

Coral Reefs & Adaptation



STEM CONNECTIONS

Science: Natural Selection

Engineering: Developing Possible Solutions



DURATION

60 Minutes



MATERIALS

- Messages in Color Handouts (1 per learner)
- World Map Handouts (1 per learner)
- Colored Pencils
- Inflatable Beach Ball Globe
- Masking Tape
- Scissors (1 per pair)

SCHEDULE

- Introduction to Coral Reefs (5 min)
- Messages in Color Activity (45 min)
- Personal Maps and Clean Up (10 min)

OBJECTIVE

Students take on the role of predator or prey in a game about camouflage in coral reefs, and discover the process of adaptation.

ALIGNED STANDARDS

Next Generation Science Standards (NGSS):

NGSS 4-LS1-1: Structure and Function

NGSS MS-ETS1-2: Engineering Design

NGSS MS-LS4-4: Natural Selection

NGSS MS-LS4-6: Adaptation

21ST CENTURY SKILLS

- Applying Past Knowledge to New Situations
- Creating, Imagining, Innovating
- Remaining Open to Continuous Learning

HABITS OF MIND

- Creativity and Innovation
- Flexibility and Adaptability
- Initiative and Self-Direction

BACKGROUND INFORMATION

Coral is a well-known habitat for many colorful fish and heat-seeking vacationers. But what most people don't know is that it is biologically unique. Coral is made up of millions of tiny invertebrates called polyps. Their feathery fronds make them look a little bit like microscopic sea anemones, but they have a hard exoskeleton at the base. Over many generations, coral polyps propagate themselves by asexual reproduction, and live on top of the left-behind exoskeletons of their ancestors. That means that all the polyps in a colony are genetically identical. There are many species of coral, and each has a different color and shape.

The kind of coral we know best lives near the surface (not below depths of 200 feet) in tropical waters. That's because it needs consistent sunlight to live. It's powered mainly by unicellular photosynthesizers that live inside each polyp. Because it takes many generations to build a colony, coral is not well-suited to the seasonal changes in the Arctic.

Although the best-known varieties of coral photosynthesize, individual polyps also filter and eat plankton. This makes coral both a producer and a consumer in the food web.

Coral colonies live in larger ecosystems called reefs. There are three types of reef:

1. Fringing Reefs: these grow along tropical shores.
2. Atoll Reefs: this is what's left behind when a fringing reef grows along the shores of a volcanic island, and the volcanic island sinks below sea level. Atoll reefs are often crescent-shaped with an open lagoon in the center.

- Barrier Reefs: these grow parallel to a shore but separated from land by an expanse of water, creating a barrier — like an obstacle course — for ships on their way to or from the shore. Australia's Great Barrier Reef is the largest coral reef system in the world. It has 400 species of coral and 900 islands which stretch for more than 1,400 miles. While the sea life there isn't as dense as it is in the Arctic, many species stay year-round and are endemic to the region. The Great Barrier Reef is home to at least 30 species of cetaceans, 1,500 species of fish, 5,000 species of mollusk, 17 species of sea snake, 6 species of turtle, 15 species of seagrass, 125 species of sharks and rays and 215 species of birds.

The Great Barrier Reef runs parallel to Australia's northeast coast and can be seen from space:

Satellite image "GreatBarrierReef-EO" by NASA

Scientists are still trying to figure out why coral reefs are so colorful.

Read about the latest research here:
<https://reefresearch.org/wp-content/uploads/2019/05/Fun-Facts-Why-are-Coral-Reefs-so-Colourful.pdf>



OVERVIEW

The big idea for today is adaptation. Animals didn't just come out of nowhere perfectly suited for their environments. Instead, genetic variation causes every creature to be a little different. Creatures whose differences help them survive in their environment are more likely to pass those traits along to their offspring, so over time, species become more and more specialized.

Camouflage is just one example of adaptation. Using bright colors to advertise poison is another. Mimicking a poisonous animal is another. Organisms don't adapt in a vacuum; instead, they co-adapt, influencing each other every step of the way.

DAILY PREP

To prepare for today's class:

- Have your supplies ready and be prepared to tweak the simulation as you go to make it work for your group. Each Messages in Color Handout will last for three or four rounds of the game, so make extra copies if you want to be prepared for more.

STEP-BY-STEP DIRECTIONS FOR INSTRUCTORS



Group Discussion

INTRODUCTION TO CORAL REEFS

Celebrate this halfway point in campers' journey through Oceanic Exploration Camp. They've already explored the Everglades of Florida and the frozen Arctic, and today they venture into a completely new aquatic ecosystem: coral reefs. Launch into a discussion to hear what students already know about coral and coral reefs:

- Today we're talking about coral reefs! Who knows what climate they live in? (The tropics)
- What is coral made of? (Tiny polyps — imagine microscopic sea anemones — living as a colony. They build hard skeletons and pile on top of each other to create amazing shapes.)
- Where do you think coral fits on the food web? (It doesn't fit perfectly into a category! Some coral photosynthesize, so they're producers at the very bottom of the food chain — or food web. But some coral also eat plankton, so they can also be consumers somewhere in the middle.)
- Where is the biggest coral reef in the world? (Off the coast of Australia: point out the Great Barrier Reef on your globe.)

Coral reefs are very colorful, so they create habitat for thousands of colorful fish. Today, we are going to figure out how fish have adapted to this colorful environment.



Whole Group

MESSAGES IN COLOR

Give each camper one Messages in Color Handout. Explain that each card on the sheet represents a tropical fish in the coral reef. Have campers carefully cut two cards off their sheet, and give them about three minutes to fill each of the cards with color.

When everyone's fish are nice and colorful, announce that it's time to see just how well the fish are adapted to their environment. Divide the class into predators and prey — there should be about twice as many prey as predators — and explain how each round works:

1. Predators: Hand your fish over to the prey and stand facing the corner with your eyes covered.
2. Prey: Hide the cards all over the room! Use masking tape if you need to.

- While they hide the cards, walk through the room and draw a black X on the back of two of the most obvious, colorful cards. (This indicates poison. Leave it up to your campers to figure out how you choose which cards to mark.)
- 3. Predators: Come on out. You have one minute to hunt and collect as many fish as you can!
- 4. Predators: Count your cards.
 - Anyone with fewer than three fish didn't get enough to eat and died! That means you're out and will be reborn as a baby prey.
 - Anyone who has a card with the X ate a poisonous fish and died! That means you're out and will be reborn as a baby prey.
- 5. Predators: If you survived, head back to the corner, facing away. If you died, come join the prey.
- 6. Prey: Go out and search for any cards that survived — since these fish didn't get eaten they're still alive and can be used again in the next round. Gather together and look at the cards. Why do you think those fish survived when the others were eaten?
 - Don't teach about camouflage yet, let them start going that direction by themselves.
- 7. Predators: Use this time to strategize.
- 8. Prey: Cut out your next two fish and completely color each card — these are the fish babies.
 - Fish who are well adapted survive and have more babies! If any of your fish survived the last round, make three new cards instead of two. Predators who just got out should color their fish to match yours, becoming part of your growing fish family.
- 9. Prey: Rehide all the cards, including the fish who survived the first round!
 - Add more poison X's to the back of a few cards that are the same color(s) as the poison cards from the last round.

Play several more rounds, rewarding the campers whose creature cards survive and duplicating the traits of the surviving fish. Each round represents a generation. You'll be able to play up to five rounds before running out of cards. Hopefully, the idea of mimics will develop, where campers try to make their animals look like the poisonous ones. If it doesn't happen naturally, try to plant the idea.

If you want to make the simulation more complex, or correct an imbalance between the number of predators and the number of prey, here are a few additional rules you could add:

- Predators who perform well (you choose the threshold of how many cards) get to reproduce by choosing a classmate from the prey side to switch over and join them on the predator team.
- Prey whose cards didn't survive become "out" like the predators who didn't find enough prey and must replicate the surviving cards as closely as possible.



Group Discussion

Get into a circle and debrief together. Ask your campers to go around and each say one word about how they felt about this game. Then ask some open-ended questions such as:

- What was fun about this game?
- What was frustrating about it?
- Do you think the game was fair? Why or why not?
- What strategies did the predators use to find the prey?
- What about the poisonous animals? How did the predators learn to avoid them?
- What strategies did the prey use to avoid the predators? (Introduce the term "mimic" if they get to this concept)
- How do you think the game would have been different if we had played it outside?
- Why do you think so much of the prey ended up looking alike?

End your discussion by defining adaptation: generational change that gives an advantage to the offspring. Emphasize that the fish didn't all start out adapted, but over time the ones that were best adapted survived and had more babies, so the adaptation become more common.



Individual

PERSONAL MAPS AND CLEAN UP

Ask your campers to draw coral, tropical fish and reef predators off the coast of Australia.

CHECK FOR UNDERSTANDING

- Why do creatures adapt?
- What does the word "camouflage" mean?

EXTENSIONS

Play a guessing game by describing real ocean creatures and allowing kids to guess how certain adaptations help the animal.

- Seahorses have really bumpy skin. (It helps them blend in with the rough textured coral.)
- Trumpetfish are long and skinny. (It helps them blend in with seagrass and vertical coral.)

- Lionfish have really spiky-looking fins and are covered in deep red and white stripes. (They are sending a message to other animals that they are very poisonous.)
- Nudibranchs, also known as Sea Slugs, are a type of mollusk. But unlike other marine mollusks, they don't have a shell: instead, their neon-colored bodies flutter unprotected as they move. (They are sending a message to other animals that they are very poisonous.)
- Octopi can change the color and texture of their skin. When they see a predator passing by, they become the texture and color of their surroundings (camouflage). But when they see another octopus coming by, they make their bodies look big and darkly colored. (They are sending a message to the other octopus that this is their turf and they are a force to be reckoned with.)
- Flounders are totally flat, with both eyes on one side of their bodies, and they are the color of sand. (They hang out on the sandy bottoms near coral reefs and are camouflaged.)
- Pufferfish can swallow water to puff their body up to twice its normal size. (It's sending a message saying, "I'm poisonous, and besides that, I'm too big and too spiky to swallow!")



Seahorses



Trumpetfish



Lionfish





Octopus



Flounder



Pufferfish



Pufferfish



