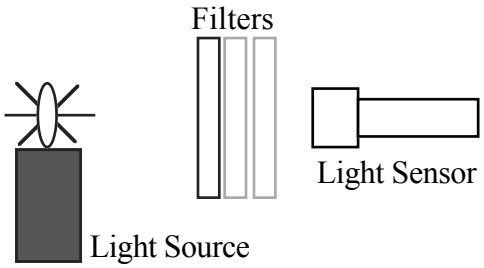
Light Filters (EZ)

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, TI Graphing Calculator with EasyData app, Go! Link or LabPro, Smoked Plastic Filters, 60-W light bulb in socket.

Procedure:

1. Plug the Light Sensor into your Go! Link or LabPro. Set the switch to the middle position, 0-600 Lux. Launch ***EasyData***.

2. When the software launches successfully, it should have found the Light Sensor and should have a temporary data collection setup. If it doesn't find the Light Sensor, select [File] and then select **New** to reset the application. Note

3. Once ***EasyData*** finds the Light Sensor, record the ambiant light reading in the space indicated in the Data Table section. You will now need to change the data collection as follows:

   - Press the button under [Setup]
   - Press **3** to select **Events with Entry**
   - Press the button under [OK]

4. Press the button under [Start]. Note that a [Keep] menu choice appears on the screen. No data is recorded until you press the button under [Keep].

5. The light intensity readings will be shown on the screen. When the value stabilizes, press the button under [Keep]. On the window that appears, enter the number of filters. Press the button under [OK] to complete recording this data point.

6. Now change the number of filters and repeat step (4). Continue adding filters until you complete the number you have. Press the button under [Stop]. Examine the graph and characterize what it tells you about how the light intensity varies as you add more and more filters.

7. Press the button under [MAIN] to return to the main menu, then press the button under [QUIT]. Note the lists that were used for storing the data from this experiment.

8. Turn the light bulb off and return the materials to the place indicated by your teacher.

Analysis:

1. Press the [STAT] button, then choose EDIT. The first two lists, L_1 and L_2, should show your number of filters (L_1) and light intensities (L_2). Copy these values into your data table, the light intensities are "Total Illumination". "Net Illumination" is the total minus the ambiant reading.

2. 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?

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

4. Calculate the ratio between each reading and the previous one for all steps except the first one. How does the percentage (fraction) of light passing through successive filters behave? Does it go down approximately the same fraction each time?

5. If you had added one more filter, what should the Illumination have been? How did you arrive at this value? Explain.

Data Table:

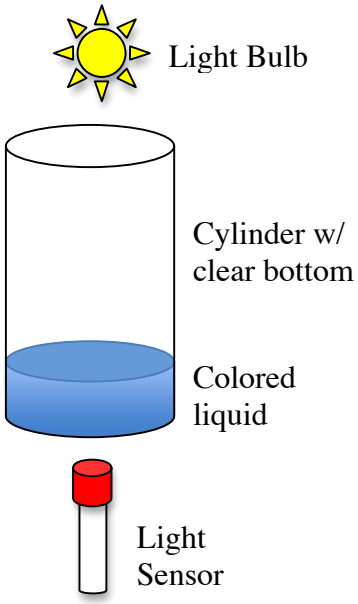
Ambiant light reading: _____

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

Extensions

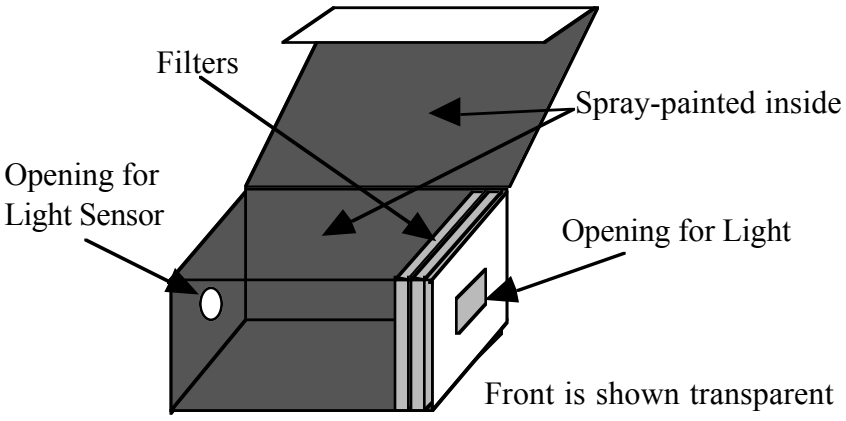
Replace the colored plastic with polaroid filters. Have one that remains fixed while the second rotates with the angle of rotation being shown. This allows students to study the effect that angle between the polaroids has on the amount of light that gets transmitted or absorbed.

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.



Teacher Notes

For this lab, the author found a small cardboard box at a local packing 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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