ANSWER KEY

# Become a CCMI researcher: Corals in a Changing Climate

As we look around us, the impacts of climate change are ever-present and increasing in strength, with 2023 being the hottest year on record! During the lesson "Corals in a Changing Climate", CCMI educators discussed how climate change impacts our oceans and corals reefs, with a focus on the impact of last year's increased water temperatures on Little Cayman's reefs.

# Become a CCMI marine biologist: Understanding climate change impacts on the ocean and coral reefs

In the lesson, we used some complicated words! However, these words are useful for helping us talk about the important topic of climate change and its impact on coral reefs! Here are some of the key terms to know.

Using the words or phrases in the answer bank, write the correct term in the left column to match them with the correct definition of each term.

Symbiotic relationship  Global warming  Marine heatwaves  Fossil fuels

Climate change  Greenhouse gases  Zooxanthellae

| | |
|---|---|
| Symbiotic relationship | A close relationship or interaction between two organisms where at least one of the organisms benefits. |
| Marine heatwave | A rapid and unusually high spike in sea temperature over a relatively short period of time |
| Zooxanthellae | Symbiotic algae that live in the tissues of coral polyps (and several other marine animals) that provides the coral with 90-95% of its needed energy and nutrients |
| Global warming | A gradual warming of the Earth's "normal" temperature over many years |
| Climate change | Change in global weather patterns over time, largely due to increased carbon dioxide in the atmosphere as the result of human activities |
| Fossil fuels | Resources such as oil, natural gas, and coal. They are found in rocks and formed over millions of years by dead plants and animals. |
| Greenhouse gases | Gases in Earth's atmosphere that trap heat like a blanket around the planet |

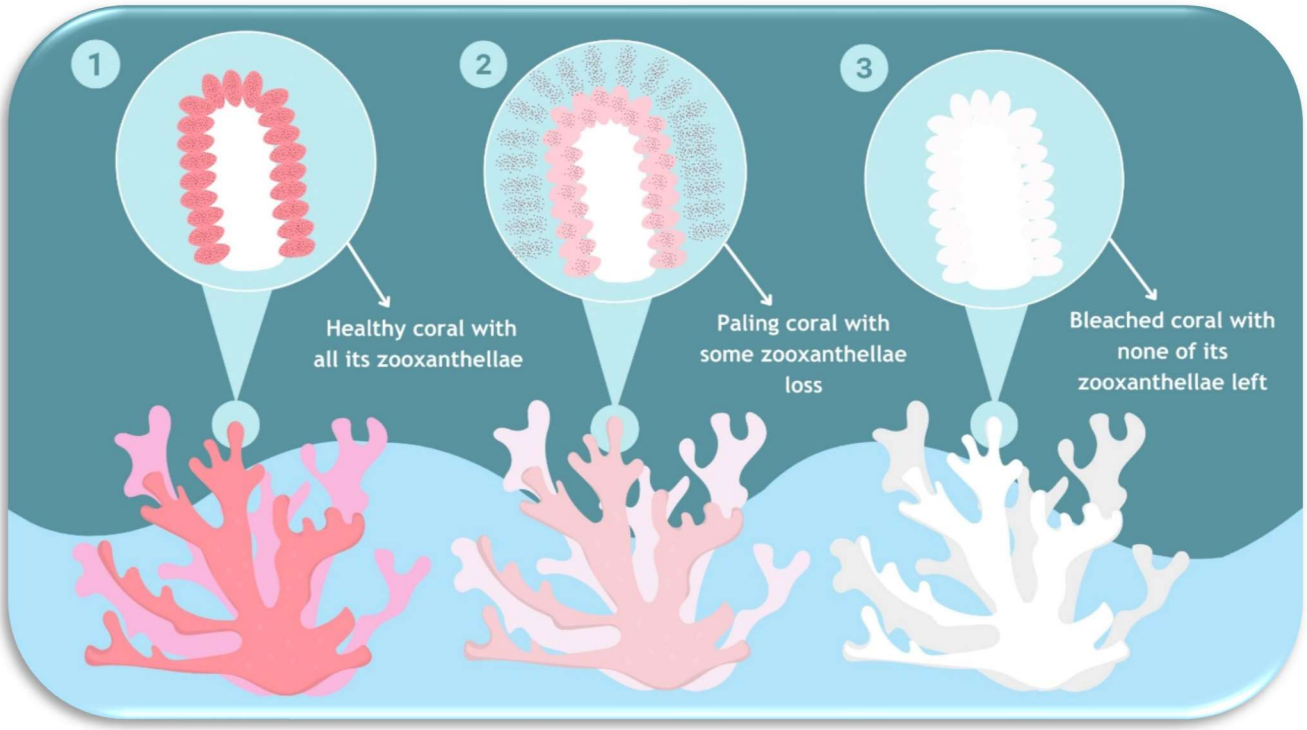
Using the words or phrases from the glossary, complete the sentences below by filling in the blanks. *Note: you can use a word or phrase more than once!*

Climate change is happening because the earth's climate is changing at a much faster rate that it would naturally, and this is due to human activities such as burning fossil fuels, which releases greenhouse gases into the atmosphere.

These gases trap heat from the sun, causing the earth to get hotter and hotter, like wrapping more and more blankets around the planet. This is known as global warming, and it has knock-on effects on the ocean.

Climate change is causing an in increase in the frequency, strength, and length of marine heatwaves, which put corals under a lot of stress. When corals are under stress, they expel, or kick out, the colourful zooxanthellae that live inside them. This is what causes coral bleaching. Without the colourful zooxanthellae, all that's left to see is the coral's white external skeleton underneath. The coral and the zooxanthellae have a symbiotic relationship with each other, where both organisms benefit. The coral provides the zooxanthellae with a safe place to live, and in return, the zooxanthellae provide the coral with 90-95% of its food!

Below is a diagram that demonstrates the process of coral bleaching.




In the lesson, we clarified that bleaching does ***not automatically*** mean the coral is dead. So, what ***does*** bleaching mean for the coral? (Answers may vary). Coral bleaching means the coral loses its zooxanthellae/photosynthetic algae. Since this is what makes most of the coral's food, the coral has to rely on feeding themselves, which isn't enough to sustain them for a long period of time. With less food, the coral has less energy and is more vulnerable to threats such as pollution and disease. If stressful conditions last for too long, the coral will starve, eventually leading to coral death. However, coral can recover if conditions return to normal soon enough.

# Become a CCMI coral biologist: Understanding post-bleaching recovery

Corals can regain their symbiotic algae and recover from bleaching if conditions return to normal in a short amount of time.

The **bleaching threshold** is the maximum temperature that corals can survive at without bleaching. A **degree heating week** is where the ocean temperature has been above the bleaching threshold for one week.

If the bleaching threshold is 30 degrees, one degree heating week would be when the water temperature is 31 degrees for one week.

If the ocean temperature was 31 degrees for two weeks, this would be two degree heating weeks.

BUT, if the ocean temperature was two degrees warmer for one week, then this would ALSO be two degree heating weeks.

Degree heating weeks are calculated by multiplying the temperature increase above the bleaching threshold by the number of weeks.

Question: Calculate the degree heating weeks for a marine heatwave that was hotter than the bleaching threshold by two (2) degrees for four (4) weeks.

Degree heating weeks: 2 x 4 = 8

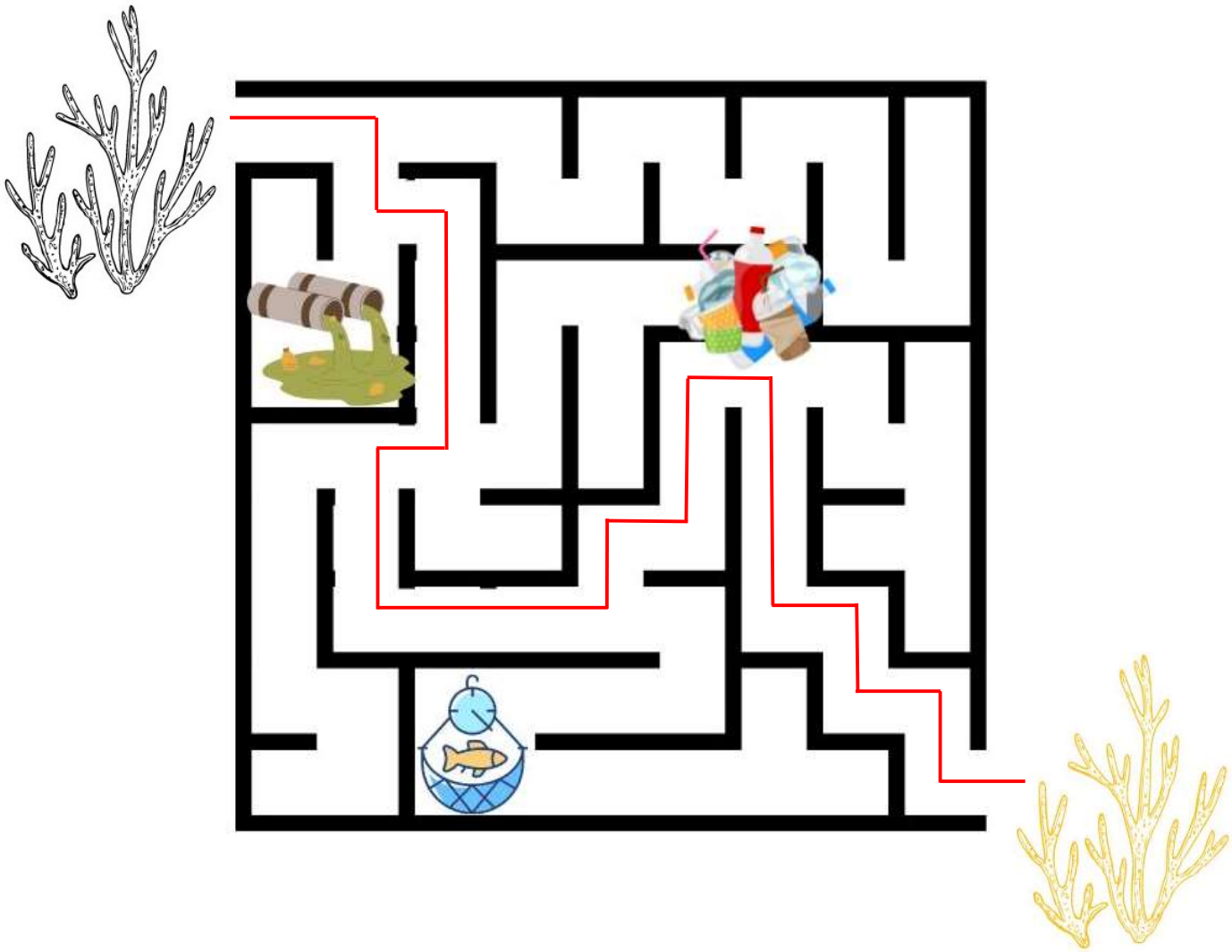
Did you know…

- That four degree heating weeks causes widespread bleaching?
- That eight degree heating weeks causes widespread coral death?

1. Using your answer and the information from above, would you expect widespread coral death if a reef experienced the amount of degree heating weeks calculated?
   Yes

Corals have a better chance of recovering from bleaching without the added pressures from local threats such as pollution and overfishing. Find a path to recovery in the maze below for the bleached coral on the left, which has lost all its zooxanthellae, to the healthy coral on the right, which has regained its zooxanthellae!

Avoid bumping into local threats within this maze and to help the coral recover faster!



# Become a CCMI coral surveyor: Conducting long-term monitoring

To know how coral reefs are doing, we need to know what a healthy coral reef is supposed to look like. In the lesson, the educators discussed some characteristics of a healthy coral reef ecosystem. In the space provided, draw what you think a healthy reef should look like, and label some of the key features of the healthy reef ecosystem.

Notes:

Students should draw a coral reef that has a lot of coral. They may annotate the drawing to say there is little macroalgae cover. They may draw many fish swimming around. They could annotate the drawing to say there are healthy amounts of parrotfish keeping macroalgae cover in check.

They may draw sponges on the reef and annotate the diagram, saying that sponges filter the water around corals and keep it clean.

During CCMI's yearly AGRRA (Atlantic and Gulf Rapid Reef Assessment) surveys, scientists look for signs of bleaching on the reef. Put a tick in the box next to each photo of a coral if you think it looks bleached.

☑ Brain coral

☐ Lettuce coral

☐ Pillar coral

☐ Star coral

☑ Staghorn coral

☐ Brain coral

## Become a CCMI conservationist

Although the challenge of tackling climate change might seem huge, everyone has an important role to play in reducing the impact of climate change through small life changes. In the lesson, we discussed different ways you can take action to help protect coral reefs against climate change. Using that information, create an action plan below of things you can do every day, every week, and every year. Some examples have been provided on the next page for inspiration.

## My Action Plan Against Climate Change

**Every day I will…**

**This will help corals in a changing climate because…**

**Every week I will…**

**This will help corals in a changing climate because…**

**Every year I will…**

**This will help corals in a changing climate because…**

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REEFS GO LIVE

You can use these cards to play a game with your friends and family. Place the cards face down in a pile. One player chooses a card from the pack, reads the card, and they try to commit to that one specific action to help tackle climate change.

## Recycle

Every week...I pledge to swap something I usually buy packaged in plastic with something packaged in cardboard so it's easier to recycle

## Education

Forever...I pledge to continue to learn about the environment and the impacts humans are having on it

## Reduce

Every week... I pledge to cycle somewhere instead of going in the car.

## Re-use

Every year... I pledge to find new ways to use my old items instead of throwing them away.

## Awareness

Forever...I pledge to talk to my friends and family about climate change and encourage them to join me in making positive changes

## Reduce

Everyday...I pledge to always turn off the lights before leaving a room to save energy.


## Community engagement

Every month...I pledge to take part in a community beach-clean once a month

## Reduce

Every day... I pledge to keep my showers to a maximum of 5 minutes each week.

## Sustainable choices

Forever...I will continue to learn about the environment and the impacts humans are having on it