1st Grade STEM DESIGN CHALLENGE
CORRESPONDING ENGINEERING DESIGN PROCESS STAGE IN RED

Unit 3: Light, Heat, and Sound Energy
Topic: Design a Solar Still
Subject/ grade level: STEM/ Grade 1

Materials:
Suggested for teams of 2-3 students, unless indicated otherwise

- Large bowls (one per group and one for teacher demonstration)
- Short glass or cup shorter than size of bowl (one per group and one for teacher demonstration)
- Tape or large rubber bands
- Plastic wrap
- Rock or other weight (one per group)
- Pitcher of water
- Salt
- Long spoon for stirring
- Large sheets of construction paper, at least 12 inches by 18 inches (one per pair of students)
- Large tag board
- Hole punch
- Brads or other type of fasteners
- Blank handout titled, "WAYS WE USE WATER AT SCHOOL"
- Blank handout titled, "WAYS I USE WATER AT HOME"
- Teacher-created parent letter
- 21st Century Skill rubric for grading the project

TEKS
Science

(PS) SCI 1.4A Collect, record, and compare information using tools, including computers, hand lenses, primary balances, cups, bowls, magnets, collecting nets, notebooks, and safety goggles; timing devices, including clocks and timers; non-standard measuring items such as paper clips and clothespins; weather instruments such as classroom demonstration thermometers and wind socks; and materials to support observations of habitats of organisms such as aquariums and terrariums.
SCI 1.5B Predict and identify changes in materials caused by heating and cooling such as ice melting, water freezing, and water evaporating.
*SCI 1.6A Identify and discuss how different forms of energy such as light, heat, and sound are important to everyday life.

Math

(PS) MATH 1.1A Apply mathematics to problems arising in everyday life, society, and the workplace.

(PS) MATH 1.1D Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.

ELPS
C2F Listen to and derive meaning from a variety of media such as audio tape, video, DVD, and CD ROM to build and reinforce concept and language attainment.
C5B Write using newly acquired basic vocabulary and content-based grade-level vocabulary.

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CCRS
Science
1E2A Define and use a basic set of technical terms correctly and in context for each discipline studied.
9F1A Describe Earth's principal sources of internal and external energy (e.g., radioactive decay, gravity, solar energy).

Math
6A1C Design and employ a plan of study to collect appropriate data.
6B2B Read and interpret graphical displays of data.

Cross-Disciplinary
1E2C Work in small groups to investigate a problem or conduct an experiment.
2D3A Compose a written document detailing a research project.

Lesson Objective
The students will be able to explain and design a simple way to desalinate water using solar energy.

Key Words:
Condensation, desalinization, evaporation, purify, solar still

Teacher Background Information:
Stills are commonly used to purify liquids. Through the process of distillation, some impurities can be separated from the liquid. Distillation can be a simple process–heat is first added to a liquid to evaporate it and produce a gas or vapor, and then heat is removed from the vapor to condense it back to a liquid. A solar still uses the greenhouse effect to trap energy from the sun. The solar still is a model of the water cycle on earth: evaporation, condensation, precipitation. The role of solar energy in the water cycle: http://serc.carleton.edu/eslabs/weather/2a.html

Essential Question:
- How can science be used to solve problems?

Differentiation strategies to meet diverse learner needs:
In all of the stages, the teacher may consider
- Implementing flexible groups, such as mixed-ability or pairs, during the engineering design process activities.
- Having students use pre-cut pictures from magazines to replace drawing tasks.
- Adjusting the pace of tasks (break into smaller units) and/or scaffolding activities for students as necessary.

IDENTIFY NEED
Share with students the following poem written by Beth Corum:

WATER IS VERY SPECIAL
Water is in drippy drops,
Water is in soapy mops,
WATER IS VERY SPECIAL.
Water fills swimming pools,
Water fills fishes schools,
WATER IS VERY SPECIAL.
Water makes spaghetti floppy,
Water makes puddles sloppy,
WATER IS VERY SPECIAL.

Water keeps us all alive,
It's necessary to survive,
WATER IS VERY SPECIAL.
Discuss the importance of water with students. Be sure to emphasize the following:
Water is very important to all living things. Without water all plants, animals, and people would die. We use water for drinking and for preparing food. We use water for cleaning our bodies, our homes, our pets, and our cars. We use water to have fun when we go swimming and boating. Water is used EVERY DAY.

Ask students: "Have you ever tasted salt water? Can we drink it?"
Near the ocean, water can contain too much salt. This can be a problem for people in areas with little access to freshwater.

Ask students: "How could we make salt water drinkable?" *(Take the salt out of it.)*

Tell the class their design challenge is to create a simple way to use solar energy and evaporation to make salty water drinkable. *(Write this goal on chart paper for display in the class.)*

Formative Assessment:
Write the poem in a single line across the top of a long piece of butcher paper. Let the children work in groups to create a mural which illustrates each line of the poem under the words.

RESEARCH THE PROBLEM

On a KWL chart, have students list what they already know about solar energy in the "K" section that might help them design. Allow students to generate questions about what they will need to know to solve the design challenge in the "W" section of the KWL. Prompt students by having them focus on the underlined terms/phrases to generate questions similar to the following:

What is evaporation?
What causes evaporation?
What ways can we clean water?

To research what evaporation is and how solar energy works, show the following video animation:
http://tinyurl.com/l2f775v [Press **STOP** at the 6 minute mark.]

Differentiation:
To address the kinesthetic learning needs of young learners, have students sing the following water cycle song to review.

WATER CYCLE SONG
(To the tune of "My Darling Clementine")
Evaporation, condensation, precipitation on my mind.
This is the water cycle
And it happens all the time.

Have students form a circle and then assume a squatting position. When they sing evaporation they will rise, slowly.

For condensation they hold hands together, and for precipitation they squat down to original position.

Extension:
Paint with water on a sidewalk on a sunny day. Discuss evaporation.
Formative Assessment:
At the culmination of this stage, have students write down what they have learned about evaporation in the "L" section. Possible answers are as follows:

What is evaporation? (*water changing to water vapor*)
What causes evaporation? (*heat from the sun or a stove*)

DEVELOP POSSIBLE SOLUTIONS

Make the following 2 designs for demonstration purposes with class. Students should record their results in their design logs.

Design #1- A Solar Still Design
Materials:

- Large bowl
- Short glass or cup
- Tape or large rubber bands
- Plastic wrap
- Small rock
- Pitcher of water
- Salt
- Long spoon for stirring

Directions can be found at the following video link:
http://www.teachersdomain.org/asset/ess05_vid_solarstill1/

Design #2- A Fog Collector Design
Materials:

- Panty hose
- Wire coat hanger
- Coffee can or other container
- Sand or rocks to weight the container
- Spray Bottle with water

Directions:

1. Stretch a wire coat hanger out to form a diamond (as seen in the picture).
2. Place the panty hose around the wire coat hanger frame (this will represent the netting of a fog collection net).
3. Bend the hook of the wire hanger until it is straight.
4. Hold the coat hanger upside down and place the straightened-out hook into a coffee can filled with sand/rocks.
5. Using the spray bottle direct the mist towards the fog net. The water droplets should form on the netting of the panty hose and run down into the coffee can.

Directions adapted from the following link:
http://teachers.egfi-k12.org/lesson-water-from-fog/

Formative Assessment:
At the culmination of this stage, have students write down what they have learned about ways to clean water in the "L" section. Possible answers are as follows:

What ways can we clean water? (*By creating a solar still or a fog collector*)

SELECT THE MOST PROMISING SOLUTION

As a class have students decide which of the two possible design solutions will do the best job of desalinating the water for drinking purposes. Make sure students consider the region in which we live. This will make the creation of the solar still the obvious choice in Houston. (Use leading questions to guide students towards this choice, if needed).

Formative Assessment:
Have students justify their decision by drawing a diagram of their design choice and a justification for why it is better.

CONSTRUCT A PROTOTYPE

1. Divide the class into working groups of 2 - 3 students per group.
2. Explain the procedure to the class:
   STEP 1: Salty water will be put in the bowl.
   STEP 2: The cup will be placed in the middle of the bowl.
   STEP 3: Plastic wrap will be pulled tightly over the top of the bowl and secured with either a rubber band or tape.
   STEP 4: A rock or weight is put in the center of the plastic wrap above the cup so that the evaporated water will drip into the cup.
3. Pass out the materials.
4. Help students during the construction process.
5. Place the solar stills in full sun.
6. Write "evaporation" on the board. Lead a discussion on what evaporation is and when they have seen it occur.
7. Check the still's progress as often as you desire, in ½ hour increments.
8. Point out the small water droplets on the inside of the plastic wrap. Solar stills can be left out for several days, if desired.
9. Taste the water in the cup. Ask the students if it tastes differently than tap water *(yes)*. Why?
10. Lead a discussion on evaporation and desalination.

TEST AND EVALUATE PROTOTYPE

Formative Assessment: In a class discussion, have the students answer the following questions in developmentally appropriate language:

Why was a cup needed?
(*Students should explain that the cup collected a greater volume of water than using just the plastic lining.*)
What was the job of the rock?
(*Its weight allowed gravity to direct the collection into the glass better than just a flat sheet of plastic.*)

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COMMUNICATE THEIR DESIGN

The class will make a non-fiction big book titled, "How We Cleaned Salt Water with Solar Energy."

Materials:

- Large sheets of construction paper, at least 12 inches by 18 inches (one per pair of students)
- Large tag board for the cover
- Hole punch
- Brads or other type of fasteners

Directions:

1. If students are not familiar with big books, select a big book to read and show them.
2. Working with the class, create a cover and then one page for each of the steps for making the still. Be sure to use words associated with procedures, like "first," "next," etc.
3. Once you have written each step on a sheet, have pairs of students illustrate the step they have been assigned.
4. When students finish their illustrations, put the pages together to make a BIG book. Read the book as a class and reread as part of the class read aloud time as an example of a non-fiction text.
5. Have students take the book home to share what they did with others.

REDESIGN

Have students brain storm how they could change the design to make larger quantities of water at one time. Students may suggest using a bigger cup inside or a larger outside vessel, like a pot or a garbage can. This is a good time to talk about how different types and colors of materials are affected by heat. (*The point is to get students to think about heat's effect on different materials and to engage them in a scientific discussion.*)

MATH CONNECTION

1. Pair students into groups giving each group a clipboard with handout titled, "WAYS WE USE WATER AT SCHOOL" and a pencil for recording. Tour the school and have them list words or record pictures of all the ways water is used at school. Return to the classroom and discuss ways that were discovered.

2. Give each student a similar handout titled," WAYS I USE WATER AT HOME" attached to a copy of a letter to parents *(letter should request parent assistance with the task*). Explain to the students that they are to complete the list at home in the same manner they completed the list at school. The list is to be returned on the day specified. On the day the students return List #2, discuss the different ways students used water at home.

3. After conducting the research, have students answer the following questions about water use at home:
   "What is one way we use water for eating or drinking?"
   "What is one way we use water for cleaning?"
   "What is one way we use water to have fun?"

4. Make each topic the subject of a graph for three consecutive days. Have students share an answer to each question based on the data they collected. Let students paint or color the sections which represent one answer to the three questions.

Teacher Background Information:
You may want to play the following video to introduce graphing and surveying to students. The link is here:
http://www.turtlediary.com/grade-1-games/math-games/graph-and-tally.html

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