

# **Minnesota Comprehensive Assessments-Series III (MCA-III)**

## **Test Specifications for Science**

**Minnesota** Department of  
**Education**

**October 10, 2012**

Based on the  
K-12 Minnesota Academic Standards in Science, 2009 version effective May 24, 2010

# MINNESOTA DEPARTMENT OF EDUCATION

## MCA-III Test Specifications for Science

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The department thanks the Test Specifications Committee, as well as all of the panelists and teachers who reviewed this document in draft form, for their hard work and continued involvement.

# TABLE OF CONTENTS

<b>THE MCA-III SCIENCE TEST SPECIFICATIONS.....</b>	<b>1</b>
INTRODUCTION .....	1
PURPOSE OF THE MINNESOTA COMPREHENSIVE ASSESSMENTS .....	1
PURPOSE AND OVERVIEW OF THE TEST SPECIFICATIONS.....	2
ITEM SPECIFICATIONS .....	3
<i>Item Specification Considerations.....</i>	<i>3</i>
COGNITIVE COMPLEXITY .....	4
PRIORITIZING STANDARDS.....	5
TEST DESIGN BY GRADE LEVEL .....	6
A GUIDE TO READING THE TEST SPECIFICATIONS .....	10
AN EXPLANATION OF TERMS RELATED TO THE GRADE-LEVEL TABLES .....	11
SCIENCE MCA-III TEST SPECIFICATIONS GRADE-LEVEL TABLES.....	12

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## **THE MINNESOTA COMPREHENSIVE ASSESSMENTS-SERIES III Science Test Specifications**

### **Introduction**

The test specifications for each grade of the Science Minnesota Comprehensive Assessments-Series III (MCA-III) are presented in this document. The reader is encouraged to read the introductory information carefully because many important concepts are presented, including the purpose of the MCA, a description of the cognitive levels and other information about the format of the test specifications.

### **Purpose of the Minnesota Comprehensive Assessments**

The *No Child Left Behind Act* (NCLB) requires that states implement “a set of high-quality, yearly student academic assessments that include, at a minimum, academic assessments in mathematics, reading or language arts, and science” (*No Child Left Behind Act of 2001*, Pub. L. No. 107-110, §11111, 115 Stat. 1449 [2002]). In science, students must be assessed 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 MCA assesses the grades 3–5 standards and the grade 8 MCA assesses the grades 6–8 standards. Students in grades 9–12 are expected to take the high school MCA if, in the current academic year, they are enrolled in a life science or biology course and/or have received instruction on all Strand 1 and Strand 4 standards that fulfill the life science credit for graduation.

The *K–12 Minnesota Academic Standards* were adopted in 2003; the Minnesota Comprehensive Assessments-Series II (MCA-II) assessed the 2003 standards. The 2008 Minnesota Legislature approved the 2008 Omnibus Education Policy Act (Minn. Stat. § 120B.023, subd. 2d). This legislation required the revision of the state's academic standards in science in the 2008–2009 school year. The legislation also required that beginning in the 2011–2012 school year, state science tests align with the revised 2009 academic standards in science. The revision to the standards was significant enough that a new series of the MCA assessments was necessary. Thus, the MCA-III are aligned with the 2009 *K–12 Minnesota Academic Standards in Science*.

## Science MCA-III

The purpose of the MCA is to measure Minnesota students' achievement with regard to the Minnesota academic standards. The MCA results can be used to inform curriculum decisions at the district and school level, inform instruction at the classroom level and demonstrate student academic progress from year to year.

### **Purpose and Overview of the Test Specifications**

The primary purpose of test specifications is to help test developers build a test that is consistent over time. The *MCA-III DRAFT Test Specifications for Science* are also meant to serve as a source of information about the test design for teachers and the general public. Test specifications do not indicate what should be taught; the Minnesota academic standards do. Test specifications do not indicate how students should be taught; the classroom teacher does. Test specifications indicate which strands, standards and benchmarks will be assessed on the test and in what proportions. In addition, test specifications provide the types of items to be included, number of items and distribution of cognitive levels. Test specifications also clarify, define and/or limit how test items will be written.

As with any test, the MCA assesses a sampling of student knowledge and does not test every standard or benchmark. There are standards and benchmarks that cannot be assessed with a standardized test. That does not mean that these skills should not be taught or assessed. Teachers need to instruct and assess their students on all of the academic standards. Standards and benchmarks that are not assessed on the MCA are indicated in this document with the phrase "Not assessed on the MCA-III." In addition, not all assessable benchmarks will be included on every assessment each year and some benchmarks are embedded within the assessment of other benchmarks.

The test specifications presented in this document were developed by panels convened for the specific task of constructing these specifications. These panels consisted of members of the Minnesota Academic Standards Committee, as well as other classroom teachers. Many of these classroom teachers were recommended to the Minnesota Department of Education (MDE) by various education organizations, school districts and other stakeholder groups.

## Item Specifications

Item specifications are provided for each benchmark. The item specifications clarify, define and limit how items should address each benchmark. The item specifications also list vocabulary that may be used in items. This list is cumulative but not exhaustive in nature. For example, vocabulary listed at grade 3 is eligible for use in all of the grades that follow.

### Item Specification Considerations

There are broad item development issues addressed during the development of test items. Each of the following issues is considered for all of the items developed for the Science MCA.

1. Each item will be written to measure primarily one benchmark; however, other benchmarks may also be reflected in the item content.
2. Items will be appropriate for students in terms of grade-level difficulty, expected knowledge of grade-level science vocabulary and life experiences.
3. Item vocabulary is taken from language of the benchmarks and item specifications. Where items commonly depart from the language of the benchmark or use additional vocabulary, the item specifications will include the statement “*Additional vocabulary may include terms such as*”. Vocabulary used in the assessment is cumulative in nature. For example, benchmark and additional vocabulary listed in grade 3 is eligible for use in all grades that follow.
4. Many of the benchmarks include examples that clarify the meaning of the benchmark or indicate the level of student understanding. The examples may suggest learning activities or instructional topics. They are NOT intended to be directives for curriculum, assessment or a comprehensive fulfillment of the benchmarks.
5. Items will use clear language based on the work by the U.S. Department of Education: LEP Partnership as outlined in *Linguistic Modification Part I: Language Factors in the Assessment of English Language Learners* and

- Linguistic Modification Part II: A Guide to Linguistic Modification*<sup>1</sup>. For example, to the extent possible, sentences will: be simple and in standard word order, use active voice, avoid using negatives, avoid proper nouns, avoid using general language terms that have a special meaning in science contexts, reduce written context and be as universal as possible.
6. At a given grade, items will range in difficulty from easy to challenging.
  7. Items will not disadvantage or disrespect any segment of the population with regard to age, gender, race, ethnicity, language, religion, socioeconomic status, disability or geographic region.
  8. Each item will be written to clearly and unambiguously elicit the desired response.
  9. Items will be written according to the MDE *Guidelines for Test Construction*.
  10. Advisory Panels will review items as specified in the MDE *Vendor Guide to Advisory Panels*.

## **Cognitive Complexity**

Cognitive complexity refers to the cognitive demand associated with an item. The level of cognitive demand focuses on the type and level of thinking and reasoning required of the student on a particular item. MCA-III levels of cognitive complexity are based on Norman L. Webb's Depth of Knowledge<sup>2</sup> levels. Although certain verbs, such as "recall," "classify" or "reason," are commonly associated with specific cognitive levels, Webb's Depth of Knowledge levels are **not** determined by the verbs that describe them, but rather the contexts in which the verbs are used and the depth of thinking required.

A Level 1 (recall) item requires the recall of information such as a fact, definition, term or simple science process or procedure. A simple science procedure is well-defined and will typically involve only one step. Listing the planets in the solar system would be in this level.

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<sup>1</sup> Both papers can be found on the [National Clearinghouse for English Language Acquisition and Language Instruction Educational Programs \(NCELA\) Website](http://ncela-beta.edstudies.net/files/uploads/10/LingusiticModificationBE024210.pdf) at (<http://ncela-beta.edstudies.net/files/uploads/10/LingusiticModificationBE024210.pdf>)

<sup>2</sup> Webb, N. L. Alignment of science and mathematics standards and assessments in four states (Research Monograph No. 18). Madison: University of Wisconsin – Madison, National Institute for Science Education, 1999.



A Level 2 (skill/concept) item calls for the engagement of some mental processing beyond a habitual response, with students required to make some decisions as to how to approach a problem or activity. Level 2 activities imply more than one mental or cognitive process and may include making observations and collecting data; classifying, organizing and comparing data; and organizing and displaying data in tables, graphs and charts. Reading and interpreting information from a graph is an example of a skill assessed by a level 2 item.

Level 3 (strategic thinking) items require students to reason, plan or use evidence to solve a problem. In most instances, requiring students to explain their thinking is a level 3 activity. A Level 3 item may be solved using routine skills, but the student is not cued or prompted as to which skills to use. Developing a scientific model for a complex situation or forming conclusions from experimental or observational data is considered to be at this level.

Level 4 (extended thinking) items require complex reasoning, planning, developing and thinking, most likely over an extended period of time. Level 4 items are best assessed in the classroom, where the constraints of standardized testing are not a factor.

Using these cognitive complexity levels to categorize items ensures that the complexity of the test items matches the complexity of the content domain assessed. Table 1 indicates the target proportion of test items at each cognitive level included in each test.

**TABLE 1.** Target Cognitive Level Distribution of Items

<b>Grades</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>
5, 8, and High School	40–60%	35–55%	5–10%

### **Prioritizing Standards**

One of the first steps in the test development process is to determine which standards will be assessed and at what level of detail. In order to provide reliable data about a concept, a test must include several items addressing that concept. This emphasis is not possible for all of the academic standards in science in each grade span within a test of appropriate length. For this reason, MDE, with the advice of teachers and other stakeholders, prioritized the academic standards in science by assigning item totals for each standard that will appear on an operational test.

## Test Design by Grade Level

The following tables (tables 2–4) provide the approximate number of points by strand on the operational test for each grade. Multiple-choice (MC) items are each worth 1 point, while other item types are worth 1-3 points. Approximately 40–60 percent of the test will be comprised of multiple-choice items, and other item types will make up the remainder of the test.

**TABLE 2.** Grade 5 Science MCA-III (Operational Form)

<b>Strand</b>	<b>Approximate Number of Points</b>	<b>Approximate Percent of Points</b>
Nature of Science and Engineering (NSE)	11–13	28
Physical Science (PS)	9–11	24
Earth and Space Science (ESS)	9–11	24
Life Science (LS)	9–11	24
<b>Total</b>	41	100

**TABLE 3.** Grade 8 Science MCA-III (Operational Form)

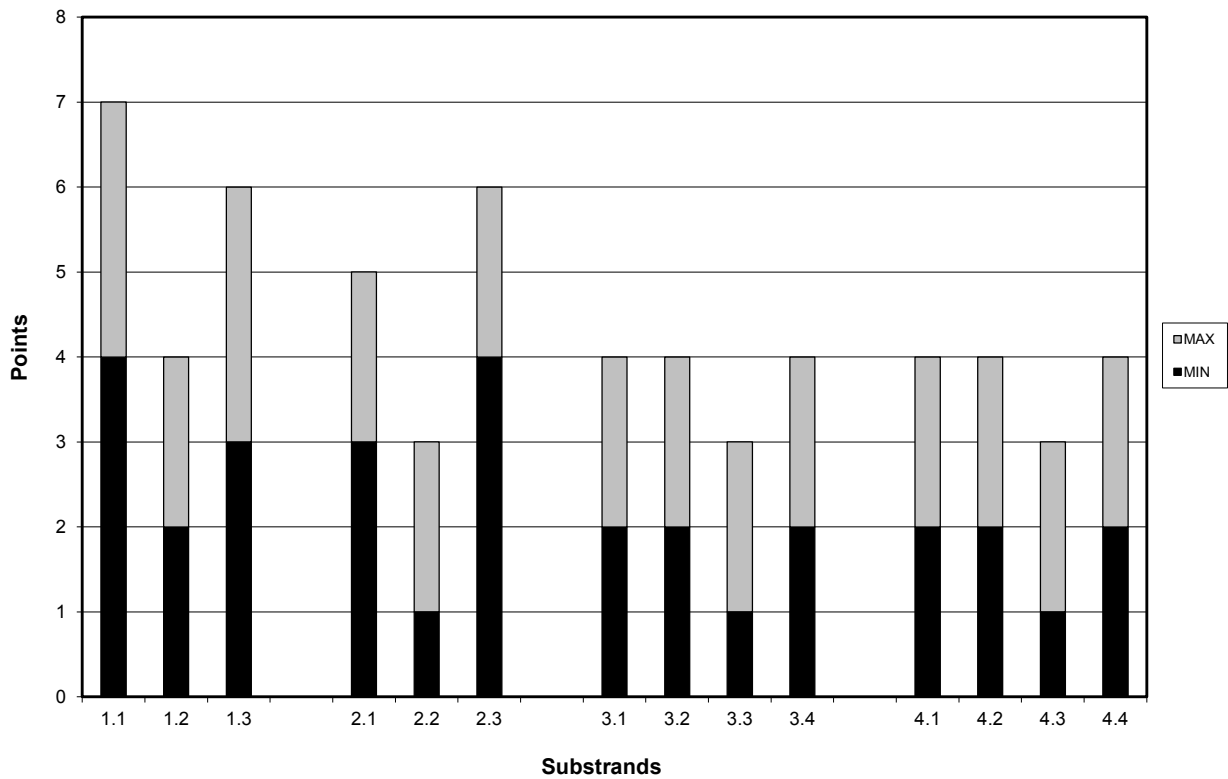
<b>Strand</b>	<b>Approximate Number of Points</b>	<b>Approximate Percent of Points</b>
Nature of Science and Engineering (NSE)	13–15	28
Physical Science (PS)	11–13	24
Earth and Space Science (ESS)	11–13	24
Life Science (LS)	11–13	24
<b>Total</b>	51	100

**TABLE 4.** Grades 9–12 Science MCA-III (Operational Form)

<b>Strand</b>	<b>Approximate Number of Points</b>	<b>Approximate Percent of Points</b>
Nature of Science and Engineering (NSE)	24–28	38
Life Science (LS)	40–44	62
<b>Total</b>	68	100

# Science MCA-III

## Grade 3–5 Points by Substrand



## Grades 3–5 Points by Substrand

### 1. Nature of Science and Engineering (11–13)

1. The Practice of Science (4–7)
2. The Practice of Engineering (2–4)
3. Interactions among Science, Technology, Engineering, Mathematics and Society (3–6)

### 2. Physical Science (9–11)

1. Matter (3–5)
2. Motion (1–3)
3. Energy (4–6)

### 3. Earth and Space Science (9–11)

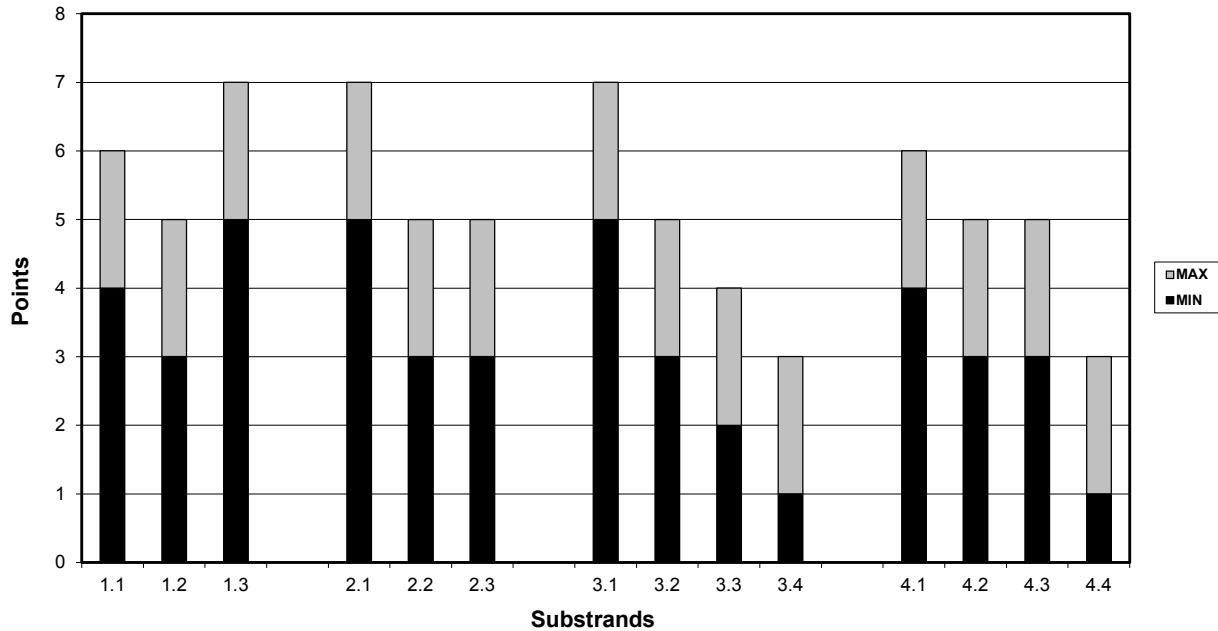
1. Earth Structure and Processes (2–4)
2. Interdependence within the Earth System (2–4)
3. The Universe (1–3)
4. Human Interactions with Earth Systems (2–4)

### 4. Life Science (9–11)

1. Structure and Function in Living Systems (2–4)
2. Interdependence Among Living Systems (2–4)
3. Evolution in Living Systems (1–3)
4. Human Interactions with Living Systems (2–4)

# Science MCA-III

## Grade 6–8 Points by Substrand



## Grades 6–8 Points by Substrand

### 1. Nature of Science and Engineering (13–15)

1. The Practice of Science (4–6)
2. The Practice of Engineering (3–5)
3. Interactions among Science, Technology, Engineering, Mathematics and Society (5–7)

### 2. Physical Science (11–13)

1. Matter (5–7)
2. Motion (3–5)
3. Energy (3–5)

### 3. Earth and Space Science (11–13)

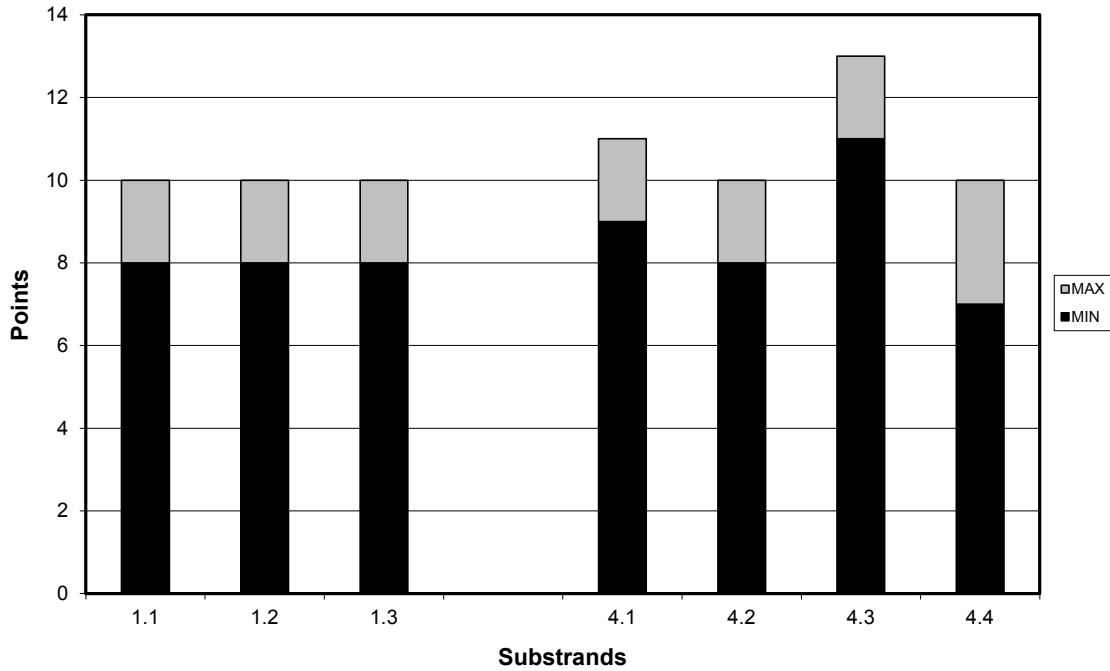
1. Earth Structure and Processes (5–7)
2. Interdependence within the Earth System (3–5)
3. The Universe (2–4)
4. Human Interactions with Earth Systems (1–3)

### 4. Life Science (11–13)

1. Structure and Function in Living Systems (4–6)
2. Interdependence Among Living Systems (3–5)
3. Evolution in Living Systems (3–5)
4. Human Interactions with Living Systems (1–3)

# Science MCA-III

## Grade 9–12 Points by Substrand



### Grades 9–12 Points by Substrand

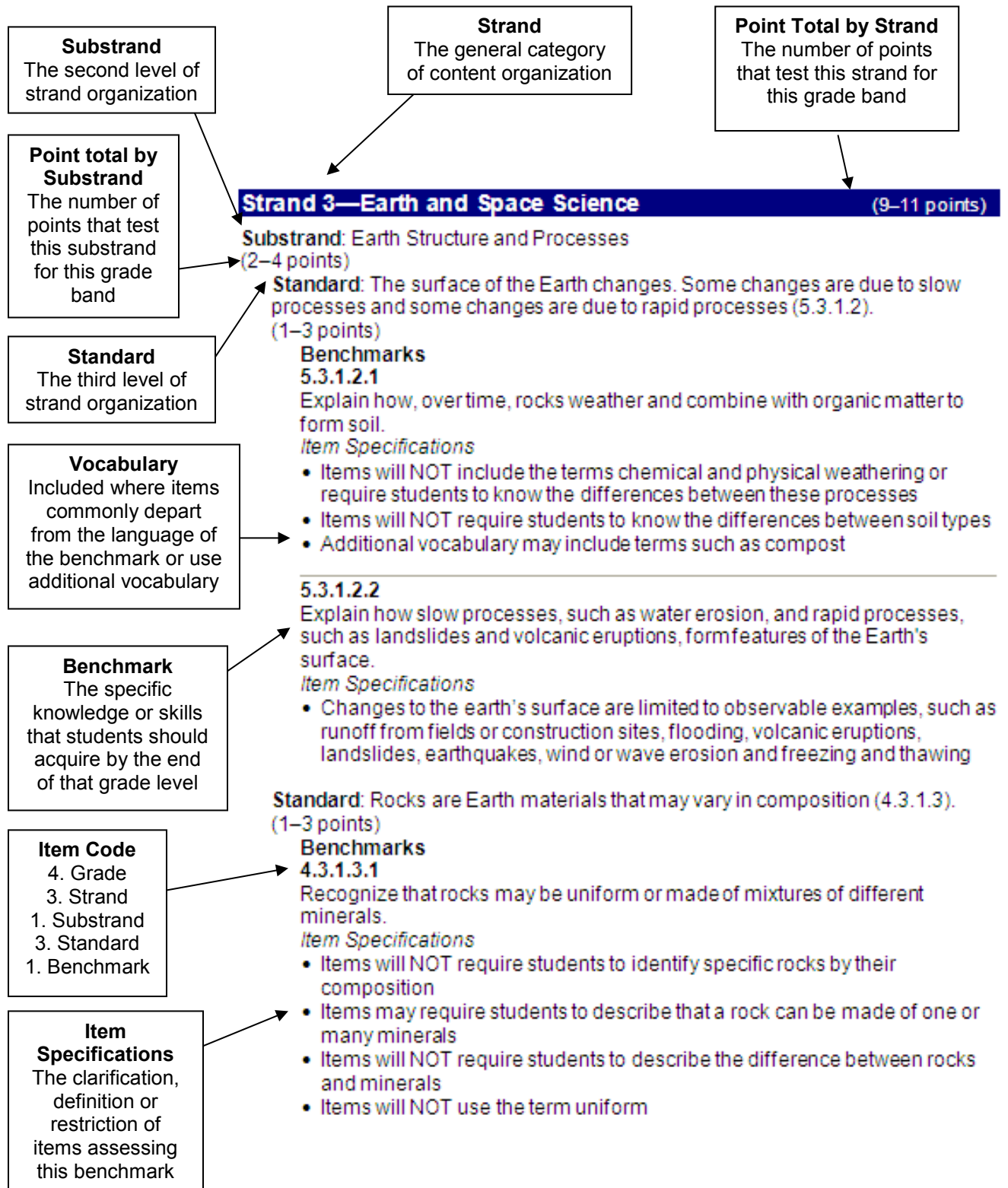
#### 1. Nature of Science and Engineering (24–28)

1. The Practice of Science (8–10)
2. The Practice of Engineering (8–10)
3. Interactions among Science, Technology, Engineering, Mathematics and Society (8–10)

#### 4. Life Science (40–44)

1. Structure and Function in Living Systems (9–11)
2. Interdependence Among Living Systems (8–10)
3. Evolution in Living Systems (11–13)
4. Human Interactions with Living Systems (7–10)

## A Guide to Reading the Test Specifications



## **An Explanation of Terms Related to the Grade-Level Tables**

**Strand:** This is the most general categorization of content in the Minnesota Academic Standards.

**Substrand:** This is the second level of strand organization. Each strand has three or four substrands.

**Standard:** Standards describe the expectations in science that all students must satisfy to meet state requirements for credit and graduation.

**Benchmark:** The purpose of benchmarks is to provide details about "the academic knowledge and skills that schools must offer and students must achieve to satisfactorily complete" the standards (Minn. Stat. § 120B.023 (2008)). Benchmarks are intended to "inform and guide parents, teachers, school districts and other interested persons and for use in developing tests consistent with the benchmarks" (Minn. Stat. § 120B.023 (2008)). Each standard is divided into several benchmarks.

**Item Code:** Test developers use this code to identify the strand, substrand and benchmark to which a test item is aligned.

**Item Specifications:** These statements provide more specific clarifications, definitions or restrictions for the benchmark as it is assessed on the MCA-III.

**Point Total by Strand:** This number is the possible number of points that will be on the operational form from a specific strand.

**Point Total by Standard:** This number is the total number of points measuring the standard that could be on the test for the indicated standard. For example, in the Grade 5 science test, 11–13 points are from Strand 1. Of those 11–13 Strand 1 points, 1–3 points are from Standard 4.1.2.2.