COURSE OUTLINE

NAME OF COURSE: CHEMISTRY

COURSE NUMBER: SCI 301 **WRITTEN / REVISED:** September, 2011

LEVEL OF COURSE: HONORS **NUMBER OF CREDITS:** SIX (6)

PREREQUISITES: "80" in Honors Biology and "80" College Prep Math A

GRADE LEVEL(S) OFFERED TO: 10 – 11

COURSE DESCRIPTION:

Honors Chemistry is full year science designed for the exceptional science student. The concepts of general chemistry and the necessary math and laboratory skills are taught in depth so that the student will be well equipped to meet the requirements of college chemistry. At the same time, the course is designed to impress upon the student the importance of chemistry in a modern world.

The Honors course requires an increased dependence on the student's ability in reading, mathematics, and independent study. The accelerated pace of the course provides for extended lab work, additional laboratory experience, and advanced topic discussions.

The basic learning principle of proceeding from familiar or known information to the unknown is fundamental to the course. A certain amount of repetition is a necessary part of the learning process. Thus, principles of structure, matter and energy relationships, the mole concept, thermodynamics, and chemical equilibrium are presented several times throughout the course with varying degrees of emphasis. Students will develop a sense of confidence when they recognize familiar concepts presented later in greater depth. Minimum emphasis has been placed on memorization of fact. Instead, our purpose is to foster understanding and the ability to predict the behavior of substances under various conditions.

GENERAL OBJECTIVES:

The four areas of general objectives for this program include:

1. Attitudes: to develop students' attitudes of curiosity and involvement with phenomena In their natural environment, to develop an appreciation for the contributions of science to daily living, and to develop the value and inclinations toward solving problems in a scientific manner.

2. Processes: to develop those intellectual processes of inquiry by which scientific problems and phenomena are explained, predicted, and/or controlled.

3. Knowledge: to develop knowledge of facts, terminology, concepts, generalizations and principles that help the students confront and interpret their environment.

4. Skills: to develop students' abilities to handle, construct and manipulate materials and equipment in a productive and safe manner, and to develop their abilities to measure, organize, and communicate scientific information.

CORE CURRICULUM STANDARDS ADDRESSED IN THIS COURSE:

5.1 - Science Practice

5.2 - Physical Science

SPECIFIC BEHAVIORAL OBJECTIVES/PROFICIENCIES AND TIME LINES:

Unit 1: Matter and Change **Time = 5 days**
The students will be able to:

1. Define chemistry
2. List examples of the branches of chemistry
3. Compare and contrast basic research, applied research, and technological development
4. Distinguish between the physical and chemical properties of matter
5. Classify physical and chemical changes
6. Explain gaseous, liquid, and solid states in terms of particles
7. Describe what is occurring on a particulate level during phase changes
8. Interpret heating/cooling curves and phase diagrams
9. Distinguish between mixtures and pure substances
10. Use the Periodic Table to name elements, given their symbols
11. Use the Periodic Table to write symbols of elements, given their names
12. Describe the arrangement of the Periodic Table
13. List distinguishing characteristics of metals, nonmetals, and metalloids

Unit 2: Measurements and Calculations **Time = 15 days**
The students will be able to:

1. Describe the purpose of the scientific method
2. Distinguish between qualitative and quantitative observations
3. Describe the differences between hypotheses, theories, and models
4. Distinguish between a quantity, a unit, and a measurement standard
5. Name S.I. units for length, mass, time, volume, and density
6. Distinguish between mass and weight
7. Perform density calculations
8. Transform a statement of equality to a conversion factor
9. Distinguish between accuracy and precision
10. Determine the number of significant figures in measurements
11. Perform math operations involving significant figures
12. Convert measurements into scientific notation
13. Distinguish between inversely and directly proportional relationships

Unit 3: Atoms: The Building Blocks of Matter **Time = 15 days**
The students will be able to:

1. Explain Laws of Conservation of Mass, Definite Proportions, Multiple Proportions
2. Summarize Dalton's Atomic Theory
3. Explain the relationship between Objectives #1 and #2 above
4. Summarize cathode rays and their relationship to the discovery of the electron
5. Summarize Rutherford's Gold Foil Experiment
6. List properties of protons, neutrons, and electrons
7. Define "*atom"*
8. Explain what isotopes are
9. Define atomic number, mass number, and they apply to isotopes
10. Determine average atomic mass from isotopic abundance data.
11. Determine the atomic structure of different nuclides
12. Define *mole* in terms of Avogadro's Number
13. Solve mole problems

Unit 4: Arrangement of Electrons in Atoms **Time = 12 days**

The student will be able to:

1. Explain the mathematical relationship between speed, wavelength, and frequency of EMR
2. Discuss the wave-particle nature of light
3. Discuss the photoelectric effect and hydrogen spectra
4. Describe the Bohr model of the hydrogen atom
5. Describe de Broglie's role in the development of the quantum atom
6. Compare and contrast the Bohr and quantum models of the atom
7. Discuss Heisenberg's Uncertainty Principle and Schrödinger's Equation
8. List the four quantum numbers and describe their significance
9. Understand the relationships between shells, sublevels, and orbitals
10. Identify the total number of electrons per energy level
11. State the Aufbau Principle, Pauli Exclusion Principle, and Hund's Rule
12. Describe the electron configurations for atoms using orbital, dot, and noble gas notation

Unit 5: The Periodic Law **Time = 10 days**

The students will be able to:

1. Explain the roles of Mendeleev and Moseley in the development of the Periodic Table
2. Describe the modern periodic table
3. Explain how the Periodic Law can be used to predict periodic properties of the elements
4. Describe how the elements in a group are related in terms of atomic number
5. Describe the relationship between sublevels and the length of a period in the Table
6. Locate and name the four sublevel blocks on the Periodic Table
7. Discuss the relationship between group configurations and group numbers
8. Describe the locations and major properties of the main groups on the Table
9. Define atomic and ionic radii, ionization energy, electron affinity, and electronegativity
10. Compare the periodic trends of the properties listed in Objective #9
11. Be able to predict the group an element is in from ionization energy data
12. Define valence electrons and their number in each of the main groups
13. Compare the properties of the d-block elements with those of the main groups.

Unit 6: Chemical Bonding **Time = 12 days**

The students will be able to:

1. Define chemical bond
2. Explain why atoms form chemical bonds

3. Explain the essential difference between intra and inter molecular bonding
4. Describe ionic and covalent bonding
5. Explain why chemical bonding is neither purely ionic nor covalent
6. Classify bond type according to electronegativity differences
7. Define molecule and molecular formula
8. Define relationships between potential energy, bond length, and bond energy
9. State the octet rule
10. List the six basic steps in writing Lewis structures
11. Explain how to determine Lewis structures for molecules with single or multiple bonds
12. Explain why scientists use resonance structures to represent some molecules
13. Predict the shape of, bond angles in, and hybridization of, simple molecules and ions using VSEPR theory.
14. Compare and contrast a chemical formula for molecular formula with an ionic formula
15. Discuss the arrangements of ions in crystals
16. List and compare major properties of ionic versus covalent compounds
17. Draw the Lewis structures of various polyatomic ions
18. Describe metallic bonding in terms of the electron-sea model
19. Explain conductivity and luster in terms of the electron-sea model
20. Explain malleability and ductility as compared to properties of ionic compounds
21. Explain what determines molecular polarity
22. Explain the occurrence, nature of, and relative strengths of dipole-dipole interactions, London dispersion forces and hydrogen bonding.

Unit 7: Chemical Formulas and Compounds **Time = 20 days**

The students will be able to:

1. Explain the significance of a chemical formula
2. Determine the formula of an ionic compound between two given ions
3. Name an ionic compound given its formula
4. Using prefixes, name a binary molecular from its formula
5. Write the formula of a binary compound given its name
6. List the rules for assigning oxidation numbers
7. Give the oxidation number for each element in a given formula
8. Name binary molecular compounds using oxidation numbers and the Stock system
9. Name simple binary acids
10. Name oxoacids and compounds containing oxoanions
11. Name hydrated salts
12. Calculate the formula mass or molar mass of a given compound
13. Use molar mass to convert between mass in grams and amount is moles
14. Calculate the number of molecules, formula units, or ions in a given molar amount
15. Calculate the percentage composition of a given compound
16. Define empirical formula, and explain how the term applies to ionic & molecular compounds
17. Determine an empirical formula from either a percentage or mass composition
18. Explain the relationship between empirical versus molecular formula
19. Determine a molecular formula from an empirical formula
20. Calculate the formula of a hydrated salt from experimental data

Unit 8: Chemical Equations and Reactions **Time = 15 days**

The students will be able to:

1. List three observations that suggest that a chemical reaction has taken place

2. List three requirements for a correctly written chemical equation
3. Write a word equation and a formula equation for a given reaction
4. Balance a formula equation by inspection
5. Define and give general equations for the five major types of reactions
6. Classify a reaction into one of the five major types of reactions
7. Predict the products of 5 major types of reaction given the reactants
8. Explain the significance of the activity series
9. Use an activity series to predict products of single replacement reactions
10. Use solubility rules to predict products of double replacement reactions
11. Write full molecular, ionic, and net ionic equations (Chap. 14)
12. Use combustion reaction data to calculate empirical formula of compounds

Unit 9: Stoichiometry **Time = 12 days**

The students will be able to:

1. Define stoichiometry
2. Describe the importance of the mole ratio in stoichiometric calculations
3. Write a mole ratio relating two substances in a chemical reaction
4. Calculate a stoichiometric problem based upon a given about in particles, moles, grams, volume (liquid), and volume (gas)
5. Describe a method for determining which of two reactants is the limiting reagent
6. Calculate a stoichiometric limiting reagent problem
7. Distinguish between theoretical, actual, and percent yield
8. Calculate percent yield, given the actual yield and quantity of a reactant

Unit 10: Physical Characteristics of Gases **Time = 15 days**

The students will be able to:

1. State the kinetic theory of matter and describe how it explains certain properties
2. List the five assumptions of the kinetic theory and define ideal versus real gas
3. Describe the major characteristics of real gases
4. Describe the conditions under which a real gas deviates from an ideal gas
5. Define pressure, and relate it to force
6. Describe how pressure is measured
7. Convert units of pressure
8. State the standard conditions of temperature and pressure
9. Use the kinetic theory to explain the relationship between gas volume, temperature, and pressure
10. Use Boyle's Law to calculate volume-pressure relationships
11. Use Charles' Law to calculate volume-temperature relationships
12. Use Gay-Lussac's Law to calculate pressure-temperature relationships
13. Use the Combined Gas Law to calculate volume-temperature-pressure relationships
14. Use Dalton's Law of Partial Pressures to calculate partial and total pressures

Unit 11: Molecular Composition of Gases **Time = 12 days**

The student will be able to:

1. State the Law of Combining Gas Volumes
2. State Avogadro's Law and explains its significance
3. Define *standard molar volume of a gas* and use it to calculate gas masses and volumes
4. Use standard molar volume to calculate the molar mass of a gas

5. State the Ideal Gas Law
6. Derive the Ideal Gas Constant and discuss its units
7. Solve for pressure, volume, temperature, or amount of gas using the Ideal Gas Law
8. Use the Ideal Gas Law to solve for molar mass or density of a gas
9. Reduce the Ideal Gas Law to simpler gas laws, describing conditions applying to each
10. Explain how Gay-Lussac's and Avogadro's Laws apply to gas volumes in chemical reactions
12. Use a balanced chemical equation to specify volume ratios for reactants, products, or both
13. Use volume ratios and the gas laws to calculate masses or moles of reactants or products
14. State Graham's Law of Effusion
15. Determine relative rates of effusion between gases of known masses
16. State the relationship between a gas's molecular velocity and its mass

Unit: 12: Solutions **Time = 12 days**

The students will be able to :

1. Distinguish between heterogeneous and homogeneous mixtures
2. List three different solute-solvent combinations
3. Compare the physical properties of suspensions, colloids and solutions
4. Distinguish between electrolytes and nonelectrolytes
5. List and explain three factors that affect the rate of dissolving
6. Explain equilibrium and distinguish among saturated, unsaturated and supersaturated
7. Explain the meaning of "like dissolves like" in terms of polarity
8. Compare the effects of temperature and pressure on solubility in basic types of solutions
9. Given the mass of solute, volume of solvent, calculate the concentration of a solution
10. Given the concentration of a solution, determine the amount of solute in a given amount of solution
11. Given the concentration, determine the amount of solution that contains a given amount of solute

Unit 13: Acids and Bases **Time = 5 days**

The students will be able to:

1. List 5 general properties of aqueous acids and bases
2. Name common binary acids and oxyacids, given their chemical formulas
3. List 5 acids commonly used in the Lab and industry and give some properties of each
4. Define acid and base according to Arrhenius ' theory of ionization
5. Explain the differences between strong and weak acids and bases
6. Define and recognize Bronsted-Lowry acids and bases
7. Define and relate conjugate acid and conjugate base
8. Determine the formula for the conjugate acid of a given base, and vice versa
9. Explain what determines whether an amphoteric substance acts as an acid or base
10. Explain the process of neutralization
11. Define a Lewis acid and a Lewis base
12. Name a compound that is a Lewis acid but not a Bronsted-Lowry acid

Unit 15: Reaction Energy and Reaction Kinetics **Time = 10 days**

The students will be able to:

1. Define *temperature* , and state the units in which it is measured
2. Define *heat,* and state its units.
3. Perform specific-heat calculations

Unit 16: Carbon and Hydrocarbons (Optional- time permitting = 3 days)

The students will be able to:

1. Relate carbon's bonding to sp3 hybridization
2. Explain how carbon's bonding leads to the diversity and number of organic compounds
3. Explain the importance and limitations of molecular versus structural formulas
4. Compare structural and geometric isomers
5. Recognize the important structural feature of saturated hydrocarbons (alkanes)
6. Be able to name and write structural formulas for alkanes
7. Distinguish between structures of alkenes, alkynes, and aromatic hydrocarbons
8. Be able to name and write structural formulas for unsaturated hydrocarbons

MATERIALS / RESOURCES:

1. **Text: Modern Chemistry, Davis, Frey, Sarquis, and Sarquis**
   Holt, Rinehart & Winston, 2009

2. **Lab Manuals:**
   Modern Chemistry, Holt, Rinehart & Winston
   Chemistry of Common Substances, Silver Burdett
   Laboratory Manual for Chemistry, Abco Standard Pub.
   Chemistry: An Experimental Science, Freeman & Co.
   Laboratory Investigations in Chemistry, Silver Burdett
   Chemistry With Computers, Vernier Inc.

Changes in Our Modern World, Prentice Hall

3. Supplemental Materials / Readings

Modern Chemistry: Exercises and Experiments
Teacher generated materials and Computer software
Assorted audio-visual materials as indicated and as available on loan purchase
Teacher Resource Package - Metcalfe "Modern Chemistry" - 2002
Various Websites

EVALUATION:

A. STUDENT PROGRESS:

The following are the items included in the evaluation of student achievement and the computation of the grade of the student:

1. Tests and quizzes	50%
2. Lab Reports and demonstrated techniques	25%
3. Class preparation/participation, homework	25%

B. PERIODIC EVALUATION OF CURRICULUM GUIDE:
The next evaluation due June 2013

DATE MID-TERM / FINAL REVISED

1. Mid-term – January 2011

2. Final – June 2011

High Point Regional High School's curriculum and instruction are aligned to the State's Core Curriculum Content Standards and address the elimination of discrimination by narrowing the achievement gap, by providing equity in educational programs and by providing opportunities for students to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.