

# Solar cookies

**Overview:** By now you know how the sun's energy can be converted to meet our energy needs. But can it be used to directly provide us with energy? Today we'll find out how and make some treats along the way.

**What to Learn:** Ask how the sun can be used to provide energy directly, without being converted into electricity or other forms of energy first. Also, you'll be able to name different parts of the electromagnetic spectrum.

## Materials

- Two large sheets of poster board (black is best)
- Aluminum foil
- Plastic wrap
- Black construction paper
- Cardboard box
- Pizza box (clean!)
- Tape & scissors
- Reusable plastic baggies
- Cookie dough (your favorite)
- Thermometer (preferably with a needle point reader)

## Lab Time

*Note: There's a real food safety concern here, as the cookie dough stays in the "danger thermal zone" for more than four hours. Do not eat the cookies until they register 165 on an instant-read thermometer, or omit the eggs in your recipe.*

1. Measure an inch from each of three sides of the pizza box. Use the scissors/razor to cut a door out of the pizza box. Bend the door open if necessary. Cover the inside of the door with aluminum foil.
2. The heat needs to get trapped inside the box. Take your plastic wrap and tape it over the opening between the door and the inside of the pizza box. It doesn't matter which side you tape it on.
3. To help the heat stay inside the box, line the inside with aluminum foil. You can also add an insulation layer with some cotton balls, shredded paper, or fine shavings. On top, place your foil. On top of this, put down the black construction paper. Use tape to secure it all in place.
4. Check to make sure the box still closes. Take your cookie dough and place it in balls onto the surface of the paper.
5. Record your observations and data on the table below. Measure the temperature with a thermometer as well.
6. Enjoy your cookies! Be sure to share!

## Solar Cookie Data Table

Time	Is it cooked?	Temperature (C)
3 hours		
4 hours		
4.5 hours		
5 hours		
5.5 hours		
6 hours		
6.5 hours		
7 hours		

The solar cookie oven uses the light from the sun, specifically the UV and IR parts of the spectrum, to bake the dough into some delicious treats. The UV rays are energetic and are responsible for damaging our skin if we don't shield it. The atmosphere of our earth does a lot to dissipate this energy so we aren't subject to some of the more harmful parts of the energy that the sun emits. In fact, the sun can eject enormous, energetic bursts of radiation far into space in the form of solar flares. We experience these flares as scrambles in our satellite signals, as well as see their effects visually in the atmosphere as aurorae.

The solar cookie oven operates on the basic principle that the electromagnetic radiation can be concentrated to be directly useful for our energy needs. Instead of converting the energy into electricity to power an oven, for example, the sun's rays are now directly heating the surfaces that the cookies rest on. A few ingredients are necessary for this oven to operate properly, which is what this experiment explores.

Sunlight at the Earth's surface is mostly in the visible and near-infrared (IR) part of the spectrum, with a small part in the near-ultraviolet (UV). The UV light has more energy than the IR, although it's the IR that you feel as heat.

We're going to use both to bake cookies in our homemade solar oven. There are two different designs – one uses a pizza box and the other is more like a light funnel. Which one works best for you?

Your solar cooker does a few different things. First, it concentrates the sunlight into a smaller space using aluminum foil. This makes the energy from the sun more potent. If you used mirrors, it would work even better!

You're also converting light into heat by using the black construction paper. If you've ever gotten into car with dark seats, you know that those seats can get *HOT* on summer days! The black color absorbs most of the sunlight and transforms it into heat (which boosts the efficiency of your solar oven).

By strapping on a plastic sheet over the top of the pizza-box cooker, you're preventing the heat from escaping and cooling the oven off. Keeping the cover clear allows sunlight to enter and the heat to stay in. (Remember the black stuff converted your light into heat?) If you live in an area that's cold or windy, you'll find this part essential to cooking with your oven!

**Exercises** Answer the questions below:

1. Name the type of heat energy that the sun provides:
  - a. Convection
  - b. Conduction
  - c. Radiation
  - d. Invection
2. What are some ways that the sun's energy can be directly harnessed?
3. Name three of the different parts of the electromagnetic spectrum:
  - a.
  - b.
  - c.

### **Answers to Exercises: Solar Cookies**

1. Name the type of heat energy that the sun provides: (radiation)
2. What are some ways that the sun's energy can be directly harnessed? (cooking, heating/cooling)
3. Name three parts of the electromagnetic spectrum: (gamma, IR, X-ray, radio, microwave, UV, visible)