

# Desalination

More than 70% of the Earth's surface is covered by water. Yet some cities and even countries do not always have enough fresh water to drink. How can this be? The answer is that most of the Earth's water is undrinkable because it contains high concentrations of salts and other minerals. Water's saltiness is referred to as its *salinity*. Ocean water has such a high salinity that we would actually become sick and dehydrated by drinking it. To make ocean water drinkable, the salts and minerals must be removed through a process called *desalination*.

One method of desalination is called *distillation*. Distillation involves heating the salty water so that it vaporizes. As the water vaporizes, it leaves the salt and other minerals behind. The water vapor is then cooled and condensed back into liquid water that is now much purer than it was before. This process is expensive because it requires a lot of energy to heat the water, but for some communities, clean water is worth the price.

In this experiment, you will first use a Conductivity Probe to measure the salinity of a sample of saltwater. You will distill the sample water by heating it and collecting the condensed vapor. The salinity of the condensed vapor will then be measured to determine the amount of salt removed.

## OBJECTIVES

In this experiment, you will

- Use a Conductivity Probe to measure the salinity of water before and after desalination.
- Distill saltwater.
- Calculate the percent of salts removed from the sample.

## MATERIALS

computer  
Vernier computer interface  
LoggerPro  
Conductivity Probe  
125 mL Erlenmeyer flask  
rubber stopper with tubing

test tube  
600 mL beaker  
hot plate  
saltwater  
ice

## PROCEDURE

1. Obtain and wear goggles. **CAUTION:** *Handle hot water, steam, and hot equipment with care throughout the experiment.*
2. Connect the Conductivity Probe to the Vernier computer interface. The switch on the Conductivity Probe should be on the 0–20000  $\mu\text{S}/\text{cm}$  setting.
3. Prepare the computer for data collection by opening the file "18 Desalination" in the *Earth Science with Vernier* folder.

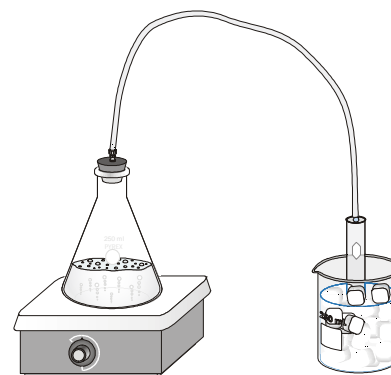


Figure 1

## Computer 18

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4. Add approximately 100 mL of saltwater and a few boiling chips to the Erlenmeyer flask.
5. Place the Conductivity Probe into the flask and monitor the salinity value on the screen. Once the reading has stabilized, record it in the data table.
6. Assemble the apparatus as shown in Figure 1.
  - a. Insert the rubber stopper and tubing assembly into the Erlenmeyer flask.
  - b. Locate the mark on the side of the test tube. This mark indicates the level of water you will need to collect so that the Conductivity Probe will be able to properly measure the salinity. It is helpful to locate it now, before the test tube goes in the ice-water bath.
  - c. While holding the test tube upright in the center of the beaker, gently fill the beaker to the top with ice. Add cold tap water to the ice in the beaker, creating an ice-water bath around the test tube. The test tube may want to float up a little. This is fine as long as no ice water gets into the test tube.
  - d. Place the Erlenmeyer flask on the hot plate.
  - e. Place the loose end of the tubing about halfway down into the test tube. It should be far enough into the test tube so that it won't come out, but it should stay above the mark.
7. Turn on the hot plate. **CAUTION:** *The flask, tubing, and top of the test tube will become very hot. Do not touch them!* As the water in the flask heats up, it will vaporize and rise into the tubing. As it moves through the tubing it will cool, condense back into liquid, and drip into the test tube. The water collected in the test tube is the desalinated water.
8. Monitor the level of the water being collected in the test tube. When it reaches the mark, turn off the hot plate and let the entire apparatus cool for a few minutes. **CAUTION:** *Do not proceed until all equipment is cool to the touch.*
9. Measure the salinity of the desalinated water. Note: The water in the test tube should be at or near room temperature when the salinity is measured.
  - a. Remove the loose end of the tubing from the test tube.
  - b. Remove the test tube from the ice water and have one student hold onto it.
  - c. Pour the ice water down the sink and refill the beaker about half-full with tap water.
  - d. Place the test tube back into the beaker with the tap water and let it sit for a few minutes to allow it to warm near room temperature.
  - e. Place the Conductivity Probe into the test tube. The water should be completely covering the hole at the end of the probe. Monitor the salinity value on the screen. Once the reading has stabilized, record it in the data table. Note: If the reading is bouncing between two numbers but is no longer drifting up or down, record the average of the two numbers in the data table.

## DATA

	Water Before Desalination	Water After Desalination
Salinity (ppt)		

## **PROCESSING THE DATA**

1. Did the process of desalination decrease the amount of salt in the water?
2. Calculate the percent of salt that the desalination process removed. Show your work. Use the equation

$$\text{Percent salt removed} = \frac{\text{salinity before} - \text{salinity after}}{\text{salinity before}} \times 100$$

3. If this process could be used to convert abundant ocean water into precious drinking water, why do you think it is not being done more frequently?

## **EXTENSIONS**

1. Design and conduct (with your teacher's permission) an experiment to test whether distilling the water a second time will decrease the salinity even more.
2. Research other methods of desalination.

# Vernier Lab Safety Instructions Disclaimer

**THIS IS AN EVALUATION COPY OF THE VERNIER STUDENT LAB.**

**This copy does not include:**

- **Safety information**
- **Essential instructor background information**
- **Directions for preparing solutions**
- **Important tips for successfully doing these labs**

The complete *Earth Science with Vernier* lab manual includes 33 labs, 6 projects, and essential teacher information. The full lab book is available for purchase at:

<http://www.vernier.com/cmat/esv.html>



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