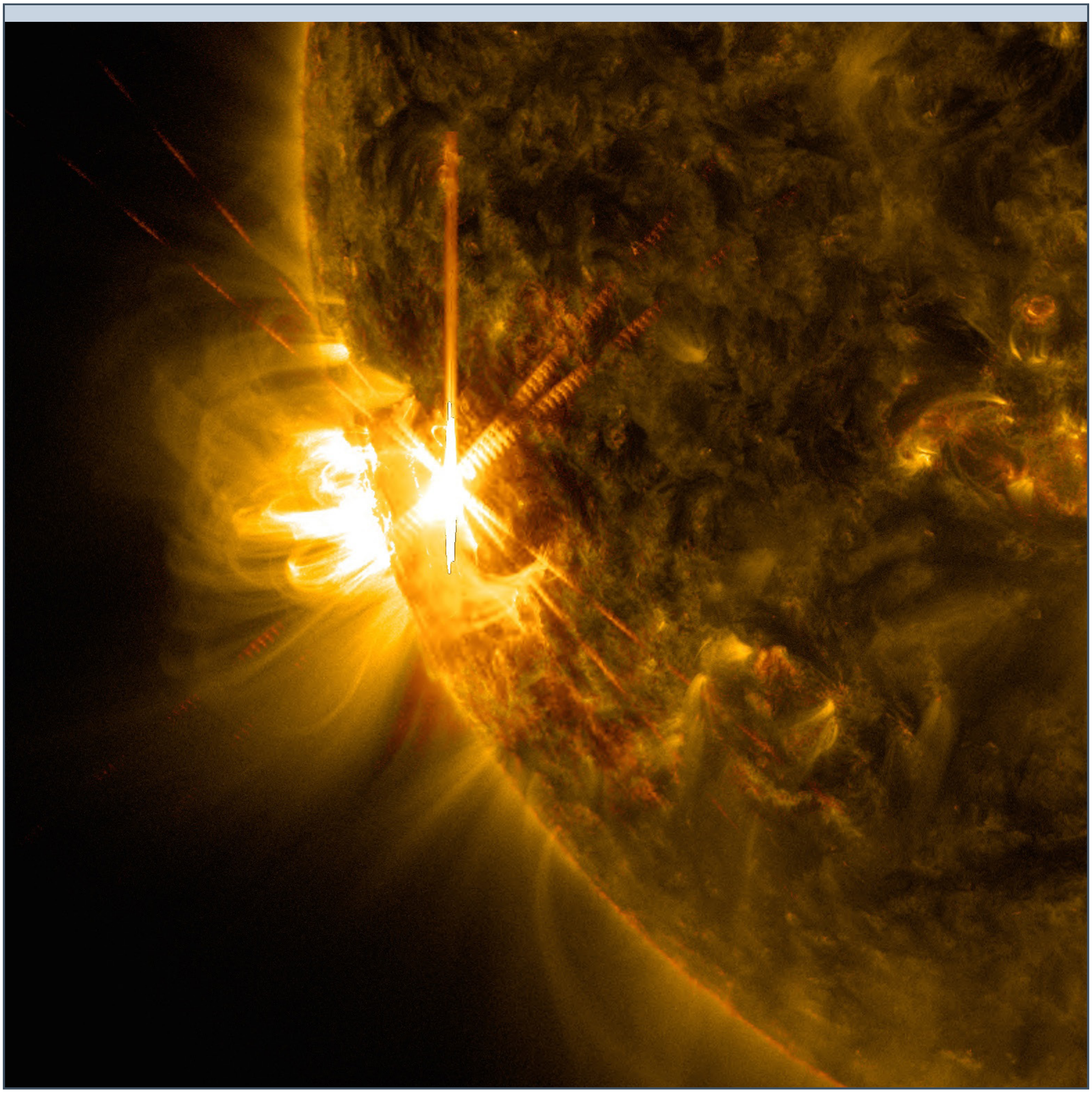
Journey To The Sun Teacher Guide Lesson 3

Grades: 6 - 8

Duration: 1 class period

Standards: MS-ESS1-2
MS-PS4-2
MS-ESS3-5



The Sun as a Star

Funded by the National Science Foundation

www.nso.edu

Objectives

At the end of this lesson, students will be able to:

1. Identify infrared as a form of light energy.
2. Describe the Sun as a star with a magnetic field.
3. Describe properties of stars and how they are formed.
4. Explain fusion and gravity, including the roles they play in a star's life cycle.

Standards

MS-ESS1-2
Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.

MS-PS4-2
Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

MS-ESS3-5
Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Key Vocabulary

Atoms

Electrons

Fusion

Gravity

Infrared

Ions

Magnetic Field

Plasma

Materials

- ☐ Lesson Packet: www.nso.edu/educators/jtts-curriculum
- ☐ Slideshow: "***The Sun as a Star***"
- ☐ Video ***A Star is born.mp4***
- ☐ Activity Materials (see activity sheet)

Background

This lesson is an introduction to the Sun as a star. What is a star? What are they made of? How do they shine? Why are they hot? These are questions that will be answered throughout this lesson. Students interact with the presentation as they learn about ***fusion*** and ***gravity*** and the roles they play throughout a star's life cycle. An informational video is included by the "How the Universe Works" series, published by the Science Channel on YouTube, to engage students in the processes involved in star formation. Lastly, students learn of the Sun's magnetic fields as responsible for space weather and the solar events that affect us here on Earth, which will be covered in more detail during lesson 4: "The Dynamic Sun".

DIRECTIONS

As students enter the classroom, have Slide 1 on display. This will give them a chance to ponder the questions: "What is the Sun?" "What are Stars?" "What are they made of?"

Slide #

2. Reveal the answers to the questions on slide 1. The Sun is a star made of hot plasma. Because of the Sun's intense heat, electrons are stripped from it's atoms, leaving free electrons and positively charged ions. This ionized substance is called plasma.

3-4. Using the images provided, lead a discussion on vocabulary terms: ***atoms***, ***electrons***, ***plasma***, and ***protons***.

5-6. Why do the Sun and other stars shine? It shines because it's hot. All hot objects give off light, although not all objects give off visible light. It's only when objects are really hot, like the Sun for example, that they glow in light that is visible.

*<u>Example</u>: When animals and humans have warm body temperatures, they give off invisible light called **infrared.***

7. Use the images provided to lead a discussion of infrared radiation and how special cameras, like telescopes, can be used to detect the infrared energy (heat) coming off of objects. These two pictures were taken simultaneously. Compare and contrast what you see in each.

8-10. Why is the Sun hot? It's hot due to ***gravity*** and ***fusion***. The Sun is made up of huge amounts of matter. The more matter, the more gravitational force. Gravity compresses matter; as matter is compressed, it heats up.

11. Play the simulation demonstrating how galaxies are pulled together by gravity.

12. Play the embedded movie "How a star is born". In the movie, scientists describe how gravity, pressure, and time work together to form a star like our Sun. The star will then use hydrogen and helium throughout its life as fuel for nuclear fusion. Nuclear fusion is responsible for creating the heavier elements (i.e. oxygen, carbon, etc.) necessary for us to survive. Fusion also releases heat and allows stars to shine.

13-16. Discuss the process of fusion. Use the images and fusion gif as visual aids. As atoms fuse to form heavier elements, light and heat energy are released.

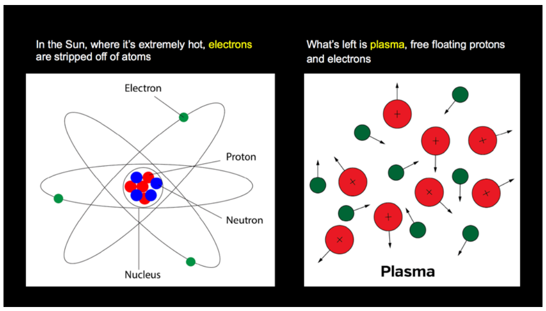
Fun Solar Fact: *The Sun radiates enough energy to melt a bridge of ice 2 miles wide, 1 mile thick, and extending the entire way from the Earth to Sun in 1 second!*
Fact provided by Dr. Louis Barbier (reference included on last slide).

17. Review questions from the video "How a Star is Born".

"The Sun as a Star" Guided Notes

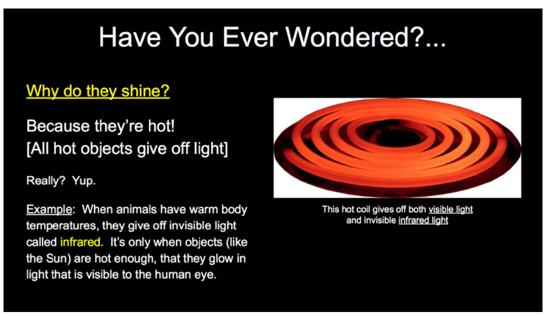
The Sun is a ________. It's made of really _______ plasma.

The _______ is made of __________!



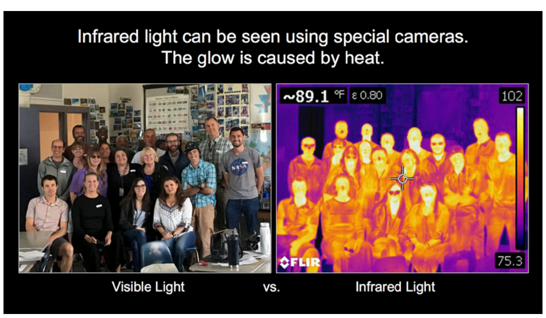
In the Sun, where it's extremely _______, _________ are stripped off of _________.

Plasma is made of free floating _______ and _________



The sun and other stars shine because they're _______.

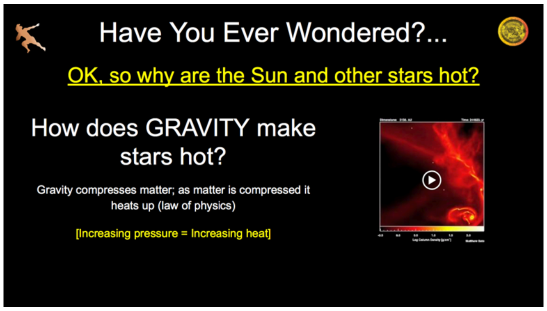
Example: When animals have warm body temperatures, they give of invisible light called ___________.



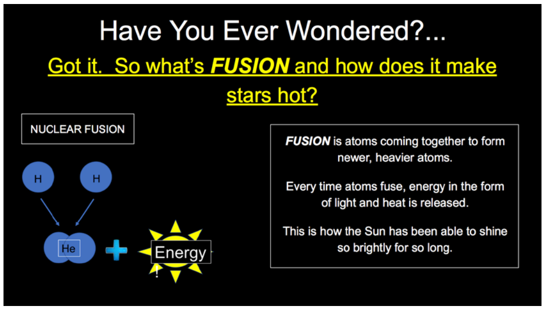
_________ light can be seen using special ________.

The glow is caused by _______.

The Sun and other stars are hot due to: _____________ and ____________



Gravity makes stars _______. Gravity _________ matter; as matter is ___________, it _______ up.



______ is atoms coming together to form heavier atoms.

Every time atoms fuse, _______ in the form of ______ and ______ is released.

Stars - A Review

- ◻ What are stars made of?
- ◻ How are they born?
- ◻ Why are they important?
- ◻ Remember, the Sun is a star, why is the sun important to us?

Activity - Electromagnetic Spectrum Poster

Adapted by NSO from "EM spectrum poster project guidelines" © 2014 Florida State University. cpalms.org

Objective

Become familiar with the electromagnetic spectrum.

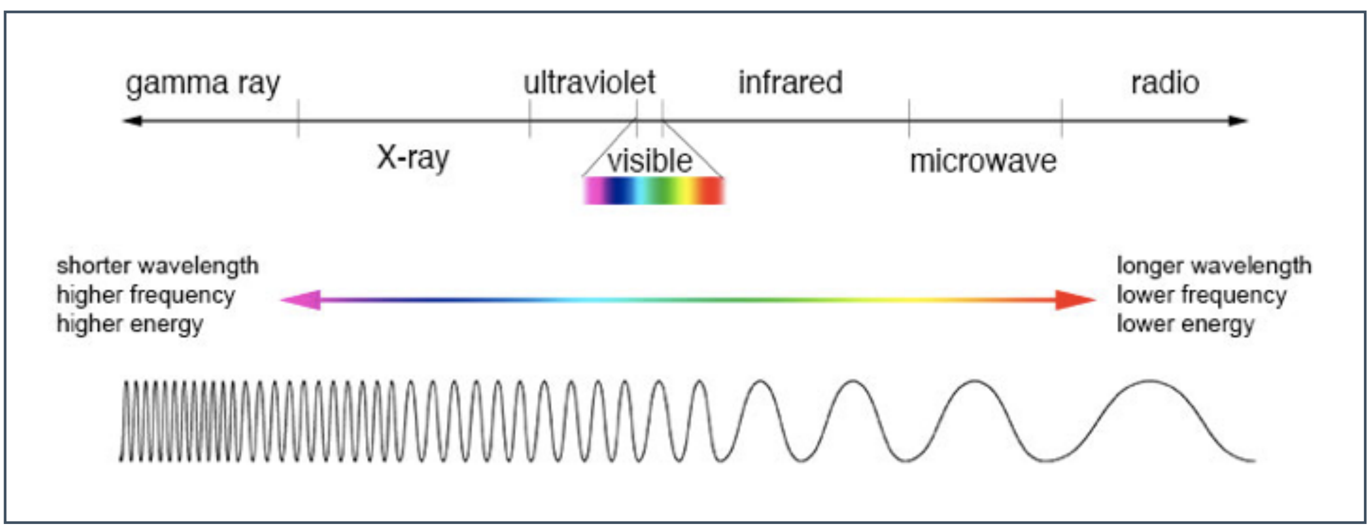
This activity is an optional pre-requisite to lessons 4 and 5, which incorporate topics requiring knowledge of electromagnetic energy waves and their properties.

Materials

- ◻ Poster paper
- ◻ Markers
- ◻ Internet access or alternative source for information

Background

The Electromagnetic (EM) Spectrum is the range of wavelengths and frequencies of electromagnetic radiation. The EM spectrum includes frequencies lower than the low radio frequencies used in radio communication and extends to gamma radiation, a short-wavelength, high-frequency radiation. The wavelengths covered in the EM Spectrum span from lengths smaller than an atom to those measuring thousands of kilometers long. Radiation energy falling within specific ranges of the EM spectrum are used for multiple purposes, including radio communication, medical diagnostics, reheating food, and night vision technology to name a few.



EM Spectrum - https://imagine.gsfc.nasa.gov/Images/science/EM_spectrum_compare_level1_lg.jpg . Retrieved 7/24/17

Directions

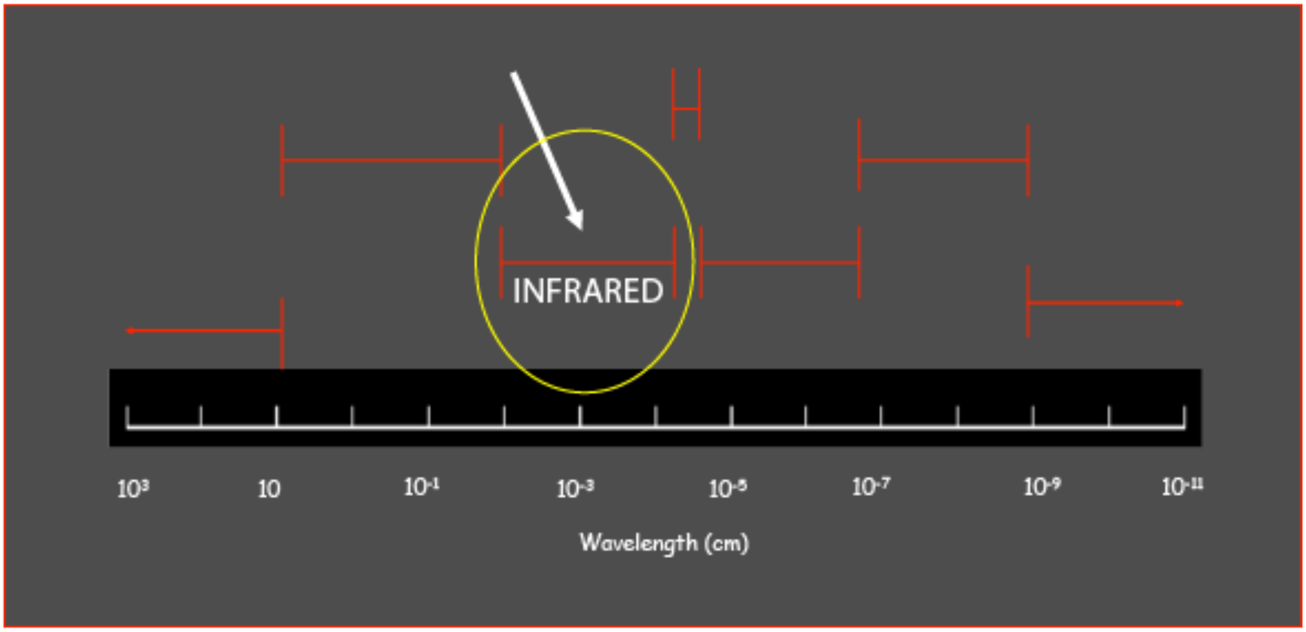
1. Assign students working in groups of 2 or 3 a specific region of the electromagnetic spectrum (i.e. radio, microwaves, infrared, visible, ultraviolet, x-ray, gamma).
2. Students will then research their assigned area of the Electromagnetic Spectrum and create a poster or other means of presenting their research. Posters must include the following information:
    a. Title and assigned region of Electromagnetic Spectrum
    b. Where is this type of radiation located on the EM Spectrum? What properties of the energy wave define its location in the spectrum?
    c. Key characteristics of the assigned radiation type (i.e. wavelength, frequency, key information, etc.)
    d. How is the assigned radiation type used or found in everyday life and/or industry? Identify and explain at least 3 uses.
    e. Is the radiation type harmful, beneficial, or both? Provide evidence to support your argument.
    f. At least 3 references, cited in a format designated by the teacher.

Assessment

1. Have students participate in a gallery walk in order to learn about the different types of radiation energy from the work of their classmates.
2. See the slideshow presentation titled “Interactive EM Quiz”. This is an interactive quiz on the electromagnetic spectrum, where students identify the type of radiation energy that is displayed on each slide.

Sample Student Poster

Infrared Radiation



Night Vision &
Heat Sensing

Cooking and Heating

Studying complex structures
in galaxies and nebulae

Can be both Harmful and Beneficial!

Harmful - too much can cause burns
Helpful - night vision, cooking, scientific discovery

Wavelengths: 0.0010 cm to 0.1 cm
Frequencies: 3 GHz to 400 THz

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***

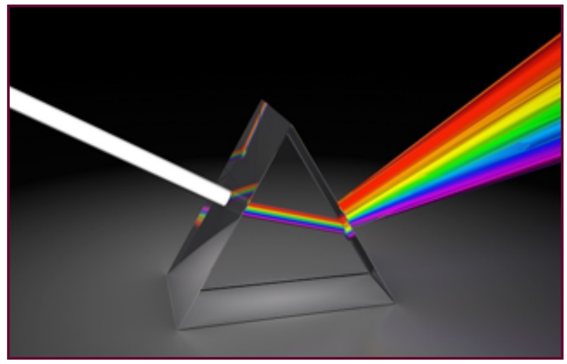


Image Credit: Mmaxer/Shutterstock.com.
Retrieved 11/29/17

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.

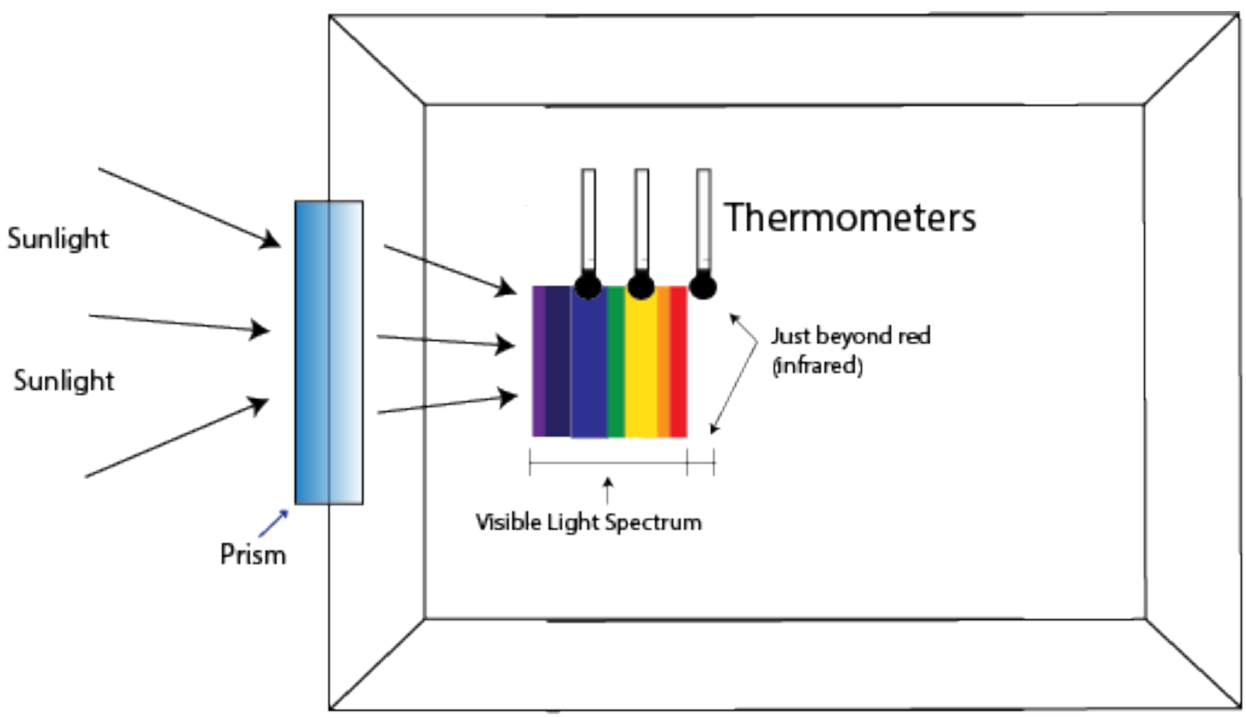
2. Place a blank, white sheet of paper in the bottom of the cardboard box.

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

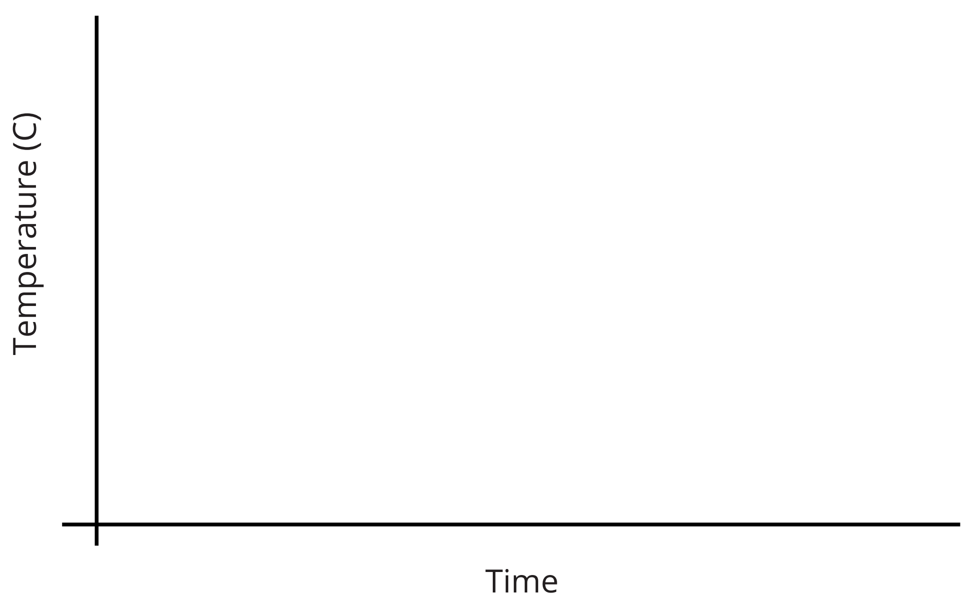
Student Data Sheet

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

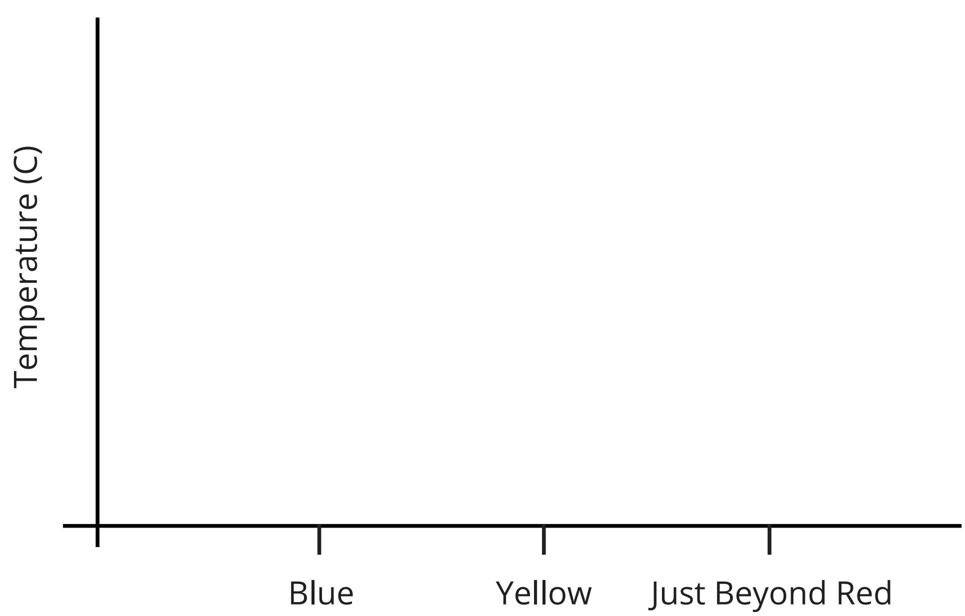
Calculate the average final temperatures measured by the class in each part of the spectrum

	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.

The National Solar Observatory (NSO) is the national center for ground-based solar physics in the United States and is operated by the Association of Universities for Research in Astronomy (AURA) under a cooperative agreement with the National Science Foundation Division of Astronomical Sciences.

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