Unit Essential Question

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

Introduction

In the Culminating Project, which students will work on throughout the unit, students will generate recommendations for their classroom, school, or district about how to reduce its carbon footprint. This Lift-Off Task serves to introduce students to what climate change is and why people care about it.

Students will see some popular images relating to climate change that they may have seen before and watch two videos explaining climate change. As they explore climate change, they will be introduced to the crosscutting concept interwoven throughout this unit—cause and effect—so they can identify this type of relationship. Once students understand what climate change is and why it is a problem, they will be introduced to the Culminating Project and asked to generate a list of need-to-know questions. This activity will frame the unit within the NGSS Science and Engineering Practice of Asking Questions and Defining Problems—questions that students will come back to throughout the tasks that follow.

Finally, students will summarize their new ideas in a class concept map related to climate change. 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. Creating the concept map will also serve to give students a more overarching view of the unit through the lens of the crosscutting concept cause and effect.

Objectives

Students will be able to

Content

- Describe climate change, its causes, and its effects.

Science and Engineering Practices

- Ask questions about climate change.

Equity and Groupwork

- Rephrase and build on others' ideas during group discussion.

Language

- Identify and connect vocabulary concepts.
- Build on what others say to help strengthen students' understanding of cause and effect relationships.

Academic Vocabulary

- carbon dioxide (CO_2)
- cause
- climate
- climate change
- effect
- greenhouse gases
- temperature
- weather
- *x*-axis
- *y*-axis

Language of Instruction

- concept map
- connection
- impact
- proposal
- relationship

Timing

This task can be completed in 3–4 class periods (based on 45-minute periods).

- Part I • What Is Climate Change and Why Does It Matter to Us and the World? (1 class period)
- Part II • What Do You Need to Know in Order to Help? (0.5 class period)
- Part III • Understand Climate Change (1 class period)
- Part IV • Connect to the Culminating Project and Assessment (1 class period)

Student Materials

per group

Part I • What Is Climate Change and Why Does It Matter to Us and the World?

- Optional: computer to watch the video clips in small groups rather than as a class

Part II • What Do You Need to Know in Order to Help?

- Optional: computer to watch the video clips in small groups rather than as a class

Part III • Understand Climate Change

- Poster paper and markers
- Optional: Sticky notes for gallery walk

Teacher Materials

- "What Is Climate Change, and Why Do We Care about It?" digital slide presentation
- Video clips:
  - *What Is Climate Change?* (cause and effects of climate change in Australia): https://youtu.be/ko6GNA58YOA
  - *Climate Change (according to a kid)*: https://youtu.be/Sv7OHfpIRfU
  - *Dreaming in Green*: http://youngvoicesonclimatechange.com/movie_dreaming.php
- Class poster for list of generated need-to-know questions
- Class poster or white-board for class concept map

Background Knowledge

Climate change is a unique topic to teach. It is one of the most complex scientific and social challenges we face today. It is also one of the most complex topics to teach. It is politically-laden and perceived as controversial, at least in part, because of the coverage of climate change "deniers" in the media. But unlike some other topics in science, it also has immediate implications for contemporary human behaviors and societal practices.

As the field has developed, educators and scientists have come to understand that there are ways to frame topics so as to convey the seriousness of the issue while also empowering students to make changes aligned with their values and principles. As Busch and Osborne (2014[1]) state: "The very same students who will bear the brunt of climate change will also be required to take on the mantle of environmental citizenship in the near future. Teaching about climate change inevitably raises the issue of 'What can we do?' The solutions of mitigation and adaptation require that we ask students to think about what they individually, or our society as a whole, might do. However, teaching about climate change and considering the implications present some unique challenges." (p. 24)

Busch and Osborne have outlined some additional considerations when teaching about climate change (pp. 28–29).

1. Climate change as both a scientific and social issue: In the classroom, the social aspects of climate change can be taught by exploring the interrelationships between science and society. For example, sea level rise has social consequences. "If we do not include the social aspects of climate change then our students may have no other opportunity to discuss and learn about how climate change is also an issue of *social* importance. This is not just a scientific problem for scientists to solve; rather it is a socio-scientific issue that will require a multidisciplinary solution."

2. Experimental research has shown that discussing climate change as a local issue is more motivating than discussing it as a global problem (Scannell & Gifford, 2012). "Indeed, climate change is a global issue; however, it will be experienced by our students at a smaller, local scale. One way in which teachers can leverage this fact is to focus on how climate change may affect their students' schools, neighbourhoods or cities. In other words, bring climate change 'closer to home'. One way this can be accomplished is by looking at how climate change may affect the local plants and animals. Another way is to look at local temperatures and precipitation records and extrapolate to the future. If living along a coastline, students could chart areas that are susceptible to sea level rise."

3. "The goal for teachers is to provide the balance between emotion and analytic reasoning to create a situation where students can effectively learn about climate change and feel empowered to act. The suggestion, then, is to provide classroom material that presents 'the facts' along with personal narrative and/or vivid imagery. For example, the Keeling Curve showing rising levels of atmospheric carbon dioxide can be used alongside a personal account of one student's contributions to that carbon dioxide through their everyday actions of driving to school and using electricity. While negative or emotionally-charged images and text can increase concern, it can also decrease feelings of empowerment." To counteract this, we have provided students with opportunities to think about actions they might take to mitigate climate change—actions that align with their (and their family's) values and concerns. By promoting the positive, we can leave students with a sense of what they *can* do.

Following is a brief summary of climate change as it will be explored in this unit.

> The average temperature on Earth has already increased 1.7°F since 1880—which doesn't seem like much, but has huge consequences. Scientists project that Earth will gradually continue to get warmer, accompanied by uncharacteristic and harmful storms as well as droughts in between. These changes can lead to disastrous results—such as habitat loss,

[1] Busch, K., and Osborne, J. "Effective strategies for talking about climate science in the classroom," *School Science Review*, 96(354) (2014): 25–32.

extinction of species, sea level rise destroying homes, loss of agricultural land for food—for natural communities and human communities alike.

While there have been natural periods of warming and cooling throughout Earth's natural history, the change in average temperature is more substantial and is accompanied by an increase in greenhouse gas emissions. Greenhouse gases are gases (like carbon dioxide and methane) that are able to trap and hold heat in the atmosphere, thereby increasing Earth's surface temperature. In the last century, there has been an increase in greenhouse gas emissions due to human activities such as burning of oil for cars, using coal and gas for industry and heating, increased livestock industry, and deforestation (because trees are able to store and cycle carbon dioxide).

The tasks following this Lift-Off Task focus on how carbon dioxide is related to temperature, what is causing climate change, the effects of climate change, and potential solutions. In each of these tasks, more detailed background information will be given about these topics.

Introduction

In the last unit, students learned about weather. In this unit, they will focus on climate, which is the weather conditions in an area over a much longer period of time—decades rather than hours or days. Scientists have discovered that in the last decade, the climate is changing at a dangerous rate. Today students will explore what climate change is, why it matters, and what they need to know more about in order to help.

Part I • What Is Climate Change and Why Does It Matter to Us and the World?

1. To introduce climate change, open the Lift-Off Task digital slide presentation and follow the presentation guidelines below.
    - Slides 1–2: Title slide
    - Slides 3–6: Show the pictures on the slides, giving time for students to write down what they observe. Ask students to turn and talk to their group members about what they saw. What do they think these images show?
    - Slide 7: Scientists have theorized that Earth is in a period of climate change. Have students examine the graph on the slide. Ask questions such as:
        - Look at the *x*-axis. How many years does this graph show?
        - Look at the *y*-axis. What is this graph measuring over time?
        - Do you think temperature has increased or decreased since 1880? How do you know?
    - Slide 8: Have students watch the two video clips about climate change (either as a class or in small groups).
        - *What Is Climate Change?* (cause and effects of climate change in Australia): https://youtu.be/ko6GNA58YOA (2:37)
        - *Climate Change (according to a kid)*: https://youtu.be/Sv7OHfpIRfU (2:11)
2. Addressing the crosscutting concept of cause and effect:
    - Slides 9–10: Discuss as a class the difference between cause and effect. Use the two examples from the slides:
        - Statement: If you don't tie your shoelace, you might trip and fall.
            - What is the cause and what is the effect?
            - Perhaps more importantly, what is the connection between the two things?
            - Explain to students that a major activity of science and engineering is to uncover such causal connections, often with the hope that understanding the mechanisms will enable us to make predictions and design solutions.
            - Optional extension question: Based on the picture, what is another effect of tripping because of an untied shoelace?
            - Justification: Students will find throughout the unit that there is often a chain of effects, not just one cause and one effect.
        - Statement: If greenhouse gases trap heat and keep the Earth warm, ice will melt.
            - What is the cause and what is the effect?
            - Based on the pictures, are there any other effects of the greenhouse effect? (Hint: How does it affect the polar bear?)

3. Ask students to write down in their Student Edition three (tentative) causes and three effects of climate change. Tell them to make sure to connect each cause with the related effect. When they have finished, explain that students will be learning a lot more about causes and effects of climate change throughout the unit.

ELL SCAFFOLD

Select one of the cause and effect relationships depicted in the video and model one example for students using a meta-think-aloud so students can understand your thoughts about the relationship.

4. In their groups, have students use the information from the videos to discuss and come up with their own definition of *climate change*.

LANGUAGE SUPPORT STRATEGIES

Pair students to discuss the video and have them change partners three times. With each switch, they should include elements of what their partner said that they feel helps them refine and build a stronger understanding of climate change.

Part II • What Do You Need to Know in Order to Help?

1. Slide 11: Explain to students that they will work on a Culminating Project about climate change. Describe the scenario: A school board is looking for proposals to reduce their school's impact on climate change, and they need your help.

    - Have students open the Culminating Project section of their Student Edition and look at description of the group Culminating project—the school board presentation.

2. Slide 12: Have students watch the following video clip about a group of students who started a Green Team at their middle school to design and implement solutions to help reduce climate change.
Dreaming in Green: http://youngvoicesonclimatechange.com/movie_dreaming.php (6:22)

3. Slide 13: With their group, have students generate a list of questions they still need to explore about climate change before they are ready to make a plan for the school board.

4. Generate a class-wide list of students' questions and record their ideas on a poster titled "Climate Change." You will refer back to the poster throughout the unit.

    - Make sure to elicit questions about the cause of climate change or a specific question relating carbon dioxide and temperature. This will serve as the foundational question for Task 1.

    Possible questions: How is climate change different today? Doesn't the Earth naturally get warm and get cold? Why do coal power plants cause climate change? How do we know carbon dioxide is causing the Earth to get warmer?

Part III • Understand Climate Change

1. Have students individually make a list in their science notebook of everything they know about climate change. Their list can be rough ideas and does not necessarily have to include scientific words.

    - Use facilitating questions such as these for students who are stuck:
        - What did you notice in the video?
        - What did it say causes climate change?
        - What are some of the effects of climate change you saw in the photos on the slides?

2. Have students collect their group's ideas on a piece of poster paper, highlighting the ideas that were the same across group members. Ask one member of each group to post the chart on the wall.

    - Tell students to walk around and look at each group's ideas. One suggestion for gallery walks is for students to interact with the posters in some way. For example, students could be required to initial or leave sticky notes on three words that they agree with on other posters.

3. Construct a whole-class concept map that starts. Write the word "climate change" in the middle of a large sheet of poster paper.

    - Ask students which key words or concepts from their posters they want to include on the map.

    - Explain that in concept maps, you use lines and words to connect the different key words. Provide an example, and then ask students to suggest connecting lines and connecting words. Reinforce the causal relationships suggested by the class by drawing arrows and eliciting from students why the two terms are connected.

    - Highlight in different colors any connector words that relate to the cause and effect crosscutting concept focused on in this unit. These could be phrases such as "which results in," "which causes," "that explains why," "is due to," etc.

    - 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.

    - Students will revisit the whole-class concept map at the end of each task. At each point, ask the following questions:
        - 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?

Reflect

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

- At the beginning of this task, you wrote down what you observed about the pictures on the slides. Look back at your observations. Consider what you learned from the graph, videos, your peers. How can you add to your observations? What details did you not include at first? Use the information you recorded in the cause and effect table and the class concept map to help you.
- In this unit, you will be focusing on the concept of cause and effect, or how one event can lead to another. Give one example of how this concept came up in today's task.

There are no right or wrong answers. If students are stuck, remind them to look back at their Student Edition and the class concept map. Emphasize that students should not change their initial responses, but rather modify and add to those responses based on what they learned in this task.

Part IV • Connect to the Culminating Project and Assessment

1. Refer students to the **Individual Project Organizer** in their Culminating Project section of their Student Edition. Tell students that after each task, they should **individually** complete the page that refers to the task.
2. Have students independently complete the Lift-Off Task section of the Individual Project Organizer during class.
3. Collect the Individual Project Organizers and assess using either:
   - The "Asking Questions" rows of the Science and Engineering Practices Rubric, or
   - A criterion of your choice
4. 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.

ELL SCAFFOLD

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.