



Question: How can you make light and study it?

 **Safety Tip: Do not try to walk around while the lights are off!**

1 Examine the effects of light on glow-in-the-dark material

Follow the procedures for part 1 and record your observations from the experiments below.

2 Recording and analyzing your results

a. What happened when the light was not allowed to strike the material? Explain.

b. What happened when light was trapped under the white paper? Explain.

In answering these questions, keep in mind that light is a form of energy. Explain what happens to the energy in both of these situations.

3**Examining the colors of light given off by a glowing source**

Record your observations from part 3 in the table.

Description of light source	Pattern observed using the diffraction grating

4**Analyzing your results**

Are there some light sources that have identical light patterns? List and describe those here.

5**What did you learn?**

- a. What must be happening if two different light sources have the same pattern?

- b. Could an astronomer use the techniques you used in the Investigation to identify and learn about different stars? Explain your answer.

- c. Some materials give off light when they are heated. How could a chemist use the techniques you used in the Investigation to identify and learn about different materials? Explain your answer.

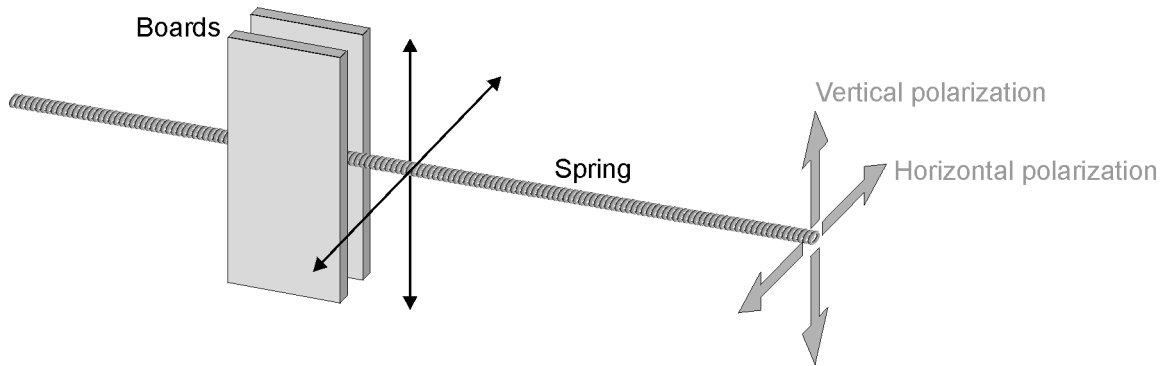
6 Polarization of a transverse spring wave

There are no questions to answer in part 6.

7 Describing and applying what you see

- a. Describe the motion of the spring using the terms ‘horizontal polarization’ and ‘vertical polarization’. Your description can be in words, diagrams, or both.

- b. Suppose you try to ‘sandwich’ your spring wave between two boards. What happens to the waves if you make them pass through the narrow space between the boards? If the boards were oriented like the one below, discuss how the two different polarizations of waves would behave. Which one would get through the slot and which one would be blocked?



- c. Describe the polarization of water waves. Are there two polarizations (like the spring) or only one? What is it about a water surface that makes it different from a spring?

8 The polarization of light

There are no questions to answer in part 8.

How do you explain what you see?

- a. The light from the sun (or a lamp) is not polarized. This means it is a mixture of light that is polarized equally in all directions. Explain why the light is reduced passing through one polarizer.

- b. When the light passes through the first polarizer it becomes polarized. We say light is polarized when it consists of only one polarization. Explain why rotating the second polarizer changes the amount of light you see coming through.

- c. The glare from low-angle sunlight reflecting from water and roads is polarized in the horizontal direction. Ordinary sunlight is not polarized. Explain how polarizing sunglasses can stop most of the glare but still allow half the regular (unpolarized) light to come through.

Extra space for notes:



Question: What happens when you mix different colors of light?

1 Mixing primary colors of light

- a. How many colors do you see in the light pattern on the screen?

- b. Use colored pencils to draw the light pattern in the space below. Pay attention to the colors of light you see when two light beams overlap.

- c. What color of light do you see when two LED light beams overlap? Write your answers in table 1.

Table 1: Mixing primary colors of light

LED color combination	Color you see
Red + Green	
Green + Blue	
Blue + Red	
Red + Green + Blue	

2**How does a color filter work?**

Record your observations in Table 2.

Table 2: Examining LEDs

Red LED	Green LED	Blue LED
White LED		

3**Drawing conclusions**

- a. Compare the colors in the red LED to those in the green LED. What are the similarities and differences in the range of colors?

- b. Compare the colors in the green LED to those in the blue LED. What are the similarities and differences in the range of colors?

- c. How do the colors in the white LED compare to the red, green, and blue LEDs combined?

- d. The red LED consists of a white LED covered with a red filter. What does the red filter do?

- e. What do color filters do?

- f. If you wanted to get yellow light, what part of the spectrum would the color filter have to absorb?

15.1

Seeing an Image



Question: What does magnification really mean and how do you plot a reflected image?

1 Finding the magnification of a lens

1. Record your data in Table 1.

Table 1: Magnification of a lens

Distance to paper	# of squares on graph paper (unmagnified squares)	# of squares in lens (magnified squares)	Magnification

2 Reflections in a mirror

There are no questions to answer in part 2.

 **Safety Tip: NEVER look directly into a laser beam. Some lasers can cause permanent damage to your eyes.**

3 Thinking about what you observed

- a. Describe how the magnification changed as you changed the distance from the paper to the lens. Does the magnification get larger or smaller with distance?

b. Could you adjust the distance between the paper and the lens to get any magnification you wanted, or was there a point where the lens could no longer create a sharp image?

c. Describe why the image formed by a mirror appears to come from the place where the reflected rays meet. Your answer should use the concept that each point on an object is the source of many rays of light. You might want to include a sketch on separate paper.

d. Pick one pair of incident and reflected rays. Draw a straight line perpendicular to the point where the rays hit the mirror. This perpendicular line is called the **normal** in optics. Use a protractor to measure the angle between the incident ray and the normal, and between the reflected ray and the normal. From your angles, what can you say about the relationship between the direction of the incident ray and the direction of the reflected ray?



Question: How does a lens form an image?

 **Safety Tip: Never look directly at the laser beam, or shine the laser beam at another's person's eyes.**

1 Refracting light through a prism

There are no questions to answer in part 1.

2 Refracting light through a lens

- a. Describe the path of the laser beam as it travels along the axis and through the lens. Compare the paths of the incident and the refracted rays.

- b. Describe the path of the laser beam as it travels parallel to the axis, above or below the axis. Compare the paths of the incident and refracted rays.

- c. How is the path of light through a converging lens like the path of light through a prism?

3 Finding the focal point

There are no questions to answer in part 3.

4**Finding an image**

There are no questions to answer in part 4.

5**Characteristics of the image**

Compare the image of the arrow to the original arrow.

- a.** Is the image larger or smaller? Calculate the magnification by dividing the length of the image by the length of the original arrow.

- b.** Is the image right side up, or is it inverted?

- c.** Is the image closer to the lens than the original arrow, or is it farther away?

Name:

15.3

Optical Technology

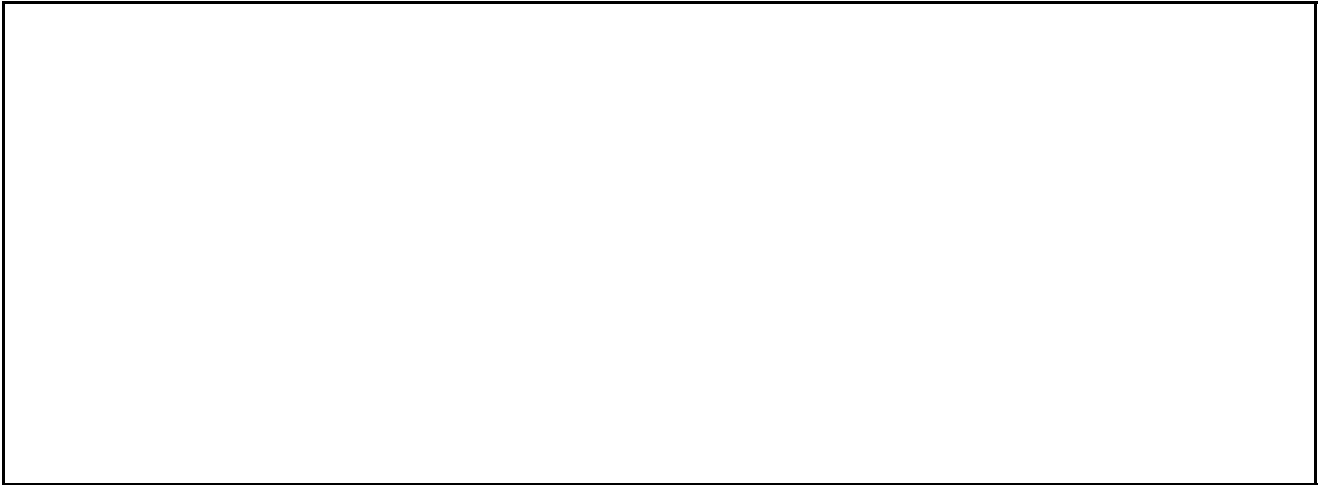


Question: How are optics used in everyday life?

1 The critical angle of refraction

- a. What happens to the image you see through the prism? Is it an X or an O?.

- b. Draw a diagram showing the path of the light rays when you see the X.



- c. Draw a diagram showing the path of the light rays when you see the O.

