



## *Minnesota Academic Standards in Science*

### **FREQUENTLY ASKED QUESTIONS**

#### **1. What is the purpose of Minnesota's science standards?**

The state standards and benchmarks set the expectations for achievement in science for K-12 students in Minnesota. In setting these expectations, the standards and benchmarks help define the science requirements for course credits and high school graduation. The standards and benchmarks for a particular grade level (or grade band in high school) describe the science content that is to be mastered by all students by the end of that grade level or band.

In accordance with Minnesota statutes, "State tests must be constructed and aligned with state academic standards" (MS 120B.030). The state tests, known as the Minnesota Comprehensive Assessments or MCAs, are administered each year in science in grades 5, 8, and high school.

The standards and benchmarks also guide school districts in designing K-12 science curricula. The standards and benchmarks describe a connected body of science and engineering knowledge acquired through active participation in science experiences. These experiences include hands-on laboratory activities rooted in scientific inquiry and engineering design. The standards are placed at the grade level where mastery is expected with recognition that a progression of learning experiences in earlier grades builds the foundation for mastery later on.

#### **2. What are the statewide requirements for science in Minnesota?**

Elementary and middle school curriculum as well as high school course requirements must ensure meaningful opportunities for every student to engage in all of the standards and benchmarks designated for their grade level or band.

In order to graduate, all students are required to complete three credits of science in high school, one of which must be biology (MS 120B.024). Students who are members of the graduating class of 2015 and beyond must also successfully complete one credit of chemistry or physics in addition to biology as part of the three-credit requirement (MS 120B.023, subd. 2; and 120B.024). All strands of the 9-12 standards must be included in the core curriculum for all high school students.

#### **3. What is the timeline for development, implementation, assessment and subsequent revision of the 2009 standards?**

A committee of thirty K-12 educators, higher education, business and community representatives spent about a year drafting the 2009 revised science standards and benchmarks. The review and revision process included many committee meetings, consultation of national and state standards documents and reports, and review of feedback provided by consultants and the public during several stages of the process. Drafts of the standards were reviewed by national science and engineering education experts, the Minnesota P-16 Education Partnership, special education experts and special topic focus groups.

The proposed 2009 revised standards document has been submitted to the commissioner of education and will proceed through the state's administrative rulemaking process before it becomes official. *The Minnesota Academic Standards: Science K-12, 2009* document should be used to make science education decisions during the rulemaking process. The standards document and related information can be accessed at the Minnesota Department of Education website at <http://education.state.mn.us>. (Click on Academic Standards/Science.)

School districts must implement the revised science standards no later than the 2011-2012 school year. The Series III version of the Minnesota Comprehensive Assessments aligned to the revised standards will be operational in the same school year, as well. Test specifications and item development will begin in May, 2009.

Following the 2009 revision, the next time that Minnesota's science standards will be revised is the 2017-2018 school year (MS 120B.023, subd. 2).

#### **4. What are the grounding documents for the revised standards?**

National documents that are widely respected in science were used as the foundation for the revision of the science standards. The following documents significantly influenced the development of the 2009 standards: 1) *National Science Education Standards*, National Academy of Science, 2) *Benchmarks for Science Literacy* and accompanying documents, American Association for the Advancement of Science Project 2061, 3) *2009 Draft National Assessment of Educational Progress (NAEP) Framework*, and 4) *Standards for Technological Literacy*, International Technology Education Association.

Other important documents included *Greenprint for Minnesota* and the *Environmental Literacy Scope and Sequence* published by the Minnesota Pollution Control Agency, the *Minnesota Educational Media Organization (MEMO) Standards for Information Literacy*, the *Minnesota Academic Standards in Mathematic-2007*, and the *Report of the Postsecondary and Workforce Science Readiness Working Group* sponsored by the Minnesota P-16 Education Partnership. The committee also referred to model standards documents from other states.

#### **5. What legislative mandates and requirements are addressed in the revised standards?**

The 2009 science standards address several legislative mandates and requirements including—

- *K-12 standards and grade-specific benchmarks*: State law requires the commissioner to develop K-12 academic standards, and grade-level benchmarks up through grade 8 (MS 120B.021; MS 120B.023, subd. 1). High school benchmarks may be placed at any grade, 9-12.
- *College and work readiness*: In each subject area, the standards and benchmarks must be aligned with the knowledge and skills needed for college readiness and advanced work (MS 120B.023, subd. 2).
- *Technology and information literacy*: Technology and information literacy standards must be embedded into the standards (MS 120B.023, subd. 2). This includes standards from sources such as the Minnesota Educational Media Organization (MEMO), International Society for Technology in Education (ISTE) and the International Technology and Education Association (ITEA).
- *Minnesota American Indian Tribes and Communities*: The revised standards “must include the contributions of Minnesota American Indian tribes and communities as they relate to the academic standards during the review and revision of the required academic standards” (MS 120B.021, subd. 1).
- *Environmental literacy*: Standards for environmental literacy must be identified and/or developed to comply with MS 115A.073. The *Greenprint for Minnesota* and the *Environmental Literacy Scope and Sequence* served as resources for the standards committee.

## 6. How are the revised science standards organized?

The 2009 science standards are organized into four strands, each of which has three or four substrands. **It is important to note that the content and skills in “The Nature of Science and Engineering” strand are not intended to be taught as a stand-alone unit or an isolated course, but should be embedded and used in the teaching, learning and assessment of the content in the other strands.**

The substrands within these four strands were determined by the standards committee after consulting several nationally respected foundational documents. Each substrand contains two or more standards and one or more benchmarks that “specify the academic knowledge and skills that schools must offer and students must achieve to satisfactorily complete a standard” (MS 120B.023, subd. 1). Some benchmarks include examples that clarify the meaning of the benchmark or indicate the level of student understanding. The examples are not intended to be directives for curriculum or a comprehensive fulfillment of the benchmarks.

The standards are placed at the grade level where mastery is expected with recognition that a progression of learning experiences in earlier grades builds the foundation for mastery later on. Not all standards are found at each grade level. The strands, substrands and standards are organized as follows:

### **STRAND 1: NATURE OF SCIENCE AND ENGINEERING**

#### *Substrand 1: The Practice of Science*

- Standard 1. Understandings about science
- Standard 2. Scientific inquiry and investigation

#### *Substrand 2: The Practice of Engineering*

- Standard 1. Understandings about engineering
- Standard 2. Engineering design

#### *Substrand 3: Interactions among Science, Technology, Engineering, Mathematics and Society*

- Standard 1. Systems
- Standard 2. Careers and contributions in science and engineering
- Standard 3. Mutual influence of science, engineering and society
- Standard 4. The role of mathematics and technology in science and engineering

### **STRAND 2: PHYSICAL SCIENCE\***

#### *Substrand 1: Matter*

- Standard 1. Properties and structure of matter
- Standard 2. Changes in matter

#### *Substrand 2: Motion*

- Standard 1. Describing motion
- Standard 2. Forces

#### *Substrand 3: Energy*

- Standard 1. Kinds of energy
- Standard 2. Energy transformations

#### *Substrand 4: Human Interactions with Physical Systems*

- Standard 1. Interaction with the environment

### **STRAND 3: EARTH AND SPACE SCIENCE**

#### *Substrand 1. Earth Structure and Processes*

- Standard 1. Plate tectonics
- Standard 2. Earth’s changing surface
- Standard 3. Rock sequences and Earth history

#### *Substrand 2. Interdependence within the Earth System*

- Standard 1. Sources and transfer of energy
- Standard 2. Weather and climate
- Standard 3. Materials cycles

#### *Substrand 3. The Universe*

- Standard 1. Solar system motion
- Standard 2. Formation of the solar system
- Standard 3. Age, scale and origin of the universe

#### *Substrand 4. Human Interactions with Earth systems*

- Standard 1. Interaction with the environment

### **STRAND 4: LIFE SCIENCE**

#### *Substrand 1. Structure and Functions in Living Systems*

- Standard 1. Levels of organization
- Standard 2. Cells

#### *Substrand 2. Interdependence of Living Systems*

- Standard 1. Ecosystems
- Standard 2. Flow of energy and matter

#### *Substrand 3. Evolution in Living Systems*

- Standard 1. Reproduction
- Standard 2. Variation
- Standard 3. Biological evolution

#### *Substrand 4. Human Interactions with Living Systems*

- Standard 1. Interaction with the environment
- Standard 2. Health and disease

\* Chemistry and Physics standards have different numbering.

## **7. How will the 2009 standards affect the MCA science assessment?**

The Minnesota Comprehensive Assessment-Series III (MCA-III) will assess the revised standards beginning in the spring of 2012. The test is scheduled to be given at the same grade levels and time of year as currently administered (grades 5, 8, and the year of instruction in the 9-12 life science standards). All strands are assessed at grades 5 and 8. The high school test will assess the “Nature of Science and Engineering” and “Life Science” strands. While taking this assessment is required, passing it is not currently required for graduation and the test is not currently figured in the Adequate Yearly Progress (AYP) determination for schools. Current participation requirements for the high school MCA-II can be found at [www.education.state.mn.us](http://www.education.state.mn.us).

## **8. What are the major changes between the 2004 standards and the proposed 2009 standards?**

Similar to the 2004 standards, the 2009 standards feature four strands representing the three major content areas of science and the nature of science and engineering. The substrands within these four strands have been reorganized somewhat to make the standards more coherent and systematic, and include the additional standards areas mandated by legislation.

For the first time, substantive engineering design process standards have been incorporated throughout the K-12 science standards, consistent with leading states’ efforts to address the increased importance of STEM (science, technology, engineering and math in an integrated way) in our modern scientific world.

Technology, engineering and information literacy standards are found in “The Nature of Science and Engineering” strand. The fourth substrand of the “Physical Science”, “Earth and Space Science,” and “Life Science” strands includes applications and connections within content areas.

The standards committee worked toward making all standards and benchmarks an appropriate *grain size*. The standards identify broad learning goals or the “big ideas” (i.e., the major concepts and essential skills) and allow for a variety of curriculum approaches. The benchmarks supplement the standards by “specifying the academic knowledge and skills that schools must offer and students must achieve to satisfactorily complete a standard” (MS 120B.023, subd. 1). The benchmarks are intended to inform the implementation of the standards and guide assessment, without being too prescriptive, task-oriented or detailed. As stated earlier, some benchmarks include examples that clarify the meaning of the benchmark or indicate the level of student understanding; the examples are not intended to be curriculum directives or a comprehensive fulfillment of the benchmarks.

Compared to the 2004 standards, some ideas have been removed, some have been added, and others have moved to different grade levels. The net effect of these changes is that the numbers of benchmarks in the 2004 and 2009 versions are similar. However, the emphasis at grade levels and within and across content areas may have changed. Most schools with curriculum aligned to the 2004 standards should not need major changes in instructional materials.

Another new feature of the revised standards is that there are specific high school chemistry and physics standards written to define the “one credit” requirement of chemistry or physics for the graduating class of 2015 and beyond. (MS 120B.023, subd. 2). This is similar to the way in which the high school life science standards define a “credit” of biology currently required for graduation (MS 120B.024).