**PhET – Greenhouse Gases and Their Effect on Earth’s Climate** (<http://phet.colorado.edu/en/simulation/greenhouse>)

Once you have navigated to PhET’s *The Greenhouse Effect* simulation page, select the large PLAY button in the middle of the simulation window.

From here the simulation will open using JAVA. Select ‘Open With JAVA’ and then select the button that says ‘Run’. **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.**

To start, let’s examine the influence that photons have on earth’s atmosphere at 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. What are photons? How are *Infrared* and *Visible* photons different from one another? You may need to do a bit of research in your textbook, or online to answer this question.
2. Identify the atmospheric gasses listed at the right of the screen. You may need to do a bit of research in Ch. 2 of your textbook or online to answer this question.

CH4:

CO2:

H2O:

N2:

O2:

1. 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.
2. Try adding some of the available atmospheric gasses to your sample one at a time. Do the various atmospheric gasses behave the same when interacting with the different types of photons (infrared vs. visible)? What observations lead you to this conclusion? Be as descriptive as possible with your answer.
3. Which gasses appear to be influenced the greatest by the presence of infrared photons? How do you know?
4. The three atmospheric gasses you just identified as most influenced by infrared photons are collectively referred to as what type of gasses?

We’re now ready to explore the impact that adding varying thicknesses of glass has on photons near earth’s surface. 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 what you observed similar to the behavior a greenhouse? How do you know?

We will conclude 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 slow/fast slider at the bottom of the viewing window appear to control?
2. 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?
3. Between what time periods (Ice Age, 1750, and Today) does there appear to be the largest increase in CO2 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.
4. Calculate the average rate of increase in CO2 concentration between 1750 and today (in ppm/year). Use this value, coupled with your findings from the previous question, to estimate when the Ice Age happened? Compare your answer to the accepted value of the date of the most recent Ice Age (you may need to do some Googling). What might any differences in these values tell you about the how the rate of increase in CO2 concentration has changed over time? **Please be sure to show all of your work here**.
5. In the space below, sketch a graph of CO2 concentration (on the vertical axis) vs. time (on the horizontal axes) using the data provided in the simulation. Be sure to label your axes and include appropriate units and scaling.
6. Based on your observations, what connection can you make between the ‘activity’ of the atmospheric (*Greenhouse*) gas molecules you observed in the first part (**Photon Absorption**) and the temperature of the atmosphere?
7. In your own words, summarize the phenomenon known as the *Greenhouse Effect*. Does this seem like an appropriate name such a phenomenon? Why or why not?
8. 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.