Life on a Coral Reef

Overview

The Ocean
The oceans are a dynamic place and its inhabitants live in an ever-changing environment. The nature of water, in that it is able to absorb chemicals, dissolve hard substances, and give and take heat make the oceans a highly variable environment. One of the primary characteristics we notice with the oceans is that the temperature is not constant: from the equator where the water temperature is at its hottest, to the polar regions, where it sits at near freezing. We also know that oceans are salty. Over millions of years, rain has dissolved rocks on the land, releasing these salts, which then flow from rivers to the oceans. These physical properties of the oceans plus others such as the pH and the oxygen content are all important factors affecting life in the oceans. Physical characteristics and processes influence our ocean and are ever-changing. Each of these is like a single instrument ecosystem. The chemistry of water, the physics of gravity, the geology of the sea floor, the atmosphere, and many other components impact how our ocean works.

NGSS

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Grade K • Obtaining, Evaluating, and Communicating Information	Grade K • ESS3.A: Natural Resources	Grade K • Patterns • Cause and Effect
Grade 1 • Constructing Explanations and Designing Solutions	Grade 1 • LS1.A: Structure and Function	Grade 1 • Patterns • Cause and Effect • Structure and Function
Grade 2 • Obtaining, Evaluating, and Communicating Information • Constructing Explanations and Designing Solutions	Grade 2 • LS4.D: Biodiversity and Humans	Grade 2 • Stability and Change • Patterns • Cause and Effect

Learning Goal

- Coral reefs are a specialized marine habitat made up of complex living and nonliving things.

Part I

Focus Questions

1. What are the characteristics of a coral reef habitat?

Teacher Background Knowledge

Coral Reef

In warm, shallow waters, corals colonize rocky areas, forming one of the most productive and diverse ecosystems in the world. Thousands of different species can be found on a single reef, which grow with the corals themselves. They continue to build additional hard surface with their calcium carbonate skeletons. 25% of marine life lives together on coral reefs, and coral reefs take up less than 1% of the sea floor. With so many different species and individuals, there are many opportunities for organisms to work together and to compete with one another. To avoid competition there are many specialized species as well as many examples of resource partitioning, when similar species coexist in the same ecosystem without competing for the same resources. Coral reefs are rich with symbiotic relationships. Without them, the corals themselves would not exist as they do today. Living within the coral's tissue are tiny cells of photosynthetic algae called zooxanthellae. Corals and zooxanthellae have a mutualistic relationship where the coral provides the zooxanthellae with protection, carbon dioxide (CO_2), and nutrients, and the zooxanthellae provide the coral with food. Zooxanthellae can provide 90-100% of the food for a coral. Because zooxanthellae can only photosynthesize and provide food for corals when enough sunlight is available (e.g. daytime), corals can also catch their own food as it drifts by using their stinging tentacles.

Coral

Despite their appearance, corals are animals. They are invertebrates that generally live together in colonies (though some species remain as individuals) and each individual is known as a polyp. Each polyp secretes a calcium carbonate (otherwise known as limestone) exoskeleton near its base, which it lives in. This is known as a corallite. Together as a colony over many generations and decades, these polyps produce the skeleton structure unique to each species. These skeletons build up over time and are the major contributors to the physical structure of coral reefs, such as the Great Barrier Reef, and the Meso-American Barrier Reef.

Each coral polyp has a mouth opening surrounded by tentacles. These tentacles house stinging cells known as cnidocysts, which are used to capture, immobilize, and kill small prey such as plankton and small fish. The tentacles then retract to bring the food item back towards the mouth and into the stomach where the animal digests its prey.

Materials

Access the internet and the Coral Explorer Series
If possible: Access to the internet and the 360° Coral Reef YouTube Video
Science notebook
Student worksheet

Advance Preparation

Visit the Coral Explorer Series to familiarize yourself with the functionality of it. Review the video. If accessible, review the 360° Coral Reef YouTube Video using a handheld device for optimal viewing.

Potential Misconceptions

- Coral is not living or is a plant.
- Coral reefs are only home to fish.
- Animals cannot live (breathe, find food, sleep, etc.) under water.

Eliciting Prior Knowledge

Ask students to share what they know about living and nonliving things. On the board, create a student-generated list of the characteristics of living things and nonliving things, and examples of each.

Discuss the concept of habitats, where animals live. Ask students to share what they know about the schoolyard habitat and other terrestrial habitats. Discuss the characteristics of the plants and animals that live in those habitats to get students thinking about adaptations.

Process and Procedure

1. As a class access the Coral Explorer Series and play the video by selecting "Video" in the top left corner. Make sure students have their science notebooks ready. Alternatively a class list can be created on the board.
2.
3. As students watch the video ask them to make observations and think about the following:
    a. What animals do you observe?
    b. What nonliving things do you see?
    c. What are the animals doing?

4. As a class, ask students to share their observations. Time permitting view the video a second time, asking students to share their observations with the class as they see them. As students share their observations, ask for more detailed observations such as:
    a. What color were the fish you observed?
    b. How did the animals move? Did they use legs and feet?
    c. How many fish did you see?
    d. Did every animal you observe have fins to swim?

5. Create a T Chart of living and nonliving things observed on the coral reef. This can be done as a whole group, or in small groups, using the worksheet at the end of this document.

6. As a class, compare and contrast the characteristics of the marine creatures observed in the video with those found in a local terrestrial habitat.
   Hint: Students should have observed that many animals are able to move from place to place, but the mode of locomotion is very different than what is used on land.
   Discuss the various physical attributes that animals living on a coral reef have as compared to those living in a forest. *Hint: Compare a deer with a fish, what can they do that is the same (move, see, eat) what do they do differently (breathe with gills/lungs, swim/run with fins/legs).*

Part 2

Focus Question

- How are coral reefs different from each other?

Teacher Background Knowledge

The Indo-Pacific
The Indo-Pacific is home to the world's center of coral reef biodiversity known as the Coral Triangle. This region has exceptionally high species richness with around 500 of the Indo-Pacific coral species found here. Coral diversity decreases as you move away from the coral triangle, but throughout the entire Indo-Pacific there is the possibility of seeing hundreds of coral species in any location. In total there are over 1,400 species of coral that currently exist throughout the Indo-Pacific, compare that to only 70 in the Caribbean.

The geological history of the Indo-Pacific has allowed vast reef structures to appear, these include the largest biological structure on earth the Great Barrier Reef. The tectonic movement and geological processes over millions of years have created vast island chains such as the Hawaiian archipelago, over 300 coral atolls, and an unknown number of sea mounts. These geological processes have facilitated the extensive diversity of corals found throughout the Indo-Pacific by creating new habitat to colonize and grow on.

The Caribbean Sea
The Caribbean is the major tropical coral reef region for the Atlantic Ocean. The region is punctuated with islands from the Florida Keys and south to the Lesser Antilles. On the western side you will find the second largest barrier reef system in the world, known as the Meso-American Barrier reef system. It stretches over 1000 km from the island known as Isla Contoy at the northeastern tip of the Yucatan Peninsula in Mexico, and south past Belize, and terminates at the Bay of Islands in Honduras. However, the most common coral reef type found throughout the Caribbean are fringing reefs that circle many of the smaller islands throughout the region.

The Caribbean is home to around 70 hard coral species, which is far less than the Indo-Pacific region. The Caribbean coral species emerged around 3.5 million years ago when a land mass began to split the two oceanic regions—the Indo-Pacific and the Atlantic. A land barrier known as the Isthmus of Panama was formed as continents moved, and sea level receded. This barrier prevented species from mixing between the two ocean bodies; no longer did the Caribbean get species from the Indo-Pacific, nor did coral species return from the Caribbean to the Indo-Pacific.

Materials

World map
Blank paper

Process and Procedures

1. Review the location of the Caribbean Sea and the Indo-Pacific region with students. Remind students that the videos of the coral reefs they saw came from those two areas. Illustrate the distance between the two locations and identify the landmasses that separate them using the world map.

2. Ask students to share their observations of the reefs found in the Caribbean Sea. What living things did they observe? Ask students to share their observations of the Indo-Pacific reefs. What living things did they observe?

3. Discuss the similarities and differences observed across both locations. Ask students if the animals they observed from the two locations were different? How were they the same? Did they see the same colors at both locations? Did they see as many different animals at both locations? *Provide the students with the term ecosystem when referring to each of the two environments. An ecosystem is all the living and nonliving things in an area that interact with each other. Hint: Although both locations are home to extensive coral reef habitats, the number of different fish and coral species in the Indo-Pacific far exceeds that of the Caribbean. Students may recall the bright colors of the Indo-Pacific reef compared to the more dull colors found in the Caribbean. The number of fish and schools of fish in the Indo-Pacific are also unique.*

4. In pairs, or individually, ask students to complete an illustration of a coral reef found in either the Caribbean Sea or the Indo-Pacific region. Each illustration should include 1-2 unique inhabitants of that reef system. If accessible, have students watch the 360° Coral Reef YouTube Video for inspiration. The 360° video was recorded during a dive in the Wakatobi National Marine Park, Indonesia.

5. As a class, have students share their illustrations, having each student share why they chose that particular coral reef and the 1-2 unique creatures they included.

Questions

1. How are coral reef habitats different from each other?
2. Are the same animals found in every coral reef around the world?
3. What can you do to become a champion for the coral reefs and a steward for a healthy ocean?

Living Things We Observed	Nonliving Things We Observed