Ninth Grade Physical Science Content Standards and Objectives

The Ninth Grade Physical Science objectives continue the development of foundational knowledge in chemistry, physics, earth science and astronomy. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy and the use of 21st Century Skills across these major fields of science.

Subject matter is delivered through a coordinated, integrated approach with an emphasis on the development of the major science themes of systems, changes, and models. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50 percent of the instructional time to develop conceptual understanding and research/laboratory skills.

Safety instruction is integrated in all activities. Building on the knowledge and skills acquired in Eighth Grade Science, students in Ninth Grade Physical Science will expand and deepen their understanding of major concepts such as energy interactions, chemical changes and earth processes.

The West Virginia Standards for 21st Century Learning include the following components: 21st Century Content Standards and Objectives and 21st Century Learning Skills and Technology Tools. All West Virginia teachers are responsible for classroom instruction that integrates learning skills, technology tools and content standards and objectives.

Grade Nine	Physical Science
Standard:1	Nature of Science
SC.S.PS.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems.

Performance Descriptors SC.PD.PS.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Ninth grade students at the distinguished level will analyze the importance of scientific innovation and relate these innovations to the utilization of scientific methodology, variability in experimental results to advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; draw conclusions from multiple data sources and interpretation of models.	Ninth grade students at the above mastery will level analyze the importance of scientific innovation and recognize the role of these innovations in advancing societal, cultural and economic issues; use scientific methodology to design, conduct, communicate and revise experiments utilizing safe procedures and appropriate technology; draw conclusions from multiple data sources and models.	Ninth grade students at the mastery level will examine the importance of scientific innovation and recognize the role of these innovations in advancing societal, cultural and economic issues; use scientific methodology to conduct, communicate and revise experiments utilizing safe procedures and appropriate technology; draw conclusions from data sources and models.	Ninth grade students at the below mastery level will describe the importance of scientific innovation and recognize the role of these innovations in advancing societal, cultural or economic issues; use scientific methodology to conduct and communicate experiments utilizing safe procedures and appropriate technology; select an appropriate conclusion from a list of possible conclusions drawn from experimental data.	Ninth grade students at the novice level will identify the importance of scientific innovation and associate these innovations with advances in societal, cultural or economic issues; conduct experiments utilizing safe procedures and appropriate technology; differentiate between observations and conclusions.

Objectives	DOK	Students will
SC.O.PS.1.1	2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.PS.1.2	1	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., “scientific method”).
SC.O.PS.1.3	1	relate societal, cultural and economic issues to key scientific innovations.
SC.O.PS.1.4	3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).
SC.O.PS.1.5	1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.PS.1.6	2	use appropriate technology solutions within a problem solving setting to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and present and communicate conclusions.
SC.O.PS.1.7	4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).
SC.O.PS.1.8	3	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles; predict the influence of external variances such as potential sources of error, or interpret maps).

Grade Nine	**Physical Science**
Standard:2	Content of Science
SC.S.PS.2	Students will • demonstrate knowledge understanding and applications of scientific facts, concepts, principles, theories, and models delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science, and astronomy; and apply knowledge, understanding and skills of science subject matter/concepts to daily life.

Performance Descriptors SC.PD.PS.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Ninth grade students at the distinguished level will apply dimensional analysis and scientific notation to evaluate student derived equations; predict chemical and physical properties of an element based on electron structure; collect data to create a model to demonstrate the relationships among density, mass and volume and apply to earth models; extrapolate absolute zero from student collected data; quantitatively express changes in energy content during physical, chemical and nuclear changes; quantitatively distinguish ionic, nonpolar and polar covalent compounds; given a chemical formula determine the oxidation numbers of its elements predict the products, write the formula and determine the coefficients of a chemical equation; predict and verify the identity of observable products of a chemical reaction given the reactants; quantitatively determine the energy produced during exothermic reactions;	Ninth grade students at the above mastery level will apply dimensional analysis and scientific notation to evaluate equations; predict chemical and physical properties of an element based on its family and period; collect data to demonstrate the relationships among density, mass and volume and apply to earth and environmental models; detect movement of particles through measures of volumetric expansion of gasses at elevated temperatures; from experimental data categorize compounds as ionic, nonpolar or polar covalent compound; given a chemical formula determine the oxidation numbers of its ions; write the formula for the compounds and determine the coefficients of a chemical equation; predict the observable product of a chemical reaction; conduct	Ninth grade students at the mastery level will apply dimensional analysis and scientific notation in making metric calculations; predict chemical and physical properties of an element using its position in the periodic table; collect data to infer the relationships among density, mass and volume and apply to earth and environmental models; relate molecular motion and the amount of kinetic energy to the temperature of a system; compare and contrast changes to atoms during physical, chemical and nuclear changes; characterize compounds as ionic, nonpolar covalent or polar covalent and distinguish the difference between molecular and ionic structures; write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions; determine the coefficients and	Ninth grade students at the below mastery level will enter conversion factors into dimensional analysis problems; identify the physical and chemical properties associated with a family of elements; collect data to calculate the relationships among density, mass and volume; illustrate molecular motion of different states of matter; identify models of ionically and covalently bonded compounds; given the chemical formula of a binary ionic compound of representative elements write the name of the compound; determine the coefficients of a chemical equation; cite evidence for the occurrence of a chemical reaction from student generated experimental data; define and give examples of the law of conservation of mass/energy; compare the types of particles liberated in nuclear decay; perform a	Ninth grade students at the novice level will select from a list the correct metric conversion factor; locate the symbol for a specific element on the periodic table; collect mass and volume data and calculate density; relate molecular motion to the states of matter; define ionic and covalent bonds; name the elements in a chemical compound; define the chemical reaction types; safely perform an experiment involving chemical reactions; safely perform an experiment involving chemical reactions; define the law of conservation of mass/energy; define the particles of nuclear decay; define heat and temperature; experimentally determine and diagram magnetic fields of magnets; diagram the magnetic field of a magnet; construct DC circuits; define electricity

evaluate isotopes with appropriate half-lives for use in medical and geological purposes; design and conduct an experiment to differentiate between heat and temperature and present results; calculate the magnitude of magnetic field; predict arrangement of a group of resistors to develop a given current when given a known voltage fields; apply concepts of electricity and magnetism to generators or motors; apply the inverse square relationship to gravitational, magnetic and/or electrical interactions; design and conduct experiment that obtain data, apply graphs, vectors and mathematical models to quantify Newton's Laws of motion (i.e., velocity, acceleration, force, momentum, and time); design a complex machine and predict the mechanical advantage based on its simple machine components; determine the acceleration due to gravity using the period of a pendulum; use refractive indices to calculate the change in velocity as electromagnetic waves change media; triangulate the location of the source for seismic waves; examine the connections between global phenomena and weather systems and climate; differentiate variation in the climates of localities based on latitude, altitude and/or surface features; evaluate prior models for the formation of Earth's surface features in view of	experiments demonstrating the law of conservation of mass/energy; given the decay particle predict the product and the mass remaining of a radioisotope after a whole number of half lives; design and conduct an experiment to differentiate between heat and temperature; predict, experimentally determine and diagram magnetic fields of interacting magnets; design, construct and diagram DC circuits and solve for unknown variables using Ohm's Law and power equations; construct a model using an electromagnet and explain its operation; mathematically represent the inverse square relationship between gravity, distance and intensity of light and sound; experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion (i.e., velocity, acceleration, force, momentum, and time) and extrapolate data to predict undetermined variables; analyze a complex machine to identify and calculate the mechanical advantage of its component simple machines; mathematically predict the period of a pendulum based on the	classify the reaction type of a chemical equation; cite evidence of the occurrence of a chemical reaction from student generated experimental data; qualitatively and quantitatively describe the law of conservation of mass/energy; compare the types of particles liberated in nuclear decay and interpret half-life graphs; experimentally demonstrate the relationship between heat and temperature; predict, experimentally determine and diagram magnetic fields of magnets; construct and diagram DC circuits and solve for unknown variables using Ohm's Law and power equations; qualitatively explain the relationship between electricity and magnetism; conduct experiments to verify the inverse square relationship between distance and intensity of light and sound; experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion (i.e., velocity, acceleration, force, momentum, and time); conduct an experiment to calculate the mechanical advantages, work in/out and efficiencies of simple machines; design, conduct	heat experiment to differentiate between heat and temperature; predict, experimentally determine and diagram magnetic fields of magnets;construct DC circuits and solve Ohm's Law and power equations problems; define electricity and magnetism; graph data from experiments describing the non linear relationship between distance and intensity of light and sound; perform calculations using velocity, acceleration, force, momentum, and time; calculate the mechanical advantage of some simple machines; conduct experiments to determine how length affects the period of pendulums; illustrate the difference between transverse and longitudinal waves; illustrate the structure of the Earth labeling the physical properties of each layer; extract data from a weather map; relate latitude, altitude and surface features to climate; describe the effects of plate tectonics on the surface features of the Earth; describe the absolute magnitude, color and surface temperature of the sun using a H-R diagram; illustrate the heliocentric and geocentric	and magnetism; recognize that the intensity of light and sound decreases as the distance increases; define Newton's Laws; list six simple machines; construct a pendulum; use a long spring to differentiate between transverse and longitudinal waves; illustrate the layers of the Earth; label a weather map; describe the latitude, altitude and surface features of a given locality; identify the surface features of the Earth located at plate boundaries; label a diagram of the sun's layers including the temperature of each; label objects in the solar system.

modern tectonic evidence; predict the impact on the solar system if the sun were a red giant or a brown dwarf; research and evaluate prior models for the origin of the solar system using modern evidence.	length; examine the effect of different media on the propagation of transverse and longitudinal waves; apply seismographic data to calculate the average density of each Earth layer; relate tilt of the Earth to seasonal changes in weather; differentiate variation in the climates of localities based on latitude, altitude and/or surface features; research, organize and report evidence to support the theory and effects of plate tectonics including density, force, radioactive decay, energy conservation, mountain building, fossil and magnetic evidence; predict the effects on the solar system as the sun changes over time; analyze the progression of theories for the formation of the Earth-Moon system.	and analyze experiments to determine variables affecting the period of pendulums; differentiate between transverse and longitudinal waves and model examples of each type and relate to water, light and sound waves; examine seismographic and geologic evidence to determine structure, composition and age of the Earth; accurately predict and present a weather forecast using a weather map and meteorological data; analyze latitude, altitude and surface features to predict climatic conditions; research and organize evidence to support the theory and effects of plate tectonics including density, force, mountain building, fossil and/or magnetic evidence; describe energy production in the sun and apply energy transfer, solar wind and gravity to interpret the sun's impact on the solar system; investigate theories for the origin and configuration of the solar system (e.g. nebular theory, Earth-Moon formation, heliocentric and geocentric models).	models of the solar system.	

Objectives	DOK	Students will
SC.O.PS.2.01	2	apply dimensional analysis and scientific notation in making metric calculations
SC.O.PS.2.02	1	predict chemical and physical properties of an element using its position in the periodic table.
SC.O.PS.2.03	3	collect data to infer the relationships among density, mass and volume and apply to earth models (e.g., plate tectonics, weather systems, ocean currents)

SC.O.PS.2.04	1	relate molecular motion and the amount of kinetic energy to the temperature of a system
SC.O.PS.2.05	1	characterize compounds as ionic, nonpolar covalent or polar covalent and distinguish the difference between molecular and ionic structures
SC.O.PS.2.06	1	write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions.
SC.O.PS.2.07	2	determine the coefficients and classify the reaction type of a chemical equation (e.g., synthesis or combination, decomposition, single replacement, or double replacement and combustion).
SC.O.PS.2.08	2	cite evidence for the occurrence of a chemical reaction from student generated experimental data (e.g., production of color, light, heat, sound, smell, gas, or precipitate).
SC.O.PS.2.09	2	qualitatively and quantitatively describe the law of conservation of mass/energy (e.g., mechanical, thermal, chemical, electrical and nuclear)
SC.O.PS.2.10	2	compare the types of particles liberated in nuclear decay and interpret half-life graphs (e.g., radiometric dating, nuclear medicine and nuclear waste disposal)
SC.O.PS.2.11	2	experimentally demonstrate the relationship between heat and temperature (i.e., specific heat, melting point, latent heat)
SC.O.PS.2.12	1	predict, experimentally determine and diagram magnetic fields of magnets.
SC.O.PS.2.13	2	construct and diagram DC circuits and solve for unknown variables using Ohm's Law and power equations
SC.O.PS.2.14	2	qualitatively explain the relationship between electricity and magnetism
SC.O.PS.2.15	2	conduct experiments to verify the inverse square relationship between gravity, distance and intensity of light and sound
SC.O.PS.2.16	2	experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion (i.e., velocity, acceleration, force, momentum, and time)
SC.O.PS.2.17	2	conduct an experiment to calculate the mechanical advantages, work in/out and efficiencies of simple machines
SC.O.PS.2.18	3	design, conduct and analyze experiments to determine variables affecting the period of pendulums.
SC.O.PS.2.19	1	differentiate between transverse and longitudinal waves and model examples of each type and relate to water, light and sound waves
SC.O.PS.2.20	2	examine seismographic and geologic evidence to determine structure, composition and age of the Earth
SC.O.PS.2.21	2	predict and present a weather forecast using a weather map and meteorological data
SC.O.PS.2.22	1	analyze latitude, altitude and surface features to predict climatic conditions.
SC.O.PS.2.23	2	research and organize evidence to support the theory and effects of plate tectonics including density, force, mountain building, fossil and/or magnetic evidence
SC.O.PS.2.24	1	apply fusion, heat transfer, gravity, and electromagnetism to the sun's evolution and its impact on the solar system
SC.O.PS.2.25	1	investigate theories for the origin and configuration of the solar system (e.g. nebular theory, Earth-Moon formation, heliocentric and geocentric models)

Grade Nine	Physical Science
Standard:3	Application of Science
SC.S.PS.3	• Students will • demonstrate the ability to use inquiry process to explore systems, models, and changes. • demonstrate an understanding of the interdependence between science and technology. • demonstrate an understanding of the utilization of technology to gather data and communicate designs, results and conclusions. • demonstrate an understanding of personal and societal benefits of science, and an understanding of public policy decisions as related to health, population, resource and environmental issues.

Performance Descriptors SC.PD.PS.3				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Ninth grade students at the distinguished level will construct, test and analyze complex systems, models, and changes across science disciplines; use a technology solution and analyze the science used in the technology; evaluate how a scientific discovery impacts public policy decisions regarding health, population resources and environmental issues.	Ninth grade students at the above mastery level will construct, test and analyze data to explore systems, models, and changes across science disciplines; analyze technological innovations and identify the science that makes them possible; evaluate the personal and societal benefits of a scientific discovery; assess the impacts of a public policy decision regarding health, population resources or environmental issues.	Ninth grade students at the mastery level will test, record and analyze data to explore systems, models, and changes; analyze a technological innovation and identify the science that makes it possible; assess positive outcomes and unintended consequences of a scientific discovery; explain the impacts of a public policy decision regarding health, population resources or environmental issues.	Ninth grade students at the below mastery level will test and record data to explore systems, models, and changes; explain a technological innovation and identify the science that makes it possible; identify positive outcomes and unintended consequences of a scientific discovery; identify the impacts of public policy decision regarding health, population resources or environmental issues.	Ninth grade students at the novice level will test and record data to explore systems, models or changes; identify a technological innovation and the science that makes it possible; identify positive outcomes or unintended consequences of a scientific discovery; identify the impact of a public policy decision regarding health, population resources or environmental issues.

Objectives	DOK	Students will
SC.O.PS.3.1	2	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).
SC.O.PS.3.2	3	investigate, compare and design scientific and technological solutions to personal and societal problems.
SC.O.PS.3.3	1	communicate experimental designs, results and conclusions using advanced technology tools.
SC.O.PS.3.4	3	collaborate to present research on current environmental and technological issues to predict possible solutions.
SC.O.PS.3.5	3	explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.
SC.O.PS.3.6	3	given a current science-technology-societal issue, construct and defend potential solutions.