

9. Measuring Light Intensity

Bright Lights

Driving Question

How does the brightness of an incandescent light bulb vary with distance?

Materials and Equipment

For each student or group:

- | | |
|---|--|
| <input type="checkbox"/> Data collection system | <input type="checkbox"/> Lamp with incandescent light bulb, without a shade |
| <input type="checkbox"/> Light sensor | <input type="checkbox"/> Clear and frosted incandescent light bulbs (optional) |
| <input type="checkbox"/> Sensor extension cable | |
| <input type="checkbox"/> Meter stick | |

Safety

Add this important safety precaution to your normal laboratory procedures:

- Do not touch or stare directly at the light bulb while it is lit—extreme burns and damage to the eyes might result! Any metal or plastic directly touching the light bulb might get very hot.

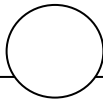
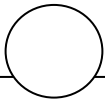
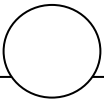
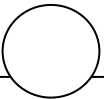
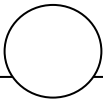
Thinking about the Question

When you are studying at night, does it matter how close you sit to the light? What is the light intensity at the position you find best? When the light bulb is turned on, light spreads out as it travels away from the bulb. The farther you are from the source of light, the larger the area a given amount of light covers.

Keeping this in mind, work with your group to design a way to determine the ideal distance you should be from the light bulb while studying at night.

Sequencing Challenge

The steps below are part of the Procedure for this lab activity. They are not in the right order. Determine the proper order and write numbers in the circles that put the steps in the correct sequence.

				
Analyze the way the light intensity changes with increasing distance from the light bulb. Find the light intensity at the study point.	Design a way to obtain light intensity using the light sensor at different distances from the light bulb.	Make sure that each lab group member is aware of safety rules for this lab.	Determine the best distance from the light bulb for studying.	Connect the light sensor to the data collection system. Record the light intensity at the different distances.

Investigating the Question

Note: When you see the symbol "◆" with a superscripted number following a step, refer to the numbered Tech Tips listed in the Tech Tips appendix that corresponds to your PASCO data collection system. There you will find detailed technical instructions for performing that step. Your teacher will provide you with a copy of the instructions for these operations.

Part 1 – Designing a research method and making predictions

- Design a method of measuring light at varying distances (between 20 to 80 cm) from a light source at intervals of 10 cm. Record your investigative procedure by writing a description of your plans or steps in the space below.

- Predict how the intensity of the light changes as you increase the distance from the light bulb.

Part 2 – Measuring the light intensity

3. Start a new experiment on the data collection system. ♦^(1.2)
4. Connect the light sensor to the data collection system. ♦^(2.1)
5. Display light intensity in a digits display. ♦^(7.3.1)
6. Put the data collection system into manual sampling mode with manually entered data. ♦^(5.2.1)
 - Note:** Enter "Light Intensity" with the units of "lx" and "Distance" with the units of "cm", with two digits past the decimal point displayed.
7. Start a new, manually sampled data set. ♦^(6.3.1)
8. Using the method of positioning the light sensor your group developed to obtain the light intensity at the different positions from the light bulb, record each data point as follows:
 - a. Record the light intensity and enter the distance from the light bulb. ♦^(6.3.2)
 - b. Record the light intensity for each distance in Table 1.
9. When you have recorded all of your data, stop the data set. ♦^(6.3.3)
10. Display Light Intensity on the y-axis of a graph with Distance on the x-axis. ♦^(7.1.1)
 - Note:** Adjust the scale of the graph as needed. ♦^(7.1.2)

Table 1: Change in light intensity as distance changes

Distance from Light (cm)	Light Intensity (lx)
20	
30	
40	
50	
60	
70	
80	

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Part 3 – Measuring the light intensity at your best study location

11. Determine the distance from the light bulb at the position you find best for studying. Record this distance.

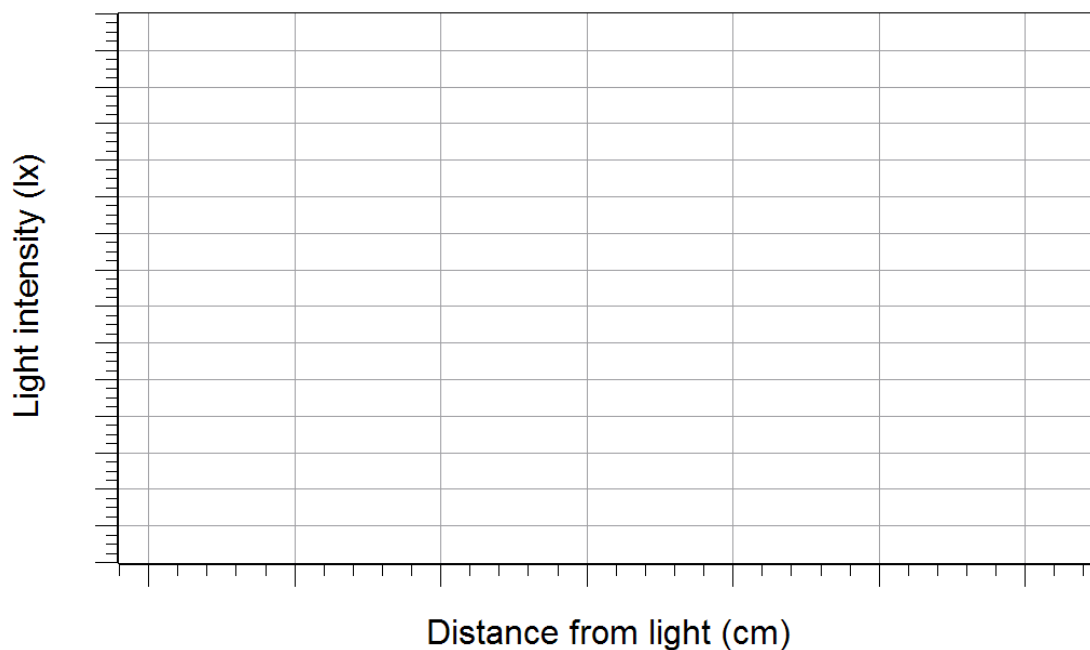
Distance from the light bulb _____ cm

12. Save your experiment $\diamond^{(11.1)}$ and clean up according to your teacher's instructions.

Answering the Question

Analysis

1. Display data in a graph to show Light Intensity versus Distance. $\diamond^{(7.1.1)}$ Sketch the Light Intensity versus Distance on the graph below.



2. Explain the relationship between distance from the source and the light intensity with the diffuser.

3. Using the graph, determine the light intensity at the distance you determined in Part 3. Note this distance on the graph.

Multiple Choice

Circle the best answer or completion to each of the questions or incomplete statements below.

1. In the SI System of measurement, what is the unit for light intensity?
 - A. Watts
 - B. Lux
 - C. Decibels

2. When you are farther away from a light source, the intensity of the light is:
 - A. Less than when you are closer
 - B. Greater than when you are closer
 - C. Exactly the same regardless of your distance away

3. A possible set of data recorded by someone backing away from a light source could be:
 - A. 5.8 lux, 33.8 lux, 1142.4 lux
 - B. 37.5 lux, 7.2 lux, 2.6 lux
 - C. 10 lux, 20 lux, 30 lux

4. Light intensity generally varies with:
 - A. A person's eyesight
 - B. The diameter of the light bulb
 - C. The distance from the light source

True or False

Enter a "T" if the statement is true or an "F" if it is false.

- _____ 1. A graph of light intensity versus distance from the light source will show a curve that decreases as distance increases.

- _____ 2. The light intensity that is best for studying is the same for everyone.

- _____ 3. If a light bulb is "incandescent," it glows as the result of being heated by a current flowing through it.

