Science Standard-Specific Supports

Grade 5

Revised October 2022

Contents

Science Standard-Specific Supports

Overview

The West Virginia College- and Career-Readiness Standards for Science[1] identify what students should know and be able to do at the end of science instruction. Each standard represents the integration of three "dimensions" of science education: practices of scientists and engineers, core science content, and science connecting concepts. As such, both student learning and assessment around the standards should be "three dimensional." The Science Standard-Specific Supports in this document are intended to show what it looks like for students to fully satisfy the intent of the standard.

The Science Standard-Specific Supports are adapted from the Evidence Statements of the Next Generation Science Standards (NGSS)[2], created when West Virginia was a lead state during the NGSS writing process, and the Framework for K-12 Science Instruction[3], created prior to the development of the NGSS. For more information on the Evidence Statements, please refer to them in their original form.

Purpose

The Science Standard-Specific Supports were designed to articulate how students can use the practices of scientists and engineers to demonstrate their understanding of the core science content through the lens of the science connecting concepts, and thus, demonstrate proficiency on each standard. The Science Standard-Specific Supports do this by clarifying:

- how the three dimensions could be assessed together, rather than in independent units;
- the underlying knowledge required for each core science content;
- the detailed approaches to the practices of scientists and engineers; and
- how science connecting concepts might be used to deepen content- and practice-driven learning.

The Science Standard-Specific Supports are not intended to be used as curriculum or limit or dictate instruction.

Structure

The practices of scientists and engineers are used as the organizing structure for the Science Standard-Specific Supports. However, this does not mean that the practices are more important than the other dimensions. The practices of scientists and engineers form the activities through which students demonstrate understanding of the science content. The proper integration of the practices makes students' thinking visible.

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[1] *West Virginia College- and Career-Readiness Standards for Science* (Policy 2520.3C) https://apps.sos.wv.gov/adlaw/csr/readfile.aspx?DocId=54673&Format=PDF

[2] NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States.* Washington, DC: The National Academies Press.

[3] National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: The National Academies Press.

How to Use the Science Standard-Specific Supports

- For instruction:
  - The Science Standard-Specific Supports can be used to aid instructional design, but it is crucial to recognize there are numerous pathways educators may use throughout the sequence of lessons and units to allow students to ultimately be prepared to demonstrate mastery of the standards.
- For assessment:
  - The Science Standard-Specific Supports can be used to inform the development of formative and summative assessments by the classroom educator.

Although supports are listed individually for each standard, this does not indicate that they should be measured individually, or that standards should be taught or assessed individually. Best practices in classroom instruction should be focused on helping students build towards several standards at one time because many concepts and practices are interrelated.

Limitations of the Science Standard-Specific Supports

The science standard-specific supports cannot do the following:

- Provide or prescribe the contexts through which the standards may be taught or assessed.
- Be the rubrics on which levels of student success would be measured.
- Identify the sequence of instruction or assessment.
- Put limits on student learning or student coursework.
- Replace lesson plans or assessment items.
- Serve as complete scoring rubrics.

Science - Grade 5 Introduction

Fifth Grade Science standards identify, compare, classify, and explain our living and designed worlds. Through a progressive rigorous, integrated approach, the inquiry-based program of study provides students opportunities to demonstrate scientific literacy in the domains of Physical Science, Life Science, and Earth and Space Science focusing on the connecting concepts: systems, changes, and models. The content develops basic problem-solving skills through observing, experimenting, and concluding. Students will engage in hands-on activities at least 50% of the instructional time as they develop and demonstrate conceptual understandings along with research and laboratory skills described in the standards and indicators for science. Engineering, Technology, and the Application of Science are integrated throughout instruction as students define problems and design solutions related to the course standards and indicators for science. Fifth Grade Science intentionally supports developmental and academic growth. Standards followed by an asterisk (*) denote the integration of traditional science content with an engineering practice.

Within the evidence statements, the words “description” or “describe” followed by an asterisk indicate those descriptions given by students could include but are not limited to written, oral, pictorial, and kinesthetic descriptions unless otherwise specified.

College- and Career-Readiness Indicators for Science Grades 3-5

<table>
<tr><th colspan="2">College- and Career-Readiness Indicators for Science</th></tr>
<tr><td colspan="2">Grades 3-5</td></tr>
<tr><th colspan="2">Nature of Science</th></tr>
<tr><td colspan="2">• Scientific knowledge is simultaneously reliable and subject to change based on empirical evidence and interpretation.
• Scientific knowledge is obtained through a combination of observations of the natural world and inferences based on those observations.
• Science is a creative human endeavor which is influenced by social and cultural biases.
• A primary goal of science is the formation of theories and laws. Theories are inferred explanations of some aspect of the natural world based on successfully tested information from evidence and evaluated phenomena. Laws describe relationships among what has been observed in the natural world.
• Scientific investigations use a variety of methods to address questions about the natural and material world.</td></tr>
<tr><th>Practices of Scientists and Engineers</th><th>Science Connecting Concepts</th></tr>
<tr><td>• Asking questions and defining problems
• Developing and using models
• Planning and carrying out investigations
• Analyzing and interpreting data
• Using mathematical and computational thinking
• Constructing explanations and designing solutions
• Engaging in argument from evidence
• Obtaining, evaluating, and communicating information</td><td>• Observing patterns
• Investigating and explaining cause and effect
• Recognizing scale, proportion, and quantity
• Defining systems and system models
• Tracking energy and matter flows, into, out of, and within systems to understand system behavior
• Determining the relationships between structure and function
• Studying stability and change</td></tr>
<tr><th>Science Literacy</th><th>Science Lab Safety</th></tr>
<tr><td>• Utilizing and connecting ideas among informational (factual) scientific texts
• Integrating and applying information presented in various media formats when writing and speaking
• Citing evidence to support scientific claims
• Comparing and contrasting sets of data
• Building and appropriately using science domain vocabulary and phrases
• Interpreting and applying visually expressed information (e.g., flowchart, diagram, model, graph, or table)</td><td>• Requiring lab safety training and archiving signed student safety contracts including medical conditions
• Wearing proper protective equipment as needed (e.g., goggles, apron, and gloves)
• Requiring grade-appropriate lab equipment operation and safety training
• Storing and disposing of chemical/biological materials properly
• Following ethical classroom use of living organisms</td></tr>
</table>

Physical Science

Topic: Structure and Properties of Matter

S.5.1. Make observations and measurements to identify materials based on their properties. [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]

Practices of Scientists and Engineers	Core Science Content
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Students will make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	Structure and Properties of Matter Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)
Science Connecting Concepts	
Scale, Proportion, and Quantity Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.	

Observable features of the student performance by the end of the course:

1) Identifying the phenomenon under investigation
    a) From the given investigation plan, students identify the phenomenon under investigation, which includes the observable and measurable properties of materials.
    b) Students identify the purpose of the investigation, which includes collecting data to serve as the basis for evidence for an explanation about the idea that materials can be identified based on their observable and measurable properties.
2) Identifying the evidence to address the purpose of the investigation
    a) From the given investigation plan, students describe* the evidence from data (e.g., qualitative observations and measurements) that will be collected, including:
        i) Properties of materials that can be used to identify those materials (e.g., color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility).
    b) Students describe* how the observations and measurements will provide the data necessary to address the purpose of the investigation.
3) Planning the investigation
    a) From the given plan investigation plan, students describe* how the data will be collected. Examples could include:
        i) Quantitative measures of properties, in standard units (e.g., grams, liters).
        ii) Observations of properties such as color, conductivity, and reflectivity.
        iii) Determination of conductors vs. nonconductors and magnetic vs. nonmagnetic materials.
    b) Students describe* how the observations and measurements they make will allow them to identify materials based on their properties.
4) Collecting the data
    a) Students collect and record data, according to the given investigation plan.

S.5.2. Develop a model to describe that matter is made of particles too small to be seen. [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

Practices of Scientists and Engineers	Core Science Content
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Students will use models to describe phenomena.	**Structure and Properties of Matter** Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.
Science Connecting Concepts	
Scale, Proportion, and Quantity Natural objects exist from the very small to the immensely large.	

Observable features of the student performance by the end of the course:

1) Components of the model
   a) Students develop a model to describe* a phenomenon that includes the idea that matter is made of particles too small to be seen. In the model, students identify the relevant components for the phenomenon, including:
      i) Bulk matter (macroscopic observable matter; e.g., as sugar, air, water).
      ii) Particles of matter that are too small to be seen.
2) Relationships
   a) In the model, students identify and describe* relevant relationships between components, including the relationships between:
      i) Bulk matter and tiny particles that cannot be seen (e.g., tiny particles of matter that cannot be seen make up bulk matter).
      ii) The behavior of a collection of many tiny particles of matter and observable phenomena involving bulk matter (e.g., an expanding balloon, evaporating liquids, substances that dissolve in a solvent, effects of wind).
3) Connections
   a) Students use the model to describe* how matter composed of tiny particles too small to be seen can account for observable phenomena (e.g., air inflating a basketball, ice melting into water).

S.5.3. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]

<table>
<tr><th>Practices of Scientists and Engineers</th><th>Core Science Content</th></tr>
<tr><td>Using Mathematics and Computational Thinking
Mathematical and computational thinking in 3– 5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Students will measure and graph quantities, such as weight, to address scientific and engineering questions and problems.</td><td rowspan="3">Structure and Properties of Matter
The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.

Chemical Reactions
No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)</td></tr>
<tr><td>Science Connecting Concepts</td></tr>
<tr><td>Scale, Proportion, and Quantity
Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.
Scientific Knowledge Assumes an Order and Consistency in Natural Systems
Science assumes consistent patterns in natural systems.</td></tr>
</table>

Observable features of the student performance by the end of the course:

1) Representation
   a) Students measure and graph the given quantities using standard units, including:
      i) The weight of substances before they are heated, cooled, or mixed.
      ii) The weight of substances, including any new substances produced by a reaction, after they are heated, cooled, or mixed.
2) Mathematical/computational analysis
   a) Students measure and/or calculate the difference between the total weight of the substances (using standard units) before and after they are heated, cooled, and/or mixed.
   b) Students describe* the changes in properties they observe during and/or after heating, cooling, or mixing substances.
   c) Students use their measurements and calculations to describe* that the total weights of the substances did not change, regardless of the reaction or changes in properties that were observed.
   d) Students use measurements and descriptions* of weight, as well as the assumption of consistent patterns in natural systems, to describe* evidence to address scientific questions about the conservation of the amount of matter, including the idea that the total weight of matter is conserved after heating, cooling, or mixing substances.

S.5.4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Practices of Scientists and Engineers	Core Science Content
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Students will conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	**Chemical Reactions** When two or more different substances are mixed, a new substance with different properties may be formed.
Science Connecting Concepts	
Cause and Effect Cause and effect relationships are routinely identified and used to explain change.	

Observable features of the student performance by the end of the course:

1) Identifying the phenomenon under investigation
   a) From the given investigation plan, students describe* the phenomenon under investigation, which includes the mixing of two or more substances.
   b) Students identify the purpose of the investigation, which includes providing evidence for whether new substances are formed by mixing two or more substances, based on the properties of the resulting substance.
2) Identifying the evidence to address the purpose of the investigation
   a) From the given investigation plan, students describe* the evidence from data that will be collected, including:
      i) Quantitative (e.g., weight) and qualitative properties (e.g., state of matter, color, texture, odor) of the substances to be mixed.
      ii) Quantitative and qualitative properties of the resulting substances.
   b) Students describe* how the collected data can serve as evidence for whether the mixing of the two or more tested substances results in one or more new substances.
3) Planning the investigation
   a) From the given investigation plan, students describe* how the data will be collected, including:
      i) How quantitative and qualitative properties of the two or more substances to be mixed will be determined and measured.
      ii) How quantitative and qualitative properties of the substances that resulted from the mixture of the two or more substances will be determined and measured.
      iii) Number of trials for the investigation.
      iv) How variables will be controlled to ensure a fair test (e.g., the temperature at which the substances are mixed, the number of substances mixed together in each trial).
4) Collecting the data
   a) According to the investigation plan, students collaboratively collect and record data, including data about the substances before and after mixing.

Life Science

Topic: Matter and Energy in Organisms and Ecosystems

S.5.5. Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

<table>
<tr><th>Practices of Scientists and Engineers</th><th>Core Science Content</th></tr>
<tr><td>Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Students will support an argument with evidence, data, or a model.</td><td rowspan="3">Organization for Matter and Energy Flow in Organisms
Plants acquire their material for growth chiefly from air and water.</td></tr>
<tr><td>Science Connecting Concepts</td></tr>
<tr><td>Energy and Matter
Matter is transported into, out of, and within systems.</td></tr>
</table>

Observable features of the student performance by the end of the course:

1) Supported claims
   a) Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that plants acquire the materials they need for growth chiefly from air and water.
2) Identifying scientific evidence
   a) Students describe* the given evidence, data, and/or models that support the claim, including evidence of:
      i) Plant growth over time.
      ii) Changes in the weight of soil and water within a closed system with a plant, indicating:
         (1) Soil does not provide most of the material for plant growth (e.g., changes in weight of soil and a plant in a pot over time, hydroponic growth of plants).
         (2) Plants' inability to grow without water.
      iii) Plants' inability to grow without air.
      iv) Air is matter (e.g., empty object vs. air filled object).
3) Evaluating and critiquing evidence
   a) Students determine whether the evidence supports the claim, including:
      i) Whether a particular material (e.g., air, soil) is required for growth of plants.
      ii) Whether a particular material (e.g., air, soil) may provide sufficient matter to account for an observed increase in weight of a plant during growth.
4) Reasoning and synthesis
   a) Students use reasoning to connect the evidence to support the claim with argumentation. Students describe* a chain of reasoning that includes:
      i) During plant growth in soil, the weight of the soil changes very little over time, whereas the weight of the plant changes a lot. Additionally, some plants can be grown without soil at all.
      ii) Because some plants don't need soil to grow, and others show increases in plant matter (as measured by weight) but not accompanying decreases in soil matter, the material from soil must not enter the plant in sufficient quantities to be the chief contributor to plant growth.
      iii) Therefore, plants do not acquire most of the material for growth from soil.
      iv) A plant cannot grow without water or air. Because both air and water are matter and are transported into the plant system, they can provide the materials plants need for growth.
      v) Since soil cannot account for the change in weight as a plant grows and since plants take in water and air, both of which could contribute to the increase in weight during plant growth, plant growth must come chiefly from water and air.

S.5.6. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. [Clarification Statement: Examples of models could include diagrams, and flow charts.]

Practices of Scientists and Engineers	Core Science Content
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Students will use models to describe phenomena.	Energy in Chemical Processes and Everyday Life The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).
Science Connecting Concepts	
Energy and Matter Energy can be transferred in various ways and between objects.	

Observable features of the student performance by the end of the course:

1) Components of the model
   a) Students use models to describe* a phenomenon that includes the idea that energy in animals' food was once energy from the sun. Students identify and describe* the components of the model that are relevant for describing* the phenomenon, including:
      i) Energy.
      ii) The sun.
      iii) Animals, including their bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
      iv) Plants.
2) Relationships
   a) Students identify and describe* the relevant relationships between components, including:
      i) The relationship between plants and the energy they get from sunlight to produce food.
      ii) The relationship between food and the energy and materials that animals require for bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
      iii) The relationship between animals and the food they eat, which is either other animals or plants (or both), to obtain energy for bodily functions and materials for growth and repair.
3) Connections
   a) Students use the models to describe* causal accounts of the relationships between energy from the sun and animals' needs for energy, including that:
      i) Since all food can eventually be traced back to plants, all of the energy that animals use for body repair, growth, motion, and body warmth maintenance is energy that once came from the sun.
      ii) Energy from the sun is transferred to animals through a chain of events that begins with plants producing food then being eaten by animals.

S.5.7. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

Practices of Scientists and Engineers	Core Science Content
Developing and Using Models Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions. Students will develop a model to describe phenomena. Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena Science explanations describe the mechanisms for natural events. Science Connecting Concepts Systems and System Models A system can be described in terms of its components and their interactions.	Interdependent Relationships in Ecosystems The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. Cycles of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment.

Observable features of the student performance by the end of the course:

1) Components of the model
   a) Students develop a model to describe* a phenomenon that includes the movement of matter within an ecosystem. In the model, students identify the relevant components, including:
      i) Matter.
      ii) Plants.
      iii) Animals.
      iv) Decomposers, such as fungi and bacteria.
      v) Environment.
2) Relationships
   a) Students describe* the relationships among components that are relevant for describing* the phenomenon, including:
      i) The relationships in the system between organisms that consume other organisms, including:
         (1) Animals that consume other animals.
         (2) Animals that consume plants.
         (3) Organisms that consume dead plants and animals.
         (4) The movement of matter between organisms during consumption.
      ii) The relationship between organisms and the exchange of matter from and back into the environment (e.g., organisms obtain matter from their environments for life processes and release waste back into the environment, decomposers break down plant and animal remains to recycle some materials back into the soil).

3) Connections
   a) Students use the model to describe*:
      i) The cycling of matter in the system between plants, animals, decomposers, and the environment.
      ii) How interactions in the system of plants, animals, decomposers, and the environment allow multiple species to meet their needs.
      iii) That newly introduced species can affect the balance of interactions in a system (e.g., a new animal that has no predators consumes much of another organism's food within the ecosystem).
      iv) That changing an aspect (e.g., organisms or environment) of the ecosystem will affect other aspects of the ecosystem.

Earth and Space Science

Topic: Earth's Systems

S.5.8. Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]

<table>
<tr><th>Practices of Scientists and Engineers</th><th>Core Science Content</th></tr>
<tr><td>Using Mathematics and Computational Thinking
Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Students will describe and graph quantities such as area and volume to address scientific questions.</td><td rowspan="3">The Roles of Water in Earth's Surface Processes
Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.</td></tr>
<tr><td>Science Connecting Concepts</td></tr>
<tr><td>Scale, Proportion, and Quantity
Standard units are used to measure and describe physical quantities such as weight and volume.</td></tr>
</table>

Observable features of the student performance by the end of the course:

1) Representation
   a) Students graph the given data (using standard units) about the amount of salt water and the amount of fresh water in each of the following reservoirs, as well as in all the reservoirs combined, to address a scientific question:
      i) Oceans.
      ii) Lakes.
      iii) Rivers.
      iv) Glaciers.
      v) Ground water.
      vi) Polar ice caps.
2) Mathematical/computational analysis
   a) Students use the graphs of the relative amounts of total salt water and total fresh water in each of the reservoirs to describe* that:
      i) The majority of water on Earth is found in the oceans.
      ii) Most of the Earth's fresh water is stored in glaciers or underground.
      iii) A small fraction of fresh water is found in lakes, rivers, wetlands, and the atmosphere.

S.5.9. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

<table>
<tr><th>Practices of Scientists and Engineers</th><th>Core Science Content</th></tr>
<tr><td>Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Students will obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.</td><td rowspan="3">Human Impacts on Earth Systems
Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.</td></tr>
<tr><td>Science Connecting Concepts</td></tr>
<tr><td>Systems and System Models
A system can be described in terms of its components and their interactions.
Science Addresses Questions About the Natural and Material World.
Science findings are limited to questions that can be answered with empirical evidence.</td></tr>
</table>

Observable features of the student performance by the end of the course:

1) Obtaining information
   a) Students obtain information from books and other reliable media about:
      i) How a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
      ii) How a given community uses scientific ideas to protect a given natural resource and the environment in which the resource is found.
2) Evaluating information
   a) Students combine information from two or more sources to provide and describe* evidence about:
      i) The positive and negative effects on the environment as a result of human activities.
      ii) How individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.

S.5.10. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

Practices of Scientists and Engineers	Core Science Content
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Students will develop a model using an example to describe a scientific principle.	**Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.
Science Connecting Concepts	
Systems and System Models A system can be described in terms of its components and their interactions.	

Observable features of the student performance by the end of the course:

1) Components of the model
   a) Students develop a model, using a specific given example of a phenomenon, to describe* ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact. In their model, students identify the relevant components of their example, including features of two of the following systems that are relevant for the given example:
      i) Geosphere (i.e., solid and molten rock, soil, sediment, continents, mountains).
      ii) Hydrosphere (i.e., water and ice in the form of rivers, lakes, glaciers).
      iii) Atmosphere (i.e., wind, oxygen).
      iv) Biosphere (i.e., plants, animals [including humans]).
2) Relationships
   a) Students identify and describe* relationships (interactions) within and between the parts of the Earth systems identified in the model that are relevant to the example (e.g., the atmosphere and the hydrosphere interact by exchanging water through evaporation and precipitation; the hydrosphere and atmosphere interact through air temperature changes, which lead to the formation or melting of ice).
3) Connections
   a) Students use the model to describe* a variety of ways in which the parts of two major Earth systems in the specific given example interact to affect the Earth's surface materials and processes in that context. Students use the model to describe* how parts of an individual Earth system:
      i) Work together to affect the functioning of that Earth system.
      ii) Contribute to the functioning of the other relevant Earth system.

S.5.11. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

<table>
<tr><th>Practices of Scientists and Engineers</th><th>Core Science Content</th></tr>
<tr><td>Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. Students will obtain and combine information from books and other reliable media to explain phenomena.</td><td rowspan="3">Natural Resources
Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.</td></tr>
<tr><td>Science Connecting Concepts</td></tr>
<tr><td>Cause and Effect
Cause and effect relationships are routinely identified and used to explain change.
Interdependence of Science, Engineering, and Technology
Knowledge of relevant scientific concepts and research findings is important in engineering.
Influence of Engineering, Technology, and Science on Society and the Natural World
Over time, people's needs and wants change, as do their demands for new and improved technologies.</td></tr>
</table>

Observable features of the student performance by the end of the course:

1) Obtaining information
    a) Students gather information from books and other reliable media about energy resources and fossil fuels (e.g., fossil fuels, solar, wind, water, nuclear), including:
        i) How they are derived from natural sources (e.g., which natural resource they are derived from) [note: mechanisms should be limited to grade appropriate descriptions*, such as comparing the different ways energy resources are each derived from a natural resource).
        ii) How they address human energy needs.
        iii) The positive and negative environmental effects of using each energy resource.
2) Evaluating information
    a) Students combine the obtained information to provide evidence about:
        i) The effects on the environment of using a given energy resource.
        ii) Whether the energy resource is renewable.
        iii) The role of technology, including new and improved technology, in improving or mediating the environmental effects of using a given resource.
3) Communicating information
    a) Students use the information they obtained and combined to describe* the causal relationships between:
        i) Energy resources and the environmental effects of using that energy source.
        ii) The role of technology in extracting and using an energy resource.

S.5.12. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Practices of Scientists and Engineers	Core Science Content
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Students will generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	Natural Hazards A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.
Science Connecting Concepts	
Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change. Influence of Engineering, Technology, and Science on Society and the Natural World Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.	

Observable features of the student performance by the end of the course:

1) Using scientific knowledge to generate design solutions
   a) Given a natural Earth process that can have a negative effect on humans (e.g., an earthquake, volcano, flood, landslide), students use scientific information about that Earth process and its effects to design at least two solutions that reduce its effect on humans.
   b) In their design solutions, students describe* and use cause and effect relationships between the Earth process and its observed effect.
2) Describing* criteria and constraints, including quantification when appropriate
   a) Students describe* the given criteria for the design solutions, including using scientific information about the Earth process to describe* how well the design must alleviate the effect of the Earth process on humans.
   b) Students describe* the given constraints of the solution (e.g., cost, materials, time, relevant scientific information), including performance under a range of likely conditions.
3) Evaluating potential solutions
   a) Students evaluate each design solution based on whether and how well it meets the each of the given criteria and constraints.
   b) Students compare the design solutions to each other based on how well each meets the given criteria and constraints.
   c) Students describe* the design solutions in terms of how each alters the effect of the Earth process on humans.

Topic: Space Systems: Stars and the Solar System

S.5.13. Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth. [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]

Practices of Scientists and Engineers	Core Science Content
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Students will support an argument with evidence, data, or a model.	**The Universe and its Stars** The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.
Science Connecting Concepts	
Scale, Proportion, and Quantity Natural objects exist from the very small to the immensely large.	

Observable features of the student performance by the end of the course:

1) Supported claims
    a) Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that the apparent brightness of the sun and stars is due to their relative distances from Earth.
2) Identifying scientific evidence
    a) Students describe* the evidence, data, and/or models that support the claim, including:
        i) The sun and other stars are natural bodies in the sky that give off their own light.
        ii) The apparent brightness of a variety of stars, including the sun.
        iii) A luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person (e.g., nearby streetlights appear bigger and brighter than distant streetlights).
        iv) The relative distance of the sun and stars from Earth (e.g., although the sun and other stars are all far from the Earth, the stars are very much farther away; the sun is much closer to Earth than other stars).
3) Evaluating and critiquing evidence
    a) Students evaluate the evidence to determine whether it is relevant to supporting the claim, and sufficient to describe* the relationship between apparent size and apparent brightness of the sun and other stars and their relative distances from Earth.
    b) Students determine whether additional evidence is needed to support the claim.
4) Reasoning and synthesis
    a) Students use reasoning to connect the relevant and appropriate evidence to the claim with argumentation. Students describe* a chain of reasoning that includes:
        i) Because stars are defined as natural bodies that give off their own light, the sun is a star.
        ii) The sun is many times larger than Earth but appears small because it is very far away.
        iii) Even though the sun is very far from Earth, it is much closer than other stars.
        iv) Because the sun is closer to Earth than any other star, it appears much larger and brighter than any other star in the sky.
        v) Because objects appear smaller and dimmer the farther they are from the viewer, other stars, although immensely large compared to the Earth, seem much smaller and dimmer because they are so far away.
        vi) Although stars are immensely large compared to Earth, they appear small and dim because they are so far away.
        vii) Similar stars vary in apparent brightness, indicating that they vary in distance from Earth.

S.5.14. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]

<table>
<tr><th>Practices of Scientists and Engineers</th><th>Core Science Content</th></tr>
<tr><td>Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Students will represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.</td><td rowspan="3">Earth and the Solar System
The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.</td></tr>
<tr><td>Science Connecting Concepts</td></tr>
<tr><td>Patterns
Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena.</td></tr>
</table>

Observable features of the student performance by the end of the course:

1) Organizing data
   a) Using graphical displays (e.g., bar graphs, pictographs), students organize data pertaining to daily and seasonal changes caused by the Earth's rotation and orbit around the sun. Students organize data that include:
      i) The length and direction of shadows observed several times during one day.
      ii) The duration of daylight throughout the year, as determined by sunrise and sunset times.
      iii) Presence or absence of selected stars and/or groups of stars that are visible in the night sky at different times of the year.
2) Identifying relationships
   a) Students use the organized data to find and describe* relationships within the datasets, including:
      i) The apparent motion of the sun from east to west results in patterns of changes in length and direction of shadows throughout a day as Earth rotates on its axis.
      ii) The length of the day gradually changes throughout the year as Earth orbits the sun, with longer days in the summer and shorter days in the winter.
      iii) Some stars and/or groups of stars (i.e., constellations) can be seen in the sky all year, while others appear only at certain times of the year.
   b) Students use the organized data to find and describe* relationships among the datasets, including:
      i) Similarities and differences in the timing of observable changes in shadows, daylight, and the appearance of stars show that events occur at different rates (e.g., Earth rotates on its axis once a day, while its orbit around the sun takes a full year).

Engineering, Technology, and Applications of Science

Topic: Engineering Design

S.5.15. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

<table>
<tr><th>Practices of Scientists and Engineers</th><th>Core Science Content</th></tr>
<tr><td>Asking Questions and Defining Problems
Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. Students will define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.</td><td rowspan="3">Defining and Delimiting Engineering Problems
Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.</td></tr>
<tr><td>Science Connecting Concepts</td></tr>
<tr><td>Influence of Science, Engineering, and Technology on Society and the Natural World
People's needs and wants change over time, as do their demands for new and improved technologies.</td></tr>
</table>

Observable features of the student performance by the end of the course:

1) Identifying the problem to be solved
   a) Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.
   b) The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
   c) Students describe* that people's needs and wants change over time.
2) Defining the boundaries of the system
   a) Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.
3) Defining the criteria and constraints
   a) Based on the situation people want to change, students specify criteria (required features) of a successful solution.
   b) Students describe* the constraints or limitations on their design, which may include:
      i) Cost.
      ii) Materials.
      iii) Time.

S.5.16. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

<table>
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<tr><td>Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Students will generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.</td><td rowspan="3">Developing Possible Solutions
Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.</td></tr>
<tr><td>Science Connecting Concepts</td></tr>
<tr><td>Influence of Science, Engineering, and Technology on Society and the Natural World
Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.</td></tr>
</table>

Observable features of the student performance by the end of the course:

1) Using scientific knowledge to generate design solutions
   a) Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
   b) Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
   c) Students specify how each design solution solves the problem.
   d) Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
   e) Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2) Describing* criteria and constraints, including quantification when appropriate
   a) Students describe*:
      i) The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
      ii) How the criteria and constraints will be used to generate and test the design solutions.
3) Evaluating potential solutions
   a) Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
   b) Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

S.5.17. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Practices of Scientists and Engineers	Core Science Content
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Students will plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
Science Connecting Concepts	

Observable features of the student performance by the end of the course:

1) Identifying the purpose of the investigation
   a) Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.
2) Identifying the evidence to be address the purpose of the investigation
   a) Students describe* the evidence to be collected, including:
      i) How well the model/prototype performs against the given criteria and constraints.
      ii) Specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
      iii) Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
   b) Students describe* how the evidence is relevant to the purpose of the investigation.
3) Planning the investigation
   a) Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:
      i) The specific criterion or constraint to be used.
      ii) What is to be changed in each trial (the independent variable).
      iii) The outcome (dependent variable) that will be measured to determine success.
      iv) What tools and methods are to be used for collecting data.
      v) What is to be kept the same from trial to trial to ensure a fair test.
4) Collecting the data
   a) Students carry out the investigation, collecting, and recording data according to the developed plan.

David L. Roach
West Virginia Superintendent of Schools