LESSON: Design & Cook with Solar Ovens

GRADE: 3

OBJECTIVES:

Mathematics
Measurement & Data
Geometric measurement: understand concepts of area and relate area to multiplication and to addition.

- **3.MD.C.5** Recognize area as an attribute of plane figures and understand concepts of area measurement.
  - A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.
  - A plane figure which can be covered without gaps or overlaps by n unit squares is said to have an area of n square units.

MATERIALS & RESOURCES:

- Access to Internet or books about solar cooking
- Very useful- download and print PDF *Solar Cooker, How to Make & Enjoy* http://solarcooking.org/plans/plans.pdf
- Materials for a quick demo solar oven:
  - Cardboard (recycle boxes)
  - Foil or silver Mylar paper
  - White glue
  - Utility knife or similar cutting device
  - Tape or glue and paintbrush,
  - Instructions and illustrations on page 44 of the PDF: *Solar Cookers, How to Make & Enjoy*
- For *Cookit* solar oven find material list & instructions on pgs. 12-17 or the Box Solar Cooker on pgs. 18-28 of PDF *Solar Cookers, How to Make & Enjoy*

PRESENTATION:

Tell students they will be studying about solar ovens. First they will learn about some designs already in use, then create their own design. They will use the solar ovens to cook and share food with family and/or another class. Discuss the various sources of energy used to cook food around the world and at home.

- Fire wood (Wood)
- Coke
- Char coal
- Propane gas in (cylinders)
- Solar power (Sun light)
- Natural gas

Discuss the pros and cons of these sources of energy. Some fuels cause health problems. Most contribute greenhouse gases and other pollution to the atmosphere. Some are in short supply or extraction causes pollution or other problems. What about solar energy?

DIRECTIONS:

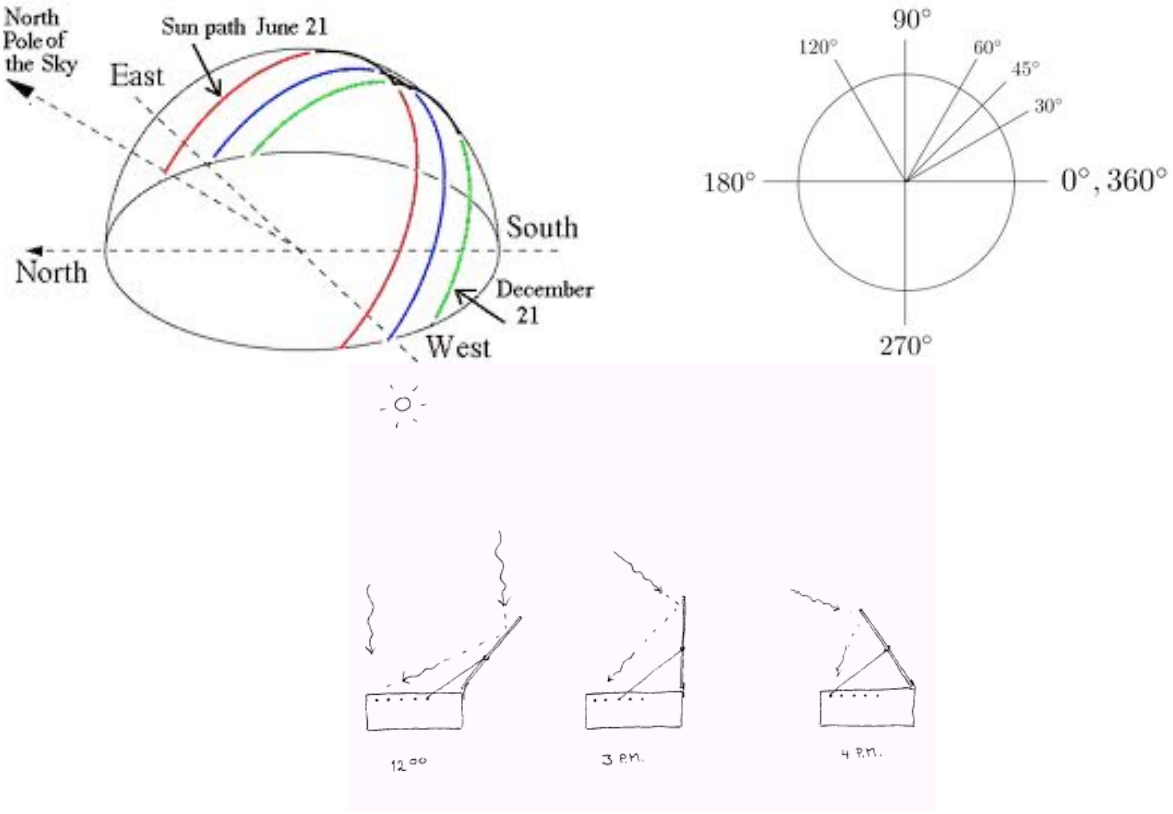
1. Download, print and study information about solar energy and cooking with solar ovens in the PDF *Solar Cooker, How to Make & Enjoy* and/or use books about solar cooking to become familiar with the various solar oven designs.
2. As a class discuss various designs of the solar cookers. Review information about food safety and safety precautions necessary to build and use a solar oven.
3. Have kids divide into groups and design a solar cooker in each group. Students need to use the area and perimeter math formulas to determine the measurements of cardboard to be cut once the box is laid out flat. Students also learn about angles by studying the location of the sun on horizon and angle at which the oven will get most sunlight. (Picture of angles below)
4. Collect the necessary materials to build the designs.
5. Build solar ovens.
6. Decide what food to cook. See recipe tips beginning on page 30 of the PDF. The kids should do the math to calculate the amount of food necessary once the number of guests is determined. (Easy snack recipes included in this lesson)
7. Look at the weather forecast and choose a sunny day in the near future. The class may want to test the ovens previous to the sharing day in order to learn about timing, operation, and work out any problems.

8. Invite classmates or parents to join the class for a solar oven experience. Follow directions in the PDF for cooking with solar cooker.
9. In conclusion, have students write and/or draw about the experience. The following aspects should be addressed:
    - Write/draw about energy- from where does it originate and what are the pros & cons of varies energy sources. What about the solar oven?
    - Write/draw about the math you used to design the oven. Where was the sun when you used your oven? How did you determine how much food to cook?
    - Write/draw revisions you could make to improve or refine your solar cooker in some way. What else did you learn. What questions occurred to you during this activity?

Garden Unit Directions: Do this activity in the garden. Use produce from the garden if possible, or if it not in season yet, produce that represents what will or did come from the garden. Talk about how the angle of the sun and earth make a difference in the amount of light. What does this information mean for the plants in the garden?

TIME: 1-2 class periods to assemble, 1 class period - 1 school day for cooking presentation

ANGLES



http://sv.wikibooks.org/wiki/Folkteknik 1

RECIPES & MATH

Determine number of people who will eat.
Determine amount of ingredients per person.
Do the math to figure out how much food in total.

Nachos
Spread corn chips on a dark metal tray and sprinkle with shredded cheese. When cheese is melted, nachos are ready.

Solar s'mores
Place marshmallows and pieces of chocolate and/or peanut butter between graham crackers. Heat in a dark, covered pot until marshmallows melt.

Fruit cut-ups
Sprinkle sliced apples with cinnamon and sugar, and cook in a dark, covered pot until done (anywhere from slightly tender to very soft).

HOW MUCH SUNLIGHT DOES EARTH RECEIVE PER DAY?

(http://www.ecoworld.com/energy-fuels/how-much-solar-energy-hits-earth.html)

In full sun, you can safely assume about 100 watts of solar energy per square foot. If you assume 12 hours of sun per day, this equates to 438,000 watt-hours per square foot per year.

Based on 27,878,400 square feet per square mile, sunlight bestows a whopping 12.2 trillion watt-hours per square mile per year.

With these assumptions, figuring out how much solar energy hits the entire planet is relatively simple.

12.2 trillion watt-hours converts to 12,211 gigawatt-hours, and based on 8,760 hours per year, and 197 million square miles of earth's surface (including the oceans), the earth receives about 274 million gigawatt-years of solar energy, which translates to an astonishing 8.2 million "quads" of Btu energy per year.

In case you haven't heard, a "quad Btu" refers to one quadrillion British Thermal Units of energy, a common term used by energy economists. The entire human race currently uses about 400 quads of energy (in all forms) per year. Put another way, the solar energy hitting the earth exceeds the total energy consumed by humanity by a factor of over 20,000 times.

Clearly there is enough solar energy available to fulfill all the human race's energy requirements now, and for all practical purposes, forever. The key is developing technologies that efficiently convert solar power into usable energy in a cost-effective manner.

For energy conversion constants a good website is Energy Conversion, to help elucidate this data. http://www.onlineconversion.com/energy.htm