CO2: How Much Do You Spew?

From the Center for Science Education

<https://scied.ucar.edu/activity/co2-how-much-do-you-spew>

Grade Level: Middle School and High School

Time: Preparation time: 10 minutes to gather supplies. Class time: 45 minutes.

Materials: Downloadable material, pencils, and calculators (optional)

## Preparation

* Copy the student page (page 1 of the Student Page and Scenarios) for each student
* Cut scenario cards apart (pages 2-6 of the Student Page and Scenarios)

## Directions

1. Survey student understanding of the relationship between greenhouse gases and global warming. Explain that carbon dioxide (CO2) is a greenhouse gas that traps infrared (heat) energy. Burning fossil fuels for energy releases more CO2 into the atmosphere, causing the Earth to warm.
2. Explain that in this activity they will explore how families use energy in their daily lives and how energy from fossil fuels contributes CO2 to the atmosphere.
3. Divide students into groups of 2-4 and provide each with a scenario card.
4. Explain that each group has a different family, that all the families live in different situations and all use energy in different ways.
5. Have students read the information about their family and follow the instructions on the Student Page to calculate CO2 emissions.
6. Discussion:
	* Once all student groups have calculated the yearly CO2 emissions for their family, have each group partner with one of the other groups and compare and contrast their families' lifestyles and use of energy.
	* As a class, Have each group describe the family they analyzed and their total emissions to the class. Create a table on the board recording the emissions for each family.
	* Ask students why there are such large differences in the amount of emissions.
	* The Kyoto Protocol recommended that emissions be reduced to at or below 1990 levels. That means less than 11,000 pounds of CO2 per person per year. Have students look at the table and consider how many of the families are meeting that goal.
	* Ask students which activities emitted the most CO2 and how they would change their scenario to reduce CO2 emissions.
	* Ask students to brainstorm ways in which emissions might be lowered from global agreements to individual actions.

## Background

Carbon dioxide (CO2) traps infrared energy emitted from the Earth’s surface and warms the atmosphere. Currently, the amount of carbon dioxide and other greenhouses gases in the atmosphere is increasing causing global warming. Prior to the Industrial Revolution, carbon dioxide in our atmosphere was at approximately 280 ppm (parts per million). As of 2021, carbon dioxide in our atmosphere is approximately 419 ppm and growing steadily upward.

Over the past 100 years, Earth’s average temperature rose 0.74° Celsius (1.33°F). Scientists are finding that the change in temperature has been causing other aspects of our planet to change. The effects of global warming are far-reaching.

Human activities, including burning fossil fuels like coal, oil, and gas, are causing Earth to warm according to the [Intergovernmental Panel on Climate Change (IPCC)](https://www.ipcc.ch/), a group of hundreds of scientists organized by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to summarize our current understanding of climate. Burning these fuels releases greenhouse gases into the atmosphere, causing the greenhouse effect to grow stronger, warming the [climate](https://scied.ucar.edu/learning-zone/how-climate-works/climate).

During the 21st Century, various computer models predict that Earth’s average temperature will rise between 1.8° and 4.0° Celsius (3.2° and 7.2° F) depending largely on how humans change the ways they live on the planet. If we continue to emit as many, or more, greenhouse gases, this will cause more warming. If we make changes to emit fewer greenhouse gases, this will cause less warming.

The Kyoto Protocol was the first attempt by countries throughout the world to address the problem of rising greenhouse gas emissions through a plan aimed at reducing emissions to 1990 levels by 2010. Many developing countries trying to improve the standard of living for their people were not required to reduce their emissions. The United States was one of the few developed countries that did not sign the Kyoto Protocol.

Although there is a certain amount of global warming that we are going to have because of our activities during the past century, there are many ways to help slow the rate of warming. Recently, many people and companies have been trying to be to prevent more greenhouse gases from entering the atmosphere.

The various scenarios shared within the activity, How Much Do You Spew?, show how a range of lifestyles produces different amounts of CO2 emissions. From the Jetsetter family with their two homes, four cars, and frequent flights, to the Demos who are producing more renewable energy than they are using, the scenarios are intended to demonstrate how lifestyle choices affect CO2 emissions. There are two scenarios included to reflect the American average. The Des Moines family and the Median family have energy use that is about the U.S. average according to data from the [US Department of Energy, Energy Information Administration.](https://www.eia.gov/)

## Extensions

Extend the activity into real life! Have students bring a copy of the Student Page home to complete with their family. (Families will need to collect their own data such as car mileage, plane flights, electric and gas bills in order to do the calculations). Have students brainstorm ways that they and their families could cut emissions. What would family members be willing to do or give up in order to make reductions in greenhouse gas levels? Are these changes easy or difficult to implement? Is there a cost to initiate them or is there a cost savings?

Literacy connections: Have students write letters to the people in their scenarios telling them how they can reduce emissions or congratulating them for keeping their emissions low. Or, have students write or produce a 30-60 second commercial, ad jingle, or print advertisement to increase public's awareness of the connection between increasing CO2 emissions and climate change.

Social studies connection: Have students research the fuel efficiency requirements became US federal policy in 2009. What are the fuel efficiency standards set by the US Department of Transportation for 2011 cars and trucks sold in the US? What type of fuel efficiency are cars and small trucks sold in the US required to achieve by 2016? Who might oppose such standards or policies? Why? Can you think of other measures that might be implemented to reduce CO2 emissions by cars or small trucks?

Math connection: Ask each student to choose a car made in the United States that they think achieves high fuel efficiency (high miles per gallon of gasoline), and another that they think achieves low fuel efficiency. Using the web site [www.fueleconomy.gov](https://www.fueleconomy.gov/), have students determine what the difference between each car's annual emissions would be if both cars were driven 15,000 miles per year (8,250 city; 6,750 miles highway). How much more does the driver in the car with low fuel efficiency spend on gas each year if gas for each car costs $2.60 per gallon?