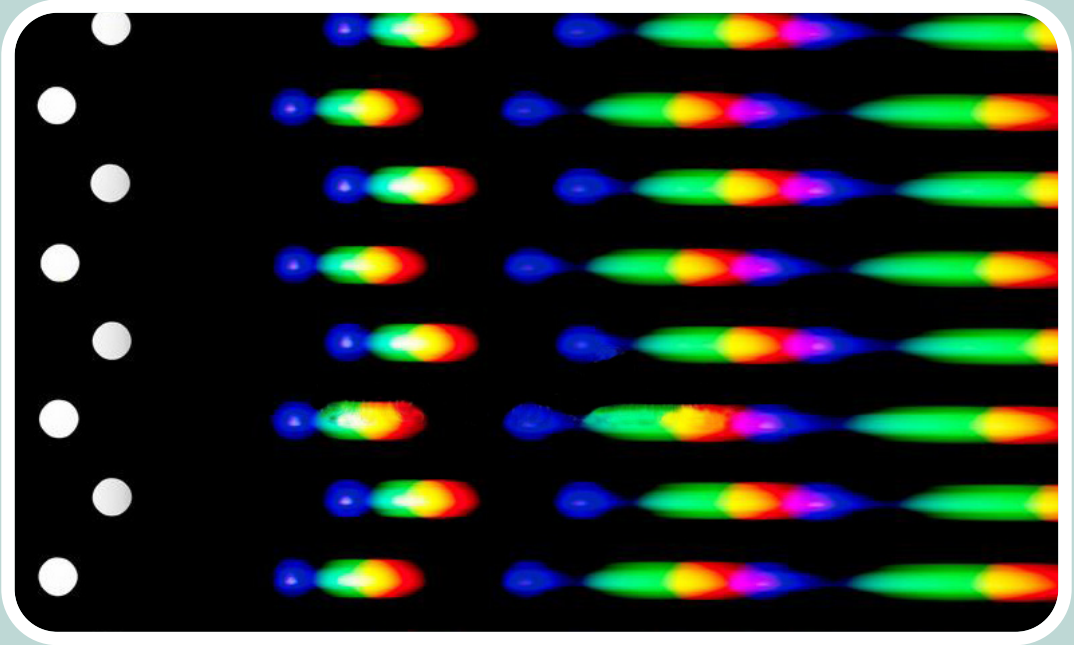
STEM Sims™

Diffraction



STEM Sims™

Diffraction

Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.

Light waves bending around an object? Is this possible? Take the following brief quiz to see how much you already know about the diffraction of light. See the bottom of page 4 to check your answers.

1. The diffraction of light is used to measure the strain of materials under a load by monitoring the changes in the:
   a. temperature of the material.
   b. time it takes the material to fracture.
   c. volume of the load.
   d. spacing of atoms in certain planes.

2. Holograms are 3-D impressions of an object. Holograms use the diffraction of light to create these images. The word “hologram” is derived from two Greek words meaning:
   a. whole and message.
   b. part and sign.
   c. angel and feature.
   d. light and plate.

3. X-ray diffraction is used to find the distance between two consecutive atoms in an element.
   a. true
   b. false

4. What is the cause of a cloud appearing to have a “silver lining?”
   a. The outer edges of a cloud have more water than the inner parts of a cloud.
   b. The pressure at the outer layers of a cloud is greater than the inner layers.
   c. The temperature of at the outer layers of a cloud is higher than the inner layers.
   d. The sunlight is being bent around the edges of the cloud.

5. When a telescope is used to observe far away stars, the diffraction pattern has a bright central disk in the middle of several fainter rings. What is this pattern called?
   a. Grate pattern
   b. Fuzzy disk
   c. Airy’s disk
   d. Globular pattern

Bending Light

Lasers produce light of one color. This light is called monochromatic light. What happens if laser light shines on a penny? How will the shadow of the penny struck by laser light appear on a screen? Make a prediction and then begin your investigation. Let your light shine!

Materials

2– 2 cm by 2cm pieces of modeling clay
1– penny 1– small laser pointer (cat toy)

Procedure

1. Use caution with the laser pointer. Never shine the laser directly at a person.
2. Place the laser on one piece of the modeling clay as shown in Figure 1 below.
3. Turn on the laser and have the laser light directly strike the light-colored wall.
4. Observe and describe in Table 1 the image made on the screen by the laser.
5. Place the penny on one piece of the modeling clay as shown in the figure below.
6. Arrange the penny and laser as shown in Figure 2 below.
7. Make sure the laser light directly strikes the penny.
8. Observe and note in Table 1 the appearance of the penny's shadow.
9. Turn off the laser.

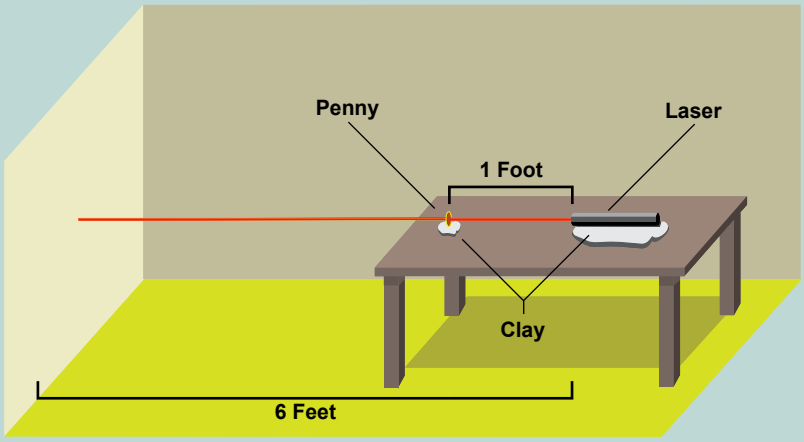


Table 1. Laser Light Appearance

Condition	Observations
Laser striking light-colored wall	
Laser striking penny and penny's shadow	

Questions

1. Describe any differences in your prediction of the shadow made by the laser and penny and your observations of the penny's shadow.

2. Propose a reason for how and why the penny's shadow appeared as it did on the wall.

Diffraction

What's on the Inside?

Scientists have created instruments and techniques for finding the molecular structure of a crystal. This process is called X-ray crystallography. Since many materials form crystals, this tool can be used to determine the size of atoms, the lengths and types of chemical bonds, as well as the structure and function of many important biological molecules. The structures of salts, metals, minerals, vitamins, proteins, semiconductors, and DNA have all been characterized using X-ray crystallography.

The device and technique work by the crystalline structure of the substance being studied causing a beam of incident X-rays to diffract into many different directions. The measurement of these beams' angles and intensities produces a 3D image of the density of the electrons associated with the crystal. The electron density can then be used to locate the specific position of atoms within the crystal and identify the chemical bonds associated with each atom.

In practice, a crystal is first mounted on a goniometer that positions the crystal atspecific orientations. A goniometer is an instrument that measures an angle or allows an object to be rotated into precise angular positions. The crystal is then bombarded with a monochromatic beam of X-rays that produce the diffraction pattern that is specific to the atomic makeup of the crystalline substance. The pattern is then compared to other patterns to discern the atoms and chemical bonds that make up the crystal.

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STEMsims.com

Answers: Page 2 Answers: 1) d, 2) a, 3) a, 4) d, 5) c. **Page 3 Answers:** Bending Light 1) Answers will vary. 2) Light can act as a wave and bend around objects in a process called diffraction.