Richmond Public Schools

Department of Curriculum and Instruction

Curriculum Pacing And Resource Guide – Unit Plan

Course Title/ Course #: EOC Chemistry/2802 or EOC Pre AP Chemistry/ 2804

Unit Title/ Marking Period # (MP):3

Start day: Day 116

Meetings (Length of Unit): 2 Weeks

Desired Results ~ What will students be learning?

Standards of Learning/ Standards

CH.4 c,d

CH.4 The student will investigate and understand that chemical quantities are based on molar relationships. Key concepts include
c) solution concentrations; and
d) acid/base theory; strong electrolytes, weak electrolytes, and nonelectrolytes; dissociation and ionization; pH and pOH; and the titration process.

Essential Understandings/ Big Ideas

The concepts developed in this standard include the following:
 When solutions are diluted, the moles of solute present initially remain.
 The saturation of a solution is dependent on the amount of solute present in the solution.
 Two important classes of compounds are acids and bases. Acids and bases are defined by several theories. According to the Arrhenius theory, acids are characterized by their sour taste, low pH, and the fact that they turn litmus paper red. According to the Arrhenius theory, bases are characterized by their bitter taste, slippery feel, high pH, and the fact that they turn litmus paper blue. According to the Bronsted-Lowry theory, acids are proton donors, whereas bases are proton acceptors. Acids and bases dissociate in varying degrees.
 Strong electrolytes dissociate completely. Weak electrolytes dissociate partially. Non-electrolytes do not dissociate.
 pH is a number scale ranging from 0 to 14 that represents the acidity of a solution. The pH number denotes hydrogen (hydronium) ion concentration. The pOH number denotes hydroxide ion concentration. The higher the hydronium [H3O+] concentration, the lower the pH.
 pH + pOH = 14
 Strong acid-strong base titration is the process that measures [H+] and [OH-].
 Indicators show color changes at certain pH levels.

Key Essential Skills and Knowledge

In order to meet this standard, it is expected that students will

 differentiate between the defining characteristics of the Arrhenius theory of acids and bases and the Bronsted-Lowry theory of acids and bases.
 identify common examples of acids and bases, including vinegar and ammonia.
 compare and contrast the differences between strong, weak, and non-electrolytes.
 relate the hydronium ion concentration to the pH scale.
 perform titrations in a laboratory setting using indicators.

Vocabulary

acid	mixture	electrolyte	indictor
empirical formula	solution	STP	volume
endpoint	formula mass	standard solution	pH
base	Bronsted-Lowry acid	gas solution	Bronsted-Lowry base
phenolphthalein	molar mass	gram atomic mass	solute
solid solution	solvent	pOH	Avogadro's principle
Arrehenius base	coefficient	molecular formula	Kelvin
liquid solution	gram formula mass	ideal gas	titration

Assessment Evidence ~ What is evidence of mastery? What did the students master & what are they missing?

Assessment/ Evidence

Evidence of Mastery: Students will display mastery by consistently scoring at a "C" or above range on all assessments. Success and mastery will also be shown by increasing scores from the beginning of the unit to the end of the unit. Overall mastery of the content and successful learning of the Targeted Objectives will be measured by assessing the Lab Journal for the "PALs: Acid-Base Titration" and the final unit assessment. Mastery will result in score 90 out of 100 points on the Acid-Base Lab Rubric and the final assessment scores at or above "C".

Other Assessment Methods

- Group Discussions
- Student Reports
- Teacher-Created IA Test/Quiz
- Writing Assignment

Learning Plan ~ What are the strategies and activities you plan to use

Learning Experiences/ Best Practice

- Dissolve copious amounts of salt in hot water, and fill a plastic bottle with the salt water solution. Add pure tap water to another plastic bottle, place the bottles in the freezer, and let them sit overnight. The next day, retrieve the bottles and observe. The pure water will be frozen because the freezer temperature is below the freezing point of pure water. The salt water will not be frozen because it freezes at a lower temperature than what is found inside the freezer. Discuss with your class why this might be. (Note: It is recommended to try this demonstration on your own before doing it with your class.)
- Mix salt into warm water to create a saturated salt solution. Have students bring the salt water to a boil and pure water to a boil. When students measure the temperature of each boiling solution, they will see that the boiling salt water is hotter than the pure water. Next, add salt water and pure water to separate plastic baggies, and place the baggies in the freezer overnight. The next morning, students will see that the pure water is frozen but the salt water is not. These demonstrations illustrate that salt elevates the boiling point and depresses the freezing point of pure water.
- Obtain a variety of solutes (sucrose, NaCl, CaCl2, KCl, etc.), and create a 1-mol/L solution with each. (Note: The mass of 1 mole of a substance in grams is equal to the molecular mass of the substance. For example, the molecular mass of sodium chloride is 22.99 u (Na) + 35.45 u (Cl) = 58.44 u. Thus, 1 mole of sodium chloride has a mass of 58.44 grams. A 1-mol/L NaCl solution contains 58.44 g of NaCl and 1 L of water.) Ask students to predict the effect of each solute on the boiling and freezing points of water. Have students determine the boiling point of each solution and compare these results to their predictions. (Note: At higher elevations, the boiling point of water is reduced.) Determining the exact freezing point of each solution is more difficult, but baggies of each solution can be visually compared after a night in the freezer.
- Practice using pH indicator paper to measure the pH of various substances. (Students should wear aprons/lab coats, goggles, and latex gloves if they are handling strong acids or bases.) After measuring pH, ask students to describe some of the common properties of acids and bases. For example, some bases such as soap are slippery to the touch and have a bitter taste. Acidic foods tend to be tart or sour. (Do NOT taste strong acids or bases.) Strong acids can corrode metal, while strong bases help to break down organic matter such as a hairball that is blocking the drain in a bathroom sink.
- An acid-base indicator is a substance that changes color when the pH changes. Along with commercial pH paper, several natural substances can be used as indicators. The most well-known natural pH indicator is red-cabbage juice. Boil red cabbage leaves for several minutes in a small amount of water. Pour the red juice into a large beaker and use this juice as a pH indicator. The cabbage juice turns pink in an acid and green or yellow in a base. (See the Selected Web Resources for details.)
- It doesn't take very much acid or base to dramatically change the pH of a solution. To demonstrate this, fill a beaker with about 100 mL of tap water and place it in front of the class. Use pH indicator paper to measure the pH of the water. (The pH should be close to 7.0.) Add two drops of 1.0 M HCl to the water and mix. Ask students to predict the new pH of the water. Use the pH paper to measure the new pH, which should be around 3. Next, repeat the equivalent experiment with a strong base such as NaOH. A few drops of 1.0 M NaOH should increase the pH of water from 7 to about 10. This experiment shows that the volume of titrant needed to neutralize a solution is extremely close to the volume needed to cause an indicator in the solution to change color.

Field Trips

- **Sewage Treatment Plant**
  Most cities and towns are within driving distance of a sewage treatment plant. A tour of the plant will teach students about the chemistry behind water purity, pH factor, pollution and some kinds of disease. Pair this field trip with classroom labs on filtering or purifying water.
- **Manufacturing**
  Chemistry is an integral part of many manufacturing operations, and a visit to a manufacturing plant or factory can be interesting and educational for a chemistry class. Countless products require the use of specialized chemicals or mixtures of chemicals in order to get made. If you can get access to a plant where students can see the result of professional chemistry it can be an unforgettable experience. Some good examples would be metal (where elements are mixed to create different grades of steel), computer components (where chemicals are used to create raw materials and others are used to make them market-ready) or plants where chemicals themselves are prepared for sale. Students can learn about the composition of Coca-Cola at a bottling facility, or take note of the melting points and composition of steel at a steel mill.
- **Ordinance Disposal**
  Pyrotechnics is a branch of applied chemistry. Most metropolitan areas have a day or two a year where the police blow up confiscated ammunition and explosives. Though not the most educational field trip imaginable, this will definitely be one of the most popular. Contact your local police department to get this ball rolling, and definitely get permission from your administrator.
- **Fire Department**
  Fire is a chemical reaction, and fire suppression depends on other chemical reactions. A trip to the fire department can show students how knowing the way chemicals can interact will save lives. As firefighting is a high-glamour job, this field trip can attract students who otherwise seem disinterested in chemistry.
- **Waste Treatment Plant**
  Chemistry is an important part of sewage treatment. When people flush their toilets, all that water has to be treated and purified before it can be released back into nature. The chemical changes that sewage goes through, including filtering and ultraviolet light, would make good examples for how chemistry is used in daily life. Most cities or towns have at least one municipal waste treatment plant.
- **Crime Lab**
  With crime scene investigation being popularized by television shows like "CSI," students may be eager to watch chemistry at work in a crime lab. Contact the local police department to make arrangements for your class to tour the crime lab. If the local police department doesn't have a crime lab of their own, find out where the police send all their crime scene evidence to be processed, and contact that facility about a tour.

POGIL Activities	Labs
Interpreting Solubility Curves Introduction to Acids and Bases Acid-Base Neutralization Reactions	Antacid – An interesting experiment that takes a closer look at acids and bases. The SOLUTION to SOLUBILITY is the SOLVENT - To determine the solubility of three general types of common solvents: water, alcohol and xylene Are We Saturated Yet? - To make and observe the properties of unsaturated, saturated, and supersaturated solutions, using photography fixer. PALs: Acid-Base Titration - Students will determine the concentration of an unknown solution.

Technology Integrations

Gizmos	PhET Simulation:	Online Flex Books
Colligative Properties Freezing Point of Salt Water Phase Changes Solubility and Temperature Osmosis Titration pH Analysis pH Analysis: Quad Color Indicator ph Analysis with OH Calculation	Salts & Solubility Sugar & Salt Solutions Acid-Base Solutions pH Scale: Basics pH Scale	Properties of Solutions Solution Formation Measuring Concentration Factors Affecting Solubility Solubility Graphs Colligative Properties

Resources

VDOE Lesson Plans	Other natural substances can also be used as indicators:	Power Points	Selected Web Resources
Solution Concentrations (PDF) / (Word) Acids and Bases (PDF) / (Word) Acid-Base Theory (PDF) / (Word)	• Red beet juice changes from red to yellow in strong bases. • Curry powder and turmeric are spices that contain a bright yellow pigment that	Bulk Properties of Water Properties of Solutions Calculations of Solution Concentration Colloids and Suspensions Properties of Acids Bases pH Calculations	Acid-base basics Acids, bases The pH scale Cabbage juice indicator lab Natural indicators Pickle science Colligative properties Colligative properties II Salt and the boiling point of water Boiling point elevation Freezing point depression

	changes from yellow to red in bases (pH > 8.5). • Blueberries turn red in strong acids (pH < 3). • Strong black tea becomes lighter in color when acids are added		Osmotic pressure Dissociation

Cross Curricular Connection

English: Journalists often write about "scientific proof" and some scientists talk about it, but in fact, the concept of proof — real, absolute proof — is not particularly scientific. Science is based on the principle that any idea, no matter how widely accepted today, could be overturned tomorrow if the evidence warranted it. Science accepts or rejects ideas based on the evidence; it does not prove or disprove them. To learn more about this, visit our page describing how science aims to build knowledge.

Math: Calculating mean, median & mode.

Real World: Use everyday ideas to introduce the terms and promote discussion:
– Accuracy and precision are required to succeed at darts and archery.
– A cookery book must contain recipes that are repeatable and reproducible, otherwise no one would want to buy it.