PHYSICAL SCIENCE A:
SYLLABUS

Course Title:
Physical Science A (introduction to chemistry)

Course Description:
This course is designed to provide an introduction to chemistry, which includes: measurement & significant digits, classification, properties & states of matter, atomic structure, periodic table, chemical bonding, and chemical reactions. The instruction is primarily aimed at aiding the continued development of skills involved with the observing, measuring, sampling, researching, experimenting, documenting, and presenting known as scientific inquiry.

Textbook: *Physical Science* © 2012 by Charles William McLaughlin, Marilyn Thompson, Dinah Zike

Scope and Sequence:

- **Measurements and Significant Digits**
- **Classification, Properties & States of Matter**
- **Atomic Structure;**
  - Atoms
  - Periodic Table
- **Midterm**
- **Energy in Chemical Processes**
  - Chemical Bonding
  - Chemical Reactions
  - Conservation and Transfer

PHYSICAL SCIENCE B:
SYLLABUS

Course Title:
Physical Science B (introduction to physics)

Course Description:
This course is designed to provide an introduction to physics, which includes: measurement & significant digit review, the study of motion (Newton's Laws), forces, energy & energy transfers within a system, work, and power. The instruction is primarily aimed at aiding the continued development of skills involved with the observing, measuring, sampling, researching, experimenting, documenting, and presenting known as scientific inquiry.

Textbook:
Physical Science © 2012 by Charles William McLaughlin, Marilyn Thompson, Dinah Zike

Scope and Sequence:

Motion / Forces;	
Motion	Speed Challenge
Forces	Wacky Washers
Interactions	
Stability and Instability in Physical Systems	
*Forces in Fluids	
*Archimedes' Principle	
*Pascal's Principle	How Do Ships Float? *
*Bernoulli's Principle	
*Boyle's Law	Redneck Spray Bottle *
Midterm	
Energy, Work, Power	
Relationship between energy and forces	3-Legged Race

* time permitting

PHYSICAL SCIENCE C: ENERGY AND RESEARCH

Course Title:
Physical Science C (Energy and Research)

Course Description:
This course is designed to serve as a continuation to physical science A & B and will include: Energy; waves, electromagnetic spectrum, atomic energy, electricity and magnetism. The instruction is primarily aimed at aiding the continued development of skills involved with the observing, measuring, sampling, researching, experimenting, documenting, and presenting known as scientific inquiry. Students will conduct a research project.

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Scope and Sequence:

Energy
- Types
- Waves — Interference
- Electromagnetic Radiation
- Waves and their applications for information transfer
- Nuclear Processes/ Atomic Energy

Midterm

Applications; Research Project

1 Week; Asking Questions, and Defining Problems
Planning and Carrying out Investigations

2 Weeks; Implementation Planning and Carrying out Investigations

2 Weeks; Analyzing and Interpreting Data
Constructing Explanations or Designing Solutions

Course Title; Physical Science A, Introduction to Chemistry

Curriculum Map;
Standard 1: Nature of Science
Standard 2: Physical Science
Standard 5: Personal and Social Perspectives; Technology

Syllabus Topics	Standard Goal	Objective/ Content Limits	Instructional Objectives	Essential Vocabulary	Task Analysis	Sample Assessment	Resources
Measurements and Significant digits **Scientific Inquiry;** Using math and computational thinking.	**Goal 1.3: Understand Constancy, Change, and Measurement**	8-9.PS.1.3.3 Measure and calculate using the metric system. (648.03c) Students should be able to use metric units to record and analyze data	. C.O.-Measure and calculate using the metric system. L.O.-Students will measure the length, mass, volume, and temperature of various types of matter and perform conversions among the quantities.	Prior: meters • liters • grams • metric system • Celsius • mass • volume • seconds • length Explicit: Kelvin • standard • cm3 Introductory:	• Compare and contrast the units of length, mass, volume, time and temperature of the metric system. • Perform conversions between units within the metric system. • Select the appropriate tool when measuring using the metric system.		
Measurements and Significant digits **Scientific Inquiry;** Using math and computational thinking.	**Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills**	8-9.PS.1.6.3 Use appropriate technology and mathematics to make investigations. (649.01c) Students should be able to identify suitable forms of technology and mathematics needed to solve a problem presented in the question stem. WHST.9-10.6	C.O.-Use appropriate technology and mathematics to conduct investigations. L.O.-Students will decide what laboratory tools and method are most appropriate for measuring mass and temperature changes in a chemical reaction. C.O.-Measure changes that can occur in and among systems. L.O.-Students will measure and record mass and temperature changes that occur in a chemical reaction.	Prior: metric ruler (meter stick) • timer • thermometer • balance • graduated cylinder Explicit: Introductory: Prior: Explicit: Introductory:	• Examine a set of tools and technologies which should be used to investigate a given situation. • Integrate mathematics in interpreting scientific data. • CCSSW 1) Use appropriate technology and mathematics to conduct investigations, 2) write the results of investigations. • Express the changes that occur in a variety of systems. The student will identify the following scientific equipment and demonstrate its correct use: metric ruler, meter stick Celsius thermometer graduated cylinder double pan and triple beam balance spring scale flask, beaker, test tube, funnel and filter paper stopwatch		
Classification, Properties & States of Matter	**Goal 2.4: Understand the Structure of Atoms**	8-9.PS.2.4.4 State the basic electrical properties of matter. (650.01d) Items should address that like charges repel and opposite charges attract, and that some forms of matter are insulators and others are conductors.	C.O.-State the basic electrical properties of matter. L.O.-Provide various materials for students to classify as conductors or insulators.	Prior: Explicit: electric current • electric charge • conductor • insulator Introductory: semiconductor • conduction • induction	• Explain how like charges repel and opposite charges attract. • Define an electric current • Determine what properties make matter a conductor or insulator. • Classify different materials as conductors or insulators. • Explain how a neutral object develops a charge by induction or conduction.		
Atomic Structure; Atoms	**Goal 2.4: Understand the Structure of Atoms**	8-9.PS.2.4.1 Describe the properties, function, and location of protons, neutrons, and electrons. (650.01a) The student will explain that the electron cloud occupies most of the space in the atom The student will describe the energy levels of the	C.O.-Describe the properties, functions, and locations of protons, neutrons, and electrons. L.O.-Students will construct a table of selected elements with	molecule • atom • periodic table Explicit: neutron • proton • electron • nucleus • atomic	• Identify mass, location, and charge of protons, neutrons, and electrons • Compare and contrast the functions of protons, neutrons, and electrons. •		

		electron cloud, the relative energies of electrons in the different energy levels, and the maximum number of electrons in levels 1-4 The student will explain that when an energy level is the outermost level, it can have no more than 2 electrons if it is the first level, and no more than 8 for all subsequent levels The student will list the mass and charge of electrons, neutrons and protons The student will determine the atomic mass of an atom given the number of protons and neutrons and explain that the number of protons determines what kind of atom it is The student will determine the charge on an atom given the number of electrons and protons The student will trace the development of the Periodic Table and explain the role of Dmitri Mendeleev The student will describe the Periodic Table as a system made up of elements arranged in order of atomic number and according to repeating patterns among elements with similar properties The student will explain that the organization of the table allows further groupings into types of elements with similar properties The student will explain the significance of elements that are organized into the same group or group Items can address electrical charges, locations in the atom of each particle and relative mass of each particle. For an atom, students should know that the proton determines the element, the neutron determines the isotope, and the electron determines the chemical properties.RST.9-10.7	corresponding atomic number, average atomic mass, mass number, and number of Protons, electrons, and neutrons.	number • ionic bond • covalent bond • valence electrons • mass number • ion • isotopes • average atomic mass • electron cloud Introductory: atomic mass unit • energy levels	Explain how like charges repel and opposite Charges attract. • Define ionic and covalent bonds • Recognize the difference between ionic and covalent bonds		
Atomic Structure; Atoms Scientific Inquiry; Asking questions and defining problems.	**Goal 1.2: Understand Concepts and Processes of Evidence, Models, and Explanations**	8-9.PS.1.2.2 Develop models to explain concepts or systems. (648.02b) The student will state a clear, testable hypothesis which refers to the independent and dependent variables given a description of a scientific investigation Assessed in the classroom, not on the ISAT.	C.O.-Students will be able to develop models to explain concepts or systems. L.O.-Students will develop a Bohr model of a specific atom and discuss the importance of using models to study atoms.	Prior: model Explicit: Introductory Lesson on Steps of the Scientific Method	• Recognize situations when scientists need to use models. • Explain how models can be used to represent concepts or systems that cannot be observed directly. • Apply the use of a scientific model in solving problems.		
Atomic Structure; Atoms	**Goal 2.4: Understand the Structure of Atoms**	**8-9.PS.2.4.3 Describe** the characteristics of isotopes. (650.01c) Items should address that isotopes are atoms of the same element that have a different number of neutrons.RST.9-10.7	C.O.-Describe the characteristics of isotopes. L.O.-Students will calculate the number of neutrons for different isotopes of the same element and indicate how they are different.	Prior: half-life Explicit: isotopes Introductory: radioactive decay	• Define isotope. • Describe how isotopes of the same element differ in numbers of neutrons while protons and electrons remain constant. • Recognize that some isotopes are unstable (Radioactive) and can undergo nuclear decay.		
	Goal 5.2: Understand the Relationship between Science and Technology	8-9.PS.5.2.3 Explain how science and technology are pursued for different purposes. (656.01b) The student will discuss the impact of the discovery of atomic energy from nuclear reactions on society The student will identify and describe examples of technologies related to isotopes and nuclear energy that are tied to advances in medicine (nuclear medicine) including how they affect our standard of living Content Limit: Topics like oil, metallic ores, and wood products are suitable for consideration. WHST.9-10.1	C.O.-Explain how science and technology are pursued for different purposes. L.O.-Students will discuss the exploration of natural resources in terms of sciences versus technology.	Prior: Explicit: Introductory:	• Compare and contrast the purposes of science and technology. • CCSSW Compare and contrast forms of alternative energy.		
Atomic	**Goal 1.1:**	8-9.PS.1.1.1 Explain the scientific meaning of system, order, and organization. (648.01a)	C.O.-Students will communicate the meaning of system, order, and	Prior: system • order •	• Explain the meaning of system, order, and organization.		

Goal 1.2: Understand Constancy, Change, and Measurement

8-9.PS.1.2.2 Develop models to explain concepts or systems. (648.02b)

8-9.PS.1.2.3 Develop scientific explanations based on knowledge, logic, and analysis. (648.02c) **WHST.9-10.7**

CL: C

The student will identify the independent and dependent variables in an experiment and explain the need to keep all other variables constant

8-9.PS.1.3.1 Measure changes that can occur in and among systems. (648.03b)

CL: E

The student will identify the following scientific equipment and demonstrate its correct use:

- metric ruler, meter stick
- Celsius thermometer
- graduated cylinder
- double pan and triple beam balance
- spring scale
- flask, beaker, test tube, funnel and filter paper
- stopwatch

Structure; Periodic Table	**Understand Systems, Order, and Organization**	The student will explain that critical thinking, creativity, imagination, and good knowledge base are all required in the work of science and engineering Students should be able to identify the components of a system and how the components interact to allow the system to function. Suitable systems to test include the structure of an electric motor, the Earth-Moon system, the solar system, the respiratory system, and the cell as a system	organization. L.O.-Students will build and examine an electric motor and discuss each component and how it makes the motor work. ?Alter?	organization Explicit: Introductory:	• Model the parts of a specific system and how they interact (e.g., atoms, roller coasters, circuits, Newton's Laws).		
Midterm							
Energy in Chemical Processes; Chemical Bonding**,** Chemical Reactions, Conservation and Transfer	**Goal 2.5: Understand Chemical Reactions**	8-9.PS.2.5.1 Explain how chemical reactions may release or consume energy while the quantity of matter remains constant. (650.03a) The student will describe chemical properties (combustibility and reactivity) and the nature of chemical change : Items should address the law of conservation of mass and exothermic and endothermic reactions .RST.9-10.7	C.O.-Explain how chemical reactions may release or consume energy while the quantity of matter remains constant. L.O.-Students will practice balancing chemical equations.	Prior: physical property • physical change Explicit: endothermic • chemical reaction • chemical property • chemical change • exothermic • law of conservation of mass Introductory: pH • acids • bases • synthesis • decomposition • single-replacement • double-replacement • combustion • neutralization • chemical equation	• Give some examples of chemical changes • Restate the law of conservation of mass. • Define exothermic and endothermic reactions. • Distinguish a reaction as exothermic or endothermic based upon given information. • Identify pH, acids, and bases. • Recognize the different types of chemical reactions. • Balance simple chemical equations.		
Energy in Chemical **Processes**; Chemical Bonding**,** Chemical Reactions, Conservation and Transfer Scientific Inquiry; Planning and carrying out investigations.	**Goal 1.2: Understand Concepts and Processes of Evidence, Models, and Explanations**	8-9.PS.1.2.3 Develop scientific explanations based on knowledge, logic, and analysis. (648.02c) The student will identify the independent and dependent variables in an experiment and explain the need to keep all other variables constant Assessed in the classroom, not on the ISAT.WHST.9-10.7	C.O.-Students will develop scientific explanations based on knowledge, logic, and analysis. L.O.-Students will discuss and analyze observations and data gathered from a scientific investigation and choose the most reasonable explanation.	Prior: Explicit: Introductory:	• Show that explanations are based on observations, evidence and testing • Using logic and analysis, predict the most reasonable explanation for a set of observations and/or data. • CCSSW 1) Analyze data, 2) generate a possible explanation.		
Energy in Chemical **Processes**; Chemical Bonding**,** Chemical Reactions, Conservation and Transfer Analyzing and	**Goal 1.3: Understand Constancy, Change, and Measurement**	8-9.PS.1.3.2 Analyze changes that can occur in and among systems. (648.03b) : Students should be able to analyze changes that take place in system performance due to external or environmental changes. Topics may include heart rate, breathing rate, and dilation of pupil changes.	C.O.-Analyze changes that can occur in and among systems. L.O. Students will discuss and analyze mass and temperature changes that occur in a chemical reaction. The student will make accurate metric measurements in correct SI units using the following equipment (Unifying Concepts I.C: Measurement): metric ruler, meter stick (meter) Celsius thermometer (degree Celsius) graduated cylinder (liter, cubic centimeter)	Prior: internal • external Explicit: Introductory:	• Predict how internal and/or external changes affect the systems performance. • Anticipate changes that can occur in and among systems.		

interpreting data			double pan and triple beam balance (grams) spring scale (Newton) stopwatch (seconds, minutes)				
Energy in Chemical Processes; Chemical Bonding**,** Chemical Reactions, Conservation and Transfer Scientific Inquiry; Constructing explanations or designing solutions.	**Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills**	8-9.PS.1.6.7 Explain the differences among observations, hypotheses, and theories. (649.01g) Students should be able to Distinguish between observations, hypotheses, and theories.	C.O.-Explain the differences among observations, hypotheses, and theories. L.O.-Students will compare and contrast observation, hypotheses, and theories in the investigation of a scientific study.	Prior: hypothesis • theory • observation • law Explicit: Introductory:	• Compare and contrast observation, hypothesis, and theory.		

Course Title; Physical Science B, Introduction to Physics

Curriculum Map;
Standard 1: Nature of Science
Standard 2: Physical Science
Standard 5: Personal and Social Perspectives; Technology

Syllabus Topics	Standard Goal	Objective/ Content Limits	Instructional Objectives	Essential Vocabulary	Task Analysis	Sample Assessment	Resources
Motion and Forces; Interactions	Goal 2.2: Understand Concepts of Motion and Forces	8-9.PS.2.2.1 Explain motion using Newton's Laws of Motion. (650.04b) Content Limit: Items should cover the relationship between force, mass, and acceleration. Inertia, balanced and unbalanced forces, action and reaction should also be addressed	C.O. -Explain motion using Newton's Laws of Motion. L.O. -Students will explain which of Newton's three Laws is demonstrated after watching various demonstrations.	Prior: speed • distance • time • motion • friction • gravity • weight • force • mass Explicit: frame of reference • velocity • acceleration • inertia • balanced force • unbalanced force Introductory: momentum	• Explain the relationship between motion and a frame of reference. • Explain the difference between balanced and unbalanced forces. • Explain the relationship between acceleration and gravity • Distinguish between mass and weight • Compare and contrast the difference between speed, velocity, and acceleration. • State Newton's Law's of Motion. • Compare Newton's Law's of Motion. • Justify which of Newton's laws is demonstrated by giving a specific example. • CCSSW 1) Write a prediction, 2) revise based upon results.		
Motion and Forces; Interactions **Scientific Inquiry;** Asking questions and defining problems.	**Goal 1.2: Understand Concepts and Processes of Evidence, Models, and Explanations**	8-9.PS.1.2.1 Use observations and data as evidence on which to base scientific explanations. (648.02a) The student will clearly state the problem in terms of cause and effect (independent and dependent variables) given a description of a scientific investigation : When presented observations and data (including different cell types, genetic traits, or environmental changes over time), students will be able to select the most reasonable explanation from a list of possibilities.WHST.9-10.9	C.O.-Use observations and data as evidence on which to base scientific explanations. L.O.-Students will discuss and analyze observations and data gathered from a scientific investigation and develop possible explanations	Observation, data, qualitative, quantitative, alternative explanations, hypothesis, theory, model	•-State that explanations that are based on observations, evidence and testing. •-Compare and contrast quantitative data with qualitative data. - Reinforce that science changes with additional data. Identify the variables in an experiment. (See Planning and carrying out investigations and Analyzing and interpretating data)- -Compare, analyze, and interpret data derived from charts and tables. (See Planning and carrying out investigations and Analyzing and interpretating data)-		
Motion and Forces; Stability and Instability in Physical Systems	Goal 5.2: Understand the Relationship between Science and Technology	8-9.PS.5.2.2 Explain how technology advances science. (655.01a)] Content Limit: Use scientists whose discoveries have significance and ramifications in today's world to frame items WHST.9-10.2	C.O.-Explain how technology advances science. L.O. - Students will plot data from an experiment and construct graphs from the data.	Prior: Explicit: Introductory:	• Reinforce the ways in which technology advances science. • CCSSW Use technology to communicate scientific principles.		
Motion and Forces; Forces In Fluids *Archimedes' Principle *Pascal's							

Principle*Bernoulli's Principle *Boyle's Law							
Midterm							
Energy, Work, Power Scientific Inquiry; Planning and carrying out investigations	**Goal 1.3: Understand Constancy, Change, and Measurement**	8-9.PS.1.3.1 Measure changes that can occur in and among systems. (648.03b) Content Limit: Students should be able to explain changes that occur in systems. Topics may include heart rate, breathing rate, and dilation of pupils, cells, ecosystems, biogeochemical cycles, and chemical reactions.	C.O.-Measure changes that can occur in and among systems. L.O.-Students will measure and record mass and temperature changes that occur in a chemical reaction.	Prior: Explicit: Introductory:	• Express the changes that occur in a variety of systems.		
Energy, Work, Power Scientific Inquiry; Analyzing and interpreting data.	Goal 1.8: Understand Technical Communication	8-9.PS.1.8.1 Analyze technical writing, graphs, charts, and diagrams. (658.02a) Students should be asked to derive information from graphs, charts, and diagrams.WHST.9-10.10	C.O.-Analyze technical writing graphs, charts, and diagrams. L.O. - Students create graphs, charts, and diagrams from information given from a scientific study.	Prior: Explicit: Introductory:	• Interpret and draw conclusions from technical writing, graphs, charts, and diagrams. • CCSSW Write laboratory reports routinely.		
Energy, Work, Power; Energy Conservation and Transfer	Goal 2.3: Understand the Total Energy in the Universe is Constant	8-9.PS.2.3.1 Explain that energy can be transformed but cannot be created nor destroyed. (650.05a) The student will describe thermal energy as consisting of the random motion and vibrations of particles The student will define temperature as a measure of the average kinetic energy of the particles in a sample of matter and as a way to quantitatively measure the effect of heat on a sample of matter The student will differentiate between heat and temperature: Items can address energy conversions including the impact of friction on the total amount of energy available.RST.9-10.1	C.O.-Explain that energy can be transformed but cannot be created or destroyed. L.O.-Students will describe the energy transformations that occur in the operation of an automobile.	Prior: Explicit: law of conservation of energy • energy Introductory: sound energy • thermal energy • mechanical energy • chemical energy • light energy • electromagnetic energy	• Recognize the different types of energy. • Explain the law of conservation of energy • Demonstrate and/or illustrate the law of conservation of energy.		
Energy, Work, Power; Energy Conservation and Transfer	Goal 5.2: Understand the Relationship between Science and Technology	8-9.PS.5.2.1 Explain how science advances technology. (655.01a) Content Limit: Issues relevant to Idaho should be addressed: stream degradation, logging, mining, dams, and wind turbines	C.O.-Explain how science advances technology. L.O.-Students will use pH meters to determine the acidity of several substances. (not at this time)	Prior: science • technology Explicit: Introductory:	• Reinforce the ways in which science advances technology.		

Course Title; Physical Science C; Energy and Research

Course Description;
This course is designed to serve as a continuation to physical science A & B and will include: chemical reactions, waves, electromagnetic spectrum, atomic energy, electricity and magnetism.

Curriculum Map;
Standard 1: Nature of Science
Standard 2: Physical Science
Standard 5: Personal and Social Perspectives; Technology

Syllabus Topics	Standard Goal	Objective/ Content Limits	Instructional Objectives	Essential Vocabulary	Task Analysis	Sample Assess-ment	Resources
Energy Types; Waves and Electromagnetic Spectrum	**Goal 2.3: Understand the Total Energy in the Universe is Constant**	8-9.PS.2.3.2 Classify energy as potential and/or kinetic and as energy contained in a field. (650.05b) Content Limit: Items should be able to distinguish between different forms of potential and kinetic energy. The relationship between magnetic fields and electrical fields can be addressed. The structure or organization of the electromagnetic spectrum can also be addressed.	C.O.-Classify energy as potential and/or kinetic and as energy contained in a field. L.O.-Students will discuss the conversion of potential to kinetic energy when observing a roller coaster.	Prior: Explicit: potential energy • kinetic energy Introductory:	• Define potential and kinetic energy. • Differentiate between potential and kinetic energy given specific examples.		
Energy Types; Nuclear Energy/ Atomic Energy	**Goal 2.4: Understand the Structure of Atoms**	8-9.PS.2.4.2 Explain the processes of fission and fusion. (650.01b) The student will describe the processes of fission and fusion and relate nuclear reactions (fission and fusion) as a source of energy Both processes release energy. Fission results in small particles. Fusion results in larger particles.	C.O.-Explain the processes of fission and fusion. L.O.-Students will illustrate simple diagrams of fission and fusion.	Prior: Explicit: fission • fusion Introductory:	• Define fission and fusion. • Recognize the difference between fission and fusion.		
Energy Types; Electromagnetism	**Goal 2.4: Understand the Structure of Atoms**	8-9.PS.2.4.5 Describe the relationships between magnetism and electricity. Items should address how generators and motors work.RST.9-10.7	C.O.-Describe the relationships between magnetism and electricity. L.O.-Students will perform an experiment on electromagnetic induction.	Prior: Explicit: electric field • magnetic field Introductory: generator • motor	• Define electric field and magnetic field. • Recognize the relationship between electric fields and magnetic fields. • Describe how electric current induces a magnetic field. • Explain how magnetism induces an electric current. • Compare and contrast electric motors and electric generators.		
Midterm							
Research Project Week 1; Scientific Inquiry; Asking questions and defining problems.	**Goal 1.1: Understand Systems, Order, and Organization**	8-9.PS.1.1.2 Apply the concepts of order and organization to a given system. (648.01a) The student will identify the advantages of working in interdisciplinary teams to solve scientific problems, Share tasks (division of labor), share talents (collaboration), share ideas (communication), share experience,	C.O.-Students will incorporate the concepts of order and organization to a given system. L.O.-Students will build a roller coaster, calculate the potential and kinetic part energy of each part and discuss how each	Prior: Explicit: Introductory:	• Incorporate the concepts of order and organization to a given system.		

		tolerance. Students should be able to identify the components of a system and the role each component has in the system's function	component is important in the function of the rollercoaster. ?Alter?				
Research Project Week 1; Scientific Inquiry; Asking questions and defining problems.	**Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills**	8-9.PS.1.6.4 Formulate scientific explanations and models using logic and evidence. (649.01d) Assessed in the classroom, not on the ISAT. WHST.9-10.8	C.O.-Formulate scientific explanations and models using logic and evidence. L.O.-Students will analyze several explanations for their mass and temperature data and choose the most logical explanation	Prior: Explicit: Introductory:	• Formulate explanations that are based on observations, evidence and testing. • Using logic and analysis, determine the most reasonable explanation for a set of observations and/or data. • CCSSW 1) Devise possible models, 2) select the most useful model, 3) justify choice in writing.		
Research Project Week 1; Scientific Inquiry; Asking questions and defining problems.	**Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills**	8-9.PS.1.6.1 Identify questions and concepts that guide scientific investigations. (649.01a) When presented a number of questions, students will be able to identify questions that can be investigated.	C.O.-Identify questions and concepts that guide scientific investigations. L.O.-Students will decide the appropriate questions that will guide in investigating mass and Temperature changes in a chemical reaction.	Prior: scientific method Explicit: Introductory:	• Given a set of questions evaluate which ones are valid for a given situation.		
Research Project Week 1; Scientific Inquiry; Asking questions and defining problems.	**Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills**	8-9.PS.1.6.5 Analyze alternative explanations and models. (649.01e) Content Limit: When offered a variety of possible explanations, students should be able to identify the most logical option to fit with the question stem.WHST.9-10.4	C.O.-Analyze alternative explanations and models. L.O.-Students will develop alternative explanations for their mass and temperature data.	Prior: Explicit: Introductory:	• Express several possible explanations for a set of data and formulate the most logical option. • CCSSW 1) Analyze possible explanations, 2) select the best explanation, 3) justify choice in writing.		
Research Project Week 2 and 3; Scientific Inquiry; Planning and carrying out investigations	**Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills**	8-9.PS.1.6.2 Utilize the components of scientific problem solving to design, conduct, and communicate results of investigations. (649.01b) Items should address experimental design.WHST.9-10.3	C.O.-Use the scientific method to design, conducts, and communicates the results of a scientific investigation. L.O.-Students will design and carry out an experiment to investigate mass and temperature changes in a chemical reaction.	Prior: control group • constant (controlled variable) • experiment Explicit: dependent variable • independent variable Introductory:	• Analyze a scientific experiment and point out the variables, procedure, and control. • Differentiate between the dependent (responding) And independent (manipulated) variables. • Design and carry out a controlled experiment given a specific problem or question. • Construct a data table, graph or chart to report the results of an experiment. • CCSSW 1) Conduct the experiment, 2) write a conclusion		
Research Project Week 4; Scientific Inquiry; Constructing explanations or designing solutions	**Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills**	8-9.PS.1.6.6 Communicate and defend a scientific argument. (649.01f) When offered a variety of possible explanations, students should be able to identify the option that will fit with the question stem	. C.O.-Communicate and defend a scientific argument. L.O.-Given a list of scientific issues, students will identify the argument, list the supporting data, and defend the argument with evidence.	Prior: Explicit: Introductory:	• Identify an argument. • Compile supporting data. • Defend the scientific argument.		

Reading, Literacy, and Writing Standards

Reading Standards for Literacy in Science						
Content Standards			Objectives		Sample Assessment	
Cite, Determine, and Analyze Key Ideas and Details	1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.		• Summarize text passages. • Provide examples from the text to support the conclusions.		Use highly effective questioning techniques to have students demonstrate understanding of a text passage.	
	2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.		• Identify the main idea of a passage. • Outline the description of a process from the passage.		Create a graphic organizer of a biological concept.	
	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions		• Read instructions. • Analyze procedures.		Read and analyze a procedure to perform a lab experiment.	
Determine and Analyze Craft and Structure	4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical		• Define and comprehend essential vocabulary and measurement units.		Define essential vocabulary from the text into their own words. Relate appropriate units to scientific measuring.	
	5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).		• Compare and contrast key vocabulary terms and concepts.		Relate the connections between variables in an experiment. Create a Venn Diagram using vocabulary or concepts from the text.	
	6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the		• Define the question the author seeks to address. • Identify the reasons an author uses a specific example in the text.		Trace the development of an idea using historical milestones such as the discovery of the structure and function of DNA.	
Translate, Assess, and Compare and Contrast Knowledge and Ideas	7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g.,		• Create a diagram, graph or table from written information. • Interpret a diagram, graph or table into words.		Draw a food web based on information from an article about a local ecosystem. Given a punnett square, describe the possible offspring.	
	8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or		• List the supporting evidence the author provides. • Determine if the evidence is based on scientific data. • Evalute how well an author supports his/her		List the ideas of natural selection and provide observational evidence for each idea. Peer review another student's scientific argument using steps in the task analysis column.	

	9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or		• Compare and contrast experimental results to key concepts presented in text.		Students may conduct an experiment from the text, comparing results to those obtained in the text.	
Read and Comprehend Text Complexity	10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.		• Implement RST standards 1-9 throughout the course.		See all of the above.	
Writing Standards for Literacy in Science,						
Write Arguments and Informative/Explanatory Texts	1. Write arguments focused on discipline-specific content.		• State your argument. • Distinguish between your claim and alternate and/or opposing claims. • Supply data and evidence for your claim. • Link claims together in a paragraph form using content vocabulary. • Provide a conclusion.			
	2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.					
	3. Not applicable					
Produce, Develop, and Distribute Writing	4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.					
	5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing					
	6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display					
Research and Gather Information to Build and Present Knowledge based on Evidence	7. Conduct short as well as more sustained research projects to answer a question (including a selfgenerated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize					
	8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas,					

	9. Draw evidence from informational texts to support analysis, reflection, and research.					
Produce Range of Writing over Extended Time Frames	10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.					

Scientific Inquiry (NGSS in bold)

Prepared by Elaine Asmus

There are activities and labs. Every science course should include labs based on scientific inquiry. It is part of scientific inquiry to experience odd results at times or find that there is an error in the way an experiment was carried out. Scientists collaborate at these times and start again. The process is fun; a possible discovery is the treat! Emphasize scientific inquiry throughout coursework.

1. **Using Math and Computational Thinking**
   Emphasis on proper measuring techniques during the investigation
   Can the students use tools and properly measure?

2. **Asking Questions, and Defining Problems.**
   Research
   Develop and Use Models
   Form a Hypothesis Statement
   Supported hypothesis become Laws

3. **Planning and Carrying out Investigations**
   Measuring
   Gather data into charts
   Single Variable; should be identified
   All other factors remain the same
   Control Group/Experiment Group
   (High school) multiple experimental groups
   Include a high number of subjects

4. **Analyzing and Interpreting Data**
   Results are entered onto a Data Chart
   Dependent & Independent variable (begin in Junior High)
   Charts generate Graphs
   Using Math and Computational Thinking;
   (High School?) Graphs produce Mathematical Formulas
   (High School) Chi Square Value; differences are significant

5. **Constructing Explanations or Designing Solutions**
   Obtaining, Evaluating, and Communicating Information
   Engaging in Argument from Evidence

Producing a Graph from a Data Chart; Instructions and Rubric; Names _____
Long Form

Scientists qualify information by carrying out scientific experimentation through a process known as the scientific method. In an experiment, the variables which will not be studied are controlled. The scientist selects a single variable to change (independent variable) and watches the effect of that change on another variable (dependent variable). Data is collected and placed in a chart.

Scientists quantify the results of an experiment when he/she graphs the collected data. The data collected is represented by dots on the graph. The best-fit line of a graph represents the result or lesson proved from the experiment. Scientists and mathematicians create formulas from line graphs. All formulas arise from graphs.

What are the 2 variables being watched? Factor 1 _____Factor 2 _____

Which is the Independent Variable? _____ Range of values (units)? _____to _____

Which is the dependent Variable? _____ Range of values (units)? _____to _____

On the graph (use the ۞ to check off the items as you place them on the graph);

۞Title both axes (Independent variable is placed on the x-axis, dependent variable on the y-axis).

۞Label both axes' units.

۞Using the range for each variable, place the units on each axis **utilizing the entire axis**. It is important to have the same amount of unit variation between each line on the graph, for example, each line represents an increase of 5 numerals.

۞Place data dots onto the graph in the appropriate places.

Best Fit Line; represents **the trend** of the data points. Best-fit lines are often either straight **or** curving lines. Discuss the following with the teacher if necessary before drawing a best-fit line;

۞Does the graph's best fit line pass through the origin? _____Why or why not? _____

_____

۞Does a best fit line connect the dots? _____Why or why not? _____

_____

۞Within the lab group, discuss if any data points might be random mistakes and why these data points might be excluded from the best fit line. Label these points and the reason for excluding any data point from the best fit line.

۞Is the best fit line straight or curved? _____

۞The best fit line should be solid as the line passes between data points, but dashed if the line is extended past or before data points. A dashed line represents predicted behavior not supported by the current experiment.

۞Draw a best-fit line

Abstract and results; each graph should include an abstract sentence or paragraph. The abstract should sound like,
"The lab group found that as the <u>independent variable</u> <u>increases</u>, the <u>dependent variable</u> <u>decreases</u>",

where the student substitutes the specific experimental data for the underlined items. Also include any explanations or notable events of the experiment.

- Write the abstract statement or paragraph on the bottom of the graph.

- Write a complete sentence for the graph title. Titles should be clear and concise.

Advanced; determination of a graph's formula.
Straight line graphs produce the following formula format;

$$y = m x + b$$

Where m = slope of the line and b = the y intercept of the line.

The formula should read;

Dependent variable = m times the independent variable + b

where the student substitutes actual experimental data for the underlined items.

- Calculate the formula showing all work.

- Write the formula in sentence form.

- Calculate a "y" value that was not experimented by randomly selecting an x axis value and using the formula. Please show all work.

Producing a Graph from a Data Chart; Instructions and Rubric; Names _____
Short Form (more experienced science students)

Scientists qualify information by carrying out scientific experimentation through a process known as the scientific method. In an experiment, the variables which will not be studied are controlled. The scientist selects a single variable to change (independent variable) and watches the effect of that change on another variable (dependent variable). Data is collected and placed in a chart.
Scientists quantify the results of an experiment when he/she graphs the collected data. The data collected is represented by dots on the graph. The best-fit line of a graph represents the result or lesson proved from the experiment. Scientists and mathematicians create formulas from line graphs. All formulas arise from graphs.

What are the 2 variables being watched? Factor 1 _____Factor 2 _____

Which is the Independent Variable? _____ Range of values (units)? _____to _____

Which is the dependent Variable? _____ Range of values (units)? _____to _____

On the graph (use the ۞to check off the items as you place them on the graph);
۞Title both axes (Independent variable is placed on the x-axis, dependent variable on the y-axis).
۞Label both axes' units.
۞Using the range for each variable, place the units on each axis **utilizing the entire axis**. It is important to have the same amount of unit variation between each line on the graph, for example, each line represents an increase of 5 numerals.
۞Place data dots onto the graph in the appropriate places.

Best Fit Line; represents **the trend** of the data points. Best-fit lines are often either straight **or** curving lines. Discuss the following with the teacher if necessary before drawing a best-fit line;
۞Does the graph's best fit line pass through the origin? Why or why not?
۞Does a best fit line connect the dots? Why or why not?
۞Within the lab group, discuss if any data points might be random mistakes and why these data points might be excluded from the best fit line. Label these points and the reason for excluding any data point.
۞Is the best fit line straight or curved?
۞The best fit line is solid as the line passes between data points, but dashed if the line is extended past or before data points. A dashed line represents predicted behavior not supported by experimentation.
۞Draw a best-fit line

Abstract and results; each graph should include an abstract sentence or paragraph. The abstract should sound like, "The lab group found that as the <u>independent variable</u> <u>increases</u>, the <u>dependent variable</u> <u>decreases</u>", where the student substitutes the specific experimental data for the underlined items. Also include any explanations or notable events of the experiment.
۞ Write the abstract statement or paragraph on the bottom of the graph.
۞ Write a complete sentence for the graph title. Titles should be clear and concise.

Advanced; determination of a graph's formula.
Straight line graphs produce the following formula format; $y = m x + b$, Where m = slope of the line and b = the y intercept of the line. The formula should read; <u>Dependent variable</u> = <u>m</u> times the <u>independent variable</u> + <u>b</u>, where the student substitutes actual experimental data for the underlined items.
۞Calculate the formula showing all work.
۞Write the formula in sentence form.
۞Calculate a "y" value that was not experimented by randomly selecting an x axis value and using the formula. Please show all work.