Chemistry **Name _____**

PhET *Sugar and Salt Solutions*

Learning Objectives:

- Describe the process of solution formation for salts versus molecular compounds.
- Identify the differences in an ionic solution and a molecular solution

Directions:

Open the *Sugar and Salt Solutions* simulation at http://phet.colorado.edu

Found under **Chemistry**

Do not update Java; click "Later."

1. Move the conductivity tester to the solution.
2. Shake some salt into the water.
   - Does the conductivity tester light up?
   - What kind of substance causes the conductivity tester to light?
3. Click on the "remove salt" button.
4. Change the solute to sugar and shake some into the water.
5. Test the solution again with the conductivity tester.
   - Did it light up?
   - What type of substance is this?
6. Use the Flinn MSDS (material safety data sheets) search to locate the MSDS to complete the missing information for the substances in the data table below. These substances were not tested in the lab. Based on the solubility & electrical conductivity in water decide if they are ionic or covalent bonds.
   - http://www.flinnsci.com/msds-search.aspx

Substance	Solubility in Water	Electrical Conductivity in Water	Type of Bond
potassium chloride KCl		Yes	
benzoic acid C_6H_5COOH		None detected	
ethyl alcohol C_2H_5OH		None detected	
iron (III) sulfate $Fe_2(SO_4)_3$		Yes	
oleic acid $C_{18}H_{34}O_2$		None detected	
nitrogen N_2	Slightly	None detected	

7. Click on the **MICRO** tab at the top of the page.
8. Select the sodium chloride solute.
9. Shake some salt into the water.
    - What happens to the salt as it mixes with the water?

10. Look at the Concentration graphic.
    - How do the concentrations of the 2 ions compare?

    - How would the concentrations of the cation and anion compare if the salt had been $CaCl_2$?
      After you have answered, click on the arrow to the right of the solute box for more options. Find $CaCl_2$ & try.

11. Reset the simulation. Return to NaCl and shake some into the water. Now move the evaporation slider to the right and hold until all the water has evaporated.
    - What do you observe?

    - Is the substance, NaCl, different than when it was first added to the water?

12. Click the reset button at the bottom.
13. Select the solute sucrose.
14. Add the sugar to the water
    - What do you observe?

    - How does process of solvation for sugar differ from that of salt?

    - Which solution results in a greater number of particles in solution- salt or sugar?

15. Use the slider at the bottom to evaporate the water.
    - What did you observe?

    - How is the formation of sugar crystals different from the formation of salt crystals?

16. Now, click on the **WATER** tab at the top. In the Show box, click "water partial charges."
    - According to our naming convention, give the name for water, H_2O.
    - What do the RED spheres represent?
    - What do the WHITE spheres represent?
    - ***Give it a Thought –*** Is the molecule symmetrical?
    - ***Give it a Thought –*** Does it have a dipole moment?
    - ***Give it a Thought –*** Is it polar or nonpolar?

17. Click and drag a sodium chloride crystal into the water. Immediately click the "pause" button in the lower left.
18. Notice that the water molecules surround the ions. This process is called ***hydration.***
    - Which end of the water molecules seem to face the Na^+ ion- the red end or the white end?
    - Is this end more positive or more negative?
    - Which end of the water molecules seems to face the Cl^- ion?
    - Is this end more positive or more negative?

19. Click the reset button.
20. Repeat the process for sucrose.
    - Does the sugar molecule break up?
    - Do the water molecules orient themselves in any particular way?

21. Click on the "Sugar in 3D" button.
    - ***Give it a Thought –*** Is the sugar molecule symmetrical?
    - ***Give it a Thought –*** Does it have a dipole moment?
    - ***Give it a Thought –*** Is it polar or nonpolar?

22. **Conclusion:** Why do ionic substances conduct electricity when dissolved in solution, whereas covalent substances do not conduct electricity?