

GREENHOUSE GAS GAME

KEY OBJECTIVES

1. Students engage in challenges that determine the fate of the Earth's atmosphere.
2. Students learn that greenhouse gases are heat-trapping gases.
3. Students learn that human actions are contributing to the levels of greenhouse gases in our atmosphere, and that these gases impact the livability of our planet.

INTRODUCTION

This Greenhouse Gas Game enables students to interact with each other as they learn about the heat trapping properties of greenhouse gases that contribute to climate change. They learn that human actions are altering the levels of greenhouse gases in our atmosphere. Teams explore how long it takes to reach the top of the temperature tracker based on human activity, with the winner taking the longest to reach the top of the temperature tracker.

GUIDING QUESTIONS

1. What is the greenhouse effect?
2. Why is the Earth getting warming?

MATERIALS

Most of the materials needed for this activity can be found in the pdf available at the following link: (https://scied.ucar.edu/sites/default/files/files/activity_files/the_greenhouse_game_1.pdf).

- Allow time to cut and organize all pieces of this board game before introducing the activity to students.
- The Game Boards for Round 1 (today) and Round 2 (future) can be found on pages 5-6; Print out one game board for each team.
- Print double-sided and cut out the Human Activity Cards on pages 7-12. For each team, stack all of the blue and the red cards in separate piles face down next to the game board. The blue cards represent human activities that decrease greenhouse gases while activities on the red cards increase greenhouse gases.
- Print double-sided and cut out the individual Atmospheric Tiles on pages 13-14. Each team will receive 4 double-sided tiles. The numbers on the board will match the number on the Atmospheric Tiles.
- Print and cut out the Temperature Trackers found on page 15 and place one Temperature Tracker next to the game board for each team.
- The following items are not included but necessary for each team: dice and small token (one each per team). While this activity uses a wooden Earth Token to track the temperature, other items such as coins could be used instead.
- Print one copy of the Inspector Sheet found on page 16 for each team; this will function as the student worksheet for both rounds of the game.
- Once all materials are prepared, review the game instructions on page 3.

CONNECTION TO SDGS



TOPICS

GREENHOUSE EFFECT **GREENHOUSE GASES**

CROSS LINKS

GOAL 7: Affordable and Clean Energy
GOAL 11: Sustainable Cities and Communities
GOAL 15: Life on Land

KEYWORDS

GREENHOUSE EFFECT **GREENHOUSE GASES**

CLIMATE CHANGE **GLOBAL WARMING**

SUSTAINABILITY

LEVEL

Primary and Secondary

RESOURCE TYPE

BOARD GAME

INTENDED AUDIENCE SIZE

The game is played with 6 players.

MODE OF DELIVERY

Small group

TIME FOR ACTIVITY

Teacher preparation: 20 min.
Introduction for students: 40 min.
Student activity: 35 min.
Class discussion/analysis: 20 min.

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TASKS/PROCEDURE

- **The Greenhouse Effect**

Energy from the Sun that makes its way to Earth can have trouble finding its way back out to space. The greenhouse effect causes some of this energy to be waylaid in the atmosphere, absorbed and released by greenhouse gases. Without the greenhouse effect, Earth's temperature would be below freezing. It is, in part, a natural process. However, Earth's greenhouse effect is getting stronger as we add greenhouse gases to the atmosphere. That is warming the climate of our planet.

- **How Does It Work?**

Solar energy absorbed at Earth's surface is radiated back into the atmosphere as heat. As the heat makes its way through the atmosphere and back out to space, greenhouse gases absorb much of it. Why do greenhouse gases absorb heat? Greenhouse gases are more complex than other gas molecules in the atmosphere, with a structure that can absorb heat. They radiate the heat back to the Earth's surface, to another greenhouse gas molecule, or out to space.

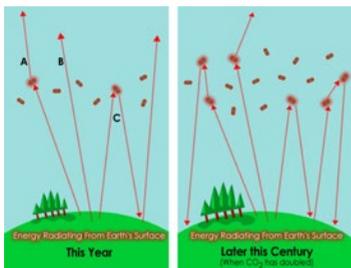
- **Greenhouse Gases**

There are several different types of greenhouse gases. The major ones are carbon dioxide, water vapor, methane, and nitrous oxide. These gas molecules all are made of three or more atoms. The atoms are held together loosely enough that they vibrate when they absorb heat. Eventually, the vibrating molecules release the radiation, which will likely be absorbed by another greenhouse gas molecule. This process keeps heat near the Earth's surface. Most of the gas in the atmosphere is nitrogen and oxygen – both of which are molecules made of two atoms. The atoms in these molecules are bound together tightly and unable to vibrate, so they cannot absorb heat and contribute to the greenhouse effect.

- **A Couple of Common Greenhouse Gases**

Carbon dioxide: Made of one carbon atom and two oxygen atoms, carbon dioxide molecules make up a small fraction of the atmosphere, but have a large effect on climate. There was about 270 parts per million volume (ppmv) of carbon dioxide in the atmosphere in the mid-19th Century at the start of the Industrial Revolution. The amount is growing as burning fossil fuels releases carbon dioxide into the atmosphere. There is about 400 parts per million volume (ppmv) now.

Methane: A powerful greenhouse gas, able to absorb far more heat than carbon dioxide, methane is made of one carbon and four hydrogen atoms. It is found in very small quantities in the atmosphere but is able to make a big impact on warming. Methane gas is also used as a fuel. When burned, it releases carbon dioxide greenhouse gas into the atmosphere.



Above: The Earth's surface, warmed by the Sun, radiates heat into the atmosphere. Some heat is absorbed by greenhouse gases like carbon dioxide and then radiated to space (A). Some heat makes its way to space directly (B). Some heat is absorbed by greenhouse gases and then radiated back towards the Earth's surface (C). With more carbon dioxide in the atmosphere later this Century, more heat will be stopped by greenhouse gases, warming the planet. (Image: Lisa Gardiner/Windows to the Universe)

- **More Greenhouse Gases = A Warmer Earth**

Even though only a tiny amount of the gases in Earth's atmosphere are greenhouse gases, they have a huge effect on climate. Sometime during this century, the amount of the greenhouse gas carbon dioxide in the atmosphere is expected to double. Other greenhouse gases like methane and nitrous oxide are increasing as well. The quantity of greenhouse gases is increasing as fossil fuels are burned, releasing the gases and other air pollutants into the atmosphere. Greenhouse gases also make their way to the atmosphere from other sources. Farm animals, for example, release methane gas as they digest food. As cement is made from limestone, it releases carbon dioxide. With more greenhouse gases in the air, heat passing through on its way out of the atmosphere is more likely to be stopped. The added greenhouse gases absorb the heat. They then radiate this heat. Some of the heat will head away from the Earth, some of it will be absorbed by another greenhouse gas molecule, and some of it will wind up back at the planet's surface again. With more greenhouse gases, heat will stick around, warming the planet.

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FOSTERING DISCUSSION

Students could read or do some research on how warming is affecting other aspects of our climate like precipitation, as well as the ocean, ice, ecosystems, and health.

SAFETY INSTRUCTIONS

None

AUTHOR

Bibliotheca Alexandrina Planetarium Science Center