



## Climate Change and the Textile & Apparel Industry Module

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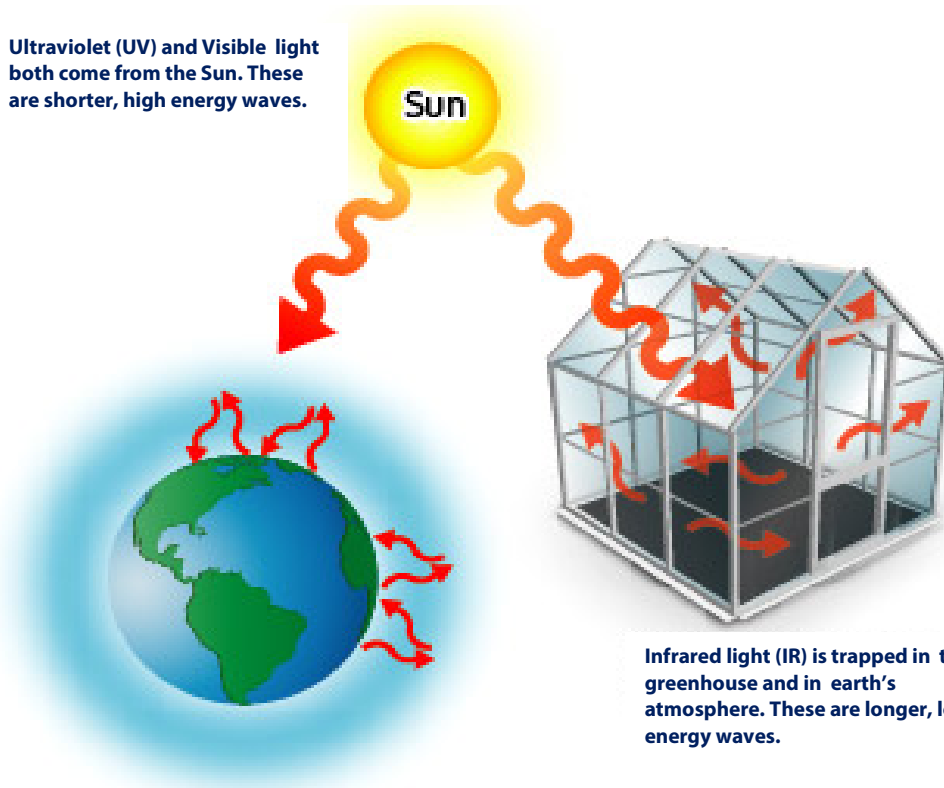
#### POGIL Activity 1: The Earth's Greenhouse (Why does Earth's atmosphere trap heat?)

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### Model 1: Energy of Electromagnetic Radiation (Light) and the Greenhouse

Ultraviolet (UV) and Visible light both come from the Sun. These are shorter, high energy waves.



Infrared light (IR) is trapped in the greenhouse and in earth's atmosphere. These are longer, lower energy waves.

## Critical Thinking Questions

1. Use Model 1 to determine the two types of light (also called electromagnetic radiation, EMR) that are radiated from the sun and penetrate the greenhouse glass.
2. What type of light is trapped in the greenhouse?
3. Is the light that penetrates the greenhouse of longer or shorter wavelength than the light that is in the greenhouse?
4. Does the light that penetrates the greenhouse have more or less energy than the light that is in the greenhouse?
5. Theorize why the lower energy infrared (IR) light would be trapped inside the glass of the greenhouse, unable to get out, while the short wavelengths of light can penetrate the glass to get in?

**Information:** When high-energy sunlight hits an object, the energy of the light warms that object. For instance sunlight heats up a black road. After some of the sunlight's energy is used to warm the object like the road, leftover energy is emitted to the surroundings as heat, that is, *infrared light*. You can feel this infrared light (heat) if you stand on the road on a sunny day.

- As the UV and visible light from the sun continues to shine on the greenhouse, how does the temperature of the greenhouse and all of its contents change?
- How does the earth's atmosphere (shown in light blue in Model 1) work similarly to the greenhouse? Individually, answer this question and write a few sentences justifying your response. When everyone in your group has finished this question, compare your answers and write the group's response in the box below your individual answer.

### Model 2: The Earth's Greenhouse

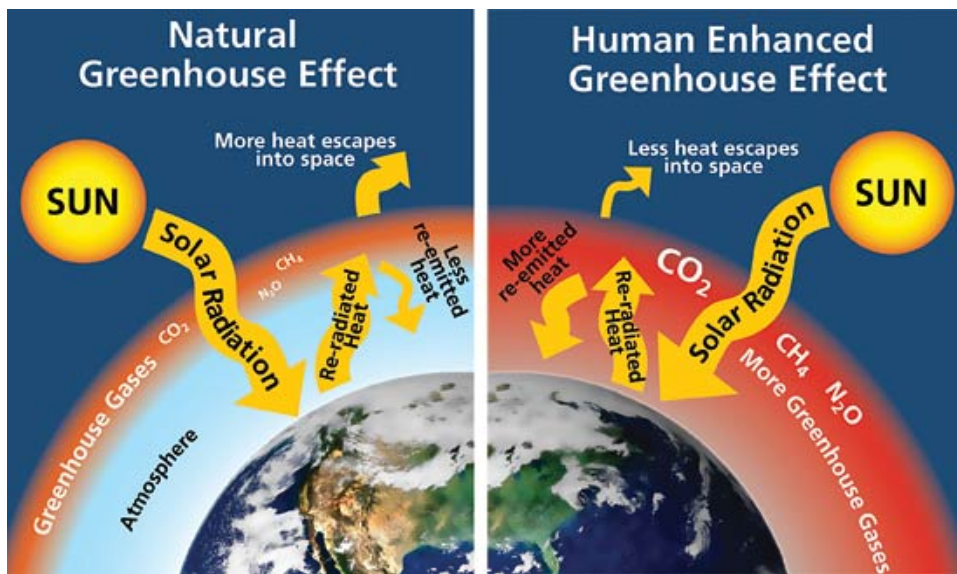


Image Source: <http://www.nps.gov/grba/naturescience/what-is-climate-change.htm>

## Critical Thinking Questions

8. What are the chemical formulas for the three greenhouse gases shown in the image titled "Natural Greenhouse Effect"? (Write their names too if you know them.) These gases occur naturally in earth's atmosphere.
  
9. How does the amount of these three gases change in the image "Human Enhanced Greenhouse Effect"?
  
10. The arrow indicating the amount of solar radiation, that is UV and visible light from the sun, is the same in both images. Similarly the amount of heat re-radiated from the earth is the same in both images. How do the two arrows showing infrared radiation (heat) change from the first to the second image?
  
11. The three substances – all gases that have increased from the first to the second image (see CTQ 9) hold the heat into the atmosphere by capturing heat (IR) and radiating it back towards the earth rather than allowing the heat to escape to space.
  - a. How is this similar to the greenhouse retaining heat (IR) because of the glass?
  
  - b. Why does the second image say "human enhanced"?
  
  - c. From your own knowledge and experience, can you list the sources of these "human enhanced" gases?

12. Describe the earth's greenhouse effect. Individually, answer this question in a few sentences. When everyone in your group has finished this question, compare your answers and write the group's response in the box below your individual answer.

**Exercise (Extra if you have time.)**

1. Describe how the image below is similar both to a greenhouse and to the earth's greenhouse effect.

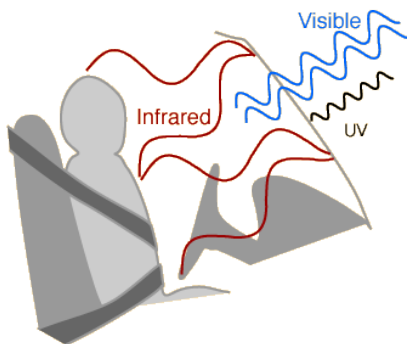


Image Source: <http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/imgheat/grhse2.gif>