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 91

Meetings (Length of Unit): 2 Weeks

Desired Results ~ What will students be learning?

Standards of Learning/ Standards

CH.3e-f

CH.3 The student will investigate and understand how conservation of energy and matter is expressed in chemical formulas and balanced equations. Key concepts include
e) reaction types; and
f) reaction rates, kinetics, and equilibrium.

Essential Understandings/ Big Ideas

The concepts developed in this standard include the following:

 Major types of chemical reactions are
- synthesis (A+B AB)
- decomposition (BC B+C)
- single replacement (A+BC B+AC)
- double replacement (AC+BD AD+BC)
- neutralization (HX+MOH H_2O + MX)
- combustion ($C_xH_y + O_2$ $CO_2 + H_2O$).

 Kinetics is the study of reaction rates. Several factors affect reaction rates, including temperature, concentration, surface area, and the presence of a catalyst.

 Reaction rates/kinetics are affected by activation energy, catalysis, and the degree of randomness (entropy). Catalysts decrease the amount of activation energy needed.

 Chemical reactions are exothermic reactions (heat producing) and endothermic reactions (heat absorbing).

 Reactions occurring in both forward and reverse directions are reversible. Reversible reactions can reach a state of equilibrium, where the reaction rates of both the forward and reverse reactions are constant. Le Chatelier's Principle indicates the qualitative prediction of direction of change with temperature, pressure, and concentration.

Key Essential Skills and Knowledge

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

- classify types of chemical reactions as synthesis, decomposition, single replacement, double replacement, neutralization, and/or combustion.
- recognize that there is a natural tendency for systems to move in a direction of randomness (entropy).
- recognize equations for redox reactions and neutralization reactions.
- distinguish between an endothermic and exothermic process.
- interpret reaction rate diagrams.
- identify and explain the effect the following factors have on the rate of a chemical reaction: catalyst, temperature, concentration, size of particles.
- distinguish between irreversible reactions and those at equilibrium.
- predict the shift in equilibrium when a system is subjected to a stress (Le Chatelier's Principle) and identify the factors that can cause a shift in equilibrium (temperature, pressure, and concentration.)

Vocabulary

catalyst	Haber process	phases	single replacement
compounds	ion	potential energy	spontaneous surface area
combustion	ionization	pressure	synthesis
concentration	ionic compounds	product	temperature
covalent bonding	entropy	reactant	yield symbol
decomposition	Intermolecular forces	reaction	anion
energy	kinetic energy	reaction rate	LeChatelier's Principle
endothermic	metallic bonding	reduction	chemical equilibrium
equilibrium	molecules	reversible	nuclear
equilibrium constant	molecular bonding	cation	enthalpy
exothermic	neutralization	molecular compounds	particle size
	oxidation	Nomenclature	

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 LeChatelier's Principle Virtual Lab and the final unit assessment. Mastery will result in score 90 out of 100 points on the LeChatelier's Principle Virtual Lab Rubric and the final assessment scores at or above "C".

Other Possible Assessments

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

Possible Learning Gaps

- Many students erroneously assume that the condition of equilibrium means equal concentrations of reactants and products.
- Students do not easily grasp the notion that one can approach an equilibrium state from either direction.

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

Learning Experiences/ Best Practice

- Ask students if the rate of a chemical reaction depends on the ability of molecules or ions to make consistent and effective collisions with each other. In this experiment, you will study various conditions and the effect they have on the collision of molecules. You will observe the effects of temperature, concentration, particle size (surface area), and catalysts on the rates of chemical reactions and then explain these effects in terms of the collision theory.
- **Journal/Writing Prompts**
  - Describe the effect of temperature on the reaction rate. Explain this effect in terms of the collision theory of reactions.
  - Describe the effect of concentration on the reaction rate. Explain this effect in terms of the collision theory of reactions.
  - Describe the effect of particle size or surface area on the reaction rate. Explain this effect in terms of the collision theory of reactions.
  - Describe the effect of a catalyst on the reaction rate. Explain this effect in terms of the collision theory of reactions. Rates of speed of chemical reactions depend on the ability of molecules to make consistent and effective collisions with each other. Explain the factors and the impact they have on rates of reactions.
- Have groups of students explore the following reaction to study further the effect of temperature on reaction rate:
  - Fill each of five 250-mL beakers with 100 mL of water adjusted to the following temperatures: 0°C, 10°C, 20°C, 30°C, and 40°C. Adjust the temperatures by using ice water, tap water, and hot water.
  - Add one Alka-Seltzer tablet to each beaker, and time the reaction until every last bit of the tablet stops fizzing. Record the results in a data table.
  - Using the data, construct a graph of the reaction time versus temperature.
  - How did the reaction rate vary with the temperature? Explain. A general rule of thumb is that on average, the reaction rate doubles for every 10°C rise in temperature. Does this rule hold true for this reaction?
- Have groups prepare an electronic presentation of their four experiments. Presentations should include photos of results and models/diagrams/animation that show how changing the variable in each experiment affects the ability of molecules to make consistent effective collisions with each other.
- Have students take digital pictures of the reactants and results of each of four experiments.
- Color-code signs to label stations with corresponding color-coded directions for each experiment.
- Invite a local chemist to demonstrate chemical reactions by other means.
- Have students do this lesson as four separate minilabs. Set up separate stations for each of the four experiments, and have students work in groups of two or three. Put specific directions at each station. Have groups complete one experiment before moving to another station, but the order in which they move is not important.
- Have the class determine a local industry and arrange for the class or a team of students to visit, or have a guest speaker from a local industry that uses the Le Chatelier's principle in product manufacturing.
- Le Chatelier's principle can be demonstrated through a student-movement demonstration: If a student pushes another student, a discussion can evolve around the reaction. How does one individual affect the movement of another?
- Have students create a color-coded flow chart to represent the reactions observed in the demonstrations.

POGIL Activities	Labs
Classifying Types of Chemical Reactions Oxidation and Reduction Half-Reactions Net Ionic Reactions Collision Theory Dynamic Equilibrium Equilibrium and Le Chatelier's Principle	Classify Chemical Reactions Classify Chemical Reactions: Analyzing & Predicting Products Classifying Chemical Reactions Rates of Reactions Rates of Reactions II Endothermic/Exothermic Lab Energy Changes in Chemical Reactions LeChatelier's Principle Virtual Lab Equilibrium and LeChatelier's Principle Lab Chemical Equilibrium and LeChatelier's Principlae Lab NSTA: All Things Equal

Technology Integrations

Gizmos	PhET Simulations:
Equilibrium & Concentration Equilibrium & Pressure Collision Theory	The Greenhouse Effect Microwaves Reactions & Rates Reversible Reactions

Resources

	Videos
Mr. Christopherson's Website **VDOE Lesson Plans** The Rate of a Chemical Reaction (PDF) / (Word) Equilibrium and Le Chatelier's Principle (PDF) / (Word) **Review Power Points** Reaction Types Basic Thermochemistry Thermochemical Calculations Reaction Kinetics Equilibrium and Le Chatelier's Principle	Types of Chemical Reactions What is Combustion? Redox Equations Collison Theory Part I Collison Theory Part II: Endothermic vs. Exothermic Rates of Reactions What are Reversible Reactions? LeChateller's Principle LeChatelier's Principle II What is Dynamic Equilibrium?

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.