



Unit: Cooking with the Sun and Solar Ovens

Lesson #11: Build the Ultimate Solar Oven

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DESCRIPTION: The purpose of this lesson is to take everything the students have learned and experienced up to this point and use it to build their own Ultimate Solar Oven using items found at school, home, the Dollar store or home improvement store for under 5 dollars. This lesson can be used for the whole class, partners or individuals.

GRADE LEVEL(S): 3-8

SUBJECT AREA(S): Solar ovens, energy transformations, heat, thermal transfer

ACTIVITY LENGTH: One week

LEARNING GOALS: At the end of this lesson students will be able to: plan, sketch, design and build a new solar oven. In addition, students will be able to cook food with their solar oven.

STANDARDS MET:

Next Generation Science Standards:

- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat and electric currents.
- 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

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- MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Educator Background:

- Knowledge of the basic components of a solar oven and how solar ovens work
- Basic understanding of energy, energy transformations, and heat transfer
- Understanding the terms and concepts of insulation, reflection, absorption
- Familiarity with engineering design process

Student Background:

This lesson comes toward the end of a larger unit that covers the basics of solar energy, including light concentration, heat absorption and insulation. In addition, students will have already built several sun oven models and tested their effectiveness (e.g., temperature, ability to cook food). Students will have also brainstormed design ideas for their own sun ovens in the extension following “Let’s Get Cooking.” See unit overview document for more details.

Other Materials List:

- Student Handout “ My Ultimate Solar Oven” (also found in “Let’s Get Cooking” lesson plan.
- Sun oven construction materials. Ideas could include:*

 - A variety of cardboard box shapes and sizes
 - Other pieces of cardboard
 - Heavy duty aluminum foil
 - White glue
 - Duct tape
 - Scissors
 - Black B-B-Q spray paint
 - Newspaper
 - Plexiglas
 - 5-gallon buckets
 - Auto shade covers with reflective material
 - Cooling racks
 - Binder clips
 - Oven roasting bag with ties
 - Poster board
 - Hammers
 - Nails

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- Shoelaces or string
- Tires ?
- Inner tubes
- Reflective insulation
- Flashing ?
- Lightweight black cooking pots and lids
- Hot pads
- Trivets
- Infra-red thermometers or oven thermometers

**Encourage students to bring in their own materials from home or recycled materials*

Vocabulary:

- Reflective panel
 - Insulation
 - Absorption
 - Heat
 - Energy/Energy transformation
 - Design
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Lesson Details:

Activity:

Students are to design an ultimate solar oven with the required components listed on their plan sheet. If you are doing this with whole class or with partners, each student could plan a design, present it and have the class vote on the winning design; otherwise, each student will design and build their own oven to keep and use to conduct experiments throughout the coming weeks.

- Students fill out their design sheets (“My Ultimate Solar Oven”)and present them for review.
- Students gather their materials from home and school and build their Solar Oven.
- Students bring their own food to test. It must be pre-approved by the teacher. No raw meat. Basically, any food that can be baked, steamed, heated or boiled will work in a Solar Oven. Only Parabolic ovens get hot enough for deep-frying and popcorn.
- Students cook their food and enjoy it.

Evaluation:

Have students write a reflection that addresses the following questions:

- Did the solar oven reach a temperature above 250 degrees?
- Did the food get cooked in a reasonable amount of time?
- Why or why not? If not, what can you do differently?

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