

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.

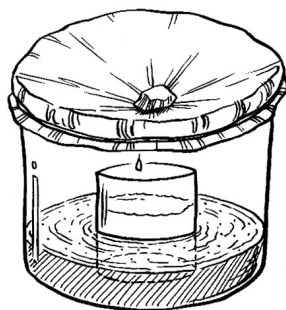
A solar still uses the greenhouse effect to trap energy from the sun. The solar still is a model of the water cycle on earth: evaporation, condensation, precipitation.

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.

Key Words and Definitions

- **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

Further Activities

1. Try the solar still with other liquids such as fruit juice, salty water, tea, soda, or any liquid of your choice.
2. 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.
3. 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

- ***A Drop Around the World*** by Barbara McKinney (Dawn Pubns, 1998)
This book engagingly leads readers around the world following a drop of water—whether as steam or snow, inside a plant or animal, or underground—teaching the wonders and importance of the water cycle.
- ***All the Water in the World*** by George Ella Lyon (Atheneum/Richard Jackson Books, 2011)
This book explains the water cycle with poetic language and wonderful illustrations.
- ***Down Comes the Rain (Let's-Read-and-Find-Out Science 2)*** by Franklyn Branley and James Hale (HarperCollins, 1997)
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 Snowflake: A Water Cycle Story*** by Neil Waldman (21st Century, 2003)
A beautiful take on the water cycle. The water begins as a snowflake that melts into a droplet, flows into the ground, bubbles up in a spring, flows into a farm's irrigation system, evaporates into the morning fog, becomes part of a cloud, rains down, enters a plumbing system, washes a little girl's face, flows out to the ocean, gets swept onto the shore and evaporates into the sky to become a snowflake once more.
- ***Water Dance*** by Thomas Locker (HMH Books for Young Readers, 2002)
Using poetry and stunning paintings (done by the author), this book shows water in various forms and artistically explains the water cycle.

Internet Sites

<http://www.swfwmd.state.fl.us/publications/files/sprinkles2.pdf>

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

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Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6
Grade K								
The Practice of Science	Big Idea 1	SC.K.N.1		X				
Grade 1								
The Practice of Science	Big Idea 1	SC.1.N.1	X					
Earth in Space and Time	Big Idea 5	SC.1.E.5				X		
Earth Structures	Big Idea 6	SC.1.E.6		X				
Grade 2								
The Practice of Science	Big Idea 1	SC.2.N.1	X					
Earth Systems and Patterns	Big Idea 7	SC.2.E.7			X			
Language Arts Standards	Kindergarten: LAFS.K.W.3.7, LAFS.K.W.3.8, LAFS.K.SL.1.1, LAFS.K.SL.1.3, LAFS.K.SL.2.5 First Grade: LAFS.1.W.3.7, LAFS.1.W.3.8, LAFS.1.SL.1.1, LAFS.1.SL.2.4 Second Grade: LAFS.2.W.3.8, LAFS.2.SL.1.1							

Kindergarten Benchmarks

Science--Big Idea 1: The Practice of Science

- SC.K.N.1.2 - Make observations of the natural world and know that they are descriptors collected using the five senses.

Language Arts--Writing Standards

- LAFS.K.W.3.7 - Participate in shared research and writing projects.
- LAFS.K.W.3.8 - With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Language Arts--Standards for Speaking and Listening

- LAFS.K.SL.1.1 - Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
- LAFS.K.SL.1.3 - Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- LAFS.K.SL.2.5 - Add drawings or other visual displays to descriptions as desired to provide additional detail.

First Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.1.N.1.1 - Raise questions about the natural world, investigate them in teams through free exploration, and generate appropriate explanations based on those explorations.

Science–Big Idea 5: Earth in Space and Time

- SC.1.E.5.4 - Identify the beneficial and harmful properties of the Sun.

Science–Big Idea 6: Earth Structures

- SC.1.E.6.2 - Describe the need for water.

Language Arts–Writing Standards

- LAFS.1.W.3.7 - Participate in shared research and writing projects.
- LAFS.1.W.3.8 - With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Language Arts–Standards for Speaking and Listening

- LAFS.1.SL.1.1 - Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.
- LAFS.1.SL.2.4 - Describe people, places, things and events with relevant details, expressing ideas and feelings clearly.

Second Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.2.N.1.1 - Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.

Science–Big Idea 7: Earth Systems and Patterns

- SC.2.E.7.3 - Investigate, observe and describe how water left in an open container disappears (evaporates), but water in a closed container does not disappear (evaporate).

Language Arts–Writing Standards

- LAFS.2.W.3.8 - Recall information from experiences or gather information from provided sources to answer a question.

Language Arts–Standards for Speaking and Listening

- LAFS.2.SL.1.1 - Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

National Next Generation Science

Kindergarten Standards

Science–Energy

- K-PS3-1 - Make observations to determine the effect of sunlight on Earth’s surface.

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

First Grade Standards

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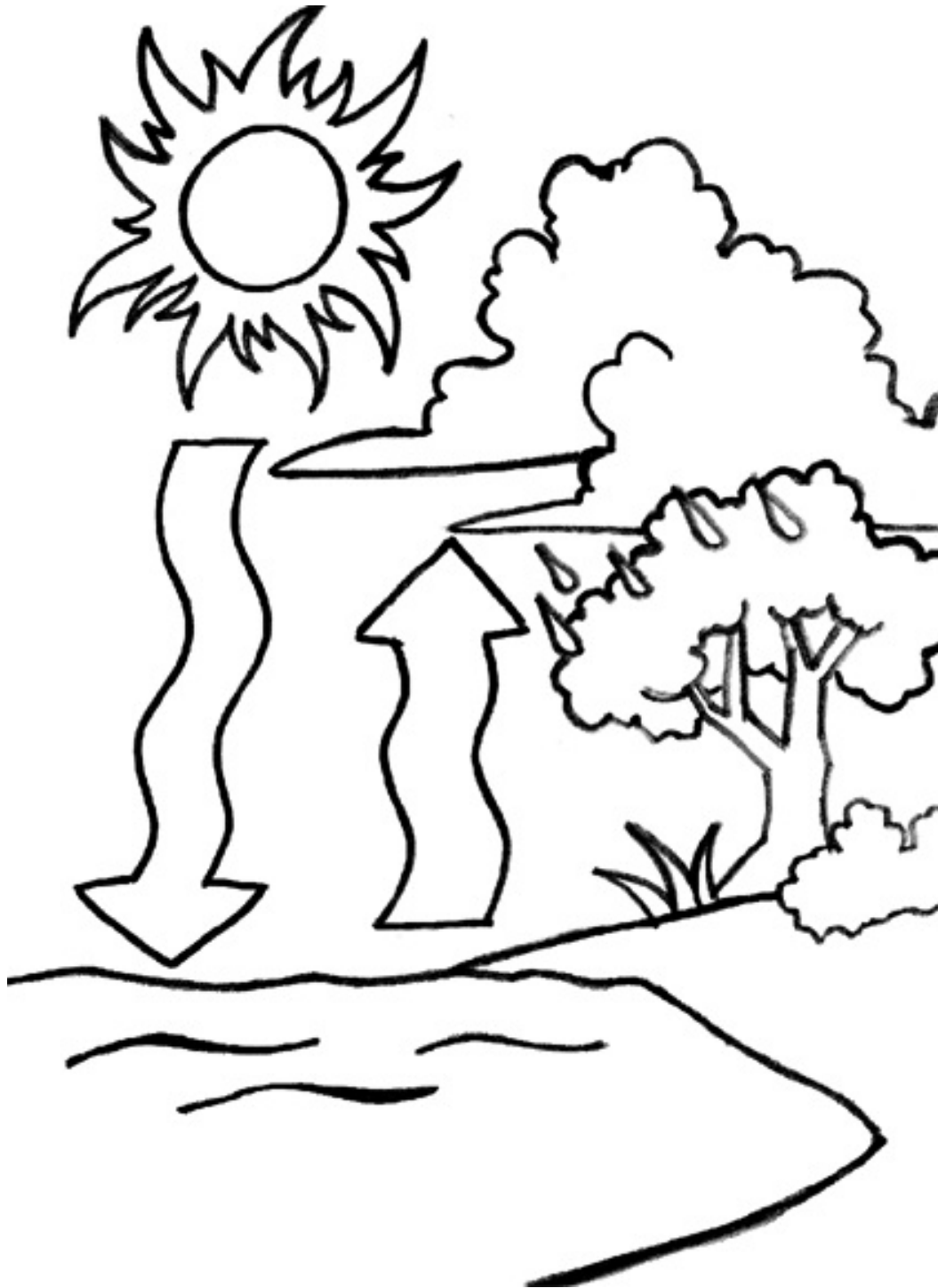
Second Grade Standards

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

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



The Earth's Water Cycle

Label these things:

Sun

cloud

rain

lake