

Activity Title: R1 - Solar BBQ

Total Time: 3 hours.

Student Age: 12-18 years.

Application Area: Physics, renewable energy, solar energy, energy transformation

Key Words: Solar Oven, Solar Cooking, Reflection, Conduction, Convection, Fossil Fuel, Electromagnetic Spectrum, Insulation, Thermal Mass, Orientation, Heat Retention.

Materials/Materials:

- Ingredients for pizza box solar cooker
 - Pizza Box
 - Pencil or Pen
 - Ruler
 - White School Glue or Glue Stick
 - Black Paper
 - Utility Knife
 - Aluminum Foil
 - Plastic Packaging
 - Black Electrical Tape
 - A Wooden Skewer or Pencil
- Other Potential materials:
- Aluminum foil
 - Cardboard
 - White office paper
 - Band
 - Newspaper
 - Black paper
 - Plastic Wrap (can also reuse plastic shopping bags!)
 - Gluing
 - Scissors



Theme:

- Water and healthy Food
- Renewable Energy
- Environment Pollution
- Global Warming

Considerations:

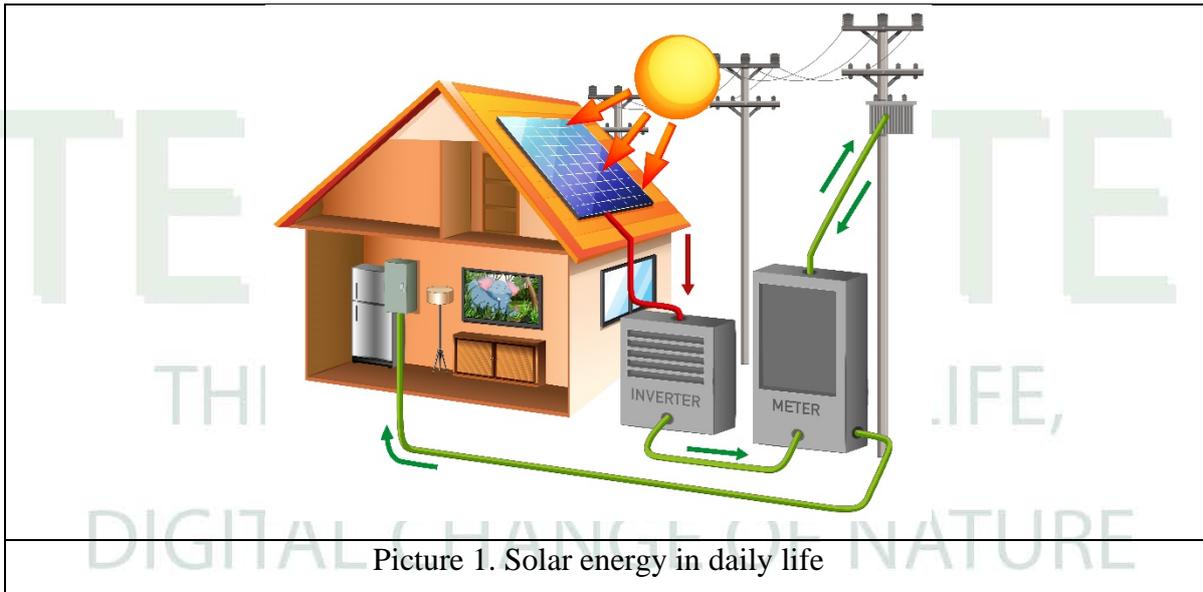
- Solar cookers should be small enough that a student can move and install the stove independently.
- Care should be taken to use sunglasses when working with reflective material.
- Since solar ovens can get very hot, it is necessary to be careful against burning.
- It is necessary to act in accordance with the learning approach by living by doing (DIY).
- Safety precautions should be taken while the cutting and gluing process is sticking.

Introduction:

In this activity, students learn to use the energy from the sun for heating and cooking while building. They discover the concepts of insulation, reflection, absorption, transmission and convection. They learn that different solar barbecue designs can be built. They conduct research on existing solar cooking technologies. Then they test and compare the performance of different designs. Such as group work, learning by living by doing, self-expression. They are expected to improve their 21. YY skills (Instructables, 2021b).

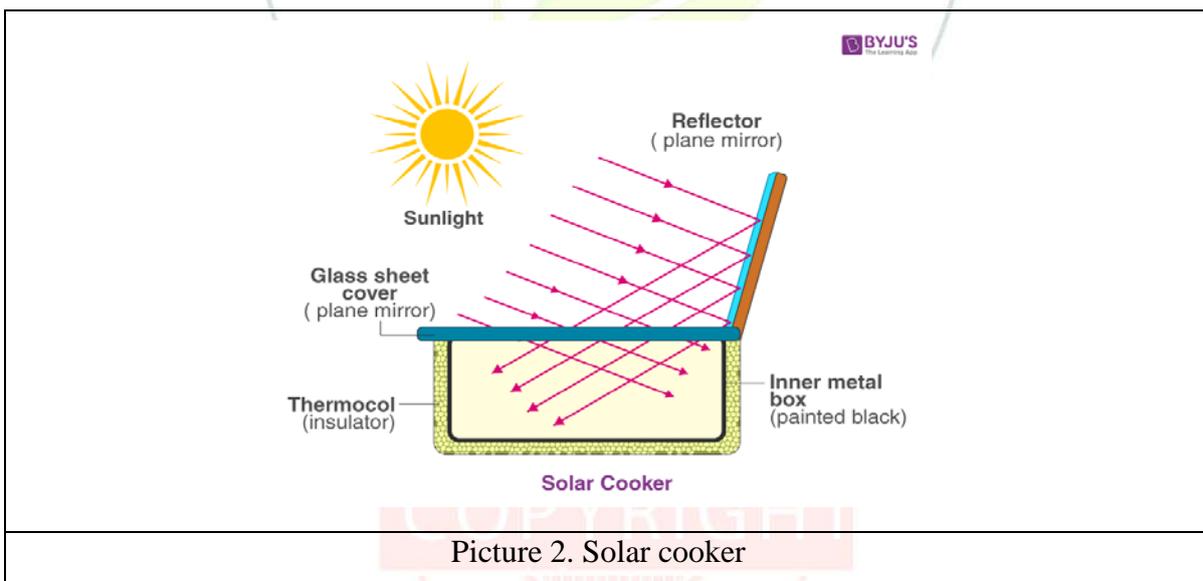
The sun is a source of continuous renewable energy. For about five billion years, the sun emits an enormous amount of energy every day. The Earth cuts off a very small fraction of the solar energy absorbed by land, water and the atmosphere and converted into measurable heat. To use the sun as an energy source, we need to convert it from visible light into heat or electricity (Mendoza et al., 2019).





Have you cooked something, such as barbecuing or camping? Can it be so much fun to be outdoors and enjoy eating fruits or hamburgers? Do you know that you can use solar energy directly for cooking? This can be done using the solar oven, which is a low-cost, environmentally friendly technology and seems to have everything (Instructables, 2021a).

A solar cooker is a solar-powered device for heating and cooking food. The solar cooker mainly works on three principles such as retention, absorption and concentration. A solar cooker consists of a mirror that helps to let in the ultraviolet rays of the sun, converting it into IR light rays. IR rays have the power to strongly shake the protein and water molecules contained in food to heat the food (Picture 2), (Elprocus, 2022).



In fact, solar energy does not heat the food, but the rays from the sun are converted into

heat energy to cook the food. A lid is used to protect food stored in a container so that its heat does not go out. Thus, solar cookers help to cook food using UV rays from the sun (NASA, 2020).

Aim of The Activity:

It is aimed to determine and apply alternative methods (fossil fuels and electricity) that is used for heating and cooking by gaining awareness about sustainable energy in underdeveloped regions. Students are asked to learn:

- Explaining how engineers have helped develop solar-powered cooking technology to benefit people.
- Explaining the important features and purposes of a solar cooker.
- Explaining the energy conversion that takes place in the solar furnace.
- Students learn the basic principles of solar furnace design and identify useful and sustainable construction materials.
- Students learn the principles of heat gain, heat loss and heat retention.
- Students work in teams to complete a task by following simple instructions.
- Students' learning to use the engineering design cycle.
- Students learn to create a procedure for comparing the performance of different devices.
- Students evaluate their designs and formulate their suggestions.
- Students present the design process and results to the class.



Activity Process:

Preparation Phase:

- The area where the event will be held is organized.
- Students are prepared for group work.
- It is ensured that the materials required to create the design are selected by the students in a complete manner and made ready.

Design Steps:

STEP 1. Create the pizza box Barbecue.

1. Using a utility knife, carefully cut out both sides of the square you have drawn, except for the side that runs along the hinge of the box. Cut the cardboard on these three sides of the square to the end. Then fold the sash slightly back along the connected side (Picture 1), (Gosun, 2022).



2. Line the inside of the cardboard cover with aluminum foil. Fold the edges of the foil over the lid to help hold the foil in place and glue the foil to the lid. Keep the foil as smooth as possible (Picture 2).

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Picture 2. Cover with aluminum foil

3. Close the opening made by the flap (on the lid) with a layer of plastic wrap. Attach the plastic wrap to the edges of the opening using shipping tape or black electrical tape. Make sure that there are no holes in the plastic packaging and that all its edges are completely closed to the lid (Picture 3).



Picture 3. Attach the plastic wrap

4. Cover the inside of the box with aluminum foil so that when you close the box, the entire inside is covered with foil. It is easiest to do this by covering the bottom of the box with foil, and then also the inside of the lid (going around the plastic-covered opening) with foil. Glue the foil in place (Picture 4).

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Picture 4. Cover inside the box

5. Glue or tape a sheet of black paper centered on the bottom of the box. This will act as the heat sink of your solar oven (Picture 5).



Picture 5. Glue centered of the box

6. Finally, use a wooden skewer or pencil to lift the lid of the solar oven up from the rest of the box at an angle of about 90 degrees. Your solar oven is ready to bake (Picture 6).



Picture 6. Output

Note: If you want to bake more, cut it in half and put a marshmallow and a small piece of chocolate between the cracker halves. Place the food you have prepared on a small square of aluminum foil and place it in your solar oven on black paper. Place the solar oven in a place where it will receive full and direct sunlight for at least 30 minutes, and

keep the oven open with the lid facing the sun. When the marshmallows soften, your food should be ready to eat and enjoy!

STEP 2. Brainstorm.

Brainstorm and explore different possibilities. Each student team builds at least 2 different designs (parabolic solar furnace, cone solar furnace ...).

Example of outputs:

At the end of the study, these outputs will be obtained (Picture 7).



Assessment:

During the process, teacher may ask the following questions.

1. How did you set up your solar cooker to work better?
2. Was there a particular place on your solar cooker that seemed to be the hottest?
3. What are some reasons to use a solar cooker?
4. What is the conversion of energy that occurs in a solar cooker?
5. What are the important features in a good solar January? What are their goals?
6. Can you make a solar cooker that works at night?
7. What are renewable and non-renewable energy sources?
8. What is the difference between renewable and non-renewable energy Decoys?

During this process, the teacher can evaluate the answers that the students will give with their observations. At the end of the process, students are evaluated through the application development rubric prepared by the teacher

Goals	Must be improved (1)	Medium (2)	Good (3)	Very good (4)
Expressing yourself				
Saying an idea				
Finding materials				
Taking necessary safety precautions				
Appearance of designing				
Coordinance with groupwork				
Using scientific procedures				
Using engineering designing system				
Total				

Links:

Elprocus. (2022). *How to Make a Solar Cooker and Its Working?* <https://www.elprocus.com/steps-to-make-solar-cooker/>

Gosun. (2022). *Solar Grills Make Outdoor Food Taste Better.* <https://gosun.co/blogs/news/solar-grills-make-outdoor-food-taste-better>

Instructables. (2021a). *Programmable Smart Solar Oven.*

Instructables. (2021b). *Simple Parabolic Solar Cooker.* <https://www.instructables.com/Simple-Parabolic-Solar-Cooker/>

Mendoza, J. M. F., Gallego-Schmid, A., Rivera, X. C. S., Rieradevall, J., & Azapagic, A. (2019). Sustainability assessment of home-made solar cookers for use in developed countries. *Science of the total environment*, 648, 184-196.

NASA. (2020). *BUILD A SOLAR OVEN*

efaidnbmnnnibpcjpcglclefindmkaj/https://www.nasa.gov/pdf/435855main_BuildaSolarOven_6to8.pdf

TEMPLATE

THE KEY TO GLOBAL LIFE, DIGITAL CHANGE OF NATURE

