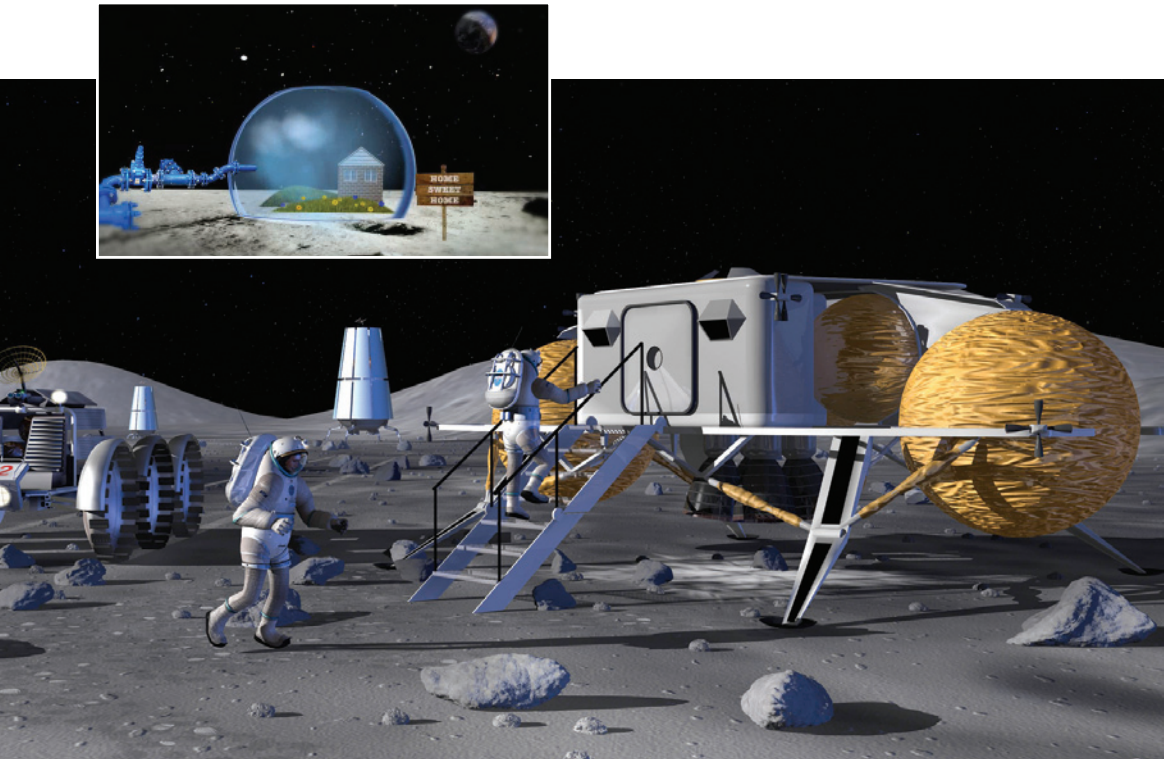
Build a Solar Oven



DESIGN challenge

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

solar oven

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, graphing and data analysis

MATERIALS

General building supplies

Thermometer

Timers

Cardboard box

Aluminum 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

Ask, Imagine and Plan

Experiment and Record

Quality Assurance Form

Fun with Engineering at Home

PRE-ACTIVITY SET-UP

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.

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 imagine a solution and draw their ideas. 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 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 goose neck lamp with the 100 W bulb.
- Ensure students use oven mitts when moving the plexiglass lid or removing items from the solar oven once exposed to the sun.

IMPROVE

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

CHALLENGE CLOSURE

Engage the students with the following questions:

- *Whose oven reached the highest temperature? What was that temperature? Did it melt the marshmallows and the chocolate?*
- *What could you have done to make your solar oven work better?*
- *Does it make a difference using actual sunlight compared to light from a lamp? Why or why not?*
- *How did the distances from the bottom reflective surface affect the cooking of the food in your oven?*

END OF PROGRAM

This session concludes the NASA's Beginning, Engineering, Science and Technology series. 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. Print out a certificate for each student for completing all the steps to becoming a NASA's BEST student (see end of guide).

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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 10 minutes, the temperature inside the oven must increase by 15 °C.***
3. ***Your food may not touch the bottom of the oven directly. You must design an effective way to cook the two S'mores without their touching of the oven bottom.***
4. ***You must cook the two S'mores at two different heights. You will also test which height allows food to cook at a faster rate.***

SAFETY NOTE: Contents of solar oven can get very hot. Make sure you use oven mitts or other protective wear when manipulating anything inside of your oven!

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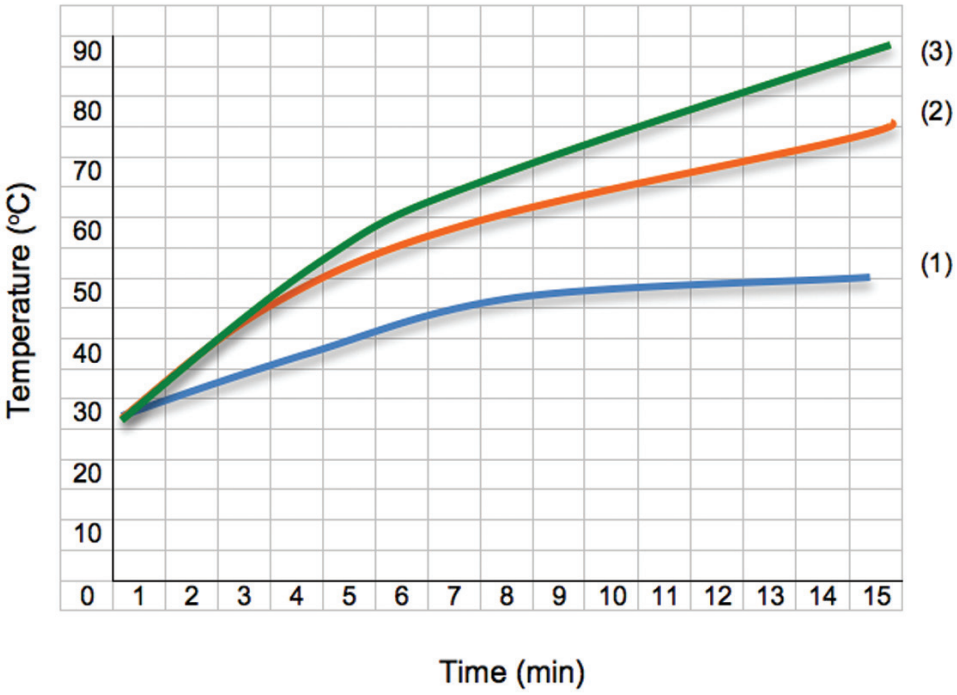
solar oven

Build a Solar Oven
Student page

ASK IMAGINE &PLAN

What questions do you have about today's challenge?

Below is a graph showing data that demonstrates the efficiency of three different solar oven designs: (1) plain box, (2) box with a black bottom and (3) a box with aluminum foil and a black bottom.



Which line (1, 2 or 3) do you think represents the solar oven that is just an empty box? Explain why.

Which line do you think represents the solar oven with aluminum foil and a black bottom? Explain why.

_____

What purpose do you think aluminum foil might serve?

_____

How will you meet the design constraint of the food not being allowed to touch the bottom surface of the solar oven?

_____

Draw and label your solar oven.

Approved by: _____

Experiment & Record

1. Using the materials provided, build you solar oven based on your design. Remember the goal is to capture heat in your oven.
2. Record the starting temperature of the oven: _____ °C
3. Record the heights of the food from the oven floor: _____ cm _____ cm
4. Prepare your S'mores and place them in the oven. Cover the oven with the plexiglass lid or plastic wrap and begin cooking.

5. **Record the temperature change in the table below.**

Solar Oven Data Table

Time Min:sec	Oven Temperature °C	Time Min:sec	Oven Temperature °C
0:00		5:30	
0:30		6:00	
1:00		6:30	
1:30		7:00	
2:00		7:30	
2:30		8:00	
3:00		8:30	
3:30		9:00	
4:00		9:30	
4:30		10:00	
5:00		10:30	

Record any observations of your food while it is cooking. These observations will help to determine which food placement height allows for quicker cooking.

Time Min:sec	S'more 1 _____ cm	S'more 2 _____ cm
1:00		
2:00		
3:00		
4:00		
5:00		
6:00		
7:00		
8:00		
9:00		
10:00		

QUALITY ASSURANCE FORM

Each team is to review another team's design and model, then answer the following questions.

Name of team reviewed: _____

	YES	NO
Did the solar oven increase in temperature by more than 10 °C?		
Did this team's design differ from your team's design?		
Did both S'mores melt?		

Which height/cooking position worked best in this solar oven?

List the specific strengths of the design:

List the specific weaknesses of the design:

How would you improve the design?

Inspected by: _____

Signatures: _____

_____

_____

Fun with Engineering at Home

TWO BIT CIRCUS FOUNDATION · INVENTING INSPIRATION ·
TWOBITCIRCUS.ORG

Today you learned a fun way to harness the Sun's energy, trapping the radiant heat from the Sun to cook food. With your family members, look up the meaning of "the greenhouse effect". Can you explain what "the greenhouse effect" has to do with the solar oven your team designed and built?

Discuss with your family members the following question:

Why do we use the term
"the greenhouse effect" when talking about
global warming?

YOU BE THE TEACHER!

Show your family how to build a solar oven. Test it out by cooking something new. How about baking a pizza in your solar oven? Grab a frozen pizza from the store or make one from scratch. Use the results of your experiment to determine at what height to place your pizza in the oven.

This marks the end to the NASA Beginning, Engineering, Science and Technology (BEST) series. We encourage you to continue to look for more activities, articles and podcasts about NASA any day and every day!

www.nasa.gov

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