Enduring Understanding # 1: Scientific inquiry affords all learners opportunities to make observations, pose questions, develop hypotheses, design and conduct investigations, and analyze data to draw conclusions.				
Physical Science Benchmarks-Grade Nine				
Students will understand:	**Essential Questions**	**Students will know the/that**	**Students will be able to**	**Notes**
1.1 Scientific theory is substantiated by valid evidence and logical arguments. -Science experiments involve manipulating variables, recording observations, measuring, analyzing and evaluating data using the metric system.	-How do we ask questions and get answers from nature? -How do you know when your information is scientifically valid? -Why would scientists want to use any other system than the English system?	-Definition of valid tests. -Differences among scientific hypothesis, theory, and law. -Advantages of using the metric system in science. -Differences between dependent and independent variables. -Prefixes of the metric system. -Basic metric units.	-Differentiate a scientific theory from a hypothesis and a law. -Make observations. -Pose questions based on those observations. -Develop and test a hypothesis. -Collect and analyze data. -Interpret data to determine if the hypothesis was supported. -Cite data used to validate hypothesis. -Select the appropriate scientific equipment. -Make and analyze an appropriate graph & table for their data. -Use dimensional analysis to convert between unit sizes.	-Inquiry is a process that progresses from teacher-directed to learner self-directed. -Students should be taught the process of being self directed in inquiry activities.
1.2 Good scientific research can be replicated and requires frequent reflection.	-How is science different from other ways of knowing? -How can you critically analyze a scientific claim?	-There are different types of scientific research. -Science uses EVIDENCE from experiments that can be repeated with similar results by others. -Difference between accuracy and precision and their relationship to scientific analysis. -Hypotheses can be validated. -Facts can be verified by experiment -Facts of science are public facts; not private facts.	-Design and conduct a simple. investigation that can be replicated. -Gather and analyze necessary and sufficient data. -Draw logical conclusions based on the data. -Evaluate and communicate results. -Identify measurement errors of accuracy and precision and their effects on results. -Improve experimental design to reduce logical or measurement errors. - Use simple statistical analysis.	

Enduring Understanding # 2: Exploring systems, order, and organizations in our natural and designed world are integral to understanding the scientific disciplines and their interdependence.

Physical Science Grade Nine Benchmarks

Students will understand :	Essential Questions	Students will know the/that	Students will be able to	Notes
2.1 The universe has composition, structure, motion, and a history that can be observed, measured, and predicted.	-How big is the universe? Where, when, from what did the universe begin? -How do our systems of understanding matter, energy and motion help us to understand other celestial bodies?	-Universe has dimensions of time, distance, and mass. -Cosmology is the study of the structure, composition, and the evolution of the universe. -Expansion of the universe is predicted by the Big Bang Theory and has not been disproved. -Behavior of light from objects in the universe tells us important information about their composition and their motion.	-Describe and classify the different kinds of structures that can be observed in the universe. -Describe the evidence for the Big Bang Theory -Interpret the meaning of Doppler shifts on the motion of objects in the universe.	
2.2 The Earth systems (atmosphere, hydrosphere, biosphere, and geosphere) are dynamic, interactive and essential for life on Earth.	-How do the Earth systems interact with each other and affect life on Earth? -Climate change: what's the forecast? -Can I make a difference in the way that Earth systems interact?	-The major parts of the water cycle are condensation and evaporation. -Changes in the ozone layer affect life on Earth. -Know the structure and characteristics of the atmosphere, hydrosphere, geosphere, and biosphere. -Clouds are indicators of weather.	-Diagram the water cycle. -List the effects of the ozone layer on life on Earth. -Predict the weather based on the structure and characteristics of different cloud formations.	
2.3 Earth's systems are unique and change over time.	-How do convection currents affect the appearance and motion of earth systems? -How are rocks changed and recycled?	-Convection is the mechanism of heat transfer in fluids. -Plate tectonics weathering and erosion are responsible for the Earth's current geological features.	-Demonstrate convection currents using fluids of different temperatures. -Explain evidence for the plate tectonic theory of continental movement. -Identify and classify minerals and rocks based on physical and chemical properties. -Classify 3 main kinds of plate boundaries -Explain the cause and effect of movement of Earth's crust (volcanoes, earthquakes, faults).	

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Students will understand:	Essential Questions	Students will know the/that	Students will be able to	Notes
2.4 Climate and seasons are a result of the Earth's tilted axis and Earth's rotation.	-What factors influence local and global climates? -How does the transfer of heat between the Earth's unevenly heated	-Climate is affected by latitude, elevation, proximity to bodies of water, and position relative to mountains. -The Coriolis Effect causes deflections of the atmosphere	-Explain the factors that influence local and global climate. -Produce diagrams of the Earth's tilt and the seasons.	

	surface and the atmosphere create the weather?	due to the rotation of Earth.	-Identify where major wind systems are located on a global map.	
2.5 Motion is a relationship between distance and time.	-What is a rate of change? -How and why do things move?	-Speed is the rate of change of distance in time. -Velocity is the rate of change of displacement in time. -Velocity is speed in a given direction. -Acceleration is the rate of change in velocity in time.	-Calculate velocity -Calculate acceleration. -Construct, interpret, and analyze distance vs. time and velocity vs. time graphs.	
2.6 Gravitational force is universal and determines the weight of a given mass.	-Why would my weight change if I left Earth? -What happens when you drop two objects of different masses? -What causes planets and other celestial bodies to move in regular and predictable patterns in the universe.	-Weight is a force. -Gravity accelerates objects independently of their mass. -Gravitational force changes with the quantity mass and the distance between the masses. -Gravity is necessary for the formation of a solar system.	-Determine the weight of a given mass. -Give qualitative interpretations of how varying mass and distances affects gravity. -Explain how gravity affects the motion in our solar system.	
2.7 Unbalanced forces cause changes in the motion of objects.	-What are the effects of forces on an object's velocity, acceleration, and momentum? -How do Newton's Laws describe the motion of everyday objects?	-Inertia is a measurement of an object's resistance to a change in its motion and is proportional to the object's mass. -Forces overcome inertia to cause motion. -Types of energy including nuclear, light, mechanical and non mechanical.	-Determine the inertia of an object based on forces applied and changes in motion. -Equate momentum changes to impulses applied to an object. -Identify action/reaction pairs. -Interpret force vs. mass - graphs for accelerations. -Provide qualitative descriptions for accelerations variations with applied forces and masses.	
2.8 Work is the transfer of energy.	-How powerful is your body compared to a machine? -Can you buy power from the electrical company?	-Power, like energy, can't be created or destroyed because power is the RATE of work.	-Calculate work and power.	

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Students will understand:	**Essential Questions**	**Students will know the/that**	**Students will be able to**	**Notes**
2.9 Atoms have specific structures that give them specific properties.	-How is the Perioidic Table like an operating manual for chemistry? -What forces keep matter from falling apart?	-Electron dot structures show valence electrons. -Chemical bonds are determined by valence electrons. -Radioactivity is caused by an unstable nucleus. -Radioactive particles originate in the nucleus of an atom.	-Explain how to make electron dot structures. -Identify trends in the periodic table. -Relate the numbers of electrons in an atom to its atomic model. -Identify the causes of radioactivity. -Discuss the types of radioactive particles, their origins, and their symbols.	
2.10 Atoms combine to form all things.	-What are the patterns in which chemical changes occur? -How can chemical changes be classified?	-There are 5 major types of reactions. -Mass is conserved in chemical reactions. -The patterns that cause ionic, metallic and covalent bonding are predictable.	-Classify the 5 major types of chemical reactions. -Explain the Law of Conservation of Mass and balance equations. -Identify ionic, metallic, and covalent bonds in molecules.	
2.11 All matter has properties that can be measured or predicted.	-What are the different physical properties of matter that can be measured or observed? -How can chemical properties be determined? -Why is water such a unique compound?	-Matter can be classified as a pure substance or a mixture. -Pure substances can be elements or compounds. -Why physical changes are different than chemical changes. -Water is a polar covalent molecule that causes it to have unique chemical and physical properties.	-Compare and contrast heterogeneous and homogenous mixtures. -Explain the differences between elements and compounds. -Classify changes as physical or chemical. -Accurately and precisely measure mass and volume to calculate density. -Explain how the structure of water affects its interactions with other substances.	

Enduring Understanding # 3: Both contemporary and historical scientific understandings inform technological, ethical, cultural and life decisions.				
Physical Science Benchmarks-Grade Nine				
Students will understand:	**Essential Questions**	**Students will know the/that**	**Students will be able to**	**Notes**
3.1 Social and economic forces strongly influence which technologies will be developed.	-What are some social and economic forces that have influenced technologies in the past?	-Our understanding of nature and the universe has undergone revolutionary changes with technological advancements.	-Identify major scientific breakthroughs in the context of history and technology.	
3.2 Reading and responding to scientific research requires critical reasoning skills in order to make sound ethical, cultural and life decisions.	-In what circumstances would incomplete data inhibit sound ethical decisions? -How did Mendeleev use the properties of elements to organize	-There are many different ways to conduct scientific research and make decisions. -Difference between values and ethics.	-Use critical thinking strategies to evaluate the validity of scientific claims. -Evaluate the credibility of information for making ethical decisions. -Use an interdisciplinary	

	his periodic table?	-Characteristics of logical, evidence-based science.	decision making model for solving complex issues in science	
3.3 There have been multiple revolutionary events uniting scientific, social, and political issues.	-How has technology impacted our view of nature and the universe? -How do cultural belief systems influence our understanding of nature and the universe?	-The universe has a history. -The major events and people who shaped our understanding of nature and the universe. -Technology has greatly influenced the advancement of astronomy since the Ancients first looked up and asked "What? Why? How? When?"	-Evaluate the cultural context in which revolutionary ideas were accepted or rejected. -Describe the major contributions of key historical persons to science.	
3.4 The Montana Native traditional beliefs are deeply rooted in an understanding of ecology, geology, astronomy and biology systems. (circle of life)	-How do previous and current reasoning models in science coincide and conflict w/ the Native American beliefs and traditions?	-Recognize standard reasoning models. -Recognize corresponding or conflicting Native American traditions and beliefs.	-Research the models -Compare and contrast the models. -Evaluate them.	See Indian Education for All: *Connecting Cultures & Classrooms* OPI for resources to use to accomplish this understanding. 1. Creation myths 2. Calendar systems