“We’re the Solar Sisters.”

Networking to Advance the Use of Solar Cookers as Educational Tools in the Classroom

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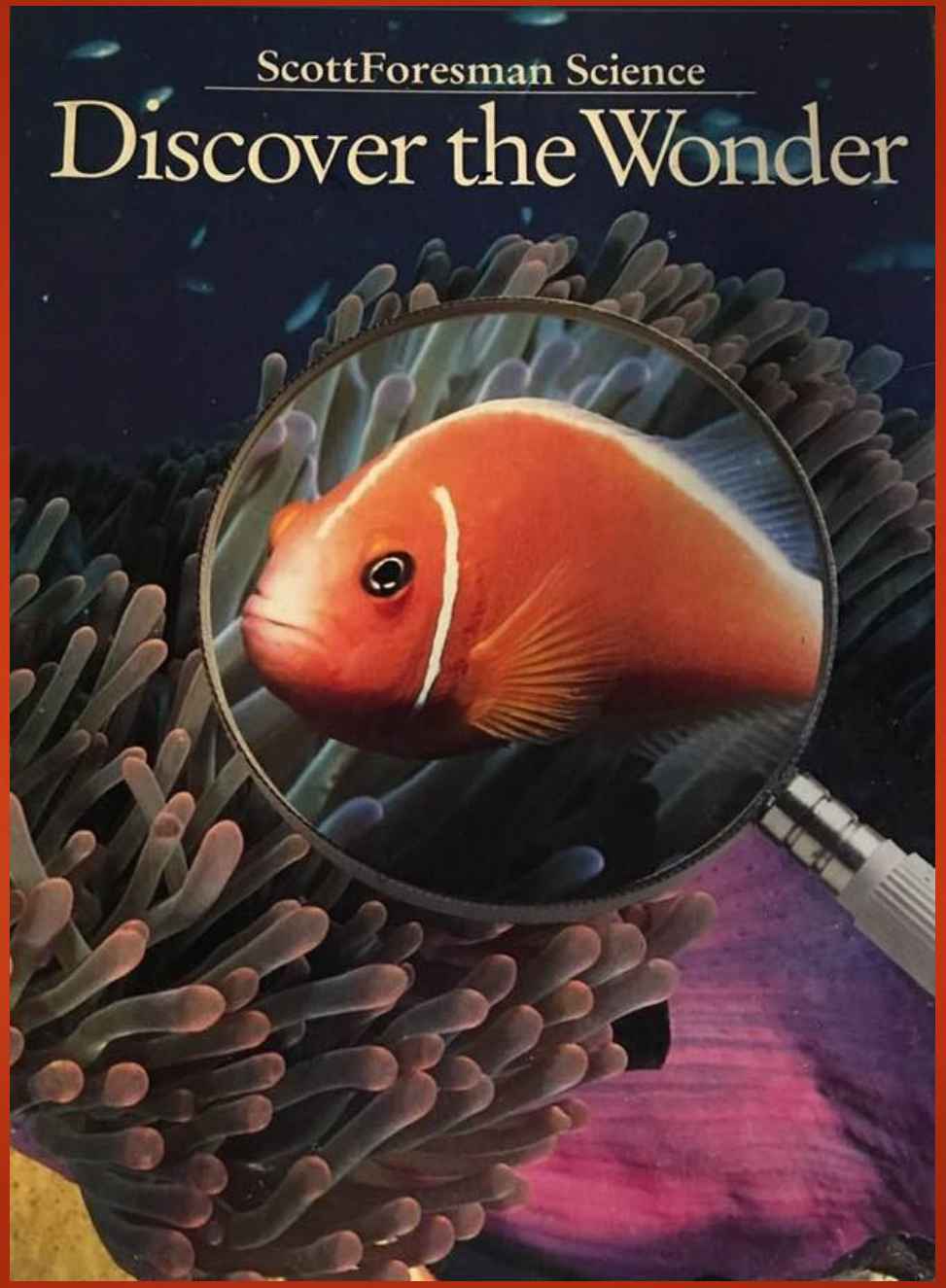
THE SOLAR SISTERS – GLOBAL DEVELOPMENT SOLUTIONS


ScottForesman Science
Discover the Wonder

SCIENCE TEXT BOOK

1 2 3 4

CHAPTER 2

Solar Energy

Discover Activity

No kidding! You can really cook a potato with sunlight?

Can you build a solar cooker?

Design and construct a solar cooker to cook a small potato. Use any materials that you can think of. Place your potato in the cooker. How long did it take to cook your potato?

For Discussion

1. How well does your solar potato cooker work?
2. How could you change your cooker design to make the potato cook even faster?

LESSON 2.1

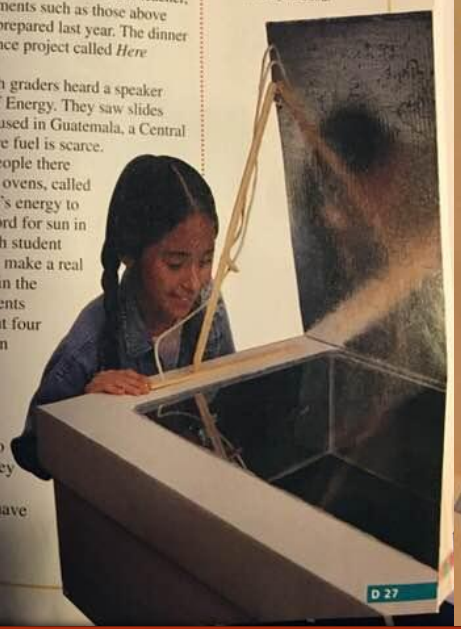
Using the Sun's Energy

Is sunlight hot enough to cook food?

"I can't believe the sun cooked the whole meal!"
"This pizza is fantastic!"
"Everything tastes just like it does at home!"

For the last two years, students in El Paso, Texas, have enjoyed a unique experience with their teacher, Louise Bergdahl. Comments such as those above describe a dinner they prepared last year. The dinner was the result of a science project called *Here Comes the Sun.*

The 60 creative sixth graders heard a speaker from the Department of Energy. They saw slides showing special ovens used in Guatemala, a Central American country where fuel is scarce. These ovens help the people there cook food cheaply. The ovens, called solar ovens, use the sun's energy to cook food. *Sol* is the word for sun in the Latin language. Each student worked with partners to make a real solar oven like you did in the Discover Activity. Students built their ovens in about four hours of class time. Then they cooked a meal in them. But the project involved more than building ovens. Ms. Bergdahl's class has also achieved local fame. They have been featured in newspaper articles and have appeared on local TV.

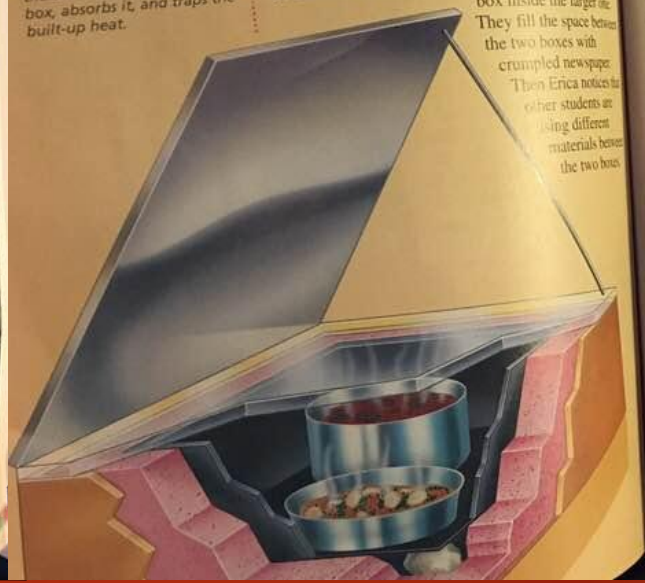


Kira Kawakami checks the finishing touches on a solar oven she helped build.

Solar Bake Off

Join Kira, and her partners Erica and Michael, as they make a solar oven. They begin by discussing how solar ovens work. Flaps covered with aluminum foil bounce sunlight into a box. The flaps can be adjusted to follow the sun as it moves. The sunlight streams through a clear glass or plastic lid into the box. Because the inside of the box is black, the box absorbs the sun's energy and gets hot. The lid holds the heat in. The oven grows hot, then hotter. Finally it becomes hot enough to cook food.

Next Kira, Erica, and Michael begin to work. Erica paints the inside of a small box with a special black paint made for use on barbeque grills. Michael places rocks in the bottom of a larger box to anchor it. When the paint dries, they fit the small box inside the larger one. They fill the space between the two boxes with crumpled newspaper. Then Erica notices that other students are using different materials between the two boxes.



The solar oven bounces the sun's energy inside the box, absorbs it, and traps the built-up heat.

One team is especially inventive. They're filling soda cans with sand to place in the empty space. Ms. Bergdahl explains that sand surrounding the heated box will prevent heat from escaping through the oven into the ground.

Next Erica and Kira glue aluminum foil onto a large square of cardboard to make the flap. After they attach the flap, they support it with a stick so it won't blow closed. Then Michael begins the last step: taping a piece of glass onto the box.

As each team puts the finishing touches on their ovens, excitement fills the air. Looking around, the group sees that none of the ovens look the same. Most ovens are bigger than theirs. Some are black, and others are covered in foil.

Finally the day of the bake-off arrives, along with cloudy skies. On the playground, students put chicken, potatoes, pizza, and other foods into their ovens. And they watch the clouds.

But the ovens begin to heat as soon as the sun appears. Many quickly rise past 75° Celsius. Temperatures above 75° Celsius are needed to kill bacteria, so the food will be safe to eat. Although solar ovens can reach 150° Celsius, most food takes about three times longer to cook than at home. At noon, the food is ready. Kira, Erica, and Michael proudly serve a meal cooked by the sun.

Ms. Cole helps Erica Whitehead, Kira, and Michael Chuilli assemble their oven.

The solar oven's inventor, Sherry Cole, puts the pizza into the oven while Kira and Erica anxiously wait for lunch!

15 YEARS

100 students per year = 1,500 students

RESEARCHED

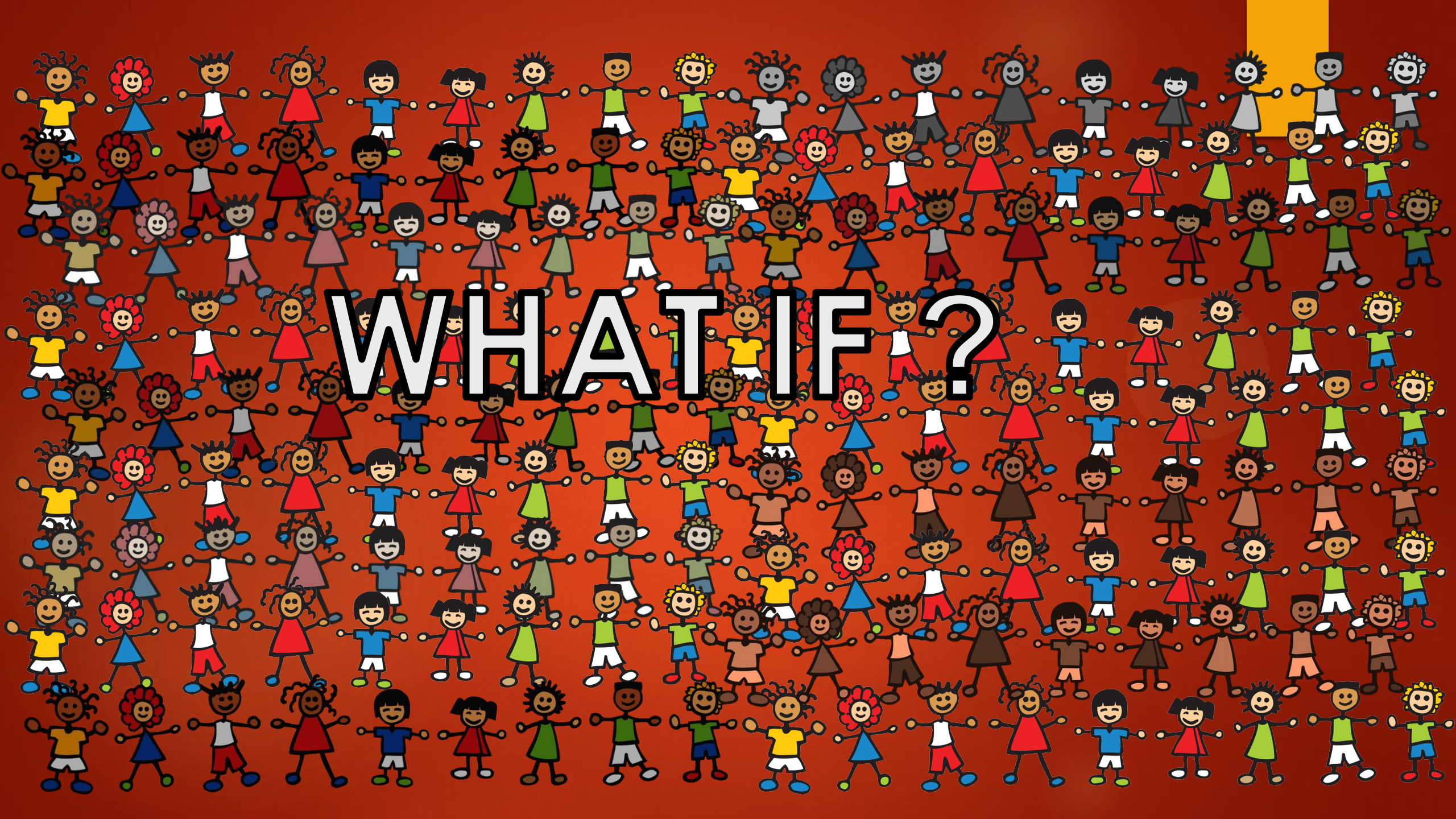
DESIGNED

BUILT

TESTED

their own unique solar ovens.

WHAT IF ?


WHAT IF?

Tools for the Classroom

Science, Technology, Engineering, Math (STEM)
Social Studies, Language Arts

Solar cooker lessons easily align to standards, or learning goals.

Next Generation *Science* Standards - Middle School

- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
- Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Common Core *Math* Standards - Middle School

- Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity (the dependent variable), in terms of the other quantity (the independent variable). Analyze the relationship between the dependent and independent variables using graphs and tables…
- Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
- Write, interpret, and explain statements of order for rational numbers in real-world contexts.
- Summarize numerical data sets in relation to their context, such as by reporting the number of observations, describing the nature of the attribute under investigation, including how it was measured and its units of measurement.

Engineering Design Process – LJCreate.com

- IDENTIFY PROBLEM OR NEED
- DEFINE THE REQUIREMENTS AND CONSTRAINTS
- BRAINSTORM SOLUTIONS
- EVALUATE SOLUTIONS
- DESIGN AND BUILD PROTOTYPE
- TEST AND EVALUATE PROTOTYPE
- REDESIGN AND IMPROVE
- COMMUNICATE RESULTS

Common Core *Language Arts* Standards - Middle School

- Cite specific textual evidence to support analysis of science and technical texts.
- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
- Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table.)
- Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Ohio *Social Studies* Standards - Middle School

- *ECONOMICS:* Identify short & long term consequences of a personal economic decision.
- Explain why some goods are easier to find than others and how this affects price.
- *HISTORY*: Use various sources to describe a historical event or period from different perspectives.
- Compare the key physical and human features of societies of the past in the Eastern Hemisphere with society today.
- *GEOGRAPHY*: Use appropriate maps, globes and other geographic resources to locate various sites or places.
- Identify the absolute location (latitude and longitude) of major places and features on a globe (e.g., charting locations on a grid).

Know your own school system's goals and objectives.

NETWORKING

LEARNING STREAMS

YOUNGSTOWN STATE UNIVERSITY

CARNEGIE SCIENCE CENTER

ONE OF THE FOUR CARNEGIE MUSEUMS OF PITTSBURGH

NSTA National Science Teachers Association

OH WOW!

THE ROGER & GLORIA JONES CHILDREN'S CENTER FOR SCIENCE & TECHNOLOGY

Education is the most powerful weapon which you can use to change the world.

Nelson Mandela

ENGINEERING DESIGN PROCESS

1. Identify Problem or Need

Natural disasters can knock out power to a home for days and even weeks. Without power, food cannot be refrigerated. People may need to rely on dried goods such as rice, beans, and root vegetables. Lack of power may also prevent people from cooking in traditional ways.

CBS/AP / September 14, 2017

4,000 Texas homes, facilities without power weeks after Harvey, governor says

Austin, Texas - An estimated 4,000 Texas homes and other facilities are still without power weeks after Harvey slammed the state, Gov. Greg Abbott said Thursday.
Abbott said those displaced by the storm can seek help via community development grants covering long-term housing needs as well as temporary costs while waiting for their homes to be repaired.
The Washington Post/ September 13, 2017

After Irma, Florida prepares for days - and maybe weeks - without power

Cape Coral, Fla. - Millions of Floridians grappled with the aftermath of Hurricane Irma on Wednesday, confronting a sweltering reality: More than 40 percent of Florida still lacked electricity, and for some of them, the light might not come back on for days or even weeks.
USA Today/ September 30, 2017

Hurricane fallout: Puerto Rico could face 6 months without power

After Puerto Rico was pummeled by Hurricane Maria last week, a Category 4 hurricane with 150 mph winds, the island has been left in shambles. After suffering widespread power outages thanks to Hurricane Irma the week before, 1 million Puerto Ricans were left without electricity. 60,000 still hadn't gotten power when Maria brought a total, island-wide power outage, and severe shortages of food, water, and other supplies.

2. Define Requirements - write a brief

Statement

Find a way for people to cook dried goods such as rice, beans and root vegetables using an oven that functions with *passive solar energy.*

Specifications and Constraints

The oven must be made from affordable and common materials.
The oven must use passive solar energy.
The oven must have the ability to direct sunlight, absorb sunlight, convert light to heat, and retain heat.
The oven must cook at temperatures that are safe for food.
The oven must be able to cook a meal between 10:00 am and 4:00 pm on a sunny day.

3. Investigate and research- *List some topics or ideas you and your team will need to investigate and research. Take notes in your journal as you conduct your research and investigation.*

4. Generate Alternative Solutions *- Use your investigation and research to brainstorm ideas with your team for a passive solar oven. Include materials needed. List in your journal.*

5. Choose a Solution *- Evaluate the pros and cons of each idea and then your team will choose the best solution. Write solution in your journal.*

6. Model and Prototype *- With your team, design and sketch in your journal a passive solar oven model that can be built. Label how the oven is designed to direct sunlight, absorb sunlight, convert light to heat, and retain heat.*

7. Test and Evaluate *- Build your team's passive solar oven prototype. Once built, ovens can be tested on a sunny day. Data and observations can be recorded in your journal.*

8. Redesign and improve *- After testing, brainstorm with your team to determine what changes can be made to improve the oven. Identify any malfunctions and ways to deal with them. Rebuild your oven incorporating these improvements and retest.*

What I loved about using Solar Cooking as the theme for a cross curricular unit of study.

Many differentiated learning opportunities.

There's food involved.

Concepts transfer more readily.

Eliminates discipline issues.

Reinforces learning.

Motivates.

Helps students experience how skills can be applied.

Promotes deeper understanding of content.

Challenges creativity.

Develops better relationships with co-workers.

Work cooperatively with co-workers in a supportive manner.

Topic lends itself to several subjects.

Students see tangible results of their planning, designing and constructing.

Students witness teachers cooperating and can use this example for their own work ethic.

Students understand the benefit of collaboration.

Opportunity to develop altruism.

Gives rise to authentic purpose for learning.

Students recall the experience years later.

Multiple applications.

Students conduct introductory experiment to test effect of directing light onto a penny in a jar of water. (Concepts support planning and design of ovens.)