International Baccalaureate
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MYP/3D Science Unit Planner

Marietta City Schools

MARIETTA CITY SCHOOLS

Grade & Course: 9-12 Chemistry	**Topic:** Solutions and Acids/Bases	**Duration:** 6 weeks

Georgia Standards and Content:

SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases.

a. Develop a model to illustrate the process of dissolving in terms of solvation versus dissociation.
b. Plan and carry out an investigation to evaluate the factors that affect the rate at which a solute dissolves in a specific solvent.
c. Use mathematics and computational thinking to evaluate commercial products in terms of their concentrations (i.e. molarity and percent by mass).
d. Communicate scientific and technical information on how to prepare and properly label solutions of specified molar concentration.
e. Develop and use a model to explain the effects of a solute on boiling point and freezing point.
f. Use mathematics and computational thinking to compare, contrast, and evaluate the nature of acids and bases in terms of percent dissociation, hydronium ion concentration, and pH. (Clarification Statement: Understanding of the mathematical relationship between negative logarithm of the hydrogen concentration and pH is not expected in this element. Only a conceptual understanding of pH as related to acid/basic conditions is needed.)
g. Ask questions to evaluate merits and limitations of the Arrhenius and Bronsted-Lowry models of acid and bases.
h. Plan and carry out an investigation to explore acid-base neutralization.

Narrative / Background Information

Prior Student Knowledge: (REFLECTION – PRIOR TO TEACHING THE UNIT)

SPS6b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent.
SPS7b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation.
SPS7c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels).
SPS7d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.

Year-Long Anchoring Phenomena: (LEARNING PROCESS)

Changes to the measurement of chemicals added to Flint Michigan's water supply created dangerous levels of lead contamination in the drinking water.

Unit Phenomena (LEARNING PROCESS)

The pH of seawater is decreasing due to increased carbon dioxide absorption by the oceans, negatively impacting marine ecosystems, coral reefs, and marine life with potential far-reaching consequences on biodiversity and global food chains.

OR

When engaging in vigorous physical activity the body produces lactic acid which is neutralized by the body through various chemical processes.

MYP Inquiry Statement:

A dynamic exchange of solute and solvent particles exists within aqueous solutions, leading to the establishment of chemical equilibrium and influencing crucial properties like pH levels.

MYP Global Context:

Fairness and Development

Approaches to Learning Skills:

- Communication skills
- Social skills
- Self Management skills
- Research skills
- Thinking skills

Disciplinary Core Ideas: (KNOWLEDGE & SKILLS)

Solutions
- Parts of a Solution
- Solvation
- Dissociation
- Rate of Dissolving

- Concentration / Saturation
  - Molarity
  - Percent by Mass
  - Dilution

Crosscutting Concepts: (KNOWLEDGE & SKILLS)

- Systems and System Models
- Patterns
- Stability and Change
- Cause and Effect

MYP Key and Related Concepts:

- Systems

	● Saturated, unsaturated, supersaturated solutions
	● Solution Preparation and Proper Labeling
	● Colligative Properties
	  ● Boiling Point Elevation
	  ● Freezing Point Depression
	● Acids and Bases
	  ● H_3O^+ Concentration
	  ● pH
	  ● Arrhenius Model
	  ● Bronsted-Lowry Model
	● Neutralization
	  ● Equivalence Point
	  ● Titration
	  ● Indicator
	  ● End point
		Related Concept(s)
		● Models
		● Movement
		● Interaction
		● Conditions
		● Function

Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)

- To dissolve means a substance disappears or is lost
- Freezing point and melting points are constant values
- Acids always have Hs and bases always have OHs
- Solutions are always liquids
- Acids are dangerous and bases are not
- Acids and bases cannot be consumed by humans (aka all chemicals, not in everyday products)
- All solutions are saturated
- You can tell the difference between the solutions just by looking at them

Key Vocabulary: (KNOWLEDGE & SKILLS)

- Solution
- Solvation
- Dissociation
- Rate of solvation
- Solute
- Solvent
- Saturated Solution
- Unsaturated Solution
- Supersaturated Solution
- Concentration
- Molarity
- Percent by mass
- Percent by volume
- Colligative property
- Boiling point
- Freezing point
- Percent dissociation

- Acid
- Base
- Arrhenius Acid/Base
- Lewis Acid/Base
- Bronsted-Lowry Acid/Base
- Neutralization
- Hydronium ion
- pH
- Equivalence point
- Titration
- Indicator
- End Point

Inquiry Questions:

Factual:

- What are the key properties that define a solution, and how do solutes and solvents interact?
- How do acids and bases differ in terms of pH, ion concentration, and their chemical properties?
- What are the common indicators used to determine whether a substance is an acid or a base?
- How does the process of neutralization occur, and what are the products of an acid-base reaction?

Conceptual:

- How do the properties of solutions, such as concentration and solubility, influence their real-world applications?
- Why is pH important in biological and environmental systems, and how can changes in pH impact these systems?
- How do acids and bases interact in neutralization reactions, and why are these reactions significant in everyday life?
- What factors affect the solubility of a substance, and how can solubility be manipulated in different industries (e.g., medicine, food production)?

Debatable

- Should the use of strong acids and bases in household products be more strictly regulated to prevent environmental and health hazards?
- Is the widespread use of acid rain mitigation strategies enough to counteract its long-term effects on ecosystems?
- Should industries be required to neutralize all acidic and basic waste before disposal, even if it increases production costs?
- Are artificial pH-balancing methods in food and water necessary, or do they pose more risks than benefits?

MYP Objectives	Summative assessment

Sciences	Criterion A: Knowing and Understanding ● Common Summative Assessment Criterion B: Inquiring and Designing Criterion C: Processing and Evaluating ● Common Laboratory Experience	Relationship between summative assessment task(s) and statement of inquiry: Students will perform tasks and respond to assessment items that will gauge their mastery of reactions as required by the Georgia Standards of Excellence. Mastery of these concepts is necessary to move forward in our student of chemical behavior.

Unit Objectives:

Learning Activities and Experiences	Inquiry & Obtain: (LEARNING PROCESS)	Evaluate: (LEARNING PROCESS)	Communicate: (LEARNING PROCESS)
Weeks 1-4:	**Engage:** ● Core Interactive Text: Thinking About Acid and Bases ●Activity: "Mystery Liquids" Demonstration The teacher presents three mystery liquids (vinegar, water, ammonia) and asks students: How can we determine if these are acids, bases, or neutral substances? What properties do they have that might help us classify them? Students record observations and hypothesize the nature of each liquid. Discussion on why solutions matter in daily life (e.g., sports drinks, cleaning agents, medicine). **Explore:** ● Activity: Demonstration of solubility using sugar and salt in water at different temperatures. ● Lab: Making different concentrations of Kool-Aid and comparing saturation.	**Evaluate:** ● Research real-world examples of solubility (e.g., medicine, environmental impact). ● Exit Ticket: Explain how temperature affects solubility.	**Explain:** ● Mini-lesson: Define solutions, solutes, solvents, and solubility. **Elaborate:** ● Activity 1: Acid Rain Case Study Students analyze acid rain data and its effects on ecosystems. They answer: How does acidic precipitation affect soil, plants, and water sources? What solutions exist to reduce acid rain?
Weeks 5-6:	**Engage:** ● Identify household acids and bases. ● Demo: Antacid neutralizing stomach acid. **Explore:**	**Evaluate:** ● Common Formative Assessment ● Exit Ticket: Compare the properties o acids and bases. ● The impact of ocean acidification.	**Explain:** ● Notes: Properties of acids and bases, Arrhenius vs. Bronsted-Lowry definitions. ● Guided Practice: Writing and balancing neutralization reactions. **Elaborate:**

	● Activity: Litmus paper testing of common substances. ● Interactive pH Lab: Students test various substances with pH indicators.		● Activity 2: Debate – Should Industries Neutralize All Waste? Groups research the pros and cons of neutralizing industrial waste before disposal. Students argue their positions and propose realistic solutions.
Week 7:	**Engage:** ● Debate: Should industries neutralize all acidic/basic waste before disposal? **Explore:** ● Jeopardy-style game covering key concepts.	**Evaluate:** ● Common Formative Assessment ● Common Summative Assessment	**Explain:** ● Review:Should industries neutralize all acidic/basic waste before disposal? **Elaborate:** ● Activity 3: Antacid Investigation Students test antacids by measuring how well they neutralize stomach acid (vinega + baking soda reaction). Discuss: Why do people take antacids? How do they work chemically?

Resources (hyperlink to model lessons and/or resources):
Discovery Education Science Techbook

Reflection: Considering the planning, process and impact of the inquiry

Prior to teaching the unit	During teaching	After teaching the unit
Students may already have some familiarity with acids and bases (e.g., lemon juice is acidic, soap is basic), but they may not understand why these substances behave differently.	What can we adjust or change? Spiral and reteach Physical Science Standard: SPS6. Did they do well on the CFA? What do we need to reteach? What do they need to practice more? procedural skills to be able to complete assignments - more explicit teaching of skills not just content	How well did the summative assessment task serve to distinguish levels of achievement?