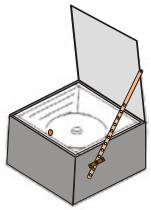
Solar box cooker with one reflector*

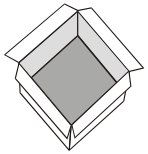
Materials

- ✓ 2 cuboid cardboard boxes, the smaller with base dimensions at least 38 × 38 cm
- ✓ a glass frame 3-4 mm thick in relevant dimensions to the open top of the cooker base
- ✓ a wooden knob and a piece of felt cloth
- ✓ aluminium foil and pieces of cardboard or a few old newspapers
- ✓ white glue, tape, aluminium tape (optional)
- ✓ a small piece of wood or a piece of thick wire
- ✓ scissors, cutter, ruler, pen or pencil

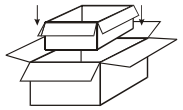


Let's put it together

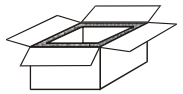
1 Take the *outer box* and glue 3-4 pieces of foiled cardboard at the bottom for insulation. *Do not cut out* the four flaps, because they will be used later to form the open top frame of the cooker base, where the glass frame will be placed.



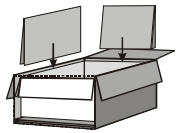
2 You may insulate the bottom of the *inner box* in the same way and then put it inside the outer box. It is better to choose boxes that fit one inside the other, reaching roughly the same height, leaving an empty space of 3-6 cm wide, in every side all around.



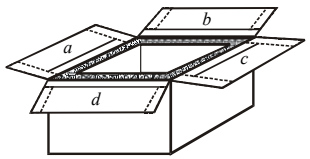
3 You may insulate the sides of the two boxes by inserting crushed pieces of newspaper inside the empty space left between them.



4 Alternatively, you can cut and fold pieces of cardboard and then insert them in the empty space between the outer and the inner box, in order to insulate the cooker base. No matter which insulation technique you will use, the insulated space between the two boxes will then have to be closed from top, using the flaps of the outer box.



5 Take each flap of the outer box, fold it along the continuous lines and cut it along the dotted lines. Notice that flaps ***b*** & ***d*** are treated differently from flaps ***a*** & ***c*** *(see drawing)*.



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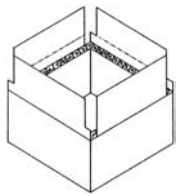
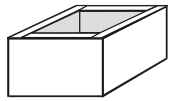
* Source: **Kofalk, H.** (1995). *Solar Cooking: A Primer Cookbook*, Tennessee: Book Publishing Company.

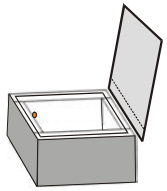
6 After cutting along the dotted lines, the four flaps are shaped as shown in the drawing. Fold each flap over the insulated area and glue it inside the inner box. If the flap comes a bit short and does not cover the whole side, you may glue extra pieces of cardboard to cover that area.



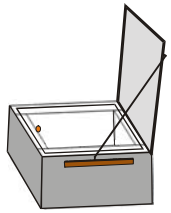
7 Glue the dull side of aluminium foil all around the sides of the inner box. The base of the solar box cooker is now ready.



8 To construct the reflector, take a piece of cardboard, roughly at the same dimensions of the base open top. Add an extra strip 5-8 cm wide, which will later be glued on a side of the cooker. Glue aluminium foil on the surface of the cardboard, using its dull side. The reflector can be fixed and adjusted by using a piece of thick wire in a "**Z**" shape, as shown in the drawing below or by using a piece of wood, as shown in the first drawing.

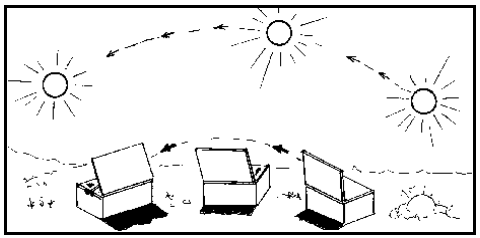


9 A glass frame needs to be cut in a shape to fit the open top of the base. The glass frame is safer and has greater endurance if its sharp edges are buffed. You may glue pieces of felt along the top edges of the box to provide a smooth, firm resting place for the glass frame and to seal in the heat. Optionally, a wooden knob can be fixed on the glass. The solar box cooker is now ready to cook!



Useful information and comments

This solar box cooker can reach temperatures up to 150º C, depending on the construction and weather conditions. It can cook nearly everything, from pies, cakes, and biscuits to chicken and fish with vegetables, rice or even spaghetti. You can cook in dark metal pots or casseroles with lids, in Pyrex glass pots with lids (preferably the brownish ones) or even in recycled jars with lids. Be careful to use oven gloves when you take your pots out of the solar box cooker, because they are hot!



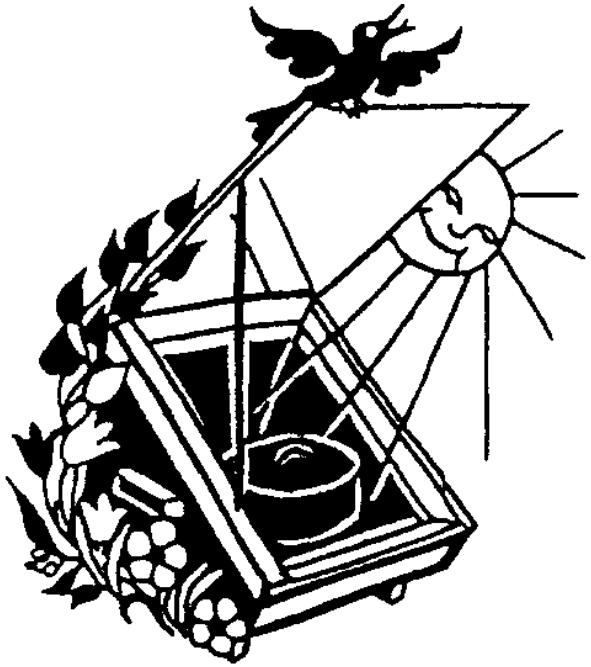
9TH PRIMARY SCHOOL OF RETHIMNO

SCIENCE LABORATORY

2 ND SCIENCE FAIR

with the topic:

Delightful Solar Cooking!



7th –10th of June 2001

This is a leaflet based on a *science fair* project held at the *9th Primary School of Rethimno* with *6th grade children*, under the supervision of their teacher, ***Nektarios Tsagliotis***.

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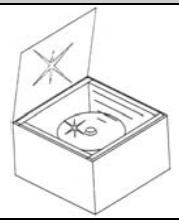
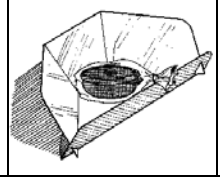
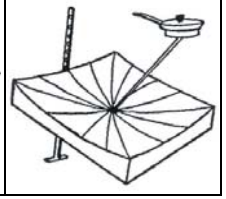
Nothing new under the Sun …
… or isn't it that way?

Solar ovens are not a new invention. Ever since 1767 the Swiss scientist *Horace De Saussure*, constructed "hot boxes", where he could cook food, in a much similar way that we cook in solar ovens today. Nevertheless, a more general spread and use of solar ovens begun in the ´70s. Nowadays, it is estimated that over 2.000.000 solar ovens are used worldwide, most of them in China, in India and in African countries. Approximately 65% of these solar ovens or solar cookers are made out of two boxes, one fitted inside the other, with insulation between them and 1-4 reflectors adjusted on the outer box. The rest appear to be parabolic and semi-cylinder solar ovens, whereas the recent advancement of solar panel cookers tends to become very popular, especially in Africa (see table below for indicative drawings).

Solar box cookers, with 1-4 reflectors	Solar panel cookers	Parabolic solar ovens
		

HOW DOES A SOLAR BOX COOKER WORK?

A solar box cooker is one the cheapest and easiest you can construct. Nevertheless it can cook your food in temperatures up to 150º C. It can be built out of *two cardboard boxes*, an outer and an inner one, with insulation between them, which can vary from feathers to cardboard or even crushed paper. The open top of the base of the cooker is covered with a glass frame, usually adjusted inside a lid. The glass frame traps *solar energy,* creating *the green house effect* inside the box cooker. The visible light easily passes through the glass frame and it is either absorbed or reflected back to the objects inside the solar cooker. Part of the solar energy absorbed by the back or dark coloured cooking utensils and/or a black metallic plate (set at the bottom of the box) is transformed to thermal energy. In principle, these dark coloured objects emit ultra-red radiation. With the aid of the glass frame, almost 50% of it is trapped inside the box cooker. The reflected light from the sides of the inner box of the cooker is either absorbed by other materials or it passes through the glass frame and goes out of the box. Placing a double glass frame (thermal plane) can significantly increase the effectiveness of the solar cooker, because of decrease in energy losses. Reflectors can be used in order to increase the amount of solar radiation coming inside the box. They can be constructed using a safe and effective reflective material like *aluminium foil*. We have to protect our eyes from the glazing of highly reflective materials (like stainless metals and mirrors), because they can be dangerous. On the contrary, we are quite safe if we use sunglasses and observe the solar cookers from the back or from the sides. Moreover, we can only use aluminium foil as reflective material, which gives a very smooth glazing.

WHY SHOULD WE USE A SOLAR COOKER?

Nearly 2 billion people, one third of the earth population, depend daily on the use of firewood fuel as the main source of energy for cooking food or heating water. Most of these people live in tropical areas, which are naturally endowed with the most favourable conditions for solar energy applications. Nevertheless, the cut of firewood results to a loss of 20.000-25.000 square kilometres of forests every year, bearing disastrous ecological consequences for the whole planet (UNEP).

Unsafe drinking water is one of the leading health challenges in the world today. Nearly 80% of all infectious diseases in the developing countries are transmitted through water (WHO). As a result, each year more than four million children die. Heating the water to a *pasteurisation* temperature (approximately 60-65º C for about 20-30 minutes), can kill germs and disease-carrying organisms commonly transmitted in contaminated water. Such temperatures can easily be achieved in solar ovens, solving the problem of drinking water for many people. Unfortunately, though, pasteurisation cannot remove chemical contamination, such as pesticides or industrial waste.

Acute respiratory infections are the cause of death of millions of children in the world every year. The large majority of these casualties occur in the developing countries as a result of polluted indoor air due to cooking over open fires in houses without chimneys or ventilation. This problem could be greatly reduced by using solar cookers, which are smokeless over the process of heating and cooking the food. Furthermore, slow solar cooking at temperatures 120-150º C preserves several micronutrients better than conventional cookers do. Generally, solar cookers are very safe because we can avoid burning accidents. The only possible exception can be the careless use of parabolic solar ovens.

In the developing countries many people, mostly women and children, have to spend hours daily collecting firewood. This is a hard work and causes many injuries. Solar cooking can reduce this time and effort significantly. Thus, women and children could use the time saved for education, leisure, social and communal activities. Of course, money can be saved to cover basic needs, since solar cookers need no fuel!

HOW LONG DOES IT TAKE TO COOK FOOD IN A SOLAR COOKER?

It depends on the food, the type of solar cooker you are using and the weather conditions. If you use a solar box oven, as a thumb rule you can estimate that it will take twice as much time to cook food than the time it would take in a conventional oven. Perhaps you can see things in a different way and not worry that much about how fast the food can be cooked. Just get it in the solar box oven early and go back at lunchtime to find a delicious meal waiting for you, without any danger of being overcooked or burned!