Name: ____ Per______

Mini Desalination Plant Activity

Given the following materials, design an apparatus for which you can use to separate salt and water from a salt-water mixture. The purity of your water will be tested, so make sure that you design an apparatus in which you capture the pure water. **In addition, your goal is get the maximum amount of pure water.**

Materials Provided:

- 100 mL of salt water mixture
- 250 mL beaker
- 100 mL beaker
- (2) watch glasses
- (4) small square glass pieces
- hot plate

Objective: In your own words write the purpose of this experiment/activity. Why are you doing this experiment/activity, and what are you trying to test?

Procedure: Write simple and clear step-by-step instructions that someone can use to repeat this experiment. Be specific and make sure to include the names of the materials that you will be using.

Diagram of Experimental Set-up: Clearly label all parts in your diagram.

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Results: Record your results

Trial	Amount of salt water	Set-up (describe what you did differently from the original procedure)	Water purity (yes or no)	Amount of Pure water	Any additional comments (What will you do differently for the next trial?
1					
2					
3					
4					

Conclusion: Write 1-2 sentences summarizing your results and what they mean. (The following sentence frame can be used to help write a conclusion.

We can conclude ____________________________ because of _____________________________.
claim data

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Additional Questions: Answer each of the following questions.

1. Now that you have run multiple trials, what adjustments/improvements would you make to your design? Are there any additional materials that you wish you could have had access to?

2. *Opinion*: Did you like this activity? Explain why or why not?

Answer the following questions after reading ***Tapping Saltwater for a Thirsty World***

3. How long can a person live without water?

4. By 2025 what percentage of the world's population is estimated to have access to clean water?

5. What is desalination?

6. How many desalination plants are their worldwide, and how much of the total water supply do they contribute to?

7. What is reverse osmosis? And how is it different than how other desalination plants work?

8. List at least two pro's of a desalination plant?

9. List at least two con's of a desalination plant?

10. Is there any part of a desalination plant that is similar to what you did in your experiment? Explain.

11. Would you support the production of more desalination plants? Why or why not?

Tapping Saltwater for a Thirsty World

By Melissa Stewart

Water, water, everywhere,

And all the boards did shrink;

Water, water, everywhere,

Nor any drop to drink.

These famous words come from "The Rime of the Ancient Mariner," an epic poem written by Samuel Taylor Coleridge in the late 1700s. Nearly dying of thirst on a storm-damaged vessel, the sailor in the poem refused to drink the ocean water all around him. He knew the salty seawater would kill him more quickly than not drinking anything at all.

Our bodies are, by mass, between 55 and 65% water. If we lose just 2% of that fluid, we will feel extremely thirsty. And if we lose 20%, we will die. That's why it's so important to drink plenty of water every day. A person deprived of water can live for only 2–14 days, depending on the conditions.

Why is water so important? It helps our cells, tissues, and organs do their jobs. The fluid in our bodies helps digest food and circulate blood. Dissolved ions, or electrolytes, in the fluid regulate osmosis—the flow of materials in and out of our cells.

Most of the time, water flows across cell membranes from areas where electrolyte concentrations are low to areas where electrolyte concentrations are high. As a result, the concentrations of sodium (Na^+), chloride (Cl^-), potassium (K^+), and other ions determine the size and shape of cells. If too much fluid moves into a cell, it will expand and eventually burst. If too much liquid flows out of a cell, it will shrink and eventually shrivel up. Cells with too much or too little water cannot function properly.

Like our body fluids, ocean water contains dissolved ions. If you've ever swallowed a bit of seawater, you've tasted these salty particles. The salt in seawater is very similar to the salt you sprinkle on French fries. It consists mostly of sodium chloride, existing as positively charged sodium ions and negatively charged chloride ions. Depending on the location, seawater may also contain smaller amounts of 53 other ions.

When a person drinks too much seawater, the dissolved ions disrupt the normal balance of electrolytes in his or her body fluids. Because too many electrolytes suddenly flood the fluid outside cells, large amounts of water flow out of the cells. If a person's brain cells dehydrate too much, they will collapse, and the person will experience seizures, coma, and finally death.

See for Yourself

You will need:

A 1-L graduated beaker filled to the liter mark with water;
10, 25, and 50-mL graduated cylinders;
Three smaller beakers;
A dropper;
A piece of wax paper;
Measuring spoons;
Table salt (sodium chloride).

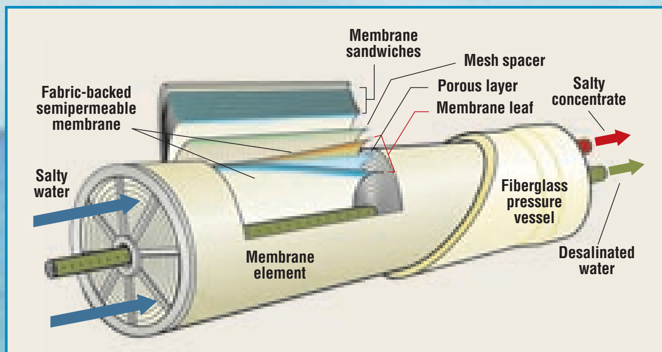
Imagine that the water in the 1-L beaker represents all the water on Earth.

1. Pour 28 mL of water from the 1-L beaker into a smaller beaker, labeled "A".

How many drops to drink?

In the modern world, very few people get lost at sea. But although three-quarters of Earth's surface is covered with water, 97 percent of it is too salty to drink. Another 2.5 percent is either frozen or too far below ground to reach, leaving just 0.5 percent of Earth's water for drinking, washing, flushing toilets, and watering crops.

In the past 50 years, the human population has skyrocketed to more than 6 billion. The United Nations estimates that by 2050, 9 billion people will have to share our planet's limited resources. The International Water Management Institute predicts that by 2025 only about one-quarter of the world's people will have enough clean, fresh water.



Reverse-osmosis systems are frequently spiral wound. Each membrane leaf contains a water-collecting porous layer sandwiched between two fabric-backed semipermeable membranes. Individual membrane leaves are separated from each other by a porous mesh spacer through which high-pressure saline water is passed. Purified water separates from the saline solution and passes through the membranes into the sandwich's central layer, which conducts the water spirally to the central perforated collection tube. Briny concentrate is collected in a separate tube.

What's the solution to the water dilemma? People all over the world must learn to use water more wisely and, at the same time, look for new sources of water. In the United States, many of the communities at greatest risk are located in coastal states. As a result, the ocean seems like an obvious potential source of water. But there's one major problem with this idea. Before seawater can pass human lips, the salt must be removed.

From deadly to drinkable

The process of removing salt from ocean water is called desalination. There are currently about 11,000 desalination plants in operation worldwide. But they provide less than 0.2% of the total global water supply.

About two-thirds of the world's desalination plants are located in the Middle East. Most of these facilities take advantage of distillation—a technique that imitates the natural water cycle to separate the salt from the water. During distillation, seawater is heated until the water molecules evaporate, leaving the dissolved salts behind. Next, the water vapor is trapped and cooled until the gas condenses, or returns to its liquid state. The pure water flows into a large collection tank. From there, it is piped to homes and businesses as needed.

Distillation is a good solution for water-poor, oil-rich Middle Eastern nations, but the high cost of heating the water makes the process less attractive in other parts of the world. On the island of Majorca, off the east coast of Spain, one of the largest desalination plants in Europe meets drinking water demands by using a process known as reverse osmosis.

After removing large solids from the seawater, the salty water is pressed against a series of thin membranes. The membranes have tiny holes that allow water molecules, but not salt particles, to flow through them. The final result is drinkable freshwater. The process is called reverse osmosis because pressure forces the water to flow from an area where the concentration of ions is higher to an area when the concentration is lower.

In the past, the membranes used during reverse osmosis were extremely expensive and wore out quickly. In addition, they caught only about 85% of the salt. But recently, scientists have developed sturdier membranes that last three times longer and cost 20% less than older models. The new membranes also filter out nearly all of the salt.

These improvements have led many American communities to take a serious look at how desalination technology may help solve their water problems. In Florida, the Tampa Bay Water Authority is currently constructing the largest desalinated seawater facility in North America. When the plant is completed in December 2002, it will be able to process 25 million gallons of ocean water per day—about 10% of the daily volume for the region.

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2. Dissolve 1 tablespoon of salt (sodium chloride) into the water in the large beaker. This now represents the saltwater in the Earth's oceans—unfit for drinking.

The water in the small beaker A represents all the Earth's freshwater.

3. Pour 6.5 mL of water from Beaker A into another beaker labeled "B".

Now the water in Beaker A represents inaccessible freshwater tied up in glaciers and polar ice caps. You can make this more dramatic by placing Beaker A into a freezer, turning its contents into ice.

The water in Beaker B represents the remaining freshwater.

4. Pour 3.4 mL of water from Beaker B into another small beaker, labeled "C".

Now the water remaining in Beaker B represents inaccessible groundwater.

The water in Beaker C represents the entire supply of freshwater on Earth. But much of this accessible freshwater is either polluted or otherwise unavailable for use.

5. Finally, use the dropper to remove 5 drops of water from Beaker C and place them on the piece of wax paper.

These five drops are a reasonable estimate of how much drinkable water is actually available from the original 1 liter of water you started with!