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Energy Transfer Lab

Introduction:

Energy is constantly changing from one form to another. The mechanical energy of moving water can spin turbines to create electrical energy. Light energy from the sun is used by plants to create chemical energy. In this activity, you will be using the principles of energy transformation to decide what color is best for an efficient solar cooker.

Directions:

You will be provided with cans of two different colors: black and silver. In your lab group you will test these cans to see which would make a better mini-solar cooker. A good solar cooker should be able to do two things:

1) Efficiently transform solar energy into heat energy
2) Retain heat energy even after the source of solar energy is removed

Your experiment should be designed to test the cans' ability to meet these criteria.

Materials:

(Using probeware)
Black and silver cans
Light
Temperature probes, LoggerPro, and computer
Ring stand
Stop watch
Ruler

(Without probeware)
Black and silver cans
Light
Thermometers
Ring stand
Stop watch
Ruler

Designing and Conducting Your Experiment

1. In your words, state the problem you are going to investigate. Write a hypothesis using an "If ... then ... because..." statement that describes what you expect to find and why. Include a clear identification of the independent and dependent variables that will be studied.

2. Design an experiment to solve the problem. Your experimental design should match the statement of the problem and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate and state which variables need to be held constant.

3. Review your design with your teacher before you begin your experiment.

4. Conduct your experiment. While conducting your experiment, take notes and organize your data into tables.

Safety note: Students must wear approved safety goggles and follow all safety instructions.

When you have finished, your teacher will give you instructions for clean up procedures, including proper disposal of all materials.

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Communicating Your Findings

Working on your own, summarize your investigation in a laboratory report that includes the following:

- **A statement of the problem you investigated. A hypothesis ("If ...then ... because... " statement) that described what you expected to find and why.** Include a clear identification of the independent and dependent variables.
- **A description of the experiment you carried out.** Your description should be clear and complete enough so that someone could easily replicate your experiment.
- **Data from your experiment.** Your data should be organized into tables, charts and/or graphs as appropriate.
- **Your conclusions from the experiment.** Your conclusions should be fully supported by your data and address your hypothesis.
- **Discuss the reliability of your data and any factors that contribute to a lack of validity of your conclusions**. Also, include ways that your experiment could be improved if you were to do it again.

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Graph and Analysis Questions

Create a double line graph of your data produced by your probes.

1. Which can heated up faster? _____
   Why did this happen? (Explain using specific evidence and terminology.)

2. Which can cooled down faster? _____
   Why did this happen? (Explain using specific evidence and terminology.)

3. Draw a labeled sketch to describe in detail how the energy traveled from the electrical outlet to the temperature probe. Include electrical energy, heat energy, electromagnetic radiation, conduction, and convection.

4. Look at the graphed results of two other groups. Are the results the same?
   What could contribute to different results?

5. What colors absorb radiated energy the best? _____
   Why?

   What colors reflect radiated energy the best: _____
   Why?

6. List 4 everyday situations that illustrate the principles learned in this lab.

   a. b.

   c. d.

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Curriculum-embedded Laboratory Investigation
Scoring Rubric

Statement of Problem and Hypothesis

3 The problem and hypothesis are stated clearly and completely. Clear identification of independent and dependent variables.

2 The problem and hypothesis are stated adequately. Adequate identification of independent and dependent variables.

1 The problem and/or hypothesis are poorly stated. Poor identification of independent and dependent variables.

0 The statement of the problem and/or hypothesis are very limited or missing altogether. No identification of independent and dependent variables.

Experimental Design

3 The experimental design matches the stated problem. Variables are held constant. The procedures are clear, complete and replicable. A control is included when appropriate.

2 The experimental design generally matches the stated problem. Attempt at holding variables constant is made. Procedures are generally complete. Minor modifications or clarifications may be needed.

1 The experimental design matches the stated problem to some extent. Little attempt to hold variables constant. Procedures are incomplete. Major modifications or clarifications may be needed.

0 The experimental design does not match the stated problem, is very incomplete or missing. There is no attempt to hold variables constant.

Data Presentation

3 Data are well organized and presented in an appropriate manner.

2 Data are organized and presented in an appropriate manner. Minor errors or omissions may be present.

1 Data are poorly organized or presented in an inappropriate manner. Major omissions or errors may be present.

0 Data are very poorly organized or presented in an inappropriate manner or missing altogether.

Conclusions

3 Conclusions are fully supported by data and address the hypothesis. Reliability of data and validity of conclusions are thoroughly discussed.

2 Conclusions are generally supported by data and address the hypothesis. Minor errors in interpretation of results may be present. Discussion of reliability of data and validity of conclusions is limited.

1 Conclusions are supported by data and address the hypothesis to a limited extent. Major errors in interpretation of results may be present. There is little discussion of the reliability of the data or validity of conclusions.

0 Conclusions are not supported by data, do not address the hypothesis or are missing. There is no discussion of the reliability of data or validity of conclusions.

Excellent Performance	10-12 Points
Proficient Performance	7-9 Points
Marginal Performance	4-6 Points
Unsatisfactory Performance	0-3 Points

Energy Transfer Lab: Radiation

Name
Date
Per

You will be designing a lab set-up using a black and a silver can, thermometers, and a light bulb to investigate radiant heat transfer. Place a thermometer in both cans and read your starting temperatures. They should be the same or very close. Record your starting temperatures for time 0 on your data table. Before you continue, write a hypothesis about what will happen when your light is turned on for 10 minutes and then turned off for 10 minutes. Be specific and include the words radiation, absorb, reflect, heat, cool, etc.

Hypothesis:

Now place both cans approximately 20 cm from the light and turn it on. Record the temperatures every minute for 10 minutes. Then turn the light off and record the temperatures for 10 more minutes. Graph your results and answer the analysis questions on the back of this sheet.

Time (Minutes)	Black Can Temp. °C	Silver Can Temp. °C
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Turn	Off	Light!
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Problem Statement:

FV:

DV: