Activity - "The Herschel Experiment"

Discovery of Infrared Light in the Electromagnetic Spectrum

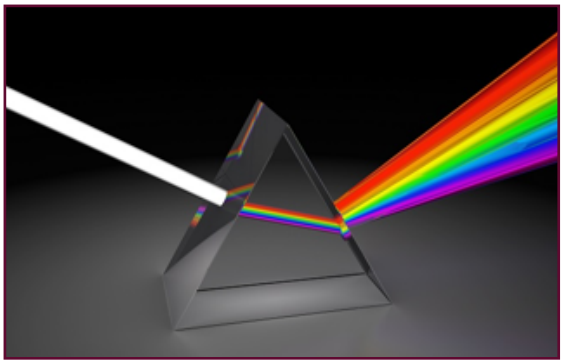
Adapted by NSO from Cool Cosmos "The Herschel Experiment".
Published online: 2014. Cool Cosmos is an IPAC website: http://coolcosmos.ipac.caltech.edu

Objective

In this activity, students learn about Herschel's discovery of infrared light by completing an experiment similar to the one Herschel conducted in the 1800s. Students use thermometers and prisms to note the temperature differences between visible light colors, and invisible light just beyond red (infrared).

Materials

- Glass Prisms
- Thermometers
- Black paint or permanent marker
- Scissors
- Cardboard Box
- Blank white paper
- Video ***Herschel Experiment - Frantisek Plasil.mp4***



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Background

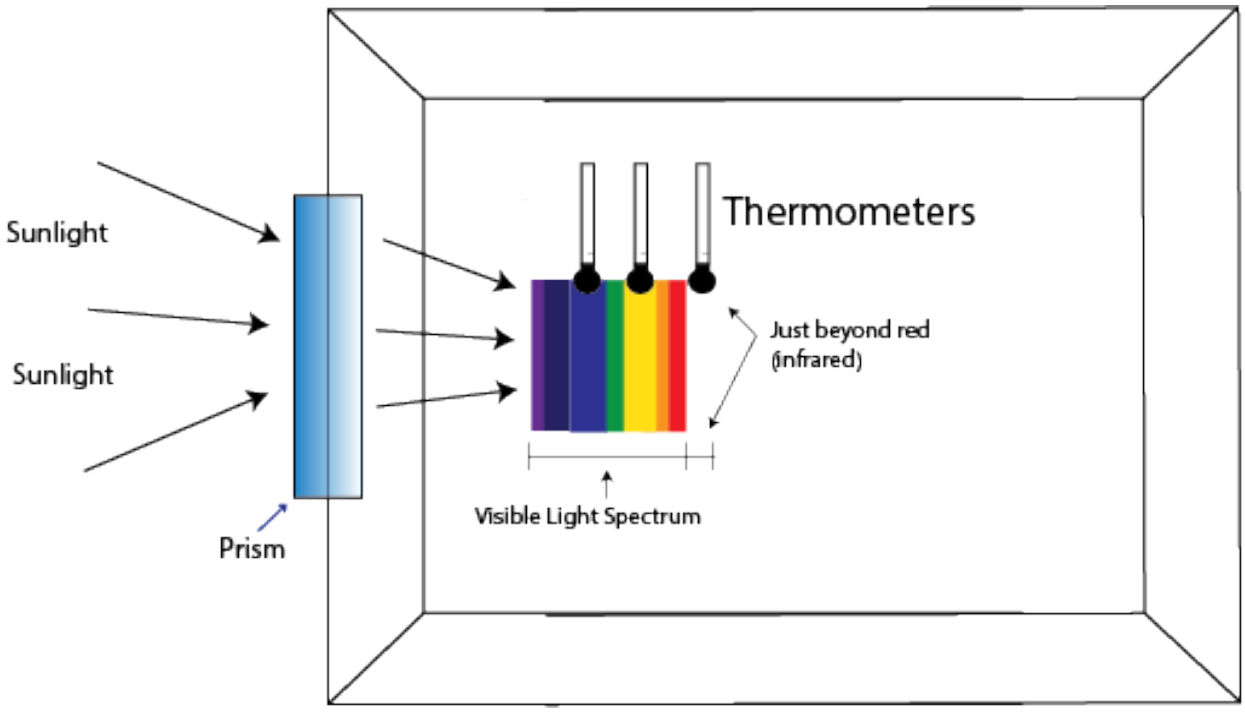
Herschel was an astronomer and musician. In 1800, he experimented by passing sunlight through a glass prism and dispersing the light into a rainbow of colors called the visible light spectrum. He investigated whether the colors had different temperatures by placing a thermometer in each color of light, and recording his results. All of the colors had temperatures higher than a thermometer in the shade. Additionally, he found that the temperatures increased from the violet to the red end of the spectrum. He then measured the region just beyond the red and found that the temperature was even higher! Herschel was the first to show that there are types of light that we can't see. What Herschel discovered was infrared light.

Optional:

Play the "***Herschel Experiment - Frantisek Plasil.mp4***" included in this lesson packet for students before beginning this experiment, to build excitement and provide background.

Directions

1. Prepare three thermometers by blackening their bulbs with either black paint or black permanent marker. This is so that they absorb heat better.
2. Place a blank, white sheet of paper in the bottom of the cardboard box.
3. Cut out an area at the top edge of the box facing the sun. This notch holds the prism while still allowing the prism to be adjusted to produce the widest possible spectrum on the white paper. It is important that the spectrum falls on the shaded portion of the white sheet of paper at the bottom of the box.
4. Once the prism is secured in place, put the thermometers in the shade and record their temperatures. These are your control temperatures.
5. Next, place the thermometers in the color spectrum, one each in the blue and yellow regions. Tape them to the box to secure them if necessary. The third thermometer is placed just beyond the red region, where no colored light is visible.
6. Record the temperatures measured by each thermometer at 1 minute intervals until final temperatures are reached after 5 minutes. Record your results in the data sheets provided. Do not move the thermometers or block the light spectrum while reading your measurements.



Experimental Set Up

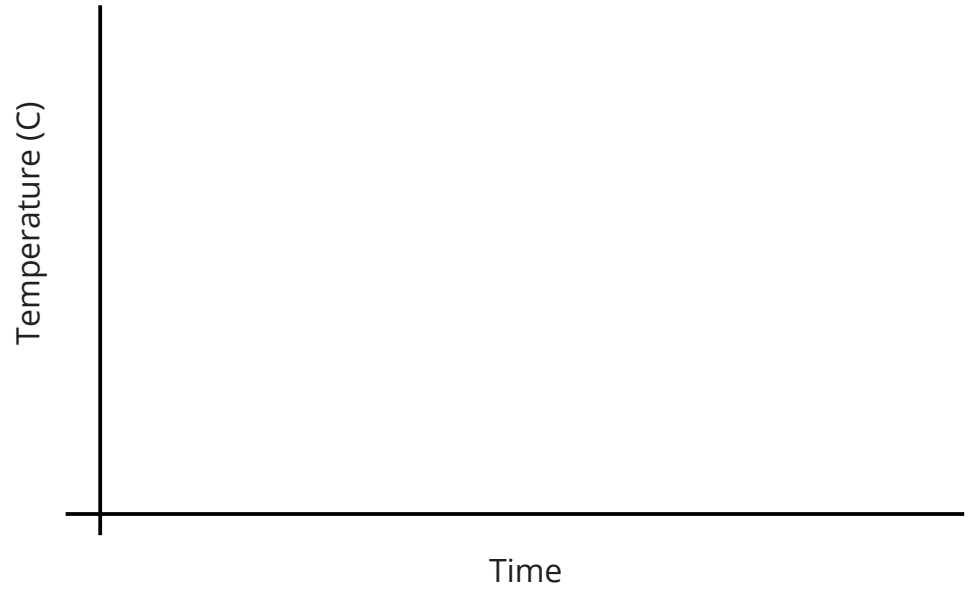
Student Data Sheet

Observations

	Thermometer 1	Thermometer 2	Thermometer 3
Control Temperature (in the shade)			

Temperature in the spectrum	Thermometer 1 (Blue)	Thermometer 2 (Yellow)	Thermometer 3 (beyond red)
1 minute			
2 minutes			
3 minutes			
4 minutes			
5 minutes			

Graph your measurements



CALCULATIONS

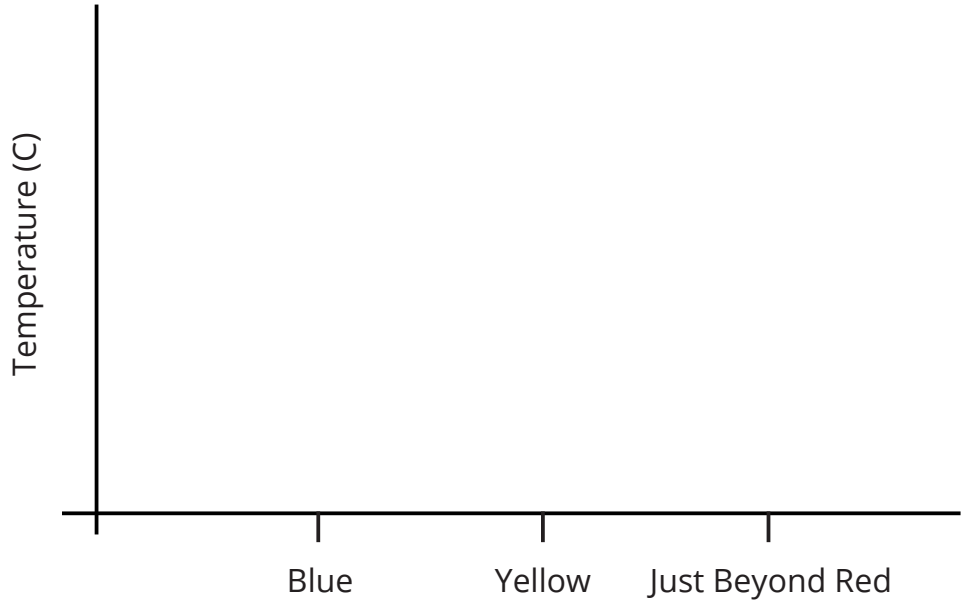
Calculate the average final temperatures measured by the class in each part of the spectrum

	Sum of final Temps (X)	Total number of final measurements (Y)	Class average (X / Y)
Blue at 5 minutes			
Yellow at 5 minutes			
Just beyond red at 5 minutes			

Calculate the difference between the control temperature and the class average final temperature for each part of the spectrum

Blue: _____ °C Yellow: _____ °C Just Beyond Red: _____ °C

GRAPH THE TEMPERATURE DIFFERENCE BETWEEN THE CONTROL AND EACH PART OF THE SPECTRUM



Conclusions

1. What are your thoughts on the temperature measurements? Did you notice anything interesting? If so, what? Explain.

2. Did you see any trends in your data? Explain.

3. Which portion of the spectrum had the highest temperature after 5 minutes? Why do you think this portion had the highest temperature?

4. What do you think exists just beyond the red light, where there was no color? What do you think caused this area to increase in temperature?

5. Was there anything that went "wrong" during this experiment that you think may have affected your results? If so, discuss them here.