MONTE VISTA CHRISTIAN SCHOOL
SCIE 3540, Chemistry Honors
Course Syllabus

Course Description:
Honors chemistry is an exciting upper division lab science course. The concepts covered in this course will be similar to General Chemistry, in most cases, but taught at a deeper level and in different time frames. We will be using several sources for studying our material. We will have an online textbook, plus an assortment of materials culminating years of research from various sources. Students need to realize they will be committing themselves to more challenging problems, mathematically, more detailed laboratory investigations and greater expectations, in regard to the quantity and quality of work submitted.

Honors Chemistry can be taken as a **Dual Credit Class**, whereby a Monte Vista Christian School student can **simultaneously earn college credit and high school credit** for the course. A partnership between Monte Vista Christian School and Colorado Christian University enables high school students to earn college credits before graduating from high school. If students wish to also take the AP Chemistry exam they may do so. Please refer to the student handbook for more information about the AP exams. Sufficient core content will be presented for preparing the students to pass the AP chemistry exam.

Curriculum Mapping:
This course will build upon the students' scientific method skills learned in Biology and problem solving skills learning in Algebra, as well as prepare the students for Physics and Human Anatomy.

Course Objectives:
Upon the successful completion of this course the student will be able to:
1. Demonstrate proper use of lab equipment and techniques
2. Make and record accurate observations
3. Organize information, evaluate, interpret and communicate experimental results
4. Write balanced equations in terms of atoms, molecules, and moles
5. Exhibit skill in the use of the periodic table in the following ways:
    - classifying elements according to their properties
    - predicting and writing chemical reactions
    - writing electron configurations and showing intermolecular forces
    - determining the subatomic make-up and mass of elements
6. Demonstrate through problem solving and correct use of nomenclature and understanding of the following:

- scientific notations and significant figures
- conservation of mass and energy (stoichiometry)
- thermodynamics and kinetics
- gas reactions
- acid-base reactions
- chemical equilibrium
- solution concentrations
- oxidation-reduction reactions

7. Show proficiency in drawing and identifying organic compounds as well as applying their use to everyday life (consumer chemistry)
8. Develop and in-depth knowledge of the origin and use of radioactivity in our growing world of energy needs (citizen responsibility)

Online Text:
Your necessary digital texts for this class will be part of a "Required Course Materials Fee" thru the EdTech bookstore. This is a bundle purchase of digital texts for your full schedule of classes and will be available for purchase after 7/18/16. For further instructions please visit the 16-17 School Year icon on the MVCS homepage. Please note: some courses may require additional purchases outside of the course materials fee.

Prerequisites**:** Biology, a grade of B or better in Algebra II and/or Pre-Calculus,
These scores on the STAR and / or PSAT tests are required:
STAR minimum benchmark = 700 (reading and math)
PSAT minimum benchmark = 550 (reading and math)
Honors Chemistry Agreement needs to be signed and turned in.

Course Outline and Requirements:

I. Introduction to Chemistry
   - A. Branches of study
   - B. Careers in chemistry
   - C. Mathematics in Chemistry: Dimensional analysis problem solving
   - D. Scientific notation
   - E. The metric system
   - F. Lab regulations and safety
   - G. Lab exercise making U-bends with glass tubing
   - H. Significant figures
   - I. Precision and accuracy
   - J. Exact Numbers

K. Lab exercise on the proper use of lab equipment and the preparation and filtering of an insoluble product.
L. States of Matter
M. Classification of Matter
N Structure of matter
O Energy and matter
P. Energy changes in chemical reactions

II. The Substance of Chemistry
A. Heterogeneous and homogeneous matter
B. Properties of matter
C. The Separation of Mixtures
D. Lab exercise of fractional distillation using CBL units
E. Lab exercise observing the properties and reactions of elements, compounds and mixtures
F. Changes of matter
G. Lab exercise observing changes and determining if they are physical or chemical
H. Elements - abundance and names
I. Subatomic particles
J. Descriptive elemental names

III. Stoichiometry: Elements and compounds
A. Formulas and names
B. The mole
C. Percentage composition
D. Deriving empirical and molecular formulas
E. Lab exercise calculating the empirical formula of an unknown hydrate

IV. Stoichiometry: Chemical reactions
A. Balancing chemical equations
B. Classification of chemical equations
C. Lab exercise predicting products in double replacement reactions (6 solution microscale lab)
D. Qualitative relationships from balanced equations
E. Sequential stoichiometry reactions
F. Lab exercise determining the mole relationship of a double replacement reaction
G. Limiting reactants
H. Lab exercise determining the mole relationship of a single replacement reaction

V. Gases

A. Kinetic molecular theory
B. The root mean square (rms
C. Kinetic energy per mole
D. Proportionality concept
E. Gas pressures
F. Boyle's law
G. Charles' law
H. Combined Gas law
I. Gay-Lussac's law
J. The Ideal Gas equation
K. van Der Waal's Equation for a real gas
L. Dalton's law of partial pressures
M. Gas mixtures and partial pressures
N. Partial pressures and mole fractions
O. Boltzmann's constant
P. Molecular effusion and diffusion
Q. Graham's law of diffusion
R. Gases in chemical reactions
S. Lab exercise determining the molar volume of a gas

VI. Chemical thermodynamics
A. Energy, heat and work
B. Enthalpy
C. Measurement of Heat
D. Lab exercise determining the specific heat of a metal in a calorimeter
E. Heats of reaction
F. Lab exercise using a calorimeter to determine the enthalpy change of a reaction
G. Heats of changes of state
H. The Clausius - Clapeyron equation
I. Entropy
J. Gibb's free energy equation

VII. Electronic structure
A. The nature of light
B. The hydrogen spectrum
C. The Bohr Atom
D. Lab exercise visualizing spectrums of gases and metal ions
E. The quantum mechanical model
F. Transition metals of periods 4, 5, 6
G. Quantum numbers

H. Shapes of orbitals
I. Lewis symbols
J. Shielding properties and stability
K. Lab exercise on preparing blueprints to show how the extent of a photochemical reaction is related to the length of exposure to light.

VIII. The Periodic Table
A. Historical development
B. Classification of the elements
C. Periodicity of Chemical properties
D. Allotropes
E. Isoelectric species / Unpaired electrons
F. Electron configuration as related to the periodicity of elements
G. Atomic sizes Vs atomic numbers
H. Lab exercise designed to plot a graph showing the relationship between atomic number and atomic radii
I. Ionization energy
J. Electron affinity
K. Electronegativity of elements
L. Descriptive chemistry

IX. The Chemical Bond and intermolecular forces
A. The octet rule
B. Ionic bonding
C. Covalent Bonding - Network Covalent substances
D. Metallic bonding
E. Predicting bond character from electronegativities
F. Lewis structures for molecular substances
G. Resonance
H. Hybridization
I. Sigma and Pi bonds
J. Exceptions to the octet rule
K. Expanded octets
L. Molecular shapes - Valence Shell Electron Pair Repulsion (VSEPR)
M. Polar and non-polar molecules
N. Lab exercise building molecules and determining bond and molecule polarity and dot structures
O. Intermolecular forces
P. Crystals - Shapes and Properties

X. Solutions and colloids
A. Defining solute, solvent and solution

B. Solution types
C. The solution process
D. Factor affecting solution rates
E. Solvent-solute interaction
F. Solution equilibrium
G. Effects of pressure and temperature on solubility
H. Heats of solution
I. Molar concentration
J. Molal concentrations
K. Colligative properties
L. Lab exercise determining molecular weight of a substance by measuring the freezing point depression.
M. Colloids
N. Soaps and detergents
O. Lab exercise preparing colloids and testing their properties
P. Lab exercise using CBL's to determine Beer's Law

XI. Chemical Kinetics
A. Reaction rates
B. Collision theory
C. Concentration effects
D. Temperature and reaction rates
E. Lab exercise measuring reaction rates with varying degrees of temperature and concentration change: A Clock Reaction
F. Effects of a catalyst
G. Measuring rates

XII. Chemical Equilibrium
A. Reversible reactions relating to equilibriums
B. Equilibrium concentrations
C. Equilibrium constants
D. The magnitude of K
E. LeChatelier's Principle
F. Application of LeChatelier's Principle
G. Lab exercise observing equilibrium shifts in a chemical reaction
H. Solubility Equilibria
I. Solubility product constants
J. Lab exercise determining Ksp of a given salt

XIII. Acids, bases, and salts
A. The Arrhenius concept
B. The Bronstead-Lowry concept

C. Naming acids
D. Polyprotic and monoprotic acids
E. Acidic and basic anhydrides
F. Strengths of acids and bases
G. Salts
H. Ionic and net ionic equations
I. Lab exercise on the reaction of acids
J. Percent by mass and mole fraction

XIV. Ionic equilibrium in solution
A. Ionization of water
B. Acidic and basic solutions
C. The pH Scale
D. The pOH
E. pH measurement
F. Lab exercise practicing the methods of pH measurements – pH meters
G. The equilibrium constant for a weak acid
H. The concentration of H_3O^+ in a water solution of a weak acid
I. The equilibrium constant for a weak base
J. Hydrolysis of salt solutions
K. Buffers
L. Using pKA values when making buffers
M. Acid-base titrations
N. CBL Lab exercise determining the titration curves of strong and weak acids and bases
O. Lab exercise titrating commercial vinegar against a known base solution
P. Solubility product constants related to acid-base titrations

XV. Oxidation-reduction reactions and electrochemistry
A. Oxidation and reduction processes
B. Oxidation numbers
C. Redox reactions
D. Lab demonstrations observing various redox reactions
E. Balancing redox reactions
F. Strengths of oxidizing and reducing agents
G. Redox titrations and volumetric analysis
H. Lab exercise doing a redox titration to analyze household bleach
I. Electric current
J. Electrolysis
J. Electroplating
K. Lab exercise preparing a silver plated mirror with electroplating

techniques

L. Voltaic cells
M. The Nernst equation
N. Spontaneity of redox reactions
O. Relating Gibb's free energy to Eo
P. Relating Eo to the equilibrium constant Keq
Q. Lab exercise making simple voltaic cell batteries and testing their efficiency

XVI. Nuclear chemistry
A. History
B. Types of radioactivity
C. Detecting radiation
D. Nuclear stability and radioactivity
E. Nuclear reactions
F. Natural radioactive decay series
G. Induced nuclear reactions
H. Rate of decay: half-life
I. Radiocarbon dating
J. Effects of radiation on matter
K. Graphing the mass defect and binding energy of nuclear material

XVII. Organic chemistry
A. Abundance and properties of organic compounds
B. Chemical bonding in organic compounds
C. Structural formulas
D. Sources and classification of hydrocarbons
E. Naming hydrocarbons
F. Lab exercise on the reactions of hydrocarbons
G. Functional groups
H. Lab exercise observing characteristics of functional groups
I. Proteins and amino acids
J. Carbohydrates
K. Lipids
L. Lab exercise on saponification: the preparing of soap and testing its properties
M. Lab exercise synthesizing an organic compound: Iodoform
N. Polymers in our society

Grading:

Grade Book Categories		**Semester Weighted Grading Configuration**	
Homework	20%	Quarter	40%
Labs	20%	Quarter	40%
Tests	60%	Final Exam	20%

Homework: On the average, an Honors Chemistry student should **plan on spending 45 – 60 minutes a day** on homework / review. No partial credit will be given for late work. See page 8 of the chemistry manual for homework guidelines. See page 9 of the chemistry manual for explanation on how homework is graded.

High School Grading Policy:
Please refer to the policy and procedures posted online in our student handbook

Class Policies:

1. **Preparation:** Students will not be excused from class to go get forgotten items
2. **Tardiness**: A tardy is given to a student not in their seat when the bell rings.
3. **Attendance:** Students are expected to be in class every day. If students are unable to attend class, it is their responsibility to get notes from a classmate. If an absence is due to a pre-planned school or personal outing, students must turn in your work before they go on their outing. See pages 10 and 13 of chemistry manual.

School Policies and Expected Student Learning Results (ESLR's)
Students are subject to all academic policies of the school as printed in the Academic Catalog and Student Handbook. Furthermore, it is each student's responsibility to read and follow all academic policies of the school.
The following five ESLRs listed below are stated in our school handbook, along with the components we are striving to demonstrate / teach to our students.

- *** Spiritual**
- *** Intellectual**
- *** Self-Management**
- *** Character**
- ***Technology**

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SCIE 3540, Chemistry HRS

Terms of Agreement

Parents and students can expect the course instructor to:

- post unit outlines at least two weeks in advance on moodle.mvcs.org
- provide unit review sheets on moodle.mvcs.org
- return graded papers and projects the next class period after their due date.
- post grades on FOCUS each day
- be timely in responding to e-mail messages MrsTarr@mvcs.org

Instructor will expect the student to:

- come to class each day with hardcopy homework from moodle.mvcs.org
- Read the assigned textbook pages
- know and follow the rules and guidelines of this syllabus as well as their school handbook.
- be responsible in doing their school work on time.
- seek out help when confusion strikes.
- have gotten notes and read the assignment BEFORE coming to the instructor for help.