

Name _____ Period _____ Date _____

Greenhouse Effect Online Lab

(<http://phet.colorado.edu/en/simulation/greenhouse>)

Greenhouse Gases:

Carbon Dioxide (CO₂)
Methane (CH₄)
Nitrous oxide (N₂O)
Chlorofluorocarbons (CFCs)
Ozone (O₃)
Atmospheric water vapor (H₂O)

Key:

Yellow Photon = Sunlight (Sun's Radiation)
Red Photon = Infrared Radiation (Heat Radiation)

Step 1: On GREENHOUSE EFFECT tab, set greenhouse gas concentration to **NONE**. Observe the sunlight photons and infrared photons.

- a. What happens to sunlight photons?
- b. What happens to the infrared photons?
- c. What is the temperature reading?
- d. Add 3 clouds. How does the activity of the infrared photons change?
- e. How does the activity of the sunlight photons change?
- f. What is the temperature reading after adding 3 clouds? How was temperature affected by the clouds?

Step 2: Set cloud count back to zero and set greenhouse gas concentration to **LOTS**. Observe the sunlight photons and infrared photons.

- a. What happens to the sunlight photons?

- b. What happens to the infrared photons?

- c. What is the temperature reading? How does the temperature compare to when there was no greenhouse gases in the atmosphere?

Step 3: Select the ice age, 1750's, and today tabs and record the changes in greenhouse gases and temperature.

Greenhouse Gas Concentration	Carbon Dioxide Concentration (CO ₂)	Methane Concentration (CO ₄)	Nitrous Oxide Concentration (N ₂ O)	Temperature
Ice Age				
1750				
Today				

- a. Have greenhouse gas concentrations increased or decreased since 1750?

- b. What happens to temperature as greenhouse gas concentration increases?

Step 4: Go to GLASS tab.

- a. Record temperature.

- b. Add 3 glass panels. Record temperature again.

- c. What effect do glass panels have on temperature?

- d. What effect do glass panels have on the infrared photons?

- e. If glass panels help trap heat, how could they be used to help a farmer keep his plants warm in a cooler climate?

Step 5: Go to Photon Absorption Tab

- a. Explore how the different molecules interact with visible and infrared light. Do you find any patterns?

- b. Which gases are considered *greenhouse gases*? Provide evidence to support your answer.

- c. Build an atmosphere with different compositions. Use the table below to record your observations.

Composition of Atmosphere	What happens to infrared photons?	What happens to visible photons?
Lots of greenhouse gases		
No greenhouse gases		

Compare your observations for infrared photons step 2 and step 5. Use this data to explain how greenhouse gases can affect global temperature. Use microscopic evidence to explain the difference in global temperatures during the ice age and present day.

Step 6: Open the Glaciers simulation

a. Open up the PhET Glaciers simulation (<http://phet.colorado.edu/en/simulation/glaciers>) and play with the sim for five minutes. **What do you find? Discuss your ideas with your partner.**

b. Observe what happens to the glacier as you adjust different parameters in the simulation. Record your observations in the table.

Action	Glacier Movement	Maximum Thickness
Decrease the average annual snowfall	<input type="checkbox"/> Advances <input type="checkbox"/> Retreats <input type="checkbox"/> None	<input type="checkbox"/> Increases <input type="checkbox"/> Decreases <input type="checkbox"/> No Change
	<input type="checkbox"/> Advances <input type="checkbox"/> Retreats <input type="checkbox"/> None	<input type="checkbox"/> Increases <input type="checkbox"/> Decreases <input type="checkbox"/> No Change
	<input type="checkbox"/> Advances <input type="checkbox"/> Retreats <input type="checkbox"/> None	<input type="checkbox"/> Increases <input type="checkbox"/> Decreases <input type="checkbox"/> No Change
	<input type="checkbox"/> Advances <input type="checkbox"/> Retreats <input type="checkbox"/> None	<input type="checkbox"/> Increases <input type="checkbox"/> Decreases <input type="checkbox"/> No Change

c. What claims can you make about the relationship between the amount of snowfall and the movement and thickness of glaciers? Provide evidence for your claims.

d. What claims can you make about the relationship between the average temperature and the movement and thickness of glaciers? Provide evidence for your claims.

Reflection

Use your observations on the *microscopic* level in The Greenhouse Effect simulation to explain your *macroscopic* observations in the Glaciers simulation. What connections can you make?