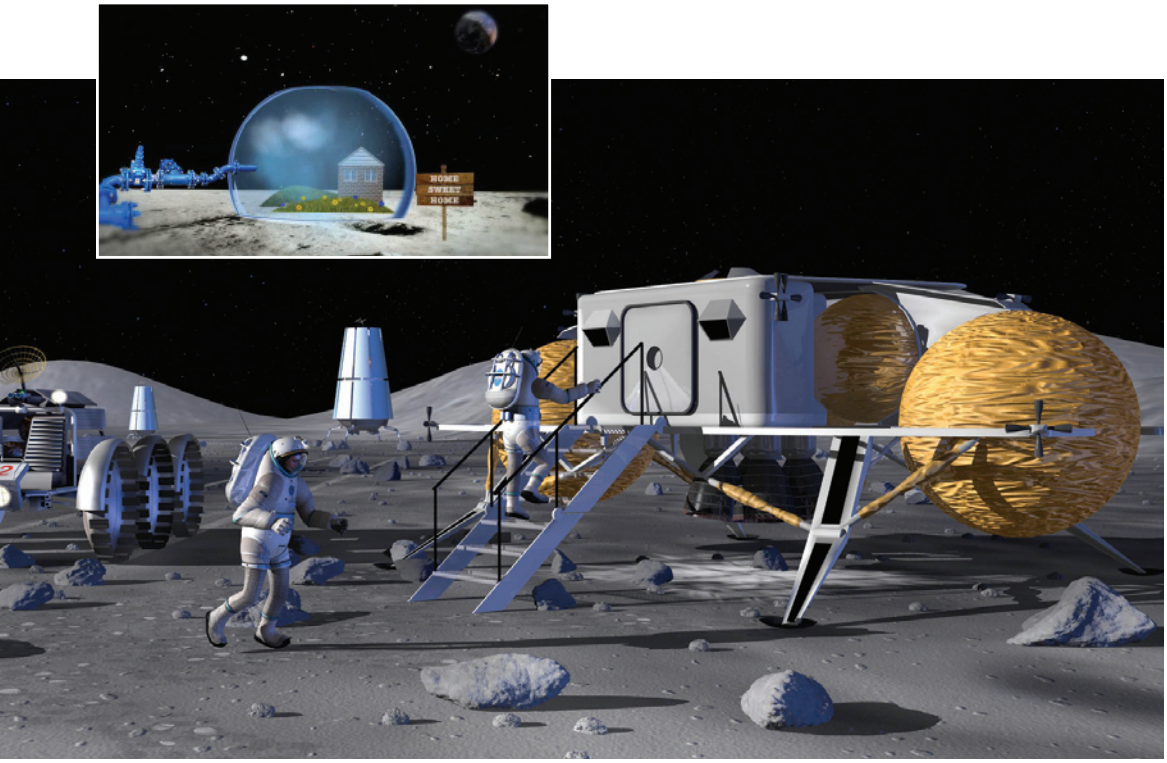
Build a Solar Oven



DESIGN challenge

To design and build a solar box cooker, and test it to see if it works well enough to make S'mores.

OBJECTIVE

To demonstrate an understanding of the Engineering Design Process while utilizing each stage to successfully complete a team challenge.

PROCESS SKILLS

Experimental design, measuring and data analysis

MATERIALS

Thermometers

Stopwatches

Cardboard box (no smaller than 40cm wide)

Aluminum pie pans

Aluminum foil

Black construction paper

Plexiglass or plastic wrap big enough to cover the box

Sunshine, OR gooseneck lamp with 100 W bulb

S'mores fixin's (graham crackers, marshmallows and chocolate)

Oven mitts or tongs

STUDENT PAGES

Design Challenge

Ask, Imagine and Plan

Experiment and Record

PRE-ACTIVITY SETUP

It is recommended to take a few minutes at the start of the session to discuss safe handling procedures of the food and of their solar ovens when exposed to the sun: (1) Remind students the importance of hand washing before handling food; and (2) Ovens will get hot and will require the use of protective gear or a tool to manipulate items in and out of the ovens.

Please note: This activity may require two 60-90 minute sessions to complete.

solar oven

MOTIVATE

- Have students watch the video “Living on the Moon“:

http://svs.gsfc.nasa.gov/goto?10515

SET THE STAGE:

ASK IMAGINE
&PLAN

- Share the *Design Challenge* with the students
- Remind students to ask questions and brainstorm ideas, then break into teams to create a drawing of a solar oven. All drawings should be approved before building.
- Tell students that if they succeed in their design, a tasty treat will be had!

CREATE

- Hand out the materials to the students and challenge them to build their own solar ovens.

EXPERIMENT

- Have students follow the directions on the Experiment and Record worksheet to complete their experiment.
- Once the oven is built, students should place a S’more and the thermometer in the box and cover the top with plastic wrap (or plexiglass lid).
- Place the box in direct sunlight (students may have to tilt the box so that there are no shadows inside). If it is a cloudy day, use a gooseneck lamp with the 100 W bulb.
- Assist students when measuring the temperature or removing items from the solar oven once exposed to the sun. Ensure safety measures are in place.

IMPROVE

If there is time, have students inspect their designs and the experiment results. Allow teams to rework their design if needed.

CHALLENGE CLOSURE

Engage the students in the following questions:

- *Whose oven got to the highest temperature?*
- *Whose oven melted the marshmallows and the chocolate?*
- *Does it make a difference to use actual sunlight compared to light from a lamp? Why or why not?*
- *What else could you cook using a solar oven?*

END OF PROGRAM

This session concludes the NASA Beginning, Engineering, Science and Technology activities. Students now should have a firm grasp of the Engineering Design Process and how it is applied in real applications of our quest to travel to the Moon, Mars and beyond. Fill out a certificate for each student for completing all the steps to becoming a NASA BEST student (see end of guide).

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solar oven

Build a Solar Oven
Teacher page

Can we cook while on the Moon?

While astronauts might have to bring just about everything with them when we establish a habitat on the Moon, one thing they won't need is solar energy. There may be no atmosphere, no climate nor weather on the Moon, but that DOES make it an ideal place to collect solar energy. Much of the Moon is exposed to sunlight constantly, except briefly during a rare lunar eclipse. If that energy could be harnessed, it could power almost everything in the lunar habitat…including that most important device that helps prepare delicious food – an oven!

THE CHALLENGE:

Your mission is to design and build a solar oven to cook your own S'mores with the materials provided. Your design constraints are:

1. **The oven must have a "footprint" of no more than 40 cm x 40 cm.**
2. **In 5 minutes, the temperature inside the box must increase by 5°C.**

***SAFETY NOTE:** Contents of solar oven can get very hot. Seek assistance from your teacher and use oven mitts, other protective gear or tools (i.e. tongs) when manipulating anything inside of your oven!*

DESIGN challenge

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solar oven

Build a Solar Oven
Student page

ASK IMAGINE &PLAN

Place a piece of white paper and a piece of black construction paper outside in the sun or under a lamp. Place a thermometer on top of each piece of paper. Let it sit for 5 minutes.

Which piece of paper had a higher temperature? _____

Can using aluminum foil help your oven? How? _____

_____

Using the answers above, design and label your solar oven.

Build a Solar Oven
Student page

solar oven

Approved by: _____

Experiment & Record

1. Using the materials provided, build your solar oven based on your design. Remember the goal is to capture heat in your oven to cook S'mores.
2. Place one S'more in the middle of the oven (1 graham cracker, 1 piece of chocolate, 1 marshmallow). Cover with plastic wrap and begin cooking.
3. Record the temperature every 30 seconds for ten and a half minutes.Record the temperature change in the table on the next page.

Solar Oven Data Table

Time Min:sec	Oven Temperature ^{o}C
0:00	
1:00	
2:00	
3:00	
4:00	
5:00	

Did your S'more melt? YES OR NO

If the answer is no, discuss with your team how to improve your solar oven. Make the changes on your drawing.