Survival Still

Grades: 9-12

Topic: Solar

Owner: Florida Solar Energy Center

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Survival Still

Student Objective:
The student:
- will be able to explain a simple way to desalinate water using solar energy
- will be able to explain capillary water in the soil and be able to explain how to construct a solar still to extract water from the soil.

Key Words:
capillary water
condensation
conduction
convection
desalinization
evaporation
radiation
solar still
thermal energy

Materials:
- sheet of thick, transparent flexible plastic at least 1 m square (1 per group)
- coffee can (1 per group)
- shovel (1 per group)
- rocks
- graduated cylinder

Time:
1 class period plus 20 minutes

Background Information:

Stills are commonly used to purify liquids. Through the process of distillation, non-volatile 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, then heat is removed from the vapor to condense it back to a liquid.

Soil always contains some moisture, but it is often in the form of capillary water. Capillarity is the force that exists between soil particles and water molecules. This force prevents all the water in the soil from draining down through the soil. The water that remains as a thin coating around the soil particles is known as capillary water.

A solar still allows this capillary water to be recovered and purified in the process. By creating a closed space with a transparent cover material, a greenhouse effect is produced which causes the temperature inside the space to rise. The trapped heat is absorbed by the soil and causes its moisture to vaporize. This vapor rises and condenses on the inside of the plastic where it then runs down and drips into the container of the still.

Procedure (prior to class):
1. Scout out your school for an area where you can build the solar still. The area must be in full sun, and you will need to be able to dig a hole (about 80 cm in diameter) there.

2. If you have a large class you may want to divide them up into two or three working groups, and let each group build their own still. Of course you will need to have materials available for each group and a place for them to dig their still.
3. Make sure there are a few fist sized rocks at each location for the groups to 'find'.

Procedure (during class):

1. Lead the class in a discussion of desalination and their results from the Solar Still investigation. Ask the class what capillary water is, and give them the definition and explanation if they are unsure of it.
2. Explain to the class that they will be using what they learned in the Solar Still investigation to design and construct a solar still that will remove the moisture from the soil and produce purified drinking water.
3. Tell the students that as of now they are stranded on a deserted island with no fresh water. They have to make a solar still to obtain drinking water to survive.
4. Show the students their materials that they 'found' on the island (a sheet of plastic, a coffee can and a shovel)--take them out to the approved area to build their stills, and wish them luck.
5. During the construction process, encourage them to brainstorm among themselves to figure out the solution. Try not to directly help them if at all possible.
6. Leave the solar stills overnight and check them during the next class period. Have the students measure the amount of water collected in the container. If no water has condensed, have the students figure out why, change their design, and check it during the next class period. Note: Common problems are not enough of a slope into the collecting container (it needs to be at least 35^{o}), too much air (and moisture) escaping around the edges of the plastic, or the weight is not right over the center of the collecting container.
7. After they have successfully built the solar still, have them complete their Science Journal.

Related Research:

1. How does the size and shape of an in-ground still affect the rate of water collection? Vary the depth and/or the width of the still and tabulate the results.
2. Would having living plants in your solar still system increase the amount of water collected? Compare the rate of water collection from equal areas of bare soil and soil covered with plants.
3. In many areas of the world, pure water is becoming very scarce. Research national and international plans and projects for obtaining pure water.
4. How much water is required for survival? How would you design a still that will provide enough water for yourself and a family of four?

Related Reading

- ***A Golden Thread: 2500 Years of Solar Architecture and Technology*** by Ken Butti & John Perlin (Cheshire Books, 1980)

A Golden Thread provides a historical perspective of the influence of solar energy on society throughout the ages. The book provides information relating to the scientific, societal and economic influences contributing to the development of solar technology, as well as explanations of how the various forms of solar technology function.

- ***How to Build a Solar Hot Water System*** by John Canivan (Sunny Future Press, 2002)
  Step by step procedures and explanations for building a simple solar hot water system.
- ***The Return of the Solar Cat*** by Jim Augustyn (Patty Paw Press, 2003)
  "A cat sunning itself in the doorway of a barn knows all about solar energy. Why can't man learn?" (E.B.White). The Return of the Solar Cat book decisively answers this question. Jim Augustyne takes the Suessian approach to showing the reader our myopia when it comes to the nature of renewable energy, politics, and economics through the fun-house mirror of technologically advanced felines and their 'natural' instincts and behavior which are optimized for solar utilization. Augustyne has developed an alternate universe of whimsy and pointy satire where kitties rule and our human foibles and blindness to the advantages of solar energy are entertainingly exposed

Internet Sites

http://www.desertusa.com/mag98/dec/stories/water.html

Desert USA's page detailing how to make a survival still in the desert.

http://www.ehow.com/how_12584_make-solar-still.html

How Things Get Done - How to make a solar still in the wilderness.

EnergyWhiz

Be an EnergyWhiz star! Submit pictures of your class' in ground solar still with a description of its size and building materials to **http://energywhiz.com/**. See your class on the internet!

Survival Still

Benchmark SC.A.1.4.3 - The student knows that a change from one phase of matter to another involves a gain or loss of energy.

Benchmark SC.B.1.4.1 - The student understands how knowledge of energy is fundamental to all the scientific disciplines.

Benchmark SC.B.1.4.2 - The student understands that there is conservation of mass and energy when matter is transformed.

Benchmark SC.B.1.4.3 - The student knows that temperature is a measure of the average translational kinetic energy of motion of the molecules in an object.

Benchmark SC.B.1.4.5 - The student knows that each source of energy presents advantages and disadvantages to its use in society.

Benchmark SC.D.1.4.1 - The student knows how climatic patterns on Earth result from an interplay of many factors.

Survival Still

capillary water - the thin film of water that coats the soil particles even in the driest soil

condensation - a reduction to a denser form as from steam to water

conduction - the movement of heat or cold through materials that are solid

convection - the movement of heat or cold through air or liquids

desalinization - process of removing salt and other chemicals and minerals from water

evaporation - process of changing a liquid into vapor

radiation - the way we receive heat from the sun each day. The energy is emitted in the form of waves/particles, and can move from one object to another without heating the area in between.

solar still - a device that uses solar energy to evaporate a liquid

thermal energy - energy that heats something

Survival Still

1. At what rate was the water removed from the soil and collected in the container?

2. What design problems did you encounter and what did you do to correct them?

3. Would you be able to collect capillary water in the desert? Why or why not?