

**WEST VIRGINIA
SECRETARY OF STATE**

NATALIE E. TENNANT

ADMINISTRATIVE LAW DIVISION

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OFFICE WEST VIRGINIA
SECRETARY OF STATE

**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 X NO _____

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

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

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

TITLE OF RULE BEING PROPOSED: _____

THE ABOVE RULE IS HEREBY ADOPTED AND FILED WITH THE SECRETARY OF STATE. THE
EFFECTIVE DATE OF THIS RULE IS September 14, 2009.


Jack McClanahan
Deputy State Superintendent of Schools

EXECUTIVE SUMMARY

WEST VIRGINIA DEPARTMENT OF EDUCATION

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

Background: West Virginia Content Standards and Objectives were formally reviewed by Dr. William Schmitt from the University of Michigan, who compared these standards to the TIMMS countries. Dr. Schmitt specifically cited the West Virginia CSOs excessive number of objectives. Ninth Grade Physical Science, Biology and Conceptual Biology were revised in earlier this year reducing the number of Standards from three to two by collapsing Standard One Nature of Science and Standard Three, Application of Science, into a new Standard One, Nature and Application of Science. The objectives were organized and written succinctly in the Performance Descriptors of the standards to indicate the level of achievement. The remaining courses in Policy 2520.35 (Biology II, Chemistry, Conceptual Chemistry, Chemistry II, Physics, Conceptual Physics, Physics II, Earth Science, and Human Anatomy and Physiology) were revised to reflect a new Standard One, Nature and Application of Science and Standard Two, The Content of Science was reformatted to align with the changes made in Ninth Grade Physical Science, Biology and Conceptual Biology.

The individuals involved with the changes of this policy are: Carla Williamson, Executive Director of the Office of Instruction; Marty Burke, Assistant Director of the Office of Instruction; Robin Anglin, Science Coordinator in the Office of Instruction; Timothy Butcher, Coordinator in the Office of Assessment/Accountability; Janet Bowling, Teacher from Fayette County; Diane Bowers, Teacher from Ohio County; Anne Smith, Teacher from Pocahontas County; Belen Hutson, Teacher from Harrison County; Rosalie Rhodes, Science Coordinator for Kanawha County Schools; Kathy Jacquez, Teacher from Harrison County; Claudia Kol, Teacher from Kanawha County, and Jane Kennedy, Teacher from Kanawha County.

Proposals: Revisions to Policy 2520.35 are being recommended for:

- Biology II Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.BII.1 Standard 1 Nature of Science and SC.S.BII.3 Standard 3, Application of Science, into a new SC.S.BII.1 Standard One, Nature and Application of Science. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors SC.S.BII.1 and SC.S.BII.2 to indicate the level of achievement.
- Chemistry Content Standard and Objectives Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.C.1 Standard 1 Nature of Science and SC.S.C.3 Standard 3, Application of Science, into a new SC.S.C.1, Standard One, Nature and Application of Science.
- Revision of SC.S.C.2 Content of Science occurred in the addition of two objectives necessary for higher cognitive demand. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors of SC.S.C.1 and

SC.S.C.2 to indicate the level of achievement.

- **Conceptual Chemistry Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.CC.1 Standard 1 Nature of Science and SC.S.CC.3 Standard 3, Application of Science, into a new SC.S.CB.1 Standard One, Nature and Application of Science. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors SC.S.CC.1 and SC.S.CC.2 to indicate the level of achievement.**
- **Chemistry II Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.CII.1 Standard 1 Nature of Science and SC.S.CII.3 Standard 3, Application of Science, into a new SC.S.CII.1 Standard One, Nature and Application of Science.**
- **Revision of SC.S.CII.2 Content of Science occurred in the addition of two objectives necessary for higher cognitive demand. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors SC.S.CII.1 and SC.S.CII.2 to indicate the level of achievement.**
- **Physics Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.P.1 Standard 1 Nature of Science and SC.S.P.3 Standard 3, Application of Science, into a new SC.S.P.1 Standard One, Nature and Application of Science. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors SC.S.P.1 and SC.S.P.2 to indicate the level of achievement.**
- **Conceptual Physics Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.CP.1 Standard 1 Nature of Science and SC.S.CP.3 Standard 3, Application of Science, into a new SC.S.CP.1 Standard One, Nature and Application of Science. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors SC.S.CP.1 and SC.S.CP.2 to indicate the level of achievement.**
- **Physics II Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.PII.1 Standard 1 Nature of Science and SC.S.PII.3 Standard 3, Application of Science, into a new SC.S.PII.1 Standard One, Nature and Application of Science. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors SC.S.PII.1 and SC.S.PII.2 to indicate the level of achievement.**
- **Earth Science Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.ES.1 Standard 1 Nature of Science and SC.S.ES.3 Standard 3, Application of Science, into a new SC.S.ES.1 Standard One, Nature and Application of Science. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors SC.S.ES.1 and SC.S.ES.2 to indicate the level of achievement.**
- **Human Anatomy and Physiology Content Standard and Objectives to reduce the number of Standards from three to two by collapsing SC.S.HAP.1 Standard 1 Nature of Science and SC.S.HAP.3 Standard 3, Application of Science, into a new SC.S.HAP.1 Standard One, Nature and Application of Science. The objectives were reformatted, clustered to concepts and written succinctly in the Performance Descriptors SC.S.HAP.1 and SC.S.HAP.2 to indicate the level of achievement.**

Impact: The proposed revision of the Content Standards and Objectives for 21st Century Science 9-12 Standards and Objectives Performance Descriptors will provide teachers information about the levels of knowledge and skills the students must acquire and will provide parents an explanation of their child's knowledge and conceptual understanding that should be acquired at each grade level

Response to Comments:

Nine teachers commented on Policy 2520.35 regarding formatting, typos, clarifications of terms, and the inclusion of stoichiometry in chemistry I level course. Recommendations were accepted. A complete log is attached.

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TITLE 126
LEGISLATIVE RULE
BOARD OF EDUCATION

OFFICE WEST VIRGINIA
SECRETARY OF STATE

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. -- August 14, 2009.

1.4. Effective Date. -- September 14, 2009.

1.5. Repeal of former rule. -- This legislative rule amends W. Va. 126CSR44R West Virginia Board of Education Policy 2520.35 "21st Century Science 9-12 Mathematics Content Standards and Objectives for West Virginia Schools (2520.35)" filed May 18, 2009 and effective July 1, 2009.

§126-44R-2. Purpose.

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

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

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

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

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

West Virginia Department of Education

West Virginia Board of Education Policy

2520.35

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

Steven L. Paine
State Superintendent

Foreword

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

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

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

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

Steven L. Paine
State Superintendent of Schools

Explanation of Terms

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

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

Performance Descriptors describe in narrative format how students demonstrate achievement of the content standards. Line breaks within the narrative format indicate clusters of concepts and skills. 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.

Distinguished: A student at this level has demonstrated exemplary performance. The work shows a distinctive and sophisticated application of knowledge and skills in real world situations that go beyond course or grade level applications.

Above Mastery: A student at this level has demonstrated effective performance and exceeds the standard. The work shows a thorough and effective application of knowledge and skills in real world situations within the subject matter and grade level.

Mastery: A student at this level has demonstrated competency over challenging subject matter, including knowledge and skills that are appropriate to the subject matter and grade level. The work is accurate, complete and addresses real world applications. The work shows solid academic performance at the course or grade level.

Partial Mastery: A student at this level has demonstrated limited knowledge and skills toward meeting the standard. The work shows basic but inconsistent application of knowledge and skills characterized by errors and/or omissions. Performance needs further development.

Novice: A student at this level has demonstrated minimal fundamental knowledge and skills needed to meet the standard. Performance at this level is fragmented and/or incomplete and needs considerable development

Numbering of Standards

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

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

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

Numbering of Objectives

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

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

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

Numbering of Performance Descriptors

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

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

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

Unique Electronic Numbers (UENs)

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

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

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

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

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

Abbreviations

Content Areas
SC Science

Other Abbreviations

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

SCIENCE – POLICY 2520.35

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

A three-dimensional instructional strategy model must be utilized to address the science curriculum and assure students' depth of understanding and breadth of knowledge in Ninth Grade Science, and Tenth Grade Science. 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.

A two-dimensional instructional strategy model must be utilized to address the science curriculum and assure students' depth of understanding and breadth of knowledge in Ninth Grade Physical Science, Biology, Conceptual Biology, Biology II, Chemistry, Conceptual Chemistry, Chemistry II, Physics, Conceptual Physics, Physics II, Earth Science, and Human Anatomy and Physiology. This model uses the content of science with the nature and application of science to develop scientific inquiry and reasoning skills in students.

Standard 1: Nature and Application 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 and application 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. Students should understand that the continuous development of scientific knowledge shapes history. Students will engage in active inquiry through investigations and hands-on activities a minimum of 50% of the instructional time using safe procedures and practices. Developing scientific literacy requires a learning environment in which students actively participate in meaningful hands-on activities while developing current technology skills. 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. 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. Students must learn to analyze situations, gather relevant information, generate and evaluate creative ideas, pose tangible solutions and communicate their analyses, results and suggestions concisely.

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.

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 9th, 10th, 11th and 12th 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	Performance Descriptors SC.PD.9.1	Above Mastery	Mastery	Partial Mastery	Novice
SC.S.9.1	Students will <ul style="list-style-type: none"> 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. 	Students at the distinguished level will analyze the importance of scientific innovation and relate these innovations to the utilization of scientific methodology, variability in experimental results to advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; draw conclusions from multiple data sources and	Students at the above mastery level will analyze the importance of scientific innovation and recognize the role of these innovations in advancing societal, cultural and economic issues; use scientific methodology to design, conduct, communicate and revise experiments utilizing safe procedures and appropriate technology; draw conclusions from multiple data sources and models.	Students at the mastery level will examine the importance of scientific innovation and recognize the role of these innovations in advancing societal, cultural and economic issues; use scientific methodology to conduct, communicate and revise experiments utilizing safe procedures and appropriate technology; draw conclusions from data sources and models.	Students at the partial mastery level will describe the importance of scientific innovation and recognize the role of these innovations in advancing societal, cultural or economic issues; use scientific methodology to conduct and communicate experiments utilizing safe procedures and appropriate technology; select an appropriate conclusion from a list of possible conclusions drawn from experimental data.	Students at the novice level will identify the importance of scientific innovation and associate these innovations with advances in societal, cultural or economic issues; conduct experiments utilizing safe procedures and appropriate technology; differentiate between observations and conclusions.

interpretation of models.		
Objectives	Students will	
SC.O.9.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.	
SC.O.9.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").	
SC.O.9.1.3	relate societal, cultural and economic issues to key scientific innovations.	
SC.O.9.1.4	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).	
SC.O.9.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.	
SC.O.9.1.6	use appropriate technology solutions within a problem solving setting to measure and collect data, interpret data, analyze and/or report data, interact with simulations, conduct research, and present and communicate conclusions.	
SC.O.9.1.7	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).	
SC.O.9.1.8	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles; predict the influence of external variances such as potential sources of error, or interpret maps).	

Grade 9	Science			
Standard 2	Content of Science			
SC.S.9.2	Students will <ul style="list-style-type: none"> demonstrate knowledge understanding and applications of scientific facts, concepts, principles, theories, and models delineated in the objectives. demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science, and astronomy; and apply knowledge, understanding and skills of science subject matter/concepts to daily life. 			
Performance Descriptors SC.PD.9.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will solve and interpret dihybrid cross; populate an environment with appropriate organisms; compare the structure and function of cells, tissues and systems of different organisms; demonstrate conservation of matter and	Students at the above mastery level will solve dihybrid cross; design environments to model interdependent populations; compare and contrast cells, tissues and systems of different organisms; relate conservation of matter and energy to cellular	Students at the mastery level will perform and interpret monohybrid crosses; design environments to model interdependent populations; compare cells, tissues and systems of different organisms; trace matter and energy through cellular	Students at the partial mastery level will solve monohybrid crosses; match populations to environments; compare cells and tissues of different organisms; trace matter through cellular processes; construct models of states of matter	Students at the novice level will complete a Punnett square; list populations in an environment; compare systems of different organisms; trace matter through a cellular process; identify models of states of matter; classify synthesis and decomposition

<p>energy through cellular processes; predict how states of matter react as kinetic energy changes; write formulas for ionically and covalently bonded compounds, balance coefficients, predict products and classify types of chemical reactions; predict density values with change of state; calculate the amount of energy produced by nuclear changes; measure the specific heat of a material; compare the properties of different magnetic fields; evaluate a circuit using Ohm's Law and power equation; calculate inverse square relations; predict the effects of a change in location on motion of a pendulum; compare and contrast transverse and longitudinal waves; make long-range weather forecasts from meteorological data; use properties to identify unknown minerals; predict the paleo-environment in which a rock type was formed; use evidence to explain the structure of the moon; explain the absence of plate tectonics on the moon; evaluate the accuracy of absolute and</p>	<p>processes; predict the state of matter given relative amounts of kinetic energy; write formulas, balance coefficients, predict products and classify types of chemical reactions and bonds; predict density value when mass and volume changes; write equations for types of nuclear changes; relate the properties of a material to its absorption or dissipation of heat; compare the properties of different magnets; construct an electric circuit applying Ohm's Law and power equation; predict inverse square relations; explain the effect of gravity on the motion of pendulums; classify waves as transverse or longitudinal; construct and interpret a weather map from data; test properties to classify minerals; predict the type of rock that forms in a paleo-environment; use evidence to explain differences in Earth's layers; evaluate evidence for the forces and mechanisms of plate tectonics; interpret data to determine absolute and relative ages.</p>	<p>processes; relate state of matter to amount of kinetic energy; write formulas, balance coefficients, and classify types of chemical reactions; classify bond types; predict density value when mass and/or volume changes; compare types of nuclear changes; assess a material's ability to absorb or dissipate heat; explore properties of a magnet; construct an electric circuit using Ohm's Law and power equation; recognize inverse square relations; examine variables that affect the motion of pendulums; differentiate transverse and longitudinal waves; predict weather using maps; relate properties to minerals; relate rocks to the environment in which they form; use evidence to interpret Earth's structure; compare and contrast the forces and mechanisms of plate tectonics; use dating techniques.</p>	<p>to indicate kinetic energy; write formulas and classify types of chemical reactions; name types of bonds; calculate density when mass or volume change; identify the uses of energy produced by nuclear changes; recognize that materials absorb and dissipate heat differently; list the properties of a magnet; construct an electric circuit using Ohm's Law; recognize that changing distance of a light source affects perceived brightness; construct a pendulum and record data; model transverse and longitudinal waves; interpret weather maps; list the parts of the rock cycle; group minerals using properties; model the layers of the earth; identify heat source and model a convection cell; use relative dating techniques.</p>	<p>reactions; define an ionic and covalent bond; define density; recognize that energy is produced by nuclear changes; identify objects as conductors or insulators of heat; list a property of a magnet; construct an electric circuit; observe that changing distance of a light source affects perceived brightness; construct a pendulum; model transverse and longitudinal waves; read weather maps; state the difference between rocks and minerals; name the layers of the earth; identify Earth's internal heat source; use the law of superposition to date strata.</p>
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relative dating techniques.	
Objectives	Students will
SC.O.9.2.1	apply principles of Mendelian genetics to solve heredity problems.
SC.O.9.2.2	illustrate meiosis and mitosis and relate to chromosome number and production of sperm, egg and body cells.
SC.O.9.2.3	analyze cyclic changes in populations of organisms.
SC.O.9.2.4	design an environment that demonstrates the interdependence of plants and animals (e.g., energy and chemical cycles, adaptations of structures and behaviors).
SC.O.9.2.5	compare and contrast the structure and function of cells, tissues and systems of different organisms.
SC.O.9.2.6	diagram the transfer of matter and energy in the chemical/molecular processes of photosynthesis, respiration and fermentation.
SC.O.9.2.7	predict chemical and physical properties of an element using its position in the periodic table.
SC.O.9.2.8	compare the types of radioactive decay in terms of particles and energy generated.
SC.O.9.2.9	predict the changes in density as mass and volume change.
SC.O.9.2.10	relate molecular motion, kinetic energy and states of matter.
SC.O.9.2.11	write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions.
SC.O.9.2.12	propose the results of changing the number of protons, neutrons or electrons on the properties of an atom.
SC.O.9.2.13	determine formulas and names for binary compounds.
SC.O.9.2.14	classify a binary chemical bond as ionic, nonpolar covalent or polar covalent.
SC.O.9.2.15	given a chemical equation deduce the coefficients and classify the reaction type (e.g., synthesis or combination, decomposition, single replacement, or double replacement and combustion).
SC.O.9.2.16	assess and provide evidence to justify the occurrence of a chemical reaction (e.g., production of color, light, heat, sound, smell, gas, or precipitate).
SC.O.9.2.17	differentiate various forms of energy and energy transformations including fission and fusion.
SC.O.9.2.18	assess absorption and dissipation of heat by various materials.
SC.O.9.2.19	experimentally deduce and diagram the magnetic field of a bar magnet.
SC.O.9.2.20	construct electric circuits and mathematically model electric circuits using Ohm's Law and power equations.
SC.O.9.2.21	establish the relationship between distance and the intensity of light, charge and gravitational attraction (e.g., inverse square law).
SC.O.9.2.22	interpret and draw conclusions from speed-distance-time data and graphs.
SC.O.9.2.23	analyze experiments to determine which variables affect the motion of pendulums.
SC.O.9.2.24	differentiate between transverse and longitudinal waves and model examples of each type (e.g., light, sound, or seismic).
SC.O.9.2.25	predict weather based on the relationships of temperature, air pressure, wind speed, wind direction and humidity as depicted on a weather map and meteorological data.
SC.O.9.2.26	analyze the relationships among latitude, altitude and climate.
SC.O.9.2.27	classify common rock forming minerals by examining their physical and chemical properties.
SC.O.9.2.28	analyze the processes of the rock cycle to predict the paleo-environment in which a rock sample is formed.
SC.O.9.2.29	examine seismographic and geologic evidence to determine structure and composition of the Earth's interior.
SC.O.9.2.30	use relative dating techniques to determine the ages of stratigraphic 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	
	<ul style="list-style-type: none"> • 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
Students at the distinguished level will construct, test and analyze complex systems, models, and changes across science disciplines; use a technology solution and analyze the science used in the technology; evaluate how a scientific discovery impacts public policy decisions regarding health, population resources and environmental issues.	Students at the above mastery level will construct, test and analyze data to explore systems, models, and changes across science disciplines; analyze technological innovations and identify the science that makes them possible; evaluate the personal and societal benefits of a scientific discovery; assess the impacts of a public policy decision regarding health, population resources or environmental issues.	Students at the mastery level will test, record and analyze data to explore systems, models, and changes; analyze a technological innovation and identify the science that makes it possible; assess positive outcomes and unintended consequences of a scientific discovery; explain the impacts of a public policy decision regarding health, population resources or environmental issues.
Partial Mastery	Novice	
Students at the partial mastery level will test and record data to explore systems, models, and changes; explain a technological innovation and identify the science that makes it possible; identify positive outcomes and unintended consequences of a scientific discovery; identify the impact of a public policy decision regarding health, population resources or environmental issues.	Students at the novice level will test and record data to explore systems, models or changes; identify a technological innovation and the science that makes it possible; identify positive outcomes or unintended consequences of a scientific discovery; identify the impact of a public policy decision regarding health, population resources or environmental issues.	
Objectives		
SC.O.9.3.1	Students will 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	Performance Descriptors SC.PD.10.1	Mastery	Partial Mastery	Novice
Standard: 1	Nature of Science				
SC.S.10.1	Students will <ul style="list-style-type: none"> 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. 	Above Mastery Students at the above mastery level will evaluate the importance of scientific innovation and relate these innovations to the utilization of scientific methodology, variability in experimental results to advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; compile data to draw conclusions from	Mastery Students at the mastery level will analyze the importance of scientific innovation and relate these innovations to the utilization of scientific methodology, variability in experimental results to advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; draw conclusions from multiple	Partial Mastery Students at the partial mastery level will recognize the importance of scientific innovation and relate these innovations to the utilization of scientific methodology, variability in experimental results to advances in societal, cultural or economic issues; conduct experiments utilizing safe procedures and appropriate technology; draw conclusions from data and generate models.	Novice Students at the novice level will identify scientific innovations and associate these innovations with the utilization of scientific methodology in advancing societal, cultural or economic issues; conduct experiments utilizing safe procedures and appropriate technology and describe results; differentiate between observations and conclusions.

validate and draw conclusions from experimental results using historical and student collected data and constructed models.	multiple data sources and interpretation of models.	data sources and interpretation of models.	
Objectives	Students will		
SC.O.10.1.1	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.		
SC.O.10.1.2	demonstrate how a testable methodology is employed to seek solutions for personal and societal issues (e.g., "scientific method").		
SC.O.10.1.3	relate societal, cultural and economic issues to key scientific innovations.		
SC.O.10.1.4	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic.)		
SC.O.10.1.5	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.		
SC.O.10.1.6	use appropriate technology solutions within a problem solving setting to measure and collect data, interpret data, analyze and/or report data interact with simulations, conduct research, and present and communicate conclusions.		
SC.O.10.1.7	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).		
SC.O.10.1.8	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, predict the influence of external variances such as potential sources of error, or interpret maps).		

Grade 10	Science		
Standard: 2	Content of Science		
SC.S.10.2	Students will <ul style="list-style-type: none"> 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
Students at the distinguished level will suggest cell functions based on structure; debate ethics	Students at the above mastery level will classify cells based on structure and function; analyze historical function;	Students at the mastery level will relate cell structure to function; apply DNA's structure to its role in	Students at the novice level will recognize that cells have different structures; recognize that DNA is the

<p>of DNA research; assess the statement "ontogeny recapitulates phylogeny"; construct a simple cladogram; explain interactions among biogeochemical cycles; associate diseases with chemical imbalances; analyze fossil and modern evidence of adaptations in response to changing environments; experimentally determine data to predict trends in characteristics among unknown substances; design experiments to demonstrate the relationships among temperature-pressure-volume and heat in substances during physical/chemical changes; relate the frequency of electromagnetic waves to energy; explain how electricity produces magnetism and how magnets produce electricity; assess error in measuring energy conservation; interpret calculations and graphs of rate, force, momentum, work and time; suggest a simple machine to provide optimum mechanical advantage; measure calculate the spring constant and relate</p>	<p>research leading to current DNA knowledge; compare ontogeny and phylogeny of a variety of animals; interpret a cladogram of a group of organisms; explain interactions between two biogeochemical cycles; describe the role of chemicals in human body systems; trace fossil and modern adaptations in response to changing environments; experimentally determine relationships among substances; experimentally and mathematically validate the relationships among temperature-pressure-volume and heat in substances during physical/chemical changes; calculate the frequency of electromagnetic waves; explain how electricity produces magnetism; describe conservation of all forms of energy; interpret calculations and/or graphs of rate, force, momentum, work and time; compare calculated mechanical advantage of similar simple machines; measure calculate the spring constant; evaluate the gravitational effects of the moon and sun on tidal phenomenon; predict the</p>	<p>heredity; compare ontogeny and phylogeny of an animal; compare traditional and modern classification systems; diagram biogeochemical cycles; describe how human body systems work together; describe fossil and modern adaptations of plant and animal populations to their changing environment; experimentally determine characteristics of substances; mathematically determine the relationships among temperature-pressure-volume and heat in substances during physical/chemical changes; characterize electromagnetic waves and their uses; describe the relationship between electricity and magnetism; quantitatively determine conservation of thermal energy; relate Newton's Laws of Motion to rate, force, momentum, work and time; calculate mechanical advantage of simple machines; compare the effect of different forces on vibrating systems; predict tidal phenomenon; determine impacts of geological and biological processes on climate; explain geological and biological</p>	<p>properties of DNA; trace ontogeny or phylogeny of an animal; identify a group of organisms whose historical classification has changed; diagram the carbon or nitrogen cycle; explain the interaction of two human body systems; recognize that populations change in response to environmental changes; experimentally determine characteristics of some substances; mathematically determine the relationships among temperature-pressure-volume; list electromagnetic waves and their uses; diagram a magnetic field around an electrical wire; recognize that energy is conserved in transformations; define Newton's Laws of Motion, rate, force, momentum, work and time; calculate mechanical advantage of some simple machines; recognize vibrating systems; explain that the moon causes tides; list geological and biological processes that affect climate; explain some processes that form fossils; state theories of cosmology.</p>	<p>material of heredity; recognize that embryos developmentally change; place organisms in a classification system; diagram the water cycle; identify human body systems; recognize that populations change over time; list characteristics of substances; state relationship among temperature-pressure-volume; list some electromagnetic waves; recognize that electricity and magnetism are interrelated; state that energy is conserved; state the three Laws of Motion; calculate mechanical advantage of a simple machine; recognize a pendulum is an example of a vibrating system; define tides; recognize that geological and biological processes affect climate; explain a process that forms fossils; state a scientifically accepted theory for the origin of the universe.</p>
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to its properties; evaluate multiple gravitational effects of the Earth-Moon system; predict the effects of geological and biological events on climate; critique geological and chemical conditions to predict fossil formation; evaluate theories of cosmology using electromagnetic evidence.	effects of geological or biological event on climate; evaluate conditions necessary for fossil formation; compare theories of cosmology using electromagnetic evidence.	biological processes of fossil formation; explain theories of cosmology using electromagnetic evidence.	
Objectives Students will			
SC.O.10.2.1	relate the structure of cell organelles to their functions.		
SC.O.10.2.2	apply knowledge of cells to variations in cells, tissues, and organs of different organisms.		
SC.O.10.2.3	compare and contrast mechanisms for the movement of materials into and out of cells.		
SC.O.10.2.4	explore the discovery of DNA and its structure; examine nucleotide bonding to the importance of to the double helix structure.		
SC.O.10.2.5	apply DNA analysis to current societal and technological issues (e.g., DNA's role in protein synthesis, heredity, cell division, or cellular functions).		
SC.O.10.2.6	integrate DNA mutations, chromosomal crossing over and linkage with the principles of genetics.		
SC.O.10.2.7	compare the ontogeny and phylogeny using the embryonic development of invertebrate and vertebrate animals.		
SC.O.10.2.8	compare traditional and modern classification systems.		
SC.O.10.2.9	construct a scientific explanation for variation in the species and common ancestors using fossil records, homologous features and selective pressures.		
SC.O.10.2.10	compare and contrast theories for the development, diversity and/or extinction of a species (e.g., natural selection, Lamarckism, or catastrophism).		
SC.O.10.2.11	construct diagrams showing energy flow and cycles of matter between chemical and biological systems including photosynthesis, stored chemical energy, decomposition, carbon and nitrogen cycles.		
SC.O.10.2.12	integrate the human body systems to the functioning of the entire organism.		
SC.O.10.2.13	design an investigation in which the needs of growing plants are determined.		
SC.O.10.2.14	evaluate environmental factors that affect succession, populations and communities.		
SC.O.10.2.15	model the flow of matter and energy flow through the respiration process.		
SC.O.10.2.16	compare and contrast by investigation the properties of solutions including density, conductivity, solubility, concentration, pH and colligative properties.		
SC.O.10.2.17	compare and contrast the characteristics of physical, chemical and nuclear changes/reactions.		
SC.O.10.2.18	determine the relationships among temperature, pressure and volume in gases and interpret graphs that depict these relationships (e.g., Charles' Law, Boyle's Law, Gay-Lussac's Law).		
SC.O.10.2.19	characterize by investigation variance in thermal energy in physical and chemical changes.		
SC.O.10.4.20	compare and contrast the characteristics and uses of electromagnetic waves and relate the frequency of the wave to its application.		
SC.O.10.2.21	correlate the motion of a body to its Doppler shift.		

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

Grade 10	Science
Standard: 3	Application of Science
SC.S.10.3	<p>Students will</p> <ul style="list-style-type: none"> • 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
Students at the distinguished level will, construct, test, analyze, and evaluate complex systems, models, and changes across science disciplines; choose a technology solution and analyze the science used in the technology; evaluate how scientific discoveries impact public policy decisions	Students at the above mastery level will, construct, test and analyze complex systems, models, and changes across science disciplines; use a technology solution and analyze the science used in the technology; evaluate how a scientific discovery impacts public policy decisions regarding health,
	Mastery
	Students at the mastery level will construct, test and analyze data to explore systems, models, and changes across science disciplines; analyze technological innovations and identify the science that makes them possible; evaluate the personal and societal benefits of a scientific discovery; assess
	Partial Mastery
	Students at the partial mastery level will test, record and analyze data to explore systems, models, and changes; analyze a technological innovation and identify the science that makes it possible; list positive outcomes and unintended consequences of a scientific discovery; identify the impacts of a
	Novice
	Students at the novice level will test and record data to explore systems, models, and changes; use technological innovations and state that science makes them possible; identify a positive outcome or a negative consequence of a scientific discovery; identify an impact of a public policy decision

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

Ninth Grade Physical Science Content Standards and Objectives

The Ninth Grade Physical Science objectives continue the development of foundational knowledge in chemistry, physics, earth science and astronomy. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy and the use of 21st Century Skills across these major fields of science. Students will explore occupational opportunities in chemistry, engineering, earth science, and technology and evaluate the required academic preparations. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50 percent of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated in all activities. Building on the knowledge and skills acquired in Eighth Grade Science, students in Ninth Grade Physical Science will expand and deepen their understanding of major concepts such as energy interactions, chemical changes and earth processes. The West Virginia Standards for 21st Century Learning include the following components: 21st Century Content Standards and Objectives and 21st Century Learning Skills and Technology Tools. All West Virginia teachers are responsible for classroom instruction that integrates learning skills, technology tools and content standards and objectives.

Grade Nine Physical Science		Nature and Application of Science			
Standard: 1		Students will			
SC.S.PS.1		<ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 	Performance Descriptors SC.PD.PS.1		
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice	
Ninth grade students at the distinguished level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	Ninth grade students at the above mastery level in the Nature and Applications of Science: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	Ninth grade students at the mastery level in the Nature and Applications of Science: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	Ninth grade students at the partial mastery level in the Nature and Applications of Science: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	Ninth grade students at the novice level in the Nature and Applications of Science: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	

construct solutions and defend their ideas to an authentic audience.	construct and defend their solutions.	construct and defend their solutions.	construct their solutions.
Objectives	Students will		
SC.O.PS.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.		
SC.O.PS.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.		
SC.O.PS.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).		
SC.O.PS.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).		
SC.O.PS.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).		
SC.O.PS.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.		
SC.O.PS.1.7	given current science-technology-societal issues, construct and defend potential solutions.		
SC.O.PS.1.8	relate societal, cultural and economic issues to key scientific innovations.		
SC.O.PS.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).		

Grade Nine	Physical Science		
Standard: 2	Content of Science		
SC.S.PS.2	Students will	<ul style="list-style-type: none"> 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
Ninth grade students at the distinguished level in content of science:	Ninth grade students at the above mastery level in content of science:	Ninth grade students at the mastery level in content of science:	Ninth grade students at the novice level in content of science:
apply dimensional analysis and metric notations when determining relations,	apply dimensional analysis and metric notations when collecting data, determining	apply dimensional analysis and metric notations when collecting data, determining	use the proper units when collecting data and solving for unknowns;

<p>deriving equations, and solving for unknowns;</p> <p>predict chemical and physical properties of elements based on electron structure quantitatively distinguish ionic, nonpolar and polar covalent compounds;</p> <p>predict and verify the identity of observable products of chemical reactions when given the reactants;</p> <p>quantitatively determine the energy produced during exothermic reactions;</p> <p>calculate the magnitudes of interacting magnetic fields and build circuits for specified scenarios;</p> <p>design experiments to determine relationships in the forces and motions of systems, and</p> <p>research and evaluate evidence for theories for the origin and composition of the Earth and solar system and use models of waves and heat transfer to explain</p>	<p>relationships, and solving for unknowns;</p> <p>predict chemical and physical properties of elements based on electron structure quantitatively;</p> <p>determine the oxidation numbers of the elements, balance the equations, and predict the products;</p> <p>design and conduct an experiment to differentiate between heat and temperature and the present results;</p> <p>predict and experimentally determine interacting magnetic fields and build circuits for specified scenarios;</p> <p>extrapolate data to solve for unknown forces and motions in systems, and</p> <p>research and site evidence for theories for the origin of the Earth and solar system and use models of waves and heat transfer to explain their composition and</p>	<p>relationships, and solving for unknowns;</p> <p>characterize the properties of elements, molecules and ionic structures and write formulas and names of ions;</p> <p>classify and cite evidence for the chemical reactions and apply the Laws of Conservation;</p> <p>conduct experiments to determine the relationships between molecular motion, kinetic energy, heat, and temperature;</p> <p>experimentally determine magnetic fields and circuits as they solve for unknowns and determine their relationships;</p> <p>use Newton's Laws to make predictions and solve for unknown forces and motions in systems, and</p> <p>investigate theories for the origin and composition of the Earth and solar system and use models of waves and heat transfer to explain their composition and</p>	<p>relationships, and solving for unknowns;</p> <p>characterize the properties of elements, molecules and ionic structures and identify chemical names;</p> <p>classify, describe chemical reactions and apply the Laws of Conservation;</p> <p>explain the relationships of molecular motion, kinetic energy, heat, and temperature;</p> <p>experimentally determine and diagram magnetic fields and circuits as they solve for unknowns;</p> <p>make predictions solve for unknown forces and motions in systems, and</p> <p>diagram the composition of the Earth and solar system and use models of waves and heat transfer to explain changes that occur.</p>	<p>list the properties of elements and ionic structures and identify chemical names;</p> <p>identify chemical reactions and state the Laws of Conservation;</p> <p>state relate molecular motion and kinetic energy to heat and temperature;</p> <p>diagram magnetic fields and circuits as they solve for unknowns;</p> <p>identify the forces and the motions they cause in systems, and</p> <p>diagram the solar system and use models to describe waves and the heat transfer that occurs on Earth and sun.</p>
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changes that occur.	changes that occur	changes that occur.
Objectives	Students will	
SC.O.PS.2.1	apply dimensional analysis and scientific notation in making metric calculations.	
SC.O.PS.2.2	predict chemical and physical properties of an element using its position in the periodic table.	
SC.O.PS.2.3	collect data to infer the relationships among density, mass and volume and apply to earth models <ul style="list-style-type: none"> • plate tectonics • weather systems • ocean currents. 	
SC.O.PS.2.4	relate molecular motion and the amount of kinetic energy to the temperature of a system.	
SC.O.PS.2.5	characterize compounds as ionic, nonpolar covalent or polar covalent and distinguish the difference between molecular and ionic structures.	
SC.O.PS.2.6	write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions.	
SC.O.PS.2.7	determine the coefficients and classify the reaction type of a chemical equation <ul style="list-style-type: none"> • synthesis or combination • decomposition • single replacement • double replacement • combustion. 	
SC.O.PS.2.8	cite evidence for the occurrence of a chemical reaction from student generated experimental data (e.g., production of color, light, heat, sound, smell, gas, or precipitate).	
SC.O.PS.2.9	qualitatively and quantitatively describe the law of conservation of mass/energy <ul style="list-style-type: none"> • mechanical • thermal • chemical • electrical • nuclear. 	
SC.O.PS.2.10	compare the types of particles liberated in nuclear decay and interpret half-life graphs: <ul style="list-style-type: none"> • radiometric dating • nuclear medicine • nuclear waste disposal. 	
SC.O.PS.2.11	experimentally demonstrate the relationship between heat and temperature: <ul style="list-style-type: none"> • specific heat • melting point • latent heat. 	
SC.O.PS.2.12	predict, experimentally determine and diagram magnetic fields of magnets.	
SC.O.PS.2.13	construct and diagram DC circuits and solve for unknown variables using Ohm's Law and power equations.	
SC.O.PS.2.14	qualitatively explain the relationship between electricity and magnetism.	
SC.O.PS.2.15	conduct experiments to verify the inverse square relationship between gravity, distance and intensity of light and sound.	

SC.O.PS.2.16	<p>experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion:</p> <ul style="list-style-type: none"> • velocity • acceleration • force • momentum • time.
SC.O.PS.2.17	conduct an experiment to calculate the mechanical advantages, work in/out and efficiencies of simple machines.
SC.O.PS.2.18	design, conduct and analyze experiments to determine variables affecting the period of pendulums.
SC.O.PS.2.19	differentiate between transverse and longitudinal waves and model examples of each type and relate to water, light and sound waves.
SC.O.PS.2.20	examine seismographic and geologic evidence to determine structure, composition and age of the Earth.
SC.O.PS.2.21	predict and present a weather forecast using a weather map and meteorological data.
SC.O.PS.2.22	analyze latitude, altitude and surface features to predict climatic conditions.
SC.O.PS.2.23	<p>research and organize evidence to support the theory and effects of plate tectonics including:</p> <ul style="list-style-type: none"> • density • force • mountain building • fossil • magnetic evidence.
SC.O.PS.2.24	apply fusion, heat transfer, gravity, and electromagnetism to the sun's evolution and its impact on the solar system.
SC.O.PS.2.25	<p>investigate theories for the origin and configuration of the solar system:</p> <ul style="list-style-type: none"> • nebular theory • Earth-Moon formation • heliocentric • geocentric models.

Biology Content Standards and Objectives

Biology is a course designed for students who desire a broader, in-depth study of the content found in many biological fields of endeavor. This course is designed to build upon and extend the Biology concepts, skills, and knowledge from the science program, using skills for the 21st Century. Students will explore occupational opportunities in health, engineering, and technology and evaluate the required academic preparations while expanding laboratory skills and experiences. Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. The West Virginia Standards for 21st Century Learning include the following components: 21st Century Content Standards and Objectives and 21st Century Learning Skills and Technology Tools. All West Virginia teachers are responsible for classroom instruction that integrates learning skills, technology tools and content standards and objectives.

Grade Ten Biology		Nature and Application of Science			
Standard: 1	Students will	Above Mastery	Mastery	Partial Mastery	Novice
SC.S.B.1	<ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions. 				
Performance Descriptors SC.PD.B.1					
Distinguished					
Biology students at the distinguished level in the nature and applications of science:	<p>implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence; and</p> <p>relate science-technology-societal issues while using a variety of sources to construct solutions and defend their ideas to an</p>	<p>Biology students at the above mastery level in the nature and applications of science:</p> <p>implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence; and</p> <p>relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.</p>	<p>Biology students at the mastery level in the nature and applications of science:</p> <p>implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence; and</p> <p>relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.</p>	<p>Biology students at the partial mastery level in the nature and applications of science:</p> <p>implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence; and</p> <p>relate science-technology-societal issues while using a variety of sources to construct their solutions.</p>	<p>Biology students at the novice level in the nature and applications of science:</p> <p>implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence; and</p> <p>relate science-technology-societal issues while using a variety of sources to construct their solutions.</p>

authentic audience.		
Objectives	Students will	
SC.O.B.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.	
SC.O.B.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.	
SC.O.B.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).	
SC.O.B.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).	
SC.O.B.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).	
SC.O.B.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.	
SC.O.B.1.7	given current science-technology-societal issues, construct and defend potential solutions.	
SC.O.B.1.8	relate societal, cultural and economic issues to key scientific innovations.	
SC.O.B.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).	

Grade Ten	Biology	
Standard: 2	Content of Science	
SC.S.B.2	Students will <ul style="list-style-type: none"> 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
Biology students at the distinguished level in content of science: investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells and organisms;	Biology students at the above mastery level in content of science: investigate the chemistry of cellular processes and biological molecules and relate variations in structures to efficiencies of functions in	Biology students at the mastery level in content of science: investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms,
Novice	Partial Mastery	Novice
Biology students at the novice level in content of science: describe the chemistry of cellular processes and biological molecules and define the structures and functions of various cells	Biology students at the partial mastery level in content of science: describe the chemistry of cellular processes and biological molecules and relate structure to function in various cells and	Biology students at the novice level in content of science: describe the chemistry of cellular processes and biological molecules and define the structures and functions of various cells

<p>analyze the flow of energy in cells, organisms, and the environment;</p> <p>determine the effectiveness and consequences of asexual or sexual reproduction within a species;</p> <p>research how scientists experimentally determined the role of tRNA, mRNA, and rRNA as agents in peptide formation and present arguments regarding the potential use and abuse of specific genetic engineering technologies, and</p> <p>research various biomes, analyze the interrelationships of organisms and explain factors the affect coevolution.</p>	<p>various cells and organisms;</p> <p>quantitatively analyze and explain the flow of energy in cells, organisms, and the environment;</p> <p>analyze cellular reproduction processes and use Mendel's Laws of Genetics to explain variations within species;</p> <p>create and use DNA and RNA models to explain protein synthesis and mutations, and research various genetic engineering technologies as potential solutions to real world problems, and</p> <p>determine how changing environmental factors disrupt the interrelationships of organisms and affect the carrying capacity of an ecosystem.</p>	<p>and viruses;</p> <p>analyze the flow of energy in cells, organisms, and the environment;</p> <p>analyze cellular reproduction processes and determine probable offspring by applying Mendel's Laws of Genetics;</p> <p>use DNA and RNA models to explain protein synthesis, mutations, and gene therapy, and</p> <p>determine how changing environmental factors disrupt the interrelationships of organisms within an ecosystem and alter energy flow.</p>	<p>organisms;</p> <p>diagram and describe the flow of energy in cells, organisms, and the environment;</p> <p>describe cellular reproduction processes and use Punnett squares to predict outcomes for monohybrid crosses;</p> <p>use DNA and RNA models to explain replication, transcription, and translation, and</p> <p>describe how abiotic variables determine an ecosystem and identify interrelationships between organisms.</p>	<p>and organisms;</p> <p>diagram the flow of energy in cells, organisms, and the environment;</p> <p>identify the products of cellular reproduction processes and use Punnett squares to predict outcomes for monohybrid crosses;</p> <p>identify DNA and RNA models and define replication, transcription, and translation, and</p> <p>list biotic and abiotic variables within an ecosystem and identify interrelationships between organisms.</p>
Objectives	Students will			
SC.O.B.2.1	investigate and correlate the properties of chemical and biological molecules to their function in biochemical pathways.			
SC.O.B.2.2	relate the structure of cellular organelles to their functions and interactions in eukaryotic cells.			
SC.O.B.2.3	compare and contrast cell types: <ul style="list-style-type: none"> • prokaryotic/eukaryotic • plant/animal • archaea/bacteria • various body cells. 			
SC.O.B.2.4	relate the structure and function of individual body systems to the overall functioning of the organism.			
SC.O.B.2.5	predict and assess responses of organisms to internal and environmental stimuli.			

SC.O.B.2.6	<p>analyze the chemistry and fluid mosaic model of the cell membrane as they relate to import and export of molecules necessary for life including:</p> <ul style="list-style-type: none"> • osmosis • diffusion • active transport • passive transport • dialysis.
SC.O.B.2.7	<p>quantitatively analyze the flow of energy through cellular processes:</p> <ul style="list-style-type: none"> • photosynthesis • cellular respiration • fermentation.
SC.O.B.2.8	<p>differentiate mechanisms of homeostasis in living systems (negative and positive feedback).</p>
SC.O.B.2.9	<p>examine the processes of binary fission, mitosis, meiosis and relate them to:</p> <ul style="list-style-type: none"> • the number of chromosomes • production of daughter cells, somatic cells, and gametes • variations or lack of variations within a species.
SC.O.B.2.10	<p>use Punnett squares to predict genotypic and phenotypic ratios by applying Mendel's Laws of Genetics:</p> <ul style="list-style-type: none"> • in monohybrid and dihybrid crosses • complete dominance • incomplete dominance • codominance • sex-linked traits • multiple alleles.
SC.O.B.2.11	<p>analyze karyotypes and pedigrees as diagnostic tools.</p>
SC.O.B.2.12	<p>construct and use models of DNA to explain replication and mutations.</p>
SC.O.B.2.13	<p>differentiate the structure and function of messenger, transfer and ribosomal RNA in the process of transcription and translation.</p>
SC.O.B.2.14	<p>research and debate the application of DNA technology in the context of social, ethical, and political issues.</p>
SC.O.B.2.15	<p>evaluate the evidence for natural selection including:</p> <ul style="list-style-type: none"> • speciation • fossil record evidence • molecular similarities • homologous structures.
SC.O.B.2.16	<p>evaluate the influence of the historical social context on the development of evolutionary theory.</p>
SC.O.B.2.17	<p>compare morphological, cladistic and other classification systems including domains, kingdoms and other taxa.</p>
SC.O.B.2.18	<p>justify the placement of viruses in classification systems.</p>
SC.O.B.2.19	<p>examine the cycle of viruses and compare disease prevention:</p> <ul style="list-style-type: none"> • vaccinations • vector control

	<ul style="list-style-type: none"> • drug therapy.
SC.O.B.2.20	evaluate environmental factors that affect succession, populations and communities.
SC.O.B.2.21	propose ecosystem models that incorporate interactions of biotic and abiotic environmental variables in biogeochemical cycles.
SC.O.B.2.22	interpret changes in energy as it flows through an ecosystem to illustrate conservation of energy in the energy pyramid, food web, and food chain.
SC.O.B.2.23	<p>analyze interrelationships of organisms within an ecosystem</p> <ul style="list-style-type: none"> • competition • predation • symbiosis <ul style="list-style-type: none"> ○ commensalism ○ mutualism ○ parasitism.
SC.O.B.2.24	analyze graphs, GIS data and traditional maps reflecting changes in population to predict limiting factors in ecosystems as they determine carrying capacity.

Conceptual Biology Content Standards and Objectives

Conceptual Biology is an introductory course designed for students who are interested in the field of technical biology which will give them the scientific knowledge, opportunities to develop the inquiry, problem solving skills, and decision making abilities necessary for their future vocation. Conceptual Biology is an alternative to Biology and is designed to prepare students for entry-level careers, using skills for the 21st Century. Students will explore occupational opportunities in health, engineering, and technology and evaluate the required academic preparations while expanding their knowledge and laboratory experiences. The course will provide an in-depth study in the chemical nature of life, cellular functions, microbiology, ecology, biotechnology, zoology and botany with an emphasis on application. 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 Standard: 1	Conceptual Biology Nature and Application of Science				
SC.S.CB.1	Students will <ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions. 				
Performance Descriptors SC.PD.CB.1					
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice	
Conceptual Biology students at the distinguished level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-	Conceptual Biology students at the above mastery level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-	Conceptual Biology students at the mastery level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and relate science-technology-	Conceptual Biology students at the partial mastery level in the nature and applications of science: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and relate science-technology-	Conceptual Biology students at the novice level in the nature and applications of science: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and relate science-technology-	

societal issues while using a variety of sources to construct solutions and defend their ideas to an authentic audience.	societal issues while using a variety of sources to construct and defend their solutions.	societal issues while using a variety of sources to construct and defend their solutions.	societal issues while using a variety of sources to construct their solutions.	societal issues while using a variety of sources to construct their solutions.
Objectives Students will				
SC.O.CB.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.			
SC.O.CB.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.			
SC.O.CB.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).			
SC.O.CB.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).			
SC.O.CB.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).			
SC.O.CB.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.			
SC.O.CB.1.7	given current science-technology-societal issues, construct and defend potential solutions.			
SC.O.CB.1.8	relate societal, cultural and economic issues to key scientific innovations.			
SC.O.CB.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).			

Grade Ten Conceptual Biology				
Standard: 2 Content of Science				
SC.S.CB.2	Students will	<ul style="list-style-type: none"> • 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 in content of science:	Conceptual Biology students at the above mastery level in content of science:	Conceptual Biology students at the mastery level in content of science:	Conceptual Biology students at the partial mastery level in content of	Conceptual Biology students at the novice level will in content of

<p>analyze the chemistry of cellular processes and explain consequences of variations of biological molecules as they relate structure to function in various cells, organisms and viruses;</p> <p>compare and contrast mechanisms of energy flow in cells, organisms, and the environment;</p> <p>determine the effectiveness and predict consequences of asexual and sexual reproduction within a species;</p> <p>trace the history and the importance of the discovery of DNA and RNA structures as they relate to the development modern biological innovations in science;</p> <p>relate disease controls measures to the viral cycle;</p> <p>apply genetic principles to predict and calculate population variances and sustainability of ecosystems, and</p> <p>manipulate multiple variables to determine environmental</p>	<p>analyze the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms and viruses;</p> <p>compare mechanisms of energy flow in cells, organisms and the environment;</p> <p>determine the effectiveness and consequences of asexual and sexual reproduction within a species;</p> <p>trace the history and the importance of DNA and RNA structures as they relate to modern biological science;</p> <p>explain events of the viral cycle as they relate to disease transmission;</p> <p>apply genetic principles to predict long range outcomes of populations, and</p> <p>manipulate multiple variables and analyze</p>	<p>investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms, and viruses;</p> <p>analyze the flow of energy in cells, organisms, and the environment;</p> <p>determine the effectiveness of asexual and sexual reproduction within a species;</p> <p>trace the history and the importance of DNA and RNA structures as they relate to everyday life;</p> <p>predict outcomes from populations applying Mendel's laws;</p> <p>relate viral cycle to disease control, and</p> <p>use modern evidence to predict and analyze</p>	<p>science:</p> <p>describe the chemistry of cellular process and biological molecules, as they relate to function in various cells, organisms and virus;</p> <p>diagram the flow of energy in cells, organisms and the environment;</p> <p>compare sexual and asexual reproduction;</p> <p>create a monohybrid cross with a Punnett square;</p> <p>recognize the structure of DNA and RNA;</p> <p>make connections between viral cycles and disease control, and</p> <p>recognize variables affecting interactions of</p>	<p>science:</p> <p>recognize different types of cells;</p> <p>identify that energy input is necessary for all living things;</p> <p>characterize sexual and asexual reproduction;</p> <p>complete a simple monohybrid Punnett square;</p> <p>recognize the general structure of DNA;</p> <p>relate viruses to the diseases they cause, and</p> <p>recognize changes in organisms, populations,</p>
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effects and analyze the interdependence of organisms.	changes to determine the interdependence of organisms and their environment.	changes in populations as they determine the interdependence of organisms.	organisms, and identify factors causing changes in populations with their environment.	and environment.
Objectives Students will				
SC.O.CB.2.1	relate molecules to their functions in biochemical pathways.			
SC.O.CB.2.2	relate the structure of cellular organelles to their functions and interactions in eukaryotic cells.			
SC.O.CB.2.3	compare and contrast cell types: <ul style="list-style-type: none"> • prokaryotic/eukaryotic • plant/animal • various body cells. 			
SC.O.CB.2.4	incorporate the structure and function of individual body systems to the overall functioning of the organism.			
SC.O.CB.2.5	predict and assess responses of organisms to internal and environmental stimuli: <ul style="list-style-type: none"> • homeostasis metabolism • cyclic behaviors. 			
SC.O.CB.2.6	correlate the properties of molecules to their movement through biological membranes: <ul style="list-style-type: none"> • osmosis • diffusion. 			
SC.O.CB.2.7	analyze the flow of energy through cellular processes: <ul style="list-style-type: none"> • photosynthesis • cellular respiration • fermentation. 			
SC.O.CB.2.8	apply the absorption spectrum of photosynthetic pigments to the action of spectrum of photosynthesis.			
SC.O.CB.2.9	examine the processes of binary fission, mitosis, and meiosis and relate them to: <ul style="list-style-type: none"> • the number of chromosomes • production of daughter cells • variations or lack of variations within a species. 			
SC.O.CB.2.10	use Punnett squares to determine genotypic and phenotypic ratios by applying Mendel's Laws of Genetics: <ul style="list-style-type: none"> • monohybrid and dihybrid crosses • complete dominance • incomplete dominance • codominance • sex-linked traits • multiple alleles. 			
SC.O.CB.2.11	explore the discovery of DNA and examine the molecular structure of the double helix.			
SC.O.CB.2.12	analyze karyotypes and pedigrees as diagnostic tools.			
SC.O.CB.2.13	compare and contrast the social, political, and ethical implications of genetic engineering using current DNA technology.			
SC.O.CB.2.14	evaluate the evidence of evolution through natural selection			

	<ul style="list-style-type: none"> • speciation • fossil record evidence • molecular similarities • homologous structures.
SC.O.CB.2.15	compare morphological and other classification systems including domains, kingdoms and other taxa.
SC.O.CB.2.16	<p>examine the cycle of viruses and compare disease prevention;</p> <ul style="list-style-type: none"> • vaccinations • vector control • drug therapy.
SC.O.CB.2.17	evaluate forest and wildlife best management practices as they affect succession, populations and communities.
SC.O.CB.2.18	assess the implications of invasive on native wildlife and their habitat requirements.
SC.O.CB.2.19	interpret changes in energy as it flows through an ecosystem to illustrate conservation of energy in the energy pyramid, food web, and food chain.
SC.O.CB.2.20	characterize complex interactions of organisms with ecosystems based on their niches including interspecific and intraspecific competition and symbiosis.
SC.O.CB.2.21	analyze graphs, GIS data, and traditional maps reflecting changes in populations to predict limiting factors in ecosystems and determine carrying capacity.
SC.O.CB.2.22	<p>predict the effects of human activities on biogeochemical cycles of matter and energy in the biosphere over time:</p> <ul style="list-style-type: none"> • water quality • air quality • recycling • climate change

Biology II Content Standards and Objectives

Biology II is an advanced course that is an elective designed for students who have completed Biology or Conceptual Biology and desire an in-depth and rigorous study of the content found in many biological fields of endeavor. This course is designed to build upon and extend the Biology and Conceptual Biology concepts, skills and knowledge from a science program, using skills for the 21st Century. Students interested in health and scientific related careers will evaluate the required academic preparations while building and expanding their laboratory skills and experiences. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. 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 11/12		Biology II		Nature and Application of Science	
Standard 1		Students will			
SC.S.Bil.1		<ul style="list-style-type: none"> • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 			
Performance Descriptors SC.PD.Bil.1					
Distinguished		Above Mastery		Mastery	
Biology II students at the distinguished level in the nature and applications of science:		Biology II students at the above mastery level in the nature and applications of science:		Biology II students at the mastery level in the nature and applications of science:	
<p>implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct solutions and</p>		<p>implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a variety of sources to construct and defend their</p>		<p>implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.</p>	
Biology II students at the novice level in the nature and applications of science:		Biology II students at the partial mastery level in the nature and applications of science:		Biology II students at the novice level in the nature and applications of science:	
<p>implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a variety of sources to construct their solutions.</p>		<p>implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a variety of sources to construct their solutions.</p>		<p>implement safe practices as they conduct experiments on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a variety of sources to construct their solutions.</p>	

defend their ideas to an authentic audience.	solutions.	
Objectives	Students will	
SC.O.BII.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.	
SC.O.BII.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.	
SC.O.BII.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).	
SC.O.BII.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).	
SC.O.BII.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).	
SC.O.BII.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.	
SC.O.BII.1.7	given current science-technology-societal issues, construct and defend potential solutions.	
SC.O.BII.1.8	relate societal, cultural and economic issues to key scientific innovations.	
SC.O.BII.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).	

Grade 11/12	Biology II		
Standard: 2	Content of Science		
SC.S.BII.2	Students will	<ul style="list-style-type: none"> demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives; demonstrate an understanding of the interrelationships among physics, chemistry, biology and the earth and space sciences. apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences. 	
Performance Descriptors SC.PD.BII.2			
Distinguished	Above Mastery	Mastery	Partial Mastery
Biology II students at the distinguished level:	Biology II students at the above mastery level:	Biology II students at the mastery level:	Biology II students at the novice level:
analyze how size, shape and functional group determines the unique properties of organic molecules;	correlate size, shape and functional group to unique properties of organic molecules to biochemical pathways;	correlate functional groups to unique molecules to biochemical pathways;	list the functional groups of organic molecules in biochemical pathways;

<p>analyze energy flow of cellular processes and evaluate other compounds with water-like properties and predict whether or not those compounds can be substituted for water in biological systems;</p> <p>design multiple generation investigations for the application of Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities;</p> <p>research and design investigations using the development of technology as it relates to analyzing chromosomal abnormalities and correcting genetic disorders;</p> <p>examine the evidence that some viruses cause cancer;</p> <p>interpret the interrelatedness of living organisms through their characteristics and investigate their structures;</p> <p>explain how the embryonic development of animals provide evidence of a shared ancestry, and</p>	<p>analyze the value of water in the energy cycles of living systems and its importance in biological systems;</p> <p>apply Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities;</p> <p>use the development of technology as it relates to analyzing chromosomal abnormalities and correcting genetic disorders;</p> <p>evaluate treatment of viral diseases based on lytic and lysogenic cycles;</p> <p>classify and analyze living organisms by their characteristics;</p> <p>survey embryonic development of animals, and</p>	<p>trace the flow of energy in condensation and hydrolysis reactions of organic molecules;</p> <p>understand the application of Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities;</p> <p>recognize the use of technology as it relates to analyzing chromosomal abnormalities and correcting genetic disorders;</p> <p>describe the lytic and lysogenic cycles and the treatments of viral diseases;</p> <p>describe the differences in living organisms by their characteristics;</p> <p>outline the embryonic development of animals, and</p>	<p>identify condensation and hydrolysis reactions of organic molecules;</p> <p>identify the application of Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities;</p> <p>relate the use of technology as it relates to analyzing chromosomal abnormalities and correcting genetic disorders;</p> <p>trace the life cycle of viruses and list of the treatments of viral diseases;</p> <p>list the characteristics of organisms;</p> <p>list the embryonic development of animals, and</p>
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examine the roles of innate and learned animal behaviors in the evolution of a species.	examine the historical study of innate and learned animal behaviors.	examine types of innate and learned animal behaviors.	compare and contrast innate and learned animal behaviors.	identify type of innate behaviors and types of learned animal behaviors.
Objectives				
SC.O.BII.2.1	correlate functional groups to unique properties of organic molecules to biochemical pathways.			
SC.O.BII.2.2	describe the transfer of energy during condensation and hydrolysis reactions of organic molecules (e.g., ATP, enzyme substrate and active site).			
SC.O.BII.2.3	summarize the electrochemical gradients in various cells and their corresponding environments.			
SC.O.BII.2.4	analyze the properties of water and its importance in biological systems: <ul style="list-style-type: none"> • polarity • solubility • specific heat • pH • and buffers. 			
SC.O.BII.2.5	examine the flow of energy through specific molecules in: <ul style="list-style-type: none"> • light dependent and light independent photosynthesis reactions • glycolysis • Kreb's cycle • EPS • fermentation. 			
SC.O.BII.2.6	interpret important research leading to the current knowledge of molecular genetics: <ul style="list-style-type: none"> • Griffith • Avery • Hershey & Chase • Chargaff • Franklin & Wilkins • Waston & Crick. 			
SC.O.BII.2.7	explain the use of restriction enzymes, vectors, plasmids and probes in recombinant DNA.			
SC.O.BII.2.8	conduct and interpret DNA investigations such as RFLP and PCR.			
SC.O.BII.2.9	analyze the process of DNA replication including: <ul style="list-style-type: none"> • DNA polymerase • semi-conservative replication • base-pairing. 			
SC.O.BII.2.10	apply the processes of transcription and translation to gene expression.			
SC.O.BII.2.11	demonstrate the role of DNA in determining phenotype and illustrate ways of controlling and regulating expression and function of genes.			

SC.O.BII.2.12	distinguish between chromosomal and gene mutations and their potential effects.
SC.O.BII.2.13	analyze a karyotype to determine chromosomal abnormalities.
SC.O.BII.2.14	<p>predict phenotypic ratios of crosses:</p> <ul style="list-style-type: none"> • pleiotropy • epistasis • multiple alleles • polygenic inheritance.
SC.O.BII.2.15	evaluate treatment of viral diseases based on lytic and lysogenic cycles.
SC.O.BII.2.16	<p>analyze the criteria for classifications of protists:</p> <ul style="list-style-type: none"> • motility • cellular structures • reproduction • energy sources.
SC.O.BII.2.17	<p>survey the fungi kingdom:</p> <ul style="list-style-type: none"> • characteristics • reproduction • relationship to humans and the ecosystem.
SC.O.BII.2.18	compare and contrast members of the plant kingdom in terms of their reproductive systems.
SC.O.BII.2.19	<p>compare and contrast members of the animal kingdom in terms of their complexity:</p> <ul style="list-style-type: none"> • tissues • nervous • digestive systems.
SC.O.BII.2.20	<p>survey embryonic development of animals:</p> <ul style="list-style-type: none"> • gastrulation • development of different body cavities • and tissues develop from germ layers.
SC.O.BII.2.21	<p>examine types of innate and learned animal behaviors:</p> <ul style="list-style-type: none"> • competitive • reproductive • social • cyclic • communication.

Chemistry Content Standards and Objectives

Chemistry is an advanced level course designed for students who desire a broader, in-depth study of the content found in the science field of chemistry. Chemistry is the study of matter, its composition and its changes. This course is designed to build upon and extend the Chemistry concepts, skills and knowledge from the science program using skills for the 21st century. This course is designed to prepare a student for college chemistry, requiring a strong mathematical base. The relationship between chemistry concepts and mathematics will be emphasized. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills as they evaluate the academic requirements and prepare for occupational opportunities in biology, chemistry, engineering, and technology. 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 Standard 1	Chemistry Nature and Application of Science	Performance Descriptors SC.PD.C.1			
SC.S.C.1	Students will	Above Mastery	Mastery	Partial Mastery	Novice
	<ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 				
		Chemistry students at the above mastery level in the nature and applications of science:	Chemistry students at the mastery level in the nature and applications of science:	Chemistry students at the partial mastery level in the nature and applications of science:	Chemistry students at novice level in the nature and applications of science:
	<ul style="list-style-type: none"> implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	<ul style="list-style-type: none"> implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	<ul style="list-style-type: none"> implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	<ul style="list-style-type: none"> implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	<ul style="list-style-type: none"> implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.

construct solutions and defend their ideas to an authentic audience.	construct and defend their solutions.	construct and defend their solutions.	construct their solutions.
Objectives	Students will		
SC.O.C.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.		
SC.O.C.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.		
SC.O.C.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).		
SC.O.C.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).		
SC.O.C.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).		
SC.O.C.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.		
SC.O.C.1.7	given current science-technology-societal issues, construct and defend potential solutions.		
SC.O.C.1.8	relate societal, cultural and economic issues to key scientific innovations.		
SC.O.C.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).		

Grade Eleven Standard 2	Chemistry Content of Science			
SC.S.C.2	Students will	<ul style="list-style-type: none"> demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences. 		
Performance Descriptors SC.PD.C.2				
Distinguished		Above Mastery	Mastery	Partial Mastery
Chemistry students at the distinguished level :	quantitatively determine the identity of a substance using physical properties	Chemistry students at the above mastery level: qualitatively identify a substance by its physical and chemical properties;	Chemistry students at the mastery level: classify pure substances by their chemical and physical properties;	Chemistry students at the novice level: define pure substances and chemical and physical properties;

<p>such as density, melting points, specific heat, etc;</p> <p>draw conclusions from historical development of the periodic table and atomic theory to validate modern theories of bonding;</p> <p>create the correct molecular formula and communicate the correct name for the hydrocarbons</p> <p>construct the appropriate balanced equation for laboratory experiments;</p> <p>explain from experimental data and appropriate stoichiometric applications the limiting reactant, excess reactant, and theoretical yield;</p> <p>determine experimentally the properties of solution ;</p> <p>perform gas stoichiometric calculations;</p> <p>conduct a neutralization experiment to construct and</p>	<p>formulate scientific explanations based on historical observations and experimental evidence to explain atomic theory and bonding;</p> <p>generate the correct molecular formula and/or name for binary, ternary and oxy-acids;</p> <p>predict the products, write and classify balanced chemical reactions;</p> <p>apply stoichiometric principles to various chemical conversions;</p> <p>determine experimentally the effects of temperature, concentration and vapor pressure on solution properties;</p> <p>perform calculations using the Ideal Gas equation;</p> <p>conduct a neutralization experiment to determine an</p>	<p>relate scientific explanations based on historical observations and experimental evidence to explain atomic theory, bonding, structure and periodic trend</p> <p>generate the correct formula and/or name ionic or molecular compounds;</p> <p>write and classify balanced chemical reactions;</p> <p>perform the following "mole" calculations: molarity, percentage composition, empirical and molecular formula, formulas of hydrates and theoretical yield;</p> <p>determine experimentally the effects of temperature and concentration on solution properties;</p> <p>perform calculations using the combined gas laws;</p> <p>compare methods of measuring pH while</p>	<p>research atomic theory to locate an atom on the periodic table and to construct models of elements and compounds;</p> <p>write formulas for/or name simple ionic and molecular compounds</p> <p>write and recognize the types of chemical reactions;</p> <p>calculate molarity and percentage composition;</p> <p>determine experimentally the effects of temperature on solution properties and water's role as a solvent;</p> <p>perform calculations using Boyle's, Charles' or Gay-Lussac's Laws;</p> <p>define Arrhenius and Brønsted-Lowry acids and</p>	<p>use the periodic table to produce atomic models;</p> <p>write formulas for/or name simple binary compounds</p> <p>identify the types of chemical reactions;</p> <p>calculate basic mole conversions;</p> <p>define solute, solvent and solution</p> <p>identify pressure, temperature, and volume units;</p> <p>classify solutions as acidic or basic using pH values;</p>
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interpret a titration curve;	unknown molarity;	conducting a neutralization experiment;	select an appropriate indicator given the pH range of a solution;	
design a properly working electrolytic cell based on redox principles, and	describe the parts of an electrolytic cell, and	apply the appropriate oxidation numbers to balance redox reactions, and	relate the role of the electron to oxidation numbers, and	identify oxidation numbers, and
predict and explain how shifts in equilibrium affect the solubility of a solid.	calculate the solubility product, K_{sp} .	identify oxidation numbers to determine electron movement.	identify factors that can cause a shift in equilibrium.	state an equilibrium expression and K from a chemical equation.
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 contributions to the evolution of the atomic theory.			
SC.O.C.2.3	describe atoms using the Quantum Model.			
SC.O.C.2.4	produce electron configurations and orbital diagrams for any element on the periodic table and predict the chemical properties of the element from the electron configuration.			
SC.O.C.2.5	illustrate Lewis' dot structures for representative (main group) elements.			
SC.O.C.2.6	generate the correct formula and/or name for ionic and molecular compounds.			
SC.O.C.2.7	analyze periodic trends in atomic size, ionic size, electronegativity, ionization energy and electron affinity.			
SC.O.C.2.8	predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic substances.			
SC.O.C.2.9	identify oxidation numbers to determine electron movement.			
SC.O.C.2.10	construct models to explain the structure and geometry of organic and inorganic molecules.			
SC.O.C.2.11	given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactions: <ul style="list-style-type: none"> • synthesis or combination, • decomposition, • single replacement, • double replacement and • combustion. 			
SC.O.C.2.12	determine experimentally the effects of temperature and concentration on solution properties: <ul style="list-style-type: none"> • solubility, • conductivity, • density and • colligative properties. 			
SC.O.C.2.132	classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction.			
SC.O.C.2.14	explain the chemical and physical concepts involved in dynamic equilibrium.			
SC.O.C.2.15	generate mole conversions that demonstrate correct application of scientific notation and significant:			

	<ul style="list-style-type: none"> • mass to number of particles, • number of particles to volume, • volume to mass.
SC.O.C.2.1.16	perform calculations using the combined gas laws.
SC.O.C.2.17	<p>perform the following "mole" calculations showing answers rounded to the correct number of significant figures:</p> <ul style="list-style-type: none"> • molarity • percentage composition • empirical formulas • molecular formulas • formulas of hydrates • mole-mole and mass-mass stoichiometry • determination of limiting reactant • theoretical yield.
SC.O.C.2.18	compare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases.
SC.O.C.2.19	<p>compare methods of measuring pH:</p> <ul style="list-style-type: none"> • indicators • indicator papers • pH meters.
SC.O.C.2.20	predict the product of an acid-base reaction.
SC.O.C.2.21	investigate and explain water's role as a solvent based upon principles of polarity of substances.

Conceptual Chemistry Content Standards and Objectives

Conceptual Chemistry is an introductory level course designed for students in the skilled pathway who desire an alternative to a traditional college preparatory course emphasizing real life applications of chemical principles. Mathematical based problem solving is de-emphasized. Conceptual Chemistry is the study of matter, its composition and its changes. Emphasis is placed on the important role chemistry plays in a student's personal life, career opportunities, environment and society while developing 21st century skills. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research laboratory skills as they evaluate the academic requirements and prepare for occupational opportunities in biology, chemistry, engineering, and technology. 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		Conceptual Chemistry		Conceptual Chemistry	
Standard: 1		Nature and Application of Science		Nature and Application of Science	
SC.S.CC.1	Students will <ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 				
Performance Descriptors SC.PD.CC.1					
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice	
Conceptual Chemistry students at the distinguished in the nature and applications of science: <ul style="list-style-type: none"> implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	Conceptual Chemistry students at the above mastery level in the nature and applications of science: <ul style="list-style-type: none"> implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	Conceptual Chemistry students at the mastery level in the nature and applications of science: <ul style="list-style-type: none"> will implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	Conceptual Chemistry students at the partial mastery level in the nature and applications of science: <ul style="list-style-type: none"> will implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	Conceptual Chemistry students at the novice level in the nature and applications of science: <ul style="list-style-type: none"> will implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to 	

construct solutions and defend their ideas to an authentic audience.	construct and defend their solutions.	construct and defend their solutions.	construct their solutions.	construct their solutions.
Objectives	Students will			
SC.O.CC.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.			
SC.O.CC.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.			
SC.O.CC.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).			
SC.O.CC.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).			
SC.O.CC.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).			
SC.O.CC.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.			
SC.O.CC.1.7	given current science-technology-societal issues, construct and defend potential solutions.			
SC.O.CC.1.8	relate societal, cultural and economic issues to key scientific innovations.			
SC.O.CC.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).			

Grade Eleven	Conceptual Chemistry			
Standard 2	Content of Science			
SC.S.CC.2	Students will	<ul style="list-style-type: none"> demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences. 		
Performance Descriptors SC.PD.CC.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Chemistry student at the distinguished level:	Conceptual Chemistry student at the above mastery level:	Conceptual Chemistry student at the mastery level:	Conceptual Chemistry student at the partial mastery level:	Conceptual Chemistry student at the novice level:
design and conduct an investigation to compare the	predict the physical and chemical properties of	classify matter as pure substance or mixture by	use position on the periodic table to classify elements	define chemical and physical properties, pure

<p>conductivity and malleability of metals, nonmetals and metalloids, to separate a mixture, and/or to identify an unknown pure substance using its chemical and physical properties;</p> <p>predict the behavior of an ideal gas and compare the behaviors of ideal and real gas;</p> <p>analyze the periodic table to produce and use electron configurations to predict the chemical properties of elements;</p> <p>generate the correct molecular formula for binary and oxy-acids;</p> <p>calculate the enthalpy of reactions from balanced equations;</p>	<p>common objects based on their composition and examine experimentally the methods of separating mixtures;</p> <p>predict the outcome of changing a variable in a gaseous system by applying the kinetic molecular theory;</p> <p>analyze the periodic table to compare chemical properties based on changes in electron configuration for elements in a period, and characterize the properties of the ionic, covalent or metallic substances;</p> <p>generate the correct formula and/or name for simple ionic and molecular compounds and predict the type of bonding;</p> <p>create balanced equations for the five general types of chemical reactions and classify exothermic or endothermic reactions;</p>	<p>listing physical and chemical properties;</p> <p>use the kinetic molecular theory to explain states of matter and perform calculations using the combined gas laws;</p> <p>analyze the periodic table to predict trends, to illustrate Lewis' dot structures for representative (main group) elements and to produce and use electron configurations to explain chemical properties;</p> <p>generate the correct formula and/or name for simple ionic and molecular compounds then characterize the properties of the ionic, covalent or metallic substance formed;</p> <p>given the reactants, predict the products, balance the equations for the five general types of chemical reactions and classify reactions as exothermic or endothermic reactions;</p>	<p>and chemical and physical properties to classify compounds and mixtures;</p> <p>illustrates the states of matter at the molecular level and perform calculation for Boyle's, Charles' and/or Gay-Lussac's law';</p> <p>use the periodic table to produce an electron configuration, to compare two elements and describe differences in periodic properties, and to match a Bohr model to the Lewis' dot structure for representative elements;</p> <p>predict the type of bonding that occurs between atoms as ionic or covalent;</p> <p>given the formulas, place the coefficient to balance chemical equations, and classify reactions as exothermic or endothermic reactions;</p>	<p>substances and mixtures, metals, nonmetals and metalloids;</p> <p>define states of matter and identify pressure, temperature and volume units;</p> <p>use the periodic table to match an element to its group and period, to recognize that placement on the periodic table determines the common ionic charge, and to classify elements as metallic or nonmetallic;</p> <p>identify the number of valence electrons in atoms of representative metals and nonmetals;</p> <p>identify the type of chemical reaction, and define exothermic and endothermic reactions;</p>
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<p>generate complex mole conversions that require three or more conversion factors and perform all calculations that use the mole as a conversion factor;</p> <p>construct models of organic molecules and apply electronegativity values and molecular shape to classify the molecules as polar or nonpolar;</p> <p>determine experimentally the properties of solution and identify the intermolecular forces;</p> <p>conduct a neutralization experiment to construct and interpret a titration curve, and</p> <p>write nuclear equations for fission and fusion reactions.</p>	<p>generate multi-step mole conversions that require three or more conversion factors and perform all calculations that use the mole as a conversion factor;</p> <p>construct models of organic molecules and apply electronegativity values to classify the bonds as polar or nonpolar;</p> <p>investigate the solubility of various materials in water and determine experimentally the effects of temperature, concentration and vapor pressure on solution properties;</p> <p>conduct a neutralization experiment to determine an unknown molarity, and</p> <p>given the initial isotope, write the decay series until a stable isotope is reached.</p>	<p>perform the following "mole" calculations: molarity, percentage composition, empirical and molecular formula, formulas of hydrates and theoretical yield;</p> <p>construct models to explain the structure and geometry of organic and inorganic molecules;</p> <p>investigate and explain the water's role as a solvent determine, and experimentally demonstrate the effects of temperature and concentration on solution properties;</p> <p>compare methods of measuring pH while conducting a neutralization experiment, and</p> <p>given the reactants, write and balance nuclear reactions.</p>	<p>write conversion factors and calculate molarity and percentage composition;</p> <p>differentiate among linear, trigonal planar, and tetrahedral shapes;</p> <p>describe properties of solutions and illustrate water as a polar molecule;</p> <p>define Arrhenius and Brønsted-Lowry acids and select an appropriate indicator given the pH range of a solution, and</p> <p>balance nuclear reactions</p>	<p>define the mole; calculate molar mass;</p> <p>construct ball and stick models for simple molecules;</p> <p>define solute, solvent and solution, and polarity</p> <p>classify solutions as acidic or basic using pH values, and</p> <p>define alpha, beta and gamma emissions.</p>
<p>Objectives Students will</p>				
<p>SC.O.CC.2.1 classify pure substances by their chemical and physical properties.</p>				
<p>SC.O.CC.2.2 classify examples of matter as pure substance or mixture.</p>				
<p>SC.O.CC.2.3 compare and contrast the properties of metals, nonmetals and metalloids.</p>				
<p>SC.O.CC.2.4 use the kinetic molecular theory to explain states of matter.</p>				
<p>SC.O.CC.2.5 perform calculations using the combined gas laws.</p>				
<p>SC.O.CC.2.6 produce and use electron configuration to explain chemical properties of elements.</p>				

SC.O.CC.2.7	generate the correct formula and/or name for ionic and molecular compounds.
SC.O.CC.2.8	predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic bond formed.
SC.O.CC.2.9	given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactions: <ul style="list-style-type: none"> • synthesis or combination • decomposition • single replacement • double replacement • combustion.
SC.O.CC.2.10	analyze the periodic table to predict trends: <ul style="list-style-type: none"> • atomic size • ionic size • electronegativity • ionization energy • electron affinity
SC.O.CC.2.11	illustrate Lewis' dot structures for representative (main group) elements.
SC.O.CC.2.12	generate mole conversions that demonstrate the ability to convert from one type of quantity to another: <ul style="list-style-type: none"> • mass to number of particles • number of particles to volume • or volume to mass.
SC.O.CC.2.13	perform the following "mole" calculations: <ul style="list-style-type: none"> • molarity • percentage composition • empirical and molecular formula • formulas of hydrates • theoretical yields.
SC.O.CC.2.14	construct models to explain the structure and geometry of organic and inorganic molecules and the lattice structures of crystals.
SC.O.CC.2.15	determine experimentally the effects of temperature and concentration on solution properties <ul style="list-style-type: none"> • solubility • conductivity • density • colligative properties.
SC.O.CC.2.16	compare methods of measuring pH: <ul style="list-style-type: none"> • indicators • indicator papers • pH meters.
SC.O.CC.2.17	investigate and explain water's role as a solvent based upon principles of polarity of substances.
SC.O.CC.2.18	compare and contrast the Arrhenius and Bronsted-Lowry definitions of acids and bases.
SC.O.CC.2.19	classify reactions as exothermic and endothermic reactions by the direction of heat flow in a chemical reaction.

16.01.01.20 given the reactants, anticipate the products and create balanced equations for nuclear reactions.

Chemistry II Content Standards and Objectives

Chemistry II is an advanced level course that is an elective designed for students who have completed Chemistry and desire a broader, in-depth study of the content found in the science field of chemistry. Chemistry is the study of matter, its composition and its changes. This course is designed to prepare students to be critical and independent thinkers who are able to function effectively in a scientific and technological society, and to build upon and extend the chemistry concepts, skills and knowledge from the previous chemistry class. This course is designed not only to prepare a student for college chemistry but to make the college chemistry experience much easier as the student will have already studied much of the material reserved for college chemistry at the high school level. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills as they evaluate the academic requirements and prepare for occupational opportunities in biology, chemistry, engineering, and technology. Safety instruction is integrated into all activities. The West Virginia Standards for 21st Century Learning include the following components: 21st Century Content Standards and Objectives and 21st Century Learning Skills and Technology Tools. All West Virginia teachers are responsible for classroom instruction that integrates learning skills, technology tools and content standards and objectives.

Grade Twelve		Chemistry II	
Standard 1		Nature and Application of Science	
SC.S.CII.1		Students will <ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 	
Performance Descriptors SC.PD.CII.1			
Distinguished		Above Mastery	Novice
Chemistry II students at the distinguished level in the nature and applications of science:	Chemistry II students at the above mastery level in the nature and applications of science:	Chemistry I students at the mastery level will in the nature and applications of science:	Chemistry II students at the novice level in the nature and applications of science:
Implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-	Implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-	Implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and relate science-technology-	Implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and relate science-technology-

societal issues while using a variety of sources to construct solutions and defend their ideas to an authentic audience.	societal issues while using a variety of sources to construct and defend their solutions.	societal issues while using a variety of sources to construct and defend their solutions.	societal issues while using a variety of sources to construct their solutions.	societal issues while using a variety of sources to construct their solutions.
Objectives	Students will			
SC.O.CII.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.			
SC.O.CII.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.			
SC.O.CII.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).			
SC.O.CII.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).			
SC.O.CII.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).			
SC.O.CII.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.			
SC.O.CII.1.7	given current science-technology-societal issues, construct and defend potential solutions.			
SC.O.CII.1.8	relate societal, cultural and economic issues to key scientific innovations.			
SC.O.CII.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).			

Grade Twelve	Chemistry II			
Standard: 2	Content of Science			
SC.O.CII.2	Students will	<ul style="list-style-type: none"> demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental sciences and astronomy. apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences. 		
Performance Descriptors SC.PD.CII.2				
	Distinguished	Above Mastery	Mastery	Partial Mastery
Chemistry II students at the distinguished level:	Chemistry II students at the above mastery level:	Chemistry II students at the mastery level:	Chemistry II students at the partial mastery level:	Chemistry II students at the novice level:
utilize VSEPR theory to	utilize VSEPR theory to	investigate valence bonds	match types of bonding	describe valence bonds and

<p>make predictions about valence bonds that can be used to compare and contrast binding forces;</p> <p>justify the ideal gas laws on the basis of the kinetic-molecular theory;</p> <p>predict theoretical yield, limiting reactant, excess reactant, percent yield, and experimental error from a designed experiment that includes the appropriate stoichiometric applications;</p> <p>design an experiment to illustrate the effect of changing concentration on the colligative properties of solutions, change of state, and molar mass;</p> <p>evaluate systems based on the physical and chemical dynamic equilibrium concepts that include equilibrium constants and system directional change according to Le Chatelier's principle ;</p> <p>design an effective battery using the voltage calculated from the Nernst equation;</p>	<p>explain valence bonding; and the types of binding forces;</p> <p>assess the ideal gas laws on the basis of the kinetic-molecular theory;</p> <p>explain from experimental data and appropriate stoichiometric applications the limiting reactant, excess reactant, and theoretical yield;</p> <p>evaluate experiments that effect colligative properties and states of matter by changing concentration;</p> <p>illustrate physical and chemical dynamic equilibrium concepts by calculating equilibrium constants and applying Le Chatelier's principle to predict system change;</p> <p>predict the voltage using the Nernst equation and use this to compare chemical cells;</p>	<p>and binding forces;</p> <p>interpret the ideal gas laws on the basis of the kinetic-molecular theory;</p> <p>perform stoichiometric calculations utilizing Avogadro's concepts, significant figures, and mathematical applications for molar mass, theoretical yield, and limiting reactant;</p> <p>explain by concentration calculations the effect of changing concentration on the colligative properties of solutions and on changes of state;</p> <p>explain the physical and chemical dynamic equilibrium concepts through calculation of equilibrium constants and application of Le Chatelier's principle;</p> <p>Identify oxidation numbers for the ions that are used to calculate the electron movement in a redox reaction and calculate the voltage using the Nernst equation;</p>	<p>forces including all that contain valence bonds;</p> <p>explain the ideal gas laws on the basis of the kinetic-molecular theory;</p> <p>perform stoichiometric calculations utilizing Avogadro's concepts, significant figures, and mathematical applications for molar mass, theoretical yield, and limiting reactant;</p> <p>calculate molar mass and concentration then describe the effect of changing concentration on colligative properties and change of state;</p> <p>describe the physical and chemical dynamic equilibrium concepts that include the calculation of equilibrium constants and Le Chatelier's principle;</p> <p>use oxidation numbers for ions in a compound to calculate the electron movement in a redox reaction and calculate the voltage using the Nernst equation;</p>	<p>types of binding forces;</p> <p>state the ideal gas laws and describe their basis on kinetic molecular theory;</p> <p>calculate theoretical yield that is expressed in correct significant figures and determine the molar mass, theoretical yield, and limiting reactant;</p> <p>match molar mass and the effect of concentration changes on colligative properties and changes of state;</p> <p>define physical and chemical dynamic equilibrium concepts, equilibrium constants and Le Chatelier's principle;</p> <p>recognize the oxidation numbers for ions in a compound used to calculate the electron movement in a redox reaction and match the voltage using the Nernst equation;</p>
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<p>design and conduct experiments to collect and graphically analyze data to investigate reaction rate and predict reactant order;</p> <p>design and conduct experiments to experimentally and mathematically demonstrate the first and second law of thermodynamics including the reaction spontaneity;</p> <p>calculate and explain the relationships among weak acids, pOH, pK, K_a, K_b, K_w, ionization constants, and percent ionization, K_{sp};</p> <p>prove the presence of specific cations and anions in an unknown mixture through experimental data;</p> <p>solve complex problems involving radioactive decay and write nuclear equations for decay, fission, and fusion;</p> <p>perform calculations involving the addition of a strong acid or base to a buffer; experimentally justify the hydrolysis of a salt and equivalence point of a</p>	<p>demonstrate reactant order, rate constants, reaction rate laws, rate calculations and predict the effect of temperature on rate changes;</p> <p>demonstrate experimentally and mathematically applications of Hess's Law, spontaneous reactions, and the second law of thermodynamics;</p> <p>explain weak electrolytes, ionization constants, and percent ionization;</p> <p>design a qualitative analysis for an unknown mixture;</p> <p>investigate the similarities and differences between radioactive processes, nuclear fission, and fusion;</p> <p>predict the pH of a salt from its formula then calculate the pH of the salt; write the reaction of hydrolyzed salt; interpret the effect of a buffer on an aqueous</p>	<p>determine reactant order, rate constants, and reaction rate laws using rate calculation and describe the effect of temperature on rate changes;</p> <p>determine the heat of formation, heat of reaction, heat of vaporization and heat of fusion while using applications of Hess's Law and use the second law of thermodynamics;</p> <p>identify weak electrolytes, pH, pOH, pK, K_a, K_b, K_w, K_{sp} and calculate pH and pOH; measure pH with indicator papers and electronic meters;</p> <p>analyze a solution that contains known cations and a solution that contains known anions;</p> <p>express radioactive decay in an equation format and solve simple problems for the half-life of an isotope;</p> <p>identify the components of a buffer and the use of buffers, and</p>	<p>estimate reactant order using rate constants, reaction rate laws, rate calculations, and temperature's influence on rate changes;</p> <p>state the second law of thermodynamics and applications of Hess's Law that include calculations of the free energy of formation and the free energy of reaction;</p> <p>identify weak electrolytes, pH, pOH, pK, K_a, K_b, K_w, K_{sp} and calculate pH and pOH; measure pH with indicator papers and electronic meters;</p> <p>construct a data table for cation and anion analysis;</p> <p>categorize by using the properties of the different types of radiation emitted during radioactive decay;</p> <p>identify salts that undergo hydrolysis and match the reaction for the ion with water; interpret a titration curve to identify the equivalence point, and</p>	<p>match reactant order, rate constants, or reaction rate laws, calculate the rate of reaction and describe the effect of temperature on rate changes;</p> <p>identify Hess's Law and the dependence of free energy on enthalpy and entropy changes;</p> <p>define weak electrolytes, pH, pOH, pK, K_a, K_b, K_w, K_{sp}; calculate pH and pOH and measure pH with indicator papers or electronic meters;</p> <p>identify the colors of specific cation and anion precipitates;</p> <p>identify a nuclear equation and generally describe radioactive decay;</p> <p>identify the equivalence point on a titration curve, and</p>
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titration curve, and	system, and	recognize and classify	identify simple organic	match simple organic
evaluate organic structures and compounds based on functional groups.	differentiate, classify and characterize simple organic functional groups and compounds.	simple organic functional groups.	functional groups and compounds.	functional groups and compounds.
Objectives	Students will			
SC.O.CII.2.1	<p>identify types of binding forces such as:</p> <ul style="list-style-type: none"> • ionic • covalent • metallic • van der Waals forces (including London) <p>and relate binding forces to state, structure, and properties of matter.</p>			
SC.O.CII.2.2	<p>investigate the valence bond including the concepts of:</p> <ul style="list-style-type: none"> • hybridization of orbitals • resonance • formation of sigma and pi bonds <p>and demonstrate an understanding of the VSEPR theory.</p>			
SC.O.CII.2.3	<p>apply the principles of chemical reactivity, products of chemical reactions, and relationships on periodic table to predict the ions in a descriptive chemistry experiment.</p>			
SC.O.CII.2.4	<p>interpret the ideal gas laws on the basis of the kinetic-molecular theory.</p>			
SC.O.CII.2.5	<p>relate Avogadro's hypothesis and its relation to the mole concept.</p>			
SC.O.CII.2.6	<p>define changes of state, including critical temperatures and triple points, based on the kinetic molecular theory.</p>			
SC.O.CII.2.7	<p>calculate concentration and explain the effect of changing concentration on the colligative properties of solutions.</p>			
SC.O.CII.2.8	<p>identify oxidation numbers for ions and for any element in a compound to calculate the electron movement in a redox reaction and calculate the voltage using the Nernst equation.</p>			
SC.O.CII.2.9	<p>explain physical and chemical dynamic concepts; calculate equilibrium constants K_p, K_c, K_{sp}, K_a, and K_b, and apply Le Chatelier's principle.</p>			
SC.O.CII.2.10	<p>use experimental data and graphical analysis to determine reactant order, rate constants, and reaction rate laws, calculate the rate of reaction and explain the effect of temperature on rate changes.</p>			
SC.O.CII.2.11	<p>determine the heat of formation, heat of reaction, heat of vaporization and heat of fusion; apply Hess's Law.</p>			
SC.O.CII.2.12	<p>using the second law of thermodynamics, calculate the free energy of formation, free energy of reaction and the dependence of free energy on enthalpy and entropy changes.</p>			
SC.O.CII.2.13	<p>perform all calculations with attention given to significant figures, precision of measured values, and the use of logarithmic and exponential relationships.</p>			
SC.O.CII.2.14	<p>calculate molar masses from gas density, freezing-point, and boiling-point measurements.</p>			
SC.O.CII.2.15	<p>experimentally determine the properties of acids:</p> <ul style="list-style-type: none"> • identify weak electrolytes; • define pH, pOH, pK, K_a, K_b, K_w, ionization constant, percent ionization, K_{sp}. 			

	<ul style="list-style-type: none"> • calculate pH and pOH; • measure pH with indicator papers and electronic meters; • recognize salts that undergo hydrolysis • write a reaction for the ion with water • interpret a titration curve to identify the equivalence point and • calculate the range of a buffer.
BC.O.CII.2.16	perform stoichiometric calculations to produce values for theoretical yield and to decide the limiting reactant of a given chemical reaction.
SC.O.CII.2.17	recognize simple organic functional groups and classify simple organic compounds by name.
SC.O.CII.2.18	given the reactants, anticipate the products and create balanced equations for nuclear reactions.

Earth Science Content Standards and Objectives

Earth Science is an advanced level lab course that is an elective designed for students who desire a broader understanding of the fundamentals of earth science and includes geology, oceanography, meteorology and astronomy. This course is designed to build on knowledge, skills, and dispositions developed during the science progression, which included the traditional disciplines of biology, chemistry, and physics where appropriate. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills as they evaluate the academic requirements and prepare for occupational opportunities in geology, astronomy, and ecology. 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 Standard: 1	Earth Science Nature and Application of Science	Students will	Performance Descriptors SC.PD.ES.1	Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
SC.S.ES.1	Students will	<ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 		Earth Science students at the distinguished level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct solutions and	Earth Science students at the above mastery level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their	Earth Science students at the mastery level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	Earth Science students at the partial mastery level in the nature and applications of science: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.	Earth Science students at the novice level in the nature and applications of science: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.

defend their ideas to an authentic audience.	solutions.
Objectives	Students will
SC.O.E.S.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.E.S.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.E.S.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).
SC.O.E.S.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).
SC.O.E.S.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).
SC.O.E.S.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.E.S.1.7	given current science-technology-societal issues, construct and defend potential solutions.
SC.O.E.S.1.8	relate societal, cultural and economic issues to key scientific innovations.
SC.O.E.S.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).

High School Standard 2	Earth Science Content of Science
SC.S.E.S.2	Students will <ul style="list-style-type: none"> 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.E.S.2	
Distinguished	Above Mastery
Earth Science students at the distinguished level of science content: investigate and evaluate geological evidence related to the structures, origin, and	Earth Science students at the above mastery level of science content: investigate and analyze geological evidence related to the structures, origin, and
Mastery	Partial Mastery
Earth Science students at the mastery level of science content: investigate geological evidence related to the structures, origin, and age	Earth Science students at the partial mastery level of science content: will describe geological structures and the origin and age of the Earth;
Novice	Novice
Earth Science students at the novice level of science content: identify Earth's structures and state the age of the Earth;	

<p>age of the Earth; assess evidence and use it to explain the significance of processes that have caused slow and rapid changes to the Earth's surface; relate meteorological evidence to weather phenomena and forecasting; experimentally determine the factors that affect climate; and debate global climatic change issues;</p> <p>use models and mathematical calculations to explain how the principles of physics and chemistry are used to determine the movements and compositions of structures within the solar system and universe, and research and debate solutions to ecological, economical, and societal conflicts.</p>	<p>age of the Earth; examine evidence and use it to explain the significance of processes that have caused slow and rapid changes to the Earth's surface; relate meteorological evidence to weather phenomena and forecasting; explain the factors that affect climate; and evaluate evidence about global climatic changes;</p> <p>use models to explain how the principles of physics and chemistry are used to determine the movements and composition of structures within the solar system and universe, and research propose solutions to ecological, economical, and societal conflicts.</p>	<p>of the Earth; investigate the processes and explain the significance of the slow and rapid changes of the Earth's surface; use meteorological tools and technology to gather data as they make forecasts and explain weather phenomena; describe the factors that affect climate; and assess evidence related to global climatic changes;</p> <p>use models to relate principles of physics and chemistry to the movements and composition of structures within the solar system and universe, and research and evaluate factors ecological, economical, and societal conflicts.</p>	<p>explain the processes that have caused slow and rapid changes to the Earth's surface; use meteorological tools to gather data as they make forecasts and explain weather phenomena; list factors that affect climate; and research evidence about global climatic changes;</p> <p>use diagrams and models to explain the movements and composition of structures within the solar system and universe, and research related to ecological, economical, and societal conflicts.</p>	<p>describe slow and rapid changes of the Earth's surface; use meteorological tools gather data and make weather forecasts; list factors that affect climate; and describe global climatic changes;</p> <p>use diagrams and models to identify structures within the solar system and universe, and list ecological, economical, and societal conflicts related to Earth Science.</p>
<p>Objectives Students will</p>				
<p>SC.O.ES.2.1 identify and describe the structure, origin, and evolution of the lithosphere, hydrosphere, atmosphere and biosphere.</p>				
<p>SC.O.ES.2.2 analyze seismic, density, gravity, and magnetic data to explain the structure of the earth.</p>				
<p>SC.O.ES.2.3 characterize the eras, epochs and periods in relation to earth history and geologic development.</p>				
<p>SC.O.ES.2.4 analyze radiometric dating and rock and fossil evidence to determine the age of substances.</p>				
<p>SC.O.ES.2.5 use chemical and physical properties to distinguish between common minerals and explain their economic uses.</p>				

SC.O.ES.2.6	use rock characteristics to predict paleoenvironments or geologic conditions which existed during the formation of a given rock sample.
SC.O.ES.2.7	investigate and describe the properties of water, which contribute to its critical role in physical and chemical weathering.
SC.O.ES.2.8	compare and contrast the effectiveness of agents and processes of degradation: <ul style="list-style-type: none"> • weathering by gravity • wind • water • ice.
SC.O.ES.2.9	predict geologic activity associated with specific plate boundaries and interactions.
SC.O.ES.2.10	analyze modern and historical seismic information to determine epicenter location and magnitude of earthquakes.
SC.O.ES.2.11	evaluate current explanations for mechanisms, which drive the motion of plates (convection, slab-pull, plate push).
SC.O.ES.2.12	relate the effect of degradation and tectonic forces on the earth's surface features: <ul style="list-style-type: none"> • weathering • physical features of the ocean floor • life with the oceans.
SC.O.ES.2.13	construct and/or interpret information on topographic maps.
SC.O.ES.2.14	identify and describe chemical and physical properties of oceans: <ul style="list-style-type: none"> • composition • currents • physical features of the ocean floor.
SC.O.ES.2.15	compare and contrast characteristics of the various oceans, including their lateral and vertical motions.
SC.O.ES.2.16	analyze the evolution of the ocean floor: <ul style="list-style-type: none"> • ocean crust • sedimentation • active and passive continental margins.
SC.O.ES.2.17	examine the stratification of the oceans: <ul style="list-style-type: none"> • temperature • salinity zones • biological zones.
SC.O.ES.2.18	investigate to explain heat transfer in the atmosphere and its relationship to meteorological processes : <ul style="list-style-type: none"> • pressure • winds • evaporation • condensation • precipitation.
SC.O.ES.2.19	predict the effects of ocean currents on climate.
SC.O.ES.2.20	use meteorological evidence and weather maps to forecast weather:: <ul style="list-style-type: none"> • air masses

	<ul style="list-style-type: none"> • wind • barometric pressure • temperature data.
SC.O.ES.2.21	<p>examine global change over time:</p> <ul style="list-style-type: none"> • climatic trends • global warming • ozone depletion.
SC.O.ES.2.22	<p>apply Newton's Law of Universal Gravitation to the motion of celestial objects to explain phenomenon observed in the sun-earth-moon system.</p>
SC.O.ES.2.23	<p>analyze several origin theories of the solar system and universe and use them to explain the celestial bodies and their movements.</p>
SC.O.ES.2.24	<p>compare ancient and modern methods of studying and uses for astronomy</p> <ul style="list-style-type: none"> • calendar, • navigation.
SC.O.ES.2.25	<p>use various wavelengths of the electromagnetic spectrum to investigate the observable universe.</p>
SC.O.ES.2.26	<p>compare the relationship between earth processes and natural disasters with their impact on humans.</p>
SC.O.ES.2.27	<p>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.</p>
SC.O.ES.2.28	<p>research alternative energy sources and evaluate the ecological, environmental and economic cost-benefit ratio.</p>

Human Anatomy and Physiology Content Standards and Objectives

Human Anatomy and Physiology is an advanced course that is an elective designed for those students wanting a deeper understanding of the structure and function of the human body. The body will be viewed as a whole using anatomical terminology necessary to describe location. Focus will be at both micro and macro levels reviewing cellular functions, biochemical processes, tissue interactions, organ systems and the interaction of those systems as it relates to the human organism. Systems covered include integumentary, skeletal, muscular, respiratory, circulatory, digestive, excretory, reproductive immunological, nervous and endocrine. This course will develop 21st century skills and be appropriate for college bound students as well as those choosing a health services career cluster. Students will engage in active inquiries, investigation, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills as they evaluate the academic requirements and prepare for occupational opportunities in health and medical fields. 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 Standard: 1	Human Anatomy and Physiology Nature and Application of Science	Above Mastery	Mastery	Partial Mastery	Novice
SC.S.HAP.1	Students will <ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 	Human Anatomy and Physiology students at the above mastery level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and	Human Anatomy and Physiology students at the mastery level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and	Human Anatomy and Physiology students at the partial mastery level in the nature and applications of science: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and	Human Anatomy and Physiology students at the novice level in the nature and applications of science: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and
Performance Descriptors SC.PD.HAP.1					
Human Anatomy and Physiology students at the distinguished level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and	Human Anatomy and Physiology students at the above mastery level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and	Human Anatomy and Physiology students at the mastery level in the nature and applications of science: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and	Human Anatomy and Physiology students at the partial mastery level in the nature and applications of science: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and	Human Anatomy and Physiology students at the novice level in the nature and applications of science: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and	Human Anatomy and Physiology students at the novice level in the nature and applications of science: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and

relate science-technology-societal issues while using a variety of sources to construct solutions and defend their ideas to an authentic audience.	relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	relate science-technology-societal issues while using a variety of sources to construct their solutions.	societal issues while using a variety of sources to construct their solutions.
Objectives	Students will			
SC.O.HAP.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.			
SC.O.HAP.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.			
SC.O.HAP.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).			
SC.O.HAP.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).			
SC.O.HAP.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variables such as potential sources of error, or interpret maps).			
SC.O.HAP.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.			
SC.O.HAP.1.7	given current science-technology-societal issues, construct and defend potential solutions.			
SC.O.HAP.1.8	relate societal, cultural and economic issues to key scientific innovations.			
SC.O.HAP.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).			

High School Standard: 2	Human Anatomy and Physiology			
SC.S.HAP.2	Content of Science			
	Students will			
	<ul style="list-style-type: none"> demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences. 			
Performance Descriptors SC.PD.HAP.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Human Anatomy and Physiology students at the distinguished level will:	Human Anatomy and Physiology students at the above mastery level will:	Human Anatomy and Physiology students at the mastery level:	Human Anatomy and Physiology students at the partial mastery level:	Human Anatomy and Physiology students at the novice level:

<p>integrate anatomical terms; sequence hierarchical organizational levels; assess interdependency and interaction; investigate and explain tissues; integrate form and function within systems and effects of aging and disease; compare/contrast system structure and function and system integration; analyze systems in maintaining homeostasis; evaluate models replicating muscular contraction; analyze neural control; evaluate models demonstrating nerve impulses; apply physics concepts to ear and eye structure and function; compare enzyme action; describe feedback loops in endocrine functioning;</p>	<p>utilize anatomical terms; compare hierarchical organizational levels; distinguish interdependency and interaction; examine tissues; determine form and function relationship within systems and effects of aging and disease; compare system structure and function and investigate system integration; examine systems in maintaining homeostasis; design and build a model of muscle cell contraction; illustrate neural control; design a model demonstrating nerve impulses; critique effectiveness of ear and eye structures; examine enzyme action;</p>	<p>apply anatomical terms; describe hierarchical organizational levels; examine interdependency and interaction; compare/contrast tissues; analyze form and function relationship within systems and effects of aging and disease; describe system structure and function and summarize system integration; explain systems in maintaining homeostasis; model muscle contraction; integrate neural control and model nerve impulses, relate ear and eye structures to function/dysfunction; apply enzyme action to function;</p>	<p>recall anatomical terms; summarize hierarchical organizational levels; discuss interdependency and interaction; classify tissues; determine form and function relationship within systems and effects of aging and disease;; recall system structure and function and recognize system integration; identify system functions in maintaining homeostasis; illustrate muscle contractions; summarize neural control and model nerve impulses, relate ear and eye structures to function/dysfunction; describe lock and key enzyme model to action; match endocrine glands to</p>	<p>define anatomical terms; identify hierarchical organizational levels; define interdependency and interaction; identify tissues; identify form and function relationship within systems and effects of aging and disease; describe system structure and function and identify system integration; recognize systems in maintaining homeostasis; describe muscle contractions; list the neuron types; describe nerve impulses, define ear and eye structures; recite specific enzyme functions; match endocrine glands to</p>
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research effects of synthetic hormones, and	research endocrine functions and dysfunctions; explain hormones in reproductive control, and	incorporate hormones to functions/dysfunctions; outline gametogenesis, fertilization, and development, and	hormones and functions; describe oogenesis and spermatogenesis, and	functions; define mitosis/meiosis;
research use of stem cells and predict how this may affect disease treatment.	examine stress effects on immunity and research history of disease treatment.	assess immune components and research disease progression.	diagram immune response and classify factors in disease progression.	describe immune defenses and match specific disease factors to prevention and treatments.
Objectives Students will				
SC.O.HAP.2.1	apply directional terminology to locate human body structures: <ul style="list-style-type: none"> • proximal • dorsal • medial • visceral • superficial • deep. 			
SC.O.HAP.2.2	describe the organizational levels, interdependency and the interaction of <ul style="list-style-type: none"> • cells • tissues • organs • organ systems. 			
SC.O.HAP.2.3	categorize, by structure and function, the various types of human tissue: <ul style="list-style-type: none"> • muscle • epithelial • connective • nervous. 			
SC.O.HAP.2.4	relate the structure of the integumentary system to its function as a/an: <ul style="list-style-type: none"> • sensory organ • environmental barrier • temperature regulator. 			
SC.O.HAP.2.5	relate how bone tissue is important to the development of the human skeleton.			
SC.O.HAP.2.6	correlate the structure and function of the elements of the skeletal system: <ul style="list-style-type: none"> • bone • articulations • insertions. 			
SC.O.HAP.2.7	model the mechanisms of muscular contraction on the cellular and molecular levels.			

SC.O.HAP.2.8	integrate the skeletal, muscular and nervous systems to the functioning of the organism.
SC.O.HAP.2.9	<p>model the muscular system including:</p> <ul style="list-style-type: none"> • locations • origins • insertions • muscle groups • types of muscles.
SC.O.HAP.2.10	classify the various types of neurons emphasizing the relationship of structure and function.
SC.O.HAP.2.11	model the mechanism of a nerve impulse at the cellular and molecular levels.
SC.O.HAP.2.12	compare and contrast the parts and functions of the central and peripheral nervous system including the autonomic portions.
SC.O.HAP.2.13	apply the structure of the ear and eye to their function/dysfunction in relation to environmental perception.
SC.O.HAP.2.14	apply the action of specific enzymes to their roles in bodily functions.
SC.O.HAP.2.15	incorporate the role of endocrine glands and their hormones into the overall functions and dysfunctions of the body.
SC.O.HAP.2.16	analyze the role of components and processes of the digestive system in supplying essential nutrients.
SC.O.HAP.2.17	explain how structures of the respiratory system are essential to cellular respiration, gas exchange and communication.
SC.O.HAP.2.18	<p>illustrate the structures of the circulatory and lymphatic systems and the function of blood to the role of:</p> <ul style="list-style-type: none"> • transportation • cellular support • defense.
SC.O.HAP.2.19	compare the compatibility of blood types and assess the molecular basis for blood functions.
SC.O.HAP.2.20	integrate the functions of the excretory system to the maintenance of the other body systems.
SC.O.HAP.2.21	compare and contrast the structure and function of male and female reproductive systems.
SC.O.HAP.2.22	outline the events of reproduction for the formation of gametes through fertilizations and embryological development.
SC.O.HAP.2.23	assess the role of components of the immune system in defending the body.
SC.O.HAP.2.24	research disease causative factors, symptoms, prevention and treatment.

Physics Content Standards and Objectives

Physics is an advanced level course that is an elective designed for students desiring a broader, in-depth study of the content found in the science field of physics. As a college preparatory course, Advanced Physics is a laboratory driven, advanced study of nature's universal laws with emphasis on process skills, using 21st century skills. This course is designed to build upon and extend the Physics concepts, skills, and knowledge from the science program. The course emphasizes a mathematical approach to the areas of kinematics, dynamics, thermodynamics, light and optics, electricity and magnetism and modern physics. Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills as they evaluate the academic requirements and prepare for occupational opportunities in biology, engineering and technology. 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 Standard: 1	Physics Nature and Applications of Science	Performance Descriptors SC.PD.P.1			
SC.S.P.1	Students will	Above Mastery	Mastery	Partial Mastery	Novice
	<ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 				
		<p>Physics students at the above mastery level in the nature and applications of science:</p> <p>implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a variety of sources to</p>	<p>Physics students at the mastery level in the nature and applications of science:</p> <p>implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a variety of sources to</p>	<p>Physics students at the partial mastery level in the nature and applications of science:</p> <p>implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a</p>	<p>Physics students at the novice level in the nature and applications of science:</p> <p>implement safe practices as they conduct experiments on base conclusions on observations and experimental evidence, and</p> <p>relate science-technology-societal issues while using a</p>

variety of sources to construct solutions and defend their ideas to an authentic audience.	variety of sources to construct and defend their solutions.	construct and defend their solutions.	variety of sources to construct their solutions.	variety of sources to construct their solutions.
Objectives				
SC.O.P.1.1	Students will implement safe procedures and practices when manipulating equipment, materials, organisms, and models.			
SC.O.P.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.			
SC.O.P.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).			
SC.O.P.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).			
SC.O.P.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).			
SC.O.P.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.			
SC.O.P.1.7	given current science-technology-societal issues, construct and defend potential solutions.			
SC.O.P.1.8	relate societal, cultural and economic issues to key scientific innovations.			
SC.O.P.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).			

High School Physics				
Standard: 2 The Content of Science				
SC.S.P.2	Students will	<ul style="list-style-type: none"> demonstrate knowledge, understanding, and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives. demonstrate an understanding of the interrelationships among physics, chemistry, biology, and the earth and space sciences. apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences. 		
Performance Descriptors SC.PD.P.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics students at the distinguished level:	Physics students at the above mastery level:	Physics students at the mastery level:	Physics students at the partial mastery level:	Physics students at the novice level:
derive formula of best-fit for representation of motion	test the theoretical basis of mathematical methods for	analyze data, construct and interpret graphs, and	construct graphs and perform calculations for	collect data for motion in one- or two-dimensions;

<p>and evaluate methods to solve problems for motion in one and/or two dimensions;</p> <p>create graphical, algebraic and/or trigonometric solutions problems involving vector components and resultants;</p> <p>experimentally verify Newton's Laws of Motion in terms of equilibrium and net force situations with an increasing number of variables;</p> <p>experimentally verify the conservation of energy and momentum and deduce solutions for elastic and inelastic collisions;</p> <p>experimentally and mathematically determine the behavior of fluids in terms of buoyant force, pressure and velocity and apply to everyday object;</p> <p>calculate the apparent frequency caused by Doppler shift and interpret the results;</p> <p>predict image placement and prove mathematically based upon the properties</p>	<p>motion in one and/or two dimensions;</p> <p>create graphical, algebraic and/or trigonometric solutions problems involving vector components and resultants;</p> <p>experimentally verify Newton's Laws of Motion in terms of equilibrium and net force situations;</p> <p>predict the energy and momentum outcomes for elastic and inelastic collisions;</p> <p>experimentally and mathematically determine the behavior of fluids in terms of buoyant force, pressure and velocity;</p> <p>calculate the apparent frequency caused by Doppler shift;</p> <p>predict image placement based upon the properties of concave or convex mirrors</p>	<p>perform calculations for motion in one and/or two dimensions</p> <p>interpret graphical, algebraic and/or trigonometric solutions to prove the values for vector components and resultants;</p> <p>experimentally verify Newton's Laws of Motion in terms of equilibrium and net force situations;</p> <p>evaluate the conservation of energy and momentum and deduce solutions for elastic and inelastic collisions;</p> <p>describe the behavior of fluids in terms of buoyant force, pressure and velocity;</p> <p>perform calculations to determine the properties of mechanical and transverse waves in order to research applications of Doppler shift;</p> <p>apply ray optics diagrams and the lens/mirror equation to solve and justify optics</p>	<p>motion in one and/or two dimensions</p> <p>draw vector solutions;</p> <p>state Newton's Laws of Motion and perform calculations involving equilibrium and net force situations;</p> <p>describe elastic and inelastic collisions;</p> <p>demonstrate the behavior of fluids in terms of buoyant force, pressure and velocity;</p> <p>define/ label the properties of mechanical and transverse waves and interpret a diagram showing the Doppler effect;</p> <p>experimentally find the image of a lens or mirror using an optics bench</p>	<p>define vectors;</p> <p>state Newton's Laws of Motion and express the difference between weight and mass;</p> <p>define the law of conservation of energy;</p> <p>define buoyant force, pressure and velocity of fluids;</p> <p>define/ label the properties of mechanical and transverse waves and the Doppler effect;</p> <p>define focal point, image, image distance and object distance;</p>
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concave or convex mirrors or lenses, and	or lenses, and	problems, and	and/or a ray diagram, and	state Ohm's law and define direct current.
construct and analyze electrical circuits and calculate Ohm's law problems for complex circuits and find kilowatt-hours for an alternating current to determine the cost of using that current.	construct and analyze electrical circuits and calculate Ohm's law problems for complex circuit, and power of direct and alternating current using resistance, current and voltage.	construct and analyze electrical circuits, calculate Ohm's law problems for series and parallel circuits and distinguish between direct and alternating current.	calculate Ohm's law problems for series circuits and distinguish between direct and alternating current.	
Objectives Students will				
SC.O.P.2.1	construct and interpret graphs of: <ul style="list-style-type: none"> • position versus time • velocity versus time • 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: <ul style="list-style-type: none"> • velocity • acceleration • momentum • net force. 			
SC.O.P.2.4	interpret graphical, algebraic and/or trigonometric solutions to prove the values for vector components and resultants.			
SC.O.P.2.5	justify Newton's Laws of Motion in terms of equilibrium and net force situations.			
SC.O.P.2.6	evaluate the conservation of energy and momentum and deduce solutions for elastic and inelastic collisions.			
SC.O.P.2.7	assess the magnitude of buoyant force on submerged and floating objects.			
SC.O.P.2.8	compare the pressure exerted by a fluid to the depth of an object in the fluid.			
SC.O.P.2.9	anticipate the effects of Bernoulli's principle on fluid motion.			
SC.O.P.2.10	examine the reflective, refractive and diffractive properties of mechanical and transverse waves.			
SC.O.P.2.11	perform calculations to determine wave properties: <ul style="list-style-type: none"> • wavelength • frequency • velocity • energy. 			
SC.O.P.2.12	compare and contrast the physical properties of mechanical and transverse waves.			
SC.O.P.2.13	research applications of Doppler shift in determining an approaching or receding source in wave propagation.			
SC.O.P.2.14	apply ray optics diagrams to lenses and mirrors; use the lens/mirror equation and the magnification equation to solve optics problems.			

SC.O.P.2.15	justify the image results obtained by diagramming the ray optics of lenses and mirrors and/or by deducing the image information from the lens/mirror equation.
SC.O.P.2.16	construct and analyze electrical circuits and calculate Ohm's law problems for series and parallel circuits.
SC.O.P.2.17	distinguish between direct and alternating current and identify ways of generating each type.
SC.O.P.2.18	analyze the motion of a projectile.

Conceptual Physics Content Standards and Objectives

Conceptual Physics is an advanced level course that is an elective designed for students who desire a physics course that will prepare them for technical careers. This course is an alternative to the traditional mathematical approach to physics. This approach covers the physics principles in a traditional sequence with an emphasis on conceptual understanding. While mathematics is de-emphasized, laboratory work will require traditional physics measurements to be made. Emphasis will be on the concepts that underlie the natural laws of the universe. Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills as they evaluate the academic requirements and prepare for occupational opportunities in biology, engineering and technology. 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 Standard: 1	Conceptual Physics Nature and Application of Science	Above Mastery	Mastery	Partial Mastery	Novice
SC.S.CP.1	Students will <ul style="list-style-type: none"> demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. demonstrate the ability to use the inquiry process to solve problems. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions 	Conceptual Physics students at the above mastery level in the nature and applications of science:	Conceptual Physics students at the mastery level in the nature and applications of science:	Conceptual Physics students at the partial mastery level in the nature and applications of science:	Conceptual Physics students at the novice level in the nature and applications of science:
Performance Descriptors SC.PD.CP.1					
Conceptual Physics students at the distinguished level in the nature and applications of science:	Conceptual Physics students at the above mastery level in the nature and applications of science:	Conceptual Physics students at the mastery level in the nature and applications of science:	Conceptual Physics students at the partial mastery level in the nature and applications of science:	Conceptual Physics students at the novice level in the nature and applications of science:	
Implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and. relate science-technology-societal issues while using a variety of sources to	implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	implement safe practices as they conduct experiments on observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to	

variety of sources to construct solutions and defend their ideas to an authentic audience.	variety of sources to construct and defend their solutions.	construct and defend their solutions.	variety of sources to construct their solutions.	construct their solutions.
Objectives	Students will			
SC.O.CP.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.			
SC.O.CP.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.			
SC.O.CP.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).			
SC.O.CP.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).			
SC.O.CP.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).			
SC.O.CP.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.			
SC.O.CP.1.7	given current science-technology-societal issues, construct and defend potential solutions.			
SC.O.CP.1.8	relate societal, cultural and economic issues to key scientific innovations.			
SC.O.CP.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).			

High School				
Standard: 2				
Content of Science				
SC.S.CP.2	Students will	<ul style="list-style-type: none"> demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. apply knowledge, understanding and skills of science subject matter/concepts to daily life/experiences. 		
Performance Descriptors SC.PD.CP.2				
Distinguished	Above Mastery	Master	Partial Mastery	Novice
Conceptual Physics students at the distinguished level:	Conceptual Physics students at the above mastery level:	Conceptual Physics students at the mastery level:	Conceptual Physics students at the partial mastery level:	Conceptual Physics students at the novice level:
Interpret graphs relating	draw graphs relating	compare and contrast	define the units distance,	define distance, velocity

distance, velocity and acceleration to time;	distance, velocity and acceleration to time;	distance, velocity and acceleration of moving objects to describe accelerated and non-accelerated motions;	velocity and acceleration;	and acceleration;
<p>solve vector problems both graphically and algebraically; apply knowledge of projectile motion to determine horizontal and vertical velocities and/or distances;</p> <p>calculate the net force acting on a two body system and determine the net force acting on the system;</p> <p>mathematically verify that mechanical energy is conserved and experimentally determine mechanical advantage of a mechanical system;</p> <p>solve equations for Archimedes' and/or Pascal's principles and apply Bernoulli's principle to everyday object (for example, paint sprayer or perfume bottle);</p> <p>interpret a phase change diagram;</p>	<p>solve vector problems graphically or algebraically; determine the horizontal and vertical distances of projectile motion;</p> <p>illustrate forces acting on a two body system with a free body diagram and apply Newton's Laws as a system to explain natural phenomena;</p> <p>calculate kinetic and potential energy and experimentally determine mechanical advantage of a mechanical system;</p> <p>test Archimede's and Pascal's principles involving floating systems and apply Bernoulli's principle to everyday object (for example, paint sprayer or perfume bottle);</p> <p>experimentally determine the melting point of a</p>	<p>solve right triangle vector problems both graphically and algebraically to analyze the motion of a projectile ;</p> <p>illustrate forces acting on objects with free body diagrams and interpret Newton's Laws in terms of natural phenomena;</p> <p>compare and contrast kinetic and potential energies, deduce work, energy, power and efficiency, and recognize situations where mechanical energy is conserved;</p> <p>analyze Archimedes' and Pascal's principles to solve problems involving floating systems and recognize the effects of Bernoulli's principle on fluid motion;</p> <p>compare and contrast the common temperature</p>	<p>solve right triangle vector problems graphically or algebraically and recognize a projectile moves in both horizontal and vertical direction;</p> <p>identify forces acting on an object and state Newton's Laws;</p> <p>define and give examples of kinetic and potential energies, efficiency in a mechanical system and state the formulas for work, energy and power;</p> <p>demonstrate Archimede's, Pascal's, and Bernoulli's principles;</p> <p>distinguish between heat and temperature;</p>	<p>draw a right triangle and recognize projectile motion;</p> <p>identify force as a vector and state one of Newton's Laws;</p> <p>define work, energy and power, stating that energy is conserved within a system;</p> <p>recognize that a floating object displaces fluid and state Bernoulli's principle;</p> <p>identify the common temperature scales and</p>

<p>appraise the role of heat transfer and the first law of thermodynamics involved in environmental and energy conservation issues and predict ways to eliminating the heat transfer;</p> <p>given wavelength calculate the energy of a wave, predict the effect of changing the frequency of a standing wave and calculate the apparent change in frequency that occurs with either a moving source or a moving detector;</p>	<p>substance and graph the results;</p> <p>examine the role of heat transfer and the first law of thermodynamics involved in environmental and energy conservation issues and predict ways of eliminating the heat transfer;</p> <p>given wavelength, calculate the energy of a wave, identify the nodes and antinodes of a standing wave and investigate the uses of Doppler shift in astronomy and cosmology;</p>	<p>scales, convert from one temperature scale to another and evaluate temperature in terms of kinetic energy;</p> <p>apply the mechanism of heat transfer and the first law of thermodynamics to environmental and energy conservation issues;</p> <p>perform calculations to determine the properties of sound and light waves, compare the Doppler shift effect for sound and light waves, and model the production of a standing wave, proposing the applications and examples of each;</p>	<p>compare and contrast the three methods of heat transfer and state the first law of thermodynamics;</p> <p>label a transverse and longitudinal wave with the parts of the wave, construct a standing wave and identify examples of Doppler shift for either sound or light waves;</p>	<p>their units;</p> <p>list the three methods of heat transfer and state the Law of Energy Conservation;</p> <p>label a transverse wave with the parts of the wave, define a standing wave, and define the Doppler shift;</p>
<p>evaluate sound and light waves using the concepts of reflection, refraction, diffraction, and interference to predict, illustrate, and calculate image location involving plane and spherical mirrors, concave and convex lenses;</p> <p>analyze the applications of colored lights and pigments and relate the concept of polarization to three dimensional viewing, and</p>	<p>analyze sound and light waves using the concepts of reflection, refraction, diffraction and interference, calculating image location involving plane and spherical mirrors, concave and convex lenses;</p> <p>compare and contrast the applications of colored lights and pigments and analyze the concept of polarization, and</p>	<p>compare and contrast sound and light waves using the concepts of reflection, refraction, diffraction and interference and diagram image location involving plane and spherical mirrors, concave and convex lenses;</p> <p>illustrate the applications of colored lights and pigments and examine the concept of polarization, and</p>	<p>compare sound and light waves using the concepts of reflection, refraction, diffraction and interference to find the image location involving plane and spherical mirrors, concave and convex lenses on an optical bench;</p> <p>compare primary and secondary colors of light and pigment and sketch the concept of polarization, and</p>	<p>define reflection, refraction, diffraction and interference and find the image location involving plane and spherical mirrors on an optical bench;</p> <p>list primary and secondary colors of light and pigment and define polarization, and</p>

calculate any variable in a complex circuit using Ohm's Law and compare and contrast between the flow of electrons in AC and DC circuits.	calculate any variable in a simple circuit using Ohm's Law and distinguish between the flow of electrons in AC and DC circuits.	analyze simple direct current circuits using Ohm's Law and distinguish between AC and DC circuits, describing how AC is converted to DC.	relate Ohm's Law to simple circuits; distinguish between direct and alternating current.	list and define the variables of Ohm's Law.
Objectives	Students will			
SC.O.CP.2.1	solve right triangle vector problems both graphically and algebraically.			
SC.O.CP.2.2	compare and contrast distance, velocity and acceleration of moving objects to describe accelerated and non-accelerated motions of a particle from textbook or lab collected data.			
SC.O.CP.2.3	analyze the motion of a projectile.			
SC.O.CP.2.4	illustrate forces acting on objects with free body diagrams.			
SC.O.CP.2.5	interpret Newton's Laws in terms of natural phenomena.			
SC.O.CP.2.6	compare and contrast kinetic and potential energies and recognize situations where mechanical energy is conserved.			
SC.O.CP.2.7	deduce work, energy, power and efficiency in mechanical systems.			
SC.O.CP.2.8	analyze Archimedes' and Pascal's principles to solve problems involving equilibrium and stability of floating systems.			
SC.O.CP.2.9	recognize the effects of Bernoulli's principle on fluid motion.			
SC.O.CP.2.10	compare and contrast the common temperature scales, convert from one temperature scale to another and evaluate temperature in terms of kinetic energy.			
SC.O.CP.2.11	apply the mechanism of heat transfer and relate to environmental and energy conservation issues.			
SC.O.CP.2.12	relate the first law of thermodynamics to energy conservation.			
SC.O.CP.2.13	compare and contrast sound and light waves using the concepts of reflection, refraction, and interference.			
SC.O.CP.2.14	solve problems involving wave speed, frequency and wavelength; determine factors that affect the speed of sound; recognize that the speed of light is a constant.			
SC.O.CP.2.15	model the production of a standing wave and propose a practical application of such a wave.			
SC.O.CP.2.16	compare the Doppler shift effect for sound and light and point out examples of its occurrences and applications.			
SC.O.CP.2.17	diagram image location: <ul style="list-style-type: none"> • plane and spherical mirrors • concave and convex lenses. 			
SC.O.CP.2.18	illustrate the applications of colored lights and pigments.			
SC.O.CP.2.19	examine the concept of polarization.			
SC.O.CP.2.20	analyze simple direct current circuits using Ohm's Law.			
SC.O.CP.2.21	distinguish between direct current and alternating current circuits and describe how AC is converted to DC.			

variety of sources to construct solutions and defend their ideas to an authentic audience.	variety of sources to construct and defend their solutions.	construct and defend their solutions.	variety of sources to construct their solutions.	construct their solutions.
Objectives	Students will			
SC.O.PII.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.			
SC.O.PII.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.			
SC.O.PII.1.3	conduct and/or design investigations that incorporate the skills and attitudes and/or values of scientific inquiry (e.g., established research protocol, accurate record keeping, replication of results and peer review, objectivity, openness, skepticism, fairness, or creativity and logic).			
SC.O.PII.1.4	design, conduct, evaluate and revise experiments (e.g., compose a question to be investigated, design a controlled investigation that produces numeric data, evaluate the data in the context of scientific laws and principles, construct a conclusion based on findings, propose revisions to investigations based on manipulation of variables and/or analysis of error, or communicate and defend the results and conclusions).			
SC.O.PII.1.5	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, or predict the influence of external variances such as potential sources of error, or interpret maps).			
SC.O.PII.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.			
SC.O.PII.1.7	given current science-technology-societal issues, construct and defend potential solutions.			
SC.O.PII.1.8	relate societal, cultural and economic issues to key scientific innovations.			
SC.O.PII.1.9	synthesize concepts across various science disciplines to better understand the natural world (e.g., form and function, systems, or change over time).			

High School Standard: 2	Physics Content of Science				
SC.S.PII.2	Students will	<ul style="list-style-type: none"> demonstrate knowledge, understanding, and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives. demonstrate an understanding of the interrelationships among physics, chemistry, biology, and the earth and space sciences. apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences. 			
Performance Descriptors SC.PD.PII.2					
Distinguished		Above Mastery	Master	Partial Mastery	Novice
Physics II students at the distinguished level:	Physics II students at the above mastery level:	Physics II students at the mastery level:	Physics II students at the partial mastery level:	Physics II students at the novice level:	Physics II students at the novice level:
differentiate among linear, quadratic, and inverse	compose equations to express the relationships	apply graphical analysis to interpret motion in terms of	will draw motion graphs to show motion in terms of	measure distance and time to calculate velocity and	

relationships found in graphs of motion in terms of position, velocity, acceleration, and time and evaluate data to deduce mathematical relationships involving one and two dimensional motion;	found in graphs of motion in terms of position, velocity, acceleration, and time and summarize data to deduce mathematical relationships involving one and two dimensional motion;	position, velocity, acceleration, and time and use data to deduce mathematical relationships involving one dimensional motion;	acceleration and describe mathematical relationships involving one dimensional motion;
critique experiments to verify laws of motion including Newton's Laws, Conservation of Momentum, Conservation of Energy, and rotational motion;	design experiments to verify laws of motion including Newton's Laws, Conservation of Momentum, Conservation of Energy, and rotational motion;	experimentally verify laws of motion including Newton's Laws, Conservation of Momentum, and Conservation of Energy can be verified experimentally and contrast the concepts of linear and rotational motion;	perform experiments on motion topics including Newton's Laws, Conservation of Momentum, and Conservation of Energy and define the concepts of rotational motion;
design experiments to verify the effect of variables on the properties and dynamics of fluids;	evaluate the effect of variables to the properties and dynamics of fluids;	predict and verify the effect of variables on the properties and dynamics of fluids;	define the properties and dynamics of fluids;
justify experimental results using concepts of thermal physics;	relate experimental results using concepts of thermal physics;	interpret and apply concepts of thermal physics;	state concepts of thermal physics;
appraise the relative values of electric force and field strength based on the magnitude of and the distance from the point charge;	summarize the relative values of electric force and field strength based on the magnitude of and the distance from the point charge;	deduce the relative values of electric force and field strength based on the magnitude of and the distance from the point charge;	calculate the field strength using Coulomb's Law;
design, construct, diagram and evaluate complex electrical circuits, adding various components;	design, construct, diagram and evaluate complex electrical circuits;	construct, diagram and evaluate complex electrical circuits;	construct and diagram simple electrical circuits;

<p>justify predictions and interpretations of magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil;</p> <p>critique electromagnetic induction and justify its application to particular electric circuits and various devices;</p> <p>investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits;</p> <p>assess the kinetic and potential energies and energy transformations of different oscillating systems;</p> <p>evaluate wave properties and their interactions, predicting how optical and acoustical devices will incorporate new materials to improve their effectiveness;</p> <p>appraise the role of</p>	<p>defend predictions and interpretations of magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil;</p> <p>critique electromagnetic induction and evaluate its application to electric circuits and various devices;</p> <p>investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors and integrated circuits;</p> <p>compare and contrast the kinetic and potential energies and energy transformations of different oscillating systems;</p> <p>analyze optical and acoustical devices for their effective application of wave properties and their interactions;</p> <p>analyze the role of technology in the</p>	<p>predict and interpret magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil;</p> <p>critique electromagnetic induction and evaluate its application to electric circuits and various devices;</p> <p>investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits;</p> <p>apply knowledge of simple harmonic motion to calculate the kinetic and potential energies of the oscillating system;</p> <p>examine wave properties and their interactions to evaluate their application in the development of optical and acoustical devices;</p> <p>examine and critique the role of technology in the</p>	<p>relate magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil;</p> <p>apply electromagnetic induction to electric circuits and various devices;</p> <p>investigate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits;</p> <p>calculate the kinetic and potential energies of the oscillating system;</p> <p>review wave properties and their interactions while researching their application to the development of optical and acoustical devices;</p> <p>research the development of historical models of the</p>	<p>relate magnetism to electric charge and electricity;</p> <p>describe electromagnetic induction;</p> <p>investigate the applications of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits;</p> <p>calculate the kinetic and/or potential energies of the oscillating system;</p> <p>list optical and acoustical devices and identify the property that is the basis of the device;</p> <p>arrange the models of the atom historically and list</p>
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<p>technology in the development of historical models of the atom and critique evidence for the historical development of the quantum mechanical theory;</p> <p>Justify an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present, and categorize nuclei based on their placement on the periodic table and proton to neutron ratio to demonstrate different types of decay processes.</p>	<p>development of historical models of the atom and categorize evidence for the historical development of the quantum mechanical theory;</p> <p>analyze an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present, and using the proton to neutron ratio, predict the type of nuclear decay that could occur for nuclei.</p>	<p>development of historical models of the atom and evidence of the quantum mechanical theory;</p> <p>calculate an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present, and differentiate between stable and nuclear nuclei, and if the nucleus is unstable predict the type(s) of nuclear decay.</p>	<p>atom and describe evidence for the historical development of the quantum mechanical theory;</p> <p>calculate an atom's binding energy as related to Einstein's special theory of relativity, and differentiate between stable and unstable nuclei and list types of decay that the unstable nuclei could display.</p>	<p>evidence for the historical development of the quantum mechanical theory;</p> <p>calculate an atom's binding energy, and</p> <p>define stable and unstable nuclei and list types of decay that the unstable nuclei could display.</p>
<p>Objectives Students will</p>				
<p>SC.O.PII.2.1</p>	<p>apply graphical analysis to interpret motion in terms of:</p> <ul style="list-style-type: none"> • position • velocity • acceleration • time. 			
<p>SC.O.PII.2.2</p>	<p>use data to deduce mathematical relationships involving one and two dimensional motion.</p>			
<p>SC.O.PII.2.3</p>	<p>experimentally verify laws of motion including :</p> <ul style="list-style-type: none"> • Newton's Laws • Conservation of Momentum (linear and angular) • Conservation of Energy. 			
<p>SC.O.PII.2.4</p>	<p>using knowledge of linear motion equations, synthesize concepts of rotational motion:</p> <ul style="list-style-type: none"> • angular speed and acceleration • centripetal acceleration • Newtonian gravitation • Kepler's Laws • torque. 			
<p>SC.O.PII.2.5</p>	<p>predict and verify the effect of variables on the properties and dynamics of fluids.</p>			
<p>SC.O.PII.2.6</p>	<p>interpret and apply concepts of thermal physics:</p>			

	<ul style="list-style-type: none"> • distinction of heat and temperature • thermal expansion • properties of Ideal Gases • Kinetic Theory • specific heat • energy transfer.
SC.O.PII.2.7	deduce the relative values of electric force and field strength based on the magnitude of and the distance from the point charge: <ul style="list-style-type: none"> • Coulomb's Law • inverse square law.
SC.O.PII.2.8	construct, diagram and evaluate complex electrical circuits.
SC.O.PII.2.9	predict and interpret magnetic forces and magnetic fields, and apply their effect on the motion of a point charge and to the electric current in a wire or coil.
SC.O.PII.2.10	critique electromagnetic induction and evaluate its application to electric circuits and various devices.
SC.O.PII.2.11	investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits.
SC.O.PII.2.12	apply knowledge of simple harmonic motion - to calculate the kinetic and potential energies of the oscillating system: <ul style="list-style-type: none"> • springs • pendulums • other oscillating objects.
SC.O.PII.2.13	examine wave properties and their interactions: <ul style="list-style-type: none"> • reflection • refraction • dispersion • total internal deflection • interference • diffraction • Doppler Shift • beats • polarization.
SC.O.PII.2.14	evaluate the application of wave properties to the development of optical and acoustical devices.
SC.O.PII.2.15	critique the role of technology in the development of historical models of the atom: <ul style="list-style-type: none"> • radioactivity • atomic spectra • particle accelerators, etc.).
SC.O.PII.2.16	examine evidence for the historical development of the quantum mechanical theory: <ul style="list-style-type: none"> • Planck's blackbody radiation • Einstein's photoelectric effect • deBroglie's duality.

SC.O.P11.2.17	calculate an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present.
SC.O.P11.2.18	differentiate between stable and unstable nuclei, and if the nucleus is unstable predict the type(s) of nuclear decay.

FISCAL NOTE FOR PROPOSED RULES

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

Type of Rule: Legislative Interpretive Procedural

Agency: West Virginia Board of Education

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

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

Fiscal Note Summary

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

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

Fiscal Note Detail

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

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

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

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

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

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

MEMORANDUM

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

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

Signature of Agency Head or Authorized Representative

Date

Stewart Paine

1/13/2009

Policy 2520.35: 21st Century High School Science Content Standards and Objectives for West Virginia Schools
Comment Log
June 2009

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

Date	Individual/Organization	Comments	Action/ Type	Rationale
6-16	Science curriculum supervisor tidevovre@access.k12.wv.us Wood County Schools 1210 13th Street Parkersburg wv 26101	In light of some changes in the strands, I am still perplexed the 9th grade Physical Science continues to include Earth Science topics. Since the reviewer sited "too many" objectives why would you continue to include Sc.O.PH 2.20-2.25. These are all Earth Science objectives and do not directly relate to any Physical Science concepts. SC.O.PS.2.20 examine seismographic and geologic evidence to determine structure, composition and age of the Earth. SC.O.PS.2.21 predict and present a weather forecast using a weather map and meteorological data. SC.O.PS.2.22 analyze latitude, altitude and surface features to predict climatic conditions. SC.O.PS.2.23 research and organize evidence to support the theory and effects of plate tectonics including: <ul style="list-style-type: none"> • density • force 	N 0	The comments were not related to the changes to the policy.

	<ul style="list-style-type: none"> • mountain building • fossil • magnetic evidence <p>SC.O.PS.2.24 apply fusion, heat transfer, gravity, and electromagnetism to the sun's evolution and its impact on the solar system.</p> <p>SC.O.PS.2.25 investigate theories for the origin and configuration of the solar system:</p> <ul style="list-style-type: none"> • nebular theory • Earth-Moon formation • heliocentric • geocentric models 			
	<p>These objectives should be removed.</p> <p>I am concerned about the new Chemistry CSOs and wanted to comment on two of the proposed changes.</p> <p>1. Scientific notation is not addressed. SC.O.C.1.3 addresses accurate record keeping, but this cannot be done without recording data with proper significant figures. The teaching of significant figures belongs in a first year Chemistry course.</p> <p>SC.O.C.2.3 uses language with which many students will be unfamiliar. The use of the quantum number designation is being de-emphasized in AP Chemistry and this wording should be reworked.</p>	<p>+ A</p> <p>+ A</p>	<p>Significant figures are now addressed in objectives- SC.O.C.2.15 and SC.O.C.2.17.</p> <p>Language was modified to current chemistry terms.</p>	
6-24	<p>Name: Jane Larke Organization: Morgantown High School Email: jlarke@access.k12.wv.us Title: teacher Address1: 45 West Park Avenue Address2: City/State/Zip: Morgantown , WV 26501 Role: Teacher</p>	<p>The new separated format for the performance descriptors is very nice. It is</p>	<p>0</p>	
6-24	<p>Name: Michael Lemley Organization:</p>			

	<p>Buckhannon Upshur High School Email: mismtcat@aol.com Title: Science Dept Chairperson/Teacher Address1: 414 College Street Address2: City/State/Zip: Clarksburg, WV 26301 Role: Teacher</p>	<p>much more like a rubric and gives very definable distinction of what a student must know and be able to do at each performance level. I feel this format will be much more useful to instructors than the previous narrative. Also, I believe that the change to the bulleted listings within the objectives will provide more clarity than the old comma separated narrative.</p> <p>I am very happy to see that redox reactions and chemical equilibrium content standards have been added/returned to the first year chemistry coursework.</p> <p>So, am I correct in understanding that there will no longer be a standard #3 and corresponding objectives? As I see it, they have been combined into the New Standard #1...Correct?</p>	<p>N</p>	
<p>6-25</p>	<p>Name: Stefan Smolski Organization: Oak Glen High School Email: ssmolski@access.k12.wv.us Title: Science Teacher Address1: 510 Pittsburgh Ave Address2: City/State/Zip: Fairmont, WV 26554</p>	<p>Page ii: Insert a space between Novice and Numbering of Standards; Indent Novice to align with previous descriptors.</p> <p>Page vi: Organization of the Science program of Study makes no mention of grade 9. I suggest that it be included in the discussion.</p> <p>Page 42: Include biology as a career that is affected by content of the course. Chemistry is a degree requirement.</p>	<p>+ A</p>	<p>Formatting issues were addressed, terms and ideas have been included in the current document.</p>

	<p>Role: Teacher</p>	<p>Page 51: Include biology as a career that is affected by content of the course. Chemistry is a degree requirement, even if these students are not in the professional track as they could opt to attend college later in their life.</p> <p>Page 60: Include biology as a career that is affected by content of the course. Chemistry is a degree requirement.</p> <p>Page 85: Include biology as a career that is affected by content of the course. Physics is a degree requirement.</p> <p>Include biology as a career that is affected by content of the course. Chemistry is a degree requirement, even if these students are not in the professional track as they could opt to attend college later in their life.</p> <p>Page 93: Include biology as a career that is affected by content of the course. Physics is a degree requirement.</p>	<p>+ NA</p>	
<p>6-25</p>	<p>Name: Jane Larke Organization: Morgantown High School Email: jlarke@access.k12.wv.</p>	<p>SC.O.C.2.2 needs to include Rutherford. The work of Bohr builds on his work on the structure of the atom. His experiment is one of the early, classic, historical experiments with which students should be familiar.</p>		<p>A complete list of all the scientists who contributed to the atomic theory was impractical, so the list of scientists was</p>

	<p><u>US</u> Title: teacher Address1: 45 West Park Avenue Address2: City/State/Zip: Morgantown, WV 26501 Role: Teacher</p>	<p>SC.O.C.2.2 needs to include Thomson. This is basic to the understanding of Bohr.</p>		<p>removed from objective SC.O.C.2.2.</p>
<p>7-3</p>	<p>Name: Kathy Jacquez Organization: Email: kjacquez@access.k12.wv.us Title: teacher Address1: POBox 4 Address2: City/State/Zip: Barrackville, WV 26559 Role: Teacher</p>	<p>balancing redox equations are extremely difficult for first year students. 2.9 does not need to say balance redox equations as balancing single replacement reactions are a form of redox equations and these can be balanced by first year students.</p> <p>2.14 is ridiculous for first year students as you must have a complete understanding of equation balancing and mole stoichiometry before the concept of equilibrium may be introduced. These calculations are difficult for AP students.</p>	<p>+ A + A</p>	<p>Wording in the objective was modified to be appropriate for the Chem I level.</p> <p>Stoichiometry is now included in objective SC.O.C.2.17.</p>

7-8-09	<p>Name: Robert St Clair Organization: Huntington High School Email: rstclair@access.k12.wv.us</p>	<p>Need to include significant figures in Chemistry I,</p> <p>CII.2.16 - should be included in Chemistry I - The descriptors include this information but it is listed as a CSO in Chem II. One substance and limiting reactant problems go hand in hand.</p> <p>Stoichiometry needs to be mentioned in the CSO.</p> <p>C.2.9 - parts of it could be moved to Chemistry 2 - balancing redox equations and electrochemical cells.</p> <p>C.2.14 - will be hard to cover in any detail. Most of the concept is contained in chem II CSO.</p>	<p>+ A</p> <p>- NA</p> <p>+ A</p> <p>+ A</p> <p>- NA</p>	<p>Significant figures are now addressed in objectives- SC.O.C.2.15 and SC.O.C.2.17.</p> <p>Acids and bases are introduced in 8th grade and included in Chem I, comparing the methods is addressed in Chem II.</p> <p>Stoichiometry is now included in objective SC.O.C.2.17.</p> <p>Wording in the objective was modified to be appropriate for the Chem I level.</p> <p>The concept can be addressed at this level; it is addressed in diffusion and osmosis on the Biology courses. Actual calculations can be done in Chem II.</p>
July 10, 2009	<p>Name: Sonya White Organization: WVDE</p>	<p>Rationale for my comments – As a parent and teacher, I am concerned</p>	<p>+ A</p>	<p>Stoichiometry is now included in objective</p>

<p>Email: snwhite@access.k12.wv.us</p> <p>Title: Coordinator Address1: 1900 Kanawha Blvd. E Address2: Bldg. 6 Room B018 City/State/Zip: Charleston, WV 25302 Role: Professional Support</p>	<p>about the lack of key concepts such as stoichiometry not being included in the chemistry curriculum. Students will be at a significant disadvantage upon entering an entry-level chemistry course in college. Specifically, my son's high school HONORS Chemistry class did not address stoichiometry because it was not explicitly stated in the CSOs. He subsequently had to repeat the basic chemistry course in college. Students need adequate exposure to the "mathematics" of chemistry if they are to be successful at the next level.</p> <p>Currently, there is a significant shortage of qualified chemistry teachers here in West Virginia and across the nation. The CSOs need to state explicitly the concepts that need to be included in the curriculum. A "novice" chemistry teacher may not be able to identify the core concepts that are paramount to the study of chemistry. Again, the lack of a fully certified chemistry teacher contributed to the curriculum gaps in my child's high school chemistry course.</p> <p>Section 1 Nature and Application of science - An objective needs to be included for all High school science courses (Especially Chemistry and Physics) regarding mathematical calculations. SC.O.C.II.2.13 is taught at the beginning of Chemistry 1 because it is foundational to all other</p>	<p>+ A</p>	<p>SC.O.C.2.17.</p> <p>Significant figures are now addressed in objectives- SC.O.C.2.15 and SC.O.C.2.17.</p> <p>Math processes are addressed within specific content objectives to insure consistent test alignment of objectives.</p>
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	<p>mathematical calculations found later in the course. I recommend adding this CSO to all high school science courses.</p> <p>Standard 2: Content of Science Performance Descriptor comments - Stoichiometry is a mastery level concept in chemistry. It is currently listed as distinguished. Students in Chemistry 1 should be able to write a balanced chemical equation, calculate the amount of a reactant or product given an amount of one or more reactants or products as a mastery concept. The mastery level of Chemistry I is not sufficient for a student to continue his/her studies of chemistry. It lists concepts that are taught in 9th grade physical science. The students at mastery level need to perform the mole calculations within the context of a balanced chemical reaction.</p> <p>Specific CSOs under Standard 2:</p> <p>SC.O.C.2.2 - Several key scientists are not included on this list. (Thompson, Rutherford, Curie, Becquerel, Chadwick, etc.) Also concepts such as atomic mass, atomic weight, isotopes and subatomic particle properties need to be mentioned as well.</p> <p>SC.O.C.2.4 – add - to predict bonding between elements according to the octet</p>	<p>+ A</p> <p>+ NA</p> <p>0</p>	<p>Stoichiometry is now included in objective SC.O.C.2.17.</p> <p>A complete list of all the scientists who contributed to the atomic theory was impractical, so the list of scientists was removed from objective SC.O.C.2.2.</p> <p>Not enough input regarding this idea to</p>
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		<p>= nRT) is separate from these. Each needs to be mentioned specifically.</p> <p>SC.O.C.2.17 - All of these calculations can be performed in absence of a balanced chemical reaction.</p> <p>SC.O.C.2.18 - Students need to apply these definitions to identify the acid - base pair in a reaction.</p> <p>SC.O.C.2.19 - pH is covered in middle school in this manner. Students in Chem 1 need to be able to calculate pH.</p> <p>Other CSOs from Chem II that are Chem I topics: SC.O.CII.2.1, SC.O.CII.2.4 - kinetic molecular theory is taught in grade 9, SC.O.CII.2.5, SC.O.CII.2.13, SC.O.CII.2.16 - Mastery for any Chem I class,</p>	<p>0 NA</p> <p>0 NA</p> <p>0 NA</p> <p>0 NA</p>	<p>Not enough input to regarding this idea to compel a change.</p> <p>Not enough input to regarding this idea to compel a change.</p> <p>Not enough input to regarding this idea to compel a change.</p> <p>These topics are not at the same rigor when addressed in the Chem II course.</p>
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Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Tuesday, June 16, 2009 3:12 PM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-06-16 15:11:45)

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Flag Status: Completed

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<http://129.71.2.32/r.html?id=6c0db5131c5a6403cda733da461c8523>
This is an encrypted URL. Please Bookmark it.

Comment Received for Policy 2520.35

#####

Name: Toni Lynne DeVore
Organization: Wood County Schools
Email: tldevore@access.k12.wv.us
Title: Science curriculum supervisor
Address1: 1210 13th Street
Address2:
City/State/Zip: Parkersburg, wv 26101
Role: Professional Support
Posted: 2009-06-16 15:11:45
Posted from IP: 168.216.33.111

Comments for section 126-44R-1 General

In light of some changes in the strands, I am still perplexed the 9th grade Physical Science continues to include Earth Science topics. Since the reviewer sited "too many" objectives why would you continue to include Sc.O.PH 2.20-2.25. These are all Earth Science objectives and do not directly relate to any Physical Science concepts.
SC.O.PS.2.20 examine seismographic and geologic evidence to determine structure, composition and age of the Earth.
SC.O.PS.2.21 predict and present a weather forecast using a weather map and meteorological data.
SC.O.PS.2.22 analyze latitude, altitude and surface features to predict climatic conditions.
SC.O.PS.2.23 research and organize evidence to support the theory and effects of plate tectonics including:
• density
• force
• mountain building
• fossil
• magnetic evidence
SC.O.PS.2.24 apply fusion, heat transfer, gravity, and electromagnetism to the sun's evolution and its impact on the solar system.
SC.O.PS.2.25 investigate theories for the origin and configuration of the solar system:
• nebular theory
• Earth-Moon formation
• heliocentric
• geocentric models

These objectives should be removed.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Wednesday, June 24, 2009 9:49 PM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-06-24 21:48:37)

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Comment Received for Policy 2520.35

Name: Jane Larke
Organization: Morgantown High School
Email: jlarke@access.k12.wv.us
Title: teacher
Address1: 45 West Park Avenue
Address2:
City/State/Zip: Morgantown , WV 26501
Role: Teacher
Posted: 2009-06-24 21:48:37
Posted from IP: 70.101.255.29

Comments for section 126-44R-1 General

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

I am concerned about the new Chemistry CSOs and wanted to comment on two of the proposed changes.

1. Scientific notation is not addressed. SC.O.C.1.3 addresses accurate record keeping, but this can not be done without recording data with proper significant figures. The teaching of significant figures belongs in a first year Chemistry course.

SC.O.C.2.3 uses language with which many students will be unfamiliar. The use of the quantum number designation is being de-emphasized in AP Chemistry and this wording should be reworked.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Wednesday, June 24, 2009 9:59 PM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-06-24 21:58:43)

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Comment Received for Policy 2520.35

Name: Michael Lemley
Organization: Buckhannon Upshur High School
Email: mlsmtcat@aol.com
Title: Science Dept Chairperson/Teacher
Address1: 414 College Street
Address2:
City/State/Zip: Clarksburg, WV 26301
Role: Teacher
Posted: 2009-06-24 21:58:43
Posted from IP: 98.157.95.207

Comments for section 126-44R-1 General

The new separated format for the performance descriptors is very nice. It is much more like a rubric and gives very definable distinction of what a student must know and be able to do at each performance level. I feel this format will be much more useful to instructors than the previous narrative. Also, I believe that the change to the bulleted listings within the objectives will provide more clarity than the old comma separated narrative.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

I am very happy to see that redox reactions and chemical equilibrium content standards have been added/returned to the first year chemistry coursework.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Wednesday, June 24, 2009 10:02 PM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-06-24 22:01:58)

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Comment Received for Policy 2520.35

Name: Michael Lemley
Organization: Buckhannon Upshur High School
Email: mlsmtcat@aol.com
Title: Science Dept Chairperson/Teacher
Address1: 414 College Street
Address2:
City/State/Zip: Clarksburg, WV 26301
Role: Teacher
Posted: 2009-06-24 22:01:58
Posted from IP: 98.157.95.207

Comments for section 126-44R-1 General

So, am I correct in understanding that there will no longer be a standard #3 and corresponding objectives? As I see it, they have been combined into the New Standard #1...Correct?

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for
West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for
West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for
West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for
West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Thursday, June 25, 2009 6:58 AM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-06-25 06:57:55)

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Comment Received for Policy 2520.35

#####

Name: Stefan Smolski
Organization: Oak Glen High School
Email: ssmolski@access.k12.wv.us
Title: Science Teacher
Address1: 510 Pittsburgh Ave
Address2:
City/State/Zip: Fairmont, WV 26554
Role: Teacher
Posted: 2009-06-25 06:57:55
Posted from IP: 141.153.125.44

Comments for section 126-44R-1 General

Page ii: Insert a space between Novice and Numbering of Standards; Indent Novice to align with previous descriptors.

Page vi: Organization of the Science program of Study makes no mention of grade 9. I suggest that it be included in the discussion.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

Page 42: Include biology as a career that is affected by content of the course. Chemistry is a degree requirement.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Page 51: Include biology as a career that is affected by content of the course. Chemistry is a degree requirement, even if these students are not in the professional track as they could opt to attend college later in their life.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Page 60: Include biology as a career that is affected by content of the course. Chemistry is a degree requirement.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Page 85: Include biology as a career that is affected by content of the course. Physics is a degree requirement.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Include biology as a career that is affected by content of the course. Chemistry is a degree requirement, even if these students are not in the professional track as they could opt to attend college later in their life.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Page 93: Include biology as a career that is affected by content of the course. Physics is a degree requirement.

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Thursday, June 25, 2009 8:46 AM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-06-25 08:45:43)

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Comment Received for Policy 2520.35

Name: Jane Larke
Organization: Morgantown High School
Email: jlarke@access.k12.wv.us
Title: teacher
Address1: 45 West Park Avenue
Address2:
City/State/Zip: Morgantown, WV 26501
Role: Teacher
Posted: 2009-06-25 08:45:43
Posted from IP: 70.101.254.194

Comments for section 126-44R-1 General

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

SC.O.C.2.2 needs to include Rutherford. The work of Bohr builds on his work on the structure of the atom. His experiment is one of the early, classic, historical experiments with which students should be familiar.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Thursday, June 25, 2009 10:14 AM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-06-25 10:13:48)

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Comment Received for Policy 2520.35

Name: Jane Larke
Organization: Morgantown High School
Email: jlarke@access.k12.wv.us
Title: teacher
Address1: 45 West Park Avenue
Address2:
City/State/Zip: Morgantown, WV 26501
Role: Teacher
Posted: 2009-06-25 10:13:48
Posted from IP: 70.101.254.194

Comments for section 126-44R-1 General

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

SC.O.C.2.2 needs to include Thomson. This is basic to the understanding of Bohr.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Friday, July 03, 2009 12:13 PM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-07-03 12:12:51)

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Comment Received for Policy 2520.35

#####

Name: Kathy Jacquez
Organization:
Email: kjacquez@access.k12.wv.us
Title: teacher
Address1: POBox 4
Address2:
City/State/Zip: Barrackville, WV 26559
Role: Teacher
Posted: 2009-07-03 12:12:51
Posted from IP: 98.157.100.55

Comments for section 126-44R-1 General

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

balancing redox equations are extremely difficult for first year students. 2.9 does not need to say balance redox equations ast balancing single replacement reactions are a from of redox equations and these can be balanced by firt year students.
2.14 is ridiculous for first year students as you must have a complete understanding of equation balancing and mole stoichiometry before the concept of equilibrium may be introduced. These calculations are difficult for AP students.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Wednesday, July 08, 2009 11:16 PM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-07-08 23:16:02)

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Comment Received for Policy 2520.35

Name: Robert St Clair
Organization: Huntington High School
Email: rlstclai@access.k12.wv.us
Title:
Address1:
Address2:
City/State/Zip: ,
Role: School System Staff
Posted: 2009-07-08 23:16:02
Posted from IP: 76.26.74.177

Comments for section 126-44R-1 General

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

Need to include significant figures in Chemistry I,
CII.2.16 - should be included in Chemistry I - The discipters include this infomation but it is listed as a cso in chem II. One substance and limiting reactant problems go hand in hand. Stoichiometry needs to be mentioned in the cso.
C.2.9 - parts of it could be moved to Chemistry 2 - balancing redox equations and electrochemical cells.

C.2.14 - will be hard to cover in any detail. Most of the concept is contained in chem II CSO.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: Nobody [nobody@wvde.state.wv.us]
Sent: Friday, July 10, 2009 1:07 PM
To: fibanez@wvde.state.wv.us; ranglin@access.k12.wv.us
Subject: Comment Received for Policy 2520.35 (2009-07-10 13:06:54)

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Comment Received for Policy 2520.35

#####

Name: Sonya White
Organization: WVDE
Email: snjwhite@access.k12.wv.us
Title: Coordinator
Address1: 1900 Kanawha Blvd. E
Address2: Bldg. 6 Room B018
City/State/Zip: Charleston, WV 25302
Role: Professional Support
Posted: 2009-07-10 13:06:54
Posted from IP: 129.71.215.161

Comments for section 126-44R-1 General

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Biology II Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry Content Standards and Objectives

Rationale for my comments -

As a parent and teacher, I am concerned about the lack of key concepts such as stoichiometry not being included in the chemistry curriculum. Students will be at a significant disadvantage upon entering an entry-level chemistry course in college. Specifically, my son's high school HONORS Chemistry class did not address stoichiometry because it was not explicitly stated in the CSOs. He subsequently had to repeat the basic chemistry course in college. Students need adequate exposure to the "mathematics" of chemistry if they are to be successful at the next level.

Currently, there is a significant shortage of qualified chemistry teachers here in West Virginia and across the nation. The CSOs need to state explicitly the concepts that need to be included in the curriculum. A "novice" chemistry teacher may not be able to identify the core concepts that are paramount to the study of chemistry. Again, the lack of a fully certified chemistry teacher contributed to the curriculum gaps in my child's high school chemistry course.

Section 1 Nature and Application of science - An objective needs to be included for all High school science courses (Especially Chemistry and Physics) regarding mathematical calculations. SC.O.CII.2.13 is taught at the beginning of Chemistry 1 because it is foundational to all other mathematical calculations found later in the course. I recommend adding this CSO to all high school science courses.

Standard 2: Content of Science

Performance Descriptor comments - Stoichiometry is a mastery level concept in chemistry. It is currently listed as distinguished. Students in Chemistry 1 should be able to write a balanced chemical equation, calculate the amount of a reactant or product given an amount of one or more reactants or products as a mastery concept. The mastery level of Chemistry I is not sufficient for a student to continue his/her studies of chemistry. It lists concepts that are taught in 9th grade physical science. The students at mastery level need to perform the mole calculations within the context of a balanced chemical reaction.

Specific CSOs under Standard 2:

SC.O.C.2.2 - Several key scientists are not included on this list. (Thompson, Rutherford, Curie, Becquerel, Chadwick, etc.) Also concepts such as atomic mass, atomic weight, isotopes and subatomic particle properties need to be mentioned as well.

SC.O.C.2.4 - add - to predict bonding between elements according to the octet rule.

SC.O.C.2.5 - Add - ions and simple compounds to the end of the CSO

SC.O.C.2.6 - Add - including binary and oxyacids.

SC.O.C.2.8 - add polar and nonpolar covalent

SC.O.C.2.9 - Students in Chem I need to be able to determine oxidation numbers of specific elements in a compound. By comparing 2 compounds, the students can predict whether an element is oxidized or reduced. Balancing Redox reactions is a Chem II topic and should be included there.

SC.O.C.2.14 - Change to predict the effect of a stress on an equilibrium system based on dynamic equilibrium and/or LeChatelier's Principle. Calculation of K_{sp} is too difficult at this level.

SC.O.C.2.15 - Avogadro's number is not mentioned.

SC.O.C.2.16 - Change to perform calculations using Boyle's Law, Charles' Law, the combined gas law and the ideal gas law. (Combined gas law is Boyle's and Charles' law together) The ideal gas law ($pV = nRT$) is separate from these. Each needs to be mentioned specifically.

SC.O.C.2.17 - All of these calculations can be performed in absence of a balanced chemical reaction.

SC.O.C.2.18 - Students need to apply these definitions to identify the acid - base pair in a reaction.

SC.O.C.2.19 - pH is covered in middle school in this manner. Students in Chem 1 need to be able to calculate pH.

Other CSOs from Chem II that are Chem I topics:

SC.O.CII.2.1, SC.O.CII.2.4 - kinetic molecular theory is taught in grade 9, SC.O.CII.2.5, SC.O.CII.2.13, SC.O.CII.2.16 - Mastery for any Chem I class,

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Chemistry Content Standards and Objectives

SC.O.CC.2.20 - This is a chemistry II topic.

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Chemistry II Content Standards and Objectives

See Chemistry I comments about CSOs that belong in that course.

Add
name basic organic compounds (hydrocarbons with single and multiple bonds, organic acids and simple ring structures)

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Earth Science Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Human Anatomy and Physiology Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Conceptual Physics Content Standards and Objectives

Comments for section 126-44R 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools at Physics II Content Standards and Objectives

Robin Anglin

From: bheckert@access.k12.wv.us
Sent: Thursday, July 16, 2009 3:32 PM
To: ranglin@access.k12.wv.us
Subject: Comment on new science standards
Attachments: Comments on New Science Standards.doc

Robin, I have tried three times to comment on the new science standards on the form provided and each time, I have been kicked off the site. I don't what the problem is, but I am sending my comments to you in hopes that you will be able to forward them to the appropriate person. Thanks. Barbara Heckert

Comments on New Science Standards

Chemistry 1:

SC. P. C. 2.3 This standard is to determine the proper set of quantum numbers, which is even being eliminated from the AP Chem standards. Surely a standard to determine the significance and meaning of the four quantum numbers would be better.

There is no standard for stoichiometry in general chemistry reactions, only the conversions found in SC.O.C. 2.15 and 2.17. This is a requirement for work in AP Chem and 1st year college chemistry. Many small high schools may not be able to teach Chem II, which does not delineate these standards. All the textbooks on the adopted list give a sizable amount of importance to these very basic calculations, which give meaning to the term "mole".

The Chemistry I standards seem to be very limited and would neither prepare a student for Chem II or for college chemistry.

Chemistry II:

SC.O. CII.2.16 deals with stoichiometry, which will take a significant part of the course if it has not been addressed in Chemistry I.

SC. O. CII. 2.10 This standard deals with rate law, and since it has graphical analysis, it would be reasonable to assume it deals with integrated rate law as well as differential. This would, again, take a significant amount of time.

SC. O. CII.2.15 2nd bullet. I see no point in simply defining these values. If they are not going to have use, which is certainly outside the scope of this course, they should not be included.

8th bullet. If this is to be from a graph, it is certainly a reasonable and valuable standard, but the scope of the course would not include calculation of these values.

These standards are very similar to those for AP Chemistry, which is designed to be equivalent to the first two semesters of college chemistry. A course designed as a high school course should have more specific content objectives to be less strenuous than AP Chemistry.