Assessment Development Guide
Educator Resource
Science: Grade 5

This document is intended to describe how the Kansas assessments align to the Kansas standards. It illustrates how standards, evidence statements, performance level descriptors (PLDs), and depth of knowledge influence the Kansas summative assessment.

The Kansas science content standards serve as the foundation of the assessment. These standards are grouped into claims, which are composed of targets, and the assessment mirrors these same groupings. By assessing at the claim level, it is possible to highlight student mastery of the connected material contained in the standards. Emphasis on particular targets captures the focus, coherence, and rigor of the standards. These content emphases guide the development of each assessment.

Suggested Uses

Educators can use this document to

- better understand the standards and the assessment.
- understand what is expected of students in order to achieve performance level 3.
- check the alignment of curriculum and learning activities.
- ensure that long-range instructional plans match the major emphases of the standards.
- apply standards at the level of rigor necessary to allow students to demonstrate success or mastery within a balanced assessment system.
- develop learning goals.
- build a greater understanding of student, grade-level, school, and district results and plan for future learning activities accordingly.
- provide professional development opportunities within a school or district, and for vertical team planning, grade-level planning, and professional learning communities.

Evidence Statements

Evidence statements are derived from the content standards and describe the knowledge and skills that an assessment item or task elicits from students.

Evidence statements are also designed to provide guidance for teachers in creating classroom learning opportunities that align with the expectations of the standards. Evidence statements should not be used as a checklist of student understanding, nor should they be used to limit instructional practices.

Performance Level Descriptors

To help educators and parents understand students' performance at each level, PLDs are available for each test. PLDs define the knowledge, skills, and processes that students likely demonstrate at different levels of proficiency within the reporting categories (1, 2, 3, 4). PLDs are not inclusive: they do not describe all possible skills students could demonstrate at each of the levels. PLDs should not be viewed as checklists of what students should know or be able to do.

These PLDs appear on Individual Student Reports and describe student performance on the assessment.

Level 1: A student at Level 1 shows a *limited* ability to understand and use the skills and knowledge needed for post-secondary readiness.

Level 2: A student at Level 2 shows a *basic* ability to understand and use the skills and knowledge needed for post-secondary readiness.

Level 3: A student at Level 3 shows an *effective* ability to understand and use the skills and knowledge needed for post-secondary readiness.

Level 4: A student at Level 4 shows an *excellen*t ability to understand and use the skills and knowledge needed for post-secondary readiness.

Detailed descriptions of performance levels for grade 5 science are contained within this document.

Depth of Knowledge

The Kansas Assessment Program (KAP) uses Webb's depth of knowledge (DOK) framework to classify each assessment item based on the level of cognitive demand required by students. The four DOK levels **do not** directly correspond to the four performance levels of the KAP summative assessments.

DOK is a measure of cognitive complexity, not a measure of difficulty. Item difficulty is determined by the percentage of students who correctly respond to an item. It is possible for a DOK 2 item to be very difficult and for a DOK 3 item to be relatively easy.

Items within an assessment include a range of DOK levels and correspond to the levels of cognitive complexity required by the content standards. There are four DOK levels, as outlined below.

<u>Level 1</u> Recall and Reproduction: Recall a fact, term, definition, principle, or concept; perform a simple procedure.

Level 2 Basic Application of Skills and Concepts: Apply conceptual knowledge; use provided information to select appropriate procedures for a task; perform two or more steps with decision points along the way; solve routine problems; organize or display data; interpret or use simple graphs.

Level 3 Strategic Thinking: Apply reasoning, using evidence, and developing a plan to approach or solve abstract, complex, or nonroutine problems; interpret information and provide justification when more than one approach is possible.

Level 4 Extended Thinking: Perform investigations or apply concepts and skills that require research and problem-solving across content areas or multiple sources.

Test Content Summary

The test summary provides general information related to the development and frequency of items on the summative assessment. Individual standards, while important, are impossible to accurately measure with limited testing time. By assessing at the target level, it is possible to highlight student comprehension of the connected material contained in the standards. The pattern of emphasis for the targets that comprise the claims is adapted from the work of national science assessment initiatives and captures the focus, coherence, and rigor of the standards. Therefore, the emphasis assigned to each target varies. However, all content is eligible for assessment, and the balance of tested content is derived from the expectations of the standards.

The claims are the broadest categories of knowledge, skills, and abilities about which inferences can be drawn. At fifth grade, the claims are physical science, life science, and Earth and space science. Claims represent the domains of the targets; targets represent topics in the standards. The evidence statements for each target describe the performance expected of students who have mastered the topic in the standards.

The goal DOK is provided as a general reference for the projected maximum DOK of items. Typically, items are at DOK 2 or 3 to complement the performance expectations of the standards. DOK 4 is generally reserved for complex tasks requiring data analysis.

TABLE 1. Grade 5 Science Test Summary

Physical Science	Percentage of Assessment	Depth of Knowledge
Structure and Properties of Matter	27%–33%	2, 3
Chemical Reactions		
Forces and Interactions		
Energy		
Waves		
Engineering Design		
Life Science	**Percentage of Assessment**	**Depth of Knowledge**
Structure and Function	34%–40%	2, 3
Matter and Energy in Organisms and Ecosystems		
Interdependent Relationships in Ecosystems		
Inheritance and Variation of Traits		
Natural Selection and Evolution		
Engineering Design		
Earth and Space Science	**Percentage of Assessment**	**Depth of Knowledge**
Space Systems	27%–33%	2, 3
History of Earth		
Earth's Systems		
Weather and Climate		
Human Sustainability		
Engineering Design		

Kansas Assessment Program Item Specifications

The Kansas science standards are a set of specific, rigorous expectations that build students' conceptual understanding and ability to apply processes and procedures across grades. The standards are designed to establish a focused, deep understanding of science and engineering and to develop a logical progression of scientific conceptual knowledge and engineering applications, moving students toward college and career readiness.

The Kansas science standards are organized into domains of disciplinary core ideas (DCI), topics, and performance expectation standards. The performance expectations are the most specific level of the science standards and define what students should understand and be able to do. A common criticism of academic achievement tests is that they focus on the level of the standard, which in many cases is a very discrete part of science understanding but does not reflect the depth and breadth of student knowledge. Parsing science out in this way for assessment may not be the most accurate model for assessing student achievement. The acquisition of discrete facts is usually neither how students learn nor how teachers teach. Instead, students commonly incorporate concepts from all three dimensions of disciplinary content knowledge, crosscutting concepts, and science and engineering practices to solve real-world problems, such as determining which products to use to meet material, time, and budget constraints in a construction scenario.

Therefore, test development for the Kansas summative assessment focuses on item development at the level of the topic. Topics are groups of related performance expectations in terms of content. (Note: The DCI arrangement has the same performance expectations in a different grouping.) The topics are reflected in this document as targets (e.g., target A, target B).

To report meaningful results, the targets are organized into larger claims about student learning and mastery. These claims are based on the first three domains of the standards: physical science, life science, and Earth and space science. The fourth domain, engineering, is included as a target within each of the three claims. Each target within a claim is followed by evidence statements that guide item writers in creating test questions that give students the opportunity to demonstrate mastery of that target. The performance expectations, from which the evidence statements are derived, are given below each target as well. For each claim, all targets will be assessed; there will be no nonassessed targets. Each claim will comprise 25%–35% of the assessment so that all domains will be approximately equal in assessment emphasis. Each claim will also include deeper problem-solving strategies.

Although the performance expectations are given with the targets and claims, there may be targets in which not all performance expectations will be assessed. While not all targets will be equally emphasized in the test, all of the content described by the target is important. Some of the content in a target may also be reflected in another target, or the content in a target in the current grade may be a critical foundation skill for success in subsequent grades. Thus, attempts to pattern instruction on the perceived or actual numbers of items in a test may not adequately serve students' needs.

Claim 1: Physical Science

Students are able to comprehend and explain physical science concepts and practices, as well as apply their knowledge to scientific investigations and engineering design problems with precision and accuracy.

Target A Understand the structure and properties of matter and its changes or reactions.

Standards 5-PS1-1, 5-PS1-2, 5-PS1-3, 5-PS1-4

Evidence Statements
Students who demonstrate understanding can 1. develop a model to describe that matter is made of particles too small to be seen. 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. 3. make observations and measurements to identify materials based on their properties. 4. conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Target B Understand that engineering designs are defined, developed, and optimized to solve physical science problems.

Standards 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3

Evidence Statements
Students who demonstrate understanding can 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. 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. 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.

Performance Level Descriptors (PLDs)			
	Level 2	**Level 3**	**Level 4**
Claim 1 Physical Science	Students typically comprehend and **describe** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **low complexity** and **inconsistently** to problems of **moderate complexity** in the physical sciences (targets A and B).	Students typically comprehend and **explain** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **moderate complexity** and **inconsistently** to problems of **high complexity** in the physical sciences (targets A and B).	Students typically comprehend and **analyze** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **high complexity** in the physical sciences (targets A and B).
Target A Structure and Properties of Matter	Students can use a model to describe that matter is made of particles too small to be seen, identify or observe properties of materials, take measurements of matter such as weight and temperature during changes in substance, and state whether the mixing of substances produces a new substance.	Students can develop a model to describe that matter is made of particles too small to be seen, use measurements to identify materials by their properties, provide evidence that matter is conserved during changes in substance, and investigate whether the mixing of substances produces a new substance.	Students can develop models to explain different types of matter made of particles too small to be seen, analyze measurement data to identify materials based upon their properties, argue using collected evidence that matter is conserved during changes in substance, and investigate and provide evidence for whether the mixing of substances produces a new substance.
Target B Engineering Design in Physical Science	Students can identify design constraints and criteria, describe a possible solution to an engineering problem, and carry out tests to improve a model or prototype.	Students can define a simple design problem, including constraints and criteria; generate and compare multiple possible solutions to an engineering design problem; and carry out tests to improve a model or prototype by controlling variables or identifying failures.	Students can argue for a simple design problem, including constraints and criteria; use several sources to generate and compare multiple possible solutions to an engineering problem; and carry out tests and analyze data to improve a model or prototype by controlling variables or identifying failures.

Claim 2: Life Science

Students are able to comprehend and explain life science concepts and practices, as well as apply their knowledge to scientific investigations and engineering design problems with precision and accuracy.

Target A Understand the relationships among matter and energy in organisms within ecosystems.

Standards 5-PS3-1, 5-LS1-1, 5-LS2-1

Evidence Statements
Students who demonstrate understanding can 1. 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. 2. support an argument that plants get the materials they need for growth chiefly from air and water. 3. develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Target B Understand that engineering designs are defined, developed, and optimized to solve life science problems.

Standards 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3

Evidence Statements
Students who demonstrate understanding can 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. 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. 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.

Performance Level Descriptors (PLDs)			
	Level 2	**Level 3**	**Level 4**
Claim 2 Life Science	Students typically comprehend and **describe** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **low complexity** and **inconsistently** to problems of **moderate complexity** in the life sciences (targets A and B).	Students typically comprehend and **explain** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **moderate complexity** and **inconsistently** to problems of **high complexity** in the life sciences (targets A and B).	Students typically comprehend and **analyze** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **high complexity** in the life sciences (targets A and B).
Target A Matter and Energy in Organisms and Ecosystems	Students can describe animal's food in terms of energy, identify evidence that plants primarily need air and water to grow, and describe how matter moves through organisms within an ecosystem.	Students can use a model to describe how energy in animal's food came from the Sun, use evidence to support an argument that plants primarily need air and water to grow, and develop a model to describe how matter moves through organisms within an ecosystem.	Students can develop a model to describe how energy in animal's food came from the Sun, use evidence and models to support the argument that plants primarily need air and water to grow, and develop a model to argue how matter moves through organisms within an ecosystem.
Target B Engineering Design in Life Science	Students can identify design constraints and criteria, describe a possible solution to an engineering problem, and carry out tests to improve a model or prototype.	Students can define a simple design problem, including constraints and criteria; generate and compare multiple possible solutions to an engineering design problem; and carry out tests to improve a model or prototype by controlling variables or identifying failures.	Students can argue for a simple design problem, including constraints and criteria; use several sources to generate and compare multiple possible solutions to an engineering problem; and carry out tests and analyze data to improve a model or prototype by controlling variables or identifying failures.

Claim 3: Earth and Space Science

Students are able to comprehend and explain Earth and space science concepts and practices, as well as apply their knowledge to scientific investigations and engineering design problems with precision and accuracy.

Target A	Understand the major systems of Earth, how they interact, and how humans can protect them.
Standards	5-ESS2-1, 5-ESS2-2, 5-ESS3-1

Evidence Statements
Students who demonstrate understanding can 1. develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 2. describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. 3. obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment.

Target B	Understand the properties of bodies and objects within the universe and our Solar System and their predictable patterns of movement.
Standards	5-PS2-1, 5-ESS1-1, 5-ESS1-2

Evidence Statements
Students who demonstrate understanding can 1. support an argument that the gravitational force exerted by Earth on objects is directed down. 2. support an argument that differences in the apparent brightness of the Sun compared to other stars is caused by their relative distance from Earth. 3. 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.

Target C Understand that engineering designs are defined, developed, and optimized to solve Earth and space science problems.

Standards 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3

Evidence Statements
Students who demonstrate understanding can 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. 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. 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.

Performance Level Descriptors (PLDs)			
	Level 2	**Level 3**	**Level 4**
Claim 3 Earth and Space Science	Students typically comprehend and **describe** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **low complexity** and **inconsistently** to problems of **moderate complexity** in the physical sciences (targets A and B).	Students typically comprehend and **explain** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **moderate complexity** and **inconsistently** to problems of **high complexity** in the physical sciences (targets A and B).	Students typically comprehend and **analyze** scientific ideas, connecting concepts, and procedures or practices (target A), and they apply scientific and engineering knowledge **consistently** to problems of **high complexity** in the physical sciences (targets A and B).
Target A Earth Systems	Students can describe the ways in which the four Earth spheres interact, describe reservoirs of water on Earth, and identify a way to protect the environment.	Students can develop a model to describe the ways in which the four Earth spheres interact, describe and graph differences in water distribution on Earth, and combine information about ways to protect the environment.	Students can develop models to describe multiple ways in which the four Earth spheres interact, explain and graph differences in water distribution on Earth, and combine information about and argue for ways to protect the environment.

Performance Level Descriptors (PLDs)			
Target B Space Systems, Stars, and the Solar System	Students can recognize that Earth's gravity pulls objects down, identify differences in brightness among stars in the sky and the Sun, and describe observable daily patterns of shadows and seasonal changes in the night sky.	Students can support an argument that Earth's gravity pulls objects down, argue that the difference in brightness of the Sun compared to other stars is caused by distance, and graph data to reveal observable daily patterns of shadows and seasonal changes in the sky.	Students can support an argument using models that Earth's gravity pulls objects down, argue using a model that the difference in brightness of the Sun compared to other stars is caused by distance, and graph data to explain observable daily patterns of shadows and seasonal changes in the sky.
Target C: Engineering Design in Earth and Space Systems	Students can identify design constraints and criteria, describe a possible solution to an engineering problem, and carry out tests to improve a model or prototype.	Students can define a simple design problem, including constraints and criteria; generate and compare multiple possible solutions to an engineering design problem; and carry out tests to improve a model or prototype by controlling variables or identifying failures.	Students can argue for a simple design problem, including constraints and criteria; use several sources to generate and compare multiple possible solutions to an engineering problem; and carry out tests and analyze data to improve a model or prototype by controlling variables or identifying failures.

Note: All engineering targets in each claim share similar PLD features but should not be compared.