



## Coral Reef Threats, Adaptation and Restoration

### Module Summary

This module is an immersive live dive where students will be taught about threats to coral reef ecosystems, how some species are able to adapt, and how scientists are using coral restoration to help protect coral reefs. They will be given an in-class activity to assist with their learning and understanding of coral reef ecosystems and how they may become imbalanced and unhealthy due to two key threats- climate change and disease. They will also learn why healthy, biodiverse coral reefs are important on a planetary level, and why humans depend upon them. Students will learn about how human activity is changing our climate and how they can all have a positive impact. It's going to be a great dive on Little Cayman!

Suitable for Years: 4, 5, 6

### Learning Objectives

- Explain some of the threats corals are facing in our oceans
- Define climate change and summarize the impact of climate change on coral reefs
- Learn what an ecosystem is and how different living and non-living elements play crucial parts
- Report on how living beings can change in response to alterations in their environment
- Illustrate the change we humans can make for the future recovery of coral reefs
- Discuss how scientists are helping to restore coral reefs so they can survive in changing environmental conditions
- Summarize why healthy coral reefs are important to coral reefs and to humans
- Think about and plan an activity to help coral reefs in the future

### Science National Curriculum Alignment

- Find out about other animals, including how they grow, feed, move, use their senses (Year 4).
- Observe similarities and differences among animals and among plants (Year 4).
- Investigate a local habitat, including the relationship between the animals and plants found there, and develop skills in classifying animals and plants by observing external features (Year 4).
- Investigate the conditions necessary for the growth of familiar plants including light, heat and water (Year 5).
- Find out how human activities create a variety of waste products; find out that some materials decay naturally while others do not.
- Understand that some waste materials can be recycled and that this can be of benefit to the environment.



## Ocean Literacy Principles

#5 - The ocean supports a great diversity of life and ecosystems.

#6 - The ocean and humans are inextricably interconnected.

## Description of the live dive

The dive will take place on a pristine coral reef rich with marine life offshore of Little Cayman, Cayman Islands, BWI. The CCMI underwater educator will communicate constantly with the live lesson host (who will be topside on the boat) and with the engaged remote class. The educator will take the students through a series of observations, fun facts and learning objectives regarding coral reef threats, climate change, adaptation, coral disease, resiliency and restoration, and how students can help, all in alignment with the Science National Curriculum of the Cayman Islands. Students will have an in-class activity to complete during the live lesson, which they are welcome to ask questions about to our underwater educator at any time during the duration of the live broadcast. Pre-recorded footage and images may be used to show key examples of adaptations, coral disease and coral restoration, should these not occur naturally on camera during the broadcast.

## Live broadcast outline (30 mins)

00:00 - 02:00	CCMI host welcomes students and outlines the lesson
02:00 - 04:00	CCMI host introduces the educator and the in-class activity
04:00 - 7:00	Educator defines and shows examples of biotic & abiotic factors
7:00 - 10:00	Educator describes climate change and how it negatively impacts life on coral reefs
10:00 - 12:00	Educator explains how species can change in response to their environment, covering plasticity and adaptation
12:00 - 15:00	Questions
15:00 - 20:00	Educator discusses coral disease and scientific restoration
20:00 - 25:00	Educator discusses what the students can do to help protect coral reefs
25:00 - 28:00	Questions
28:00 - 30:00	CCMI host recaps the live dive and thanks the students for joining

## Materials

internet connection, laptop, projector, speakers, paper, pencils/pens, CCMI activity sheet, CCMI definitions list, CCMI fun fact sheet

## Useful resources

- [www.reefresearch.org/reefs-go-live](http://www.reefresearch.org/reefs-go-live)
- [www.projectaware.org](http://www.projectaware.org)
- [www.doe.ky](http://www.doe.ky)
- [www.education.gov.ky](http://www.education.gov.ky)
- [www.oceanservice.noaa.gov/kids/](http://www.oceanservice.noaa.gov/kids/)



## Fun Fact Sheet: Coral Reef Threats, Adaptation & Restoration

1. Corals are animals living in a symbiotic (e.g. beneficial) relationship with microscopic algae called zooxanthellae that live within the coral's polyps. Corals also build their own internal skeleton out of calcium carbonate similar to our own human skeleton. This makes them an animal, a plant, AND a rock (Jackson 1997)!
2. Corals and algae survive symbiotically within a certain temperature range. When oceans warm above a certain temperature, the relationship will be lost. Temperature-stressed coral have no choice but to expel the algae from their tissues or the algae may choose to leave the stressed-out coral; This is called coral-bleaching (Barnes and Hughes 1999).
3. Staghorn coral grows an average of 8-10 cm per year in the wild, however CCMI scientists have shown that in a nursery setting it can grow an average of 50-70 cm per year (CCMI 2017).
4. Coral reefs are important because they protect our coastlines from storm damage, provide habitat for many commercially important fishes, and are estimated to generate \$375 billion USD in economic and environmental services worldwide annually (Costanza et al. 1997).
5. Some reef fishes have very detailed and intricate patterns on their bodies. When these fishes school together the patterns confuse predators allowing the fish to retreat quickly, creating an obscure blur (Rosenthal 2017).
6. Small ornamental reef fishes are a beautiful variety of bright colours, however underwater in natural lighting these colour combinations blend into the colourful background of the coral reef and provide camouflage from predators (Marshall 2017).
7. Marine ecosystems are aquatic environments with high levels of dissolved salt, such as those found in or near the ocean. Marine ecosystems are defined by their unique biotic (living) and abiotic (nonliving) factors. Biotic factors include plants, animals, and microbes; important abiotic factors include the amount of sunlight in the ecosystem, the amount of oxygen and nutrients dissolved in the water, proximity to land, depth, and temperature (National Geographic 2021).
8. Coral reefs act as the world's carbonic sink, trapping carbon. Excessive CO<sub>2</sub> is being emitted into our atmosphere, and as the atmosphere becomes supersaturated excess carbon is forced into our oceans resulting in ocean acidification. However, coral reefs are taking up this excess carbon in their nutrient cycle and helping to clean our oceans (Anthony et al. 2011).
9. It is estimated that we have lost approximately half of the world's coral reefs over the last 30 years, and could potentially lose more than 90% by the year 2050 if we don't take drastic measures (Gates 2016).



## Teacher Resources: Coral Reef Threats, Adaptation & Restoration Definitions List

Our CCMI educator and host will refer to a number of key terms which will be defined throughout the broadcast. We have also provided a definitions activity for students to complete while viewing the episode. The relevant terms are defined below.

**ANTHROPOGENIC-** human impacts on the environment, ecosystems, biodiversity, and natural resources, caused directly or indirectly

**BIODIVERSITY-** the variety of life in a particular area/ecosystem, in this case referring to different species

**CLIMATE CHANGE-** change in global weather patterns over time, largely because of increased carbon dioxide in the atmosphere as a result of human activities

**ECOSYSTEM-** a community of living organisms in conjunction with the nonliving components of their environment, interacting as a system

**BIOTIC FACTORS-** living things that shape their ecosystem

**ABIOTIC FACTORS-** non-living physical or chemical elements that shape an ecosystem

**PLASTICITY-** how a living thing changes its body or behaviour based upon its environment or differences between its various habitats

**ADAPTATION-** changes in a living being's shape or behaviour, which improves its ability to survive, these changes are passed on to future generations through the organism's genes

## Coral Reef Threats, Adaptation & Restoration In-Class Activity Sheet

FILL IN THE BLANKS BELOW WITH SOME OF THE KEY TERMS FROM THIS LESSON

\_\_\_\_\_ are all of the living beings within an ecosystem. All of the non-living physical or chemical elements that shape an ecosystem are called \_\_\_\_\_. When a living being changes because of its environment or differences between its various habitats, it is called \_\_\_\_\_. Over time, this can lead to \_\_\_\_\_, where these changes are passed down genetically from one generation to the next.

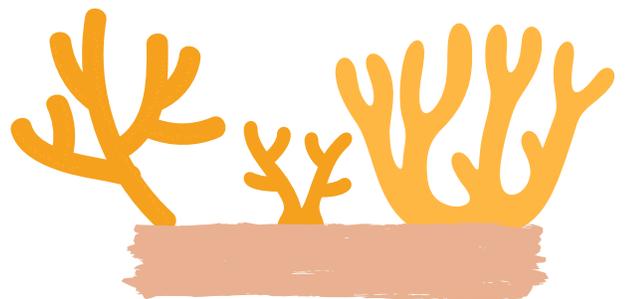
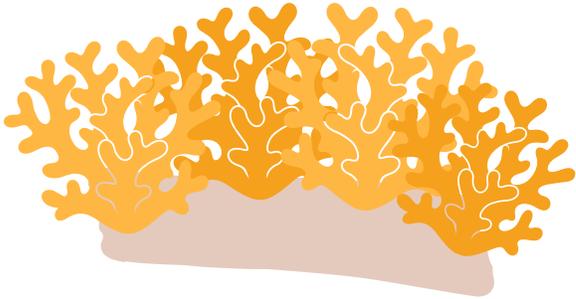
GIVE TWO EXAMPLES OF HUMAN ACTIVITIES THAT ARE CONTRIBUTING TO CLIMATE CHANGE: \_\_\_\_\_

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WHAT IS ONE ACTION THAT YOU CAN TAKE TO PROTECT CORAL REEFS? \_\_\_\_\_

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THE TWO PATCHES OF CORAL ARE THE SAME SPECIES, BUT THEY LOOK VERY DIFFERENT. DESCRIBE WHY THEY MIGHT HAVE GROWN DIFFERENTLY AND WHAT THAT MIGHT TELL US ABOUT THEIR ECOSYSTEM.



DRAW YOUR OWN: IN THE SPACE PROVIDED BELOW, DRAW A PICTURE OF A CORAL REEF WITH EXAMPLES OF FISH AND CORALS THAT HAVE SPECIAL ADAPTATIONS (SHAPE, COLOR, CAMOUFLAGE) TO LIVE THERE.

