

Rain Machine (Solar Still)

Student Objective

The student:

- will be able to explain a simple way to purify water using solar energy
- will understand the evaporation and condensation process, and relate it to the water cycle on Earth.

Key Words:

condensation
desalinization
evaporation
purify
solar still

Materials:

- bowl
- plastic cup, 1" shorter than sides of bowl or cut to size
- clear plastic food wrap
- tape or rubber band large enough to go around bowl
- small rock or weight
- Kool-Aid™ or other colored drink

Time:

1 hour

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.

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.

Procedure

1. At your discretion, the solar still can either be constructed prior to class and used for the demonstration or constructed during class time with student help/discussion, depending on the level of the class.
2. Lead the class in a discussion of pure and not pure water. Questions that might be asked:
 - Have you ever tasted salt water? Can we drink it?
 - Are we able to drink the water that comes from all lakes and rivers as it is? (*no*) Why not? (*pollution, run off, natural contaminants*)
 - How could we make this water drinkable? (*take the contaminants out of it, water treatment plants, water filters, etc.*)
2. Tell the class that they are going to experiment with a ‘solar still’, a simple way to use

evaporation to make salty or contaminated water drinkable.

3. Explain the procedure and the solar still to the class:
 - Kool-Aid™ will be put in the bowl
 - the cup will be placed in the middle of the bowl
 - plastic wrap will be pulled tightly over the top of the bowl and secured with either a rubber band or tape
 - a weight is put in the center of the plastic wrap above the cup so that the evaporated water will drip into the cup.



4. Place the solar still in full sun.
5. Lead a discussion on what evaporation is and when they have seen it occur (*after a rainstorm, clothes drying on a line, water 'disappearing' out of a birdbath, etc.*). Discuss the water cycle, how water evaporates, condenses in the clouds and falls back to the earth as rain. Point out that it is the energy from the sun that makes the water cycle work.
6. Check the still's progress as often as you desire, in ½ to 1 hour increments. Point out the small water droplets on the inside of the plastic wrap.
7. After some water has accumulated in the cup, remove the cup for observation and class discussion:
 - What color is the the water in the cup? (*no color*)
 - Let several volunteers taste the water in the cup. Do they taste the Kool-Aid™? (*no*)
 - Where is the Kool-Aid? (*in the bowl, it did not evaporate with the water*)
8. Lead a discussion of evaporation and desalination. Brainstorm with the students ways a solar still could be used.
9. Students should complete their Science Discovery page. Younger students may just color the diagram, older students should label the parts of the solar still energy system.

Further Activities

- Try the solar still with other liquids such as fruit juice, salty water, tea, soda, or any liquid of your choice.
- Will the solar still work better if the bottom is painted black? Use two stills that are identical except that one has the bottom painted black to see if there is a difference in the amount of purified water produced.
- Another demonstration of the invisible water vapor in the air can be done by putting a mirror in a zip type plastic bag and placing it in the refrigerator. When the mirror is

removed from the refrigerator and the bag, moisture appears on it. Where does the water come from?

Related Reading

- ***Down Comes the Rain (Let's-Read-and-Find-Out Science 2)*** by Franklyn Branley and James Hale
This book is a concise and informative look at the water cycle. Branley provides a fundamental understanding of how water is recycled, how clouds are formed, and why rain and hail occur. A few easy science activities are included.
- ***The Magic School Bus Wet All Over: A Book About The Water Cycle*** by Pat Relf and Carolyn Bracken
Experience the earth's water cycle first hand as Ms. Frizzle's class rises into the air, forms a rain cloud and drizzles down upon earth, just like rain! It discusses evaporation, condensation, and precipitation and how they all work together to create the continuous water cycle.

Internet Sites

<http://www.swfwmd.state.fl.us/infoed/sprinkles/SprinklesWEB.pdf>

Southwest Florida Water Management District's downloadable water cycle activity book for K-2

EnergyWhiz

View a video clip of the Rain Machine experiment on the EnergyWhiz website:

<http://energywhiz.com/>

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			.1	.2	.3	.4	.5
Nature of Matter	Standard 1	SC.A.1.1-		X	X		
	Standard 2	SC.A.2.1-					
Energy	Standard 1	SC.B.1.1-	X		X	X	
	Standard 2	SC.B.2.1-	X				
Nature of Science	Standard 1	SC.H.1.1-	X				
	Standard 2	SC.H.2.1-					
	Standard 3	SC.H.3.1-					

Benchmark SC.A.1.1.2 - The student recognizes that the same material can exist in different states.

Grade Level Expectations

The student:

Kindergarten

- knows that matter exists in different states

First

- knows the effects of heating and cooling on solids, liquids and gases

Second

- knows examples of solids, liquids, and gases
- knows the observable properties of solids, liquids, and gases.

Benchmark SC.A.1.1.3 -The student verifies that things can be done to materials to change some of their physical properties but not all materials respond the same way.

Grade Level Expectations

The student:

First

- knows the physical properties of ice, water and steam.

Benchmark SC.B.1.1.1 - The student knows that the Sun supplies heat and light energy to Earth.

Grade Level Expectations

The student:

First

- knows that heat from the Sun has varying effects depending on the surface it strikes.

Benchmark SC.B.1.1.3 - The student describes a model energy system.

Grade Level Expectations

The student:

First

- understands that models can be used to observe processes and changes over time

Second

- understands that models can be used to illustrate how energy flows through a system.

Benchmark SC.B.1.1.4 - The student knows that heat can be produced in many ways.

Grade Level Expectations

The student:

Second

- knows different heat sources.

Benchmark SC.B.2.1.1 - The student recognizes systems of matter and energy.

Grade Level Expectations

The student:

Second

- understands ways energy and matter interact.

Benchmark SC.H.1.1.1 -The student knows that in order to learn, it is important to observe the same things often and compare them.

Grade Level Expectations

The student:

Kindergarten

- knows that learning can come from careful observations.

Rain Machine (Solar Still)

condensation - a reduction to a denser form of matter such as from steam to water

desalinization - process of removing salt and other chemicals and minerals from a liquid

evaporation - process of changing a liquid into vapor

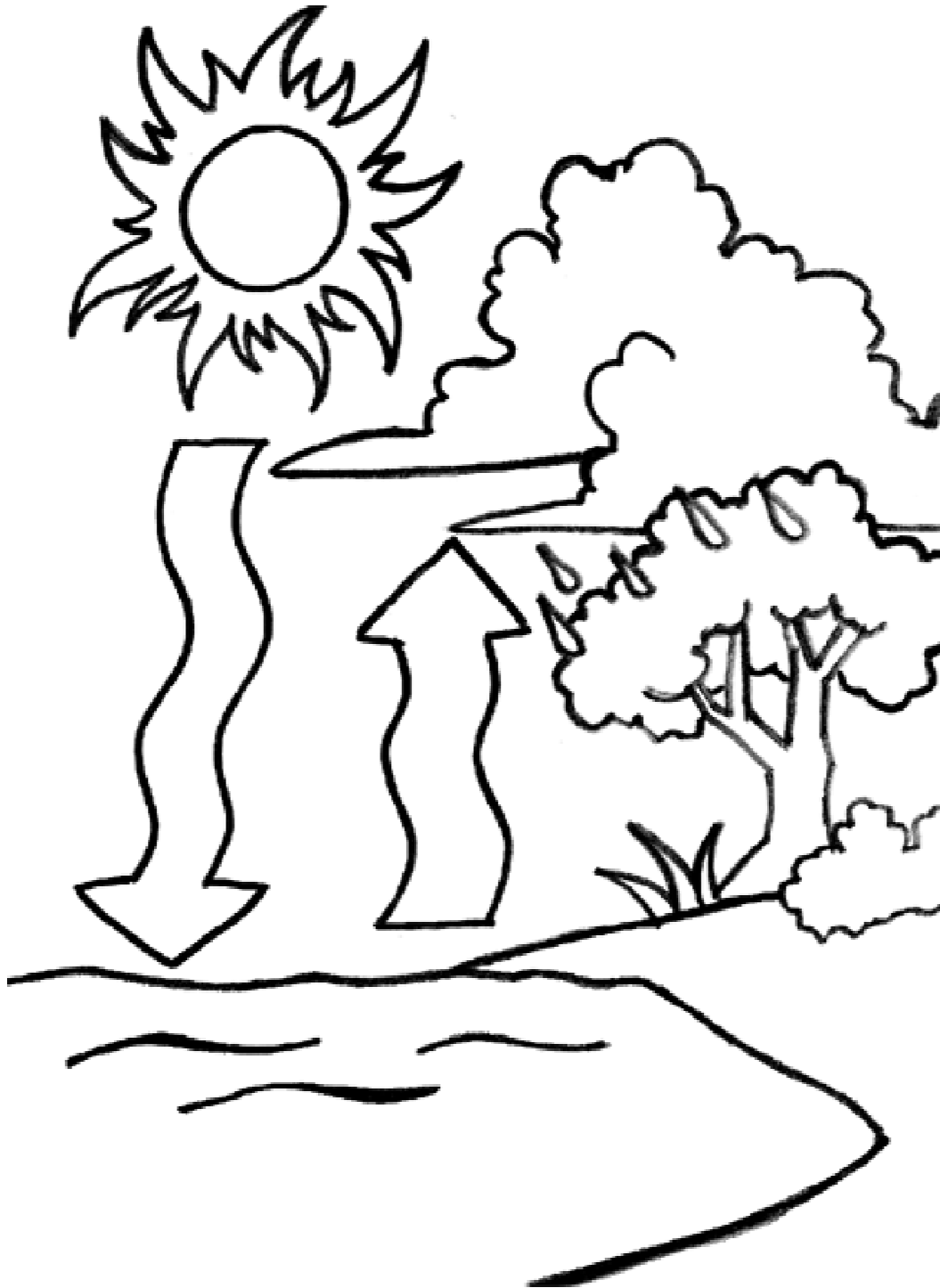
purify - to remove undesirable elements or impurities

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

Rain Machine (Solar Still)



Our Solar Still collected pure water using the Sun's energy.



The Earth's Water Cycle

Label these things:

Sun

cloud

rain

lake