

Suitable for
3-7 years

- Solo
- Pairs
- Groups

Salma's activity

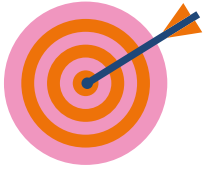
Build a solar oven

How to guide



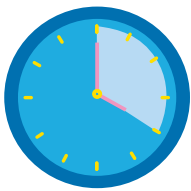
Salma's activity

Build a solar oven



Aim

In this activity, students will take on the role of an Engineer and challenge themselves to build efficient solar oven. Solar ovens can be used to cook food using solar energy in the absence of electricity. In rural and remote areas, where people do not have electricity, a solar oven can be a good and clean way to cook food. Without a solar oven people might need to burn wood or coal to generate heat and cook food. Burning wood or using coal everyday can release toxic gases that can be harmful to people's health.



Timings

This activity is designed for small groups working independently or collaboratively. It's expected the activity might last from 20-30 minutes, but it can be extended as needed depending on your group. There are optional Extension Ideas at the end of this guide.



Story to guide activity

Chandra's Magic Light by Theresa Heine



Materials and equipment

- Cardboard box with attached lid. Lid should have flaps so that the box can be closed tightly. Box should be at least 3 inches deep and big enough to set a pie tin inside. (pizza box is enough)

- Box knife or scissors
- Aluminium foil
- Clear tape
- Black and white construction paper
- Plastic wrap (a heavy-duty or freezer zip lock bag will also work)
- Black and white construction paper
- Newspapers
- Ruler or a stick
- Thermometer
- An adult to help with cutting



Safety

You know your class better than anyone and are the best judge as to whether they are able to complete this activity. We've highlighted a few safety areas that you might like to think about when planning this activity:

- The cutting part of the cardboard box can constitute to dangers
- The high temperature of the interior of the solar oven is hazardous when practical test of the oven is carrying out
- Suggest adults do the cutting and cooking parts



Instructions

- Read the story Chandra's Magic Light. Talk about solar energy and how else could solar energy help Chandra and her family? In the story they purchase a solar lamp - solar ovens allow for cooking without producing gases that can be harmful to health
- Explain that the students that their challenge is to build a solar oven using the materials listed above. Demonstrate the box and how it opens and proceed to work through the below challenges to assemble a solar oven
- Prior to that it might be useful for the instructor to watch this [YouTube video](#) on how to make a solar oven. Where appropriate share that with the students to provide them a visual illustration.

Challenge 1

- **Is there something that we could change about the box to get sunlight in, while the box is closed?**

Solution: A window could work! It will be like how windows can let sunlight into a building, even when they are closed. A flap on the lid will then help create the window effect.

1. Set out the construction materials and ask an adult to help you with a box knife or sharp scissors to cut a flap in the lid of the cardboard box. Ask the adult to help you cut along three sides, leaving about an inch between the sides of the flap and the edges of the lid. Fold this flap out so that it stands up when the box lid is closed.

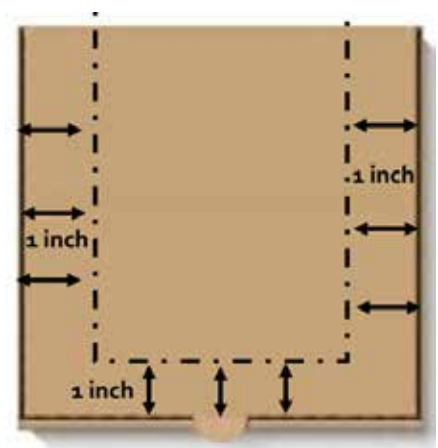


Figure 1: Creating a flap/window to allow sunlight into the box.

Challenge 2

→ Is there anything we can do to make light bounce or reflect back inside the box?

Solution: A shiny surface would work!
A shiny surface can reflect sunlight into the box

→ Is aluminium foil a good insulator?

Solution: Yes! This is because it prevents heat radiation by reflecting the heat back.

2. Cover the inner side of the flap with Aluminium foil so that it will reflect rays from the sun. To do this, tightly wrap foil around the flap, then tape it to the back, or outer side of the flap.
- For the oven to work we need the air inside the box to get hot (from the energy provided by the light of the sun). At home the oven door opens to let us put food in and then shuts to keep all the hot air inside. Now that we have cut the window part out of the opening part (door) of our oven the air can escape.



The inner side of the flap tightly covered with Aluminum foil

Figure 2: Creating a reflector to reflect sunlight inside the solar oven (box).

Challenge 3

→ Is there anything we can do to make sure that:

- The light goes into the box?
- And the heat from the sunlight stays in the box?

Solution: Cover up the cut out region in the door to stop air escaping. A clear surface can allow the sunlight to penetrate inside the box. Plastic wrap can do both these tasks.

3. Use clear plastic wrap to create an airtight window for sunlight to enter the box. Do this by opening the box and taping a double layer of plastic wrap over the opening you made when you cut the flap in the lid. Leave about an inch of plastic overlap around the sides and tape each side down securely, sealing out air. Two layers of plastic wrap for interior and exterior of the lid to make it more air-sealed. If you use a plastic bag, cut out a square big enough to cover the opening and tape one layer over the opening.



Figure 3: Creating an airtight window to keep more heat inside the solar oven (box)



Challenge 4

- **Is there anything else we can do to trap the heat in the box and stop it escaping?**

Solution: Heat insulating materials is needed. Think of more examples of heat-insulating materials like plastic bag, paper and styrofoam.

- **We have both white and black paper, which one should we use to wrap the interior of the box?**

Solution: The colour matters, because dark surfaces can absorb more energy and hence heat faster than light surfaces.

4. Line the bottom of the box with black construction paper—black absorbs heat. The black surface is where your food will be set to cook. How much you need will depend on the size of the box you're using to make your solar oven.



Figure 4: Making the oven more energy efficient by adding a dark surface to absorb more energy.

Improvements

- To increase the heat of the oven and cook faster, before you add the black construction paper, layer the bottom of the box with a layer of aluminium foil to allow more heat to be reflected.
- To insulate your oven so it holds in more heat, roll up sheets of newspaper and place them on the bottom of the box. Tape them down so that they form a border around the cooking area. It may be helpful to also tape the rolls closed first. The newspaper rolls should make it so that the lid can still close, but there is a seal inside of the box, so air cannot escape.

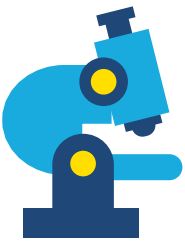
5. The best hours to set up your solar oven are when the sun is high overhead. Take your solar oven outside to a sunny spot and adjust the flap until the most sunlight possible is reflecting off the aluminium foil and onto the plastic-covered window. Use a ruler or a stick to prop the flap at the right angle.



6. In a good sunny day, you can make toast by buttering a slice of bread then letting the sun do the rest. It would also work great to heat up leftovers. So the paper at the bottom doesn't get dirty, put what you would like to cook on a clear plastic or glass plate. A pie plate would work well. Place the thermometer inside your oven before you close it, so you can check the temperature.



7. To take food out of the oven, open up the lid of the box, and using oven mitts to lift the glass dish out of the oven.
8. As the activity draws to an end, ask them to think about what they needed to do to be a good Engineer, foster their discussion about the purposes and benefits of this special oven.



How does it work?

Rays of light are coming to the earth at an angle. The foil reflects the ray and bounces the light directly into the opening of the box. Once it has gone through the plastic wrap, it heats up the air that is trapped inside. The black paper absorbs the heat at the bottom of the oven, and the newspaper makes sure that the heat stays where it is, instead of escaping out the sides of the oven.



Questions and Discussion Prompts

- What happens if your food is cooked unevenly? Is there anything you can do to change the flap to improve that?
- What other shiny materials you can use to reflect more sunlight into the box (Answer, mirror)
- What other transparent materials can be used to create an airtight window and not let heat out of the oven (Answer, glass)
- Ask students to give examples of where can solar ovens be used? (Answer, remote and rural areas with no or limited

access to electricity, camp sites, in hot climate solar oven can be a clean and environmentally friendly way to cook food)

- Ask students on how solar ovens can be useful for the environment (Answer, it uses clean and renewable energy and does not require electricity. Unlike with burning wood and coal, solar oven does not emit any toxic gases)



Extension ideas

- Measure and record the temperature for the best angle for the reflector (flap).
- Because we do not get enough sunlight in the UK, a solar oven might work for recipes that does not require intensive heat. Think of recipes that you can cook inside solar oven in the U.K. How about S'mores?

Potential Adaptions

- Ask the students to work in groups to complete the task and try their best to communicate through out it – Engineers don't work alone, they work in large teams with everyone playing an important role.
- Engineers work from designs and plans; you could get your class to make design their own solar oven individually before building them in a group.
- Prepare the activity with a set of building materials which includes both good and bad absorbers to let them decide and learn from the experiment and discuss which materials worked best.