Connected Chemistry

Solutions Unit

Lesson 8: Application in the Real World

Student's Lesson at a Glance

Lesson Summary

The final lesson solidifies the importance of solubility as it relates to real-world issues. Students discover how solubility curves are used as a tool to prevent water pollution. Students analyze the effectiveness of ionic compounds as a means to prevent roads from icing. Finally, as a tie-in to solubility curves and multiphase solutions, students research and present on the environmental impact of dissolved oxygen levels.

SWBAT (Students Will Be Able To)

- Apply prior knowledge of solubility and solubility curves to real-world problems.

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

- Use your notes and vocabulary from this unit to develop your presentation.
- 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 or making graphs. Symbolic keys can help you and others decode your sketches at a later time. Keys on a regular graph will help clearly interpret data.
- Be careful when using the word "salt" in chemistry. Salt can be used to describe any number of ionic compounds including regular table salt (sodium chloride), calcium chloride, copper sulfate, potassium chloride, and other substances.

Notes

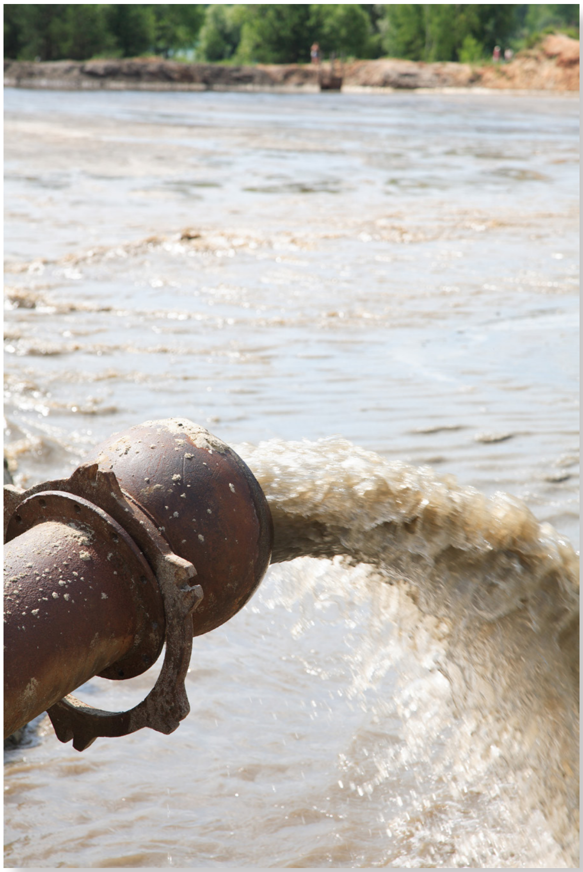
Homework

Upcoming Quizzes/ Tests

Activity 1: Connecting

1. What substances do you think you dump down the drain? Include anything you flush, rinse, dump, or pour down all the drains inside or outside in the gutter.

Water is considered to be a "universal solvent" and is one of the most abundant natural resources on the planet. Clean, pollutant-free water is essential for maintaining life on Earth. *Water pollution* occurs when pollutants from agricultural field *runoff*, waste products from factories, sewage from storm drains and other sources end up in the water cycle. Because water is an a excellent solvent for many substances, harmful levels of toxins can build up in the water unintentionally as a result of human actions.



The Clean Water Act of 1977 and the Water Quality Act of 1987 are two laws passed by the United States government to regulate and eventually eliminate the practice of releasing toxic substances into rivers, lakes, and other sources of water. The Environmental Protection Agency (EPA) is the federal government agency entrusted with monitoring water and making sure it is safe for the environment. Despite strict penalties and fines, some companies continue to violate these laws. Below is an excerpt released by the EPA about violations by a major homebuilder that built many houses in 21 states. The homebuilder allowed dangerous substances to wash away into local storm drains around the building sites.

Cynthia Giles, an assistant administrator for EPA's Office of Enforcement and Compliance and Assurance states, "Contaminated storm water puts children and families at risk as it may carry pollutants, including sediment, debris, and pesticides that contribute to water quality problems. These pollutants affect our nation's rivers, lakes and sources of drinking water" (Kika, 2010).

So how does the EPA ensure that companies are abiding by the law? The EPA sends out scientists to gather water samples from all over the country. The scientists that work for the EPA need to have a very strong understanding of solubility. These researchers must know many things about the waste produced by different companies. For instance, scientists must determine the following information on different wastes:

- Whether substances are soluble or insoluble in water
- How temperature affects a substance's ability to dissolve in water
- What levels of dissolved solutes are safe for the environment
- Consequences for organisms exposed to concentrated levels of dissolved solutes

The EPA scientists use solubility curves for each substance they are studying to determine how much a given solute will dissolve at a specific temperature. These solubility graphs are reference tools that help guide the scientists in gathering evidence to prosecute companies that continue to harm the environment.

2. Try to recall any examples from the media or your own experience when you have heard about pollutants in the water. Describe one example and what happened in two or three sentences.

3. Consider what you already know about solubility. Why do you think gathering more water samples during the summer months is more important as compared to the winter months?

4. Think about all the substances you have at home. Name two to three substances you think would be toxic if enough of each were allowed to get into the water supply.

5. Do you think the amount of contaminated solutes that dissolve into a river changes its toxicity? *Support your claim with evidence.*

Activity 2: Teacher Facilitated Discussion

Part 1

Colligative properties are a set of properties for solutions that depend on the number of solute particles in a given volume of solvent. The number of solute particles in a solution can change the temperature at which a solution will boil or freeze. For instance, during the winter months, the conditions for traveling become hazardous due to ice formation on road surfaces. Many highway departments turn to the common chemical compound of salt to help travelers reach their destination safely. Salt dissolves in the water from melting ice and snow on the roads to create a solution called *brine*. Road crews use the colligative properties of the brine to keep the roads from forming ice. There are four deicing salts for creating brine: sodium chloride (rock salt), calcium chloride, potassium chloride, and magnesium chloride. Each salt has different physical characteristics and consequences on the environment that may make it more or less suitable to use.

In your small group, use the Internet to research each of the colligative properties of each salt solution as it is used for deicing. After researching, please answer the following questions.

- *Identify the relationship between the concentration of dissolved salt and solution freezing point*
- *Identify the temperature limitations of each of the salts*

6. Would colligative properties be classified as chemical or physical properties? *Support your claim with evidence.*

7. How does the number of molecules affect a solution's freezing point?

8. What happens if a road crew uses too little salt?

9. Can a road crew use "too much" salt? *Support your claim with evidence.*

10. Explain which salt you would use at home if you needed to deice your sidewalk. *Support your selection with at least three reasons from your research.*

Lesson Reflection Question

11. Salt and sugar can both be used to change the freezing point of water. *Explain why salt is the better choice based on what you know about solutions and colligative properties.*

Activity 3: Putting It All Together

Oxygen is a critical substance for the survival of nearly every living thing, including many aquatic organisms. Water contains dissolved oxygen; the oxygen comes from the atmosphere and aquatic plants. Atmospheric oxygen is mixed in as water moves in rivers, lakes, and oceans. Plants living in the water also produce oxygen as a byproduct of photosynthesis. The oxygen from the plants can be dissolved into water. The amount of oxygen that dissolves in water is limited by physical conditions, such as the temperature of the water.

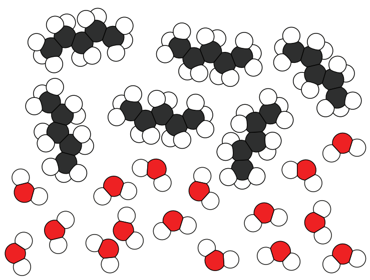
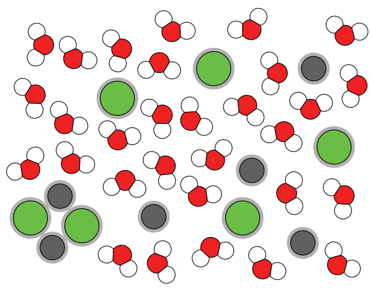
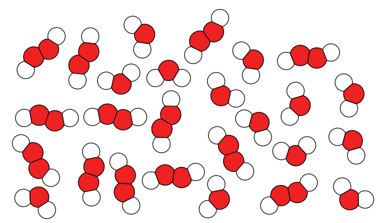
In this next activity, you will get a chance to use the Internet to research the impact of dissolved oxygen on organisms in lakes. Once the research is complete, answer the following questions.

1. Identify the conditions in the environment that affect the solubility of dissolved oxygen. Explain why the concentration of oxygen is affected by these conditions.
2. Create a graph that represents the relationship between temperature and dissolved oxygen. Explain how the graph differs from what you have learned about solid solutes in the previous lesson.
3. Create a visual representation of the dissolved oxygen zones or layers in a lake during the summer. Identify where the most living organisms would be found and why.
4. Explain how humans can impact dissolved oxygen levels.
5. Be prepared to teach a three to five minute lesson to another small group. The goal of the lesson is to define what dissolved oxygen is, how dissolved oxygen levels are affected by different environmental variables, and the impact of fluctuations of dissolved oxygen levels.

Activity 4: Capstone

Given the following submicroscopic images, determine the following for each picture. *Be sure to provide evidence for your answer to each part of the question.*

- Is this an example of dissociation?
- Is this an example of dissolution?
- Is the solute soluble in water?
- Is the solute insoluble in water?
- Is the solute a molecular compound?
- Is the solute an ionic compound?
- Label which substance is the solute.
- Label which substance is the solvent.
- Is this a solution?
- Would this be considered aqueous?
- Is this a homogeneous mixture?
- Is this a heterogeneous mixture?
- Is this a pure substance?

A	B	C
		

A nurse gives a patient an intravenous (IV) solution that has 10 grams of calcium chloride in 100 mL of water. Draw a submicroscopic picture of what you think this would look like in the first box. There was a leak in the IV bag and half of the solution dripped out of the bag. In the second box, draw a picture of what you think it will look like after half has leaked out. To cover the mistake, the nurse added 50 mL of water back to the IV bag and sealed it. In the third box, draw what you think it looks like after 50 mL of water is added to what is left after the second box. Determine whether you think that this fixes the problem.

Box 1: 10 grams of calcium chloride in 100 mL of water	Box 2: Half is poured out	Box 3: 50 mL water is added to Box 2