MEDFORD HIGH SCHOOL
COURSE SYLLABUS

Department:	Science

Course Title:	Chemistry

Level and/or Grade:	Honors; Grades 10-11

Prerequisite:	A grade of "B" or better in Honors Biology and Algebra I or a grade of "A-" or better in Standard Biology and Algebra I or teacher recommendation and department approval

Course Description:

This course is an accelerated and honors version of Standard Chemistry. Strong mathematical and reading abilities are essential. Standards are covered in more depth and at higher levels of sophistication than those for the standard level course. The course uses inquiry and lab-based experiences to explore the properties of matter and how these properties help to organize elements on the periodic table. Students develop an understanding of the structure of the atom and of chemical reactions, including the involvement of energy and sub-atomic particles to better understand the nature of chemical changes. They learn about chemical reactions (e.g. oxidation-reduction, combustion, decomposition), and gain an understanding of acids and bases and rates of reaction. By calculating stoichiometry problems and molar concentrations, students strengthen proportionality and other mathematical skills. They will encounter other standards in the areas of *Properties of Matter; Atomic Structure and Nuclear Chemistry; Periodicity; Chemical Bonding; Chemical Reactions and Stoichiometry; States of Matter, Kinetic Theory, and Thermochemistry; Solutions, Rates of Reactions, and Equilibrium; and Acids, Bases, and Reduction-Oxidation Reactions.*

Learning Standards: *Through inquiry, experimentation, labs, use of tools, discussion, presentation, and composition, students will be able to…*

Properties of Matter:
- Identify and explain physical properties that are used to classify matter.
- Distinguish between chemical and physical changes.
- Explain the difference between mixtures and pure substances.
- Describe the states of matter in terms of energy, particle motion, and phase transitions.

Atomic Structure and Nuclear Chemistry:
- Trace the development of atomic theory and structure of an atom from the ancient Greeks to the present.
- Use Bohr's model of the atom to interpret changes (emission, absorption) in electron energies in the hydrogen atom corresponding to emission transitions between quantum levels.
- Describe the electromagnetic spectrum; identify regions of the electromagnetic spectrum.
- Identify the major components of the nuclear atom; explain how they interact.
- Interpret Dalton's atomic theory in terms of the Laws of conservation of Mass, Constant Composition, and Multiple Proportions.
- Write the electron configurations for elements of the periodic table.
- Describe alpha, beta, and gamma particles; discuss properties of alpha, beta, and gamma radiation.
- Write balanced equations.
- Explain the concept of half-life of a radioactive element; describe the process of radioactive decay.

Atomic Structure and Nuclear Chemistry (cont.):

- Explain the difference between stable and unstable isotopes.
- Compare nuclear fission and nuclear fusion and mass defect.

Periodicity:

- Explain the relationship of an element's position on the periodic table to its atomic number and mass.
- Use the periodic table to identify metals, nonmetals, metalloids, families/groups, periods, valence electrons, and reactivity with other elements in the table.
- Relate the position of an element on the periodic table to its electron configuration.
- Identify trends on the periodic table.

Chemical Bonding:

- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Draw Lewis dot structures for simple molecules.
- Relate electronegative and ionization energy to the type of bonding an element is likely to undergo.
- Predict the geometry of simple molecules and their polarity (valence-shell electron pair repulsion).
- Identify the types of intermolecular forces present based on molecular geometry and polarity.
- Predict chemical formulas based on the number of valence electrons.
- Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (such as, surface tension, capillary action, density, and boiling point).
- Name and write chemical formulas for simple ionic and molecular compounds.

Chemical Reactions and Stoichiometry:

- Balance chemical equations by applying the laws of conservation of mass.
- Recognize synthesis, decomposition, single displacement, double displacement, combustion, and neutralization reactions.
- Understand the mole concept in terms of number of particles, mass, and gaseous volume.
- Determine molar mass, percent composition, empirical formulas, and molecular formulas.
- Calculate mass-mass, mass-volume, volume-volume, and limiting reactant problems.
- Calculate percent yield in a chemical reaction.

States of Matter, Kinetic Molecular Theory, and Thermochemistry:

- Using the kinetic molecular theory, explain the relationship between pressure and volume, volume and temperature, and number of particles in a gas sample.
- Interpret Dalton's empirical Law of Partial Pressures and use it to calculate partial and total pressures.
- Use the combined gas law to determine changes in pressure, volume, and temperature.
- Perform calculations using the ideal gas law.
- Describe the conditions under which a real gas deviates from the ideal behavior.
- Explain the relationship between temperature and average kinetic energy.
- Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids.
- Describe and interpret the law of conservation of energy.
- Explain the difference between an endothermic process and an exothermic process.
- Analyze the energy changes involved in physical and chemical processes using calorimetry.
- Apply Hess' Law to determine the heat of a reaction.
- Use Heat Energy and Entropy to determine free energy, and use it to predict spontaneity.
- Explain the relationship between energy transfer and disorder in the universe.

Solutions, Rates of Reaction, and Equilibrium:

- Describe the process by which solutes dissolve in solvents.
- Calculate concentration in terms of molarity, molality, and percent by mass.
- Identify and explain the factors affecting the rate of dissolving (e.g. temperature, concentration, mixing).
- Use a solubility curve to determine saturation values at different temperatures.
- Calculate the freezing point depression and boiling point elevation of a solution.
- Use the structures of crystals to explain their behaviors.
- Identify the factors that affect the rate of a chemical reaction.

Solutions, Rates of Reaction, and Equilibrium (cont.):

- Define the role of activation energy in a chemical reaction.
- Explain rates of reaction in terms of collision frequency, energy of collisions, and orientation of colliding molecules.
- Understand and predict the shift in equilibrium when the system is subjected to stress (LeChatelier's Principle); identify factors that cause the shift (concentration, pressure, volume, temperature).
- Write the equilibrium expression and calculate the equilibrium constant for a reaction (or acid's imitation or a salt's dissolving).

Acids and Bases and Oxidation-Reduction Reactions:

- Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronsted-Lowry theory of acids and bases in terms of proton donor and acceptor.
- Calculate the pH or pOH of aqueous solutions using the hydronium or hydroxide ion concentration.
- Compare and contrast the nature, behavior, concentration, and strength of acids and bases.
- Explain how indicators are used in titrations and how they are selected.
- Describe an acid-base titration. Identify and explain significance of equivalence point.
- Identify a buffer and explain how it works.
- Use principals of solubility and pH to identify ions in a qualitative analysis.
- Describe the chemical processes of oxidation and reduction.
- Assign oxidation numbers in a reaction.
- Balance oxidation-reduction equations using half-reactions.

Electrochemistry:

- Identify the components, and describe the processes that occur in an electrochemical cell.
- Explain how a typical battery works.
- Compare and contrast voltaic and electrolytic cells and their uses.
- Calculate net voltage of a cell given a table of standard reduction potentials.
- Use Faraday's Law to determine amounts of plating/gal evolved.

Organic Chemistry:

- Name all the simple hydrocarbons and benzenes.
- Identify basic functional groups.
- Predict and name products of simple reactions.
- Draw isomers of organic structures with their names.

Course Alignment with High School Expectations for Student Learning:

Students will…

1. Analyze, interpret, evaluate and use logical reasoning to solve problems using a variety of resources and strategies.
    - Make observations, raise questions, and formulate hypotheses.
    - Read, interpret, and examine the credibility and validity of scientific claims in different sources of information.
    - Design and conduct scientific investigations - identify purpose, select appropriate tools and conditions; identify variables; write clear procedures; measure accurately and collect data in organized ways; follow safety guidelines.
    - Analyze and interpret results of scientific investigations.
2. Communicate effectively to a variety of audiences.
    - Communicate orally and in writing, and apply the results of scientific investigations.
    - Explain diagrams and charts and prepare lab reports,
    - Use language and vocabulary appropriately, speak clearly, and use appropriate technology.
3. Create works using a variety of communication forms.
    - Present arguments through writing; solve problems through projects, homework, tests, and lab experiences; use technology; make oral presentations.
4. Develop skills and knowledge to reach personal and career goals.
- Develop 'habits of mind': work beyond center of competence; gain attitude of persistence; seek feedback; develop confidence.
- Become familiar with careers related to science.
5. Work cooperatively to achieve objectives.
    - Work in pairs, small groups, and part of the whole class to solve problems.
    - Analyze and evaluate the mathematical thinking and strategies of others.

Assessment:

- See grading policy attached.