A Local Weather Study

*Weather* is simply what is happening in the atmosphere at a particular place at a particular moment. *Climate*, on the other hand, is the average weather in an area over a long period of time.

In this experiment, you will make weather measurements and investigate factors that influence weather and climate.

**PROCEDURE**

1. Go to a web site, suggested by your teacher, which gives the local weather for your school area. Note the displayed weather characteristics and their units.

2. Connect a Temperature Probe to the data-collection interface.

3. Note and record the displayed values.

4. Disconnect the Temperature Probe from the data-collection interface.

6. Note and record the displayed reading.

**QUESTIONS**

1. Describe the location where you recorded your measurements. Include observations such as:
   a. Is the spot open? Are there buildings, trees, or other objects that could have affected your measurements?

   b. What is the ground cover like—soil, vegetation, asphalt, concrete, or other?

   c. Are there any living organisms in the immediate area?

2. Did the measurements of other groups differ from yours? Why?

3. How did your weather observations of the local weather compare with those of the web site?

4. List at least one researchable question for this experiment.
Global Warming

Global warming is an environmental science topic of much concern. The average surface temperature the Earth increased by 0.6°C during the 20th century, with the increase occurring mainly from 1910 to 1945 and 1976 to 2000. The 1990s was the warmest decade, and 1998 was the warmest year of the century and on record. Growing scientific consensus attributes this global warming to the enhanced greenhouse effect. In this experiment you and your classmates will investigate the greenhouse effect and the enhanced greenhouse effect.

In the Preliminary Activity, you will gain experience using a Temperature Probe and learn technique that can be used in your subsequent research.

After completing the Preliminary Activity, you will first use reference sources to find out more about global warming, the greenhouse effect, and the enhanced greenhouse effect before you choose and investigate a researchable question. Some topics to consider in your reference search are:

- global warming
- greenhouse effect
- enhanced greenhouse effect
- greenhouse gases
- infrared radiation
- anthropogenic effect

**PROCEDURE**

1. Connect the Temperature Probe to the interface.

2. Open the data-collection program and set up the program to collect data for 15 minutes.

3. Tape the Temperature Probe to a ruler as shown in Figure 1. The probe tip should be 5 cm from the ruler end, and the tape should not cover the probe tip.

4. Obtain a cutoff bottle and prepare it for data collection
   a. Place the Temperature Probe in the cutoff bottle as shown in Figure 1.
   b. Position a lamp centered above the cutoff bottle. The bulb should be about 5 cm above the cutoff bottle. The ruler should shield the Temperature Probe from direct light emitted by the lamp.

5. Start data collection, and then turn on the lamp.

6. When data collection is complete, turn off the lamp.

7. Use the Statistics function to determine the initial (minimum) and final (maximum) temperatures. Record these values.
**QUESTIONS**
1. What was the initial temperature in the Preliminary Activity? What was the final temperature?
2. Calculate the temperature change.
3. List five greenhouse gases.
4. List at least one researchable question for this experiment.

**Reflection and Absorption of Light**

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.

**OBJECTIVES**

In this experiment, you will
- 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.

**MATERIALS**

- Computer
- Vernier computer interface
- LoggerPro
- 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

![Figure 1](image)

**PROCEDURE**

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. Connect the Light Sensor to Channel 1 and the Temperature Probe to Channel 2 of the Vernier computer interface.

3. Prepare the computer for data collection by opening the file “23 Reflect and Abs Light” in the Earth Science with Vernier folder.

4. Switch on the light bulb. Click Collect 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 ok 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 ok. 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.
DATA

<table>
<thead>
<tr>
<th>Color</th>
<th>White</th>
<th>Black</th>
<th>Aluminum</th>
<th>_______</th>
<th>_______</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Temperature (°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Temperature (°C)</td>
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</tr>
<tr>
<td>Change in Temperature (°C)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflection value (lux)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent reflectivity</td>
<td>%</td>
<td>%</td>
<td>100 %</td>
<td>%</td>
<td>%</td>
</tr>
</tbody>
</table>

PROCESSING THE DATA
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?


10. Does the planet Earth have high reflectivity? Why or why not?