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 3 • Constructing Explanations and Designing Solutions	Grade 3 • LS4.C: Adaptations • LS4.D: Biodiversity and Humans	Grade 3 • Stability and Change • Patterns • Cause and Effect
Grade 4 • Constructing Explanations and Designing Solutions	Grade 4 • LS1.A: Structure and Function	Grade 4 • Stability and Change • Patterns • Cause and Effect
Grade 5 • Obtaining, Evaluating, and Communicating Information	Grade 5 • LS2.A: Interdependent Relationships in Ecosystems	Grade 5 • Stability and Change • Patterns • Cause and Effect

Learning Goal

- Coral reefs are highly diverse ecosystems that rely on a balance of physical and biological factors to remain healthy.

Part I

Focus Questions

1. What are the biotic (living) and abiotic (nonliving) characteristics of a coral reef ecosystem?

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 (CO2), 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

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.

Eliciting Prior Knowledge

Ask students to share the type of animals they expect to find on a coral reef. Ask them to share with a partner and then add to their own list. On the board, create a student-generated list of potential organisms that can be found on a coral reef.

Discuss the concept of biodiversity, the variability among living organisms between species and across ecosystems. Ask students to share what they know about the biodiversity found around the schoolyard, local ecosystems, and other terrestrial habitats.

Process and Procedure

1. As a class, or in small groups, 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, view the 360° Coral Reef YouTube Video.

2. As students watch the video ask them to record their observations. To get them started, suggest that they record:
    a. Any abiotic (nonliving) objects or matter.
    b. Any vertebrate organisms.
    c. Any invertebrate organisms.
    d. Any plant or algae.
    e. Any interactions between animals.

3. As a class, have students share their observations. Time permitting view the video a second time, asking students to share their observations with the class as they see them.

4. Ask students to think about the characteristics of the animals they observed. Put students in small groups to share and identify their observations. Ask one person from each group to write down their group's main ideas on the board. Come to a whole-class consensus on the features and characteristics of the living things observed on the coral reef.

5. As a class compare and contrast the characteristics and features of the marine creatures observed in the video with those found in a savanna or forest ecosystem. *Hint: Students should have observed that many animals are able to move from place to place, the way it is done is highly specialized for the ecosystem they inhabit.*
Ask students to infer how predators might capture prey on a reef vs. a predator in a forest. Discuss the various physical attributes that impact life on a coral reef as compared to life in the forest. *Hint: Review the abiotic observations students made of the coral reef, are they the same as those observed in a forest?*

6. Discuss student ideas as a class. Ask students to add to their thinking in their notebooks.

Part 2

Focus Question

- How is the biodiversity of the Caribbean Sea different from that of the Indo-Pacific?

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
Science notebook
Student data sheet

Process and Procedures

1. Review the location of the Caribbean Sea and the Indo-Pacific region with students.

2. Review the concepts presented in the virtual field trip, including:
    a. The disproportionate biodiversity found in the Indo-Pacific as compared to the Caribbean Sea
    b. Student observations of the Caribbean reef system
    c. Student observations of the Indo-Pacific reef system
    d. Endemic species found only in the Indo-Pacific region

3. In pairs, or individually, ask students to complete a Frayer Model (see below) for each region. Ask students to share their Frayer models in small groups.

4. As a class, review what it means to be a steward of the ocean and summarize the suggested actions mentioned in the Virtual Field Trip. Ask students to share their ideas for improving the local ecosystem as well as what can be done from home to reduce their impact on the world's oceans.

Questions

1. How do scientists observe and measure the biodiversity of a coral reef?
2. What changes are impacting biodiversity today?
3. What can you do to become a champion for the coral reefs and a steward for a healthy ocean?

Caribbean Coral Reef

What is a coral reef?

Illustration of this reef.

Where will you find this reef?

Animals you won't find on this reef.

Indo-Pacific Coral Reef

What is a coral reef?

Illustration of this reef.

Where will you find this reef?

What is unique about this reef?