

RESOURCE LIBRARY | ACTIVITY : 1 HR 15 MINS

# Greenhouse Effect

Students consider what happens when there is more carbon than usual in the atmosphere. They then model the greenhouse effect of Earth's atmosphere through a hands-on experiment. Finally, students deepen their understanding of the greenhouse effect by watching a short video and undertaking a reading and reflection activity.

## GRADES

6, 7, 8

## SUBJECTS

*Earth Science, Climatology*

## CONTENTS

1 Link, 3 Resources, 1 PDF

## OVERVIEW

Students consider what happens when there is more carbon than usual in the atmosphere. They then model the greenhouse effect of Earth's atmosphere through a hands-on experiment. Finally, students deepen their understanding of the greenhouse effect by watching a short video and undertaking a reading and reflection activity.

For the complete activity with media resources, visit:

<http://www.nationalgeographic.org/activity/greenhouse-effect/>

## In collaboration with



## DIRECTIONS

This activity is part of the Carbon Trackers unit.

### 1. Introduce the greenhouse effect by leading a brief class discussion.

- Ask: *What do you think happens if there is too much carbon moved from other reservoirs (or “spheres”) into the atmosphere?*
  - Students will likely have ideas around global warming or the greenhouse effect. Help them get as specific as possible about what they think is happening, as well as the causes and mechanisms, so that you can target instruction to their current level of understanding.
  - During the discussion, it may be helpful to sketch their ideas on the board to get a clear idea of their understanding of the terms.
- Confirm that this activity will explore the greenhouse effect.
  - Ask: *What is a greenhouse? What does it do? How might Earth be like a greenhouse?* (Correct responses: Heat comes in through the Earth’s atmosphere, but not all of it escapes, which causes the planet to get warm.)

### 2. Challenge students, either in pairs or small groups, to carry out a brief experiment to understand the basic concept of the greenhouse effect.

- In this experiment, students will compare the air temperatures in two bags, one sealed with added carbon dioxide from sodium bicarbonate tablets and another with no sodium bicarbonate tablets (i.e., no added carbon dioxide), as a model of the greenhouse effect.
- Distribute the Greenhouse Effect Exploration Lab Guide and review the steps with students.
- Prompt the students to predict the temperature of the air inside each bag and record it under the “Prediction” section of the lab guide. Then have students complete the lab with a partner or a small group.
- When the whole class has completed the investigation, lead a discussion to debrief. Emphasize the following ideas:
  - The bags are a proxy for the Earth’s atmosphere. The bag with added carbon dioxide represents added greenhouse gases.
  - In a greenhouse, solar energy (light) is converted into thermal energy (heat) that can’t escape the glass and thus it heats up. Incoming solar energy is mostly short

wavelength (mostly visible light), and outgoing energy from the planet is mostly long wavelength (infrared).

- Sunlight interacts with chemicals in the atmosphere and is converted into heat that remains trapped. Of the incoming solar radiation, roughly 25 percent is reflected by the atmosphere (it just bounces off and doesn't heat anything up), 25 percent is absorbed by the atmosphere (it heats things up), 5 percent is reflected by the Earth's surface, and 45 percent is absorbed by the Earth's surface. Greenhouse gasses are doing more than absorbing some energy directly from the sun; they are absorbing and then reemitting heat radiating from the Earth that would otherwise be lost to space.

### **3. Direct students to deepen their understanding of the greenhouse effect through a video and a reading.**

- Show a short introduction video from PBS, [\*Global Warming: The Physics of the Greenhouse Effect\*](#).
- Follow the video by having students read the [\*Greenhouse Effect\*](#) article and asking them to highlight or take notes on key information.
- Once they complete the reading, have students answer the questions in Part B of the *Greenhouse Effect Exploration Lab Guide*. Give students roughly 20 minutes to read and answer the questions.

### **4. Ask each student to individually respond to the following questions to help them reflect on their learning during the [\*Modeling the Carbon Cycle to Inform Others\*](#) lesson:**

- *How do greenhouse gasses impact Earth's systems? Answer the question in two paragraphs using evidence from your readings, videos, discussions, diagrams, and the experiment you completed today.*
- Ask students to address the following in their answer:
  - Explain the science of why increased greenhouse gas emissions contribute to rising global temperatures.
  - Explain how the greenhouse effect supports life on Earth, and why elevated greenhouse gasses can create a less supportive environment for life on Earth.
  - Explain where greenhouse gasses come from (think back to the carbon cycle listing natural sources and human activities that contribute).

- Explain how plants impact atmospheric greenhouse gasses.

## Modification

**Step 2:** It's best to do this experiment outdoors in bright sunlight. If this isn't possible because of weather or location, use a heat lamp to do a class demonstration in lieu of the student experiment.

## Informal Assessment

Collect and review students' writing from Step 4 and the completed *Greenhouse Effect Exploration Lab Guide* to assess their understanding.

## Extending the Learning

### PhET Simulation

An alternative to the video and article in Step 3 is the [Greenhouse Effect PhET Simulation](#), an interactive computer simulation where students explore how various levels of greenhouse gasses impact temperatures.

### Global Sources of Greenhouse Gasses

If you'd like to have students explore sources of greenhouse gas emissions in a more global way, show them the graphs at the [Center for Climate and Energy Solutions](#), which show how various countries and industries contribute.

## OBJECTIVES

## Subjects & Disciplines

### Earth Science

- Climatology

## Learning Objectives

Students will:

- Understand that human activities can create an increase in carbon dioxide concentrations.

## Teaching Approach

- Project-based learning

## Teaching Methods

- Hands-on learning
- Lab procedures
- Research

## Skills Summary

This activity targets the following skills:

- Science and Engineering Practices
  - Analyzing and interpreting data
  - Constructing explanations (for science) and designing solutions (for engineering)
  - Developing and using models
  - Obtaining, evaluating, and communicating information
  - Planning and carrying out investigations

## National Standards, Principles, and Practices

### COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- **CCSS.ELA-LITERACY.RST.6-8.2:**

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

- **CCSS.ELA-LITERACY.RST.6-8.3:**

Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

# NEXT GENERATION SCIENCE STANDARDS

- **Crosscutting Concept 7:**

Stability and change

- **Crosscutting Concepts: Cause and Effect:**

- **ESS3.D: Global Climate Change:**

Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming).

Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

- **MS. Earth and Human Activity:**

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

- **Science and Engineering Practice 2:**

Developing and using models

- **Science and Engineering Practice 3:**

Planning and carrying out investigations

- **Science and Engineering Practice 4:**

Analyzing and interpreting data

- **Science and Engineering Practice 8:**

Obtaining, evaluating, and communicating information

## Preparation

## What You’ll Need

## MATERIALS YOU PROVIDE

- A copy of the *Greenhouse Effect Exploration Lab Guide* for every student
- Paper cups
- A sunny area to work, either outside or inside (or alternately a heat lamp)
- Two large plastic bags that will seal
- Two tablets of sodium bicarbonate
- Thermometers
- Timer or stopwatch

## REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per classroom, Monitor/screen, Projector

## PHYSICAL SPACE

- Classroom
- Other

## GROUPING

- Small-group learning
- Small-group work

## ACCESSIBILITY NOTES

**Step 3:** For the video, turn on the closed caption option to support ELL individuals and students who are hard of hearing. The *Greenhouse Effect* article has options to support students at multiple levels.

## RESOURCES PROVIDED: UNDEFINED

- PBS: Global Warming: The Physics of the Greenhouse Effect

## RESOURCES PROVIDED: HANDOUTS & WORKSHEETS

- [Greenhouse Effect Exploration Lab Guide](#)

## RESOURCES PROVIDED: REFERENCE

- Global Warming
- Greenhouse Effect

## RESOURCES PROVIDED: ARTICLES & PROFILES

- Greenhouse Effect

## BACKGROUND & VOCABULARY

# Background Information

When energy from the sun enters Earth's atmosphere, greenhouse gasses in the atmosphere such as carbon dioxide, methane, and water vapor absorb some of the energy and radiate some of it either back into space, to other molecules in the atmosphere, or to Earth's surface. This effect helps maintain Earth's temperature.

However, when greenhouse gasses increase in the atmosphere, they can hold onto more heat, increasing the planet's temperature and impacting climate in various ways. Fossil fuel combustion is one way that we add additional greenhouse gasses to the atmosphere at a rapid rate.

## Prior Knowledge

["Students need to understand that fossil fuel combustion adds carbon dioxide emissions to the atmosphere."]

## Recommended Prior Activities

- [Matter and Energy Cycles: Modeling](#)
- [Matter and Energy Cycles: Research](#)
- [Putting the "Fossil" in Fossil Fuels](#)
- [Researching Fossil Fuels](#)
- [Tracking Down the Carbon](#)

## Vocabulary

Term	Part of Speech	Definition
electromagnetic radiation	<i>noun</i>	energy waves affected by both electricity and magnetic fields; includes radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays.
greenhouse effect	<i>noun</i>	phenomenon where gases allow sunlight to enter Earth's atmosphere but make it difficult for heat to escape.

<b>Term</b>	<b>Part of Speech</b>	<b>Definition</b>
<b>greenhouse gas</b>	<i>noun</i>	gas in the atmosphere, such as carbon dioxide, methane, water vapor, and ozone, that absorbs solar heat reflected by the surface of the Earth, warming the atmosphere.
<b>solar energy</b>	<i>noun</i>	radiation from the sun.
<b>thermal energy</b>	<i>noun</i>	heat, measured in joules or calories.



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