

Lesson plan for *Sugar and Salts*

<http://phet.colorado.edu>

Learning Goals: Students will be able to:

- Identify if a compound is a salt or sugar by macroscopic observations or microscopic representations.
- Explain how using combinations of solutes changes solution characteristics or not.
- Use observations to explain ways concentration of a solute can change.
- Describe ways the formula, macroscopic observations, or microscopic representations of a compound indicates if the bonding is ionic or covalent.

Background:

Most of the college prep chemistry students will have experience with molecular representations of moving particles in physics, but not all of the students took physics. In honors chemistry, students will have used molecular representations in their text book, physics and chemistry lessons using PhET. In regular chemistry, during a lab about salts, I put out some sugar, salt, and acid solutions and provided a conductivity tester. The honors students should have experience with conductivity from physics. At this point in the course, we will not have talked about anhydrides, so the students would not predict molecular compounds like CO_2 to conduct in water. I have avoided the issue in the clicker questions.

***Sugar and Salt* Introduction:**

Students may have difficulty with the scale of the Micro tab since the water is not depicted. The number of water particles is really quite small, so the representation is an over simplification of the actual hydration process. The third tab is meant to help with this, but there is no way to exclude the water particles, so during the post-lab or during class, I plan to demonstrate that the third tab is a “super microscopic” version of the second tab. [Tips for Teachers](#) are provided by the PhET team.

Lesson: In college prep chemistry, the students will work in pairs during class. I noticed that students did not realize that there were 5 different solutes and many only were answering the questions for “salt” and “sugar”; I began checking groups and guiding them to use the other salt and sugars. I changed the directions to include the number of chemicals available hoping this helps. My honors chemistry students will do this activity for homework because they have already had an introduction to molecular representations of solutes using Salts and Solubility [Activity 1](#).

Post-Lesson: I plan to use clicker questions included in this activity. For some of the questions, if I saw that the distribution of answers was great, I demonstrated the sim to help students after the first clicker response before I made any comments. Then I would have a “revote”. This stimulated lots of discussion between votes.

I included an alcohol in the lab and it seemed that most students made appropriate predictions because “it was made up of the same elements as sugar that it would not dissociate”. I included a clicker question to help them see the difference between acids and alcohols because my texts both integrate acids and alcohols early in the sequence, but just as classification introduction, not function. I also specifically included aluminum because some students think it is a metalloid; the texts both mention this irregularity on the periodic table, so I wanted to reinforce the metal nature of Al. Having HCl in the questions also provides an opportunity to remind students that Hydrogen is not a metal even though it is on the metal side of the periodic table in the versions that they use.

Following Activities: Real lab with Salt and sugar (see activity for file) and Molarity: Quantitative Relationship's.

Student directions: *Sugar and Salts* activity

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Directions:

1. Describe:
 - a. Solute, solvent, and solution.
 - b. What solvent is used in the sim? Why do you think it was chosen? What types of solutes are used? What representations or tools did you use to help you decide the “type of solute”?
 - c. List each of the 5 chemicals in the simulation and identify the “type of solute” to which each belongs. Give at least one piece of evidence for each.
 - d. Which the *Micro* tab solute combinations are more complex than others? Explain.
2. What is the “concentration” specifically indicating for each “type of solute”? Make sure to include the differences between the Macro and Micro tabs.
3. Find all the ways you can change the concentration of a solute. Describe what you would do in a real lab to increase or decrease the concentration of a solution.
4. Using your text or cite other resources to describe the difference between an “ionic” and a “covalent” compound. Why is the periodic table given as an optional display? How could you use your periodic table to predict conductivity of a solution?
5. Draw pictures that would show what the following chemicals would look like on a microscopic scale if dissolved in water-
 - a. LiF
 - b. KNO₃
 - c. C₂H₅OH
 - d. MgF₂

Laboratory: Solubility of Table Salt and Table Sugar in Water

Purpose: Determine the solubility of table salt and table sugar in room temperature water using varying amounts of water.

Data: Read the experiment directions and the calculations. Then design a data table that will serve to show your data and allow required predictions.

Directions:

Part A: Table salt

1. Mass a clean cup or beaker, then put about 150 grams of table salt in it and record the amount of salt.
2. Measure 20 ml of water into a 150 ml beaker.
3. Carefully add salt and while stirring until the solution appears to be barely over saturation.
4. Record the amount of salt that dissolved.
5. Add another 10 ml of water to your salt solution and then find out how much will dissolve.
6. Continue adding 10ml of water and then salt until you reach a total of 80 ml of solution.

Part A: Table sugar

Repeat 1-6 procedure with table sugar and water.

Graph and Calculations:

1. Graph your results and include a trendline. (use graph paper or Excel). Consider these ideas before you finalize your graph.
 - a. How did you decide what to put on the x- axis?
 - b. How did you decide what type of trendline to use?
 - c. Do you have any outliers that should be excluded in a trendline?
2. Describe how to use your graph to predict how much of each substance in grams will dissolve in 100 ml of water at room temperature using each trial. State your prediction.
3. Research to find the accepted value for solubility of each substance in g/100ml. Then calculate your percent error.
4. Show how to calculate how much of each substance in moles will dissolve in 100 ml of water using each trial.

Questions:

1. Explain why your results might have some variation and also a percent error. (ie. your precision and accuracy errors) Make sure to explain experimental errors that are not just “mistakes”, but design issues.
2. What ideas do you have that might explain why the solubility of salt is not the same as sugar?

Clicker Questions

1. Which would you predict to be a salt?

- A. CO_2
- B. CaCl_2
- C. $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
- D. HCl

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H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn						

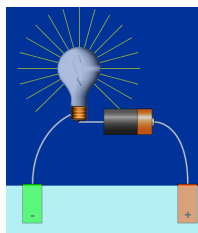
Metal

Non-metal

A metal combined with a non-metal make a "salt".

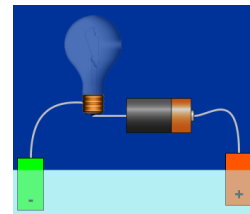
2. If a compound conducts electricity when in solution with water, you might categorize the compound as a

- A. salt
- B. sugar
- C. Both conduct
- D. Neither conduct



3. Which would not conduct electricity very well in solution with pure water?

- A. O_2
- B. CaCl_2
- C. $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
- D. HCl
- E. More than one of these

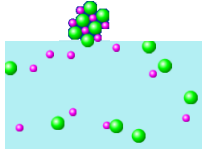
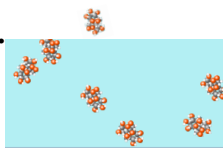


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- E. More than one of these

Non-metals combined with each other don't break into ions in solution. Ions are needed to conduct. Acids are an exception (compounds that begin with H); usually they break into ions.

4. If the microscopic view of a compound in water looks like the picture on the left (I.), you might categorize the compound as a

- I. 
 - II. 
- A. Salt B. Sugar C. Neither