*Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period \_\_\_\_\_\_\_\_\_\_*

<http://phet.colorado.edu/en/simulation/greenhouse> Greenhouse Effect

* Click on “Run Now” to run the simulation.
* Follow all instructions carefully!

*When the simulation opens,* ***move the slider*** *along the bottom of the screen towards “****slow****”.*

**General Questions:**

1. What do the yellow dots moving down represent?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What do the red dots represent?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*\*\*Watch the red dots carefully.*

1. Do they all move upwards? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Why or why not? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Important Information**: Sunlight photon represents light & infrared photon represents heat

*\*\*Make sure to let the simulation run for at least 60 seconds before recording the data below\*\**

Today

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Record the composition of the atmosphere:  *(on the right side of the screen)*   |  |  | | --- | --- | | H2O (water vapor) |  | | CO2 (carbon dioxide) |  | | CH4 (methane) |  | | N2O (nitrous oxide) |  |   *(ppm means “parts per million”)* | Record the temperature on the thermometer:   |  |  | | --- | --- | | K (kelvin) |  | | °F (degrees Fahrenheit) |  | |

1. What happens to the sunlight photons as they hit the ground? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*\*\*Using the “options” section on the bottom right of your screen,* ***add 3 clouds*** *to the simulation. Let the simulation run for at least 60 seconds before recording your findings.*

1. What happens to the temperature as you add clouds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How are the photons affected by adding clouds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1750

*\*\* Make sure to click* ***“RESET ALL”*** *at the bottom right of your screen before moving on. Click on “1750” on the right side of the screen to set the atmosphere to the proportions for that date. Move the slider back to slow.*

*\*\*Make sure to let the simulation run for at least 60 seconds before recording the data below\*\**

1750

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Record the composition of the atmosphere:  *(on the right side of the screen)*   |  |  | | --- | --- | | H2O (water vapor) |  | | CO2 (carbon dioxide) |  | | CH4 (methane) |  | | N2O (nitrous oxide) |  | | Record the temperature on the thermometer:   |  |  | | --- | --- | | K (kelvin) |  | | °F (degrees Fahrenheit) |  | |

1. What happens to the sunlight photons as they hit the ground? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*\*\*Using the “options” section on the bottom right of your screen,* ***add 3 clouds*** *to the simulation. Let the simulation run for at least 60 seconds before recording your findings.*

1. What happens to the temperature as you add clouds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How are the photons affected by adding clouds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ice Age

*\*\* Make sure to click* ***“RESET ALL”*** *at the bottom right of your screen before moving on. Click on “Ice Age” on the right side of the screen to set the atmosphere to the proportions for that date. Move the slider back to slow.*

*\*\*Make sure to let the simulation run for at least 60 seconds before recording the data below\*\**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Record the composition of the atmosphere:  *(on the right side of the screen)*   |  |  | | --- | --- | | H2O (water vapor) |  | | CO2 (carbon dioxide) |  | | CH4 (methane) |  | | N2O (nitrous oxide) |  | | Record the temperature on the thermometer:   |  |  | | --- | --- | | K (kelvin) |  | | °F (degrees Fahrenheit) |  | |

1. What happens to the sunlight photons as they hit the ground? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What about when they hit the ice? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Are all of the sunlight photons being reflected back into space? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*\*\*Using the “options” section on the bottom right of your screen,* ***add 3 clouds*** *to the simulation. Let the simulation run for at least 60 seconds before recording your findings.*

1. What happens to the temperature as you add clouds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How are the photons affected by adding clouds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Summary:**

1. What would happen if there were no Greenhouse Gases? *(Hint: Adjust the Greenhouse Gas Concentration Level slider on the upper right of your screen to “None” and wait for the numbers to stabilize.)*
2. What would happen if the amount of Greenhouse Gases increased? *(Hint: Adjust the Greenhouse Gas Concentration Level slider on the upper right of your screen to “Lots” and wait for the numbers to stabilize.)*

Photon Absorption

*\*\*Click on the “Photon Absorption” tab at the top left of the screen.*

A methane (CH4) molecule sits in the middle of the screen. Use the slider in the photon releaser on the left side of the screen to shoot some infrared photons at the molecule.

1. Do all the photons pass through the molecule? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. When a photon gets absorbed, what happens next?

*\*\*Use the buttons on the right side of the screen to test different molecules. Record your observations in the table below. Write* ***“yes”*** *if any photons get absorbed; write* ***“no”*** *if no photons get absorbed. You can switch the type of photon being used by clicking below the photon releaser.*

**Which gases absorb photons?**

|  |  |  |
| --- | --- | --- |
|  | *Infrared Photons* | *Visible Photons* |
| CH4 (methane) |  |  |
| CO2 (carbon dioxide) |  |  |
| H2O (water vapor) |  |  |
| N2 (nitrogen) |  |  |
| O2 (oxygen) |  |  |

1. Which three gases contribute to the greenhouse effect in our atmosphere? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Which two gases do NOT contribute to the greenhouse effect? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ENRICHMENT:**

Glass Layers

*\*\*Click on the “Glass Layers” tab at the top of the screen. On the right side of the screen, set the Number of Glass Panes to “1”.*

1. Watch the yellow photons carefully. Do they pass through the glass or are they blocked? \_\_\_\_\_\_\_\_\_\_\_\_
2. Watch the red photons carefully. Do they pass through the glass or are they blocked? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *(Move the slider at the bottom of the screen to slow down the animation if necessary.)*
3. Record the temperature on the thermometer: \_\_\_\_\_\_\_\_\_\_K, \_\_\_\_\_\_\_\_\_\_\_ °F.
4. Your family’s car has been parked outside on a cold but sunny day. When you get in the car, it is much warmer than the air outside. Explain how this can happen.