

Solar Cooking

Benefits, Applications, and Science of Solar Cooking

Information: The website www.solarcooking.org is a *great* resource for information about solar cooking, and shouldn't be missed. It includes many solar oven plans, cooking instructions, and lots of pictures of many different types of solar cookers, many of them very unique and interesting.

Solar Cooking has Unique Benefits: Natural gas, wood, and cow dung are generally used as cooking fuel across the world. Solar cooking can be used as an alternative to these fuels, especially in very sunny parts of the world. Many of the sunniest parts of the world are also arid, and so have the least available firewood. Gathering scarce firewood can be a time consuming and even dangerous task (for example, if women have to walk far to find it). Moreover, burning wood or cow dung in small indoor kitchens can harm lungs. So solar cooking has many unique benefits, including:

- Saving fuel.
- Lowering pollution from burning of fuels.
- Saving the world's forests.
- Saving money.
- Eliminating the need to roam far for firewood.
- Improving indoor air quality.

Applications: Solar cooking can be used to bake, steam, boil, or fry food. There is almost no cooking, in fact, that can't be at least assisted with solar energy using the right kind of solar cooker.

Scientific Aspects of Solar Cooking: A solar oven is an excellent means to explore the three basic ways that light interacts with materials, including:

- **Reflection:** Light reflects off the mirrors on a solar oven. Verify that the reflectors don't get hot, because they don't absorb light!
- **Transmission/Transparency:** Light travels through the glass cover on a solar cooker, but the air underneath is trapped.
- **Absorption:** Light is absorbed, and thereby transformed into heat, by the black interior surfaces of a solar oven.

Solar cooking can also be used to discuss the concept of the greenhouse effect and insulation:

- **Greenhouse Effect:** The transmission of light into a solar oven, the transformation of the light into heat, and the trapping of the heat by the oven, are all together a dramatic example of the greenhouse effect.
- **Insulation:** The walls of the solar oven are insulated to trap heat. They do this by simply not allowing the air in the walls to move. Air is, surprisingly, a very good thermal insulator, but only if its prevented from moving.

Types of Solar Cookers:

There are three basic types of solar cookers in common use today:

Box Cookers: These are the classic “solar ovens”, and are used for baking, boiling, or steaming food inside containers. These are the most common and useful type of solar cooker. They are relatively easy to make and use. There is also at least one commercial version that can be purchased easily.



“Minimum” style (single reflector) box cooker. This one has a collapsible design. Plans can be found at: <http://www.solarcooking.org/collapsible-box.htm>.



Four reflector box cooker, using the “Sunstar” design. Plans can be found at: <http://www.backwoodshome.com/articles/radabaugh30.html>, or from the book “Heaven’s Flame” by Joseph Radabaugh.

The “minimum box cooker” shown on the left above, is the simplest. An even simpler version of this can be made with pizza boxes (See the “Build a Pizza Box Solar Cooker” in Part IV, which is appropriate for elementary school class projects). The design for the “Sunstar” oven (above right) is more intricate, but it works extremely well. The book “Heaven’s Flame”, by J. Radabaugh, which describes this design, also has lots of good solar cooking advice.

Commercial Box Cookers

One commercial box cooker that is widely used and quite useful for practical cooking and educational purposes is the “global sun oven” by Sun Oven International (www.sunoven.com). This oven generally costs around \$200. The reflectors fold nicely for portability and storage. Sun Oven International also makes a giant solar cooker



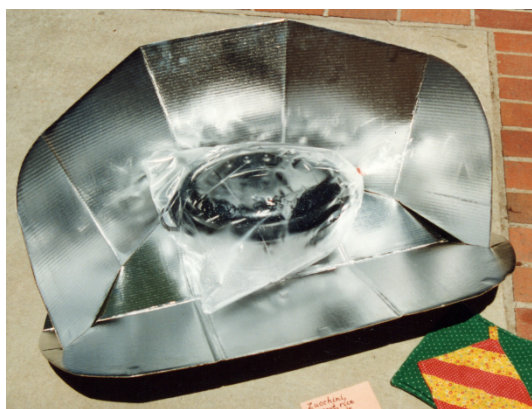
“Global Sun Oven”

called the “Villager”. This impressive oven is capable of cooking up to six turkeys at a time!

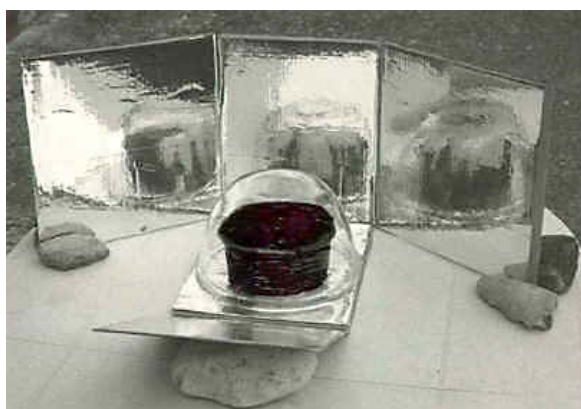
Panel Cookers

Many early attempts to introduce solar cooking with box cookers into third world countries failed because people ended up disassembling the ovens to use the valuable glass and metal for other purposes. Panel cookers were invented to overcome this problem: They use simple, everyday materials: cardboard, foil, a black painted cooking container, and an oven bag or a glass bowl for a cover. They work quite well, and can also be transported very compactly.

Below are photos of two widely used styles of panel cookers: The “cookit” style panel cooker on the left utilizes a cleverly cut piece of cardboard, and this one is shown using an oven bag to contain the hot air around the black cooking pot. The “Bernard” panel cooker on the right (the first panel cooker design, historically speaking), uses the cardboard from a single cardboard box in a very simple arrangement. This one uses a glass bowl instead of an oven bag to trap the hot air. One can see that many variations are possible.



“Cookit” style panel cooker.



The original “Bernard Panel Cooker”.

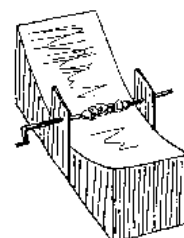
Parabolic Cookers

As shown at right, parabolic cookers use a parabolic shaped mirror to concentrate sunlight. A highly focused parabolic oven can achieve very high temperatures - enough to fry food. **For this reason they can be dangerous, both to hands and eyes, and should be used with extreme caution!** They are not recommended for classroom projects, at least large ones. And they are also not as useful as the box and panel cookers for general purpose solar cooking.



One version of a parabolic cooker that is more appropriate for classroom projects is the (cylindrical) parabolic hot dog cookers, diagrammed at right. These can be made out of cardboard, foil, and posterboard. Plans for these can be found at:

<http://www.energyquest.ca.gov/projects/solardogs.html>.



Solar Cooking Vessels

It is best to use black colored, metal cooking vessels to cook food in. Other colors will still work, but black is definitely best. You can paint jars and pots *on the outside (non-food surfaces) only* with *high temperature* black spray paint, but make sure the paint is well dried and cured in the hot sun first before using.

Hint: If you paint a jar black, put a narrow vertical strip of tape on the outside first, and peel the tape off after the paint is dry so that an unpainted strip will remain, allowing you to see the food inside easily.

WARNING! Do not put a sealed jar in a solar cooker! Make sure that jar lids have a small hole poked in them to relieve pressure.

Solar Cooking Techniques

Solar cooking is easy! Baking is quite trivial: just put a pan of cookie dough, cornbread, or what have you, inside the oven, point the oven towards the Sun, and let it cook. Vegetables can be cooked easily in a closed (but not sealed!) container with a little water: Just let them steam in their own juices. Most foods should be covered (not exposed to sunlight), except for baked goods. Unshucked corn can also be cooked easily (best to cover them in some way). A jar or small pot one third full of beans, and two-thirds full of water, is a great way to cook beans (this takes some time and generally requires the oven to be re-aimed one or more times). Cooking beans generally takes a lot of energy, and this is an ideal use for a solar oven.

Cooking Time: A good rule of thumb is that it takes about twice as long to cook food in a solar oven (on a sunny day) compared to using a conventional stove. So don't worry about cooking things too long, especially because it's hard to burn things in a solar oven. You'll notice that solar cooked food tends to taste better, because slow-cooking food retains both flavor and nutrients. One can "aim" the oven ahead of the Sun's position to lengthen cooking time. Note that the movement of the Sun will automatically "shut off" the oven.

WARNING! When demonstrating solar cooking at school, be sure to pre-cook any meat, to make sure it's adequately cooked. Solar ovens are a great way to simply re-heat food.