Unit 8 - Solutions & pH

Content Area: **Science**
Course(s):
Time Period: **Marking Period 4**
Length: **15 days**
Status: **Published**

Summary

Introductory chemical reactions often proceed in the forward direction; however, many chemical processes from simple acid-base to complex biochemistry exist in equilibrium. This means instead of an arrow pointing forward (→) there is a pair of arrows ↔. In this unit, students will learn that the chemistry of acids and bases (and other solutions) is often in equilibrium and these substances can be investigated beyond calculating pH. Students will also investigate the effects of solutes on the concentration, boiling point, and freezing point of various substances.

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P.3	Consider the environmental, social and economic impacts of decisions.
P.4	Demonstrate creativity and innovation.
P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
9.4.12.CT	Critical Thinking and Problem-solving
P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
P.9	Work productively in teams while using cultural/global competence.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.6	Determine the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
9.4.12.GCA	Global and Cultural Awareness
9.4.12.IML	Information and Media Literacy
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
9.4.12.TL	Technology Literacy
HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a

	reaction occurs.
LA.WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Essential Questions/Enduring Understandings

Essential Questions

- What effect does the amount of solute have on the concentration of a substance?
- What effect does the amount of solute have on the boiling/freezing point of a substance?
- What occurs for a chemical process to exist at equilibrium?
- How is the pH midpoint represented by an equilibrium process?
- What properties distinguish between an acid and a base?

Enduring Understandings

- Molarity is the amount of moles per liter of solution.
- Molality is the amount of moles per kilogram of solution.
- Solutes can increase the boiling point of substances (boiling point elevation) and decrease the freezing point of substances (freezing point depression), known as colligative properties.
- Equilibrium is a point where two competing processes (forward and reverse) occur at equal rates.
- Systems can be stressed by changes in temperature, pressure, and addition/removal of reagents.
- pH is scaled logarithmically so a change of 1 on the scale represents a solution becoming 10x more or less acidic.

Objectives

Students Will Know

- Students will know how to identify the parts of a solution (solute vs. solvent).
- Students will know how to identify a solution as unsaturated, saturated, or supersaturated.
- Students will know how to calculate molarity, molality, and colligative properties (boiling point elevation and freezing point depression)

- Students will know how to recognize a system at equilibrium.
- Students will know how to identify a substance as an acid or a base.
- Students will know the difference between strong and weak acids or bases.
- Students will know the primary definitions of acids and bases.
- Students will know how the temperature and pressure affect the solubility of solutes.
- Students will know how to calculate the concentration of a solution (molarity/molality).
- Students will know how the properties of a solution (i.e. boiling point) are affected by concentration (molality).

Students Will Be Skilled At

- Students will be skilled at calculating molarity and molality.
- Students will be skilled at calculating the freezing point depression or boiling point elevation of a substance.
- Students will be skilled at identifying the number of ions (Van't Hoff factor) that a solute creates in solution.
- Students will be skilled at calculating the pH of a solution.
- Students will be skilled at recognizing equations including strong or weak acids and bases.

Learning Plan

- Preview essential questions and connect them to the concepts we will cover in the unit.
- Identify solutions as unsaturated, saturated, and supersaturated.
- Define molality and molarity.
- Calculate the molarity of a solution.
- Calculate the molality of a solution, and determine the boiling point elevation or freezing point depression of various substances using their Van't Hoff factors.
- Define acids and bases according to their behavior as described by Arrhenius, Bronsted, and Lewis.
- Differentiate between strong and weak acids and bases.
- Calculate the pH of a solution and determine the percent acidity change for a 0.1 and 1.0 change in pH level.
- Utilize chemical equations, pH, and the concept of equilibrium to identify strong and weak acids and bases.
- Prepare solutions of specific molar or molal concentrations (i.e. for use during a lab).
- Investigate how temperature affects the solubility of substances (or pressure on gases) and/or equilibrium of a solution.
- Predict and experimentally determine the change in boiling point and freezing point when a solute is dissolved in water.

Assessment

Formative Assessment

- Do Now Questions
- Exit Ticket Questions
- Whole Class Discussion Participation
- Small Group Discussion Participation
- Individual Student Questions/Responses
- Independent Tasks
    - Identify a solution as unsaturated, saturated, or supersaturated.
    - Calculate the molarity of a solution.
    - Calculate the molality and colligative properties of a solution.
    - Identify strong and weak acids and bases by properties and when viewing equations.
    - Define acids and bases according to three characteristics (Arrhenius, Bronsted, Lewis).
    - Calculate the pH of a solution.
    - Determine how temperature affects the solubility of a substance or solution.
- Lab Experiments

Summative Assessment

- Unit Quizzes
- Unit Tests
- Lab Reports

Benchmark Assessment

- CP Chemistry Final Exam

Alternative Assessment

- Prepare solutions of specific molar or molal concentrations.
- Evaluate the change in boiling point of water with the addition of a solute.
- Predict the acidity of various household substances and test them using pH paper.

Materials

- SAVVAS Experience Chemistry 2021 Textbook Volumes 1 & 2
- Guided notes
- Teacher handouts
- Supplementary worksheets
- Lab Handouts (Boiling Point Elevation Lab, pH Lab, Titration of Vinegar/HCl Lab, NOTE: Supplies for each lab included on handout.)
- Simulations:
    - "Collisions" [https://app.playmada.com/Collisions/] Acids/Bases, Equilibrium
    - "Virtual Titration Experiment" [https://virtual.edu.rsc.org/titration/experiment/2]
    - "pH Scale: Basics" [https://phet.colorado.edu/en/simulation/ph-scale-basics]
    - "pH Scale" [https://phet.colorado.edu/en/simulation/ph-scale]
    - "Acid-Base Solutions" [https://phet.colorado.edu/en/simulation/acid-base-solutions]
    - "Molarity" [https://phet.colorado.edu/en/simulation/molarity]
    - "Concentration" [https://phet.colorado.edu/en/simulation/concentration]
- Safety Supplies (specifics to when they are required included in lab handouts)

Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk students, Gifted and Talented students, Career Education, and those with 504s

https://docs.google.com/spreadsheets/d/1mfe42JCam4Rlgd626vidMg54nDZ1ic055qKKGLvhcPg/edit?usp=sharing