

Chapter 13: Build a Spectroscope

Student Worksheet

Objective:

Build a spectroscope out of simple materials and use it to look at different light sources.

Engage:

Hold the diffraction grating by the edges. Look around the room. What do you see? What can you observe by playing around with this spectroscope?

Introduction:

The vast majority of what we know about the universe comes from light. The vast majority of what we know about light comes from spectroscopy. The spectrum of a star or galaxy can tell us about its temperature, composition, velocity, and more. Today you will make a spectroscope which will separate visible light into its spectrum. You can use your spectroscope to observe different light sources to learn more about the light you see. You will also learn about the three types of spectra: continuous, absorption, and emission.

A SAFETY NOTE: NEVER LOOK DIRECTLY AT THE SUN.

You will be looking at different light sources during this activity. The Sun can be viewed outside by looking at the sunlight bouncing off a white sheet of paper.

Materials:

- Half a manila folder, or an 8.5 x 11 inch piece of card stock
- Piece of dark colored paper
- 3 3x5 index cards
- Diffraction grating- *Do not touch this with your fingers; grab by edges.*
- Tape
- Scissors

Procedure:

1. Lay the dark colored paper on top of the manila folder half.

2. Roll the two sheets together into a tube with the dark paper on the inside of the tube. This should be rolled from the short end. You should end up with a cylinder 8.5 inches long with an opening approximately 2.5 inches in diameter.
3. Tape your tube shut across the seam.
4. Cut a 1-inch square hole in the center of 2 of the 3 index cards.
5. Cut the remaining index card in half, resulting in 2, 2.5x3-inch cards. Discard one of the halves. Cut the other in half again, resulting in two cards that are 25% of the original size.
6. Tape the diffraction grating to cover the 1-inch hole on 1 of the index cards.
7. Use the two halves of the index card you cut to make a narrow, vertical slit over the 1-inch hole on the other card. The slit should be as wide as the thickness of 2 index cards. So not really wide at all. Figure 1 shows the slit a bit wider than it should be.

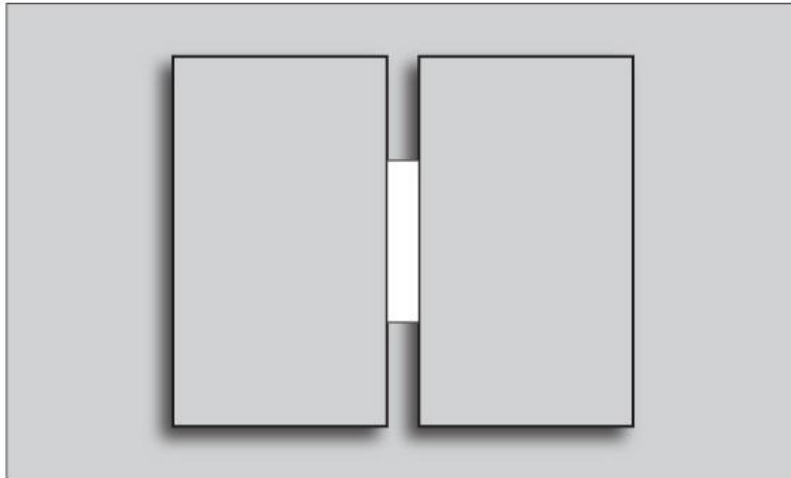


Figure 1 The slit covering the diffraction grating

8. Tape the card with the diffraction grating to one end of the tube.
9. Look through the tube from the end with the diffraction grating. Point the open end of the tube toward a light source. Moving your eye to the left or right, you should see a rainbow – a spectrum. Turn the tube until the rainbows are horizontal.

10. Keeping your tube in the position that produces a horizontal rainbow, tape the card with the slit on the other end of the spectroscope. The slit should be vertical.
11. Your spectroscope is complete. Your instructor will have a variety of light sources at which you can point your spectroscope. Try to line up your line of sight through the slit at the end of the spectroscope to the light source.

Conclusion:

1. What kind of spectrum--absorption, emission, or continuous-- would you expect to see if you looked at the Moon?
2. Explain why a fluorescent bulb produces an emission spectrum.
3. Explain why an incandescent bulb produces a continuous spectrum.
4. The Sun's spectrum is an absorption spectrum. If stars are large bodies of gas, why would they not produce emission spectra?
5. Which color of light appears closer to the light source--blue or red?

Extend:

- The element Helium was discovered using stellar spectroscopy. Learn the exciting story of Helium's discovery.
- Look at the designs of spectrographs used on different kinds of telescopes. How would the spectrograph on an infrared telescope be different from one on an optical telescope?