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 102

Meetings (Length of Unit): 3 Weeks

Desired Results ~ What will students be learning?

Standards of Learning/ Standards

CH.4 b

CH.4 The student will investigate and understand that chemical quantities are based on molar relationships. Key concepts include
b) stoichiometric relationships;

Essential Understandings/ Big Ideas

The concepts developed in this standard include the following:
- Stoichiometry involves quantitative relationships. Stoichiometric relationships are based on mole quantities in a balanced equation.
- Total grams of reactant(s) = total grams of product(s).
- Molarity = moles of solute/L of solution.
- [ ] refers to molar concentration.

Key Essential Skills and Knowledge

In order to meet this standard, it is expected that students will
- identify the limiting reactant (reagent) in a reaction.
- calculate percent yield of a reaction.
- perform calculations involving the molarity of a solution, including dilutions.
- interpret solubility curves.

Vocabulary

Solid Solution	Mixture	Solvent	Gas Solution	Gram Formula Mass
Liquid Solution	Solution	Molar Volume	Gram	Solute
Electrolyte	Formula Mass	Solution	Atomic Mass	Avogadro's Principle
STP	Molar Mass	Coefficient	Molecular Formula	Limiting Reactant
Theoretical Yield	Dilutions	Molarity	Percent Yield	Excess

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 "Reaction of Copper Lab" and the final unit assessment. Mastery will result in score 90 out of 100 points on the Reaction of Copper 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

Possible Misconceptions

- Students may often see the Mole as just a number (1 mole, 2 moles, etc.) but should emphasize that 1 mole is equal to Avogadro's constant, 6.02 x 1023.
- Students may try to change the subscripts in chemical formulas rather than the coefficient in front of the chemical formula (remind them that if no coefficient, it is 1).
- Limiting reagent: students might choose the reactant with the smallest number of moles as the limiting reactant (must consider RATIO of reactants instead)
- Students equate the mass ratio of atoms in a molecule with the ratio of the number of these atoms and the mass ratio with the molar mass ratio.
- Students calculate the molar mass of a given substance by summing up the atomic masses and then multiplying or dividing this sum by the coefficient of the substance in the chemical equation; others do not understand the significance of the coefficients in a chemical equation at all.
- Students confuse the concepts of conservation of atoms and possible non-conservation of molecules or do not take into account the conservation of atoms or mass at all.
- Students cannot determine the 'limiting reagent' in a given problem, when one substance is added in excess.
- Students confuse or do not know the definitions of and relationships between stoichiometric entities in general.

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

Learning Experiences/ Best Practice

- Have students work in groups to assemble a snack food, such as a slice of celery with a tablespoon of peanut butter or a cracker with a slice of cheese. Make sure each group has an excess of one ingredient. After students assemble their snacks, have them identify how many total snacks they were able to make, how much of the excess ingredient they have left over, and which ingredient limited the number of snacks they could produce. Explain to students that this situation—having an excess of one substance and not enough of another—often occurs when chemical reactions take place. Have students discuss what they think will happen in chemical reactions with excess and limiting reactants.
- Fill five empty soda bottles with 250 mL of vinegar. Add the following amounts of baking soda to five labeled balloons: 6 g, 12 g, 18 g, 24 g, and 30 g. Stretch the balloons over the mouth of each bottle (you may want to secure the balloons with rubber bands), and shake the bottles to mix the ingredients. The baking soda will begin to react with the vinegar to produce carbon dioxide gas. The gas will cause the balloons to expand. Have students compare the size of the balloons after the reactions are finished. Students should realize that the 6-g balloon is smallest, the 12-g balloon is slightly larger, and the 18-g balloon is larger still. However, the 24-g balloon and 30-g balloon are the same size as the 18-g balloon. Have students use what they've learned about limiting reactants to explain why. For other ideas of limiting reactant lab demonstrations and experiments, see the Selected Web Resources.
- Stoichiometry Teaching Strategy: Start off with different counting words, like a couple (=2) or a dozen (=12), and then the mole (=6.02 x 1023). So the mole is related to a specific number and can be used to count anything. In chemistry, the mole is a standard number of particles, 6.02 x 1023 molecules, atoms, or ions, etc. In fact, the mole is an SI Unit for an amount of a substance.
- Chemical Proportions in Compounds: Teaching Strategy: Molecular modelling kits or Lego can be useful in showing the difference between an

empirical formula and a molecular formula. Can mass the atoms making up an empirical formula and relate to the mass of atoms making up different molecular formulas that are whole number multiples of the original empirical formula (e.g. Compare mass of modelling kit atoms for the empirical formula CH, and the molecular formulas C_2H_2 and C_6H_6).

- Cutouts of cars and wheels put in different ratios. Have students predict how many cars they can make (one body and 4 wheels). Will find that wheels often run out first, so LIMITING REAGENT, even though more wheels than car bodies.

POGIL Activities

Limiting Reactants
Percent Composition
Molarity

Labs

Limiting reactant labs
Limiting Reactant Lab II
Limiting Reactant Lab III
S'mores Activity pdf
Nuts and Bolts Activity pdf
Baking Soda Limiting Reagent (pdf)
Reactions of Copper (pdf)
Reactions of Copper version 2

Technology Integrations

PhET Simulations:

Reactants, Products & Leftovers
Beer's Law Lab
Molarity
Concentration

Gizmos

Stoichiometry
Limiting Reactants

Resources

Review Power Point

Molar Relationships
Stoichiometry

Videos

% Yield
Calculating Masses in Reactions
Theoretical Yield

Selected Web Resources

Introduction to stoichiometry
Stoichiometry
Stoichiometry tutorial
Limiting reactant tutorials
Limiting Reactant Practice Problems
Mr. Christopherson's Website

United Streaming Videos

- A Simplified Conversion Equation and Review
- Standard Deviants School Chemistry: Percent Composition
- Chemistry Connections: Acid-Base Stoichiometry and Titration Curves
- Chemistry Connections: Oxidation-Reduction Titrations and Stoichiometry
- Head Rush: Liquid Nitrogen Balloon
- How Do Chemists Use Indicators?
- Using Acid-Base Titration to Solve a Mystery

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.