WEST VIRGINIA SECRETARY OF STATE

NATALIE E. TENNANT

ADMINISTRATIVE LAW DIVISION

eFILED

7/12/2013 12:08:08 PM

OFFICE OF
WEST VIRGINIA SECRETARY OF STATE

FORM 1 -- NOTICE OF A PUBLIC HEARING OR COMMENT PERIOD ON A PROPOSED RULE
(Page 1)

AGENCY **Education**
RULE TYPE **Legislative Exempt** AMENDMENT TO EXISTING RULE **Yes** TITLE-SERIES **126-044R**
RULE NAME **21st Century Science 9-12 Content Standards And Objectives For West Virginia Schools (2520.35)**
CITE AUTHORITY **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)**

COMMENTS LIMITED TO
Written

DATE OF PUBLIC HEARING

LOCATION OF PUBLIC HEARING

DATE WRITTEN COMMENT PERIOD ENDS
Monday, August 12, 2013 4:00 PM

WRITTEN COMMENTS MAY BE MAILED TO
Robin Anglin Sizemore, Science Coordinator
WVDE Office of Instruction
Capitol Building 6, Room 617
1900 Kanawha Boulevard, East
Charleston, West Virginia 25305-0330

BY CHOOSING 'YES', I ATTEST THAT THE PREVIOUS STATEMENTS ARE TRUE AND CORRECT.

Yes
Charles K Heinlein -- By my signature, I certify that I am the person authorized to file legislative rules, in accordance with West Virginia Code §29A-3-11 and §39A-3-2.

Title-Series: 126-044R

Rule Id: 9225

Document: 25061

WEST VIRGINIA SECRETARY OF STATE

NATALIE E. TENNANT

ADMINISTRATIVE LAW DIVISION

eFILED

7/12/2013 12:08:08 PM

OFFICE OF
WEST VIRGINIA SECRETARY OF STATE

FORM 1 -- NOTICE OF A PUBLIC HEARING OR COMMENT PERIOD ON A PROPOSED RULE (Page 2)

AGENCY **Education**

RULE TYPE **Legislative Exempt** AMENDMENT TO EXISTING RULE **Yes** TITLE-SERIES **126-044R**

RULE NAME **21st Century Science 9-12 Content Standards And Objectives For West Virginia Schools (2520.35)**

CITE AUTHORITY **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)**

PROVIDE A BRIEF SUMMARY OF YOUR PROPOSAL

The current version of Policy 2520.35 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools, became effective September 14, 2009. Policy 2510: Assuring Quality of Education: Regulations for Education Programs requires the third science credit above biology for graduation. Individual counties have requested that WVDE define the content, standards and the objectives for a Forensic Science course that students may use as the third credit. Many counties been offering a Forensic Science course that has been very popular and prepares students possible career in Forensics but it did not count as a third credit in science. These courses varied with rigor and content. The objectives in Standard Two - Content were written succinctly and organized around the four themes which include concepts from physical science, chemistry, earth, life science; and engineering was integrated where appropriate. Two CATS Science courses (9-10) were removed from the policy. These courses are no longer taught. The proposed revision will result in the implementation of the new elective science course for credit toward graduation.

BY CHOOSING 'YES', I ATTEST THAT THE PREVIOUS STATEMENTS ARE TRUE AND CORRECT.

Yes

Charles K Heinlein -- By my signature, I certify that I am the person authorized to file legislative rules, in accordance with West Virginia Code §29A-3-11 and §39A-3-2.

Title-Series: 126-044R

Rule Id: 9225

Document: 25061

WEST VIRGINIA SECRETARY OF STATE

NATALIE E. TENNANT

ADMINISTRATIVE LAW DIVISION

eFILED

7/12/2013 12:08:08 PM

OFFICE OF
WEST VIRGINIA SECRETARY OF STATE

FORM 11 -- FISCAL NOTE FOR PROPOSED RULES (Page 1)

AGENCY **Education**
RULE TYPE **Legislative Exempt** AMENDMENT TO EXISTING RULE **Yes** TITLE-SERIES **126-044R**
RULE NAME **21st Century Science 9-12 Content Standards And Objectives For West Virginia Schools (2520.35)**
CITE AUTHORITY **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)**

SUMMARIZE IN A CLEAR AND CONCISE MANNER WHAT IMPACT THIS MEASURE WILL HAVE ON COSTS AND REVENUES OF STATE GOVERNMENT.

No costs or revenue will be impacted by the proposed amendment of W.Va. 126CSR44R, Policy 2520.35 21st Century Science Content Standards and Objectives for West Virginia Schools.

Charles K Heinlein -- By my signature, I certify that I am the person authorized to file legislative rules, in accordance with West Virginia Code §29A-3-11 and §39A-3-2.

Title-Series: 126-044R
Rule Id: 9225
Document: 25061

WEST VIRGINIA SECRETARY OF STATE

NATALIE E. TENNANT

ADMINISTRATIVE LAW DIVISION

eFILED

7/12/2013 12:08:08 PM

OFFICE OF
WEST VIRGINIA SECRETARY OF STATE

FORM 11 -- FISCAL NOTE FOR PROPOSED RULES (Page 2)

AGENCY **Education**
RULE TYPE **Legislative Exempt** AMENDMENT TO EXISTING RULE **Yes** TITLE-SERIES **126-044R**
RULE NAME **21st Century Science 9-12 Content Standards And Objectives For West Virginia Schools (2520.35)**
CITE AUTHORITY **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)**

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.

Effect Of Proposal	Current Increase/Decrease (use ' - ')	Next Increase/Decrease (use ' - ')	Fiscal Year (Upon Full Implementation)
ESTIMATED TOTAL COST	0	0	0
PERSONAL SERVICES	0	0	0
CURRENT EXPENSES	0	0	0
REPAIRS AND ALTERATIONS	0	0	0
ASSETS	0	0	0
OTHER	0	0	0
ESTIMATED TOTAL REVENUES	0	0	0

Charles K Heinlein -- By my signature, I certify that I am the person authorized to file legislative rules, in accordance with West Virginia Code §29A-3-11 and §39A-3-2.

WEST VIRGINIA SECRETARY OF STATE

NATALIE E. TENNANT

ADMINISTRATIVE LAW DIVISION

eFILED

7/12/2013 12:08:08 PM

OFFICE OF
WEST VIRGINIA SECRETARY OF STATE

FORM 11 -- FISCAL NOTE FOR PROPOSED RULES (Page 3)

AGENCY **Education**
RULE TYPE **Legislative Exempt** AMENDMENT TO EXISTING RULE **Yes** TITLE-SERIES **126-044R**
RULE NAME **21st Century Science 9-12 Content Standards And Objectives For West Virginia Schools (2520.35)**
CITE AUTHORITY **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)**

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 revenue will be impacted by the proposed amendment of W.Va. 126CSR44R, Policy 2520.35 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools.

Charles K Heinlein -- By my signature, I certify that I am the person authorized to file legislative rules, in accordance with West Virginia Code §29A-3-11 and §39A-3-2.

Title-Series: 126-044R Rule Id: 9225 Document: 25061

WEST VIRGINIA SECRETARY OF STATE

NATALIE E. TENNANT

ADMINISTRATIVE LAW DIVISION

eFILED

7/12/2013 12:08:08 PM

OFFICE OF
WEST VIRGINIA SECRETARY OF STATE

FORM 11 -- FISCAL NOTE FOR PROPOSED RULES (Page 4)

AGENCY **Education**
RULE TYPE **Legislative Exempt** AMENDMENT TO EXISTING RULE **Yes** TITLE-SERIES **126-044R**
RULE NAME **21st Century Science 9-12 Content Standards And Objectives For West Virginia Schools (2520.35)**
CITE AUTHORITY **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)**

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.

0No costs or revenue will be impacted by the proposed amendment of W.Va. 126CSR44R, Policy 2520.35 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools.

BY CHOOSING 'YES', I ATTEST THAT THE PREVIOUS STATEMENTS ARE TRUE AND CORRECT.

Charles K Heinlein -- By my signature, I certify that I am the person authorized to file legislative rules, in accordance with West Virginia Code §29A-3-11 and §39A-3-2.

Title-Series: 126-044R
Rule Id: 9225
Document: 25061

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 Schools

Background: The current version of Policy 2520.35 – 21st Century Science 9-12 Content Standards and Objectives for West Virginia Schools, became effective September 14, 2009. Policy 2510: Assuring Quality of Education: Regulations for Education Programs requires the third science credit above biology for graduation. Individual counties have requested that WVDE define the content, standards and the objectives for a Forensic Science course that students may use as the third credit. Many counties been offering a Forensic Science course that has been very popular and prepares students possible career in Forensics but it did not count as a third credit in science. These courses varied with rigor and content. The objectives in Standard Two - Content were written succinctly and organized around the four themes which include concepts from physical science, chemistry, earth, life science; and engineering was integrated where appropriate. The Forensic Science CSOs were written by: Robin Anglin Sizemore, WVDE; Marty Burke, WVDE; Danielle Dexter, Kanawha County teacher; Jodie Kissner, Berkeley County Teacher; Myriaha Selbe, Cabell County teacher; Tina Cool, Preston County teacher; Lenora Richardson, Cabell County Coordinator; and Rosie Rhodes, Kanawha County Coordinator.

Two CATS Science courses (9-10) were removed from the policy. These courses are no longer taught.

Proposals: It is recommended that ninth and tenth grade section of Policy 2520.35 be removed and to allow the addition of Forensic Science course to policy 2520.35 beginning in September 2013.

Impact: The proposed revision will result in the implementation of the new elective science course for credit toward graduation.

Response to Comments:

126CSR44R

TITLE 126
LEGISLATIVE RULE
BOARD OF EDUCATION

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

§126-44R-1. General.

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

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

1.3. Filing Date. -- ~~April 16, 2010.~~

1.4. Effective Date. -- ~~July 1, 2010.~~

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 ~~August 14, 2009~~April 16, 2010 and effective ~~September 14, 2009~~July 1, 2010.

§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.

§126-44R-5. Severability.

5.1 If any provision of this rule or the application thereof to any person or circumstance is held invalid, such invalidity shall not affect other provisions or applications of this rule .

~~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.

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.

llustration: 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
ENV	Environmental Science
F	Forensic 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, Environmental 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 9^{th}, 10^{th}, 11^{th} and 12^{th} grades participate in advanced in-depth laboratory-based elective courses designed to expand their conceptual understanding and enhance their research and laboratory skills.

Ninth Grade Science Content Standards and Objectives

The Ninth Grade Science objectives continue the development of foundational knowledge in biology, chemistry, physics, earth/environmental science and astronomy. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy and the use of 21st Century Skills across these major fields of science. Subject matter is delivered through a coordinated, integrated approach with an emphasis on the development of the major science themes of systems, changes, and models. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50 percent of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated in all activities. Building on the knowledge and skills acquired in Eighth Grade Science, students in Ninth Grade Science will expand and deepen their understanding of major concepts such as energy interactions, genetic probabilities, chemical changes and mineral composition of local rock layers. The West Virginia Standards for 21st Century Learning include the following components: 21st Century Content Standards and Objectives and 21st Century Learning Skills and Technology Tools. All West Virginia teachers are responsible for classroom instruction that integrates learning skills, technology tools and content standards and objectives.

Grade 9	**Science**
Standard: 1	Nature of Science
SC.S.9.1	Students will • Demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems.

Performance Descriptors SC.PD.9.1

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will: analyze the importance of scientific innovation and relate these innovations to the utilization of scientific methodology, variability in experimental results to advances in societal, cultural and economic issues;	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;	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;	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;	Students at the novice level will: identify the importance of scientific innovation and associate these innovations with advances in societal, cultural or economic issues;

design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; and draw conclusions from multiple data sources and interpretation of models.	use scientific methodology to design, conduct, communicate and revise experiments utilizing safe procedures and appropriate technology; and draw conclusions from multiple data sources and models.	use scientific methodology to conduct, communicate and revise experiments utilizing safe procedures and appropriate technology; and draw conclusions from data sources and models.	use scientific methodology to conduct and communicate experiments utilizing safe procedures and appropriate technology; and select an appropriate conclusion from a list of possible conclusions drawn from experimental data.	conduct experiments utilizing safe procedures and appropriate technology; and differentiate between observations and conclusions.

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

Grade 9	**Science**
Standard: 2	Content of Science

~~SC.S.9.2~~	~~Students will~~ • ~~demonstrate knowledge understanding and applications of scientific facts, concepts, principles, theories, and models delineated in the objectives.~~ • ~~demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science, and~~ • ~~astronomy; and apply knowledge, understanding and skills of science subject matter/concepts to daily life.~~

~~Performance Descriptors SC.PD.9.2~~				
~~Distinguished~~	~~Above Mastery~~	~~Mastery~~	~~Partial Mastery~~	~~Novice~~
~~Students 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 energy through cellular processes;~~ ~~predict how states of matter react as kinetic energy changes;~~ ~~write formulas for ionically and covalently~~	~~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 processes;~~ ~~predict the state of matter given relative amounts of kinetic energy;~~ ~~write formulas, balance coefficients, predict~~	~~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 processes;~~ ~~relate state of matter to amount of kinetic energy;~~ ~~write formulas, balance coefficients, and classify~~	~~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 to indicate kinetic energy;~~ ~~write formulas and classify types of chemical~~	~~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 reactions;~~

~~bonded compounds, balance coefficients, predict products and classify types of chemical reactions;~~	~~products and classify types of chemical reactions and bonds;~~	~~types of chemical reactions; classify bond types;~~	~~reactions; name types of bonds;~~	~~define an ionic and covalent bond;~~
~~predict density values with change of state;~~	~~predict density value when mass and volume changes;~~	~~predict density value when mass and/or volume changes;~~	~~calculate density when mass or volume change;~~	~~define density;~~
~~calculate the amount of energy produced by nuclear changes;~~	~~write equations for types of nuclear changes;~~	~~compare types of nuclear changes;~~	~~identify the uses of energy produced by nuclear changes;~~	~~recognize that energy is produced by nuclear changes;~~
~~measure the specific heat of a material;~~	~~relate the properties of a material to its absorption or dissipation of heat;~~	~~assess a material's ability to absorb or dissipate heat;~~	~~recognize that materials absorb and dissipate heat differently;~~	~~identify objects as conductors or insulators of heat;~~
~~compare the properties of different magnetic fields;~~	~~compare the properties of different magnets;~~	~~explore properties of a magnet;~~	~~list the properties of a magnet;~~	~~list a property of a magnet;~~
~~evaluate a circuit using Ohm's Law and power equation;~~	~~construct an electric circuit applying Ohm's Law and power equation;~~	~~construct an electric circuit using Ohm's Law and power equation;~~	~~construct an electric circuit using Ohm's Law;~~	~~construct an electric circuit;~~
~~calculate inverse square relations;~~	~~predict inverse square relations;~~	~~recognize inverse square relations;~~	~~recognize that changing distance of a light source affects perceived brightness;~~	~~observe that changing distance of a light source affects perceived brightness;~~
~~predict the effects of a change in location on motion of a pendulum;~~	~~explain the effect of gravity on the motion of pendulums;~~	~~examine variables that affect the motion of pendulums;~~	~~construct a pendulum and record data;~~	~~construct a pendulum;~~
~~compare and contrast transverse and~~	~~classify waves as transverse or longitudinal;~~	~~differentiate transverse and longitudinal waves;~~	~~model transverse and longitudinal waves;~~	~~model transverse and longitudinal waves;~~

~~longitudinal waves;~~				
~~make long-range weather forecasts from meteorological data;~~	~~construct and interpret a weather map from data;~~	~~predict weather using maps;~~	~~interpret weather maps;~~	~~read weather maps;~~
~~use properties to identify unknown minerals;~~	~~test properties to classify minerals;~~	~~relate properties to minerals;~~	~~list the parts of the rock cycle;~~	
~~predict the paleo-environment in which a rock type was formed;~~	~~predict the type of rock that forms in a paleo-environment;~~	~~relate rocks to the environment in which they form;~~	~~group minerals using properties;~~	~~state the difference between rocks and minerals;~~
~~use evidence to explain the structure of the moon;~~	~~use evidence to explain differences in Earth's layers;~~	~~use evidence to interpret Earth's structure;~~	~~model the layers of the earth;~~	~~name the layers of the earth;~~
~~explain the absence of plate tectonics on the moon; and~~ ~~evaluate the accuracy of absolute and relative dating techniques.~~	~~evaluate evidence for the forces and mechanisms of plate tectonics; and~~ ~~interpret data to determine absolute and relative ages.~~	~~compare and contrast the forces and mechanisms of plate tectonics; and~~ ~~use dating techniques.~~	~~identify heat source and model a convection cell; and~~ ~~use relative dating techniques.~~	~~identify Earth's internal heat source; and~~ ~~use the law of superposition to date strata.~~

~~Objectives~~	~~Students will~~
~~SC.O.9.2.1~~	~~apply principles of Mendelian genetics to solve heredity problems.~~
~~SC.O.9.2.2~~	~~illustrate meiosis and mitosis and relate to chromosome number and production of sperm, egg and body cells.~~
~~SC.O.9.2.3~~	~~analyze cyclic changes in populations of organisms.~~
~~SC.O.9.2.4~~	~~design an environment that demonstrates the interdependence of plants and animals (e.g., energy and chemical cycles, adaptations of structures and behaviors).~~
~~SC.O.9.2.5~~	~~compare and contrast the structure and function of cells, tissues and systems of different organisms.~~
~~SC.O.9.2.6~~	~~diagram the transfer of matter and energy in the chemical/molecular processes of photosynthesis, respiration and fermentation.~~
~~SC.O.9.2.7~~	~~predict chemical and physical properties of an element using its position in the periodic table.~~
~~SC.O.9.2.8~~	~~compare the types of radioactive decay in terms of particles and energy generated.~~
~~SC.O.9.2.9~~	~~predict the changes in density as mass and volume change.~~

~~SC.O.9.2.10~~	~~relate molecular motion, kinetic energy and states of matter.~~
~~SC.O.9.2.11~~	~~write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions.~~
~~SC.O.9.2.12~~	~~propose the results of changing the number of protons, neutrons or electrons on the properties of an atom.~~
~~SC.O.9.2.13~~	~~determine formulas and names for binary compounds.~~
~~SC.O.9.2.14~~	~~classify a binary chemical bond as ionic, nonpolar covalent or polar covalent.~~
~~SC.O.9.2.15~~	~~given a chemical equation deduce the coefficients and classify the reaction type (e.g., synthesis or combination, decomposition, single replacement, or double replacement and combustion).~~
~~SC.O.9.2.16~~	~~assess and provide evidence to justify the occurrence of a chemical reaction (e.g., production of color, light, heat, sound, smell, gas, or precipitate).~~
~~SC.O.9.2.17~~	~~differentiate various forms of energy and energy transformations including fission and fusion.~~
~~SC.O.9.2.18~~	~~assess absorption and dissipation of heat by various materials.~~
~~SC.O.9.2.19~~	~~experimentally deduce and diagram the magnetic field of a bar magnet.~~
~~SC.O.9.2.20~~	~~construct electric circuits and mathematically model electric circuits using Ohm's Law and power equations.~~
~~SC.O.9.2.21~~	~~establish the relationship between distance and the intensity of light, charge and gravitational attraction (e.g., inverse square law).~~
~~SC.O.9.2.22~~	~~interpret and draw conclusions from speed-distance-time data and graphs.~~
~~SC.O.9.2.23~~	~~analyze experiments to determine which variables affect the motion of pendulums.~~
~~SC.O.9.2.24~~	~~differentiate between transverse and longitudinal waves and model examples of each type (e.g., light, sound, or seismic).~~
~~SC.O.9.2.25~~	~~predict weather based on the relationships of temperature, air pressure, wind speed, wind direction and humidity as depicted on a weather map and meteorological data.~~
~~SC.O.9.2.26~~	~~analyze the relationships among latitude, altitude and climate.~~
~~SC.O.9.2.27~~	~~classify common rock forming minerals by examining their physical and chemical properties.~~
~~SC.O.9.2.28~~	~~analyze the processes of the rock cycle to predict the paleo environment in which a rock sample is formed.~~
~~SC.O.9.2.29~~	~~examine seismographic and geologic evidence to determine structure and composition of the Earth's interior.~~
~~SC.O.9.2.30~~	~~use relative dating techniques to determine the ages of stratagraphic layers.~~
~~SC.O.9.2.31~~	~~interpret a half life graph to determine the absolute age of a given sample.~~
~~SC.O.9.2.32~~	~~compare and contrast theoretical models explaining forces driving lithospheric plate motion (e.g., slab pull, plate push, or convection).~~
~~SC.O.9.2.33~~	~~research and organize evidence to support the theory of plate tectonics.~~
~~SC.O.9.2.34~~	~~apply fusion, heat transfer, gravity, and electromagnetism to the sun, its evolution and its impact on earth.~~

Grade 9	Science
Standard: 3	Application of Science
SC.S.9.3	Students will • demonstrate the ability to use inquiry process to explore systems, models, and changes. • demonstrate an understanding of the interdependence between science and technology. • demonstrate an understanding of the utilization of technology to gather data and communicate designs, results and conclusions. • demonstrate an understanding of personal and societal benefits of science, and an understanding of public policy decisions as • related to health, population, resource and environmental issues.

Performance Descriptors SC.PD.9.3				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will: construct, test and analyze complex systems, models, and changes across science disciplines; use a technology solution and analyze the science used in the technology; evaluate how a scientific discovery impacts public policy decisions regarding health, population resources and environmental issues.	Students at the above mastery level will: construct, test and analyze data to explore systems, models, and changes across science disciplines; analyze technological innovations and identify the science that makes them possible; evaluate the personal and societal benefits of a scientific discovery; assess the impacts of a public policy decision regarding health, population resources or environmental issues.	Students at the mastery level will: test, record and analyze data to explore systems, models, and changes; analyze a technological innovation and identify the science that makes it possible; assess positive outcomes and unintended consequences of a scientific discovery; explain the impacts of a public policy decision regarding health, population resources or environmental issues.	Students at the partial mastery level will: test and record data to explore systems, models, and changes; explain a technological innovation and identify the science that makes it possible; identify positive outcomes and unintended consequences of a scientific discovery; identify the impacts of public policy decision regarding health, population resources or environmental issues.	Students at the novice level will: test and record data to explore systems, models or changes; identify a technological innovation and the science that makes it possible; identify positive outcomes or unintended consequences of a scientific discovery; identify the impact of a public policy decision regarding health, population resources or environmental issues.

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

Tenth Grade Science Content Standards and Objectives

The Tenth Grade Science objectives conclude the development of foundational knowledge of biology, chemistry, physics, and the earth and space sciences. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy and use of 21st century skills in the fields of biology, chemistry, physics and earth/environmental science and astronomy. The subject matter is delivered through a coordinated, integrated approach with an emphasis on the development of the major science themes of systems, changes, and models. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50 percent of the instructional time to develop conceptual understanding and research laboratory skills. Safety instruction is integrated in all activities. Building on the knowledge and skills acquired in Ninth Grade Science, students in Tenth Grade Science will expand their depth of understanding of major concepts such as energy transformation qualifications; cellular biology; molecular genetics; embryology; physical, chemical and nuclear changes; fossils and environmental concerns. The West Virginia Standards for 21st Century Learning include the following components: 21st Century Content Standards and Objectives and 21st Century Learning Skills and Technology Tools. All West Virginia teachers are responsible for classroom instruction that integrates learning skills, technology tools and content standards and objectives.

Grade 10	**Science**			
Standard: 1	Nature of Science			
SC.S.10.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse • cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems.			
Performance Descriptors SC.PD.10.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will: evaluate the importance of scientific innovation; relate these innovations to the utilization of scientific methodology, variability in experimental results	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	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	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	Students at the novice level will: identify scientific innovations and associate these innovations with the utilization of scientific methodology in

and interpret the impact of these advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; and validate and draw conclusions from experimental results using historical and student collected data and constructed models.	advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; and compile data to draw conclusions from multiple data sources and interpretation of models.	advances in societal, cultural and economic issues; design, conduct, communicate, evaluate and revise experiments utilizing safe procedures and appropriate technology; and draw conclusions from multiple data sources and interpretation of models.	advances in societal, cultural or economic issues; conduct and communicate experiments utilizing safe procedures and appropriate technology; and draw conclusions from data and generate models.	advancing societal, cultural or economic issues; conduct experiments utilizing safe procedures and appropriate technology and describe results; and differentiate between observations and conclusions.

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

SC.O.10.1.8	draw conclusions from a variety of data sources to analyze and interpret systems and models (e.g., use graphs and equations to measure and apply variables such as rate and scale, evaluate changes in trends and cycles, predict the influence of external variances such as potential sources of error, or interpret maps).

Grade 10	**Science**
Standard: 2	Content of Science
SC.S.10.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.10.2

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will: suggest cell functions based on structure;	Students at the above mastery level will: classify cells based on structure and function;	Students at the mastery level will: relate cell structure to function;	Students at the partial mastery level will: recognize that cells have different structures and functions;	Students at the novice level will: recognize that cells have different structures;
debate ethics of DNA research;	analyze historical research leading to current DNA knowledge;	apply DNA's structure to its role in heredity;	list properties of DNA;	recognize that DNA is the material of heredity;
assess the statement "ontogeny recapitulates phylogeny";	compare ontogeny and phylogeny of a variety of animals;	compare ontogeny and phylogeny of an animal;	trace ontogeny or phylogeny of an animal;	recognize that embryos developmentally change;
construct a simple cladogram;	interpret a cladogram of a group of organisms;	compare traditional and modern classification systems;	identify a group of organisms whose historical classification has changed;	place organisms in a classification system;
explain interactions	explain interactions	diagram biogeochemical	diagram the carbon or	diagram the water cycle;

~~among biogeochemical cycles;~~	~~between two biogeochemical cycles;~~	~~cycles;~~	~~nitrogen cycle;~~	
~~associate diseases with chemical imbalances;~~	~~describe the role of chemicals in human body systems;~~	~~describe how human body systems work together;~~	~~explain the interaction of two human body systems;~~	~~identify human body systems;~~
~~analyze fossil and modern evidence of adaptations in response to changing environments;~~	~~trace fossil and modern adaptations in response to changing environments;~~	~~describe fossil and modern adaptations of plant and animal populations to their changing environment;~~	~~recognize that populations change in response to environmental changes;~~	~~recognize that populations change over time;~~
~~experimentally determine data to predict trends in characteristics among unknown substances;~~	~~experimentally determine relationships among substances;~~	~~experimentally determine characteristics of substances;~~	~~experimentally determine characteristics of some substances;~~	~~list characteristics of substances;~~
~~design experiments to demonstrate the relationships among temperature-pressure-volume and heat in substances during physical/chemical changes;~~	~~experimentally and mathematically validate the relationships among temperature-pressure-volume and heat in substances during physical/chemical changes;~~	~~mathematically determine the relationships among temperature-pressure-volume and heat in substances during physical /chemical changes;~~	~~mathematically determine the relationships among temperature-pressure-volume;~~	~~state relationship among temperature-pressure-volume;~~
~~relate the frequency of electromagnetic waves to energy;~~	~~calculate the frequency of electromagnetic waves;~~	~~characterize electromagnetic waves and their uses;~~	~~list electromagnetic waves and their uses;~~	~~list some electromagnetic waves;~~
~~explain how electricity produces magnetism and how magnets produce electricity;~~	~~explain how electricity produces magnetism;~~	~~describe the relationship between electricity and magnetism;~~	~~diagram a magnetic field around an electrical wire;~~	~~recognize that electricity and magnetism are interrelated;~~

~~assess error in measuring energy conservation;~~	~~describe conservation of all forms of energy;~~	~~quantitatively determine conservation of thermal energy:~~	~~recognize that energy is conserved in transformations;~~	~~state that energy is conserved;~~
~~interpret calculations and graphs of rate, force, momentum, work and time;~~	~~interpret calculations and/or graphs of rate, force, momentum, work and time;~~	~~relate Newton's Laws of Motion to rate, force, momentum, work and time;~~	~~define Newton's Laws of Motion, rate, force, momentum, work and time;~~	~~state the three Laws of Motion;~~
~~suggest a simple machine to provide optimum mechanical advantage;~~	~~compare calculated mechanical advantage of similar simple machines;~~	~~calculate mechanical advantage of simple machines;~~	~~calculate mechanical advantage of some simple machines;~~	~~calculate mechanical advantage of a simple machine;~~
~~measure calculate the spring constant and relate to its properties;~~	~~measure calculate the spring constant;~~	~~compare the effect of different forces on vibrating systems;~~	~~recognize vibrating systems;~~	~~recognize a pendulum is an example of a vibrating system;~~
~~evaluate multiple gravitational effects of the Earth-Moon system;~~	~~evaluate the gravitational effects of the moon and sun on tidal phenomenon;~~	~~predict tidal phenomenon;~~	~~explain that the moon causes tides;~~	~~define tides;~~
~~predict the effects of geological and biological events on climate;~~	~~predict the effects of geological or biological event on climate;~~	~~determine impacts of geological and biological processes on climate;~~	~~list geological and biological processes that affect climate;~~	~~recognize that geological and biological processes affect climate;~~
~~critique geological and chemical conditions to predict fossil formation; and~~	~~evaluate conditions necessary for fossil formation; and~~	~~explain geological and biological processes of fossil formation; and~~	~~explain some processes that form fossils; and~~	~~explain a process that forms fossils; and~~
~~evaluate theories of cosmology using electromagnetic evidence.~~	~~compare theories of cosmology using electromagnetic evidence.~~	~~explain theories of cosmology using electromagnetic evidence.~~	~~state theories of cosmology.~~	~~state a scientifically accepted theory for the origin of the universe.~~
~~Objectives~~	~~Students will~~			

~~SC.O.10.2.1~~	~~relate the structure of cell organelles to their functions.~~
~~SC.O.10.2.2~~	~~apply knowledge of cells to variations in cells, tissues, and organs of different organisms.~~
~~SC.O.10.2.3~~	~~compare and contrast mechanisms for the movement of materials into and out of cells.~~
~~SC.O.10.2.4~~	~~explore the discovery of DNA and its structure; examine nucleotide bonding to the importance of to the double helix structure.~~
~~SC.O.10.2.5~~	~~apply DNA analysis to current societal and technological issues (e.g., DNA's role in protein synthesis, heredity, cell division, or cellular functions).~~
~~SC.O.10.2.6~~	~~integrate DNA mutations, chromosomal crossing over and linkage with the principles of genetics.~~
~~SC.O.10.2.7~~	~~compare the ontogeny and phylogeny using the embryonic development of invertebrate and vertebrate animals.~~
~~SC.O.10.2.8~~	~~compare traditional and modern classification systems.~~
~~SC.O.10.2.9~~	~~construct a scientific explanation for variation in the species and common ancestors using fossil records, homologous features and selective pressures.~~
~~SC.O.10.2.10~~	~~compare and contrast theories for the development, diversity and/or extinction of a species (e.g., natural selection, Lamarckism, or catastrophism).~~
~~SC.O.10.2.11~~	~~construct diagrams showing energy flow and cycles of matter between chemical and biological systems including photosynthesis, stored chemical energy, decomposition, carbon and nitrogen cycles.~~
~~SC.O.10.2.12~~	~~integrate the human body systems to the functioning of the entire organism.~~
~~SC.O.10.2.13~~	~~design an investigation in which the needs of growing plants are determined.~~
~~SC.O.10.2.14~~	~~evaluate environmental factors that affect succession, populations and communities.~~
~~SC.O.10.2.15~~	~~model the flow of matter and energy flow through the respiration process.~~
~~SC.O.10.2.16~~	~~compare and contrast by investigation the properties of solutions including density, conductivity, solubility, concentration, pH and colligative properties.~~
~~SC.O.10.2.17~~	~~compare and contrast the characteristics of physical, chemical and nuclear changes/reactions.~~
~~SC.O.10.2.18~~	~~determine the relationships among temperature, pressure and volume in gases and interpret graphs that depict these relationships (e.g., Charles' Law, Boyle's Law, Gay-Lussac's Law).~~
~~SC.O.10.2.19~~	~~characterize by investigation variance in thermal energy in physical and chemical changes.~~
~~SC.O.10.4.20~~	~~compare and contrast the characteristics and uses of electromagnetic waves and relate the frequency of the wave to its application.~~
~~SC.O.10.2.21~~	~~correlate the motion of a body to its Doppler shift.~~
~~SC.O.10.2.22~~	~~qualitatively explain the relationship between electricity and magnetism.~~
~~SC.O.10.2.23~~	~~qualitatively and quantitatively describe the conservation of energy (e.g., thermal, chemical, or mechanical).~~

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

Grade 10	**Science**
Standard: 3	Application of Science
SC.S.10.3	Students will • demonstrate the ability to use inquiry process to explore systems, models, and changes. • demonstrate an understanding of the interdependence between science and technology. • demonstrate an understanding of the utilization of technology to gather data and communicate designs, results and conclusions. • demonstrate an understanding of personal and societal benefits of science, and an understanding of public policy decisions as related to health, population, resource and environmental issues.

Performance Descriptors SC.PD.10.3

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Students at the distinguished level will: construct, test, analyze, and evaluate complex systems, models, and changes across science	Students at the above mastery level will: construct, test and analyze complex systems, models, and changes across science disciplines;	Students at the mastery level will: construct, test and analyze data to explore systems, models, and changes across science disciplines;	Students at the partial mastery level will: test, record and analyze data to explore systems, models, and changes;	Students at the novice level will: test and record data to explore systems, models, and changes;

disciplines; choose a technology solution and analyze the science used in the technology; and evaluate how scientific discoveries impact public policy decisions regarding health, population resources and environmental issues.	use a technology solution and analyze the science used in the technology; and evaluate how a scientific discovery impacts public policy decisions regarding health, population resources and environmental issues.	analyze technological innovations and identify the science that makes them possible; evaluate the personal and societal benefits of a scientific discovery; and assess the impacts of a public policy decision regarding health, population resources or environmental issues.	analyze a technological innovation and identify the science that makes it possible; list positive outcomes and unintended consequences of a scientific discovery; and identify the impacts of a public policy decision regarding health, population resources or environmental issues.	use technological innovations and state that science makes them possible; identify a positive outcome or a negative consequence of a scientific discovery; and identify an impact of a public policy decision regarding health, population resources or environmental issues.

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

Ninth Grade Physical Science Content Standards and Objectives

The Ninth Grade Physical Science objectives continue the development of foundational knowledge in 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**
Standard: 1	Nature and Application of Science
SC.S.PS.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse • cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.PS.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Ninth grade students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for	Ninth grade students at the above mastery level in the Nature and Applications of Science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on	Ninth grade students at the mastery level in the Nature and Applications of Science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and	Ninth grade students at the partial mastery level in the Nature and Applications of Science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and	Ninth grade students at the novice level in the Nature and Applications of Science will: implement safe practices as they conduct experiments and base conclusions on observations and

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 defend their ideas to an authentic audience	observations and experimental evidence; and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence; and relate science-technology-societal issues while using a variety of sources to construct their solutions.	experimental evidence; and relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.PS.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.PS.1.2	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 • demonstrate knowledge understanding and applications of scientific facts, concepts, principles, theories, and models delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science, and • astronomy; and apply knowledge, understanding and skills of science subject matter/concepts to daily life.			
Performance Descriptors SC.PD.PS.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Ninth grade students at the distinguished level in content of science will: apply dimensional analysis and metric notations when determining relations, deriving equations, and solving for unknowns;. predict chemical and physical properties of elements based on electron structure quantitatively distinguish ionic, nonpolar and polar covalent compounds; predict and verify the identity of observable products of chemical reactions when given the reactants;	Ninth grade students at the above mastery level in content of science will: apply dimensional analysis and metric notations when collecting data, determining relationships, and solving for unknowns; predict chemical and physical properties of elements based on electron structure quantitatively; determine the oxidation numbers of the elements, balance the equations, and predict the products;	Ninth grade students at the mastery level in content of science will: apply dimensional analysis and metric notations when collecting data, determining relationships, and solving for unknowns; characterize the properties of elements, molecules and ionic structures and write formulas and names of ions; classify and cite evidence for the chemical reactions and apply the Laws of Conservation;	Ninth grade students at the partial mastery level in content of science will: apply dimensional analysis and metric notations when collecting data, examining relationships, and solving for unknowns; characterize the properties of elements, molecules and ionic structures and identify chemical names; classify, describe chemical reactions and apply the Laws of Conservation:	Ninth grade students at the novice level in content of science will: use the proper units when collecting data and solving for unknowns; list the properties of elements and ionic structures and identify chemical names; identify chemical reactions and state the Laws of Conservation;

quantitatively determine the energy produced during exothermic reactions;	design and conduct an experiment to differentiate between heat and temperature and the present results;	conduct experiments to determine the relationships between molecular motion, kinetic energy, heat, and temperature;	explain the relationships of molecular motion, kinetic energy, heat, and temperature;	state relate molecular motion and kinetic energy to heat and temperature;
calculate the magnitudes of interacting magnetic fields and build circuits for specified scenarios;	predict and experimentally determine interacting magnetic fields and build circuits for specified scenarios;	experimentally determine magnetic fields and circuits as they solve for unknowns and determine their relationships;	experimentally determine and diagram magnetic fields and circuits as they solve for unknowns;	diagram magnetic fields and circuits as they solve for unknowns;
design experiments to determine relationships in the forces and motions of systems, and	extrapolate data to solve for unknown forces and motions in systems, and	use Newton's Laws to make predictions and solve for unknown forces and motions in systems, and	make predictions solve for unknown forces and motions in systems, and	identify the forces and the motions they cause in systems, and
research and evaluate evidence for theories for the origin and composition of the Earth and solar system and use models of waves and heat transfer to explain changes that occur.	research and site evidence for theories for the origin of the Earth and solar system and use models of waves and heat transfer to explain their composition and changes that occur	investigate theories for the origin and composition of the Earth and solar system and use models of waves and heat transfer to explain their composition and changes that occur.	diagram the composition of the Earth and solar system and use models of waves and heat transfer to explain changes that occur.	diagram the solar system and use models to describe waves and the heat transfer that occurs on Earth and sun.

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 • 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 • 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 • mechanical • thermal • chemical • electrical • nuclear.
SC.O.PS.2.10	compare the types of particles liberated in nuclear decay and interpret half-life graphs: • radiometric dating • nuclear medicine • nuclear waste disposal.
SC.O.PS.2.11	experimentally demonstrate the relationship between heat and temperature: • specific heat • melting point • latent heat.
SC.O.PS.2.12	predict, experimentally determine and diagram magnetic fields of magnets.
SC.O.PS.2.13	construct and diagram DC circuits and solve for unknown variables using Ohm's Law and power equations.
SC.O.PS.2.14	qualitatively explain the relationship between electricity and magnetism.
SC.O.PS.2.15	conduct experiments to verify the inverse square relationship between gravity, distance and intensity of light and sound.
SC.O.PS.2.16	experimentally obtain data and apply graphs, vectors and mathematical models to quantify Newton's Laws of motion:

	• 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	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.

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**
Standard: 1	Nature and Application of Science
SC.S.B.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. Relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.B.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology students at the distinguished level in the nature and applications of science will: 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;	Biology students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence; and	Biology students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence; and	Biology students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence; and	Biology students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence; and

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.	relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.B.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.B.1.2.	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 • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives;

	• demonstrate an understanding of the interrelationships among physics, chemistry, biology and the earth and space sciences. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.B.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology students at the distinguished level in content of science will: investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells and organisms; analyze the flow of energy in cells, organisms, and the environment; determine the effectiveness and consequences of asexual or sexual reproduction within a species; research how scientists experimentally determined the role of tRNA, mRNA, and rRNA as agents in peptide formation and present	Biology students at the above mastery level in content of science will: investigate the chemistry of cellular processes and biological molecules and relate variations in structures to efficiencies of functions in various cells and organisms; quantitatively analyze and explain the flow of energy in cells, organisms, and the environment; analyze cellular reproduction processes and use Mendel's Laws of Genetics to explain variations within species; create and use DNA and RNA models to explain protein synthesis and mutations, and research various genetic engineering technologies	Biology students at the mastery level in content of science will: investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms, and viruses; analyze the flow of energy in cells, organisms, and the environment; analyze cellular reproduction processes and determine probable offspring by applying Mendel's Laws of Genetics; use DNA and RNA models to explain protein synthesis, mutations, and gene therapy, and	Biology students at the partial mastery level in content of science will: describe the chemistry of cellular processes and biological molecules and relate structure to function in various cells and organisms; diagram and describe the flow of energy in cells, organisms, and the environment; describe cellular reproduction processes and use Punnett squares to predict outcomes for monohybrid crosses; use DNA and RNA models to explain replication, transcription and translation, and	Biology students at the novice level in content of science will: describe the chemistry of cellular processes and biological molecules and define the structures and functions of various cells and organisms; diagram the flow of energy in cells, organisms, and the environment; identify the products of cellular reproduction processes and use Punnett squares to predict outcomes for monohybrid crosses; identify DNA and RNA models and define replication, transcription, and translation, and

arguments regarding the potential use and abuse of specific genetic engineering technologies, and research various biomes, analyze the interrelationships of organisms and explain factors the affect coevolution.	as potential solutions to real world problems, and determine how changing environmental factors disrupt the interrelationships of organisms and affect the carrying capacity of an ecosystem.	determine how changing environmental factors disrupt the interrelationships of organisms within an ecosystem and alter energy flow.	describe how abiotic variables determine an ecosystem and identify interrelationships between organisms.	list biotic and abiotic variables within an ecosystem and identify interrelationships between organisms.

Objectives	Students will
SC.O.B.2.1	investigate and correlate the properties of chemical and biological molecules to their function in biochemical pathways.
SC.O.B.2.2	relate the structure of cellular organelles to their functions and interactions in eukaryotic cells.
SC.O.B.2.3	compare and contrast cell types • prokaryotic/eukaryotic • plant/animal • archaea/bacteria • various body cells.
SC.O.B.2.4	relate the structure and function of individual body systems to the overall functioning of the organism.
SC.O.B.2.5	predict and assess responses of organisms to internal and environmental stimuli.
SC.O.B.2.6	analyze the chemistry and fluid mosaic model of the cell membrane as they relate to import and export of molecules necessary for life including: • osmosis • diffusion • active transport • passive transport • dialysis.
SC.O.B.2.7	quantitatively analyze the flow of energy through cellular processes: • photosynthesis • cellular respiration

	• fermentation.
SC.O.B.2.8	differentiate mechanisms of homeostasis in living systems (negative and positive feedback).
SC.O.B.2.9	examine the processes of binary fission, mitosis, meiosis and relate them to: • 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	use Punnett squares to predict genotypic and phenotypic ratios by applying Mendel's Laws of Genetics: • in monohybrid and dihybrid crosses • complete dominance • incomplete dominance • codominance • sex-linked traits • multiple alleles.
SC.O.B.2.11	analyze karyotypes and pedigrees as diagnostic tools.
SC.O.B.2.12	construct and use models of DNA to explain replication and mutations.
SC.O.B.2.13	differentiate the structure and function of messenger, transfer and ribosomal RNA in the process of transcription and translation.
SC.O.B.2.14	research and debate the application of DNA technology in the context of social, ethical, and political issues.
SC.O.B.2.15	evaluate the evidence for natural selection including: • speciation • fossil record evidence • molecular similarities • homologous structures.
SC.O.B.2.16	evaluate the influence of the historical social context on the development of evolutionary theory.
SC.O.B.2.17	compare morphological, cladistic and other classification systems including domains, kingdoms and other taxa.
SC.O.B.2.18	justify the placement of viruses in classification systems.
SC.O.B.2.19	examine the cycle of viruses and compare disease prevention: • vaccinations • vector control • 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	analyze interrelationships of organisms within an ecosystem $ competition • predation • Symbiosis • 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	**Conceptual Biology**
Standard: 1	Nature and Application of Science
SC.S.CB.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.CB.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Biology students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for	Conceptual Biology students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on	Conceptual Biology students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and	Conceptual Biology students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and	Conceptual Biology students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on observations and

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 defend their ideas to an authentic audience.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.CB.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.CB.1.2	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 • 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 will: 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; compare and contrast mechanisms of energy flow in cells, organisms, and the environment; determine the effectiveness and predict consequences of asexual and sexual reproduction within a species; trace the history and the importance of the	Conceptual Biology students at the above mastery level in content of science will: analyze the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms and viruses; compare mechanisms of energy flow in cells, organisms and the environment; determine the effectiveness and consequences of asexual and sexual reproduction within a species; trace the history and the importance of DNA and	Conceptual Biology students at the mastery level in content of science will investigate the chemistry of cellular processes and biological molecules and relate structure to function in various cells, organisms, and viruses; analyze the flow of energy in cells, organisms, and the environment; determine the effectiveness of asexual and sexual reproduction within a species; trace the history and the importance of DNA and	Conceptual Biology students at the partial mastery level in content of science will: describe the chemistry of cellular process and biological molecules, as they relate to function in various cells, organisms and virus; diagram the flow of energy in cells, organisms and the environment; compare sexual and asexual reproduction; create a monohybrid cross with a Punnett square;	Conceptual Biology students at the novice level will in content of science will: recognize different types of cells; identify that energy input is necessary for all living things; characterize sexual and asexual reproduction; complete a simple monohybrid Punnett

discovery of DNA and RNA structures as they relate to the development modern biological innovations in science;	RNA structures as they relate to modern biological science;	RNA structures as they relate to everyday life;		square;
relate disease controls measures to the viral cycle;	explain events of the viral cycle as they relate to disease transmission;	predict outcomes from populations applying Mendel's laws;	recognize the structure of DNA and RNA;	recognize the general structure of DNA;
apply genetic principles to predict and calculate population variances and sustainability of ecosystems, and	apply genetic principles to predict long range outcomes of populations, and	relate viral cycle to disease control, and	make connections between viral cycles and disease control, and	relate viruses to the diseases they cause, and
manipulate multiple variables to determine environmental effects and analyze the interdependence of organisms.	manipulate multiple variables and analyze changes to determine the interdependence of organisms and their environment.	use modern evidence to predict and analyze changes in populations as they determine the interdependence of organisms.	recognize variables affecting interactions of organisms, and identify factors causing changes in populations with their environment.	recognize changes in organisms, populations, 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: • prokaryotic/eukaryotic • plant/animal • various body cells.
SC.O.CB.2.4	incorporate the structure and function of individual body systems to the overall functioning of the organism.
SC.O.CB.2.5	• predict and assess responses of organisms to internal and environmental stimuli: • homeostasis metabolism • cyclic behaviors.
SC.O.CB.2.6	correlate the properties of molecules to their movement through biological membranes:

	• osmosis • diffusion.
SC.O.CB.2.7	analyze the flow of energy through cellular processes: • 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: • 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: • 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 • 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	examine the cycle of viruses and compare disease prevention; • 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 species 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	predict the effects of human activities on biogeochemical cycles of matter and energy in the biosphere over time: • 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**
Standard: 1	Nature and Application of Science
SC.S.BII.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.BII.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology II students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on	Biology II students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence,	Biology II students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and	Biology II students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and	Biology II students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and

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.	and 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.	relate science-technology-societal issues while using a variety of sources to construct their 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 • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives; demonstrate an understanding of the interrelationships among physics, chemistry, biology and the earth and space sciences. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.			
Performance Descriptors SC.PD.BII.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Biology II students at the distinguished level will: analyze how size, shape and functional group determines the unique properties of organic molecules; analyze energy flow of cellular processes and evaluate other compounds with water-like properties and predict whether or not those compounds can be substituted for water in biological systems; design multiple generation investigations for the application of Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities; research and design investigations using the	Biology II students at the above mastery level will: correlate size, shape and functional group to unique properties of organic molecules to biochemical pathways; analyze the interrelationships of energy cycles in different systems and how they affect the energy flow to entropy; design investigations for the application of Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities; research and use the development of	Biology II students at the mastery level will: correlate functional groups to unique molecules to biochemical pathways; analyze the value of water in the energy cycles of living systems and its importance in biological systems; apply Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities; use the development of technology as it relates to	Biology II students at the below mastery level will: identify the properties of the functional groups of organic molecules found in biochemical pathways; trace the flow of energy in condensation and hydrolysis reactions of organic molecules; understand the application of Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities; recognize the use of technology as it relates to	Biology II students at the novice level will: list the functional groups of organic molecules in biochemical pathways; identify condensation and hydrolysis reactions of organic molecules; identify the application of Mendelian genetics to explanations of phenotypic probabilities and genetic abnormalities; relate the use of technology as it relates to

development of technology as it relates to analyzing chromosomal abnormalities and correcting genetic disorders;	technology as it relates to analyzing chromosomal abnormalities and correcting genetic disorders;	analyzing chromosomal abnormalities and correcting genetic disorders;	analyzing chromosomal abnormalities and correcting genetic disorders;	analyzing chromosomal abnormalities and correcting genetic disorders;
examine the evidence that some viruses cause cancer;	compare and contrast historical and current treatments for varying viral infections;	evaluate treatment of viral diseases based on lytic and lysogenic cycles;	describe the lytic and lysogenic cycles and the treatments of viral diseases;	trace the life cycle of viruses and list of the treatments of viral diseases;
interpret the interrelatedness of living organisms through their characteristics and investigate their structures;	interpret the interrelatedness of living organisms through their characteristics;	classify and analyze living organisms by their characteristics;	describe the differences in living organisms by their characteristics;	list the characteristics of organisms;
explain how the embryonic development of animals provide evidence of a shared ancestry, and	examine the common stages of embryonic development of animals, and	survey embryonic development of animals, and	outline the embryonic development of animals, and	list the embryonic development of animals, and
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	Students will
SC.O.BII.2.1	correlate functional groups to unique properties of organic molecules to biochemical pathways.
SC.O.BII.2.2	describe the transfer of energy during condensation and hydrolysis reactions of organic molecules (e.g., ATP, enzyme substrate and active site).
SC.O.BII.2.3	summarize the electrochemical gradients in various cells and their corresponding environments.

SC.O.BII.2.4	analyze the properties of water and its importance in biological systems: • polarity • solubility • specific heat • pH • and buffers.
SC.O.BII.2.5	examine the flow of energy through specific molecules in: • light dependent and light independent photosynthesis reactions • glycolysis • Kreb's cycle • EPS • fermentation.
SC.O.BII.2.6	interpret important research leading to the current knowledge of molecular genetics: • 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: • 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	predict phenotypic ratios of crosses: • 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	analyze the criteria for classifications of protists: • motility • cellular structures • reproduction • energy sources.
SC.O.BII.2.17	survey the fungi kingdom: • characteristics • reproduction • relationship to humans and the ecosystem.
SC.O.BII.2.18	compare and contrast members of the plant kingdom in terms of their reproductive systems.
SC.O.BII.2.19	compare and contrast members of the animal kingdom in terms of their complexity: • tissues • nervous • digestive systems.
SC.O.BII.2.20	survey embryonic development of animals: • gastrulation • development of different body cavities • and tissues develop from germ layers.
SC.O.BII.2.21	examine types of innate and learned animal behaviors: • 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	Chemistry
Standard: 1	Nature and Application of Science
SC.S.C.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions

Performance Descriptors SC.PD.C.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Chemistry students at the distinguished in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base	Chemistry students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and	Chemistry students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence,	Chemistry students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence,	Chemistry students at novice level in the nature and applications of science will: imple ment safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and

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.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	and relate science-technology-societal issues while using a variety of sources to construct their solutions.	relate science-technology-societal issues while using a variety of sources to 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	**Chemistry**
Standard: 2	Content of Science

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

Performance Descriptors SC.PD.C.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Chemistry students at the distinguished level will: quantitatively determine the identity of a substance using physical properties such as density, melting points, specific heat, etc; draw conclusions from historical development of the periodic table and atomic theory to validate modern theories of bonding; create the correct molecular formula and communicate the correct name for the hydrocarbons construct the appropriate balanced equation for laboratory experiments;	Chemistry students at the above mastery level will: qualitatively identify a substance by its physical and chemical properties; formulate scientific explanations based on historical observations and experimental evidence to explain atomic theory and bonding; generate the correct molecular formula and/or name for binary, ternary and oxy-acids; predict the products, write and classify balanced chemical reactions;	Chemistry students at the mastery level will: classify pure substances by their chemical and physical properties; relate scientific explanations based on historical observations and experimental evidence to explain atomic theory, bonding, structure and periodic trend generate the correct formula and/or name ionic or molecular compounds; write and classify balanced chemical reactions;	Chemistry students at the partial mastery level will: list the physical properties of a given pure substance; research atomic theory to locate an atom on the periodic table and to construct models of elements and compounds; write formulas for/or name simple ionic and molecular compounds write and recognize the types of chemical reactions;	Chemistry students at the novice level will: define pure substances and chemical and physical properties; use the periodic table to produce atomic models; write formulas for/or name simple binary compounds identify the types of chemical reactions;

explain from experimental data and appropriate stoichoimetric applications the limiting reactant, excess reactant, and theoretical yield;	apply stoichiometric principles to various chemical conversions;	perform the following "mole" calculations: molarity, percentage composition, empirical and molecular formula, formulas of hydrates and theoretical yield;	calculate molarity and percentage composition;	calculate basic mole conversions;
determine experimentally the properties of solution;	determine experimentally the effects of temperature, concentration and vapor pressure on solution properties;	determine experimentally the effects of temperature and concentration on solution properties;	determine experimentally the effects of temperature on solution properties and water's role as a solvent;	define solute, solvent and solution
perform gas stoichiometric calculations;	perform calculations using the Ideal Gas equation;	perform calculations using the combined gas laws;	perform calculations using Boyle's, Charles' or Gay-Lussac's Laws;	identify pressure, temperature, and volume units;
conduct a neutralization experiment to construct and interpret a titration curve;	conduct a neutralization experiment to determine an unknown molarity;	compare methods of measuring pH while conducting a neutralization experiment;	define Arrhenius and Brönsted-Lowry acids and select an appropriate indicator given the pH range of a solution;	classify solutions as acidic or basic using pH values;
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: • 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: • solubility, • conductivity, • density and • colligative properties.
SC.O.C.2.13	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: • mass to number of particles, • number of particles to volume, • volume to mass.
SC.O.C.2.16	perform calculations using the combined gas laws.

SC.O.C.2.17	perform the following "mole" calculations showing answers rounded to the correct number of significant figures: • 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	compare methods of measuring pH: • 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**
Standard: 1	Nature and Application of Science
SC.S.CC.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • 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 will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for	Conceptual Chemistry students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on	Conceptual Chemistry students at the mastery level in the nature and applications of science will: will implement safe practices as they design, conduct, and revise experiments and base conclusions on	Conceptual Chemistry students at the partial mastery level in the nature and applications of science will: will implement safe practices as they conduct and revise experiments, then base conclusions on observations and	Conceptual Chemistry students at the novice level in the nature and applications of science will: will implement safe practices as they conduct experiments and base conclusions on observations and

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 defend their ideas to an authentic audience.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to 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 • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.			
Performance Descriptors SC.PD.CC.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Chemistry student at the distinguished level will: design and conduct an investigation to compare the 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; predict the behavior of an ideal gas and compare the behaviors of ideal and real gas; analyze the periodic table to produce and use	Conceptual Chemistry student at the above mastery level will: predict the physical and chemical properties of common objects based on their composition and examine experimentally the methods of separating mixtures; predict the outcome of changing a variable in a gaseous system by applying the kinetic molecular theory; analyze the periodic table to compare chemical	Conceptual Chemistry student at the mastery level will: classify matter as pure substance or mixture by listing physical and chemical properties; use the kinetic molecular theory to explain states of matter and perform calculations using the combined gas laws; analyze the periodic table to predict trends, to	Conceptual Chemistry student at the partial mastery level will: use position on the periodic table to classify elements and chemical and physical properties to classify compounds and mixtures; illustrate the states of matter at the molecular level and perform calculation for Boyle's, Charles' and/or Gay-Lussac's law; use the periodic table to produce an electron	Conceptual Chemistry student at the novice level will: define chemical and physical properties, pure substances and mixtures, metals, nonmetals and metalloids; define states of matter and identify pressure, temperature and volume units; use the periodic table to match an element to its

electron configurations to predict the chemical properties of elements;	properties based on changes in electron configuration for elements in a period, and characterize the properties of the ionic, covalent or metallic substances;	illustrate Lewis' dot structures for representative (main group) elements and to produce and use electron configurations to explain chemical properties;	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;	group and period, to recognize that placement on the periodic table determines the common ionic charge, and to classify elements as metallic or nonmetallic;
generate the correct molecular formula for binary and oxy-acids;	generate the correct formula and/or name for simple ionic and molecular compounds and predict the type of bonding;	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;	predict the type of bonding that occurs between atoms as ionic or covalent;	identify the number of valence electrons in atoms of representative metals and nonmetals;
calculate the enthalpy of reactions from balanced equations;	create balanced equations for the five general types of chemical reactants and classify reactions as exothermic or endothermic reactions;	given the reactants, predict the products, balance the equations for the five general types of chemical reactants and classify reactions as exothermic or endothermic reactions;	given the formulas, place the coefficient to balance chemical equations, and classify reactions as exothermic or endothermic reactions;	identify the type of chemical reaction, and define exothermic and endothermic reactions;
generate complex mole conversions that require three or more conversion factors and perform all calculations that use the mole as a conversion factor;	generate multi-step mole conversions that require three or more conversion factors and perform all calculations that use the mole as a conversion factor;	perform the following "mole" calculations: molarity, percentage composition, empirical and molecular formula, formulas of hydrates and theoretical yield;	write conversion factors and calculate molarity and percentage composition;	define the mole; calculate molar mass;
construct models of	construct models of	construct models to	differentiate among linear,	construct ball and stick

organic molecules and apply electronegativity values and molecular shape to classify the molecules as polar or nonpolar;	organic molecules and apply electronegativity values to classify the bonds as polar or nonpolar;	explain the structure and geometry or organic and inorganic molecules;	trigonal planar, and tetrahedral shapes;	models for simple molecules;
determine experimentally the properties of solution and identify the intermolecular forces;	investigate the solubility of various materials in water and determine experimentally the effects of temperature, concentration and vapor pressure on solution properties;	investigate and explain the water's role as a solvent determine, and experimentally demonstrate the effects of temperature and concentration on solution properties;	describe properties of solutions and illustrate water as a polar molecule;	define solute, solvent and solution, and polarity
conduct a neutralization experiment to construct and interpret a titration curve, and	conduct a neutralization experiment to determine an unknown molarity, and	compare methods of measuring pH while conducting a neutralization experiment, and	define Arrhenius and Brönsted-Lowry acids and select an appropriate indicator given the pH range of a solution, and	classify solutions as acidic or basic using pH values, and
write nuclear equations for fission and fusion reactions.	given the initial isotope, write the decay series until a stable isotope is reached.	given the reactants, write and balance nuclear reactions.	balance nuclear reactions.	define alpha, beta and gamma emissions.

Objectives	Students will
SC.O.CC.2.1	classify pure substances by their chemical and physical properties.
SC.O.CC.2.2	classify examples of matter as pure substance or mixture.
SC.O.CC.2.3	compare and contrast the properties of metals, nonmetals and metalloids.
SC.O.CC.2.4	use the kinetic molecular theory to explain states of matter.
SC.O.CC.2.5	perform calculations using the combined gas laws.
SC.O.CC.2.6	produce and use electron configuration to explain chemical properties of elements.
SC.O.CC.2.7	generate the correct formula and/or name for ionic and molecular compounds.

SC.O.CC.2.8	predict the type of bonding that occurs between atoms and characterize the properties of the ionic, covalent or metallic bond formed.
SC.O.CC.2.9	given the reactants, anticipate the products and create balanced equations for the five general types of chemical reactions: • synthesis or combination • decomposition • single replacement • double replacement • combustion.
SC.O.CC.2.10	analyze the periodic table to predict trends: • 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: • mass to number of particles • number of particles to volume • or volume to mass.
SC.O.CC.2.13	perform the following "mole" calculations: • molarity • percentage composition • empirical and molecular formula • formulas of hydrates • theoretical yields.
SC.O.CC.2.14	construct models to explain the structure and geometry of organic and inorganic molecules and the lattice structures of crystals.
SC.O.CC.2.15	determine experimentally the effects of temperature and concentration on solution properties • solubility • conductivity • density • colligative properties.
SC.O.CC.2.16	compare methods of measuring pH:

	• 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.
SC.O.CC.2.20	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 • 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	Mastery	Partial Mastery	Novice
Chemistry II students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world	Chemistry II students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors,	Chemistry II students at the mastery level will in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on	Chemistry II students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on	Chemistry II students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on

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 defend their ideas to an authentic audience.	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.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.	observations and experimental evidence, and relate science-technology-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 • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental sciences and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.CII.2

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Chemistry II students at the distinguished level will: utilize VSEPR theory to make predictions about valence bonds that can be used to compare and contrast binding forces; justify the ideal gas laws on the basis of the kinetic-molecular theory; predict theoretical yield, limiting reactant, excess reactant, percent yield, and experimental error from a designed experiment that includes the appropriate stoichiometric applications;	Chemistry II students at the above mastery level will: utilize VSEPR theory to explain valence bonding; and the types of binding forces; assess the ideal gas laws on the basis of the kinetic-molecular theory; explain from experimental data and appropriate stoichoimetric applications the limiting reactant, excess reactant, and theoretical yield;	Chemistry II students at the mastery level will: investigate valence bonds and binding forces; interpret the ideal gas laws on the basis of the kinetic-molecular theory; perform stoichiometric calculations utilizing Avogadro's concepts, significant figures, and mathematical applications for molar mass, theoretical yield, and limiting reactant;	Chemistry II students at the partial mastery level will: match types of bonding forces including all that contain valence bonds; explain the ideal gas laws on the basis of the kinetic-molecular theory; perform stoichiometric calculations utilizing Avogadro's concepts, significant figures, and mathematical applications for molar mass, theoretical yield, and limiting reactant;	Chemistry II students at the novice level will: describe valence bonds and types of binding forces; state the ideal gas laws and describe their basis on kinetic molecular theory; calculate theoretical yield that is expressed in correct significant figures and determine the molar mass, theoretical yield, and limiting reactant;

design an experiment to illustrate the effect of changing concentration on the colligative properties of solutions, change of state, and molar mass;	evaluate experiments that effect colligative properties and states of matter by changing concentration;	explain by concentration calculations the effect of changing concentration on the colligative properties of solutions and on changes of state;	calculate molar mass and concentration then describe the effect of changing concentration on colligative properties and change of state:	match molar mass and the effect of concentration changes on colligative properties and changes of state;
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;	illustrate physical and chemical dynamic equilibrium concepts by calculating equilibrium constants and applying Le Chatelier's principle to predict system change:	explain the physical and chemical dynamic equilibrium concepts through calculation of equilibrium constants and application of Le Chatelier's principle;	describe the physical and chemical dynamic equilibrium concepts that include the calculation of equilibrium constants and Le Chatelier's principle;	define physical and chemical dynamic equilibrium concepts, equilibrium constants and Le Chatelier's principle;
design an effective battery using the voltage calculated from the Nernst equation;	predict the voltage using the Nernst equation and use this to compare chemical cells;	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;	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;	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;
design and conduct experiments to collect and graphically analyze data to investigate reaction rate and predict reactant order;	demonstrate reactant order, rate constants, reaction rate laws, rate calculations and predict the effect of temperature on rate changes;	determine reactant order, rate constants, and reaction rate laws using rate calculation and describe the effect of temperature on rate changes;	estimate reactant order using rate constants, reaction rate laws, rate calculations, and temperature's influence on rate changes;	match reactant order, rate constants, or reaction rate laws, calculate the rate of reaction and describe the effect of temperature on rate changes;
design and conduct experiments to	demonstrate experimentally and	determine the heat of formation, heat of	state the second law of thermodynamics and	identify Hess's Law and the dependence of free

experimentally and mathematically demonstrate the first and second law of thermodynamics including the reaction spontaneity;	mathematically applications of Hess's Law, spontaneous reactions, and the second law of thermodynamics;	reaction, heat of vaporization and heat of fusion while using applications of Hess's Law and use the second law of thermodynamics;	applications of Hess's Law that include calculations of the free energy of formation and the free energy of reaction;	energy on enthalpy and entropy changes:
calculate and explain the relationships among weak acids, pH, pOH, pK, K_a, K_b, K_w, ionization constants, and percent ionization, K_{sp};	explain weak electrolytes, ionization constants, and percent ionization;	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;	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;	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;
prove the presence of specific cations and anions in an unknown mixture through experimental data;	design a qualitative analysis for an unknown mixture;	analyze a solution that contains known cations and a solution that contains known anions;	construct a data table for cation and anion analysis;	identify the colors of specific cation and anion precipitates;
solve complex problems involving radioactive decay and write nuclear equations for decay, fission, and fusion;	investigate the similarities and differences between radioactive processes, nuclear fission, and fusion;	express radioactive decay in an equation format and solve simple problems for the half-life of an isotope;	categorize by using the properties of the different types of radiation emitted during radioactive decay;	identify a nuclear equation and generally describe radioactive decay;
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 titration curve, and	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 system, and	identify the components of a buffer and the use of buffers, and	identify salts that undergo hydrolysis and match the reaction for the ion with water; interpret a titration curve to identify the equivalence point, and	identify the equivalence point on a titration curve, and

evaluate organic structures and compounds based on functional groups.	differentiate, classify and characterize simple organic functional groups and compounds.	recognize and classify simple organic functional groups.	identify simple organic functional groups and compounds.	match simple organic functional groups and compounds.

Objectives	Students will
SC.O.CII.2.1	identify types of binding forces such as: • ionic • covalent • metallic • van der Waals forces (including London) and relate binding forces to state, structure, and properties of matter.
SC.O.CII.2.2	investigate the valence bond including the concepts of: • hybridization of orbitals • resonance • formation of sigma and pi bonds and demonstrate an understanding of the VSEPR theory.
SC.O.CII.2.3	apply the principles of chemical reactivity, products of chemical reactions, and relationships on periodic table to predict the ions in a descriptive chemistry experiment.
SC.O.CII.2.4	interpret the ideal gas laws on the basis of the kinetic-molecular theory.
SC.O.CII.2.5	relate Avogadro's hypothesis and its relation to the mole concept.
SC.O.CII.2.6	define changes of state, including critical temperatures and triple points, based on the kinetic molecular theory.
SC.O.CII.2.7	calculate concentration and explain the effect of changing concentration on the colligative properties of solutions.
SC.O.CII.2.8	identify oxidation numbers for ions and for any element in a compound to calculate the electron movement in a redox reaction and calculate the voltage using the Nernst equation.
SC.O.CII.2.9	explain physical and chemical dynamic concepts; calculate equilibrium constants K_p, K_c, K_{sp}, K_a, and apply Le Chatelier's principle.
SC.O.CII.2.10	use experimental data and graphical analysis to determine reactant order, rate constants, and reaction rate laws, calculate the rate of reaction and explain the effect of temperature on rate changes.
SC.O.CII.2.11	determine the heat of formation, heat of reaction, heat of vaporization and heat of fusion; apply Hess's Law.
SC.O.CII.2.12	using the second law of thermodynamics, calculate the free energy of formation, free energy of reaction and the dependence of free energy on enthalpy and entropy changes.
SC.O.CII.2.13	perform all calculations with attention given to significant figures, precision of measured values, and the use of logarithmic

	and exponential relationships.
SC.O.CII.2.14	calculate molar masses from gas density, freezing-point, and boiling-point measurements.
SC.O.CII.2.15	experimentally determine the properties of acids: • identify weak electrolytes; • define pH, pOH, pK, K_a, K_b, K_w, ionization constant, percent ionization, K_{sp}; • calculate pH and pOH; • measure pH with indicator papers and electronic meters; • recognize salts that undergo hydrolysis • write a reaction for the ion with water • interpret a titration curve to identify the equivalence point and • calculate the range of a buffer.
SC.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, 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	**Earth Science**
Standard: 1	Nature and Application of Science
SC.S.ES.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions

Performance Descriptors SC.PD.ES.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Earth Science students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on	Earth Science students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence,	Earth Science students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and	Earth Science students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and	Earth Science students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and

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.	and 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.	relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.ES.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.ES.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.ES.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.ES.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.ES.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.ES.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.ES.1.7	given current science-technology-societal issues, construct and defend potential solutions.
SC.O.ES.1.8	relate societal, cultural and economic issues to key scientific innovations.
SC.O.ES.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	**Earth Science**
Standard: 2	Content of Science

SC.S.ES.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.			
Performance Descriptors SC.PD.ES.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Earth Science students at the distinguished level of science content will: investigate and evaluate geological evidence related to the structures, origin, and 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;	Earth Science students at the above mastery level of science content will: investigate and analyze geological evidence related to the structures, origin, and 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;	Earth Science students at the mastery level of science content will: investigate geological evidence related to the structures, origin, and age 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;	Earth Science students at the partial mastery level of science content will: will describe geological structures and the origin and age of the Earth; 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;	Earth Science students at the novice level of science content will: identify Earth's structures and state the age of the Earth; 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;

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.	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.	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.	use diagrams and models to explain the movements and composition of structures within the solar system and universe, and research and describe factors related to ecological, economical, and societal conflicts.	use diagrams and models to identify structures within the solar system and universe, and list ecological, economical, and societal conflicts related to Earth Science.

Objectives	Students will
SC.O.ES.2.1	identify and describe the structure, origin, and evolution of the lithosphere, hydrosphere, atmosphere and biosphere.
SC.O.ES.2.2	analyze seismic, density, gravity, and magnetic data to explain the structure of the earth.
SC.O.ES.2.3	characterize the eras, epochs and periods in relation to earth history and geologic development.
SC.O.ES.2.4	analyze radiometric dating and rock and fossil evidence to determine the age of substances.
SC.O.ES.2.5	use chemical and physical properties to distinguish between common minerals and explain their economic uses.
SC.O.ES.2.6	use rock characteristics to predict paleoenvironments or geologic conditions which existed during the formation of a given rock sample.
SC.O.ES.2.7	investigate and describe the properties of water, which contribute to its critical role in physical and chemical weathering.
SC.O.ES.2.8	compare and contrast the effectiveness of agents and processes of degradation: • 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: • 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: • 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. • ocean crust • sedimentation • active and passive continental margins.
SC.O.ES.2.17	examine the stratification of the oceans: • temperature • salinity zones • biological zones.
SC.O.ES.2.18	investigate to explain heat transfer in the atmosphere and its relationship to meteorological processes: • 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:: • air masses • wind • barometric pressure • temperature data.

SC.O.ES.2.21	examine global change over time: • climatic trends • global warming • ozone depletion.
SC.O.ES.2.22	apply Newton's Law of Universal Gravitation to the motion of celestial objects to explain phenomenon observed in the sun-earth-moon system.
SC.O.ES.2.23	analyze several origin theories of the solar system and universe and use them to explain the celestial bodies and their movements.
SC.O.ES.2.24	compare ancient and modern methods of studying and uses for astronomy • calendar • navigation.
SC.O.ES.2.25	Use various wavelengths of the electromagnetic spectrum to investigate the observable universe.
SC.O.ES.2.26	compare the relationship between earth processes and natural disasters with their impact on humans.
SC.O.ES.2.27	evaluate the potential conflicts, which arise between societal reliance on natural resources and the need to act as responsible stewards to reclaim the earth, including disposal of hazardous and non-hazardous waste.
SC.O.ES.2.28	research alternative energy sources and evaluate the ecological, environmental and economic cost-benefit ratio.

Environmental Science Content Standards and Objectives

Environmental Science is an elective, advanced level lab course which builds on foundational knowledge of the chemical, physical, biological, geological processes and focuses on the natural world. Through an inquiry-based program of study, all students will demonstrate environmental literacy as they explore the economic, social, political, and ecological interdependence in urban and rural areas. Students will synthesize information and experiences across disciplines as they acquire knowledge, values, and skills needed to protect and improve the environment. 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. 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	**Environmental Science**
Standard: 1	Nature and Application of Science
SC.S.ENV.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.ENV.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Environmental students at the distinguished level in the nature and application of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base conclusions on	Environmental students at the above mastery level in the nature and application of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and experimental evidence,	Environmental students at the mastery level in the nature and application of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence, and	Environmental students at the partial mastery level in the nature and application of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence, and	Environmental students at the novice level in the nature and application of science will: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence, and

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.	and 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.	relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.ENV.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.ENV.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.ENV.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.ENV.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.ENV.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.ENV.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.ENV.1.7	given current science-technology-societal issues, construct and defend potential solutions.
SC.O.ENV.1.8	relate societal, cultural and economic issues to key scientific innovations.
SC.O.ENV.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	**Environmental Science**
Standard: 2	Content of Science
SC.S.ENV.2	Students will

	• demonstrate knowledge understanding and applications of scientific facts, concepts, principles, theories, and models delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science, and astronomy; and apply knowledge, understanding and skills of science subject matter/concepts to daily life.

Performance Descriptors SC.PD.ENV.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Environmental students at the distinguished level will: analyze natural and human influences on the rate elements cycle through the ecosphere; predict how changes in the availability and use of natural resources will affect society-evaluate costs and benefits; analyze population dynamics relative to biodiversity, invasive species, and population growth factors; evaluate impact of various	Environmental students at the above mastery level will: compare and contrast the rate elements cycle through the ecosphere, explain how the chemical components fit biogeochemical cycling; assess how changes in the availability and use of natural resources will affect human activities; research and evaluate legislation protecting ecosystems; critique climate change	Environmental students at the mastery level will: explain biogeochemical cycles describing influences on reaction rates between biological and physical processes; analyze and evaluate energy sources and energy generation and assess how natural resources can be sustained through technological advances; explain factors effecting population dynamics, trace the flow of energy through living systems, assess the effect of invasive species, and compare legislation protecting ecosystems; investigate and explain	Environmental students at the partial mastery level will: describe biogeochemical cycles describing influences on reaction rates; determine the influence of energy production on the availability of renewable and nonrenewable energy sources; explain the effects of biotic and abiotic factors on population dynamics, trace the flow of energy through living systems, and compare legislation protecting ecosystems; describe climates in	Environmental students at the novice level will: diagram cycles of elements in the biogeochemical cycles; describe the use of renewable and nonrenewable energy resources relative to energy production; explain the effects of biotic and abiotic factors on population dynamics, trace the flow of energy through living systems; match biomes to

treaties and laws on society and global systems;	issues and arguments;	climate effects on biomes, and causes of air pollutants, acid rain, ozone layer, greenhouse gases;	various biomes and natural and anthropogenic causes of air pollutants, acid rain, ozone layer, greenhouse gases;	corresponding climates and list causes of air pollutants, acid rain, ozone layer, greenhouse gases;
debate national and international clean water agreements; and	analyze cause and effect relationships of pollutants on surface and ground water resources; and	investigate water sources and pollutants, use GIS to analyze data and model local watersheds, describe wastewater treatment methods, and examine laws to maintain clean water; and	investigate water sources and pollutants, use GIS to gather data and diagram a local watershed, describe wastewater treatment methods, examine laws to maintain clean water; and	recognize water pollution, use maps to identify a local watershed, list wastewater treatment methods, examine national laws to maintain clean water; and
when given a scenario, determine the best solid waste management method, justify the selection.	classify soils by their characteristics and evaluate best practices for agriculture to minimize water pollution.	examine soil characteristics and determine best practices for agriculture and solid waste management.	describe soil characteristics and recommend practices for agriculture.	examine soil characteristics and determine best practices for agriculture and solid waste management.

Objectives	Students will
SC.O.ENV.2.1	compare and contrast the rate elements cycle through the ecosphere, describing natural and human influences on reaction rates: • carbon • nitrogen • phosphorus • oxygen • sulfur.
SC.O.ENV.2.2	explain how the chemical components of biological and physical processes fit in the overall process of biogeochemical cycling such as photosynthesis, respiration, nitrogen fixation, or decomposition.
SC.O.ENV.2.3	analyze and evaluate the use and availability of renewable and nonrenewable energy resources: • coal • solar • biomass

	• biofuels • hydropower • natural gas • wind • geothermal • nuclear.
SC.O.ENV.2.4	evaluate environmental and economic advantages and disadvantages of using nonrenewable and renewable energy.
SC.O.ENV.2.5	differentiate various means of generating electricity in terms of the transformation of energy among forms, the relationship of matter and energy, and efficiency/production of heat energy.
SC.O.ENV.2.6	explain how technology has influenced the sustainability of natural resources over time: • forestry practices • fossil fuels • farming.
SC.O.ENV.2.7	relate logistic, exponential, and irruptive population growth to population dynamics including: • natural selection • predator/prey relationships • reproductive strategies • carrying capacity • limiting factors.
SC.O.ENV.2.8	create food web diagrams to explain how adding and/or removing a species from an ecosystem may affect other organisms and the entire ecosystem.
SC.O.ENV.2.9	evaluate the leading causes of species decline and premature extinction: • habitat destruction and degradation • invasive species • pollution • human population growth • over exploitation.
SC.O.ENV.2.10	analyze biological diversity as it relates to the stability of an ecosystem.
SC.O.ENV.2.11	relate habitat changes to plant and animal populations and climate influences: • variations in habitat size • fragmentation • fluctuation in conditions of abiotic factors • albedo

	• surface temperature.
SC.O.ENV.2.12	compare and contrast legislation and international agreements associated with protecting habitats, ecosystems, and species: • Superfund • Surface Mining Control and Reclamation Act • Wilderness Act • Endangered Species Act • Marine Mammals Act.
SC.O.ENV.2.13	illustrate how changes in wind patterns or ocean temperatures can affect weather in different parts of the world: • El Nino • La Nina • Santa Ana winds.
SC.O.ENV.2.14	identify natural and anthropogenic sources of primary, secondary, and indoor air pollutants and the resulting environmental and health effects.
SC.O.ENV.2.15	explain the formation of acid rain and describe the resulting effect on soil, plants, water, statues, etc.
SC.O.ENV.2.16	identify causes for the thinning of the ozone layer and evaluate the effectiveness of the Montreal Protocol for reducing ozone depletion.
SC.O.ENV.2.17	debate climate changes as it relates to greenhouse gases, human changes in atmospheric concentrations of greenhouse gases, and relevant laws and treaties.
SC.O.ENV.2.18	identify sources, uses, quality, conservation, and global distribution of water.
SC.O.ENV.2.19	create models to show surface and groundwater flows in a local drainage and explain how surface and ground water are related.
SC.O.ENV.2.20	contrast point source and non-point source water pollutants.
SC.O.ENV.2.21	use GIS data to analyze the parameters of a watershed and interpret physical, chemical and biological data as a means of assessing environmental quality.
SC.O.ENV.2.22	examine legislation associated with the protection of water: • Clean Water Act • London Dumping Convention of 1972.
SC.O.ENV.2.23	describe the processes involved and compare different methods of wastewater treatment.
SC.O.ENV.2.24	classify and analyze characteristics of different soil types: • texture • pH • nitrogen

	• phosphorus • potassium.
SC.O.ENV.2.25	analyze best management practices of the agriculture business: • fertilizers • integrated pest management • associated water pollution • irrigation practices.
SC.O.ENV.2.26	research and describe how communities have restored or protected ecosystems: • remediation • mitigation • rehabilitation • reclamation • preservation.
SC.O.ENV.2.27	evaluate solid waste management practices: • recycling • incineration • sanitary landfills • hazardous waste disposal.

Forensic Science Content Standards and Objectives

Forensic Science is an advanced level course that is an elective designed to provide students with hands-on experience in various aspects of a criminal investigation. Utilizing 21st Century skills students will demonstrate proficiency in evidence collection; interpretation and analysis of collected data, maintenance of data integrity, formulation of a conclusion/summary, and succinct communication of findings. -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 science, technology, engineering, and math. 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.

<table>
<tr><td>High School</td><td colspan="5">Forensic Science</td></tr>
<tr><td>Standard: 1</td><td colspan="5">Nature and Application of Science</td></tr>
<tr><td>SC.S.FS.1</td><td colspan="5">Students will
• demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists.
• demonstrate the ability to use the inquiry process to solve problems.
• relate science-technology-societal issues while using a variety of sources to construct and defend their solutions</td></tr>
<tr><td colspan="6">Performance Descriptors SC.PD.FS.1</td></tr>
<tr><td>Distinguished</td><td>Above Mastery</td><td>Mastery</td><td>Partial Mastery</td><td>Novice</td></tr>
<tr><td>Forensic 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</td><td>Forensic 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</td><td>Forensic 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</td><td>Forensic 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</td><td>Forensic 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</td></tr>
</table>

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.	relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.FS.1.1	implement safe procedures and practices when manipulating equipment, materials, organisms, and models.
SC.O.FS.1.2	formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.O.FS.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.FS.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.FS.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.FS.1.6	investigate, compare and design scientific and technological solutions to address personal and societal problems.
SC.O.FS.1.7	given current science-technology-societal issues, construct and defend potential solutions.
SC.O.FS.1.8	relate societal, cultural and economic issues to key scientific innovations.
SC.O.FS.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	**Forensics Science**
Standard: 2	Content of Science
SC.S.FS.2	Students will • demonstrate knowledge understanding and applications of scientific facts, concepts, principles, theories, and models delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, and earth/environmental science; and apply knowledge, understanding and skills of science subject matter/concepts to daily life.

Performance Descriptors SC.PD.FS.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice

Forensic science student at distinguished level of science content:	Forensic science student at advanced mastery level of science content:	Forensic science student at mastery level of science content:	Forensic science student at partial mastery level of science content:	Forensic science student at novice level of science content:
apply conclusions to develop arguments establishing links between a crime and its victim or a crime and its perpetrator;	draw conclusions from the evidence according to the crime scene processing which may establish links between a crime and its victim or a crime and its perpetrator;	interpret the evidence according to the crime scene processing which may establish links between a crime and its victim or a crime and its perpetrator;	classify the evidence according to the crime scene processing which may establish links between a crime and its victim or a crime and its perpetrator;	recognize crime scene processes which enable links to be established between a crime and its victim or a crime and its perpetrator;
establish probative value of the data generated by chemical analysis;	interpret data to identify known and unknown substances and distinguish their effects on organisms and/or the environment;	perform chemical analysis to identify known and unknown substances;	classify the effects of known substances on the human body and their impacts on society and environment using forensic applications;	define the effects of known substances on the human body and their impacts on society and environment using forensic applications;
evaluate testimonial arguments related to the physics used analyze evidence of a crime scene;	draw conclusions from the physics of force, motion, and waves to support testimony related to the evidence of crime scenes;	apply the physics of force, motion, and waves to analyze evidence from crime scenes;	calculate forces and motions and investigate wave interactions in the natural world;	recognize forces, motions, and waves as phenomena which affect the natural world
determine probative value of biotic and abiotic factors which establish the sequence of events, period of time, and/or location of a crime ;	manipulate the variables on the evidence and the crime scene to be affected by biotic and abiotic factors;	investigate the effects of biotic and abiotic factors on the evidence and the crime scene;	explain weathering processes, life cycles, and behaviors of organisms in a local area;	recognize weathering processes and organisms of a local area;
establish probative value of evidence using anatomical structure,	argue the limitations of forensic science as applied to anatomical structures,	perform forensic science techniques on anatomical structures, features, and	recognize that some anatomical structures, features, and fluids are	identify basic anatomical structures, features, and fluids; and

features, and fluids to connect an individual to a crime; and speculate about technological advances and their impact on forensic science careers .	features, and fluids to identify an individual; and analyze the impact of technological advances on forensic careers.	fluids to identify a known or unknown individual; and investigate technological advances and careers in the field of forensics.	common or unique to individuals; and compare technological advances and explore careers in the field of forensics.	 identify technological advances and careers in the field of forensics.

Objectives	Students will
SC.O.FS.2.1	identify evidence which encompasses materials establishing a link between a crime and its victim or a crime and its perpetrator: • impressions (tire, tool, teeth, shoes) • prints (finger, lip, voice) • hair and fiber analysis • drugs and poisons • ballistics • soil and pollen • glass • serology • questioned documents.
SC.O.FS.2.2	distinguish between types of evidence : • testimonial • physical: individual and class • quantitative • qualitative.
SC.O.FS.2.3	analyze modes of transfer and the factors affecting persistence of evidence (Locard's Exchange Principle): • indirect • direct
SC.O.FS.2.4	demonstrate steps of crime scene processing: • Note-taking • Photography • Sketching to scale • Evidence collection • chain of custody.

SC.O.FS.2.5	validate, classify, and analyze fingerprints as individual evidence: • type • pattern • minutiae.
SC.O.FS.2.6	model techniques of collecting and developing prints on various objects and textures: • physical (dusting powders) • chemical (ninhydrin, iodine, cyanoacrylate).
SC.O.FS.2.7	examine the absorption and effects of toxins in the human body: • alcohol • drugs • poisons.
SC.O.FS.2.8	identify known and unknown substances utilizing the techniques of forensic toxicology: • white powders • blood alcohol • over the counter/illicit drugs • gas chromatography charts.
SC.O.FS.2.9	discuss and cite evidence of biological and chemical hazards and their impact on society and the environment: • arson • bombs • bioterrorism • environmental terrorism.
SC.O.FS.2.10	apply forensic entomology to assess a crime scene: • Berlese funnel • life cycles.
SC.O.FS.2.11	analyze bones and teeth as forensic evidence: • type • articulation • origin • sex • age • race • stature • disease/injury.

SC.O.FS.2.12	analyze the composition of blood as evidence: • ABO system • Rh factor • DNA fingerprinting.
SC.O.FS.2.13	investigate forensic applications of chromatography: • inks and dyes • cosmetics • calculation of R_f values.
SC.O.FS.2.14	explore earth science concepts as they relate to forensic science: • rock and mineral identification • classify soils' common constituents in relation to crime scene location.
SC.O.FS.2.15	identify and describe agents and processes of degradation of evidence: • weathering • scavengers.
SC.O.FS.2.16	solve multi-step problems involving velocity, acceleration, net force, and projectile motion during analysis of crime scene: • ballistics • vehicular collisions • blood spatter.
SC.O.FS.2.17	investigate and analyze forensic evidence utilizing optical and acoustical applications
SC.O.FS.2.18	utilize biometric techniques for forensic science investigations: • prints • recognition scans • anthropometry.
SC.O.FS.2.19	research and evaluate technological advances and careers related to the field of forensics.

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	**Human Anatomy and Physiology**
Standard: 1	Nature and Application of Science
SC.S.HAP.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.HAP.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Human Anatomy and Physiology students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems,	Human Anatomy and Physiology students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors,	Human Anatomy and Physiology students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on	Human Anatomy and Physiology students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on	Human Anatomy and Physiology students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on

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 defend their ideas to an authentic audience.	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.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.	observations and experimental evidence, and relate science-technology-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 variances 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	**Human Anatomy and Physiology**			
Standard: 2	Content of Science			
SC.S.HAP.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.			
Performance Descriptors SC.PD.HAP.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Human Anatomy and Physiology students at the distinguished level will: integrate anatomical terms; sequence hierarchal organizational levels; assess interdependency interaction; investigate and explain tissues; integrate form and function within systems and effects of aging and disease; compare/contrast system	Human Anatomy and Physiology students at the above mastery level will: utilize anatomical terms; compare hierarchal organizational levels; distinguish interdependency and interaction; examine tissues; determine form and function relationship within systems and effects of aging and disease; compare system structure	Human Anatomy and Physiology students at the mastery level will: apply anatomical terms; describe hierarchal 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	Human Anatomy and Physiology students at the partial mastery level will: recall anatomical terms; summarize hierarchal organizational levels; discuss interdependency and interaction; classify tissues; determine form and function relationship within systems and effects of aging and disease; recall system structure	Human Anatomy and Physiology students at the novice level will: define anatomical terms; identify hierarchal organizational levels; define interdependency and interaction; identify tissues; identify form and function relationship within systems and effects of aging and disease; describe system structure

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; research effects of synthetic hormones, and research use of stem cells and predict how this may affect disease treatment.	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; research endocrine functions and dysfunctions; explain hormones in reproductive control, and examine stress effects on immunity and research history of disease treatment.	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; incorporate hormones to functions/dysfunctions; outline gametogenesis, fertilization, and development, and assess immune components and research disease progression.	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 hormones and functions; describe oogenesis and spermatogenesis, and diagram immune response and classify factors in disease progression.	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 functions; define mitosis/meiosis; 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: • proximal • dorsal • medial • visceral • superficial • deep.
SC.O.HAP.2.2	describe the organizational levels, interdependency and the interaction of • cells • tissues • organs • organ systems.
SC.O.HAP.2.3	categorize, by structure and function, the various types of human tissue: • muscle • epithelial • connective • nervous.
SC.O.HAP.2.4	relate the structure of the integumentary system to its function as a/an: • 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: • 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	model the muscular system including: • 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	illustrate the structures of the circulatory and lymphatic systems and the function of blood to the role of: • 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	**Physics**
Standard: 1	Nature and Applications of Science
SC.S.P.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.P.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for errors, and base	Physics students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on observations and	Physics students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and experimental evidence,	Physics students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and experimental evidence,	Physics students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on observations and experimental evidence,

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.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	and relate science-technology-societal issues while using a variety of sources to construct their solutions.	and relate science-technology-societal issues while using a variety of sources to construct their solutions.

Objectives	Students will
SC.O.P.1.1	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 • demonstrate knowledge, understanding, and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, and the earth and space sciences. • apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences.

Performance Descriptors SC.PD.P.2				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics students at the distinguished level will: derive formula of best-fit for representation of motion and evaluate methods to solve problems for motion in one and/or two dimensions; create graphical, algebraic and/or trigonometric solutions problems involving vector components and resultants; experimentally verify Newton's Laws of Motion in terms of equilibrium and net force situations with an increasing number of variables; experimentally verify the conservation of energy	Physics students at the above mastery level will: test the theoretical basis of mathematical methods for motion in one and/or two dimensions; create graphical, algebraic and/or trigonometric solutions problems involving vector components and resultants; experimentally verify Newton's Laws of Motion in terms of equilibrium and net force situations; predict the energy and momentum outcomes for	Physics students at the mastery level will: analyze data, construct and interpret graphs, and perform calculations for motion in one and/or two dimensions interpret graphical, algebraic and/or trigonometric solutions to prove the values for vector components and resultants; experimentally verify Newton's Laws of Motion in terms of equilibrium and net forces situations; evaluate the conversation of energy and momentum	Physics students at the partial mastery level will: construct graphs and perform calculations for motion in one and/or two dimensions draw vector solutions; state Newton's Laws of Motion and perform calculations involving equilibrium and net force situations; describe elastic and inelastic collisions;	Physics students at the novice level will: collect data for motion in one- or two-dimensions; define vectors; state Newton's Laws of Motion and express the difference between weight and mass; define the law of conservation of energy;

and momentum and deduce solutions for elastic and inelastic collisions;	elastic and inelastic collisions;	and deduce solutions for elastic and inelastic collisions;		
experimentally and mathematically determine the behavior of fluids in terms of buoyant force, pressure and velocity and apply to everyday object;	experimentally and mathematically determine the behavior of fluids in terms of buoyant force, pressure and velocity;	describe the behavior of fluids in terms of buoyant force, pressure and velocity;	demonstrate the behavior of fluids in terms of buoyant force, pressure and velocity;	define buoyant force, pressure and velocity of fluids;
calculate the apparent frequency caused by Doppler shift and interpret the results;	calculate the apparent frequency caused by Doppler shift;	perform calculations to determine the properties of mechanical and transverse waves in order to research applications of Doppler shift;	define/ label the properties of mechanical and transverse waves and interpret a diagram showing the Doppler effect;	define/ label the properties of mechanical and transverse waves and the Doppler effect;
predict image placement and prove mathematically based upon the properties concave or convex mirrors or lenses, and	predict image placement based upon the properties concave or convex mirrors or lenses, and	apply ray optics diagrams and the lens/mirror equation to solve and justify optics problems, and	experimentally find the image of a lens or mirror using an optics bench and/or a ray diagram, and	define focal point, image, image distance and object distance; and
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.	state Ohm's law and define direct current.
Objectives	Students will			

SC.O.P.2.1	construct and interpret graphs of: • 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: • 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: • 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	**Conceptual Physics**
Standard: 1	Nature and Application of Science
SC.S.CP.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.CP.1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Conceptual Physics students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for	Conceptual Physics students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on	Conceptual Physics students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and	Conceptual Physics students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and	Conceptual Physics students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on observations and

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 defend their ideas to an authentic audience.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence, and. relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to 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	**Conceptual Physics**			
Standard: 2	Content of Science			
SC.S.CP.2	Students will • demonstrate knowledge, understanding and applications of scientific facts, concepts, principles, theories and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, earth/environmental science and astronomy. • apply knowledge, understanding and skills of science subject matter/concepts to daily life\experiences.			
Performance Descriptors SC.PD.CP.2				
Distinguished	Above Mastery	Master	Partial Mastery	Novice
Conceptual Physics students at the distinguished level will: interpret graphs relating distance, velocity and acceleration to time; solve vector problems both graphically and algebraically; apply knowledge of projectile motion to determine horizontal and vertical velocities and/or distances; calculate the net force acting on a two body system and determine the net force acting on the	Conceptual Physics students at the above mastery level will: draw graphs relating distance, velocity and acceleration to time; solve vector problems graphically or algebraically; determine the horizontal and vertical distances of projectile motion; illustrate forces acting on a two body system with a free body diagram and apply Newton's Laws as a	Conceptual Physics students at the mastery level will: compare and contrast distance, velocity and acceleration of moving objects to describe accelerated and non-accelerated motions; solve right triangle vector problems both graphically and algebraically to analyze the motion of a projectile; illustrate forces acting on objects with free body diagrams and interpret Newton's Laws in terms	Conceptual Physics students at the partial mastery level will: define the units distance, velocity and acceleration; solve right triangle vector problems graphically or algebraically and recognize a projectile moves in both horizontal and vertical direction; identify forces acting on an object and state Newton's Laws;	Conceptual Physics students at the novice level will: define distance, velocity and acceleration; draw a right triangle and recognize projectile motion; identify force as a vector and state one of Newton's Laws;

system;	system to explain natural phenomena;	of natural phenomena;		
mathematically verify that mechanical energy is conserved and experimentally determine mechanical advantage of a mechanical system;	calculate kinetic and potential energy and experimentally determine mechanical advantage of a mechanical system;	compare and contrast kinetic and potential energies, deduce work, energy, power and efficiency, and recognize situations where mechanical energy is conserved;	define and give examples of kinetic and potential energies, efficiency in a mechanical system and state the formulas for work, energy and power;	define work, energy and power, stating that energy is conserved within a system;
solve equations for Archimedes' and/or Pascal's principles and apply Bernoulli's principle to everyday object (for example, paint sprayer or perfume bottle);	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);	analyze Archimedes' and Pascal's principles to solve problems involving floating systems and recognize the effects of Bernoulli's principle on fluid motion;	demonstrate Archimede's, Pascal's, and Bernoulli's principles;	recognize that a floating object displaces fluid and state Bernoulli's principle;
interpret a phrase change diagram;	experimentally determine the melting point of a substance and graph the results;	compare and contrast the common temperature scales, convert from one temperature scale to another and evaluate temperature in terms of kinetic energy;	distinguish between heat and temperature;	identify the common temperature scales and their units;
appraise the role of heat transfer and the first law of thermodynamics involved in environmental and energy conservation issues and predict ways to	examine the role of heat transfer and the first law of thermodynamics involved in environmental and energy conservation issues and predict ways of	apply the mechanism of heat transfer and the first law of thermodynamics to environmental and energy conservation issues;	compare and contrast the three methods of heat transfer and state the first law of thermodynamics;	list the three methods of heat transfer and state the Law of Energy Conservation;

eliminating the heat transfer; 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; 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; analyze the applications of colored lights and pigments and relate the concept of polarization to three dimensional viewing, and calculate any variable in a complex circuit using Ohm's Law and compare	eliminating the heat transfer; 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; 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; compare and contrast the applications of colored lights and pigments and analyze the concept of polarization, and calculate any variable in a simple circuit using Ohm's Law and	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; 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; illustrate the applications of colored lights and pigments and examine the concept of polarization, and analyze simple direct current circuits using Ohm's Law and	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; 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; compare primary and secondary colors of light and pigment and sketch the concept of polarization, and relate Ohm's Law to simple circuits; distinguish between direct	label a transverse wave with the parts of the wave, define a standing wave, and define the Doppler shift; define reflection, refraction, diffraction and interference and find the image location involving plane and spherical mirrors on an optical bench; list primary and secondary colors of light and pigment and define polarization, and list and define the variables of Ohm's Law.

and contrast between the flow of electrons in AC and DC circuits.	distinguish between the flow of electrons in AC and DC circuits.	distinguish between AC and DC circuits, describing how AC is converted to DC.	and alternating current.	

Objectives	Students will
SC.O.CP.2.1	solve right triangle vector problems both graphically and algebraically.
SC.O.CP.2.2	compare and contrast distance, velocity and acceleration of moving objects to describe accelerated and non-accelerated motions of a particle from textbook or lab collected data.
SC.O.CP.2.3	analyze the motion of a projectile.
SC.O.CP.2.4	illustrate forces acting on objects with free body diagrams.
SC.O.CP.2.5	interpret Newton's Laws in terms of natural phenomena.
SC.O.CP.2.6	compare and contrast kinetic and potential energies and recognize situations where mechanical energy is conserved.
SC.O.CP.2.7	deduce work, energy, power and efficiency in mechanical systems.
SC.O.CP.2.8	analyze Archimedes' and Pascal's principles to solve problems involving equilibrium and stability of floating systems.
SC.O.CP.2.9	recognize the effects of Bernoulli's principle on fluid motion.
SC.O.CP.2.10	compare and contrast the common temperature scales, convert from one temperature scale to another and evaluate temperature in terms of kinetic energy.
SC.O.CP.2.11	apply the mechanism of heat transfer and relate to environmental and energy conservation issues.
SC.O.CP.2.12	relate the first law of thermodynamics to energy conservation.
SC.O.CP.2.13	compare and contrast sound and light waves using the concepts of reflection, refraction, and interference.
SC.O.CP.2.14	solve problems involving wave speed, frequency and wavelength; determine factors that affect the speed of sound; recognize that the speed of light is a constant.
SC.O.CP.2.15	model the production of a standing wave and propose a practical application of such a wave.
SC.O.CP.2.16	compare the Doppler shift effect for sound and light and point out examples of its occurrences and applications.
SC.O.CP.2.17	diagram image location: • 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.

Physics II Content Standards and Objectives

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

High School	**Physics II**
Standard: 1	Nature and Application of Science
SC.S.PII.1	Students will • demonstrate an understanding of history and nature of science as a human endeavor encompassing the contributions of diverse cultures and scientists. • demonstrate the ability to use the inquiry process to solve problems. • relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.

Performance Descriptors SC.PD.PII,1				
Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
Physics II students at the distinguished level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments to solve real world problems, analyze data for	Physics II students at the above mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments, analyze data for errors, and base conclusions on	Physics II students at the mastery level in the nature and applications of science will: implement safe practices as they design, conduct, and revise experiments and base conclusions on observations and	Physics II students at the partial mastery level in the nature and applications of science will: implement safe practices as they conduct and revise experiments, then base conclusions on observations and	Physics II students at the novice level in the nature and applications of science will: implement safe practices as they conduct experiments and base conclusions on observations and

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 defend their ideas to an authentic audience.	observations and experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct and defend their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to construct their solutions.	experimental evidence, and relate science-technology-societal issues while using a variety of sources to 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	**Physics**			
Standard: 2	Content of Science			
SC.S.PII.2	Students will • demonstrate knowledge, understanding, and applications of scientific facts, concepts, principles, theories, and models as delineated in the objectives. • demonstrate an understanding of the interrelationships among physics, chemistry, biology, and the earth and space sciences. • apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences.			
Performance Descriptors SC.PD.PII.2				
Distinguished	Above Mastery	Master	Partial Mastery	Novice
Physics II students at the distinguished level will: differentiate among linear, quadratic, and inverse relationships found in graphs of motion in terms of position, velocity, acceleration, and time and evaluate data to deduce mathematical relationships involving one and two dimensional motion; critique experiments to verify laws of motion including Newton's Laws, Conservation of Momentum, Conservation of Energy, and rotational motion;	Physics II students at the above mastery level will: compose equations to express the relationships found in graphs of motion in terms of position, velocity, acceleration, and time and summarize data to deduce mathematical relationships involving one and two dimensional motion; design experiments to verify laws of motion including Newton's Laws, Conservation of Momentum, Conservation of Energy, and rotational motion;	Physics II students at the mastery level will: apply graphical analysis to interpret motion in terms of position, velocity, acceleration, and time and use data to deduce mathematical relationships involving one and two dimensional motion; experimentally verify laws of motion including Newton's Laws, Conservation of Momentum, and Conservation of Energy and synthesize concepts of rotational motion from linear motion equations;	Physics II students at the partial mastery level will: will draw motion graphs to show motion in terms of position, velocity, acceleration, and time and use data to deduce mathematical relationships involving one dimensional motion; recognize that laws of motion including Newton's Laws, Conservation of Momentum, and Conservation of Energy can be verified experimentally and contrast the concepts of	Physics II students at the novice level will: measure distance and time to calculate velocity and acceleration and describe mathematical relationships involving one dimensional motion; perform experiments on motion topics including Newton's Laws, Conservation of Momentum, and Conservation of Energy and define the concepts of rotational motion;

			linear and 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;	apply Pascal's Archimedes', and Bernoulli's, principles in everyday situations;	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;	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;	relate electric fields to electric forces and distinguish between them;	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, diagram and evaluate simple electrical circuits;	construct and diagram simple electrical circuits;
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;	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;	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;	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;	relate magnetism to electric charge and electricity;
critique electromagnetic induction and justify its	critique electromagnetic induction and evaluate its	critique electromagnetic induction and evaluate its application to electric	apply electromagnetic induction to electric circuits and various	describe electromagnetic induction;

application to particular electric circuits and various devices;	application to electric circuits and various devices;	circuits and various devices;	devices;	
investigate, analyze, and evaluate the concepts of solid-state physics and the application of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits;	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;	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;	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;	investigate the applications of semiconductors and superconductors in the advancement of electronics through the development of diodes, transistors, and integrated circuits;
assess the kinetic and potential energies and energy transformations of different oscillating systems;	compare and contrast the kinetic and potential energies and energy transformations of different oscillating systems;	apply knowledge of simple harmonic motion to calculate the kinetic and potential energies of the oscillating system;	calculate the kinetic and potential energies of the oscillating system;	calculate the kinetic and/or potential energies of the oscillating system;
evaluate wave properties and their interactions, predicting how optical and acoustical devices will incorporate new materials to improve their effectiveness;	analyze optical and acoustical devices for their effective application of wave properties and their interactions;	examine wave properties and their interactions to evaluate their application in the development of optical and acoustical devices;	review wave properties and their interactions while researching their application to the development of optical and acoustical devices;	list optical and acoustical devices and identify the property that is the basis of the device;
appraise the role of technology in the development of historical models of the atom and	analyze the role of technology in the development of historical models of the atom and	examine and critique the role of technology in the development of historical models of the atom and	research the development of historical models of the atom and describe evidence for the historical	arrange the models of the atom historically and list evidence for the historical development of the

critique evidence for the historical development of the quantum mechanical theory; justify an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present, and categorize nuclei based on their placement on the periodic table and proton to neutron ratio to demonstrate different types of decay processes.	categorize evidence for the historical development of the quantum mechanical theory; analyze an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present, and using the proton to neutron ratio, predict the type of nuclear decay that could occur for nuclei.	evidence of the quantum mechanical theory; calculate an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present, and differentiate between stable and nuclear nuclei, and if the nucleus is unstable predict the type(s) of nuclear decay.	development of the quantum mechanical theory; 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.	quantum mechanical theory; calculate an atom's binding energy, and define stable and unstable nuclei and list types of decay that the unstable nuclei could display.

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

	• torque.
SC.O.PII.2.5	predict and verify the effect of variables on the properties and dynamics of fluids.
SC.O.PII.2.6	interpret and apply concepts of thermal physics: • 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: • 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: • springs • pendulums • other oscillating objects.
SC.O.PII.2.13	examine wave properties and their interactions: • 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: • radioactivity • atomic spectra • particle accelerators, etc.
SC.O.PII.2.16	examine evidence for the historical development of the quantum mechanical theory: • Planck's blackbody radiation • Einstein's photoelectric effect • deBroglie's duality.
SC.O.PII.2.17	calculate an atom's binding energy as related to Einstein's special theory of relativity, and interpret the nuclear forces present.
SC.O.PII.2.18	differentiate between stable and unstable nuclei, and if the nucleus is unstable predict the type(s) of nuclear decay.

126CSR44R

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

COMMENT PERIOD ENDS: August 12, 2013

COMMENT RESPONSE FORM

NOTICE: Comments, as submitted, shall be filed with the West Virginia Secretary of State's Office and open for public inspection and copying for a period of not less than five years.

The following form is provided to assist those who choose to comment on Policy ####: (Name of Policy). Additional sheets may be attached, if necessary.

Name: _____ Organization: _____

Title: _____

City: _____ State: _____

Please check the box below that best describes your role.

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

COMMENTS/SUGGESTIONS
§126-44R-1. General.
§126-44R-2. Purpose.

§126-44R-3. Incorporation by Reference.
§126-44R-4. Summary of the Content Standards and Objectives

Please direct all comments to:

Robin Anglin Sizemore, Science Coordinator
Office of Instruction
West Virginia Department of Education
Capitol Building 6, Room 617
1900 Kanawha Boulevard, East
Charleston, West Virginia 25305-0330
E-Mail Address: ranglin@access.k12.wv.us
Fax No.: (304) 558-1834.