Save the Planet

Subject Area(s): Biology

Associated Unit: Ecology

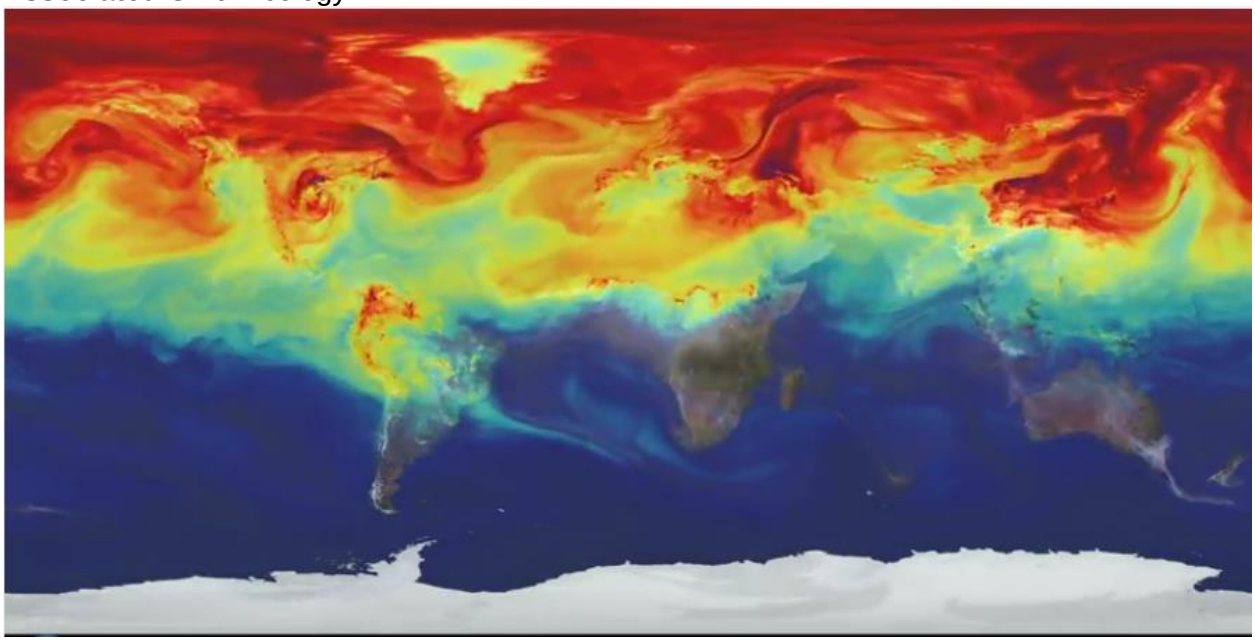


Image 1

ADA Description: An image of the surface of the Earth with levels of Atmospheric CO2 shown by color. The higher the concentration, the darker red the image is.

Source/Rights: Copyright © NASA 2014

Caption: The visual accumulation of atmospheric CO2.

Grade Level: 9th

Lesson #: 1 of 1

Time Required: One 50 minute class period

Summary:
In this lesson, students will develop their sense of the carbon cycle through gaining a better understanding of greenhouse gases and climate change. The students should have already completed a lesson on the basics of the carbon cycle, including the path in which carbon travels through the ecosystem. Students will explore real world issues and propose solutions to those issues.

Educational Standards (List 2-4)
State STEM Standard

SC.912.E.7.1 Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.

NGSS Standard

MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Learning Objectives
Describe CO2 as the major contributing factor in climate change and how carbon plays a role in biological ecosystems.

Introduction / Motivation (5E – Engage)
Students will be shown a 4 minute NASA video visualizing global CO2 dispersion and movement over a one year period.

https://www.youtube.com/watch?v=x1SgmFa0r04

Lesson Background & Concepts for Teachers (5E – Explain)
Teachers should have an understanding of the carbon cycle as well as the contributing factors to climate change.

Vocabulary / Definitions

Word	Definition
Greenhouse Gas	Any of the gases whose absorption of solar radiation is responsible for increased atmospheric temperature.
Carbon Cycle	The circulation of carbon between living organisms and their surroundings

Associated Activities (5E – Explore)

- Students will read background information regarding CO2 as a greenhouse gas titled "Overview of Greenhouse Gases" (Attached)
- In groups of two, students will discuss CO2 as a greenhouse gas and the effects on the ecosystem.
- In groups of two, students will create a plan of action for decreasing atmospheric CO2 over the next 10 years. (Attached)

Lesson Closure
The lesson will close with each group briefly stating the overall plan they proposed and polling to see how many different plans were developed.

Assessment (5E – Evaluate)

Pre-Lesson Assessment
Descriptive Title: Question of the day

Before we begin the lesson, students will individually answer the following question in their notebook: "What gas is the major contributing factor to climate change?"

Post-Introduction Assessment
Descriptive Title: Question for understanding

During their paired discussion, students will answer the following questions and we will have whole class discussion of their thoughts.

1) What is the major contributing course of atmospheric CO2?
2) Why is atmospheric CO2 less during the summer months in the Northern Hemisphere?
3) What dangers do high levels of atmospheric CO2 pose to humans?

Lesson Summary Assessment
Descriptive Title: Reverse Climate Change Handout

Students will complete the reverse climate change handout describing their plan of action to decrease atmospheric CO2.

Lesson Extension Activities (5E – Extension)
What other unplanned benefits might occur if your action plan is successful?

References
Vocabulary - Dictionary.com

http://www.nextgenscience.org

http://www.fldoe.org

Attachments
Overview of Climate Change

Reverse Climate Change Action Plan

Contributors
Jesse Hope

Supporting Program
USF – Research Experiences for Teachers (RET)

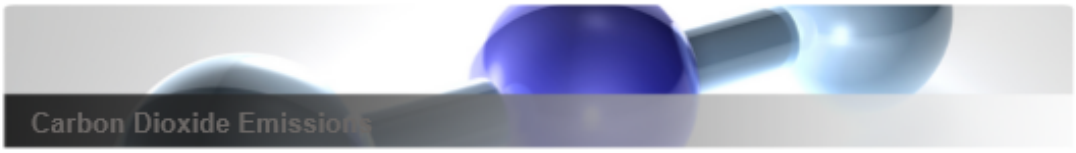
Attachments

EPA United States Environmental Protection Agency

https://www3.epa.gov/climatechange/ghgemissions/gases/co2.html

Climate Change

Overview of Greenhouse Gases



ON THIS PAGE

Carbon dioxide (CO_2) is the primary greenhouse gas emitted through human activities. In 2014, CO_2 accounted for about 80.9% of all U.S. greenhouse gas emissions from human activities. Carbon dioxide is naturally present in the atmosphere as part of the Earth's carbon cycle (the natural circulation of carbon among the atmosphere, oceans, soil, plants, and animals). Human activities are altering the carbon cycle–both by adding more CO_2 to the atmosphere and by influencing the ability of natural sinks, like forests, to remove CO_2 from the atmosphere. While CO_2 emissions come from a variety of natural sources, human-related emissions are responsible for the increase that has occurred in the atmosphere since the industrial revolution. [1]

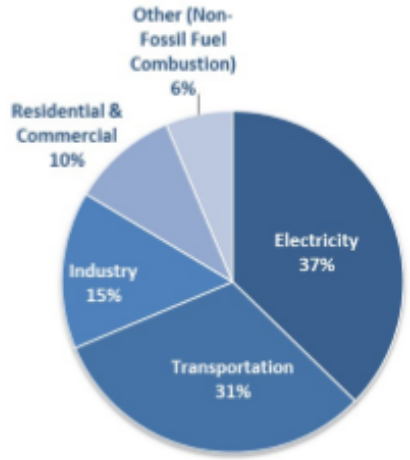
Properties of Carbon Dioxide

Chemical Formula	CO_2
Lifetime in Atmosphere	See below*
Global Warming Potential (100-year)	1

The main human activity that emits CO_2 is the combustion of fossil fuels (coal, natural gas, and oil) for energy and transportation, although certain industrial processes and land-use changes also emit CO_2. The main sources of CO_2 emissions in the United States are described below.

- **Electricity.** Electricity is a significant source of energy in the United States and is used to power homes, business, and industry. The combustion of fossil fuels to generate electricity is the largest single source of CO_2 emissions in the nation, accounting for about 37% of total U.S. CO_2 emissions and 30% of total U.S. greenhouse gas emissions in 2014. The type of fossil fuel used to generate electricity will emit different amounts of CO_2. To produce a given amount of electricity, burning coal will produce more CO_2 than oil or natural gas.
- **Transportation.** The combustion of fossil fuels such as gasoline and diesel to transport people and goods is the second largest source of CO_2 emissions, accounting for about 31% of total U.S. CO_2 emissions and 25% of total U.S. greenhouse gas emissions in 2014. This category includes transportation sources such as highway vehicles, air travel, marine transportation, and rail.
- **Industry.** Many industrial processes emit CO_2 through fossil fuel combustion. Several processes also produce CO_2 emissions through chemical reactions that do not involve combustion, for example, the production and consumption of mineral products such as cement, the production of metals such as iron and steel, and the production of chemicals. Fossil fuel combustion from various industrial processes accounted for about 15% of total U.S. CO_2 emissions and 12% of total U.S. greenhouse gas emissions in 2014. Note that many industrial processes also use electricity and therefore indirectly cause the emissions from the electricity production.

U.S. Carbon Dioxide Emissions, By Source



Note: All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014*.

Carbon dioxide is constantly being exchanged among the atmosphere, ocean, and land surface as it is both produced and absorbed by many microorganisms, plants, and animals. However, emissions and removal of CO_2 by these natural processes tend to balance. Since the Industrial Revolution began around 1750, human activities have contributed substantially to climate change by adding CO_2 and other heat-trapping gases to the atmosphere.

In the United States, since 1990, the management of forests and non-agricultural land has acted as a net sink of CO_2, which means that more CO_2 is removed from the atmosphere, and stored in plants and trees, than is emitted. This sink offset about 11% of total emissions in 2014 and is discussed in more detail in the Land Use, Land-Use Change, and Forestry section.

Group Members: _____ Period: ___

Reverse Climate Change!

Goal: To decrease atmospheric carbon dioxide levels by ___% by 2026.

Action Step: *What Will Be Done?*
Responsibilities: *Who Will Do It?*
Timeline: *Month/Year*
Resources Needed: *What Resources are Needed? (financial, human, political & other)*
Resources Available: *What Resources are Available? (financial, human, political & other)*

Action Step 1: _____
Responsibilities: _____
Timeline: _____
Resources Needed: _____
_____
Resources Available: _____
_____

Action Step 2: _____
Responsibilities: _____
Timeline: _____
Resources Needed: _____
_____
Resources Available: _____
_____

Action Step 3: _____
Responsibilities: _____
Timeline: _____
Resources Needed: _____
_____
Resources Available: _____
_____

What individuals or organizations might resist? How?

How will you overcome these barriers?

How will you know that you are making progress?

How will you determine that your goal has been reached?