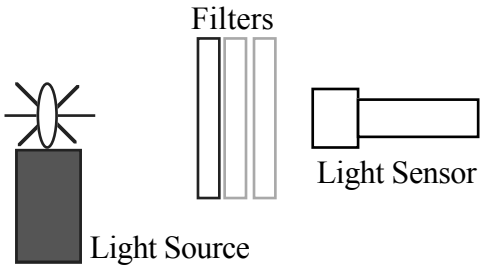
Light Filters

Theory

When light passes through colored plastic (sometimes called smoked plastic), the intensity is decreased. If a percentage of light passes through one piece of plastic, that same percentage should also pass through a second piece. But with less light hitting the second one, the result will be even less light transmitted. This process will continue as more and more filters are placed in front of the light source.

Purpose

Study the absorption of light by smoked plastic filters.



Equipment

Light Sensor, Interface*, Computer, Smoked Plastic Filters, 60-watt bulb in socket

Procedure

1. Plug the Light Sensor into your interface. Set the switch to the middle position, 0-600 Lux. Connect the interface to your computer then launch Logger *Pro* or Logger Lite software. When the software launches successfully, it should have a graph of Light Intensity vs. time.

2. Set up Events with Entry mode where the Entry is the number of filters.

3. Set up a 60-watt light bulb about 30 cm from the Light Sensor. With the light off, take a reading of the ambiant light**. Take readings with various numbers of filters between the light and the sensor.

4. Turn the light bulb off when finished and return the materials to the place indicated by your teacher.

Analysis

1. How does the amount of light passing through the filters change as you increase the number of filters? If you put twice the number of filters, do you get half the illumination? If not, what do you notice about the way the illumination values decrease?

2. Determine the mathematical relationship between the number of filters and the resulting light intensity. This makes an excellent activity for Algebra II mathematics students.

3. Enter your data in a table like the one below. Then calculate the ratio between the next reading and the previous one for each of the steps except the first one.

4. How does the percentage (fraction) of light passing through successive filters behave? Does it go down approximately the same fraction each time?

Data Table

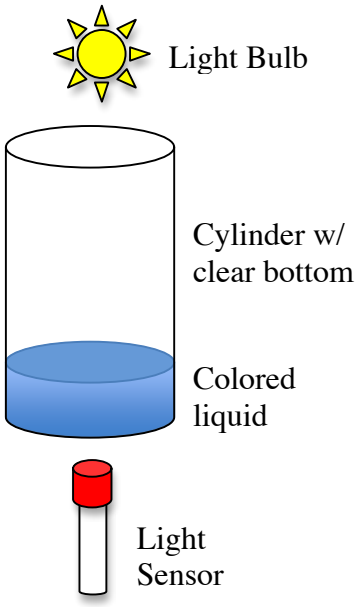
Ambiant light reading: _____

Number of Filters	Total Illumination, Lux	Net Illumination, Lux	Ratio
1			
2			
3			
4			
:			
		Average Ratio	

Extensions

Replace the colored plastic with polaroid filters. Have one that remains fixed while the second rotates through different measured angles. Study the effect that angle between the polaroids has on the amount of light that gets transmitted or absorbed.

A cylindrical tube with transparent bottom could be used for this experiment as shown in the diagram to the right. To reduce ambiant light, wrap black construction paper around the cylinder and extend it below to isolate the Light Sensor. Hold the sensor with a ring stand if needed. Measure the light that is transmitted with different depths of the colored liquid. Note that this directly models the reduction in light intensity as one descends into the ocean.

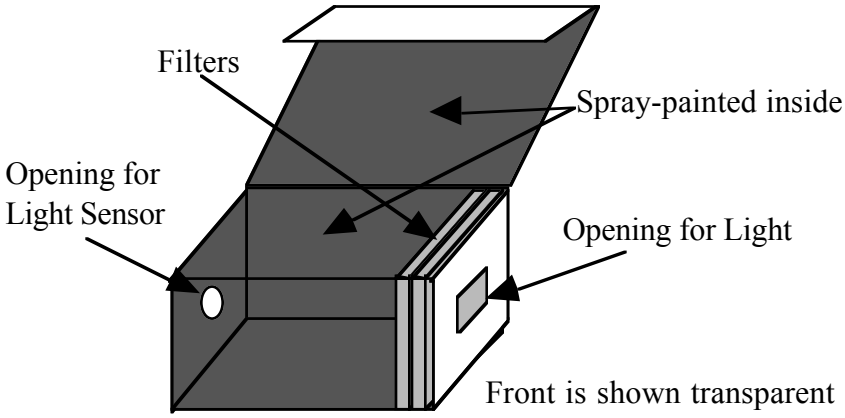


* The interface can be LabPro, LabQuest, LabQuest Mini or Go! Link. All work well in this experiment. Additionally, the lab can be done nicely with Logger Lite as well as Logger Pro. And the experiment can be done with LabQuest only plus the sensor.

** Collect ambiant light readings with the light source turned off. Record the value in your notes. Subtract that reading from the readings with the light source turned on to get the net reading.

Teacher Notes

For this lab, the author found a small cardboard box at a local pack-to-ship company that came flat. He created a hole just big enough for the light probe in one end, and cut out a square at the other end to admit light. Then he spray painted the inside flat black and obtained smoked plastic in just the right size to fit inside the box.



Scheme for Light Filters Box

In practice, the light needs to be stabilized, but could be used by two groups at once. A 60-W bulb seems sufficient. Also, the light box needs to be stabilized, which can be done through use of wide masking tape doubled over on the bottom.

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