WEST VIRGINIA
SECRETARY OF STATE

NATALIE E. TENNANT

ADMINISTRATIVE LAW DIVISION

Form #2

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OFFICE WEST VIRGINIA
SECRETARY OF STATE

NOTICE OF A COMMENT PERIOD ON A PROPOSED RULE

AGENCY: West Virginia Board of Education TITLE NUMBER: 126

RULE TYPE: Legislative CITE AUTHORITY: W. Va. Constitution, Article XII, §2, W. Va. Code §18-2-5 and §18-9A-22

AMENDMENT TO AN EXISTING RULE: YES X NO _____

IF YES, SERIES NUMBER OF RULE BEING AMENDED: 44R

TITLE OF RULE BEING AMENDED: 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools (2520.35)

IF NO, SERIES NUMBER OF NEW RULE BEING PROPOSED: _____

TITLE OF RULE BEING PROPOSED: _____

IN LIEU OF A PUBLIC HEARING, A COMMENT PERIOD HAS BEEN ESTABLISHED DURING WHICH ANY INTERESTED PERSON MAY SEND COMMENTS CONCERNING THESE PROPOSED RULES. THIS COMMENT PERIOD WILL END ON March 16, 2009 AT 4:00 p.m. . ONLY WRITTEN COMMENTS WILL BE ACCEPTED AND ARE TO BE MAILED TO THE FOLLOWING ADDRESS:

Marty Burke
Office of Instruction
West Virginia Department of Education
Capitol Building 6, Room 608
1900 Kanawha Boulevard, East
Charleston, West Virginia 25305-0330

COMMENTS TO BE CONSIDERED ARE LIMITED TO **the content standards and objectives for ninth grade physical science, biology and conceptual biology** OF THIS PROPOSED RULE.

Jack McClanahan
Deputy State Superintendent of Schools

ATTACH A **BRIEF** SUMMARY OF YOUR PROPOSAL

EXECUTIVE SUMMARY
WEST VIRGINIA DEPARTMENT OF EDUCATION

Policy Number and Title: Policy 2520.35 - 21st Century Science 9-12 Content Standards and Objectives for West Virginia

Background: West Virginia Content Standards and Objectives were formally reviewed by Dr. William Schmitt from the University of Michigan, who compared these standards to the TIMMS countries. Dr. Schmitt specifically cited the West Virginia CSOs excessive number of objectives and the lack of advanced level cognitive demand skills of Standard Two. The individuals who were involved with the changes of this policy are Carla Williamson, Executive Director of the Office of Instruction; Marty Burke, Assistant Director of the Office of Instruction; Robin Anglin, Science Coordinator in the Office of Instruction; Tim Butcher, Coordinator in the Office of Assessment/Accountability; Steve Beckelhimer, Coordinator in the Office of Instruction; and Rosalie Rhodes, Science Coordinator for Kanawha County Schools.

Proposals: Revisions to Policy 2520.35 are being recommended for:

- Ninth Grade Physical Science Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.PS.1 Standard 1 Nature of Science and SC.S.PS.3 Standard 3, Application of Science, into a new SC.S.PS.1 Standard One, Nature and Application of Science. The objectives were organized and written succinctly in the Performance Descriptors SC.S.PS.1 and SC.S.PS.2 to indicate the level of achievement.
- Biology Content Standard and Objectives Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.B.1 Standard 1 Nature of Science and SC.S.B.3 Standard 3, Application of Science, into a new SC.S.B.1, Standard One, Nature and Application of Science.
- Revision of SC.S.B.2 Content of Science occurred in the rewriting of these objectives with higher cogitative demand. The objectives were organized thematically and written succinctly in the Performance Descriptors of SC.S.B.1 and SC.S.B.2 to indicate the level of achievement.
- Conceptual Biology Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.CB.1 Standard 1 Nature of Science and SC.S.CB.3 Standard 3, Application of Science, into a new SC.S.CB.1 Standard One, Nature and Application of Science.
- Revision of SC.S.CB.2, Content of Science, occurred in the rewriting of these objectives with higher cogitative demand. The objectives were organized thematically and written succinctly in the Performance Descriptors SC.S.CB.1 and SC.S.CB.2 to indicate the level of achievement.

Impact: The proposed revision of the Content Standards and Objectives of Ninth Grade Physical Science, Biology and Conceptual Biology will provide the desired direction for students and teachers to focus on specific concepts that are necessary to achieve the desired 21st century science skills.

Response to Comments:

TITLE 126
LEGISLATIVE RULE
BOARD OF EDUCATION

SERIES 44R
21st CENTURY SCIENCE 9-12 CONTENT STANDARDS AND OBJECTIVES FOR WEST VIRGINIA SCHOOLS (2520.35)

§126-44R-1. General.

1.1. Scope. -- West Virginia Board of Education Policy 2510 provides a definition of a delivery system for, and an assessment and accountability system for, a thorough and efficient education for West Virginia public school students. Policy 2520.35 defines the content standards (or instructional goals) and objectives for science 9-12 as required by W. Va. 126CSR42 (Policy 2510).

1.2. Authority. -- W. Va. Constitution, Article XII, §2, W. Va. Code §18-2-5 and §18-9A-22.

1.3. Filing Date. -- ~~March 13, 2008~~

1.4. Effective Date. -- ~~July 1, 2008~~

1.5. Repeal of former rule. -- This legislative rule ~~repeals and replaces~~amends W. Va. 126CSR44R West Virginia Board of Education Policy 2520.35 "21st Century Science 9-12 ~~Mathematics~~ Science Content Standards and Objectives for West Virginia Schools (2520.35)" filed ~~December 15, 2008~~March 13, 2008 and effective July 1, 2008.

§126-44R-2. Purpose.

2.1. This policy defines the content standards (or instructional goals) and objectives for the program of study required by Policy 2510 in science 9-12.

§126-44R-3. Incorporation by Reference.

3.1. A copy of 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools is attached and incorporated by reference into this policy. Copies may be obtained in the Office of the Secretary of State and in the West Virginia Department of Education, Office of Instruction.

§126-44R-4. Summary of the Content Standards and Objectives.

4.1. The West Virginia Board of Education has the responsibility for establishing high quality standards pertaining to all educational standards (W. Va. Code §18-9A-22). The content standards and objectives provide a focus for teachers to teach and students to learn those skills and competencies essential for future success in the workplace and further education. The document includes content standards for science, an explanation of terms, objectives that reflect a rigorous and challenging curriculum, and performance descriptors.

West Virginia Department of Education

West Virginia Board of Education Policy 2520.35 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools

Steven L. Paine
State Superintendent

Foreword

A 21st century science curriculum is an increasingly important component in the development learners prepared for success in the 21st century. Thus, the West Virginia Board of Education and the West Virginia Department of Education are pleased to present Policy 2520.35, 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools. The West Virginia Science Standards for 21st Century Learning includes 21st century *content* standards and objectives as well as 21st century standards and objectives for *learning skills* and *technology tools*. This broadened scope of science curriculum is built on the firm belief that quality engaging instruction must be built on a curriculum that triangulates rigorous 21st century content, 21st century learning skills and the use of 21st century technology tools.

Committees of educators from across the state convened to revise the content standards and objectives. The overarching goal was to build a rigorous, relevant and challenging science curriculum that would prepare students for the 21st century. West Virginia educators, including regular classroom teachers, special education teachers, and teachers representing higher education institutions played a key role in shaping the content standards to align with national standards, rigorous national assessments, and research and best practice in the field of science education. The contribution of these professionals was critical in creating a policy that is meaningful to classroom teachers and appears in a format that can easily be used and understood.

Policy 2520.35 is organized around the three major components of a standards-based curriculum: learning standards, instructional objectives and performance descriptors. The learning standards are the *broad descriptions* of what *all* students must know and be able to do at the conclusion of the instructional sequence. The accompanying grade-level objectives are specific descriptors of knowledge, skills and attitudes that when mastered will enable the student to attain the standard. The instructional objectives guide instructional *planning* and provide a basis for determining appropriate *assessments, instructional strategies and resources*. The performance descriptors provide the basis for *assessing* overall student competence of grade level standards. The performance descriptors define the five student performance levels ranging from novice to distinguished. With the ultimate goal of "learning for all," these descriptors allow the teacher, students and parents to judge the *level* of student proficiency in each 21st century learning standard.

In combination, the use of learning standards, instructional objectives and performance descriptors become a comprehensive guide for delivering a rigorous and relevant science curriculum to all West Virginia students. These elements, when used to guide the instructional process and when delivered with the creativity and instructional expertise of West Virginia teachers, will become a powerful resource for preparing students to meet the challenges of the 21st century.

Steven L. Paine
State Superintendent of Schools

Explanation of Terms

Content Standards are broad descriptions of what students should know and be able to do in a content area. Content standards describe what students' knowledge and skills should be at the end of a K-12 sequence of study.

Objectives are incremental steps toward accomplishment of content standards. Objectives are listed by course title and are organized around the content standards.

Performance Descriptors **describe in narrative format how students demonstrate achievement of the content standards. West Virginia has designed five performance levels: distinguished, above mastery, mastery, partial mastery and novice. Performance Descriptors serve two functions. Instructionally, they give teachers more information about the level of knowledge and skills students need to acquire. Performance levels and descriptors are also used to categorize and explain student performance on statewide assessment instruments.**

Numbering of Standards
The number for each content standard is composed of four parts, each part separated by a period:

- the content area code is SC for Science,
- the letter S, for Standard,
- the grade level and
- the standard number.

Illustration: SC.S.C.1 refers to Chemistry science content standard #1.

Numbering of Objectives
The number of each objective is composed of five parts, each part separated by a period:

- the content area code (SC for Science),
- the letter O is for Objective,
- the course title,
- the number of the content standard addressed, and
- the objective number.

Illustration: SC.O.C.2.3 refers to a Chemistry objective that addresses standard #2 in science, and that is the third objective listed under that standard.

Numbering of Performance Descriptors
The number for each group of three performance descriptors is composed of four parts, each part separated by a period:

- the content area (SC for Science),
- the letters PD are for Performance Descriptors,
- the course title, and
- the standard number.

Illustration: SC.PD.C.2 refers to science performance descriptors for Chemistry, content standard 2.

Unique Electronic Numbers (UENs)
Unique Electronic Numbers (or UENs) are numbers that help to electronically identify, categorize and link specific bits of information. Once Policy 2520.35 is available on the Web, each standard, each objective, and each group of five performance descriptors will have a Unique Electronic Number (UEN) that will always remain the same.

The codes printed in Policy 2520.35 form the basis of the UENs. The only additional set of numbers that will be added to each code to formulate its UEN will be a prefix that indicates the year and month that a particular version of Policy 2520.35 is approved by the State Board of Education.

The prefix for the UENs for each content area in Policy 2520.35 is noted at the top of each page containing standards, objectives and performance descriptors. As sections of 2520.35 are revised, UENs will be changed to reflect the new approval date.

UENs (Unique Electronic Numbers) are unique numbers that facilitate implementation of WV Standards into Electronic formats such as Databases and XML Files. The WV Department of Education encourages everyone who is going to use the WV Content Standards in any kind of electronic distribution, alignment, or software development to use the UENs so that all efforts can be cross-referenced and there is consistency across initiatives.

Illustration: The UEN for fifth grade science standard #2 will be "200602.SC.S.5.2".

Abbreviations

Content Areas

SC	Science

Other Abbreviations

PD	Performance Descriptors
O	Objective
S	Standard (Content Standard)
B	Biology
BII	Biology II
C	Chemistry
CII	Chemistry II
CB	Conceptual Biology
CC	Conceptual Chemistry
CP	Conceptual Physics
E	Earth Science
HA	Human Anatomy and Physiology
P	Physics
PII	Physics II
PS	Physical Science

SCIENCE – POLICY 2520.35

The high school science content standards identify what students should know, understand and be able to do in the natural sciences throughout the eighth grade. Because each content standard utilizes the knowledge and skills of other standards, they are designed to be used as an integrated whole. Although material can be added to the content standards, using only a subset of the standards will leave gaps in the students' scientific literacy.

A three-dimensional instructional strategy model must be utilized to address the science curriculum and assure students' depth of understanding and breadth of knowledge. That model uses the nature, content and application of science concepts to develop scientific inquiry and reasoning skills in students.

Standard 1: Nature of Science
The study of science as a human endeavor provides for the acquisition of ideas leading toward the current knowledge base that represents science content. The nature of science encompasses the basic values and beliefs that make up the scientific world view, how scientists go about their work and the general culture of scientific enterprise. Studying historical and current discoveries of scientists and scientific milestones provides students with information about how discoveries have influenced current scientific thought and advancements. Students should understand that the continuous development of scientific knowledge shapes history. The study of the history and nature of science clarifies scientific inquiry and the role of science in the development of world cultures. Students will engage in active inquiry through investigations and hands-on activities a minimum of 50% of the instructional time. Developing scientific literacy requires a learning environment in which students actively participate in meaningful hands-on activities while developing current technology skills. These investigations explore the natural world, require critical thinking and develop process skills. Learning activities are sequenced to shape, modify and develop students' knowledge in order for them to become independent inquirers.

Standard 2: Content of Science
Science subject matter focuses on the scientific facts, concepts, principles, theories and models that are important for all students to know, understand and apply. Through the integration of the fields of science and the development of unifying themes, students will understand the interrelationships among biology, chemistry, physics and the earth sciences. Scientifically literate students will make connections in the formal education setting and will apply their knowledge and skills to daily life experiences. The objectives describe the specific subject matter/concepts that students are to master at each grade level.

Standard 3: Application of Science
Broad unifying themes complement the perspectives presented in the other content standards. These themes are fundamental to understanding and unifying the various science disciplines. Major unifying themes are systems, models and changes. Scientific design and application permits the extension of senses, the enhancement of the knowledge base, transportation of materials and information, synthesizing of new products and the modification of the world. Students must learn to use technology to analyze situations, gather relevant information, generate and evaluate creative ideas, pose tangible solutions and communicate their analyses, results and suggestions concisely. The need to adapt to the rapid changes that are likely to occur in the future makes it imperative that students develop a broad spectrum of technology-related skills and an openness to change. Applying science and technological innovations to personal and social issues such as health, populations, resources and

environment helps students to develop decision-making skills. As students expand their conceptual horizons, they should recognize that collective individual actions manifest as societal issues. Students must recognize that society cannot afford to deal only with symptoms; personal and societal actions must be focused on elimination of the causes of problems. Students should recognize that unless imposed by legislation social change involves negotiation among different interest groups. Students must be allowed to encounter and examine social change in a variety of current and historical contexts.

The Role of Technology

West Virginia's vision for education includes the integration of technology throughout the curriculum so that all West Virginia students have the opportunity to develop technology skills that support learning and provide the ability to adapt to change. Successful learning environments provide opportunities for students to use education technology interwoven with relevant curricular content. West Virginia teachers are responsible for integrating technology appropriately in the students' learning environment.

Organization of the Science Program of Study

The West Virginia Science Program of Study is drawn from the National Science Education Standards and the Project 2061 Benchmarks to promote a rigorous and challenging science curriculum. Through experiencing a spiraling, inquiry-based program of study, students in grades K-8 will develop foundational knowledge and skills in the physical sciences, the life sciences, and the earth and space sciences. To assure scientific literacy for all students, a coordinated, integrated approach is utilized in grades K-8. Students in the 10^{th}, 11^{th} and 12^{th} grades participate in advanced in-depth laboratory-based elective courses designed to expand their conceptual understanding and enhance their research and laboratory skills.

Ninth Grade Science Content Standards and Objectives

The Ninth Grade Science objectives continue the development of foundational knowledge in biology, chemistry, physics, earth/environmental 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 Science will expand and deepen their understanding of major concepts such as energy interactions, genetic probabilities, chemical changes and mineral composition of local rock layers. 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 9	Science			
Standard: 1	Nature of Science			
SC.S.9.1	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.9.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
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	Students at the above mastery level will 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.	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.	Students at the partial 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.	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.

interpretation of models.				

Objectives	Students will
SC.O.9.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.9.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.9.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.9.1.4	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.9.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.9.1.6	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.9.1.7	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.9.1.8	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 9	Science
Standard 2	Content of Science
SC.S.9.2	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.9.2.

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will solve and interpret dihybrid cross; populate an environment with appropriate organisms; compare the structure and function of cells, tissues and systems of different organisms; demonstrate conservation of matter and	Students at the above mastery level will solve dihybrid cross; design environments to model interdependent populations; compare and contrast cells, tissues and systems of different organisms; relate conservation of matter and energy to cellular	Students at the mastery level will perform and interpret monohybrid crosses; design environments to model interdependent populations; compare cells, tissues and systems of different organisms; trace matter and energy through cellular	Students at the partial mastery level will solve monohybrid crosses; match populations to environments; compare cells and tissues of different organisms; trace matter through cellular processes; construct models of states of matter	Students at the novice level will complete a Punnett square; list populations in an environment; compare systems of different organisms; trace matter through a cellular process; identify models of states of matter; classify synthesis and decomposition

energy through cellular processes; predict how states of matter react as kinetic energy changes; write formulas for ionically and covalently bonded compounds, balance coefficients, predict products and classify types of chemical reactions; predict density values with change of state; calculate the amount of energy produced by nuclear changes; measure the specific heat of a material; compare the properties of different magnetic fields; evaluate a circuit using Ohm's Law and power equation; calculate inverse square relations; predict the effects of a change in location on motion of a pendulum; compare and contrast transverse and longitudinal waves; make long-range weather forecasts from meteorological data; use properties to identify unknown minerals; predict the paleo-environment in which a rock type was formed; use evidence to explain the structure of the moon; explain the absence of plate tectonics on the moon; evaluate the accuracy of absolute and	processes; predict the state of matter given relative amounts of kinetic energy; write formulas, balance coefficients, predict products and classify types of chemical reactions and bonds; predict density value when mass and volume changes; write equations for types of nuclear changes; relate the properties of a material to its absorption or dissipation of heat; compare the properties of different magnets; construct an electric circuit applying Ohm's Law and power equation; predict inverse square relations; explain the effect of gravity on the motion of pendulums; classify waves as transverse or longitudinal; construct and interpret a weather map from data; test properties to classify minerals; predict the type of rock that forms in a paleo-environment; use evidence to explain differences in Earth's layers; evaluate evidence for the forces and mechanisms of plate tectonics; interpret data to determine absolute and relative ages.	processes; relate state of matter to amount of kinetic energy; write formulas, balance coefficients, and classify types of chemical reactions; classify bond types; predict density value when mass and/or volume changes; compare types of nuclear changes; assess a material's ability to absorb or dissipate heat; explore properties of a magnet; construct an electric circuit using Ohm's Law and power equation; recognize inverse square relations; examine variables that affect the motion of pendulums; differentiate transverse and longitudinal waves; predict weather using maps; relate properties to minerals; relate rocks to the environment in which they form; use evidence to interpret Earth's structure; compare and contrast the forces and mechanisms of plate tectonics; use dating techniques.	to indicate kinetic energy; write formulas and classify types of chemical reactions; name types of bonds; calculate density when mass or volume change; identify the uses of energy produced by nuclear changes; recognize that materials absorb and dissipate heat differently; list the properties of a magnet; construct an electric circuit using Ohm's Law; recognize that changing distance of a light source affects perceived brightness; construct a pendulum and record data; model transverse and longitudinal waves; interpret weather maps; list the parts of the rock cycle; group minerals using properties; model the layers of the earth; identify heat source and model a convection cell; use relative dating techniques.	reactions; define an ionic and covalent bond; define density; recognize that energy is produced by nuclear changes; identify objects as conductors or insulators of heat; list a property of a magnet; construct an electric circuit; observe that changing distance of a light source affects perceived brightness; construct a pendulum; model transverse and longitudinal waves; read weather maps; state the difference between rocks and minerals; name the layers of the earth; identify Earth's internal heat source; use the law of superposition to date strata.

relative dating techniques.				

Objectives	Students will
SC.O.9.2.1	apply principles of Mendelian genetics to solve heredity problems.
SC.O.9.2.2	illustrate meiosis and mitosis and relate to chromosome number and production of sperm, egg and body cells.
SC.O.9.2.3	analyze cyclic changes in populations of organisms.
SC.O.9.2.4	design an environment that demonstrates the interdependence of plants and animals (e.g., energy and chemical cycles, adaptations of structures and behaviors).
SC.O.9.2.5	compare and contrast the structure and function of cells, tissues and systems of different organisms.
SC.O.9.2.6	diagram the transfer of matter and energy in the chemical/molecular processes of photosynthesis, respiration and fermentation.
SC.O.9.2.7	predict chemical and physical properties of an element using its position in the periodic table.
SC.O.9.2.8	compare the types of radioactive decay in terms of particles and energy generated.
SC.O.9.2.9	predict the changes in density as mass and volume change.
SC.O.9.2.10	relate molecular motion, kinetic energy and states of matter.
SC.O.9.2.11	write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions.
SC.O.9.2.12	propose the results of changing the number of protons, neutrons or electrons on the properties of an atom.
SC.O.9.2.13	determine formulas and names for binary compounds.
SC.O.9.2.14	classify a binary chemical bond as ionic, nonpolar covalent or polar covalent.
SC.O.9.2.15	given a chemical equation deduce the coefficients and classify the reaction type (e.g., synthesis or combination, decomposition, single replacement, or double replacement and combustion).
SC.O.9.2.16	assess and provide evidence to justify the occurrence of a chemical reaction (e.g., production of color, light, heat, sound, smell, gas, or precipitate).
SC.O.9.2.17	differentiate various forms of energy and energy transformations including fission and fusion.
SC.O.9.2.18	assess absorption and dissipation of heat by various materials.
SC.O.9.2.19	experimentally deduce and diagram the magnetic field of a bar magnet.
SC.O.9.2.20	construct electric circuits and mathematically model electric circuits using Ohm's Law and power equations.
SC.O.9.2.21	establish the relationship between distance and the intensity of light, charge and gravitational attraction (e.g., inverse square law).
SC.O.9.2.22	interpret and draw conclusions from speed-distance-time data and graphs.
SC.O.9.2.23	analyze experiments to determine which variables affect the motion of pendulums.
SC.O.9.2.24	differentiate between transverse and longitudinal waves and model examples of each type (e.g., light, sound, or seismic).
SC.O.9.2.25	predict weather based on the relationships of temperature, air pressure, wind speed, wind direction and humidity as depicted on a weather map and meteorological data.
SC.O.9.2.26	analyze the relationships among latitude, altitude and climate.
SC.O.9.2.27	classify common rock forming minerals by examining their physical and chemical properties.
SC.O.9.2.28	analyze the processes of the rock cycle to predict the paleo-environment in which a rock sample is formed.
SC.O.9.2.29	examine seismographic and geologic evidence to determine structure and composition of the Earth's interior.
SC.O.9.2.30	use relative dating techniques to determine the ages of stratagraphic layers.
SC.O.9.2.31	interpret a half-life graph to determine the absolute age of a given sample.
SC.O.9.2.32	compare and contrast theoretical models explaining forces driving lithospheric plate motion (e.g., slab pull, plate push, or convection).
SC.O.9.2.33	research and organize evidence to support the theory of plate tectonics.

SC.O.9.2.34	apply fusion, heat transfer, gravity, and electromagnetism to the sun, its evolution and its impact on earth.

Grade 9	Science			
Standard: 3	Application of Science			
SC.S.9.3	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.9.3				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
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.	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.	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.	Students at the partial 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.	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	Students will			
SC.O.9.3.1	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).			
SC.O.9.3.2	investigate, compare and design scientific and technological solutions to personal and societal problems.			
SC.O.9.3.3	communicate experimental designs, results and conclusions using advanced technology tools.			
SC.O.9.3.4	collaborate to present research on current environmental and technological issues to predict possible solutions.			
SC.O.9.3.5	explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.			
SC.O.9.3.6	given a current science-technology-societal issue, construct and defend potential solutions.			

Tenth Grade Science Content Standards and Objectives

The Tenth Grade Science objectives conclude the development of foundational knowledge of biology, chemistry, physics, and the earth and space sciences. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy and use of 21st century skills in the fields of biology, chemistry, physics and earth/environmental science and astronomy. The 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 Ninth Grade Science, students in Tenth Grade Science will expand their depth of understanding of major concepts such as energy transformation qualifications; cellular biology; molecular genetics; embryology; physical, chemical and nuclear changes; fossils and environmental concerns. 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 10	Science			
Standard: 1	Nature of Science			
SC.S.10.1	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.10.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will evaluate the importance of scientific innovation; relate these innovations to the utilization of scientific methodology, variability in experimental results and interpret the impact of these advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology;	Students at the above mastery level will evaluate 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; compile data to draw conclusions from	Students at the mastery 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	Students at the partial mastery level will recognize the importance of scientific innovation and relate these innovations to the utilization of scientific methodology, variability in experimental results to advances in societal, cultural or economic issues; conduct and communicate experiments utilizing safe procedures and appropriate technology; draw conclusions from data and generate models.	Students at the novice level will identify scientific innovations and associate these innovations with the utilization of scientific methodology in advancing societal, cultural or economic issues; conduct experiments utilizing safe procedures and appropriate technology and describe results; differentiate between observations and conclusions.

validate and draw conclusions from experimental results using historical and student collected data and constructed models.	multiple data sources and interpretation of models.	data sources and interpretation of models.		

Objectives	Students will
SC.O.10.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.10.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.10.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.10.1.4	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.10.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.10.1.6	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.10.1.7	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.10.1.8	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 10	**Science**
Standard: 2	Content of Science
SC.S.10.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.10.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will suggest cell functions based on structure; debate ethics	Students at the above mastery level will classify cells based on structure and function; analyze historical	Students at the mastery level will relate cell structure to function; apply DNA's structure to its role in	Students at the partial mastery level will recognize that cells have different structures and functions; list	Students at the novice level will recognize that cells have different structures; recognize that DNA is the

of DNA research; assess the statement "ontogeny recapitulates phylogeny"; construct a simple cladogram; explain interactions among biogeochemical cycles; associate diseases with chemical imbalances; analyze fossil and modern evidence of adaptations in response to changing environments; experimentally determine data to predict trends in characteristics among unknown substances; design experiments to demonstrate the relationships among temperature-pressure-volume and heat in substances during physical/chemical changes; relate the frequency of electromagnetic waves to energy; explain how electricity produces magnetism and how magnets produce electricity; assess error in measuring energy conservation; interpret calculations and graphs of rate, force, momentum, work and time; suggest a simple machine to provide optimum mechanical advantage; measure calculate the spring constant and relate	research leading to current DNA knowledge; compare ontogeny and phylogeny of a variety of animals; interpret a cladogram of a group of organisms; explain interactions between two biogeochemical cycles; describe the role of chemicals in human body systems; trace fossil and modern adaptations in response to changing environments; experimentally determine relationships among substances; experimentally and mathematically validate the relationships among temperature-pressure-volume and heat in substances during physical/chemical changes; calculate the frequency of electromagnetic waves; explain how electricity produces magnetism; describe conservation of all forms of energy; interpret calculations and/or graphs of rate, force, momentum, work and time; compare calculated mechanical advantage of similar simple machines; measure calculate the spring constant; evaluate the gravitational effects of the moon and sun on tidal phenomenon; predict the	heredity; compare ontogeny and phylogeny of an animal; compare traditional and modern classification systems; diagram biogeochemical cycles; describe how human body systems work together; describe fossil and modern adaptations of plant and animal populations to their changing environment; experimentally determine characteristics of substances; mathematically determine the relationships among temperature-pressure-volume and heat in substances during physical /chemical changes; characterize electromagnetic waves and their uses; describe the relationship between electricity and magnetism; quantitatively determine conservation of thermal energy; relate Newton's Laws of Motion to rate, force, momentum, work and time; calculate mechanical advantage of simple machines; compare the effect of different forces on vibrating systems; predict tidal phenomenon; determine impacts of geological and biological processes on climate; explain geological and	properties of DNA; trace ontogeny or phylogeny of an animal; identify a group of organisms whose historical classification has changed; diagram the carbon or nitrogen cycle; explain the interaction of two human body systems; recognize that populations change in response to environmental changes; experimentally determine characteristics of some substances; mathematically determine the relationships among temperature-pressure-volume; list electromagnetic waves and their uses; diagram a magnetic field around an electrical wire; recognize that energy is conserved in transformations; define Newton's Laws of Motion, rate, force, momentum, work and time; calculate mechanical advantage of some simple machines; recognize vibrating systems; explain that the moon causes tides; list geological and biological processes that affect climate; explain some processes that form fossils; state theories of cosmology.	material of heredity; recognize that embryos developmentally change; place organisms in a classification system; diagram the water cycle; identify human body systems; recognize that populations change over time; list characteristics of substances; state relationship among temperature-pressure-volume; list some electromagnetic waves; recognize that electricity and magnetism are interrelated; state that energy is conserved; state the three Laws of Motion; calculate mechanical advantage of a simple machine; recognize a pendulum is an example of a vibrating system; define tides; recognize that geological and biological processes affect climate; explain a process that forms fossils; state a scientifically accepted theory for the origin of the universe.

to its properties; evaluate multiple gravitational effects of the Earth-Moon system; predict the effects of geological and biological events on climate; critique geological and chemical conditions to predict fossil formation; evaluate theories of cosmology using electromagnetic evidence.	effects of geological or biological event on climate; evaluate conditions necessary for fossil formation; compare theories of cosmology using electromagnetic evidence.	biological processes of fossil formation; explain theories of cosmology using electromagnetic evidence.		

Objectives	Students will
SC.O.10.2.1	relate the structure of cell organelles to their functions.
SC.O.10.2.2	apply knowledge of cells to variations in cells, tissues, and organs of different organisms.
SC.O.10.2.3	compare and contrast mechanisms for the movement of materials into and out of cells.
SC.O.10.2.4	explore the discovery of DNA and its structure; examine nucleotide bonding to the importance of to the double helix structure.
SC.O.10.2.5	apply DNA analysis to current societal and technological issues (e.g., DNA's role in protein synthesis, heredity, cell division, or cellular functions).
SC.O.10.2.6	integrate DNA mutations, chromosomal crossing over and linkage with the principles of genetics.
SC.O.10.2.7	compare the ontogeny and phylogeny using the embryonic development of invertebrate and vertebrate animals.
SC.O.10.2.8	compare traditional and modern classification systems.
SC.O.10.2.9	construct a scientific explanation for variation in the species and common ancestors using fossil records, homologous features and selective pressures.
SC.O.10.2.10	compare and contrast theories for the development, diversity and/or extinction of a species (e.g., natural selection, Lamarckism, or catastrophism).
SC.O.10.2.11	construct diagrams showing energy flow and cycles of matter between chemical and biological systems including photosynthesis, stored chemical energy, decomposition, carbon and nitrogen cycles.
SC.O.10.2.12	integrate the human body systems to the functioning of the entire organism.
SC.O.10.2.13	design an investigation in which the needs of growing plants are determined.
SC.O.10.2.14	evaluate environmental factors that affect succession, populations and communities.
SC.O.10.2.15	model the flow of matter and energy flow through the respiration process.
SC.O.10.2.16	compare and contrast by investigation the properties of solutions including density, conductivity, solubility, concentration, pH and colligative properties.
SC.O.10.2.17	compare and contrast the characteristics of physical, chemical and nuclear changes/reactions.
SC.O.10.2.18	determine the relationships among temperature, pressure and volume in gases and interpret graphs that depict these relationships (e.g., Charles' Law, Boyle's Law, Gay-Lussac's Law).
SC.O.10.2.19	characterize by investigation variance in thermal energy in physical and chemical changes.
SC.O.10.4.20	compare and contrast the characteristics and uses of electromagnetic waves and relate the frequency of the wave to its application.
SC.O.10.2.21	correlate the motion of a body to its Doppler shift.

SC.O.10.2.22	qualitatively explain the relationship between electricity and magnetism.
SC.O.10.2.23	qualitatively and quantitatively describe the conservation of energy (e.g., thermal, chemical, or mechanical).
SC.O.10.2.24	apply Newton's Laws of Motion to depict the relationship among rate, force, momentum, work, and time using kinematics graph and mathematical models.
SC.O.10.2.25	describe and quantify how machines can provide mechanical advantage.
SC.O.10.2.26	determine the effect of different forces on vibrating systems (e.g., pendulums, or springs).
SC.O.10.2.27	apply the characteristics and behaviors of mechanical waves to earth processes.
SC.O.10.2.28	predict the amplitude and frequency of tides using the concepts of gravity and positions of the earth-sun-moon (e.g., spring and neap tides).
SC.O.10.2.29	evaluate the effects of geological events on weather and climate (e.g., volcanism and bolide impact).
SC.O.10.2.30	analyze the effects of mechanical and chemical weathering mechanisms on the earth's surface to produce sediments.
SC.O.10.2.31	relate the theories of electric and magnetic fields to the dynamics of the earth's magnetosphere.
SC.O.10.2.32	examine the effects of plate tectonics on geological and biological processes (e.g., rock cycle and paleo-geography).
SC.O.10.2.33	correlate geological and chemical processes to fossil formation (e.g., petrification, permineralization, or rapid burial).
SC.O.10.2.34	explain theories of cosmology using electromagnetic evidence.

Grade 10	**Science**			
Standard 3	**Application of Science**			
SC.S.10.3	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.10.3				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will, construct, test, analyze, and evaluate complex systems, models, and changes across science disciplines; choose a technology solution and analyze the science used in the technology; evaluate how scientific discoveries impact public policy decisions	Students at the above mastery 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,	Students at the 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	Students at the partial 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; list positive outcomes and unintended consequences of a scientific discovery; identify the impacts of a	Students at the novice level will test and record data to explore systems, models, and changes; use technological innovations and state that science makes them possible; identify a positive outcome or a negative consequence of a scientific discovery; identify an impact of a public policy decision

regarding health, population resources and environmental issues.	population resources and environmental issues.	the impacts of a public policy decision regarding health, population resources or environmental issues.	public policy decision regarding health, population resources or environmental issues.	regarding health, population resources or environmental issues.

Objectives	Students will
SC.O.10.3.1	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).
SC.O.10.3.2	investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.10.3.3	communicate experimental designs, results and conclusions using advanced technology tools.
SC.O.10.3.4	collaborate to present research on current environmental and technological issues to predict possible solutions.
SC.O.10.3.5	explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.
SC.O.10.3.6	given a current science-technology-societal issue, construct and defend potential solutions.

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. Students will explore occupational opportunities in chemistry, engineering, earth science, and technology and evaluate the required academic preparations. ~~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 and Application 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. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions			
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;~~	Ninth grade students at the above mastery level will ~~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~~	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 partial 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~~	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.~~ implement safe practices as they conduct experiments and base

~~draw conclusions from multiple data sources and interpretation of models.~~ implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct solutions and defend their ideas to an authentic audience.	~~data sources and models.~~ implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	~~conclusions drawn from experimental data.~~ implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct their solutions.	conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.PS.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.PS.1.~~4~~2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.PS.1.~~2~~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).~~demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").~~
SC.O.PS.1.~~3~~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).~~relate societal, cultural and economic issues to key scientific innovations.~~
SC.O.PS.1.~~4~~5	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, or predict the influence of external variances such as potential sources of error, or interpret maps).~~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~~6	investigate, compare and design scientific and technological solutions to address personal and societal problems.~~implement safe procedures and practices when manipulating equipment, materials, organisms, and models.~~
SC.O.PS.1.~~6~~7	given current science-technology-societal issues, construct and defend potential solutions.~~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~~8	relate societal, cultural and economic issues to key scientific innovations.~~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~~9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).~~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 distinguish ionic, nonpolar and polar covalent compounds; given a chemical formula determine the oxidation numbers of its elements predict the~~	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 models; detect movement of particles through measures of volumetric expansion of gasses at elevated temperatures; from experimental data categorize compounds; given a chemical formula determine the oxidation~~	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 the periodic table; collect data to infer the relationships among density, mass and volume and apply to earth models; relate molecular motion and the amount of kinetic energy to the temperature of a system; characterize compounds and distinguish the difference between molecular and ionic structures; write formulas and name compounds given oxidation numbers of~~	Ninth grade students at the partial 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~~	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~~

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; 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 design and conduct experiment that obtain data, apply graphs, vectors and mathematical models to quantify Newton's Laws of motion; 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	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 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; experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion and extrapolate data to predict undetermined variables; analyze a complex machine to identify and calculate the	monatomic and polyatomic ions; determine the coefficients and classify the reaction type of a chemical equation; cite evidence for 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; experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion; conduct an experiment to calculate the mechanical advantages, work in/out and efficiencies	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 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;	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 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. use the proper units when collecting data and solving for unknowns. They will list the properties of elements and ionic structures and identify chemical names. As they balance equations, students will identify chemical reactions and state the Laws of

~~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 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.~~ apply dimensional analysis and metric notations when determining relations, deriving equations, and solving for unknowns. They will predict chemical and physical properties of elements based on electron structure quantitatively distinguish ionic, nonpolar and polar covalent compounds. Students will predict and verify the identity of observable products of chemical reactions when given the reactants. They will quantitatively determine	~~mechanical advantage of its component simple machines; mathematically predict the period of a pendulum based on the 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; 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.~~ apply dimensional analysis and metric notations when collecting data, determining relationships, and solving for unknowns. They will predict chemical and physical properties of elements based on electron structure quantitatively. When given chemical formulas, students will determine the oxidation	~~of simple machines; design, conduct 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; 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; 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.~~ apply dimensional analysis and metric notations when collecting data, determining relationships, and solving for unknowns. They will characterize the properties of elements, molecules and	~~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 models of the solar system.~~ apply dimensional analysis and metric notations when collecting data, examining relationships, and solving for unknowns. They will characterize the properties of elements, molecules and ionic structures and identify chemical names. As they balance equations, students will classify, describe chemical reactions and apply the Laws of Conservation. They will explain the relationships of molecular motion, kinetic energy, heat, and temperature. They will experimentally determine and diagram magnetic fields and circuits as they solve for unknowns. They will make predictions solve for unknown forces and motions in systems. They will diagram the composition of the Earth	Conservation. They will state relate molecular motion and kinetic energy to heat and temperature. They will diagram magnetic fields and circuits as they solve for unknowns. They will identify the forces and the motions they cause in systems. They will diagram the solar system and use models to describe waves and the heat transfer that occurs on Earth and sun.

the energy produced during exothermic reactions. They will calculate the magnitudes of interacting magnetic fields and build circuits for specified scenarios. They will design experiments to determine relationships in the forces and motions of systems. They will research and evaluate evidence for theories for the origin and composition of the Earth and solar system and use models of waves and heat transfer to explain changes that occur.	numbers of the elements, balance the equations, and predict the products. They will design and conduct an experiment to differentiate between heat and temperature and the present results. They will predict and experimentally determine interacting magnetic fields and build circuits for specified scenarios. They will extrapolate data to solve for unknown forces and motions in systems. They will research and site evidence for theories for the origin of the Earth and solar system and use models of waves and heat transfer to explain their composition and changes that occur	ionic structures and write formulas and names of ions. As they determine coefficients, students will classify and cite evidence for the chemical reactions and apply the Laws of Conservation. They will conduct experiments to determine the relationships between molecular motion, kinetic energy, heat, and temperature. They will experimentally determine magnetic fields and circuits as they solve for unknowns and determine their relationships. They will use Newton's Laws to make predictions and solve for unknown forces and motions in systems. They will investigate theories for the origin and composition of the Earth and solar system and use models of waves and heat transfer to explain their composition and changes that occur.	and solar system and use models of waves and heat transfer to explain changes that occur.	

Objectives	Students will
SC.O.PS.2.1	apply dimensional analysis and scientific notation in making metric calculations.
SC.O.PS.2.2	predict chemical and physical properties of an element using its position in the periodic table.
SC.O.PS.2.3	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.2.4	relate molecular motion and the amount of kinetic energy to the temperature of a system.
SC.O.PS.2.5	characterize compounds as ionic, nonpolar covalent or polar covalent and distinguish the difference between molecular and ionic structures.
SC.O.PS.2.6	write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions.
SC.O.PS.2.7	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.2.8	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.2.9	qualitatively and quantitatively describe the law of conservation of mass/energy (e.g., mechanical, thermal, chemical, electrical and nuclear).
SC.O.PS.2.10	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	experimentally demonstrate the relationship between heat and temperature (i.e., specific heat, melting point, latent heat).
SC.O.PS.2.12	predict, experimentally determine and diagram magnetic fields of magnets.
SC.O.PS.2.13	construct and diagram DC circuits and solve for unknown variables using Ohm's Law and power equations.
SC.O.PS.2.14	qualitatively explain the relationship between electricity and magnetism.
SC.O.PS.2.15	conduct experiments to verify the inverse square relationship between gravity, distance and intensity of light and sound.
SC.O.PS.2.16	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	conduct an experiment to calculate the mechanical advantages, work in/out and efficiencies of simple machines.
SC.O.PS.2.18	design, conduct and analyze experiments to determine variables affecting the period of pendulums.
SC.O.PS.2.19	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	examine seismographic and geologic evidence to determine structure, composition and age of the Earth.
SC.O.PS.2.21	predict and present a weather forecast using a weather map and meteorological data.
SC.O.PS.2.22	analyze latitude, altitude and surface features to predict climatic conditions.
SC.O.PS.2.23	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	apply fusion, heat transfer, gravity, and electromagnetism to the sun's evolution and its impact on the solar system.
SC.O.PS.2.25	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~~	~~Ninth grade students at the above mastery level will~~	~~Ninth grade students at the mastery level will test,~~	~~Ninth grade students at the partial mastery level will test~~	~~Ninth grade students at the novice level will test and~~

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.	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.	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.	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.	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	Students will
SC.O.PS.3.1	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	investigate, compare and design scientific and technological solutions to personal and societal problems.
SC.O.PS.3.3	communicate experimental designs, results and conclusions using advanced technology tools.
SC.O.PS.3.4	collaborate to present research on current environmental and technological issues to predict possible solutions.
SC.O.PS.3.5	explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.
SC.O.PS.3.6	given a current science-technology-societal issue, construct and defend potential solutions.

Biology Content Standards and Objectives

Biology is a course designed for students who desire a broader, in-depth study of the content found in many biological fields of endeavor. This course is designed to build upon and extend the Biology concepts, skills, and knowledge from the science program, using skills for the 21st Century. Students ~~interested~~ will explore occupational opportunities in health, engineering, and technology and evaluate the required academic preparations while ~~and scientific related careers will build and~~ expanding ~~their~~ laboratory skills and experiences. Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. 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 Ten	Biology
Standard: 1	Nature and Application of Science
SC.S.B.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. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.B.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology 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~~	Biology students at the above mastery level will ~~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.~~ implement safe practices as they design,	Biology 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.~~ implement safe practices as they design, conduct, and revise	Biology students at the partial 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.~~ implement safe	Biology 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.~~ implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence. They will relate science-

~~models.~~implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct solutions and defend their ideas to an authentic audience.	conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experiments and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct their solutions.	technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.B.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.B.1.~~1~~2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.B.1.~~2~~3	~~demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").~~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.B.1.~~3~~4	~~relate societal, cultural and economic issues to key scientific innovations.~~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.B.1.~~4~~5	~~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).~~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, or predict the influence of external variances such as potential sources of error, or interpret maps).
SC.O.B.1.~~5~~6	~~implement safe procedures and practices when manipulating equipment, materials, organisms, and models.~~investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.B.1.~~6~~7	~~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.~~given current science-technology-societal issues, construct and defend potential solutions.
SC.O.B.1.~~7~~8	~~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).~~relate societal, cultural and economic issues to key scientific innovations.
SC.O.B.1.~~8~~9	~~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, or predict the influence of external variances such as potential sources of error, or interpret maps).~~synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).

Grade Ten	**Biology**
Standard 2	Content of Science
SC.S.B.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives; demonstrate an understanding of the interrelationships among physics, chemistry, biology and the earth and space sciences. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.B.2

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology students at the distinguished level will ~~correlate size, shape and functional group to unique properties of organic compounds and molecules to biochemical pathways; research and present endosymbiosis as possible evolution of more complex organization of eukaryotic cell from simpler prokaryotic cells; research extracellular components and connections between cells; research the possible evolutionary connections of cell types and the chemical pathways in cell differentiation; analyze energy flow of cellular processes and their effect on environments in a way that could influence the evolution of populations; research~~	Biology students at the above mastery level will ~~correlate the properties of biological molecules to their function in biochemical pathways; relate the structural similarities of organelles to their function and interactions in eukaryotic cells; analyze the chemistry and fluid mosaic model of the cell membrane and correlate the forces necessary for the import and export of molecules; analyze the parts of different types of cells as they contribute to the function of the cell; analyze the interrelationships of different systems and how they affect the energy flow to entropy; analyze the mechanisms that organisms use to control the rate of cell division; explain crossing over and how it contributes to the production~~	Biology students at the mastery level will ~~correlate the properties of biological molecules to their function in biochemical pathways; relate the structure of cellular organelles to their functions and interactions in eukaryotic cells; analyze the chemistry and fluid mosaic model of the cell membrane necessary for life; compare and contrast cell types by structures and functions; analyze the flow of energy through cellular processes such as photosynthesis, cellular respiration and fermentation; outline mechanisms of homeostasis in living systems; analyze meiosis and the cell cycle and relate the processes to the~~	Biology students at the partial mastery level will ~~classify biological molecules; match function of organelles with list of organelles; perform diffusion or osmosis labs and draw diagram showing the movement of molecules in these processes; identify cell types of their structures; diagram flow charts to demonstrate flow of energy through cellular processes; correlate negative feedback as integration of different organ systems; compare the end products of meiosis and the cell cycle; predict phenotypic ratios by applying Mendel's Laws of Genetics and determine the phenotypes of the offspring of dihybrid across for~~	Biology students at the novice level will ~~define biological molecules; draw a model of a cell and label organelles; describe the chemistry and structure of the cell membrane; define prokaryotes and eukaryotes; define photosynthesis cellular, respiration, and fermentation; give examples of how an animal can control internal and external environmental changes; relate meiosis to the production of egg and sperm relate the cell cycle to the production of body cells; determine the phenotypes of the offspring of monohybrid cross for complete dominance, incomplete~~

~~physiological changes in animals during dormancy or hibernation necessary to maintain homeostasis; evaluate the advantages and disadvantages of both sexual and asexual reproduction; apply genetics to modern agricultural practices to increase production or quality of products; interpret research leading to the current knowledge of molecular genetics; present scientist's experimental validation of role tRNA, mRNA, and rRNA have in the process of protein synthesis; compare and contrast the use of various genetic engineering technologies as potential solutions to real world problems; compare and contrast gradualism and punctuated equilibrium models; research and present information about the social changes resulting from the publication of Darwin's Theory; evaluate and present recent research that supports molecular relationships between species; compare and contrast viruses to living organisms; compare and contrast the structures and functions of one organism to structures with similar~~	~~of unique cells; predict phenotypic ratios by applying Mendel's Laws of Genetics; evaluate the contributions of Franklin and Wilkins in the discovery of the double helix structure of DNA; research how scientists experimentally determined the role of tRNA, mRNA, and rRNA as agents in peptide formation; present arguments regarding the potential use and abuse of specific genetic engineering technologies; compare the theory of natural selection to prior evolutionary models; evaluate the influence of the historical social context on the development of evolutionary theory; draw cladograms to show evolutionary relationships between species; compare lytic and lysogenic cycles of viruses; compare the anatomy of related species to demonstrate the similarities of their structures and functions; describe important mechanisms that are used as an organism maintains homeostasis; evaluate how species' adaptations are driven by the changing environmental factors in an ecosystem; explain how major biogeochemical processes move nutrients between biotic and abiotic~~	~~number of chromosomes and production of gametes and somatic cells; predict phenotypic ratios by applying Mendel's Laws of Genetics; explore the discovery of DNA and examine the molecular structure of the double helix; distinguish the structure and function of messenger, tRNA and rRNA in the processes of transcription and translation; research and debate the application of DNA technology in the context of social, political and ethical issues; evaluate the evidence for natural selection; evaluate the influence of the historical social context on the development of evolutionary theory; compare classification systems; interpret the placement of viruses in the current classification systems; incorporate the structure and function of individual body systems to the overall functioning of the organism; assess responses of organisms to internal and environmental stimuli; evaluate environmental factors that affect succession, populations and~~	~~complete dominance, and codominance using a Punnett square; describe the molecular structure of DNA; mastery correlate the relationship between mRNA and tRNA in the process of protein synthesis; research the application of DNA technology in the context of social, political and ethical issues; compare artificial selection and natural selection; cite examples of how social climate influenced the development of ideas about evolution; compare relationships between kingdoms and domains; describe the basic structures and functions of a virus; describe the functions of structures of the major body systems in an organism; explain the importance of homeostasis; list environmental factors that affect succession, populations, and communities; describe the interdependency of biotic factors in an ecosystem; contrast a food chain to a food web; compare and contrast interrelationships of organisms within an ecosystem; calculate the growth rate for a population as it is represented on a graph.~~describe the	~~dominance, and codominance using a Punnett square; model the double helix structure of DNA; define translation, transcription, mRNA, tRNA, and rRNA; list DNA technologies that may have social and ethical implications; define natural selection; list some evolutionary theories; define morphology and name domains and kingdoms; define morphology and name domains and kingdoms; list diseases caused by viruses; identify the structures of the major body systems in an organism; define homeostasis; define succession, population and describe kinds of communities; list biotic and abiotic factors in a given ecosystem; define producers and consumers; distinguish between the interrelationship of organisms within an ecosystem; identify limiting factors in an environment.~~describe the chemistry of cellular processes and biological molecules and define the structures and functions of

~~functions of other organisms; access the role of negative and positive feedback in controlling the rates of life processes; explain how Hardy Weinberg conditions stabilize the genetic composition of population; design an experiment to determine the effects of decomposition rates on nutrient recycling; use mathematical calculations to explain why food chains usually do not exceed three or four levels; determine factors that influence coevolution; explain why small or isolated populations are more vulnerable to extinction than large populations.~~investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells and organisms. They will analyze the flow of energy in cells, organisms, and the environment. Students will determine the effectiveness and consequences of asexual or sexual reproduction within a species. They will research how scientists experimentally determined the role of tRNA, mRNA, and rRNA as agents in peptide formation and present arguments regarding	~~parts of the ecosystem; explain why a given area of land can support more herbivores then carnivores; determine how changing environmental factors disrupt the interrelationships of organisms within ecosystems; predict future population increases or decreases based on current demographic information and GIS data.~~investigate the chemistry of cellular processes and biological molecules and relate variations in structures to efficiencies of functions in various cells and organisms. They will quantitatively analyze and explain the flow of energy in cells, organisms, and the environment. Students will analyze cellular reproduction processes and use Mendel's Laws of Genetics to explain variations within species. They will create and use DNA and RNA models to explain protein synthesis and mutations, and research various genetic engineering technologies as potential solutions to real world problems. They will determine how changing environmental factors disrupt the interrelationships of organisms and affect the	~~communities; propose ecosystem models that incorporate interactions of environmental variables; diagram changes in energy as it flows through an ecosystem to illustrate conservation of energy; characterize interrelationships of organisms within an ecosystem; analyze graphs, GIS data and traditional maps reflecting changes in population to predict limiting factors in ecosystems.~~investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms, and viruses. They will analyze the flow of energy in cells, organisms, and the environment. Students will analyze cellular reproduction processes and determine probable offspring by applying Mendel's Laws of Genetics. They will use DNA and RNA models to explain protein synthesis, mutations, and gene therapy. They will determine how changing environmental factors disrupt the interrelationships of	chemistry of cellular processes and biological molecules and relate structure to function in various cells and organisms. They will diagram and describe the flow of energy in cells, organisms, and the environment. Students will describe cellular reproduction processes and use Punnett squares to predict outcomes for monohybrid crosses. They will use DNA and RNA models to explain replication, transcription and translation. They will describe how abiotic variables determine an ecosystem and identify interrelationships between organisms.	various cells and organisms. They will diagram the flow of energy in cells, organisms, and the environment. Students will identify the products of cellular reproduction processes and use Punnett squares to predict outcomes for monohybrid crosses. They will identify DNA and RNA models and define replication, transcription, and translation. They will list biotic and abiotic variables within an ecosystem and identify interrelationships between organisms.

the potential use and abuse of specific genetic engineering technologies. They will research various biomes, analyze the interrelationships of organisms and explain factors the affect coevolution.	carrying capacity of an ecosystem.	organisms within an ecosystem and alter energy flow.		

Objectives	Students will
SC.O.B.2.1	investigate and correlate the properties of chemical and biological molecules to their function in biochemical pathways.
SC.O.B.2.2	relate the structure of cellular organelles to their functions and interactions in eukaryotic cells.
SC.O.B.2.3	compare and contrast cell types: • prokaryotic/eukaryotic • plant/animal • archaea/bacteria • various body cells.
SC.O.B.2.4	relate the structure and function of individual body systems to the overall functioning of the organism.
SC.O.B.2.5	predict and assess responses of organisms to internal and environmental stimuli.
SC.O.B.2.36	analyze the chemistry and fluid mosaic model of the cell membrane as ~~it~~ they relates to import and export of molecules necessary for life including: • osmosis~~,~~ • diffusion~~,~~ • active transport ~~and~~ • passive transport ~~and~~ • dialysis.
~~SC.O.B.2.4~~	~~compare and contrast cell types (e.g., prokaryotic/eukaryotic, plant/animal, nerve/muscle, archaea/bacteria).~~
SC.O.B.2.57	quantitatively analyze the flow of energy through cellular processes; ~~such as~~ • photosynthesis~~,~~ • cellular respiration ~~and~~ • fermentation.
SC.O.B.2.68	differentiate~~outline~~ mechanisms of homeostasis in living systems (negative and positive feedback).
SC.O.B.2.79	examine the processes of binary fission, mitosis, ~~analyze~~ meiosis and ~~the cell cycle and~~ relate them ~~processes to~~: • the number of chromosomes ~~and~~ • production of daughter cells, somatic cells, and gametes ~~and somatic cells.~~ • variations or lack of variations within a species.
SC.O.B.2.810	use Punnett squares to predict genotypic and phenotypic ratios by applying Mendel's Laws of Genetics; ~~(e.g.,~~ • in monohybrid and dihybrid crosses • complete dominance ~~and~~

	• incomplete dominance~~,~~ • codominance~~,~~ • sex-linked traits~~, crossing over)~~. • multiple alleles.
SC.O.B.2.11	analyze karyotypes and pedigrees as diagnostic tools.
SC.O.B.2.~~9~~12	construct and use models of DNA to explain replication and mutations.~~explore the discovery of DNA and examine the molecular structure of the double helix.~~
SC.O.B.2.~~10~~13	differentiate ~~distinguish~~ the structure and function of messenger, transfer and ribosomal RNA in the process of transcription and translation.
SC.O.B.2.~~11~~14	research and debate the application of DNA technology in the context of social, ethical, and political issues.
SC.O.B.2.~~12~~15	evaluate the evidence for natural selection including: • speciation~~,~~ • fossil record evidence~~,~~ • molecular similarities ~~and~~ • homologous structures.
SC.O.B.2.~~13~~16	evaluate the influence of the historical social context on the development of evolutionary theory.
SC.O.B.2.~~14~~17	compare morphological, cladistic and other classification systems including domains, kingdoms and other taxa.
SC.O.B.2.~~15~~18	justify~~interpret~~ the placement of viruses in ~~the current~~ classification systems.
~~SC.O.B.2.16~~	~~incorporate the structure and function of individual body systems to the overall functioning of the organism.~~
SC.O.B.2.19	examine the cycle of viruses and compare disease prevention: • vaccinations • vector control • drug therapy.
~~SC.O.B.2.17~~	~~assess responses of organisms to internal and environmental stimuli.~~
SC.O.B.2.~~18~~20	evaluate environmental factors that affect succession, populations and communities.
SC.O.B.2.~~19~~21	propose ecosystem models that incorporate interactions of biotic and abiotic environmental variables in~~(e.g., biogeochemical cycles)~~.
SC.O.B.2.~~20~~22	interpret~~diagram~~ changes in energy as it flows through an ecosystem to illustrate conservation of energy ~~(e.g.,~~in the energy pyramid, food web, and food chain~~)~~.

SC.O.B.2.~~21~~23	analyze~~characterize~~ interrelationships of organisms within an ecosystem ~~(e.g., symbiosis, competition, predation, mutualism, parasitism, commensalism).~~
	• competition
	• predation
	• symbiosis
	  ○ commensalism
	  ○ mutualism
	  ○ parasitism.

SC.O.B.2.~~22~~24	analyze graphs, GIS data and traditional maps reflecting changes in population to predict limiting factors in ecosystems as they determine carrying capacity.

Grade Ten	Biology
Standard 3	Application of Science
SC.S.B.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 the ability to evaluate personal and societal benefits, the impact of different points of view, predict the long-term societal impact and an understanding of public policy decisions as related to health, population, resource and environmental issues.

Performance Descriptors SC.PD.B.3

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology 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.	Biology 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.	Biology 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.	Biology students at the partial 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.	Biology 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	Students will
SC.O.B.3.1	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, and change over time.
SC.O.B.3.2	investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.B.3.3	communicate experimental designs, results and conclusions using advanced technology tools.
SC.O.B.3.4	collaborate to present research on current environmental and technological issues to predict possible solutions.
SC.O.B.3.5	explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.
SC.O.B.3.6	given current science-technology-societal issues, construct and defend potential solutions.

Conceptual Biology Content Standards and Objectives

Conceptual Biology is an introductory course designed for students who are interested in the field of technical biology which will give them with the scientific knowledge, and opportunities to develop the inquiry, problem solving skills, and decision making abilities necessary for their future vocation. Conceptual Biology is an alternative to Biology and is designed to prepare students for entry-level careers, using skills for the 21st Century. Students will explore occupational opportunities in health, engineering, and technology and evaluate the required academic preparations while expanding their knowledge and laboratory experiences. The course will provide an in-depth study in the chemical nature of life, cellular functions, microbiology, ecology, biotechnology, zoology and botany with an emphasis on application ~~emphasis. It builds on the fundamental concepts developed in the science program in a rigorous and integrated manner.~~ Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. 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 Ten	Conceptual Biology			
Standard 1	Nature and Application of Science			
SC.S.CB.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. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.			
Performance Descriptors SC.PD.CB.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Biology 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~~	Conceptual Biology students at the above mastery level will ~~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~~	Conceptual Biology 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~~	Conceptual Biology students at the partial 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~~	Conceptual Biology 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.~~ implement safe practices as they conduct experiments and base

~~appropriate technology; draw conclusions from multiple data sources and interpretation of models~~implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct solutions and defend their ideas to an authentic audience.	~~multiple data sources and models.~~implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	~~sources and models.~~implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	~~possible conclusions drawn from experimental data.~~implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct their solutions.	conclusions on observations and experimental evidence. They will relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.CB.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.CB.1.~~1~~2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.CB.1.~~2~~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).~~demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").~~
SC.O.CB.1.~~3~~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).~~relate societal, cultural and economic issues to key scientific innovations.~~
SC.O.CB.1.~~4~~5	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, or predict the influence of external variances such as potential sources of error, or interpret maps).~~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.CB.1.~~5~~6	investigate, compare and design scientific and technological solutions to address personal and societal problems.~~implement safe procedures and practices when manipulating equipment, materials, organisms, and models.~~
SC.O.CB.1.~~6~~7	given current science-technology-societal issues, construct and defend potential solutions.~~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.CB.1.~~7~~8	relate societal, cultural and economic issues to key scientific innovations.~~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 CB.1.~~8~~9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).~~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 Ten	Conceptual Biology				
Standard 2	Content of Science				
SC.S.CB.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology and the earth and space sciences. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.				
Performance Descriptors SC.PD.CB.2					
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice	
Conceptual Biology students at the distinguished level will ~~construct physical models to explain the major processes associated with biochemical pathways such as photosynthesis and cellular respiration; research and present endosymbiosis as possible evolution of more complex organization of eukaryotic cell from simpler prokaryotic cells; experimentally quantify the raters of diffusion and osmosis, then explain the processes and results; research the possible evolutionary connections of~~	Conceptual Biology students at the above mastery level will ~~explain the movement of electrons and the rearrangement of carbon-based molecules as they move through biochemical pathways such as photosynthesis and cellular respiration; relate the structural similarities of organelles to their function and interactions in eukaryotic cells; construct and label diagrams to illustrate the cellular process that allow various kinds of molecules to move through biological membranes;~~	Conceptual Biology students at the mastery level will ~~relate molecules to their functions in biochemical pathways; relate the structure of cellular organelles to their functions and interactions in eukaryotic cells; correlate the properties of molecules to their movement through biological membranes; compare and contrast cell types by structures and functions; analyze the flow of energy through cellular process such as photosynthesis and cellular respiration; apply the~~	Conceptual Biology students at the partial mastery level will ~~identify molecules associated with biochemical pathways such as photosynthesis and cellular respiration; match function of organelles with list of organelles; describe the properties of the parts of the phospholipid bilayer of the plasma membrane; identify cell types of their structures; diagram flow charts to demonstrate flow to energy through cellular processes; describe the pigments used in the photosynthesis process and~~	Conceptual Biology students at the novice level will ~~define biological molecules; draw a model of a cell and label organelles; describe the plasma membrane of a cell; define prokaryotes and eukaryotes; compare and contrast photosynthesis and cellular respiration; identify pigments that are active in photosynthesis define and list examples of biochemical pathways; relate meiosis to the production of egg and sperm and relate the cell~~	

~~cell types and the chemical pathways in cell differentiation; analyze energy flow of cellular processes and their effect on environments in a way that could influence the evolution of populations; describe what happens to an electron when it absorbs a photon of light energy during the photosynthesis process; evaluate the advantages and disadvantage of both sexual and asexual reproduction; apply genetics to modern agricultural practices to increase production or quality of products; interpret research leading to the current knowledge of molecular genetics; determine the probability of a genetic disorder for offspring using pedigrees and karyotypes; compare and contrast the use of various genetic engineering technologies as potential solutions to real world problems; compare and contrast gradualism and punctuate equilibrium models; evaluate and present recent research that supports molecular relationships between species; discuss the relationship between viruses and cancer; compare and contrast the structures and functions of one organism to structures with similar~~	~~analyze the parts of different types of cells as they contribute to the function of the cell; analyze the interrelationships of different systems and how they affect the energy flow to entropy; construct a graph to show the relative effectiveness of different wavelengths of light for chlorophylls and other pigments; explain crossing over and how it contributes to the production of unique cells; predict phenotypic ratios by applying Mendel's Laws of Genetics; evaluate the contributions of Franklin and Wilkins in the discovery of the double helix structure of DNA; prepare example karyotypes and pedigrees for example genetic disorders; present arguments regarding the potential use and abuse of specific genetic engineering technologies; compare the theory of natural selection to prior evolutionary models; draw cladograms to show evolutionary relationships between species; compare the effectiveness of vaccinations, vector control and drug therapy; compare the anatomy of related species to demonstrate the similarities of their structures and functions; describe~~	~~absorption spectrum of photosynthetic pigments to the action spectrum of photosynthesis; analyze meiosis and the cell cycle and relate the processes to the number of chromosomes and production of gametes and somatic cells; predict phenotypic ratios by applying Mendel's Law of Genetics; explore the discovery of DNA and examine the molecular structure of the double helix; analyze karyotypes and pedigrees as diagnostic tools; research and debate the social, political and ethical implications of genetic engineering using current DNA technology; evaluate the evidence for evolution through natural selection; compare other classification systems; examine the life cycles of viruses and compare disease prevention; incorporate the structure and function of individual body systems to the overall functioning of the organisms; assess responses of organisms to internal and environmental stimuli; evaluate forest and wildlife best management practices as they affect~~	~~their functions; compare the end products of meiosis and the cell cycle; predict phenotypic ratios by applying Mendel's Laws of Genetics and determine the phenotypes of the offspring of dihybrid across for complete dominance, and codominance using a Punnett square; describe the molecular structure of DNA; identify common genetic disorders using pedigrees and karyotypes; trace the social, political and ethical implications of past DNA technology; compare artificial selection and natural selection; compare relationships between kingdoms and domains; describe the basic structures and functions of a virus; describe the functions of structures of the major body systems in an organism; explain the importance of homeostasis; discuss uses of forest and wildlife best management practices by industry; contrast a food chain to a food web; identify simple interactions of organisms within ecosystems based on their niches; use maps and data to locate patterns in biological and environmental systems;~~	~~cycle to the production of body cells; determine the phenotypes of the offspring of monohybrid cross for complete dominance, incomplete dominance, and codominance using a Punnett square; model the double helix structure of DNA; use a karyotype to determine chromosomes count of an individual; list DNA technologies that may have social and ethical implications; define natural selection; list some evolutionary theories; define morphology and name domains and kingdoms; list diseases caused by viruses; indentify the structures of the major body systems in an organism; define homeostasis; identify the use of best management practice; define producers and consumers; collect samples to study an ecosystem; describe niches in your community and identify the interactions of organisms that live there; use a map to find a location; match organisms to their niches in an ecosystem; list some of the effects of human~~

~~functions of other organisms; access the role of negative and positive feedback in controlling the rates of life processes; recommend a forest management for a particular region and predict its short and long term effects; evaluate the characteristics of wild and cultivated plants that make them important to human society, economic and environments; design a model of an ecosystem and explain the complex interactions of organisms based on their niches including interspecific and intraspecific competition, and symbiosis; produce maps of an area based on GIS and other data that predict biological and environmental systems; debate the possible solutions to correct human interference in a biogeochemical process.~~analyze the chemistry of cellular processes and explain consequences of variations of biological molecules as they relate structure to function in various cells, organisms and viruses. They will compare and contrast mechanisms of energy flow in cells, organisms, and the environment. Students will determine the effectiveness and predict consequences of	~~important mechanisms that are used as an organism maintains homeostasis; evaluate forest management practices for short and long-term resource utilization; analyze the role that wild and cultivated plants have had on changes in human society, economics and environments; analyze a local ecosystem to determine complex interactions of organisms within ecosystems based on their niches including interspecific and intraspecific competition, and symbiosis; collect GIS, map, and other data to determine patterns in biological and environmental systems; explain possible causes and consequences of human activity on a biogeochemical process.~~analyze the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms and viruses. They will compare mechanisms of energy flow in cells, organisms and the environment. Students will determine the effectiveness and consequences of asexual and sexual reproduction within a species. They will trace the	~~succession, populations and communities; assess the implications of the introduction of exotic species on native wildlife and their habitat requirements; diagram changes in energy as it flows through an ecosystem to illustrate conservation of energy; characterize complex interactions of organisms within ecosystems based on their niches including interspecific and intraspecific competition, and symbiosis; analyze graphs, GIS data and traditional maps reflecting changes in population to predict limiting factors; predict the effects of human activities on biogeochemical cycles of matter and energy in the biosphere over time.~~investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms, and viruses. They will analyze the flow of energy in cells, organisms, and the environment. Students will determine the effectiveness of asexual and sexual reproduction within a	~~diagram one major biogeochemical process that moves nutrients through biotic and abiotic forms.~~describe the chemistry of cellular process and biological molecules, as they relate to function in various cells, organisms and virus. They can diagram the flow of energy in cells, organisms and the environment. They can compare sexual and asexual reproduction. Students can create a monohybrid cross with a Punnett square. They will recognize the structure of DNA and RNA. They will make connections between viral cycles and disease control. They will recognize variables affecting interactions of organisms, and identify factors causing changes in populations with their environment.	~~activities of the biosphere.~~describe the chemistry of cellular process and biological molecules. They will recognize different types of cells. They will relate viruses to the diseases they cause. They will identify that energy input is necessary for all living things. They will characterize sexual and asexual reproduction. They will complete a simple monohybrid Punnett square. They will recognize the general structure of DNA. They will recognize changes in organisms, populations, and environment.

asexual and sexual reproduction within a species. They will trace the history and the importance of the discovery of DNA and RNA structures as they relate to the development modern biological innovations in science. They will relate disease controls measures to the viral cycle. They will apply genetic principles to predict and calculate population variances and sustainability of ecosystems. They will manipulate multiple variables to determine environmental effects. and analyze the interdependence of organisms.	history and the importance of DNA and RNA structures as they relate to modern biological science. They will explain events of the viral cycle as they relate to disease transmission. They will apply genetic principles to predict long range outcomes of populations. They will manipulate multiple variables and analyze changes to determine the interdependence of organisms and their environment.	species. They will trace the history and the importance of DNA and RNA structures as they relate to everyday life. They will predict outcomes from populations applying Mendel's laws. They will relate viral cycle to disease control. Students will use modern evidence to predict and analyze changes in populations as they determine the interdependence of organisms.		

Objectives	Students will
SC.O.CB.2.1	relate molecules to their functions in biochemical pathways.
SC.O.CB.2.2	relate the structure of cellular organelles to their functions and interactions in eukaryotic cells.
SC.O.CB.2.3	compare and contrast cell types: • prokaryotic/eukaryotic • plant/animal • various body cells.
SC.O.CB.2.4	incorporate the structure and function of individual body systems to the overall functioning of the organism.
SC.O.CB.2.5	predict and assess responses of organisms to internal and environmental stimuli: • homeostasis metabolism • cyclic behaviors.
SC.O.CB.2.36	correlate the properties of molecules to their movement through biological membranes; ~~(e.g.,~~ • osmosis ~~and~~ • diffusion~~)~~.
~~SC.O.CB.2.4~~	~~compare and contrast cell types (e.g., prokaryotic/eukaryotic, plant/animal).~~
SC.O.CB.2.57	analyze the flow of energy through cellular processes; ~~such as~~ • photosynthesis~~,~~ • cellular respiration ~~and~~ • fermentation.

SC.O.CB.2.68	apply the absorption spectrum of photosynthetic pigments to the action of spectrum of photosynthesis.
SC.O.CB.2.79	~~analyze meiosis and the cell cycle and relate the processes to the number of chromosomes and production of gametes and somatic cells.~~examine the processes of binary fission, mitosis, and meiosis and relate them to: • the number of chromosomes • production of daughter cells • variations or lack of variations within a species.
SC.O.CB.2.810	~~predict phenotypic ratios by applying Mendel's Laws of Genetics (e.g., complete and incomplete dominance, codominance, sex-linked, and crossing over).~~use Punnett squares to determine genotypic and phenotypic ratios by applying Mendel's Laws of Genetics: • monohybrid and dihybrid crosses • complete dominance • incomplete dominance • codominance • sex-linked traits • multiple alleles.
SC.O.CB.2.911	explore the discovery of DNA and examine the molecular structure of the double helix.
SC.O.CB.2.1012	analyze karyotypes and pedigrees as diagnostic tools.
SC.O.CB.2.1113	compare and contrast ~~research and debate~~ the social, political, and ethical implications of genetic engineering using current DNA technology.
SC.O.CB.2.1214	evaluate the evidence of evolution through natural selection ~~(e.g.,~~ • speciation~~,~~ • fossil record evidence~~,~~ • molecular similarities ~~and~~ • homologous structures.
SC.O.CB.2.1315	compare morphological and other classification systems including domains, kingdoms and other taxa.
SC.O.CB.2.1416	examine the ~~life~~ cycle of viruses and compare disease prevention; ~~(e.g.,~~ • vaccinations~~,~~ • vector control ~~and~~ • drug therapy~~).~~
~~SC.O.CB.2.15~~	~~incorporate the structure and function of individual body systems to the overall functioning of the organism.~~
~~SC.O.CB.2.16~~	~~assess responses of organism to internal and environmental stimuli (e.g., homeostasis metabolism, and cyclic behaviors).~~
SC.O.CB.2.17	evaluate forest and wildlife best management practices as they affect succession, populations and communities.
SC.O.CB.2.18	assess the implications of invasive ~~the introduction of exotic species~~ on native wildlife and their habitat requirements.
SC.O.CB.2.19	interpret~~diagram~~ changes in energy as it flows through an ecosystem to illustrate conservation of energy~~, (e.g.,~~ in the energy pyramid, food web, and food chain~~)~~.
SC.O.CB.2.20	characterize complex interactions of organisms with ecosystems based on their niches including interspecific and intraspecific competition and symbiosis.
SC.O.CB.2.21	analyze graphs, GIS data, and traditional maps reflecting changes in populations to predict limiting factors in ecosystems ~~as they~~and determine carrying capacity.

SC.O.CB.2.22	predict the effects of human activities on biogeochemical cycles of matter and energy in the biosphere over time: ~~(e.g.,~~ • water quality~~,~~ • air quality~~,~~ • recycling ~~and~~ • global warming~~).~~

~~Grade Ten~~	~~Conceptual Biology~~			
~~Standard 3~~	~~Application of Science~~			
~~SC.S.CB.3~~	~~Students will~~ • ~~demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives.~~ • ~~demonstrate an understanding of the interrelationships among physics, chemistry, biology and the earth and space sciences.~~ • ~~apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.~~			
~~Performance Descriptors SC.PD.CB.3~~				
~~Distinguished~~	~~Above Mastery~~	~~Mastery~~	~~Partial Mastery~~	~~Novice~~
~~Conceptual Biology 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.~~	~~Conceptual Biology 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.~~	~~Conceptual Biology 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.~~	~~Conceptual Biology students at the partial 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.~~	~~Conceptual Biology 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~~	~~Students will~~
~~SC.O.CB.3.1~~	~~synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).~~
~~SC.O.CB.3.2~~	~~investigate, compare and design scientific and technological solutions to address personal and societal problems.~~
~~SC.O.CB.3.3~~	~~communicate experimental designs, results and conclusions using advanced technology tools.~~
~~SC.O.CB.3.4~~	~~collaborate to present research on current environmental and technological issues to predict possible solutions.~~
~~SC.O.CB.3.5~~	~~explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.~~

~~SC.O.CB.3.6~~	~~given a current science-technology-societal issue, construct and defend potential solutions.~~

Biology II Content Standards and Objectives

Biology II is an advanced course that is an elective designed for students who have completed Biology or Conceptual Biology and desire an in-depth and rigorous study of the content found in many biological fields of endeavor. This course is designed to build upon and extend the Biology and Conceptual Biology concepts, skills and knowledge from a science program, using skills for the 21st Century. Students interested in health and scientific related careers will build and expand their laboratory skills and experiences. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. The West Virginia Standards 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 11/12	Biology II			
Standard: 1	Nature of Science			
SC.S.BII.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.BII.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology II 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.	Biology II students at the above mastery level will 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 source and models.	Biology II 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.	Biology II students at the partial 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.	Biology II 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	Students will			

SC.O.BII.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.BII.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.BII.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.BII.1.4	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.BII.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.BII.1.6	use appropriate technology solutions with 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.BII.1.7	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.BII.1.8	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, or predict the influence of external variances such as potential sources of error, or interpret maps.

Grade 11/12	**Biology II**			
Standard 2	**Content of Science**			
SC.S.BII.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives; demonstrate an understanding of the interrelationships among physics, chemistry, biology and the earth and space sciences. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.			
Performance Descriptors SC.PD.BII.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology II students at the distinguished level will analyze how size, shape and functional group determines the unique properties of organic molecules; analyze energy flow of cellular processes and their effects on environments in a way that could influence evolution of populations; evaluate	Biology II students at the above mastery level will correlate size, shape and functional group to unique properties of organic molecules to biochemical pathways; analyze the interrelationships of different systems and how they affect the energy flow to entropy; analyze the electrochemical gradients in	Biology II students at the mastery level will correlate functional groups to unique molecules to biochemical pathways; describe the transfer of energy during condensation and hydrolysis reactions of organic molecules; summarize the electrochemical gradients in various cells and their corresponding	Biology II students at the below mastery level will identify the properties of the functional groups of organic molecules found in biochemical pathways; trace the flow of energy in condensation and hydrolysis reactions of organic molecules; describe a sodium-potassium pump and how it is affect by	Biology II students at the novice level will list the functional groups of organic molecules in biochemical pathways; identify condensation and hydrolysis reactions of organic molecules; describe active transport and electrochemical gradients in cells; list and describe the unique properties of water;

changes in environments that effect the electrochemical gradient in various cells; evaluate other compounds with water-like properties and predict whether or not those compounds can be substituted for water in biological systems; evaluate the process of removing hydrogen from glucose to be used as a fuel resource; predict how future technologies will change the current knowledge of molecular genetics; evaluate the ethical implications of genetic engineering using restriction enzymes, vectors, plasmids and probes in recombinant DNA; analyze the accuracy (including human error) of DNA investigations such as RFLP and PCR; summarize the importance of gene expression in the development of an organism; discuss the roles of operon, inducer and repressor in gene expression; predict how chromosomal and gene mutations could affect the evolution of a species; determine the probability of a chromosomal abnormality or genetic disorder for offspring using karyotypes;	various cells and their corresponding environments; evaluate the relationship of hydrogen bonding and the different properties of water; analyze the production of energy in photosynthesis reactions, glycolysis and fermentation; evaluate the contributions of Franklin & Wilkins in helping Watson & Crick discover the double helix structure of DNA; analyze the beneficial values of genetic engineering using restriction enzymes, vectors, plasmids and probes in recombinant DNA; evaluate the social and scientific values of DNA investigation such as RFLP and PCR; analyze the process of DNA replication; compare gene expression in prokaryotes and eukaryotes; compare and contrast the ways genes expression is controlled analyze possible cause of chromosomal and gene mutations and their potential effects; prepare a karyotype of chromosomal abnormality or genetic disorder; predict phenotypic ratios of crosses involving pleiotrophy, epistasis, multiple alleles and polygenic inheritance;	environments; analyze the properties of water and its importance in biological systems; examine the flow of energy through specific molecules in light dependent and light independent photosynthesis reactions, glycolysis, Kreb's cycle, EPS, and fermentation; interpret important research leading to the current knowledge of molecular genetics; explain the use of restriction enzymes, vectors, plasmids and probes in recombinant DNA; conduct and interpret DNA investigations such as RFLP and PCR; analyze the process of DNA replication; apply the processes of transcription and base-pairing; apply the processes of transcription and translation to gene expression; demonstrate the role of DNA in determining phenotype and illustrate ways of controlling and regulating expression and function of genes; distinguish between chromosomal and gene mutations and their potential effects; analyze a karyotype to determine chromosomal abnormalities; predict phenotypic ratios of crosses involving pleiotrophy,	electrochemical gradients in a cell; identify the properties of water that lend to its importance to biological systems; trace the flow of energy in the light dependent and light independent photosynthesis reactions; develop a timeline of research, discoveries and scientists important to the current knowledge of molecular genetics; identify the ways in which recombinant DNA can be produced; examine the processes of DNA investigations such as DNA fingerprinting, RFLP and PCR; describe the process of DNA replication; summarize transcription and compare the roles of mRNA, rRNA and tRNA in translation; demonstrate roles of DNA and protein in determining phenotype; compare and contrast chromosomal and gene mutations; identify common genetic disorders using karyotypes; determine the possible phenotypes of the offspring for traits with multiple alleles or polygenic inheritance; describe the lytic and lysogenic cycles and the treatments of viral diseases; describe the	define light dependent and light independent photosynthesis reactions, glycolysis, Kreb's cycle, EPS and fermentation; identify scientists whose research and discoveries are important to the current knowledge of molecular genetics; define genetic engineering and recombinant DNA; state the uses of DNA investigations such as DNA fingerprinting, RFLP and PCR; define DNA replication; compare the structures of RNA and DNA and how they are replicated; summarize the relationships between DNA, RNA and proteins; define chromosomal and gene mutations; use a karyotype to determine the chromosome count of an individual; identify traits affected by multiple alleles and polygenic inheritance; trace the life cycle of viruses and list of the treatments of viral diseases; list the criteria for classifications of protists; compare and contrast the phyla of fungi; describe asexual reproduction in plants; list the structures that are used to classify animals; outline the embryonic development of animals from fertilization

calculate the probability of phenotypic ratios of crosses involving pleiotrophy, epistasis, multiple alleles and polygenic inheritance; examine the evidence that some viruses cause cancer; examine the importance of protists in scientific research in particularly microbiology; evaluate benefits and detriments of fungi to humans; evaluate the evidence of the evolutionary success of angiosperms; explain how primitive animals may have evolved from unicellular organisms; explain how the embryonic development of animals provide evidence of a shared ancestry; examine the roles of innate and learned animal behaviors in the evolution of a species.	compare and contrast historical and current treatments for varying viral infections; analyze the criteria for classifications of protists; compare the life cycle of zygomycetes, basidomycetes, and ascomycetes; examine the differences between gymnosperms and angiosperms; analyze the similarities and differences of invertebrates and vertebrates; examine the common stages of embryonic development of animals; examine the historical study of innate and learned animal behaviors.	epistasis, multiple alleles and polygenic inheritance; evaluate treatment of viral diseases based on lytic and lysogenic cycles; analyze the criteria for classifications of protists; survey the fungi kingdom; compare and contrast members of the plant kingdom in terms of their reproductive systems; compare and contrast members of the animal kingdom in terms of their complexity (e.g., tissues, nervous and digestive systems); survey embryonic development of animals including gastrulation, development of different body cavities, and tissues develop from germ layers; examine types of innate and learned animal behaviors.	criteria for classifications of protists; describe the role of fungi mycorrhizae and lichens in the ecosystem; describe the alternation of generations in the sexual reproduction of plants; describe the differences in body structure and support, symmetry and segmentation in invertebrates and vertebrates; outline the embryonic development of animals from fertilization to embryo; compare and contrast innate and learned animal behaviors.	to embryo; identify type of innate behaviors and types of learned animal behaviors.

Objectives	Students will
SC.O.BII.2.1	correlate functional groups to unique properties of organic molecules to biochemical pathways.
SC.O.BII.2.2	describe the transfer of energy during condensation and hydrolysis reactions of organic molecules (e.g., ATP, enzyme substrate and active site).
SC.O.BII.2.3	summarize the electrochemical gradients in various cells and their corresponding environments.
SC.O.BII.2.4	analyze the properties of water and its importance in biological systems (e.g., polarity, solubility, specific heat, pH, and buffers).
SC.O.BII.2.5	examine the flow of energy through specific molecules in light dependent and light independent photosynthesis reactions, glycolysis, Kreb's cycle, EPS, and fermentation.
SC.O.BII.2.6	interpret important research leading to the current knowledge of molecular genetics (e.g., Griffith, Avery, Hershey & Chase, Chargaff, Franklin & Wilkins and Waston & Crick).
SC.O.BII.2.7	explain the use of restriction enzymes, vectors, plasmids and probes in recombinant DNA.
SC.O.BII.2.8	conduct and interpret DNA investigations such as RFLP and PCR.
SC.O.BII.2.9	analyze the process of DNA replication including DNA polymerase, semi-conservative replication and base-pairing.
SC.O.BII.2.10	apply the processes of transcription and translation to gene expression.

SC.O.BII.2.11	demonstrate the role of DNA in determining phenotype and illustrate ways of controlling and regulating expression and function of genes.
SC.O.BII.2.12	distinguish between chromosomal and gene mutations and their potential effects.
SC.O.BII.2.13	analyze a karyotype to determine chromosomal abnormalities.
SC.O.BII.2.14	predict phenotypic ratios of crosses involving pleiotropy, epistasis, multiple alleles and polygenic inheritance.
SC.O.BII.2.15	evaluate treatment of viral diseases based on lytic and lysogenic cycles.
SC.O.BII.2.16	analyze the criteria for classifications of protists (e.g., motility, cellular structures, reproduction, energy sources).
SC.O.BII.2.17	survey the fungi kingdom (e.g., characteristics, reproduction, relationship to humans and the ecosystem).
SC.O.BII.2.18	compare and contrast members of the plant kingdom in terms of their reproductive systems.
SC.O.BII.2.19	compare and contrast members of the animal kingdom in terms of their complexity (e.g., tissues, nervous and digestive systems).
SC.O.BII.2.20	survey embryonic development of animals including gastrulation, development of different body cavities, and tissues develop from germ layers.
SC.O.BII.2.21	examine types of innate and learned animal behaviors (e.g., competitive, reproductive, social, cyclic, and communication).

Grade 11/12	**Biology II**			
Standard 3	**Application of Science**			
SC.S.BII.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 the ability to evaluate personal and societal benefits, the impact of different points of view, predict the long-term societal impact and an understanding of public policy decisions as related to health, population, resource and environmental issues.			
Performance Descriptors SC.PD.BII.3				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology II 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	Biology II students as 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	Biology II students at the mastery level will test, record an 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;	Biology II students at the partial 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 are unintended consequences of a scientific discovery;	Biology II 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 or a scientific discovery; identify the

decisions regarding health, population resources and environmental issues.	benefits of a scientific discovery; assess the impacts of a public policy decision regarding health, population resources or environmental issues.	explain the impacts of a public policy decision regarding health, population resources or environmental issues.	identify the impacts of public policy decision regarding health, population resources or environmental issues.	impact of a public policy decision regarding health, population resources or environmental issues.

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

Chemistry Content Standards and Objectives

Chemistry is an advanced level course designed for students who desire a broader, in-depth study of the content found in the science field of chemistry. Chemistry is the study of matter, its composition and its changes. This course is designed to build upon and extend the Chemistry concepts, skills and knowledge from the science program using skills for the 21st century. This course is designed to prepare a student for college chemistry, requiring a strong mathematical base. The relationship between chemistry concepts and mathematics will be emphasized. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. 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 Eleven	Chemistry			
Standard: 1	Nature of Science			
SC.S.C.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.C.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Chemistry 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.	Chemistry students at the above mastery level will 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.	Chemistry 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.	Chemistry students at the partial 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.	Chemistry students at novice level will identify the importance of scientific innovation and associate these innovations with advances in societal, cultural or economic issues; conduct experiment utilizing safe procedures and appropriate technology; differentiate between observations and conclusions.
Objectives	Students will			

SC.O.C.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.C.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.C.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.C.1.4	conduct and 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.C.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.C.1.6	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.C.1.7	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, or propose revisions to investigations based on manipulation of variables and/or analysis of error; communicate and defend the results and conclusions).
SC.O.C.1.8	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 Eleven	**Chemistry**			
Standard 2	**Content of Science**			
SC.S.C.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.			
Performance Descriptors SC.PD.C.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Chemistry students at the distinguished level will quantitatively determine the identity of a substance using physical properties such as density, melting points, specific heat, etc; develop a historical timeline and describe the evolution of the atomic theory based on the contributions of	Chemistry students at the above mastery level will qualitatively identify a substance by its physical and chemical properties; research the experimental procedures that lead to evidence of atomic theory; apply the Pauli Exclusion Principle to delimit the number of electrons	Chemistry students at the mastery level will classify pure substances by their chemical and physical properties; research and evaluate the contributions of Dalton, Bohr, Heinsenberg and Schrödinger to the evolution of the atomic theory; determine the proper set of quantum	Chemistry students at the partial mastery level will list the physical properties of a given pure substance; research the contributions of Dalton, Bohr, Heisenberg, and Schrödinger to the evolution of the atomic theory; determine shape (s, p, d, f) from the element's place on	Chemistry students at the novice level will define pure substances and chemical and physical properties; describe the limitations of Dalton's model in light of modern evidence; use data obtained from the periodic table to determine proton, neutron, and electron count; produce electron

Dalton, Crookes, Thomson, Rutherford, Planck, Bohr, Einstein, deBroglie, Heisenberg, and Schrödinger; discuss the probabilistic shapes and energy content of s, p, d, and f orbitals and their relevance to shapes of molecular compounds; produce specified excited-state electron configurations for the element carbon and predict the bonding possibilities from the configuration; illustrate Lewis' dot structure for polyatomic ions and organic functional groups; generate the correct molecular formula and communicate the correct name for the aliphatic hydrocarbons; interpret periodic trends to create graphs and make inferences and predictions; predict the type of bonding that occurs between two nonmetallic elements and describe the polarity of the bonds; construct models of organic molecules and apply electronegativity values and molecular shape to classify the molecules as polar or nonpolar; given the reactants, anticipate the products and create balanced equations for the five general types of	occurring in any one orbital; produce electron configurations for ions and identify the element with which it is isoelectronic; illustrate Lewis' dot structures for ionic compounds and covalent molecules; generate the correct molecular formula for binary and oxy-acids and communicate the correct names; interpret periodic trends to create graphs and make inferences and predictions; predict the type of bonding that occurs between metallic and nonmetallic elements and write ionic formulas; construct models of organic molecules and apply electronegativity values to classify the bonds as polar and nonpolar; given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactions; determine experimentally the effects of temperature and concentration on solution properties; calculate the quantities of energy required for exothermic and endothermic reactions; generate multi step mole conversions that require	numbers (n, l, ml, and ms) for any electron in any given element and apply those numbers to what they represent in quantum theory; produce electronic configurations and orbital diagrams for any element on the periodic table and predict the chemical properties of the element from the electron configuration; illustrate Lewis' dot structures for representative (main group) elements; generate the correct formula and/or name ionic or molecular compound analyze periodic trends in atomic size, ionic size, electronegativity ionization energy and electron affinity; predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic substances; construct models to explain the structure models to explain the structure and geometry of organic and inorganic molecules; given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactions; determine experimentally the effects of temperature	the periodic table; produce electron configurations for elements with atomic number 1-54 and predict the chemical properties of the element from the electron configuration; match a Bohr model to the Lewis' dot structure for representative elements; generate the correct ionic or molecular formula and communicate the correct name for binary compounds to include roman numerals or prefixes as needed; compare two elements and describe differences in atomic size, ionic size, and ionization energy; define ionic, covalent and metallic bonds; differentiate among linear, trigonal planar, and tetrahedral shapes; write balanced equations when reactants and products are given and classify the reaction type; describe properties of solutions; classify reactions as exothermic and endothermic reactions; write conversion factors; perform calculations using Boyle's, Charles' or Gay-Lussac's Laws; calculate molarity and percentage composition; define Arrhenius and Bronsted-Lowry acids; select an appropriate	configurations for elements with atomic number 1-18 and predict the chemical properties of the element from the electron configuration; identify the number of valence electrons in atoms of representative metals and nonmetals; classify compounds as ionic w/main group elements, ionic w/transition metals, covalent molecules, or acids; distinguish between metals and nonmetals and describe the differences in their ionization energy; classify elements as metallic or nonmetallic; construct ball and stick models for simple molecules differentiate between organic and inorganic compounds; write balanced equations when reactants and products are given; define solute, solvent and solution; define exothermic and endothermic reactions; define the mole; identify pressure, temperature, and volume units; define molarity; classify solutions as acidic or basic; define pH; observe and record the pH of a solution; define polarity.

chemical reaction; determine experimentally the effects of temperature and concentration on solution properties; experimentally determine the quantities of energy required for exothermic and endothermic reactions; generate complex mole conversions that require three or more conversion factors; predict the behavior of an ideal gas and identify the reasons that real gasses do not react in the same way; perform all calculations that use the mole as a conversion factor; justify that the net ionic equation for the combination of a strong acid and a strong base is always the same; evaluate the appropriate use of technology in determining pH values and measuring equivalence points; predict the pH and/or pOH of a solution following a partial neutralization; identify the intermolecular forces between molecules as London dispersion, dipole-dipole and hydrogen.	three or move conversion factors; predict the outcome of changing a variable in a gaseous system and calculate the value of the responding variable; perform all calculations that use the mole as a conversion factor; balance equations that contain acids and bases as reactants; predict the color change of an indication given its starting and pH during a titration; conduct a neutralization experiment to construct a titration curve; investigate the solubility of various materials in water.	and concentration on solution properties; classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction; generate mole conversions that demonstrate the ability to convert from one type of quantity to another; perform calculations using the combined gas laws; perform the following "mole" calculations: molarity, percentage composition, empirical and molecular formula, formulas of hydrates and theoretical yield; compare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases; compare methods of measuring pH; conduct a neutralization experiment to determine an unknown molarity; investigate and explain the water's role as a solvent based upon principles of polarity of substances..	indicator given the pH range of a solution; define neutralization in terms of mole equality; illustrate water as a polar molecule.	

Objectives	Students will
SC.O.C.2.1	classify pure substances by their chemical and physical properties.
SC.O.C.2.2	research and evaluate the contributions of Dalton, Bohr, Heisenberg, and Schrödinger to the evolution of the atomic theory.
SC.O.C.2.3	determine the proper set of quantum numbers (n, l, m_l, and m_s) for any electron in any given element.
SC.O.C.2.4	produce electron configurations and orbital diagrams for any element on the periodic table and predict the chemical properties of the element from the electron configuration.

SC.O.C.2.5	illustrate Lewis' dot structures for representative (main group) elements.
SC.O.C.2.6	generate the correct formula and/or name for ionic and molecular compounds.
SC.O.C.2.7	analyze periodic trends in atomic size, ionic size, electronegativity, ionization energy and electron affinity.
SC.O.C.2.8	predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic substances.
SC.O.C.2.9	construct models to explain the structure and geometry of organic and inorganic molecules.
SC.O.C.2.10	given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactions (e.g., synthesis or combination, decomposition, single replacement, or double replacement and combustion).
SC.O.C.2.11	determine experimentally the effects of temperature and concentration on solution properties (e.g., solubility, conductivity, density and colligative properties).
SC.O.C.2.12	classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction.
SC.O.C.2.13	generate mole conversions that demonstrate the ability to convert from one type of quantity to another (e.g., mass to number of particles, number of particles to volume, or volume to mass).
SC.O.C.2.14	perform calculations using the combined gas laws.
SC.O.C.2.15	perform the following "mole" calculations: molarity, percentage composition, empirical and molecular formula, formulas of hydrates and theoretical yield.
SC.O.C.2.16	compare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases.
SC.O.C.2.17	compare methods of measuring pH (e.g., indicators, indicator papers, or pH meters).
SC.O.C.2.18	predict the product of an acid-base reaction.
SC.O.C.2.19	investigate and explain water's role as a solvent based upon principles of polarity of substances.

Grade Eleven	**Chemistry**
Standard: 3	Application of Science
SC.S.C.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
Chemistry 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	Chemistry students at the above mastery will level construct, test and analyze data to explore systems, models, and changes across science disciplines; analyze technological innovations and identify the	Chemistry 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	Chemistry students at the partial 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	Chemistry 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

the technology; evaluate how a scientific discovery impacts public policy decisions regarding health, population resources and environmental issues.	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.	positive outcomes and unintended consequences of a scientific discovery; explain the impacts of a public policy decision regarding health, population resources or environmental issues.	positive outcomes and unintended consequences of a scientific discovery; identify the impacts of public policy decision regarding health, population resources or environmental issues.	outcomes or unintended consequences of a scientific discovery; identify the impact of a public policy decision regarding health, population resources or environmental issues.

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

Conceptual Chemistry Content Standards and Objectives

Conceptual Chemistry is an introductory level course designed for students in the skilled pathway who desire an alternative to a traditional college preparatory course emphasizing real life applications of chemical principles. Mathematical based problem solving is de-emphasized. Conceptual Chemistry is the study of matter, its composition and its changes. Emphasis is placed on the important role chemistry plays in a student's personal life, career opportunities, environment and society while developing 21st century skills. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research laboratory skills. Safety instruction is integrated into all activities. 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 Eleven	Conceptual Chemistry
Standard: 1	History and Nature of Science
SC.S.CC.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.CC.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Chemistry students at the distinguished level 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.	Conceptual Chemistry students at the above mastery 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.	Conceptual Chemistry students at the mastery level 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.	Conceptual Chemistry students at the partial mastery level 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.	Conceptual Chemistry students at the novice level 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	Students will
SC.O.CC.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.CC.1.2	demonstrate how a testable framework is employed to seek solutions for personal and societal issues. (e.g., "scientific method").
SC.O.CC.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.CC.1.4	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.CC.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.CC.1.6	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.CC.1.7	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.CC.1.8	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 Eleven	**Conceptual Chemistry**
Standard: 2	**Content of Science**
SC.S.CC.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.CC.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Chemistry student at the distinguished level will identify an unknown pure substance using its chemical and physical properties; design an activity to separate a mixture; design and conduct an investigation to compare the conductivity and malleability	Conceptual Chemistry student at the above mastery level will predict the chemical and physical properties of similar pure substances; examine experimentally the methods of separating mixtures; predict the physical and chemical properties of	Conceptual Chemistry student at the mastery level will classify pure substances by their chemical and physical properties; classify examples of matter as pure substance or mixture; compare and contrast the properties of metals,	Conceptual Chemistry student at the partial mastery level will provide examples of chemical and physical properties; classify examples of matter as pure substance or mixture; identify substances as metals, nonmetals and metalloids from their	Conceptual Chemistry student at the novice level will define chemical and physical properties; define pure substance and mixture; define metals, nonmetals and metalloids; define states of matter; identify pressure, temperature and volume

of metals, nonmetals and metalloids; predict relative velocities of molecules with different masses at the same temperature; predict the behavior of an ideal gas and identify the reasons that real gasses do not react in the same way; produce and use electron configurations to predict the chemical properties of elements; generate the correct molecular formula for binary and oxy-acids and communicate the correct names; predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic substances; given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactions; utilize effective nuclear charge and electron pairing to explain deviations from general trends in ionization energies; illustrate Lewis' dot structures for polyatomic ions and organic functional groups; generate complex mole conversions that require three or more conversion factors; perform all calculations that use the mole as a conversion factor;	common objects based on their composition; use the kinetic molecular theory to explain changes of state at the molecular level; predict the outcome of changing a variable in a gaseous system and calculate the value of the responding variable; match the changes in chemical properties to the changes in electron configuration for elements in a period; generate the correct ionic or molecular formula and communicate the correct name for the compound to include roman numerals or prefixes as needed; predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic substances; given the reactants, anticipate the products and create a balanced equations for the five general types of chemical reactions; utilize effective nuclear charge and electron energy states to explain trends in atomic size, ionic size, and ionization energies; illustrate Lewis' dot structures for ionic compounds and covalent molecules; generate multi step mole conversions that	nonmental and metalloids; use the kinetic molecular theory to explain states of matter; perform calculations using the combined gas laws; produce and use electron configurations to explain chemical properties; generate the correct formula and/or name for simple ionic and molecular compounds; predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic substances; given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactants; analyze the periodic table to predict trends in atomic size, ionic size, electronegativity, ionization energy and electron affinity; illustrate Lewis' dot structures for representative (main group) elements; generate mole conversions that demonstrate the ability to convert from one type of quantity to another; perform the following "mole" calculations: molarity, percentage composition, empirical and molecular formula, formulas of hydrates and theoretical	locations on the periodic table; illustrates the states of matter at the molecular level; perform calculation for Boyle's, Charles' and/or Gay Lussac's law; produce an electron configuration; generate the correct formula or name for simple ionic and molecular compounds; define ionic, covalent and metallic bonds; given the formulas, place the coefficient to balance the chemical equation; compare two elements and describe differences in atomic size, ionic size, and ionization energy; match a Bohr model to the Lewis' dot structure for representative elements; write conversion factors; calculate molarity and percentage composition; differentiate among linear, trigonal planar, and tetrahedral shapes; describe properties of solutions; select an appropriate indicator given the pH range of a solution; define neutralization in terms of mole equality; illustrate water as a polar molecule; define Arrhenius and Bronsted-Lowry acids; classify reactions as exothermic and endothermic reactions.	units; match an element to its group and period on the periodic table; recognize that placement on the periodic table determines the common ionic charge of representative elements; classify elements as metallic or nonmetallic; identify the type of chemical reaction; distinguish between metals and nonmetals and describe the differences in their ionization energy; identify the number of valence electrons in atoms of representative metals and nonmetals; define the mole; calculate molar mass; construct ball and stick models for simple molecules; define solute, solvent and solution; define pH; observe and record the pH of a solution; define polarity; classify solutions as acidic or basic; define exothermic and endothermic reactions.

construct models of organic molecules and apply electronegativity values and molecular shape to classify the molecules as polar or nonpolar; determine experimentally the effects of temperature and concentration on solution properties; evaluate the appropriate use of technology in determining pH values and measuring equivalence points; conduct a neutralization experiment to determine an unknown molarity or volume; identify the intermolecular forces between molecules as London dispersion, dipole-dipole and hydrogen; justify that the net ionic equation for the combination of a strong acid and a strong base is always the same; calculate the enthalpy of reactions using Hess's Law and identify as being exothermic or endothermic.	require three or more conversion factors; perform all calculations that use the mole as a conversion factor; construct models of organic molecules and apply electronegativity values to classify the bonds as polar or nonpolar; determine experimentally the effects of temperature and concentration on solution properties; predict the color change of an indicator given its starting and ending pH during a titration; conduct a neutralization experiment to determine an unknown molarity or volume; investigate the solubility of various materials in water; balance equations that contain acids and bases as reactants; interpret a phase change diagram to calculate the heat flow.	yield; construct models to explain the structure and geometry or organic and inorganic molecules; determine experimentally the effects of temperature and concentration on solution properties; compare methods of measuring pH; conduct a neutralization experiment to determine an unknown molarity; investigate and explain the water's role as a solvent based upon principles of polarity of substances; compare and contrast the Arrhenius and Bronsted-Lowery definitions of acids and bases; classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction.		

Objectives	Students will
SC.O.CC.2.1	classify pure substances by their chemical and physical properties.
SC.O.CC.2.2	classify examples of matter as pure substance or mixture.
SC.O.CC.2.3	compare and contrast the properties of metals, nonmetals and metalloids.
SC.O.CC.2.4	use the kinetic molecular theory to explain states of matter.
SC.O.CC.2.5	perform calculations using the combined gas laws.
SC.O.CC.2.6	produce and use electron configuration to explain chemical properties of elements.
SC.O.CC.2.7	generate the correct formula and/or name for ionic and molecular compounds.
SC.O.CC.2.8	predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic bond formed.
SC.O.CC.2.9	given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactions (e.g., synthesis or combination, decomposition, single replacement, or double replacement and combustion).

SC.O.CC.2.10	analyze the periodic table to predict trends in atomic size, ionic size, electronegativity, ionization energy and electron affinity
SC.O.CC.2.11	illustrate Lewis' dot structures for representative (main group) elements.
SC.O.CC.2.12	generate mole conversions that demonstrate the ability to convert from one type of quantity to another (e.g., mass to number of particles, number of particles to volume, or volume to mass).
SC.O.CC.2.13	perform the following "mole" calculations: • molarity • percentage composition • empirical and molecular formula • formulas of hydrates • theoretical yields.
SC.O.CC.2.14	construct models to explain the structure and geometry of organic and inorganic molecules and the lattice structures of crystals.
SC.O.CC.2.15	determine experimentally the effects of temperature and concentration on solution properties (e.g., solubility, conductivity, or density and colligative properties).
SC.O.CC.2.16	compare methods of measuring pH (e.g., indicators, indicator papers, or pH meters).
SC.O.CC.2.17	investigate and explain water's role as a solvent based upon principles of polarity of substances.
SC.O.CC.2.18	compare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases.
SC.O.CC.2.19	classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction.
SC.O.CC.2.20	given the reactants, anticipate the products and create balanced equations for nuclear reactions.

Grade Eleven	**Conceptual Chemistry**
Standard: 3	**Application of Science**
SC.S.CC.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.CC.3

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Chemistry students at the distinguished level construct, test and analyze complex systems, models, and changes across science disciplines; use a technology solution and analyze the science used in	Conceptual Chemistry students at the above mastery level construct, test and analyze data to explore systems, models, and changes across science disciplines; analyze technological innovations and identify the science that	Conceptual Chemistry students at the mastery level test, record and analyze data to explore systems, models, and changes; analyze a technological innovation and identify the science that makes it possible; assess	Conceptual Chemistry students at the partial mastery level test and record data to explore systems, models, and changes; explain a technological innovation and identify the science that makes it possible; identify	Conceptual Chemistry students at the novice level . 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

the technology; evaluate how a scientific discovery impacts public policy decisions regarding health, population resources and environmental issues.	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.	positive outcomes and unintended consequences of a scientific discovery; explain the impacts of a public policy decision regarding health, population resources or environmental issues.	positive outcomes and unintended consequences of a scientific discovery; identify the impacts of public policy decision regarding health, population resources or environmental issues.	consequences of a scientific discovery; identify the impact of a public policy decision regarding health, population resources or environmental issues.

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

Chemistry II Content Standards and Objectives

Chemistry II is an advanced level course that is an elective designed for students who have completed Chemistry and desire a broader, in-depth study of the content found in the science field of chemistry. Chemistry is the study of matter, its composition and its changes. This course is designed to prepare students to be critical and independent thinkers who are able to function effectively in a scientific and technological society, and to build upon and extend the chemistry concepts, skills and knowledge from the previous chemistry class. This course is designed not only to prepare a student for college chemistry but to make the college chemistry experience much easier as the student will have already studied much of the material reserved for college chemistry at the high school level. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. 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 Twelve	Chemistry II				
Standard 1	Natural Science				
SC.S.CII.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.CII.1					
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice	
Chemistry II 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	Chemistry II students at the above mastery level will 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.	Chemistry II 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.	Chemistry II students at the partial 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 the safe procedures and appropriate technology; select an appropriate conclusion from a list of possible conclusions drawn from experimental data.	Chemistry II 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 experiment utilizing safe procedures and appropriate technology; differentiate between observations and conclusions.	

interpretation of models.				
Objectives	Students will			
SC.O.CII.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.			
SC.O.CII.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").			
SC.O.CII.1.3	relate societal, cultural and economic issues to key scientific innovations.			
SC.O.CII.1.4	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate recording keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic.			
SC.O.CII.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.			
SC.O.CII.1.6	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.CII.1.7	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, or propose revisions to investigations based on manipulation of variables and/or analysis of error; communicate and defend the results and conclusions).			
SC.O.CII.1.8	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 Twelve	**Chemistry II**			
Standard: 2	Content of Science			
SC.O.CII.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental sciences and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.			
Performance Descriptors SC.PD.CII.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Chemistry II students at the distinguished level will compare and contrast types of binding forces; utilize VSEPR theory to make predictions about valence bonds; justify the ideal gas laws on the basis of the kinetic-molecular theory;	Chemistry II students at the above mastery level will classify types of binding forces; utilize VSEPR theory to explain valence bonding; assess the ideal gas laws on the basis of the kinetic-molecular theory; model Avogadro's hypothesis and	Chemistry II students at the mastery level will identify types of binding forces; investigate valence bonds; interpret the ideal gas laws on the basis of the kinetic-molecular theory; relate Avogadro's hypothesis to the mole concept; define	Chemistry II students at the partial mastery level will match types of binding forces; describe valence bond; explain the ideal gas laws on the basis of the kinetic-molecular theory; generalize Avogadro's hypothesis and its relation	Chemistry II students at the novice level will list types of binding forces; describe valence bonds; state the ideal gas laws and describe their basis on kinetic molecular theory; quote Avogadro's hypothesis; identify changes of state;

interpret Avogadro's hypothesis and relationship to the mole concept; evaluate changes of state; design an experiment to illustrate the effect of changing concentration on the colligative properties of solutions; use calculations to evaluate results; predict the voltage using the Nernst equations and use this to design an effective battery; evaluate systems based on the physical and chemical dynamic equilibrium concepts; calculate equilibrium constants and apply Le Chatelier's principle to predict the effect of changes on systems and to the design of systems that favor a particular direction; design and conduct experiments to collect and graphically analyze data to investigate reaction; design and conduct experiments to; demonstrate applications of Hess's Law both experimentally and mathematically; apply the second law of thermodynamics to evaluate the free energy of reaction and relate the dependence of free energy on enthalpy and entropy changes; evaluate spontaneity of	produce examples of its relation to the mole concept; anticipate changes of state; calculate concentration; predict and justify the effect of changing concentration on the colligative properties of solutions; predict the voltage using the Nernst equation and use this to compare chemical cells; illustrate physical and chemical dynamic equilibrium concepts; calculate equilibrium constants and apply Le Chatelier's principle to predict the effect of changes on systems; demonstrate reactant order, rate constants, and reaction rate laws, calculate the rate of reaction and predict the effect of temperature on rate changes; demonstrate applications of Hess's Law both experimentally and mathematically; apply the second law of; identify spontaneous reactions; perform all calculations with attention given to significant figures based on precision of measured values; demonstrate correct use of logarithmic and exponential relationships; evaluate experiments for calculating molar masses; identify weak electrolytes and explain	changes of state; calculate concentration and explain the effect of changing concentration on the colligative properties of solutions; identify oxidation numbers for ions and for any element in a compound to calculate the electron movement in a redox reaction and calculate the voltage using the Nernst equation; explain the physical and chemical dynamic equilibrium concepts; calculate equilibrium constants and apply le Chatelier's principle; determine reactant order, rate constants, and reaction rate laws, calculate the rate of reaction and describe the effect of temperature on rate changes; determine the heat of formation, heat of reaction, heat of vaporization and heat of fusion; match applications of Hess's Law; use the second law of thermodynamics; perform most calculations with attention given to significant figures, precision of measured values, and the use of logarithmic and exponential relationships; calculate molar masses identify weak electrolytes;	to the mole concept; define changes of state; calculate concentration and describe the effect of changing concentration on the colligative properties of solutions; use oxidation numbers for ions and for elements in a compound to calculate the electron movement in a redox reaction and calculate the voltage using the Nernst equation; describe the physical and chemical dynamic equilibrium concepts; calculate equilibrium constants and recognize applications of Le Chatelier's principle; estimate reactant order, rate constants, and reaction rate laws, calculate the rate of reaction and describe the effect of temperature on rate changes; match applications of Hess's Law; state the second law of thermodynamics; calculate the free energy of formation, free energy of reaction and describe the dependence of free energy on enthalpy and entropy changes; perform most calculations with attention given to significant figures, precision of measured values, and the use of logarithmic and exponential relationships;	match concentration with the effect of changing concentration of the colligative properties of solutions; use oxidation numbers for ions and for elements in a compound to calculate the electron movement in a redox reaction and match the voltage using the Nernst equation; define physical and chemical dynamic equilibrium concepts; calculate equilibrium constants and describe Le Chatelier's principle; match reactant order, rate constants, or reaction rate laws, calculate the rate of reaction and describe the effect of temperature on rate changes; recognize Hess's Law; recognize the dependence of free energy on enthalpy or entropy changes; perform calculations and match results to those expressed to correct significant figures, precision of measured values; use logarithmic and exponential relationships; match molar masses; name some weak electrolytes; define pH, pOH, pK, K_a, K_b, K_w, K_{sp}; calculate pH and pOH; measure pH with indicator papers or electronic meters; identify

reactions; perform all calculations with appropriate significant figures; justify significant figures based on precision of measured values; demonstrate correct use of logarithmic and exponential relationships; design and evaluate experiments for calculating molar masses; identify weak electrolytes and justify why they are weak; calculate and explain the relationships among pH, pOH, pK, K_a, K_b, K_w, ionization constant, percent ionization, K_{sp}; recognize salts that undergo hydrolysis, write a reaction for the ion with water and justify your choices, experimentally; interpret a titration curve to identify the equivalence point; appraise the effect of a buffer on an aqueous system; predict values for theoretical yield and to evaluate reactants to determine which is limiting and which is in excess in a given chemical reaction; design an experiment to justify results; determine percent yield and discuss sources of experimental error; evaluate organic structures and compounds based on functional groups.	what distinguishes them as weak; define pH, pOH, pK, K_a, K_b, K_w, ionization constants, percent, ionization, K_{sp}; calculate pH and pOH; recognize salts that undergo hydrolysis and write a reaction for the ion with water and interpret a titration curve to identify the equivalence; interpret the effect of a buffer on an aqueous system; predict values for theoretical yield and to evaluate reactants to determine which is limiting and which is in excess in a given chemical reaction; explain how choices could be determined experimentally; differentiate, classify and characterize simple organic functional groups and compounds.	define pH, pOH, pK, K_a, K_b, K_w, K_{sp}; calculate pH and pOH; measure pH with indicator papers and electronic meters; recognize salts that undergo hydrolysis and match the reaction for the ion with water and interpret a titration curve to identify the equivalence point; examine the importance of a buffer; perform stoichiometric calculations to produce values for theoretical yield and to decide the limiting reactant of a given chemical reaction; recognize and classify simple organic functional groups.	calculate molar masses identify weak electrolytes; define pH, pOH, pK, K_a, K_b, K_w, K_{sp}; calculate pH and pOH; measure pH with indicator papers and electronic meters; recognize salts that undergo hydrolysis and match the reaction for the ion with water and interpret a titration curve to identify the equivalence point; perform stoichiometric calculations to produce values for theoretical yield and to decide the limiting reactant of a given chemical reaction; identify simple organic functional groups and compounds.	the equivalence point on a titration curve; given the identity of the limiting reactant, calculate theoretical yield, or given amounts of reactants, decide the limiting reactant of a given chemical reaction; match simple organic functional groups and compounds.
Objectives	Students will			

SC.O.CII.2.1	identify types of binding forces such as: ionic, covalent, metallic, and van der Waals forces (including London) and relate binding forces to state, structure, and properties of matter.
SC.O.CII.2.2	investigate the valence bond including the concepts of hybridization of orbitals, resonance, and formation of sigma and pi bonds and demonstrate an understanding of the VSEPR theory.
SC.O.CII.2.3	interpret the ideal gas laws on the basis of the kinetic-molecular theory.
SC.O.CII.2.4	relate Avogadro's hypothesis and its relation to the mole concept.
SC.O.CII.2.5	define changes of state, including critical temperatures and triple points, based on the kinetic molecular theory.
SC.O.CII.2.6	calculate concentration and explain the effect of changing concentration on the colligative properties of solutions.
SC.O.CII.2.7	identify oxidation numbers for ions and for any element in a compound to calculate the electron movement in a redox reaction and calculate the voltage using the Nernst equation.
SC.O.CII.2.8	explain physical and chemical dynamic concepts; calculate equilibrium constants K_p, K_c, K_{sp}, K_a, and apply Le Chatelier's principle.
SC.O.CII.2.9	use experimental data and graphical analysis to determine reactant order, rate constants, and reaction rate laws, calculate the rate of reaction and explain the effect of temperature on rate changes.
SC.O.CII.2.10	determine the heat of formation, heat of reaction, heat of vaporization and heat of fusion; apply Hess's Law.
SC.O.CII.2.11	using the second law of thermodynamics, calculate the free energy of formation, free energy of reaction and the dependence of free energy on enthalpy and entropy changes.
SC.O.CII.2.12	perform all calculations with attention given to significant figures, precision of measured values, and the use of logarithmic and exponential relationships.
SC.O.CII.2.13	calculate molar masses from gas density, freezing-point, and boiling-point measurements.
SC.O.CII.2.14	identify weak electrolytes; define pH, pOH, pK, K_a, K_b, K_w, ionization constant, percent ionization, K_{sp}; calculate pH and pOH; measure pH with indicator papers and electronic meters; recognize salts that undergo hydrolysis and write a reaction for the ion with water and interpret a titration curve to identify the equivalence point don't forget buffers.
SC.O.CII.2.15	perform stoichiometric calculations to produce values for theoretical yield and to decide the limiting reactant of a given chemical reaction.
SC.O.CII.2.16	recognize simple organic functional groups and classify simple organic compounds by name.

Grade Twelve	**Chemistry II**				
Standard: 3	Application of Science				
SC.S.CII.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.CII.3					
Distinguished		Above Mastery	Mastery	Partial Mastery	Novice
Chemistry II students at the distinguished level will		Chemistry II students at the above mastery level will	Chemistry II students at the mastery level will test,	Chemistry II students at the partial mastery level will test	Chemistry II students at the novice level will test and

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.	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 decisions regarding health, population resources or environmental issues.	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.	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 impact of public policy decision regarding health, population resources or environmental issues.	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	Students will
SC.O.CII.3.1	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, system, or change over time).
SC.O.CII.3.2	investigate, compare and design scientific and technological solutions to address and societal problems.
SC.O.CII.3.3	communicate experimental designs, results and conclusions using advanced technology tools.
SC.O.CII.3.4	collaborate to research present current environmental and technological and evaluate the required academic preparation.
SC.O.CII.3.5	explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.
SC.O.CII.3.6	given a current science-technology-societal issue, construct and defend potential solutions.

Earth Science Content Standards and Objectives

Earth Science is an advanced level lab course that is an elective designed for students who desire a broader understanding of the fundamentals of earth science and includes geology, oceanography, meteorology and astronomy. This course is designed to build on knowledge, skills, and dispositions developed during the science progression, which included the traditional disciplines of biology, chemistry, and physics where appropriate. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. 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.

High School	Earth Science			
Standard: 1	Nature of Science			
SC.S.ES.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.ES.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Earth Science 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 in advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; drawn conclusions from multiple data sources and interpret models.	Earth Science students at the above mastery level will 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.	Earth Science 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.	Earth Science students at the partial 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 procedure and appropriate technology; select an appropriate conclusion from a list of possible conclusions drawn from experimental data.	Earth Science 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 experiment utilizing safe procedures and appropriate technology; differentiate between observations and conclusions.
Objectives	Students will			
SC.O.ES.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in			

	experimental results.
SC.O.ES.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.ES.1.3	relate societal, cultural, and economic issues to key scientific innovations.
SC.O.ES.1.4	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocols, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).
SC.O.ES.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.ES.1.6	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 to present and communicate conclusions.
SC.O.ES.1.7	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numerical data, evaluate the data in the context of scientific laws and principles, construct a conclusion bases 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.ES.1.8	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).

High School	**Earth Science**
Standard 2	**Content of Science**
SC.S.ES.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.ES.2

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Earth Science students at the distinguished level will evaluate data supporting theories relating to the structure, origin, and evolution of Earth's spheres' analyze seismic, density, gravity, and magnetic data to explain the structure of the earth; contrast the eras, epochs, and periods; analyze radiometric dating	Earth Science students at the above mastery level will contrast the theories relating to the structure, origin, and evolution of Earth's sphere; analyze seismic, density, gravity, and magnetic data to explain the structure of the earth; contrast the eras, epochs and periods; analyze radiometric data	Earth Science students at the mastery level will identify and describe the structure, origin, and evolution of Earth's spheres; analyze seismic, density, gravity, and magnetic data to explain the structure of the earth; characterize the eras, epochs and periods; analyze radiometric dating	Earth Science students at the partial mastery level will identify and describe the structure, origin, and evolution of Earth's spheres; use seismic, density, gravity, and magnetic data to explain the structure of the earth; characterize the eras, epoch and periods; describe radiometric dating	Earth Science students at novice level will identify the structure origin, and evolution of Earth's spheres; state seismic, density, gravity, and magnetic data are used to explain the structure of the earth; sequence the eras, epochs and periods; recognize that analyze radiometric dating and rock

and rock and fossil evidence to determine the age of substances; create new uses for common materials based on their properties; predict paleoenvironments or geologic conditions which existed during the formation of rock samples; predict weathering related to water properties; prove the effectiveness of agents and processes of degradation; design structures that withstand effects of geologic activities; use seismic information to predict earthquakes; evaluate current explanations of platetectonics; analyze the long term effect of forces that change Earth's surface; analyze and revise topographic maps; create models to represent properties and features of oceans; analyze the characteristics, evolution and effects of the oceans; apply heat transfer to meteorological phenomena and weather forecasting; design models that demonstrate global change; connect Newton's Laws to Kepler's Laws; analyze several origin theories of the solar system and universe and use them to explain celestial bodies and their	and rock and fossil evidence to determine the age of substances; explain how the properties common minerals determine their economic uses; predict paleoenvironments or geologic conditions which existed during the formation or rock samples; investigate and explain water properties which contribute to weathering; experimentally determine agents and processes of degradation; predict the effects of geologic activity at plate boundaries; analyze seismic information to investigate earthquakes; evaluate current explanations for of platetectonics; compare forces that change Earth's surface; use ground-truthing to analyze topographic maps; investigate properties and features of oceans; investigate properties and features of oceans; analyze the characteristics, evolution and effects of the oceans; investigate heat transfer and gather meteorological evidence to forecast weather; cite evidence of global change; apply Newton's Law of Universal Gravitation; analyze several origin	and rock and fossil evidence to determine the age of substances; use properties to distinguish between common minerals and explain their economic uses; predict paleonvironments or geologic conditions which existed during the formation of rock samples; investigate and describe water properties which contribute to weathering; compare and contrast the effectiveness of agents and processes of degradation; predict geologic activity associated with specific plate boundaries and interactions; analyze seismic information to investigate earthquakes; evaluate current explanations of platetectonics; relate forces to changes on Earth's surface; construct and/or interpret topographic maps; compare and contrast properties and features of oceans; analyze the characteristics, evolution and effects of the oceans; investigate heat transfer and use meteorological evidence to forecast weather; examine global change; apply Newton's Law of Universal	and rock and fossil evidence to determine the age of substances; relate the properties of common minerals to their economic uses; relate paleoenvironments or geologic conditions to specific rock formations; describe water properties which contribute to weathering; compare and contrast agents and processes of degradation; relate geologic activity to plate boundaries; use seismic information to determine epicenter of an earthquake; describe the effects of platetectonics; classify forces that effect Earth's surface; interpret topographic maps; describe properties and features of oceans; describe the evolution and effects of the oceans; use meteorological evidence to forecast weather; describe global changes; apply Newton's Law of Universal Gravitation; compare several origin theories of the solar system and universe; relate astronomy to the development of the calendar and navigation; list uses for wavelengths in the electromagnetic spectrum; relate earth processes to	and fossil evidence is used to determine the age of substances; explain the economic uses of common minerals; describe paleoenvironments or geologic conditions which existed during the formation of a given rock sample; describe water properties which contribute to weathering; identify agents and processes of degradation; relate geologic activity to plate boundaries; define magnitude and epicenter; illustrate platetectonics; list forces that effect Earth's surface; interpret topographic maps; illustrate properties and features of oceans; describe the evolution and effects of the oceans; use meteorological evidence to forecast weather; recognize that global changes occur; cite evidence for Newton's Law of Universal Gravitation; list several origin theories of the solar system and universe; record the angle and apparent movement of the sun in a calendar; construct a diagram of the wavelengths in the electromagnetic spectrums; relate earth processes to natural disasters; list

movements; investigate methods used to study astronomy and apply them to the development of the calendar and navigation; explain the electromagnetic spectrum and its occurrence in the universe; analyze the relationship between earth processes, natural disasters, and humans; create an action plan for responsible stewards of the earth; evaluate the pros and cons responsible stewards of the earth; evaluate the pros and cons of using alternative energy sources.	theories of the solar system and universe and use them to explain celestial bodies and their movements; investigate astronomy and the development of the calendar and navigation; explain the electromagnetic spectrum and its occurrence in the universe; analyze the relationship between earth processes, natural disasters, and humans; develop a logical argument for being a responsible steward of the earth; cite evidence for using alternative energy sources.	Gravitation; analyze several origin theories of the solar system and universe and use them to explain celestial bodies and their movements; compare methods of studying and uses for astronomy; use the electronic spectrum to investigate the universe; compare the relationship between earth processes and natural disasters; evaluate our need to act as responsible stewards of the earth; research and evaluate alternative energy sources.	natural disasters; describe appropriate behaviors for responsible stewards of the earth; research alternative energy sources.	appropriate behaviors for responsible stewards of the earth; describe alternative energy sources.

Objectives	Students will
SC.O.ES.2.1	identify and describe the structure, origin, and evolution of the lithosphere, hydrosphere, atmosphere and biosphere.
SC.O.ES.2.2	analyze seismic, density, gravity, and magnetic data to explain the structure of the earth.
SC.O.ES.2.3	characterize the eras, epochs and periods in relation to earth history and geologic development.
SC.O.ES.2.4	analyze radiometric dating and rock and fossil evidence to determine the age of substances.
SC.O.ES.2.5	use chemical and physical properties to distinguish between common minerals and explain their economic uses.
SC.O.ES.2.6	use rock characteristics to predict paleoenvironments or geologic conditions which existed during the formation of a given rock sample.
SC.O.ES.2.7	investigate and describe the properties of water, which contribute to its critical role in physical and chemical weathering.
SC.O.ES.2.8	compare and contrast the effectiveness of agents and processes of degradation, i.e., • weathering by gravity, • wind, • water, • ice.
SC.O.ES.2.9	predict geologic activity associated with specific plate boundaries and interactions.
SC.O.ES.2.10	analyze modern and historical seismic information to determine epicenter location and magnitude of earthquakes.
SC.O.ES.2.11	evaluate current explanations for mechanisms, which drive the motion of plates (convection, slab-pull, plate push).
SC.O.ES.2.12	relate the effect of degradation and tectonic forces on the earth's surface features, i.e., • weathering, • physical features of the ocean floor,

	• life with the oceans.
SC.O.ES.2.13	construct and/or interpret information on topographic maps.
SC.O.ES.2.14	identify and describe chemical and physical properties of oceans, i.e., • composition, • currents, • physical features of the ocean floor.
SC.O.ES.2.15	compare and contrast characteristics of the various oceans, including their lateral and vertical motions.
SC.O.ES.2.16	analyze the evolution of the ocean floor including ocean crust, sedimentation, active and passive continental margins.
SC.O.ES.2.17	examine the stratification of the oceans, i.e., • temperature, • salinity zones, • biological zones.
SC.O.ES.2.18	investigate to explain heat transfer in the atmosphere and its relationship to meteorological processes (e.g., pressure, winds, evaporation, condensation, or precipitation).
SC.O.ES.2.19	predict the effects of ocean currents on climate.
SC.O.ES.2.20	use meteorological evidence and weather maps (including air masses, wind, barometric pressure, and temperature data) to forecast weather.
SC.O.ES.2.21	examine global change over time, i.e., • climatic trends, • global warming, • ozone depletion.
SC.O.ES.2.22	apply Newton's Law of Universal Gravitation to the motion of celestial objects to explain phenomenon observed in the sun-earth-moon system.
SC.O.ES.2.23	analyze several origin theories of the solar system and universe and use them to explain the celestial bodies and their movements.
SC.O.ES.2.24	compare ancient and modern methods of studying and uses for astronomy (e.g., calendar, navigation).
SC.O.ES.2.25	use various wavelengths of the electromagnetic spectrum to investigate the observable universe.
SC.O.ES.2.26	compare the relationship between earth processes and natural disasters with their impact on humans.
SC.O.ES.2.27	evaluate the potential conflicts, which arise between societal reliance on natural resources and the need to act as responsible stewards to reclaim the earth, including disposal of hazardous and non-hazardous waste.
SC.O.ES.2.28	research alternative energy sources and evaluate the ecological, environmental and economic cost-benefit ratio.

High School	**Earth Science**
Standard 3	**Application of Science**
SC.S.ES.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.ES.3				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Earth Science student 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 specific discovery impacts public policy decisions regarding health, population resources and environmental issues.	Earth Science 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.	Earth Science students at the mastery level will test, record and analyze data to explore systems, models, and changes; analyze a technological innovations that 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 resource or environmental issues.	Earth Science students at the above 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.	Earth Science 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; indentify the impact of a public policy decision regarding health, population resources or environmental issues.

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

Human Anatomy and Physiology Content Standards and Objectives

Human Anatomy and Physiology is an advanced course that is an elective designed for those students wanting a deeper understanding of the structure and function of the human body. The body will be viewed as a whole using anatomical terminology necessary to describe location. Focus will be at both micro and macro levels reviewing cellular functions, biochemical processes, tissue interactions, organ systems and the interaction of those systems as it relates to the human organism. Systems covered include integumentary, skeletal, muscular, respiratory, circulatory, digestive, excretory, reproductive immunological, nervous and endocrine. This course will develop 21st century skills and be appropriate for college bound students as well as those choosing a health services career cluster. Students will engage in active inquiries, investigation, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. 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.

High School	Human Anatomy and Physiology			
Standard 1	Nature of Science			
SC.S.HAP.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.HAP.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Human Anatomy and Physiology students at the distinguished level will analyze the importance of scientific innovation and relate these innovation 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 procedure and appropriate technology; draw conclusions from	Human Anatomy and Physiology students at the above mastery level will 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.	Human Anatomy and Physiology students at the mastery level will examine the importance of scientific innovation 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 procedure and appropriate technology; draw conclusions from data sources and models.	Human Anatomy and Physiology students at the partial 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	Human Anatomy and Physiology students at the novice level will identify the importance of scientific innovation with advances in societal, cultural or economic issues; conduct experiment utilizing safe procedures and appropriate technology; differentiate between observations and conclusions.

multiple data sources and interpretation of models.			experimental data.	

Objectives	Students will
SC.O.HAP.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.HAP.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.HAP.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.HAP.1.4	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.HAP.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.HAP.1.6	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.HAP.1.7	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.HAP.1.8	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).

High School	Human Anatomy and Physiology
Standard 2	Content of Science
SC.S.HAP.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.HAP.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Human Anatomy and Physiology students at the distinguished level will apply directional terminology to locate human body structures; determine the organizational levels, interdependency and the	Human Anatomy and Physiology students at the above mastery level will apply directional terminology to locate human body structures; compare the organizational levels, interdependency	Human Anatomy and Physiology students at the mastery level will apply directional terminology to locate human body structures; describe the organizational levels, interdependency and the	Human Anatomy and Physiology students at the partial mastery level will apply directional terminology to locate human body structures; describe the organizational levels, interdependency	Human Anatomy and Physiology students at the novice level will define directional terminology that is used to locate human body structures; identify the organizational levels, interdependency and the

interaction of cells, tissues, organs, and organ systems; compare and contrast the various types of human tissue; investigate structures and functions of the integumentary system; investigate diseases related to the bone tissue; evaluate models of muscular system that replicate mechanisms of contraction; analyze the integration of the skeletal, muscular and nervous system; compare and contrast the various types of neurons; compare and contrast the parts of the nervous system and evaluate models that demonstrate nerve impulses; apply physics concepts to the structures and functions of the ears and eyes; experimentally determine factors that inhibit the effectiveness of various enzymes; experimentally evaluate the positive and negative feedback of the endocrine system during an observed behavior; analyze the processes of the digestive system in supplying essential nutrients; apply gas laws to the functions of the respiratory system; investigate the effects of aging on the circulatory and lymphatic systems; research technologies related to blood	and the interaction of cells, tissues, organs, and organ systems; compare and contrast the various types of human tissue; investigate structures and functions of the integumentary system; research the effects of aging on bone tissue; design and build a model of muscular system that replicates mechanisms of contraction; analyze the integration of the skeletal, muscular and nervous system; compare and contrast the various types of neurons; compare and contrast the parts of the nervous system and design a model that demonstrates nerve impulses; critique the effectiveness of the structures of the eyes and ears; categorize enzymes based on their roles in bodily functions; diagram, label, and describe the positive and negative feedback of the endocrine system; analyze the processes of the digestive system in supply essential nutrients; research illnesses related to the respiratory system; compare and contrast circulatory and lymphatic systems and the describe	interaction of cells, tissues, organs, and organ systems; categorize the various types of human tissue; relate the structure of the integumentary system to its functions; correlate the structures and functions, and determine the importance of the skeletal system; model the muscular system and mechanisms of contraction; integrate the skeletal, muscular and nervous systems; classify the various types of neurons; compare and contrast the parts of the nervous system and model nerve impulses; relate the structures of the ears and eyes to their function/dysfunction; apply the action of specific enzymes to their roles in bodily functions; incorporate the role of endocrine glands and their hormones into the overall functions and dysfunctions of the body; analyze the processes of the digestive system in supply essential nutrients; explain how structures and functions of the respiratory system; illustrate the circulatory and lymphatic systems and describe the functions of blood; compare the	and the interaction of cells, tissues, organs, and organ systems; categorize the various types of human tissue; summarize the functions of the integumentary system; classify the structures and functions, and determine the importance of the skeletal system; describe the muscular system and mechanisms of contraction; summarize the integration between the skeletal, muscular and nervous system; identify the various parts of the nervous system and model nerve impulses; relate the structures of the ears and eyes to their function/dysfunction; describe the lock and key model of enzymes and substrates; match endocrine glands to hormones and functions; describe the processes of the digestive system in supply essential nutrients; define structures of the respiratory system; label the circulatory and lymphatic systems and describe the functions of blood; determine compatibility of blood types; describe the structural features of the kidneys; describe the structures and	interaction of cells, tissues, organs, and organ systems; identify the various types of human tissue; recall the functions of the integumentary system; identify the structures and functions, and determine the importance of the skeletal system; label muscular system and mechanisms of contraction; outline integration between the skeletal, muscular and nervous systems; list the various types of neurons; recognize parts of the nervous system and model nerve impulses; define the structures of the ears and eyes; recite specific enzymes and their functions; match endocrine glands to their functions; identify processes of the digestive system in supplying essential nutrients; label structures of the respiratory system; label the circulatory and lymphatic systems and identify the functions of blood; determine compatibility of blood types; list the structures of the excretory system; identify the structures and functions the reproductive systems; define mitosis and meiosis; describe nonspecific

types and the molecular structure blood; investigate conditions related to and treatments renal failure; differentiate hormone regulations of male and female productive systems; research the effects of artificial hormones on human development; predict the consequences of modern medicine manipulation of the immune system; evaluate a variety of modern treatments for disease caused illnesses.	the functions of blood; evaluate the causes of the variances and global distribution of blood types; explain the interdependence of the excretory, integumentary, respiratory, and digestive systems; differentiate the effects of aging in the male and female reproductive systems; relate hormones to the formation of gametes, prenatal development, and labor; support a hypothesis about the effects of stress on the immune system; asses the rationale for various treatments of disease through history.	compatibility of blood types and assess the molecular basis for blood functions; integrate the functions of the excretory system; compare and contrast the structure and functions of male and female reproductive systems; outline the formation of gametes through fertilizations and embryological development; assess the role of components of the immune system in defending the body; research disease causative factors, symptoms, prevention and treatment.	functions of reproductive systems; describe oogenesis and spermatogenesis; diagram the patterns of immune response; classify disease, causative factors, symptoms, prevention, and treatments.	defenses of the immune system; match specific disease to their causative factors, symptoms, prevention, and treatments.

Objectives	Students will
SC.O.HAP.2.1	apply directional terminology (proximal, dorsal, medial, lateral, visceral, superficial, deep, etc.) to locate human body structures.
SC.O.HAP.2.2	describe the organizational levels, interdependency and the interaction of cells, tissues, organs, and organ systems.
SC.O.HAP.2.3	categorize, by structure and function, the various types of human tissue (e.g., muscle, epithelial, connective, or nervous).
SC.O.HAP.2.4	relate the structure of the integumentary system to its function as a sensory organ, environmental barrier and temperature regulator.
SC.O.HAP.2.5	relate how bone tissue is important to the development of the human skeleton.
SC.O.HAP.2.6	correlate the structure and function of the elements of the skeletal system (bone, articulations and insertions).
SC.O.HAP.2.7	model the mechanisms of muscular contraction on the cellular and molecular levels.
SC.O.HAP.2.8	integrate the skeletal, muscular and nervous systems to the functioning of the organism.
SC.O.HAP.2.9	model the muscular system including locations, origins, insertions, muscle groups and types of muscles.
SC.O.HAP.2.10	classify the various types of neurons emphasizing the relationship of structure and function.
SC.O.HAP.2.11	model the mechanism of a nerve impulse at the cellular and molecular levels.
SC.O.HAP.2.12	compare and contrast the parts and functions of the central and peripheral nervous system including the autonomic portions.
SC.O.HAP.2.13	apply the structure of the ear and eye to their function/dysfunction in relation to environmental perception.
SC.O.HAP.2.14	apply the action of specific enzymes to their roles in bodily functions.
SC.O.HAP.2.15	incorporate the role of endocrine glands and their hormones into the overall functions and dysfunctions of the body.
SC.O.HAP.2.16	analyze the role of components and processes of the digestive system in supplying essential nutrients.

SC.O.HAP.2.17	explain how structures of the respiratory system are essential to cellular respiration, gas exchange and communication.
SC.O.HAP.2.18	illustrate the structure of the circulatory and lymphatic systems and the function of blood to the role of transportation, cellular support and defense.
SC.O.HAP.2.19	compare the compatibility of blood types and assess the molecular basis for blood functions.
SC.O.HAP.2.20	integrate the functions of the excretory system to the maintenance of the other body systems.
SC.O.HAP.2.21	compare and contrast the structure and function of male and female reproductive systems.
SC.O.HAP.2.22	outline the events of reproduction for the formation of gametes through fertilizations and embryological development.
SC.O.HAP.2.23	assess the role of components of the immune system in defending the body.
SC.O.HAP.2.24	research disease causative factors, symptoms, prevention and treatment.

High School	**Human Anatomy and Physiology**
Standard: 3	**Application of Science**
SC.S.HAP.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.HAP.1

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Human Anatomy and Physiology 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.	Human Anatomy and Physiology 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.	Human Anatomy and Physiology 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.	Human Anatomy and Physiology students at the partial mastery level will test and record data to explore systems, models, and changes; explain a technological innovation and identify positive outcomes and unintended consequences of a scientific discovery; indentify the impacts of public policy decisions regarding health, population resources or environmental issues.	Human Anatomy and Physiology 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	Students will
SC.O.HAP.3.1	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).
SC.O.HAP.3.2	investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.HAP.3.3	communicate experimental designs, results and conclusions using advanced technology tools.
SC.O.HAP.3.4	collaborate to present research on current environmental and technological issues to predict possible solutions.
SC.O.HAP.3.5	explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.
SC.O.HAP 3.6	given a current science-technology-societal issue, construct and defend potential solutions.

Physics Content Standards and Objectives

Physics is an advanced level course that is an elective designed for students desiring a broader, in-depth study of the content found in the science field of physics. As a college preparatory course, Advanced Physics is a laboratory driven, advanced study of nature's universal laws with emphasis on process skills, using 21st century skills. This course is designed to build upon and extend the Physics concepts, skills, and knowledge from the science program. The course emphasizes a mathematical approach to the areas of kinematics, dynamics, thermodynamics, light and optics, electricity and magnetism and modern physics. Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. 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.

High School	Physics			
Standard: 1	Nature of Science			
SC.S.P.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.P.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics 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.	Physics students at the above mastery level will 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.	Physics 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.	Physics students at the partial 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.	Physics students at the novice level 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	Students will
SC.O.P.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.P.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.P.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.P.1.4	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.P.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.P.1.6	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.P.1.7	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.P.1.8	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).

High School	Physics
Standard 2	The Content of Science
SC.S.P.2	Students will • demonstrate knowledge, understanding, and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, and the earth and space sciences. • apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.P.2

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics students at the distinguished level will derive formula of best-fit for representation of motion (velocity, acceleration); test the theoretical basis of mathematical methods for motion in one and/or two dimensions; evaluate methods to solve problems	Physics students at the above mastery level will given formula, match the graph of position versus time, velocity versus time or acceleration versus time; test the theoretical basis of mathematical methods for motion in one and/or two dimensions; solve problems	Physics students at the mastery level will construct and interpret graphs of position versus time, velocity versus time and acceleration versus time; analyze data, for motion in one and/or two dimensions then select the correct mathematical method for	Physics students at the partial mastery level will construct graphs of position versus time, velocity versus time and acceleration versus time; relate data from motion in one- or two-dimension to mathematical functions; solve one-step problems involving velocity,	Physics students at the novice level will match the unit to the correct measurement of motion (position, speed, velocity, acceleration); collect data for motion in one- or two-dimensions; match the unit with the variable; define vectors; state Newton's

involving velocity, acceleration, momentum and net force using more than one equation; create graphical, algebraic and/or trigonometric solutions problems involving vector components and resultants; experimentally verify Newton's Laws of Motion in terms of equilibrium and net force situations; experimentally verify the conservation of energy and momentum and deduce solutions for elastic and inelastic collisions; calculate the density of an unknown liquid given the buoyant behavior of an object of known density; solve problems involving pressure using more than one equation; apply Bernoulli's principle to everyday object; explain mathematically the reflective, refractive and diffractive properties of mechanical and transverse waves; apply calculations to determine the speed of a seismic waves; apply knowledge of simple harmonic motion (e.g., springs, pendulums and other oscillating objects) to calculate the kinetic and potential energies of the oscillating system; calculate the apparent frequency	involving velocity, acceleration, momentum and net force using more than one equation; create graphical, algebraic and/or trigonometric solutions problems involving vector components and resultants; experimentally verify Newton's Laws of Motion in terms of equilibrium and net force situations; evaluate the conservation of energy and momentum and deduce solutions for elastic and inelastic collisions; calculate the density of an unknown liquid given the buoyant behavior of an object of known density; calculate pressure when given depth, density and volume; apply Bernoulli's principal to everyday object (for example, paint sprayer or perfume bottle); explain mathematically the reflective, refractive and diffractive properties of mechanical and transverse waves; given wavelength, calculate the energy of a wave; experimentally determine the factors that affect an oscillating system; calculate the apparent frequency caused by Doppler shift; differentiate the properties concave or convex mirrors or lenses;	communicating the value of unknown variable; develop solutions for multistep problems involving velocity, acceleration, momentum and net force; interpret graphical, algebraic and/or trigonometric solutions to prove the values for vector components and resultants; experimentally verify Newton's Laws of Motion in terms of equilibrium and net forces situations; evaluate the conversation of energy and momentum and deduce solutions for elastic and inelastic collisions; experimentally verify that the apparent weight of a submerged object depends upon density; compare the pressure exerted by a fluid to the depth of an object in the fluid; anticipate the effects of Bernoulli's principle on fluid motion; examine the reflective, refractive and diffractive properties of mechanical and transverse waves; perform calculations to determine wavelength, frequency, velocity or energy of a wave; investigate simple harmonic motion as result of an object's displacement; research applications of Doppler shift in determining	acceleration, momentum and net force; draw vector solutions; perform calculations involving equilibrium and net force situations; define the law of conservation of energy; assess the magnitude of buoyant force on submerged and floating objects; recognize that fluids exert force on objects in the fluid; demonstrate Bernoulli's principle; define reflective, refractive and diffractive properties of mechanical and transverse waves; label a transverse and longitudinal wave with the parts of the wave; relate the restoring force to displacement; diagram waves showing the Doppler effect; experimentally find the image of a lens or mirror using an optic bench; calculate Ohm's law problems for series circuits; distinguish between direct and alternating current and identify ways of generating each type; recognize a projectile moves in both horizontal and vertical direction.	Laws of Motion; describe elastic and inelastic collisions; express the difference between weight and mass; define pressure as force/area; state Bernoulli's principle; define reflective and refractive properties of mechanical and transverse waves; label a transverse wave with the parts of the wave; define simple harmonic motion; define Doppler effect; define focal point, image, image distance and object distance; state Ohm's law; define direct current and identify ways of generating it; recognize projectile motion.

caused by Doppler shift and interpret the results; differentiate mathematically the properties concave or convex mirrors or lenses; construct and analyze electrical circuits and calculate Ohm's law problems for complete circuits; calculate kilowatt-hours for an alternating current and determine the cost of using that current; apply knowledge of projectile motion to determine horizontal and vertical velocities and/or distances.	construct and analyze electrical circuits and calculate Ohm's law problems for complex circuits; calculate power of direct and alternating current using resistance, current and voltage; determine the forces acting on the projectile.	an approaching or receding source in wave propagation; apply ray optics diagrams to lenses and mirrors; use the lens/mirror equation and the magnification equation to solve optics problems; construct and analyze electrical circuits and calculate Ohm's law problems for series and parallel circuits; distinguish between direct and alternating current and identify ways of generating each type; analyze the motion of a projectile.		

Objectives	Students will
SC.O.P.2.1	construct and interpret graphs of position versus time, velocity versus time and acceleration versus time.
SC.O.P.2.2	appraise data, either textbook generated or laboratory collected, for motion in one and/or two dimensions, then select the correct mathematical method for communicating the value of unknown variables.
SC.O.P.2.3	develop solutions for multi-step problems involving velocity, acceleration, momentum and net force.
SC.O.P.2.4	interpret graphical, algebraic and/or trigonometric solutions to prove the values for vector components and resultants.
SC.O.P.2.5	justify Newton's Laws of Motion in terms of equilibrium and net force situations.
SC.O.P.2.6	evaluate the conservation of energy and momentum and deduce solutions for elastic and inelastic collisions.
SC.O.P.2.7	assess the magnitude of buoyant force on submerged and floating objects.
SC.O.P.2.8	compare the pressure exerted by a fluid to the depth of an object in the fluid.
SC.O.P.2.9	anticipate the effects of Bernoulli's principle on fluid motion.
SC.O.P.2.10	examine the reflective, refractive and diffractive properties of mechanical and transverse waves.
SC.O.P.2.11	perform calculations to determine wavelength, frequency, velocity or energy of a wave.
SC.O.P.2.12	compare and contrast the physical properties of mechanical and transverse waves.
SC.O.P.2.13	research applications of Doppler shift in determining an approaching or receding source in wave propagation.
SC.O.P.2.14	apply ray optics diagrams to lenses and mirrors; use the lens/mirror equation and the magnification equation to solve optics problems.
SC.O.P.2.15	justify the image results obtained by diagramming the ray optics of lenses and mirrors and/or by deducing the image information from the lens/mirror equation.
SC.O.P.2.16	construct and analyze electrical circuits and calculate Ohm's law problems for series and parallel circuits.
SC.O.P.2.17	distinguish between direct and alternating current and identify ways of generating each type.

SC.O.P.2.18	analyze the motion of a projectile.

High School	Physics			
Standard 3	Application of Science			
SC.S.P.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.P.3				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics 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.	Physics 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.	Physics 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.	Physics students at the partial 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.	Physics 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	Students will
SC.O.P.3.1	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).
SC.O.P.3.2	investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.P.3.3	communicate experimental designs, results and conclusions using advanced technology tools.
SC.O.P.3.4	collaborate to present research on current environmental and technological issues to predict possible solutions.
SC.O.P.3.5	explore occupational opportunities in science, engineering and technology and evaluate the required academic preparation.
SC.O.P.3.6	given a current science-technology-societal issue, construct and defend potential solutions.

Conceptual Physics Content Standards and Objectives

Conceptual Physics is an advanced level course that is an elective designed for students who desire a physics course that will prepare them for technical careers. This course is an alternative to the traditional mathematical approach to physics. This approach covers the physics principles in a traditional sequence with an emphasis on conceptual understanding. While mathematics is de-emphasized, laboratory work will require traditional physics measurements to be made. Emphasis will be on the concepts that underlie the natural laws of the universe. Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. 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.

High School	Conceptual Physics			
Standard: 1	Nature of Science			
SC.S.CP.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.CP.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Physics students at the distinguished level will analyze the importance of scientific 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.	Conceptual Physics students at the above mastery level will 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.	Conceptual Physics 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.	Conceptual Physics students at the partial 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 conclusions from a list of possible conclusions drawn from experimental data.	Conceptual Physics students at the novice level will identify the importance of scientific innovations 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	Students will			

SC.O.CP.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.CP.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues. (e.g., "scientific method").
SC.O.CP.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.CP.1.4	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.CP.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.CP.1.6	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.CP.1.7	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; communicate and defend the results and conclusions).
SC.O.CP.1.8	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).

High School	**Conceptual Physics**
Standard: 2	Content of Science
SC.S.CP.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life\experiences.

Performance Descriptors SC.PD.CP.2

Distinguished	Above Mastery	Master	Partial Mastery	Novice
Conceptual Physics students at the distinguished level will solve vector problems both graphically and algebraically; interpret graphs relating distance, velocity and acceleration to time; apply knowledge of projectile motion to determine horizontal and vertical velocities and/or	Conceptual Physics students at the above mastery level will solve vector problems graphically or algebraically; draw a graph relating distance, velocity and acceleration to time; determine the horizontal and vertical distances of projectile motion; illustrate forces	Conceptual Physics students at the mastery level will solve right triangle vector problems both graphically and algebraically; compare and contrast distance, velocity and acceleration of moving objects to describe accelerated and non-accelerated motions of a	Conceptual Physics students at the partial mastery level will solve right triangle vector problems graphically or algebraically; define the units distance, velocity and acceleration; recognize a projectile moves in both horizontal and vertical direction; identify forces acting on an	Conceptual Physics students at the novice level will draw a right triangle; define distance, velocity and acceleration; recognize projectile motion; identify force as a vector; state one of Newton's Laws; state that energy is conserved within a system; define work, energy and power;

distances; calculate the net force acting on a two body system; determine the net force acting on a system; mathematically verify that mechanical energy is conserved; experimentally determine mechanical advantage of a mechanical system; solve equations for Archimedes' and/or Pascal's principles; apply Bernoulli's principle to everyday object (for example, paint sprayer or perfume bottle); interpret a phrase change diagram; appraise the role of heat transfer involved in environmental and energy conservation issues and predict ways to eliminating the heat transfer; defend that heat added to a system will raise the internal energy or increase the amount of work done externally by the system; evaluate sound and light waves using the concepts of reflection, refraction, diffraction, and interference; given wavelength calculate the energy of a wave; examine factors that affect the speed of sound; explain why the speed of light is a constant; predict the effect of changing the frequency of a standing wave; demonstrate the effect of changing the	acting on a two body system with a free body diagram; apply Newton's Laws as a system to explain natural phenomena; calculate kinetic and potential energy; experimentally determine mechanical advantage of a mechanical system; recognize a floating object displaces a weight of fluid equal to its own weight and recognize that pressure is equal at all points in an enclosed system; apply Bernoulli's principle to everyday object (for example, paint sprayer or perfume bottle); experimentally determine the melting point of a substance and graph the results; examine the role of heat transfer involved in environmental and energy conservation issues and predict ways of eliminating the heat transfer; analyze the first law of thermodynamics and relate it to energy conservation; analyze sound and light waves using the concepts of reflection, refraction, diffraction and interference; given wavelength, calculate the energy of a wave; determine factors that affect the speed of sound;	particle from textbook or lab collected data; analyze the motion of a projectile; illustrate forces acting on objects with free body diagrams; interpret Newton's Laws in terms of natural phenomena; compare and contrast kinetic and potential energies and recognize situations where mechanical energy is conserved; deduce work, energy, power and efficiency in mechanical systems; analyze Archimedes' and Pascal's principles to solve problems involving equilibrium and stability of floating systems; recognize the effects of Bernoulli's principle on fluid motion; compare and contrast the common temperature scales, convert from one temperature scale to another and evaluate temperature in terms of kinetic energy; apply the mechanism of heat transfer and relate to environmental and energy conservation issues; relate the first law of thermodynamics to energy conservation; compare and contrast sound and light waves using the concepts of reflection, refraction, diffraction and interference;	object; state Newton's Laws; define and give examples of kinetic and potential energies; define efficiency in a mechanical system and state the formulas for work, energy and power; distinguish between weight and mass; demonstrate Bernoulli's principle; distinguish between heat and temperature; compare and contrast the three methods of heat transfer; state the first law of thermodynamics; compare sound and light waves using the concepts of reflection, refraction, diffraction and interference; label a transverse and longitudinal wave with the parts of the wave; determine factors that affect the speed of sound; recognize that the speed of light is a constant; construct a standing wave; identify examples of Doppler shift for either sound or light waves; find the image location involving plane and spherical mirrors, concave and convex lenses on an optical bench; compare primary and secondary colors of light and pigment; sketch the concept of polarization; relate Ohm's Law to simple circuits;	recognize a floating object displaces fluid; state Bernoulli's principle; identify the common temperature scales and their units; list the three methods of heat transfer; state the Law of Energy Conservation; define reflection, refraction, diffraction and interference; label a transverse wave with the parts of the wave; define a standing wave; define the Doppler shift; find the image location involving plane and spherical mirrors on an optical bench; list primary and secondary colors of light and pigment; define polarization; list and define the variables of Ohm's Law.

frequency; calculate the apparent change in frequency that occurs with either a moving source or a moving detector; predict, illustrate, and calculate image location involving plane and spherical mirrors, concave and convex lenses; analyze the applications of colored lights and pigments; relate the concept of polarization to three dimensional viewing; calculate any variable in a complex circuit using Ohm's Law and compare and contrast between the flow of electrons in AC and DC circuits.	recognize that the speed of light is a constant; identify the nodes and antinodes of a standing wave and demonstrate the relationship between frequency and the creation of more nodes; investigate the uses of Doppler shift in astronomy and cosmology; calculate image location involving plane and spherical mirrors, concave and convex lenses; compare and contrast the applications of colored lights and pigments; analyze the concept of polarization; calculate any variable in a simple circuit using Ohm's Law and distinguish between the flow of electrons in AC and DC circuits.	solve problems involving wave speed, frequency and wavelength; determine factors that affect the speed of sound; recognize that the speed of light is a constant; model the production of a standing wave and propose a practical application of such a wave; compare the Doppler shift effect for sound and light and point out examples of its occurrences and applications; diagram image location involving plane and spherical mirrors, concave and convex lenses; illustrate the applications of colored lights and pigments; examine the concept of polarization; analyze simple direct current circuits using Ohm's Law, distinguish between direct current and alternating current circuits and describe how AC is converted to DC.	distinguish between direct and alternating current.	

Objectives	Students will
SC.O.CP.2.1	solve right triangle vector problems both graphically and algebraically.
SC.O.CP.2.2	compare and contrast distance, velocity and acceleration of moving objects to describe accelerated and non-accelerated motions of a particle from textbook or lab collected data.
SC.O.CP.2.3	analyze the motion of a projectile.
SC.O.CP.2.4	illustrate forces acting on objects with free body diagrams.
SC.O.CP.2.5	interpret Newton's Laws in terms of natural phenomena.
SC.O.CP.2.6	compare and contrast kinetic and potential energies and recognize situations where mechanical energy is conserved.
SC.O.CP.2.7	deduce work, energy, power and efficiency in mechanical systems.
SC.O.CP.2.8	analyze Archimedes' and Pascal's principles to solve problems involving equilibrium and stability of floating systems.
SC.O.CP.2.9	recognize the effects of Bernoulli's principle on fluid motion.
SC.O.CP.2.10	compare and contrast the common temperature scales, convert from one temperature scale to another and evaluate temperature in

	terms of kinetic energy.
SC.O.CP.2.11	apply the mechanism of heat transfer and relate to environmental and energy conservation issues.
SC.O.CP.2.12	relate the first law of thermodynamics to energy conservation.
SC.O.CP.2.13	compare and contrast sound and light waves using the concepts of reflection, refraction, and interference.
SC.O.CP.2.14	solve problems involving wave speed, frequency and wavelength; determine factors that affect the speed of sound; recognize that the speed of light is a constant.
SC.O.CP.2.15	model the production of a standing wave and propose a practical application of such a wave.
SC.O.CP.2.16	compare the Doppler shift effect for sound and light and point out examples of its occurrences and applications.
SC.O.CP.2.17	diagram image location involving plane and spherical mirrors, concave and convex lenses.
SC.O.CP.2.18	illustrate the applications of colored lights and pigments.
SC.O.CP.2.19	examine the concept of polarization.
SC.O.CP.2.20	analyze simple direct current circuits using Ohm's Law.
SC.O.CP.2.21	distinguish between direct current and alternating current circuits and describe how AC is converted to DC.

High School	**Conceptual Physics**
Standard 3	**Application of Science**
SC.S.CP.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.CP.3

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Physics 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	Conceptual Physics 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	Conceptual Physics 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	Conceptual Physics students at the partial 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	Conceptual Physics 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.	policy decision regarding health, population resources or environmental issues.	regarding health, population resources or environmental issues.	health, population resources or environmental issues.	environmental issues.

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

Physics II Content Standards and Objectives

Physics II advanced level course that is an elective designed for students who have completed Physics and desire a broader, in-depth study of physics content beyond those studied in Physics. As a college preparatory course, Physics II is a laboratory driven, advanced study of nature's universal laws with emphasis on process skills, using 21st century skills. This course is designed to build upon and extend the Physics concepts, skills, and knowledge from the science program. The course emphasizes a mathematical approach to the area of mechanics, thermodynamics, light and optics, electricity and magnetism and modern physics. Students will engage in active inquires, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. The West Virginia Standards for 21st Century Learning include the following components: 21st Century Content Standards and Objectives and 21st Century Learning Kills and Technology Tools. All West Virginia teachers are responsible for classroom instruction that integrates learning skills, technology tools and content standards and objectives.

High School	Physics II			
Standard 1	Natural Science			
SC.S.PII.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.PII.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics II students at the distinguished level will analyze the importance of scientific 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.	Physics II students at the above mastery level will 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.	Physics II 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.	Physics II students at the partial 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 conclusions from a list of possible conclusions drawn from experimental data.	Physics II students at the novice level will identify the importance of scientific innovations 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	Students will			

SC.O.PII.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.PII.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.PII.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.PII.1.4	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.PII.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.PII.1.6	use appropriate technology solutions with 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.PII.1.7	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 analyze of error, or communicate and define the results and conclusions).
SC.O.PII.1.8	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).

High School	Physics
Standard 2	Content of Science
SC.S.PII.2	Students will • demonstrate knowledge, understanding, and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, and the earth and space sciences. • apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.PII.2

Distinguished	Above Mastery	Master	Partial Mastery	Novice
Physical Science II students at the distinguished level will differentiate among linear, quadratic, and inverse relationships found in graphs of motion in terms of position, velocity, acceleration, and time; evaluate data to deduce mathematical relationships involving one and two	Physical Science II students at the above mastery level will compose equations to express the relationships found in graphs of motion in terms of position, velocity, acceleration, and time; summarize data to deduce mathematical relationships involving one and two dimensional motion; design	Physical Science II students at the mastery level will apply graphical analysis to interpret motion in terms of position, velocity, acceleration, and time; use data to deduce mathematical relationships involving one and two dimensional motion; experimentally verify laws of	Physical Science II students at the partial mastery level will draw motion graphs to show motion in terms of position, velocity, acceleration, and time; use data to deduce mathematical relationships involving one dimensional motion; recognize that laws of motion including	Physical Science II students at the novice level will measure distance and time to calculate velocity and acceleration; describe mathematical relationships involving one dimensional motion; perform experiments on motion topics including Newton's Laws, Conservation of

dimensional motion; critique experiments to verify laws of motion including Newton's Laws, Conservation of Momentum, and Conservation of Energy; using knowledge of linear motion equations, synthesize concepts of rotational motion; design experiments to verify the effect of variables on the properties and dynamics of fluids; justify experimental results using concepts of thermal physics; appraise the relative values of electric force and field strength based on the magnitude of and the distance from the point charge; design, construct, diagram and evaluate complex electrical circuits; defend predictions and interpretations of magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil; critique electromagnetic induction and justify its application to particular electric circuits and various devices; investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the	experiments to verify laws of motion including Newton's Laws, Conservation of Momentum, and Conservation of Energy; using knowledge of linear motion equations, synthesize concepts of rotational motion; evaluate the effect of variables to the properties and dynamics of fluids; relate experimental results using concepts of thermal physics; summarize the relative values of electric force and field strength based on the magnitude of and the distance from the point charge; design, construct, diagram and evaluate complex electrical circuits; defend predictions and interpretations of magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil; critique electromagnetic induction and evaluate its application to electric circuits and various devices; investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics	motion including Newton's Laws, Conservation of Momentum, and Conservation of Energy; using knowledge of linear motion equations, synthesis concepts of rotational motion; predict and verify the effect of variables on the properties and dynamics of fluids; interpret and apply concepts of thermal physics; deduce the relative values of electric force and field strength based on the magnitude of and the distance from the point charge; construct, diagram and evaluate complex electrical circuits; predict and interpret magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil; critique electromagnetic induction and evaluate its application to electric circuits and various devices; investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits; apply	Newton's Laws, Conservation of Momentum, and Conservation of Energy can be verified experimentally; perform calculations involving the concepts of rotational motion; apply Pascal's Archimedes', and Bernoulli's, principles in everyday situations; apply concepts of thermal physics; relate electric fields to electric forces and distinguish between them; construct, diagram and evaluate simple electrical circuits; relate magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil; apply electromagnetic induction to electric circuits and various devices; investigate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits; calculate the kinetic and potential energies of the oscillating system; review wave properties and their interactions; research the application of wave	Momentum, and Conservation of Energy; define the concepts of rotational; define the properties and dynamics of fluids; state concepts of thermal physics; calculate the field strength using Coulomb's Law; construct and diagram simple electrical circuits; relate magnetism to electric charge and electricity; describe electromagnetic induction; investigate the applications of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits; calculate the kinetic and/or potential energies of the oscillating system; list wave properties and their interactions; list optical and acoustical devices and identify the property that is the basis of the device; arrange the models of the atom historically; list evidence for the historical development of the quantum mechanical theory; calculate an atom's binding energy; define stable and unstable nuclei and list types of decay that the unstable nuclei could display.

advancement of electronics through the development of diodes, transistors, and integrated circuits; assess and contrast the kinetic and potential energies and energy transformations of different oscillating systems; evaluate wave properties and their interactions; predict how optical and acoustical devices will incorporate new materials to improve their effectiveness; appraise the role of technology in the development of historical models of the atom; summarize and critique evidence for the historical development of the quantum mechanical theory; justify an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present; categorize nuclei based on their placement on the periodic table and proton to neutron ratio to demonstrate different types of decay processes.	through the development of diodes, transistors and integrated circuits; compare and contrast the kinetic and potential energies and energy transformations of different oscillating systems; analyze wave properties and their interactions; compare and contrast optical and acoustical devices for their effective application of wave properties; analyze the role of technology in the development of historical models of the atom; categorize evidence for the historical development of the quantum mechanical theory; analyze an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present; using the proton to neutron ratio, predict the type of nuclear decay that could occur for nuclei.	knowledge of simple harmonic motion to calculate the kinetic and potential energies of the oscillating system; examine wave properties and their interactions; evaluate the application of wave properties of the development of optical and acoustical devices; critique the role of technology in the development of historical models of the atom; examine evidence for the historical development of the quantum mechanical theory; calculate an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present; differentiate between stable and nuclear nuclei, and if the nucleus is unstable predict he type(s) of nuclear decay.	properties to the development of optical and acoustical devices; research the development of historical models of the atom; describe evidence for the historical development of the quantum mechanical theory; calculate an atom's binding energy as related to Einstein's special theory of relativity; differentiate between stable and unstable nuclei and list types of decay that the unstable nuclei could display.	

Objectives	Students will
SC.O.PII.2.1	apply graphical analysis to interpret motion in terms of position, velocity, acceleration, and time.
SC.O.PII.2.2	use data to deduce mathematical relationships involving one and two dimensional motion.
SC.O.PII.2.3	experimentally verify laws of motion including Newton's Laws, Conservation of Momentum (linear and angular), and Conservation of Energy.
SC.O.PII.2.4	using knowledge of linear motion equations, synthesize concepts of rotational motion (e.g., angular speed and acceleration, centripetal acceleration, Newtonian gravitation, Kepler's Laws, torque).
SC.O.PII.2.5	predict and verify the effect of variables on the properties and dynamics of fluids.

SC.O.PII.2.6	interpret and apply concepts of thermal physics (e.g., distinction of heat and temperature, thermal expansion, properties of Ideal Gases, Kinetic Theory, specific heat, and energy transfer).
SC.O.PII.2.7	deduce the relative values of electric force and field strength based on the magnitude of and the distance from the point charge (e.g., Coulomb's Law and inverse square law).
SC.O.PII.2.8	construct, diagram and evaluate complex electrical circuits.
SC.O.PII.2.9	predict and interpret magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil.
SC.O.PII.2.10	critique electromagnetic induction and evaluate its application to electric circuits and various devices.
SC.O.PII.2.11	investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits.
SC.O.PII.2.12	apply knowledge of simple harmonic motion (e.g., springs, pendulums and other oscillating objects) to calculate the kinetic and potential energies of the oscillating system.
SC.O.PII.2.13	examine wave properties and their interactions (e.g., reflection, refraction, dispersion, total internal deflection, interference, diffraction, Doppler Shift, beats, and polarization).
SC.O.PII.2.14	evaluate the application of wave properties to the development of optical and acoustical devices.
SC.O.PII.2.15	critique the role of technology in the development of historical models of the atom (e.g., radioactivity, atomic spectra, particle accelerators, etc.).
SC.O.PII.2.16	examine evidence for the historical development of the quantum mechanical theory (e.g., Planck's blackbody radiation, Einstein's photoelectric effect, deBroglie's duality).
SC.O.PII.2.17	calculate an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present.
SC.O.PII.2.18	differentiate between stable and unstable nuclei, and if the nucleus is unstable predict the type(s) of nuclear decay.

High School	**Physics II**			
Standard: 3	**Application of Science**			
SC.S.PII.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.PII.3				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics II students at the distinguished level will construct, test and analyze complex systems, models, and changes across science disciplines; use a	Physics II students at the above mastery level will construct, test and analyze data to explore systems, models and changes across science disciplines; analyze	Physics II students at the mastery level will test, record and analyze data to explore systems, models, and changes; analyze a technological innovation	Physics II students at the partial mastery level will test and record data to explore systems, models, and changes; explain a technological innovation	Physics II students at the novice level will test and record data to explore systems, models or changes; identify a technological innovation

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

FISCAL NOTE FOR PROPOSED RULES

Rule Title: **W. Va. 126CSR44R, Policy 2520.35 Science 9-12 Content Standards and Objectives for West Virginia Schools**

Type of Rule: X Legislative ☐ Interpretive ☐ Procedural

Agency: West Virginia Board of Education

Address: Capitol Building 6, Room 608
1900 Kanawha Boulevard, East
Charleston, WV 25305

Phone Number: 304.558.5325 Email: mburke@access.k12.wv.us

Fiscal Note Summary

Summarize in a clear and concise manner what impact this measure will have on costs and revenues of state government.

No costs or revenues will be impacted by the proposed amendment of W. Va. 126CSR44R, Policy 2520.35 Science 9-12 Content Standards and Objectives

Fiscal Note Detail

Show over-all effect in Item 1 and 2 and, in Item 3, give an explanation of Breakdown by fiscal year, including long-range effect.

	FISCAL YEAR		
Effect of Proposal	Current Increase/Decrease (use"-")	Next Increase/Decrease (use"-")	Fiscal Year (Upon Full Implementation)
1. Estimated Total Cost	0	0	0
Personal Services	0	0	0
Current Expenses	0	0	0
Repairs & Alterations	0	0	0
Assets	0	0	0
Other	0	0	0
2. Estimated Total Revenues	0	0	0

Rule Title: **W. Va. 126CSR44R, Policy 2520.35 Science 9-12 Content Standards and Objectives for West Virginia Schools**

Rule Title: **W. Va. 126CSR44R, Policy 2520.35 Science 9-12 Content Standards and Objectives for West Virginia Schools**

3. **Explanation of above estimates (including long-range effect);**
Please include any increase or decrease in fees in your estimated total revenues.

No costs or revenues will be impacted by the proposed amendment of W. Va. 126CSR44R, Policy 2520.35 Science 9-12 Content Standards and Objects for West Virginia Schools.

MEMORANDUM

Please identify any areas of vagueness, technical defects, reasons the proposed rule **would not** have a fiscal impact, and/or any special issues **not** captured elsewhere on this form.

When Policy 2520.35 was last submitted to the WV Board of Education for approval, we submitted a cash estimate of $2,250,000 due to increased science graduation requirements. However these revisions will not impact costs and revenues.

Signature of Agency Head or Authorized Representative — Date

Edward L Paine — 1/13/2009

126CSR44R

POLICY 2520.35: 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools

COMMENT PERIOD ENDS: March 16, 2009

COMMENT RESPONSE FORM

The following form is provided to assist those who choose to comment on Policy 2520.35: 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools. Additional sheets may be attached, if necessary.

Name : _____ Organization: _____

Title: _____

Street Address: _____

City: _____ State: _____ Zip: _____

Please check the box below that best describes your role.

☐ School System Superintendent	☐ School System Staff	☐ Parent/Family
☐ Principal	☐ Teacher	☐ Business/Industry
☐ Professional Support Staff	☐ Service Personnel	☐ Community Member

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COMMENTS/SUGGESTIONS
§126-44R-1. General.

§126-44R. 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at *Ninth Grade Physical Science Content Standards and Objectives.*
§126-44R. 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at *Biology Content Standards and Objectives.*
§126-44R. 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at *Conceptual Biology Content Standards and Objectives.*

Please direct all comments to:

Marty Burke
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West Virginia Department of Education
Capitol Building 6, Room 608
1900 Kanawha Boulevard, East
Charleston, West Virginia 25305-0330
E-Mail Address: mburke@access.k12.wv.us
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