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iBIO STEM Kits: Solar Cookers

iBIO STEM Kits welcomes you to a SCIENTIFIC JOURNEY!

This kit contains the materials you will need to build a working solar cooker. The purpose of this kit is to challenge you to learn about radiant and thermal energy and to apply what you have learned to building a simple solar cooker. You will evaluate how well your solar cooker converts radiant energy into thermal energy and then, we challenge you to engineer a better solar cooker as a scientist. What does this mean?

Scientific exploration is different than just playing around because it asks you to think about HOW you investigate. This means you need to do your investigation by observing what happens when you change an element of your design that you have carefully chosen. Good observation will help you to understand WHY something happens. Scientific exploration also means that you record WHAT you see or measure so that you can alter your design based upon what works for you. The STEM Kit Notebook that you are holding will help to guide your investigation and give you a place to record your observations, create your design and document your changes.

Follow the QR code at the top of the page for additional resources on this activity. There are many resources for you to use on our website. This type of investigation is associated with some very exciting careers! We hope that you will explore these resources while you are doing your investigation!

Let's Get Started!

FIRST, you will need to prepare your workspace. Having a clear space where you can see all of your materials and tools is very helpful. A kitchen table will work nicely. To make your clean up easier, you should protect your surface by laying out some used newspaper or opening up a paper grocery bag.

SECOND, you want to unpack your materials. Use the list below to identify which materials are used in each part and organize them in your workspace.

Kit Materials for Part A:

Pringles can
Thermometer
Marshmallow
Wooden Skewer
Nail

Kit Materials for Part B:

Tape and/or glue
Transparency acetate
Black & White construction paper
Marshmallow
Aluminum foil
Sandwich bag

General Supplies:

Scissors or Utility knife *(ADULTS only)***
**Hammer

****Disclaimer: Please make sure an adult handles the utility knife/scissors and hammer when doing this activity.**

LAST, you need to be prepared for experimenting safely. You will need to ask an adult for help or supervision when you need to use a hammer and nail to punch holes at the end of the can and when the can needs to be cut with a utility knife.

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Solar Cookers

Adapted from Discovery Education and https://www.pcc.edu/about/events/sustainability-training/documents/solar-cooker.pdf

Part A: BUILD: Building a Basic Solar Cooker

Here's what you need from your STEM Kit:
Pringles can
Wooden Skewer
Thermometer
Nail
Marshmallows

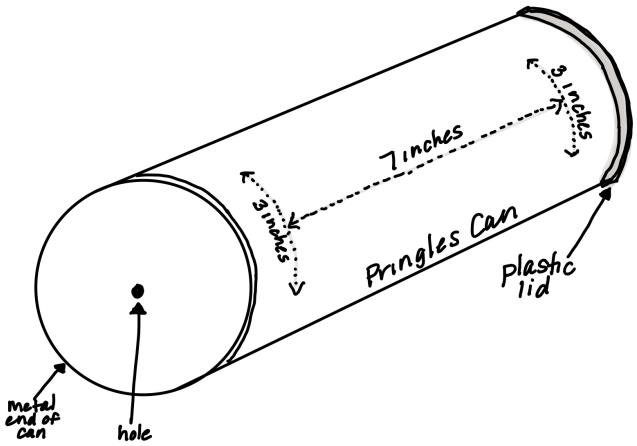
General Supplies:
Scissors or Utility knife ***(ADULTS only)***
Hammer

What

Radiant energy from the sun can be reflected and concentrated on an object. A portion of the radiant energy absorbed by an object is in the form of thermal energy (heat). This is an energy conversion: radiant energy to thermal energy. Radiant energy can pass through clear materials much easier than thermal energy can.
The flaps on the Pringles can be used to reflect radiant energy onto the marshmallow, thus concentrating the amount of energy that will be converted into heat.
When positioning the flaps on the can to reflect the maximum amount of radiant energy onto the marshmallow.

Basic Procedure:

1. Open the Pringles can and remove the chips.
2. If you have a hammer, have an adult help you to use a hammer and nail to punch a hole in the center of the bottom of the can as shown in the diagram.
   OR
   If you do not have a hammer, have an adult help you to use the nail to dent the center of the can. Carefully push and twist the nail until you have created a hole in the can. You may need to move the nail around to make the hole big enough so that the wooden skewer is able to fit through it.
3. Measure and mark the can as shown in the diagram below. Have an adult help you to cut your marks on the Pringles can. They will need to use the utility knife to carefully cut the can.



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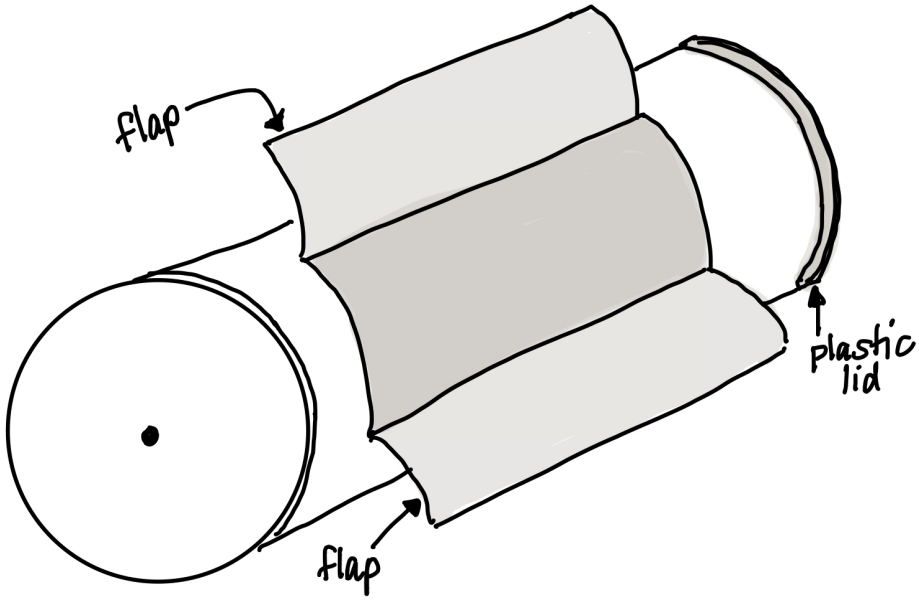
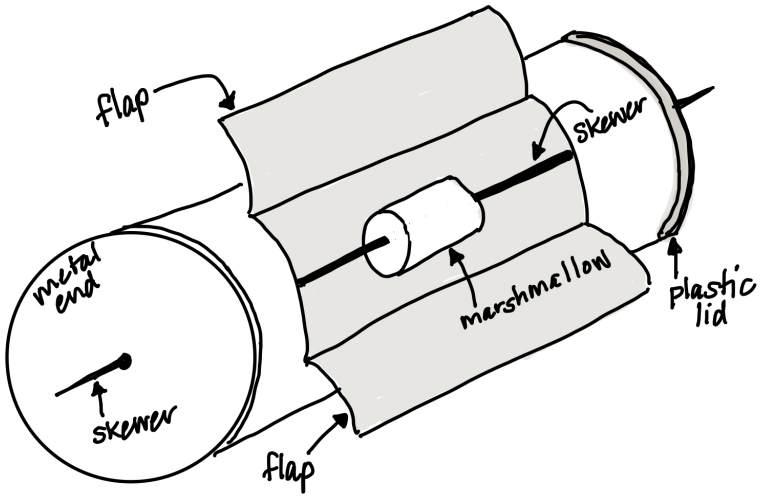
4. Bend back the flaps, but do not remove them from the can.



5. Remove the plastic lid from the can. Place the skewer through the plastic lid. Put the plastic lid back onto the can, adjusting so the skewer reaches the hole in the metal end of the can. Push the skewer so that it is secured through the hole in the metal end of the can. The marshmallow should be suspended inside the can.
6. Take the temperature of the solar cooker before you start cooking. Record the starting temperature on your data chart.
7. Place the solar cooker in direct sunlight, positioning the flaps to reflect the maximum amount of radiant energy onto the marshmallow.
8. At the end of cooking, take the temperature again and record the temperature. Record the amount of time required to cook the marshmallow.



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Part B: REDESIGN: Improving your Solar Cooker

Here's what you need from your STEM Kit:

Thermometer
Tape and/or glue
Acetate and sandwich bag
Aluminum foil
Black construction paper
White construction paper
Marshmallows

General Supplies:
Scissors or Utility knife
(ADULTS only)

In order to cook using sunlight, we need to transform the radiant energy of sunlight into thermal energy. Thermal energy is heat. It is the internal energy of substances. It is caused by the vibration and movement of atoms and molecules within substances. The faster the molecules in a substance move or vibrate, the more thermal energy is in that substance.

Successful solar cookers must have a large area of reflecting surface to focus light waves. All cookers are most effective if:

- they directly face the sun (or are at least at a 45-degree angle to the sun to catch incoming energy)
- when their reflective material is as smooth as possible.
- when the user is able to change the angle of reflection so that it hits the food more directly.
- thermal heat is contained inside the cooker.
- when the cooking container is a dark color.
- when the cooker is only a bit larger than the food it holds.

USE YOUR MATERIALS TO PLAN SOME CHANGES:

1. Look at the basic solar cooker that you built. What types of improvements can you make to make it more effective? Use your additional materials to make changes to the basic design.
    a. How can you better direct the light to your marshmallow?
    b. How can you direct MORE light to your marshmallow?
    c. How can you allow light to enter but trap the heat inside the can?
    d. Is your can the appropriate size for the marshmallow? How can you adjust the size of the internal cooking area WITHOUT changing the size of the can?
    e. How can the rest of the can absorb heat, even if light cannot enter?

TEST YOUR REDESIGN:

2. Remove the plastic lid from the can. Place the skewer through the plastic lid. Put the plastic lid back onto the can, adjusting so the skewer reaches the hole in the metal end of the can. Push the skewer so that it is secured through the hole in the metal end of the can. The marshmallow should be suspended inside the can as in the diagram.
3. Take the temperature of the solar cooker before you start cooking. Record the starting temperature on your data chart.
4. Place the solar cooker in direct sunlight, positioning the flaps to reflect the maximum amount of radiant energy onto the marshmallow.
5. Take the temperature again at the end of cooking. Record the amount of time required to cook the marshmallow.
6. Did your cooking time and cooking temperature improve?

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Part A: EXPLORE: Building a Basic Solar Cooker

	Starting Temperature	Ending Temperature	How much did the temperature change?	Cooking time
Basic Solar Cooker				
Redesigned Solar Cooker 1				
Redesigned Solar Cooker 2				

Part B: REDESIGN: PLAN for your SOLAR COOKER

Ask: What is the problem you need to solve?

Imagine: What are your ideas for solving this problem?

1.

2.

3.

Plan: What will your design look like? Draw a labeled diagram and write down your materials with the amount you need: