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SCIENCE – POLICY 2520.3

The science content standards identify what students should know, understand and be able to do in the natural sciences throughout their K-12 education. 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.

Doing Science:
* Standard 1 - History and Nature of Science
* Standard 2 - Science as Inquiry

Knowing Science:
* Standard 3 - Unifying Themes
* Standard 4 - Science Subject Matter/Concepts

Context of Science:
* Standard 5 - Scientific Design and Application
* Standard 6 - Science in Personal and Social Perspectives

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

Standard 1: History and the 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.

Standard 2: Science as Inquiry

Science is a process of discovery. 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. 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 3: Unifying Themes

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.

Standard 4: Science Subject Matter/Concepts

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 5: Scientific Design and Application

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.

Standard 6: Science in Personal and Social Perspectives

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

The Role of Technology

West Virginia's vision for education includes the integration of technology throughout the curriculum so that all West Virginia students have the opportunity to develop technology skills that support learning. 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-10 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-10. Students in the 11th and 12th grades participate in advanced in-depth laboratory-based elective courses designed to expand their conceptual understanding and enhance their research and laboratory skills.

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Science Content Standards K-12

Standard 1: History and the Nature of Science (SC.S.1)
Students will:

- demonstrate an understanding of the history of science and the evolvement of scientific knowledge,
- demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists, and
- demonstrate an understanding of the nature of science.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

- demonstrate the abilities necessary to do scientific inquiry,
- demonstrate understanding about scientific inquiry, and
- demonstrate the ability to think and act as scientists by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Standard 3: Unifying Themes (SC.S.3)
Students will:

- demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order, and organization; evidence, models, and explanation; constancy, change and measurement; equilibrium and evolution; form and function),
- demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes, and
- demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Standard 4: Science Subject Matter/Concepts (SC.S.4)
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, and
- apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Standard 5: Scientific Design and Application (SC.S.5)
Students will:

- demonstrate an understanding of the interdependence between science and technology,
- demonstrate the ability to distinguish between natural and man-made objects,
- demonstrate abilities of technological design, and
- demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:

- demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues,
- demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices,
- predict the long-term societal impact of specific health, population, resource and environmental practices, and
- demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

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Kindergarten Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Kindergarten objectives emphasize the process skills. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the physical sciences, the life sciences and the earth and space sciences. 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% of the instructional time to develop conceptual understanding and research/laboratory skills. CATS Kindergarten enhances the child's natural curiosity about the environment and augments the awe and wonder of inquiries and discoveries using the senses and by hands-on manipulation of objects to build a strong foundation of concepts blended with safety principles. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:

- demonstrate an understanding of the history of science and the evolvement of scientific knowledge,
- demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists, and
- demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:
SC.K.1.1 ask questions about themselves and their world.
SC.K.1.2 listen to stories about the lives and discoveries of scientists.

Performance Descriptors (SC.PD.K.1)

- **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students construct questions about the lives and discoveries of scientists after listening to stories.
- **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students retell in their own words stories about scientists' lives and discoveries after listening to stories.
- **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students sequence pictures representing stories about scientists' lives and discoveries.
- **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omission in **history and the nature of science**. Performance needs further development. Students cite facts about scientists' lives and discoveries after listening to stories.
- **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science**. Performance needs considerable development. Students seldom cite facts about scientists' lives and discoveries after listening to stories.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquires,
* demonstrate understanding about scientific inquiry, and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:

SC.K.2.1 demonstrate curiosity, initiative and creativity by asking questions about the environment noting patterns and variations of natural objects (e.g., trees, leaves, animal structures).
SC.K.2.2 explore and describe objects and events using the five senses to develop observational skills and make predictions based on personal observation.
SC.K.2.3 use scientific instruments and everyday materials to investigate the natural world (e.g., hand lens, balance, magnets).
SC.K.2.4 use safe and proper techniques for handling, manipulating and caring for science materials (e.g., follow safety rules, maintain a clean work area, treat living organisms humanely).
SC.K.2.5 collect and record information in a variety of ways (e.g., drawings, weather calendar, graphs).

Performance Descriptors (SC.PD.K.2)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students explore and describe objects and events using the five senses. Students select questions based on observed patterns and select predictions based on observations. Students explain scientific instruments used to investigate the natural world. Students use safety rules, and use safe and proper techniques for handling, manipulating and caring for science materials.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students describe objects and events using the five senses. Students connect questions to observed patterns and connect predictions to observations. Students use scientific instruments to investigate the natural world. Students interpret safety rules, and demonstrate safe and proper techniques for handling, manipulating and caring for science materials.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students explore and describe objects using the five senses. Students explore questions based on observed patterns and explore predictions based on observations. Students describe scientific instruments used to investigate the natural world. Students give examples of safety rules, and give examples of safe and proper techniques for handling, manipulating and caring for science materials.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omission in **science as inquiry**. Performance needs further development. Students describe objects using the five senses. Students make questions based on observed patterns and make predictions based on observations. Students identify scientific instruments used to investigate the natural world. Students state safety rules, and state safe and proper techniques for handling, manipulating and caring for science materials.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and

skills, characterized by fragmented and incomplete performance in **science as inquiry**. Performance needs considerable development. Students seldom describe objects using the five senses. Students seldom make questions based on observed patterns and seldom make predictions based on observations. Students seldom identify scientific instruments used to investigate the natural world. Students seldom state safety rules, and seldom state safe and proper techniques for handling, manipulating and caring for science materials.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change, and measurement; equilibrium and evolution; form and function),
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models and changes, and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

SC.K.3.1 recognize that models are representations of real things.

SC.K.3.2 observe that change occurs gradually, repetitively, or randomly within the environment.

Performance Descriptors (SC.PD.K.3)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students draw conclusions about change that occurs gradually, repetitively, or randomly within the environment. Students create models that represent real things.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students illustrate change that occurs gradually, repetitively or randomly within the environment. Students explain models that represent real things.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students explain that change occurs gradually, repetitively, or randomly within the environment. Students match models with the real things they represent.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omission in **unifying themes of science**. Performance needs further development. Students state that change occurs gradually, repetitively, or randomly within the environment. Students relate models with the real things they represent.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science**. Performance needs considerable development. Students seldom state that change occurs gradually, repetitively, or randomly within the environment. Students seldom relate models with the real things they represent.

Standard 4: Science Subject Matter/Concepts (SC.S.4)
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, and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives
Students will:
Characteristics of Organisms
SC.K.4.1 using the five senses, identify living and non-living things.
Life Cycles of Organisms
SC.K.4.2 observe the movement, growth and changes in plants and animals.
Organisms and Environments
SC.K.4.3 observe models of plants and animals in different environments (e.g., terrariums, aquariums, animals and plants in a forest, pond, field).
Properties of Objects and Materials
SC.K.4.4 describe, compare, sort and group objects in terms of what they are made of (clay, cloth, paper, metal, etc.) and their physical properties of size, shape, color, weight or texture.
SC.K.4.5 identify liquids and solids.
Light, Heat, Electricity and Magnetism
SC.K.4.6 identify colors.
SC.K.4.7 explore changes in energy (e.g., hot/cold and light/dark).
SC.K.4.8 explore magnetic properties of objects.
Position and Motion of Objects
SC.K.4.9 explore the different ways objects can be moved (e.g., straight, circular, fast, slow).
Changes in Earth and Sky
SC.K.4.10 observe and record daily changes in weather (e.g., clouds, air temperature).
Objects in the Sky
SC.K.4.11 identify objects in the day and night sky (e.g., moon, stars, sun).
Properties of Earth Materials
SC.K.4.12 observe and compare differences in earth materials.

Performance Descriptors (SC.PD.K.4)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students relate scientific facts, concepts, principles, theories and models to daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

  Characteristics of Organisms
  Life Cycles of Organisms
  Organisms and Environments
  Properties of Objects and Materials
  Light, Heat, Electricity and Magnetism
  Position and Motion of Objects
  Changes in Earth and Sky
  Objects in the Sky
  Properties of Earth Materials

  Students apply interconnections among the above categories.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students interpret scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students summarize interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students discuss scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students describe interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omission in **science subject matter/concepts**. Performance needs further development. Students identify scientific facts, concepts, principles, theories and models found in daily life experiences. Students demonstrate knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students recognize interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts**. Performance needs considerable development. Students seldom identify scientific facts, concepts, principles, theories and models found in daily life experiences.

Students seldom demonstrate knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students seldom match interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)
Students will:

* demonstrate an understanding of the interdependence between science and technology,
* demonstrate the ability to distinguish between natural and man-made objects,
* demonstrate abilities of technological design, and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives.
Students will:
SC.K.5.1 observe the uses of tools and appliances at home and at play.

Performance Descriptors (SC.PD.K.5)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students classify tools and appliances used at home and at play.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students give examples of tools and appliances used at home and at play.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students describe how tools and appliances are used at home and at play.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omission in **scientific design and application**. Performance needs further development. Students identify tools and appliances used at home and at play.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application**. Performance needs considerable development. Students seldom identify tools and appliances used at home and at play.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues,
* demonstrate the ability to evaluate the impact of different points of view on health, population,

resource and environmental practices,
* predict the long-term societal impact of specific health, population, resource and environmental practices, and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives.
Students will:
SC.K.6.1 work in groups, listen to and be tolerant of different viewpoints.

Performance Descriptors (SC.PD.K.6)
* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students work in groups, listen to and discover different viewpoints.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students work in groups, listen to and explore different viewpoints.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students work in groups, listen to and give examples of different viewpoints.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omission in **science in personal and social perspectives**. Performance needs further development. Students listen to and recognize different viewpoints.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives**. Performance needs considerable development. Students seldom listen to and seldom recognize different viewpoints.

First Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) One objectives build on the process skills and add data gathering and reporting. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the fields of biology, chemistry, physics, and earth and space sciences. 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% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated in all activities. CATS One continues the excitement of learning about the natural world and allows the beginning of experimentation and data collection to emphasize the tools of science and the properties of matter. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

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Standard 1: History and the Nature of Science (SC.S.1)
Students will:

- demonstrate an understanding of the history of science and the evolvement of scientific knowledge,
- demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists, and
- demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

SC.1.1.1 ask questions about themselves and their world.
SC.1.1.2 discuss the lives and discoveries of scientists after listening to stories about their lives and discoveries.

Performance Descriptors (SC.PD.1.1)

- **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students examine contributions of diverse cultures and scientists. Students illustrate stories about the lives and discoveries of scientists after listening to stories.
- **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students illustrate contributions of diverse cultures and scientists. Students discuss stories about scientists' lives and discoveries after listening to stories.
- **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students describe contributions of diverse cultures and scientists. Students retell stories about scientists' lives and discoveries after listening to stories.
- **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students identify contributions of diverse cultures and scientists. Students cite facts about scientists' lives and discoveries after listening to stories.
- **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science.** Performance needs considerable development. Students seldom identify contributions of diverse cultures and scientists. Students seldom cite facts about scientists' lives and discoveries after listening to stories.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

- demonstrate the abilities necessary to do scientific inquiry,
- demonstrate understanding about scientific inquiry, and
- demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:

SC.1.2.1 demonstrate curiosity, initiative and creativity by questioning observations of changes in the environment (e.g., life cycles; motion of celestial objects; sun and shadow).

SC.1.2.2 use scientific instruments and everyday materials to investigate the natural world (e.g., hand lens, balance, magnets, thermometer, seeds, rocks).

SC.1.2.3 use safe and proper techniques for handling, manipulating and caring for science materials (e.g., follow safety rules, maintain a clean work area, treat living organisms humanely).

SC.1.2.4 collect, record and compare information using a variety of classification systems (e.g., ordering, sorting, sequencing) and using a variety of communication techniques (e.g., sketches, pictographs, models).

Performance Descriptors (SC.PD.1.2)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students apply a variety of classification and communication methods when collecting, recording and comparing information. Students apply scientific instruments to investigate the natural world. Students explain safety rules, and explain safe and proper techniques for handling, manipulating and caring for science materials.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students demonstrate a variety of classification and communication methods when collecting, recording and comparing information. Students demonstrate the use of scientific instruments used to investigate the natural world. Students demonstrate safety rules, and demonstrate safe and proper techniques for handling, manipulating and caring for science materials.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students describe a variety of classification and communication methods used to collect, to record and to compare information. Students describe scientific instruments used to investigate the natural world. Students use safety rules, and use safe and proper techniques for handling, manipulating and caring for science materials.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students identify a variety of classification and communication methods used to collect, to record and to compare information. Students label scientific instruments used to investigate the natural world. Students state safety rules, and state safe and proper techniques for handling, manipulating and caring for science materials.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students seldom identify a variety of classification and communication methods used to collect, to record and to compare information. Students seldom label scientific instruments used to investigate the natural world. Students seldom state safety rules, and seldom state safe and proper techniques for handling, manipulating and caring for science materials.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function),
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models and changes, and

* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives
Students will:
SC.1.3.1 identify that systems are made of parts that interact with one another.
SC.1.3.2 use models as representations of real things.

Performance Descriptors (SC.PD.1.2)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students illustrate systems that are made of parts that interact with one another. Students explain models that represent real things.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students describe systems that are made of parts that interact with one another. Students illustrate models that represent real things.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students discuss systems that are made of parts that interact with one another. Students describe models that represent real things.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. Students name systems that are made of parts that interact with one another. Students show models that represent real things.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. Students seldom name systems that are made of parts that interact with one another. Students seldom show models that represent real things.

Standard 4: Science Subject Matter/Concepts (SC.S.4)
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, and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives
Students will:
<u>Characteristics of Organisms</u>
SC.1.4.1 classify objects as living or non-living.
SC.1.4.2 identify that most living things need water, food, light and air.
<u>Life Cycles of Organisms</u>
SC.1.4.3 recognize changes in life cycle of living organisms.
SC.1.4.4 identify the parts of growing plants as they develop.

Organisms and Environments

SC.1.4.5 depict movement of living things in air, water and on land. (e.g., birds flying, fish swimming, worms burrowing in soil).

Properties of Objects and Materials

SC.1.4.6 recognize that materials are composed of smaller parts that may be seen with a magnifier.
SC.1.4.7 recognize that materials can be recycled and used again, sometimes in different forms.
SC.1.4.8 recognize that water can be a solid or a liquid, and can change from one form to another.
SC.1.4.9 predict and investigate the buoyancy of objects in water.

Light, Heat, Electricity and Magnetism

SC.1.4.10 classify objects as magnetic or non-magnetic.
SC.1.4.11 observe and record shadows at different times of the day.

Position and Motion of Objects

SC.1.4.12 describe the changes in the motion of objects (e.g., slowing, speeding up, curving).
SC.1.4.13 demonstrate that sounds are produced by vibrations.

Changes in Earth and Sky

SC.1.4.14 observe, identify and record changes in weather and effects on living organisms.
SC.1.4.15 recognize that the sun, moon, and stars appear to move.

Objects in the Sky

SC.1.4.16 observe and discuss the importance of objects in the day and night sky.

Properties of Earth Materials

SC.1.4.17 use a model to compare land and water features on the Earth.
SC.1.4.18 identify important uses of air.
SC.1.4.19 investigate and compare the properties of soil (e.g., sand, clay, humus).

Performance Descriptors (SC.PD.1.4)

* **Distinguished**

  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students explain scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

  Characteristics of Organisms
  Life Cycles of Organisms
  Organisms and Environments
  Properties of Objects and Materials
  Light, Heat, Electricity and Magnetism
  Position and Motion of Objects
  Changes in Earth and Sky
  Objects in the Sky
  Properties of Earth Materials

  Students compare and contrast interconnections among the above categories.

* **Above Mastery**

  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students relate scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

  Characteristics of Organisms
  Life Cycles of Organisms
  Organisms and Environments
  Properties of Objects and Materials
  Light, Heat, Electricity and Magnetism
  Position and Motion of Objects

Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students examine interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students describe scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students interpret interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students examine scientific facts, concepts, principles, theories and models found in daily life experiences. Students demonstrate knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students give examples of interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts.** Performance needs considerable development. Students seldom examine scientific facts, concepts, principles, theories and models found in daily life experiences. Students seldom demonstrate knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky

Objects in the Sky

Properties of Earth Materials

Students seldom give examples of interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology,
* demonstrate the ability to distinguish between natural and man-made objects,
* demonstrate abilities of technological design, and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

SC.1.5.1 distinguish between natural and man-made objects.

Performance Descriptors (SC.PD.1.5)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students compare and contrast natural and man-made objects.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students examine natural and man-made objects.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students describe natural and man-made objects.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students label natural and man-made objects.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application.** Performance needs considerable development. Students seldom label natural and man-made objects.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues,
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices,
* predict the long-term societal impact of specific health, population, resource and environmental practices, and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

SC.1.6.1 listen to and be tolerant of different viewpoints while working in collaborative groups.

SC.1.6.2 develop respect and responsibility for the environment by engaging in conservation practices (e.g., recycling, trash clean-up).

Performance Descriptors (SC.PD.1.6)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students work in groups, listen to and discover different viewpoints. Students explain the importance of conservation practices.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students work in groups, listen to and explore different viewpoints. Students illustrate conservation practices.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students work in groups, listen to and give examples of different viewpoints. Students give examples of conservation practices.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students identify conservation practices.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives**. Performance needs considerable development. Students seldom listen to and seldom recognize different viewpoints. Students seldom identify conservation practices.

Second Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Two objectives build upon the early stages of experimentation and maintenance of natural curiosity. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the fields of biology, chemistry, physics and earth and space sciences. 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% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated in all activities. CATS Two will provide opportunities for developmental and academic growth. The activities will introduce the concepts that science and technology are interrelated. The curricular thrust will be to develop early problem-solving skills through observation, experimenting and concluding. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)

Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge,
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists, and
* demonstrate an understanding of the nature of science.

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History and the Nature of Science Objectives
Students will:
SC.2.1.1 recognize science as the human's search for an understanding of the world by asking questions about themselves and their world.
SC.2.1.2 discuss the lives and discoveries of scientists of different cultures and backgrounds.
SC.2.1.3 identify and discuss the role of community people in science careers.

Performance Descriptors (SC.PD.2.1)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students generate questions about themselves and their world. Students classify contributions of diverse cultures and scientists. Students categorize science careers in the community.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students prioritize questions about themselves and their world. Students examine contributions of diverse cultures and scientists. Students compare science careers in the community.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students discover questions about themselves and their world. Students give examples of contributions of diverse cultures and scientists. Students illustrate science careers in the community.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students discuss questions about themselves and their world. Students identify contributions of diverse cultures and scientists. Students list science careers in the community.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science.** Performance needs considerable development. Students seldom discuss questions about themselves and their world. Students seldom identify contributions of diverse cultures and scientists. Students seldom list science careers in the community.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquiry,
* demonstrate understanding about scientific inquiry, and
* demonstrate the ability to think and act as scientists.

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:
SC.2.2.1 demonstrate curiosity, initiative and creativity by observing, classifying and comparing the patterns, variations and interactions of natural objects in the environment.
SC.2.2.2 manipulate scientific instruments and everyday materials to investigate the natural world (e.g., hand lens, balance, thermometer, metric ruler, magnets, weather instruments, calculators).

SC.2.2.3 measure the length and width of various objects using standard and non-standard units (e.g., metric ruler, paper clips, counting bears).

SC.2.2.4 use safe and proper techniques for handling, manipulating, and caring for science materials (e.g., follow safety rules, maintain a clean work area, treat living organisms humanely).

SC.2.2.5 conduct simple investigations; observe, collect and record information using a variety of classification systems; describe trends of data; and make predictions based on that data (e.g., seasonal changes and plants; temperature and weather).

Performance Descriptors (SC.PD.2.2)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students classify scientific instruments and materials used to investigate the natural world. Students explain safety rules, and explain safe and proper techniques for handling, manipulating and caring for science materials. Students compare measurements of objects using standard and non-standard units. Students explain simple investigations.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students determine appropriate scientific instruments and materials to investigate the natural world. Students demonstrate safety rules, and demonstrate safe and proper techniques for handling, manipulating and caring for science materials. Students determine measurements of objects using standard and non-standard units. Students interpret simple investigations.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students use appropriate scientific instruments and materials to investigate the natural world. Students use safety rules, and use safe and proper techniques for handling, manipulating and caring for science materials. Students interpret measurements of objects using standard and non-standard units. Students describe simple investigations.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students identify appropriate scientific instruments and materials used to investigate the natural world. Students tell safety rules, and tell safe and proper techniques for handling, manipulating and caring for science materials. Students identify measurements of objects using standard and non-standard units. Students name simple investigations.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students seldom identify appropriate scientific instruments and materials used to investigate the natural world. Students seldom tell safety rules, and seldom tell safe and proper techniques for handling, manipulating and caring for science materials. Students seldom identify measurements of objects using standard and non-standard units. Students seldom name simple investigations.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function),
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes, and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed

systems.

Unifying Themes Objectives
Students will:
SC.2.3.1 identify that systems are made of parts that interact with one another.
SC.2.3.2 use models as representations of real things.
SC.2.3.3 observe that changes occur gradually, repetitively, or randomly within the environment.

Performance Descriptors (SC.PD.2.3)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students explain systems are made of parts that interact with one another. Students compare and contrast changes that occur within systems. Students construct models that represent real things.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students illustrate systems made of parts that interact with one another. Students explore changes that occur within systems. Students explain models that represent real things.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students discuss systems made of parts that interact with one another. Students interpret changes that occur within systems. Students examine models that represent real things.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. Students identify systems made of parts that interact with one another. Students label changes that occur within systems. Students match models that represent real things.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science**. Performance needs considerable development. Students seldom identify systems made of parts that interact with one another. Students seldom label changes that occur within systems. Students seldom match models that represent real things.

Standard 4: Science Subject Matter/Concepts (SC.S.4)
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, and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives
Students will:
<u>Characteristics of Organisms</u>
SC.2.4.1 identify that plants and animals have different structures.
SC.2.4.2 identify the structures of physical characteristics of living things and explain their functions (e.g., wings for flying, fins for swimming; roots for support and obtaining water).

Life Cycles of Organisms
SC.2.4.3 sequence pictures of events to illustrate the changes in the life cycle of plants and animals.
SC.2.4.4 relate observations of the butterfly's life cycle to student's own growth and change.
Organisms and Environments
SC.2.4.5 observe and compare simple models of different kinds of habitats, including a forest and a stream.
Properties of Objects and Materials
SC.2.4.6 identify materials as a solid, a liquid or a gas and recognize that matter can change from one state to another.
SC.2.4.7 demonstrate that solids, liquids and gases take up space.
Light, Heat, Electricity and Magnetism
SC.2.4.8 demonstrate that a magnet can attract or repel objects.
SC.2.4.9 recognize that some materials and colors conduct heat better than others.
SC.2.4.10 demonstrate that a shadow is cast when an object blocks light.
Position and Motion of Objects
SC.2.4.11 compare the effects of force on the motion of an object.
SC.2.4.12 recognize that sound can change in pitch and volume.
Changes in Earth and Sky
SC.2.4.13 examine changes in the earth's surface (e.g., weathering, erosion).
SC.2.4.14 identify the effects of wind movement.
SC.2.4.15 observe and describe different types of precipitation.
SC.2.4.16 compare seasonal changes.
SC.2.4.17 explain how the rotation of the Earth on its axis causes day and night.
Objects in the Sky
SC.2.4.18 understand that the moon has phases.
Properties of Earth Materials
SC.2.4.19 describe how fossils are formed.
SC.2.4.20 match a fossil or a picture of a fossil, with a picture of its original organism (e.g., dinosaur bones, shell, fern).

Performance Descriptors (SC.PD.2.4)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students compare and contrast scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

  Characteristics of Organisms
  Life Cycles of Organisms
  Organisms and Environments
  Properties of Objects and Materials
  Light, Heat, Electricity and Magnetism
  Position and Motion of Objects
  Changes in Earth and Sky
  Objects in the Sky
  Properties of Earth Materials

  Students construct interconnections among the above categories.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students apply scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

  Characteristics of Organisms

Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students analyze interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students summarize scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students demonstrate interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students identify scientific facts, concepts, principles, theories and models found in daily life experiences. Students demonstrate knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students discuss interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts.** Performance needs considerable development. Students seldom identify scientific facts, concepts, principles, theories and models found in daily life experiences. Students seldom demonstrate knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism

Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students seldom discuss interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)
Students will:
* demonstrate an understanding of the interdependence between science and technology,
* demonstrate the ability to distinguish between natural and man-made objects,
* demonstrate abilities of technological design, and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives
Students will:
SC.2.5.1 recognize that common objects and events incorporate science (e.g., CD players, Velcro, weather) to solve human problems and enhance the quality of life.

Performance Descriptors (SC.PD.2.5)
* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students explain common objects and events that incorporate science to solve human problems and enhance the quality of life.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students illustrate common objects and events that incorporate science to solve human problems and enhance the quality of life.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students describe common objects and events that incorporate science to solve human problems and enhance the quality of life.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students identify common objects and events that incorporate science to solve human problems and enhance the quality of life.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application.** Performance needs considerable development. Students seldom identify common objects and events that incorporate science to solve human problems and enhance the quality of life.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:
* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues,

* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices,
* predict the long-term societal impact of specific health, population, resource and environmental practices, and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:
SC.2.6.1 listen to and be tolerant of different viewpoints while working in collaborative groups.
SC.2.6.2 develop respect and responsibility for the environment by engaging in conservation practices (e.g., recycling, trash clean-up, power consumption reduction).

Performance Indicators (SC.PD.2.6)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students work in groups, listen to and explain different viewpoints. Students model conservation practices.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students work in groups, listen to and classify viewpoints. Students select conservation practices.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students work in groups, listen to and discuss different viewpoints. Students examine conservation practices.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students listen to and give examples of different viewpoints. Students describe conservation practices.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives.** Performance needs considerable development. Students seldom listen to and seldom give examples of different viewpoints. Students seldom describe conservation practices.

Third Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Three objectives build upon problem-solving and experimentation and move into a more in-depth study of science. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the fields of biology, chemistry, physics and earth and space sciences. 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% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated in all activities. CATS Three highlights science-related careers. The study of geology and astronomy expands in CATS Three. Collecting materials, testing the materials, recording

data and developing concepts related to physics and chemistry are introduced to expand investigative abilities that lead to logical conclusions. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

SC.3.1.1 recognize that scientific explanations may lead to new discoveries (e.g., new knowledge leads to new questions).
SC.3.1.2 study the lives and discoveries of scientists of different cultures and backgrounds.
SC.3.1.3 explore science careers in the community.

Performance Descriptors (SC.PD.3.1)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students assess changes in scientific knowledge over time. Students assess science careers in the community.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students explain changes in scientific knowledge over time. Students categorize science careers in the community.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students state changes in scientific knowledge over time. Students examine science careers in the community.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students describe changes in scientific knowledge over time. Students list science careers in the community.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science.** Performance needs considerable development. Students seldom describe changes in scientific knowledge over time. Students seldom list science careers in the community.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

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Science as Inquiry Objectives

Students will:

SC.3.2.1 demonstrate curiosity, initiative and creativity by planning and conducting simple investigations.

SC.3.2.2 recognize that developing solutions to problems takes time, patience and persistence through individual and cooperative ventures.

SC.3.2.3 support statements with facts found through research in reference books, science-related magazines and the Internet.

SC.3.2.4 use scientific instruments and everyday materials to investigate the natural world (e.g., graduated cylinder, hand lens, metric ruler, magnets, weather instruments, thermometer, calculators).

SC.3.2.5 use safe and proper techniques for handling, manipulating and caring for science materials (e.g., follow safety rules, maintain a clean work area, treat living organisms humanely).

SC.3.2.6 apply mathematical skills and use metric units in measurements.

SC.3.2.7 interpret data presented in a table, graph, map or diagram and use it to answer questions and make predictions and inferences based on patterns of evidence.

SC.3.2.8 test variables (e.g., those that affect plant growth; speed; action of water on soil; shadow formation)

Performance Descriptors (SC.PD.3.2)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students select appropriate scientific instruments and materials to investigate the natural world. Students recommend safety rules, and recommend safe and proper techniques for handling, manipulating and caring for science materials. Students select mathematical skills and metric units in measurements. Students draw conclusions from data presented in a table, graph, map or diagram. Students defend predictions and inferences based on patterns of evidence. Students assess variables in simple investigations.

*** Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students classify appropriate scientific instruments and materials to investigate the natural world. Students explain safety rules, and explain safe and proper techniques for handling, manipulating and caring for science materials. Students combine mathematical skills and metric units in measurements. Students analyze data presented in a table, graph, map or diagram. Students create predictions and inferences based on patterns of evidence. Students draw conclusions about variables in simple investigations.

*** Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry.** Students use appropriate scientific instruments and materials to investigate the natural world. Students demonstrate safety rules, and demonstrate safe and proper techniques for handling, manipulating and caring for science materials. Students apply mathematical skills and metric units in measurements. Students explain data presented in a table, graph, map or diagram. Students examine predictions and inferences based on patterns of evidence. Students interpret variables in simple investigations.

*** Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry.** Performance needs further development. Students identify appropriate scientific instruments and materials to investigate the natural world. Students list safety rules, and list safe and proper techniques for handling, manipulating and caring for science materials. Students associate mathematical skills and metric units in measurements. Students apply data presented in a table, graph, map or diagram. Students define predictions and inferences based on patterns of evidence. Students list variables in simple investigations.

*** Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills,

characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students seldom identify appropriate scientific instruments and materials to investigate the natural world. Students seldom list safety rules, and seldom list safe and proper techniques for handling, manipulating and caring for science materials. Students seldom associate mathematical skills and metric units in measurements. Students seldom apply data presented in a table, graph, map or diagram. Students seldom define predictions and inferences based on patterns of evidence. Students seldom list variables in simple investigations.

Standard 3: Unifying Themes (SC.S.3)
Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives
Students will:

SC.3.3.1 identify that systems are made of parts that interact with one another.
SC.3.3.2 use models as representations of real things.
SC.3.3.3 observe that changes occur gradually, repetitively, or randomly within the environment and question causes of changes.
SC.3.3.4 given a set of objects, group or order the objects according to an established scheme (e.g., celestial objects, patterns of motion, constellations).
SC.3.3.5 given a set of events, objects, shapes, designs, or numbers, find patterns of constancy or regularity.

Performance Descriptors (SC.PD.3.3)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students analyze systems made of parts that interact with one another. Students draw conclusions about changes that occur within systems. Students select models that represent real things.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students explain systems made of parts that interact with one another. Students compare and contrast changes that occur within systems. Students create models that represent real things.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students illustrate systems made of parts that interact with one another. Students describe changes that occur within systems. Students relate models that represent real things.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. Students name systems made of parts that interact with one another. Students identify changes that occur within systems. Students show models that represent real things.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. Students seldom name systems made of parts that interact with one another. Students seldom identify changes that occur within systems. Students seldom show models that represent real things.

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

Characteristics of Organisms

SC.3.4.1 identify the structures of living things, including their systems and explain their functions (e.g., roots absorb water, circulatory system to move materials).

Life Cycles of Organisms

SC.3.4.2 observe, measure and record changes in living things (e.g., growth and development, variations within species).

Organisms and Environments

SC.3.4.3 compare physical characteristics and behaviors of living organisms and explain how they are adapted to a specific environment (e.g., beaks and feet in birds, seed dispersal, camouflage, different types of flowers).

SC.3.4.4 observe and describe relationships among organisms in an ecosystem (e.g., sequencing food chains, behavior, adaptations, factors that effect populations, predator-prey relationships).

Properties of Objects and Materials

SC.3.4.5 relate the buoyancy of an object to its density.

SC.3.4.6 identify physical and chemical properties.

SC.3.4.7 relate changes in states of matter to changes in temperature.

SC.3.4.8 investigate the dissolving of solids in liquids.

Light, Heat, Electricity and Magnetism

SC.3.4.9 investigate the absorption, reflection and refraction of light by objects.

SC.3.1.10 relate how the color of an object is based upon the absorption or reflection of light.

Position and Motion of Objects

SC.3.4.11 recognize that it takes work to move objects over a distance.

SC.3.4.12 recognize that speed, distance, and time are interrelated.

SC.3.4.13 recognize that the greater a force is exerted on an object, the greater the change of its motion will be.

SC.3.4.14 identify examples of potential and kinetic energy.

Changes in Earth and Sky

SC.3.4.15 identify fossils as a record of time (e.g., what organisms once lived on Earth, where they lived).

SC.3.4.16 explore the eroding of different materials by water and wind (e.g., sand, mud pile and rocks).

SC.3.4.17 describe how volcanoes and earthquakes change the Earth.

Objects in the Sky

SC.3.4.18 recognize the relative movement of the Sun and Moon in relationship to the Earth's position.

SC.3.4.19 describe the similarities and differences among the planets.

Properties of Earth Materials

SC.3.4.20 identify properties of minerals and recognize that rocks are composed of different minerals.

SC.3.4.21 explain how igneous, sedimentary and metamorphic rocks are formed.

SC.3.4.22 identify geographical features using a model or map (e.g., mountains, rivers, valleys, lakes, glaciers, volcanoes).

SC.3.4.23 describe the layers of the Earth and their various features.

Performance Descriptors (SC.PD.3.4)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students critique scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students generate interconnections among the above categories.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students compare and contrast scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students draw conclusions about the interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students interpret scientific facts, concepts, principles, theories and models found in daily life experiences. Students comprehend and apply knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials

Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students explain interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students recall scientific facts, concepts, principles, theories and models found in daily life experiences. Students demonstrate knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students identify interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts**. Performance needs considerable development. Students seldom recall scientific facts, concepts, principles, theories and models found in daily life experiences. Students seldom demonstrate knowledge of the objectives at the level indicated in Standard 4 in the following categories:

Characteristics of Organisms
Life Cycles of Organisms
Organisms and Environments
Properties of Objects and Materials
Light, Heat, Electricity and Magnetism
Position and Motion of Objects
Changes in Earth and Sky
Objects in the Sky
Properties of Earth Materials

Students seldom identify interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

SC.3.5.1 cite examples of the uses of science and technology in common daily events and in the community.

SC.3.5.2 explain a simple problem and identify a specific solution describing the use of tools and/or materials to solve the problem or to complete the task.

Performance Descriptors (SC.PD.3.5)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students assess uses of science and technology in the community. Students assess the tools and materials used to solve problems.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students compare and contrast the uses of science and technology in the community. Students apply the tools and materials used to solve problems.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students examine science and technology in the community. Students select the tools and materials to solve problems. Students distinguish between natural and manmade objects.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students identify uses of science and technology in the community. Students identify the tools and materials used to solve problems.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application.** Performance needs considerable development. Students seldom identify uses of science and technology in the community. Students seldom identify the tools and materials used to solve problems.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

SC.3.6.1 recognize that a solution to one scientific problem often creates new problems (e.g., recycling, pollution, conservation, waste disposal).

SC.3.6.2 listen to and be tolerant of different viewpoints by engaging in collaborative activities and be willing to modify ideas when new and valid information is presented.

SC.3.6.3 develop respect and responsibility for the environment by engaging in conservation practices.

SC.3.6.4 describe how modern tools and appliances have positively and/or negatively impacted their daily lives.

Performance Descriptors (SC.PD.3.6)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students work in groups, listen to and assess different viewpoints. Students select conservation practices. Students assess the impact of personal choices on the quality of life.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students work in groups, listen to and analyze different viewpoints. Students explain conservation practices. Students analyze the impact of personal choices on the quality of life.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students work in groups, listen to and examine different viewpoints. Students demonstrate conservation practices. Students determine the impact of personal choices on the quality of life.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students work in groups, listen to and describe different viewpoints. Students contrast conservation practices. Students predict the impact of personal choices on the quality of life.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives.** Performance needs considerable development. Students seldom work in groups, seldom listen to and seldom describe different viewpoints. Students seldom contrast conservation practices. Students seldom predict the impact of personal choices on the quality of life.

Fourth Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Four objectives build on the study of geology, astronomy, chemistry and physics. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the fields of biology, chemistry, physics and earth and space sciences. 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% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. CATS Four promotes cooperative learning, group decisions, cultural diversity, careers and expands the development of hands-on exploration. Basic science concepts are developed and problem-solving abilities are augmented. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)

Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives

Students will:

SC.4.1.1 contrast changes in scientific knowledge resulting from new discoveries (e.g., new knowledge leads to new questions).

SC.4.1.2 study the lives and discoveries of scientists of different cultures and backgrounds.

SC.4.1.3 explore science careers in West Virginia.

Performance Descriptors (SC.PD.4.1)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students analyze changes in scientific knowledge over time. Students compare and contrast science careers in West Virginia.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students contrast changes in scientific knowledge over time. Students explain science careers in West Virginia.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students describe changes in scientific knowledge over time. Students recognize and describe science careers in West Virginia.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students identify changes in scientific knowledge over time. Students recognize science careers in West Virginia.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science.** Performance needs considerable development. Students seldom identify changes in scientific knowledge over time. Students seldom recognize science careers in West Virginia.

Standard 2: Science as Inquiry (SC.S.2)

Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives

Students will:

SC.4.2.1 demonstrate curiosity, initiative and creativity by developing questions that lead to investigations; designing simple experiments; and trusting observations of discoveries when trying new tasks and skills.

SC.4.2.2 recognize that developing solutions to problems requires persistence, flexibility, open-mindedness, and alertness for the unexpected.

SC.4.2.3 support statements with facts found through research in reference books, science-related magazines, multimedia and the Internet.

SC.4.2.4 use scientific instruments and everyday materials to investigate the natural world (e.g., hand lens, telescope, thermometer, balances, magnets, tuning forks, bulbs and batteries, graduated cylinders, calculators, computers).

SC.4.2.5 demonstrate safe and proper techniques for handling, manipulating and caring for science materials.

SC.4.2.6 construct a hypothesis when provided a problem.

SC.4.2.7 establish variables and controls in an experiment; test variables through experimentation.

SC.4.2.8 interpret data presented in a table, graph, or diagram and use it to answer questions and make decisions.

SC.4.2.9 draw and support conclusions, make predictions and inferences based on patterns of evidence (e.g., weather maps, change of speed in a given amount of time, change in wave motions with changes in energy, variation of plants).

SC.4.2.10 apply mathematical skills and use metric units in measurements and calculations.

Performance Descriptors (SC.PD.4.2)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students develop questions and propose solutions; use scientific instruments to make observations, measure and collect data; and extract information from charts, tables and graphs.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students develop questions, use scientific instruments to make observations, measure and collect data; and extract information from charts, tables and graphs. Students routinely apply safety techniques.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. When provided a problem, students construct a hypothesis. Students make observations using scientific instruments and develop questions. Students routinely apply safety techniques.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students make observations using scientific instruments. Students frequently apply safety techniques.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students are inconsistent in using safety techniques.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);

* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

SC.4.3.1 identify that systems are made of parts that interact with one another.
SC.4.3.2 use models as representations of real things.
SC.4.3.3 observe that changes occur gradually, repetitively, or randomly within the environment and question causes of changes.
SC.4.3.4 given a set of objects, group or order the objects according to an established scheme.
SC.4.3.5 given a set of events, objects, shapes, designs, or numbers, find patterns of constancy or regularity.

Performance Descriptors (SC.PD.4.3)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students compare and contrast the relationships between the forms of objects or systems and their functions. Students will predict changes in and draw conclusions about systems. Students differentiate between models that represent systems.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students explain the relationship between the form of an object or system and its function. Students compare models that represent systems.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students identify and describe how modifications to the parts of a system affect interactions between its parts. Students describe models that represent systems.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Students identify observable changes to the parts of the system. Students label models that represent systems.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. Students seldom identify observable changes to the parts of the system. Students inaccurately label models that represent systems.

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

<u>Characteristics of Organisms</u>

SC.4.4.1 describe the different characteristics of plants and animals which help them to survive in different niches and environments.
SC.4.4.2 associate the behaviors of living organisms to external and internal influences (e.g., hunger, climate, seasons).
SC.4.4.3 identify and classify variations in structures of living things including their systems and explain their functions (e.g., skeletons, teeth, plant needles, leaves).

Life Cycles of Organisms

SC.4.4.4 compare and sequence changes in plant and animal life cycles.
SC.4.4.5 understand that plants and animals closely resemble their parents and that some characteristics are inherited from the parents and others result from interaction with the environment.

Organisms and Environments

SC.4.4.6 identify human uses of plants and animals (e.g., food sources, medicines).
SC.4.4.7 describe environmental barriers to the migration of animals.
SC.4.4.8 construct and explain models of habitats, food chains, and food webs.

Properties of Objects and Materials

SC.4.4.9 investigate how properties can be used to identify substances.
SC.4.4.10 investigate and compare the dissolving of different solids in a given liquid.
SC.4.4.11 examine simple chemical changes (e.g., tarnishing, rusting, burning).
SC.4.4.12 understand that materials including air mass, take up space and are made of parts that are too small to be seen without magnification.
SC.4.4.13 identify various changes in states of matter to heat loss or gain.
SC.4.4.14 investigate variables that affect the rate of evaporation of a liquid.
SC.4.4.15 investigate the density of liquids.

Light, Heat, Electricity and Magnetism

SC.4.4.16 identify different forms of energy and describe energy transformations that occur between them (e.g., electrical to heat, light to mechanical).
SC.4.4.17 examine types and properties of waves (e.g., transverse, longitudinal, frequency, wavelengths).
SC.4.4.18 investigate static electricity and conductors/nonconductors of electricity.
SC.4.4.19 construct simple electrical circuits.
SC.4.4.20 understand the relationship between a compass and a magnetic field.

Position and Motion of Objects

SC.4.4.21 relate motion of an object to its frame of reference.
SC.4.4.22 predict and investigate the motion of an object if the applied force is changed.
SC.4.4.23 explore that sounds are produced by vibrating objects and columns of air and explore the relationship between frequency and pitch of sound.
SC.4.4.24 investigate the change in the length, tension, or thickness of the vibrating object on the frequency of vibration (e.g., string, wire, rubber band).

Changes in Earth and Sky

SC.4.4.25 become familiar with the geologic time scale.
SC.4.4.26 locate and identify patterns of stars and their seasonal changes.
SC.4.4.27 compare and explain the relative time differences to erode materials (e.g., a sand pile, mud pile, rock pile).
SC.4.4.28 investigate the cause and effects of volcanoes, earthquakes and landslides.
SC.4.4.29 interpret a weather chart or map.

Objects in the Sky

SC.4.4.30 identify the sun as a star.
SC.4.4.31 describe the orbits of the Sun and Moon.
SC.4.4.32 describe and explain the planets orbital paths.

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Properties of Earth Materials

SC.4.4.33 describe the rock cycle.
SC.4.4.34 explain the relationship between the rate of cooling and crystal size of igneous rocks.
SC.4.4.35 compare ocean water and fresh water.

Performance Descriptors (SC.PD.4.4)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge, applications of the objectives in standard 4 in the following categories:

* Characteristics of Organisms
* Life Cycles of Organisms
* Organisms and Environments
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Changes in Earth and Sky
* Objects in the Sky
* Properties of Earth Materials

Students analyze interconnections among the above categories.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 in the following categories:

* Characteristics of Organisms
* Life Cycles of Organisms
* Organisms and Environments
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Changes in Earth and Sky
* Objects in the Sky
* Properties of Earth Materials

Students generate and explain interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students demonstrate knowledge of the objectives in standard 4 in the following categories:

* Characteristics of Organisms
* Life Cycles of Organisms
* Organisms and Environments
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Changes in Earth and Sky
* Objects in the Sky
* Properties of Earth Materials

Students draw conclusions about interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**.

Performance needs further development. Students demonstrate limited knowledge of the objectives in standard 4 in the following categories:

* Characteristics of Organisms
* Life Cycles of Organisms
* Organisms and Environments
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Changes in Earth and Sky
* Objects in the Sky
* Properties of Earth Materials

Students identify interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts.** Performance needs considerable development. Students demonstrate incomplete knowledge of the objective in standard 4 in the following categories:

* Characteristics of Organisms
* Life Cycles of Organisms
* Organisms and Environments
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Changes in Earth and Sky
* Objects in the Sky
* Properties of Earth Materials

Students seldom identify interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

SC.4.5.1 identify and explain a simple problem or task to be completed; identify a specific solution; and list task requirements.

SC.4.5.2 use an appropriate engineering design to solve a problem or complete a task.

Performance Descriptors (SC.PD.4.5)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students develop an appropriate engineering design for a given task and produce a product or process that exceeds the task requirements. Students utilize technology to gather data, analyze statistics and develop conclusions.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students compare, contrast and select an engineering design for a given task and produce a product that meets task requirements. Students utilize technology to gather data, display it, and interpret it.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students select an appropriate engineering design for a given task and produce a product or process to meet the task requirements. Students utilize technology to gather data and to display the data.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students select an engineering design for a given task and produce a product or process that does not meet all of the task requirements. Students utilize technology to gather data.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application.** Performance needs considerable development. Students seldom select an engineering design for a given task that produce a product or process that meets requirements. Students inaccurately use technology to gather data.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

SC.4.6.1 recognize that a solution to one scientific problem often creates new problems (e.g., recycling, pollution, conservation, waste disposal, need for technology).

SC.4.6.2 listen to and be tolerant of different viewpoints by engaging in collaborative activities and modifying ideas when new and valid information is presented from a variety of resources.

SC.4.6.3 describe the positive and negative consequences of the application of technology on personal health and the environment.

SC.4.6.4 develop respect and responsibility for the environment by engaging in conservation practices.

Performance Descriptors (SC.PD.4.6)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students analyze and evaluate positive and negative consequences of human choices and technology applications on personal health populations and the environment.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students describe the positive and negative consequences of human choices and technology applications on personal health, populations and the environment.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students identify positive and negative consequences of human choices on

personal health, populations and the environment.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students list consequences of human choices on personal health and the environment.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives.** Performance needs considerable development. Students seldom list consequences of human choices on personal health and the environment.

Fifth Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Five objectives identify, compare, classify and explain our living and designed worlds. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the fields of biology, chemistry, physics, and earth and space sciences. 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% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated in all activities. CATS Five reviews earth and the sky, life cycles and habitats of organisms, properties, positions and motions of objects and energy. New major concepts introduced at the fifth grade level include changes in properties of matter, structures, functions and adaptations of organisms, and the structure of the earth's system. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)

Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives

Students will:

SC.5.1.1 realize that scientists formulate and test their explanations of nature using observation and experiments.

SC.5.1.2 recognize scientific knowledge is subject to modification as new scientific information challenges current explanations.

SC.5.1.3 examine the careers and contributions of men and women of diverse cultures to the development of science

SC.5.1.4 articulate the historical significance of scientific discoveries.

Performance Descriptors (SC.PD.5.1)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students evaluate changes in scientific knowledge over time. Students compare and contrast the

careers and contributions of men and women from diverse cultures and articulate the historical significance of their scientific discoveries.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students analyze changes in scientific knowledge over time. Students explain the careers and contributions of men and women from diverse cultures and articulate the historical significance of their scientific discoveries.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students compare changes in scientific knowledge over time. Students recognize and describe the scientific contributions of men and women from diverse cultures throughout history.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students identify changes in scientific knowledge over time. Students recognize science careers of men and women from diverse cultures throughout history.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science.** Performance needs considerable development. Students seldom identify changes in scientific knowledge over time. Students seldom recognize a science career of men and women form diverse cultures.

Standard 2: Science as Inquiry (SC.S.2)

Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives

Students will:

SC.5.2.1 cooperate and collaborate to ask questions, find answers, solve problems, conduct investigations to further an appreciation of scientific discovery.

SC.5.2.2 formulate conclusions through close observations, logical reasoning, objectivity, perseverance and integrity in data collection.

SC.5.2.3 apply skepticism, careful methods, logical reasoning and creativity in investigating the observable universe.

SC.5.2.4 use a variety of materials and scientific instruments to conduct explorations, investigations and experiments of the natural world (e.g., barometer, anemometer, microscope, computer).

SC.5.2.5 demonstrate safe techniques for handling, manipulating and caring for science materials, equipment, natural specimens and living organisms.

SC.5.2.6 utilize experimentation to demonstrate scientific processes and thinking skills (e.g., formulating questions, predicting, forming hypotheses, quantifying, identifying dependent and independent variables).

SC.5.2.7 construct and use charts, graphs and tables to organize, display, interpret, analyze and explain data.

SC.5.2.8 use inferential reasoning to make logical conclusions from collected data.

Performance Descriptors (SC.PD.5.2)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students develop questions, generate hypothesis, propose solutions and draw conclusions. Students use scientific instruments to make observations and to measure and collect data. Students organize and display data in charts, tables and graphs. Students extract information from the charts, tables and graphs. Students identify a constant and variable in an experiment. Students routinely apply safety techniques.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students develop questions and generate hypothesis. Students use scientific instruments to make observations, measure and collect data. Students display and interpret information in charts, tables and graphs. Students name a constant and a variable in an experiment. Students routinely apply safety techniques.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students develop questions and generate a hypothesis. Students make observations through use of scientific instruments. Students measure and collect data. Students display information in charts, tables or graphs. Students routinely apply safety techniques.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students use scientific instruments to make observations, collect data and read charts, tables and graphs. Students frequently apply safety techniques.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students inaccurately collect data and make observations. Students are inconsistent in using safety techniques.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

SC.5.3.1 compare and contrast the relationship between the parts of a system to the whole system (e.g., take a part or build mechanical, electrical, or biological systems).

SC.5.3.2 construct a variety of useful models of an object, event, or process.

SC.5.3.3 compare and contrast changes that occur in an object or a system to its original state.

SC.5.3.4 identify the influence that a variation in scale will have on the way an object or system works. (e.g., cooling rates of different-sized containers of water, strength of different-sized constructions from the same material, flight characteristics of different-sized model airplanes).

Performance Descriptors (SC.PD.5.3)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students analyze and evaluate the relationships between the forms of objects or systems and their functions.

Students design models to represent systems. Students predict changes and present supporting details to draw conclusions.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students incorporate model to compare and contrast the relationships between the forms of objects or systems and their functions. Students predict changes in and draw conclusions about systems.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students use models to explain the relationship between the form of an object or system and its function. Students predict changes in systems.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. Students use models to identify that there is a relationship between the form of an object or system and its function.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. Students seldom use models to identify that there is a relationship between the form of an object or system and its function.

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

SC.5.4.1 demonstrate an understanding of the interconnections of biological, earth and space, and physical science concepts.

<u>Structure and Function in Living Systems</u>

SC.5.4.2 identify and explain common energy conversions in cycles of matter including photosynthesis and carbon dioxide cycle.

SC.5.4.3 identify the structures of living organisms and explain their function.

SC.5.4.4 observe and identify cells of organisms using a microscope.

<u>Life Cycles of Organisms: Reproduction and Heredity</u>

SC.5.4.5 compare variations of plant growth and reproduction.

Populations and Ecosystems

SC.5.4.6 explain how the different characteristics of plants and animals help them to survive in different niches and environments including adaptations, natural selection, extinction.

SC.5.4.7 explore the extinction of a species due to environmental conditions.

SC.5.4.8 trace and describe the pathways of the sun's energy through producers, consumers and decomposers using food webs and pyramids.

Properties of Objects and Materials

SC.5.4.9 explain that the mass of a material is conserved whether it is together, in parts, or in a different state.

SC.5.4.10 recognize that elements are composed of only one type of matter.

SC.5.4.11 using the periodic table, identify common elements according to their symbols.

SC.5.4.12 identify substances by their relative densities (e.g., floating; sinking).

Light, Heat, Electricity and Magnetism

SC.5.4.13 analyze diagrams of electrical circuits.

SC.5.4.14 use SI (metric) measurement units of volts, amps and watts as they apply to electricity.

SC.5.4.15 investigate the properties of an electromagnet.

Position and Motion of Objects

SC.5.4.16 describe how the variables of gravity and friction affect the motion of objects.

SC.5.4.17 compare and contrast the change in length, tension, or thickness of a vibrating object on the frequency of vibration.

Structure of the Earth System

SC.5.4.18 describe the layers of the earth and their various features.

SC.5.4.19 identify and describe natural landforms, how they change and impact weather and climate.

SC.5.4.20 use a variety of instruments and sources to collect and display weather data to describe weather patterns (e.g., temperatures, wind direction, wind speed, precipitation).

SC.5.4.21 compare and explain the different rates of weathering, erosion and deposition in certain materials.

SC.5.4.22 identify land features and elevations on a topographical map.

SC.5.4.23 identify resources as being renewable or non-renewable.

Earth's History

SC.5.4.24 explore and explain how fossils and geologic features can be used to determine the relative age of rocks and rock layers.

SC.5.4.25 identify that the Earth is made of plates (plate tectonics).

Performance Descriptors (SC.PD.5.4)

* **Distinguished**

  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

  * Structure and function in Living Systems
  * Life Cycles of Organisms: Reproduction and Heredity
  * Populations and Ecosystems
  * Properties of Objects and Materials
  * Light, Heat, Electricity and Magnetism
  * Position and Motion of Objects
  * Structure of the Earth System
  * Earth's History

  Students analyze interconnections among the above categories.

* **Above Mastery**

  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 in the following categories:

* Structure and function in Living Systems
* Life Cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Structure of the Earth System
* Earth's History

Students explain interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students demonstrate knowledge of the objectives in standard 4 in the following categories:

* Structure and function in Living Systems
* Life Cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Structure of the Earth System
* Earth's History

Students identify interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students demonstrate knowledge of the objectives in Standard 4 in the following categories:

* Structure and function in Living Systems
* Life Cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Structure of the Earth System
* Earth's History.

Students identify interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts.** Performance needs considerable development. Students demonstrate incomplete knowledge of the objectives in standard 4 in the following categories:

* Structure and function in Living Systems
* Life Cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Properties of Objects and Materials
* Light, Heat, Electricity and Magnetism
* Position and Motion of Objects
* Structure of the Earth System
* Earth's History.

Students seldom identify interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)
Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives
Students will:
SC.5.5.1 research everyday applications and interactions of science and technology.
SC.5.5.2 implement engineering solutions for given tasks and measure their effectiveness.

Performance Descriptors (SC.PD.5.5)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students contrast the interactions between science and technology in daily living. Given a task, students design an engineering solution, measure and evaluate its effectiveness. Students utilize technology to gather data, analyze statistics and develop conclusions.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students describe the interactions between science and technology. Students utilize technology to gather, display and interpret data.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students identify interactions between science and technology in daily living. Given a task, students select an engineering solution and measure its effectiveness. Students utilize technology to gather and display data.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students identify interactions between science and technology in daily living. Students utilize technology to gather data.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application.** Performance needs considerable development. Students seldom identify interactions between science and technology in daily living. Students inaccurately use technology to gather data.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:

SC.5.6.1 use scientific reasoning and the knowledge of science and technology to make informed personal decisions at the local and global levels.
SC.5.6.2 evaluate and critically analyze mass media reports of scientific developments and events.
SC.5.6.3 critically analyze the effects and impacts of science and technology on global and local problems (e.g., mining, manufacturing, recycling, farming, water quality).
SC.5.6.4 explore the connections between science, technology, society and career opportunities.
SC.5.6.5 analyze the positive and negative effects of technology on society and the influence of societal pressures on the direction of technological advances.

Performance Descriptors (SC.PD.5.6)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students evaluate the causes/effects of science and technology on global and local problems. Students identify and describe the connections between science, technology, society and career opportunities.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students analyze the causes/effects of science and technology on global and local problems. Students identify the connections between science, technology, society and career opportunities.

*** Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students list causes/effects of science and technology on local problems. Students state connections between science, technology, society and career opportunities.

*** Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students list causes/effects of science and technology on local problems.

*** Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives.** Performance needs considerable development. Students seldom list causes/effects of science and technology on local problems.

Sixth Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Six objectives demonstrate, differentiate, and apply concepts of the living and designed worlds. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the fields of biology, chemistry, physics, and earth and space sciences. The subject matter is delivered through a coordinated, integrated approach with an emphasis on the development of major science themes of systems, changes and models. 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 in all activities. CATS Six reviews changes in the properties of matter, structures, functions and adaptations of organisms, and the structure of the earth's systems. New major concepts introduced at the sixth grade level include motions and forces, ecosystems, diversity of life, energy transformations, plate tectonics, earth's resources and weather. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning

environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

SC.6.1.1 explain that scientists formulate and test their explanations of nature using observation and experiments.
SC.6.1.2 recognize that scientific knowledge is subject to modification as new scientific information challenges current theories.
SC.6.1.3 examine the careers and contributions of men and women of diverse cultures to the development of science.
SC.6.1.4 articulate the historical significance of scientific discoveries as influenced by technological demands, competition, controversy, world events, personalities and societal issues.

Performance Descriptors (SC.PD.6.1)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students provide evidence of how careers relate with scientific fields of study. Students recall and relate the response of the scientific community to a specific historical setting.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students identify careers when given a scientific field of study. Students relate the response of the scientific community to a specific historical setting.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students match careers with specific scientific fields of study. Students recognize that scientific discovery is influenced by the historical climate.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students identify specific scientific fields of study. Students chronologically order major scientific discoveries.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science.** Performance needs considerable development. Students recall a job/career from any field. Students seldom recognize that scientists formulate and test their explanations. Students recognize that scientific knowledge increases over time.

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Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:

SC.6.2.1 cooperate and collaborate to ask questions, find answers, solve problems, conduct investigations to further an appreciation of scientific discovery.
SC.6.2.2 formulate conclusions through close observations, logical reasoning, objectivity, perseverance and integrity in data collection.
SC.6.2.3 apply skepticism, careful methods, logical reasoning and creativity in investigating the observable universe.
SC.6.2.4 use a variety of materials and scientific instruments to conduct explorations, investigations and experiments of the natural world (e.g., barometer, anemometer, microscope, computer).
SC.6.2.5 demonstrate safe techniques for handling, manipulating and caring for science materials, equipment, natural specimens and living organisms.
SC.6.2.6 utilize experimentation to demonstrate scientific processes and thinking skills (e.g., formulating questions, predicting, forming hypotheses, quantifying, identifying dependent and independent variables).
SC.6.2.7 construct and use charts, graphs and tables to organize, display, interpret, analyze and explain data.
SC.6.2.8 use inferential reasoning to make logical conclusions from collected data.
SC.6.2.9 use appropriate technology solutions to gather data; graph data; interpret data; and analyze information.

Performance Descriptors (SC.PD.6.2)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students describe the influence that skepticism, bias, methodology, logical reasoning and creativity have on scientific investigations. Students choose selected scientific processes and skills to formulate questions, explain and relate dependent and independent variables, make predictions, and form hypothesis for a given problem; analyze records for consistency and accuracy; construct appropriate charts, tables and graphs. Students explain safety techniques and choose proper equipment to solve the problems (Science Subject Matter/Concept appropriate).

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students can match the effects of skepticism, recognizing bias, methodology, logical reasoning and creativity with results in scientific investigations. Students apply scientific processes and skills to formulate questions, identify dependent and independent variables, make predictions and form hypothesis; maintain consistent and accurate records; organize data into appropriate charts, tables and graphs. Students explain safety techniques and use proper equipment to solve problems (Science Subject Matter/Concept appropriate).

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students identify skepticism, bias, methodology, logical reasoning and creativity in scientific investigations. Students describe scientific process and skills needed to formulate questions, identify dependent and independent variables, make predictions and form hypothesis; maintain consistent and accurate records; select appropriate data on charts, tables and graphs. Students routinely apply safety

techniques and use proper equipment to solve problems (Science Subject Matter/Concept appropriate).

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students can define skepticism, bias, methodology, logical reasoning and creativity as they apply to scientific investigations. Students identify scientific process and skills used to examine questions, choose hypothesis; maintain records; select data from charts, tables and graphs. Students occasionally demonstrate safety techniques and use proper equipment to solve problems (Science Subject Matter/Concept appropriate).

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students name factors such as skepticism, bias, methodology, logical reasoning and creativity, which influence scientific investigations. Students name scientific process and skills used to examine questions, choose hypothesis; maintain records; select data from charts, tables and graphs. Students can explain safety techniques and use proper equipment to solve problems (Science Subject Matter/Concept appropriate).

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order, and organization; evidence, models, and explanation; constancy, change, and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze, and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

SC.6.3.1 compare and contrast the relationship between the parts of a system to the whole system (e.g., take apart or build mechanical, electrical, or biological systems).

SC.6.3.2 construct a variety of useful models of an object, event, or process.

SC.6.3.3 compare and contrast changes that occur in an object or a system to its original state.

SC.6.3.4 identify the influence that a variation in scale will have on the way an object or system works. (e.g., cooling rates of different-sized containers of water, strength of different-sized constructions from the same material, flight characteristics of different-sized model airplanes).

Performance Descriptors (SC.PD.6.3)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students evaluate the accuracy of models (e.g., physical, pictorial) of objects or systems and predict how to manipulate variables to improve the model.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students design models (e.g., physical, pictorial) of objects or systems and predict how variables affect their function.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students compare and contrast models (e.g., physical, pictorial) of objects or systems and predict how variables affect their function.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. Students examine models (e.g., physical, pictorial) of objects or systems and realize that changing variables and/or scale affects its function.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. Students inconsistently connect the model with what it represents.

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

SC.6.4.1 demonstrate an understanding of the interconnections of biological, earth and space and physical science concepts.

Structure and Function in Living Systems

SC.6.4.2 describe the interactions of various cycles that provide energy through decomposition, photosynthesis, respiration, transpiration in the food web; nitrogen cycle.

SC.6.4.3 classify living organisms according to their structure and functions.

SC.6.4.4 compare the similarities of internal features of organisms which can be used to infer relatedness.

SC.6.4.5 explain how abiotic and biotic factors affect the interdependence among organisms.

SC.6.4.6 construct models of plant and animal cells which show the basic parts (e.g., cytoplasm, cell wall, cell membrane, nucleus, chloroplasts).

Life Cycles of Organisms: Reproduction and Heredity

SC.6.4.7 compare growth patterns in different plants (e.g., mosses, ferns, perennials, biennials, woody plants, herbaceous plants).

Populations and Ecosystems

SC.6.4.8 demonstrate changes in populations of organisms due to limiting environmental factors (e.g., food supply, predators, disease, habitat).

SC.6.4.9 analyze the ecological consequences of human interactions with the environment (e.g., renewable and non-renewable resources).

Structure and Properties of Matter

SC.6.4.10 classify and investigate properties and processes (changes) as either physical or chemical.

SC.6.4.11 investigate the composition of matter concluding that matter is composed of tiny particles and that the particles are the same for the same type of matter.

SC.6.4.12 investigate the formation and separation of simple mixtures.

SC.6.4.13 use indicators to identify substances as acidic, basic or neutral.

SC.6.4.14 identify the symbols of elements.

SC.6.4.15 use the periodic table to identify elements as solids, liquids and gases, metals or nonmetals.

SC.6.4.16 describe properties of matter (e.g., inertia, specific heat, malleability, melting point, density).

Energy

SC.6.4.17 investigate the properties electromagnetic spectrum (e.g., wavelengths, frequencies, visible light); relate wave lengths and/or frequency to position on electromagnetic spectrum (e.g., colors, x-ray).

SC.6.4.18 identify factors affecting reflection and refraction (e.g., nature of surfaces, color, density of medium).

SC.6.4.19 explain absorption and reflection of light by different objects of various colors and textures (e.g., transparent, translucent, opaque, different colors).

SC.6.4.20 describe the flow of heat between objects (e.g., hot air rises, absorption and release of heat by metals).

SC.6.4.21 diagram simple parallel and series circuits (e.g., bulbs, battery, wires, switch).

Motion and Forces

SC.6.4.22 interpret the relationship of mass to gravitational force (e.g., larger the mass the larger the gravitational force, the closer the objects the stronger the force).

SC.6.4.23 examine simple machines and the forces involved; apply the effects of balanced and unbalanced forces on motion of objects.

SC.6.4.24 explain motion in terms of frames of reference and analyze graphs depicting motion and predicted future motion.

Structure of the Earth System

SC.6.4.25 track major atmospheric events.

SC.6.4.26 describe and demonstrate the forces and results of plate tectonics.

Earth's History

SC.6.4.27 describe changes in the rock record due to geologic and physical events over time. (e.g., rock cycle as it relates to plate tectonics.).

Earth and the Solar System

SC.6.4.28 recognize the phases of the Moon.

SC.6.4.29 investigate models of Earth-Moon-Sun relationships (e.g., gravity, time, tides).

SC.6.4.30 compare the Earth's tilt and revolution to the seasonal changes.

Performance Descriptors (SC.PD.6.4)

* Distinguished

  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

  * Structure and Function in Living Systems
  * Life cycles of Organisms: Reproduction and Heredity
  * Populations and Ecosystems
  * Structure and Properties of Matter
  * Energy
  * Motion and Forces
  * Structure of the Earth System
  * Earth's History
  * Earth and the Solar System

  Students analyze interconnections among the above categories.

* **Above Mastery**

  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

  * Structure and Function in Living Systems
  * Life cycles of Organisms: Reproduction and Heredity
  * Populations and Ecosystems
  * Structure and Properties of Matter

* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students explain interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students identify interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students demonstrate knowledge of the objectives in standard 4 in the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students identify interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts.** Performance needs considerable development. Students demonstrate incomplete knowledge of the objectives in standard 4 in the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students seldom identify interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)
Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives
Students will:

SC.6.5.1 given a set of attributes, produce a product or process and cite how design priorities (e.g., space, safety) and available materials impact the outcome.
SC.6.5.2 evaluate the appropriateness of the materials and procedures in given engineering solutions.

Performance Descriptors (SC.PD.6.5)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students propose and defend alternative materials for use in natural and designed structures.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students predict the consequences of using inappropriate materials in a natural or designed structure.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students describe the appropriateness of properties for materials used in natural and designed structures.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students identify properties of materials used in natural and designed structures.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application.** Performance needs considerable development. Students name some of the materials that have been used in natural and designed structures.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

SC.6.6.1 use scientific reasoning and the knowledge of science and technology to make informed personal decisions at the local and global levels.

SC.6.6.2 evaluate and critically analyze mass media reports of scientific developments and events.

SC.6.6.3 critically analyze the effects and impacts of science and technology on global and local problems (e.g., mining, manufacturing, recycling, farming, water quality).

SC.6.6.4 explore the connections between science, technology, society and career opportunities.

SC.6.6.5 analyze the positive and negative effects of technology on society and the influence of societal pressures on the direction of technological advances.

Performance Descriptors (SC.PD.6.6)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students describe the science/technology/society effects on a global or local problem.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students identify the science/technology/society effects on a global or local problem.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students match science/technology/society effects with global or local problems.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students relate science/technology/society effects to global or local problems.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives.** Performance needs considerable development. Students recognize global and local problems.

Seventh Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Seven objectives evaluate, interpret, and predict conditions and phenomena of the living and designed worlds. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the fields of biology, chemistry, physics and earth and space sciences. 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% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. CATS Seven reviews motions and forces, ecosystems, diversity of life, energy transformations, plate tectonics, earth's resources and weather. Major concepts expanded at the seventh grade level include elements, mixtures, and compounds, populations/ecosystems, conservation of matter and energy and earth's history. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

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Standard 1: History and the Nature of Science (SC.S.1)
Students will:

- demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
- demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
- demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

SC.7.1.1 realize that scientists formulate and test their explanations of nature using observation, experiments and theoretical models.

SC.7.1.2 recognize and appreciate that scientific knowledge is subject to modification as new scientific information challenges current theories.

SC.7.1.3 examine the careers and contributions of men and women of diverse cultures to the development of science.

SC.7.1.4 articulate the historical significance of scientific discoveries as influenced by technological demands, competition, controversy, world events, personalities and societal issues.

Performance Descriptors (SC.PD.7.1)

- Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students evaluate choices made by the scientific community in response to the historical setting. Students can select discipline specific activities when given a chosen scientific career.

- **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students recall and relate the response of the scientific community to a specific historical setting. Students provide evidence of how careers relate with scientific fields of study.

- **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students relate the response of the scientific community to a specific historical setting. Students identify careers when given a scientific field of study.

- **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students recognize that the scientific community is influenced by the historical climate. Students match careers with specific scientific fields of study.

- **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science**. Performance needs considerable development. Students chronologically order major scientific discoveries. Students identify specific scientific fields of study.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

- demonstrate the abilities necessary to do scientific inquiry;
- demonstrate understanding about scientific inquiry; and
- demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

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Science as Inquiry Objectives

Students will:

SC.7.2.1 cooperate and collaborate to ask questions, find answers, solve problems, conduct investigations to further an appreciation of scientific discovery.

SC.7.2.2 formulate conclusions through close observations, logical reasoning, objectivity, perseverance and integrity in data collection.

SC.7.2.3 examine the role of skepticism, careful methods, logical reasoning and creativity in investigating the observable universe.

SC.7.2.4 use a variety of materials and scientific instruments to conduct explorations, investigations and experiments of the natural world (e.g., barometer, anemometer, microscope, computer).

SC.7.2.5 demonstrate safe techniques for handling, manipulating and caring for science materials, equipment, natural specimens and living organisms.

SC.7.2.6 utilize experimentation to demonstrate scientific processes and thinking skills (e.g., formulating questions, predicting, forming hypotheses, quantifying, identifying dependent and independent variables).

SC.7.2.7 construct and use charts, graphs and tables to organize, display, interpret, analyze and explain data.

SC.7.2.8 use appropriate technology solutions to gather data; graph data; interpret data; and analyze information.

SC.7.2.9 use inferential reasoning to make logical conclusions from collected data.

Performance Descriptors (SC.PD.7.2)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students design an experiment that incorporates independent, dependent, controlled variables; use multiple trials in an experiment for reliability; suggest multiple alternative approaches to investigations. Students apply safety techniques and choose the proper equipment to solve problems (Science Subject Matter/Concept appropriate). Students predict the impact of skepticism, bias, methodology, logical reasoning and creativity on scientific investigations.

*** Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students can select an experiment that incorporates independent, dependent, and controlled variables; use multiple trials in an experiment for reliability; suggest multiple alternative approaches to investigations. Students apply safety techniques and choose the proper equipment to solve problems (Science Subject Matter/Concept appropriate). Students describe the influence that skepticism, bias, methodology, logical reasoning and creativity have on scientific investigations.

*** Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students identify independent, dependent, and controlled variables; and explain why multiple trials in an experiment are necessary for reliability. Students suggest an alternative approach to investigations. Students apply safety techniques using proper equipment to solve problems (Science Subject Matter/Concept appropriate). Students can match the effects of skepticism, recognizing bias, methodology, logical reasoning and creativity with results in scientific investigations.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students define independent, dependent, and controlled variables; and use multiple trials in an experiment for reliability. Students can only justify using the given approach in solving an investigation. Students apply safety techniques and use proper equipment to solve problems (Science Subject Matter/Concept appropriate). Students identify skepticism, bias, methodology, logical reasoning and creativity in scientific investigations.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students seldom recognize dependent, independent and controlled variables; they do not recognize the need for multiple trials. Students are inconsistent in the use of proper equipment and safety techniques to solve problems. Students define skepticism, bias, methodology, logical reasoning and creativity as they apply to scientific investigations.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

SC.7.3.1 compare and contrast the relationship between the parts of a system to the whole system (e.g., take apart or build mechanical, electrical or biological systems).

SC.7.3.2 construct a variety of useful models of an object, event or process.

SC.7.3.3 compare and contrast changes that occur in an object or a system to its original state.

SC.7.3.4 identify the influence that a variation in scale will have on the way an object or system works. (e.g., cooling rates of different-sized containers of water, strength of different-sized constructions from the same material, flight characteristics of different-sized model airplanes).

Performance Descriptors (SC.PD.7.3)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students justify the design models of objects or systems and predict how variables and scale affect their function.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students construct scale models and predict the influences that a variation in scale will have on an object or system.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students design models of objects or systems when given scale and defined variables.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. Students compare models of objects or systems and predict how variables and scale affect their function.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. Students examine models (e.g., physical, pictorial) of objects or systems and realize that changing variables and/or scale affects its function.

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

SC.7.4.1 demonstrate an understanding of the interconnections of biological, earth and space and physical science concepts.

<u>Structure and Function in Living Systems</u>

SC.7.4.2 identify and describe disease causing organisms (such as bacteria, viruses, protozoa, fungi) and the diseases they cause.

SC.7.4.3 explain how the skeletal, muscular and integumentary systems work together in the human body.

SC.7.4.4 compare the level of organization of cells, tissues and organs in living things.

SC.7.4.5 construct simple keys to differentiate among living things with similar characteristics.

SC.7.4.6 use pictures to show cyclical processes in nature (e.g., water cycle, nitrogen cycle, and carbon cycle).

<u>Life Cycles of Organisms: Reproduction and Heredity</u>

SC.7.4.7 evaluate how the different adaptations and life cycles of plants and animals help them to survive in different niches and environments (e.g., inherited and acquired adaptations).

SC.7.4.8 analyze how changes in the environment have led to reproductive adaptations through natural selection.

SC.7.4.9 relate how an organism's behavior response is a combination of heredity and environment.

SC.7.4.10 analyze the differences in the growth, development and reproduction of flowering and non-flowering plants.

<u>Populations and Ecosystems</u>

SC.7.4.11 predict the trends of interdependent populations if one of the limiting factors is changed.

SC.7.4.12 evaluate the consequences of the introduction of chemicals into the ecosystem (e.g., environmental consequences, human health risks, mutations).

<u>Structure and Properties of Matter</u>

SC.7.4.13 differentiate among elements, compounds, homogeneous and heterogeneous mixtures.

SC.7.4.14 evaluate types of solutions (e.g., solutes and solvents relative concentrations, conductivity, pH).

<u>Chemical Reactions</u>

SC.7.4.15 study chemical reactions involving acids and bases by monitoring color changes of indicator(s) and identifying the salt formed in the neutralization reaction.

SC.7.4.16 write word equations to describe chemical reactions.

Energy

SC.7.4.17 describe the behavior of individual particles and verify the conservation of matter (e.g., melting and freezing of pure substances).

SC.7.4.18 trace the energy flow during phase changes

SC.7.4.19 define characteristics of light and sound waves and describe how sound is perceived by the ear and light is perceived by the eye.

SC.7.4.20 investigate application of lenses to science (e.g., microscopes, telescopes, magnifying glass, periscopes).

SC.7.4.21 identify characteristics of AC and DC circuits.

SC.7.4.22 explain conservation of matter and energy qualitatively and recognize that energy can be changed from one form to another.

Motion and Forces

SC.7.4.23 perform experiments with simple machines to demonstrate the relationship between forces and distance; use vectors to represent motion.

SC.7.4.24 explain the effect of gravity on falling objects (e.g., g= 9.8m/s^2, object dropped on earth and on moon).

SC.7.4.25 analyze motion graphically and use vectors to represent direction of motion.

Structure of the Earth System

SC.7.4.26 depict and relate causes of tides, surfs and currents.

SC.7.4.27 examine the relationships among air masses, oceans, weather, convection currents and the sun's energy.

SC.7.4.28 interpret and create topographical maps.

Earth's History

SC.7.4.29 compare and contrast periods of geologic time using rocks and rock layers.

Earth and the Solar System

SC.7.4.30 explain and model using manipulatives how the Earth's tilt and revolution determine the seasonal changes and weather patterns.

SC.7.4.31 recognize the changes involved in the life cycle of a star.

SC.7.4.32 describe and compare the physical characteristics of celestial objects.

SC.7.4.33 compare the characteristics of the members of our solar system.

Performance Descriptors (SC.PD.7.4)

* **Distinguished**

  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

  * Structure and Function in Living Systems
  * Life cycles of Organisms: Reproduction and Heredity
  * Populations and Ecosystems
  * Structure and Properties of Matter
  * Chemical Reactions
  * Energy
  * Motion and Forces
  * Structure of the Earth System
  * Earth's History
  * Earth and the Solar System

  Students analyze interconnections among the above categories.

* **Above Mastery**

  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

  * Structure and Function in Living Systems

* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Chemical Reactions
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students explain interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Chemical Reactions
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students identify interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students demonstrate knowledge of the objectives in standard 4 in the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Chemical Reactions
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students identify interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts.** Performance needs considerable development. Students demonstrate incomplete knowledge of the objectives in standard 4 in the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Chemical Reactions
* Energy
* Motion and Forces

* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students seldom identify interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

SC.7.5.1 make and compare different proposed solutions to an identified problem in light of specified criteria.

SC.7.5.2 test and evaluate different types of materials and/or design approaches in building objects or completing tasks.

Performance Descriptors (SC.PD.7.5)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students propose and defend alternative materials for use in natural and designed systems.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students analyze the properties and characteristics of materials that make them appropriate for use in natural and designed systems.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students predict the consequences of using inappropriate materials in natural and designed systems.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students identify inappropriate materials for use in natural and designed systems.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application.** Performance needs considerable development. Students name some of the materials that have been used in natural and designed structures.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;

* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

SC.7.6.1 use scientific reasoning and the knowledge of science and technology to make informed personal decisions at the local and global levels.

SC.7.6.2 evaluate and critically analyze mass media reports of scientific developments and events.

SC.7.6.3 critically analyze the effects and impacts of science and technology on global and local problems (e.g., mining, manufacturing, recycling, farming, water quality).

SC.7.6.4 explore the connections between science, technology, society and career opportunities.

SC.7.6.5 analyze the positive and negative effects of technology on society and the influence of societal pressures on the direction of technological advances.

Performance Descriptors (SC.PD.7.6)

* **Distinguished**
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students analyze and evaluate effects of science/technology/society on global and local problems.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students describe the science/technology/society effects on a global or local problem.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students identify the science/technology/society effects on a global or local problem.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students can match science/technology/society effects with global or local problems.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives.** Performance needs considerable development. Students relate science/technology/society effects to global or local problems.

Eighth Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Eight objectives analyze, quantify, and explain conditions and phenomena of the living and designed worlds. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy in the fields of biology, chemistry, physics and earth and space sciences. 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% of the

instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. CATS Eight reviews elements, mixtures, and compounds, populations/ecosystems, conservation of matter and energy and earth's history. Major concepts introduced at the eighth grade level include reproduction, genetics, behavior, chemical reactions and environmental concerns. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

SC.8.1.1 realize that scientists formulate and test their explanations of nature using observation, experiments and theoretical models.
SC.8.1.2 recognize and appreciate that scientific knowledge is subject to modification as new scientific information challenges current theories.
SC.8.1.3 examine the careers and contributions of men and women of diverse cultures to the development of science.
SC.8.1.4 articulate the historical significance of scientific discoveries as influenced by technological demands, competition, controversy, world events, personalities and societal issues.

Performance Descriptors (SC.PD.8.1)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students predict the response the scientific community would choose given a hypothetical historical setting. Students identify the educational experiences needed to enter a specified science career.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students evaluate choices made by the scientific community in response to the historical setting. Students can select discipline specific activities when given a chosen science-related career.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students recall and relate the response of the scientific community to a specific historical setting. Students provide evidence of how careers relate to scientific fields of study.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students relate the response of the scientific community to a specific historical setting. Students identify careers when given a scientific field of study.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science.** Performance needs considerable development. Students recognize that scientific discovery is influenced by the historical climate. Students match careers with specific scientific fields of study.

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Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:

SC.8.2.1 cooperate and collaborate to ask questions, find answers, solve problems, conduct investigations to further an appreciation of scientific discovery.
SC.8.2.2 formulate conclusions through close observations, logical reasoning, objectivity, perseverance and integrity in data collection.
SC.8.2.3 apply skepticism, careful methods, logical reasoning and creativity in investigating the observable universe.
SC.8.2.4 use a variety of materials and scientific instruments to conduct explorations, investigations and experiments of the natural world (e.g., barometer, anemometer, microscope, computer).
SC.8.2.5 demonstrate safe techniques for handling, manipulating and caring for science materials, equipment, natural specimens and living organisms.
SC.8.2.6 utilize experimentation to demonstrate scientific processes and thinking skills (e.g., formulating questions, predicting, forming hypotheses, quantifying, identifying dependent and independent variables).
SC.8.2.7 construct and use charts, graphs and tables to organize, display, interpret, analyze and explain data.
SC.8.2.8 use appropriate technology solutions to gather, graph and interpret data and analyze information.
SC.8.2.9 use inferential reasoning to make logical conclusions from collected data.

Performance Descriptors (SC.PD.8.2)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students can design an experiment that solves a problem; collect, organize and graph the data applying the measurement of central tendency and frequency to draw conclusions. Students can explain and relate dependent, independent, and controlled variables. Students apply safety techniques and use proper equipment to solve the problem (Science Subject Matter/Concept appropriate). Students, when given a completed scientific investigation, critically evaluate the motives and identify the role of skepticism, recognizing bias, methodology, logical reasoning and creativity in scientific investigations.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students perform experiments and will organize, graph, analyze data and draw conclusions from data collected; calculate measures of central tendency (mean, median, mode) and frequency. Students can explain and relate dependent, independent, and controlled variables. Students apply safety techniques and use proper equipment to solve problems (Science Subject Matter/Concept appropriate). Students predict the impact of skepticism, bias, methodology, logical reasoning and creativity on scientific investigations.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students perform experiments and will organize, graph, analyze data, and draw conclusions from data collected in experiments. Students can explain and relate dependent, independent, and controlled variables. Students apply safety techniques and use proper equipment to solve problems (Science Subject Matter/Concept appropriate). Students describe the influence that skepticism, bias, methodology, logical reasoning and creativity have on scientific investigations.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students can organize, graph, and form conclusions from given data. Students identify independent, dependent, controlled variables. Students routinely apply safety techniques and use proper equipment to solve problems (Science Subject Matter/Concept appropriate). Students can match the effects of skepticism, recognizing bias, methodology, logical reasoning and creativity with results in scientific investigations.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students have a beginning knowledge of organizing, graphing, and forming conclusions from given data. Students are beginning to identify independent, dependent, controlled variables. Students are inconsistent in the application of safety techniques use proper equipment to solve problems (Science Subject Matter/Concept appropriate). Students identify skepticism, bias, methodology, logical reasoning and creativity in scientific investigations.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

SC.8.3.1 compare and contrast the relationship between the parts of a system to the whole system (e.g., take apart or build mechanical, electrical, or biological systems).

SC.8.3.2 construct a variety of useful models of an object, event, or process.

SC.8.3.3 compare and contrast changes that occur in an object or a system to its original state.

SC.8.3.4 identify the influence that a variation in scale will have on the way an object or system works. (e.g., cooling rates of different-sized containers of water, strength of different-sized constructions from the same material, flight characteristics of different-sized model airplanes).

Performance Descriptors (SC.PD. 8.3)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students provide evidence to justify the appropriateness of a design of model of an object or system and design methods to demonstrate how variables and scale affect their function.

* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students evaluate the design of models of objects or systems and predict how variables and scale affect their function.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students construct scale models and predict the influences that a variation in scale will have on an object or system.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. Students design models of objects or systems when given scale and defined variables.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. Students compare scale models of an object or system. Students describe the effects of variation in scale on the object or system.

Standard 4: Science Subject Matter/Concepts (SC.S.4)
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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives
Students will:
SC.8.4.1 demonstrate an understanding of the interconnections of biological, earth and space, and physical science concepts.

<u>Structure and Function in Living Systems</u>
SC.8.4.2 identify and explain the structures and functions of cell organelles.
SC.8.4.3 explain how the circulatory, respiratory and reproductive systems work together in the human body.
SC.8.4.4 compare the variations in cells, tissues and organs of the circulatory, respiratory and reproductive systems of different organisms.
SC.8.4.5 demonstrate how living cells obtain the essentials of life through chemical reactions of transpiration, respiration and photosynthesis.

<u>Life Cycles of Organisms: Reproduction and Heredity</u>
SC.8.4.6 analyze how behaviors of organisms lead to species continuity (e.g., reproductive/mating behaviors, seed dispersal).
SC.8.4.7 demonstrate the basic principles of genetics to include Mendel's laws, DNA, monohybrid crosses, production of sperm and egg, production of body cells, genes, chromosomes, inherited traits.
SC.8.4.8 examine how patterns of human development are similar to other vertebrates.

<u>Populations and Ecosystems</u>
SC.8.4.9 group unknown organisms based on observable characteristics (e.g., use dichotomous keys).
SC.8.4.10 trace matter and energy flow in a food web as it goes from sunlight to producers to consumers, design an environment in which the chemical and energy needs for the growth, reproduction and development of plants are met (e.g., food pyramids, decomposition).

Structure and Properties of Matter

SC.8.4.11 use the periodic table to locate and classify elements as metallic, non-metallic or metalloid.

SC.8.4.12 trace the development of the model of the atom (e.g., Crookes, Thompson, Becquerel, Rutherford, Bohr).

SC.8.4.13 determine the number of protons, neutrons and electrons and use information to draw a Bohr model of the atom.

SC.8.4.14 assign an element to its chemical family on the periodic table and note similarities in outer energy level electrons within each family.

SC.8.4.15 evaluate gaseous systems noting the variation in diffusion rates and examine the expansion of gases at elevated temperatures.

Chemical Reactions

SC.8.4.16 conduct and classify chemical reactions by reaction type (synthesis, decomposition, single replacement or double replacement); energy type (endothermic and exothermic); and write word equations for the chemical reactions**.**

SC.8.4.17 identify chemical reaction factors that might affect the reaction rates including catalysts, temperature changes, light energies and particle size.

Energy

SC.8.4.18 identify types of energy and their sources (e.g., petroleum refinement, windmills, geothermal).

SC.8.4.19 interpret and illustrate changes in waves as they pass through various mediums (e.g., sound through water and metal, light through thicknesses of glass)**.**

SC.8.4.20 apply the conservation of energy theory to energy transformations (e.g., electrical/heat, heat/mechanical).

SC.8.4.21 quantitatively represent work, power, pressure (e.g., W=fd, P=W/t, pressure =force/area)**.**

Motion and Forces

SC.8.4.22 graph and interpret the relationships (e.g., distance versus time, speed versus time, acceleration versus time).

SC.8.4.23 describe Newton's Laws of Motion; identify examples; illustrate qualitatively and quantitatively drawing vector quantities.

SC.8.4.24 illustrate quantitatively mechanical advantage of simple machines.

Structure of the Earth System

SC.8.4.25 summarize problems related to water on earth as a life sustaining substance (e.g., quality and quantity of surface and ground water).

SC.8.4.26 identify the principle forces of plate tectonics and related geological events.

SC.8.4.27 relate global patterns of atmospheric movement on local weather and the impact of oceans on weather and climate.

Earth's History

SC.8.4.28 relate rock formations to the types of fossil fuels.

SC.8.4.29 describe the factors involved in mining resources.

SC.8.4.30 construct and interpret rock layer models through stratigraphic interpretation.

Earth and the Solar System

SC.8.4.31 recognize societal concerns with exploration and colonization of space.

SC.8.4.32 diagram the motions of the Sun, Moon and Earth and explain the phenomena associated with these motions (e.g., glacial periods, eclipses, tides, meteor showers).

SC.8.4.33 compare and contrast the orbits of planets and comets.

SC.8.4.34 compare and contrast the different types of galaxies (e.g., shape, size, components).

Performance Descriptors (SC.PD.8.4)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

* Structure and Function in Living Systems

* Life cycles of Organisms: Reproduction and Heredity

* Populations and Ecosystems
* Structure and Properties of Matter
* Chemical Reactions
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students analyze interconnections among the above categories.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Chemical Reactions
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students explain interconnections among the above categories

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in standard 4 of the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Chemical Reactions
* Energy
* Motion and Forces
* Structure of the Earth System
* Earth's History
* Earth and the Solar System

Students identify interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students demonstrate knowledge of the objectives in standard 4 in the following categories:

* Structure and Function in Living Systems
* Life cycles of Organisms: Reproduction and Heredity
* Populations and Ecosystems
* Structure and Properties of Matter
* Chemical Reactions
* Energy
* Motion and Forces
* Structure of the Earth System

- Earth's History
- Earth and the Solar System

Students identify interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts.** Performance needs considerable development. Students demonstrate incomplete knowledge of the objectives in standard 4 in the following categories:

- Structure and Function in Living Systems
- Life cycles of Organisms: Reproduction and Heredity
- Populations and Ecosystems
- Structure and Properties of Matter
- Chemical Reactions
- Energy
- Motion and Forces
- Structure of the Earth System
- Earth's History
- Earth and the Solar System

Students seldom identify interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
- demonstrate the ability to distinguish between natural and man-made objects;
- demonstrate abilities of technological design; and
- demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

SC.8.5.1 research applications of space technology in everyday life (e.g., Velcro, Teflon, weather satellites).
SC.8.5.2 compare scientific inquiry and technological design processes.
SC.8.5.3 explain why no technological design is perfect (e.g., constraints lead to tradeoffs).
SC.8.5.4 design and construct engineering solutions to problems according to specified constraints.

Performance Descriptors (SC.PD.8.5)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students evaluate the appropriateness of materials and procedures in natural and designed systems and suggest alternatives.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students analyze the properties and characteristics in natural and designed systems.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students describe the properties and characteristics of materials that make them well suited to specific natural and designed systems.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs

further development. Students identify the properties and characteristics of materials in a natural or designed system.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application**. Performance needs considerable development. Students name some of the materials that have been used in a natural or designed system.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

SC.8.6.1 use scientific reasoning and the knowledge of science and technology to make informed personal decisions at the local and global levels.

SC.8.6.2 evaluate and critically analyze mass media reports of scientific developments and events.

SC.8.6.3 critically analyze the effects and impacts of science and technology on global and local problems (e.g., mining, manufacturing, recycling, farming, water quality).

SC.8.6.4 explore the connections between science, technology, society and career opportunities.

SC.8.6.5 analyze the positive and negative effects of technology on society and the influence of societal pressures on the direction of technological advances.

Performance Descriptors (SC.PD.8.6)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students design a strategy to counteract the negative effects of science/technology/society on a global or local problem.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students analyze and evaluate effects of science/technology/society on global and local problems.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students describe the science/technology/society effects on a global or local problem.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students identify the science/technology/society effects on a global or local problem.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social**

perspectives. Performance needs considerable development. Students can match science/technology/society effects with global or local problems.

Ninth Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Nine objectives continue the development of foundational knowledge in biology, chemistry, physics, and the earth and sciences. Through a spiraling, inquiry-based program of study, all students will demonstrate scientific literacy 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 CATS Eight, students in CATS Nine will expand and deepen their understanding of major concepts such as energy interactions, genetic probabilities, chemical changes and mineral composition of local rock layers. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

SC.9.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.
SC.9.1.2 recognize that science has practical and theoretical limitations.
SC.9.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.
SC.9.1.4 conclude that science is a blend of creativity, logic and mathematics.
SC.9.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.

Performance Descriptors (SC.PD.9.1)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students evaluate experimental data in comparison to predicted results derived by scientific laws and explanations. Measures of variance and sources of error should be determined.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students use appropriate scientific laws or explanations to analyze a set of data or observations.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing

consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students select the scientific laws or explanations that would be appropriate for evaluating a set of data or observations.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students will name and describe some scientific laws.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science.** Performance needs considerable development. Students will name or describe a scientific law.

Standard 2: Science as Inquiry (SC.S.2)

Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives

Students will:

SC.9.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).

SC.9.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).

SC.9.2.3 apply scientific approaches to seek solutions for personal and societal issues.

SC.9.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.

SC.9.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).

SC.9.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and to present and communicate conclusions.

SC.9.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives and applying).

SC.9.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument).

Performance Descriptors (SC.PD.9.2)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students design and conduct investigations, collect data, graph trends in the data, identify patterns in the experimental results within the context of scientific theory. Investigations will be evaluated for safety and ethics.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students conduct investigations, collect data, graph the data and use the experimental evidence to draw conclusions.

Investigations will be performed in a safe and ethical manner.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students conduct investigations, collect data, represent the data in appropriate graphical form. Investigations will be performed in a safe and ethical manner.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students conduct safe and ethical investigations from a stepwise set of laboratory instructions. Data collected will be accurately recorded.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students participate in investigations in a safe manner and collect data.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order, and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

SC.9.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.

SC.9.3.2 apply evidence from models to make predictions about interactions and changes in systems.

SC.9.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

SC.9.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Performance Descriptors (SC.PD.9.3)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. The student will interpret multiple graphical representations of data to predict changes including the relationship between independent and dependent variables.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. The student will make predictions about a set of experimental data using graphical representations.

Standard 4: Science Subject Matter/Concepts

l:

trate knowledge, understanding and applications of scientific facts, concepts, principles, theories and as delineated in the objectives;

trate an understanding of the interrelationships among physics, chemistry, biology and the earth and ciences; and

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. The student will accurately locate specific data points on a graph of collected data.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. The student will identify changes in data as presented by a line graph.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. The student will demonstrate that graphs may be pictorial representations of numbers.

* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives (SC.S.4)

Students will:

SC.9.4.1 demonstrate an understanding of the interconnections of biological, earth/space and physical science concepts.

<u>The Cell and Molecular Basis for Heredity</u>

SC.9.4.2 analyze and explain the principles of genetics (e.g., monohybrid and dihybrid crosses, mutations, genotypes, phenotypes, X and Y chromosomes, multiple alleles, DNA, probability, diversity).

SC.9.4.3 illustrate meiosis and mitosis and relate to chromosome number and production of sperm, egg and body cells.

<u>The Interdependence of Organisms</u>

SC.9.4.4 mathematically illustrate changes in populations of organisms.

SC.9.4.5 identify and describe microscopic organisms and foreign substances in the environment and their harmful effects (e.g., microorganisms, mutagens, carcinogens).

SC.9.4.6 design an environment that demonstrates the interdependence of plants and nals (e.g., energy and chemical cycles, adaptations of structures and behaviors).

<u>Matter, Energy, and Organization in Living Systems</u>

SC.9.4.7 explain how excretory, digestive systems work together in the human body.

SC.9.4.8 identify and compare the structure and function of cell, tissues and systems of different organisms.

SC.9.4.9 identify the organisms and the chemical processes involved in the decay of materials.

SC.9.4.10 trace the transfer of matter and energy in the chemical/molecular processes of photosynthesis, respiration and fermentation.

<u>Structure and Properties of Matter</u>

SC.9.4.11 using the element's position on the Periodic Table, predict physical and chemical properties.

SC.9.4.12 describe the characteristics of radioactivity substances including alpha particles, beta particles and gamma rays; the half life of a radioactive isotope; a chain reaction; and differentiate between fission and fusion.

SC.9.4.13 investigate the relationship between the density of an object, its mass, and its volume.

SC.9.4.14 investigate physical states of matter including descriptions of the behavior of atoms and molecules in terms of the Kinetic Molecular Theory.

<u>Chemical Reaction</u>

SC.9.4.15 write formulas and name compounds given oxidation numbers of monatomic and polyatomic ions.

SC.9.4.16 identify the various types of chemical bonds and the resulting compounds that are formed (e.g., ionic, nonpolar covalent, polar covalent).
SC.9.4.17 experimentally determine the products of chemical reactions; write balanced chemical equations; classify type of reaction; and describe energy changes.

Energy

SC.9.4.18 identify, describe and differentiate various forms of energy and energy transformations.
SC.9.4.19 relate absorption and dissipation of heat to the composition of a material.
SC.9.4.20 demonstrate and diagram a magnetic field using bar magnets and iron fillings.
SC.9.4.21 hypothesize and experiment when different components are substituted in an electrical circuit; define and solve electrical problems involving potential difference, Ohm's Law and power.

Motions and Forces

SC.9.4.22 relate the forces between charged objects to the charge on the objects and the distance between them.
SC.9.4.23 review foundational concepts of kinematics (e.g., speed-distance-time relationships) and dynamics (e.g., Newton's Laws, simple machines).
SC.9.4.24 experiment with a pendulum to determine which variables (amplitude, mass, length) will affect the motion of the pendulum.
SC.9.4.25 investigate types of waves and their properties including interference, diffraction, resonance; differences and similarities between transverse and longitudinal waves; wave equation to determine the relationships among speed, wavelength and frequency.

Energy in the Earth System

SC.9.4.26 investigate formation and destruction of landforms.
SC.9.4.27 demonstrate the relationships of temperature, air pressure, wind speed, wind direction and humidity as elements of weather.
SC.9.4.28 compare and analyze the characteristics of oceans, including their lateral and vertical motions.

Geochemical Cycles

SC.9.4.29 employ a variety of tests to identify common rock-forming minerals.
SC.9.4.30 analyze and describe common rock samples using grain size and shape, and mineral composition.
SC.9.4.31 use models to describe interactive cycles such as the water, the nitrogen and the carbon dioxide cycles.

Origin and Changes in the Earth Systems and Universe

SC.9.4.32 examine how scientists use seismographic evidence in determining structure and composition of the Earth's interior.
SC.9.4.33 determine the relative age of materials using time-stratigraphic and bio-stratigraphic relationships.
SC.9.4.34 estimate the absolute age of materials using existing radioisotropic data.
SC.9.4.35 describe the effects of the movement of subsurface water.
SC.9.4.36 relate changes in the Earth's surface to the motion of lithospheric plates.
SC.9.4.37 summarize and discuss the evidentiary basis for the Theory of Plate Tectonics.
SC.9.4.38 research and describe the life cycles of various stellar types.
SC.9.4.39 interpret topographic maps, weather maps and charts, and astronomical models such as solar systems, galaxies, constellations, stellar types and stellar evolution.

Performance Descriptors (SC.PD.9.4)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge, applications and interconnections of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Interdependence of Organisms

Matter, Energy, and Organization in Living Things
Structures and Properties of Matter
Chemical Reaction
Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Changes in the Earth Systems and Universe

Students analyze interconnections among the above categories.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Interdependence of Organisms
Matter, Energy, and Organization in Living Things
Structures and Properties of Matter
Chemical Reaction
Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Changes in the Earth Systems and Universe

Students generate and explain interconnections among the above categories.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students demonstrate knowledge of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Interdependence of Organisms
Matter, Energy, and Organization in Living Things
Structures and Properties of Matter
Chemical Reaction
Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Changes in the Earth Systems and Universe

Students draw conclusions about interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students demonstrate limited knowledge of some of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Interdependence of Organisms
Matter, Energy, and Organization in Living Things
Structures and Properties of Matter
Chemical Reaction
Energy

Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Changes in the Earth Systems and Universe

Students identify interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts.** Performance needs considerable development. Students demonstrate incomplete knowledge of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Interdependence of Organisms
Matter, Energy, and Organization in Living Things
Structures and Properties of Matter
Chemical Reaction
Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Changes in the Earth Systems and Universe

Students seldom identify interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

SC.9.5.1 identify the scientific concepts underlying simple technological innovations**.**

SC.9.5.2 cite examples of the interdependence of science and technology (e.g., new technologies have lead to development of new scientific knowledge).

SC.9.5.3 apply scientific skills and technological tools to design a solution that addresses a personal or societal need.

SC.9.5.4 analyze the consequences of imposed constraints on an engineering solution.

Performance Descriptors (SC.PD.9.5)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students develop proposed alterations in natural and designed systems and evaluate consequences of these changes.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students analyze multiple effects of an alteration to a component of natural and designed systems.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students describe the consequences of alterations to natural and designed systems.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students identify alterations that have occurred in natural and designed systems.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application**. Performance needs considerable development. Students list natural and designed systems.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

SC.9.6.1 research uses and values of natural resources.

SC.9.6.2 research current environmental issues (e.g., effects of pollution, solid waste management, local, national, and global issues).

SC.9.6.3 describe the impact of cultural, technological, and economic influences on the evolving nature of scientific thought and knowledge.

SC.9.6.4 explore occupational opportunities in science and technology including the academic preparation necessary.

SC.9.6.5 engage in decision making activities and actions to resolve science-technology-society issues.

Performance Descriptors (SC.PD.9.6)

* **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students evaluate public policy decisions affecting health practices, population changes, resource utilization and environmental practices from the multiple perspectives.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students describe how public policy decisions impact health practices, population changes, resource utilization and environmental practices.

* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students identify public policy decisions that impact health practices, population changes, resource utilization and environmental practices.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students identify a policy decision that has impacted health practices, population changes, resource utilization or environmental practices.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives.** Performance needs considerable development. Students state that a health practice, population change, resource utilization or environmental practice may be affected by outside causes.

Tenth Grade Science Content Standards and Objectives

The Coordinated and Thematic Science (CATS) Ten objectives conclude the development of foundational knowledge of biology, chemistry, physics, and the earth and space sciences. Through the spiraling, inquiry-based program of study, all students will demonstrate scientific literacy across these major fields of science. 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 CATS Nine, students in CATS Ten 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. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:
* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:
SC.10.1.1 formulate scientific explanations based on historical observations and experimental evidence, accounting for variability in experimental results.
SC.10.1.2 recognize that science has practical and theoretical limitations.
SC.10.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.
SC.10.1.4 conclude that science is a blend of creativity, logic and mathematics.
SC.10.1.5 trace the development of key historical concepts and principles describing their impact on

modern thought and life by identifying the scientist's contributions.

Performance Descriptors (SC.PD.10.1)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students evaluate the development in scientific knowledge and changes in society as a whole and how the specific change affects daily life.

*** Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **history and the nature of science**. Students explain how technological and societal advancements affect the progression of scientific thought.

*** Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **history and the nature of science**. Students identify major events and the work of major contributors in the development of a scientific thought.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **history and the nature of science**. Performance needs further development. Students describe the components of a scientific explanation (e.g., students should cite several models of the atom leading to the current theory).

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **history and the nature of science**. Performance needs considerable development. Students state that scientific models, theories and ideas have changed over time.

Standard 2: Science as Inquiry (SC.S.2)

Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives

Students will:

SC.10.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).

SC.10.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).

SC.10.2.3 apply scientific approaches to seek solutions for personal and societal issues.

SC.10.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.

SC.10.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).

SC.10.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and present and communicate conclusions.

SC.10.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, and applying).

SC.10.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument).

Performance Descriptors (SC.PD.10.2)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science as inquiry**. Students design and conduct investigations, collect data, graph trends in the data, identify central tendency and variance and explain the experimental results within the context of scientific theory. Investigations will be evaluated for safety and ethics.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science as inquiry**. Students conduct investigations, collect data, graph the data and use the experimental evidence to draw conclusions. Investigations will be performed in a safe and ethical manner.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science as inquiry**. Students conduct investigations, collect data, represent the data in appropriate graphical form. Investigations will be performed in a safe and ethical manner.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science as inquiry**. Performance needs further development. Students conduct safe and ethical investigations from a stepwise set of laboratory instructions. Data collected will be accurately recorded.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science as inquiry.** Performance needs considerable development. Students participate in investigations in a safe manner and collect data.

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order, and organization; evidence, models, and explanation; constancy, change, and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze, and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

SC.10.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.

SC.10.3.2 apply evidence from models to make predictions about interactions and changes in systems.

SC.10.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

SC.10.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Performance Descriptors (SC.PD.10.3)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students model changes in data using a variety of graphical and mathematical techniques. Students interpolate and extrapolate beyond observed data to make predictions.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **unifying themes of science**. Students interpret a variety of graphical representations to predict changes in data including the relationship between independent and dependent variables.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **unifying themes of science**. Students accurately draw a line graph to represent a simple set of collected data.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **unifying themes of science**. Performance needs further development. Students identify some differences in graphs of different data sets.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **unifying themes of science.** Performance needs considerable development. Students demonstrate that graphs can represent collected data.

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

SC.10.4.1 demonstrate an understanding of the interconnections of biological, earth and space and physical science concepts.

<u>The Cell and Molecular Basis for Heredity</u>

SC.10.4.2 identify and explain the structure and function of cell organelles (e.g., Golgi bodies, endoplasmic reticulum, mitochondria, chloroplasts, ribosomes, lysosomes, vacuoles).

SC.10.4.3 compare the variations in cells, tissues and organs of different organisms (e.g., endocrine, nervous, digestion and immune systems).

SC.10.4.4 identify mechanisms for the movement of materials into and out of cells (e.g., active and passive transport, endo- and exocytosis).

SC.10.4.5 explore the discovery of DNA and its structure by constructing a model to demonstrate the nucleotide bonding and the double helix structure.

SC.10.4.6 relate the role of DNA analysis to genetic disorders, forensic science, molecular genetics, and biotechnology (e.g., protein synthesis, heredity, cell division, cellular functions).

SC.10.4.7 review principles of genetics (e.g., number of chromosomes, mutations, crossover, Punnett squares, linkage).

<u>Evolution and Interdependence of Organisms</u>

SC.10.4.8 compare the embryonic development of invertebrate and vertebrate animals (e.g., ontogeny and phylogeny, diversity, taxonomy).

SC.10.4.9 construct and manipulate models which show variations in living things.

SC.10.4.10 recognize that fossil records provide a scientific explanation for variation in the species and common ancestors.
SC.10.4.11 relate the role of natural selection to the development, diversity and or extinction of a species.

Matter, Energy, and Organization in Living Systems

SC.10.4.12 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.10.4.13 explain how the nervous, endocrine and immune systems work together in the human body.
SC.10.4.14 review the needs of growing plants and the environments supplying those needs.
SC.10.4.15 review factors that affect succession, populations and communities (e.g., use maps, graphs, charts, tables).
SC.10.4.16 trace matter and energy flow through the respiration process (e.g., ATP, carbon, oxygen, water).

Structure and Properties of Matter

SC.10.4.17 investigate the properties of solutions including density, conductivity, solubility, concentration, pH and colligative properties.

Chemical Reaction

SC.10.4.18 differentiate among physical, chemical and nuclear changes and reactions.

Energy

SC.10.4.19 investigate 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.10.4.20 investigate and measure changes in thermal energy in physical and chemical changes.
SC.10.4.21 compare and contrast the characteristics and uses of waves in various parts of the electromagnetic spectrum; calculate the frequency of a particular wavelength.
SC.10.4.22 summarize the relationship between frequency and speed (e.g., Doppler effect).
SC.10.4.23 qualitatively explain the relationship between electricity and magnetism and describe how electrical components of a circuit function.
SC.10.4.24 qualitatively and quantitatively describe the conservation of energy (e.g., thermal, chemical, mechanical).

Motions and Forces

SC.10.4.25 apply Newton's Laws of Motion to depict the relationship among rate, force, momentum, work, and time using kinematics graph and mathematical models.
SC.10.4.26 describe and quantify how machines can provide mechanical advantages.
SC.10.4.27 determine the effect of different forces on vibrating systems (e.g., pendulums, springs).
SC.10.4.28 demonstrate qualitative and quantitative understanding of pressure in various systems (e.g., water pipes, circuits, blood vessels).

Energy in the Earth System

SC.10.4.29 relate the characteristics and behavior of mechanical waves to earth processes (e.g., explain the formation of water waves as a function of wind velocity, duration, and fetch).
SC.10.4.30 relate the cause of tides to their height and frequency.
SC.10.4.31 investigate effects of geological events on weather and climate (e.g., ocean currents and atmospheric conditions).
SC.10.4.32 observe and describe the effects of water on the earth's surface (e.g., changes in particle size, slope, velocity).
SC.10.4.33 relate Earth's electromagnetic field to the dynamics of the magnetosphere.
SC.10.4.34 discuss theories for the causes of plate tectonics.

Geochemical Cycles

SC.10.4.35 discuss physical and chemical relationships between minerals in rock cycle.

Origin and Evolution in the Earth Systems and Universe

SC.10.4.36 investigate fossils as evidence for evolution and indicators of paleo-environments.

SC.10.4.37 compare and contrast morphological features of fossils to present-day organisms.

SC.10.4.38 use fossil evidence to estimate the relative and absolute ages of rock layers.

SC.10.4.39 compare and contrast the characteristics of Earth and the other planets relative to their distance from the Sun.

SC.10.4.40 interpret apparent motion of constellations and their relationship to the rotation of the earth.

Performance Descriptors (SC.PD.10.4)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge, applications and interconnections of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Evolution and Interdependence of Organisms
Matter, Energy, and Organization in Living Systems
Structure and Properties of Matter
Chemical Reaction
Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Evolution in the Earth Systems and Universe

Students analyze interconnections among the above categories.

*** Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science subject matter/concepts**. Students demonstrate knowledge and applications of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Evolution and Interdependence of Organisms
Matter, Energy, and Organization in Living Systems
Structure and Properties of Matter
Chemical Reaction
Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Evolution in the Earth Systems and Universe

Students generate and explain interconnections among the above categories.

*** Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science subject matter/concepts**. Students demonstrate knowledge of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Evolution and Interdependence of Organisms
Matter, Energy, and Organization in Living Systems
Structure and Properties of Matter
Chemical Reaction

Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Evolution in the Earth Systems and Universe

Students draw conclusions about interconnections among the above categories.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science subject matter/concepts**. Performance needs further development. Students demonstrate limited knowledge of some of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Evolution and Interdependence of Organisms
Matter, Energy, and Organization in Living Systems
Structure and Properties of Matter
Chemical Reaction
Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Evolution in the Earth Systems and Universe

Students identify interconnections among the above categories.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science subject matter/concepts**. Performance needs considerable development. Students demonstrate incomplete knowledge of the objectives in Standard 4 in the following categories:

The Cell and Molecular Basis for Heredity
Evolution and Interdependence of Organisms
Matter, Energy, and Organization in Living Systems
Structure and Properties of Matter
Chemical Reaction
Energy
Motions and Forces
Energy in the Earth System
Geochemical Cycles
Origin and Evolution in the Earth Systems and Universe

Students seldom identify interconnections among the above categories.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

SC.10.5.1 investigate and analyze the interdependence of science and technology.
SC.10.5.2 research and design solutions to a personal or a societal problem created by technology.
SC.10.5.3 compare and test modifications to an engineering design.
SC.10.5.4 utilize technology to communicate designs, results and conclusions.

Performance Descriptors (SC.PD.10.5)

* Distinguished
  The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **scientific design and application**. Students suggest improvements to structural components of a life, Earth or physical design and indicate how these changes affect the overall function.
* **Above Mastery**
  The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **scientific design and application**. Students analyze how physical and chemical properties of structural components of a life, Earth or physical system affect the function of the system as a whole.
* **Mastery**
  The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **scientific design and application**. Students describe relationships between the structure and function of designs in life, Earth and physical systems.
* **Partial Mastery**
  The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **scientific design and application**. Performance needs further development. Students identify relationships between the structure and function of designs in life, Earth and physical systems.
* **Novice**
  The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **scientific design and application.** Performance needs considerable development. Students name some functional parts of a structure.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

SC.10.6.1 investigate the effects of natural phenomena on the habitat and habitat change.

SC.10.6.2 research current environmental issues (e.g., depletion of fossil fuels, global warming, destruction of rainforest pollution).

SC.10.6.3 describe the impact of cultural, technological, and economic influences on the evolving nature of scientific thought and knowledge.

SC.10.6.4 explore occupational opportunities in science and technology including the academic preparation necessary.

SC.10.6.5 engage in decision making activities and actions to resolve science-technology-society issues.

Performance Descriptors (SC.PD.10.6)

* Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students predict the future societal impact of innovations in health practices, population changes, resource utilization and environmental practices.

* **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in **science in personal and social perspectives**. Students use a variety of perspectives to analyze the societal impact of historical innovations in health practices, population changes, resource utilization and environmental practices.

* **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in **science in personal and social perspectives**. Students describe the societal impact of historical innovations in health practices, population changes, resource utilization and environmental practices.

* **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **science in personal and social perspectives**. Performance needs further development. Students identify some changes in health practices, population changes, resource availability and environmental practices that have had an impact on society.

* **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **science in personal and social perspectives.** Performance needs considerable development. Students list some health practices, population changes, resource utilizations and environmental practices.

Eleventh and Twelfth Grade Science Content Standards and Objectives

Advanced Biology (11/12) Content Standards and Objectives

This is an advanced level course designed for students who have completed Coordinated and Thematic Science (CATS) 10 and 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 CATS 7-10 program. Students interested in health and scientific related careers will build and expand their laboratory skills and experiences. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)

Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;

* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives

Students will:

AB.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.

AB.1.2 recognize that science has practical and theoretical limitations.

AB.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.

AB.1.4 conclude that science is a blend of creativity, logic and mathematics.

AB.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.

AB.1.6 integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.

Standard 2: Science as Inquiry (SC.S.2)

Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives

Students will:

AB.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).

AB.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).

AB.2.3 apply scientific approaches to seek solutions for personal and societal issues.

AB.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.

AB.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).

AB.2.6 use computers and other electronic technologies (e.g., computer, CBL, probe interfaces, laser discs) to collect, analyze and/or report data, interact with simulations, and conduct research.

AB.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, applying).

AB.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument.).

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order, and organization; evidence, models, and explanation; constancy, change, and measurement; equilibrium and evolution; form and function);

* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

AB.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.

AB.3.2 apply evidence from models to make predictions about interactions and changes in systems.

AB.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

AB.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

Chemical Foundations

AB.4.1 review foundational chemical concepts including atomic structure, bonding, chemical reactions, water and pH as they relate to living systems.

AB.4.2 investigate the molecules of life and their function in the living systems.

Cell Function and Genetics

AB.4.3 identify the structure, functions, and interactions of eukaryotic cell organelles and their products.

AB.4.4 analyze the chemistry and structure of the cell membrane as it relates to import and export of molecules necessary for life, exploring osmosis, diffusion, active and passive transport and dialysis.

AB.4.5 research the diversity/uniqueness of cell types (compare differences in prokaryotic/eukaryotic, plant/animal cells; explore nerve cells, blood cells, gametes, etc.).

AB.4.6 explore capture and release of energy as demonstrated by photosynthesis, cellular respiration, fermentation, and the role of coenzymes and vitamins.

AB.4.7 investigate and discuss homeostasis.

AB.4.8 recognize and describe the phases of eukaryotic and prokaryotic cell cycles.

AB.4.9 identify the stages of mitotic and meiotic eukaryotic cell division and explain significance of the stages.

AB.4.10 investigate and discuss DNA as the agent of heredity.

AB.4.11 investigate and discuss the importance of replication and mutation in the diversity of life.

AB.4.12 evaluate the advantages of asexual and sexual reproduction.

AB.4.13 identify Mendel's 1st Law and 2nd Law of Genetics and apply these laws to predict phenotypic and genotypic ratios from mono and dihybrid crosses.

AB.4.14 explore basic phenotypic and genotypic genetics beyond Mendel including such things as incomplete dominance, gene interaction, codominance, multi-alleles, crossing over, genetic recombination; and influences of environment, development, sex and age.

AB.4.15 identify the function of DNA in replication and transfer of the genetic code .

AB.4.16 identify the function of the RNAs; messenger, transfer and ribosomal in the transcription and

translation process of protein formation.
AB.4.17 recognize that differentiation is regulated through the expression of different genes.
AB.4.18 discuss the regulatory process in controlling gene function.
AB.4.19 introduce genetic engineering through current DNA technology practices and the social issues that it raises.
AB.4.20 discuss gene mutations.

Evolution

AB.4.21 discuss evidence of evolution and natural selection, including examples such as peppered moth, fossil records, biogeography, molecular biology and comparative anatomy.
AB.4.22 investigate and discuss that behavioral response is a set of actions determined in part by heredity and in part from experience.
AB.4.23 research pioneers and current authors of evolutionary ideas.

Classification of Organisms

AB.4.24 present overview of the taxonomy and systematics of living organisms comparing DNA as the modern basis of classification to older methods based on morphology.
AB.4.25 discuss reasons why viruses are not included in the modern classification system.

Human Systems

AB.4.26 explore the various systems of the human organism and their interactions.

Environment and Ecosystems

AB.4.27 investigate and discuss responses of organisms to internal and environmental stimuli.
AB.4.28 investigate and discuss that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival.
AB.4.29 investigate and discuss ecology as the interaction of living organisms and their nonliving environment.
AB.4.30 trace the energy flow through an ecosystem.
AB.4.31 investigate and discuss that the number of organisms any environment can support depends on the resources available.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

AB.5.1 summarize technological advances in the biological sciences.
AB.5.2 investigate and analyze the interdependence of science and technology.
AB.5.3 apply scientific skills and technological tools to design solutions that address personal and societal needs.
AB.5.4 describe the scientific concepts underlying technological innovations.
AB.5.5 use appropriate technology solutions to measure and gather data; interpret data; analyze data, and to present and communicate conclusions.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;

* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:

AB.6.1 investigate and discuss the impact that humans may have on the quality of the biosphere such as depletion of the rainforest, pollution of estuaries, strip mining, depletion of fossil fuels and deterioration of ozone layer.
AB.6.2 investigate the effects of natural phenomena on the environment (e.g., oceanographic, meteorologic).
AB.6.3 research current environmental issues (e.g., depletion of fossil fuels, global warming, destruction of rainforest pollution).
AB.6.4 describe the impact of cultural, technological, and economic influences on the evolving nature of scientific thought and knowledge.
AB.6.5 explore occupational opportunities in science and technology including the academic preparation necessary.
AB.6.6 engage in decision making activities and actions to resolve science-technology-society issues.

Biology - Technical Conceptual (11/12) Content Standards and Objectives

This is an advanced level course designed for students who have completed Coordinated and Thematic Science (CATS) 10 and who are interested in the field of technical biology with the scientific knowledge and opportunities to develop the inquiry, problem solving and decision making abilities necessary for their future vocation. Biology - Technical Conceptual (11/12) is an alternative to Advanced Biology (11/12) and is designed to prepare students for technical careers. The course will provide an in-depth study in the chemical nature of life, cellular functions, microbiology, ecology, biotechnology, zoology and botany with application emphasis. It builds on the fundamental concepts developed in CATS 7-10 in a rigorous and integrated manner. Students will engage in active inquires, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

BTC.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.
BTC.1.2 recognize that science has practical and theoretical limitations.
BTC.1.3 recognize that science is based on a set of observations in a testable framework that

demonstrate basic laws that are consistent.

BTC.1.4 conclude that science is a blend of creativity, logic and mathematics.

BTC.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.

BTC.1.6 integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.

Standard 2: Science as Inquiry (SC.S.2)

Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives

Students will:

BTC.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).

BTC.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).

BTC.2.3 apply scientific approaches to seek solutions for personal and societal issues.

BTC.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.

BTC.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).

BTC.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and to present and communicate conclusions.

BTC.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, applying).

BTC.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument).

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

BTC.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or

events.

BTC.3.2 apply evidence from models to make predictions about interactions and changes in systems.

BTC.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

BTC.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

Matter and Energy

BTC.4.1 trace matter and energy transfers occurring during photosynthesis, cell respiration, and fermentation.

BTC.4.2 explore material transport in and out of cells (e.g., diffusion and osmosis).

BTC.4.3 investigate the nature of light in relation to energy transformation in photosynthesis.

BTC.4.4 compare and describe the properties of sound waves and how they affect organisms (e.g., sound pollution, sonography, echolocation and animal vocalization).

BTC.4.5 investigate how electric and magnetic forces affect life.

Chemical Foundations

BTC.4.6 review of foundational chemical concepts including atomic structure, bonding, chemical reactions, water and pH as they relate to living systems.

BTC.4.7 investigate the molecules of life and their function in the living systems.

BTC.4.8 estimate molecular weight through the diffusion of biological stains.

Conservation and Human Impact on the Environment

BTC.4.9 explain common problems related to conservation, use, supply and quality of water.

BTC.4.10 investigate recycling in relation to human consumption of natural resources.

BTC.4.11 describe landfills and sewage treatment facilities and how they work.

BTC.4.12 investigate and analyze the impact that humans have on the quality of the biosphere (e.g., locally, regionally, and globally).

BTC.4.13 use topographic maps and Geographic Information Systems (GIS) to investigate biological systems and patterns (e.g., land use).

BTC.4.14 examine global change over time (e.g., climatic trends, fossil fuel depletion, global warming, ozone depletion).

Populations and Ecosystems

BTC.4.15 investigate interspecific and intraspecific competition.

BTC.4.16 apply sampling techniques to the study of ecosystems.

BTC.4.17 investigate variations in ecosystem productivity.

BTC.4.18 investigate population biology.

BTC.4.19 investigate soil and soil organisms.

BTC.4.20 explain the mechanics of composting.

BTC.4.21 evaluate the effects of large scale use of fungicides and pesticides on the diversity of organisms.

BTC.4.22 discuss and categorize chemical hazards and how they impact life. (e.g., flammable, reactive, poisons, corrosive).

Cell Function and Genetics

BTC.4.23 review the structure and function of cell membranes.

BTC.4.24 review DNA as it relates to mitosis, meiosis and protein synthesis.
BTC.4.25 review basic genetics including incomplete dominance, gene interactions, co-dominance, multiple-alleles, crossing over, genetic recombinations, environmental influences, development, sex and age
BTC.4.26 analyze karyotypes and pedigrees as diagnostic tools.
BTC.4.27 research genetic engineering through current DNA technology and the social and ethical issues that it raises (e.g., bacterial production of human insulin, DNA, cloning, fingerprinting, etc.).
BTC.4.28 analyze gene expression and embryonic development.

Plants

BTC.4.29 compare and contrast hydrophytic, mesophytic and xerophytic plants.
BTC.4.30 investigate the diversity of plants, their habitat, transport system, reproduction and life cycle.
BTC.4.31 investigate methods of plant propagation (e.g., culturing techniques, hydroponics, cloning, grafting, vegetative propagation).
BTC.4.32 research forest-management practices (e.g., clear cutting, selective cutting, pruning, fire ecology).
BTC.4.33 research and evaluate the importance of cultivated and wild plants to human society, economics and the environment.

Animals

BTC.4.34 investigate and analyze animal distribution.
BTC.4.35 research variations in animal reproductive strategies.
BTC.4.36 explain animal behavior.

Life Cycles of Organisms

BTC.4.37 compare the characteristics, structures and life cycles of simple to complex organisms.

Application of Biotechnology Techniques

BTC.4.38 apply techniques of biotechnology to phylogenetics, forensics, paleontology, and human genetics.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

BTC.5.1 summarize technological advances in the biological sciences.
BTC.5.2 investigate and analyze the interdependence of science and technology.
BTC.5.3 apply scientific skills and technological tools to design solutions that address personal and societal needs.
BTC.5.4 describe the scientific concepts underlying technological innovations.
BTC.5.5 use appropriate technology solutions to measure and gather data; interpret data; analyze data; and to present and communicate conclusions.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and

* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:
BTC.6.1 research current environmental issues pertaining to biology.
BTC.6.2 describe the impact of cultural, technological and economic influences on the evolving nature of scientific thought and knowledge.
BTC.6.3 explore occupational opportunities in science and technology including the academic preparation necessary.
BTC.6.4 engage in decision making activities and actions to resolve science-technology-society issues.

Human Anatomy and Physiology (11/12) Content Standards and Objectives

This advanced course is designed for those students wanting a deeper understanding of the structure and function of the human body. The body will be viewed as a whole using anatomical terminology necessary to describe location. Focus will be at both micro and macro levels reviewing cellular functions, biochemical processes, tissue interactions, organ systems and the interaction of those systems as it relates to the human organism. Systems covered include integumentary, skeletal, muscular, respiratory, circulatory, digestive, excretory, reproductive immunological, nervous and endocrine. This course will be appropriate for college bound students as well as those choosing a health services career cluster. Students will engage in active inquiries, investigation, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.
Standard 1: History and the Nature of Science (SC.S.1)
Students will:
* demonstrate an understanding of the history of science and the evolvement of scientific knowledge,
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists, and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:
HAP.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.
HAP.1.2 recognize that science has practical and theoretical limitations.
HAP.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.
HAP.1.4 conclude that science is a blend of creativity, logic and mathematics.
HAP.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.
HAP.1.6 integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.

Standard 2: Science as Inquiry (SC.S.2)

Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives

Students will:

HAP.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).

HAP.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).

HAP.2.3 apply scientific approaches to seek solutions for personal and societal issues.

HAP.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.

HAP.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).

HAP.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and to present and communicate conclusions.

HAP.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, applying).

HAP.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument).

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

HAP.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.

HAP.3.2 apply evidence from models to make predictions about interactions and changes in systems.

HAP.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

HAP.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

Frame of Reference for Anatomical Studies

HAP.4.1 demonstrate knowledge of directional terminology necessary for anatomical location such as proximal, dorsal, medial, lateral, visceral, superficial and deep.

HAP.4.2 explore current literature and research related to human anatomy and physiology.

Chemical Level of Organization

HAP.4.3 review of foundational chemical concepts including atomic structure, bonding, chemical reactions, water and pH as they relate to living systems.

HAP.4.4 trace the transfer of energy in chemical molecular processes in the human body (e.g., glycolysis, Krebs cycle, electron transport system).

Cellular /Tissue/System Levels of Organization

HAP.4.5 identify the role of DNA in transcription and relate to types of RNA and protein synthesis.

HAP.4.6 identify the structure, functions and interactions of eukaryotic cell organelles and their products.

HAP.4.7 describe the organizational levels, interdependency and the interaction of cells, tissues, organs, organ systems.

HAP.4.8 categorize, by structure and function, the various types of human tissue (e.g., muscle, epithelial, connective, nervous).

Systems Level of Organization

HAP.4.9 relate the structure of the integumentary system to its function as a sensory organ, environmental barrier and temperature regulator.

HAP.4.10 relate how bone tissue is important to the development of the human skeleton.

HAP.4.11 investigate the structure and function of the skeletal system, including identification of bones, markings on bones and articulations.

HAP.4.12 show the mechanism of muscle contraction on micro and macro levels.

HAP.4.13 recognize the relationship between the skeletal, neural and muscular systems.

HAP.4.14 research the musculature system including locations, origins, insertions, muscle groups and types of muscles.

HAP.4.15 classify, describe and investigate the various types of neurons emphasizing structure and function.

HAP.4.16 trace and describe a nervous impulse including a discussion of the sodium-potassium pump.

HAP.4.17 locate, identify and discuss the structure and function of the parts of the central nervous system.

HAP.4.18 illustrate the nerves and functions of the peripheral nervous system including the autonomic portions.

HAP.4.19 apply the knowledge of the structure of the ear and eye to their function/dysfunction in relationship to environmental perception.

HAP.4.20 discuss the specific role of enzymes and hormones to bodily functions.

HAP.4.21 explore the endocrine system emphasizing glands, hormonal control and problems in hormone production.

HAP.4.22 investigate the male and female reproductive systems including identification of structures and their functions.

HAP.4.23 relate the male and female reproductive systems to human growth and development.

HAP.4.24 compare and contrast the purposes, processes and outcomes of cellular meiosis and mitosis.

HAP.4.25 research the formation of gametes, fertilization and embryonic development.

HAP.4.26 analyze the change in DNA activity and how it affects the control of protein synthesis and

human inheritance.

HAP.4.27 relate Mendel's laws of inheritance and DNA to genetic diseases such as sickle-cell anemia, chromosomal abnormalities, Tay-Sachs disease, Huntington's disease, etc.

HAP.4.28 identify the cellular processes and the energy and nutritional requirements needed to maintain human metabolism.

HAP.4.29 illustrate how transport mechanisms in cells, tissues and/or organs depend on osmosis and mixture gradients.

HAP.4.30 examine the role of the digestive system in supplying nutrients (carbohydrates, proteins, lipids, vitamins, minerals, water).

HAP.4.31 explain how structures of the respiratory system are significant to communication, gas exchange and cellular respiration.

HAP.4.32 illustrate the structure of the circulatory and lymphatic systems and the function of blood to the role of transportation, cellular support and defense.

HAP.4.33 investigate the composition of blood and compatibility of blood types.

HAP.4.34 describe the relationship of the excretory system to other organs and systems.

Human Immune Systems and Health

HAP.4.35 describe potential system failures in the human body due to genetic, nutritional, operational, disease, or environmental influences.

HAP.4.36 investigate the immunological system emphasizing its role in defense of the human organism.

HAP.4.37 investigate and research the causative factors, symptoms, prevention and treatment of diseases.

HAP.4.38 identify disorders related to each major system.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

HAP.5.1 summarize technological advances in medicine and health.

HAP.5.2 investigate and analyze the interdependence of science and technology.

HAP.5.3 apply scientific skills and technological tools to design solutions that address personal and societal needs.

HAP.5.4 describe the scientific concepts underlying technological innovations.

HAP.5.5 use appropriate technology solutions to measure and gather data; interpret data; analyze data; and to present and communicate conclusions.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;

* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:
HAP.6.1 describe the impact of cultural, technological, and economic influences on the evolving nature of scientific thought and knowledge.
HAP.6.2 explore occupational opportunities in science and technology including the academic preparation necessary.
HAP.6.3 engage in decision making activities and actions to resolve science-technology-society issues.

Advanced Chemistry (11/12) Content Standards and Objectives

An advanced level course designed for students who have completed Coordinated and Thematic Science Ten (CATS 10) and desire a broader, in-depth study of the content found in the science field of chemistry. *Advanced Chemistry* (Eleven/Twelve) is the advanced study of matter, its composition and its changes. This course is designed to build upon and extend the Chemistry concepts, skills and knowledge from the CATS 7-10 program. This course is designed to prepare a student for college chemistry, requiring a strong mathematical base. The relationship between chemistry concepts and mathematics will be emphasized. Students will engage in active inquiries, investigations and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:
* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science **Objectives**
Students will:
AC.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.
AC.1.2 recognize that science has practical and theoretical limitations.
AC.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.
AC.1.4 conclude that science is a blend of creativity, logic and mathematics.
AC.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.
AC.1.6 integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives

Students will:

AC.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).

AC.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).

AC.2.3 apply scientific approaches to seek solutions for personal and societal issues.

AC.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.

AC.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).

AC.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data, interact with simulations; conduct research; and to present and communicate conclusions.

AC.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, applying).

AC.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument.).

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

AC.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.

AC.3.2 apply evidence from models to make predictions about interactions and changes in systems.

AC.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

AC.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

Properties of Matter

AC.4.1 review the classification of matter using the periodic table; the use the kinetic molecular theory to explain physical states of matter; physical and chemical properties; and physical and chemical changes.

Atomic Structure

AC.4.2 review Bohr model of the atom and calculation of subatomic particles - protons, neutrons, and electrons.

AC.4.3 research and evaluate the contributions of Dalton, Planck, Bohr, Einstein, and de Broglie, Heisenberg, and Schrodinger to the evolution of the atomic theory.

AC.4.4 identify four types of electron clouds (s, p, d, f) and describe the quantum number (n, l, m, s) for electrons.

AC.4.5 write electron configurations and associate electron configuration of elements with element location on periodic table.

AC.4.6 write electron dot structures for representative elements.

Bonding

AC.4.7 predict the formulas of ionic compounds and molecular compounds.

AC.4.8 analyze the periodic table to predict trends in atomic size, ionic size, electronegativity, ionization energy and electron affinity.

AC.4.9 using the periodic table, predict the type of bonding that occurs between atoms and differentiate among properties of ionic, covalent and metallic bonds.

AC.4.10 construct models to explain the structure and geometry of organic and inorganic molecules and the lattice structures of crystals.

AC.4.11 recognize simple organic functional groups and name simple organic compounds.

Stoichiometry

AC.4.12 predict the products and write balanced equations for the general types of chemical reactions.

AC.4.13 use dimensional analysis to perform unit conversions and to verify experimental calculations.

AC.4.14 use the Avogadro constant to define the mole and to calculate molecular and molar mass as well as a molar volume.

AC.4.15 perform calculations using the combined and ideal gas laws.

AC.4.16 use molar mass to calculate the molarity of solutions, percentage composition, empirical formulas and formulas of hydrates.

AC.4.17 experimentally determine the empirical formulas of hydrates.

AC.4.18 perform stoichiometric calculations including mass-mass, mass-volume, volume-volume including problems to determine theoretical yield and to identify the limiting reactant.

Equilibrium

AC.4.19 experimentally determine the factors that influence the rate of reaction.

AC.4.20 apply LeChatelier's principle to explain the effect of changes in concentration, pressure, volume, and temperature on an equilibrium system.

Solution Chemistry

AC.4.21 review colligative properties.

AC.4.22 name and define acids and bases using Arrhenius, Bronsted-Lowry and Lewis definitions.

AC.4.23 predict the products upon adding water to both acidic and basic anhydrides.

AC.4.24 write and balance net ionic equations.

AC.4.25 solve problems using the solubility product constants.

AC.4.26 calculate the pH and/or pOH for various solutions and relate to the pH scale.

AC.4.27 conduct titrations and perform calculations for both acid-base and oxidation-reduction

reactions.

Electrochemistry

AC.4.28 define oxidation and reduction in terms of electron transfer within reactions.

AC.4.29 construct electrolytic cells, write and balance the half-cell reactions and calculate cell voltage.

Reaction Dynamics

AC.4.30 calculate the enthalpy change in reactions using the heat of formation.

AC.4.31 evaluate the factors driving chemical reactions including enthalpy and entropy and their interrelationship.

Nuclear Chemistry

AC.4.32 write balanced nuclear equations and make predications using half-life values.

AC.4.33 list the biological effects of radiation and the units used to measure radiation.

AC.4.34 compare and contrast fusion and fission reactions.

AC.4.35 research the application of nuclear technology.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

AC.5.1 summarize technological advances in chemistry.

AC.5.2 investigate and analyze the interdependence of science and technology.

AC.5.3 apply scientific skills and technological tools to design solutions that address personal and societal needs.

AC.5.4 describe the scientific concepts underlying technological innovations.

AC.5.5 use appropriate technology solutions to measure and gather data; interpret data; analyze data; and to present and communicate conclusions.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)

Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives

Students will:

AC.6.1 research current environmental issues pertaining to chemistry.

AC.6.2 describe the impact of cultural, technological and economic influences on the evolving nature of scientific thought and knowledge.

AC.6.3 explore occupational opportunities in science and technology including the academic preparation necessary.

AC.6.4 engage in decision making activities and actions to resolve science-technology-society issues.

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Chemistry-Technical Conceptual (11/12) Content Standards and Objectives

An advanced level course designed for students who have completed Coordinated and Thematic Science Ten (CATS 10) and desire an alternative to a traditional college preparatory course emphasizes real life applications of chemical principles. Mathematical based problem solving is de-emphasized. Chemistry -Technical Conceptual 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. Students will engage in active inquiries, investigations and hand-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. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

Standard 1: History and the Nature of Science (SC.S.1)
Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

CTC.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.
CTC.1.2 recognize that science has practical and theoretical limitations.
CTC.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.
CTC.1.4 conclude that science is a blend of creativity, logic and mathematics.
CTC.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.
CTC.1.6 integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:

CTC.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).
CTC.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).
CTC.2.3 apply scientific approaches to seek solutions for personal and societal issues.
CTC.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.
CTC.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).

CTC.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and to present and communicate conclusions.

CTC.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, and applying).

CTC.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument).

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

CTC.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.

CTC.3.2 apply evidence from models to make predictions about interactions and changes in systems.

CTC.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

CTC.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

<u>Properties of Matter</u>

CTC.4.1 review the classification of matter and the properties of metals and nonmetals.

CTC.4.2 identify sources and uses of elements.

CTC.4.3 use the kinetic molecular theory to explain physical states of matter.

CTC.4.4 perform calculations using the gas laws.

CTC.4.5 apply the principle of distillation to the separation of liquids (e.g., petroleum or water purification).

<u>Atomic Structure</u>

CTC.4.6 review the parts of the atom.

CTC.4.7 review the relationship of an element's group and period position with its properties.
CTC.4.8 compare atomic and ionic electronic structures.

Bonding

CTC.4.9 review formula writing and ionic and covalent bonding.
CTC.4.10 recognize the impact of water's unusual physical properties.
CTC.4.11 predict solute solubility based on molecular polarity.

Stoichiometry

CTC.4.12 review balancing equations.
CTC.4.13 use dimensional analysis to perform unit conversions and to verify experimental calculations.
CTC.4.14 relate the mole concept to chemical formulas.
CTC.4.15 use moles to measure chemical quantities.
CTC.4.16 determine the percent composition by mass of the elements in a compound.
CTC.4.17 make connections between resource conservation and the Law of Conservation of Matter.
CTC.4.18 illustrate the concept of a limiting reagent.

Solution chemistry

CTC.4.19 review solution properties (e.g., solubility, conductivity, density, pH and colligative).
CTC.4.20 define solutions in terms of saturation.
CTC.4.21 perform solutions concentration calculations (e.g., molarity, ppm).
CTC.4.22 compare and contrast the properties of strong and weak acids and bases.
CTC.4.23 perform an acid-base neutralization reaction.

Electrochemistry

CTC.4.24 construct electrolytic cells to observe the reduction of ions into free metals and write the half reactions that occur.
CTC.4.25 predict reactions of metals with aqueous solutions using the Metal Activity Series.

Reaction Dynamics

CTC.4.26 review temperature and heat.
CTC.4.27 measure the flow of energy into or out of chemical reactions.
CTC.4.28 predict the effect of temperature and catalysts on reaction rates.
CTC.4.29 apply LeChatelier's Principle in determining equilibrium.

Carbon and Petroleum

CTC.4.30 draw and construct models for the first ten alkanes.
CTC.4.31 relate the properties of organic compounds to their functional groups (e.g., alcohol and esters).
CTC.4.32 demonstrate the formation of polymers from smaller molecules.
CTC.4.33 compare and contrast the use of petroleum as either a source of energy or as a fundamental ingredient of synthetic materials.

Nuclear Chemistry

CTC.4.34 review nuclear fusion and fission, isotopes and half-lives.
CTC.4.35 compare the penetrating energies of nuclear radiation.
CTC.4.36 balance simple nuclear equations.
CTC.4.37 explain practical applications of nuclear technology (e.g., radioactive dating, radioisotopes in medicine).

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives
Students will:
CTC.5.1 summarize technological advances in chemistry.
CTC.5.2 investigate and analyze the interdependence of science and technology.
CTC.5.3 apply scientific skills and technological tools to design solutions that address personal and societal needs.
CTC.5.4 describe the scientific concepts underlying technological innovations.
CTC.5.5 use appropriate technology solutions to measure and gather data; interpret data; analyze data; and to present and communicate conclusions.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:
* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:
CTC.6.1 research current environmental issues pertaining to chemistry.
CTC.6.2 describe the impact of cultural, technological, and economic influences on the evolving nature of scientific thought and knowledge.
CTC.6.3 explore occupational opportunities in science and technology including the academic preparation necessary.
CTC.6.4 engage in decision making activities and actions to resolve science-technology-society issues.

Advanced Environmental Earth Science (11/12) Content Standards and Objectives

As responsible citizens on this planet, students must be able to recognize their role as caretakers of the earth in order to protect its fragile environment. This is possible only if students have a deep understanding of the earth and its processes. Advanced Environmental Earth Science (11/12) is designed for students who have completed Coordinated and Thematic Science Ten (CATS 10) and desire to build on the fundamentals of geology, oceanography, meteorology and astronomy developed in CATS 7-10 in a rigorous and integrated manner with the traditional disciplines of biology, chemistry and physics where appropriate. As stewards of the earth, an emphasis on environment should be included within the traditional earth science disciplines. Ecology, economics, politics and social considerations all combine to help students develop an understanding of how humans effect and are effected by their environment. 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. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

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Standard 1: History and the Nature of Science (SC.S.1)
Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

AES.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.
AES.1.2 recognize that science has practical and theoretical limitations.
AES.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.
AES.1.4 conclude that science is a blend of creativity, logic and mathematics.
AES.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.
AES.1.6 integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:

AES.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).
AES.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).
AES.2.3 apply scientific approaches to seek solutions for personal and societal issues.
AES.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.
AES.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).
AES.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and to present and communicate conclusions.
AES.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, and applying).
AES.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument).

Standard 3: Unifying Themes (SC.S.3)
Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives
Students will:

AES.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.
AES.3.2 apply evidence from models to make predictions about interactions and changes in systems.
AES.3.3 measure changes in systems using graph and equations relating these to rate, scale, patterns, trends and cycles.
AES.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Standard 4: Science Subject Matter/Concepts (SC.S.4)
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; and
* apply knowledge, understanding and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives
Students will:

<u>Dynamic Earth</u>

AES.4.1 review foundational earth science concepts including rocks and minerals, properties of waves, constructing and interpreting weather maps, surface features found on maps, climatic relationships to biomes, use of data gathering instruments, temperature-phase change relationships.
AES.4.2 identify and describe the structure, origin, and evolution of the lithosphere, hydrosphere, atmosphere and biosphere.

<u>Geology</u>

AES.4.3 identify components of the solid earth and the natural processes relating to its development.
AES.4.4 list, identify, and sequence eras, epochs and periods in relation to earth history and geologic development.
AES.4.5 utilize fossil evidence to estimate the relative and absolute ages of rock layers (time-stratographic and biostratographic).
AES.4.6 estimate the absolute age of materials using existing radioisotopic data.
AES.4.7 identify the type and composition of various minerals.
AES.4.8 investigate and explain the processes of the rock cycle.
AES.4.9 explain the relationship between pressure and temperature to the formation and reformation of rocks.
AES.4.10 identify and describe agents and processes of degradation (e.g., weathering by gravity, wind, water, and ice).
AES.4.11 identify and describe tectonic forces relating to internal energy production and convection currents.

AES.4.12 understand the cause and effect relationships of degradational and tectonic forces with respect to the dynamic earth and its surface (e.g., volcanoes, earthquakes).
AES.4.13 construct and/or interpret information on topographic maps.

Oceanography

AES.4.14 identify and describe properties of our oceans (e.g., composition, physical features of the ocean floor, and life within the oceans).
AES.4.15 compare and contrast characteristics of the oceans, including their lateral and vertical motions.
AES.4.16 investigate the evolution of the ocean floor that results in the creation of new materials and features.
AES.4.17 investigate the stratification of the ocean (colligative properties and biological zonation).

Meteorology

AES.4.18 investigate and explain, heat transfer in the atmosphere and its relationship to meteorological processes (e.g., pressure, winds, evaporation, condensation, and precipitation).
AES.4.19 predict the effects of ocean currents on climate.
AES.4.20 compare and contrast meteorological processes related to air masses, weather systems, and forecasting.
AES.4.21 examine global change over time (e.g., climatic trends, fossil fuel depletion, global warming, ozone depletion).

Astronomy

AES.4.22 research theories concerning origins of the universe.
AES.4.23 apply Newton's Law of Universal Gravitation to the motion of celestial objects.
AES.4.24 investigate the solar system including origin theories, comparing and contrasting the planets, planetary motions, and other celestial bodies.
AES.4.25 investigate celestial bodies and their evolution.
AES.4.26 explain the relationships between location, navigation and time.
AES.4.27 compare ancient and modern methods and tools used to study astronomy.
AES.4.28 investigate the electromagnetic spectrum as related to observable phenomena in the universe.

Environment

AES.4.29 describe the relationship between earth processes and natural disasters and draw conclusions concerning their human impact.
AES.4.30 explore the relationships between human consumption of natural resources and the stewardship responsibility for reclamations including disposal of hazardous and non-hazardous waste.
AES.4.31 investigate and describe in detail the physical and chemical properties of water.
AES.4.32 explain common problems related to the conservation, use, supply and the quality of water.
AES.4.33 explore the relationships between the extraction and use of natural resources and the impact on the environment.
AES.4.34 research alternative energy sources.
AES.4.35 understand the fragile nature of the Earth.
AES.4.36 research and explain how the political system influences environmental decisions.
AES.4.37 investigate which federal and state agencies have responsibility for environmental monitoring and actions.
AES.4.38 develop decision-making skills with respect to addressing environmental problems.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives
Students will:
AES.5.1 summarize technological advances in the earth sciences.
AES.5.2 investigate and analyze the interdependence of science and technology.
AES.5.3 apply scientific skills and technological tools to design solutions that address personal and societal needs.
AES.5.4 describe the scientific concepts underlying technological innovations.
AES.5.5 use appropriate technology solutions to measure and gather data; interpret data; analyze data; and to present and communicate conclusions.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:
* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:
AES.6.1 research and explain how the political system influences environmental decisions.
AES.6.2 investigate the effects of natural phenomena on the environment (e.g., oceanographic, meteorologic).
AES.6.3 research current environmental issues (e.g., depletion of fossil fuels, global warming, destruction of rainforest pollution).
AES.6.4 describe the impact of cultural, technological and economic influences on the evolving nature of scientific thought and knowledge.
AES.6.5 explore occupational opportunities in science and technology including the academic preparation necessary.
AES.6.6 engage in decision making activities and actions to resolve science-technology-society issues.

Advanced Physics (11/12) Content Standards and Objectives

An advanced level course designed for students who have completed Coordinated and Thematic Science Ten (CATS 10) and desire a broader, in-depth study of the content found in the science field of physics. As a college preparatory course, *Advanced* Physics (Eleven/Twelve) is a laboratory driven, advanced study of nature's universal laws with emphasis on process skills. This course is designed to build upon and extend the Physics concepts, skills, and knowledge from the CATS 7-10 program. The course emphasizes a mathematical approach to the areas of kinematics, dynamics, thermodynamics, light and optics, electricity and magnetism and modern physics. Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

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Standard 1: History and the Nature of Science (SC.S.1)
Students will:

* demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
* demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
* demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

AP.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.
AP.1.2 recognize that science has practical and theoretical limitations.
AP.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.
AP.1.4 conclude that science is a blend of creativity, logic and mathematics.
AP.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.
AP.1.6 integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

* demonstrate the abilities necessary to do scientific inquiry;
* demonstrate understanding about scientific inquiry; and
* demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:

AP.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).
AP.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).
AP.2.3 apply scientific approaches to seek solutions for personal and societal issues.
AP.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.
AP.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).
AP.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and to present and communicate conclusions.
AP.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, and applying).
AP.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument).

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order and organization; evidence, models and explanation; constancy, change and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

AP.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.

AP.3.2 apply evidence from models to make predictions about interactions and changes in systems.

AP.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

AP.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

<u>Mechanics</u>

AP.4.1 review Newton's Laws of Motion.

AP.4.2 using both given information and laboratory collected data, calculate velocity and acceleration along linear and circular paths.

AP.4.3 solve multi-step problems involving velocity, acceleration and net force.

AP.4.4 apply both graphical, algebraic, and trigonometric solutions to vector, problems involving two or more vectors; calculate both vector components and resultants including projectile motion in both one and two dimensions.

AP.4.5 apply the concepts of potential and kinetic energy to final velocity of an object-independent of path; evaluate the conservation of energy and momentum in simple harmonic motion.

AP.4.6 investigate and calculate the work, energy, power, mechanical advantage, and efficiency using simple machines involving linear and rotational motion.

<u>Fluids</u>

AP.4.7 define fluids and determine the magnitude of buoyant force exerted on floating and submerged objects; explain why some objects float or sink.

AP.4.8 relate the pressure exerted by a fluid to its depth; calculate the pressure exerted by a fluid.

AP.4.9 examine the motion of a fluid; apply Bernoulli's equation to solve fluid problems; recognize the effects of Bernoulli's principle on fluid motion.

AP.4.10 define the general properties of an ideal gas; apply the Ideal Gas Law to predict the properties of an ideal gas under different conditions.

Thermodynamics

AP.4.11 distinguish between temperature and heat; relate these to kinetic energy and internal energy of matter; apply the principle of conservation of energy to calculate changes in potential, kinetic and internal energy.

AP.4.12 investigate and apply concepts of specific heat, heat of fusion and vaporization to calculate phase changes of materials, and perform calculations using the specific heat equation; interpret phase diagrams.

Waves, Sound and Optics

AP.4.13 investigate and apply the reflective, refractive and diffractive properties of waves to study mechanical and electromagnetic waves.

AP.4.14 relate the wavelength, velocity and frequency of waves with the equation velocity=frequency x wavelength and use it to perform calculations.

AP.4.15 analyze the properties of sound waves and perform appropriate calculations; relate the physical properties of sound waves to the way sound is perceived.

AP.4.16 define Doppler shift and identify applications.

AP.4.17 apply ray optics diagrams to lenses and mirrors, use the lens/mirror equation and the magnification equation to solve optics problems.

AP.4.18 investigate and analyze optical applications in technology.

Electricity and Magnetism

AP.4.19 measure and draw electrical and magnetic fields; describe applications of electrical and magnetic fields.

AP.4.20 recognize the basic properties of electrical charge, charging by conduction and induction, and differentiate between conductors and insulators; calculate electrical force using Coulomb's law.

AP.4.21 recognize that circuits are closed loops; define units of electrical measure.

AP.4.22 construct and analyze electrical circuits and calculate Ohm's law problems for series, parallel and complex circuits including voltage drops; calculate power and energy in electrical systems.

Astronomy and Modern Physics

AP.4.23 describe the orbital relationships within the solar system; apply Kepler's Laws to calculate orbital periods.

AP.4.24 apply Newton's law of Universal Gravitation to derive relationships to calculate acceleration of gravity on other planets and orbital velocities.

AP.4.25 research and evaluate evidence of the Big Bang model of the universe.

AP.4.26 describe Einstein's special theory of relativity and its basic development through assumptions and logical consequences.

AP.4.27 describe nuclear reactions and discuss applications of nuclear energy.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

AP.5.1 investigate, analyze, synthesize, and evaluate those devices in the home that were developed from the understanding of science and technology.

AP.5.2 investigate and analyze the interdependence of science and technology.

AP.5.3 apply scientific skills and technological tools to design solutions that address personal and societal needs.

AP.5.4 describe the scientific concepts underlying technological innovations.

AP.5.5 use appropriate technology solutions to measure and gather data; interpret data; analyze data; and to present and communicate conclusions.

Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:

AP.6.1 describe the impact of cultural, technological, and economic influences on the evolving nature of scientific thought and knowledge.

AP.6.2 explore occupational opportunities in science and technology including the academic preparation necessary.

AP.6.3 engage in decision making activities and actions to resolve science-technology-society issues.

Physics-Technical Conceptual (11/12) Content Standards and Objectives

Physics-Technical Conceptual (11/12) is a course designed for students who have completed Coordinated and Thematic Science Ten (CATS 10) and desire an in-depth study in physics to prepare them for technical careers. This course is an alternative to the traditional mathematical approach to physics. Curriculum organization and delivery for Physics-Technical Conceptual may be addressed by either of two approaches.

A thematic approach would cover the physics principles as applied to four energy systems: mechanical, fluid, thermal, and electrical that make up both simple and complex technological devices and equipment. This approach would emphasize the analogies in mechanical, fluid, thermal, and electrical systems. Incorporated in the instruction is the mathematics needed to understand and apply the principles.

A topic approach would cover 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 which underlie the natural laws of the universe.

Students will engage in active inquiries, investigations, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills. Safety instruction is integrated into all activities. West Virginia teachers are responsible for analyzing the benefits of technology for learning and for integrating technology appropriately in the students' learning environment. See the related grade-level Technology Standards and Objectives.

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Standard 1: History and the Nature of Science (SC.S.1)
Students will:

- demonstrate an understanding of the history of science and the evolvement of scientific knowledge;
- demonstrate an understanding of science as a human endeavor encompassing the contributions of diverse cultures and scientists; and
- demonstrate an understanding of the nature of science.

History and the Nature of Science Objectives
Students will:

PTC.1.1 formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.
PTC.1.2 recognize that science has practical and theoretical limitations.
PTC.1.3 recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.
PTC.1.4 conclude that science is a blend of creativity, logic and mathematics.
PTC.1.5 trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.
PTC.1.6 integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.

Standard 2: Science as Inquiry (SC.S.2)
Students will:

- demonstrate the abilities necessary to do scientific inquiry;
- demonstrate understanding about scientific inquiry; and
- demonstrate the ability to think and act as scientists

by engaging in active inquiries, investigations and hands-on activities a minimum of 50% of the instructional time.

Science as Inquiry Objectives
Students will:

PTC.2.1 model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).
PTC.2.2 demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).
PTC.2.3 apply scientific approaches to seek solutions for personal and societal issues .
PTC.2.4 properly and safely manipulate equipment, materials, chemicals, organisms and models.
PTC.2.5 conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).
PTC.2.6 use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and to present and communicate conclusions.
PTC.2.7 demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting, inferring, considering alternatives, and applying).
PTC.2.8 design, conduct, evaluate and revise experiments (e.g., identify questions and concepts that guide investigations; design investigations; identify independent and dependent variables in experimental investigations; manipulate variables to extend experimental activities; use technology and mathematics to improve investigations and communications; formulate and revise scientific explanations and models using logic and evidence; recognize alternative explanations; communicate and defend a scientific argument).

Standard 3: Unifying Themes (SC.S.3)

Students will:

* demonstrate an understanding of interdependent themes present in the natural and designed world (e.g., systems, order, and organization; evidence, models, and explanation; constancy, change, and measurement; equilibrium and evolution; form and function);
* demonstrate the ability to identify, construct, test, analyze, and evaluate systems, models, and changes; and
* demonstrate the ability to draw conclusions about and predict changes in natural and designed systems.

Unifying Themes Objectives

Students will:

PTC.3.1 analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.

PTC.3.2 apply evidence from models to make predictions about interactions and changes in systems.

PTC.3.3 measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.

PTC.3.4 understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).

Standard 4: Science Subject Matter/Concepts (SC.S.4)

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; and
* apply knowledge, understanding, and skills of science subject matter/concepts to daily life experiences.

Science Subject Matter/Concepts Objectives

Students will:

<u>Mechanics</u>

PTC.4.1 qualitatively and quantitatively analyze mechanical systems (e.g., force, work, rate, resistance, energy, power, force transformations).

PTC.4.2 use both given information and lab collected data to calculate velocity and acceleration along linear and circular paths.

PTC.4.3 draw free body diagrams to illustrate the forces acting on objects and perform simple calculations involving velocity, acceleration and net force; research the applications of force and acceleration in modern design and technology.

PTC.4.4apply graphical and algebraic solutions to vector problems.

PTC.4.5 identify the relationship between potential energy and kinetic energy in gravitational and elastic potential/kinetic energy systems; recognize the conservation of energy in simple harmonic motion.

PTC.4.6 calculate work, energy, power and efficiency in mechanical systems.

PTC.4.7 construct models and/or working systems that show applications of technology to solve problems involving mechanical systems.

<u>Fluids</u>

PTC.4.8 qualitatively and quantitatively analyze fluid systems (e.g., pressure, work, rate, resistance, energy, power, force transformations).

PTC.4.9 identify and apply the properties of solids, liquids and gases to explain their behavior at different pressures and temperatures.

PTC.4.10 identify and apply Bernoulli's principle to floating objects; identify the buoyant force acting on floating and submerged objects.

PTC.4.11 calculate the pressure of a solid object on a surface and the pressure exerted by a fluid at a given depth; relate the measure of pressure in kPa and/or in N/m^2.
PTC.4.12 construct models and/or working systems that show applications of technology to solve problems involving fluid systems.

Thermodynamics

PTC.4.13 qualitatively and quantitatively analyze thermal systems (e.g., temperature, rate, resistance, energy).
PTC.4.14 perform conversions between Fahrenheit, Celsius, and Kelvin temperature scales.
PTC.4.15 define specific heat capacity; use the specific heat equation to calculate heat gained or lost during phase changes and heat lost when objects cool.
PTC.4.16 investigate and analyze the different rates of heat transfer by different materials.
PTC.4.17 construct models and/or working systems that show applications of technology to solve problems involving heat flow and heat exchange.

Waves, Sound and Optics

PTC.4.18 investigate and apply the reflective, refractive and diffractive properties of waves to study mechanical and electromagnetic waves.
PTC.4.19 use the relationship between wavelength, velocity and frequency to calculate the speed of waves; recognize that the speed of light is a constant.
PTC.4.20 construct models and/or working systems that show applications of technology to solve problems involving energy transfer by wave motion.
PTC.4.21 research and describe new developments in optical technology.

Electricity and Magnetism

PTC.4.22 qualitatively and quantitatively analyze electrical systems (e.g., voltage, work, rate, resistance, energy, power, force transformations).
PTC.4.23 investigate the nature of electrical and magnetic fields; recognize the basic properties of electrical charge and differentiate between conductors and insulators.
PTC.4.24 draw and construct electrical circuits; apply Ohm's law to calculate voltage drops in series and parallel circuits.
PTC.4.25 construct models and/or working systems that show applications of technology to solve problems involving use of electricity.

Modern Physics

PTC.4.26 recognize and distinguish between Einstein's General and Special Theories of Relativity and research evidences to support these theories.
PTC.4.27 recognize the products of nuclear decay and write decay chain equations.

Standard 5: Scientific Design and Application (SC.S.5)

Students will:

* demonstrate an understanding of the interdependence between science and technology;
* demonstrate the ability to distinguish between natural and man-made objects;
* demonstrate abilities of technological design; and
* demonstrate the ability to utilize technology to gather data and communicate designs, results and conclusions.

Scientific Design and Application Objectives

Students will:

PTC.5.1 investigate, analyze, synthesize, and evaluate those devices in the home that were developed from the understanding of science and technology.
PTC.5.2 investigate and analyze the interdependence of science and technology.
PTC.5.3 apply scientific skills and technological tools to design solutions that address personal and societal needs.
PTC.5.4 describe the scientific concepts underlying technological innovations.
PTC.5.5 use appropriate technology solutions to measure and gather data; interpret data; analyze data; and to present and communicate conclusions.

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Standard 6: Science in Personal and Social Perspectives (SC.S.6)
Students will:

* demonstrate the ability to evaluate personal and societal benefits when examining health, population, resource and environmental issues;
* demonstrate the ability to evaluate the impact of different points of view on health, population, resource and environmental practices;
* predict the long-term societal impact of specific health, population, resource and environmental practices; and
* demonstrate an understanding of public policy decisions as related to health, population, resource and environmental issues.

Science in Personal and Social Perspectives Objectives
Students will:

PTC.6.1 describe the impact of cultural, technological, and economic influences on the evolving nature of scientific thought and knowledge.
PTC.6.2 explore occupational opportunities in science and technology including the academic preparation necessary.
PTC.6.3 engage in decision making activities and actions to resolve science-technology-society issues.