

## Lesson Plan: The Greenhouse Effect

As a **Middle School** or **High School Environmental Sciences** teacher, you can use this lesson plan to teach about the **Greenhouse Effect** of the Earth's atmosphere. This lesson plan will explain what are **Greenhouse Gases (GHGs)**, what is the **Global Warming Potential (GWP)** of atmospheric Greenhouse Gases, and how increased concentrations of greenhouse gases in the atmosphere can cause global warming of the planet.

The Earth's atmosphere is made up of several gases. It allows incoming solar radiation to enter and warm the Earth's surface which then radiates energy back into space. Some gases in the atmosphere absorb the outgoing terrestrial radiation and re-radiate it back to the Earth, thereby increasing Earth's surface temperature. These gases are called Greenhouse Gases and this warming is known as the Greenhouse Effect. Important greenhouse gases in the atmosphere include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), water vapor (H<sub>2</sub>O), and nitrous oxide (N<sub>2</sub>O). Since the beginning of the industrial age, increased greenhouse gas emissions have potentially led to global warming of the planet. This lesson plan includes reading and activity-based resources to teach your students about the **Greenhouse Effect, Global Warming** and the **Global Warming Potential (GWP)** of atmospheric Greenhouse Gases.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in **Environmental Sciences or Chemistry**.

Use this lesson plan to help your students find answers to:

- What is the Greenhouse Effect of the Earth's atmosphere?
- What are Greenhouse Gases?
- Explain the role of Greenhouse Gases in causing global warming.

### About the Lesson Plan

**Grade Level:** Middle School or High School

**Discipline:** Environmental Sciences, Chemistry

**Topic(s) in Discipline:** Greenhouse Effect, Greenhouse Gases (GHGs), Greenhouse Gas Emissions, Global Warming, Global Warming Potential (GWP)

**Climate Topic:** The Greenhouse Effect, Introduction to Climate Change

**Location:** Global

**Access:** Online, Offline

**Language(s):** English, French, German, and Spanish. One resource available in several other languages.

**Approximate Time Required:** 60 min

# 1 Contents

## 1. Reading (30 min)

A reading that introduces the greenhouse effect, explains what greenhouse gases are and describes their role in causing global warming. It includes in-section questions, discussion points and suggested activities for extending students' understanding of the topic. This document is available to download in English, French, German, and Spanish.

This can be accessed at:

<https://www.oce.global/en/resources/climate-science/ST1.5-EN> (pages 7-9)

## 2. Simulation (30 min)

An interactive simulation to explore the role of different greenhouse gases and their atmospheric concentrations in causing the greenhouse effect. This resource is available in several languages including English, French, German, and Spanish.

This can be accessed at:

<https://phet.colorado.edu/en/simulation/greenhouse>

## 3. Suggested questions/assignments for learning evaluation

- What is the Greenhouse Effect of the Earth's atmosphere?
- What are Greenhouse Gases?

- Explain the role of Greenhouse Gases in causing global warming.

## 2 Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

### 1. Topic introduction and discussion

Use the section, 'A. Understanding global warming', pages 7-9 of the document, '[IPCC Special Report "Global Warming of 1.5°C"- Summary for Teachers](#)' by the Office for Climate Education (OCE), France, to introduce your students to the topic of greenhouse gases and the greenhouse effect of the atmosphere. Discuss how the industrial revolution has resulted in an increase in the concentration of some GHGs in the atmosphere. Use the in-section questions and tasks to discuss the global warming potential of various GHGs. Further, use the document to emphasize how an increase in the atmospheric concentrations of such gases has potentially caused global warming of the planet. This document is available in English, French, German, and Spanish.

This can be accessed at:

<https://www.oce.global/en/resources/climate-science/ST1.5-EN> (pages 7-9)

### 2. Extend student understanding of the topic using an interactive simulation

Use the interactive PhET simulation, '[The Greenhouse Effect](#)' by University of Colorado, Boulder, to enable your students to visualize the greenhouse effect of the atmosphere. Use the simulation to show students how certain gases in the atmosphere absorb outgoing terrestrial radiation and re-radiate the energy back to Earth's surface. Emphasize that this is the greenhouse effect of the atmosphere and increased

concentration of these gases causes warming of the Earth's surface. Instruct your students to explore different scenarios such as 'Ice Age', '1750' (pre-Industrial Age) and 'Today' to visualize the effect of corresponding concentrations of atmospheric greenhouse gases on observed temperatures. Direct your students to adjust the concentration of different greenhouse gases and to note the corresponding surface temperatures of the planet. You may also use the 'Photon Absorption' tab in the simulation to help your students visualize the interaction of infrared radiation with different greenhouse gas molecules. This resource is available in several languages including English, French, German, and Spanish.

This can be accessed at:

<https://phet.colorado.edu/en/simulation/greenhouse>

### 3. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- What is the Greenhouse Effect of the Earth's atmosphere?
- What are Greenhouse Gases?
- Explain the role of Greenhouse Gases in causing global warming.

## 3 Learning Outcomes

The tools in this lesson plan will enable students to:

- understand the Greenhouse Effect of Earth's atmosphere
- list some important greenhouse gases
- understand the relationship between atmospheric concentration of greenhouse gases and planetary surface temperature

- discuss the anthropogenic contribution to global warming and climate change

## 4 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and ownership details for each tool by following the individual links provided. We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

### 1. Reading; 'IPCC Special Report "Global Warming of 1.5°C"- Summary for Teachers'

Published by the [Office for Climate Education \(OCE\)](#), France.

### 2. Simulation; 'The Greenhouse Effect'

Developed by [University of Colorado Boulder](#), USA.