

Carbon Dioxide, Temperature, and Human Impact

Lesson Overview

Grade Level: 6th

Subject Area: Earth and Human Activity: Climate Change

Next Generation Standards: MS-ESS3-1

Inquiry Questions: How is carbon dioxide related to climate change? How has human activity caused excess carbon dioxide in the atmosphere?

Overview: In this lesson students will be introduced to the link between increase of carbon dioxide and increased temperatures with an interactive map activity.

In a six minute video called “Worse Than Poop”, by Vanessa Warheit, students will learn about carbon dioxide and how excess carbon dioxide produced through human activity is bad for the Planet. Students will be asked to think of solutions to climate change through a creative homework assignment.

Preparation: Have computers or smart screen board prepared as this lesson uses the internet.

Teacher Background

This lesson is centered on a short animation called “Worse than Poop,” created by filmmaker Vanessa Warheit. This film, which features an 8 year old climate “scientist”, was released in 2014 and has screened at film festivals internationally. As Warheit puts it, “Worse than Poop” focuses on the idea that “poop, like CO₂, can be good-if you have the right amount to sustain the life cycle. But when you have a lot...that’s a problem.” By graphically illustrating the quantity of CO₂ pollution created by gasoline-powered transportation, the film touches on the short and long carbon cycle, and introduces kids to the benefits of renewable energy sources.

The short carbon cycle is the movement of carbon through surface reservoirs such as trees, plants, atmosphere, soil, biosphere, and the ocean. This process typically takes months, decades, or centuries. The natural movement of carbon through the short term process usually balances itself out and this balance of carbon in the atmosphere is what has allowed the planet to flourish with the relatively mild climate we’ve had for so long; it acts as a global thermostat.¹

The long term carbon cycle involves the circulation of carbon through the ocean, atmosphere, and solid Earth and includes the process of decayed carbon matter assimilating into fossil fuel deposits.² This

Prior Knowledge

Students should have a basic understanding of climate change.

It is helpful if students have learned about the carbon cycle but not necessary.

Student Objectives

Students will be able to understand that rising temperatures and rising CO₂ is linked.

Students should be able to convey that excess carbon dioxide in the atmosphere is bad for the earth.

Students will have an understanding of how human activity leads to excess carbon dioxide in the atmosphere.

Materials

Provided:

Link to video and websites needed
Student post video question sheet

Needed:

Internet Access
Technology

Time Needed

50 Minutes

¹ <http://www.amnh.org/learn/climate/Resource13>

² http://www.atmos.washington.edu/2002Q4/211/notes_carboncycle.html

process is immeasurably slow and takes hundreds to millions of years. When fossil fuels are removed from the Earth for human use they are being artificially moved into the short carbon cycle. Therefore, they are used up at a much faster rate than they can be returned back to the Earth through the natural process. Human's heavy reliance on fossil fuels has disrupted the delicate balance of the carbon cycle that has kept the Earth's climate stable and allowed life to thrive on Earth.

In 2013, carbon dioxide comprised 82% of the greenhouse gases emitted in the US. Once carbon dioxide is in the atmosphere it can affect the climate for thousands of years. This is because processes that remove carbon from the atmosphere, such as rock formation and chemical weathering, are very slow.³ The lifetime of carbon dioxide in the atmosphere is hard to quantify because the gas moves between the ocean, atmosphere, and land systems rather than being destroyed over time.⁴ Humans have not only altered the carbon cycle by putting carbon from the long cycle into the atmosphere but by destroying carbon sinks, which absorb carbon dioxide, like forests.

There have been significant increases of greenhouse gases and carbon dioxide in the atmosphere since the 1750s. Records comparing increases in atmospheric carbon dioxide in previous 1,000 year periods, show that there was never an increase in carbon dioxide over 30ppm. In the last two decades we've already seen a raise above 30ppm in atmospheric carbon dioxide. The link to dramatic increases in greenhouse gases correlates with the Industrial Revolution, a societal shift from agrarian to industrial and urban societies, which began in Europe and America in the 18th and 19th centuries.⁵ Before the Industrial Revolution, production of merchandise was done in people's homes with hand tools and basic machinery. With the invention of the steam engine, and advances in communication and banking, came a new focus on mass production, factories, and specialized machinery. While this transition created improvements in human standard of living and technological innovation, it relied almost exclusively on fossil fuel energy.⁶

Luckily, there has recently been a plethora of research into renewable forms of energy to replace the dependence on fossil fuels. Currently, renewable energy exists in the form of solar, wind, geothermal, bioenergy and wind. Since transportation accounted for 31% of the United States' greenhouse gas emissions in 2013, it is important to look at how the transportation sector can reduce its emissions through the use of both renewable energy and behavioral changes.⁷ The film, "Worse than Poop" focuses on the transition from fossil fuel driven transportation to other modes of transportation such as biking, walking, busing, and driving electric vehicles. Driving electric vehicles produces significantly less greenhouse gases especially when powered by renewable energy such as solar or wind.⁸

³ <http://www.theguardian.com/environment/2012/jan/16/greenhouse-gases-remain-air>

⁴ <http://www.epa.gov/climatechange/ghgemissions/gases/co2.html>

⁵ <http://www.acs.org/content/acs/en/climatescience/greenhousegases/industrialrevolution.html>

⁶ <http://www.history.com/topics/industrial-revolution>

⁷ <http://www.epa.gov/climatechange/ghgemissions/gases/co2.html>

⁸ <http://www.epa.gov/climatechange/ghgemissions/gases/co2.html>

Procedures

ENGAGE

Grouping: Class

Timing: 5 minutes

- Explain that carbon dioxide is a gas in the environment. Ask students if they think there is a connection between how much carbon dioxide is in the atmosphere and how warm the Earth is?

EXPLORE

Grouping: Table

Timing: 10 minutes

- Tell students you are going to explore the connection between carbon dioxide and temperature through an interactive program online from NASA called “Climate Time Machine”.
- Hand out chrome books to table groups, or participate as a whole class on a Smart Board. Go to the following link: <http://climatekids.nasa.gov/time-machine/>
- Ask students to look at the carbon emissions and average global temperature sections and, in their table group, answer the following questions listed on the site:
 - How much has temperature risen around the world in just a little over 100 years?
 - How much has the greenhouse gas CO₂ increased in the atmosphere in just the last few years?

EXPLAIN

Grouping: Class

Timing 10 minutes

- Ask students if they can explain what a trend is. Explain what a trend is (write definition on board).
- Explain that increase of CO₂ and temperature has been an upward trend.
- Project the following graph on the board (<http://www.climatechoices.org.uk/images/globalTempCO2.gif>) and explain how quickly carbon dioxide has increased in the atmosphere since the 1800s.
- Ask students to guess why carbon dioxide started increasing since the 1800s. Briefly explain the link between carbon dioxide increase and the start of the industrial revolution (1760-1840).

ELABORATE

Grouping: Class

Timing 10 minutes

- Explain that you are going to watch a short movie that describes why releasing too much carbon dioxide with the long carbon cycle can be bad.
- Tell students to take notes because they are going to have to answer some short questions about the film after the movie. Hand out the “*Worse Than Poop* student comprehension sheet” before starting the movie so they have time to look over the questions.
- Play *Worse Than Poop*: <http://www.worsethanpoop.com/educational> (password: CO₂@caca) Film lasts 6 minutes.

EVALUATE

Grouping: Individual

Timing 15 minutes

- Ask students if they have any questions about the film.
- Ask students to answer “*Worse Than Poop* student comprehension sheet” with complete sentences.

HOMEWORK

Grouping: Individual

Timing: Outside Class

- Homework Assignment 1: Tell students that they have a homework assignment to create a climate change super hero.
 - Explain that the super hero has to have a unique power to help combat climate change. What would they do?
 - Ask them to make a story for their super hero and think about what kind of world the super hero is fighting for
 - Ask them to name their super hero and draw super hero if they want to.
 - Tell students they must include with their super hero a description of how they personally would help their super hero succeed.
 - Tell students they will share their super hero with the rest of the class.
- Homework Assignment 2: Ask students to research what the difference is between a renewable and nonrenewable energy source and report back on 3 renewable energy sources.

Assessment:

Option 1: Do students understand that rising CO2 level are linked to rising global temperatures?

- Ask students to answer the following question, “Do you think that CO2 levels are linked to rising temperatures? Why or why not?”

Option 2: Do students understand that human activity leads to excess CO2 in the atmosphere and excess CO2 is bad?

- Ask students to answer the following questions:
 - Do you think that human activity is linked to an increase in CO2 in the atmosphere?
 - Do you think too much CO2 in the atmosphere is an issue?

Extensions: If students are already familiar with the effect of carbon dioxide you can do an extension looking at the greenhouse gas Methane. This can also be done as a homework assignment.

- After watching *Worse Than Poop* have students watch *Overpopulation of Cows and Global Warming* <https://www.youtube.com/watch?v=2gHn4NvrF5s>.
- Ask students to compare the two films.
 - What is similar? Is the message similar?
 - What is different?
 - How do both films link back to human activity? What can we do to reduce CO2 emissions? What can we do to reduce methane emissions?
- Ask students to fill out the *Overpopulation of Cows and Global Warming* student comprehension sheet.

Resources:

The following two short films are a great introduction to the effects of methane on climate change:

“Cows Releasing Methane Into the Air” 0:59

https://www.youtube.com/watch?v=Xai_i3cngq4

“Cow Farts, Methane, and Your Health: A Call to Action for Meatless Mondays” 3:55

<https://www.youtube.com/watch?v=ElrDuQMBdh0>

The following links are good sources to learn about renewable energy for kids:

<http://www.alliantenergykids.com/energyandtheenvironment/renewableenergy/>

http://www.eia.gov/kids/energy.cfm?page=renewable_home-basics

Vocabulary

Carbon Dioxide: a colorless, odorless, incombustible gas, CO₂, present in the atmosphere and formed during respiration usually obtained from coal, coke, or natural gas by combustion, from carbohydrates by fermentation, by reaction of acid with limestone or other carbonates, or naturally from springs: used extensively in industry as dry ice, or carbon dioxide snow, in carbonated beverages, fire extinguishers, etc.

Methane: a colorless, odorless, flammable gas, CH₄, the main constituent of marsh gas and the fire damp of coal mines, obtained commercially from natural gas: the first member of the methane, or alkane, series of hydrocarbons.

Fossil Fuels: any combustible (burnable) organic material, as oil, coal, or natural gas, derived from the remains of former life.

Climate: the generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds throughout the year, averaged over a series of years.

Atmosphere: the gaseous envelope surrounding the earth; the air.

Greenhouse Gases: any of the gases whose absorption of solar radiation is responsible for the greenhouse effect, including carbon dioxide, methane, ozone, and the fluorocarbons.

Fossil Fuels: any combustible organic material, as oil, coal, or natural gas, derived from the remains of former life.

Trend: the general course or prevailing tendency; drift: *trends in the teaching of foreign languages; the trend of events.*

Temperature: a measure of the warmth or coldness of an object or substance with reference to some standard value. The temperature of two systems is the same when the systems are in thermal equilibrium.

Renewable Resource: any natural resource that can replenish itself naturally over time, as wood or solar energy; also called renewable energy.

Industrial Revolution: the totality of the changes in economic and social organization that began about 1760 in England and later in other countries, characterized chiefly by the replacement of hand tools with power driven machines, as the power loom and the steam engine, and by the concentration of industry in large establishments.

Definitions taken from Dictionary.com unless noted otherwise.

Worse Than Poop Comprehension Questions

1. What is carbon dioxide?
2. How does excess carbon dioxide get emitted into the atmosphere?
3. Why is it bad to have too much carbon dioxide in the atmosphere?
4. According to the film how is carbon dioxide similar to poop?
5. What can humans do to reduce the amount of carbon dioxide in the atmosphere?
6. What were some examples in the film of renewable energy sources?