

Name: _____ Date: _____

Student Exploration: Greenhouse Effect

Vocabulary: global warming, greenhouse effect, greenhouse gas, heat flow

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

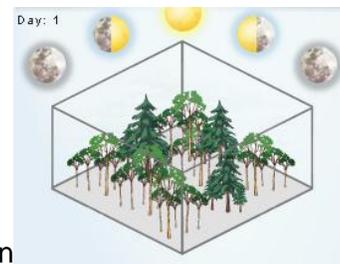
1. What do you notice when you get into a car that has been sitting in the Sun for a while?

2. Why is the inside of the car so hot? _____

3. How would things be different if the car's windows were left open? _____

Gizmo Warm-up

Like the windows of a car, **greenhouse gases** play a major role in regulating Earth's climate. Without the gases that trap heat in Earth's atmosphere, Earth would be a frigid desert like Mars (average temperature -55°C). Too much greenhouse gas and Earth could be a fiery inferno like Venus (average temperature 450°C). On the *Greenhouse Effect Gizmo*TM, set the **Greenhouse gases** to 0% and the **Simulation speed** to **fast**.



1. Click **Play** (▶) and view the BAR CHART tab. The temperature will go up and down. Look at the overall trend. What happens to the temperature over time?

2. Now set the **Greenhouse gases** to 100% and let the simulation run for a while. How does a maximum amount of greenhouse gas affect the temperature?

<p>Activity: Heat in, heat out</p>	<p>Get the Gizmo ready:</p> <ul style="list-style-type: none"> • Click Reset (↺). • Set Simulation speed to slow. • Be sure the Greenhouse gases level is 10%. 	
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Question: How do greenhouse gases affect Earth's climate?

1. **Observe:** Select the BAR CHART tab and click **Play**. After about 24 simulated hours, click **Pause** (⏸). What do you notice about the **heat flow** into and out of Earth's atmosphere?

2. **Analyze:** Select the TABLE tab.
 - A. At what time of day is heat flow into the atmosphere (H_{in}) greatest? _____
 - B. At what time of day is heat flow into the atmosphere (H_{in}) least? _____
 - C. Does heat flow out of the atmosphere (H_{out}) change during a day? _____
 - D. At what time of day is surface temperature highest? _____ Lowest? _____

3. Predict: Click **Reset**. When you change the amounts of greenhouse gases in the atmosphere, which factor(s) do you expect to change? (Circle your answer/answers.)

Heat flow in

Heat flow out

Temperature

4. Experiment: Select the BAR CHART tab, and click **Play**. While the simulation is playing, move the **Greenhouse gases** slider back and forth. What do you notice?

5. Experiment: Click **Play**, and this time observe the GRAPH tab as you change the **Greenhouse gases**. What do you notice?

6. Draw conclusions: The influence of greenhouse gases on temperature is called the **greenhouse effect**. Based on what you have seen, how do greenhouse gases affect the heat flow into and out of Earth's atmosphere?

7. Extend your thinking: Atmospheric concentrations of greenhouse gases such as carbon dioxide have risen dramatically in the past century. Most scientists agree that this has begun to result in **global warming**, a slow increase in average temperature worldwide.

What are the possible consequences of global warming?

Note: The reason greenhouse gases raise the temperature of Earth's atmosphere is similar to, but not identical to, the way that the glass in a greenhouse raises the temperature inside.

In a greenhouse, sunlight passes through the transparent glass and is absorbed by the plants and soil below. Heat is then radiated from plants and soil, which heats the air inside the greenhouse. The hot air is trapped by the glass. If the glass were not there, the hot air would mix with the colder air outside, and the result would be similar temperatures inside and outside the greenhouse.

In Earth's atmosphere, greenhouse gases are transparent to visible light but absorb heat that is emitted from Earth's surface. Some of this heat is then reflected back to Earth. If the greenhouse gases were not present, all of the heat would radiate into space instead.

Activity 2 - For about the last 150 years or so, people have been burning fossil fuels to get energy for transportation, industry, and electricity. The two main gases produced by the burning of fossil fuels are carbon dioxide and water vapour. This has caused an increase in the amount of greenhouse gases in the atmosphere.

Is there any change in the amount of sun's energy reaching the earth when the amount of greenhouse gases in the atmosphere changes? Why or why not?

What will happen to the amount of heat energy going out into space as the amount of greenhouse gases in the atmosphere increases? Why?

Press **Reset** (🔄). Run the simulation at fast speed for about 100 days. Record the heat out, high, and low temperatures for day 100 in the chart below. Hint: switch to the TABLE tab to get an accurate figure for the amount of heat out.

Press **Reset** (🔄). Change the Greenhouse gases to 11%. (Move the slider or highlight the number in the box and change by typing the desired number and then click ENTER)

Run the simulation at fast speed for about 100 days. Record the data for day 100 in the chart below.

Record data for day 100 with the simulations using greenhouse gases set at 12%, 13%, 14%, and 15%

Greenhouse Gases (%)	Heat Out	High Temperature (°C)	Low Temperature (°C)
10			
11			
12			
13			
14			
15			

Why is a small increase in the amount of greenhouse gases in the atmosphere a bad thing for life on earth?

At what point does it seem as if life on Earth might be killed because of rising levels of greenhouse gases?

The increase in global temperatures resulting from increased levels of greenhouse gases because of human activity such as burning fossil fuels is referred to as **Anthropogenic Greenhouse Effect**.

Many people think that Ozone depletion is one of the causes of Global Warming/Global Climate Change. Although both processes involve gasses in the atmosphere, there are not directly connected.

Visit the following website to identify the similarities and differences between Ozone Depletion and the Greenhouse Effect.

<http://www.atm.ch.cam.ac.uk/tour/part1.html>

<http://www.epa.gov/ozone/science/process.html>

<http://www.epa.gov/climatestudents/basics/today/greenhouse-effect.html>

https://www.ucar.edu/learn/1_3_1.htm

	Ozone Depletion	Greenhouse Effect	
What chemicals are involved?			
How is it helpful/what are the helpful components to life on earth?			
How is it a problem to life on earth?			
What human activities are causing the problem?			
How can the problem be solved?			

Ozone Depletion

Greenhouse Effect