Albedo and Heat Absorption

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In this experiment, we will be delving into the world of reflection and absorption.

As light energy hits different surfaces, some of the light energy is reflected, while most of the rest of the light is absorbed and converted into heat energy. The ratio of absorption/reflection is mainly determined by the color of the substance.

When white light hits a piece of red paper, all of the colors (or wavelengths) of light that are NOT red are absorbed and converted into heat energy; only the red light is reflected back towards your eye. Black paper absorbs all of the light, thus the amount of absorption is high and most of the light is converted to heat energy. This is why wearing a black shirt on a sunny day makes you feel warmer than a white shirt; the white shirt reflects most of the sun's energy.

This works on a larger scale as well. Light colors (like clouds and snow) reflect the sun's energy back into space; dark colors (like oceans and blacktop parking lots) absorb most of the incoming radiation and convert it to heat. This is why it is usually warmer in a city than in the open countryside, or why it is cooler on a cloudy day or when there is snow cover on the ground.

For this experiment, you will need the following items:

- LabPro
- SS Temperature Probe
- Light Probe
- Clamp light
- Color Paper Packet

Setup your LabPro, and connect the Light Probe to Channel 1. Hang your light probe from the horizontal lab bar so that it dangles about 5 cm above the lab bench level (where you will place your paper samples). Use the ambient room light and make sure there are no shadows on your paper sample.

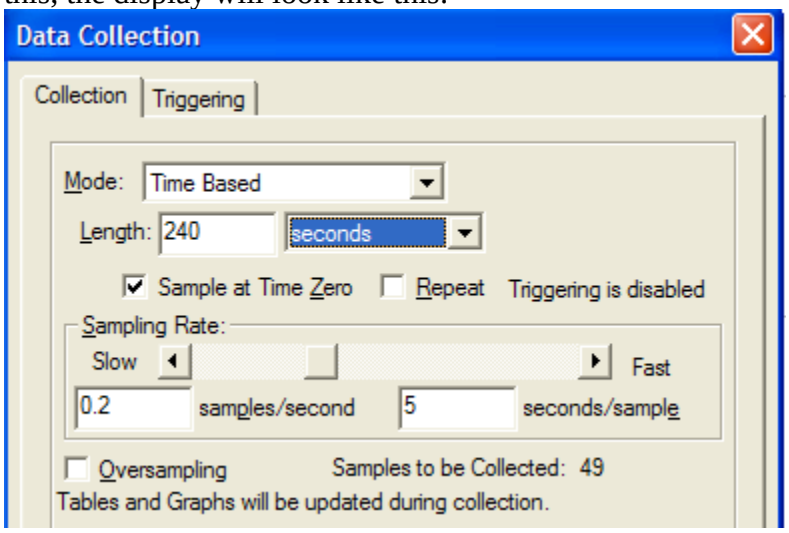
You may have to manually set-up your light probe for channel 1. You will also want to set-up channel 1 for real time monitoring (so that the reading displays next to the LabPro symbol). If you get a reading of greater than 1.00, your light probe is pegged and readings will be inaccurate.

Once the real time reading gets stable, record the number into your data table for that color paper. YOU DO NOT NEED TO COLLECT AND GRAPH DATA FOR THIS PART, JUST USE THE REAL TIME READING. Once you have recorded the light level for each of your samples, calculate the % reflectivity of each (assuming that the aluminum foil has a reflectivity of 100%). Use the following formula:

$$\%\text{reflectivity} = \frac{LightLevel_{paper}}{LightLevel_{Alu\,\min\,umFoil}}$$

If your white paper has a high reflectivity than the aluminum foil, you have a problem. See the instructor.

Next, change out your light probe for a stainless steel temperature probe. Place the probe where your paper sample will lie. This probe should be detected automatically when you plug it in. Under the Experiment menu (in the Logger Pro software), choose Data Collection. Set the length of the experiment to 240 seconds. Set the samples per second to 1 sample every 5 seconds (when you do this, the display will look like this:



Next, set-up your clamp light so that the light is about 12 inches from the surface of the paper sample. Do not turn your light on yet.

Once you are setup, place your first paper sample on top of the temperature probe. Make sure your light is turned off, and wait for the temperature to stabilize. Please note the starting temperature (this starting temperature must be the same for every sample you do).

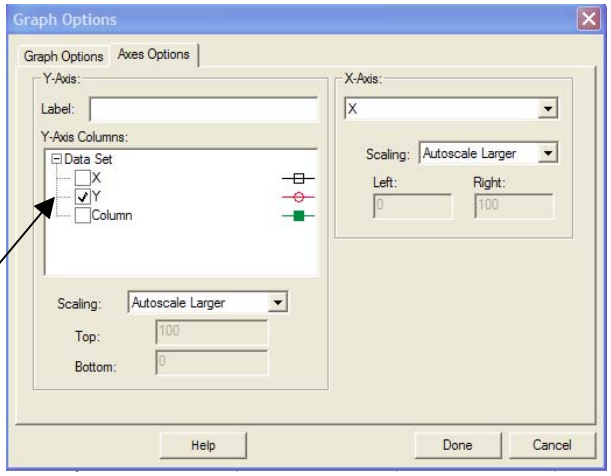
Start collecting data. At the 10 second mark, turn on the light. MAKE SURE YOU TURN ON THE LIGHT AT THE SAME TIME FOR EACH COLOR PAPER. Continue to collect data for the remaining 240 seconds. <u>Label your data table with the color of paper you used for that run.</u>

From the data table, find the starting temperature and the final temperature for your sample. Record this data in the Data Table.

When your run is complete, pull down the Experiment Menu and choose the **Store Latest Run** option (make sure your last run is labeled).

Turn the light off, switch the paper samples and do it again. Repeat for all five samples.

To display all the data in a single graph, double click anywhere on your graph. This window should pop up.



Click on the Axes Option tab (if it isn't already selected), and put a check mark in the box next to the data you want displayed (you should have 5 check marks when you are all done).

NOTE: While you are collecting data, you can work on Part B of this experiment. Just minimize Logger Pro (don't Close it!) and do Part B.

Once you have all of your data displayed, **print out the graph (in LANDSCAPE mode) and the data table separately**. Make sure to have your names print in the footer.

Complete the data in your data table by calculating the change in temperature for each paper sample.

Part II: Albedo

Albedo is a measurement of the percentage of light that is reflected from an object. Planets in our solar system are visible only because they reflect light from the sun. Each planet has an albedo based on the percentage of light that is reflected from the sun.

On your lab PC, run the Firefox browser, and under this lab, click on the **Planet Albedo Ranking** link.

Turn in your Data Sheet and Graph printout when you are done.

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DATA TABLE

Color	Alum Foil	White	Green	Brown	Black
Reflection Value (lux) Measured					
% Reflectivity (ReflectionVal) / (Reflec Foil)	100%				
Starting Temperature (Celsius)					
Final Temperature (Celsius)					
Temperature Change (Final-Starting) (Celsius)					

PLANET ALBEDO RANKING

Ranking (from highest Albedo to lowest)	Planet
1	
2	
3	
4	
5	
6	
7	
8	
9	