Sparta Area School District

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Course Outcome Summary

Course Information: (SCCHEM) Chemistry

Description: This course describes the nature of matter in terms of molecular behavior. Major topics are atomic structure, periodic table, chemical bonding and reactions, chemical calculations including stoichiometry, thermodynamics, kinetics, equilibrium, gas laws, solids, liquids, solutions, acids and bases, and electrochemistry. The goal of Chemistry is to instill in the student a curiosity about matter and its interactions; to initiate a lifetime of using an organized, evidence based approach to solving problems; and to recognize the central significance of chemistry to the understanding of all other sciences and its applications to everyday lives and real world situations. Evaluation is based on written tests, laboratory reports, projects and homework. This course meets most college entrance requirements for three natural science courses (Biology, Chemistry, and Physics).

Instruction Level: 10th grade

Total Credits: 2

Prerequisites: Biology and Algebra I

Textbooks: Holt McDougal Modern Chemistry 2012

Course Standards:

- The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.
- Chemical and physical properties of materials can be explained by the structure and the arrangements of atoms, ions, or molecules and the forces between them.
- Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.
- The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.
- Any bond or intermolecular attraction that can be formed can be broken. These two processes are in a dynamic competition, sensitive to initial conditions and external perturbations.
- The student can use representations and models to communicate scientific phenomena and solve problems.
- The student can use mathematics appropriately.

- The student can engage in scientific questioning to extend thinking or to guide investigations within the context of this course.
- The student can plan and implement data collection strategies in relation to a particular scientific question.
- The student can perform data analysis and evaluation of evidence.
- The student can work with scientific explanations and theories.
- The student is able to connect and relate knowledge across scales, concepts, and representations in and across domains.

Unit

1. **Electrons and Periodic Table**
2. **Bonding**
3. **Scientific Method and Measurements**
4. **Chemical Reactions**
5. **Moles**
6. **Stoichiometry**
7. **KMT and Gas Laws**
8. **Solutions and Solubility**
9. **Acids and Bases**
10. **Nuclear Chemistry**

Unit Outlines

1. Electrons and Periodic Table

Standards:

- Student can explain that chemical and physical properties of materials can be explained by the structure and the arrangements of atoms or molecules and the forces between them.
- Student can explain that the chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.

Essential Question:

- How do the various atomic models compare with current scientific evidence?
- What can we determine about the properties of elements based on its position on the periodic table?
- How can the shape, bond angles and polarity be predicted by using VSEPR theory?

Essential Knowledge:

- Students can describe the parts of the nucleus and determine the subatomic particles in a given isotope by obtaining, evaluating, and communicating scientific theories.
- Students can describe the location of electrons within an atom by developing and using models.
- Students can connect electron structure to periodic table structure by interpreting atomic models.
- Students can relate electron structure to elemental physical properties by developing and using models.

2. Bonding

Standards:

- Student can explain that changes in matter involve the rearrangement of atoms or the transfer of electrons.

Essential Question:

- How are ionic and covalent bonds formed and how does the bond type influence the properties of compounds?
- How do you name ionic and molecular compounds and use their names to determine their chemical formulas?

Essential Knowledge:

- Students can describe how ionic, covalent, and metallic bonds form by planning and caring out an investigation.
- Students can name compounds and write chemical formulas by evaluating information.
- Students can create a model of an ionic, molecular, or metallic compound.

3. Scientific Method and Measurements

Standards:

- Student can plan and implement data collection strategies in relation to a particular scientific question.

Essential Question:

- How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?
- How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?

Essential Knowledge:

- Students can use the scientific method by designing and conducting an investigation.
- Students can make accurate and precise measurements of mass, volume, and length using computational thinking.
- Students can identify independent and dependent variables of a scientific experiment by planning and carrying out investigations.

4. Chemical Reactions

Standards:

- Student can explain that bonds or intermolecular attractions can be formed and broken. These two processes are in a dynamic competition, sensitive to initial and external conditions.

Essential Question:

- How does the Law of Conservation of Mass and chemical equations explain the interactions of atoms and molecules both conceptually and mathematically?
- What are 5 major types of chemical reactions and their identifying characteristics?

Essential Knowledge:

- Students can write a balanced chemical reaction by using mathematics and computational thinking.
- Students can identify evidence and signs of a chemical reaction by interpreting and evaluating data.
- Students can classify chemical reactions by obtaining and evaluating information.

5. Moles

Standards:

- Students can use scientific quantities (moles) to determine the number of particles and the mass of elements or compounds.

Essential Question:

- How can conversions be made among particles, mass and moles of any substance?
- What does percent composition tell us about and what can it be used for?

Essential Knowledge:

- Students can calculate percent composition by planning and carrying out investigations.
- Students can calculate grams, moles and atoms when given a starting unit by using mathematics and computational thinking.

- Students can experimentally determine the formula of a hydrate by analyzing and interpreting data.

6. Stoichiometry

Standards:

- Students can analyze the proportionality of a chemical reaction to predict the quantity of substances made or used in a reaction.

Essential Question:

- How does stoichiometry predict the quantities of substances from a given amount of reactants?

Essential Knowledge:

- Students can calculate mass or moles of a product by using mathematics and computational thinking.
- Students can use the limiting reactant to calculate the product by using mathematical and computational thinking.
- Students can calculate percentage yield when given the actual yield and/or quantity of a reactant by performing data analysis and evaluation of evidence.

7. KMT and Gas Laws

Standards:

- Students can describe the properties and molecular structure of solids, liquids and gases and explain changes between theses phases based on forces between molecules and energy changes.

Essential Question:

- How is the relationship between temperature, pressure and volume and amount of gas described?
- How does the Kinetic Molecular Theory predict the relationship between particles of a solid, liquid and gas?

Essential Knowledge:

- Students can relate solid, liquid, and gas structures to intermolecular forces by developing and using models.
- Students can relate physical properties to the different phases of matter by obtaining and communicating information.
- Students can relate pressure, volume, moles and temperature to the ideal gas law by planning and implementing data collection strategies in relation to a particular scientific question.

- Students can describe the effects of adding/removing energy from matter by evaluating and communicating information.

8. Solutions and Solubility

Standards:

- Students can describe that physical properties are dependent on the concentration of the solute and the strengths of all interactions among the parts of a solution.

Essential Question:

- What are the various types and characteristics of different chemical solutions?
- How are concentrations and formations of a solution described?
- What are the physical conditions that affect solution formation, and what is the effect of each physical condition?

Essential Knowledge:

- Students can identify and describe different types of mixtures by working with scientific explanations.
- Students can calculate the concentration of a solution by performing data analysis and evaluation of evidence.
- Students can predict solubility and write net ionic equations by using representations and models to communicate scientific phenomena and solve problems.

9. Acids and Bases

Standards:

- Use the concept of pH as a model, to predict the relative properties of strong, weak, concentrated and dilute acids and bases.

Essential Question:

- What gives acids and bases their particular characteristics and properties?
- How do you calculate the pH, pOH, and concentrations of acids and bases?

Essential Knowledge:

- Students can describe and identify acids, bases and their conjugates in a reaction by developing and using models.
- Students can calculate pH, pOH, $[H_3O^+]$ and $[OH^-]$ by using mathematics and computational thinking.
- Students can differentiate between strong and weak acids and bases and use Ka/Kb to help describe their strength by using mathematics and computational thinking.

- Students can connect and relate knowledge across scales, concepts, and representations of acids and bases.

10. Nuclear Chemistry

Standards:

- Student can explain that the chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.

Essential Question:

- How do nuclear reactions produce energy and how can that energy be used?

Essential Knowledge:

- Students can describe why an atom is radioactive or stable by using models.
- Students can describe applications of radioactive processes by connecting and relating knowledge across scales, concepts, and representations in and across domains.