

Solar Cooking

A Design and Technology project for Key Stage 2



Objectives

- To learn about the problems which come with cooking in the developing world and how solar power can help.
- To learn about the basic principles of solar cooking.
- To build a solar cooker.

Information notes

The building of the solar cookers could take up to half a day. The testing and cooking needs to be done on a very sunny day and would be well suited to demonstration at a school fete or Green Day. Cooking works best in the hours leading up to midday and immediately after.

More information: <http://tiny.cc/6qc4r>

Solar Power

There are two types of solar power;

- Photovoltaic solar power: the energy created by converting solar power into electricity using photovoltaic solar cells.
- Solar thermal energy, or direct solar power: the energy created by converting solar energy into heat.

Solar cooking does not require any electricity but uses solar thermal energy to cook the food. This means that you can use a solar oven anywhere that has lots of sun.

Solar Cookers

Solar cookers are used to cook food and pasteurise water for safe drinking. They use a free, renewable energy source and do not pollute the environment. There are many benefits to solar cooking, explained later in the pack. They are particularly useful when other sources of fuel are unavailable.

There are different types and variations of solar cookers but the basic principles of all solar cookers are:

1. **Concentrating sunlight:** A mirror, or reflective metal, is used to reflect the sunlight so that it is concentrated and the energy is stronger.
2. **Converting light to heat:** Parts of the inside of the cooker are painted black. Black surfaces absorb and retain heat which is important for keeping the cooker hot.
3. **Trapping heat:** Isolating the air inside the cooker from the air outside the cooker makes an important difference. A plastic or glass cover creates a greenhouse effect within the oven to make sure that the heat is allowed in but can't escape out.

Safety!

- The contents of solar cookers can get very hot.
- Do not put fully sealed jars or bottles inside a cooker as pressure will build up inside it.
- Take extreme care cutting with craft knives.
- If working outdoors, remember sun cream, hats and sunglasses.

Why Solar Cooking?

Cooking in the developing world.

More than half of the world's population rely on dung, wood, crop waste or coal to meet their most basic energy needs¹. However, according to the United Nations, about one third of the world – two billion people – now suffer fuel wood shortages, which means it is harder to find and more expensive. Women, and sometimes children, must walk further distances to find fuel for the family. Some urban families spend 30-50% of their income on cooking fuel or must barter away food for fuel to cook the remainder. As a result, families drop the nutritious foods that require lengthy cooking – such as vegetables – from their diet, contributing to malnutrition.

Solar cookers prevent deforestation.

Cooking is the main source of demand for wood fuel and can be a major cause of deforestation. Deforestation contributes to climate change, floods and soil erosion, increasing environmental degradation, and increasing poverty and hunger.

Each solar cooker in sunny, arid climates can save one ton of wood per year. Meanwhile, with solar cookers families often reduce fuel wood needs by half.

Solar cookers prevent pollution.

Burning fuels such as wood and gas pollutes the air and contributes to climate change. Solar cookers provide a pollution-free alternative.

Cooking and heating on open fires or stoves without chimneys leads to indoor air pollution. Every year, indoor air pollution is responsible for the death of 1.6 million people². Because most of the cooking in developing countries is done by women, and they look after the children, 56% of all indoor air pollution-attributable deaths occur in children under five years of age.

Solar cookers take longer to cook food but are easy to run.

Solar cooking can save time and work. Meals in solar cookers can take one to two hours longer to cook than in wood-burning cookers but they require less attention. Food does not need stirring and there is no worry about the flames from the fire.

Fuel collection can impose a serious time burden on women and children. Alleviating this work can free women's time for more productive endeavours and child care, and can boost children's school attendance and time for homework.

1., 2. WHO Fact sheet No292 June 2005

Solar Cookers around the world.

Although there are some people in the UK who do solar cooking as a hobby, it is rarely used as a method of cooking because the weather is unpredictable. Cooking food using solar energy will take on average two hours longer than in a normal oven so they need to be used in an area with a near constant supply of sunshine. The food will cook as long as the cooker is in an area with 20 minutes of sunshine per hour. In countries like Kenya or India, where they have more sun, solar cooking is more widely used.

Facts

- There are over 100,000 solar cookers being used in both India and China
- More than 5000 families in Kenya are using solar cookers because of Solar Cookers International
- Developing countries are fuel poor but sun rich
- In the Touloum Refugee Camp in Chad, Africa, 5,000 women have been trained to use solar cookers and about 16,000 have been distributed.

Videos

Video of the solar cookers in Touloum:

<http://tiny.cc/vmumyw>

Making popcorn on a solar cooker

<http://tiny.cc/aqumyw>



Solar cooking conference in Dinguyare, Guinea

Photos



Solar cooking workshop in Streatham, London, demonstrating a range of different solar cookers

<http://tiny.cc/grumyw>

<http://tiny.cc/fsumyw>

Teacher Notes: Making a Solar Oven

In the following pages there are instructions for two simple solar ovens, one to be made using a pizza box and one using a Pringles tube. These cookers are suitable for simple cooking, such as melting chocolate, reheating pizza or baking small cookies, but they are not suitable for cooking meals.

The testing and cooking needs to be done on a very sunny day and would be well suited to demonstration at a school fete or Green Day. Cooking works best in the hours leading up to midday and immediately after.

The building of the solar cookers could take up to half a day and will need adult support, particularly cutting with craft knives.

For more advanced solar cookers, see the following websites.

<http://www.solarcooking.org/plans/funnel.htm>

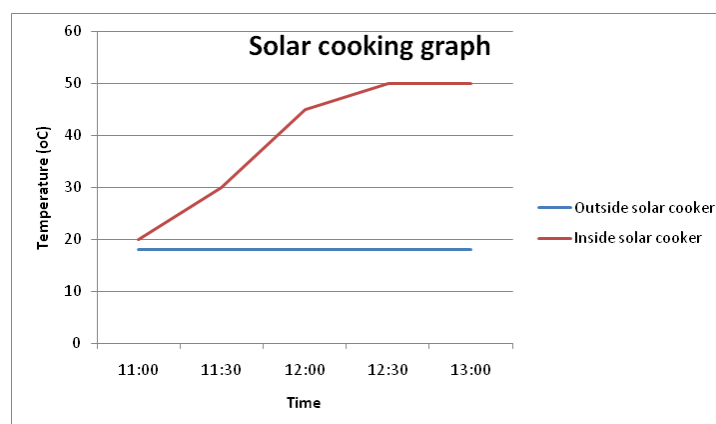
(Scroll down for instructions)

<http://tiny.cc/vtummyw>

These cookers will need larger materials and will take several sessions to design and build.

Extension

To extend this activity into a science activity, use two thermometers to measure the temperature inside and outside the solar cooker. Pupils can take regular readings and record in tables. These can then be plotted on graphs comparing the temperatures:



Evaluating the solar cookers

The last page of the pack is a simple evaluation tool to help the pupils to evaluate their work.

Pizza Box Solar Oven

You will need:

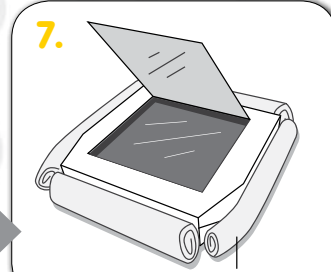
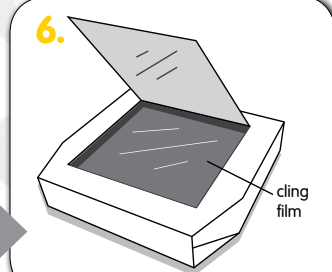
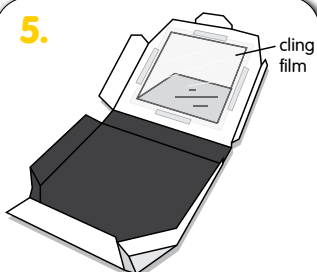
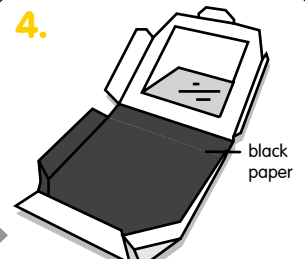
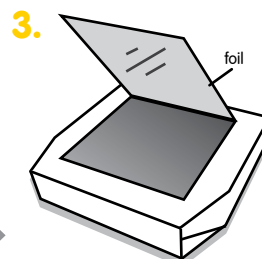
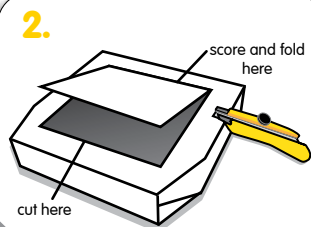
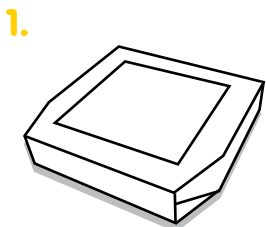
- A large pizza box
- Black paper
- Tinfoil or crisp packets
- Cling film or oven-roasting bags
- Newspaper
- Sticky tape and white glue

Tools

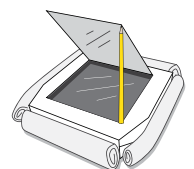
- 30cm ruler
- Craft knife or sharp scissors
- Marker pen

Method:

1. On the top flap of the pizza box use a marker to draw a square with edges spaced 3cm from the sides of the box.
2. Use a craft knife or sharp scissors to cut a flap in the lid of the pizza box. Cut along three sides and score the fourth. Fold the flap up gently.
3. Cover the underside of the flap with tinfoil or crisp packets with the shiny side facing up so that the rays from the sun will be reflected off. Be careful to make as few wrinkles as possible. This will reflect the solar radiation into the box.
4. Open the box and line the inside with black paper. This will help to absorb the heat.
5. Cut two pieces of cling film larger than the window in the lid, or stick together zip-lock food bags big enough to cover the window. With the lid open, tape the first piece to the underside of the window. Make sure it is completely sealed and stretched tight.
6. Next, close the lid but keep the flap open and tape the second piece of cling film to the window, taping all four sides down to create a seal. This will create a greenhouse effect inside the box, allowing the heat in but not letting it out.
7. Finally, roll up some newspaper into tubes approximately 2cm thick. Cover all four sides of the outside of the box and tape the newspaper to the bottom to secure it. This will insulate it and help to stop heat escaping.



Get Cooking!



How to Test your Solar Oven

Take it outside to a sunny spot (if the ground is cold, place on a towel or blanket). Open the lid, place a piece of pizza or cheese on toast onto a paper plate and put it in the centre of the box. If you have a thermometer, place it inside also, noting down the temperature at the start. Close the lid and open the flap, directing the box so the foil flap is facing the sun. Experiment with the angle of the flap until the most sunlight possible is reflecting into the box. Use a stick or ruler to prop the flap up at the correct angle. Whilst it is cooking, regularly check the angle of the box and the flap, adjusting as needed to make sure it is pointing fully towards the sun. Allow 30 minutes for the oven to pre-heat, then double the usual cooking time.

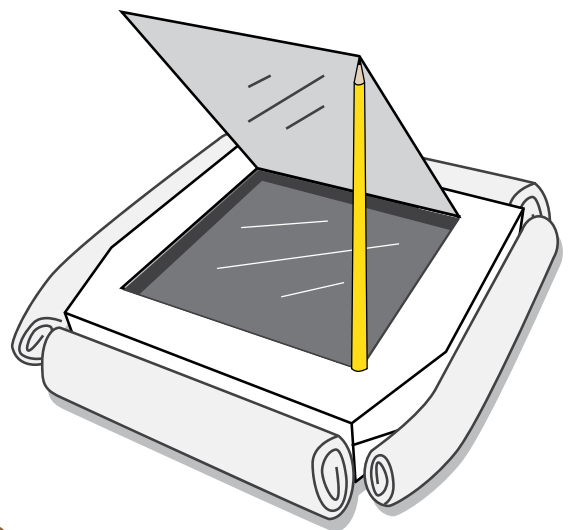
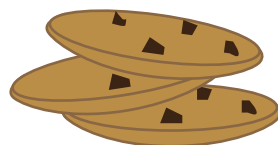
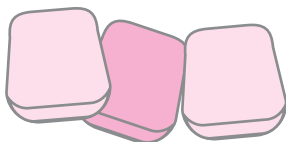
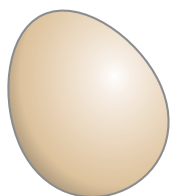
Other solar oven recipe ideas:

- Melt marshmallows
- Bake simple cookies or fairy cakes
- Boil an egg – without any water!

For more information, watch 'How to Turn a Pizza Box into a Solar Oven' :

<http://tiny.cc/uuumyw>

Your recipe ideas:



Pringles Tube Solar Oven

You will need:

- An empty Pringles tube with the lid still on
- Cling film
- A long skewer
- Marshmallows
- Sticky tape

Tools

- Craft knife
- Ruler

Method:

1. Ensure that the inside of the Pringles tube is clean and dry.
2. With a craft knife, cut down the middle of the tube lengthways, leaving about 5cm at either end. Then, cut about 5cm either side of the lines at each end, perpendicular to the first cut. This will create two flaps; fold them out.
3. Cover the new hole that you have created with cling film. Pull the film across tightly and tape it down to ensure that no air can get in.
4. Take off the lid of the Pringles can and push the skewer all the way through the middle of it, leaving only enough to hold on to.
5. Place three marshmallows on the skewer and put it inside the Pringles tube, securing the lid shut, so the marshmallows are now inside your solar oven.
6. Place the Pringles tube outside so that the sun is shining into the cling film covered hole and on to the marshmallows. You may need to turn them halfway through.
7. The sun will heat up the solar oven and you will have gooey marshmallows!

For a demonstration, watch 'Cooking with Pringles: how to make a solar oven' :

<http://tiny.cc/f1umyw>

Evaluation

How successful was your solar cooker? Why do you think this was?

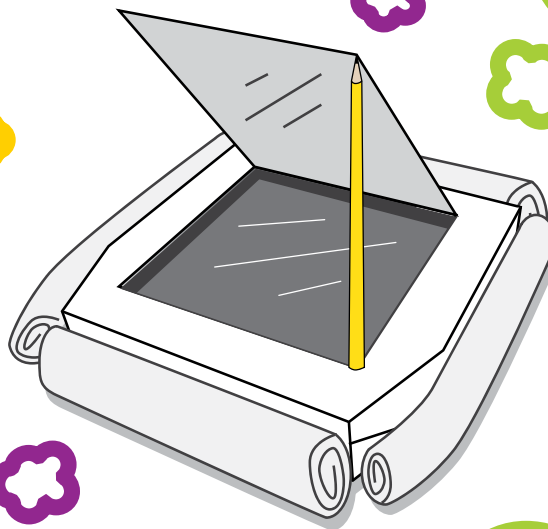
What else could be cooked in the Pringles tube oven?

Which countries are most suited to using solar cookers? Why?

How can you improve the design of your cooker?

For the pizza box oven, what angle should the flap be pointing at 11am? 2pm? 4pm?

Why is the inside of the oven painted black?



How is the greenhouse effect created in a solar cooker?

What types of solar cooker are there? What are the advantages and disadvantages of the different designs?

What is the purpose of having insulation?