

Greenhouse Lab

Purpose: Determine the effect of greenhouse gases on infrared radiation emitted from the Earth.

Procedure: Go to <http://phet.colorado.edu/>, click “online”, click “physics”, click “Heat & Thermo”, and click on “The Greenhouse Effect.”

I. Look at the model of the Earth with “No Greenhouse Gases” selected.

A. What do the red and yellow arrows represent?

B. If you were talking to a friend about what you observe, how would you explain what is happening with the energy from the sun and the energy from the Earth?

C. What is the equilibrium temperature at the surface of the Earth (in Kelvin)? Describe what a TV weatherperson would say about the day. Show how he or she would have to convert Kelvin to Fahrenheit for the viewers.

D. Follow 10 infrared photons coming off the ground. Every time a photon changes direction it has been absorbed and re-emitted by a gas molecule in the air.

1. How many of the 10 photons travel through the atmosphere without being absorbed and re-emitted?
2. How many of the 10 photons make it to outer space?

II. Click on the “today” button to see our atmosphere now.

A. List the four main greenhouse gases in our atmosphere in order from least to most abundant.

B. What is the equilibrium temperature at the surface of the Earth (in Kelvin)? Convert this to Fahrenheit.

C. Follow 10 infrared photons coming off the ground. If they are hard to follow, uncheck “view all photons”.

1. How many of the 10 photons travel through the atmosphere without being absorbed and re-emitted?
2. How many times are your photons absorbed and re-emitted before they reach space or the ground?
3. How many of the 10 photons make it to outer space? How many of the 10 photons return to the ground?

III. Drag the slider to “lots” of greenhouse gases.

A. What is the equilibrium temperature at the surface of the Earth (in Kelvin)? Convert this to Fahrenheit.

B. Follow 10 infrared photons coming off the ground. If they are hard to follow, uncheck “view all photons”.

1. How many of the 10 photons travel through the atmosphere without being absorbed and re-emitted?
2. How many times are your photons absorbed and re-emitted before they reach space or the ground?

3. How many of the 10 photons make it to outer space? How many of the 10 photons return to the ground?

IV. Return to “today” for the greenhouse gas concentration. Put in three clouds.

A. A. What is the equilibrium temperature at the surface of the Earth (in Kelvin)? Convert this to Fahrenheit.

B. Follow 10 infrared photons coming off the ground. If they are hard to follow, uncheck “view all photons”.

1. How many of the 10 photons travel through the atmosphere without being absorbed and re-emitted?
2. How many times are your photons absorbed and re-emitted before they reach space or the ground?
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Conclusion: From the above investigations using the simulation, how do you think greenhouse gases increase the surface temperature of the Earth? What are the effects of clouds (if any)?