

Unit Essential Question

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

Introduction

In this final task, students will estimate the carbon footprint of their classroom. A carbon footprint is defined as: *The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO₂).* For example, when you drive a car, the engine burns fuel, which creates a certain amount of CO₂ (depending on fuel consumption and driving distance). When you heat your house with oil, gas, or coal, then you also generate CO₂. Even if you heat your house with electricity, the generation of the electrical power may emit CO₂. The production of the food and goods you buy also emits some quantities of CO₂. Your carbon footprint is the sum of all emissions of CO₂ (carbon dioxide), which were induced by your activities in a given time frame. Students will conduct a classroom audit to gather data about a particular source of carbon emissions. They will use this data to develop actions they could take to reduce carbon emissions in their classroom.

Objectives

Students will be able to

Content

- Identify ways their class can reduce greenhouse gas emissions.

Science and Engineering Practices

- Analyze data and apply the data to develop actions for reducing greenhouse gas in their classroom.

Equity and Groupwork

- Listen to others' ideas.

Language

- Draw and label a diagram to show their plan for reducing greenhouse gas emissions.

Academic Vocabulary

- audit
- carbon footprint
- electricity vampire
- greenhouse gas emissions
- mitigation
- recycling habits
- waste generation

Language of Instruction

- carbonated
- category
- reduce

Timing

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

- Part I • Conduct a Classroom Audit (1–1.5 class periods)
- Part II • Reduce Greenhouse Gas Emissions (1 class period)
- Part III • Connect to the Culminating Project (1 class period)

Student Materials

per student

- Handout: Background Information

per group

- Handout: Classroom Audit Worksheet

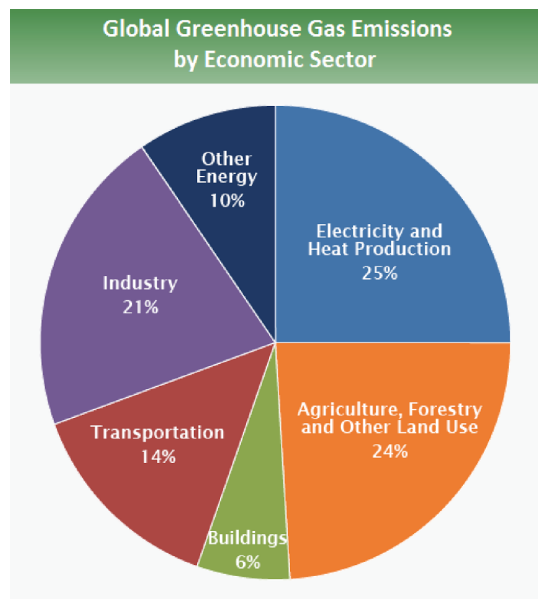
Teacher Materials

- Classroom Carbon Calculator (see spreadsheet)

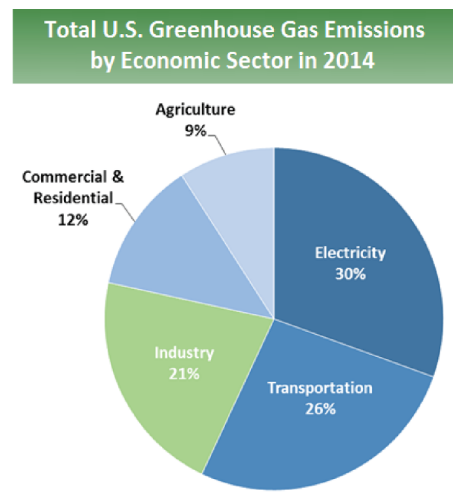
Background Knowledge

At this point in the unit, students know that climate change is happening. They have seen evidence that climate change exists, explanations of its causes, and examples of its many impacts. As stated in previous tasks, it is important that students do not despair. While the consequences are great and mounting, there are ways to mitigate them. By taking action now to reduce the greenhouse gas emissions that warm our planet, we can reduce the risks that future generations will otherwise face.

At present, the largest contributors to greenhouse gas emissions are electricity and heat production, agriculture, industry, transportation, buildings, and other energy, in that order. These are broad categories that students might find to be obscure. For students, they mean things like the lights they turn on and off, the clothes and products they buy, the cars their parents drive, the food they eat, and the trash they produce. To connect the broader categories with students' understanding, students will conduct a classroom audit that links these larger categories to examples they see every day. In their classrooms, they will look at energy "vampires" that suck up energy even when they are not being used: lighting, heating, transportation, and waste disposal. For more information on these, read the Background Information handout.



Credit: EPA, U.S. Department of Energy
Source: IPCC (2014)

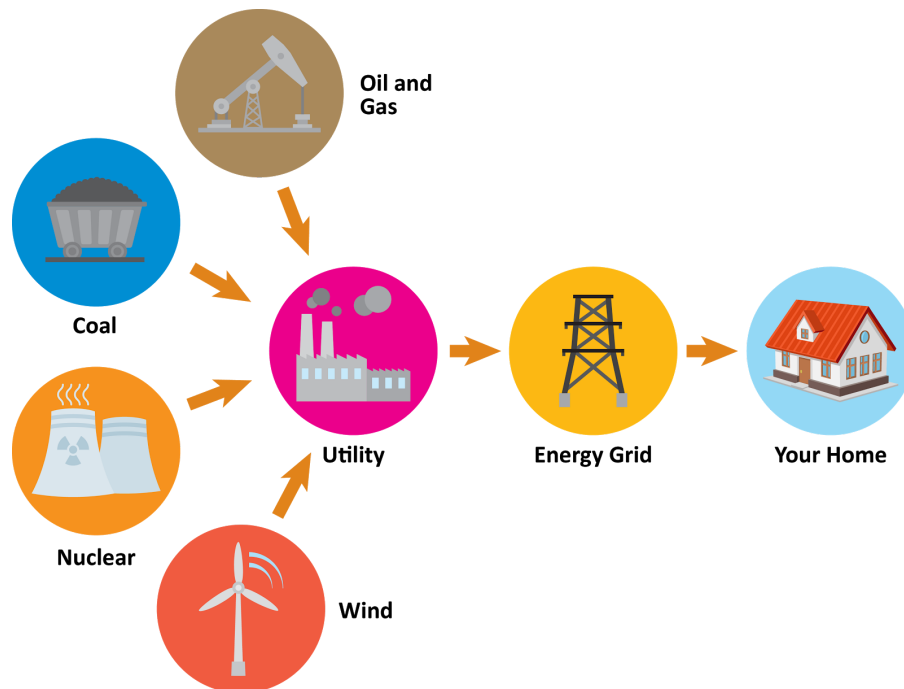


In general, students will find that by making even small changes in each of the categories, they will be able to make significant reductions in their classroom's carbon footprint. They will then be able to take these practices home and make an even greater positive impact. Some simple practices at home could include buying products with minimal packaging; recycling; reusing products; adjusting thermostats to use less heating and air conditioning; replacing light bulbs with compact fluorescent lighting; walking, biking, or carpooling; buying energy-efficient products; using less hot water; unplugging devices; using the off switch; planting more trees; using renewable energy sources (i.e., installing solar panels), eating less meat, and so on.

The hope at the end of this task is that students will feel empowered and inspired to make an informed difference in the fight against climate change.

Introduction

1. Have students read the Introduction in their Student Edition:
 - You've learned that climate change is happening and why. You have examined evidence for the causes and effects of climate change. In this activity, you will learn about **what people can do about climate change**. Your group will gather data about electricity use, transportation, heating, lighting, and waste generation and recycling habits in your classroom. You will then figure out ways to reduce the amount of greenhouse gases your classroom produces.
2. Have students use their own knowledge about the causes of climate change to brainstorm ways that they can reduce their own carbon emissions, emphasizing how each action actually reduces carbon emissions. They should record their ideas in their Student Edition. This activity starts students thinking about the **cause and effect** relationship between their actions and carbon emission reduction.
 - Students may include suggestions like turning off the lights or unplugging appliances, which involve decreasing the use of electricity.
 - Take this opportunity to review with students why electricity causes carbon dioxide emissions, since this is not always obvious to students: Most of our electricity is made by burning fossil fuels. As students learned in Task 2, burning fossil fuels releases carbon dioxide into the atmosphere. Thus, electricity indirectly causes a lot of our greenhouse gas emissions. You may want to use the picture below as a visual aid to your explanation.



Part I • Conduct a Classroom Audit

1. Tell students that in their final presentation for the Culminating Project, they will need to recommend to the school board some strategies for how we, as a community, can reduce greenhouse gas emissions produced by the class.
2. To do that, students first have to estimate how much carbon their class emits.
3. Assign each group to **one** of these carbon emission categories:
 - Electricity “vampires”
 - Lighting
 - Heating
 - Transportation
 - Solid waste garbage and recycling

Some of the categories take more time to complete than others, so have another task ready for those who get done quickly.

4. Distribute the following handouts:
 - Background Information
 - Classroom Audit Worksheet
5. Have the groups summarize their data to the class, emphasizing the **cause and effect** relationship between actions and carbon emissions.
6. Enter the information from each audit category in the Classroom Carbon Calculator spreadsheet.
(Alternatively, students can enter the data—but this might be challenging for students, depending on their experience working with spreadsheets.)

Part II • Reduce Greenhouse Gas Emissions

1. Present the data (as a digital slide show/PowerPoint) from each of the categories to the whole class. For each category, have students discuss **in their group**:
 - Which category in your classroom includes activities that produce the greatest amount of CO₂?
 - Which category includes activities that produce the least amount of CO₂?
 - Cause and effect: Choose one category for which you feel the class could make changes to reduce the amount of CO₂ that the classroom produces.
2. Have each group choose one category for which they feel the class could make changes to reduce the amount of CO₂ that the classroom produces.
3. Ask students to create a drawing (with labels) to show:
 - How the activities in this category result in the production of CO₂
 - How your class could reduce the CO₂ produced by activities in this category
 - Approximately how much CO₂ they could save by making this change
 - What might be easy and/or challenging about making this change

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?



ELL SCAFFOLD

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 potential solutions, connecting them either to the impacts that they address or to the carbon dioxide emissions they reduce.
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 brainstormed ways you personally could reduce your carbon emissions. Look back at your ideas. After conducting the classroom audit today, how could 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. 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 4 section of the Individual Project Organizer during class.
2. Collect the Individual Project Organizers and assess using:
 - The “Analyzing and Interpreting Data” row 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.



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.