Lab: PhET Sugar and Salt Solutions

Name:
Date:
Class:

This lab is a computer-simulation-based activity. The simulation requires Java and may not run on all computers. If it won't run on student machines the activity can be done by showing the simulator using a computer-projection system. The simulator is available for download at https://phet.colorado.edu/en/simulation/legacy/sugar-and-salt-solutions. Or, perhaps more easily accessed by performing a search for "PhET Sugar and Salt".

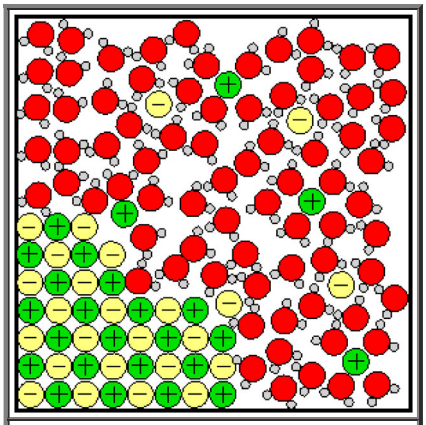
Background

Sugar and salt both dissolve easily in water and they look a lot alike. There is an important difference between them, though. Salt is an ionic compound made up of two kinds of ion: sodium ions (Na^+) and chloride ions (Cl^-). Sugar is a molecular compound made of one kind of molecule: $C_{12}H_{22}O_{11}$.

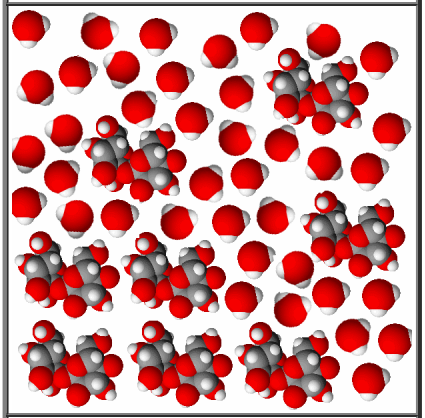
Though it looks the same to the naked eye when you add a spoonful of either of these substances to water, what happens to the ions or molecules is quite different. The ions of the salt separate and become surrounded by water molecules. The chemical formula of salt is broken in half and instead of having just one kind of thing dissolved in the water there are two, a positive ion and a negative ion. See the image at right.

When sugar dissolves the molecules separate from each other but the chemical formula stays together. There is just one kind of thing dissolved in the water and it is neutrally charged. See the image at right.

Ionic compounds are also called **electrolytes**. An electrolyte is a material which breaks up into ions when it dissolves in water. When electrolytes dissolve in water they cause the water to be able to conduct electricity. Molecular compounds are usually **non-electrolytes**. A non-electrolyte is a material that dissolves in water as whole molecules: no ions are produced and the water does not gain the ability to conduct electricity.



Salt dissolving in water. The salt ions are positive and negative. The water molecules have one large oxygen atom and two small hydrogen atoms.



Sugar dissolving in water. The sugar molecules are the large groups of atoms. The molecules in the solid are stuck together but the dissolved sugar molecules move separately while remaining whole sugar molecules.

Questions

Put the conductivity tester into the water in the simulator on the "Macro" tab.

1. What happens when you add salt to the water? How does it change as you add more and more salt?

2. What does "concentration" mean? Refer to the graph in the upper-right corner of the sim.

3. Reset All using the button in the lower-right corner. What happens when you add sugar to the water? How does it change as you add more sugar?

4. Reset All again. Add all of the salt. What changes when you drain water out? Explain.

5. Reset All again. Add all of the salt. What changes when you add water? Explain.

6. Reset All again. Add all of the salt. What changes when you evaporate water out? Explain.

Switch to the “Micro” tab. Remember that you already know how to classify elements as metals or non-metals. This is important for this part of the activity. Remember, too, that molecular compounds are composed of non-metal elements and that ionic compounds are composed of ions, usually a metal ion and a non-metal ion.

7. Add all of the Sodium Chloride. Describe what happens to the ions of the salt when they dissolve.

8. With Sodium Chloride selected, use the Periodic Table button to see where the elements that compose this compound are located on the periodic table. Is this compound ionic or molecular?

9. Use the Remove Solute button to clear the water. Switch to Sucrose and add all of it. What happens to the molecules of sucrose when they dissolve in water?

10. With Sucrose selected, use the Periodic Table button to see where the elements that compose this compound are located on the periodic table. Is this compound ionic or molecular?

11. For both substances the dissolving process results in the solid material being broken up into individual particles. What are the particles and how many kinds of particles are there when Sodium Chloride dissolves?

12. What are the particles and how many kinds of particles are there when Sucrose dissolves?

13. At the top of the screen, switch the Solute by clicking the right arrow. Add all of the Calcium Chloride. Identify the particles dissolved in the water. Is this an ionic or molecular compound?

14. Click the right arrow on the Solute box again. Try adding the Sodium Nitrate. Identify the particles dissolved in the water. Is this compound ionic or molecular? Explain.

15. You know that Sodium Chloride is an electrolyte because when you add it to water, the water becomes conductive. Will Calcium Chloride or Sodium Nitrate cause the water to be conductive when they are dissolved? Explain.

16. Click the arrow one more time. Add the Glucose. Is Glucose ionic or molecular? Will adding it to water cause the water to be conductive? Explain.

17. In general, how are electrolytes different from non-electrolytes when it comes to how the particles of each substance behave when the substance dissolves in water?

18. Make a list of the characteristics of electrolytes and non-electrolyte as a way to define both of these terms.