STEM Sims™

Desalination

ATHENA
Educational Products

Desalination

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Try out one of our ideas or make one of your own.

Start learning right now learning about how to turn salt water into fresh drinking water. Take the following brief quiz to see how much you already know about the desalination process. See the bottom of page 4 to check your answers.

1. How do birds like pelicans desalinate their own drinking water?
   a. They sift the salt out of the water through the tiny crevice between the beaks.
   b. They drink the saltwater, the salt is absorbed in a gland, and they sneeze the brine out.
   c. They gurgle the water in their throat pouch (the gullet) and their tongue catches the salt.
   d. They have microorganisms that live in their gullets that absorb the salt.

2. Which of the following is **NOT** a desalination process?
   a. distillation
   b. electrodialysis
   c. chlorination
   d. reverse osmosis

3. Which water treatment option uses the most energy?
   a. seawater desalination
   b. brackish water desalination
   c. recycled water (membrane treatment)
   d. recycled water (tertiary treatment)

4. Which famous philosopher is often credited as the frst to use solar power to desalinate water?
   a. Plato
   b. Aristotle
   c. Confucius
   d. Lao Tzu

5. In the mid nineteenth century, an American engineer from which industry invented the multiple-effect distillation that led to many advances in desalination?
   a. shipbuilding industry
   b. steel industry
   c. sporting goods industry
   d. sugar industry

A Magic Trick: I Will Now Make This Salt Disappear

While human engineers have been developing numerous techniques for desalination for centuries, nature had already devised its own method, known as the water cycle. During the daytime, the temperature of bodies of water rise due to the Sun. At the surface of these bodies of water, water molecules evaporate into the atmosphere and rise high up in the air, becoming water vapor. The water vapor in the sky then condenses to form clouds as the temperatures cool. Eventually the water vapor becomes heavier than the surrounding air currents, and it falls back down to the earth as precipitation. How might this model help us remove the salt from saltwater to get fresh drinking water? Let's find out!

Supplies Needed:

- one tablespoon of table salt
- two cups of water
- one large mixing bowl
- two drinking glasses
- a spoon
- a large rubber band
- plastic wrap
- any light paperweight or stone
- a sunny day

Instructions:

1. Pour the salt and the two cups of water into one of the glasses.
2. Stir the mixture with the spoon until the salt is completely dissolved.
3. Place your second (completely dry and clean) glass in the center of your large bowl.
4. Pour your solution of the salt and water into the bowl (not in the glass) so that it surrounds the glass.
5. Tightly stretch and cover the bowl with the plastic wrap.
6. Stretch the rubber band around the plastic wrap to hold it tight to the bowl.
7. Place your weight directly above the center of the glass on the plastic wrap so that it creates a small indent.
8. Very carefully move your experiment to a very sunny area where you can leave it for a couple of hours.
9. After two hours, return to your experiment and record your observations.

Questions:

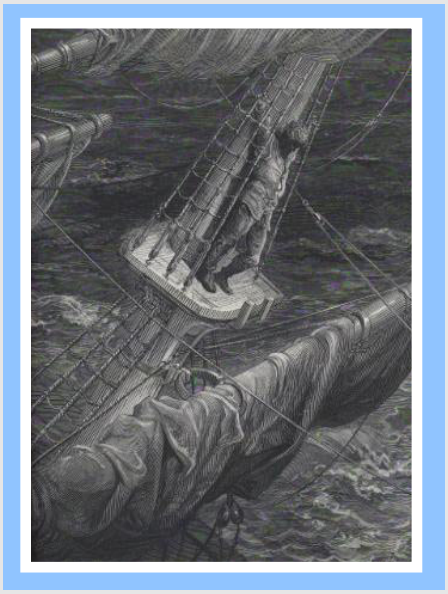
1. What happened in your experiment?

2. Remove the plastic wrap and drink the water in the glass. How salty is it? Why do you think that is?

Desalination

Water, Water, Everywhere, Nor Any Drop to Drink

These famous lines were written by British poet Samuel Coleridge in “The Rime of the Ancient Mariner” back in 1798, six years after American Secretary of State, Thomas Jefferson, suggested that each U.S. ship have a printed manual on seawater desalination. Despite the fact that water makes up about 70% of Earth’s surface, over 96% of that water is saltwater and, therefore, “undrinkable.”



Unfortunately, humans are quite dependent on freshwater: most humans cannot live longer than three days without it. Because of this need, scientists, engineers, and inventors have been trying for centuries to effectively desalinate (or remove the salt from) water. Their methods are wide-ranging, and both physical and chemical changes are involved in the various techniques. Water has been desalinated via distillation, membrane technologies, and chemical reactions.

Distillation desalination utilizes the same general schema as the water cycle. The saltwater is heated, the water evaporates, but instead of returning to the brine, it is collected in a separate container. Some distillation techniques that use thermal physical changes to remove salt from water include solar distillation, thermal vapor compression, multiple effect evaporation, and many more.

For membrane desalination, a material covered in microscopic holes is used, which allows small water molecules to pass through, but larger organic (viruses, bacteria, etc.) and inorganic (metals, salts, etc.) materials cannot pass. This process requires either electricity or pressure to move the contents. Hyperfltration, nanofltration, ultrafltration, and microfltration all use pressure, while electrodialysis and electrodialysis reversal use electricity.

The process of exchanging ions can also be used to purify water. It is a complex process, but basically, chemicals that naturally balance out the saltwater are added to exchange and remove sodium cations and chlorine anions from the saltwater.

Please visit our site for more helpful information:
http://www.STEMsims.com/desalination

Answers: Page 2 Answers: 1) b. 2)c. 3) a. 4) b. 5) d. **Page 3 Answers**: 1) Answers will vary. 2) The water in the glass should not be salty as salt molecules are too large to be evaporated along with the water molecules.

The Green Engineering Magnet (GEM) project was funded in part under the National Science Foundation grant contract #IIP-1127544. Its contents are solely the responsibilities of the authors and do not necessarily represent the official views of the National Science Foundation.