

## SOLAR COOKER—LEARNING FACILITATOR'S GUIDE

*This activity requires a sunny day when it is 75+ degrees.*

### Introduction

The participant will be acting as solar energy systems engineer in this activity.

**Solar Energy Systems engineers** design, develop, and evaluate energy-related projects and programs to reduce energy costs or improve energy efficiency during the designing, building, or remodeling stages of construction. Energy engineers may specialize in electrical systems; heating, ventilation, and air-conditioning (HVAC) systems; green buildings; lighting; air quality; or energy procurement.

<http://www.troopstoenergyjobs.com/energycareers/engineer-solar.php>

More information on related careers in solar power may be found at

[http://www.bls.gov/green/solar\\_power/](http://www.bls.gov/green/solar_power/)

The video link about solar energy systems engineers contained in the activity guide is well worth exploring. <https://www.youtube.com/watch?v=wnTUvWjNTMM>

Participants will be focusing their design efforts on two aspects of the solar cooker design:

1. The best angle for the foil-covered lid to reflect the maximum amount of solar energy to supplement the solar energy hitting the bottom of the box directly.
2. How to cook the S'mores

When light strikes an object, it may do one of three different things. It may pass through the material, it may reflect off the material, or it may be absorbed and changed into another form of energy, most often heat. Light will be doing all three of these phenomena in this activity. Light will pass through the cellophane into the box. It will be reflected off the aluminum foil on the lid and it will be absorbed by the s'more and black paper and converted into heat.

### Safety notes

**You should be aware of any food allergies or dietary restrictions that might prevent a participant from consuming graham crackers, chocolate, and/or marshmallows. Although probably not an issue, participants should be cautioned that the oven and food components may be hot.**

## Preparation

1. Materials: participants should set up four S'mores and plan to share several of them
  - 4 Marshmallows
  - 2 chocolate bars (e.g. Hershey's)
  - 4 graham crackers
  - clear cellophane (Saran Wrap)
  - aluminum foil
  - 14" pizza boxes
  - black construction paper
  - 2 tongue depressors (popsicle sticks)
2. Additional materials that should be readily available:
  - Scissors
  - Rolls of tape: cellophane, masking, and/or duct
3. Timing – If 75 minutes are allocated for this activity, the approximate breakdown of the time should be:
  - 10 minutes – introduction
  - 25 minutes – design, build/construct and test
  - 30 minutes – S'mores require 30 minutes to cook in the sun
  - 10 minutes – follow-upNote – more time or multiple sessions could be utilized, if desired.

## The Design Challenge Notes

1. Testing the solar cooker will require sunlight. The best time of day is around noon. Much less satisfactory results will occur in the early morning or late afternoon or on a cloudy day.
2. S'mores, are an American summer tradition, typically cooked in a conventional oven or microwave.
3. A few hints (which you may or may not share):
  - Tilting the box bottom so that the sun's rays fall more perpendicular into the, box will improve results. (Put a block or book under the back of the box.)
  - Minimize wrinkles on the aluminum foil and cellophane wrap
  - Seal the cellophane wrap to the box with tape so that the warm air does not escape.
  - Setting up the cooker on a blacktop or other dark surface adds heat.
4. If available, an oven thermometer may be set inside the solar cookers to monitor the temperature inside. It may be a surprise to see how warm a solar cooker can get!

The criteria to evaluate the designs:

Solar Cooker Rating	1	2	3
Angle Design	The sunlight reflects outside of the solar cooker.	The sunlight reflects inside the box, but is NOT centered.	The sunlight reflects inside the box AND is centered.
Ready to Eat	The chocolate did not melt AND the marshmallows did not become gooey.	The chocolate melted OR the marshmallows became gooey.	The chocolate melted AND the marshmallows became gooey.
Time	2 or less S'mores are ready to eat after 30 minutes	3-4 S'mores are ready to eat after 30 minutes	4 S'mores are ready to eat in less than 30 minutes.

### Reflection

As with all of these engineering design activities, the reflection part is crucial to the experience. After they finish enjoying their S'mores, they will rate their design and contemplate how to improve it.

### Final notes:

If time allows or if additional sessions can be scheduled, three important aspects of engineering can be addressed:

1. Sharing of ideas and designs. Encourage participants to discuss their work. What was helpful and what was not?
2. Engineering is iterative. It would be great to go back and "try again:" modify the design, use new ideas – ultimately try to improve on their work.
3. What it's like to be a solar energy systems engineer.