

Grade 5 - Lesson 2.1

Using Dissolving to Identify Substances

Teacher Background

Solubility is a Characteristic Property of a Substance

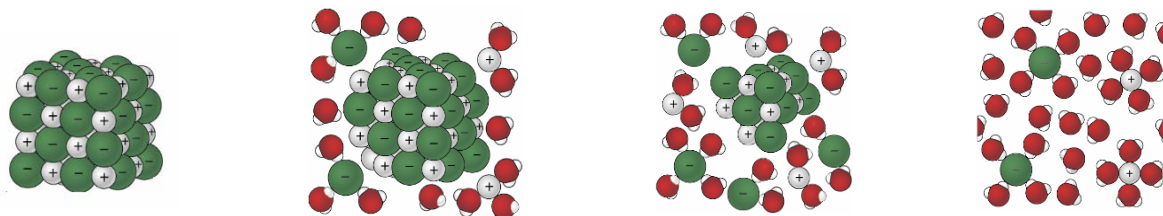
The extent to which a substance dissolves in a given amount of water over a range of temperatures is called the *solubility* of that substance. The solubility of a substance is a characteristic property that can help identify the substance.

The Process of Dissolving

The process of dissolving takes place at the molecular level. The substance being dissolved is called the *solute* and the liquid doing the dissolving is called the *solvent*. In order for a substance to dissolve, the molecules of the solute need to interact with the molecules of the solvent.

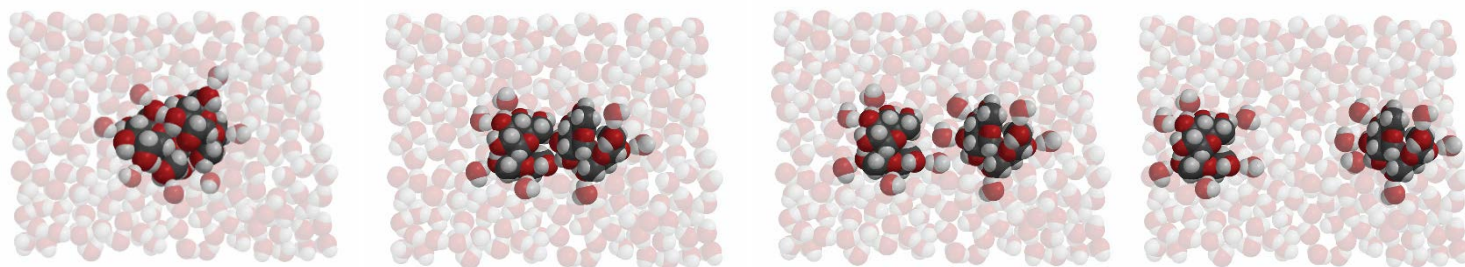
Since each substance is composed of different atoms in different arrangements, and bonded together in different ways, each substance interacts with water in its own way and has its own characteristic solubility.

Water Dissolving Salt



Salt is made from positively charged sodium ions (gray) and negatively charged chloride ions (green). The oppositely charged ends of polar water molecules attract the ions and pull them away, resulting in dissolving.

Water Dissolving Sugar

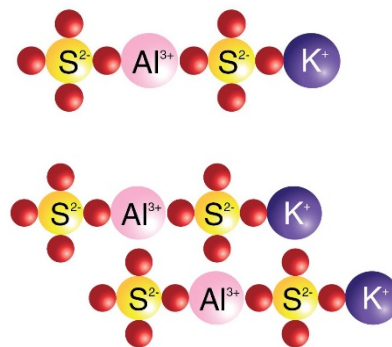


Sugar is made from sucrose molecules which are larger and more complex than the ions in salt (See Teacher Background Lesson 1.2). The sucrose molecules are attracted to one another by positive and negative polar areas. The polar water molecules attract the oppositely charged polar areas of the sucrose molecules and pull them away, resulting in dissolving. Since the ions in salt and the molecules in sugar are very different, their solubilities tend to be different.

Alum, another Soluble Substance

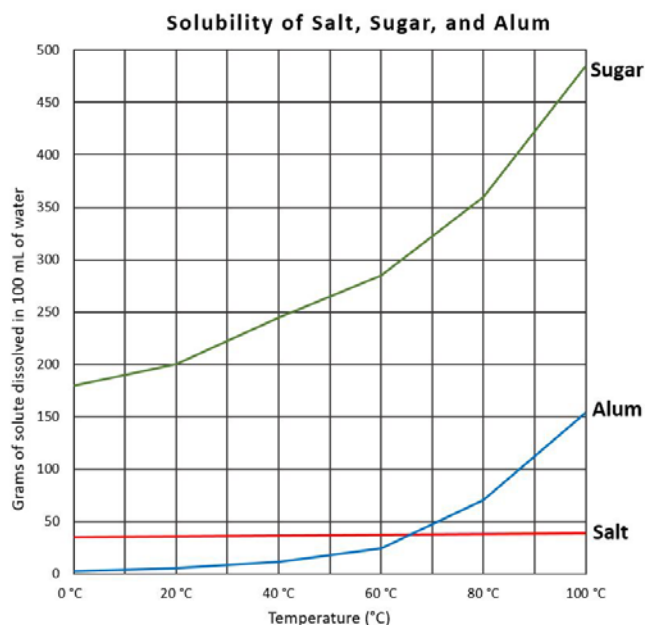
Another solid that is soluble in water is alum (potassium aluminum sulfate, $KAl(SO_4)_2$). A molecule of alum is made up of a potassium ion (K^+) and an aluminum ion (Al^{3+}) and two sulfate ions (SO_4^{2-}).

Here is a model of two alum molecules. Its structure and charges are different from both salt and sugar and has its own characteristic solubility.



Solubility of Salt, Sugar, and Alum

Here is a graph showing the solubility of salt, sugar, and alum in 100 milliliters of water over a range of temperatures from 0 to 100 °C. The substances all have different structures made from different atoms so you might expect them to have different solubilities.



You can see that at all temperatures, many more grams of sugar dissolve than salt. The graph also shows that the solubility of sugar increases much more than the solubility of salt as the temperature of the water increases. Alum is the least soluble until the temperature of the water increases to about 65 °C. After that point, the solubility of alum is greater than that of salt but never as great as sugar.

Since the experiment was run with room temperature water (about 20 °C) the results agree with the graph showing that alum was the least soluble, salt was more soluble than alum, and sugar was the most soluble.