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OFFICE WEST VIRGINIA SECRETARY OF STATE

FORM #5

NOTICE OF AGENCY ADOPTION OF A PROCEDURAL OR INTERPRETIVE RULE OR A LEGISLATIVE RULE EXEMPT FROM LEGISLATIVE REVIEW

AGENCY: West Virginia Board of Education TITLE NUMBER: 126

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

RULE TYPE: PROCEDURAL _____ INTERPRETIVE _____

EXEMPT LEGISLATIVE RULE X

CITE STATUTE(s) GRANTING EXEMPTION FROM LEGISLATIVE REVIEW
W. Va. Code §§29A-3B-1, et seq.; *W. Va. Board of Education v. Hechler*, 180 W.Va. 451; 376 S.E.2d 839 (1988).

AMENDMENT TO AN EXISTING RULE: YES ____ NO X

IF YES, SERIES NUMBER OF RULE BEING AMENDED: _____

TITLE OF RULE BEING AMENDED: _____

IF NO, SERIES NUMBER OF NEW RULE BEING PROPOSED: 44R

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

THE ABOVE RULE IS HEREBY ADOPTED AND FILED WITH THE SECRETARY OF STATE. THE EFFECTIVE DATE OF THIS RULE IS July 1, 2008.

Steven L. Paine
State Superintendent of Schools

EXECUTIVE SUMMARY
FOR
WEST VIRGINIA BOARD OF EDUCATION POLICY 2520.35
21st CENTURY SCIENCE 9-12 CONTENT STANDARDS AND OBJECTIVES FOR WEST VIRGINIA SCHOOLS

Policy Number and Title: West Virginia Board Of Education Policy 2520.35: *21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools*

Background: Policies 2520 define the content standards and objectives for the programs of study required by Policy 2510 and establish a standardized format for such.

- The original effective date of the policy was July, 1997.
- In October, 2001, a revision of the Policy incorporating the Content Standards and Objectives (CSOs) for Mathematics, Reading and English Language Arts, Science, Social Studies and Technology was presented to the West Virginia Board of Education.
- Policy 2520.3 was placed on public comment and was approved by the Board on December 13, 2001 and became effective on July 1, 2003.

Major Revisions or Reasons for New Policy: Policy 2520.3 now contains the 21st Century Science Content Standards and Objectives for grades K- 8. New Policy 2520.35 contains the 21st Century Science Content Standards and Objectives for grades 9-12.

- The science CSOs have been revised to
    - reorganize the science content under three standards,
    - incorporate higher levels of critical thinking skills and problem solving skills,
    - establish an improved alignment with national assessments (NAEP, ACT, and SAT), and
    - incorporate 21st century knowledge and skills that West Virginia students will need to be successful in the global world of the 21st century.
    - place high school science courses in new Policy 2520.35
    - set the required science as follows: Ninth Grade Physical Science, Tenth Grade Biology or Conceptual Biology and Eleventh Grade Chemistry or Conceptual Chemistry.

Impact:

- Students will be better prepared for success on national assessments, in postgraduate studies and in the workplace of the 21st century.
- Students will acquire a higher level of critical thinking and problem solving skills needed for success in post graduate studies and the workplace of the 21st century.
- The revised format will better enable West Virginia educators to focus instruction on the approved CSOs.

Response to Comments:

Fourteen comments were received during the comment period. No changes to the policy are recommended as a result of the comments received.

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. -- December 15, 2006

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

1.5. Repeal of former rule. -- None. This is a new rule.

§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 Instructional Services.

§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
C	Chemistry
CB	Conceptual Biology
CC	Conceptual Chemistry
CP	Conceptual Physics
E	Earth Science
HA	Human Anatomy and Physiology
P	Physics
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 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.	Students 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 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 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 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.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 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 energy through cellular processes; predict how	Students 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 processes; predict the state of matter given relative	Students 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 processes; relate state of matter to amount of kinetic	Students 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 to indicate kinetic energy; write formulas and classify types of chemical reactions;	Students 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 reactions; define an ionic

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 relative dating techniques.	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.	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.	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.	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.
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 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 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 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 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 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 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; validate and draw conclusions from	Students 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 multiple data sources and	Students 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 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 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.

experimental results using historical and student collected data and constructed models.	interpretation of models.	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 suggest cell functions based on structure; debate ethics of DNA research; assess the statement "ontogeny recapitulates phylogeny";	Students classify cells based on structure and function; analyze historical research leading to current DNA knowledge; compare ontogeny and phylogeny of	Students relate cell structure to function; apply DNA's structure to its role in heredity; compare ontogeny and phylogeny of an animal; compare traditional and	Students recognize that cells have different structures and functions; list properties of DNA; trace ontogeny or phylogeny of an animal; identify a group	Students recognize that cells have different structures; recognize that DNA is the material of heredity; recognize that embryos developmentally

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 to its properties; evaluate multiple gravitational effects of the Earth-Moon system;	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 effects of geological or biological event on climate; evaluate conditions	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 biological processes of fossil formation; explain theories of cosmology using	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.	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.

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.	necessary for fossil formation; compare theories of cosmology using electromagnetic evidence.	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 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 regarding health, population resources and environmental issues.	Students 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 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 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 public policy decision regarding health, population resources or environmental issues.	Students 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 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 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 Physical 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 Nine	**Physical Science**			
Standard 1	**Nature of Science**			
SC.S.PS.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems.			
Performance Descriptors SC.PD.PS.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Ninth grade students at the distinguished level 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	Ninth grade 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.	Ninth grade 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.	Ninth grade students at the below 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.	Ninth grade 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.

interpretation of models.				

Objectives	Students will
SC.O.PS.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.PS.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.PS.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.PS.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.PS.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.PS.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.PS.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.PS.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 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 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	Ninth grade students at the above mastery level 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	Ninth grade students at the mastery level apply dimensional analysis and scientific notation in making metric calculations; predict chemical and physical properties of an element using its position in the periodic table; collect data to infer the relationships	Ninth grade students at the below mastery level 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	Ninth grade students at the novice level 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

demonstrate the relationships among density, mass and volume and apply to earth and environmental models; extrapolate absolute zero from student collected data; quantitatively express changes in energy content during physical, chemical and nuclear changes; quantitatively distinguish ionic, nonpolar and polar covalent compounds; given a chemical formula determine the oxidation numbers of its elements predict the products, write the formula and determine the coefficients of a chemical equation; predict and verify the identity of observable products of a chemical reaction given the reactants; quantitatively determine the energy produced during exothermic reactions; 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	relationships among density, mass and volume and apply to earth and environmental models; detect movement of particles through measures of volumetric expansion of gasses at elevated temperatures; model atomic changes occurring during physical, chemical and nuclear changes; from experimental data categorize compounds as ionic, nonpolar or polar covalent compound; given a chemical formula determine the oxidation numbers of its ions; write the formula for the compounds and determine the coefficients of a chemical equation; predict the observable product of a chemical reaction; conduct 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	among density, mass and volume and apply to earth and environmental models; relate molecular motion and the amount of kinetic energy to the temperature of a system; compare and contrast changes to atoms during physical, chemical and nuclear changes; characterize compounds as ionic, nonpolar covalent or polar covalent and distinguish the difference between molecular and ionic structures; write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions; determine the coefficients and classify the reaction type of a chemical equation; 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	density, mass and volume; illustrate molecular motion of different states of matter; recognize that atoms are not altered during physical changes and are rearranged during chemical reactions; identify models of ionically and covalently bonded compounds; given the chemical formula of a binary ionic compound of representative elements write the name of the compound; determine the coefficients of a chemical equation; cite evidence for the occurrence of a chemical reaction from student generated experimental data; define and give examples of the law of conservation of mass/energy; compare the types of particles liberated in nuclear decay; perform a heat experiment to differentiate between heat and temperature; 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;	matter; identify the difference between physical and chemical change; define ionic and covalent bonds; name the elements in a chemical compound; define the chemical reaction types; safely perform an experiment involving chemical reactions; safely perform an experiment involving chemical reactions; define the law of conservation of mass/energy; define the particles of nuclear decay; define heat and temperature; experimentally determine and diagram magnetic fields of magnets; diagram the magnetic field of a magnet; construct DC circuits; define electricity 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

when given a known voltage fields; apply concepts of electricity and magnetism to generators or motors; apply the inverse square relationship to gravitational, magnetic and/or electrical interactions; design and conduct experiment that obtain data, apply graphs, vectors and mathematical models to quantify Newton's Laws of motion (i.e., velocity, acceleration, force, momentum, and time); design a complex machine and predict the mechanical advantage based on its simple machine components; determine the acceleration due to gravity using the period of a pendulum; use refractive indices to calculate the change in velocity as electromagnetic waves change media; triangulate the location of the source for seismic waves; examine the connections between global phenomena and weather systems and climate; differentiate variation in the climates of localities based on latitude, altitude and/or surface features; evaluate prior models for the formation of Earth's surface features in view of modern tectonic	solve for unknown variables using Ohm's Law and power equations; construct a model using an electromagnet and explain its operation; mathematically represent the inverse square relationship between distance and intensity of light and sound; experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion (i.e., velocity, acceleration, force, momentum, and time) and extrapolate data to predict undetermined variables; analyze a complex machine to identify and calculate the mechanical advantage of its component simple machines; mathematically predict the period of a pendulum based on the 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	equations; qualitatively explain the relationship between electricity and magnetism; conduct experiments to verify the inverse square relationship between distance and intensity of light and sound; experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion (i.e., velocity, acceleration, force, momentum, and time); conduct an experiment to calculate the mechanical advantages, work in/out and efficiencies of simple machines; design, conduct and analyze experiments to determine variables affecting the period of pendulums; differentiate between transverse and longitudinal waves and model examples of each type and relate to water, light and sound waves; examine seismographic and geologic evidence to determine structure, composition and age of the Earth; accurately predict and present a weather forecast using a weather map and meteorological data; analyze latitude, altitude and surface features to predict climatic	calculate the mechanical advantage of some simple machines; conduct experiments to determine how length affects the period of pendulums; illustrate the difference between transverse and longitudinal waves; illustrate the structure of the Earth labeling the physical properties of each layer; extract data from a weather map; relate latitude, altitude and surface features to climate; describe the effects of plate tectonics on the surface features of the Earth; describe the absolute magnitude, color and surface temperature of the sun using a H-R diagram; illustrate the heliocentric and geocentric models of the solar system.	diagram of the sun's layers including the temperature of each; label objects in the solar system.

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.	features; research, organize and report evidence to support the theory and effects of plate tectonics including density, force, radioactive decay, energy conservation, mountain building, fossil and magnetic evidence; predict the effects on the solar system as the sun changes over time; analyze the progression of theories for the formation of the Earth-Moon system.	conditions; research and organize evidence to support the theory and effects of plate tectonics including density, force, mountain building, fossil and/or magnetic evidence; describe energy production in the sun and apply energy transfer, solar wind and gravity to interpret the sun's impact on the solar system; investigate theories for the origin and configuration of the solar system (e.g. nebular theory, Earth-Moon formation, heliocentric and geocentric models).		

Objectives	Students will
SC.O.PS.2.01	apply dimensional analysis and scientific notation in making metric calculations
SC.O.PS.2.02	predict chemical and physical properties of an element using its position in the periodic table.
SC.O.PS.2.03	collect data to infer the relationships among density, mass and volume and apply to earth and environmental models (e.g., plate tectonics, weather systems, ocean currents)
SC.O.PS.2.04	relate molecular motion and the amount of kinetic energy to the temperature of a system
SC.O.PS.2.05	compare and contrast changes to atoms during physical, chemical and nuclear changes
SC.O.PS.2.06	characterize compounds as ionic, nonpolar covalent or polar covalent and distinguish the difference between molecular and ionic structures
SC.O.PS.2.07	write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions.
SC.O.PS.2.08	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.2.09	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.2.10	qualitatively and quantitatively describe the law of conservation of mass/energy (e.g., mechanical, thermal, chemical, electrical and nuclear)
SC.O.PS.2.11	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.2.12	experimentally demonstrate the relationship between heat and temperature (i.e., specific heat, melting point, latent heat)
SC.O.PS.2.13	predict, experimentally determine and diagram magnetic fields of magnets.
SC.O.PS.2.14	construct and diagram DC circuits and solve for unknown variables using Ohm's Law and power equations

SC.O.PS.2.15	qualitatively explain the relationship between electricity and magnetism
SC.O.PS.2.16	conduct experiments to verify the inverse square relationship between distance and intensity of light and sound
SC.O.PS.2.17	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.2.18	conduct an experiment to calculate the mechanical advantages, work in/out and efficiencies of simple machines
SC.O.PS.2.19	design, conduct and analyze experiments to determine variables affecting the period of pendulums.
SC.O.PS.2.20	differentiate between transverse and longitudinal waves and model examples of each type and relate to water, light and sound waves
SC.O.PS.2.21	examine seismographic and geologic evidence to determine structure, composition and age of the Earth
SC.O.PS.2.22	accurately predict and present a weather forecast using a weather map and meteorological data
SC.O.PS.2.23	analyze latitude, altitude and surface features to predict climatic conditions.
SC.O.PS.2.24	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.2.25	apply fusion, heat transfer, gravity, and electromagnetism to the sun's evolution and its impact on the solar system
SC.O.PS.2.26	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 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,	Ninth grade 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 makes them possible; evaluate the personal and societal benefits of a scientific	Ninth grade 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 positive outcomes and unintended consequences of a scientific discovery; explain the impacts of a	Ninth grade students at the below 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 positive outcomes and unintended consequences of a scientific discovery; identify the impacts of public	Ninth grade 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 consequences of a scientific discovery; identify the impact of a public policy

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

This is an advanced level course designed for students who have completed Physical Science and 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 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. 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.

<table>
<tr><td>Grade Ten</td><td colspan="5">Biology</td></tr>
<tr><td>Standard 1</td><td colspan="5">Nature of Science</td></tr>
<tr><td>SC.S.B.1</td><td colspan="5">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.</td></tr>
<tr><td colspan="6">Performance Descriptors SC.PD.B.1</td></tr>
<tr><td>Distinguished</td><td>Above Mastery</td><td>Mastery</td><td>Partial Mastery</td><td>Novice</td></tr>
<tr><td>Biology 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</td><td>Biology 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.</td><td>Biology 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.</td><td>Biology students at the below 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.</td><td>Biology 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.</td></tr>
<tr><td>Objectives</td><td colspan="5">Students will</td></tr>
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SC.O.B.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.B.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.B.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.B.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.B.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.B.O.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.B.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.B.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 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	Biology students at the above mastery level will relate the structure similarities of organelles to their function; relate the structural similarities of organelles to their function; analyze the chemistry and structure of the cell membrane and correlate the forces necessary for the	Biography 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 structure of the cell membrane as it	Biology students at the below mastery level with 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;	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, respiration, and fermentation; give

cell from simpler prokaryotic cells; research extracellular components and connections between cells (cell wall, extra cellular matrix, intercellular junctions); 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 physiological changes in animals during dormancy or hibernation necessary to maintain homeostasis; research and present information about the role of chemicals and their control of the cell cycle and disease; apply genetics to modern agricultural practices to increase production or quality of products; present scientist's experimental validation of role tRNA, mRNA, and rRNA have in the process of protein synthesis; discuss the roles of operons, inducer, and repressor in gene expression; compare and contrast the use of various genetic engineering technologies as potential solutions to real world	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; research how scientists experimentally determined the role of tRNA, mRNA, and rRNA as agents in peptide formation; compare ways gene expression is controlled; 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	relates to import and export of molecules necessary for life, including osmosis, diffusion, active and passive transport and dialysis; compare and contrast cell types (e.g., prokaryotic/eukaryotic, plant/animal, nerve/muscle, archaea/bacteria) by structures and functions; analyze the flow of energy through cellular processes such as photosynthesis, respiration and fermentation; analyze control mechanisms of themoregulation, osmoregulation, and excretion; outline mechanisms of homeostasis in living systems (negative and positive feedback); discriminate the events of the prokaryotic and eukaryotic cell cycles to distinguish important cellular and molecular processes; predict phenotypic results of a non Mendellian cross and provide examples of results; distinguish the structure and function of messenger, transfer and ribosomal RNA in the processes of transcription and translation; demonstrate the role of DNA in determining	diagram flow charts to demonstrate flow of energy through cellular processes; correlate negative feedback as integration of different organ systems (nervous, circulatory, reparatory); compare the cell cycles of prokaryotic and eukaryotic cells; predict phenotypic ratios by applying Mendel's Laws of Genetics; determine the phenotypes of the offspring of dihybrid across for complete dominance, and codominance using a Punnett square; mastery-correlate the relationship between mRNA and tRNA in the process of protein synthesis; demonstrate roles of DNA and protein in determining phenotype; trace the social and ethical implications of past DNA technology; 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 systems in an organism;	examples of how an animal can control internal and external environmental changes; outline the eukaryotic cell cycle; determine the phenotypes of the offspring of monohybrid cross for complete dominance, incomplete dominance, and codominance using a Punnett square; define translation, transcription, mRNA, tRNA, and rRNA; summarize the relationships between DNA, RNA, and proteins; 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; define viruses, list the major systems of an organism; define homeostasis; define genetic equilibrium; list biotic and abiotic factors in a given ecosystem; define producers and consumers; identify limiting factors in an environment.

problems; compare and contrast gradualism and punctuate 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 functions of other organisms; access the role of negative and positive feedback in controlling the rates of life processes; estimate the percentage of a population carrying the recessive allele for an inherited disease; 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; explain why small o r isolated populations are more vulnerable to extinction than large populations.	mechanisms that are used as an organism maintains homeostasis; apply the Hardy-Weinberg theory to analyze changes or problems within a given population; explain how major biogeochemical processes move nutrients between biotic and abiotic parts of the ecosystem; explain why a given area of land can support more herbivores then carnivores; predict future population increases or decreases based on current demographic information available for a population.	phenotype and illustrate ways of controlling and regulating expression and function of genes; research the application of DNA technology in the context of social and political issues; evaluate the evidence for natural selection including speciation, fossil record evidence, molecular similarities and homologous structure; evaluate the influence of the historical social context on the development of evolutionary theory; compare morphological, cladistic and other classification systems including domains, kingdoms, and other taxa; interpret the placement of viruses in the current classification systems; incorporate the structure and function of individual systems to the overall functioning of the organism; assess responses of organisms to internal and environmental stimuli; predict probability of extinction based on Hardy-Weinberg calculations; propose ecosystem models that incorporate interactions of biotic and abiotic environmental variables; diagram changes in energy as it flows through an	explain the importance of homeostasis; explain how Hardy-Weinberg conditions stabilize the genetic composition of a population; describe the interdependency of biotic factors in an ecosystem; contrast a food chain to a food web; calculate the growth rate for a population as it is represented on a graph.	

		ecosystem to illustrate conservation of energy; analyze population growth curves to predict limiting factors in ecosystems as they determine carrying capacity.		

Objectives	Students will
SC.O.B.2.1	correlate the properties of 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	analyze the chemistry and structure of the cell membrane as it relates to import and export of molecules necessary for life including osmosis, diffusion, active 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.2.5	analyze the flow of energy through cellular processes such as photosynthesis, respiration and fermentation.
SC.O.B.2.6	outline mechanisms of homeostasis in living systems (negative and positive feedback).
SC.O.B.2.7	discriminate the events of the prokaryotic and eukaryotic cell cycles to distinguish important cellular and molecular processes.
SC.O.B.2.8	predict phenotypic ratios by applying Mendel's Laws of Genetics (e.g., incomplete dominance, pleiotrophy, epistasis, crossing over, environment, or development and age to phenotypic changes).
SC.O.B.2.9	distinguish the structure and function of messenger, transfer and ribosomal RNA in the processes of transcription and translation.
SC.O.B.2.10	demonstrate the role of DNA in determining phenotype and illustrate ways of controlling and regulating expression and function of genes.
SC.O.B.2.11	research the application of DNA technology in the context of social and political issues.
SC.O.B.2.12	evaluate the evidence for natural selection including speciation, fossil record evidence, molecular similarities and homologous structures.
SC.O.B.2.13	evaluate the influence of the historical social context on the development of evolutionary theory.
SC.O.B.2.14	compare morphological, cladistic and other classification systems including domains, kingdoms and other taxa.
SC.O.B.2.15	interpret the placement of viruses in the current classification systems.
SC.O.B.2.16	incorporate the structure and function of individual systems to the overall functioning of the organism.
SC.O.B.2.17	assess responses of organisms to internal and environmental stimuli.
SC.O.B.2.18	predict probability of extinction based on Hardy-Weinberg calculations.
SC.O.B.2.19	propose ecosystem models that incorporate interactions of biotic and abiotic environmental variables.
SC.O.B.2.20	diagram changes in energy as it flows through an ecosystem to illustrate conservation of energy.
SC.O.B.2.21	analyze population growth curves 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 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 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 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 below 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 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 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

This is an introductory course designed for students who have completed Physical Science and who are interested in the field of technical biology with the scientific knowledge and opportunities to develop the inquiry, problem solving 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. The course will provide an in-depth study in the chemical nature of life, cellular functions, microbiology, ecology, biotechnology, zoology and botany with 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 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.			
Performance Descriptors SC.PD.CB.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Technical/ Conceptual Biology 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	Technical/ Conceptual Biology 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.	Technical/ Conceptual Biology 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.	Technical/ Conceptual Biology students at the below 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	Technical/ Conceptual Biology 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.

data sources and interpretation of models			experimental data.	

Objectives	Students will
SC.O.CB.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.CB.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").
SC.O.CB.1.3	relate societal, cultural and economic issues to key scientific innovations.
SC.O.CB.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.CB.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.CB.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.CB.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 CB.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 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 calculate and compare the efficiencies of lactic acid fermentation and cellular respiration; experimentally quantify the raters of	Conceptual Biology students at the above mastery level will compare and contrast cellular respiration, photosynthesis, and fermentation; construct and label diagrams to illustrate the cellular	Conceptual Biology students at the mastery level analyze the flow of matter and energy through cellular processes such as photosynthesis, respiration and fermentation; correlate the properties of molecules	Conceptual Biology students at the below mastery level will identify the interdependency of cellular respiration and photosynthesis; describe the properties of the parts of the phospholipid bilayer of	Conceptual Biology students at the novice level will define photosynthesis and cellular respiration; describe the plasma membrane of a cell; identify pigments that are active in photosynthesis define and

diffusion and osmosis; explain the processes and results; describe what happens to an electron when it absorbs a photon of light energy during the photosynthesis process ; construct physical models to explain the major processes associated with biochemical pathways such as photosynthesis and cellular respiration; synthesize information about bioaccumulation and biomagnification with water pollution and use practices; experimentally determine the decomposition effectiveness of biodegradable products; propose solutions to the problems created by modern landfills; construct a model to predict the of human activity on a biogeochemical process; produce maps of an area based on GIS and other data that predict patterns in biological and environmental systems; design a model of an ecosystem and explain the complex interactions of organisms based on their niches including interspecific and intraspecific competition, and symbiosis; collect	process that allow various kinds of molecules to move through biological membranes; construct a graph to show the relative effectiveness of different wavelengths of light for chlorophylls and other pigments; explain the movement of electrons and the rearrangement of carbon-based molecules as they move through biochemical pathways such as photosynthesis and cellular respiration; research and present methods of reducing or preventing water pollution at the local level; design a recycling or conservation program for the school/community to increase public awareness and cooperation; describe environmental problems caused by landfills; explain possible causes and consequences of human activity on a biogeochemical process; collect GIS, map and other data to determine patterns in biological and environmental systems; analyze a local ecosystem to determine complex interactions of organisms within ecosystems based on their niches including interspecific and intraspecific competition,	to their movement through biological membranes; apply the absorption spectrum of photosynthetic pigments to the action spectrum of photosynthesis; relate molecules to their functions in biochemical pathways; assess water use practices based on water supply and quality; defend the use of recycling as a tool for energy and resource conservation; illustrate the functioning of modern sanitary landfills and compare them with historic disposal methods; predict the effects of human activity on cycles of matter and energy in the biosphere over time compile GIS and traditional map data to locate patterns in biological and environmental systems; characterize complex interactions of organisms within ecosystems based on their niches including interspecific and intraspecific competition, and symbiosis; evaluate the use of a particular sampling technique to study ecosystems; predict changes in an ecosystem's productivity when environmental variables are altered; analyze graphs reflecting changes in	the plasma membrane; describe the pigments used in the photosynthesis process and their functions; identify molecules associated with associated with biochemical pathways such as photosynthesis and cellular respiration; explain why fresh water is a limited resource; lists the steps an item must go through to be recycled; describe how a modern landfill works; identify how human activities affect cycles of matter and energy; use maps and data to locate patterns in biological and environmental systems; identify simple interactions of organisms within ecosystems based on their niches; use an appropriate sampling technique to study an ecosystem; identify variables that will influence the productivity of an ecosystem; graph population changes over time; analyze a model of soil development to identify influential factors; analyze past effects of biocides on diversity of life in an ecosystem; model DNA and RNA molecules; identify phenotypic changes that result from molecular differences; identify	list examples of biochemical pathways; list reasons why water is important to organisms in an ecosystem; identify ways to reduce waste; identify types of solid waste; diagram one major biogeochemical process that moves nutrients through biotic and abiotic forms; use a map to find a location; match organisms to their niches in an ecosystem; collect samples to study an ecosystem; define productivity; determine population size from a graph; list factors that influence soil development; define biocides; list and describe the parts of a nucleic acid; discriminate between phenotype and genotype; use a karyotype to determine chromosome count of an individual; list DNA technologies that may have social and ethical implications; compare morphology, reproduction and life cycles of plants; describe a forest management practice; list common wild and cultivated plants that are important to humans; recognize animal distributions in a representation of the environment; identify a

samples from an ecosystems using multiple sampling techniques and justify the effectiveness of each; quantify productivity of an ecosystem resulting from changes in multiple environmental variables; produce complex graphs with multiple environmental factors and assess the impact of each variable on a population; apply soil development cycles to local human activity and predict future impact; justify the use of a biocide in the context of potential impact on biodiversity; evaluate the roles nucleic acids and proteins in the central dogma; synthesize the Hardy-Weinberg principle with phenotypic and molecular changes in populations of organisms; 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; predict the effects of altering a variable in a habitat on the morphology, reproduction and life cycles of plants in these habitats; recommend a forest	and symbiosis; predict alternative outcomes for an ecosystem study that may result from different sampling techniques; model an ecosystem showing changes in productivity when environmental variables are altered; produce graphs showing changes in populations from raw data and extrapolate to future populations; evaluate the influence of past human and natural activity that has influenced soil development and use; evaluate the effects of biocide use and chemical hazards on the diversity of life in ecosystems; analyze the roles of DNA and types of RNA in inheritance and gene expression; analyze the molecular changes that cause phenotypic differences in an organism; prepare example karyotypes and pedigrees for example genetic disorders; present arguments regarding the potential use and abuse of specific genetic engineering technologies; model a variety of habitats and identify the morphology, reproduction and life cycles of plants in these habitats; evaluate forest	populations to predict future populations; model cycles in soil including natural and human interactions that influence soil development; evaluate the effects of biocide use and chemical hazards on the diversity of life in ecosystems; demonstrate the role of DNA in inheritance and gene expression; apply principles of genetics to the molecular processes that lead to phenotypic changes; analyze karyotypes and pedigrees as diagnostic tools; debate the social and ethical implications of genetic engineering using current DNA technology; compare and contrast the morphology, reproduction and life cycles of plants in view of the habitats supporting the plants; evaluate forest management practices for short and long-term resource utilization; assess the importance of wild and cultivated plants to human society, economics and environment; analyze animal distributions and the environments supporting those populations; compare animal behaviors and reproductive strategies as they lead to evolutionary	common genetic disorders using pedigrees and karyotypes; trace the social and ethical implications of past DNA technology; match morphology, reproduction and life cycles of plants to habitats supporting the plants; compare two forest management practices that attempt to utilize resources; compare related wild and cultivated plants that are important to humans; describe how animal populations are dependent on their environments; identify animal behaviors and reproductive strategies that lead to success in a specific environment; match characteristics of organisms to their life cycles.	behavior in an animal that leads to success in its environment; identify some characteristics of organisms.

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, economics and environment; design a model environment and predict the distribution of animals in this environment; predict changes in animal behaviors and reproductive strategies as specific environments change; evaluate the suitability of characteristics, structures, life cycles and functions of organisms as they enable survival in a changing environment.	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 environment; predict characteristics of environments based on distributions of animals in them; evaluate how specific environmental variables lead to animal behaviors and reproductive strategies; predict life cycles and functions of organisms based on their characteristics and structures.	success in specific environments; compare the characteristics, structures and life cycles of simple to complex organisms.		

Objectives	Students will
SC.O.CB.2.1	analyze the flow of matter and energy through cellular processes such as photosynthesis, respiration and fermentation.
SC.O.CB.2.2	correlate the properties of molecules to their movement through biological membranes.
SC.O.CB.2.3	apply the absorption spectrum of photosynthetic pigments to the action spectrum of photosynthesis.
SC.O.CB.2.5	relate molecules to their functions in biochemical pathways.
SC.O.CB.2.7	assess water use practices based on water supply and quality.
SC.O.CB.2.8	defend the use of recycling as a tool for energy and resource conservation.
SC.O.CB.2.9	illustrate the functioning of modern sanitary landfills and compare them with historic disposal methods.
SC.O.CB.2.10	predict the effects of human activity on cycles of matter and energy in the biosphere over time.
SC.O.CB.2.11	compile GIS and traditional map data to locate and evaluate patterns in biological and environmental systems.
SC.O.CB.2.12	characterize complex interactions of organisms within ecosystems based on their niches including interspecific and intraspecific competition, and symbiosis.
SC.O.CB.2.13	evaluate the use of a particular sampling technique to study ecosystems.
SC.O.CB.2.14	predict changes in an ecosystem's productivity when environmental variables are altered.
SC.O.CB.2.15	analyze graphs reflecting changes in populations to predict future populations.
SC.O.CB.2.16	model cycles in soil including natural and human interactions that influence soil development.
SC.O.CB.2.17	evaluate the effects of biocide use and chemical hazards on the diversity of life in ecosystems.
SC.O.CB.2.18	demonstrate the role of DNA in inheritance and gene expression.

SC.O.CB.2.19	apply principles of genetics to the molecular processes that lead to phenotypic changes.
SC.O.CB.2.20	analyze karyotypes and pedigrees as diagnostic tools.
SC.O.CB.2.21	debate the social and ethical implications of genetic engineering using current DNA technology.
SC.O.CB.2.22	compare and contrast the morphology, reproduction and life cycles of plants in view of the habitats supporting the plants.
SC.O.CB.2.23	evaluate forest management practice for short and long-term resource utilization.
SC.O.CB.2.24	assess the importance of wild and cultivated plants to human society, economics and environment.
SC.O.CB.2.25	analyze animal distributions and the environments supporting those populations.
SC.O.CB.2.26	compare animal behaviors and reproductive strategies as they lead to evolutionary success in specific environments.
SC.O.CB.2.27	compare the characteristics, structures and life cycles of simple to complex organisms

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
Biology Technical/ Conceptual 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 the technology; evaluate how a scientific discovery impacts public policy decisions regarding health, population resources and environmental issues.	Biology Technical/ Conceptual 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 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 Technical/ Conceptual 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 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 Technical/ Conceptual students at the below 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 positive outcomes and unintended consequences of a scientific discovery; identify the impacts of public policy decision regarding health, population resources or environmental issues.	Biology Technical/ Conceptual 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 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.

Chemistry Content Standards and Objectives

An advanced level course designed for students who have completed Ninth Grade Physical Science and desire a broader, in-depth study of the content found in the science field of chemistry. Chemistry is the advanced 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 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 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 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 below 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.	Chemistry students at novice level 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/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 (Number)

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	Chemistry students at the above mastery level qualitatively identify a substance by its physical and chemical properties; relate the electron configuration of hydrogen to the spectral lines emitted when a hydrogen discharge tube in energized; apply the	Chemistry students at the mastery level classify pure substances by their chemical and physical properties; construct the atomic structures of elements as they would appear if limited respectively to the contributions of a) Dalton, b)	Chemistry students at the below mastery level list the physical properties of a given pure substance; research and evaluate the contributions of Dalton, Planck, Bohr, Einstein, deBroglie, Heisenberg, and Schrödinger to the evolution of the atomic theory; draw a	Chemistry students at the novice level define pure substances and chemical and physical properties; describe the limitations of Dalton's model in light of modern evidence describe Dalton's model of the atom; use data obtained from the periodic table to determine

on the contributions of Dalton, Crookes, Thompson, Rutherford, Planck, Bohr, Einstein, deBroglie, Heisenberg, and Schrödinger; discuss the inherent limitations when applying the Bohr model to elements beyond hydrogen; 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; utilize effective nuclear charge and electron pairing to explain deviations from general trends in ionization energies; 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	Pauli Exclusion Principle to delimit the number of electrons 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; 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; name straight and branched chained hydrocarbons containing a maximum of ten carbon atoms following the IUPAC nomenclature; apply activity series to justify redox reactions and solubility table to justify precipitation reactions; apply activity series to justify redox reactions and solubility table to justify precipitation reactions; predict the product of reactions based on the driving forces:	Rutherford and Thompson, c) Bohr, and d) Schrödinger; draw Bohr models to demonstrate number and relative placement of protons, neutrons, and electrons for any element on the periodic table determine the proper set of quantum numbers (n, l, ml, and ms) for any electron in any given element; produce electronic configurations 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 elements; generate the correct ionic or molecular formula and communicate the correct name for the compound to include roman numerals or prefixes as needed; utilize effective nuclear charge and electron energy states to explain trends in atomic size, ionic size, and ionization energies; analyze the periodic table to predict 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, convalent or	model of an atom reflecting the number of protons and neutrons in the nucleus and the number of electrons surrounding the nucleus; determine shape (s, p, d, f) from the element's place on 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; identify hydrocarbons as being either an alkane, alkene, or alkyne; write balanced equations when reactants and products are given and classify the reaction type; write balanced equations when reactants and products are given and	proton, neutron, and electron count; relate the period number to n (principle quantum number) for representative metals and nonmetals; produce electron 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; write balanced equations when reactants and products are given; list some of the driving forces in reactions: formation of solid, formation of water, transfer of electrons and formation of a gas; given the formulas

the molecules as polar or nonpolar; name alcohols, aldehydes, ketones, and ethers following the IUPAC nomenclature; write balanced half reactions for redox reactions and complete and net ionic equations for precipitation reactions; write balanced half reactions for redox reactions and complete and net ionic equations for precipitation reactions; collect data to demonstrate driving forces: formulation of a solid, formulation of water, transfer of electrons and formation of a gas; after balancing an equation, immediately produce the net ionic equation without writing the complete ionic equation; predict the amount of gas produced by chemical reaction, perform the laboratory investigation, examine the gas produced, and calculate percent yield; balance all redox reactions using the transfer of electrons involved; calculate the enthalpy of reactions using Hess's Law and identify as being exothermic or endothermic; generate complex mole conversions that require three or more conversion factors; predict the behavior of an ideal gas	formation of a solid, formation of water, transfer of electrons and formation of a gas; write net ionic equations for all "molecular" equations; measure the amount of gas produced by chemical reaction; balance synthesis, decomposition, and single replacement reactions as redox reactions; interpret a phase change diagram to calculate the heat flow; generate multi step mole conversions that require 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; validate the formula of a hydrated compound experimentally, calculate the percent error and suggest reasons for this error; experimentally determine the limiting reactant, and find percent yield and/or percent error; experimentally determine the extent to which factors influence the rate of a reaction; experimentally determine how the colligative properties respond to changes in	metallic bond formed; construct models to explain the structure models to explain the structure and geometry of organic and inorganic molecules and the lattice structures of crystals; recognize simple organic functional groups and classify simple organic compounds by name; 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); 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); identify the driving forces in reactions: formation of a solid, formation of water, transfer of electrons and formation of a gas; justify that the net ionic equation for the combination of a strong acid and a strong base in always the same design a means of	classify the reaction type; write balanced equations when reactants and products are given and classify the reaction type; list the driving forces in reactions: formation of solid, formation of water, transfer of electrons and formation of a gas; balance equation that contain acids and bases as reactants; perform a laboratory investigation to produce a gas by reacting a specified acid with a specified metal; recognize the transfer of electrons involved in synthesis, decomposition, and single replacement reaction; balance synthesis, decomposition, and single replacement reactions; 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 hydrated crystals, write the formulas and calculate the formula masses; calculate theoretical yield; identify how a factor influences the rate of a reaction; describe how the amount of solute affects the freezing point	for all reactants and products in an equation, correctly place the coefficients to balance the equation; perform a laboratory investigation to produce a gas by reacting a specified acid with a specified carbonate compound; identify chemical equations as synthesis, decomposition, or single replacement reactions; define exothermic and endothermic reactions; define the mole; convert Celsius temperatures to Kelvin; define molarity; define hydrated crystal; define theoretical yield; list the factors that influence the rate of reaction; define colligative properties of solutions; classify solutions as acidic or basic; describe the distinctive properties of acids and bases; observe and record the pH of a solution; recognize the mass number and number of protons and neutrons in a given isotope; define half-life; define radioactive isotope; label a phase change diagram; define specific heat capacity define heat and temperature; identify the components of a diagram of a chemical half-cell.

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; design and perform an experiment to identify the formula of a hydrated compound; a design an experiment to determine the limiting reactant; manipulate the amount of reactants to change the limiting reactant and validate the results of the experiments by calculating the percent yield and percent error; determine the rate order of a reaction; predict the effect on colliative properties of a solution when the amount of solute is changed; design and conduct a titration experiment to determine the equivalence point, pH and volume of reactants necessary; evaluate the appropriate use of technology in determining pH values and measuring equivalence points predict the stability of a nucleus by considering the factors such as nuclear size, binding energy, and the ratio of neutrons to protons in the nucleus; design and conduct a simulation of radioactive decay and compare simulated	mortal concentration; predict the outcome of an acid-base neutralization and determine conjugate acid-base pairs; predict the pH and/or pOH of a solution following a partial neutralization; predict the color change of an indicator given its starting and ending pH during a titration; design a flow chart showing a nuclear decay series given its associated nuclear decay particles and beginning isotope; predict the shape of a decay curve for a radioactive sample and determine the age of an artifact given mass and half life data; develop a presentation describing a specific application of radioactive technology; calculate the heat needed to change a solid below the melting temperature to a gas above the boiling point under standard conditions; design and conduct an investigation to determine the specific heat of an unknown metal; design and conduct an investigation to rate the effectiveness of various materials as heat sinks; design and conduct an investigation to produce an electrolytic cell with a specific voltage.	preparing a gas by chemical reaction; classify reactions by the direction of heat flow in a chemical reaction; a generate mole conversions that demonstrate the ability to convert from one type of quantity to another; perform calculations using the combined and ideal gas laws; perform calculations to communicate the molarity of solutions, percentage composition of elements in a compound, the empirical and molecular formula of elements in a compound and the formulas of hydrates; validate the formula of a hydrated compound experimentally; perform stoichiometric calculations to produce values for theoretical yield and to decide the limiting reactant of a given chemical reaction investigate the factors of reaction; investigate colligative properties of solutions; prepare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases; relate the pH or pOH to the hydronium ion or hydroxide ion concentration; compare methods of measuring pH (e.g., indicators, indicator paper, or pH meters); given the	and boiling point of a solution; define Arrhenius and Bronsted-Lowry acids; define pH and pOH; select an appropriate indicator given the pH range of a solution; identify a balanced nuclear equation by using nuclear mass and charge sums; determine the mass remaining after a given number of half lives, given a radioactive decay graph of mass remaining vs. time; list radioactive isotopes used in chemistry, industry and/or medicine; recognize the freezing point and boiling point; construct a calorimeter; measure temperatures; perform calculations to determine heat absorbed or released during temperature changes; write and balance the half-cell reactions.	

graphical results with actual radioactive decay; associate properties of radioisotopes such as types of decay particles, energies and storage/disposal requirements to industrial and/or medical applications; interpret a phase diagram showing the triple point; apply the law of conservation of energy in the calculation of specific heat; design and conduct an investigation to determine the change in heat content associated with a phase change; determine the effect of changes in concentration on the voltage of an electrolytic cell.		reactants, anticipate the products and create balanced equations for nuclear reactions; predict the amount of a radioactive sample that will remain after a given time period, given the decay constant or half-life of the sample; research applications of radioactive isotopes in chemistry, industry and/or medicine; interpret a phase change diagram; perform experiments of determine the specific heat capacity of metal; compare and contrast the concepts of heat and temperature; construct electrolytic cells, write and balance the half-cell reactions and calculate cell voltage.		

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, Planck, Bohr, Einstein, deBroglie, Heisenberg, and Schrödinger to the evolution of the atomic theory.
SC.O.C.2.3	draw Bohr models to demonstrate number and relative placement of protons, neutrons, and electrons for any element on the periodic table.
SC.O.C.2.4	determine the proper set of quantum numbers (n, l, ml, and ms) for any electron in any given element.
SC.O.C.2.5	produce electron configurations for any element on the periodic table and predict the chemical properties of the element from the electron configuration.
SC.O.C.2.6	illustrate Lewis' dot structures for representative (main group) elements.
SC.O.C.2.7	generate the correct ionic or molecular formula and communicate the correct name for the compound to include roman numerals or prefixes as needed.
SC.O.C.2.8	analyze the periodic table to predict trends in atomic size, ionic size, electronegativity, ionization energy and electron affinity.
SC.O.C.2.9	predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic bond formed.
SC.O.C.2.10	construct models to explain the structure and geometry of organic and inorganic molecules and the lattice structures of crystals.
SC.O.C.2.11	recognize simple organic functional groups and classify simple organic compounds by name.
SC.O.C.2.12	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.2.13	identify the driving forces in reactions: formation of a solid, formation of water, transfer of electrons and formation of a gas.
SC.O.C.2.14	justify that the net ionic equation for the combination ~~on~~ of a strong acid and a strong base is always the same.
SC.O.C.2.15	design a means of preparing a gas by chemical reaction.
SC.O.C.2.16	recognize the transfer of electrons involved in synthesis, decomposition, and single replacement reactions.
SC.O.C.2.17	classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction.
SC.O.C.2.18	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.2.19	perform calculations using the combined and ideal gas laws.
SC.O.C.2.20	perform calculations to communicate the molarity of solutions, percentage composition of elements in a compound, the empirical and molecular formula of elements in a compound and the formulas of hydrates.
SC.O.C.2.21	validate the formula of a hydrated compound experimentally.
SC.O.C.2.22	perform stoichiometric calculations to produce values for theoretical yield and to decide the limiting reactant of a given chemical reaction.
SC.O.C.2.23	investigate the factors that influence the rate of reaction.
SC.O.C.2.24	investigate colligative properties of solutions
SC.O.C.2.25	compare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases.
SC.O.C.2.26	relate the pH or pOH to the hydronium ion or hydroxide ion concentration.
SC.O.C.2.27	compare methods of measuring pH (e.g., indicators, indicator papers, or pH meters).
SC.O.C.2.28	given the reactants, anticipate the products and create balanced equations for nuclear reactions.
SC.O.C.2.29	predict the amount of a radioactive sample that will remain after a given time period, given the decay constant or half-life of the sample.
SC.O.C.2.30	research applications of radioactive isotopes in chemistry, industry and/or medicine.
SC.O.C.2.31	interpret a phase change diagram.
SC.O.C.2.32	perform experiments to determine the specific heat capacity of metal.
SC.O.C.2.33	compare and contrast the concepts of heat and temperature.
SC.O.C.2.34	construct electrolytic cells, write and balance the half-cell reactions and calculate cell voltage.

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 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.	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 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.	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 positive outcomes and unintended consequences of a scientific discovery; explain the impacts of a public policy decision regarding health, population resources or environmental issues.	Chemistry students at the below 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 positive outcomes and unintended consequences of a scientific discovery; identify the impacts of public policy decision regarding health, population resources or environmental issues.	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 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	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).
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

An introductory level course designed for students in the skilled pathway who have completed Ninth Grade Physical Science and who desire an alternative to a traditional college preparatory course emphasizes 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 below 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.CTC.1. 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
The Technical/Conceptual Chemistry student at the distinguished level will design an activity to separate a heterogeneous and homogenous mixtures; design and conduct an investigation to compare the conductivity and malleability of metals, nonmetals and	The Technical/ Conceptual Chemistry student at the above mastery level will classify a substance as a compound or element; predict the physical and chemical properties of common objects based on their composition; calculate the percent composition of	The Technical/Conceptual Chemistry student at the mastery level will differentiate between heterogeneous and homogenous mixture; compare and contrast the properties of metals, nonmetals and metalloids; research the sources and	The Technical/Conceptual Chemistry student at the below mastery level will classify examples of matter as pure substance or mixture; identify substances as metals, nonmetals and metalloids from their locations on the periodic table; given the formula of a	The Technical/Conceptual Chemistry student at the novice level will define pure substance and mixture; define metals, nonmetals and metalloids; define elements and minerals; define states of matter; convert Celsius temperature to Kelvin temperature;

metalloids; relate the %comp of an element to the source or strength of a mineral; predict the physical state of matter using both the attractive forces between molecules and their kinetic energy; predict the outcome of changing a variable in a gaseous system and calculate the value of the responding variable; perform an investigations to compare and contrast the physical and chemical properties of elements within a period; design an experiment to separate components of a heterogeneous and homogenous mixture; generate the correct molecular formula for binary and oxy-acids and communicate the correct names; predict the type of bonding that occurs between two nonmetallic elements and describe the polarity of the bonds; 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; predict the products, write the formula and determine the	each element in a compound; predict relative velocities of molecules with different masses at the same temperature; perform calculations using the combined and ideal gas laws; perform an investigations to compare and contrast the physical and chemical properties of elements within a period; design an experiment to separate components of a heterogeneous mixture; 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 metallic and nonmetallic elements and write ionic formulas; 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; write the formula for the compounds and determine the coefficients of a chemical equation; apply dimensional analysis and scientific notation to evaluate equations;	uses of elements; use the kinetic molecular theory to explain states of matter; perform calculations using the gas laws; predict the physical and chemical properties of an element based on the relationship between its group and period on the periodic table; examine experimentally the methods of separating mixtures; generate the correct formula and/or name for ionic and molecular compounds; predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic bond formed; analyze the periodic table to predict trends in atomic size, ionic size, electronegativity, ionization energy and electron affinity; illustrate Lewis' dot structures for representative elements; determine the coefficients and classify the reaction type of a chemical equation; apply dimensional analysis and scientific notation in making metric calculations; generate mole conversions that demonstrate the ability to convert from one type of quantity to another; perform calculations to communicate	mineral identify the elemental composition; illustrates the states of matter at the molecular level; identify pressure and volume units; match an element to its group and period on the periodic table; identify the physical properties necessary to separate mixtures; generate the correct formula or name for ionic and molecular compounds; define ionic, covalent and metallic bonds; 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; determine the coefficients of a chemical equation; enter conversion factors into dimensional analysis problems; write conversion factors; calculate molarity and percentage composition; differentiate among linear, trigonal planar, and tetrahedral shapes; make a solution of a specified concentration; select an appropriate indicator given the pH range of a solution; illustrate water as a polar molecule; define Arrhenius and Bronsted-Lowry acids; write formula	define element, group and period; identify materials as mixtures or pure substances; recognize that placement on the periodic table determines the common ionic charge of representative elements; classify elements as metallic or nonmetallic; 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 chemical reaction types; select from a list the correct metric conversion factor; define the mole; define molarity; construct ball and stick models for simple molecules; define solute, solvent and solution; observe and record the pH of a solution; define polarity; classify solutions as acidic or basic; write formula for acids and bases; define heat and temperature; define exothermic and endothermic reactions; define specific heat capacity; label a phase change diagram; list the factors that influence the rate of reaction; recognize the mass number and

coefficients of a chemical equation; apply dimensional analysis and scientific notation to evaluate student derived equations; generate complex mole conversions that 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 and molecular shape to classify the molecules as polar or nonpolar; experimentally determine how the colligative properties respond to changes in molal concentration; evaluate the appropriate use of technology in determining pH values and measuring equivalence points; identify the intermolecular forces between molecules as London dispersion, dipole-dipole and hydrogen; design and conduct an experiment to buffer a solution; justify that the net ionic equation for the combination of a strong acid and a strong base is always the same; design and conduct an investigation to determine the change in heat content associated with a phase change; calculate the enthalpy of reactions using	generate multi step mole conversions that 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; investigate colligative properties of solutions; predict the color change of an indicator given its starting and ending pH during a titration; investigate the solubility of various materials in water; predict the outcome of an acid-base neutralization and determine conjugate acid-base pairs; balance equations that contain acids and bases as reactants; design and conduct an investigation to rate the effectiveness of various materials as heat sinks; interpret a phase change diagram to calculate the heat flow; design and conduct an investigation to determine the specific heat of an unknown metal; calculate the heat needed to change a solid below the melting temperature to a gas above the boiling point under standard conditions experimentally determine	the molarity of solutions, percentage composition of elements in a compound, the empirical and molecular formula of elements in a compound and the formulas of hydrates; construct models to explain the structure and geometry of organic and inorganic molecules and the lattice structures of crystals; determine experimentally the effects of temperature and concentration on solution properties such as solubility, conductivity, or density; compare methods of measuring pH (e.g., indicators, indicator papers, or pH meters); recognize that water's role as a solvent is dependent upon its polarity; compare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases; predict the product of an acid-base reaction; compare and contrast the concepts of heat and temperature; classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction; perform experiments to determine the specific heat capacity of metal; interpret a phase change diagram;	for acids and bases; perform calculations to determine heat absorbed or released during temperature changes; classify reactions as exothermic and endothermic reactions; construct a calorimeter; measure temperatures; recognize the freezing point and boiling point; identify how a factor influences the rate of a reaction; identify a balanced nuclear equation by using nuclear mass and charge sums.	number of protons and neutrons in a given isotope.

Hess's Law and identify as being exothermic or endothermic; apply the law of conservation of energy in the calculation of specific heat; interpret a phase diagram showing the triple point; determine the rate order of a reaction; predict the stability of a nucleus by considering the factors such as nuclear size, binding energy, and the ratio of neutrons to protons in the nucleus.	the extent to which factors influence the rate of a reaction; design a flow chart showing a nuclear decay series given its associated nuclear decay particles and beginning isotope.	investigate the factors that influence the rate of reaction; given the reactants, anticipate the products and create balanced equations for nuclear reactions.		

Objectives	Students will
SC.O.CC.2.1	classify examples of matter as pure substance or mixture.
SC.O.CC.2.2	compare and contrast the properties of metals, nonmetals and metalloids.
SC.O.CC.2.3	research the sources and uses of elements.
SC.O.CC.2.4	use the kinetic molecular theory to explain states of matter.
SC.O.CC.2.5	perform calculations using the gas laws.
SC.O.CC.2.6	predict the physical and chemical properties of an element based on the relationship between its group and period on the periodic table.
SC.O.CC.2.7	examine experimentally the methods of separating mixtures (e.g., filtration, distillation, or chromatography).
SC.O.CC.2.8	generate the correct formula and/or name for ionic and molecular compounds.
SC.O.CC.2.9	predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic bond formed.
SC.O.CC.2.10	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	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.CC.2.13	apply dimensional analysis and scientific notation in making metric calculations
SC.O.CC.2.14	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.2.15	perform calculations to communicate the molarity of solutions, percentage composition of elements in a compound, the empirical and molecular formula of elements in a compound and the formulas of hydrates.
SC.O.CC.2.16	construct models to explain the structure and geometry of organic and inorganic molecules and the lattice structures of crystals.
SC.O.CC.2.17	determine experimentally the effects of temperature and concentration on solution properties (e.g., solubility, conductivity, or density and colligative properties).
SC.O.CC.2.18	compare methods of measuring pH (e.g., indicators, indicator papers, or pH meters).

SC.O.CC.2.19	recognize that water's role as a solvent is dependent upon its polarity.
SC.O.CC.2.20	compare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases.
SC.O.CC.2.21	predict the product of an acid-base reaction.
SC.O.CC.2.22	compare and contrast the concepts of heat and temperature.
SC.O.CC.2.23	classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction.
SC.O.CC.2.24	perform experiments to determine the specific heat capacity of metal.
SC.O.CC.2.25	interpret a phase change diagram.
SC.O.CC.2.26	investigate the factors that influence the rate of reaction.
SC.O.CC.2.27	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.PS.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 the technology; evaluate how a scientific discovery impacts public policy decisions regarding health, population resources and environmental issues.	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 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 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 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 Chemistry students at the below 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 positive outcomes and unintended consequences of a scientific discovery; identify the impacts of public policy decision regarding health, population resources or environmental issues.	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 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.

Earth Science Content Standards and Objectives

An advanced level lab course designed for students who have completed Science Nine and desire a broader understanding of the fundamentals of earth science that includes geology, oceanography, meteorology and astronomy. This course is designed to build on knowledge, skills, and dispositions developed during the science progression, which approached science in a rigorous and integrated manner including 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.
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.
Objectives	Students will
SC.O.ES.2.1	review foundational earth science concepts including rocks and the rock cycle, minerals, properties of waves, constructing and interpreting weather maps, surface features found on maps, climatic relationships to biomes, use of data gathering instruments, temperature-phase change relationships.
SC.O.ES.2.2	identify and describe the structure, origin, and evolution of the lithosphere, hydrosphere, atmosphere and biosphere.
SC.O.ES.2.3	analyze seismic, density, gravity, and magnetic data to explain the structure of the earth.
SC.O.ES.2.4	characterize the eras, epochs and periods in relation to earth history and geologic development.
SC.O.ES.2.5	analyze rock and fossil evidence to estimate the relative ages of rocks.
SC.O.ES.2.6	estimate the absolute age of materials using radiometric data.
SC.O.ES.2.7	use chemical and physical properties to distinguish between common minerals and explain their economic uses.
SC.O.ES.2.8	use rock characteristics to predict paleoenvironments or geologic conditions which existed during the formation of a given rock sample.
SC.O.ES.2.9	investigate and describe the properties of water, which contribute to its critical role in physical and chemical weathering.
SC.O.ES.2.10	compare and contrast the effectiveness of agents and processes of degradation, i.e., • weathering by gravity, • wind, • water, • ice.
SC.O.ES.2.11	predict geologic activity associated with specific plate boundaries and interactions.
SC.O.ES.2.12	analyze modern and historical seismic information to determine epicenter location and magnitude of earthquakes.
SC.O.ES.2.13	evaluate current explanations for mechanisms, which drive the motion of plates (convection, slab-pull, plate push).
SC.O.ES.2.14	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.2.15	construct and/or interpret information on topographic maps.
SC.O.ES.2.16	identify and describe chemical and physical properties of oceans, i.e., • composition, • currents, • physical features of the ocean floor.
SC.O.ES.2.17	compare and contrast characteristics of the various oceans, including their lateral and vertical motions.
SC.O.ES.2.18	analyze the evolution of the ocean floor including ocean crust, sedimentation, active and passive continental margins.

SC.O.ES.2.19	examine the stratification of the oceans, i.e., • temperature, • salinity zones, • biological zones.
SC.O.ES.2.20	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.2.21	predict the effects of ocean currents on climate.
SC.O.ES.2.22	use meteorological evidence and weather maps (including air masses, wind, barometric pressure, and temperature data) to forecast weather.
SC.O.ES.2.23	examine global change over time, i.e., • climatic trends, • global warming, • ozone depletion.
SC.O.ES.2.24	compare and contrast theories concerning origins of the universe.
SC.O.ES.2.25	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.2.26	analyze several origin theories of the solar system to explain the planets, planet anomalies, planetary motion, and the asteroid belt.
SC.O.ES.2.27	examine celestial bodies, their formation, and their evolution (e.g., moon, stars, or comets).
SC.O.ES.2.28	relate the determination of time and location to navigation.
SC.O.ES.2.29	compare ancient and modern methods used to study astronomy.
SC.O.ES.2.30	use various wavelengths of the electromagnetic spectrum to investigate the observable universe.
SC.O.ES.2.31	compare the relationship between earth processes and natural disasters with their impact on humans.
SC.O.ES.2.32	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.2.33	research alternative energy sources to 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.
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

This advanced course is 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.
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.
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	correlate the properties of biological molecules to their function in biochemical pathways.
SC.O.HAP.2.3	diagram the role of DNA and the types of RNA in transcription and translation processes of protein synthesis.
SC.O.HAP.2.4	predict the movement of materials into and out of cells based on principles of osmosis and concentration gradients.
SC.O.HAP.2.5	relate the structure of cellular organelles to their functions and interactions in eukaryotic cells.
SC.O.HAP.2.6	describe the organizational levels, interdependency and the interaction of cells, tissues, organs, and organ systems.
SC.O.HAP.2.7	categorize, by structure and function, the various types of human tissue (e.g., muscle, epithelial, connective, or nervous).
SC.O.HAP.2.8	relate the structure of the integumentary system to its function as a sensory organ, environmental barrier and temperature regulator.
SC.O.HAP.2.9	relate how bone tissue is important to the development of the human skeleton.
SC.O.HAP.2.10	correlate the structure and function of the elements of the skeletal system (bone, articulations and insertions).
SC.O.HAP.2.11	model the mechanisms of muscular contraction on the cellular and molecular levels.
SC.O.HAP.2.12	integrate the skeletal, muscular and nervous systems to the functioning of the organism.
SC.O.HAP.2.13	model the muscular system including locations, origins, insertions, muscle groups and types of muscles.
SC.O.HAP.2.14	classify the various types of neurons emphasizing the relationship of structure and function.
SC.O.HAP.2.15	model the mechanism of a nerve impulse at the cellular and molecular levels.
SC.O.HAP.2.16	compare and contrast the parts and functions of the central and peripheral nervous system including the autonomic portions.
SC.O.HAP.2.17	apply the structure of the ear and eye to their function/dysfunction in relation to environmental perception.
SC.O.HAP.2.18	apply the action of specific enzymes to their roles in bodily functions.
SC.O.HAP.2.19	incorporate the role of endocrine glands and their hormones into the overall functions and dysfunctions of the body.
SC.O.HAP.2.20	analyze the role of components and processes of the digestive system in supplying essential nutrients.
SC.O.HAP.2.21	explain how structures of the respiratory system are essential to cellular respiration, gas exchange and communication.
SC.O.HAP.2.22	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.2.23	compare the compatibility of blood types and assess the molecular basis for blood functions.
SC.O.HAP.2.24	integrate the functions of the excretory system to the maintenance of the other body systems.
SC.O.HAP.2.25	compare and contrast the structure and function of male and female reproductive systems.
SC.O.HAP.2.26	apply the purposes, processes and outcomes of meiosis and mitosis to reproduction and growth.
SC.O.HAP.2.27	outline the events of reproduction for the formation of gametes through fertilizations and embryological development.
SC.O.HAP.2.28	analyze changes in DNA activity and the effects on protein synthesis, gene expression and human inheritance.
SC.O.HAP.2.29	apply Mendel's laws of inheritance to predict and current advances in DNA research to detect genetic diseases.

SC.O.HAP.2.30	assess the role of components of the immune system in defending the body.
SC.O.HAP.2.31	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.
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

An advanced level course designed for students who have completed Science Nine and desire 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.
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.
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 principal on fluid motion.
SC.O.P.2.10	critique the properties of an Ideal Gas in a variety of conditions and calculate these properties using the Boltzman constant.
SC.O.P.2.11	compare and contrast heat and temperature; validate this comparison by calculating values for kinetic, potential and internal energy.
SC.O.P.2.12	examine the reflective, refractive and diffractive properties of mechanical and transverse waves.
SC.O.P.2.13	perform calculations to determine wavelength, frequency, velocity or energy of a wave.
SC.O.P.2.14	compare and contrast the physical properties of mechanical and transverse waves.
SC.O.P.2.15	research applications of Doppler shift in determining an approaching or receding source in wave propagation.
SC.O.P.2.16	apply ray optics diagrams to lenses and mirrors; use the lens/mirror equation and the magnification equation to solve optics problems.
SC.O.P.2.17	justify the image results obtained by diagramming the ray optics of lenses and mirrors by deducing the image information from the lens/mirror equation.
SC.O.P.2.19	predict 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.P.2.20	construct and analyze electrical circuits and calculate Ohm's law problems for series, parallel and complex circuits including voltage drops; calculate power and energy in electrical systems.
SC.O.P.2.21	distinguish between direct and alternating current and identify ways of generating each type.
SC.O.P.2.22	conclude that modern astronomy reveals the universe through mathematical relationships (e.g., Kepler's Law, Newton's Law of Universal Gravitation, Einstein's special theory of relativity, Big Bang model, or inflation theory).

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.
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 introductory course designed for students who have completed Science Nine and desire an in-depth study in physics to 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.
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	

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.
Objectives	Students will
SC.O.CP.2.1	make measurements, construct and interpret graphs of data and apply basic problem-solving solutions.
SC.O.CP.2.2	solve right triangle vector problems both graphically and algebraically.
SC.O.CP.2.3	compare and contrast distance, speed, 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.2.4	analyze the motion of a projectile.
SC.O.CP.2.5	illustrate forces acting on objects with free body diagrams.
SC.O.CP.2.6	summarize Newton's laws distinguishing mass and weight to analyze and solve linear dynamics problems.
SC.O.CP.2.7	interpret Newton's Laws in terms of natural phenomena.
SC.O.CP.2.8	research the applications of force and acceleration in modern design and technology.
SC.O.CP.2.9	characterize conservation of momentum and kinetic energy in terms of elastic ands inelastic collisions.
SC.O.CP.2.10	compare and contrast kinetic and potential energies and recognize situations where mechanical energy is conserved.
SC.O.CP.2.11	deduce work, energy, power and efficiency in mechanical systems.
SC.O.CP.2.12	analyze Archimedes's and Pascal's principles to solve problems involving equilibrium and stability of floating systems.
SC.O.CP.2.13	compare the calculation of pressure for a solid object upon its surroundings with the calculation of a solid object in a fluid depth.
SC.O.CP.2.14	recognize the effects of Bernoulli's principle on fluid motion.
SC.O.CP.2.15	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.2.16	experimentally determine an object's specific heat capacity and evaluate the heat gained or lost by the object.
SC.O.CP.2.17	apply the mechanism of heat transfer and relate to environmental and energy conservation issues.
SC.O.CP.2.18	relate the first law of thermodynamics to energy conservation.
SC.O.CP.2.19	compare and contrast sound and light waves using the concepts of reflection, refraction, diffraction and interference.
SC.O.CP.2.20	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.2.21	model the production of a standing wave and propose a practical application of such a wave.
SC.O.CP.2.22	compare the Doppler shift effect for sound and light and point out examples of its occurrences and applications.
SC.O.CP.2.23	diagram image location involving plane and spherical mirrors, concave and convex lenses.
SC.O.CP.2.24	illustrate the applications of colored lights and pigments.
SC.O.CP.2.25	research total internal reflection, its effects, and its applications.
SC.O.CP.2.26	examine the concept of polarization and the means by which light becomes polarized.
SC.O.CP.2.27	illustrate a sketch of symmetrical electric and magnetic fields associated with various geometric charge distributions.
SC.O.CP.2.28	analyze simple direct current circuits using Ohm's and Kirchhoff's laws.
SC.O.CP.2.29	distinguish between direct current and alternating current circuits and describe how AC is converted to DC.

SC.O.CP.2.30	relate the magnitude and direction of an induced electric field to the inducing magnetic field, and visa versa.
SC.O.CP.2.31	critique the advantages and limitations of nuclear fission and nuclear fusion as energy sources.
SC.O.CP.2.32	compare and contrast Newton's and Einstein's concepts of gravity.
SC.O.CP.2.33	recognize how the Special Theory of Relativity applies to time dilation, length contraction, space time, space travel and length contraction.

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.
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.

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FISCAL NOTE WORKSHEET
(Submit 4 Copies)

D NO _____ DRAFT NO _____ BILL NO _____ RESOLUTION NO _____

UBJECT State Board Policy 2520.35: Science 9-12, Content Standards and Objectives for WV Schools FUND _____

OURCE OF REVENUE: ☐ GENERAL FUND ☐ SPECIAL ☐ OTHER (SPECIFY) _____

OST OF ESTIMATE BASED ON: ☐ AN ORIGINAL ESTIMATE ☐ BUDGET BILL ☐ OTHER (SPECIFY) _____

NCOME ESTIMATE BASED ON: ☐ AN ORIGINAL ESTIMATE ☐ BUDGET BILL ☐ OTHER (SPECIFY) _____

SHOW OVER-ALL EFFECT IN ITEMS 1 AND 2 & GIVE EXPLANATION OF BREAKDOWN BY FISCAL YEAR INCLUDING LONG-RANGE EFFECT

EFFECT OF PROPOSAL	ANNUAL		FISCAL YEAR		
	INCREASE	DECREASE	CURRENT ____	NEXT ___X__	THEREAFTER
1. ESTIMATED TOTAL COST	$ 0	$ 0	$ 0	$ 2,250,000.00	$ 150,000.00
PERSONAL SERVICES CURRENT EXPENSES REPAIRS/ALTERATIONS EQUIPMENT OTHER	$ 0	$ 0	$ 0	$ 0	$ 0
2. ESTIMATED TOTAL REVENUES	$ 0	$ 0	$ 0	$ 0	$ 0

3. EXPLANATION OF ABOVE ESTIMATES (INCLUDING LONG-RANGE EFFECT):

Instructional Materials (textbooks, etc.) $1,500,000.00
Lab Supplies and Equipment $ 250,000.00 initial cost; $150,000.00 ongoing cost
Laboratory Facilities Renovation $ 500,000.00

DATE 10/27/06

AGENCY West Virginia Department of Education

AUTHORIZED REPRESENTATIVE

Policy *2520.35: 21st Century High School Science Content Standards and Objectives for West Virginia Schools*
Comment Log
November , 2006 - December 1, 2006

Action	Type
N: No Response	- Negative
NA: Not Accepted	+ Positive
A: Accepted	0 Neutral

Date	Individual/Organization	Comments	Action/ Type	Rationale
11/08/06	Janet Richardson South Charleston High School	126-44R-1 In the first part of the document it is stated that students will have physical science in 9th grade and biology in 10th grade. I agree that this is the best way to sequence science curriculum. However, later in the document, it seems that under the headings of "mastery", etc, that the CATS objectives are still in place.	N -	The 9th and 10th grade science CSOs (old name-CATS 9 and CATS 10) are still in Policy 2520.35 (21st Century High School Science CSOs) because some students will still be taking theses classes until the current 8th graders graduate. These have been revised and the rigor has increased.
11/09/06	Judy Ruhlin Charleston Catholic High School	126-44R-1+ In the executive summary, one of the reasons given for revisions is to change the alignment of high school science courses to ninth grade physical science, tenth grade biology, eleventh grade chemistry. However, even a casual glance at the proposed objectives for these courses registers that	N -	The 9th and 10th grade science CSOs (old name-CATS 9 and CATS 10) are still in Policy 2520.35 (21st Century High School Science CSOs)

		the objectives are the same mixed up mess of topics that CATS science left us with. Does the right hand know what the left hand is doing? If the comment in the executive summary is correct, the entire list of proposed CSOs for high school science must be rewritten to reflect this. If the intent is to continue teaching teaching cell biology (etc) in ninth grade and Newton's Laws of Motion (etc) in the tenth grade, then the Executive Summary should reflect this.		because some students will still be taking these classes until the current 8th grade students graduate. These have been revised and the rigor has increased.
11/09/06	Mark LeMasters Magnolia High School	126-44R-1 If Biology/Conceptual Biology will be required of all 10th graders a) Why are there 10th grade science objectives? Are they general in nature or are they objectives for the WESTEST?	N 0 N 0	The 9th and 10th grade science CSOs (old name-CATS 9 and CATS 10) are still in Policy 2520.35 (21st Century High School Science CSOs) because some students will still be taking these classes until the current 8th graders graduate. These have been revised and the rigor has increased.
		b) Will the state achievement test be written to address skills at grade 10 or grade 11	N 0	WESTEST will be given at both grades.
		c) I think it should clearly identify what population is to take the		Policy 2510 identifies the target populations for these courses.

		conceptual versions of chemistry and biology. The objectives are broad enough to be general introductory courses capable by all students, especially those identified as LD or wishing to pursue non-technical classes. It should state explicitly what the advantage of taking the "Biology" or "Chemistry" class would be.		
11/11/06	Stefan Smolski Oak Glen High school	126-44R-4 Policy 2510 specifies the order in which the science classes are to be taken. It is redundant to add grade levels to the tables of content standards. Recommend replace grade levels such as Grade Nine Grade Ten, etc. with simply High School. > "Ninth Grade Physical Science Content Standards and Objectives." Recommend remove "Ninth Grade" from the content standards title. > > "Ninth grade students at the distinguished level construct, test..." Replace "Ninth grade" with Physical science. > SC.O.PS.2.20 - differentiate between transverse and longitudinal waves and model examples of each type and relate to water, light and sound wave. Include the differences between mechanical and electromagnetic waves.	N 0 N 0 N 0 NA + NA +	The titles are formatted for consistency with Policy 2520.3. The titles are formatted for consistency with Policy 2520.3. The titles are formatted for consistency with Policy 2520.3. Wording was specifically chosen by CSO committee. Included in Objective SC.O.PS.2.21

		> Add the following objectives to standard 2 for Physical Science: > 1) classify common rock forming minerals by examining their physical and chemical properties. > 2) analyze the processes of the rock cycle to predict the paleo-environment in which a rock sample is formed > 3) analyze the relationships of temperature, air pressure, wind speed, wind direction and humidity as depicted on a weather map and meteorological data. > 3) analyze the relationships of temperature, air pressure, wind speed, > wind direction and humidity as depicted on a weather map and meteorological data. rock sample is formed > 3) analyze the relationships of temperature, air pressure, wind speed, > wind direction and humidity as depicted on a weather map and meteorological data.	NA + NA +	Included in Objective SC.O.PS.2.21 Included in Objective SC.O.PS.2.22
11/13/06	Beth Moore Liberty High School (Harrison County)	126-44R-1 I was reviewing Policy 2530 and am unclear about the science requirements. When does the policy go into effect? Is it for the Freshmen class entering in 2008-09 or all students (including current 9th and 10th graders) who will be juniors and seniors in 2008-2009?	N -	The Policy goes into effect for students who are in the ninth grade in the 2008-2009 academic year. Rigor has increased in

		No where can I find that. Also, I certainly do hope that you are not advocating in the policy that all students take chemistry. As a parent and high school counselor, I certainly hope it is not for current high schoolers, but will be phased in with the 08-09 freshmen.		all curricular areas in order to provide 21st century skills and content knowledge for all students.
11/14/06	Dr. Pat Obenauf West Virginia University	126-44R-1 Thanks for the info. Tis interesting because much of the country is moving toward the integrated science and math approach. That means more texts will be coming out with that approach. It's sad to see WV moving backward again. Pat	N -	Changes in policy reflect current trends across the United States according to CCSSO reports and other data. Integrated science courses are aught from kindergarten until eighth grade. New texts will not be adopted in science until 2012.
11/14/06	Tina Cool Preston County High School	126-44R-1 How do we get the Forensics Science added to the list for a 4th science credit? The colleges in the state have already agreed to accept it as a lab science.	N +	This would require a change to Policy 2510. It can be used with a waiver under the current version of the policy.
11/14/0	Kim Poling	126-44R-1	N +	The CSOs for Biology

6	Wirt County High School	Where are the CSOs for Biology II? When will they be ready for comment?		II, Physics II, and Chemistry II are scheduled to be written during the summer of 2007 and will go out for comment sometime after that.
11/14/06	Rachel Merrifield East Fairmont High School	126-44R-1 I do not see any CSO's for Photo Journalism. They were listed under the Language Arts section previously, but I don't see them under the ones for public comment -- Does that mean that there are no plans to change any of the Photo journalism CSO's? I do have a concern with the current ones, they mainly address black and white print photography, which I think better relates to the technical photography courses. I teach photojournalism and we're doing much of the work with digital photography, which really is not addressed much in the current CSOs. I'm trying to train my students based on the premise that they plan to work in print media. Most newspapers, magazines, etc., are using digital photograp	N +	Photo Journalism is not a science course.
11/16/06	Greg Dodd George Washington High School	126-44R-1 THe format for the standards is nearly unreadable and therefore unuseable. They consist of runon sentences. They need to be separated and bulleted	N -	The CSOs are formatted for consistency with Policy 2520.3 and all other CSOS.
11/17/0	Michael Carte	126-44R-1	N +	This is addressed in

6	Riverside High school	I feel that students should take chemistry at the high school level. It is the central science, and a knowledge of chemistry is needed to properly understand biology, anatomy/physiology, environmental science, earth science, forensics, etc. Therefore, I applaud the move to make chemistry a requirement. Regarding sequencing, I feel that students should be required to take chemistry in the sophomore year rather than the junior year. This would allow students to better grasp biology (required) and other life science electives. Moreover, it would allow them to take AP chemistry during the junior year. This is important for college admissions purposes. Many selective colleges would like to see AP grades in the physical sciences prior to the senior year. By having a grade in the AP chemistry course rather than the status of "in progress," students will be placed at a competitive level nationally during the college admissions process.		Policy 2510.
11/24/06	Connie Huffman George Washington High school	126-44R-4 If I understand it correctly, students will have just 2 choices of chemistry—honors level or conceptual, which, for whatever reasons, is not accepted by WV colleges as a lab course. This is so limiting—why do students who want to go to college have to take a such a fast-paced, all-consuming course as honors chemistry? My daughter attends GW and the honors chemistry class there is extremely demanding, with many hours of	N -	The courses accepted for entry into higher education programs are determined by the Higher Education Policy Commission.

		study and preparation. This is fine for some students, but what about the students who want to major in business, music, art, journalism, etc. in college? Why an advanced chemistry? For that matter, if a teacher teaches chemistry correctly, even if just the conceptual level,it will still be considered a lab course. If teachers are not giving a conceptual chemistry class the lab time required, that is the administration's fault. And requiring all students to take chemistry?? Why can't students have more choices? Why chemistry of all things? Yes, it promotes logical thinking skills, but so do many other courses. We are pigeon-holing our students and trying to make them all fit into the same mold. What happened to individuality? Choice? About about the low-level students who cannot even comprehend the conceptual chemistry? Talk about leaving a child behind...		Rigor has increased in all curricular areas in order to provide 21st century skills and content knowledge for all students.
11/25/06	Thomas Ditty, Ed.D.Chair, Science Dept. TVHS	126-44R-4 In order to stimulate and maintain interest in various fields of science, students should be provided the opportunity to take a variety of courses beyond physical science and biology.	N 0	Policy 2510 provides for additional science courses such (i.e., Physics, Human Anatomy and Physiology, Earth Science, Biology II, Physics II, Chemistry II, AP science courses and college courses). In addition, waivers my be written for other courses.

11/29/06	Mrs. Meador Science Teacher	126-44R-2 The CSOs are poorly organized! There needs to be a more clear sequential order to the CSOs! Performance Descriptors are illogical! Let us teachers be the evaluators of mastery - that's what grades are for (get rid of those columns on mastery level-they are not very useful)! CSOs need to be more specific! Ex "demonstrate the ability to use the inquiry process to solve problems" is too vague. List the steps of the scientific method or conduct an experiment using dependent variable, independent variable, control and constants is a more appropriate objective! The CSOs as written leave too many unanswered questions and can be interpreted in many different ways, thus leading to inconsistencies as to what material is taught within the state based on individual teacher's interpretations of the objectives! To the best of my ability, I am teaching the current objectives in Biology and CAT9. Should my understanding be flawed, then I may miss a few details of a few CSOs, but my successful students will have a broad understanding of Biology...In Florida the objectives are clearly stated in terms of specific academic information. For example, " the student will be able to draw and label a food chain"..."the student will be able to explain the different tropic levels of an energy pyramid"..."the student will be able to label the respiratory structures in the human respiratory system and identify similar structures in other animals(such as book lungs, tracheal tubes...)..." With objectives such as the ones that I have cited, the	N 0	The CSOs are formatted for consistency with Policy 2520.3 and all other CSOS. The content of these standards have been carefully considered by groups of science teachers and closely match national standards. Additionally, data from TIMMS, PISA, NAEP, ACT, Partnership for 21st Century Skills Organization and other sources have been carefully considered. Student expectations are clearly indicated in the appropriate Performance Descriptors.

		teacher who understands his/her subject matter has no doubt about what he or she is being asked to do! With your current CSOs and your proposed CSOs, even the best teacher still has to interpret "what does this CSO really want me to teach"? and the teacher will not know without a standard exam as a "frame of reference"!		

Mike Kees

From: Carla Williamson [cljwilli@access.k12.wv.us]
Sent: Monday, November 27, 2006 9:18 AM
To: Mike Kees
Subject: FW: science requirements

Mike,

Please respond. Thanks!

Carla Williamson

Carla Williamson, Special Assignment
Office of Instruction
West Virginia Department of Education
1900 Kanawha Boulevard East
Charleston, West Virginia 25305-0330
Phone (304) 558-5325
Fax (304 558-3741
Email cljwilli@access.k12.wv.us

-----Original Message-----
From: Beth Moore [mailto:bqmoore@access.k12.wv.us]
Sent: Monday, November 13, 2006 10:43 AM
To: cljwilli@access.k12.wv.us
Subject: science requirements

Carla:

I was reviewing Policy 2530 and am unclear about the science requirements. When does the policy go into effect? Is it for the Freshmen class entering in 2008-09 or all students (including current 9th and 10th graders) who will be juniors and seniors in 2008-2009? No where can I find that.

Also, I certainly do hope that you are not advocating in the policy that all students take chemistry.

As a parent and high school counselor, I certainly hope it is not for current high schoolers, but will be phased in with the 08-09 freshmen. Thanks.

Beth Moore
Liberty Harrison

Mike Kees

From: jruhlin@charter.net
Sent: Tuesday, November 14, 2006 4:09 PM
To: Mike Kees
Subject: Re: New HS Science CSOs

Dear Mr. Kees,
Thank you for the clarity of your response. Partially because Charleston Catholic never adopted the CATS program, I neglected to consider those students already in the pipeline. My apologies.
Judy Ruhlin
Charleston Catholic High
---- Mike Kees <mkees@access.k12.wv.us> wrote:

> The 9th and 10th grade science CSOs (old name-CATS 9 and 10) are still
> in Policy 2520.35 (21st Century High School Science CSOs) because some
> students will still be taking theses classes until the current 8th graders graduate.
> These have been revised and the rigor has increased.
>
> Next years 9th grade, 10th grade and 11th grade students will still
> need the Ninth Grade Science class (old name- CATS 9) to graduate.
> Next years 12th grade students may still need the Tenth Grade Science
> (old name- CATS 10) if they haven't passed it to graduate. The old
> CATS 9 and CATS 10 CSOs will be removed as soon as students no longer need them to graduate.
>
> In 2008- 2009, the incoming freshmen will need Physical Science,
> Biology (or Conceptual Biology), and Chemistry (or Conceptual
> Chemistry). The "Conceptual" courses are to be taken only by students
> in the skilled career pathway. These skilled pathway students may
> also take the same courses as those in the professional pathway.
> Professional career pathway students cannot take the conceptual
> courses. Conceptual courses will not be accepted as lab science
> courses for entry into a 4-year college program in a West Virginia college or university.
>
> Students in the Professional career pathway will also need a 4th
> science credit from the list in Policy 2510 to graduate. These courses
> include Physics, Human Anatomy and Physiology, Earth Science, Biology
> II, Chemistry II, Physics II, AP Science, IB science, Dual and college
> credit science courses. Conceptual Physics will also be available for
> students in the Skilled career pathway.
>
> Please direct any questions to mkees@access.k12.wv.us.
>
> Thanks,
>
> Mike
>
> Michael Kees, Science Coordinator
>
> Office of Instruction
>
> Building 6 Room 304

> 1900 Kanawha Blvd., East
>
> Charleston, WV 25305-0330
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>

Mike Kees

From: Kim Poling [kpoling@access.k12.wv.us]
Sent: Tuesday, November 14, 2006 1:53 PM
To: 'Mike Kees'
Subject: RE: CSO's

Mike,

In your message, you mention that after the student has finished the sequence Physical Science, Biology, and Chemistry; they
could take Biology II, Chemistry II and various other courses. I am not familiar with a Biology II course, are there CSO's for this Biology II course.
If there are CSO's where would I find them.

Kim Poling

-----Original Message-----
From: Mike Kees [mailto:mkees@access.k12.wv.us]
Sent: Tuesday, November 14, 2006 10:30 AM
To: 'Kim Poling'
Subject: RE: CSO's

The policy online contains CSOs for Ninth Grade Science (CATS 9), Science 10 (CATS 10), Physical Science (new ninth grade course), Biology and Conceptual Biology , and Physics and conceptual Physics. They are currently out on comment.
Mike

Michael Kees, Science Coordinator
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From: Kim Poling [mailto:kpoling@access.k12.wv.us]
Sent: Tuesday, November 14, 2006 1:19 PM
To: mkees@access.k12.wv.us
Subject: CSO's

Mike,

Where are the cso's for biology II? When will they be ready for comment?

Kim Poling

DATE	INDIVIDUAL ORGANIZATION	COMMENTS	ACTION/ TYPE	RATIONALE
§ 126-44R-1 General				
11-08	Janet Richardson jrichardson@kcs.kana.k12.wv.us South Charleston High School 1 Eagle Way South Charleston WV 25309	In the first part of the document it is stated that students will have physical science in 9th grade and biology in 10th grade. I agree that this is the best way to sequence science curriculum. However, later in the document, it seems that under the headings of "mastery", etc, that the CATS objectives are still in place.		
11-09	Judy Ruhlin jruhlin@charter.net Charleston Catholic High 1033 Virginia St East Charleston WV 25301	In the executive summary, one of the reasons given for revisions is to change the alignment of high school science courses to ninth grade physical science, tenth grade biology, eleventh grade chemistry. However, even a casual glance at the proposed objectives for these courses registers that the objectives are the same mixed up mess of topics that CATS science left us with. Does the right hand know what the left hand is doing? If the comment in the executive summary is correct, the entire list of proposed CSOs for high school science must be rewritten to reflect this. If the intent is to continue teaching teaching cell biology (etc) in ninth grade and Newton's Laws of Motion (etc) in the tenth grade, then the Executive Summary should reflect this.		
	Mark Lemasters	If Biology/Conceptual Biology will be required of all 10th graders a) Why are there 10th grade science objectives? Are they general in nature or are they objectives for the WESTEST? b) Will the state achievement test be written to address skills at		

11-09	Teacher--Science marlemas@access,k12.wv.us MAgnolia High School 601 Maple Ave New Martinsville WV 26155	grade 10 or grade 11 c) I think it should clearly identify what population is to take the conceptual versions of chemistry and bilogy. The objectives are broad enough to be general introductory courses capable by all students, especially those identified as LD or wishing to pursue non-technical classes. It should state explicitly what the advantage of taking the "Biology" or "Chemistry" class would be		
11-13	Rachel Merrifield journalism teacher rmerrifi@access.k12.wv.us East Fairmont HS 8 Carriage Drive Fairmont WV 26554	I do not see any CSO's for Photo Journalism. They were listed under the Language Arts section previously, but I don't see them under the ones for public comment -- Does that mean that there are no plans to change any of the Photo journalism CSO's? I do have a concern with the current ones, they mainly address black and white print photography, which I think better relates to the technical photography courses. I teach photojournalism and we're doing much of the work with digital photography, which really is not addressed much in the current CSOs. I'm trying to train my students based on the premise that they plan to work in print media. Most newspapers, magazines, etc., are using digital photography.		
11-16	Greg Dodd Chemistry Instructor gbdodd@verizon.net George Washington High School 1522 Tennis Club Road Charleston W.Va. 25314	THe format for the standards is nearly unreadable and therefore unuseable. They consist of runon sentences. They need to be separated and bulleted.		
		I feel that students should take chemistry at the high school level. It is the central science, and a knowledge of chemistry is		

11-17	Michael T. Carte Chemistry Instructor mcarte@kcs.kana.k12.wv.us Riverside High School One Warrior Way Belle WV 25015	needed to properly understand biology, anatomy/physiology, environmental science, earth science, forensics, etc. Therefore, I applaud the move to make chemistry a requirement. Regarding sequencing, I feel that students should be required to take chemistry in the sophomore year rather than the junior year. This would allow students to better grasp biology (required) and other life science electives. Moreover, it would allow them to take AP chemistry during the junior year. This is important for college admissions purposes. Many selective colleges would like to see AP grades in the physical sciences prior to the senior year. By having a grade in the AP chemistry course rather than the status of "in progress," students will be placed at a competitive level nationally during the college admissions process.		
11-29	Mrs. Meador Science Teacher vmeador1@hotmail.com	The CSOs are poorly organized! There needs to be a more clear sequential order to the CSOs! Performance Descriptors are illogical! Let us teachers be the evaluators of mastery - that's what grades are for (get rid of those columns on mastery level- they are not very useful)! CSOs need to be more specific! Ex "demonstrate the ability to use the inquiry process to solve problems" is too vague. List the steps of the scientific method or conduct an experiment using dependent variable, independent variable, control and constants is a more appropriate objective! The CSOs as written leave too many unanswered questions and can be interpretted in many different ways, thus leading to inconsistencies as to what		

		material is taught within the state based on individual teacher's interpretations of the objectives!		
§ 126-44R-2 Purpose				
11-29	Mrs. Meador Science Teacher vmeador1@hotmail.com	To the best of my ability, I am teaching the current objectives in Biology and CAT9. Should my understanding be flawed, then I may miss a few details of a few CSOs, but my successful students will have a broad understanding of Biology...In Florida the objectives are clearly stated in terms of specific academic information. For example, " the student will be able to draw and label a food chain"..."the student will be able to explain the different trophic levels of an energy pyramid"..."the student will be able to label the respiratory structures in the human respiratory system and identify similar structures in other animals(such as book lungs, tracheal tubes...)..." With objectives such as the ones that I have cited, the teacher who understands his/her subject matter has no doubt about what he or she is being asked to do! With your current CSOs and your proposed CSOs, even the best teacher still has to interpret "what does this CSO really want me to teach"? and the teacher will not know without a standard exam as a "frame of reference"!		
§ 126-44R-4 Summary of the Content Standards and Objectives				
	Stefan Smolski	Policy 2510 specifies the order in which the science classes are to be taken. It is redundant to add grade levels to the tables of content standards. Recommend replace grade levels such as Grade Nine Grade Ten, etc. with simply High School.		

11-11	Science Teacher ssmolski@access.k12.wv.us Oak Glen High School 510 Pittsburgh Ave Fairmont WV 26554	"Ninth Grade Physical Science Content Standards and Objectives." Recommend remove "Ninth Grade" from the content standards title. "Ninth grade students at the distinguished level construct, test..." Replace "Ninth grade" with Physical science.		
11-25	Thomas Ditty, Ed.D. Chair, Science Dept. TVHS tditty@cebridge.net WVSTA 141 Buffalo Street Elkins WV 26241	You need to incorporate additional courses to meet the objectives at the third and fourth year levels. Earth Science, Environmental Science, Astronomy, Geology, Botany, Zoology are just as valuable and credible for students as chemistry and physics. Not all studnets are college-bound or interested in chemistry/physics.		
§ 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools				
11-09	Mark Lemasters Teacher--Science marlemas@access.k12.wv.us Magnolia High School 601 Maple Ave New Martinsville WV 26155	I don't think that it is wise to mix and match objectives between disciplines when the name of the course is Physical Science or Biology or Chemistry. In reading these objectives, it seems that we as science teachers are being held accountable for the objectives of a specific discipline curriculum AND meet the objectives of a coordinated/thematic program. While teaching science MUST be truly integrated, most teachers will teach to their strengths. Then we are right back to square one. A required class needs to focus on one set of specific objectives.		
		SC.O.PS.2.20 - differentiate between transverse and longitudinal waves and model examples of each type and relate		

11-11	Stefan Smolski Science Teacher ssmolski@access.k12.wv.us Oak Glen High School 510 Pittsburgh Ave Fairmont WV 26554	to water, light and sound wave. Include the differences between mechanical and electromagnetic waves. Add the following objectives to standard 2 for Physical Science: 1) classify common rock forming minerals by examining their physical and chemical properties. 2) analyze the processes of the rock cycle to predict the paleo-environment in which a rock sample is formed 3) analyze the relationships of temperature, air pressure, wind speed, wind direction and humidity as depicted on a weather map and meteorological data.		
11-23	Connie Huffman conhuff@yahoo.com 424 Porter Road Charleston WV 25314	If I understand it correctly, students will have just 2 choices of chemistry—honors level or conceptual, which, for whatever reasons, is not accepted by WV colleges as a lab course. This is so limiting—why do students who want to go to college have to take a such a fast-paced, all-consuming course as honors chemistry? My daughter attends GW and the honors chemistry class there is extremely demanding, with many hours of study and preparation. This is fine for some students, but what about the students who want to major in business, music, art, journalism, etc. in college? Why an advanced chemistry? For that matter, if a teacher teaches chemistry correctly, even if just the conceptual level,it will still be considered a lab course. If teachers are not giving a conceptual chemistry class the lab time required, that is the administration's fault. And		

		requiring all students to take chemistry?? Why can't students have more choices? Why chemistry of all things? Yes, it promotes logical thinking skills, but so do many other courses. We are pigeon-holing our students and trying to make them all fit into the same mold. What happened to individuality? Choice? About about the low-level students who cannot even comprehend the conceptual chemistry? Talk about leaving a child behind...		
11-25	Thomas Ditty, Ed.D. Chair, Science Dept. TVHS tditty@cebridge.net WVSTA 141 Buffalo Street Elkins WV 26241	In order to stimulate and maintain interest in various fields of science, students should be provided the opportunity to take a variety of courses beyond physical science and biology.		