Unit Overview: Cooking with the Sun and Solar Ovens

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Grade Level: 3-8

Time required: Two weeks to three months, depending on grade levels and lessons taught.

Learning Goals:
The student understands how the sun's light can be captured and transformed into heat to cook food in a solar oven. The student understands the components of a successful sun oven and can plan, build and cook food with more than one design. The student can explain how solar cooking works, how to improve on solar oven designs, and how sun ovens are used worldwide. Students will also become familiar with these terms: **radiation, insulation, reflection, absorption, heat, temperature, energy, energy transformation**

Background Information:

Is it really possible to cook with the sun? Yes. From the beginning of time, daily cooking has required fire, fuel gathering and constant attention to be sure that food cooks evenly and doesn't burn. Solar ovens are different. Foods do not burn in solar ovens and they do not need to be stirred or tended. This leaves cooks free to pursue other activities while their food is cooked slowly in its own liquids, which retains more nutrients and intensifies the natural flavor of the food. Solar ovens can be made from inexpensive materials and cost nothing to run. Two billion people in the world rely on wood and charcoal for cooking fuel. Biomass and petroleum fueled cooking fires pollute the air. Solar cookers are pollution free, cost free and when used in large numbers could have the potential to help curb global warming.

Most Solar cookers have four main components:

1. Reflectors (foil, mirrors) to concentrate more sunlight into the oven.
2. Glass or heat safe plastic to surround the cooking pot, allowing in light while holding heat in.
3. Dark interior and cooking pots to absorb the light, converting it into heat.
4. Insulation (cardboard, newspaper) to retain heat and maintain temperature.

Solar ovens are helping to improve the quality of life for many people around the world. Solar ovens have been introduced in parts of South America, Africa and India. In these areas, it is typical for women and children to spend half their days searching for sparse firewood. They must walk several miles to find it and risk danger of attack and kidnapping. Most cooking takes

place indoors over an open fire. This causes burns and the toxic smoke contributes to respiratory problems and other debilitating illnesses. Solar cooking offers a clean, effective alternative. For one reason or another, many governments and aid organizations are reluctant to embrace and support solar cooking.

Worldwide, unsafe water is a major health problem. Preventable water borne diseases are responsible for approximately 80% of all illnesses and deaths in the developing world. Solar ovens can be used to successfully sterilize water and medical equipment.

It is important for students to learn about people living in other countries, their homes, customs, work and food. They also need to understand different forms and sources of energy and where they come from, in order to make responsible, sustainable choices throughout their lives. This unit on solar cooking in the classroom and around the world integrates science, social studies, global economics, conservation, art, math and language arts lessons into activities that engage students in hands-on learning that supports and encourages open ended inquiry, design and experimentation.

From the Next Generation Science Standards:

Students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.
See specific lesson for exact standards addressed.

Helpful Resources:

Safety Smart Science with Bill Nye the Science Guy: Renewable Energy 2013
Disney Education Productions
http://www.amazon.com/Safety-Smart-Science-Bill-Nye/dp/B008REC554

Bill Nye: The Sun: Disney Education Productions
http://www.youtube.com/watch?v=cfwSNtlX-bw

http://solarcooking.org/plans/plans.pdf — Solar Cookers: How to Make, Use and Enjoy. Solar Cookers International 10th Edition. This quality book contains background information, solar cooker designs, recipes, lesson plans for teachers and more.

http://www.solarcookers.org — Solar Cookers International
Information, equipment, materials, videos, recipes, lesson plans and much more.

http://www.solarcooker-at-cantinawest.com — This website sells solar cooking equipment. They also sell materials and have free lesson plans, international news articles and background information.

Used in Lessons 4 and 9:
http://youtu.be/D619r8FiRDs-- "A More Durable Solution for Desert Refugee Camps"
This video provides background information on solar ovens and cooking and the need for design improvements. Students will get several ideas for oven designs and gain a better understanding of life for people living in refugee camps in Africa.

Used in Lesson #4: Saving Lives with Solar Ovens
http://youtu.be/Ew3RbeuntMg--"How to Build a Copenhagen Solar Oven".
This video can be used in lesson #9 to provide backup assistance for building the Copenhagen Solar Oven.

Guiding Questions

1. How does a solar oven work?
2. What components does a solar oven need to cook food successfully?
3. What factors impact the success of solar cooking?
4. Why are solar ovens being used in developing countries?
5. If solar cooking is such a good alternative energy solution, why isn't it more popular with people and governments?
6. Can solar ovens be used for anything else besides cooking food?

Objectives

Attitudes and Appreciations

- Students will understand why it is important to use energy sources mindfully.
- Students will gain a better understanding of some people living in developing countries.
- Students will gain a better understanding of the hardships people in other parts of the world endure.
- Students will gain a better understanding of the reasons why seemingly good social changes are slow to take effect.

Knowledge

- Students will learn about different sources of energy
- Students will learn about different models of solar ovens.
- Students will learn about the movement of the sun.
- Students will learn about reflection of light and absorption of heat.

Skills

- Students will follow directions to build solar ovens.
- Students will learn how to repurpose inexpensive items for use in a solar oven.
- Students will learn how to prepare food to cook in a solar oven.
- Students will learn what kind of containers and coverings work best for different styles of ovens.
- Students will learn to read and record temperatures using an infra-red thermometer.
- Students will learn to analyze solar oven design and make adjustments.
- Students will learn how to align ovens with direct sunlight.
- Students will design and build their own solar oven.

Concepts

Radiant light	Thermal heat	Reflection
Absorption	Insulation	Condensation
Alternative energy	Biomass fuel	Fossil fuel

Generalizations

- Solar cooking is a sustainable alternative to conventional cooking.
- Solar energy is clean, free and endless.
- Solar cooking is best achieved between the hours of 10:00 a.m. and 2:00 p.m.
- Efficient solar ovens can be made with recycled and inexpensive materials.
- Solar ovens are saving lives in some parts of the world.
- Solar ovens do not need high temperatures to cook. They need full sunlight.

Activities Overview

Introductory Lessons:

Lesson 1: School Energy Hunt
Students take a walking tour of the school, writing down all the items they think require energy to run. They then come back to the classroom and discuss and define the source of energy for each item they found.

Lesson 2: The Amazing Cardboard Cook-O-Matic
Students are given cards each with a different food item written on it. They are asked to list the different equipment they would need to cook that food. A box solar oven is hidden under a cloth in the front of the room. The teacher will “wow and amaze the class with a presentation of the solar oven as a new “to you” product that is cheap, safe, efficient and easy to use.

Lesson 3: Our Sensational Sun!
Students create a “What Do We Know, What Do We Want to Know and What Have We Learned” chart about solar energy on a sun shaped display with the statements and questions written on red, orange and yellow rays of the sun.

Intermediate Lessons:

Lesson 4: Saving Lives with Solar Ovens
Students receive background information about cooking with solar ovens. Students learn about life in a refugee camp in Africa and the benefits and challenges of using solar ovens there.

Lessons 5, 6, 7, 8:
Students participate in four hands on activities that teach the basic concepts of solar cooking.
5 – Understanding Light
6 – Light isTransformed into Heat
7 – Heat Transfer
8 - Daily Variations in Solar Energy

Lesson 9: Let's Build Sun Ovens
The class builds three different inexpensive solar ovens using provided instructions and materials found mostly around the classroom and at the Dollar Store or home improvement store.

Lesson 10: Lets Get Cooking
Students prepare and cook cookies in the three different solar ovens. Students use an infrared thermometer to record temperatures every 15 minutes and discuss observations about the design, ease of construction and efficiency of each of the three ovens.

Advanced Lessons:

Lesson 11: Build the Ultimate Solar Oven
1. Class designs, builds and tests an "ultimate solar oven" using materials found in the classroom,
2. Or students each design and build their own solar oven at school or at home.
3. The class or students design experiments to make changes and test solar ovens.

Lesson 12: Individual Independent Projects
Students choose or design an independent solar related project that could be presented at a "Salute to the Sun Celebration" for parents and other classrooms to visit.