UNDERSTANDING CLIMATE CHANGE

Just like the seasons change throughout the year, Earth experiences natural cycles of warming and cooling. In spring and summer, it gets warmer as the Earth tilts toward the sun, and in fall and winter, it cools down as the Earth tilts away from the sun. Similarly, Earth goes through long-term warming and cooling periods due to various natural factors, like changes in the sun’s intensity and volcanic activity. However, human activities are causing an unusually rapid warming. In the past century, most of this warming has been attributed to human actions, which release greenhouse gases like carbon dioxide (CO₂), methane (NH₄), and nitrous oxide (N₂O) into the air. These gases act like a cozy blanket, trapping heat in the Earth’s atmosphere.
What are some human actions that add greenhouse gases into the atmosphere?

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2. _____________________________________________________
3. _____________________________________________________
4. _____________________________________________________
5. _____________________________________________________
6. _____________________________________________________

What are some other signs that the climate is changing?

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Just like a fever can make you feel sick, Earth’s rising temperature affects its health too. Scientists watch important signs, like how warm the whole planet is getting. Changes are showing up all around us, like coral reefs bleaching, sea levels rising, and glaciers melting. **Climate change** doesn’t just mean hotter days. It causes a mix of things like changing weather patterns, shifts in rain fall, and even impacting ocean chemistry.
Corals’ Partners

Corals have tiny partners called zooxanthellae that live within their tissues. Corals and zooxanthellae form a **symbiotic relationship**, both benefiting from their partnership. Zooxanthellae give corals their color. More importantly, they also **photosynthesize**, providing corals with up to 95% of the food that they need to survive. Without them, corals won’t survive for long. In return, corals provide nutrients to the zooxanthellae and a safe home to live in.

In the drawing you see below, there’s another cool symbiotic relationship between gobies (a kind of fish) and pistol shrimp. These two animals can partner to make holes in the sandy seafloor that they both live in. Pistol shrimp are excellent hole-diggers, but where the goby fish comes in is that they have poor eyesight. That’s where the goby helps by keeping predators at bay and warns the shrimp when something potentially harmful is coming. This teamwork helps them both have a safe place to call home in the ocean.

Provide one other example of a symbiotic relationship. List each animal and describe each animal’s relationship with the other.

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COLOR THE DIFFERENT PARTS OF A CORAL AND LABEL THEM USING THESE WORDS:
• CORAL POLYP
• SKELETON
• ZOOXANTHELLAE
CORALS IN TROUBLE: BLEACHING

Climate change is also having a profound impact on wildlife and ecosystems around the world, even in the ocean. As the Earth warms up, some of that heat is absorbed by the ocean, increasing its temperature.

Warmer than usual waters can stress corals, just like a fever stresses our bodies. When corals are stressed, they expel the zooxanthellae into the surrounding water. The corals appear white or “bleached,” revealing their hard calcium-like skeleton underneath. If high water temperatures continue, corals might starve and die without their partners; however, if conditions improve, the zooxanthellae can be reabsorbed into their tissues, continuing their relationship.

When you’re not feeling well, your body works hard to get better. But if another illness comes along, it makes your recovery even more challenging, and your body has to put in extra effort. Similar things can happen to bleached corals. When corals bleach, they’re already under a lot of stress and not getting the right nutrients from their partners, the zooxanthellae. If something else, like harmful chemicals or a coral disease, shows up when the corals are already struggling, it becomes even tougher for them to get better.

Most coral bleaching happens when the ocean gets too warm. But other things can cause it too, like too much sunlight, changes in water chemistry, and even pollution from chemicals.
COLOR EACH CORAL TO SHOW HOW MANY ZOOXANTHELLAE SHOULD BE IN HEALTHY, BLEACHED, AND DEAD CORALS ON THIS PAGE AND THE NEXT ONE.

Dead Coral Skeleton

Bleached Coral

Healthy Coral

Amount of Zooxanthellae
CORAL BLEACHING

Dead Coral

Bleached Coral

Healthy Coral
Mass bleaching occurs when many corals in one area, or even across large parts of the ocean, all experience a stressful event at the same time. Entire reef systems can be affected that can span tens to even thousands of kilometers. The main cause of these events is when the sea temperatures stay high for a long time. Scientists are worried because, over the past few decades, these events are occurring more often and are becoming more severe. This is yet another warning sign that something bad is happening in our ocean.

If we don’t take action to stop putting lots of greenhouse gases into the atmosphere, mass bleaching will continue to harm coral reefs. It’s not just the corals that will be in danger. Corals are the foundation of the coral reef ecosystem. When corals bleach, this disrupts the entire coral reef ecosystem and impacts the countless marine species that depend on the reef for survival.

**WHAT ARE SOME ANIMALS OR PLANTS THAT LIVE IN THE CORAL REEF ECOSYSTEM, AND HOW DO THEY RELY ON IT?**
SOLVE THIS FUN CROSSWORD PUZZLE BY USING THE NEW WORDS YOU’VE LEARNED IN THIS BOOKLET.

DOWN
1. These marine animals create a hard calcium carbonate skeleton beneath their soft bodies, which helps build reefs.
2. The process that plants or other organisms use to convert light energy into chemical energy.
3. A long-term shift in average temperature and weather patterns.
4. Gas in the Earth’s atmosphere that trap heat, including carbon dioxide (CO₂), methane (NH₄), nitrous oxide (N₂O), and fluorinated gases.
5. When zooxanthellae are expelled from a coral’s tissues due to extreme changes in environmental conditions, causing the coral to appear white.

ACROSS
6. Yellow-brown symbiotic algae that live in the tissues of corals and other marine invertebrates.
7. Large-scale bleaching events are typically triggered by a rise in average sea temperature for prolonged periods of time.
8. An ecological level of organization that includes all the living factors, the nonliving factors, and how they interact.
9. A close ecological relationship between the individuals of two (or more) different species.

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REFLECTION: WHAT ARE SOME WAYS THAT YOU CAN REDUCE YOUR CARBON FOOTPRINT?

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The Khaled bin Sultan Living Oceans Foundation is a US-based nonprofit environmental science organization. The Foundation was established to protect and restore the world’s oceans through scientific research, outreach, and education.