# Minnesota Comprehensive Assessment-Series IV (MCA-IV)

## Draft Test Specifications for Science

## May 2023

***Based on the Minnesota K-12 Academic Standards in Science –2019, Commissioner Approved Draft***

The information contained in this document should **not** be used as a curriculum guide.

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## MCA Purpose Statement

To ensure that all students have access to high-quality content and instruction, the Minnesota K–12 Academic Standards outline statewide expectations for student learning in Minnesota K–12 public and charter schools. Student mastery of the standards is best measured through a combination of classroom, school, district, and state assessment tools. The Science MCA-Series IV (Science MCA-IV) is a set of assessment tools designed at the state level to measure effective implementation of the 2019 Minnesota K–12 Science Standards.

Federal law (Every Student Succeeds Act) and State law (Minnesota Statutes 2022, section 120b.30) require students to be assessed in science three times: once in grades 3–5, 6–9, and 10–12. The Minnesota Department of Education (MDE) has selected grades 5 and 8 for assessments in the first two grade bands. The grade 5 Science MCA assesses the grades 3–5 standards, and the grade 8 Science MCA assesses the grades 6–8 standards. Students in grades 9–12 are expected to take the High School Science MCA during the year in which they are enrolled in a life science or biology course and/or when they have received instruction on all 9–12 life science benchmarks. The life science credit is required for high school graduation for all students. This is why the high school MCAs assesses the life science benchmarks only.

The MCAs are criterion-referenced assessments, which means they measure performance against a fixed set of criteria; for the MCAs, these criteria are the Minnesota Academic Standards. Criterion-referenced assessments are used to determine mastery of concepts and skills and to measure progress toward goals and objectives. While criterion-referenced tests may provide information about how well students have mastered certain concepts, they do not provide a complete picture of what students have learned throughout an entire school year. The MCAs provide one data point that should be considered in the context of additional evidence of student learning visible through classroom activities, local formative assessments, and district and classroom interim assessments. Visit Testing 1, 2, 3 (testing123.education.mn.gov > Assess > Classroom Assessments) for more resources about standards-aligned classroom assessments.

## Test Specifications Purpose

The Science MCA-IV Test Specifications document provides information on the assessment of the 2019 Minnesota K–12 Academic Standards in Science on the Science MCA. The specifications were developed in collaboration with Minnesota science educators during Science MCA Test Specification Committee advisory meetings and during public review. The specifications provide a summary blueprint for test construction, specifying the quantity of questions for each reporting category. This summary blueprint outlines the essential features of the test design to provide consistency and transparency across test forms for the life of the Science MCA-IV.

## Assessing Multidimensional Science Standards

The 2019 Minnesota K-12 Science Standards are based on current science education principles found in *A Framework for K-12 Science Education*. The Framework emphasizes the inclusion of three dimensions (Scientific and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas) within science standards,

curriculum, and instruction. The standards are broken down further into individual benchmarks that incorporate aspects of the Framework's three dimensions. The benchmarks indicate how students could demonstrate mastery of the knowledge and skills underlying that benchmark. It is intended that the specific combination of Practice, Crosscutting Concept, and Core Idea indicated in the benchmark should NOT dictate instruction. Instruction will normally include a mixture of several Practices and Crosscutting Concepts.

However, for purposes of the Science MCA-IV, test questions will be aligned to the specific practice, core idea, and crosscutting concept as written in the benchmark. Each question on the MCA will be multidimensional, which means that at a minimum, each question will align to the practice and core idea of the benchmark. Where possible, questions will also align to the crosscutting concept of the benchmark.

## Cognitive Complexity

On the Science MCA, questions associated with the phenomena will require students to use levels of cognitive complexity based on Webb's Depth of Knowledge scale (Webb, 1999). Webb's DOK – Categories of Engagement is a tool used to evaluate the cognitive engagement students use to interact with tasks used in assessment (Webb, 2019). Questions assessing the multiple dimensions of the Practices, Core Ideas and Crosscutting Concepts will assess a range of knowledge, skills and abilities and will reflect the cognitive complexity called for by the Minnesota K–12 Science Standards. Cognitive complexity refers to the cognitive demand associated with an item. The level of cognitive demand focuses on the degree of processing (or depth of thinking) the student needs to apply concepts and skills on a particular item.

**Category 1: Recall and Reproduction** – This category requires the recall of information or the reproduction of a simple procedure or skill. Tasks that involve recalling a discrete fact, definition, term, or basic concept or the completion of a process or formula, a set of procedures or a series of steps are category 1 tasks. Items that ask a student to use a balance, read information from the Periodic Table, list the planets in the solar system, directly read information provided on a chart/diagram or follow a protocol could be examples of a Category 1 item. Category 1 skills are not assessed in isolation on the MCA-IV, however could be applied in combination with Category 2 and Category 3 skills.

**Category 2: Skills and Concepts** – This category requires the application of skills or the comprehension of concepts. The category requires knowledge-in-use and may ask a student to engage with some degree of mental processing beyond a habitual response. Category 2 tasks involve applying procedures, interpreting data or explaining science ideas and concepts involving fairly straightforward or routine relationships or interactions. Students may be asked to demonstrate how to approach or interpret a problem or activity, use observations to classify, organize, draw conclusions and compare data in various graphic formats or as part of a phenomenon. Items may include identifying the characteristics of different states of matter and explain how they change, describe the basic structure and function of the human body systems and explain how they are impacted, identify types of energy and explain how they are transformed and conserved, explain relationships between photosynthesis and cellular respiration and describe how they contribute to ecosystems, or describe different stages of cycles or types of forces and how they are affected.

**Category 3: Strategic Thinking** – This category requires the use of reasoning, planning and higher-order thinking skills. Tasks typically involve analyzing, evaluating or synthesizing information. Tasks require more demanding, thorough and abstract reasoning grounded in contextual evidence and information given through a phenomenon or problem. Tasks may ask a student to provide an evidence-based rationale or engage in a scientific argument using evidence to justify their response with consideration of purpose and constraint demonstrating multiple approaches and solutions in context. Tasks may require a student to demonstrate understanding of scientific ideas and concepts applied to hypothetical situations or authentic science or engineering problems and support proposed solutions, claims and arguments in context. Tasks may ask a student to consider and apply ideas from diverse concepts, contexts and disciplines. Items may include analyzing and interpreting data from an experiment, applying scientific laws to explain behavior and predict changes, evaluate scientific data presented in a graph or table and draw conclusions about the relationship between variables, compare and contrast scientific principles and cause and effect or analyze the impact of human activities and propose solutions to mitigate those impacts.

**Category 4: Extended Thinking** – This category requires the use of complex reasoning, planning and creative thinking. Tasks at this category typically involve investigating, researching, developing new ideas and application of scientific concepts in novel and non-routine contexts. Tasks may involve authentic scientific inquiry or process that requires abstract thinking to create and synthesize diverse ideas, concepts, contexts and disciplines. Items may include analyzing data, designing an experiment and proposing solutions, exploring implications of climate change, evaluating the effectiveness of different methods and proposing strategies to invoke change, conducting a comparative analysis of two systems and making recommendations or developing a model to explain cause and effect.

Using these cognitive complexity categories to categorize items ensures that the complexity of the test items matches the complexity of the content domain assessed.

## Test Structure

The Science MCA is an online phenomenon-based assessment. The context for each phenomenon is focused around observable events occurring in the universe that can be explained or predicted with scientific reasoning (Achieve, Next Generation Science Storylines and STEM Teaching Tools). Text, graphics, animations, or simulations are used to provide context for the student to engage in the phenomena. Various question types, including multiple choice, technology enhanced, and constructed response, are used to assess Minnesota's multidimensional benchmarks. The Science MCA is a fixed form test, which means all students taking the same test version are administered the same questions. The operational test includes embedded field test questions that do not contribute to a student's score.

**Table 1. Test Construction: All Grades Science MCA**

| Grade Level | Total Number of Test Questions | Total Number of Points | Total Number of 1-Point Questions | Total Number of 3-Point Questions |
|---|---|---|---|---|
| **Grade 5** | 39–43 | 45 | 36–42 | 1–3 |
| **Grade 8** | 39–43 | 45 | 36–42 | 1–3 |
| **High School** | 48–54 | 56 | 44–53 | 1–4 |

**Table 2. Grade 5 Science MCA: Numbers in Each Reporting Category**

| Reporting Category | Number of Test Questions | Number of Points | Number of 3-Point Questions |
|---|---|---|---|
| **Practices in Earth Science (3–5E)** | 13–15 | 15 | 0–1 |
| **Practices in Life Science (3–5L)** | 13–15 | 15 | 0–1 |
| **Practices in Physical Science (3–5P)** | 13–15 | 15 | 0–1 |

**Table 3. Grade 8 Science MCA: Numbers in Each Reporting Category**

| Reporting Category | Number of Test Questions | Number of Points | Number of 3-Point Questions |
|---|---|---|---|
| **Practices in Earth Science (6E)** | 13–15 | 15 | 0–1 |
| **Practices in Life Science (7L)** | 13–15 | 15 | 0–1 |
| **Practices in Physical Science (8P)** | 13–15 | 15 | 0–1 |

**Table 4. High School Science MCA: Numbers in Each Reporting Category**

| Reporting Category | Number of Test Questions | Number of Points | Number of 3-Point Questions |
|---|---|---|---|
| **Practices in LS1** | 12–14 | 14 | 0–1 |
| **Practices in LS2** | 12–14 | 14 | 0–1 |
| **Practices in LS3** | 12–14 | 14 | 0–1 |
| **Practices in LS4** | 12–14 | 14 | 0–1 |

Life Science (LS) 1-From molecules to organisms: Structure and processes. LS2-Ecosystems: Interactions, energy, and dynamics. LS3-Heredity: Inheritance and variation of traits. LS4-Biological Evolution: Unity and diversity.

For information on administration details, visit PearsonAccess Next (minnesota.pearsonaccessnext.com). For information on the full test development process visit Testing 1,2,3 (Testing 123 > Assess > Statewide Assessments (under Test Development)).

The Science MCA Test Specifications will remain in draft form and modified as needed to reflect lessons learned during test development and test construction until the first operational assessment of the MCA-IV in spring 2025.

## References


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