Connected Chemistry

Solutions Unit

Lesson 6: Determining Concentration

Student's Lesson at a Glance

Lesson Summary

This lesson contains activities that help students understand what concentration is through the use of real-world examples and submicroscopic level observations of concentrated and dilute solutions. Students use simulations to gather data that allows them to learn how to calculate mass per volume and molarity. The authors of Connected Chemistry acknowledge that teachers may implement the Solutions Unit before or after the introduction of the mole. Teachers have the option to use either the mass per volume or the molarity activities depending on the pacing of their own curriculum.

SWBAT (Students Will Be Able To)

- Define concentration and how it can be represented on the submicroscopic level
- Define dilution and how it can be represented on the submicroscopic level
- Calculate mass per volume for solutions created AND/OR
- Calculate molarity for solutions created

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

- 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.
- Sample calculations for mass per volume and molarity can be found in Appendix A (pages 76-77).

Notes

Homework

Upcoming Quizzes/ Tests

Activity 1: Connecting

1. In art class, what is the purpose of adding water to concentrated paint?

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The **concentration** of a solution is defined as the amount of solute dissolved in a given quantity of solvent. Solutions can be described as **concentrated** or **dilute**, but these designations only give a relative qualitative idea of concentration. The effects of concentration on the physical properties of a solution can be observed at home and in school. For example, watercolor paints in an art class are mostly made up of a mixture of pigments and water or another solvent, and paint can be diluted to affect color *saturation.*

Sketch red watercolor paint before adding water at the submicroscopic level	Sketch red watercolor paint after diluting with water at the submicroscopic level
Key	

2. Besides adding water, how else can you dilute concentrated paint?

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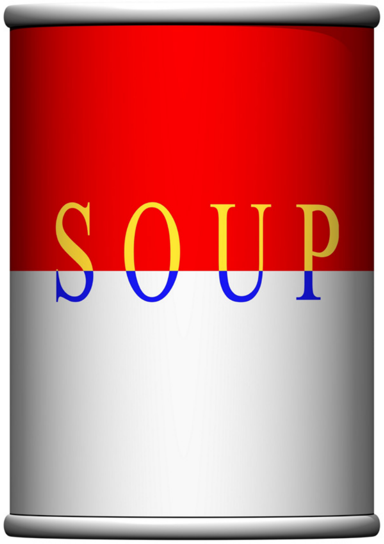
A student comes home from school on a chilly day and decides that they want something to eat to warm up their body. The student finds a can of tomato soup and opens up the can. They pour the mixture in the pot and wait for it to warm up. Upon tasting one spoonful of the warm liquid, they immediately realize they did something wrong. They read the front label of the can and it says "condensed." On the side of the can, directions indicate to add one can of water to the soup before cooking.



3. In your own words, what does "condensed" mean?

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4. Why would condensing some products be beneficial?

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Soup, watercolor paint, and many other products you use at home are condensed or concentrated. Some juices, soups, and flavor extracts come in a highly concentrated form. Recall that the solute in a solution does not necessarily have to be a solid. It can also be a liquid or a gas. Hydrogen peroxide that you buy in the store is actually a diluted solution with a liquid solute.

Sketch concentrated soup solution at the submicroscopic level	Sketch diluted soup solution at the submicroscopic level
Key	

Activity 2: Determining the Concentrations of Solutions

Simulation

Use Simulation 3, Sets 1, 3, and 6

Part 1: Mass per Volume

- *Run three trials adding different amounts of sodium chloride to water. You may use different solutes for each trial if you wish. Remember to add solute before solvent when running simulations.*
- *Using simulation outputs, record the amount of solute dissolved and the different amounts of solute that you selected. Make sure to include labels for all measurements.*
- *Once you have collected your data, use the values and the example calculation below to calculate the percent mass per volume. Fill in the columns with the asterisks using data from the simulation. Pause at 30 seconds and sketch as directed on the next page for trials 1, 2 and 3. For help in performing calculations, see "percent mass per volume" in Appendix A on page 76. The independent variable column is bolded in the table and the dependent variables are noted with an asterisk in the table. Do not forget to draw the solvent in your submicroscopic drawings.*

Trial	Temp. (°C)	Mixture (solute + water)	Mass Solute Added (g)	Solvent Volume (mL)	* Mass Dissolved Solute (g)	* Solution Volume (mL)	Mass / volume percent
1							
2							
3							

Sketch submicroscopic view of trial 1 after 30 seconds	Sketch submicroscopic view of trial 2 after 30 seconds	Sketch submicroscopic view of trial 3 after 30 seconds
Key		
Observations	Observations	Observations

5. Classify your sketches in order from the most concentrated to the least concentrated.

6. Using your sketches, explain why the volume of the solution increases even though you did not add more of the solvent.

Part 2: Molarity

- *Using Simulation 3, Set 1 run three trials adding different amounts of sodium chloride to water.*
- *You should include a wide range of amounts. You may use different solutes for each trial if you*

wish. Output displays both mass and moles in the concentration tab automatically.

- *Using the counters on the simulation, record the amount of solute dissolved at each different amount of solute that you selected. Make sure to include labels for all measurements. Pause at 30 seconds and sketch as directed below for trials 1, 2, and 3.*
- *Once you have collected all the data, calculate the molarity (M) using the data. Example calculations can be found the "calculating molarity" section of the calculation appendix.*

Trial	Temp. (°C)	Mixture: (solute + water)	Amount of solute added (moles)	* Volume of Water (mL)	* Amount of solute dissolved (moles)	* Volume of solution (ml)	Molarity (M)
1							
2							
3							

Sketch submicroscopic picture of trial 1 after 30 seconds	Sketch submicroscopic picture of trial 2 after 30 seconds	Sketch submicroscopic picture of trial 3 after 30 seconds
Observations	**Observations**	**Observations**
Key		

7. Classify your sketches in order from the most concentrated to the least concentrated.

Lesson Reflection Questions

8. Consider the following scenario: You are in the lab and you have 100 mL of a solution with a certain concentration in a beaker. You pour half of the solution out of the beaker. Is the concentration of the remaining solution in the beaker greater, lower, or the same as the original solution? *Explain your answer.*

9. Consider the following scenario: You are in the lab and you have 100 mL of a solution with a certain concentration in a beaker. Your lab mate accidentally pours 100 mL of water into the solution. Is the concentration of the solution in your beaker greater, lower, or the same as the original solution?*Explain your answer.*

10. It is possible to add more solute to a solution or to add more solvent to a given solution. Is it possible to take solute out of a solution or solvent out of a solution to make it more or less concentrated?