Build a solar oven

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Digging Deeper

Solar ovens use solar energy — light and heat emitted from the sun — to cook food, pasteurize water, or even sterilize instruments. How does a solar oven work? The simple answer is that it is designed to absorb more heat than it releases.

The solar oven you build in this activity is a relatively simple one made out of a pizza box, aluminum foil, plastic wrap, and a sheet of black paper. You cut a flap out of the pizza box's lid and line this flap with aluminum foil so that sunlight can be reflected off of the foil and into the box. You also seal the opening with plastic wrap to create a plastic "window" that works like a greenhouse roof, allowing (direct and reflected) sunlight to pass into the box, while also retaining heat. At the bottom of the box, you placed black paper to create a "heat sink." This heat sink works by absorbing direct and reflected sunlight to become warm so that it can then heat up food placed on top of it.

The Challenge

Have you ever cooked something outside, like for a BBQ or while camping? It can be a lot of fun to be outdoors and enjoy eating the fruits — or burgers — of your cooking labors. Did you know that you can directly use solar power to cook food? This can be done using a solar oven, which is a low-cost, ecologically-friendly technology that seems to have everything going for it. In this science activity, you will build your very own simple solar oven out of a pizza box to gather the sun's rays and cook a tasty treat for you!

Your materials:

1- Pizza box. The larger the box, the better the oven should work.
2- Pencil or pen
3- Ruler
4- White school glue
5- A sheet of black paper
6- Utility knife
7- Aluminum foil
8- Plastic wrap
9- Shipping tape or black electrical tape
10- A wooden skewer or pencil

To do some cooking with your solar oven, you will need sunlight and fairly warm outside temperatures (above 75 degrees Fahrenheit is recommended, and the hotter it is the better). It should also not be windy. If you want to cook some s'mores in your solar oven, you will also need graham crackers, marshmallows,

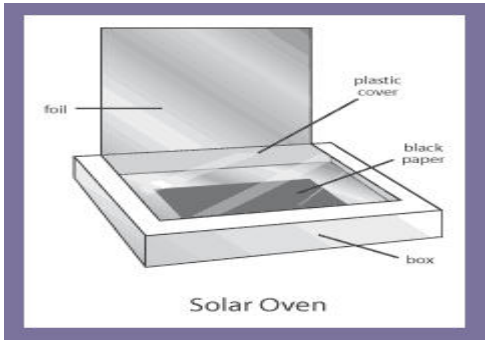
Problem Solving

Ask:

What do you know about solar oven ?

Imagine:

What are some ideas you can try as you design your model?



Planning

Plan : Label your steps and identify who will do each step.

2. Test your steps

Perseverance

Test

Test your model

What do you think the purpose of this foil is?

Improve

How do you think it will help cook your food?

Presentation

Congratulations on persevering through this STEM challenge!

As you review your final product, please answer the following questions:

- What was your **plan** and why did you use this design?

- How did you solve **problems**?

Presentation

What are some examples of how you **persevered**?

STEAM integration

Science : Heating and cooling .
Matter .
Material changing shape by heating .

Math : Mathematical calculation.
Shapes and angels .

Engineering : Adjusting angels and dimensions of shapes .

Art : Design logo for solar oven .

Technology : Slide show presentation about solar oven .

Procedure

1- On the top of the pizza box's lid, draw a square that is about one inch inward from each edge.

2- Use a utility knife (and the ruler as a straightedge) to carefully cut along each side of the square you just drew except for the side that runs along the hinge of the box. Cut all the way through the cardboard on those three sides of the square. Then fold the flap back slightly along the attached side.

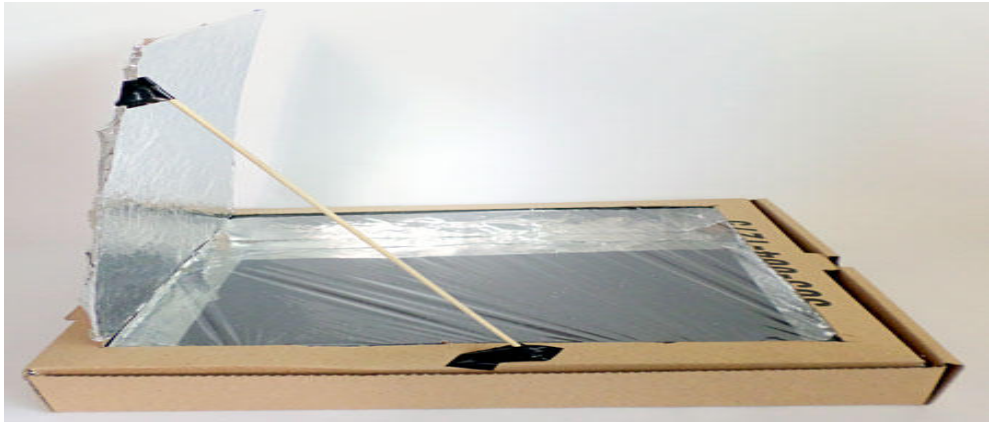
3- Line the inside of the cardboard flap with aluminum foil. Fold the edges of the foil over the flap to help hold the foil in place and glue the foil onto the flap. Keep the foil as smooth as possible.

4- Cover the opening made by the flap (in the lid) with a layer of plastic wrap. Attach the plastic wrap to the opening's edges using shipping tape or black electrical tape. Make sure there are no holes in the plastic wrap, and that all of its edges are completely closed onto the lid. Why do you think it is important to make sure the plastic wrap completely seals the lid's opening?

5- Line the inside of the box with aluminum foil so that when you shut the box, the entire interior is coated with foil. It is easiest to do this by covering the bottom of the box with foil, and then the covering the inside part of the lid (going around the plastic-covered opening) with foil too. Glue the foil in place. Why do you think you should coat the inside of the box with foil like this?

6- Glue or tape a sheet of black paper to the bottom of the box, centered there. This will act as your solar oven's heat sink.

7- Lastly, use a wooden skewer or pencil (and some tape) to prop the solar oven's lid up, at about a 90 degree angle from the rest of the box. Your solar oven is ready to do some cooking!



8- If you want to cook a s'more, break a graham cracker in half and place a marshmallow and small piece of chocolate between the cracker halves. Place the prepared s'more on a small square of aluminum foil (slightly larger than the s'more — this will serve as a tray) and put it in your solar oven, on top of the black sheet of paper. Put the solar oven outside where it will get full, direct sunlight for at least 30 minutes, and keep the oven turned so that the flap faces the sun. When the marshmallow is soft, your s'more should be ready to eat and enjoy!

Heat –

the movement of thermal energy from hotter to cooler objects

Temperature-

The measure of how hot or cold something is

.

Insulator –

an object that does not conduct heat well

Examples – Wood, cloth, plastic

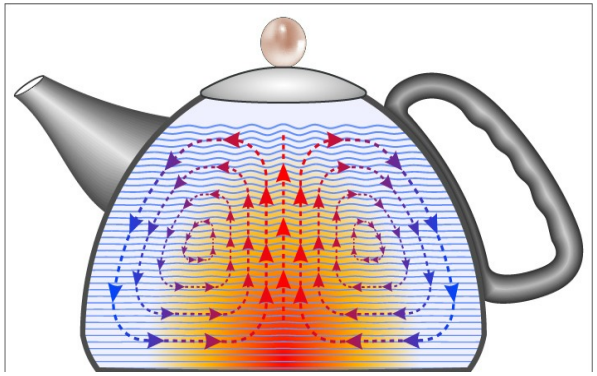
Types of Heat Transfer

Heat is transferred from one object to another three different ways: conduction, convection, and radiation.

Conduction

Conduction is the transfer of heat energy within a solid object or between two or more objects that are touching.

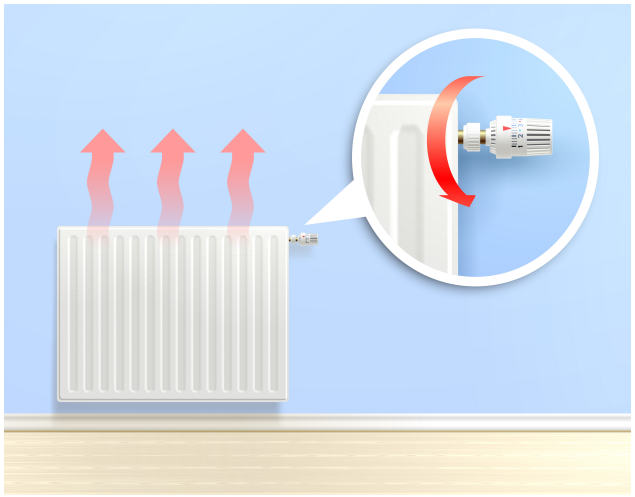
Example: A hand getting burned when touching a hot pan is an example of conduction.



Convection

Convection is the transfer of heat energy within liquids and gases by hotter molecules rising and cooler molecules falling.

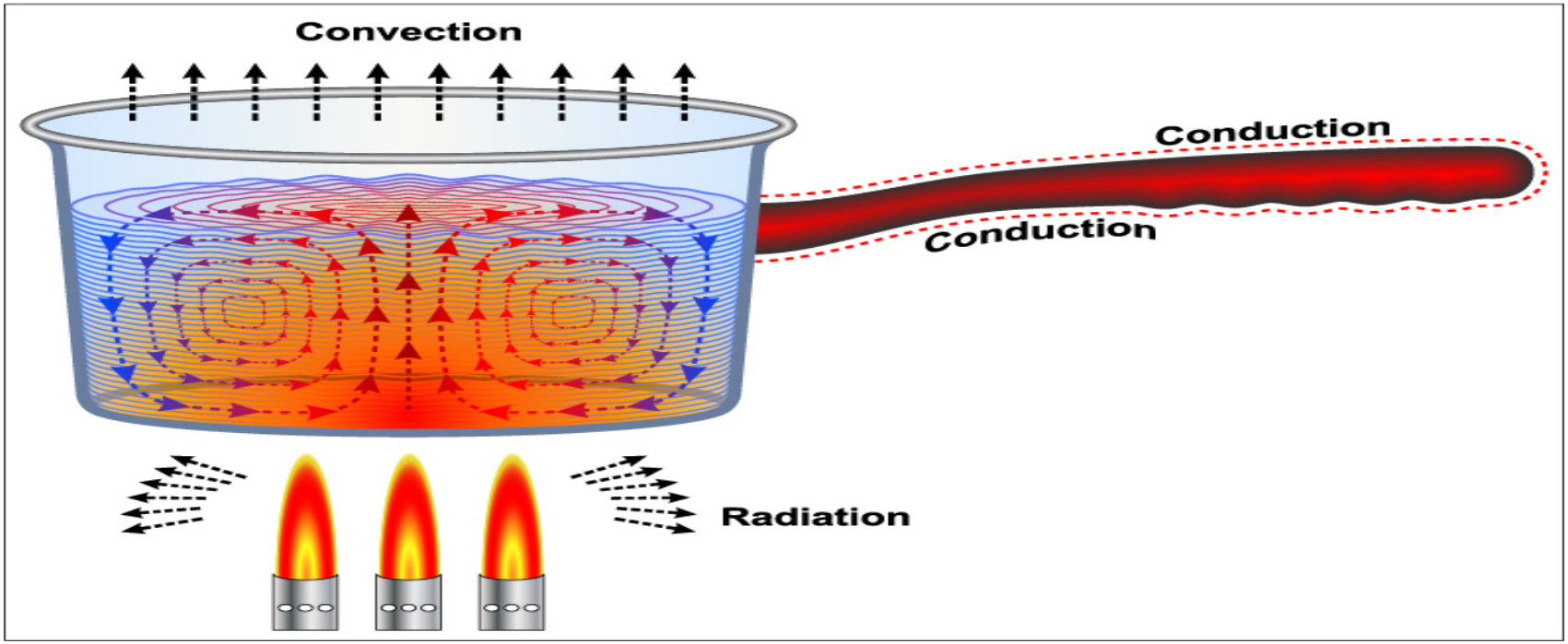
Example: The warm water vapor that rises into the air during evaporation is an example of convection.



Radiation

Radiation is the transfer of heat energy by electromagnetic waves.

The Sun's heat and heat from a fire are both examples of radiation.



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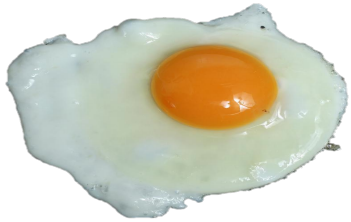
Convection: the transfer of heat energy within liquids and gases by hotter molecules rising and cooler molecules falling

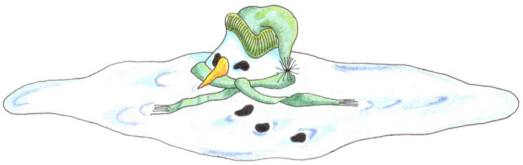
Radiation: the transfer of heat energy by electromagnetic waves

Heat Changes

Before Heat	After Heat
	
	

Before Heat

After Heat



Facilitator

- Supervises and makes sure that all group members are on task
- Encourages participation
- Has final say in arguments

Reporter

- Records detailed notes on ideas and progress
- Revises notes as needed from tests of prototype

Materials Manager

- Gets materials and tools for group
- Makes sure materials are kept neat
- Supervises clean up

Presenter

- Presents finished work to class
- Leads discussion of group's work

Reader

- Reads the problem to the group
- Leads discussion of ideas

Time Keeper

- Monitors the time
- Helps to keep the group on task

STEM Lesson Checklist

	Self-Assessment - Developing (1) - Satisfactory (2) - Outstanding (3)
1. Aligned to Grade-Level Standards The lesson is aligned to appropriate state and/or national math, science, technology, and engineering standards.	
2. Multidisciplinary A true STEM lesson must integrate science, technology, engineering, and mathematics.	
3. Addresses Authentic Challenges The lesson presents students with real-world challenges or problems with practical and meaningful implications.	
4. Integrates 21st Century Skills The lesson encourages students to develop creativity, critical thinking, problem solving, and teamwork.	
5. More Than One Solution The lesson includes problems or challenges that have more than one possible solution.	
6. Uses the Engineering Design Process Any design, construction, or prototyping follows the steps of the engineering design process.	
7. Hands-On The lesson encourages hands-on manipulation of technology or materials to solve a problem or engineer a design.	
8. Integrates Technology The lesson incorporates technology is a way that is seemly and appropriate, simplifying rather than complicating the lesson.	
Overall Score	