Unit Essential Question

How do we know human activity is influencing climate, and what can we do about it?

Introduction

Now that students have considered the causes and evidence of climate change, they will turn their attention to the effects of climate change on both natural and physical systems. Students will examine resource cards to identify ways that climate change is affecting plants, animals, humans, and the Earth. As they collect evidence, students will identify the cause and effect relationship between climate change and nature, which then affects corresponding human communities. Students will relate their understanding back to what they have learned in previous tasks as they add to the cause and effect diagram they created in the previous task. The result will be one long chain of causes and effects within the topic of climate change, enabling students to see the complex mechanism as a whole.

Objectives

Students will be able to

Content

• Identify and explain ways that climate change affects plants, animals, and humans.

Science and Engineering Practices

- Analyze data about the effects of climate change on the world around us.
- Construct an explanation linking the cause and effects of climate change.

Equity and Groupwork

• Make contributions to group discussions.

Language

• Discuss with a partner the impacts of climate change on animals and the environment.

Academic Vocabulary

- cause
- effect
- extreme weather
- glacier
- impact
- production
- reasoning
- sea level
- wildfire

Language of Instruction

- adjust
- fueling
- human community
- natural system
- rise
- zoom



Timing

This task can be completed in 4 class periods (based on 45-minute periods).

- Part I Stations: Gather Information and Analyze Data (2 class periods)
- Part II Chain of Cause and Effect—An Example (1 class period)
- Part III Connect to the Culminating Project and Assessment (1 class period)

Student Materials

- Handout: Resource Cards (one card for each station)
- Handout: Resource Card Questions (optional)
- Computer or tablet at stations 1 and 4

Teacher Materials

• "The Effects of Climate Change on Humans and the Environment" digital slide presentation

Background Knowledge

Studying the effects of climate change on our ecosystems can leave students feeling bad or sad. There are many photos and videos showing the unfortunate state of various species (pika, polar bear, etc.), the destruction of land from wildfires, the melting of beautiful glaciers, and disastrous weather events. Research suggests that for people to change their behavior, it is important that they feel some sense of hope and urgency. Additionally, people tend to be more motivated to avoid future losses than to make potential gains. Thus, we recommend framing the lesson in these ways:

- Everyone will be affected by climate change because it affects food production, the economy, and weather. If we don't take action, there will be more negative effects of climate change. **But** actions we take now can reduce the negative effects.
- The rising sea level map shows what might happen if changes aren't made to reduce the effects of sea level rise or to reduce emissions. Sea levels will rise, but how much they rise depends on what we do about climate change.
- There are more and more people who are changing the way they live, eat, dress, travel, and play in order to reduce the amount of greenhouse gases in the atmosphere.
- Governments around the world are becoming more active and assertive, supporting policies and legislation to reduce the amount of greenhouse gases produced by manufacturing, factories, farms, and transportation.

Students have already learned that human activities such as burning fossil fuels lead to increased greenhouse gases in the atmosphere, causing the global temperature of Earth to rise and other changes in climate. In this lesson, they will focus on the negative effects of climate change.

Increased temperatures are leading to melting glaciers, which leads to a number of negative effects. Animal species such as polar bears are losing their habitats. Human communities are losing gradual glacier melt as an essential drinking water source. Perhaps most importantly, the melting is causing global sea levels to rise. If this sea level rise continues at the current rate, many coastal communities will be under water in the future, causing millions of humans, plants, and animals to lose their homes.

As the climate warms, dry areas tend to become drier. This means that soil is drying out and plants are drying out. Not only does this make these regions more susceptible to wildfires, it also makes wildfires more intense and difficult to stop. The fires lead to loss of habitat for plants and animals as well as displacement and millions of dollars in property damage for humans.

Plants and animals, however, are not just affected by loss of habitat from wildfires. Increased temperatures are forcing many animals (for example, the pika) to migrate farther and farther toward the Poles in search of cooler climates, and some species are dying out entirely.

The consequences of climate change are not always due to rising temperature. Increased carbon dioxide also has negative effects. Carbon dioxide can affect plants and make them toxic to the animals that eat them, destroying essential food sources for these animals. (For example, carbon dioxide causes eucalyptus—which koala bears survive on—to become toxic).

Not all species are being harmed by climate change, however. The bark beetle population is flourishing at higher temperatures, infecting millions of forest acres in the United States and killing hundreds of thousands of trees. This infestation actually worsens climate change, because trees are essential for carbon storage and cycling.

Students often think of climate change and global warming as synonymous. However, climate change has also been associated with extreme weather events, such as increased precipitation during normally drier summer months and more consecutive dry days during winter. These weather aberrations are projected to have a huge effect on crop production, leading to a much higher percentage of failed crops. Fewer crops leads to greater food shortages and thus increased conflict over limited food resources.

For more detailed information, reference the information provided on the resource cards.

Introduction

We often hear in the news scientists claiming that changes in climate may significantly affect our lives and the environment in the future. So what does that mean exactly?

• Have students use their own prior knowledge to brainstorm ways that they think climate change impacts our lives and the environment. Have them record their ideas in the Student Edition.

Part I • Stations: Gather Information and Analyze Data

- 1. Tell students that today they will focus on the question: How is climate change impacting humans, animals, and the environment? To answer this question, students will learn about the different ways that climate change impacts the Earth and, in turn, how these impacts affect animals and humans.
- 2. Have students read the introduction.
- 3. Explain to students that they will rotate through six different stations with a partner. At each station, they will read a resource card that provides information about a different impact. Students should look at the information, discuss it with their group, and then answer the questions on the resource cards in their science notebook as a pair or group.
 - There is an optional handout (Resource Card Questions) that only has the discussion questions from the resource cards. You might want to make a copy for each student and have them paste it in their science notebook. Doing this may help students better organize their note-taking as they go through the stations.
- 4. Have students rotate through the stations and answer the questions on each resource card.
- 5. Tell students that as they move through the stations, they should fill in the Cause and Effects Chart in their Student Edition. *Note: This activity explicitly emphasizes the crosscutting concept of cause and effect. Students will make these connections both through discussion and by filling in the chart.*

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To clarify and contrast natural systems and human communities, model how to fill out the cause and effect chart using an impact that is not presented in the stations.

- 6. After students have gone through all of the stations, have them discuss the following with their partner:
 - Explain the impacts of climate change on humans, animals, and the environment. Provide at least two examples.

Sample Answers for Causes and Effects Chart

Station	Cause	Effect on Natural System	Effect on Human Communities
Station 1	Melting ice	Sea level rise	Loss of homes in coastal regions
Station 2	Melting glaciers	Sea level rise	Loss of homes in coastal regions, loss of drinking water source
Station 3	Increased temperatures and drier soils	Increased wildfires	Loss of homes, millions of dollars in property damage, lung disease from smoke
Station 4	Change in food sources (e.g., toxic eucalyptus) Warmer habitats	Death of species (koala bears and pikas) Moving of species towards poles	Not listed
Station 5	Higher emissions	Increases in temperature, decreased rainfall, and more consecutive dry days	Inability to farm dry soil, less outdoor recreation because of high heat, less water sports and skiing, etc.
Station 6	Increased temperatures and extreme times of rainfall and drought	Decreased production of crops	Food shortages and conflict

Part II • Chain of Cause and Effect—An Example

- 1. As a class, discuss the information that students collected and analyzed. Use Slides 2–8 of the digital slide presentation to go through each station.
 - Have students briefly summarize the causes and effects they researched for each station.
 - If time permits, have students discuss several of the questions on the resource cards.
 - You might have students volunteer to share which station they had the strongest emotional reaction to and explain why.
 - This is also an excellent opportunity to look beyond students' city or state and consider the social justice issues surrounding climate change. The most vulnerable and least resourced countries and places are experiencing the greatest effects on their food and land. Low-income countries, which produce the least greenhouse gases, are being more adversely affected by climate change than high-income countries, which produce substantially higher amounts of greenhouse gases. In addition, low-income countries have far less capability to adapt to climate change than high-income countries. For example, there are island nations that are experiencing flooding due to sea level rise caused by global warming. Yet these small, poorer countries don't have the resources to build levees or dikes.

- 2. Slides 10–11: Return to the crosscutting concept of cause and effect.
 - Remind students that in this unit they have focused on the causes and effects of climate change.
 - In Task 1, students made a simple statement: an increase in greenhouse gases causes an increase in the average global temperature. In Task 2, students added the understanding that it is human activities that lead to this increase in greenhouse gases.
 - Show Slide 9, which focuses on the **causes** of climate change. Ask students to fill in the last box based on what they have learned in previous tasks.



- Show Slide 11. Explain that from students' learning today, they can now add the **effects** of climate change to the chain of causes and effects around climate change. Ask students whether they noticed that some of the stations seem to be related—that one could lead to another?
 - Have students choose one example from the stations and use it to fill out the flowchart in their Student Editions. Their answers will vary depending on what relationships they choose.
 - Have several students share their charts in a class-wide discussion.

Sample answer:



Class Concept Map

- 1. Return to the whole-class climate change concept map from the Lift-Off Task.
- 2. Have students work in groups to brainstorm new words or new connections that they learned in this task that they would like to add to the class concept map.
- 3. Ask groups to share their ideas aloud in a class-wide discussion, and add their ideas to the class concept map.
- 4. Some facilitating questions to ask students are:
 - Are there any connections you want to change?
 - Do you want to revise and/or add anything to the description of the relationship between any concepts?
 - Are there more connections you can make between the ideas/concepts already on the map?
 - Do you want to add any new ideas/concepts to the map?

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Reinforce the causal relationships being suggested by the class by drawing arrows and eliciting from students why two terms are connected.

5. Highlight any connector words that relate to the crosscutting concept of **cause and effect**. These could be phrases such as "which results in," "which causes," "that explains why," "is due to," etc.

- 6. At this point, students should be able to add the connection that increases in average global temperature lead to various effects on environments, animals, and humans. They should be able to incorporate specific examples, using their flowcharts to help them.
- 7. Once again, the purpose of this concept map is to promote language development throughout the unit. Allowing students to give names to concepts and to share their ideas about how the concepts are related will help their oral and written language development.

Reflect

At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following two questions in their Student Edition:

- 1. At the beginning of this task, you used your own prior knowledge to brainstorm how climate change can affect your lives and the environment. Look back at your ideas. After gathering and analyzing evidence today, how would you add to your ideas?
- 2. In this task, you focused on the crosscutting concept of cause and effect, or how one event can lead to another. Give one example of how this crosscutting concept came up in today's task.

There are no right answers. If students are stuck, encourage them to look back at their Student Edition. Emphasize that they should not change their initial responses, but rather use this reflection space to modify their original ideas and add to their initial responses based on what they have learned in this task.

Part III • Connect to the Culminating Project and Assessment

- 1. Have students independently complete the Task 3 section of the Individual Project Organizer during class.
- 2. Collect the Individual Project Organizers and assess using:
 - The "Analyzing and Interpreting Data" and "Constructing Explanations" rows of the Science and Engineering Practices Rubric
 - A criterion of your choice
- 3. Return the Individual Project Organizers. Give students time to make revisions based on one of these two options.
 - Have students make changes to their Individual Project Organizer according to your comments. (This could be done for homework, depending upon students' needs and/or class scheduling.)
 - Ask students to exchange their Individual Project Organizer with a partner, and give partners 5 minutes to provide written feedback. Then allow students time to make changes to their work according to the feedback.

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Pair ELLs with a student with a higher level of English proficiency, and one who can offer content insight that could strengthen what they wrote. Further, ELLs may need additional time to work on the Individual Project Organizer.