

Reflection and Absorption of Light

ENSC 162 Solar Energy Lab

Purpose of the experiment

- Use a Light Sensor to measure the amount of reflected light.
- Calculate percent reflectivity of various colored paper.
- Use a Temperature Probe to measure the energy absorbed from light.
- ^{fyi}

^{fyi} More than 2500 left handed people are killed every year from using right handed products.

Table of Contents

| | |
|---------------|---|
| Background | 3 |
| Equipment | 5 |
| Lab Procedure | 6 |

Equipment List

- LabQuest Interface
- Light Sensor
- Temperature Probe
- 4 cm piece of drinking straw
- lamp and 150 W clear bulb
- aluminum foil
- white paper
- black paper
- 2 other pieces of colored paper
- ring stand
- 2 utility clamps
- Tape
- Ruler

Background

Would you feel cooler wearing a light or dark-colored shirt on a hot, sunny day? The color and texture of an object influences how much radiant energy from the sun it will absorb or reflect. Every color reflects a certain amount of light while absorbing the rest as heat energy. The amount of reflected light is called the color's *light reflectance value*. Dark colors with low light reflectance values tend to reflect little light while absorbing lots of heat energy, whereas light colors with high reflectance values reflect a lot of light and absorb little energy. People in warm, sunny climates are more likely to purchase light-colored cars since they don't heat up as quickly as dark-colored ones. Many house paints come with a predetermined light reflectance value to guide consumers when making color choices for their homes. Since the Earth's surface is made of many colors and textures, it is heated unevenly. Snow, ice, and clouds reflect a lot of energy back into space while green forests and vegetated lands absorb energy.

In this experiment, you will investigate the relationship between the percent reflectivity of various colors and the temperature change due to energy absorption. You will measure the amount of light reflected from paper of various colors using a Light Sensor and calculate percent reflectivity. You will also measure the temperature change of the air under the paper due to energy absorption by the paper using a Temperature Probe.

The Lab

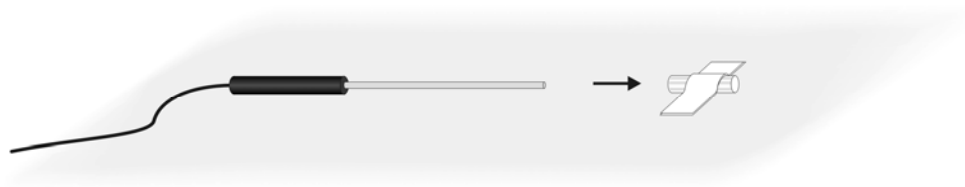


Figure 1

1. Prepare the sensors for data collection.
 - a. Tape the straw to the table surface as shown in Figure 1.
 - b. Insert a Temperature Probe into the straw as far as it will go. Check to make sure the end of the Temperature Probe is not touching the tabletop.
 - c. Place the piece of white paper over the Temperature Probe.
 - d. Use a utility clamp and ring stand to fasten a Light Sensor 5 cm above a piece of colored paper as shown in Figure 2. The Light Sensor should be set on the 0-6000 lux position.
 - e. Use the other utility clamp to fasten the lamp and bulb to the ring stand 10 cm above the paper.
 - f. The classroom lights should be on.
2. Plug the Light Sensor into Channel 1 and the Temperature Probe into Channel 2 of the LabQuest interface.
3. Prepare the computer for data collection by opening the file “Reflect and Abs Light” in the *ENSC 162* folder.
4. Switch on the light bulb. Click to begin data collection. Record the starting temperature.
5. When data collection is complete, record the final temperature. Click on the Illumination graph to select it. Click the Statistics button, , then click to display a Statistics box for the first run. Record the mean light reflection value (in lux). The lux is the SI unit for light illumination. Click on the Temperature graph to select it. Click the Statistics button, , then click . Verify the minimum and maximum readings for temperature.
6. Repeat Steps 4 and 5 for black paper and aluminum foil. If time allows, make and record readings for two additional colors of paper.

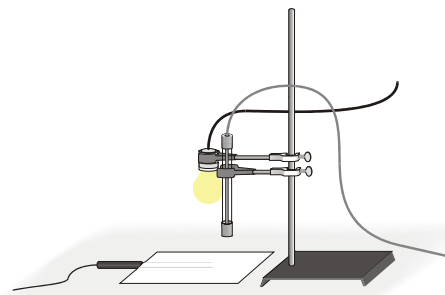


Figure 2

Data Table

| Color | White | Black | Aluminum | _____ | _____ |
|----------------------------|-------|-------|----------|-------|-------|
| Starting Temperature (°C) | | | | | |
| Final Temperature (°C) | | | | | |
| Change in Temperature (°C) | | | | | |
| Reflection value (lux) | | | | | |
| Percent reflectivity | % | % | 100 % | % | % |

Data Analysis

1. Subtract to find the change in temperature for each color paper.
2. Which color paper had the largest temperature increase?
3. Which color paper had the smallest temperature increase?
4. Solar collectors can be used to absorb the sun's radiation and change it to heat. What color would work best for solar collectors? Explain.
5. Calculate the percent reflectivity of each color paper using the relationship:

$$\% \text{ Reflectivity} = \frac{\text{reflection value for paper}}{\text{reflection value for aluminum}} \times 100$$

Show your work in the data table above.

6. Which color paper has the highest reflectivity?
7. Which color paper has the lowest reflectivity?
8. What relationship do you see between percent reflectivity and temperature change?
9. What types of surfaces might give a planet a high reflectivity? Explain.
10. Does the planet Earth have high reflectivity? Why or why not?