“We’re the Solar Sisters.”
Networking to Advance the Use of Solar Cookers as Educational Tools in the Classroom

MARY BUCHENIC AND JENNIFER GASSER
THE SOLAR SISTERS – GLOBAL DEVELOPMENT SOLUTIONS
CHAPTER 2

Solar Energy

Discover Activity

Can you build a solar cooker?

Design and construct a solar cooker to cook your potato. Use any materials that you can find. Place your potato in the cooker. How long did it take to cook your potato?

For Discussion

1. How will you increase the solar power from the cooker?
2. How could you change your design to make the cooker more efficient?

Using the Sun’s Energy

Light bulb enough to cook food?

“Is it true that the sun cooked the whole meal?”

“Everything tastes just like it did at home!”

For the last two years, students in El Paso, Texas, have enjoyed unique experiences with their teacher, Ms. Balaghi. Comments such as these above describe a dinner they prepared last year. The dinner was the result of a science project called Here Comes the Sun.

The alternative sixth graders hosted a speaker from the Department of Energy. They saw slides showing special events used in Guatemala, a Central American country where fuel is scarce. These events help the people there cook food cheaply. The events used solar energy, and the sun’s energy is in food. Set is the word for sun in the Latin language. Each student worked with partners to make a real time event like you did in the Discover Activity. Students built their events in about four hours of class time. They made a meal in the event. The event was seen more than twenty times. Ms. Balaghi’s class has also cooked in a game. They have been featured on a TV on the internet and have filmed on local TV.

The solar oven in the picture below is a simple oven. It is made from a box, a black paint, a heat source, and a metal lid.

The solar oven operates by absorbing the light energy from the sun and converting it to heat energy. The heat energy is then used to cook the food placed inside the oven.

Solar Bake Off

Join Kira, and her partner, Erica, and Michael. They make a solar oven. They begin by discussing how solar ovens work. Kira covers her aluminum foil bouncing sunlight into a box. The lid can be adjusted to allow the sun to hit it more directly. Sunlight streams through a clear glass pan into the box. Because the inside of the box absorbs the sun’s energy and gets hot, it holds the heat in. The oven grows hot, and the food cooks.

Finally, it becomes hot enough to cook the potato. Next, Kira, Erica, and Michael begin to use the oven. Erica paints the inside of a small box with black paint. For an experiment, Michael places rocks in the bottom of a larger oven to anchor it. When the paint dries, they place a potato inside the larger oven. They fill the space between the boxes, which makes the oven more portable. Then they lighten the oven, and the potato is cooked.

One team is especially inventive. They’re filling the oven with sand to make a soil box. Later, they expand the oven to fit a sleeping bag. When they’re done cooking, they put the box into the oven. The oven is now ready to use. The team is especially proud of their invention.

For Discussion

1. How will you increase the solar power from the oven?
2. How could you change your design to make the oven more efficient?

The solar oven is a simple device that uses the sun’s energy to cook food. It is made from a box, a black paint, a heat source, and a metal lid. The oven absorbs the sun’s energy and converts it to heat energy, which is then used to cook the food placed inside the oven.
15 YEARS
100 students per year = 1,500 students
RESEARCHED
DESIGNED
BUILT
TESTED
their own unique solar ovens.
WHAT IF?
Solar cooker lessons easily align to standards, or learning goals.
Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Cite specific textual evidence to support analysis of science and technical texts.

Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table.)

Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

ECONOMICS: Identify short & long term consequences of a personal economic decision.

EXPLAIN why some goods are easier to find than others and how this affects price.

HISTORY: Use various sources to describe a historical event or period from different perspectives.

Compare the key physical and human features of societies of the past in the Eastern Hemisphere with society today.

GEOGRAPHY: Use appropriate maps, globes and other geographic resources to locate various sites or places.

Identify the absolute location (latitude and longitude) of major places and features on a globe (e.g., charting locations on a grid).
Know your own school system’s goals and objectives.
Education is the most powerful weapon which you can use to change the world.  

Nelson Mandela
ENGINEERING DESIGN PROCESS

1. Identify Problem or Need
Natural disasters can knock out power to a home for days and even weeks. Without power, food cannot be refrigerated. People may need to rely on dried goods such as rice, beans, and root vegetables. Lack of power may also prevent people from cooking in traditional ways.

CBS/AP / September 14, 2017
4,000 Texas homes, facilities without power weeks after Harvey, governor says
Austin, Texas - An estimated 4,000 Texas homes and other facilities are still without power weeks after Harvey slammed the state, Gov. Greg Abbott said Thursday. Abbott said those displaced by the storm can seek help via community development grants covering long-term housing needs as well as temporary costs while waiting for their homes to be repaired.
The Washington Post/ September 13, 2017
After Irma, Florida prepares for days - and maybe weeks - without power
Cape Coral, Fla. - Millions of Floridians grappled with the aftermath of Hurricane Irma on Wednesday, confronting a sweltering reality: More than 40 percent of Florida still lacked electricity, and for some of them, the light might not come back on for days or even weeks.
USA Today/ September 30, 2017
Hurricane fallout: Puerto Rico could face 6 months without power
After Puerto Rico was pummeled by Hurricane Maria last week, a Category 4 hurricane with 150 mph winds, the island has been left in shambles. After suffering widespread power outages thanks to Hurricane Irma the week before, 1 million Puerto Ricans were left without electricity. 60,000 still hadn’t gotten power when Maria brought a total, island-wide power outage, and severe shortages of food, water, and other supplies.

2. Define Requirements - write a brief
Statement
Find a way for people to cook dried goods such as rice, beans and root vegetables using an oven that functions with passive solar energy.

Specifications and Constraints
The oven must be made from affordable and common materials.
The oven must use passive solar energy.
The oven must have the ability to direct sunlight, absorb sunlight, convert light to heat, and retain heat.
The oven must cook at temperatures that are safe for food.
The oven must be able to cook a meal between 10:00 am and 4:00 pm on a sunny day.

3. Investigate and Research - List some topics or ideas you and your team will need to investigate and research. Take notes in your journal as you conduct your research and investigation.

4. Generate Alternative Solutions - Use your investigation and research to brainstorm ideas with your team for a passive solar oven. Include materials needed. List in your journal.

5. Choose a Solution - Evaluate the pros and cons of each idea and then your team will choose the best solution. Write solution in your journal.

6. Model and Prototype - With your team, design and sketch in your journal a passive solar oven model that can be built. Label how the oven is designed to direct sunlight, absorb sunlight, convert light to heat, and retain heat.

7. Test and Evaluate - Build your team’s passive solar oven prototype. Once built, ovens can be tested on a sunny day. Data and observations can be recorded in your journal.

8. Redesign and Improve - After testing, brainstorm with your team to determine what changes can be made to improve the oven. Identify any malfunctions and ways to deal with them. Rebuild your oven incorporating these improvements and retest.
What I loved about using Solar Cooking as the theme for a cross curricular unit of study.

- Helps students experience how skills can be applied.
- Challenges creativity.
- Promotes deeper understanding of content.
- Motivates.
- Eliminates discipline issues.
- Concepts transfer more readily.
- Reinforces learning.
- There's food involved.
- Many differentiated learning opportunities.
- Develops better relationships with co-workers.
- Students understand the benefit of collaboration.
- Students recall the experience years later.
- Work cooperatively with co-workers in a supportive manner.
- Topic lends itself to several subjects.
- Students witness teachers cooperating and can use this example for their own work ethic.
- Opportunity to develop altruism.
- Multiple applications.
- Students see tangible results of their planning, designing and constructing.
- Gives rise to authentic purpose for learning.
Students conduct introductory experiment to test effect of directing light onto a penny in a jar of water. (Concepts support planning and design of ovens.)

![Graph showing temperature of water in Celsius over time for control and magnified jars.](image-url)