Student's Lesson at a Glance

Lesson Summary

The importance of studying solubility is reinforced through an introduction regarding the role of solubility in the human body. Students explore solubility through the real-world application of hydrophobic and hydrophilic substances, a topic they may have some familiarity with from biology. Students continue to explore the differences between a solvent and solute on the macroscopic and submicroscopic levels. In the final activity of the unit, students will once again practice formula writing for the substances they will encounter throughout the unit.

SWBAT (Students Will Be Able To)

- Define solubility
- Explore the concepts of hydrophobic and hydrophilic
- Identify the components that make up a solution
- Define the difference between a solvent and a solute submicroscopically

Essential Vocabulary

Keep a list of all important words from this lesson. This list, in addition to the lists from other lessons, will make studying easier and improve scientific communication skills. The essential vocabulary from the unit is in bold. Additional words that will expand your scientific vocabulary are in italics.

Connected Chemistry Reminder

- Students and teachers from many different schools helped designed Connected Chemistry so that the lessons are more helpful and meaningful for all classroom participants.
- Many questions will ask you "what you think" or "to make predictions." The only answer that is wrong is the answer that is left blank.
- Prefixes and suffixes on words can help you discover the meaning of a word.
- Use the vocabulary section and note section to take good notes so that studying for tests and quizzes will be easier.
- Supporting claims with evidence is not only a skill that scientists use, but a skill that will help you in other classes and everyday life.
- Draw a key when you are sketching. Symbolic keys can help you and others decode your sketches at a later time.
- Ions are charged particles that show up with a gray halo in the simulations. Ions makeup ionic compounds. Use the periodic table to determine the charge of an ion.

Notes

Homework

Upcoming Quizzes/ Tests

Activity 1: Connecting

1. Why do you think water is called the "universal solvent"?

2. What chemical and physical properties do you think make water a good solvent?

3. What do you think it means to have a "phobia"?

4. What do you think the prefix "hydro" means?

Solubility is the ability of a solute to dissolve in a solvent. A **solute** is the substance that is dissolved into a solvent and the **solvent** is the liquid in which the solute dissolved. **Dissolving** is when a compound breaks apart into isolated particles. A common solvent is water, and a solution that has a substance dissolved in water is called an **aqueous solution.** Other liquids can be solvents too (e.g. hexane or acetone), but they do not form aqueous solutions because they are not composed of water. These solvents form non-aqueous solutions. Chemists are not the only scientists interested in studying how substances dissolve. Solubility is very important in the fields of nutrition, medicine, and environmental studies. Knowing what substances dissolve in water is important. For example, many substances that are helpful and harmful to people can dissolve in the water that people consume.

Nutritionists also need to differentiate which substances are soluble in water and which ones are insoluble in water. A substance is **soluble** in water if it dissolves when added to water. Likewise, a substance is **insoluble** in water if it does not dissolve in water. A nutritionist may suggest taking daily vitamins. Some vitamins are soluble in water, which we can drink to support the function of our body systems. Similarly, our digestive system breaks food into particles that can dissolve into our blood stream. Blood is an aqueous solution, which means it is a combination of water and other dissolved substances, such

as vitamins and nutrients. Because blood is aqueous, it can transport many dissolved substances (e.g., vitamins and medicines) to the rest of the body.

Vitamins are necessary in very small amounts to help support many of the chemical reactions in your body. Unlike plants and bacteria that make their own vitamins, humans and other animals do not make all the vitamins they need to survive. Animals must get some vitamins from the food they eat, such as plants that produce edible fruits and vegetables. In fact, Vitamin D is the only vitamin that humans make, which is synthesized in the skin when it is exposed to sunlight. There are three essential vitamins (see table below) people must consume to stay healthy.

Understanding the chemical and physical properties of vitamins can help doctors, nutritionists, and patients make better choices about health. Knowledge of how vitamins work in the body allows you to get the maximum benefit from them. Some vitamins are *water soluble* and some vitamins are only soluble in fats. Vitamins B and C are water soluble and easily go into the bloodstream.

Water insoluble vitamins are also called *fat soluble* vitamins. Vitamins A, D, K, and E are insoluble in water, but soluble in fats. These vitamins mix with fats in foods and interact with *hydrophobic* and *hydrophilic* carriers in the body. These carriers can engulf the fat soluble vitamins and carry them into the bloodstream. Water soluble vitamins need to be replaced because they are flushed and excreted out easily; however, fat insoluble vitamins are stored in the liver. Taking too many fat soluble vitamins could cause a large build up in the liver and cause toxicity in the body.

Vitamin	Function
Vitamin B	Keeps the brain and nervous system healthy
Vitamin C	Keeps your immune system healthy
Vitamin K	Needed for blood and bones

5. Do you think that fats (such as oils) are soluble or insoluble in water? *Support your claim with evidence.*

6. Would vitamins A, D, K, and E be classified as *polar* or *nonpolar* based on how they behave in water? *Please explain.*

7. Would vitamins B and C be classified as polar or nonpolar substances based on how they behave in water? *Please explain.*

8. Since vitamins A, D, K, and E are insoluble in water, would they be classified as hydrophobic or hydrophilic? *Please explain.*

Activity 2: Introduction to Solutions and Solubility

Part 1: *Use Simulation 1, Set 1*

Many of the substances people use on a daily basis- such as hand soap, soup, orange juice, tap water, and soda – are not *pure substances*. Rather, these substances are **solutions**. Solutions are an example of **homogeneous mixtures**. Recall that a homogeneous mixture is one in which the solute molecules are evenly spread throughout the solvent molecules. Many, but not all, solutions include water as a solvent because one of water's physical properties is that it can dissolve many substances due to its *polarity*. Because of this, scientists often refer to water as the "universal solvent". Recall that a solution that has a solute dissolved in water as a solvent is called an aqueous solution. When a tablespoon of Kool-Aid © powder (solute) is added to a cup of water (solvent), the Kool-Aid © powder dissolves to form a Kool-Aid © drink (an aqueous solution) that contains sugar molecules, dye molecules, and water molecules.

9. Define solvent in your own words.

10. Define solute in your own words.

List four everyday substances which are solutions. Identify one solute and one solute in each solution.

Solution	One solute in the solution	Solvent in the solution
e.g., Kool Aid®	Sugar	Water

View your teacher's simulation of a aqueous solution of water and another common substance. Create a submicroscopic sketch of the solution. Sketch one molecule of the solvent and one formula unit of the solute. Remember, the gray halos in a simulation indicates that an ion has formed.

Sketch submicroscopic view of the solution	Sketch one molecule of the solvent	Sketch one formula unit of the solute
Key		

11. Using the computer simulation monitors, determine how many solute particles are in the simulation.

12. Using the computer simulation monitors, determine how many solvent particles are in the simulation.

Lesson Reflection Questions

13. Based on what you see in the simulation you just sketched, can you revise your definition of a solvent by adding more information? If so, what can you add to your definition?

14. Based on what you see in the simulation you just sketched, can you update your definition for a solute with more information? If so, what can you add to your definition?

15. Based on what you see in the simulation you just sketched, can you update your definition for a solution with more information? If so, what can you add to your definition?

16. Based on what you see in the simulation you just sketched, can you update your definition for an aqueous solution with more information? If so, what can you add to your definition?

Part 2

Although Kool-Aid® powder is soluble in water, other substances such as pure metals (e.g., gold, silver, titanium), wax, and olive oil are insoluble in water.

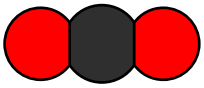
17. Would you classify solubility as a chemical or physical property? *Support your claim with evidence.*

18. If a substance is soluble in water, can you classify it as hydrophilic or hydrophobic? *Support your claim with evidence.*

19. If a substance is insoluble in water, can you classify it as hydrophilic or hydrophobic? *Support your claim with evidence.*

Activity 3: Putting It All Together – Decoding Scientific Observations Using a Key

Create a key for individual atoms. Decode the model of the compounds, using the key you created, into a chemical formula.

Name	Formula	Model
Carbon dioxide	CO_2	
Water		

Name	Formula	Model
Acetic acid (vinegar)		
Glycerol		
Sodium bicarbonate (baking soda)		
Pentane (oil)		
Ethanol		
Silicon dioxide (sand)		
Calcium chloride		

Name	Formula	Model
Sodium chloride		
Key		

20. Which substances from the table above are ionic compounds? *Support your claim with evidence.*