Helena Public Schools
Teacher Desk Reference

EARTH SCIENCE

Grade Level 9 Course Duration: Full year

Course Description

Earth Science is designed to cover Astronomy, Geology, Oceanography, and Meteorology with emphasis on hands-on learning. Because it covers the essentials of the abiotic environment, it is recommended that this course be taken as one of the two required laboratory science courses for high school graduation.

Curriculum Design

Course Content	Learner Outcomes	MT Standard	Possible Delivery Methods
	The student will be proficient in solving problems and demonstrating skills in the following areas: astronomy, geology, oceanography and meteorology.		(in addition to text, class discussion, worksheets, videos, and study guides)
Astronomy	• describe the location of Earth in space	1.1, 1.2, 1.5	H-R Star Classification Activity
	• list and compare physical and chemical data for the Sun, planets, the Moon and stars	1.1, 1.4, 2.2, 2.3	Determining size of Sun Scale Model of the Solar System
	• explain how the position and motion of the earth to cause seasons, daylight, darkness, and the apparent motion of celestial objects	1.1, 1.2, 1.5	Apparent Size of the Sun Apparent Size of the Moon Phases of the Moon Lab
	• investigate lunar history, lunar motions and the the Earth/Moon system	1.5	Life and Death of Stars Spectroscope Lab
	• investigate wave theory as it applies to electromagnetic radiation	2.2	Ellipse Lab Rocket Construction and Launch Activities
	• investigate the density as it applies to stellar processes	2.2, 2.3	Interpreting Solar Cycles Activity
	• explore the forces involved with stellar evolution	4, 2.1, 2.5	
	• explore planetary magnetism while investigating magnetic declination and magnetic polarity and auroras	2.5	
	• relate how evidence from advanced technology, applied to scientific investigations has dramatically impacted our understanding of the origin, size, and evolution of the Universe.	4.3	
	• explain the impact of astronomical events and conditions on Earth's climate	4.5	

Course Content	Learner Outcomes	MT Standard	Possible Delivery
Astronomy continued	• describe the origin, location, and evolution of stars and their planetary systems in respect to the Solar System, the Milky Way, the Local Galactic Group, and the Universe.	4.6	
	• examine the historical developments of man's study of the heavens, including scientific theories regarding the origin of the universe.	5.1, 5.4, 6.1, 6.2	
	• examine the history of space exploration and advances in space technology		
Geology	• examine and explore the processes and effects of volcanism, earthquakes and mountain building.	1.1, 1.5, 2.1, 2.3	Magnetic Polarity Demonstration Plate Tectonics Map
	• explore and apply the concepts of plate tectonics and the evidence that supports it	1.2, 1.4, 2.6, 4.1, 5.1	San Andreas. Earthquakes Hawaiian Hot Spot Map Actvity
	• use the theory of plate tectonics to explain earthquakes, volcanoes and sea floor spreading	4.1,5.4, 6.1,6.2	Eratosthenes Circumference Problems Yellowstone Volcano Assignment
	• investigate the dynamic nature of the Earth's crust and internal structure	1.4	Sea floor Spreading Model Volcanic Rock Analysis
	• investigate weathering and erosion as caused by wind, water and ice and their effects upon the Earth's surface	1.4	Density Lab Rock Labs
	• examine the utilization of natural resources and the importance of planetary stewardship	1.4, 2.1	Rock Cycle Exercise Rock Problem
	• examine and describe rock cycle	1.4, 2.6	Interpreting Topographic Maps
	•use maps and other models of the Earth to interpret and understand crustal, oceanic, and atmospheric conditions	1.5	Latitude and Longitude Diagram of Earth Structure Interpreting Alaskan Seismogram
	• identify and classify the common rocks and minerals using chemical and physical properties	1.2, 2.1, 2.4, 4.2	Mineral Labs: Hardness, Specific Gravity other properties.
	• examine the role of convection currents in the plate tectonics	2.2	Epicenter Location Problems Travel Time Graph
	• explore wave theory as it applies to seismic waves and tsunamis	2.2	Virtual Field Trips
	• investigate density as it applies to Earth structure and Earth materials	2.2, 2.3	
	• explore the impact of terrestrial conditions and changes on Earth's climate	4.5	
	• trace the diversity and complexity of life through geologic time	5.1	

Course Content	Learner Outcomes	MT Standard	Possible Delivery
Geology continued	• examine/discuss benefits, limitations, costs, consequences and ethics involved in using scientific and technological innovations to make reasoned decisions through the study of natural resources and environmental pollution.	5.3	Water "Hardness" Lab Drainage Basin Map Activity
	• investigate the roles and processes of ground and surface water in the hydrologic cycle	1.1, 1.4, 1.5, 2.2, 2.3 4.5, 5.3	Stream Table Lab Porosity and Permeability Lab
Oceanography	• investigate chemical, physical and biological characteristics of the oceans	1.1, 1.5, 2.1	Hydrometer Lab Temperature of Salt Water
	• explore geologic features of ocean basins and continental margins	1.1, 1.2	Density Currents Lab Ocean Currents Map Activity
	• investigate processes which create waves and currents	1.4	Sea Floor Profile Activity
	• explore the wave theory as it applies to oceanic waves	2.2	
	• explore the relationship between oceanic circulation and Earth's climate	4.5	
	• investigate historical discoveries in oceanography	6.1, 6.2	

Course Content	Learner Outcomes	MT Standard	Possible Delivery
Meteorology	• utilize raw data to develop weather maps and predict weather	1.1, 1.2, 1.4	Burning Up the Atmosphere Lab Structure of Atmosphere Graph Activity
	• discuss evaporation, condensation, precipitation and humidity	1.1	Isotherm Map Activity Isobar Map Activity
	• measure and evaluate the effects of pressure, temperature, humidity and atmospheric composition on weather	1.1, 1.4, 2.3	Heating Land and Water Lab Relative Humidity Labs Global Circulation Map Activity
	• investigate climate factors and climate change	1.2, 1.4, 5.1	Modeling a Convection Current Lab
	• investigate the effects of man's activities on the atmosphere	1.4, 2.1, 2.4, 5.1 6.1, 6.2	Modeling Fronts Lab or Demonstration Greenhouse Lab
	• investigate the composition of the atmosphere and its dynamic nature	1.5, 2.4	Weather Maps Activities Carbon Dioxide Lab
	• explore the cyclic nature and balances that exist in the atmosphere	1.5	Tree Ring Analysis Climate Graphs Activities
	• investigate evaporation, condensation, precipitation and humidity	2.1, 2.2	
	• examine the role of convection in atmospheric circulation	2.2, 2.3	
	• examine and explore the processes and effects of plate tectonics as they relate to climate change	2.3	
	• explain the relationship of the hydrologic cycle to weather.	2.6	
	• explain the Greenhouse Effect and discuss its connection to Global Warming	2.6	
	• collect and analyze local, regional, and global weather-related data in order to make inferences and predictions about weather patterns.	4.4	
	• explain the impact of terrestrial, solar, oceanic, and atmospheric conditions on global climatic patterns.	4.5	

BIOLOGY I and/or HONORS BIOLOGY I

Grade Level: 10 Course Duration: Full Year
Prerequisite: Taken Earth Science

Course Description

Biology I is a survey course in the Life Sciences which includes laboratory experiences. The purpose of this course is to develop an understanding of living things and their relationship to one another. It is recommended that this course be taken as one of the two required laboratory science courses needed for high school graduation.

Curriculum Design

Course content	**Learner outcomes**	**MT Standard**	**Possible Delivery Methods**
	The student will be proficient in solving problems and demonstrating skills with		(in addition to text, class discussion, worksheets and study guides)
General	• learn and exhibit safety, proper handling, and care of laboratory equipment, specimens, and organisms	1.1, 2.1, 2.2, 2.4, 2.6, 3.1-3.4, 5.3	Safety Lab Recognizing Lab Equipt.Lab
	• understand and conduct investigations using the scientific method and appropriate technologies	1.1-1.3, 1.6, 2.1, 2.2, 2.4, 2.6, 3.1-3.4, 5.1, 6.1	Marigold Lab, Daphnia Lab Germination Lab
	• learn how to use the International system of measurement	1.1-1.3,1.6, 2.1, 2.2, 2.6, 3.1-3.4	Measurement Lab
	• demonstrate awareness of career opportunities in the biological field	3.1-3.5, 5.1, 5.3, 5.4, 6.1, 6.2	Current Events, Guest speakers Reports by students
	• understand the chronological order of scientific events and discoveries	3.1-3.5, 5.1, 5.2, 5.4, 6.1, 6.2	Current Events, Guest speakers Reports by students, Videos
	• demonstrate proficiency in using the microscope, balance, and other tools associated with science	1.1, 1.2, 1.6, 2.1, 2.3, 3.1-3.4, 5.1, 5.2, 5.4	All Labs
	• integrate basic skills such as reading, writing, speaking, listening, and mathematics into the study of biology	1.1-1.6, 2.1, 2.2, 2.4, 2.6, 3.1-3.5, 5.1-5.4, 6.1, 6.2	All Activities
Cell	• know the basic principles and characteristics that govern living things	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.4, 6.1, 6.2	Metabloism Lab Response Lab
	• understand the basic principles involving matter, inorganic chemistry, and biochemistry	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.4, 6.1, 6.2	Organic Comp. I.D. Yeast Experiments
	• understand the structure and	1.1-1.6, 2.1-2.4, 2.6,	Osmosis/Diffusion Labs

	functions of cells	3.1-3.5, 5.1, 5.2, 5.4 6.1, 6.2	Cell Structure Lab, Video
	• know the basic chemical processes which enable organisms to meet their metabolic and developmental needs	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.4	Yeast Lab, Demos
	• know the processes of cell division, mitosis, and meiosis	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.4	Videos, Onion Slides, Models/Drawings
Heredity	• describe the structure and function of nucleic acids and relate them to protein synthesis and he molecular basis of heredity	1.5, 1.6, 2.1, 2.2, 2.5, 3.1, 3.2, 3.3, 3.5,	Models
	• know the principles of heredity and how they apply in living organisms	1.5, 1.6, 3.1, 3.3-3.5, 5.1-5.4, 6.1, 6.2	Genetic Problems, Videos, Karyotype Lab, Blood type Lab Genetic Disorder Reports
	• understand genetic variations and how they affect organisms and populations	1.5, 1.6, 3.1, 3.3, 3.4, 3.5, 5.1-5.4, 6.1, 6.2	Genetic Problems, Videos, Karyotype Lab, Blood type Lab Genetic Disorder Reports
	• understand the methods and technology used in the study of genetics	1.5, 1.6, 3.1, 3.3, 3.4, 3.5, 5.1, 5.2, 5.3, 5.4, 6.1, 6.2	Electropheresis, Mapping Chromosome Lab
	• understand both the current and historical scientific theories on the origin of life and organic variation	1.5, 1.6, 3.3, 3.4, 3.5, 5.2, 5.4, 6.1, 6.2	Embryo Comparison, Fossil Comp. Lab, Human Evolution Lab, Video
Microbes	• describe and understand the characteristics of microbes (viruses, monerans, protists), methods by which they are studied, and their role in the environment	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.5, 5.1-5.4, 6.1, 6.2	Mouthwash Lab, Models, Videos, Microscope Labs, Hay Infusion Lab
Fungi	• describe and understand the characteristics of fungi and their ecological significance	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.5, 5.1-5.4, 6.1, 6.2	Slime Mold Lab, Growing Mold Lab Yeast Lab
Plants Labs	• describe and understand the characteristics of plants (nonvascular and vascular) and their ecological significance	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.5, 5.1-5.4, 6.1, 6.2	Root Stem Leaf Lab, Flower Dissection, Algae Lab, Monocot Vs Dicot Lab, Seed Videos
Animals	• describe and understand the characteristics of animals (invertebrates and vertebrates) and their ecological significance	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.5, 5.1-5.4, 6.1, 6.2	Dissections, Videos, Presentations

Ecology	• understand, interpret, and analyze ecological interrelationships within the biosphere and the role humans play in these processes	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.5, 4.4, 4.5, 5.1-54, 6.1, 6.2	Population Studies, Field Trips, Food Webs, Presentations, Succession Videos Fire Ecology

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CHEMISTRY

Grade Level	11,12	Course Duration:	Full Year
Prerequisite:	Concurrent enrollment of completion of Math III	Recommended for:	College Preparatory

Course Description
Chemistry I is a survey course dealing with the compositions of substances and the changes they undergo. The basic principles and concepts of chemistry are developed through extensive laboratory investigations.

Curriculum Design

Course Content	**Learner Outcomes**	**MT Standard**	**Activities in addition to worksheets, text,**
problems	The student will be proficient in solving problems and demonstrating skills in the following areas.		
Measurement and Math Skills	• Gain a perspective of the history of chemistry.	5.1- 5.4, 6.1, 6.2	
	• Discuss the significance of chemistry today.	5.1-5.4., 6.1, 6.2	
	• Measure and convert within the SI and other standard systems.	1.2	
	• Demonstrate an ability to solve appropriate problems involving basic algebra.	1.2, 2.1- 2.6	
	• Explain the significance of numbers an uncertainty of measurements.	1.2, 2.1- 2.6	
	• Apply dimensional analysis to problem solving.	1.2	
	• Solve problems involving ratio, proportion and percentages.	1.1	
	• Write numbers in scientific notation.	1.2	
	• Relate scientific method to problem solving.	1.1-1.6, 2.1- 2.6, 5.1-5.4	
Laboratory	• Demonstrate appropriate laboratory techniques and safe use of equipment while working individually and in small groups.	1.1, 1.3-1.6	lab safety quiz lab equipment location/I.D exercise
	• Evaluate critical experiments in which independent and dependent variables are measured, analyzed and controlled, using tools such as accuracy and precision.	1.1-1.6, 2.3, 2.6	ALL LAB WORK |
	• Graph correctly and interpret experimental data.	1.1-1.6	|
	• Gain experience and develop skills in laboratory techniques which are emphasizes in experimental procedures.	1.1-1.6, 2.3, 2.6	|

Atomic Structure and Periodic Properties of Atoms	• Describe the formation of isotopes through the use of nuclear equations.	2.1, 2.5	
	• Relate periodic trends, such as electronegativity, affinity, ionization energy and atomic size to ion formation and bonding.	2.1, 2.5	
	• Illustrate the formation of ions.	2.1, 2.5	I.D. of anions and cations
	• Explain the fundamental structure of the atom.	2.1, 2.5, 5.1-5.4, 6.1, 6.2	precipitation reactions lab
	• Relate radioactivity to atomic structure.	2.1, 2.5, 5.1-5.4	drawings, models
	• Sketch appropriate Bohr shell diagrams	2.1,2.5	videos
	• Relate chemical properties to atomic structure.	2.1,2.5	periodic properties lab
	• Describe the development and arrangement of the modern periodic table.	2.1, 2.5, 6.1, 6.2	flame test for metals lab Spectrophotometer lab
	• State the Periodic Law and give several examples of periodicity.	2.1, 2.5, 6.1, 6.2	demo emission spectra
	• Relate elemental position on the periodic table to atomic structure.	2.1, 2.5	
	• Illustrate behavior of elements in a family and in a period.	2.1, 2.5	
	• Apply basic bonding theory to compounds involving representative elements including ionic and covalent bonding and Van der Waal forces.	2.1, 2.5, 6.1, 6.2	double displacement lab
	• Describe general metal properties and use both systems of nomenclature to name and write formulas of transitional metal compounds.	2.1, 2.5	videos reactivity of metals lab
	• Describe the significance of the four quantum numbers and write appropriate electron notations.	2.1, 2.5, 6.1, 6.2	
Properties of Matter	• Distinguish between matter and energy.	2.1-2.6	
	• Describe elements, compounds, mixtures.	2.1-2.6, 6.1, 6.2	physical/chem change lab
	• Differentiate between chemical and physical properties and changes.	2.1-2.6	observing a chem rxn lab
	• Solve appropriate problems involving density and specific gravity.	2.1-2.6	mass, volume, density lab
	• Write and interpret elemental symbols and compound formulas.	2.1-2.6	

	• Summarize the basic concepts of modern atomic theory.	1.3, 1.5,2.1-2.6, 5.1-5.4, 6.1, 6.2	changes of physical states
	• Differentiate phases of matter and their relationship to the kinetic molecular theory.	2.1- 2.6	
Mole Concept	• Calculate formula weights and solve problems utilizing formulas.	2.3, 2.6	
	• Apply Avagadro's number to the mole concept.	1.1, 1.5, 2.3, 2.6, 5.1, 5.2, 5.4, 6.1, 6.2	
	• Explain the significance and calculate molar mass and molar volume.	2.3, 2.6	
	• Calculate gram-formula weights.	2.3, 2.6	
	• Calculate empirical and molecular formulas.	2.3, 2.6	empirical formula lab
	• Solve basic Stoichiometric problems based on chemical equations.	2.3, 2.6	quantitative analysis lab
			balanced chem. Equations
Chemical Bonding	• Recognize crystal systems and crystal types and relate them to chemical bonding.	2.1-2.6	Molecular models lab
	• Identify the geometry of molecules and relate to electronegativity and bond polarity.	2.1-2.6	precipitation rxns lab
	• Explain hybridization and the octet rule.	2.1-2.6	
	• Relate chemical activity to electron gain or loss.	2.1-2.6	flame test for metals lab
	• Differentiate ionic bonding from covalent bonding.	2.1-2.6	water of hydration
	• Illustrate covalent bonding.	2.1-2.6	
	• Apply nomenclature rules and formula writing to covalent compounds.	2.1-2.6	
	• Utilize the "table of common ions" in formula writing and nomenclature.	2.1-2.6	
	• Draw appropriate Lewis diagrams.	2.1-2.6	
	• Recognize differences in molecular bonding theory.	2.1-2.6,5.1-5.4, 6.1, 6.2	
Formula and Equation Writing	• Apply nomenclature rules and formula-writing to ionic and covalent compounds.	2.1, 2.4	types of chemical rxns lab

	• Balance equations and interpret their significances through calculations.	2.1, 2.4	quantitative anal. lab
	• Apply the law of definite composition to appropriate problems.	2.1, 2.4	balanced chem equations
	• Explain the significance of the law of conservation of matter.	2.1, 2.4, 5.1, 5.2, 5.4, 6.1, 6.2	lab
	• Solve basic and advanced Stoichiometric problems.	2.1, 2.4, 5.1, 5.2, 5.4, 6.1, 6.2	
Gases	• Relate the postulates of the kinetic molecular theory to the fundamental properties of gasses including ideal gases.	2.1-2.6, 5.4, 6.1, 6.2	Demos, videos Temp/vol lab
	• Solve appropriate gas law problem.	2.1-2.6, 5.4, 6.1, 6.2	Boyles Law lab Graham's Law lab
Solutions and Suspensions	• Explain terminology associated with solution phenomena	2.1-2.6	
	• Discuss factors affecting solubility	2.1-2.6	solvent properties of water
	• Describe the nature of specific solutions	2.1-2.6	distillation, supersat. lab
	• Interpret solubility curves	2.1-2.6	electrolytes vs nonelectro
	• Distinguish colloids from true solutions	2.1-2.6, 6.1, 6.2	chromotography lab
	• Define various concentration units and use them to solve appropriate problems	2.1-2.6, 6.1, 6.2	freezing pt depression lab
Acids and Bases	• Explain the strength of acids and bases	2.1-2.6	estimation of pH
	• Solve problems involving pH and acidity	2.1-2.6	rxn of acids lab
	• Relate hydrolysis to solution formation of acidic, basic and neutral salts	2.1-2.6	neutralization lab titrations lab
	• Describe titration curves and relate them to strengths of acids and bases	2.1-2.6	buffers lab
	• Explain how acid/base indicators work	2.1-2.6	
	• Compare and contrast several acid/base models	2.1-2.6, 5.1-5.4, 6.1, 6.2	
	• Solve problems involving the volumetric analysis of acids and bases	1.2, 2.1-2.6, 5.1-5.4, 6.1, 6.2	
	• Use the pH scale and indicators to determine acid and base strength	1.2, 2.1-2.6, 5.1-5.4, 6.1, 6.2	
Energy and Reaction Rates	• Distinguish between kinetic and potential energy	2.1-2.4, 2.6	factors affecting

	• Interpret potential energy diagrams	2.1-2.4, 2.6	reaction rate lab
	• Use enthalpy and entropy to predict reaction spontaneity and their relationship to free energy.	2.1-2.4, 2.6	
	• Describe those factors affecting reaction rates	2.1-2.4, 2.6	
	• Discuss the significance of energy distribution diagrams		
	• Apply basic calorimetry to the interpretation of phase diagrams	2.1-2.4, 2.6	
Chemical Equilibrium	• Relate the postulates of the kinetic molecular theory to the fundamental properties of solids and liquids.	2.1-2.6, 6.1, 6.2	
	• Interpret vapor pressure curves and their application in the determination of boiling points.	2.1-2.4, 2.6	
	• Apply Le Chatelier's principle to various equilibrium systems	1.1-1.4, 2.1-2.4, 2.6, 5.3, 5.4, 6.1, 6.2	
	• Apply solution equilibrium to crystal development.	2.1-2.4, 2.6	clock rxn lab
	• Define and use the law of mass action in theory and problems	1.1-1.4, 2.1-2.4, 2.6	disturbing equil. lab
	• Derive and solve problems involving equilibria constants	2.1-2.4, 2.6	
Oxidation/Reduction	• Recognize redox reactions and assign oxidation numbers to elements in a compound	2.1-2.6, 6.1, 6.2	redox lab corrosion lab
	• Balance redox reactions by the electron transfer method	2.1-2.6, 6.1, 6.2	electrochemistry
	• Identify oxidizing and reducing agents.	2.1-2.6, 6.1, 6.2	
	• Describe the process of electrolysis	2.1-2.6, 6.1, 6.2	

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CHEMISTRY IN THE COMMUNITY

Grade Level 11,12 Course Duration: Full Year
Prerequisite: Successful completion of Earth Science and Biology

Course Description

Chemcom is a course to show how chemistry relates to the everyday world. This course will cover many of the same topics of the Chemistry I course and include extensive laboratory investigation. The major difference will be less emphasis on the mathematical concepts related to Chemistry.

Curriculum Design

Course Content Activities	**Learner Outcomes**	**MT Standard**	
	The student will be proficient in solving problems and demonstrating skills with		
Measurement and Math Skills and activities	• Gain a perspective of the history of chemistry.	1.3-1.6, 5.1-5.4, 6.1,6.2	All labs
	• Discuss the significance of chemistry today.	1.3-1.6, 5.1-5.4, 6.1,6.2	
	• Measure and convert within the SI and other standard systems.	1.2	
	• Demonstrate an ability to solve appropriate problems involving basic algebra.	1.2, 2.1-2.6	
	• Explain the significance of numbers an uncertainty of measurements.	1.2	
	• Apply dimensional analysis to problem solving.	1.2	
	• Solve problems involving ratio, proportion and percentages.	1.2	
	• Write numbers in exponential notation.	1.2	
	• Relate scientific method to problem solving.	1.3-1.6, 2.1-2.6, 5.1-5.4	
	• Describe the methodology, terms and implications of scientific thought and processes.	1.3-1.6, 5.1-5.4, 6.1, 6.2	
Laboratory	• Demonstrate appropriate laboratory techniques and safe use of equipment while working individually and in small groups.	1.3-1.6,2.1-2.6	All labs
	• Evaluate critical experiments in which variables are measured, analyzed and controlled, using tools such as accuracy and precision.	1.2-1.6,2.1-2.6	
	• Graph correctly and interpret experimental data.	1.2-1.6, 2.3, 2.6	
	• Gain experience and develop skills in laboratory techniques which are emphasizes in experimental procedures.	1.2-1.6, 2.3, 2.6	

Atomic Structure and pennies lab Periodic Properties of Atoms activity	• Describe the formation of isotopes through the use of nuclear equations.	2.1, 2.5	Isotopic Half life
	• Relate periodic trends, such as eletronegativity, affinity, ionization energy and atomic size to ion formation and bonding.	2.1,2.5	
	• Illustrate the formation of ions.	2.1, 2.5	Water testing lab
	• Explain the fundamental structure of the atom.	2.1, 2.5	
	• Relate radioactivity to atomic structure.	2.1, 2.5	Alpha,beta and gamma rays lab and
	• Sketch appropriate Bohr shell diagrams.	2.1, 2.5	Radioactivity lab
	• Relate chemical properties to atomic structure.	2.1, 2.5	
	• Describe the development and arrangement of the modern periodic table.	2.1, 2.5	
	• State the Periodic Law and give several examples of periodicity.	2.1, 2.5	Periodic variation in properties activity
	• Relate elemental position on the periodic table to atomic structure.	2.1, 2.5	
	• Illustrate behavior of elements in a family and in a period.	2.1, 2.5	Metal reactivities lab
	• Apply basic bonding theory to compounds involving representative elements including ionic and covalent bonding and Van der Waal forces.	2.1, 2.5	
	• Describe general metal properties and use both systems of nomenclature to name and write formulas of transitional metal compounds.	2.1, 2.5	Metals and Nonmetal lab
Properties of Matter	• Distinguish between matter and energy.	2.1, 2.6	
	• Describe elements, compounds, mixtures.	2.1, 2.2	Foul water lab
	• Differentiate between chemical and physical properties and changes.	2.2,2.3	Mixtures lab
	• Solve appropriate problems involving density and specific gravity.	2.2	Density columns activity
	• Write and interpret elemental symbols and compound formulas.	2.6	
	• Differentiate phases of matter and their relationship to the kinetic molecular theory.	2.6	
Chemical Bonding	• Identify the geometry of molecules and relate to electronegativity and bond polarity.	2.1-2.5	

	• Relate chemical activity to electron gain or loss.	2.1-2.5	Metals reactivities lab
	• Differentiate ionic bonding from covalent bonding.	2.1-2.5	Water testing lab
	• Illustrate covalent bonding.	2.1-2.5	Petroleum labs
	• Apply nomenclature rules and formula writing to covalent compounds.	2.1-2.5	
	• Utilize the "table of common ions" in formula writing and nomenclature.	2.1-2.5	
	• Draw appropriate Lewis diagrams.		
Formula and Equation Writing	• Apply nomenclature rules and formula-writing to ionic and covalent compounds.	2.4	
	• Balance equations and interpret their significances vis-à-vis calculations.	2.4	Law of conservation of matter demo
	• Explain the significance of the law of conservation of matter (LCM).	2.6	Environmental implications of LCM
	• Solve basic Stoichiometric problems.	2.4	
Gases	• Relate the postulates of the kinetic molecular theory to the fundamental properties of gasses including ideal gases.	2.1-2.6	Temp.-Vol. relationships lab Atmosphere lab
	• Solve appropriate gas law problem.	2.1-2.6	
	• Explain impact of terrestrial and atmospheric conditions on global climatic patterns.	4.5	Environmental impact project
Solutions and Suspensions	• Explain terminology associated with solution phenomena	2.1-2.6	Solvents lab
	• Discuss factors affecting solubility	2.1-2.6	
	• Describe the nature of specific solutions	2.1-2.6	
	• Interpret solubility curves	2.1-2.6	
	• Distinguish colloids from true solutions	2.1-2.6	Mixtures lab
	• Define various concentration units and use them to solve appropriate problems	2.1-2.6	
Acids and Bases	• Explain the strength of acids and bases	2.1-2.6	Acid rain lab
	• Solve problems involving pH and acidity	2.1-2.6	
	• Explain how acid/base indicators work	2.1-2.6	Many labs involve indicators
	• Use the pH scale and indicators to determine acid and base strength	2.1-2.6	Many labs involve pH
Energy and Reaction Rates	• Distinguish between kinetic and potential energy	2.1-2.6	

	• Apply basic calorimetry to the interpretation of phase diagrams	2.1-2.6	Calorimetry Lab
Chemical Equilibrium	• Relate the postulates of the kinetic molecular theory to the fundamental properties of solids and liquids.	2.1-2.6	Demo
Oxidation/Reduction	• Recognize redox reactions and assign oxidation numbers to elements in a compound	2.1-2.6	Redox demo
	• Identify oxidizing and reducing agents.	2.1-2.6	
	• Describe the process of electrolysis	2.1-2.6	Potato battery lab

Helena Public Schools
Teacher Desk Reference

CHEMISTRY II

Grade level: 12
Prerequisite: Chemistry I and instructor approval, concurrent enrollment in math IV or equal level math

Course Duration: Full Year
Recommended for: College Preparatory

Course Description: Chemistry II is an opportunity for students who have a desire to continue their study of chemistry and apply their knowledge in a relevant, practical, and useful course while increasing their understanding of fundamental principles, problem solving and laboratory sills and techniques. The chemical analysis learned in this course is used in many fields of science, and the skills and techniques learned in this course are invaluable to the student choosing a science related career.

Curriculum Design

Course Content	**Learner Outcomes**	**MT Standard**	**Activities in addition to w.sheets, text, problems**
Measurement and math Skills	-Gain a perspective of the history of chemistry	5.1-5.4, 6.1, 6.2	
	-Discuss the significance of chemistry today	5.1-5.4, 6.1, 6.2	
	-Measure and convert within SI and other standard systems and use of scientific notation	1.2	
	-Demonstrate an ability to solve appropriate problems	1.2, 2.1-2.6	
	-Explain the significance of numbers and uncertainty in measurements	1.2, 2.1-2.6	
	-Apply dimensional analysis to problem solving	1.2	
	-Solve problems involving ratio, proportion, and percentages	1.1	
	-Relate scientific method to problem solving	1.1-1.6, 2.1-2.6, 5.1-5.4	
Laboratory	-Demonstrate appropriate laboratory techniques and safe use of equipment while working individually and in small groups	1.1, 1.3-1.6	lab safety quiz lab equipment location/I.D. ALL LAB WORK
	-Evaluate critical experiments in which independent and dependent variables are measured, analyzed and controlled, using tools such as accuracy and precision	1.1-1.6, 2.3, 2.6	⇓
	-Graph correctly and interpret experimental data	1.1-1.6	
	-Gain experience and develop skills in laboratory techniques which are emphasized in experimental procedures	1.1-1.6, 2.3, 2.6	
Stoichiometry	-Predict, calculate, and quantify chemical reactions and formation of chemical compounds	1.2, 1.3, 2.1, 2.3, 2.4, 2.6 5.1, 5.2	Chemical reactions labs Percent yield experiments

	-Use molarity, solubility, redox, etc for aqueous systems and solution chemistry	2.1-2.6	Colligative properties labs
Atomic Structure and the Periodic Table	-Relate atomic structure and the electronic structure of atoms	1.5, 2.2, 2.5, 6.1, 6.2	Chemical formulas lab
	-Explore from the Bohr model through the Quantum Theory of the atom	1.5, 1.6, 2.4, 5.2, 5.3, 6.1, 6.2	
	-Explore the wave nature of light and atomic spectra	2.3, 2.5, 5.4, 6.1, 6.2	Atomic Spectra and Atomic Structure
	-Gain an historical perspective of the periodic table	1.5, 2.2, 2.4, 6.1, 6.2	
	-Relate periodic trends of electronegativity, ionization energy, electron affinity, atomic radius, metal/nonmetal character and group trends	1.2, 1.5, 2.1, 2.2, 2.3,	
Thermodynamics	-Relate Hess's Law, enthalpy, heats of formation to the First Law of Thermodynamics	1.2, 1.3, 2.3, 2.4, 2.6,	Electrochemical Cells and Thermodynamics
	-Apply specific heat to calorimetry	1.1, 1.3, 1.4, 2.3, 2.4, 2.6	Heat of Reaction lab
	-Evaluate enthalpy, entropy and temperature to determine sponteneity of reactions	2.3, 2.4, 2.6	Heat of Neutralization lab
Chemical Bonding	-Predict ionic compounds and relate crystal structure to ion size	1.2, 2.2	
	-Apply the octet rule, exceptions, Lewis dot structures, resonance and oxidation numbers to covalent bonding	1.5, 2.2	
Molecular Geometry	-Apply VSEPR theory and molecular orbital theory (hybridization and multiple bonds) to predict molecular geometry	1.2, 2.5, 2.1, 2.2, 5.2, 5.4, 6.1	Molecular Geometry lab Modeling molecular geometry
Organic Chemistry	-Apply nomenclature rules and formula writing to alkanes, alkenes, and alkynes	2.1, 2.2, 2.4, 2.6	Preparation of Aspirin and Oil of Wintergreen
	-Relate nomenclature to structure and properties	2.1, 2.2, 2.4	Structure and Physical Properties

	of organic molecules		of Polymers Preparation of Polymers
Gases	-Relate the postulates of the Kinetic Molecular Theory to the fundamental properties of gases (pressure, volume, temperature)—including ideal gases	1.2, 1.3, 1.4, 2.2, 2.4	Behavior of Gases: Molecular Weight of a Vapor
	-Predict volumes, pressures of gases in chemical reactions	2.2, 2.4, 2.6	Determination of *R*: The Gas-Law Constant
Analysis	-Apply and integrate varied background knowledge to perform laboratory investigation of:		
	-Volumetric analysis	1.1-1.3, 2.1, 2.4	Titrations of Acids and Bases Analysis of Aspirin
	-Gravimetric analysis	1.1-1.3, 2.1, 2.4	Gravimetric Analysis of a Chloride Salt Gravimetric Determination of Nickel
	-Colorimetric analysis	1.1-1.3, 2.1, 2.4	Colorimetric Determination of Iron
	-Qualitative analysis	1.1-1.3, 2.1, 2.4	Abbreviated Qualitative-Analysis Scheme
Equilibrium	-Derive and solve problems involving Equilibrium constants	1.1-1.4, 2.4, 2.6	
	-Predict changes in equilibrium using Le'Chatelier's Principle	1.1-1.4, 2.4, 2.6	Student developed experiment for Le Chatelier's Principle
	-Compare and contrast several acid/base models	1.3, 1.5, 2.1, 6.1, 6.2	Determination of the Dissociation Constant of a Weak Acid
	-Relate strength to K_a and K_b	1.4, 2.1, 2.3, 2.4	Titration Curves of Polyprotic Acids
	-Apply concepts of buffers and common ion effect	2.1, 2.3	Acid-Base Properties of Salt Solutions: Hydrolysis
	-Relate salt hydrolysis to solution formation of acidic, basic, and neutral salts	2.1-2.6	Determination of the Solubility-Product Constant for a Sparingly Soluble Salt
	-Apply criteria for precipitation or dissolution	2.1-2.6	

Chemical Kinetics	-Describe the relationship between reaction rate and temperature/concentration (change in concentration over time)	1.4, 2.1-2.6	Rates of reactions: A Clock Reaction Rates of reactions: Rate and Order of H_2O_2
Oxidation/Reduction	-Apply redox to voltaic cells, EMF, and Electrolysis -Predict spontaneity of redox reactions	2.1-2.2	Electrolysis, the Faraday, and Avogadro's Number Analysis of Water for Dissolved Oxygen Oxidation-reduction titrations: Determination of Oxalate
Nuclear Chemistry	-Relate nuclear stability to radioactivity -Investigate rates of radioactive decay	2.1-2.6, 6.1, 6.2	
	-Distinguish between fission and fusion and relate to energy changes in nuclear reactions	2.1-2.6	

Helena Public Schools
Teacher Desk Reference

BIOLOGY II
Grade Level: 11, 12
Prerequisite: "B" or better in Biology I, recommendation of Biology I instructor

Course Duration: Full Year
Recommended for: College Preparatory

Course Description:
Biology II is a college preparatory course offered to juniors or seniors who have received a "B" or better in Biology I. This course is designed for students who are interested in the biological fields or in studies beyond the scope of Biology.

Curriculum Design

Course Content	**Learner Outcomes**	**MT Standard**	**Activities in addition to w.sheets, text, problems**
	The student will be proficient in solving problems and demonstrating skills with		
General	-learn and exhibit safety, proper handling, and care of laboratory equipment, specimens, and organisms	1.1, 2.1, 2.2, 2.4, 2.6 3.1-3.4, 5.3	Activities for each of the following areas of biology may include: lecture discussion, problem solving, lab activities, modeling, worksheets and handouts, field trips, special speakers.
	-understand and conduct investigations using the scientific method and appropriate technologies	1.1-1.3, 1.6, 2.1, 2.2, 2.4, 2.6, 3.1-3.4, 5.1, 6.1	
	-learn how to use the SI system of measurement	1.1-1.3, 1.6, 2.1, 2.2, 2.6, 3.1-3.4	
	-demonstrate awareness of career opportunities in the biological field	3.1-3.5, 5.1, 5.3, 5.4 6.1, 6.2	
	-understand the chronological order of scientific events and discoveries	3.1-3.5, 5.1, 5.2, 5.4 6.1, 6.2	Laboratory Activities appropriate to the area for possible use follow:
	-demonstrate proficiency in using the tools and technology associated with biology	1.1, 1.2, 1.6, 2.1, 2.3, 3.1-3.4, 5.1, 5.2, 5.4	
	-integrate basic skills such as reading, writing, speaking, listening, and mathematics into the study of biology	1.1-1.6, 2.1, 2.2, 2.4, 2.6 3.1-3.5, 5.1-5.4, 6.1, 6.2	

Course Content	**Learner Outcomes**	**MT Standard**
Cells and tissues	-know the basic principles and characteristics that govern living things	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.4, 6.1, 6.2

	-understand the basic principles involving matter, inorganic chemistry, and biochemistry	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.4, 6.1, 6.2	Catalysis Enzymes
	-understand the structure and functions of cells	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.5, 5.1, 5.2, 5.4, 6.1, 6.2	Molecular Biology
	-know the basic chemical processes which enable organisms to meet their metabolic and developmental needs	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.4	Diffusion and Osmosis Cell Respiration
	-know the processes of cell division, mitosis, and meiosis	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.4	Mitosis and Meiosis
	-recognize different tissues and their abnormalities	1.1-1.6,3.1-3.5,6.1,6.2	Cytology
Heredity	-describe the structure and function of nucleic acids and relate them to protein synthesis and the molecular basis of heredity	1.5, 1.6, 2.1, 2.2, 2.5, 3.1, 3.2, 3.3, 3.5	
	-know the principles of heredity and how they apply in living organisms	1.5, 1.6, 3.1, 3.3-3.5, 5.1-5.4, 6.1, 6.2	Mendelian Problems Genetics of Organisms
	-understand genetic variations and how they affect organisms and populations	1.5, 1.6, 3.1, 3.3, 3.4, 3.5, 5.1-5.4, 6.1, 6.2	Population Genetics
	-understand the methods and technology used in the study of genetics and their applications	1.5, 1.6, 3.1, 3.3, 3.4, 3.5, 5.1, 5.2, 5.3, 5.4, 6.1, 6.2	Use of Restriction enzymes
	-understand gene regulation and mutations		Human Genome Studies
	-understand the mechanisms involved in evolutionary biology	1.1-1.6,3.4,3.5,4.1,4.3-4.5 5.1,5.2,5.4,6.1,6.2	
Microbes	-describe and understand the characteristics of microbes (viruses, monerans, protists), methods by which they are studied, and their role in the environment	1.1-1.6, 2.1-2.4, 2.6 3.1-3.5, 5.1-5.4, 6.1, 6.2	Viral DNA Fragmentation
Fungi `	-describe and understand the characteristics of fungi and their ecological significance	1.1-1.6, 2.1-2.4, 2.6, 3.1-3.5 5.1-5.4, 6.1, 6.2	Yeast Population Study

Course Content	**Learner Outcomes**	**MT Standard**	
Plants	-understand the reproduction, growth, development structure, physiology and behavioral adaptations	1.1-1.6,2.1-2.4,2.6,3.1-3.5, 5.1-5.4,6.1,6.2	Plant pigments Plant tropisms Transpiration
Animals	-understand the reproduction, growth, development structure, physiology and behavioral adaptations	1.1-1.6,2.1-2.4,2.6,3.1-3.5, 5.1-5.4,6.1,6.2	Embryology labs Comparative mammilian

	-compare and contrast the anatomy of vertebrate organisms	1.1-1.6,2.1-2.4,2.6,3.1-3.5, 5.1-5.4,6.1,6.2	anatomy studies Circulatory system
	-learn the processes and complexities of the organ systems of the human body	1.1-1.6,2.1-2.4,2.6,3.1-3.5, 5.1-5.4,6.1,6.2	Exercise physiology Animal behavior
	-analyze, compare, measure and test human exercise physiology and body processes	1.1-1.6,2.1-2.4,2.6,3.1-3.5, 5.1-5.4,6.1,6.2	
Ecology	-understand, interpret, and analyze ecological interrelationships within the biosphere and the role humans play in these processes	1.1-1.6,2.1-2.4,2.6,3.1-3.5, 5.1-5.4,6.1,6.2	Dissolved oxygen and productivity Field trips
	-understand how to conduct field studies involving management of natural resources	1.1-1.6,2.1-2.4,2.6,3.1-3.5 5.1-5.4,6.1,6.2	Fire ecology Forest Management study Range Management study

Physical Science

Grade Level: 11,12
Prerequisite: Successful completion of Earth Science and Biology
Course Duration: Full Year
Recommended for: College Preparatory: **Non-Science Degrees** (Science elective)

Course Description

Physical Science. Physical Science is a course that integrates the two scientific disciplines of Physics and Chemistry. Many of the same topics of the Chemistry I and Physics courses will be covered. This course teaches Physics and Chemistry concepts through the investigation of local issues and current events. Topics covered are listed below. The value of teaching physical science conceptually is NOT to minimize mathematics, but to maximize the use of student's personal experiences such as laboratory exercises, field studies and community partnerships.

Course Content	Learner Outcomes	MT Standard
	At a level of proficiency, the student will:	
Measurement and Math Skills	• Gain a perspective of the history of chemistry.	1.3-1.6, 5.1-5.4, 6.1,6.2
	• Discuss the significance of chemistry today.	1.3-1.6, 5.1-5.4, 6.1,6.2
	• Measure and convert within the SI and other standard systems.	1.2
	• Demonstrate an ability to solve appropriate problems involving basic algebra.	1.2, 2.1-2.6
	• Explain the significance of numbers an uncertainty of measurements.	1.2
	• Apply dimensional analysis to problem solving.	1.2
	• Solve problems involving ratio, proportion and percentages.	1.2
	• Write numbers in scientific notation.	1.2
	• Relate scientific method to problem solving.	1.3-1.6, 2.1-2.6, 5.1-5.4
	• Describe the methodology, terms and implications of scientific thought and processes.	1.3-1.6, 5.1-5.4, 6.1, 6.2
Laboratory	• Demonstrate appropriate laboratory techniques and safe use of equipment while working individually and in small groups.	1.3-1.6,2.1-2.6
	• Evaluate critical experiments in which variables are measured, analyzed and controlled, using tools such as accuracy and precision.	1.2-1.6,2.1-2.6
	• Graph correctly and interpret experimental data.	1.2-1.6, 2.3, 2.6
	• Gain experience and develop skills in laboratory techniques which are emphasizes in experimental procedures.	1.2-1.6, 2.3, 2.6

Atomic Structure and Periodic Properties of Atoms	• Describe the formation of isotopes through the use of nuclear equations.	2.1, 2.5
	• Relate periodic trends, such as electronegativity, affinity, ionization energy and atomic size to ion formation and bonding.	2.1,2.5
	• Illustrate the formation of ions.	2.1, 2.5
	• Explain the fundamental structure of the atom.	2.1, 2.5
	• Relate radioactivity to atomic structure.	2.1, 2.5
	• Sketch appropriate Bohr shell diagrams.	2.1, 2.5
	• Relate chemical properties to atomic structure.	2.1, 2.5
	• Describe the development and arrangement of the modern periodic table.	2.1, 2.5
	• State the Periodic Law and give several examples of periodicity.	2.1, 2.5
	• Relate elemental position on the periodic table to atomic structure.	2.1, 2.5
	• Illustrate behavior of elements in a family and in a period.	2.1, 2.5
	• Apply basic bonding theory to compounds involving representative elements including ionic and covalent bonding and Van der Waal forces.	2.1, 2.5
	• Describe general metal properties and use both systems of nomenclature to name and write formulas of transitional metal compounds.	2.1, 2.5
Properties of Matter	• Distinguish between matter and energy.	2.1, 2.6
	• Describe elements, compounds, mixtures.	2.1, 2.2
	• Differentiate between chemical and physical properties and changes.	2.2,2.3
	• Solve appropriate problems involving density and specific gravity.	2.2
	• Write and interpret elemental symbols and compound formulas.	2.6
	• Differentiate phases of matter and their relationship to the kinetic molecular theory.	2.6
	• Apply the principles of fluid dynamics.	2.6
Chemical Bonding	• Identify the geometry of molecules and relate to electronegativity and bond polarity.	2.1-2.5
	• Relate chemical activity to electron gain or loss.	2.1-2.5
	• Differentiate ionic bonding from covalent bonding.	2.1-2.5
	• Illustrate covalent bonding.	2.1-2.5
	• Apply nomenclature rules and formula writing to covalent compounds.	2.1-2.5
	• Utilize the “table of common ions” in formula writing and nomenclature.	2.1-2.5
	• Draw appropriate Lewis diagrams.	

Formula and Equation Writing	• Apply nomenclature rules and formula-writing to ionic and covalent compounds.	2.4
	• Balance equations and interpret their significance vis-à-vis calculations.	2.4
	• Explain the significance of the law of conservation of matter.	2.6
	• Solve basic Stoichiometric problems.	2.4
Gases	• Relate the postulates of the kinetic molecular theory to the fundamental properties of gasses including ideal gases.	2.1-2.6
	• Solve appropriate gas law problem.	2.1-2.6
	• Explain impact of terrestrial and atmospheric conditions on global climatic patterns.	4.5
Solutions and Suspensions	• Explain terminology associated with solution phenomena	2.1-2.6
	• Discuss factors affecting solubility	2.1-2.6
	• Describe the nature of specific solutions	2.1-2.6
	• Interpret solubility curves	2.1-2.6
	• Distinguish colloids from true solutions	
	• Define various concentration units and use them to solve appropriate problems	2.1-2.6
Acids and Bases	• Explain the strength of acids and bases	2.1-2.6
	• Solve problems involving pH and acidity	2.1-2.6
	• Explain how acid/base indicators work	2.1-2.6
	• Use the pH scale and indicators to determine acid and base strength	2.1-2.6
Energy and Reaction Rates	• Distinguish between kinetic and potential energy	2.1-2.6
	• Apply basic calorimetry to the interpretation of phase diagrams	2.1-2.6
Chemical Equilibrium	• Relate the postulates of the kinetic molecular theory to the fundamental properties of solids and liquids.	2.1-2.6
Oxidation/Reduction	• Recognize re-dox reactions and assign oxidation numbers to elements in a compound	2.1-2.6
	• Identify oxidizing and reducing agents.	2.1-2.6
	• Describe the process of electrolysis	2.1-2.6

Course Content	Learner Outcomes	Montana Standard
General:	• demonstrate respect for classroom equipment	1.1
	• practice safe laboratory procedures	1.1
	• integrate the basic skills of reading, writing, speaking, listening, and mathematics into the study of physics.	1.1, 1.2,1.3, 1.6, 2.4, 2.6, 5.2
	• appreciate the historical, social, and scientific events that have contributed to the development of physics.	6.1, 6.2
	• communicate to others that physics is a dynamic field in which concepts change as new relationships are discovered.	1.3, 6.1, 6.2
	• compare the differences and interrelationships between technology and science.	6.1, 6.2
	• model good data-gathering and measurement techniques in the laboratory.	1.1, 1.2, 1.3, 1.5, 1.6, 2.3, 2.4, 2.5, 2.6, 5.2
	• conduct scientific investigations and communicate the results of these studies to others.	1.1, 1.2, 1.6, 2.2, 2.3, 2.4, 2.5, 2.6, 5.2
	• exhibit analytical and critical thinking.	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.3, 2.4, 2.5, 2.6, 5.2, 5.4
Mechanics:	• distinguish among and utilize the concepts of speed, distance, position, acceleration, velocity, and momentum.	1.1, 2.2, 2.3, 2.4, 2.5, 2.6, 5.2
	• distinguish among and utilize the concepts of potential energy, kinetic energy, work, power, and simple mechanics.	1.1, 1.4, 2.2, 2.3, 2.4, 2.5, 2.6, 5.2
	• use graphs to understand the concepts of mechanics.	1.1, 1.2, 2.2, 2.3, 2.4, 2.5, 2.6, 5.2
	• describe Newton's laws and their applications.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.5, 2.6, 5.4, 6.1, 6.2
	• express the conservation laws for energy and for momentum.	1.1, 1.2, 1.4, 2.2, 2.3, 2.4, 2.5, 2.6
	• use vectors to describe motion and solve problems.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.5, 2.6
	• use the conservation laws to solve problems.	1.1, 1.5, 2.4, 2.6
	• understand gravitational interactions.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.5, 2.6, 5.4, 6.1, 6.2
	• differentiate the various aspect of special relativity.	
Waves:	• express the nature of waves as to type and characteristics.	1.1, 1.2, 1.5, 2.2, 5.4
	• explain how energy is transferred through wave motion.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.6
	• explain how waves reflected, refracted, and diffracted.	1.1, 1.2, 1.5, 2.2, 2.3, 2.4, 2.6

Course content	Learner outcomes	MT Standard
	• discuss interference of waves.	1.1, 1.2, 1.3, 1.5, 2.2, 2.3, 2.6
	• describe the relationship of waves to sound and light.	1.1, 1.2, 1.5, 2.2, 2.3, 2.4, 2.6
Heat:	• distinguish between heat and temperature.	2.3, 2.6
	• demonstrate heat exchange and its applications.	1.1, 1.4, 2.2, 2.3, 2.4, 2.6
	• compare the relationship of heat and work, including heat engines.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.6, 5.2
	• test the laws of thermodynamics.	1.1, 1.4, 1.5, 2.2, 2.3, 2.4, 2.6, 5.2
	• relate the concepts behind changes of state.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.6
Electricity and Magnetism:	• describe magnetism (including poles and fields), and its relationship to electric current.	1.1,1.4, 1.5, 2.3, 2.5, 6.1, 6.2
	• describe and apply electrostatic principles.	1.1,1.4, 1.5, 2.3, 2.5, 6.1, 6.2
	• apply the principles of electricity to every day life.	1.1,1.4, 1.5, 2.3, 2.5, 6.1, 6.2
Light:	• illustrate how light rays reflect from a surface.	1.2, 5.2
	• locate and describe images formed by plane and spherical mirrors.	1.1, 1.2, 5.2
	• use Snell's law and ray diagrams to explain the refraction of light rays.	1.1, 1.2, 1.5, 5.2, 6.1, 6.2
	• explain the behavior of convex and concave lenses.	1.1, 1.2, 1.5, 5.2
	• locate and describe images formed by convex and concave lenses.	1.1, 1.2, 1.5
	• explains Newton's particulate theory of light.	6.1, 6.2
	• use Huygen's principle to explain the behavior of light.	6.1, 6.2
	• describe the current understanding of the nature of light.	1.1, 1.2, 2.6, 5.4
	• demonstrate the interference and diffraction of light.	1.1
	• illustrate the position of visible light in the electromagnetic spectrum.	1.1, 1.2
	• recognize modern applications of optics.	1.1, 1.3, 1.5, 2.6, 5.4
Modern Physics:	• restate that the speed of light is constant, regardless of the relative motion of source or observer.	5.4
	• describe Einstein’s theory of special relativity.	5.2, 5.4, 6.1, 6.2

Physics

Grade level: 11-12 Course duration: Full year

Prerequisites: Three years of math are required: Algebra I, Geometry, and Algebra II, though Algebra II may be taken concurrently. Trigonometry and three years other sciences are recommended.

Course Description:

Physics is the study of the relationships of matter and energy. Laboratory experiences are used to teach such topics as motion, heat, sound, wave mechanics, light, magnetism, and electricity. In addition to lab work, discussions and demonstrations as well as text assignments will be part of the course.

Curriculum Design

Course Content	Learner Outcomes	MT Standard	Possible Delivery Methods
	The student will be proficient in solving problems and demonstrating skills with:		(in addition to text, class discussion, worksheets and study guides)
General:	• demonstrate respect for classroom equipment	1.1	Safety Lab
	• practice safe laboratory procedures	1.1	Metric Recognition
	• integrate the basic skills of reading, writing, speaking, listening, and mathematics into the study of physics.	1.1, 1.2,1.3, 1.6, 2.4, 2.6, 5.2	Lab Equipment Checklist Displaying Data Worksheet
	• appreciate the historical, social, and scientific events that have contributed to the development of physics.	6.1, 6.2	
	• communicate to others that physics is a dynamic field in which concepts change as new relationships are discovered.	1.3, 6.1, 6.2	
	• compare the differences and interrelationships between technology and science.	6.1, 6.2	
	• model good data-gathering and measurement between technology and science.	1.1, 1.2, 1.3, 1.5, 1.6, 2.3, 2.4, 2.5, 2.6, 5.2	
	• conduct scientific investigations and communicate the results of these studies to others.	1.1, 1.2, 1.6, 2.2, 2.3, 2.4, 2.5, 2.6, 5.2	
	• exhibit analytical and critical thinking.	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.3, 2.4, 2.5, 2.6, 5.2, 5.4	
Mechanics:	• distinguish among and utilize the concepts of speed, distance, position,acceleration, velocity, and momentum.	1.1, 2.2, 2.3, 2.4, 2.5, 2.6, 5.2	Vector Worksheets Car Labs/Velocity Acceleration Displacement Force Labs
	• distinguish among and utilize the concepts	1.1, 1.4, 2.2, 2.3,	Projectile Motion Lab

	of potential energy, kinetic energy, work, power, and simple mechanics.	2.4, 2.5, 2.6, 5.2	Universaal Gravitation Videos
	• use graphs to understand the concepts of mechanics.	1.1, 1.2, 2.2, 2.3, 2.4, 2.5, 2.6, 5.2	
	• describe Newton's laws and their applications.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.5, 2.6, 5.4, 6.1, 6.2	
	• use vectors to describe motion and to solve problems.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.5, 2.6	
	• express the conservation laws for energy and for momentum.	1.1, 1.2, 1.4, 2.2, 2.3, 2.4, 2.5, 2.6	
	• use the conservation laws to solve problems.	1.1, 1.5, 2.4, 2.6	
Waves:	• express the nature of waves as to type and characteristics.	1.1, 1.2, 1.5, 2.2, 5.4	
	• explain how energy is transferred through wave motion.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.6	
	• explain how waves reflected, refracted, and diffracted.	1.1, 1.2, 1.5, 2.2, 2.3, 2.4, 2.6	
	• discuss interference of waves.	1.1, 1.2, 1.3, 1.5, 2.2, 2.3, 2.6	
	• describe the relationship of waves to sound and light.	1.1, 1.2, 1.5, 2.2, 2.3, 2.4, 2.6	
Heat:	• distinguish between heat and temperature.	2.3, 2.6	
	• demonstrate heat exchange and its applications.	1.1, 1.4, 2.2-2.4, 2.6	
	• compare the relationship of heat and work, including heat engines.	1.1, 1.2, 1.4, 1.5, 2.2-2.4, 2.6, 5.2	
	• test the laws of thermodynamics.	1.1, 1.4, 1.5, 2.2, 2.3, 2.4, 2.6, 5.2	
	• relate the concepts behind changes of state.	1.1, 1.2, 1.4, 1.5, 2.2, 2.3, 2.4, 2.6	
Electricity and Magnetism:	• describe magnetism (including poles and fields), and its relationship to electric current.	1.1,1.4, 1.5, 2.3, 2.5	
	• describe the characteristics of electrostatic charges	2.1	
	• demonstrate how to charge an object	1.2, 1.4	
	• state the differences between conductors and insulators	1.2, 1.4	
	• define what an electric field is	1.4	

	• distinguish between force and field	1.4
	• measure an electric field	1.2, 1.4
	• define electric current and ampere	1.2, 2.6
	• define power in electric circuits	1.2, 2.6
	• define resistance	1.2, 1.4
	• define Ohm's Law	1.4
	• diagram simple electric circuits	1.4
	• use Ohmmeters, voltmeters and ammeters	1.2, 1.4
Light:	• illustrate how light rays reflect from a surface.	1.2, 5.2
	• locate and describe images formed by plane and spherical mirrors.	1.1, 1.2, 5.2
	• use Snell's law and ray diagrams to explain the refraction of light rays.	1.1, 1.2, 1.5, 5.2, 6.1, 6.2
	• explain the behavior of convex and concave lenses.	1.1, 1.2, 1.5, 5.2
	• locate and describe images formed by convex and concave lenses.	1.1, 1.2, 1.5
	• explains Newton's particulate theory of light.	6.1, 6.2
	• use Huygen's principle to explain the behavior of light.	6.1, 6.2
	• describe the current understanding of the nature of light.	1.1, 1.2, 2.6, 5.4
	• demonstrate the interference and diffraction of light.	1.1
	• illustrate the position of visible light in the electromagnetic spectrum.	1.1, 1.2
	• recognize modern applications of optics.	1.1, 1.3, 1.5, 2.6, 5.4
Modern Physics:	• restate that the speed of light is constant, regardless of the relative motion of source or observer.	5.4
	• describe Einstein's theory of special relativity.	5.2, 5.4, 6.1, 6.2
	• define isotope and nuclide	2.2, 2.3
	• describe three modes of radioactive decay	2.3
	• define half life	2.1
	• recognize the role and nature of the strong nuclear force	2.6, 5.3, 5.4

SCIENCE SEMINAR

Grade Level	12	Course Duration:	Full Year
Prerequisites:	Must have completed at least 4 lab sciences with a grade of "B" or better and signature of instructor	Recommended for:	College Preparatory

Course Description

This course is available to seniors who have demonstrated high ability and motivation in science by taking many high school laboratory science courses and excelling in all the science courses taken. This course provides an opportunity for students to explore science enrichment topics not emphasized in other science courses.

Scientific problems, concerns and controversial issues will be explored through literature review, student presentation, debate, and discussion within the class and interaction with community resource personnel. Students will have the opportunity to explore careers in science, scientific technology, and related fields. Students shall also write a technical library or investigative research paper on a scientific problem, concern, or controversial issue.

Extended and local field trips shall be a part of this course. Students choosing not to go on the extended trip will be given alternative assignments. The extended trip shall occur during the regular academic schedule. The cost of the extended trip is paid by the student or the student's parents, either directly or through fundraisers.

Curriculum Design

Course Content	Montana Standard	Possible Activities
Understanding Scientific Research	**1.1-1.3, 1.6, 3.3, 5.4, 6.1, 6.2**	**Review of Literature, Research Projects, Filed Trips, Class Discussion, Class Presentations, Guest Speakers, Audiovisual Aids, Handouts, Articles, Journals, Debates, Position Papers, Group Activities**
The Relationship of Science and Politics	**3.4, 3.5, 5.4, 6.1, 6.2**	
Bioethics	**5.2-5.4, 6.1, 6.2**	
Environmental Topics	**1.4, 1.5, 5.1, 5.2, 5.4, 6.1, 6.2**	