Build a Sizzling Solar Oven

Ages: 6 and up (Adult supervision recommended for ages under 10 due to sharp objects)

Materials

- Any box with a hinged lid (*like a pizza box*)
- Tape and/or glue
- A cutting tool strong enough to cut through cardboard, such as scissors or a craft razor
- Something to prop open the "lid" of the oven, such as craft sticks or a ruler
- Plastic wrap
- Aluminum foil
- Black paper
- Pie tin
- Pencil or pen
- Oven thermometer or Infrared thermometer (*optional*)

Solar Oven Materials

Instructions

1. Using a straight edge as a guide, draw a square on the top of your pizza box so that there are 2-3 inches between the edges of your square and the lid of the pizza box.

2. Using your cutting tool, cut through the lid of the pizza box along the square, leaving the top line uncut.

3. Open the solar oven lid you just cut out, using the uncut edge as a hinge.

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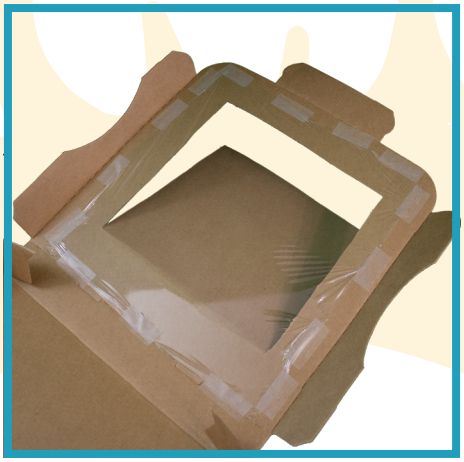
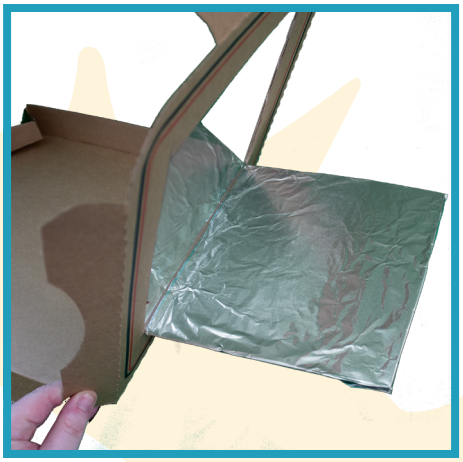
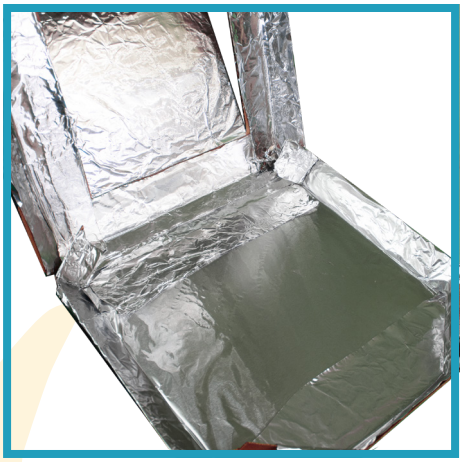


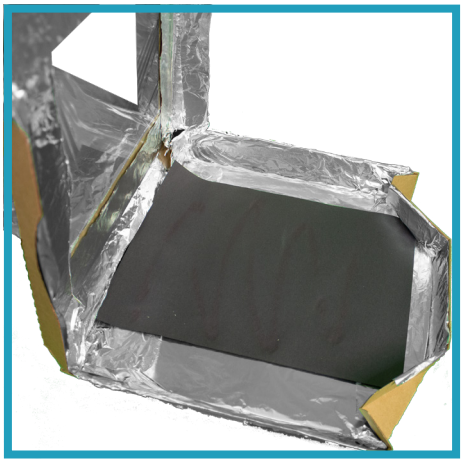
4. Open your solar oven and tape a piece of plastic wrap large enough to cover the opening you just cut to the inside of your pizza box oven. This will trap the solar energy and heat inside your oven, so make sure it's as taut and flush against the lid of your box as possible.



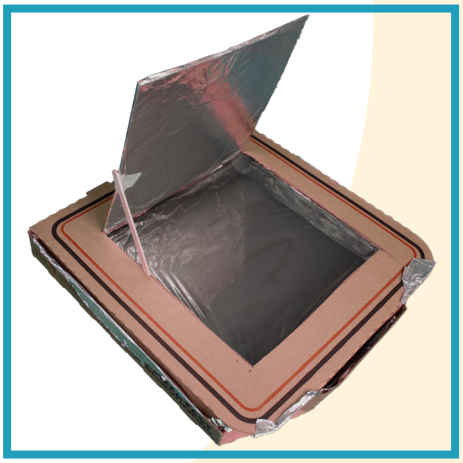
5. Cover the inside of the hinged section you cut out with foil, using glue or tape to secure it to the lid.



6. Line the inside of your pizza box with foil, securing it with glue or tape.

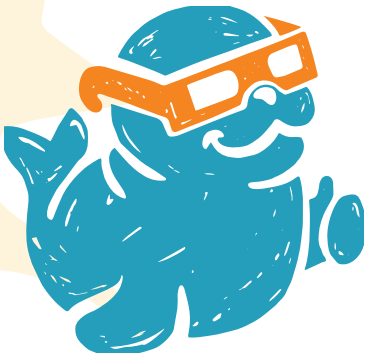


7. Glue or tape a piece of black paper to the bottom of your solar oven that will act as a heat sink.



8. Using tape and your ruler, chopsticks, or craft sticks, prop open the lid of your solar oven so that it is almost but not quite at 90 degrees from top of the oven.

Now you're ready to bake! Check out the Solar Oven Recipes for instructions.



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Solar Oven Recipes

Each recipe requires

- Solar Oven
- Cooking dish or pie tin that will fit in solar oven when the lid is closed

Nutty for Solar Science Cookies

Ingredients:

- 1 Banana (the riper the better)
- ½ cup oats
- ¼ cup nut butter (peanut butter, sunbutter, almond butter, etc.)
- 1/3 cup chocolate chips

Instructions:

1. In a mixing bowl, smash the banana until the banana is completely turned to mush.
2. Mix the nut butter into the mushed banana until the nut butter and banana are combined.
3. Stir in the oats and chocolate chips.
4. Spoon your cookie mixture onto your solar oven cooking dish or pie tin, making each cookie about the size of a golf ball.
5. Move your cooking dish or pie tin to your solar oven. Your cookies are done when they are firm and the chocolate chips are all melty!

Note 1 : This cookie recipe is completely safe to eat raw, so underbaked cookies are more than okay to eat!

Note 2: Any nut butter will work in this recipe but the amount of each ingredient may need to be changed to get the right consistency. Your dough should hold its shape and not be too sticky before baking. If your dough is too runny or sticky, add some more oats. If your dough is to dry and stiff, add more nut butter.

Note 3: If your bananas are just barely ripe, you can sweeten the recipe by adding a liquid sweetener like honey, agave nectar, or maple syrup!

(*Continued on page 4*)

Sun-baked S'mores

Ingredients:

- Graham Crackers
- Marshmallows
- Chocolate bars

Instructions:

1. Split a graham cracker in half "hamburger style" so that the two halves are large enough to support your chocolate and your marshmallow and place them in your solar oven cooking dish or pie tin.
2. Place a piece of chocolate on one half of your graham cracker and a marshmallow on the other half.
3. Move your cooking dish or pie tin with the s'mores to your solar oven and close the lid. Your s'mores are ready when the marshmallow has softened and the chocolate melted to your liking.
4. Put the two halves of your graham cracker together to make a sandwich and enjoy!

Tortilla Eclipse Quesadillas

Ingredients:

- Shredded cheese or non-dairy cheese alternative
- Tortillas (small enough to fit into your solar oven cooking dish or pie tin)
- Quesadilla fillings of your choice (salsa, tomatoes, onions, etc.) (optional)

Instructions:

1. Place your tortilla in the bottom of your solar oven cooking dish or pie tin.
2. Cover the surface of your tortilla with shredded cheese and your quesadilla fillings of choice.
3. Place your solar oven cooking dish or pie tin into the bottom of your solar oven. Your quesadilla is ready when the cheese is as melty as you want it to be!
4. Remove your quesadilla from the solar oven, fold in half and enjoy!

Note: Veggie fillings like salsa and tomatoes do not need to be cooked to enjoy in your quesadilla. Meat fillings (raw or cooked) need to be heated to temperatures your solar oven will not be able to heat quickly and are not recommended to use in this recipe!

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Solar Oven Supplemental Science

Your pizza box solar oven bakes food with no electricity or heat source, just the light of the sun! But how do solar ovens do this?

Like a car with the windows rolled up on a hot day, solar ovens generate heat by converting solar energy in the form of light and trapping it to convert it to lower-wavelength infrared (or heat) energy. Solar ovens operate by three main principles:

1

Reflection

The foil lining of your solar oven reflects and concentrates the light energy from the sun.

2

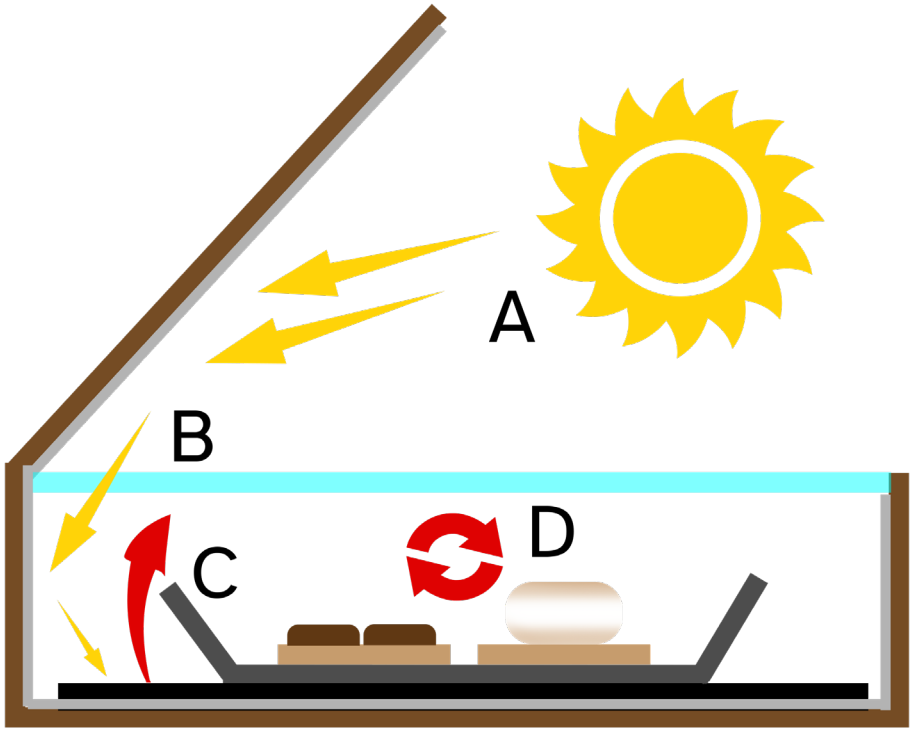
Absorption

The black paper at the bottom of your solar oven acts as a heat sink, absorbing the solar energy and allowing it to become heat or infrared energy that cooks your food.

3

Retention

The plastic film that covers the opening of your solar oven not only allows light to be absorbed but also prevents heat from escaping.



Examine the diagram to the left. Light energy from the sun **(A)** is reflected from the solar oven lid into the enclosed oven. This light energy is reflected by the foil walls of the oven and converted by the black paper heat sink into heat energy **(C)**. This heat energy is trapped by the plastic wrap the encloses the oven **(D)** heating the air around the food that allows you to cook your tasty treats!

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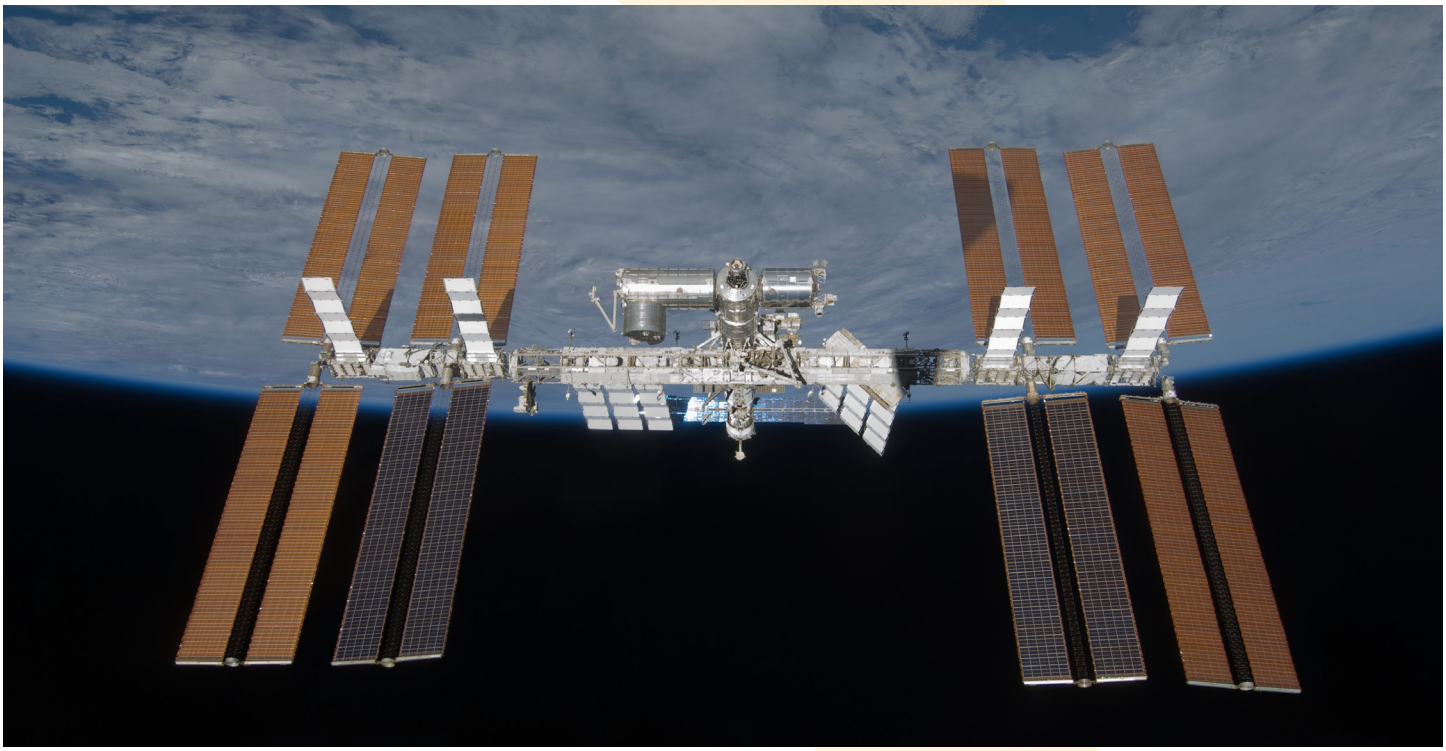
Your pizza box solar oven is a type of solar oven known as a box cooker that works be concentrating and trapping solar heat inside an enclosed box. Other types of solar ovens known as parabolic cookers use a curved reflector that resembles a satellite dish to concentrate solar energy and heat onto a suspended cookpot.

While parabolic cookers can reach temperatures of 400 F or higher (*hot enough to deep fry!*), box cookers are only able to reach about 250-280 F. Your homemade pizza box solar oven may only reach temperatures of about 200 F.

Capturing and storing solar energy isn't just for cooking food here on Earth. Due to the weight and cost of bringing fuel to space, many spacecraft and orbiting space stations rely on solar energy power at least in part to operate.



"International Space Station" by NASA

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Solar Oven Still Extension

Too cloudy for baking? Looking for more uses for your solar oven?

For your pizza box solar oven to get hot enough to bake your local weather must be sunny and at least 70 degrees Fahrenheit or 21 degrees Celsius in temperature. However, there is another way you can use your pizza box solar oven for a fun and engaging STEM activity: purifying dirty water through the process of distillation by turning your solar oven into a solar still! A still is a device that uses the power of evaporation to purify different liquids such as water or alcohol. Stills are even used to concentrate the fragrant compounds used in making perfumes and cologne!

Instructions

To build your solar still:

1. In a pie tin, shallow bowl, or other container add some water and debris (potting soil works well). Place this container of dirty water into the bottom of your solar oven on top of the black paper heat sink.
2. Place an empty smaller container into the container of dirty water. Make sure that the height of both containers is short enough so that it is beneath the plastic film of your solar oven.
3. Close the lid of your solar oven and place some small rocks or weights onto the plastic wrap of your solar oven directly over the small empty container so that the plastic film bends slightly over the container.
4. Place your solar oven where it will receive heat and sunlight, as much as possible. Watch as condensation collects on the inside of the plastic film and drips into your clean water container!

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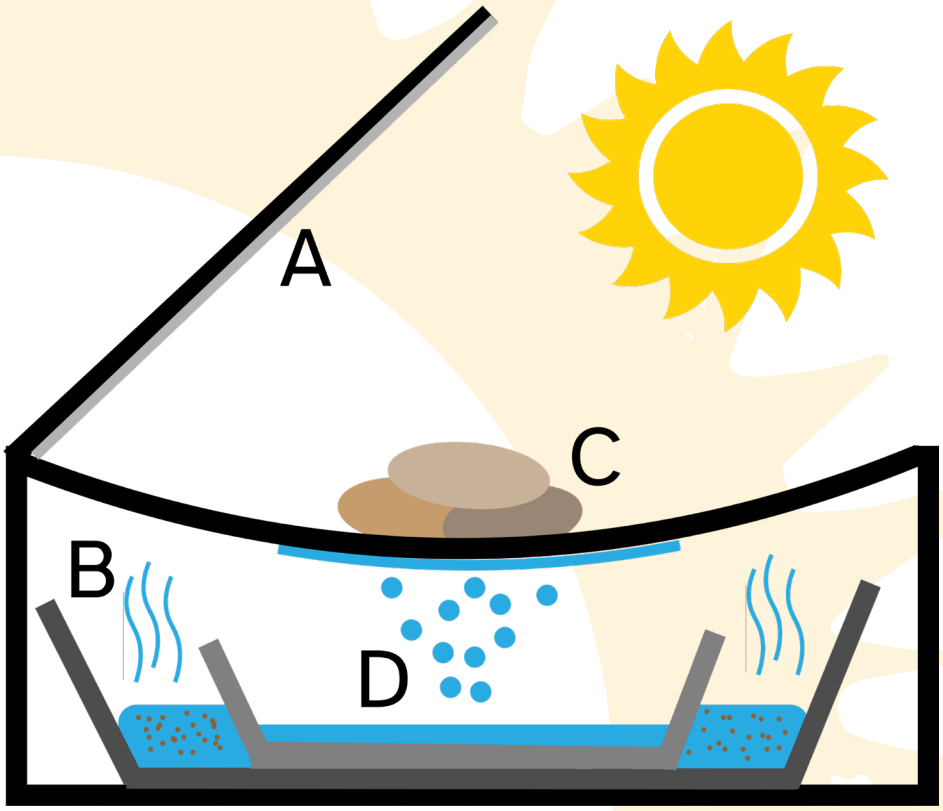
How does this work?



Turning your pizza box solar oven into a solar still uses the same properties (*reflection, absorption, and retention)* that allow you to bake yummy treats and harnesses them for a new purpose: distillation. Distillation is a process that allows for impurities to be removed from water by heating the water until it evaporates, or turns from a liquid (*water*) to vapor (*steam*).

Examine the diagram above. Energy from the sun is reflected from the lid of the solar oven **(A)** warming the debris filled water in the outer container. As the water heats, it turns into vapor **(B)** and collects on the underside of your solar oven's plastic sheeting as condensation. The rocks or weights **(C)** create a "dip" in the plastic sheeting that causes that condensation to collect in a point over the inner container where the now purified water collects **(D)**.

Solar stills have a long history of being used to purify water so that it is safe to drink. References to water distillation date back to Ancient Greece. Solar stills just like this one are used today in remote areas to purify water when access to fresh water is scarce.