Module 10: Solutions

Topic 1 Content: Solutions Presentation Notes

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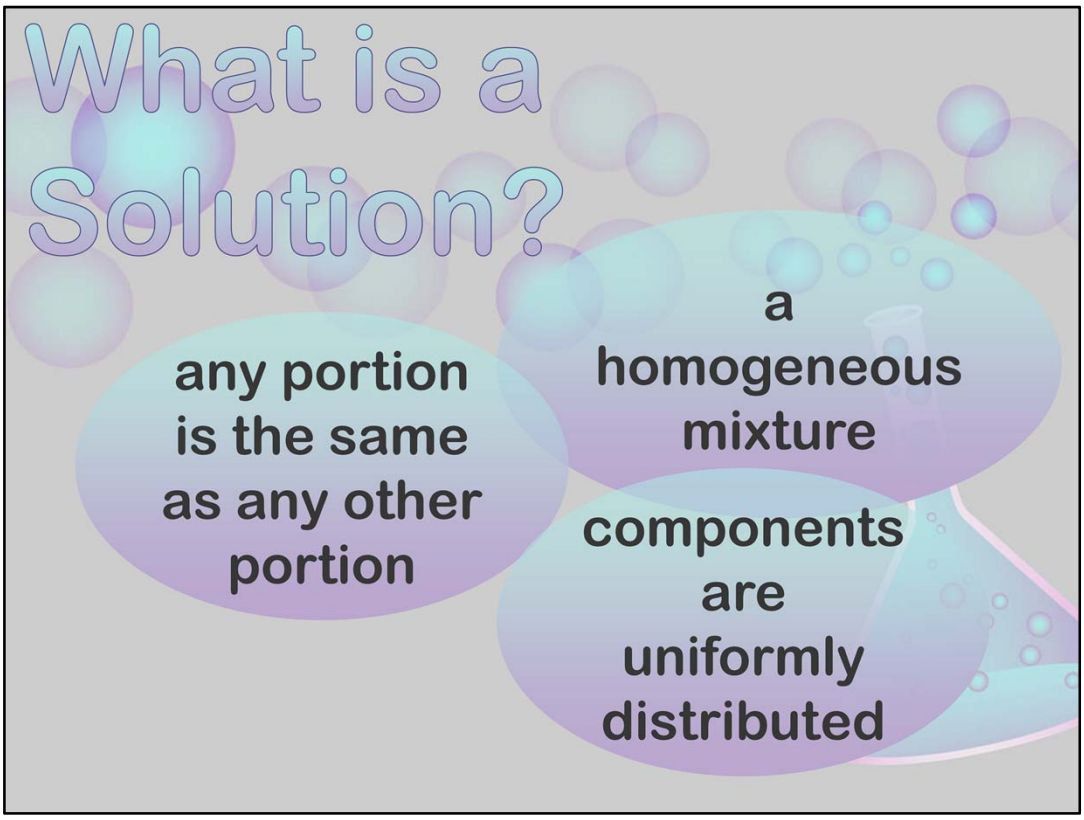
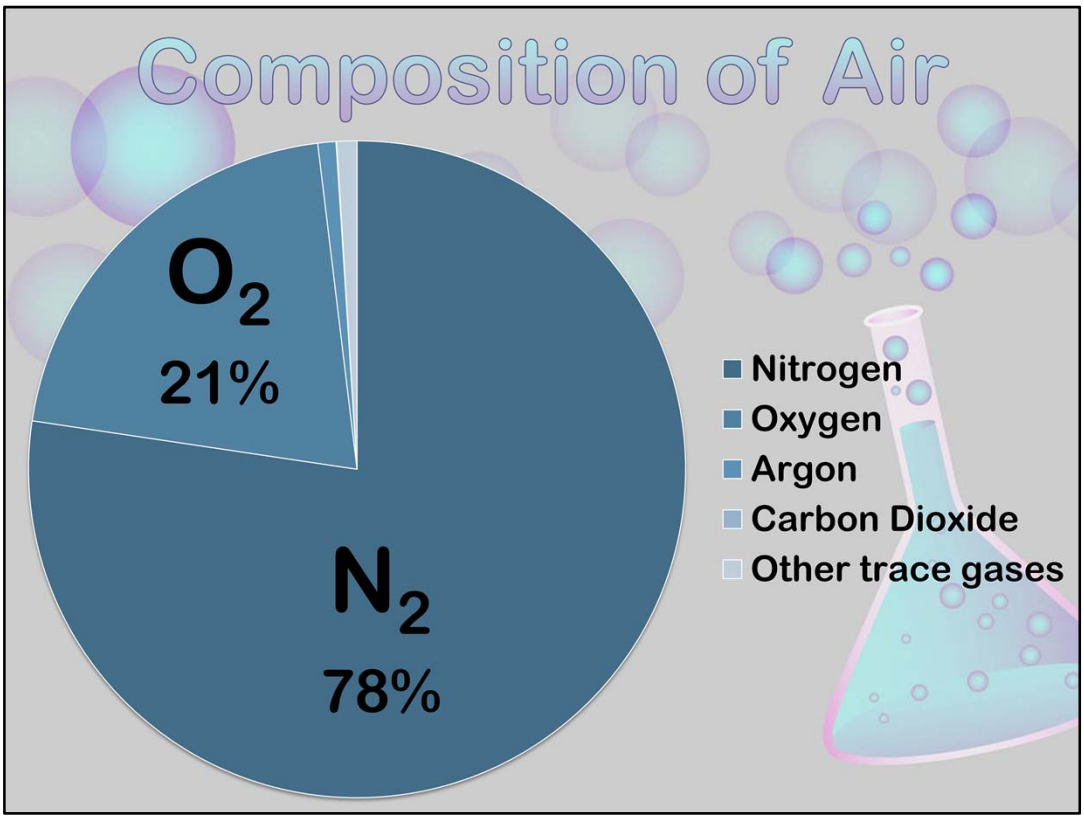


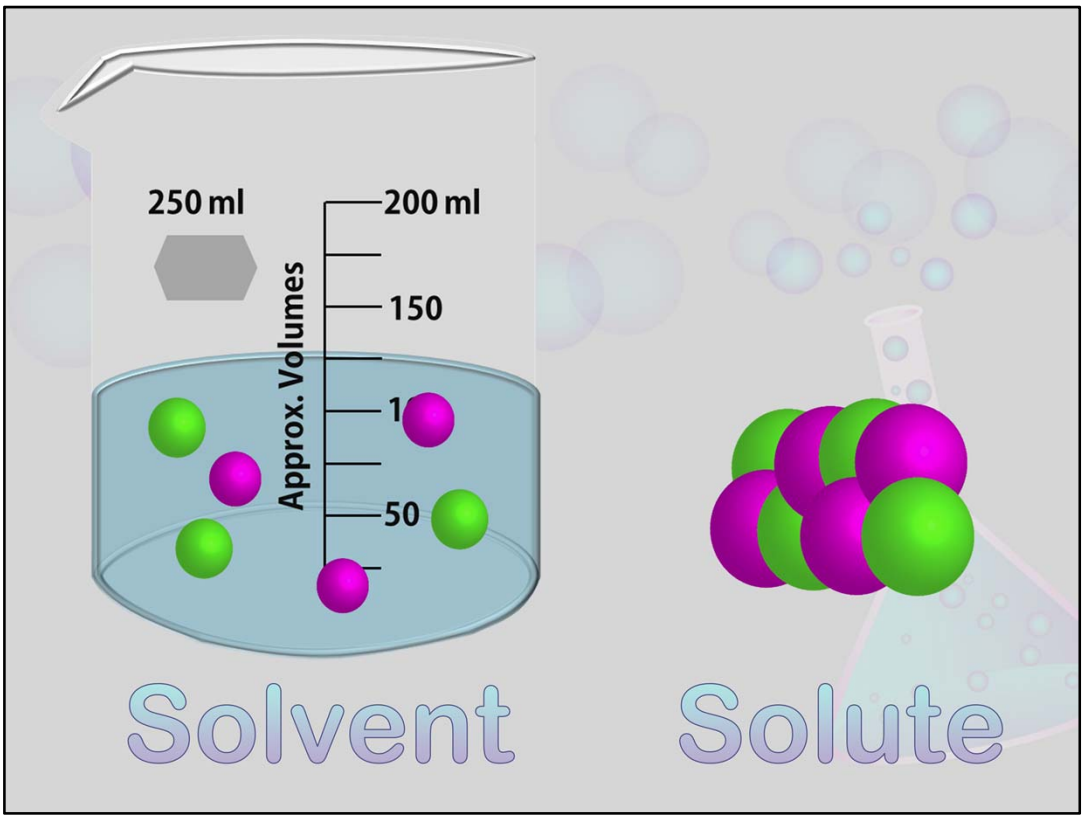
A solution is a homogeneous mixture. That means that any portion of the mixture is the same as any other portion, and the components of the solution are uniformly distributed.



Air is an example of a solution, and it is composed of at least sixteen different gases. Nitrogen and oxygen are the biggest components, but you might be surprised to know that it also contains argon, carbon dioxide, and other trace amounts of numerous gases, including krypton, neon, helium, methane, hydrogen, carbon monoxide, xenon, ozone, nitrous oxide, iodine, ammonia and nitrogen dioxide.

Module 10: Solutions

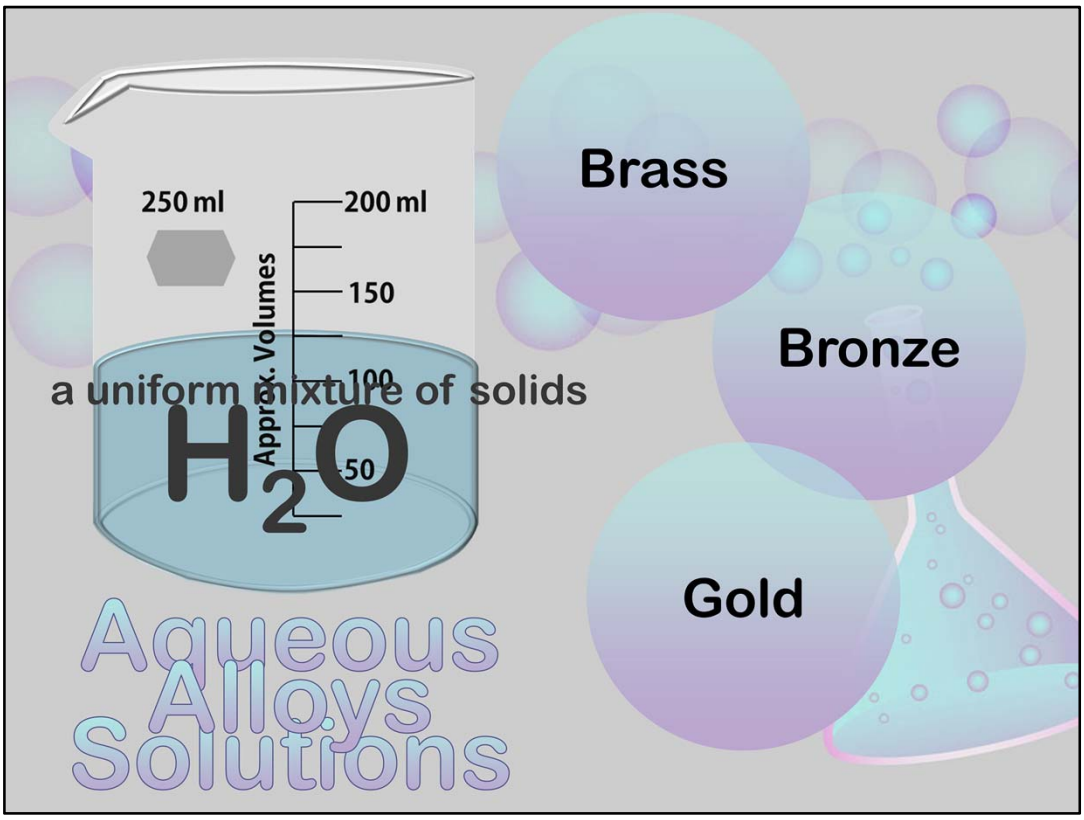
Topic 1 Content: Solutions Presentation Notes



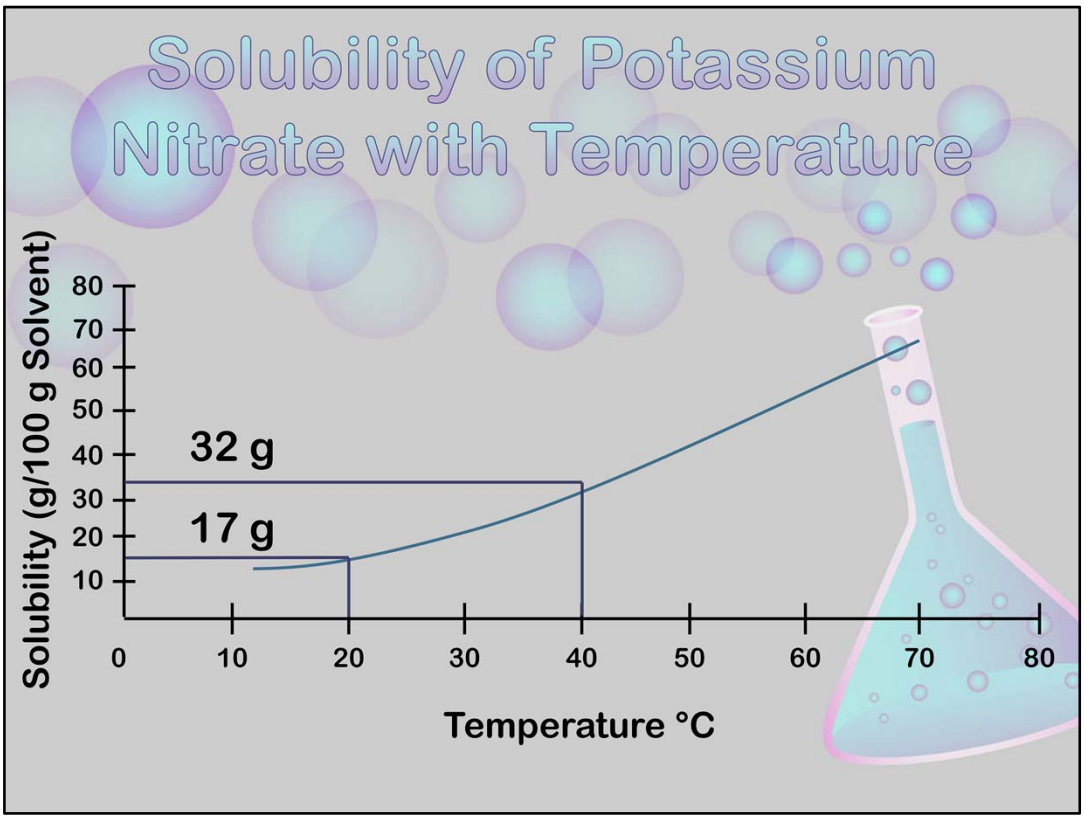
Solutions may be mixtures of gases, solids, and liquids in any combination. A solution is composed of two types of materials. The solvent is the substance which does the dissolving or is present in the largest percentage. The solute is the substance being dissolved. In this image, the solvent is water and the solute is represented by green and pink atoms.

Module 10: Solutions

Topic 1 Content: Solutions Presentation Notes



When water is the solvent, solutions are called aqueous solutions, abbreviated as *aq*. Another special type of solution is an alloy. An alloy is a uniform mixture of solids. Two examples include brass and bronze. Brass is a mixture of copper and zinc. Bronze is a mixture of copper and tin. Unless gold jewelry is twenty-four karat, it is also an alloy. Pure gold is considered too soft for most jewelry, so it is usually strengthened by adding silver and other metals.



What happens if too much of a solute is added to the solvent? In this case, the solute is not totally dissolved. Using laboratory data, chemists have developed solubility curves. A solubility curve is a graphical representation showing how much of a solute can be added to a certain volume of solvent and completely dissolve at a given temperature. Shown here is the solubility curve for potassium nitrate.

The curved line in a solubility curve represents the maximum amount of solute that can be dissolved in 100 g of solvent, which in this case is water. The solubility curve represents a saturated solution. It is determined by starting with 100 g of water to see how much solute will dissolve at various temperatures. By reading the curve, you can determine that at 20 °C, about 17 g of potassium nitrate will dissolve in 100 g of water. At 40 °C, about 32 g of potassium nitrate will dissolve in 100 g of water.

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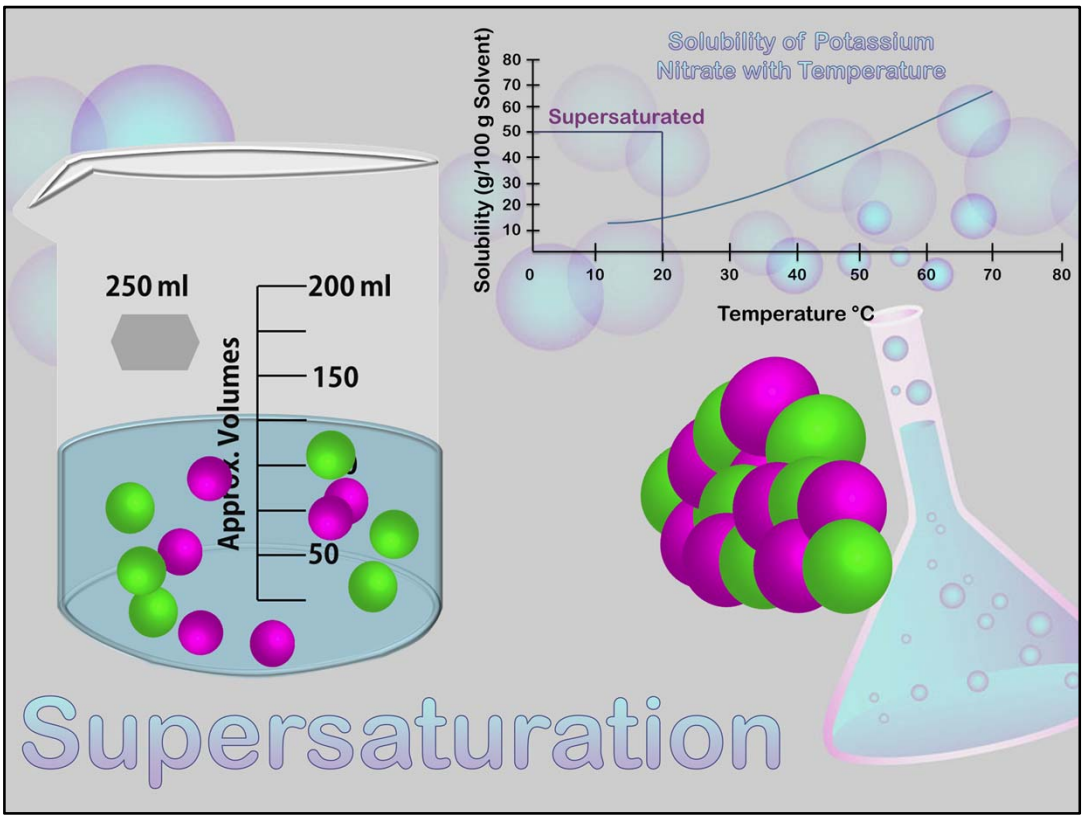
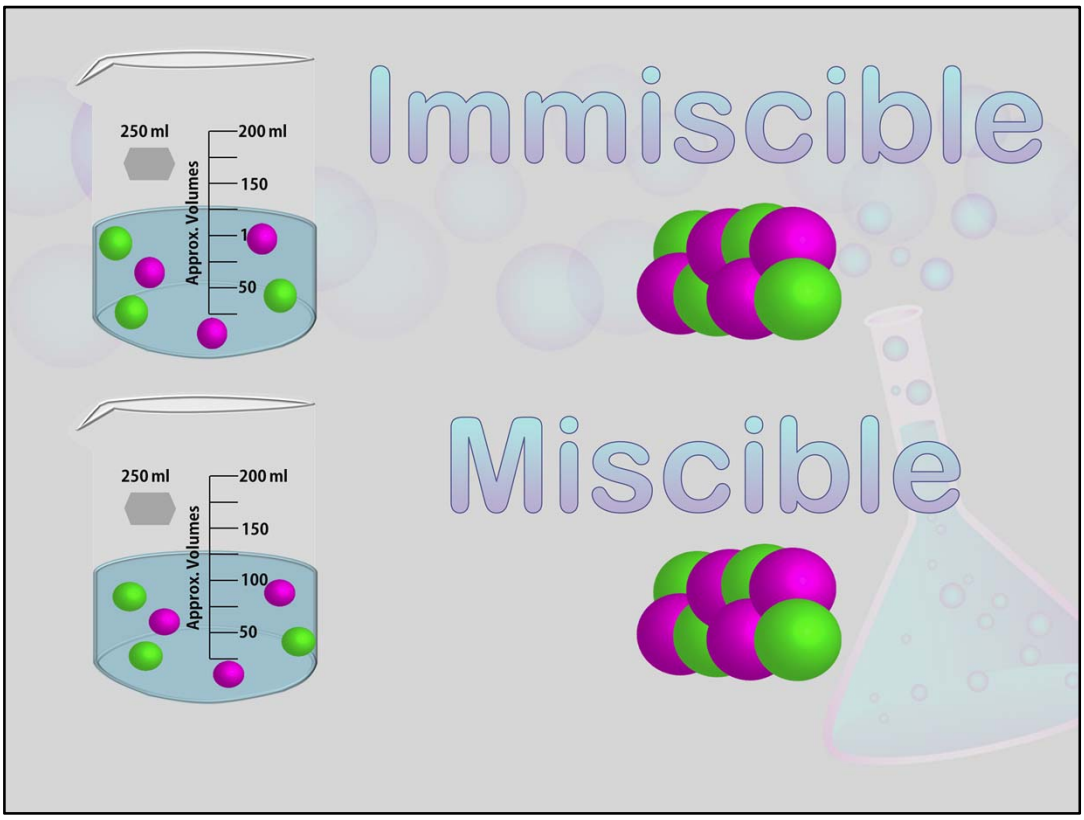


A solution which contains more dissolved solid than a saturated solution will hold at a given temperature is said to be supersaturated. For instance, a solution of 20 g of potassium nitrate dissolved in 50 g of water at 20 °C lies above the solubility curve and is a supersaturated solution. How can this be achieved? Perhaps you have been faced with this problem when trying to make a very sweet iced tea. You may have figured out that all you need to do is heat the solvent first, dissolve the solute, which is sugar, and then cool the mixture down. If you make tea this way, all of the solute, in this case sugar, will remain dissolved.

What about a solution which lies below the solubility curve? These solutions are said to be unsaturated because more solute could potentially be dissolved into the solvent.



Very frequently, solutes are not soluble in solvents at all. These types of solutions are said to be immiscible. Liquids that are soluble in any proportion of solvent are said to be miscible. These different conditions are highly dependent on the extent of intermolecular forces present between particles. Salt dissolves very easily in water, so salt and water are miscible in each other. On the other hand, oil does not dissolve in water, so the two substances are said to be immiscible.