Light Intensity

Lesson 1 of 2

Grade Level: 9-12
Subject(s): Physical Science, Physics
Prep Time: 10 – 30 minutes
Activity Duration: 50 minutes
Materials Category: Special requirements

National Education Standards				
Science	Mathematics	Technology		Geography
		ISTE	ITEA	
3e, 3f, 5a				

Objective:

To measure the intensity of a light as it is moved away from the light probe of a calculator-based laboratory (CBL).

Materials:

(Per group of three)

- Meter stick
- Shadeless lamp or socket
- One light bulb (40 watts or less)
- Light probe
- Ring stand
- CBL unit with light intensity program
- TI-83 graphing calculator or equivalent

Related Link(s):

Modification of lesson from NASA Imagine
Apparently, They Are Absolutely Bright
http://imagine.gsfc.nasa.gov

Light Intensity

Teacher Sheets

Pre-lesson Instructions

Do this activity without the students first to learn how to use the TI-83 function BULB.

Background

The intensity of light decreases the farther away a light of a given intensity is. The inverse square law governs the relationship between the distance of a source of light and its apparent intensity. The inverse square law for light states that as the distance between a source of light and its sensor doubles, the light appears to become 1/4 as intense. Likewise, as the distance between a source of light and its sensor is halved, the intensity of the light appears to quadruple. The actual light does not vary. It only appears to do so as a result of being sensed at a different distance; the farther away it is sensed, the larger the area the photons are spread over and the fewer are sensed.

The relationship can be expressed most simply as: one over the distance squared ($1/d^2$).

Guidelines

1. Read the 9-12 NASAexplores articles, "Slow and Steady Wins The Race…To Distant Space." Discuss the advantages and disadvantages of using solar cells. Have students make a list of information that must be known before solar cells can be experimented with (in particular, focus of sunlight waves' intensity).

2. Distribute materials to groups of three.

3. Review with students how to use the CBL and the graphing calculator.

Discussion / Wrap-up

Have students write a conclusion paragraph summarizing the activity and their findings.

Extension(s)

- Perform the experiment again with either a brighter or dimmer bulb. Consider also taking data at different distances.

- Examine how the inverse square law is applied to sound waves.

- Ask students, "*When studying stars how could the inverse square law be used?*"

Light Intensity

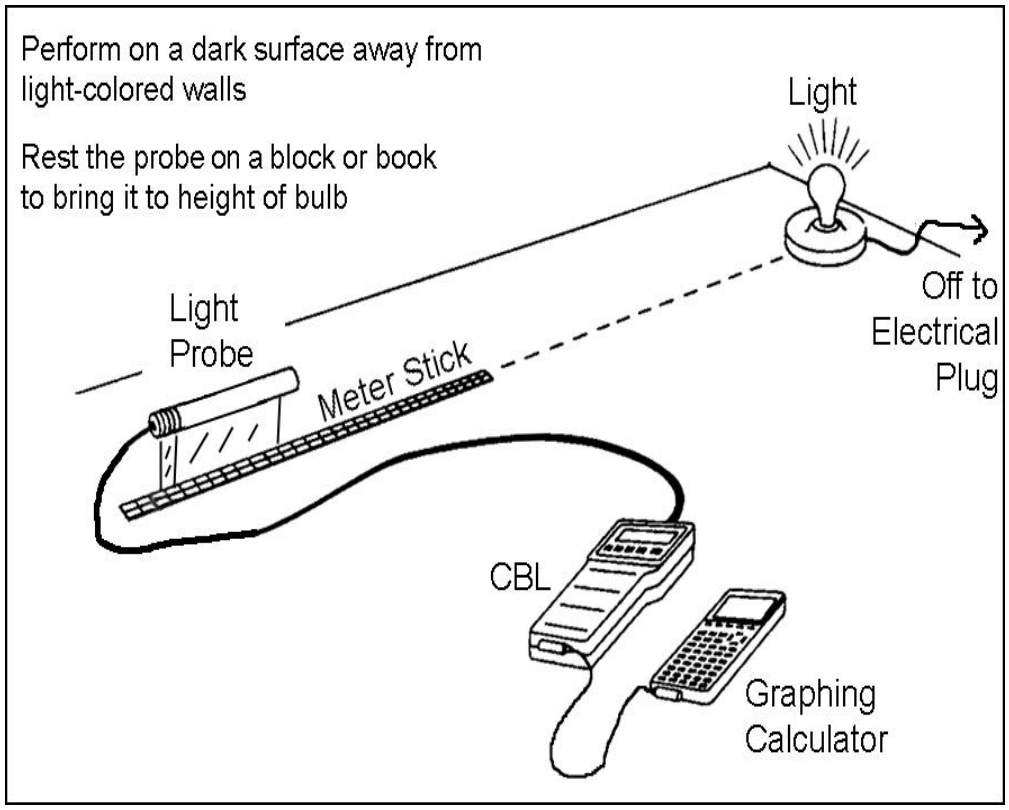
Student Sheet(s)

Materials

- Meter stick
- Shadeless lamp or socket
- One light bulb (40 watts or less)
- Light probe
- Ring stand
- Calculator-based laboratory (CBL) unit with light intensity program
- TI-83 graphing calculator or equivalent

Procedure

1. Place a 40-watt (or less) bulb in a shadeless lamp or socket.
2. Put a meter stick 2 meters away from the bulb.
3. Clamp the light probe to a ring stand so that it is the same height as the light source.
4. Place the light probe next to the end of the meter stick. While taking intensity readings, the light probe should be pointed directly at the illuminated bulb. Make sure nothing obstructs the path between the two. Darken the room.
5. Connect the light probe to the CBL unit.
6. Set up the light probe so that the CBL automatically measures the intensity of light falling on the probe and displays the intensity. Run the appropriate program on the TI-83 (either BULB, LIGHT, or PHYSCI), and follow the directions it gives you.
7. Measure the intensity of a light at 2 meters. Increase the distance between the probe and the light source in 2-centimeter units. Record measurements until you have 10 measurements. The resulting data can be graphed and analyzed.



Questions

1. Plot the light intensity (y-axis) versus distance (x-axis).
2. What happens to the light intensity as the probe becomes closer to the source?
3. Use data-plotting software to vary the power of the x-y values so that the plot of intensity versus distance is a straight line. What does the graph look like?
4. What relationship does the graph suggest between the light intensity and the distance?
5. How would using a brighter or dimmer light bulb affect your data readings?
6. Explain the inverse square law of light propagation.