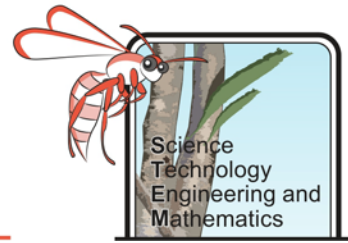


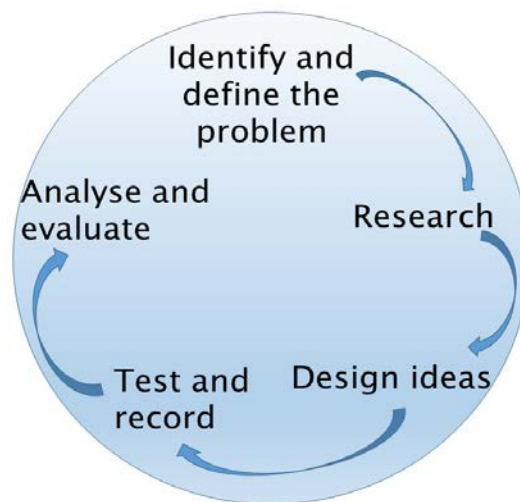
# Solar Oven – Student Booklet



## The Challenge

Can you cook a meal without using electricity or gas? Is it possible to use just the power of the Sun to cook food?

Your task is to investigate solar ovens and then use your findings to design and make a working oven.



## Background Information

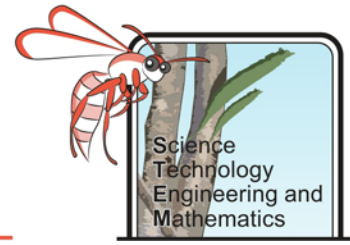
Solar ovens are designed to harness energy from the Sun to cook food without the need of gas or electricity, this makes them very environmentally friendly. Solar ovens can be bought in camping stores, but they can also be made using everyday household equipment.



*Figure 1. Hot Pot solar cooker with panel reflector (Wikipedia, photograph by Paul Averson, June 27, 2011)*

The Sun emits infrared (heat) and light radiation as waves which travel to the Earth through space. It is the infrared waves which a solar cooker uses to heat food. These infrared waves can be focused to a point by using reflective material, like in the image above. By focusing the rays they concentrate the heat and so make the oven more efficient.

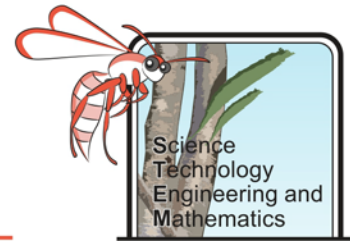
## Solar Oven – Student Booklet



### Background Research

1. What are some advantages of using a solar oven to cook food?
2. What are some disadvantages of using a solar oven to cook food?
3. What are some safety precautions that need to be taken when using a solar oven?
4. What are some foods you could cook on a solar oven?
5. Write a definition for the following words:
  - a. Transparent
  - b. Translucent
  - c. Opaque
6. How many hours of sunlight do you get in midsummer and midwinter where you live?
7. What time of day is the Sun at its strongest?

# Solar Oven – Student Booklet



## Cooking Pot Colour

### Objective

To plan and conduct an investigation to determine which coloured pot would cook food fastest.

### Equipment

What equipment will you need to conduct this investigation?

### Method

Write a step by step method of how you will conduct the experiment, ensuring you explain any precautions you will take to minimise risks. Show this to your teacher and gain their approval before conducting the experiment.

### Hypothesis

Which colour can do you think will have the largest change in temperature?

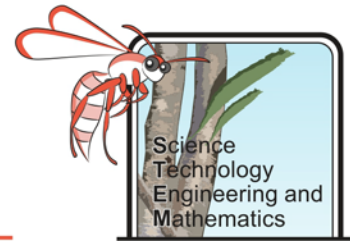
### Results and Analysis

1. Record your results in a table and as a bar graph.
2. List the colours in order from largest change in temperature to smallest change in temperature?

### Evaluation

1. Which variables (s) did you keep the same?
2. Which variable did you change in this experiment?
3. Was this a fair test? Explain your answer.
4. How could you improve this investigation?
5. What colour will be best for the cooking pot in our solar oven if we want to cook the food quickest?

## Solar Oven – Student Booklet



### Investigating Reflection

You may have been to a house of mirrors at a fair or in a theme park before. The mirrors are not flat, like the ones you have at home, but have bends in them which can make you look very funny; some might stretch you while others squash you. You might also have looked at your reflection in a spoon and noticed that you appear upside down. This is all because of the path that the reflected light rays take.

Some houses have satellite dishes on their roofs, these help to reflect the radio and television waves to one point so that the signal becomes stronger, giving you better reception.

### Objective

To investigate how light is reflected to draw ray diagrams and consider how this could be useful in the design of a solar oven.

### Equipment

Use the method below to come up with an equipment list. Show this to your teacher before conducting the investigation.

### Method

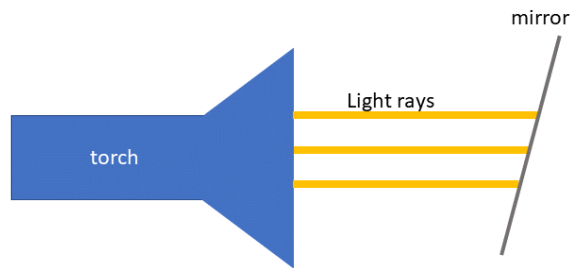
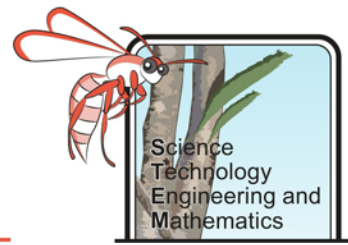
1. Draw around the top of your torch on your piece of paper.
2. Cut out the circle you have drawn and then cut three slits in the circle that are parallel to each other and run about halfway up the circle.



*Figure 1. Cut 3 parallel slits in the piece of paper.*

3. Stick this onto the front of your torch.
4. Make the room as dark as possible, place the torch on another piece of paper with the slits at the bottom of the torch and turn the torch on.
5. Place the straight mirror in front of the torch about 10 cm away at an angle (as shown by the diagram below). Mark on the paper where you have placed the mirror and draw on the ray paths of the light, and the reflected ray paths.

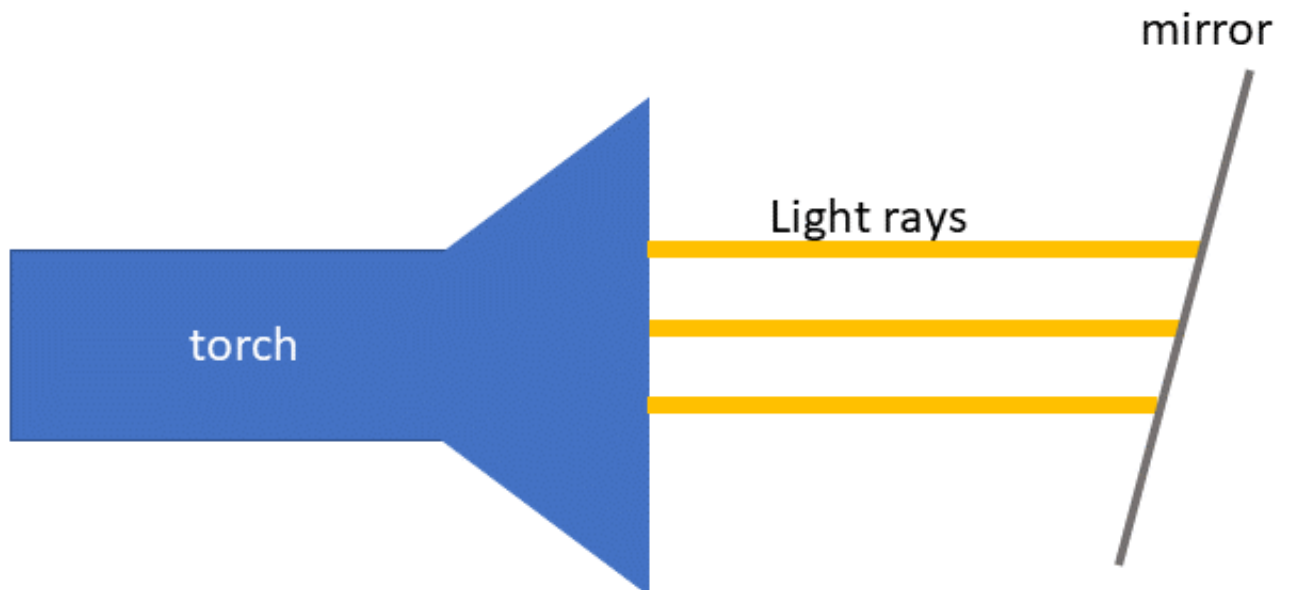
## Solar Oven – Student Booklet



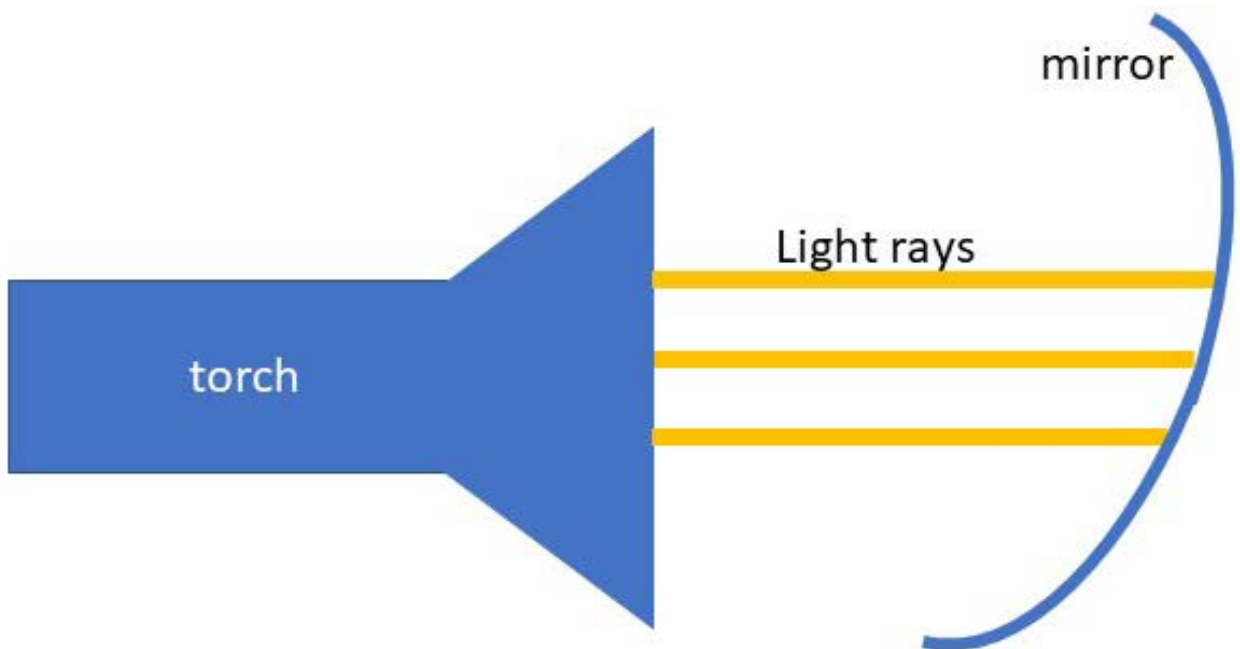
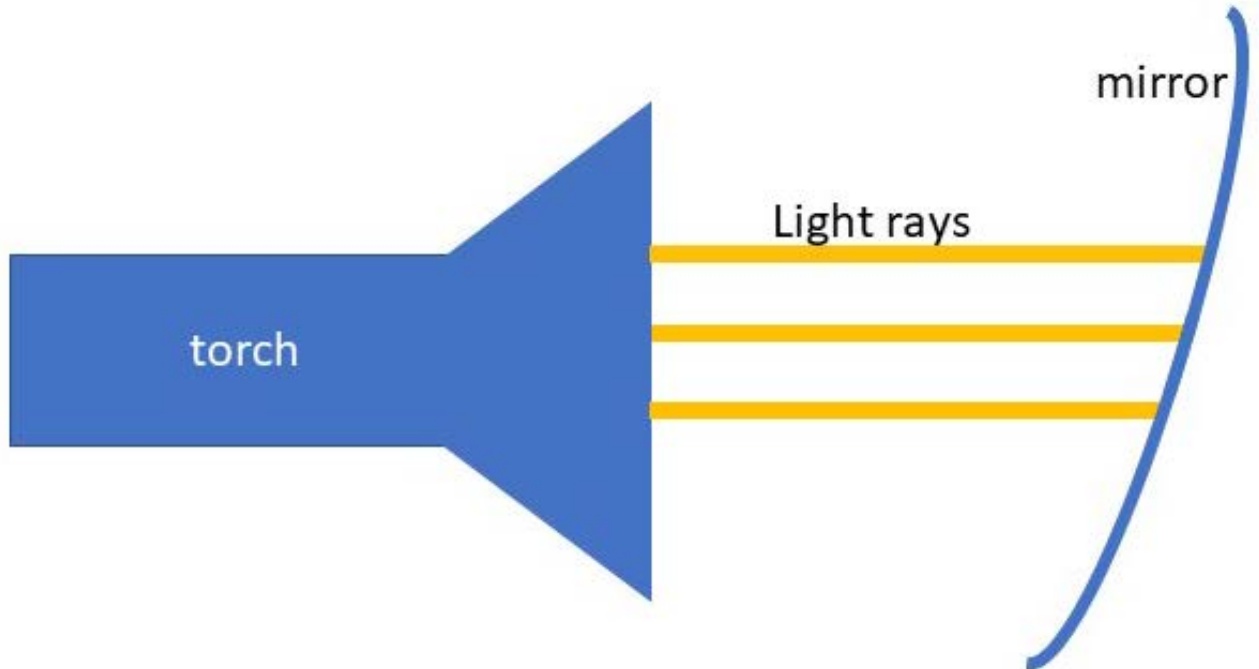
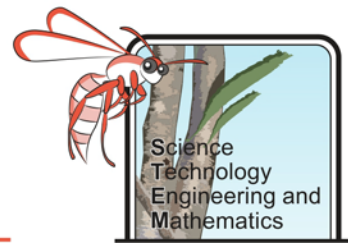
6. Repeat steps 4 and 5 curving the mirror slightly by pushing in the sides. Use a new piece of paper to draw the ray and reflected paths on.
7. Curve the mirror even more and draw on the ray paths on a new piece of paper.

### Hypothesis

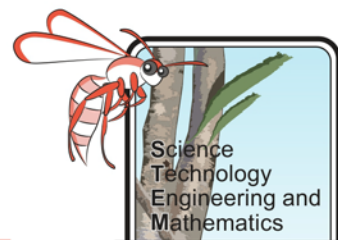
Draw what you think will happen to the reflected rays in each circumstance below.



# Solar Oven – Student Booklet



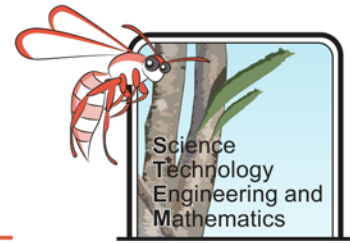
## Solar Oven – Student Booklet



### Results and Analysis

1. What happened to the reflected light rays when they hit the straight mirror?
2. What happened to the reflected light rays when the mirror was curved?
3. What happened to the reflected light rays as the mirror was curved even more?
4. Were your predictions correct?
5. How could this experiment help you with the design of a solar oven?

# Solar Oven – Student Booklet



## Reflecting the Rays

### Objective

To determine if using a reflective lining in a solar oven helps it to cook foods more quickly.

### Equipment

Write an equipment list for this investigation.

### Method

Write a step by step method of how you will conduct the experiment, ensuring you explain any precautions you will take to minimise risks. Show this to your teacher and gain their approval before conducting the experiment.

### Results and Analysis

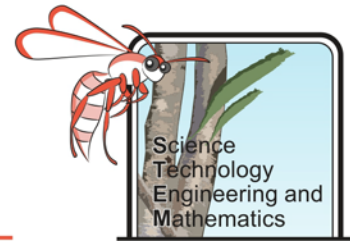
Display your results in an appropriate manner.  
Did a reflective lining help cook the food faster?

### Evaluation

1. Was this a fair test? Explain your answer.
2. How could you improve this investigation?
3. Would you recommend lining your solar oven to make cooking quicker?



## Solar Oven – Student Booklet



### Covering the Cooker

#### Objective

To determine if using a clear lid on a solar cooker increases how fast it heats water.

#### Equipment

Write an equipment list for this investigation.

#### Method

Write a step by step method of how you will conduct the experiment, ensuring you explain any precautions you will take to minimise risks. Show this to your teacher and gain their approval before conducting the experiment.

#### Hypothesis

In which box do you think the temperature of the water will increase the most, the one with a lid or without? Explain your answer.

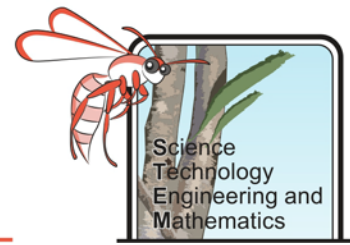
#### Results and Analysis

1. Record your results as both a table and a graph.
2. What did you find out?

#### Evaluation

1. Which variables did you keep the same?
2. Which variable did you change in this experiment?
3. Was this a fair test? Explain your answer.
4. How could you improve this investigation?
5. Would you recommend placing a lid on your solar oven or not?

# Solar Oven – Student Booklet



## Increasing Insulation

Insulation is used in housing and clothing to prevent heat flow. For example, a ski jacket usually has lots of insulating material in it to stop your body heat from escaping to the outside. A house has insulation in the walls and the roof to prevent heat loss in the winter, but it also prevents too much heat from entering the house in the summer.

## Objective

To determine if using insulation helps to cook food faster (heat up water) in a solar oven.

## Equipment

Write an equipment list for this investigation.

## Method

Write a step by step method of how you will conduct the experiment, ensuring you explain any precautions you will take to minimise risks. Show this to your teacher and gain their approval before conducting the experiment.

## Hypothesis

In which solar oven do you think the temperature will increase the most, the one with or without insulation? Explain your answer.

## Results and Analysis

1. Record your results as both a table and graph.
2. Did adding insulation help the food to cook faster?

## Evaluation

1. Which variables did you keep the same?
2. Which variable did you change in this experiment?
3. Was this a fair test? Explain your answer.
4. How could you improve this investigation?
5. Was your hypothesis supported?
6. Would you recommend placing an insulating layer around your solar oven or not?

## Solar Oven – Student Booklet

### Focusing the Sunlight

#### Background

Some solar ovens are very simple boxes with silver lining, others may have one flap on them – like those found in pizza boxes, where the lid is covered with aluminium foil to reflect light into the box. Just as curving a mirror can help focus light, it might be the case that if a solar oven has flaps on it they can also help to focus light into the box, meaning that the food will cook faster.



Figure 2. Solar oven with two flaps angles at ~ 45 degrees

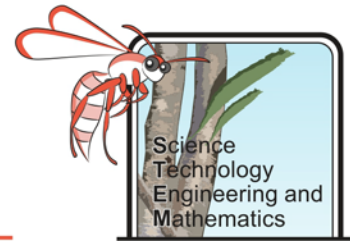


Figure 3. Chocolate melting in a solar oven with four flaps

#### Objective

To determine if increasing the number of focusing flaps help to speed up cooking times.

# Solar Oven – Student Booklet



## Equipment

Write an equipment list for this investigation.

## Method

Write a step by step method of how you will conduct the experiment, ensuring you explain any precautions you will take to minimise risks. Show this to your teacher and gain their approval before conducting the experiment.

## Hypothesis

Do you think the number of flaps will affect the cooking time? Explain your answer.

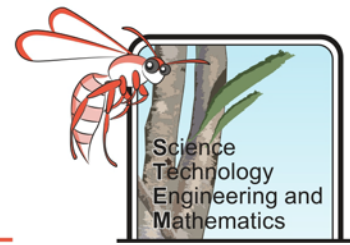
## Results and Analysis

1. Record your results as both a table and a graph.
2. What did you find out?

## Evaluation

1. Which variables did you keep the same?
2. Which variable did you change in this experiment?
3. Was this a fair test? Explain your answer.
4. Was your hypothesis supported?
5. How could you improve the investigation?
6. Would you recommend adding focusing flaps to your solar oven or not, explain your answer?

# Solar Oven – Student Booklet



## Designing a Solar Oven

### Objective

To design and build a solar oven that can bake cookies in it.

### Design Ideas

Analyse existing products or ideas. What are the pros and cons of each idea? Consider factors such as time taken to build, ease of getting the equipment, cost of the equipment, size of the finished product etc.

### Ideate

Using your research and what you have learned from your experiments draw three labelled diagrams of your solar oven designs, highlighting any important features.

Which design idea have you chosen to build, and why have you decided to go with that design?

### Equipment

Write a list of equipment that you will need to make your solar oven.

### Method

Write a step-by-step method of how you will make and test your solar oven. Ensure you have listed any safety precautions you will take to minimise risks when making the product. Show this to your teacher and make any necessary changes before making the oven.

### Evaluation

1. Were you able to bake some cookies in your oven?
2. How efficient was your solar oven compared to a normal oven?
3. How did your finished oven compare to your original design you drew? What changes did you have to make?
4. What improvements could you make to your solar oven?
5. What other experiments could you conduct to investigate how well your oven performs under different conditions?
6. What key ideas have you learnt from this project?