

# Reflectivity of Light

Light is reflected differently from various surfaces and colors. An understanding of these differences is useful in choosing colors and materials for clothing, in choosing colors for cars, and in city planning. Astronomers use reflectivity differences to help determine characteristics of planets. In this experiment, you will be measuring the percent reflectivity (*albedo*) of various colors. You will measure reflection values from paper of various colors using a Light Sensor and then compare these values to the reflection value of aluminum foil. The aluminum foil will arbitrarily be assigned a reflectivity of 100 percent. You will then calculate percent reflectivity using the relationship

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

## OBJECTIVES

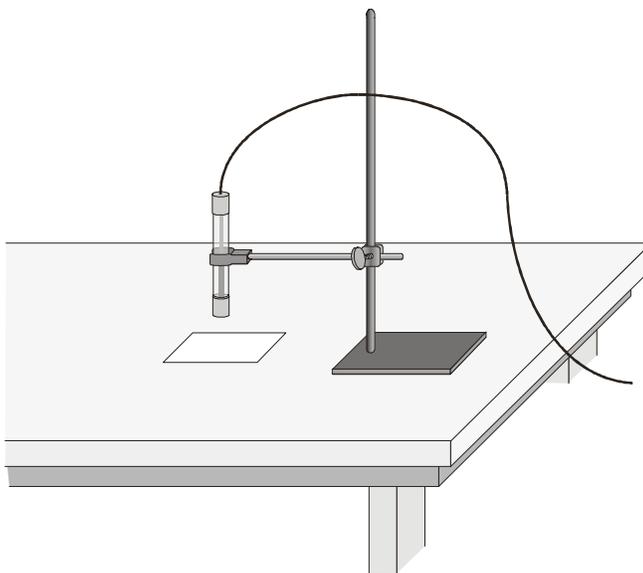
In this experiment, you will

- use a TI Graphing Calculator, a LabPro or CBL 2 interface, and a Light Sensor to measure reflected light
- calculate percent reflectivity of various colors
- make conclusions using the results of the experiment

## MATERIALS

LabPro or CBL 2 interface  
TI Graphing Calculator  
DataMate program  
Light Sensor  
white paper

black paper  
2 other pieces of colored paper  
aluminum foil  
ring stand and utility clamp



*Figure 1*

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## PROCEDURE

1. Attach the Light Sensor to Channel 1 of the LabPro or CBL 2 interface. If your sensor has a range switch, set it to 600 lux. Firmly press in the cable ends.
2. Turn on the calculator, and start the DATAMATE program. Press **CLEAR** to reset the program.
3. Set up the calculator and interface for the Light Sensor.
  - a. Select SETUP from the main screen.
  - b. If the calculator displays a Light Sensor in CH 1, proceed directly to Step 4. If it does not, continue with this step to set up your sensor manually.
  - c. Press **ENTER** to select CH 1.
  - d. Choose LIGHT from the SELECT SENSOR list.
  - e. Choose LIGHT 600 (LX) from the LIGHT list.
4. Set up the data-collection mode.
  - a. To select MODE, press **▲** once and press **ENTER**.
  - b. Select SINGLE POINT from the SELECT MODE menu.
  - c. Select OK to return to the main screen.
5. Use a utility clamp and ring stand to fasten the Light Sensor 5 cm from and perpendicular to a piece of colored paper as shown in Figure 1. The classroom lights should be on.
6. When the light reading displayed on the calculator screen is stable, select START to begin collecting data. **Note:** The calculator and interface will be taking data for the next 10 seconds.
7. After 10 seconds, the light value will appear on the screen. Record this value in your data table.
8. Press **ENTER** to return to the main screen.
9. Obtain a second piece of colored paper. Repeat Steps 5-8. Continue with this method to collect and record readings for aluminum, black, white, and two other colors.

## DATA

Color	Aluminum	Black	White	_____	_____
Reflection Value	_____	_____	_____	_____	_____

## PROCESSING THE DATA

1. Calculate the percent reflectivity (albedo) of each color using the formula given in the introduction. Show your work and record the results in the table below.

Color	Aluminum	Black	White	_____	_____
Percent Reflectivity	<u>100%</u>	_____	_____	_____	_____

2. Which color, other than aluminum, has the highest reflectivity?
3. Which color has the lowest reflectivity?
4. What materials might give a planet a high reflectivity or albedo? Explain.
5. Does the planet Earth have high reflectivity? Why?

## EXTENSION

1. Design an experiment to determine if there is a relationship between reflected light and heat absorbed by various colors or materials.



## TEACHER INFORMATION

## Reflectivity of Light

1. Equal-size pieces of construction paper and aluminum foil can be used and saved for reuse.
2. Although undetectable to your eyes, artificial lights flicker. The Light Sensor picks up this flicker, and variations in light intensity can be seen when you view the values displayed on the main screen of DataMate. The Single Point data-collection mode averages out the flicker and enables the calculator to provide a single illumination value for each trial.
6. The experiment can also be done using either the Vernier Light Sensor, or the TI Light Sensor that is shipped with the CBL or CBL 2. When using the Vernier Light Sensor, the 600-lux range is used. The TI Light Sensor has only one setting.

### SAMPLE RESULTS

Color	Aluminum	Black	White	Purple	Green
Reflection Value	0.163	0.018	0.130	0.077	0.091
Percent Reflectivity	100	11.0	79.8	47.3	55.8

### ANSWERS TO QUESTIONS

1. See the Sample Results above.
2. White has the highest reflectivity.
3. Black has the lowest reflectivity.
4. Surfaces such as snow, ice, sand, and water would be expected to give a planet high reflectivity. The results of this experiment suggest that light-colored and shiny surfaces reflect light best.
5. Planet Earth has high reflectivity because much of it is covered by snow, ice, sand, and water. The results of this experiment suggest that dark-colored parts of the earth, such as forests and green-crop land, would have lower reflectivity.