

3.2 The Greenhouse Effect Simulation Worksheet

Directions: If your instructor has not already done so, you will need download the PhET simulation onto the computers or device that you will be using. To do so, visit <https://phet.colorado.edu/en/simulation/greenhouse> . Open the PhET simulation. On the center of the right-side panel under “Atmosphere during...”, select “Adjustable Concentration”.

1. **Trial 1** – In the “Greenhouse Gas Concentration” panel, move the slider to “None”. Watch the red infrared photons as they move from the surface of the earth to outer space. What observations can you make about their movement?

2. **Trial 2** – Next, move the slider to “Lots”. Again, watch the red infrared photons as they move from the surface of the earth to outer space. How has this changed the movement of the infrared photons as they leave the surface of the earth? (You can switch back and forth between the two scenarios if that makes it easier to observe the differences).

3. Summarize the changes that occurred to the movement of infrared photons as the concentration of greenhouse gases increased:

As greenhouse gas concentrations increased, the movement of infrared photons will...

4. Why would the movement of infrared photons change in this way if the concentrations of greenhouse gases are increased? (Hint: what makes something a greenhouse gas?).

5. What is happening to the movement of the yellow visible light photons as greenhouse gas concentrations are increased?
 - a. Fewer visible light photons can get through the atmosphere.
 - b. More visible light photons can get through the atmosphere.
 - c. No changes occurred to the movement of visible light photons.

6. How do your observations in the previous question relate to the Greenhouse Effect? Return to the definition in the reading if needed.

7. What would happen to the movement of infrared photons if we increased the concentration of N₂ or O₂? Choose one of the options below and explain your choice:

- a. More infrared photons would leave the atmosphere more quickly.
- b. Fewer infrared photons would be able to leave the atmosphere as quickly.
- c. No change would occur to the movement of infrared photons.

I chose _____ because _____

8. In the “Atmosphere during...” panel, select each time period option (Today, 1750, Ice Age) and complete the table below using the information in the “Greenhouse Gas Composition” panel:

	CO ₂ (ppm)	Temperature
Today		
1750		
Ice Age		

9. What do you notice in regards to the relationship between the concentration of CO₂ and the temperature?

10. Next, click on the “Photon Absorption” tab from the blue tabs in the upper left of the screen. Under the “Atmospheric Gases” panel, select CO₂. On the “radiation gun” on the left-hand side of the screen, make sure that the “Infrared Photon” option is selected. Move the slider on the gun all the way to the right and observe how the infrared photons respond when they encounter the CO₂ molecule. Then circle one of the options below:

When an infrared photon hits CO₂, the photon’s movement is... **Unchanged** **Scattered**

11. Now select the “Visible Photon” option on the gun. Make sure the slider is still adjusted so that it is all the way to the right. Observe how the visible light photons respond when they encounter the CO₂ molecule. Then complete the sentence below:

When a visible light photon hits CO₂, the photon’s movement is... **Unchanged** **Scattered**

12. How do your observations in this exercise relate to the Greenhouse Effect? Revisit the definition in the reading if needed.

13. Next, select N₂ under the “Atmospheric Gases” panel. Select the “Infrared Photon” option on the gun. Move the slider on the gun all the way to the right. Then complete the sentence below:

When an infrared photon hits N₂, the photon’s movement is... **Unchanged** **Scattered**

14. Now select the “Visible Photon” option on the gun. Make sure the slider is still adjusted so that it is all the way to the right. Observe how the visible light photons respond when they encounter the N₂ molecule. Then complete the sentence below:

When a visible light photon hits N₂, the photon’s movement is... **Unchanged** **Scattered**

15. How do you think that carbon dioxide affects the Earth’s temperature?
