Light Lab

Problem: How is the intensity of light affected by distance and what is the relationship between them?

Materials: LabQuest2, LED flashlight, clamp, ringstand, meterstick, red laser, compass ,black paper

Procedure:

Preparation of equipment:

1. Assemble ringstand, clamp and flashlight as shown.
2. Place the **bottom edge** of the clamp on the **top edge** of first tape mark and tighten.
3. Turn on Labquest2 (upper left top).

4. Click on LabQuest App
5. On the meter screen tap **sensors**, then **sensor setup**
6. Check light sensor, then tap **OK**
7. You should see a screen with a red bar containing an illumination reading.
8. In the upper right corner tap on **Mode: time based**.
9. On the pulldown menu from time based, tap on **Events with Entry**.
10. Tap event and type in Distance, then tap **done**
11. Tap **units** box and type in meters for units, then tap **done**.
12. Check to see name and units are correct, then tap **OK**
13. The upper right hand portion of the screen should read **Mode**: events with entry and **Event Name:** distance (meters). If not, re-tap **mode** and re-enter distance and meters
14. Place the LabQuest on the table behind the ring-stand, aligning the light sensor to the center of the flashlight.

Data Collection part I –light intensity (illumination) and distance:

1. Measure the vertical distance from the light sensor to the flashlight in meters.
2. Turn the flashlight on and check alignment. Record the initial illumination value on the data table.
3. *Tap on the **graph icon, graph** and then **graph options**.
4. *Tap on **Y-axis** top box and change top to a value larger than the initial illumination value – tap **done** and **OK.**
5. **Tap on the X axis right to 0.5 M.**
6. *Tap **analyze** tab and tap on **Draw Prediction**.
7. *Draw in your prediction using the stylus starting with your original illumination value and distance.
8. Press **collect** button, when value stabilizes, tap the **keep** button.
9. Enter the **distance** in meters in the box. Tap **OK**
10. Move the clamp with flashlight to the top of the next mark and tighten clamp.
11. Measure the distance in meters between the light sensor and the flashlight.
12. Repeat steps 8-11 for the final two marks. When tapping the collect button a message may appear asking you to **store, append or discard the latest run**. ALWAYS TAP **APPEND**.

13. What do you notice about the illumination value as the flashlight gets farther from the light sensor?
14. Is this a linear relationship?
15. How did your prediction compare with your actual data?
16. Push the square red **stop** button.
17. Tap the **analyze** tab and then tap **curve fit**. Check **illumination** and **choose Fit**
18. **Choose power.**
19. Look at the equation of the line on the fit equation screen. What does the equation tell you about the relationship between illumination and distance from illumination?
20. Determine the equation for illumination and distance (round B to the nearest whole number).
21. How could you linearize the graph?

Data Collection part II area of light with distance.

1. Move the **bottom** of the clamp to the **bottom** of the first tape mark on the ringstand.
2. Mark the center of the black paper with a pencil dot.
3. Remove the LabQuest, turn on the flashlight and center the dot on the piece of black paper under the flashlight.
4. Draw the circumference of the brightest circle of light with a compass. Label and measure the radius.
5. Move the clamp to the next position on the ringstand and tighten clamp. Center the dot under the light and on the same piece of paper draw the circumference of the light at that distance. Measure and record the radius of the circle.
6. Repeat steps 4 and 5 once more for the third circumference and radius.
7. What is the relationship amongst radii 1, 2 and 3?
8. Does the amount of light in each case differ in each circle?
9. Calculate the area of each circle. Divide the area of circle 2 by the area of circle 1. How do they compare? Do the same for Circles 3 and 1.
10. Do you notice any similarity between the relationship of the area of the light and the illumination of light as the distance increases?

Data Collection part III – light intensity and distance with laser:

1. Replace the flashlight with a red laser. Center the laser with the light sensor and repeat Data collection parts I and II. Do not look directly into the laser – look from the side and use the illumination values to guide you.
2. What is the relationship between intensity of light and distance? Area and distance?

	Distance (m)	Light intensity	Radius	Area
Flashlight	0.10			
	0.20			
	0.30			
Laser	0.10			
	0.20			
	0.30			

Analysis:

1. Compare the data between the flashlight and laser.
2. Explain the differences in the data.
3. Why are lasers dangerous to flying airplanes?
4. Linearize the graph of intensity vs distance.
5. Predict the illumination when the distance is 100 cm
6. This same relationship is also true for sound and radioactivity. How is this useful in your daily life?