Kentucky Alternate Assessment

Kentucky Department of
EDUCATION

Kentucky Academic Standards
Alternate Assessment Targets

Science Grade 4

INTRODUCTION

Background on the Kentucky Academic Standards for Science

In a world that is becoming increasingly complex, it is important that students have the knowledge and understanding to engage in public discussions around issues infused in science. The *Framework for K-12 Science Education* outlines three dimensions that, when used together, support students' deep understanding of the sciences, how science knowledge is acquired and understood and how the sciences are all connected through concepts that have a common application across the disciplines.

Promoting scientific literacy in an equitable and quality manner for *all* students is an ideal worthy of focused attention and continued effort. Equitable access to high-quality educational standards provides common expectations for all students and equips students with the strong science-based skills, including critical thinking and inquiry-based problem-solving, to be scientifically literate and succeed in college, careers and citizenship.

Engineering is taking science and applying it to create solutions that benefit society and the environment. The *Kentucky Academic Standards for Science* represents a commitment to integrate engineering thinking through engineering design practices into the structure of science education from kindergarten through grade 12 by raising engineering design thinking to the same level as scientific inquiry when teaching science disciplines. Providing all students with a foundation in engineering design allows them to better engage in and aspire to solve major societal and environmental challenges they will face in the decades ahead and to engage in public discussions on science-related issues related to their everyday lives.

Kentucky's Vision for Students

Knowledge about science and the ability to be critically educated consumers of scientific information related to their everyday lives directly aligns with the vision of the Kentucky Board of Education (KBE). The board's vision is that each and every student is empowered and equipped to pursue a successful future. To equip and empower students, the following capacity and goal statements frame instructional programs in Kentucky schools. These statements were established by the Kentucky Education Reform Act (KERA) of 1990, as found in Kentucky Revised Statute (KRS) 158.645 and KRS 158.6451, stating that all students shall have the opportunity to acquire the following capacities and learning goals:

- Communication skills necessary to function in a complex and changing civilization;
- Knowledge to make economic, social and political choices;
- Core values and qualities of good character to make moral and ethical decisions throughout life;
- Understanding of governmental processes as they affect the community, the state and the nation;
- Sufficient self-knowledge and knowledge of their mental health and physical wellness;
- Sufficient grounding in the arts to enable each student to appreciate their cultural and historical heritage;
- Sufficient preparation to choose and pursue their life's work intelligently; and
- Skills to enable students to compete favorably with students in other states

Furthermore, schools shall:

- Expect a high level of achievement from all students.
- Develop their students’ ability to:
    - Use basic communication and mathematics skills for purposes and situations they will encounter throughout their lives;
    - Apply core concepts and principles from mathematics, the sciences, the arts, the humanities, social studies and practical living studies to situations they will encounter throughout their lives;
    - Become self-sufficient individuals of good character exhibiting the qualities of altruism, citizenship, courtesy, hard work, honesty, human worth, justice, knowledge, patriotism, respect, responsibility and self-discipline;
    - Become responsible members of a family, work group or community, including demonstrating effectiveness in community service;
    - Think and solve problems in school situations and a variety of other situations they will encounter in life;
    - Connect and integrate experiences and new knowledge from all subject matter fields with what students have previously learned and build on past learning experiences to acquire new information through various media sources; and
    - Express their creative talents and interests in visual arts, music, dance and dramatic arts.
- Increase student attendance rates.
- Increase students' graduation rates and reduce dropout and retention rates.
- Reduce physical and mental health barriers to learning.
- Be measured on the proportion of students who make a successful transition to work, postsecondary education and the military.

To ensure legal requirements of science classes are met, the Kentucky Department of Education (KDE) encourages schools to use the *Model Curriculum Framework* to ensure curricular coherence in the development of curricula that meet the grade-level expectations set forth by standards. The Model Curriculum Framework describes curricular coherence as the “local alignment of the standards, curriculum, instructional resources, assessment and instructional practices within and across grade-levels in a school or district to help students meet grade-level expectations.”

Legal Basis

The following KRS and Kentucky Administrative Regulations (KAR) provide a legal basis for this publication:

> **KRS 156.160 Promulgation of administrative regulations by the Kentucky Board of Education**
> With the advice of the Local Superintendents Advisory Council (LSAC), the KBE shall promulgate administrative regulations establishing standards that public school districts shall meet in student, program, service and operational performance. These regulations shall comply with the expected outcomes for students and schools set forth in KRS 158:6451.

KRS 158.6453 Review of academic standards and assessments
Beginning in fiscal year 2017-2018, and every six (6) years thereafter, the Kentucky Department of Education shall implement a process for reviewing Kentucky's academic standards and the alignment of corresponding assessments for possible revision or replacement to ensure alignment with post-secondary readiness standards necessary for global competitiveness and with state career and technical education standards. The revisions to the content standards shall:

1. Focus on critical knowledge, skills, and capacities needed for success in the global economy;
2. Result in fewer but more in-depth standards to facilitate mastery learning;
3. Communicate expectations more clearly and concisely to teachers, parents, students and citizens;
4. Be based on evidence-based research;
5. Consider international benchmarks; and
6. Ensure that the standards are aligned from elementary to high school to post-secondary education so that students can be successful at each education level.

704 KAR 3:305 Minimum high school graduation requirements
This administrative regulation establishes the minimum high school graduation requirements necessary for entitlement to a public high school diploma.

704 KAR 008:120 Kentucky Academic Standards for Science
This administrative regulation adopts into law the *Kentucky Academic Standards for Science*.

Standards Creation Process

Per KRS 158.6453, the *Kentucky Academic Standards for Science* were entirely conceived and written by teams of Kentucky educators. Kentucky teachers understand that elementary and secondary academic standards must align with postsecondary readiness standards and state career and technical education standards. This focus helps ensure that students are prepared for the jobs of the future and can compete with students from other states and nations.

The Science Advisory Panel (AP) was composed of 28 teachers, three public post-secondary professors from institutes of higher education and three community members. The function of the AP was to review public comments on the existing standards and make recommendations for changes to a Review Committee (RC). The Science RC was composed of six science teachers, two public post-secondary professors from institutes of higher education and three community members. The function of the Science RC was to review the work and findings from the AP and make recommendation to revise or replace existing standards.

The team was selected based on their expertise in the field of science and their role as practicing science teachers. When choosing writers, the selection committee considered state-wide representation for public elementary, middle and high school teachers as well as higher education instructors and community members.

Writers' Vision Statement

The writing team was guided by a vision for equitable science education in Kentucky that begins in kindergarten and progresses yearly through grade 12 to ensure that all students possess sufficient understanding of the science and engineering practices, crosscutting concepts and core ideas of science to engage in public discussions on science-related issues and are critically educated consumers of scientific information related to their everyday lives. To achieve this, *all* students at *all* grade levels must experience multiple sustained and authentic learning opportunities to investigate phenomena, engage in collaborative conversations and reflect the diversity encountered within the classroom in the local community and across the globe.

To meet this vision, the writers recognize that students need sustained opportunities to work with and develop the ideas that underly science and engineering practices and to appreciate how those ideas are interconnected over a period of years rather than weeks or months. Students should be provided multiple, ongoing opportunities to engage with the interconnectedness of the three dimensions of science as they work to make sense of the natural world. To assist teachers in this endeavor, the writers recommend that teachers at all grade levels have ongoing access to high-quality professional learning and resources about science.

The KDE provided the following foundational documents to inform the writing team's work:

- Bell, P. (2019). Infrastructuring Teacher Learning about Equitable Science Instruction. *Journal of Science Teacher Education*, *30*(7), 681–690. https://doi.org/10.1080/1046560X.2019.1668218
- Bell, P. & Bang, M. (2015). *STEM Teaching Tool #15 Overview: How can we promote equity in science education?* http://stemteachingtools.org/brief/15
- Michaels, S., Shouse, A., & Schweingruber, H. (2008). Ready, Set, SCIENCE!: Putting Research to Work in K-8 Science Classrooms. The National Academies Press. https://www.nap.edu/catalog/11882/ready-set-science-putting-research-to-work-in-k-8
- Morrison, D. & Bell, P. (2018). *STEM Teaching Tool #54 How to build an equitable learning community in your science classroom.* http://stemteachingtools.org/brief/54
- National Research Council. (2012). *A Framework for K-12 Science Education Practices, Crosscutting Concepts, and Core Ideas.* https://www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts
- NGSS Lead States. (2013). *The Next Generation Science Standards: For States, By States.* Appendix D: All Standards, All Students. https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf
- NGSS Lead States. (2013). *The Next Generation Science Standards: For States, By States.* Appendix E: DCI Progressions in the NGSS. https://www.nextgenscience.org/sites/default/files/resource/files/AppendixE-ProgressionswithinNGSS-061617.pdf
- NGSS Lead States. (2013). *The Next Generation Science Standards: For States, By States.* Appendix F: Science and Engineering Practices. https://www.nextgenscience.org/sites/default/files/resource/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf

- NGSS Lead States. (2013). *The Next Generation Science Standards: For States, By States.* Appendix G: Crosscutting Concepts. https://www.nextgenscience.org/sites/default/files/resource/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf
- Review of state academic documents and frameworks (Alaska, Arizona, Massachusetts, New York, Oklahoma, South Dakota, Tennessee, Utah).
- Duncan, R., Krajcik, J., & Rivet, A. (Eds.). (2017). *Disciplinary Core Ideas Reshaping Teaching and Learning*. NSTA Press.
- Schwarz, C., Passmore, C., & Reiser, B. (Eds.). (2017). *Helping Students Make Sense of the World Using Next Generation Science and Engineering Practices.* NSTA Press.

Additionally, participants brought their own knowledge to the process. The writers also thoughtfully considered feedback from the public and science community.

Design Considerations

Design considerations were informed by research, public comment and review of science standards from other states. A recurring theme reported from the first round of public comment was the desire to have more clarity about what specific performance expectations required. Upon examination, it was determined that examples and further information were provided but that the information was not readily accessible. This resulted in a redesign of the layout to address this concern.

Three-Dimensional Science

Understanding science and how it works goes beyond knowing discrete pieces of information. To meet the vision of scientifically literate students, the integration of the three dimensions of science, as outlined in the *Framework for K-12 Science Education*, must be maintained. These dimensions are:

- Science and Engineering Practices – describe the methods and way that:
  - Scientists investigate and develop models about the natural world and
  - Engineers design and build systems;
- Crosscutting Concepts – intellectual tools that students can draw from as they begin to investigate the natural/designed world;
- Disciplinary Core Ideas – ideas that have broad importance across multiple sciences or a key principle in a discipline

For students to develop a deep understanding of the core ideas, they must engage in exploring the natural and designed world. This is accomplished through the use of the practices and the crosscutting concepts. While only a subset of science and engineering practices and crosscutting concepts are explicitly identified as the mechanism for how students demonstrate mastery of a performance expectation at the end of instruction, students should still use all of the science and engineering practices and crosscutting concepts as they develop their understanding of each disciplinary core idea.

Engineering, Technology and Application of Science

The linkage between learning science and learning engineering is demonstrated within the *Kentucky Academic Standards for Science*.

> *Just as new science enables or sometimes demands new technologies, new technologies enable new scientific investigations, allowing scientists to probe realms and handle quantities of data previously inaccessible to them. It is impossible to do engineering today without applying science in the process, and, in many areas of science, designing and building new experiments requires scientists to engage in some engineering practices. This interplay of science and engineering makes it appropriate to [include] engineering and technology.* (National Research Council, 2012)

Engineering design in the earliest grades introduces students to "problems" as situations that people want to change. They can use tools and materials to solve simple problems, use different representations to convey solutions, and compare different solutions to a problem and determine which is best. Students in all grade levels are not expected to come up with original solutions, although original solutions are always welcome. Emphasis is on thinking through the needs or goals that need to be met, and which solutions best meet those needs and goals.

For those engineering design standards with no crosscutting concepts identified, the crosscutting concept will be identified by the nature of the problem chosen.

Clarification Statements and Assessment Boundaries

A recurring theme reported from the first round of public comment was the desire to have more clarity about what specific performance expectations required. Most of the performance expectations defined in the *Kentucky Academic Standards for Science* include clarification statements and assessment boundaries. Clarification statements are one or two sentences that provide examples or particular emphasis that can assist in further understanding of the intent and in developing instructional experiences. Assessment boundaries define the limits of large-scale assessment. This, however, does not limit assessment practices within the classroom.

Science for All

The vision set forth by the writers emphasizes that "*all* students will possess sufficient understanding … to engage in public discussion … and be critically educated consumers of scientific information." The *Kentucky Academic Standards for Science*, written as performance expectations, imply that students will be active participants in the scientific and engineering process. The inclusion of the science and engineering practices "offer rich opportunities and demands for language learning while they support science learning for all students" (Appendix D, p. 5).

The crosscutting concepts demonstrate the interrelatedness of scientific concepts, which is often seen as implied background knowledge – knowledge that derives from experiences that not all students have access to. As noted in Appendix D of the Next Generation Science Standards (NGSS), "Explicit teaching of the crosscutting concepts enables less privileged students … to make connections among big ideas that cut across science disciplines" (Appendix D, p. 6). As such, the multidimensionality demonstrated in the *Kentucky Academic Standards for Science* levels the playing field for all students to actively engage in scientific sensemaking and engineering design.

Standards Use and Development

The Kentucky Academic Standards Are Standards, Not Curriculum

The *Kentucky Academic Standards for Science* outlines the minimum standards Kentucky students should learn in each grade level kindergarten through eighth grade or high school grade-span. The standards address a foundational framework of what is to be learned, but do not address how learning experiences are to be designed or what resources should be used.
A standard represents a goal or outcome of an educational program; standards are vertically aligned expected outcomes for all students. The standards do not dictate the design of a lesson plan or how units should be organized. The standards establish a statewide baseline of what students should know and be able to do at the conclusion of a grade or grade-span. The instructional program should emphasize the development of students' abilities to acquire and apply the standards. The curriculum must ensure that appropriate accommodations are made for diverse populations of students found within Kentucky schools.

These standards are not a set of instructional or assessment tasks, but rather statements of what students should be able to master after instruction. Decisions on how best to help students meet these program goals are left to local school districts and teachers. Curriculum includes the vast array of instructional materials, readings, learning experiences and local mechanisms of assessment, including the full body of content knowledge to be covered, all of which are to be selected at the local level according to Kentucky law.

Translating the Standards into Curriculum

The Kentucky Department of Education does not require specific curricula or strategies to be used to engage students in the *Kentucky Academic Standards*. Local schools and districts choose to meet the minimum required standards using a locally adopted curriculum according to KRS 160.345, which outlines the method by which the curriculum is to be determined. As educators implement academic standards, they, along with community members, must guarantee postsecondary readiness that will ensure all learners are transition ready. To achieve this, Kentucky students need a curriculum designed and structured for a rigorous, relevant and personalized learning experience, including a wide variety of learning opportunities. The Kentucky *Model Curriculum Framework* is a resource to support districts and schools in the continuous process of designing and reviewing local curriculum.

Organization of the Standards

The *Kentucky Academic Standards for Science* are organized by grade level for kindergarten through grade 8, with high school standards being grade banded. Within each grade level/band, the performance expectations are organized around the disciplinary core ideas, resulting in a coherence of understanding as students move through their academic career. This, in turn, provides for greater flexibility for arranging the performance expectations in a grade level in a way that best represents the needs of schools and districts without sacrificing coherence.

The National Research Council, the functional staffing of the National Academies of Science, released the *Framework for K-12 Science Education* in 2011, which is the research base that was used in the development of the science standards. The framework provides that a quality science education for K-12 students integrates the three dimensions of science: science and engineering practices, disciplinary core ideas and the crosscutting concepts.

This results in the *Kentucky Academic Standards for Science* being written at the intersection of these three dimensions and being described as performance expectations students are required to demonstrate to show mastery. These dimensions describe the processes of doing science, the structure that helps organize and connect understanding and the deep knowledge that provides predictive power. Taken together, these represent how we use science to make sense of the natural/designed world and are most meaningful when learned in concert with one another.

Science and Engineering Practices: Practices refer to the way in which scientists and engineers engage in their work. They engage in wonder, design, modeling, argumentation, communication, and engineering thinking. While a specific practice may be identified in each performance expectation, students should engage in all practices because this helps them understand how scientific knowledge develops and the links between science and engineering.

Disciplinary Core Ideas: Core ideas found in the *Kentucky Academic Standards for Science* are foundational understandings so that students may later acquire additional information on their own. The core ideas are organized within physical, life and earth/space science, which are traditionally associated with science knowledge. Also found here are the ideas used in the engineering design process, identified as ETS (engineering, technology, and application of science).

Crosscutting Concepts: Crosscutting concepts are conceptual tools that are used as lenses for understanding the natural/designed world. They provide ways of thinking and reasoning about phenomena across disciplines, uniting core ideas throughout the fields of science and engineering. While specific crosscutting concepts may be identified in each performance expectation, explicit instruction and engagement in all of the crosscutting concepts is expected. This will help deepen students' sensemaking across a range of disciplinary contexts.

The table below provides a summary of each science dimension mentioned above.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking questions or defining problems: Students engage in asking testable questions and defining problems to pursue understanding of phenomena. **Developing and using models:** Students develop physical, conceptual and other models to represent relationships, explain mechanisms, communicate ideas and predict outcomes. **Planning and carrying out investigations:** Students plan and conduct scientific investigations to test, revise or develop explanations.	**Physical Sciences:** (PS1) Matter and Its Interactions (PS2) Motion and Stability: Forces and Interactions (PS3) Energy (PS4) Waves **Life Sciences:** (LS1) Molecules to Organisms (LS2) Ecosystems (LS3) Heredity (LS4) Biological Evolution	**Patterns:** Students observe patterns to organize and classify factors that influence relationships. **Cause and effect mechanisms and explanation**: Students investigate and explain causal relationships and their mechanisms to make tests and predictions. **Scale, proportion and quantity:** Students recognize the relevancy of and changes in scale, proportions and quantities of measurement within and between various systems.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and interpreting data: Students analyze various types of data to identify features or patterns for interpretation and further use. **Using mathematics and computational thinking:** Students use fundamental tools in science to compute relationships and interpret results. **Constructing explanations and designing solutions:** Students construct explanations about the world and design solutions to problems using observations that are consistent with current evidence and scientific principles. **Engaging in argument from evidence:** Students support their best conclusions and solutions with lines of reasoning using evidence to defend their claims. **Obtaining, evaluating and communicating information:** Students obtain, evaluate and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables or orally.	**Earth and Space Sciences:** (ESS1) Earth's Place in the Universe (ESS2) Earth's Systems (ESS3) Earth and Human Activity **Engineering Design:** (ETS1.A) Defining and Delimiting an Engineering Problem (ETS1.B) Developing Possible Solutions (ETS1.B) Optimizing the Design Solution	**Systems and system models:** Students use models to explain the boundaries and relationships that describe complex systems. **Energy and matter flows, cycles and conservation:** Students describe cycling of matter and flow of energy through systems, including transfer, transformation and conservation of energy and matter. **Structure and function:** Students relate the shape and structure of an object or living thing to its properties and functions. **Stability and change:** Students explain how and why a natural or built system can change or remain stable over time.

How to Read the Standards

Performance Expectation (PE): The performance students demonstrate to show mastery

Foundation Boxes: Provides further information about each dimension that was combined to develop the PE.

Clarification Statement: Provide examples or additional information

Assessment Boundary: States the limit of assessment for large-scale assessment

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.		
Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, swings on a playground, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other. **Assessment Boundary:** Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Planning and Carrying Out Investigations With guidance, plan and conduct an investigation in collaboration with peers.	**PS2.A: Forces and Motion** Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. **PS2.B: Types of Interactions** When objects touch or collide, they push on one another and can change motion. **PS3.C: Relationship Between Energy and Forces** A bigger push or pull makes things speed up or slow down more quickly.	**Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Meaning of Each Component

Performance Expectation: The performance students demonstrate to show mastery. It states how a student will demonstrate their understanding of a core idea on a large-scale assessment. Some performance expectations include an asterisk, which signifies the inclusion of engineering design.

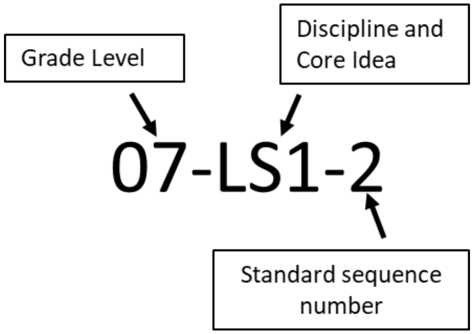
Clarification Statement: These provide examples or additional information about the performance expectation. Not all performance expectations include a clarification statement. In instances in which the committee felt clarification was not necessary, the notation "none provided" is present.

Assessment Boundary: This states the limit of assessment for a large-scale assessment. It does not, however, limit the assessment that could occur in the classroom. The notation "none provided" indicates that the committee did not believe a boundary needed to be identified.

Foundation Boxes: These boxes represent the foundational components of three dimensions that encompass the performance expectation, which are:

- Science and Engineering Practices: This box describes the element of the practice associated with the performance expectation.
- Disciplinary Core Idea: This box includes conceptual information related to the overall core idea of the performance expectation. The coding found in this box is consistent with the coding and component ideas described in the framework.
- Crosscutting Concepts: This box describes the element of the concept associated with the performance expectation.

How to Read the Coding



Discipline Codes	
PS	Physical Science
LS	Life Science
ESS	Earth and Space Science
ETS	Engineering, Technology and Applications of Science

Supplementary Materials to the Standards

Appendix A: Writing and Review Teams

This appendix includes information on the writing teams who developed the Kentucky Academic Standards for Science.

Alternate Assessment Targets: (not a standard)

An Alternate Assessment Target represents limits to a selected Kentucky Academic Standard. An Alternate Assessment Target may reduce parts of the standard with specific guidance to what an assessment item could represent. Not all Kentucky Academic Standards selected for assessments will have an Alternate Assessment Target and may display the language: "*No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.*" This would mean that the entire standard in its original form is reduced in depth and breadth and is eligible in its entirety to be used in the development of assessment items.

Grade 4 Science Kentucky Academic Standards Assessed by Window

Window	Standard
1	4-PS3-2
1	4-PS3-3
1	4-PS3-4
1	3-LS4-3
1	3-LS4-4

Window	Standard
2	4-LS1-1
2	4-ESS1-1
2	4-ESS2-1
2	4-ESS2-2
2	3-5-ETS1-1

Third Grade Overview

To meet the third-grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems; developing and using models; planning and conducting investigations; analyzing and interpreting data; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating and communicating information. Students are expected to use these practices to demonstrate their understanding of the core ideas. Third-grade performance expectations include weather conditions and hazards, life cycles, traits, the environment, balanced and unbalanced forces, and magnetic interactions. Students can organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students can make a claim about the merit of a design solution that reduces the impacts of such hazards. Third graders are expected to develop an understanding of the idea that when the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Students can determine the effects of balanced and unbalanced forces on the motion of an object and the cause-and-effect relationships of electric or magnetic interactions between two objects not in contact with each other. They are then able to apply their understanding of magnetic interactions to define a simple design problem that can be solved with magnets. The crosscutting concepts of patterns that include cause and effect; scale, proportion and quantity; and systems and system models are highlighted as organizing concepts for these disciplinary core ideas.

Note While only a subset of science and engineering practices and crosscutting concepts are explicitly identified as the mechanism for how students demonstrate mastery at the end of instruction, students should still utilize all of the science and engineering practices and crosscutting concepts as they develop their understanding. See front matter for more information.

3-LS4-3.	**Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.**	
Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other. **Assessment Boundary:** None provided.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Engaging in Argument from Evidence Construct an argument with evidence.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	**Cause and Effect** Cause-and-effect relationships are routinely identified and used to explain change.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*		
Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms. **Assessment Boundary:** Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Engaging in Argument from Evidence Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** When the environment changes in ways that affect a place's physical characteristics, temperature, or the availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. **LS4.D: Biodiversity and Humans** Populations live in a variety of habitats, and changes in those habitats affect the organisms living there.	**Systems and System Models** A system can be described in terms of its components and their interactions.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

Fourth Grade Overview

To meet the fourth-grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating and communicating information. Students are expected to use these practices to demonstrate their understanding of the core ideas. Fourth-grade performance expectations include waves, weathering, impacts of Earth processes, Earth features, map analysis, animal and plant anatomy, speed, energy transfer and encoding with patterns. Students can use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students will be able to model patterns that can encode, send, receive, and decode information. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test and refine a device that converts energy from one form to another. The crosscutting concepts of patterns that include cause and effect, energy and matter, and systems and system models are highlighted as organizing concepts for these disciplinary core ideas.

Note While only a subset of science and engineering practices and crosscutting concepts are explicitly identified as the mechanism for how students demonstrate mastery at the end of instruction, students should still utilize all of the science and engineering practices and crosscutting concepts as they develop their understanding. See front matter for more information

4-PS3-2.	**Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.**	
Clarification Statement: None provided. **Assessment Boundary:** Assessment does not include quantitative measurements of energy.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Make observations in order to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	**PS3.A: Definitions of Energy** Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **PS3.B: Conservation of Energy and Energy Transfer** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. Light also transfers energy from place to place. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.	**Energy and Matter** Energy can be transferred in various ways and between objects.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

4-PS3-3. **Ask questions and predict outcomes about the changes in energy that occur when objects collide.**		
Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. **Assessment Boundary:** Assessment does not include quantitative measurements of energy.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Asking Questions and Defining Problems Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.	**PS3.A: Definitions of Energy** Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **PS3.B: Conservation of Energy and Energy Transfer** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. **PS3.C: Relationship Between Energy and Forces** When objects collide, the contact forces transfer energy so as to change the objects' motions.	**Energy and Matter** Energy can be transferred in various ways and between objects.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. *		
Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. **Assessment Boundary:** Devices should be limited to those that convert motion energy to electrical energy or use stored energy to cause motion or produce light or sound.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Apply scientific ideas to solve design problems.	**PS3.B: Conservation of Energy and Energy Transfer** Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. **PS3.D: Energy in Chemical Processes and Everyday Life** The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. **ETS1.A: Defining 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.	**Energy and Matter** Energy can be transferred in various ways and between objects.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.		
Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin. **Assessment Boundary:** Assessment is limited to macroscopic structures within plant and animal systems.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Engaging in Argument from Evidence Construct an argument with evidence, data, and/or a model.	**LS1.A: Structure and Function** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	**System and System Models** A system can be described in terms of its components and their interactions.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

4-ESS1-1.	**Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.**	
Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. **Assessment Boundary:** Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Identify the evidence that supports particular points in an explanation.	**ESS1.C: The History of Planet Earth** Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.	**Patterns** Patterns can be used as evidence to support an explanation.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.		
Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow. **Assessment Boundary:** Assessment is limited to a single form of weathering or erosion.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Make observations and/or measurements in order to produce data to serve as the basis for evidence for an explanation of a phenomenon.	**ESS2.A: Earth Materials and Systems** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. **ESS2.E: Biogeology** Living things affect the physical characteristics of their regions.	**Cause and Effect** Cause-and-effect relationships are routinely identified, tested, and used to explain change.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.		
Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes. **Assessment Boundary:** None provided.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyze and interpret data to make sense of phenomena using logical reasoning.	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features of Earth.	**Patterns** Patterns can be used as evidence to support an explanation.

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.

3-5 Engineering Design Overview

At the upper elementary grades, engineering design engages students in more formalized problem solving. Students define a problem using criteria for success and constraints or limits of possible solutions. Students research and consider multiple possible solutions to a given problem. Generating and testing solutions also becomes more rigorous as the students learn to optimize solutions by revising them several times to obtain the best possible design.

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. *		
Clarification Statement: None provided. **Assessment Boundary:** None provided.		
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concepts**
Asking Questions and Defining Problems 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.	**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.	

Alternate Assessment Target: No limitations. All parts of the Kentucky Academic Standard are eligible to be included as an assessment item.