of the piece. If time allows, find dark space to see the glow in the dark paint work!



ASSESSMENT OF LEARNING:

- Ask students to describe which species of coral their clay sculptures are modeled after
- Ask students which physical elements are inside of coral
- Ask students what are some of the threats that coral species are currently facing

CLOSING:

As you teach lessons linked to our Galveston Bay watershed and the Gulf of Mexico you can use the "I Wonder" board as a closure assignment. You might ask what else the students want to learn about corals. Students may ask about photosynthesis, or depth of water or who eats them or how boats anchor in areas with coral. All of their questions (even the ones asked multiple times) would go on the I Wonder board. If a question was answered in the lesson, it still goes on the board.

Students may even have questions days later that could be added. The goal is to have a place for all questions about Galveston Bay and Gulf of Mexico to be housed.

EXTENSION:

- Ask and discuss with students the ways that humans can do to keep coral reef ecosystems healthy
  - Use a reef-friendly sunscreen - Chemicals in sunscreen like oxybenzone and octinoxate harm marine life and can kill corals
  - Reduce carbon emissions - Climate change is one of the leading threats to coral reef survival
  - Look but don't touch the reef - Trampling the reef with your feet or fins will damage the corals
  - Conserve water - The less water that you use, the less wastewater will eventually find its way back into the ocean
  - Don't pollute - Choose biodegradable cleaning and gardening products at home to prevent chemical runoff into the water system
  - Don't buy wild coral - Corals grow very slowly, harvesting wild corals is unsustainable
  - Volunteer in a beach or reef cleanup - Help keep plastics and other debris out of the water
  - Choose sustainable seafood - Overfishing is a major threat to reef ecosystems and the ocean as a whole

NOTES: