

BEMIDJI AREA SCHOOLS

APPLIED SCIENCE

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: *Hypothesis: pre-lab of various lab activities*
 Theory: atomic, plate tectonics, and kinetics
 Law: Gas Laws, Conservation Laws, Gravity Laws

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 cell theory, atomic theory, theory of evolution, plate tectonic theory, germ theory of disease and big bang theory.

Activity: *History of atomic theory (GFG)*

3. Recognize that in order to be valid, scientific knowledge must meet certain criteria including that it: be consistent with experimental, observational and inferential evidence about nature; follow rules of logic and reporting both methods and procedures; and, be falsifiable and open to criticism.

Activity: *Ongoing throughout course during conclusion write-ups of lab activities*
 (example: Conservation of Matter with Ziploc baggies) (WF)

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

Activity: *History of Galileo's biography, ethics involved in rebuilding after natural disasters discussion (QBS).*

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.

Activity: *Law of Conservation of Mass (WF). Calorie Lab (WF)*

2. Distinguish between qualitative and quantitative data.
Activity: *Various labs involving both measurements and observations*
3. Apply mathematics and models to analyze data and support conclusions.
Activities: *Models: Models of atoms, models of layers of earth, models simulating earthquakes*
Math: *Analysis of various data collect labs including: ohm's law, speed, acceleration, power, force, and heat capacity.*
4. Identify possible sources of error and their effects on results.
Activities: *A follow-up question for 40 out of 50 semester lab activities.*
5. Give examples of how different domains of science use different bodies of scientific knowledge and employ different methods to investigate questions.
Activities: *The course is designed specifically to meet this goal. The themes used to teach this course incorporate all domains of science working together to solve problems and discover science. ((WF, GFG, QBS and MC)*

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.
Activity: *Career Project/Interviews and videos of various scientists*
2. Provide an example of a need or problem identified by science and solved by engineering or technology.
Activity: *Career Project/Interviews and videos of various scientists*
3. Provide an example of how technology facilitates new discoveries and the development of scientific knowledge.
Activity: *Career Project/Interviews and videos of various scientists*
4. Know that technological changes and scientific advances are often accompanied by social, political, environmental and economic changes.
Activity: *Career Project/Interviews and videos of various scientists*
5. Recognize that science and technology are influenced by cultural backgrounds and beliefs and by social needs, attitudes, values and limitations.
Activity: *Career Project/Interviews and videos of various scientists*

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.
Activity: *Models of Atoms activity (GFG)*
2. Be able to explain the relationship of an element's position on the periodic table to its atomic number and atomic mass.
Activity: *Tour of the Periodic Table/Model of Krypton activity (GFG)*
3. Use the periodic table to identify regions, families, groups and periods.
Activity: *Alkali Metals Demo (GFG)*
4. Explain how neutral atoms become ions.
Activity: *Notes on chemical bonding (GFG: Dig It)*
5. Be able to explain how atoms form compounds through bonding.
Activity: *Notes on chemical bonding (GFG: Dig It)*
6. Compare and contrast the states of matter in terms of interactions between particles.
Activity: *Hot Ice Lab (phase changes of water activity) (WF)*
7. Differentiate between an atom and a molecule.
Activity: *Identifying Mixture, Compound, or Element (GFG)*
8. Differentiate between an element and a compound.
Activity: *Identifying Mixture, Compound, or Element (GFG)*

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.
Activity: *Pick Up the Pace lab (Wildfire), notes on Types of Reactions Copper reactions, Acid/Base labs and reactions (WF)*
2. Explain the influence of temperature, surface area, agitation and catalysts on the rate of a reaction.
Activity: *Plop Plop Fizz lab (WF), Blues in a Beaker (WF), and notes on rates of reactions.
Disappearing Act of Volcanoes (QBS)*

3. Explain how the rearrangement of atoms and molecules in a chemical reaction illustrates conservation of mass.

Activity: *Conservation of Mass activity (WF), Pick Up the Pace (WF)*

4. Describe how combining acids and bases produce a neutral solution.

Activity: *Acid/Base packet (end of Wildfire) and notes on types of reactions.*

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.

Activity: *Making a rollercoaster/catapult (MC)*

2. Differentiate between kinetic and potential energy and identify situations where kinetic energy is converted into potential energy and vice versa.

Activity: *Making a rollercoaster/catapult (MC)*

3. Be able to describe physical and chemical changes in terms of the law of conservation of energy.

Activity: *Making a rollercoaster/catapult (MC)*

4. Describe energy, work and power both conceptually and quantitatively.

Activity: *Power up the Stairs, Valley Fair Power Tower activity (MC)*

D. Motion

Standard: The student will understand the nature of force and motion.

The student will:

1. Use Newton's three laws of motion to qualitatively and quantitatively describe the interaction of objects.

Activity: *Newton's Law Demos, Newton's 2nd Law Lab (MC)*

2. Describe the effect of friction and gravity on the motion of an object.

Activity: *Friction Lab (MC) and Bouncy Ball lab (MC)*

E. Forces of Nature

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

The student will:

1. Identify the dominant force or forces in a variety of interactions.

Activity: *Balanced vs. Unbalanced forces identification (MC)*

F. 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.
Activity: *Where on Earth Lab (QBS)*
2. Apply the laws of thermodynamics to explain the cycling of materials and transfer of energy in the Earth system.
Activity: *Weather Report (WF), Molding and Folding Lab, Lava in the Lab, Disappearing Act Lab (QBS)*
3. Use the theory of plate tectonics to analyze relationships among earthquakes, volcanoes, mountains fossil deposits, rock layers and ocean features.
Activity: *Where On Earth Lab (QBS), Playing with Blocks (QBS)*
4. Describe how glaciers, gravity, wind, temperature changes, waves and rivers cause weathering and erosion.
Activity: *Lava In the Lab (QBS), Grand Canyon Internet activity (QBS), Towers and Bridges Lab (QBS), Disappearing Act (QBS)*
5. Describe the rock cycle and compare and contrast the processes responsible for the formation of igneous, sedimentary and metamorphic rocks.
Activity: *Lava in the Lab (QBS), Disappearing Act (QBS), and Identification Of Rocks (GFG)*
6. Use evidence found in fossils, rock layers, ice cores, radiometric dating and globally gathered data to explain how Earth has changed over short and long periods of time.
Activity: *Molding and Folding Lab (QBS)*

Note: *WF* is the Wildfire unit, *GFG* is the Going for the Gold Unit, *WFL* is the What's for Lunch unit, *QBS* if the Quake Bake and Shake unit.