CHEMISTRY IN THE COMMUNITY
CHEMCOM

GRADES 11-12

2004

Chemistry in the Community

Summer 2004

COURSE DESCRIPTION: (The course description sets the parameters, scope and sequence for the course:

I. Introduction to Sciences

A. Lab Safety

1. Students will learn the rules and why they apply to the classroom.

2. Students will learn the proper procedure for using safety equipment and their locations in the classroom.

3. Student will sign and return a safety contract.

B. Scientific Method

1. Students will learn the parts of the scientific method.

2. Students will apply the scientific method to an experiment.

C. Metric and English Systems

1. Students will mathematically use unit conversions within one system (ex. m → km).

2. Students will use unit conversions between systems (ex. Mile → meter)

3. Students will discover the different uses of measurement systems.

4. Students will be able to measure using a variety of measurement apparatus.

II. Water

A. Sources and Uses

1. Students will discuss direct and indirect water uses and their importance.

2. Students will be able to identify and discuss the various methods of water cleansing such as purification (natural and artificial), distillation, and filtration.

3. Students will evaluate the chlorination and softening of water

4. Students will evaluate personal water usage.

5. Students will be able to diagram the water cycle and indicate the primary locations of Earth's water.

B. Contaminants

1. Students will classify matter in terms of elements, compounds and mixtures.

2. Students will distinguish between different types of mixtures and recognize the differences.

3. Students will define the terms homogeneous mixture, heterogeneous mixture, solution, colloid, suspension, solute, solvent.

4. Students will recognize physical properties such as physical states, boiling and freezing points, solvent characteristics.

5. Students will be able to apply and manipulate the density equation as well as be able to find density in a laboratory situation.

6. Student will be able to read solubility curves to find the effect of temperature on solubility.

7. Students will define and apply the terms insoluble, unsaturated, saturated, supersaturated, solution concentration.

8. Students will evaluate the risks of contamination in our water supply.

III. The Atom and its History

A. History

1. Students will be able to discuss the evolution of the atomic model by using the theories and discoveries of the Greeks, Dalton, J.J. Thomson, Rutherford, Milikan, and Bohr.

B. Architecture of the Atom

1. Students will be able to define the following terms: nucleons, neutrons, protons, electrons, nucleus, matter, subatomic particles, isotope.

2. Students will describe the functions of the three subatomic particles.

3. Students will recognize isotopes and radioisotopes and be able to find the average atomic weight and perform isotope notation.

IV. Nuclear Chemistry

A. Radiation

1. Students will recognize common sources of radiation.

2. Students will discuss different types of radiation (nonionizing, ionizing, alpha, beta, and gamma) and their uses.

3. Students will learn the use of Geiger-Mueller counter.

4. Students will calculate radioactive decay and half-lives.

5. Students will investigate radioisotopes in medicine, and nuclear medicine technologies like MRI and PET.

B. Nuclear Energy

1. Students will define the terms chain reaction, critical mass, fission, and fusion.

C. Nuclear Power Plants

1. Students will name the parts of the plant and their purposes.

2. Students will discuss and describe the chain reaction and the political and environmental effects of nuclear energy.

3. Students will describe the process involved in nuclear fusion and fission.

4. Students will discuss the political and environmental issues with high and low level nuclear waste and waste sites.

V. Periodic Table

A. Properties and Changes

1. Students will define chemical change, physical change, chemical property, and physical property.

2. Students will distinguish between and give examples of chemical and physical changes. As well as chemical and physical properties.

3. Students will classify elements based on properties into metal, nonmetal and metalloid.

B. Use of periodic table

1. Students will define the following terms: atomic mass, atomic number, family, period, group, electronegativity, ionization energy, ionic radius.

2. Students will use the periodic table to predict the properties of an element, identify atomic masses and numbers.

3. Students will locate and name periods and groups of elements.

4. Students will determine the properties of an element by the number and arrangement of electrons in the atom.

5. Students will discuss and recognize periodic trends such as electronegativity, ionic radius, and ionization energy.

VI. Conservation

A. Formulas and Equations

1. Students will define the following terms; coefficients, subscripts, formula units, formula, equation.

2. Students will write chemical formulas using the charges found on the periodic table.

3. Students will identify the four major types of chemical reactions; single replacement, double replacement, synthesis, and decomposition.

4. Students will state and apply the Law of Conservation of Matter.

5. Students will write and balance equations using the Law of Conservation of Matter.

6. Students will investigate the percent composition of compounds and be able to calculate the percent of each element in the compound.

B. Mole

1. Students will define mole.

2. Students will calculate molar mass.

3. Students will calculate mole to mass and mass to mole conversions.

4. Students will apply the mole concept to balanced equations.

VII. Bonding and Petroleum

A. Petroleum

1. Students will describe the chemical makeup of petroleum, how it differs from other natural resources and how it is refined.

2. Students will describe the process of refining petroleum and name the products, which can be produced from it.

B. Chemical Bonding

1. Students will describe ionic and covalent bonding and how the electron shells act in each type.

2. Students will compare and contrast covalent and ionic bonding.

3. Students will represent covalent bonding by drawing electron-dot structures and structural formulas.

4. Students will graph trends in alkane boiling points.

VIII. Energy and Fossil Fuels

A. Potential and Kinetic Energy

1. Students will define and give examples of each.

B. Endothermic and Exothermic reactions

1. Students will define and give examples of each.

2. Students will investigate bond formation and bond breaking.

3. Students will recognize graphs of each.

C. Energy Conversions

1. Students will define and apply the Law of Conservation of energy.

D. Types of Energy

1. Students will define, give examples of and discuss conversions of mechanical and nonmechanical energies.

2. Students will investigate the uses of energy in a car.

3. Students will calculate the energy to move a car in a week.

4. Students will define and apply the specific heat capacity equation.

5. Students will calculate molar heats of combustion.

E. Petroleum Industry

1. Students will investigate jobs in the petroleum industry.

2. Students will investigate the products produced from the petroleum industry.

F. Alternating Fuels

1. Students will define and apply the following terms: leaded fuel, unleaded fuel, cracking, octane rating, oxygenated fuels, and gasohol.

2. Students will discuss the advantages and disadvantages of alternative energies to petroleum.

IX. Gases

A. Exploring properties of gases

1. Students will explore the properties of weight, space occupation, pressure, volume, temperature and the relationships between them.

B. Structure of the atmosphere

1. Students will explore the major, minor and trace components of the atmospheric makeup.

2. Students will graph atmospheric data.

C. Pressure

1. Students will define pressure.

2. Students will be able to read a barometer and discuss its uses and history.

3. Differences in phases

4. Students will investigate the differences between solids, liquids and gases.

5. Students will read and interpret phase diagrams.

6. Students will define and apply the Kinetic Molecular Theory.

D. Gas Laws

1. Boyle's Law

a) Students will define, and solve problems with Boyle's Law.

b) Students will investigate the pressure volume relationship.

2. Charles Law

a) Students will define and solve problems with Charles' Law.

b) Students will investigate the volume temperature relationship.

3. Gay-Lussac's Law

a) Students will define and solve problems with Gay-Lussac's Law.

b) Students will investigate the pressure temperature relationship.

4. Ideal Gas Law

   a) Students will define and recognize a real gas and an ideal gas.

   b) Students will define and solve problems with the Ideal Gas Law.

   c) Students will investigate the relationships between moles, volume, temperature, and pressure.

5. Molar Volume

   a) Students will calculate molar volume of a given sample.

CORE CURRICULUM CONTENT STANDARDS:

STANDARD 5.1 (SCIENTIFIC PROCESSES) ALL STUDENTS WILL DEVELOP PROBLEM-SOLVING, DECISION-MAKING AND INQUIRY SKILLS, REFLECTED BY FORMULATING USABLE QUESTIONS AND HYPOTHESES, PLANNING EXPERIMENTS, CONDUCTING SYSTEMATIC OBSERVATIONS, INTERPRETING AND ANALYZING DATA, DRAWING CONCLUSIONS, AND COMMUNICATING RESULTS.

STANDARD 5.2 (SCIENCE AND SOCIETY) ALL STUDENTS WILL DEVELOP AN UNDERSTANDING OF HOW PEOPLE OF VARIOUS CULTURES HAVE CONTRIBUTED TO THE ADVANCEMENT OF SCIENCE AND TECHNOLOGY, AND HOW MAJOR DISCOVERIES AND EVENTS HAVE ADVANCED SCIENCE AND TECHNOLOGY.

STANDARD 5.3 (MATHEMATICAL APPLICATIONS) ALL STUDENTS WILL INTEGRATE MATHEMATICS AS A TOOL FOR PROBLEM-SOLVING IN SCIENCE, AND AS A MEANS OF EXPRESSING AND/OR MODELING SCIENTIFIC THEORIES.

STANDARD 5.4 (NATURE AND PROCESS OF TECHNOLOGY) ALL STUDENTS WILL UNDERSTAND THE INTERRELATIONSHIPS BETWEEN

SCIENCE AND TECHNOLOGY AND DEVELOP A CONCEPTUAL UNDERSTANDING OF THE NATURE AND PROCESS OF TECHNOLOGY.

STANDARD 5.6 (CHEMISTRY) ALL STUDENTS WILL GAIN AN UNDERSTANDING OF THE STRUCTURE AND BEHAVIOR OF MATTER.

STANDARD 5.7 (PHYSICS) ALL STUDENTS WILL GAIN AN UNDERSTANDING OF NATURAL LAWS AS THEY APPLY TO MOTION, FORCES, AND ENERGY TRANSFORMATIONS.

STANDARD 5.10 (ENVIRONMENTAL STUDIES) ALL STUDENTS WILL DEVELOPAN UNDERSTANDING OF THE ENVIRONMENT AS A SYSTEM OF INTERDEPENDENT COMPONENTS AFFECTED BY HUMAN ACTIVITY AND NATURAL PHENOMENA.

CUMULATIVE PROGRESS INDICATORS:

Standard 5.1

A. Habits of Mind

1. When making decisions, evaluate conclusions, weigh evidence, and recognize that arguments may not have equal merit.
2. Assess the risks and benefits associated with alternative solutions.
3. Engage in collaboration, peer review, and accurate reporting of findings.
4. Explore cases that demonstrate the interdisciplinary nature of the scientific enterprise.

B. Inquiry and Problem Solving

1. Select and use appropriate instrumentation to design and conduct investigations.
2. Show that experimental results can lead to new questions and further investigations.

C. Safety

1. Understand, evaluate and practice safe procedures for conducting science investigations.

Standard 5.2

A. Cultural Contributions

1. Recognize the role of the scientific community in responding to changing social and political conditions and how scientific and technological achievement effect historical events.

B. Historical Perspectives

1. Examine the lives and contributions of important scientists who effected major breakthroughs in our understanding of the natural and designed world.
2. Discuss significant technological achievements in which science has played an important part as well as technological advances that have contributed directly to the advancement of scientific knowledge.

3. Describe the historical origin of important scientific developments such as atomic theory, genetics, plate tectonics, etc., showing how scientific theories develop, are tested, and can be replaced or modified in light of new information and improved investigative techniques.

Standard 5.3

A. Numerical Operations

1. Reinforce indicators from previous grade level.

B. Geometry and Measurement

1. When performing mathematical operations with measured quantities, express answers to reflect the degree of precision and accuracy of the input data.

C. Patterns and Algebra

1. Apply mathematical models that describe physical phenomena to predict real world events.

D. Data Analysis and Probability

1. Construct and interpret graphs of data to represent inverse and non-linear relationships, and statistical distributions.

Standard 5.4

A. Science and Technology

1. Know that scientific inquiry is driven by the desire to understand the natural world and seeks to answer questions that may or may not directly influence humans, while technology is driven by the need to meet human needs and solve human problems.

B. Nature of Technology

1. Assess the impacts of introducing a new technology in terms of alternative solutions, costs, tradeoffs, risks, benefits and environmental impact.

Standard 5.6

A. Structure and Properties of Matter

1. Know that atoms are made of a positive nucleus surrounded by negative electrons and that the nucleus, a tiny fraction of the volume of an atom, is composed of protons and neutrons, each almost 2,000 times more massive than an electron.
2. Know that the number of protons in the nucleus defines the element.
3. Know that an atom's electron arrangement, particularly the outermost electrons, determines how the atom can interact with other atoms.
4. Explain that atoms form bonds (ionic and covalent) with other atoms by transferring or sharing electrons.
5. Explain how the Periodic Table of Elements reflects the relationship between the properties of elements and their atomic structure.
6. Know that many biological, chemical and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.
7. Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds.

8. Know that different levels of energy of an atom are associated with different configurations of its electrons.

B. Chemical Reactions

1. Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst.
2. Show that some changes in chemical bonds require a net input or net release of energy.

Standard 5.7

A. Motion and Forces

4. Recognize that electrically charged bodies can attract or repel each other with a force that depends upon the size and nature of the charges and the distance between them and know that electric forces play an important role in explaining the structure and properties of matter.
5. Know that there are strong forces that hold the nucleus of an atom together and that significant amounts of energy can be released in nuclear reactions (fission, fusion, and nuclear decay) when these binding forces are disrupted.
6. Explain how electromagnetic, gravitational, and nuclear forces can be used to produce energy by causing chemical, physical, or nuclear changes and relate the amount of energy produced to the nature and relative strength of the force.
7. Demonstrate that moving electric charges can produce magnetic forces and moving magnets can produce electric forces.

B. Energy Transformations

1. Explain how the various forms of energy (heat, electricity, sound, light) move through materials and identify the factors that affect that movement.
2. Explain that while energy can be transformed from one form to another, the total energy of a closed system is constant.
3. Recognize that whenever mechanical energy is transformed, some heat is dissipated and is therefore unavailable for use.
4. Explain the nature of electromagnetic radiation and compare the components of the electromagnetic spectrum from radio waves to gamma rays.

Standard 5.10

B. Human Interactions and Impact

1. Assess the impact of human activities on the cycling of matter and the flow of energy through ecosystems.
2. Use scientific, economic, and other data to assess environmental risks and benefits associated with societal activity

SUGGESTED ACTIVITIES THAT ADDRESS THESE STANDARDS MAY INCLUDE BUT ARE NOT LIMITED TO:

Standard 5.1

- ChemCom Laboratory Safety Agreement Form
  - ChemCom Activity book page 1
- Foul Water Laboratory Activity
  - ChemCom Activity book page 3

Standard 5.2

- Putting it all together: Riverwood Town Council
  - ChemCom Activity book page35-38
- Research project on a Atomic Scientist
  - Powerpoint, written or oral

Standard 5.3

- Dissolving Ionic Compounds, Graphing Solubilities
  - ChemCom book page 56
- Molar mass computation and conversion
  - ChemCom Activity book page 53
- Half-Life (graphing)
  - ChemCom Activity book page179

Standard 5.4

- Your annual Ionizing-Radiation Dose
  - ChemCom Activity book page 169

Standard 5.6

- Separation by Distillation
  - ChemCom Activity book page 69
- Modeling Alkanes
  - ChemCom Activity book page 75

Standard 5.7

- Research project on Nuclear reactions and innovations
  - Powerpoint, oral or written

Standard 5.10

- Putting it all together: Riverwood Town Council
  - Runs throughout the whole book
- Uses of water
  - ChemCom Activity book page 7
- Water Use Analysis
  - ChemCom Activity book page 9

INSTRUCTIONAL STRATEGIES:

Direct Instruction
Cooperative Learning
Team Learning
Reciprocal Style Learning
Constructivist Learning

EVALUATION/ASSESSMENT OF STUDENTS:

Laboratory Reports/Activities
Quizzes
Homework assignments
Tests
Class work assignments
Oral Presentations
Written projects
Class participation

EVALUATION/ASSESSMENT OF CURRICULUM:

This course of study will be evaluated/assessed by instructional staff during the first year of implementation for the purpose of necessary revision at the end of the first year. In addition, this course of study will be reviewed according to the Five-Year Curriculum Review schedule (see attached).

RESOURCES/BIBLIOGRAPHY:

Course Book:

Chemistry in the Community 4th ed. W.H. Freeman and Company, 2002, ISBN 0-7167-3918-6

Teacher Supplements:

Activities Workbook for Chemistry in the Community 4th ed. W.H. Freeman and Company, 2002, ISBN 0-7167-3918-6

Introductory Chemistry, A Foundation 3rd ed. Steven Zumdahl, D.C. Heath, 1996, ISBN 0669-39954-X

Chemistry Concepts and Applications. Cheryl Wistrom, John Phillips, and Victor Strozak, Glencoe/McGrawHill, 1997, ISBN 0-02-827453-9

Criminalists: An Introduction to Forensic Science. Richard

Saferstein, Prentice Hall, 2004, ISBN 0-13-111-852-8

Merrill Chemistry. Robert C. Smoot, Richard G. Smith, and Jack Price, Glencoe/McGrawHill, 1998, ISBN 0-02-825527-5

Prentice Hall Chemistry: Laboratory Manual 3rd ed. Prentice Hall, 2004, ISBN 0-13-191363-2