**Vernier LabQuest: Reflection/Absorption of Light Lab**

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| Name: Carol Hall | Date: 7/16/11 |
| Content Area: Physical Science | Grade Level(s): 8th | Topic(s): light, reflection, absorption, technology |

**Standards (SOL)**

PS.1 (d) Students will conduct investigations using technology to gather data and equipment is used safely.

PS.9 (a) Students will investigate the behavior of light reflection and absorption.

**Objectives (UKD’s)**

*Students will know that light reflects off mirrors best.*

*Students will understand that light can be absorbed differently by various materials.*

*Students will investigate the reflectivity of light using a Vernier LabQuest.*

*Students will extend the reflectivity of light to do a schoolyard study of the temperature of ground and air at various locations where light is reflected and absorbed differently.*

**Materials & Resources**

Content Teaching Academy References: David Slykhuis, Technology in Science Education, 6/30/11, 6:30-8:00 pm

Materials: Vernier LabQuest, light meter probe, temperature probe, aluminum foil, various colors of paper, sand water, the outdoors

**Safety Considerations**

*Students will work in small groups with objects that will demonstrate the lab objectives. There are no specific dangers with the objects, but small groups must behave appropriately to allow all members to focus on and understand the lab.*

**Engage – Time Estimate \_\_\_\_\_10 minutes\_\_\_**

*Create interest by having the teacher start class reflecting a spotlight off a mirror; then try to reflect the spotlight off a green piece of paper. How are they different? What has happened to the light? Uncover what the students know about the behavior of light, reflection and absorption.*

**Explore – Time Estimate \_\_\_\_20 minutes\_\_\_\_**

The first lab allows a very simple introduction to the light sensor and Vernier LabQuest. This lab can be completed within 20 minutes. Students may visit stations as partners to quickly access the data and return to small groups to process the data questions.

Reflectivity of Light

Light is reflected differently from various surfaces and colors. In this experiment, you will be measuring the percent reflectivity of various colors. You will measure reflection values from paper of the various colors using a Light Sensor and then compare these values to the reflection value of aluminum foil. You will then calculate percent reflectivity using the relationship:

% Reflectivity = X 100

OBJECTIVES

In this experiment, you will

* Use a Light Sensor to measure reflected light.
* Calculate percent reflectivity of various colors.
* Make conclusions using the results of the experiment.

MATERIALS

|  |  |
| --- | --- |
| LabQuest  | aluminum foil  |
| LabQuest App | 2 other pieces of colored paper  |
| Light Sensor  | ring stand  |
| white paper  | utility clamp  |
| black paper  | Extension materials: water and sand |



Figure 1

PROCEDURE

1. Use a utility clamp and ring stand to fasten a Light Sensor 5 cm above a piece of colored paper as shown in Figure 1. The classroom lights should be on.

2. If your Light Sensor has a switch, set it to 6000 lux. Connect the sensor to LabQuest and choose New from the File menu. If you have an older sensor that does not auto-ID, manually set up the sensor.

3. The light readings are displayed on the screen. When the reading stabilizes, record the color and the reflected light value in your data table.

4. Make and record readings for aluminum, black, white, and two other colors plus extension materials: water and sand.

DATA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Color  | Aluminum | Black  | White | \_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_ | Water | Sand |
| Reflection value  |  |  |  |  |  |  |  |
| Percent reflectivity | 100% | % | % | % | % | % | % |

PROCESSING THE DATA

1. Calculate the percent reflectivity of each color using the formula given in the introduction. Show your work in the data table above.

2. Which color, other than aluminum, has the highest reflectivity?

3. Which color has the lowest reflectivity?

4. What surfaces might give a planet a high reflectivity? Explain.

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

EXTENSION

1. Design an experiment to test the reflectivity light in an outdoor setting.

**Explain -- Time Estimate \_\_\_\_10 minutes\_\_\_\_**

*Student will share first with their groups and then with the class their Processing the Data answers.*

**Extend -- Time Estimate \_\_\_60 minutes\_\_\_\_\_**

*Students will develop an investigation to test how light reflectivity/absorption would affect the schoolyard environment. Small groups will choose a section of the school property with a variety of surfaces to investigate. They may then see the Schoolyard Study to guide their investigation.*

Schoolyard Study

Our environment is important to all of us. In this activity you will investigate your schoolyard as an environment. Scientists study large areas by looking at samples. One way to sample an environment is to look at data along a straight line called a *transect*. In this experiment, you will gather data along a transect in your schoolyard.

OBJECTIVES

In this experiment, you will

* Measure ground and air temperatures at various locations along a transect.
* Measure the light intensity at the same locations.
* Observe and classify the living organisms at those locations.
* Determine if there are temperature differences between the ground and air above it.
* Organize and present your results.

MATERIALS

|  |  |
| --- | --- |
| LabQuest  | 10 meters of string |
| LabQuest App | meter stick |
| Temperature Probe  | ruler |
| Light Sensor | 2 rubber bands |

PROCEDURE

Part I Making a Transect

1. Make your transect.

1. Stretch 10 meters of string in a straight line across an area of your schoolyard.You will be collecting data along this line called a transect. Choose a stretch with as many different conditions as possible (e.g., shade vs. sun, asphalt vs. grass).
2. In the data table, write a description of each location you choose to study along the transect.
3. Record observations of any living things you see at the chosen locations.
4. Measure and record the distance (in m) from the beginning of your string to each location.

2. In the space provided on Page 8–3, make a sketch of your transect. Label each location on the sketch.

Part II Measuring Temperature and Reflected Light Intensity

3. If your Light Sensor has a switch, set it to 150,000 lux. Connect the Light Sensor and Temperature Probe to LabQuest. Choose New from the File menu. If you have older sensors that do not auto-ID, manually set up the sensors.

4. Measure the surface temperature at one end of your string. Place the tip of the Temperature Probe on the ground. **Note:**If there is direct sunlight on the probe tip during data collection, the readings will be too high. To prevent this, use your hand to shade the tip of the probe.

5. Have one person cover the tip of the Light Sensor with his hand so that the ground-level light intensity value will be zero.

6. Wait approximately one minute for the temperature and light intensity readings to stabilize. Record the temperature and light values in your data table.

7. Repeat steps 4–6 for each location you chose in Step 1.



Figure 1

 8. Return to your first location. Fasten the Light Sensor to a ruler using two rubber bands as shown in Figure 1. Slide the Temperature Probe under the rubber bands on the other side of the ruler as shown in Figure 1. Both probe tips should be at the 5 cm mark.

 9. Measure the temperature and light intensity 5 cm above the surface by repeating Step 6 at the same locations along your transect: Wait for the temperature reading in the upper right corner of the handheld screen to stabilize before recording it. **Note:** If it is a sunny day, hold the ruler so that the Temperature Probe is on the shady side.

SKETCH OF TRANSECT

DATA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Distance (m) | Description | Temperature(at surface)(°C) | Temperature(at 5 cm)(°C) | Temperaturedifference(°C) | Lightintensity(lux) |
|  |  |  |  |  |  |
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|  |  |  |  |  |  |

PROCESSING THE DATA

1. In the space provided in the data table, subtract to find the difference between the temperature on the surface and the temperature 5 cm above the surface at each location.

2. Which location had the greatest difference between its two temperatures? The smallest difference?

3. Give possible reasons for the results in Question 2.

4. Which location had the highest reflectivity? The lowest?

5. Give possible reasons for the results in Question 4.

6. Look at your reflectivity and temperature data. Do your results follow a pattern? Explain.

7. Prepare a poster that presents your results.

EXTENSIONS

1. Prepare one or more bar graphs from your data.

2. Do additional transects in different areas and compare results.

3. Include a pH study of the soils along your transect.

**Evaluate -- Time Estimate \_\_\_10 minutes\_\_\_\_\_**

*Teacher will observe the students as they perform their investigations and collect the lab responses.*

**Plans for Diversity**

*Students of all learning abilities have the opportunity to process and problem solve with this lab. Reading abilities are not essential to excel in this lab. Perseverance is the characteristic most needed for this lab. Many special needs students will do well in these investigations. Encourage all students to share access and exposure to the Vernier LabQuest.*

**Connections**

*These investigations allow students to become experienced with science technology. The Vernier LabQuests can be used many times throughout the school year.*