PhET – Greenhouse Effect (http://phet.colorado.edu/en/simulation/greenhouse)

*Once you have navigated to PhET's Greenhouse Effect simulation page, select the green button '**Run Now!**' at the bottom right-hand-corner of the simulation window.*

From here the simulation will open using JAVA. If you're unable to open the simulation on your home computer, make sure that you have and updated version of JAVA. Otherwise, please complete this activity from a computer at the campus or center closest to you.

*We will begin by exploring the tab labeled '**Greenhouse Effect**.' Take a minute to familiarize yourself with the various controls.*

*When you are ready to start answering questions, hit the '**Reset All**' button at the bottom of the right side of the screen.*

1. What does the fast/slow slider at the bottom of the viewing window appear to control?

2. Comment on the relative directions that the different types of photons travel. Do they seem to behave identically or does one behave differently than the other? Be as descriptive as possible with your answer.

3. What are *photons*? How are infrared photons different from the other photons emitted by the sun? You may need to look around online to help answer this question.

4. What affect does changing the **Greenhouse Gas Concentration** appear to have on the system? Based on your observation, what leads you to believe that this is true?

5. Between what time periods (Ice Age, 1750, and Today) does there appear to be the largest increase in CO_2 concentration? What time periods experience the largest increase in temperatures? Can you think of any reasons why this might be the case? Please be as quantitative (numbers!) as possible with your answer.

6. Calculate the average rate of increase in CO_2 concentration between 1750 and today (in ppm/year). Use this value, coupled with your findings from question 5, to estimate <u>when</u> the Ice Age happened? Compare your answer to the accepted value of the date of the most recent Ice Age. What might any differences in these values tell you about the how the rate of increase in CO_2 concentration has changed over time? **Please be sure to show all of your work here**.

7. In your opinion are greenhouse gasses (and thus the '*Greenhouse Effect*') a good thing, or a bad thing for Earth her inhabitants? Be sure to support your opinion with evidence.

*We're now ready to explore the impact that adding varying thicknesses of glass has on our system. To do this select the tab on the top of the screen labeled '**Glass Layers**.' Take a minute to familiarize yourself with the various settings before you proceed. Once you're ready to begin answering questions, hit the '**Reset All**' button at the bottom of the right side of the screen.*

1. Comment on the relative directions that the different types of photons travel. Do they seem to behave identically or does one behave differently than the other? Be as descriptive as possible with your answer.

2. What effect does adding panes of glass have on the system? What leads you to believe that this is true? Try to incorporate the behavior of the infrared photons into your answer.

3. How is this analogous to the behavior of earth's atmosphere?

*Finally we are ready to examine the behavior that photons exhibit on the microscopic scale, and the impact that different photons have on different components of the atmosphere. To do this, select the tab labeled '**Photon Absorption**' and take a minute to familiarize yourself with the various settings. Once you're ready to begin answering questions, hit the '**Reset All**' button at the bottom of the right-hand side of the screen.*

1. Of the atmospheric gasses listed at the right of the screen, which are categorized as 'Greenhouse Gasses?' You may need to do a bit of research online to answer this question.

2. What effect does moving the slider on the side of the light source appear to have? What lead you to this conclusion? Be as descriptive as possible with your answer.

3. Do the various atmospheric gasses behave the same when interacting with the different types of photons (infrared vs. visible)? What lead you to this conclusion? Be as descriptive as possible with your answer.

4. Which gasses appear to be influenced the greatest by the presence of infrared photons? Why does (or doesn't) this seem to make sense?

5. Try building an atmosphere similar in composition to earth's atmosphere (Today). You may have to go online to help with this question. How do the various components of the atmosphere behave when interacting with certain photons?

6. Based on your observations, what connection can you make between the 'activity' of the greenhouse gas molecules and the temperature of the atmosphere?