

The atmospheric greenhouse effect

Why do planets have different temperatures
even under the same Sun?

Key questions: What is the greenhouse effect, and how does it actually work? How do certain gases in our planetary atmosphere trap heat?

Station 1: What is the atmosphere, weather and climate?

1. Take a look at this atmosphere [simulation](#). Write three observations and two questions that stem from your participation with the simulation.
2. Review the difference between weather and climate by watching this [video](#). While watching, define **weather** and **climate** here.
3. Describe the weather conditions around you today:
4. Describe your state's overall climate:

Station 2: PhET simulation: Molecules and light

1. Open the [Molecules and Light PhET simulation](#).
2. Choose a molecule and a type of light.
3. Move the dial on the light beam to the midway point.
4. Send that type of light toward your chosen molecule for at least 5 seconds. Write down your observations in the table below.
5. Do this for the other types of light, while keeping the same molecule.
6. Choose at least **three additional molecules** and shine microwave, infrared, visible, and ultraviolet light at them.
7. Record your observations below.

[illegible]

Station 3: Why do planets have different temperatures even under the same Sun?

1. Decide which group member will measure the heat from their palm for this experiment.
2. Place your hand at the bottom of the popsicle structure, against the table, with your palm facing up. Don't put any plastic sheets on top of the popsicle structure yet.
 - a. Make sure the infrared laser is NEVER pointed towards someone's eyes.
 - b. Hold the thermometer just above the top level of the structure.
 - c. Point the infrared thermometer to the middle of the test subject's palm and record the temperature readout below.
3. Place the 0.002 inch thick plastic film on top of the popsicle stick structure. Make sure to only handle films by the edges.
 - a. Check that the film is smooth and even.
 - b. Hold the thermometer just above the plastic sheeting and take a measurement of the palm's temperature THROUGH the plastic sheet.
 - c. Record your measurement in the table below.
4. Make sure to use the same hand, the same distance from the sheeting, and the same position of the thermometer for each measurement.
5. Repeat for each plastic thickness.
6. Calculate the difference in temperature when the film is and isn't present.
7. If time allows, place different thicknesses together, calculate the thickness, and repeat steps.
8. If time allows, try measuring the temperature of different hands.

Film thickness [inches]	Temperature of palm without film [°C]	Temperature of palm with film [°C]	Difference in temperature [°C]
0.002			
0.005			
0.01			

Describe your observations in terms of atmospheric thickness. How does this relate to the concept of the "greenhouse effect"?

Station 4: Atmosphere on different planets

Research aspects of these planets' atmospheric makeup and temperature. These data will be discussed by the whole class later.

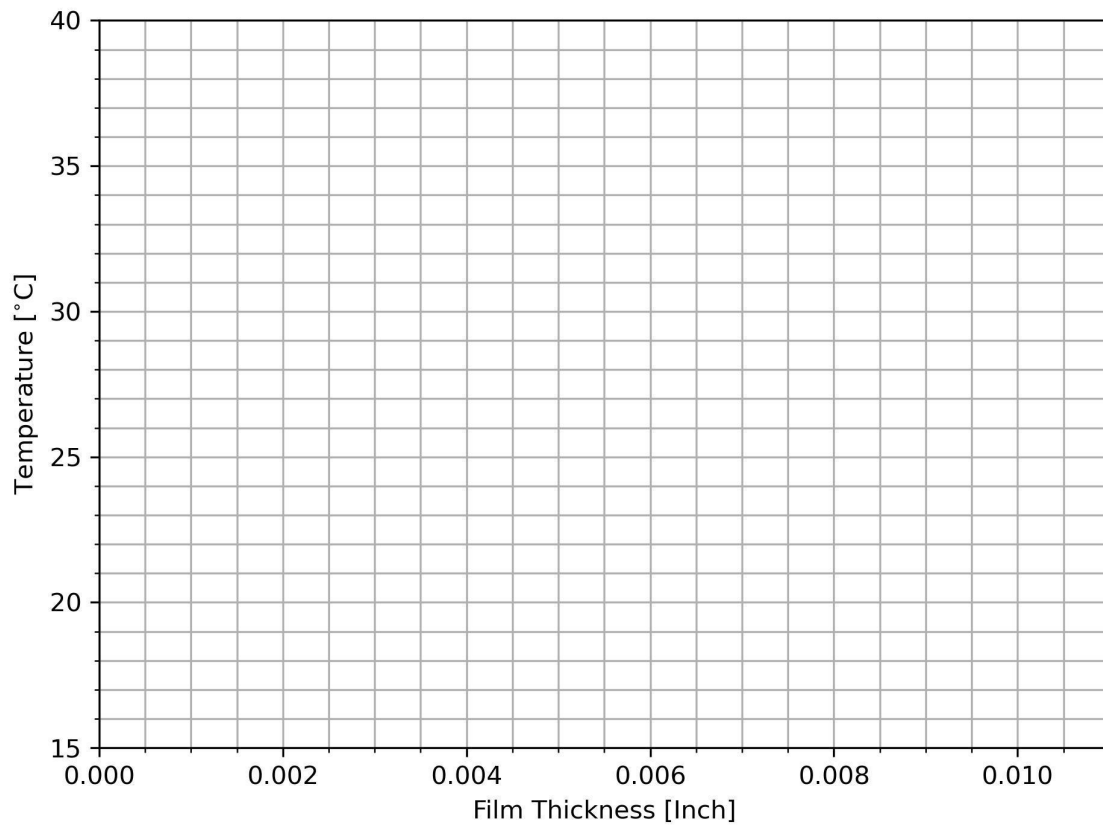
	Venus	Earth	Mars
Distance from the Sun/solar constant			
Planet radius			
Surface temperature			
Surface pressure			
Atmospheric composition			

Research or remind yourself of the concept of the "greenhouse effect". How does this relate to the data you collected above?



Conclusions/Discussion: Your teacher will lead you through a discussion and conclusion based on the prompts below:

1. Plot your data from Station 3 on the provided graph.



2. What patterns can you identify in the data?
3. Connect your data from Station 3 to the information you gathered about Mars, Venus, and Earth in Station 4. Which level of plastic thickness matches with each planet?
4. Based on Station 3, what do you think optical thickness means? How can you connect to what you learned about the greenhouse effect in a few of the stations?

5. Connect greenhouse gases to the Molecules and Light simulation. Which types of light interacted most with certain molecules, and how does that relate to heat being trapped in Earth's atmosphere?
6. What final conclusions can you make? Support your conclusions with data.
7. What careers might involve studying how energy moves through the atmosphere or analyzing climate data, and what skills from this activity would be useful in those jobs?

