Strand I: Energy Transformations

Solar Cooker
Laboratory Investigation

Renewable Energy

Teacher Materials

This curriculum-embedded science performance task is related to the content standards and expected performances for Grades 9-10, as described in the Core Science Curriculum Framework, under Scientific Inquiry, Literacy and Numeracy, Strand I – Energy Transformations.

Targeted Content Standard
9.3 - Various sources of energy are used by humans and all have advantages and disadvantages.
Targeted Scientific Inquiry, Literacy and Numeracy Standards
D INQ. 1 Identify questions that can be answered through scientific investigation.
D INQ. 3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ. 4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ. 5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ. 6 Use appropriate tools and techniques to make observations and gather data.
D INQ. 7 Assess the reliability of the data that was generated in the investigation.
D INQ. 9 Articulate conclusions and explanations based on research data, and assess results based on the design of an investigation.

Learning objective:

Students will be able to use solar energy to heat water and understand the design factors that influence the effectiveness of capturing solar energy in this context.

Listed below are the suggested materials for the laboratory exercise. You may use additional materials if they are available.

Materials:

- heat lamps or sunlight
- cardboard
- aluminum foil
- containers for water
- safety goggles
- tape
- thermometer
- water
- colored paper or paint

Considerations:

Teams of two students are ideal for laboratory work, but circumstances may necessitate teams of three students. Students will need a minimum of 90 minutes to complete this laboratory exercise if you expect their lab reports to be written during class time. You should allow at least 60 minutes of instructional time for the students to design and conduct their experiment and a minimum of 30 minutes for the students to write about their results. As an alternative, the students can write their lab report for homework. These time frames are merely suggestions. Additional time is appropriate if the circumstances and schedule at your school call for it. A sample scoring rubric is provided for your convenience or you may design one of your own.

If the weather is unfavorable and the laboratory exercise must take place indoors, heat lamps can be used as an alternative to sunlight. If your students are unfamiliar with solar cookers, various designs and photographs of solar cookers may be found at these and many other sites:

http://solarcooking.org
http://pbskids.org/zoom/activities/sci/solarcookers.html

The curriculum-embedded task can be integrated into a unit on energy sources and used in any high school physical or Earth science course. The curriculum-embedded task is intended to be used as a formative assessment during the appropriate instructional unit. The Connecticut Academic Performance Test – Generation III will include some open-ended items that will assess scientific inquiry and communication skills in the same context as this task.

Student Name:_____ Class:_____

Laboratory Investigation
Student Materials

Solar Cooker

Student Materials

Most people in the United States use an electric stove or a natural gas stove to cook their food. This is not the case in much of the world. Approximately 50% of the people on Earth cook using fire from burning wood. However, due to overuse, wood is becoming a scarce commodity in many countries. In addition, burning wood is a major source of air pollution.

One alternative to cooking with wood is using solar cookers. These devices use energy from the sun to cook food without producing any pollution. While there are many designs for solar cookers, a simple solar cooker can be made from everyday materials. There are many factors that can influence the effectiveness of a solar cooker including the size of the collector, the orientation of the panel and the color of the container.

Your Task

You and your lab partner will design and conduct an experiment to investigate one factor that contributes to the effectiveness of a solar cooker in heating water. Factors you may want to investigate include: the shape of the collector, the shape of the water container, orientation of the collector, surface area or color of the container.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided.

Suggested materials:

heat lamps or sunlight
cardboard
aluminum foil
container for water
safety goggles
tape
thermometer
water
colored paper or paint

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 cleanup procedures, including proper disposal of all materials.

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.