

HOW TO BUILD A PIZZA BOX SOLAR OVEN

ACTIVITY

- Get cooking with the sun! Use one of our MANY sunny days to learn how you can trap the sun's natural heat to make a homemade oven.

KEY CONCEPTS

ENERGY

HEAT

SOLAR POWER

COOKING

SUN

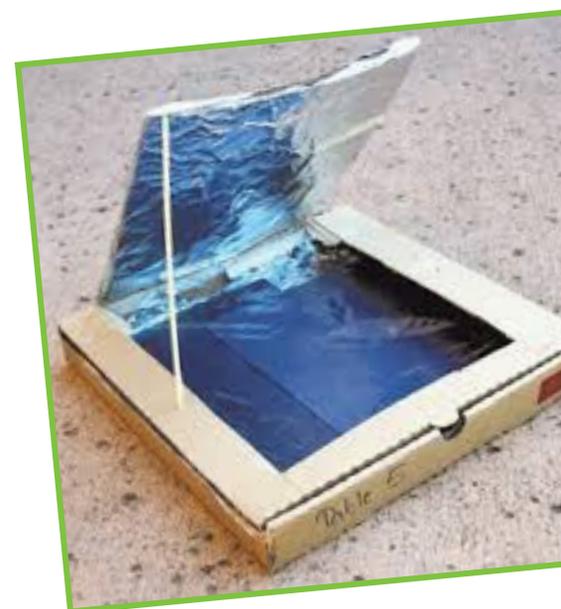
RECYCLING

BACKGROUND

Solar ovens use solar energy—light and heat emitted from the sun—to cook food. How does a solar oven work? It is designed to absorb more heat than it releases. The solar oven you will build in this activity is a relatively simple one made out of a pizza box. You will cut a flap out of the pizza box's lid and line it with aluminum foil. This will reflect sunlight into the box. You will also seal the opening with plastic wrap. This plastic "window" 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 will place black construction paper. This will act as a "heat sink" that absorbs direct and reflected sunlight to warm it, which will heat food placed on top of it.

MATERIALS

- Pizza box – *make sure that it's pizza-free and the larger the box, the better!*
- Scissors, box cutter or utility knife
- Aluminum foil
- Black construction paper
- Tape (black electrical tape or masking tape)
- Non-toxic, white school glue
- Plastic wrap
- Ruler
- Pencil (or pen)



INSTRUCTIONS

On the top of the pizza box's lid, draw a square that measures one inch inward from each edge. 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. Then fold the flap back slightly along the attached side. 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.

INQUIRY:

WHAT DO YOU THINK THE PURPOSE OF THIS FOIL IS?

Cover the opening made by the flap in the lid of the pizza box with a layer of plastic wrap. Attach the plastic wrap to the opening's edges using tape or glue. Make sure there are no holes in the plastic wrap and that all of its edges are completely attached to the lid.

INQUIRY:

WHY DO YOU THINK IT'S IMPORTANT TO MAKE SURE THE PLASTIC WRAP SEALS THE LID'S OPENING?

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 covering the inside part of the lid (going around the plastic-covered opening) with foil, too. Glue the foil in place.

INQUIRY:

WHY DO YOU THINK YOU SHOULD COAT THE INSIDE OF THE BOX WITH FOIL LIKE THIS?

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.

INQUIRY:

HOW DO YOU THINK IT WILL HELP COOK YOUR FOOD?

Lastly, use the ruler or your pencil to keep the pizza box's lid up, at about a 90-degree angle from the rest of the box. Leave the solar oven outside on a hot day.

INQUIRY:

HOW WARM DOES THE OVEN GET? DO YOU THINK IT COULD COOK YOUR FOOD?

SOLAR ART PROJECT

ACTIVITY

Create your own artwork using UV sensitive paper!

KEY CONCEPTS

Solar radiation contains high-energy ultraviolet rays which are outside the visible spectrum. The energy in these rays is high, so it can split apart some molecules. We can use UV radiation to make art through a photographic printing process called cyanotype. Paper is treated with ammonium iron (III) citrate and potassium ferricyanide to make it sensitive to UV rays. When exposed to solar radiation, the UV rays knock an electron off the iron (III), reducing it to iron (II) which then reacts with the potassium ferricyanide to produce a blue dye. Objects that are placed on top of the paper block UV light, and the paper stays white, while the rest of the paper turns blue.

BACKGROUND

This activity demonstrates how the sun leaves an imprint of the objects on the UV paper, similar to how it could leave a sunburn on your skin.

MATERIALS

- UV paper (can be purchased online)
- Plastic plates
- Container
- Spray bottle with water
- Small plastic/wooden objects (small toys, keys, pencils, paperclips, plastic barrettes, etc.)
- Sunlight

INSTRUCTIONS

1. Lay a piece of UV paper on the plastic plate.
2. Place the small objects onto the paper.
3. Place a second plastic plate on top so objects don't move.
4. Take the paper outside and set it in full sunlight for 2-5 minutes, or until most of the color disappears from the paper.
5. Bring the UV paper back inside, take the objects off of it and lay the paper in the container.
6. Spray it with water to wash off the chemicals from the UV paper. You can also leave the paper to soak in the water for a few minutes until it turns deep blue.
7. Observe your Solar Art!



SOLAR CARS

ACTIVITY

Experiment with cars and robots that are powered by photovoltaic cells!

KEY CONCEPTS

An atom is comprised of three subatomic particles: protons, neutrons, and electrons. Protons and neutrons are both in the nucleus, surrounded by a cloud of negatively-charged electrons. Atoms can bond with one another by sharing electrons in their outer (valence) level of electrons. Solar panels function by bonding silicon with phosphorus and boron to create positive and negative charges. Photons, or light particles, excite electrons in the solar panel, which then help generate electricity.

BACKGROUND

Powering a car with solar energy is one of many rapidly developing ideas for using alternative forms of energy. A panel of solar cells, instead of gasoline, is used to run the car.

Solar panels, made up of photovoltaic cells, generate power through the flow of electrons. Silicon is a major component of solar panels, and it is the 8th most abundant element in the universe, found in dusts, sands, and planets in the form of silicates or silicon dioxides. Over 90% of the Earth's crust is composed of silicate minerals. Silicon, which is also used in computers, provides a great neutral platform for the transmission of electrons because it is a semiconductor, meaning that it has the ability to conduct an electrical current. A silicon atom has room for 8 electrons in its outer band, but only carries 4 in its natural state. This means that two silicon atoms can bond and share their electrons to have 8 electrons, making it a neutral molecule and giving it a pure crystalline structure. This material is used to form the plates on a solar panel.

But two plates of pure silicon would not generate electricity because of its neutral charge. Therefore, we must add impurities by combining silicon with other elements to create positive and negative charges. Phosphorus, for example, has 5 electrons, so when combined with silicon's 4 electrons, there are 9 electrons in the outer band. This means that there is one extra electron, giving it a negative charge. You also need a positive charge, so silicon is combined with other elements like boron, which have 3 electrons in their valence level. This gives us 7 electrons, which creates a positive charge. The two plates are sandwiched together between solar panels, with conductive wires running between them.

Natural sunlight sends out photons, which bombard the silicon/phosphorus atoms. Eventually the 9th electron, which wants to be free anyways, is knocked off the outer ring. This electron can then move around the crystalline silicon freely, creating an electrical current. Wiring attached to the positive and negative sides creates an electrical circuit, and these conductors can then transfer this energy to a motor, tool, or light.

MATERIALS

- Solar Cars
- Solar Robots

BOTH CAN BE PURCHASED ONLINE AT VARIOUS RETAILERS INCLUDING:

hometrainingtools.com

fatbraintoy.com

sunwindsolar.com

INSTRUCTIONS

Construct the car and/or robot from the instructions provided.
Take them outside on a sunny day to observe what is happening.

WHAT'S HAPPENING?

- The solar panels on the car/robot use photons from the sun for power.
- Solar panels are made of silicon, with impurities of phosphorus and boron mixed in to create positive and negative charges.
- The photons excite electrons, which start moving to create an electrical current.
- This current can be transferred to the objects we want to power!

INQUIRY:

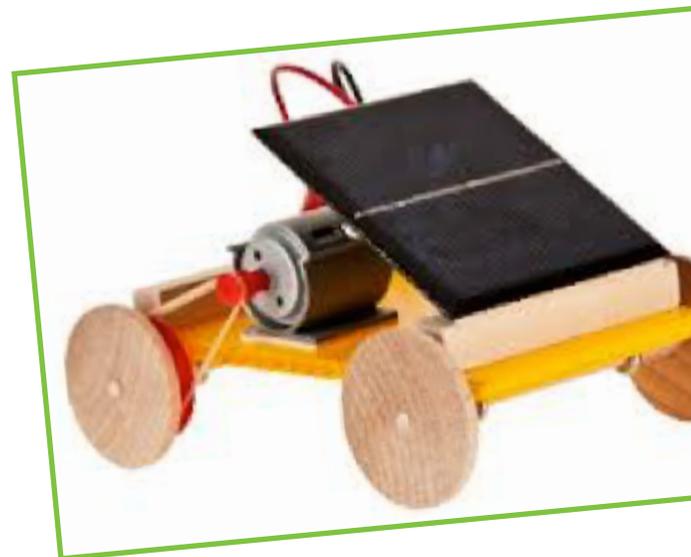
WHAT HAPPENS WHEN YOU COVER A PORTION OF THE SOLAR PANEL WITH A SMALL PIECE OF PAPER?

INQUIRY:

WHAT ELSE COULD YOU PUT A SOLAR PANEL ON?

INQUIRY:

HOW LARGE OF A SOLAR PANEL WOULD IT TAKE TO POWER A FULL-SIZED CAR?



SOLAR TOOLS FOR TEACHERS

We've compiled some of our favorite and most useful K-12 educational resources that provide hands-on, problem-based learning opportunities to help your students apply classroom knowledge in real and relevant ways. Explore the links below and mix and match resources that best fit your needs.

1. Arizona Science Center General Educator Resources

Arizona Science Center provides a variety of programs tailored for educators. Guides and curricula are available for use in the classroom or for your visit to the Science Center. The Science Center also offers Arizona Certified educators a free annual membership.

2. Arizona Science Center Teacher Professional Development

The Professional Development Department of the Freeport-McMoRan Foundation Center for Leadership in Learning offers professional development services in the areas of Science, Technology, Engineering, and Math, S.T.E.M. customized to suit your needs and the needs of your students.

3. Engineering is Elementary® - Now You're Cooking Designing Solar Ovens Unit

Arizona Science Center has partnered with the Museum of Science in Boston to be the Southwest hub for Engineering is Elementary® training.

4. PSB Learning Media – Renewable Energy Resource

5. National Geographic – Solar Energy

**6. Office of Energy Efficiency and Renewable Energy –
Wonders of the Sun**

7. Energy.gov – Solar Classroom Lesson Plan

**8. National Renewable Energy Laboratory – Educational
Resources**

**9. National Energy Education Development Project – The Sun
and Its Energy**

10. Energy Kids – Solar Basics

Visit Solarville in the APS Solar Gallery on Level 4 at Arizona Science Center to explore ways in which you can utilize solar and renewable energy in your everyday life. Turn up the heat. Learn how poop can turn into power. Pedal to create energy. Explore renewable energy from around the world.