

BEMIDJI AREA SCHOOLS

GENERAL CHEMISTRY

Grades 9-12

I. HISTORY AND NATURE OF SCIENCE

A. Scientific World View

Standard: The student will understand the nature of scientific ways of thinking and that scientific knowledge changes and accumulates over time.

The student will:

1. Be able to distinguish among hypothesis, theory and law as scientific terms and how they are used to answer a specific question.

Activity: *Discussion of Atomic Theory and Kinetic Theory throughout the course
Law of Conservation of Matter in Resource Unit*

2. Be able to explain how scientific and technological innovations as well as new evidence can challenge portions of or entire accepted theories and models including but not limited to atomic theory.

Activities: *Science vs. Tech. Question explored in Resources Unit
Organic Molecule Models are Created in Petroleum and Food Units*

3. Explain how traditions of ethics, peer review, conflict and general consensus influences the conduct of science.

Activities: *Resources: Recycling Issues
Petroleum: import/export Problems discussed
Food: Infant Mortality Activity*

4. Recognize that some scientific ideas are incomplete, and opportunity exists in these areas for new advances.

Activity: *Video Series: Search for Solutions*

B. Scientific Inquiry

Standard: The student will design and conduct a scientific investigation.

The student will:

1. Design and complete a scientific experiment using scientific methods by determining a testable question, making a hypothesis, designing a scientific investigation with appropriate controls, analyzing data, making conclusions based on evidence and comparing conclusions to the original hypothesis and prior knowledge.

Activities: *Variety of labs (at least 1 per week) found in the textbook Chem Com address this standard strand.*

2. Distinguish between qualitative and quantitative data.
Activity: *PIAT: Recycling of Copper*

3. Apply mathematics and models to analyze data and support conclusions.
Activities will include:
 - Molar Mass Problems*
 - % of Sugar in Gum*
 - Concentration Lab*
 - Viscosity and Density Lab*
 - % of Copper in a Penny*
 - Periodic Variation*
 - Boiling Point Trends*
 - Organic Packet*
 - Making Alkanes, Revisiting Alkanes, The Builders*
 - How Many Calories?*
 - Combustion Lab*
 - Milk Analysis*

4. Identify possible sources of error and their effects on results.
Activities: *% of Copper in a Penny*
All labs that include a RECAP or conclusion

5. Know that professional scientists and engineers have ethical codes.
Guest Speakers:
 - Petroleum Unit*
 - Nuclear Submarine Operator***Activity:** *Town Meeting (Water Unit)*

C. Scientific Enterprise

Standard: The student will understand the relationship between science and technology and how both are used.

The student will:

1. Compare and contrast the purposes and career opportunities of engineering, technology and science.
Activities: *Reading in Text: "Chemistry at Work" pages*

2. Provide an example of a need or problem identified by science and solved by engineering or technology.
Activity: *As part of introduction in Resources Unit*

3. Provide an example of how technology facilitates new discoveries and the development of scientific knowledge.
Activities: *The Good Ol' Days (Petroleum)*
Alternative Fuels (Petroleum)
Alternative Resources (Resources)

4. Know that technological changes and scientific advances are often accompanied by social, political, environmental and economic changes.

Activities: *The Good Ol' Days (Petroleum)*
Alternative Fuels (Petroleum)
Alternative Resources (Resources)

5. Recognize that science and technology are influenced by cultural backgrounds and beliefs and by social needs, attitudes, values and limitations.

Activities: *The Good Ol' Days (Petroleum)*
Alternative Fuels (Petroleum)
Alternative Resources (Resources)
You Decide: Petroleum World

D. Historic Perspectives

Standard: The student will recognize the historical and cultural context of scientific endeavors and how they influence each other.

The student will:

1. Be able to trace the development of a scientific advancement, invention or theory and its impact on society.

Activity: *The Good Old Days (Petroleum)*
History of the Atom notes
Water unit: Water uses, Water and Health, Water Purification Processes

2. Provide examples of scientific advancements contributed by other civilizations and cultures.

Activities: *D. Mendeleev work with Periodic Table (Resources)*
M. Curie and Radiation (Nuclear)

II. PHYSICAL SCIENCE

A. Structure of Matter

Standard: The student will understand the nature of matter including its forms, properties and interactions.

The student will:

1. Identify protons, neutrons and electrons as the major components of the atom, their mass relative to one another, their arrangement and their charge.

Notes: *Water Unit and Petroleum Unit*

2. Be able to explain the relationship of an element's position on the periodic table to its atomic number and atomic mass.

Notes: *Tour of Periodic Table (Resources)*

Activity: *Coloring Periodic Table*
Molar Mass Problems
Drawing Atomic Models

3. Compare and contrast the properties of an element and its isotopes, and describe how isotopes can be used in research, medicine and industry.
Notes: *Nuclear Unit*
Video: *Radioactivity*

4. Use the periodic table to identify regions, families, groups and periods.
Notes: *Tour of Periodic Table (Resources)*
Activity: *Coloring Periodic Table*
 DEMO: Alkali Metals
 Lab: Metal Reactivity
 Lab: Metal/Non-Metal

5. Explain how neutral atoms become ions.
Activity: *Drawing Atomic Models*
 Lab: Water Testing
 PIAT: Recycling Copper
Notes: *Redox Reactions*
 Electron Dot Models and Ionic vs. Covalent

6. Be able to explain how atoms form compounds through bonding.
Activities: *Drawing Atomic Models*
 Writing Ionic Compounds
Notes: *Covalent vs. Ionic Bonds*
 Organic Models

7. Compare and contrast the states of matter in terms of interactions between particles.
Activities: *Your Turn: Boiling Point Trends of Alkanes and Isomers*

8. Differentiate between an atom and a molecule.
Notes: *Mixture, Compound, and Elements (water unit)*
Activity: *Identify Mix, Cpd, and Elements (Water Unit)*
Lab: *Using up a Metal*
 Recycling Copper

9. Differentiate between an element and a compound.
Notes: *Mixture, Compound, and Elements (Water Unit)*
Activity: *Identify Mix, Cpd, and Elements (Water Unit)*

B. Chemical Reactions

Standard: The student will describe chemical reactions and the factors that influence them.

The student will:

1. Describe chemical reactions using words and symbolic equations.
Notes: *How to Write/Balance a Chemical Equation (Resources Unit)*
Activity: *Worksheet: Atom Inventory*

2. Explain the influence of temperature, surface area, agitation and catalysts on the rate of a reaction.
Activity: *Petroleum Unit: Addition Reactions*

3. Distinguish between a chemical reaction and a nuclear reaction.
Notes: *Nuclear Unit*

4. Explain how the rearrangement of atoms and molecules in a chemical reaction illustrates conservation of mass.
Lab: *Conservation of Matter*
Lab: *PIAT: Recycling Copper*

5. Describe how combining acids and bases produce a neutral solution.
Lab: *Turns vs. Rolaids (Water Unit)*
Notes: *Acid Contamination (Water Unit)*
 Acids vs. Bases

C. Energy Transformations

Standard: The student will understand energy forms, transformations and transfers.

The student will:

1. Know that potential energy is stored energy and is associated with gravitational or electrical force, mechanical position or **chemical composition**.
Notes and Demos:
 Endothermic and Exothermic Reaction

2. Be able to describe physical and chemical changes in terms of the law of conservation of energy.
Notes and Your Turn Assignments:
 Physical vs. Chemical Properties and Changes (Resources Unit)

3. Compare and contrast the amount of energy released through chemical reactions and nuclear fission and fusion.
Notes: *Nuclear Unit*
 Endothermic and Exothermic Reactions

4. Describe the risks and benefits of fossil fuels, renewable sources and nuclear power as sources of usable energy.
Activities: *Petroleum Unit – To Burn? To Build?*
 Resources Unit: Consuming Resources (You Decide)
 Nuclear Unit: Radiation: Is Elimination Possible or Desirable?

5. Describe applications of the different wavelengths of the electromagnetic spectrum.
Demo: *Nuclear Unit: Gases in Cathode Ray tubes*
 Electromagnetic Spectrum
Lab: *Flame Test*

D. Forces of Nature

Standard: The student will understand the forces of nature and their application.

The student will:

1. Recognize the factors that affect the presence and magnitude of gravitational, electromagnetic, weak and strong nuclear forces.

Notes and Demos: *Nuclear Unit*

E. Earth Structure and Processes

Standard: The student will understand that the interactions of the atmosphere, biosphere, lithosphere, hydrosphere and space have resulted in ongoing change of the Earth system over geologic time.

The student will:

1. Identify the internal and external sources of energy for the Earth.

Activities: *Resources: Where do we get them*

Petroleum Unit: Fossil Fuel Formation

2. Apply the laws of thermodynamics to explain the cycling of materials and transfer of energy in the Earth system.

Resources: *Lab: Conservation of Matter, Discussion of Nuclear Reactions and $E=mc^2$, energy transfer notes in Petroleum Unit*

3. Illustrate how biological processes have played significant roles in determining the character of the atmosphere, biosphere, hydrosphere and lithosphere over time.

Activity: *Resources Part C: Sources of Resources*

F. The Water Cycle, Weather and Climate

Standard: The student will explain the causes and effects of the Earth's atmospheric and hydrologic processes.

The student will:

1. Trace the cyclical movement of carbon and water through the lithosphere, hydrosphere, atmosphere and biosphere.

Petroleum Unit:

Where does it come from?

Air Unit

2. Identify, predict and investigate the factors that influence the quality of water and how it can be reused, recycled and conserved.

Whole Concept of Water Unit

G. The Universe

Standard: The student will use astronomical data to reveal the structure, scale, and changes in the stars, galaxies and universe over time.

The student will:

1. Explain how nuclear fusion produces energy and other elements.
Activity: *Nuclear Unit: Radioactive Decay and Decay Series*

III. LIFE SCIENCE

A. Cells

Standard: The student will comprehend that all living things are composed of cells, and that the life processes in a cell are based on molecular interactions.

The student will:

1. Describe the role of enzymes as catalysts in metabolism and cellular synthesis of new molecules.
Activity: *Food Unit: What is Amylase?*
2. Differentiate between the processes of photosynthesis and respiration in terms of energy flow, reactants and products.
Activity: *Food Unit: Respiration and Metabolism*

B. Flow of Matter and Energy

Standard: The student will describe and explain the cycling of matter and flow of energy through an ecosystem's living and non-living components.

The student will:

1. Explain the relationship between abiotic and biotic components of an ecosystem in terms of the cycling of water, carbon, oxygen and nitrogen.
Activity: *Water Unit: The Hydrologic Cycle and Notes: Where is the Earth's Water*
2. Explain that sunlight is transformed into chemical energy by photosynthetic organisms.
Activity: *Food Unit: Process of Photosynthesis to Make Carbs*
Petroleum: Heat of Combustion
3. Explain that respiration releases chemical energy through the breakdown of molecules.
Activity: *Food Unit: Respiration and Metabolism*