FIFTH GRADE

The performance expectations in fifth grade help students formulate answers to questions such as: “When matter changes, does its weight change? How much water can be found in different places on Earth? Can new substances be created by combining other substances? How does matter cycle through ecosystems? Where does the energy in food come from and what is it used for? How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?” Fifth grade performance expectations include PS1, PS2, PS3, LS1, LS2, ESS1, ESS2, and ESS3

Disciplinary Core Ideas from the NRC Framework. Students are able to describe that matter is made of particles too small to be seen through the development of a model. Students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. Through the development of a model using an example, students are able to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. They describe and graph data to provide evidence about the distribution of water on Earth. Students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals’ food was once energy from the sun. Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; energy and matter; and systems and systems models are called out as organizing concepts for these disciplinary core ideas. In the fifth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, engaging in argument from evidence, and obtaining, evaluating, and communicating information; and to use these practices to demonstrate understanding of the core ideas.

5. Structure and Properties of Matter

Students who demonstrate understanding can:

5-PS1-1

Develop and use 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*.]

5-PS1-2

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.*]

5-PS1-3

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*.]

5-PS1-4

Conduct an investigation to determine whether the mixing of two or more substances results in new substances. [Clarifying Statement: Share finding from the investigation.]

5-PS1-1

Students who demonstrate understanding can: Develop and use 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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Use models to describe phenomena.	**PS1.A: 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.	**Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large.

5-PS1-2

Students who demonstrate understanding can: 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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking • Measure and graph quantities such as weight to address scientific and engineering questions and problems.	**PS1.A: 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. **PS1.B: 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.)	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes consistent patterns in natural systems.

5-PS1-3

Students who demonstrate understanding can: 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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations • Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	**PS1.A: 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.)	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

5-PS1-4

Students who demonstrate understanding can: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Clarifying Statement: Share finding from the investigation.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations • 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.	**PS1.B: Chemical Reactions** • When two or more different substances are mixed, a new substance with different properties may be formed.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

5. Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can:

5-PS3-1

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

5-LS1-1

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.]

5-LS2-1

Develop and describe a model that describes 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*.]

5-PS3-1

Students who demonstrate understanding can: Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun.

Clarification Statement: Examples of models could include diagrams, and flow charts.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Use models to describe phenomena.	**PS3.D: 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). **LS1.C: Organization for Matter and Energy Flow in Organisms** • Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (*Secondary*)	**Energy and Matter** • Energy can be transferred in various ways and between objects.

5-LS1-1

Students who demonstrate understanding can: 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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence • Support an argument with evidence, data, or a model.	**LS1.C: Organization for Matter and Energy Flow in Organisms** • Plants acquire their material for growth chiefly from air and water.	**Energy and Matter** • Matter is transported into, out of, and within systems.

5-LS2-1

Students who demonstrate understanding can: Develop and describe a model that describes 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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model to describe phenomena. **Connections to the Nature of Science** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Science explanations describe the mechanisms for natural events.	**LS2.A: 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. »	**Systems and System Models** • A system can be described in terms of its components and their interactions.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
	LS2.B: 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.	

5. Earth's Systems

Students who demonstrate understanding can:

5-ESS2-1

Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere (water), cryosphere (ice), 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, cryosphere, atmosphere, and biosphere are each a system.] [*Assessment Boundary: Assessment is limited to the interactions of two systems at a time*.]

5-ESS2-2

Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Clarification Statement: Examples could include lakes, rivers, glaciers, sea ice, oceans, groundwater, and polar ice caps. Represent and interpret the data represented by the graphical displays.] [*Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere*.]

5-ESS3-1

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

5-ESS2-1

Students who demonstrate understanding can: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere (water), cryosphere (ice), 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, cryosphere, atmosphere, and biosphere are each a system.

Assessment Boundary: Assessment is limited to the interactions of two systems at a time.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model using an example to describe a scientific principle.	**ESS2.A: 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.	**Systems and System Models** • A system can be described in terms of its components and their interactions.

5-ESS2-2

Students who demonstrate understanding can: Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Clarification Statement: Examples could include lakes, rivers, glaciers, sea ice, oceans, groundwater, and polar ice caps. Represent and interpret the data represented by the graphical displays.

Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking • Describe and graph quantities such as area and volume to address scientific questions.	**ESS2.C: 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.	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight and volume.

5-ESS3-1

Students who demonstrate understanding can: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	**ESS3.C: 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.	**Systems and System Models** • A system can be described in terms of its components and their interactions. **Connections to Nature of Science** **Science Addresses Questions About the Natural and Material World.** • Science findings are limited to questions that can be answered with empirical evidence.

5. Space Systems: Stars and the Solar System

Students who demonstrate understanding can:

5-PS2-1

Support an argument that the gravitational force exerted by Earth on objects is directed toward the center of the Earth. [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [*Assessment Boundary: Assessment does not include mathematical representation of gravitational force.*]

5-ESS1-1

Support an argument that differences in the apparent brightness of the sun compared to other 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, and stage).*]

5-ESS1-2

Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, daily appearance of the moon, 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.*]

5-PS2-1

Students who demonstrate understanding can: Support an argument that the gravitational force exerted by Earth on objects is directed toward the center of the Earth.

Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.

Assessment Boundary: Assessment does not include mathematical representation of gravitational force.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence • Support an argument with evidence, data, or a model.	**PS2.B: Types of Interactions** • The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

5-ESS1-1

Students who demonstrate understanding can: Support an argument that differences in the apparent brightness of the sun compared to other 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, and stage).

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence • Support an argument with evidence, data, or a model.	**ESS1.A: 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.	**Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large.

5-ESS1-2

Students who demonstrate understanding can: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, daily appearance of the moon, 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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data • Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	**ESS1.B: 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.	**Patterns** • Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena.

3-5.Engineering Design

Students who demonstrate understanding can:

3-5-ETS1-1

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

3-5-ETS1-2

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.

3-5-ETS1-3

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.

3-5-ETS1-1

Students who demonstrate understanding can: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems • Define a simple 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.	**ETS1.A: 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.	**Influence of Engineering, Technology, and Science on Society and the Natural World** • People's needs and wants change over time, as do their demands for new and improved technologies.

3-5-ETS1-2

Students who demonstrate understanding can: 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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	**ETS1.B: 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.	**Influence of Engineering, Technology, and Science 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.

3-5-ETS1-3

Students who demonstrate understanding can: 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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations • 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 is considered.	**ETS1.B: Developing Possible Solutions** • Tests are often designed to identify failure points or difficulties which suggest the elements of a design that need to be improved. **ETS1.C: 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.	