

## Solar Still 2

### Student Objective

The student:

- will be able to explain a simple way to desalinate water using solar energy
- will be able to explain why desalination of water is important for the future.

### Key Words:

condensation  
desalinization  
evaporation  
purify  
solar still

### Materials:

- 2 liter bottle clear (1 per group)
- 2 liter bottle with outside painted black (1 per group)
- ½” clear plastic tubing (1 foot per group)
- duct tape
- salt
- water
- bowls or containers for mixing
- spoons
- funnel (1 for every 3 or 4 groups)

### Time:

1 hour to build still and discuss

### Background Information

Over the last 50 years in seaside population centers where drinking water is scarce, desalination plants have been built that turn salt water into fresh water. Currently in Florida, roughly 180 desalinization plants purify brackish water (a mixture of salt water and fresh water). At present no desalination plants that purify sea water are operating in the state, but there are plans to build some in the future.

The traditional way to purify salt water is through **distillation**—heating the water until it turns into steam and then collecting the steam in a separate container. The problem with this method is the large amount of energy required to produce small amounts of purified water.

Another way of desalination is through **reverse osmosis**. In reverse osmosis salt water is pushed through a membrane under high pressure. The membrane allows the water but not the salt to pass through it, resulting in purified water on one side and brine on the other.

The drawbacks to desalination include the high cost of the energy needed to operate the plants and the safe disposal of the brine. These factors have made researchers find new ways to desalinate water with greater energy efficiency and to dilute the brine and return it safely to the ocean so that it doesn't harm marine life.

### **Procedure (prior to class)**

1. Paint the outside of half of the bottles black.
2. Make a model of the solar still that the students can refer to during the construction process.

### **Procedure (during class)**

1. Lead the class in a discussion of desalination. Ask the class to describe what happened during the Rain Machine investigation.
2. Tell the class that they are going to experiment with another solar still design.
3. Show them the model of the still they are going to make. Explain that salty water will be put into the black bottle and then the still will be put in the sun. Ask them what they think will happen. Some points to cover:
  - Why is the bottle with the salt water painted black? (*Because it will absorb more solar radiation—remember the Solar Energy and Color Investigation!*)
  - Where do they think the drinkable water will end up?
4. Explain the construction process:
  - mix 1 Tablespoon salt in one quart of water
  - pour the salt water into black painted bottle using a funnel
  - with duct tape, attach one end of the tubing to the black bottle and the other end of the tubing to the clear bottle—seal tightly.
5. Pass out the materials.
6. Help students during the construction process.
7. Place the solar stills outside or in a sunny windowsill. The black bottle should be slightly elevated (place on a board or a book). Leave for a day (outside), or several days (inside on a windowsill).

### **Procedure (follow-up day)**

1. Have the students observe their bottles. They should taste a drop or two of the water in the clear bottle to verify that it is not salty.
2. Have the students complete their Science Journal.
3. Discuss the investigation and the results with the class. Were they surprised that the water ‘moved’ from the black bottle to the clear. Make sure that they understand that evaporation and distillation were involved in the process. Compare the apparatus and process in this investigation with the Rain Machine investigation.
4. Lead a discussion with the class about drinking water and desalination. Points to cover are:
  - We have only so much drinking water available naturally from our rivers and springs
  - Our population is growing and our water consumption is growing
  - We waste a lot of water for non-drinking and non-cooking purposes
  - The majority of the water on the planet is salt water and undrinkable for humans.
5. Ask the students what they think should be done about this problem.

### Further Research

1. What kind of desalinization plants are in use in the state of Florida? Are there any in your community?
2. How could solar stills be used in refugee camps? In hurricane relief efforts?
3. How could you use a solar still if you were stranded on an island (like Robinson Crusoe)? What kind of materials might you use to make your still?

### 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.
- ***Hydro's Adventure Through the Water Cycle*** by Randi Goodrich and Michael Goodrich  
This book tells the story of Hydro, a wise and whimsical water molecule who travels through a never-ending water cycle crisscrossing the skies, sliding down mountains, and evaporating into a cloudy mist. Deftly embedded within the text of a charmingly told tale is basic information on how the earth's water cycle works; who is affected by the earth's water cycle; and the challenges that confront the water cycle.

### Internet Sites

**[http://www.atmos.washington.edu/k12/pilot/water\\_cycle/index.html](http://www.atmos.washington.edu/k12/pilot/water_cycle/index.html)**

Water: A Never-Ending Story. Student friendly information on the water cycle

**<http://kids.earth.nasa.gov/droplet.html>**

NASA kids site. Droplet and the Water Cycle game—get Droplet safely from the forest out to the sea where the Sun can warm him and help him get back to the clouds.

**<http://www.swfwmd.state.fl.us/education/splash/>**

Splash: Water Resources Education by the Southwest Florida Water Management District includes lesson plans, fact pages and a game.

### EnergyWhiz

Draw a solar still that could be used by your family to make drinking water after a hurricane. Submit your design to the EnergyWhiz website at **<http://energywhiz.com/>** . If we publish your design we will send you an EnergyWhiz t-shirt!

## Solar Still 2

			.1	.2	.3	.4	.5	.6
Energy	Standard 1	SC.B.1.2-	X	X	X	X		X
	Standard 2	SC.B.2.2-						
Processes that Shape the Earth	Standard 1	SC.D.1.2-			X			
	Standard 2	SC.D.2.2-						
Earth and Space	Standard 1	SC.E.1.2-			X			
	Standard 2	SC.E.2.2-						
Nature of Science	Standard 1	SC.H.1.2-						
	Standard 2	SC.H.2.2-						
	Standard 3	SC.H.3.2-	X					

**Benchmark SC.B.1.2.1** - The student knows how to trace the flow of energy in a system.

**Grade Level Expectations**

The student:

*Fourth*

- knows how to trace the flow of energy in a system

*Fifth*

- knows how to trace the flow of energy in a system.

**Benchmark SC.B.1.2.2** -The student recognizes various forms of energy.

**Grade Level Expectations**

The student:

*Third*

- knows objects that emit heat and light
- knows different forms of energy.

**Benchmark SC.B.1.2.3** - The student knows that most things that emit light also emit heat.

**Grade Level Expectations**

The student:

*Third*

- knows that the Sun provides energy for the Earth in the form of heat and light.

**Benchmark SC.B.1.2.4** - The student knows the many ways in which energy can be transformed

from one type to another.

**Grade Level Expectations**

The student:

*Fourth*

- knows ways that energy can be transformed.

**Benchmark SC.B.1.2.6** - The student knows ways that heat can move from one object to another.

**Grade Level Expectations**

The student:

*Fifth*

- understands that convection, radiation, and conduction are methods of heat transfer.

**Benchmark SC.D.1.2.3** - The student knows that the water cycle is influenced by temperature, pressure, and the topography of the land.

**Grade Level Expectations**

The student:

*Third*

- understands the stages of the water cycle

*Fourth*

- understands how the water cycle is influenced by temperature and land features.

**Benchmark SC.E.1.2.3** - The student knows that the Sun is a star and that its energy can be captured or concentrated to generate heat and light for work on Earth.

**Grade Level Expectations**

The student:

*Fourth*

- knows how the energy of the Sun can be captured as a source of heat and light on Earth.

**Benchmark SC.H.3.2.1** - The student understands that people, alone or in groups, invent new tools to solve problems and do work that affects aspects of life outside of science.

**Grade Level Expectations**

The student:

*Fifth*

- knows areas in which technology has improved human lives
- knows that new inventions often lead to other new inventions and ways of doing things.

### Solar Still 2

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

**desalinization** - process of removing salt and other chemicals and minerals in water

**evaporation** - process of changing into vapor

**purify** - to remove undesirable elements or impurities

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

Solar Still 2

1. Draw a diagram of your desalination plant below and label its parts.

2. Where did the water in the clear bottle come from? \_\_\_\_\_

\_\_\_\_\_

3. How did the water get from one bottle to another? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4. Do you think that this kind of desalination plant could be used to make drinking water for a whole city? \_\_\_\_\_ Why or why not?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_