Murrieta Valley Unified School District **Board Submission: May 2018**
HIGH SCHOOL COURSE OUTLINE

Course Title: Medical Chemistry

Department: Science

Course #: 3524

Grade Level/s: 10-12

Length of Course: 1 year

Prerequisite/s: Completion of Biology or Medical Biology, and concurrent enrollment in Math II or higher.

UC/CSU (A-G) Req: (D) Laboratory Science

Brief Course Description: This course meets UC/CSU (D) laboratory and district physical science graduation requirement. This course is designed to prepare the college-bound student for the rigors they will encounter as they enter college science courses and satisfies the laboratory science requirement for entrance into most colleges. The emphasis of study will be on human chemical concepts and processes as they apply to the human body, such as how biomolecules and the essential chemicals for life cycle in the body. This course is different from Chemistry in that it focuses on chemical processes that occur in the human body. This course includes labs and activities that can be used to reinforce the Next Generation Science Standards (NGSS) and incorporate a link between chemistry and medicine.

I. GOALS

The students will:

A. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms
B. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties
C. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy
D. 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.
E. Refine the designed of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium
F. Use mathematical representation to support the claim that atoms, and therefore mass, are conserved during a chemical reaction

G. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion and radioactive decay
H. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known
I. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles
J. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system

II. OUTLINE OF CONTENT FOR MAJOR AREAS OF STUDY

Semester 1

A. Foundations of Chemistry
Topics may include:
1. Significant Figures
2. Accuracy and Precision
3. SI Units; Unit Conversions
4. Scientific Notation

B. Energy (HS-PS1-4, HS-PS3-1, HS-PS3-3, HS-PS3-4, HS-ETS1-1, HS-ETS1-2, HS-ETS1-3)
Topics may include:
1. Endothermic and Exothermic
2. Transfer Energy
3. Kinetic versus Potential Energy
4. Specific Heat and Calorimetry
5. Heating Curves
6. Phase Changes

C. The Atom (HS-PS1-1, HS-PS1-8)
Topics may include:
1. Atomic Theory
2. Atomic Structure
3. Converting mass to moles for single atoms

D. Electrons and The Periodic Table (HS-PS1-1, HS-PS1-2, HS-PS1-3)
Topics may include:
1. Organization of the Periodic Table
2. Trends of the Periodic Table
3. Valence Electrons
4. Electron Configurations
    a. Dot Structure
    b. Orbital Notation
5. Wave length and frequency of light

E. Bonding and Mixtures- Intramolecular & Intermolecular Forces (HS-PS1-1, HS-PS1-3)
   Topics may include:
   1. Heterogeneous and Homogenous Mixtures
   2. Ionic charges
   3. Ionic Bonding and Naming
   4. Covalent Bonding and Naming
   5. Intermolecular Forces
   6. Molar Mass

Semester 2

A. Molecules (HS-PS1-4, HS-PS1-7)
   Topics may include:
   1. Lewis Structures
   2. Percent Compositions
   3. Hydrated Crystals
   4. Basic Organic Chemistry
      a. Macromolecules
         (i) DNA
         (ii) Protein
   5. Microscopic versus Macroscopic Scale

B. Reactions (HS-PS1-7)
   Topics may include:
   1. Balancing Reactions
   2. Predicting Products in Reactants
   3. Stoichiometry
   4. Percent Yield and Percent Error

C. Water, Solutions & Acids (HS-PS1-6, HS-ESS3-6)
   Topics may include:
   1. Solutions
   2. Acids and Bases
   3. Concentration Calculations
   4. Ocean Acidification

D. Rates and Equilibrium (HS-PS1-5, HS-PS1-6)
   Topics may include:
   1. Reaction Rates
   2. Reaction Kinetics
   3. Variables that change rates
   4. Activation Energy
   5. Equilibrium

E. Gases and Atmosphere (HS-PS1-7, HS-ESS3-6)
   Topics may include:
   1. Gas Stoichiometry
   2. Kinetic Molecular Theory
   3. Relationships between Earth’s Systems
   4. Carbon Cycle

F. Intro to Organic Chemistry (HS-PS1-3)
   Topics may include:
   1. Reading Shorthand notation molecular structures
   2. Molar mass of large molecules
   3. Overview of functional groups

II. ACCOUNTABILITY DETERMINANTS

A. Key Assignments
   1. Calorimeter Design Project
      In this lab students will act as engineers to identify the qualities of a good insulating device and use class wide data to inform their own calorimeter design. Students read about medical device and equipment engineering.
   2. Discovering Isotopes of Pennium
      In this lab students compare the two isotopes of Pennium, and find the percent abundance of each isotope in a sealed container. Pennies before 1982 differ in mass from pennies after 1982 because their composition changed, so their difference in mass serves to provide a model for isotopes. This lab focuses on significant figures and computational thinking as well as isotopes. Students learn about the role of isotopes in medical imaging.
   3. Modeling of Molecules: A 3D look at what you're made of
      In this lab students will learn to draw Lewis structures using their knowledge of the periodic table and valence electrons, then create physical models of specific molecules using VSEPR (Valence Shell Electron Pair Repulsion). The background information links the 3D structure of molecules to the interaction between biological receptors and medications or other ligands that can bind.
   4. Determining Bonding Types
      In this lab students are given three unknown substances and need to deduce which is ionic, which is covalent and which is polar covalent through testing the solubility, melting point and conductivity of the substances. The background explains the role that electrolytes play in the body.
   5. Molecules of Life
      In this lab students will read about different macromolecules, then go through a condensation polymerization by taping amino acids together into a protein in order to "synthesize" insulin. This lab is great way to show how chemistry is relevant in the biological sciences.
   6. Aspirin Titration
      In this lab students compare two types of aspirin using titration. The focus of the lab is on stoichiometry. Students will first calculate how much NaOH it should take to neutralize the aspirin based on stoichiometric calculations. Then they will complete the lab and find out how much NaOH it actually takes to neutralize the aspirin and do a percent error calculation.
   7. Blood and Sea Buffer Lab
      The addition of carbon dioxide to a water based solution can cause acidification of that solution. In the blood and in the ocean, this is mitigated through a complex buffer system. In this lab students compare the addition of carbon dioxide to a buffered solution and a non-buffered solution. The CO2 is added in two different ways so that students can study the effects of CO2 on pH as well as the effects of the buffer. The first way CO2 is added is through breathing from the top and the second is by bubbling the CO2 into the solution with a

straw. Students will also learn that a buffer system is actually a complex change in equilibrium.

8. Alka Seltzer Rates of Reaction
   In this lab students study reaction rates as they pertain to changes in temperature and concentration. By adding certain amounts of Alka-Seltzer to water and sealing it into a film canister, they can take data on the time it takes for the reaction to build up enough pressure to pop the top.
9. Stomach Stoichiometry
   In this lab students study the creation of CO2 in order to study atmospheric chemistry. Students will create gas in two different ways. They will use organisms (yeast) to create CO2 and they will also burn a candle to release CO2. In this they can study stomach gas stoichiometry and connect it to the global warming concepts from NGSS.
10. Smell Lab- Receptors in Action
    In this lab students relate the Lewis dot structure to larger molecules. With a background reading on drug molecules and receptors, the smell lab then walks students through the identification of a number of functional groups as well as how to understand a shorthand drawing of any chemical structure.

B. Assessment Methods
1. Daily Student Observation of Classroom Participation, Effort and Achievement
2. Classwork/Homework
3. Performance Tasks
4. Laboratory Experiments, Reports and Assessments
5. Projects
6. Presentations
7. Quizzes
8. End of Unit Tests
9. Semester Final Exams

III. INSTRUCTIONAL MATERIALS AND METHODOLOGIES

A. Required Textbook(s):
Title: Chemistry Matter and Change
ISBN: 9780078772375
Format: Print
Author(s): Dingrando, L.: Tallman, K.; Hainen, N; Wistrom, C.
Publisher: Glencoe
Year: 2007
Additional Info: N/A

B. Supplementary Materials:
1. www.haspi.org

C. Instructional Methodologies:
1. Hands-on learning opportunities using tools and scientific equipment
2. Direct Instruction
3. Guided Inquiry
4. Discourse
5. Laboratory Activities and Projects
6. Interactive Tools

7. Presentations, Exhibits and Competitions
8. Self-Directed, Cooperative and Collaborative Learning
9. Problem-Based Learning
10. Visual Representations and Concrete Models
11. SDAIE (Specially Designed Academic Instruction in English) methods