NASA SUMMER OF INNOVATION

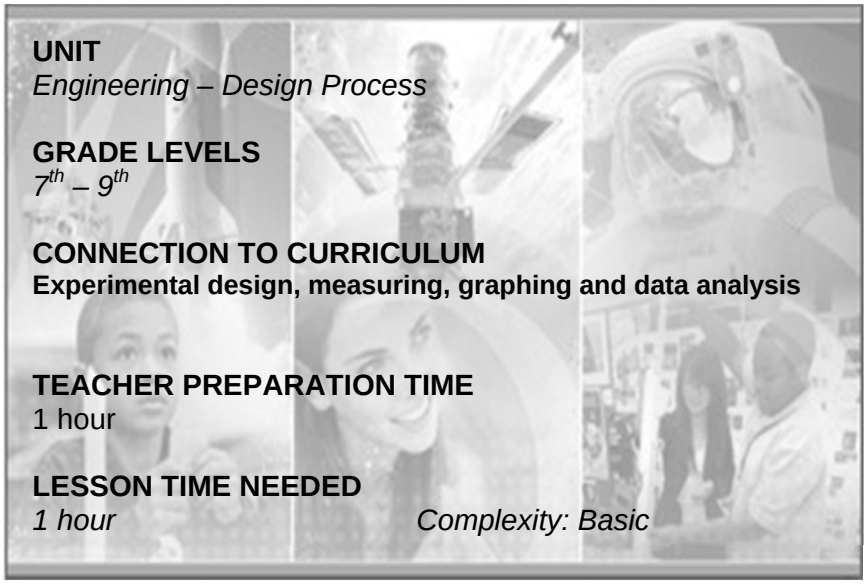
Build A Solar Oven

LESSON THEME

An engineering Design Challenge to design and build a solar box cooker, and test it out to see if it works well enough to make S 'mores.

OBJECTIVES

Students will:
Engage in the Engineering Design Process to complete a team challenge building a simple solar powered oven.



UNIT
Engineering – Design Process

GRADE LEVELS
7th – 9th

CONNECTION TO CURRICULUM
Experimental design, measuring, graphing and data analysis

TEACHER PREPARATION TIME
1 hour

LESSON TIME NEEDED
1 hour *Complexity: Basic*

NATIONAL STANDARDS

National Science Education Standards (NSTA)
Science as Inquiry
- Understanding of scientific concepts
- An appreciation of "How we know" what we know in science
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities and attitudes associated with science.

Earth and Space Science
- Energy in the earth Systems

Science in Personal and Social Perspectives
- Natural Resources
- Science and Technology in local, national and global challenges

Common Core Standards for Mathematics (NCTM)
Ratios and Proportional Relationships
- Analyze proportional relationships and use them to solve real-world and mathematical problems

Geometry
- Solve real-life and mathematical problems Involving angle measure, area, surface area, and volume

ISTE NETS and Performance Indicators for Students (ISTE)
Creativity and Innovation
- Apply existing knowledge to generate new ideas, products, or processes
- Use models and simulations to explore complex systems and issues

Research and Information Fluency
- Plan strategies to guide inquiry
- Process data and report results

Critical Thinking, Problem Solving, and Decision Making
- Plan and manage activities to develop a solution or complete a project

MANAGEMENT

Share the *Design Challenge* with the students. Hand out the materials to the students and challenge them to build their own solar ovens. 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 close the Plexiglas lid. Place the box in direct sunlight (they 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 100W bulb. Ensure students use oven mitts when moving the Plexiglas lid or removing items from the solar oven once exposed to the sun.

CONTENT RESEARCH

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

MATERIALS

- General building supplies
- Thermometer
- Timers
- Cardboard box
- Aluminum pans
- Aluminum foil
- Black construction paper
- One piece of Plexiglas big enough to cover the box
- Sunshine, OR gooseneck lamp with
- 100 W bulb
- S 'mores fixings (graham crackers, marshmallows and chocolate)
- Oven mitts

WORKSHEETS

- *Imagine and Plan*
- *Experiment and Record*
- *Quality Assurance*
- *Fun with Engineering at Home*

Key Concepts

Radiation- The Sun's energy radiates through space to reach Earth. That means it travels in waves and doesn't need atoms and molecules to move along. Energy that travels by radiation is called electromagnetic radiation. Light is one kind of electromagnetic radiation we can see. But light is just one tiny part of all the kinds of electromagnetic radiation.

Solar Energy- Having to do with the sun's energy.

Solar Powered- Sun's rays come to the earth at an angle. The foil reflects the ray and bounces it directly into the box. It gets trapped inside. It is absorbed by the black paper and the heat energy cooks the food.

LESSON ACTIVITIES

http://www.nasa.gov/pdf/435855main_BuildaSolarOven_6to8.pdf

1. Review the Design Process
2. Show the video "living on the Moon" http://svs.gsfc.nasa.gov/goto?10515
3. List the specification of the solar oven challenge.
4. Build the ovens.
5. Create data charts.
6. Share data and reports.
7. Eat S 'mores!

ADDITIONAL RESOURCES

Building a solar cooker:
http://scifiles.larc.nasa.gov/text/educators/activities/2000_2001/inclass/solar_cooker.html

Solar radiation mathematically speaking: http://edmall.gsfc.nasa.gov/inv99Project.Site/Pages/science-briefs/ed-stickler/ed-irradiance.html
Earth's energy budget poster: http://www.nasa.gov/pdf/535742main_Energy_Budget_Cover.pdf
Activity, Seasonal cycles in radiation flux: http

DISCUSSION QUESTIONS

1. Whose oven got to the highest temperature? *Answers will vary*.
2. Whose oven melted the marshmallows and the chocolate? *Answers will vary*
3. What could you have done to make your solar oven work better? *Answers will vary*
4. Does it make a difference to use actual sunlight compared to light from a lamp? Why or why not?
5. What else could you cook using a solar oven? *Answers will vary*
6. How could your oven design be adapted to use in a Lunar Colony? *Answers will vary*

ASSESSMENT ACTIVITIES

Record data for temperature changes and observations
List the specific strengths and weaknesses of the designs.
Make suggestions for improvements for each design.

ENRICHMENT

Describe how this experiment relates to the "green house effect".