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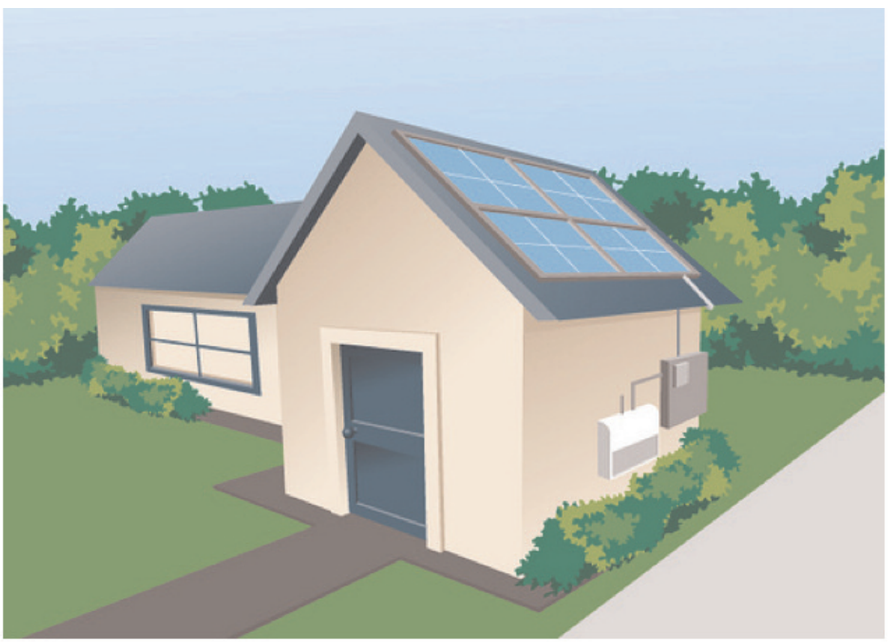
8

Do It Yourself Solar Cooker



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Do It Yourself
Solar Cooker

You should also see this "Crisis Cooker" here:

http://linx.onlinesupportsolutions.com/cb.php?l=crisiscooker

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Introduction

Cooking is an integral part of all of our lives. Through evolution, our ability to eat raw food has atrophied and been replaced by the need for cooked food. Cooking does more for the food that we eat than simply make it more delicious and palatable.

For many people, finding raw food devoid of disease and bacteria is impossible. In North America, we either eat out at restaurants, or buy our raw food at supermarkets to cook in our own homes.

Figure 1 - Cooking with solar cookers in Kenya

In rural areas of many other countries, both meat and vegetables are gathered by hand, without the aid of supermarkets or restaurants. In these cases, the raw food gathered is often riddled with bacteria. Cooking or boiling the food before hand is integral.

Unfortunately, some of these rural areas lack electricity, gas lines or even running water, so many of these methods must be tackled in a different way. Our natural world is a wondrous place,

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though, and the natural rays of the sun can cook our food with just little ingenuity and know-how.

This is the legacy of the Solar Cooker. Designed to capture and focus the natural heating rays of our sun, the solar cooker has become a very important part of many people's lives. The solar cooker is not just a tool for impoverished rural inhabitants, though. It can be a powerful cooking tool for anyone willing to keep an open mind, and try something entirely new.

With this guide, you too can reap the benefits of the solar cooker, and make more delicious, healthier meals with the natural power of the sun.

What is a Solar Cooker?

Quite simply, a solar cooker is a device that uses special inexpensive, but specific, material to heat up your food. In the case of almost all solar cookers, the pot of food in question is kept within the cooker itself, which collects the suns rays and focuses it on cooking your meal.

Figure 2 - The famous "Kyoto Box Cooker" design

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What the cooker is focusing is technically the heat contained within the wide spectrum of electromagnetic radiation released by the sun. Much the way a magnifying glass can be used to focus sunlight through its lens to melt army men action figures, the solar cooker's mirrors bounce the electromagnetic radiation that hit them straight into the food situated at the correct spot.

Because it uses electromagnetic radiation to heat food, rather than a fire, food cooks slower, but also maintains a lot of its moisture and flavor.

Solar Cookers have become increasingly popular in fuel-scarce regions of the world, as its one and only fuel is energy of the sun. Many of these rural areas have fairly warm climates, and during the hottest months of the year, it is a godsend.

Contrary to what you might think, there are actually a large number of Solar Cooker designs available. While there are common designs that are used by most people, there are a number of unconventional designs worth trying. We will be highlighting the most ubiquitous of these designs: the box cooker.

A Brief History

The ability to manipulate sunlight both in focus and in direction has been known by a number of civilizations for centuries. Both the Romans and the Chinese researched the science of using reflective surfaces to direct sunlight to a predetermined point, but the applications were scant. Most application was of military importance, directing focused sunlight at wooden machinery to cause fires or injure ill-equipped soldiers. There were also accounts of using mirrors to light altar pyres and light sources for ceremonial parades, but the application stopped there.

There is little to no evidence that any sort of mirror-influenced technology during this time

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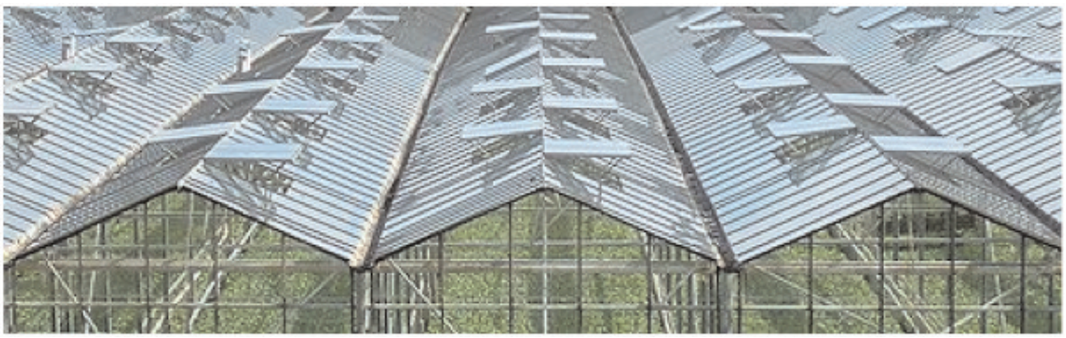
led to solar cooking.

The more direct influence would probably be the use of glass. While plenty of wealthy Roman families had glass in their hopes, it wasn't until the 16th century that glass production became cheap enough to pass into ubiquity.

Figure 3 - Greenhouses in The Netherlands (Photo taken by Wikipedia user Quistnix)



Global trade saw the transfer of rare tropical plants and fruits to northern countries with climates too hospitable for this new flora. The Dutch and Flemish (and later the French and English) built the first greenhouses, keeping the cold climate out of the leaves, but allowing heating rays of the sun in.

These "solar heat traps" became increasingly popular as tropical flora became the main focus of horticultural activity during this time. The substantial use of glass in green houses also may have led to the popularity of sunrooms later.

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Figure 4 - A portrait of Horace de Saussure

Saussure, from a picture by Juchl.

Despite the widespread use of greenhouses, the application of glass boxes to heat and grow plants was limited. In 1767, French-Swiss scientist Horace de Saussure took the concept several steps further. He had built five glass boxes of decreasing size, and placed one inside the other. He then placed a fruit inside the fifth smallest box, and placed the entire contraption on a black tabletop.

The fruit obviously cooked nicely and evenly, and a breakthrough was made. De Saussure continued his research and experimentation for years, using different materials, including insulation, and even experimented with cooking at various altitudes.

As De Saussure's research became better known, others followed suit, such as Samuel Pierpont Langley, who would later become the head of the Smithsonian. Langley himself worked predominantly with the hotbox, which many considered to be the direct predecessor to the box cooker (the most popular solar cooker design in existence).

Augustin Mouchot, a French mathematician with a great interest in solar energy, began his

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own research a century after De Saussure. Not particularly interested in parlor trickery and toys that used solar energy, Mouchot's main interest was both in scientific progress as well as practical application. His first, but unsuccessful idea was in using solar energy to boil the water in steam engines. After this ended in failure, he switched gears over to using the same mirror concept with the greenhouse heat trap idea, effectively creating a working solar oven.

After this point, many started to believe solar energy could be a viable tool for scientific progress. Solar research began to branch out into a number of applications outside of cooking, and progress continued.

Figure 5 - Augustin Mouchot

It was not until the 1950's, though, that real progress in the science of solar cooking began again. Maria Telkes was an M.I.T. scientist whose work on solar cooking first extended from her work in heating homes and other buildings with solar energy. Using many of the principles she had learned doing the work on a larger scale, Telkes used plywood, two layers of glass and large

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reflectors to build the first “box cooker”.

Despite the time of its construction, the classic box cooker design is still the most widely used type of solar cooker in the world today.

It was after this point that variation in the design began, along with the creation of “kits” that could be purchased and assembled by any customer. Solar Cookers International was founded in 1987. They declared that one billion people (1/5th of the total population) could benefit greatly from knowledge on how to cook with the sun. Since then, the solar cooker community has grown to become one based on information sharing and education.

The Benefits of Solar Cooking

Solar cookers have a number of fantastic advantages. The most obvious is its ease of use. Unlike fast cooking devices like stoves and ovens, there is no need to constantly watch the cooking food, nor is any stirring or constant movement required. Solar cookers follow a slow cooking concept similar to that of a Crock-pot slow cooker. Food is cooked slowly over time, preventing burning or charring.

Meals can be left supervised, and the clean up afterwards only involves cleaning the pot itself. There’s no soot to clean, no expended fuel to throw away, and no mess around the cooking site to maintain. Because food cooks slowly in the cooker, it never sticks to the inside of the pan or pot, making cleaning and serving incredibly easy.

Solar cookers are also extremely safe. There are no fires involved in the cooking process, so there’s never any danger of burning yourself or the surrounding area.

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Many people claim that the slow cooking process employed by solar cooking makes food taste better. Food retains moisture and remains flavorful, and meat doesn't cook to carcinogenic levels.

The most important benefit of the solar cooker is its versatility in construction. Solar cookers can be built with a variety of different materials, and can easily adapt to any number of cuisine types and cooking styles. To suggest it is the most versatile cooking apparatus you may ever have in your home sounds like hyperbole, but it is closer to the truth than you may actually think.

Constructing the Box Cooker

While there are many different kinds of solar cookers one can choose from, the most well known, most widely used and most foolproof, is the box cooker.

Before we begin building our box cooker, we'll need to prepare the materials to build it. Remember that because we're building a relatively simple solar cooker, we want to use easy-to-find and inexpensive materials to keep cost down. There's no reason to use materials that are more expensive outside of personal preference, so replace the recommended materials with your own at your own peril.

Scoring Cardboard

Before you get started on this relatively easy project, it is essential to understand how scoring works, as it means the difference between a beautiful solar cooker, and utter frustration.

Scoring is relatively easy, but it is an essential part of cardboard construction. Scoring is the

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act of cutting halfway through the material you're folding in order to thin the folding joint. This prevents bunching and tearing, and makes particularly thick cardboard easier to fold without damaging or ruining your work.

The steps are short and fairly simple, but it's important that none of them are skipped.

1. Mark your folding line with a marker and a straight edge. Make sure it's straight and in the right place, because you won't get a second chance.
2. Take your box cutter and carefully cut through only a single layer of your cardboard along the line you drew. Don't cut all the way through the cardboard! A single layer is all you need.
3. Retract the blade on your box cutter completely, and run the blade end of your retracted box cutter through the fissure you created into order to widen it into a valley.
4. Place a rules into this new channel, and carefully fold along your new scored line.

If you're worried about ruining your hard work because of your lack of experience scoring, practice a few times on spare cardboard you don't need for your project. Practice makes perfect, and it's important to proficient before undertaking the project. Scoring is not difficult, but ruining a carefully measured and cut portion of your project can be a frustrating experience.

Preparation

The first step in constructing your cooker is to prepare the parts beforehand, so that assembly goes smoothly. For this project, you need both an inner box and an outer box. The outer box needs no construction, and only serves as a cradle for the rest of the cooker. Try to acquire a box roughly

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16” x 22” x 6”. If you find something slightly bigger than that, you can still use it, but you might need to use crumpled newspaper or foam to keep the reflector in place.

With that out of the way, let’s start with the cardboard for the inner box.

1. Using a T-square and a straight edge, cut 5” wide strips of cardboard until you have a total length of 62”.
2. Using aluminum foil tape, tape all the pieces together end-to-end, until you have one long 62” strip of cardboard.

NOTE: Remember that Aluminum foil tape is recommended because of its resistance to heat. Other tapes will either lose their adhesive ability, or crack and crumble when exposed to heat.

Next, let’s prepare the insulation for the inner box.

1. You will be cutting foil backed foam board insulation. Remember to wear some thick gloves when cutting to avoid skin irritation.
2. Cut two strips that are 5” x 12 ½”, and then two strips that are 5” x 18”. These will constitute the insulation for the sides of the box.
3. Cut a portion of insulation measured 12 ½” x 19”. This will be the bottom insulation.

Finally, let’s tackle the most complicated portion of the preparation: the reflector crown. The reflector crown is made of four trapezoids. When completed, the shape of the crown resembles a funnel, with the smaller end connecting to the box, and the larger end facing up. Since the reflector fits a rectangular box (rather than a square), two sides of the reflector will end up being wider than the other two.

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Let's start with the widest two sides.

1. Cut a rectangle of cardboard 40" x 35". Make a small marking on one 40" side to signify it as the reflector's top.

2. Mark a horizontal line 20" from the top of the reflector, parallel to the top. Mark x's on this new line, 10" from each side.

3. Measure two 22 ½ degree angles at either end of the 40" top of the reflector, with the top of the reflector serving as the base of the angle. Extend the lines of each angle so that they meet the horizontal line drawn through the middle. You should now have the shape of a trapezoid at the top of your rectangle.

4. Using the new intersection in the previous steps, draw a vertical line straight down from the bottom corners of the small trapezoid all the way to the bottom of the reflector. If done correctly, you should now have a rectangle measuring 20" x 15" sitting below your trapezoid.

5. Cut along the lines you've created, but do not cut the horizontal line separating the trapezoid and the rectangle. It is very important that this stays intact.

6. Since we need two sides of the same shape and size, repeat the last six steps. If you choose, you may also trace your first side on another piece of cardboard and cut it. If you do this, do not forget to draw the horizontal line separating the trapezoid and the rectangle. This will prove important later.

To make the other two sides for your reflector crown, you will be performing similar steps, but will instead be using slightly smaller dimensions to compensate for the smaller side.

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1. This time, cut a cardboard rectangle that is roughly 34” x 35”. Mark one 34” side as the top of the reflector.
2. Once again, draw a horizontal line 20” from the top of the reflector. Mark the same x’s on this horizontal line, 10” from either side of the cardboard rectangle.
3. Make the same 22 ½ degree angles at either edge of the reflector top, and extend the acute angle’s line so that it intersects with the horizontal line.
4. Draw the same vertical lines to outline the rectangle that the trapezoid sits atop. The rectangle should measure 14” x 15”.
5. Cut along the outer lines of this shape, but keep the trapezoid and rectangle connected, as with the last couple reflector sides.
6. Repeat these steps (or trace) to make the final side for your reflector crown.

The benefit of doing a lot of this preparation is to alleviate the amount of cutting required for the last half of the construction process. You no longer need to cut anything, but a box cutter might be a good idea to keep so that you can score lines across the cardboard to make it easier to fold.

Construction

From here, let’s get started on constructing the most essential part: the inner box. The inner box itself has three parts: the bottom, the glass cover, and the lid. The bottom is best built using an old printer paper box. You can either buy these from Office Depot (provided you actually need that much paper), or you can ask for a spare from your office. If you have trouble finding it, you can try asking at a print shop if they have any spare boxes lying around.

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Let's start with constructing the bottom.

1. Line the inside of the box evenly with aluminum foil, adhering it to the inside using a glue simple diluted glue mixture (2 parts glue, one part water).
2. If there's any excess foil sticking from the top, fold it over the outside.
3. Using five pieces of foil-backed radiant barrier sheathing, cover the outside of the box (one piece per side), and use glue (not the glue mixture) to hold the pieces in place while you prepare the permanent adhesive.
4. Once the sheathing is in place, tape each side down with aluminum foil tape. Tape goes along the bottom edge first, then the vertical side edges, and lastly along the top edge. It's important to tape in this order.

NOTE: Be sure to cover all exposed edges of sheathing with tape, as the fiberglass in the sheathing will crumble and flake away over time.

Once we've completed all the above steps, it's time to start preparing the glass for installation. The glass is going to be fitting over the bottom we just constructed, so it's important that we know that it fits properly.

1. The pane of glass should measure 12" x 18 ½". Place it on top of the inner box bottom and make sure the sides line up exactly. We finished the bottom previously, so there should be no discrepancies in the measurement.
2. If the glass doesn't fit, you will need a pane of glass that does fit the measurements you're now using.

NOTE: It's helpful to know the measurements for the box bottom before purchasing the glass you wish to use. This will save you money, time and frustration.

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3. Once you have the correct glass, it's time to add weather-stripping. The weather-stripping we want in this case is ½" wide adhesive-backed foam weather-stripping. Apply it to the four edges of the glass on one side. The side with the weather stripping will be the side that rests on the bottom.

Next, we will be putting together the inner box lid. The lid will be the part that fastens the glass and bottom into place, so they don't slip around. The middle of the lid will be open to let the sun's rays pass through the glass underneath. If the lid were not open at the top, the food wouldn't cook!

1. For the lid, you'll need a 62" x 5" strip of cardboard. Using a ruler and a T-square (to make sure your line is perfectly parallel), mark a line 1" away from, and parallel to, one of the 62" sides. This side will serve as the top of your lid.

2. Next, you will need to draw lines for each of the edges for this lid. Using the same tools as the last step, mark a line perpendicular to the line you just drew, 12 ¼" from one of the 5" edges.

3. Next, draw another line, parallel to the last line, 18 ¾" away from it. Draw another line, 12 ¼" from the last one. Draw one last vertical line, 18 ¾" from your third line.

4. When you're done, you should have a horizontal line running the length of the

5. Cut along the lines above the horizontal line (but do not go any farther down), as this part will serve as the frame for the upper portion of the lid.

6. The lines you have not cut should be scored. Scoring these lines will make the cardboard easier to fold. If you don't know how to score cardboard, refer to the section earlier in this guide entitled "Scoring Cardboard".

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7. Fold the lid into a rectangle, and check if it fits the bottom and glass. It should be snug, but should also be easy to remove.

8. Once you know it fits, unfold it again, and apply foil to both sides of the lid using the thinned glue mixture from before. Gently press foil into the scored lines you created.

9. Use aluminum foil tape to seal the top and bottom edges.

10. Once the glue has dried, fold the lid back into its rectangle shape, and tape the ends together with aluminum foil tape from the base of the lid to the top, stopping where you cut.

11. Fold the flaps down and tape them into place with the aluminum foil tape.

12. Turn the whole lid over so you can see the inside of the flaps. Take some ½" adhesive-backed foam insulation, and apply it to all four flaps.

Now that you're finished the bottom part of your box cooker, the only thing left to construct is the reflector crown, which we build most of earlier.

1. Glue aluminum foil to ONLY the trapezoidal shape on each of the four reflectors, using the thinned glue mixture from before.

2. Mark a horizontal line 5" below the base of the trapezoid so that it is bisecting the rectangle. Score this line, and fold. Do this for all four reflectors.

3. Tape the four reflectors to each other along three of the angled sides so that it looks like a large fan.

4. Fold the reflector around the tape seams to create a funnel shape.

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5. Fold the bottom of the reflector out across the scored lines to form a base.

6. Place the reflector into the outer box and make sure it is secure. If you need help, you can always ask someone to hold it in place while you prepare the rest.

7. Place the inner box in the middle of the reflector, and keep the reflector closed with rope or a bungee cord, so that it remains secure around the inner box.

Conclusion

We hope this guide has been both informative as well as helpful. Don't forget that solar cooking is not just a good fit for cooking the dishes you love, but can also be a fantastic way to learn how to make new and exotic new dishes. Branch out, try new cuisines, and even experiment with your friends' recipes. The solar cooking community is all about information sharing, and you can continue that tradition as well.

Once you have finished constructing your solar cooker and you've tried a few recipes, you can always find more at a variety of sites, including the following:

- http://solarcooking.wikia.com/wiki/Recipes
- http://www.cookwiththesun.com/recipes.htm
- http://solarcooking.org/recipes.htm

Remember, solar cooking should be fun, so keep cooking, experiment, and have fun!

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