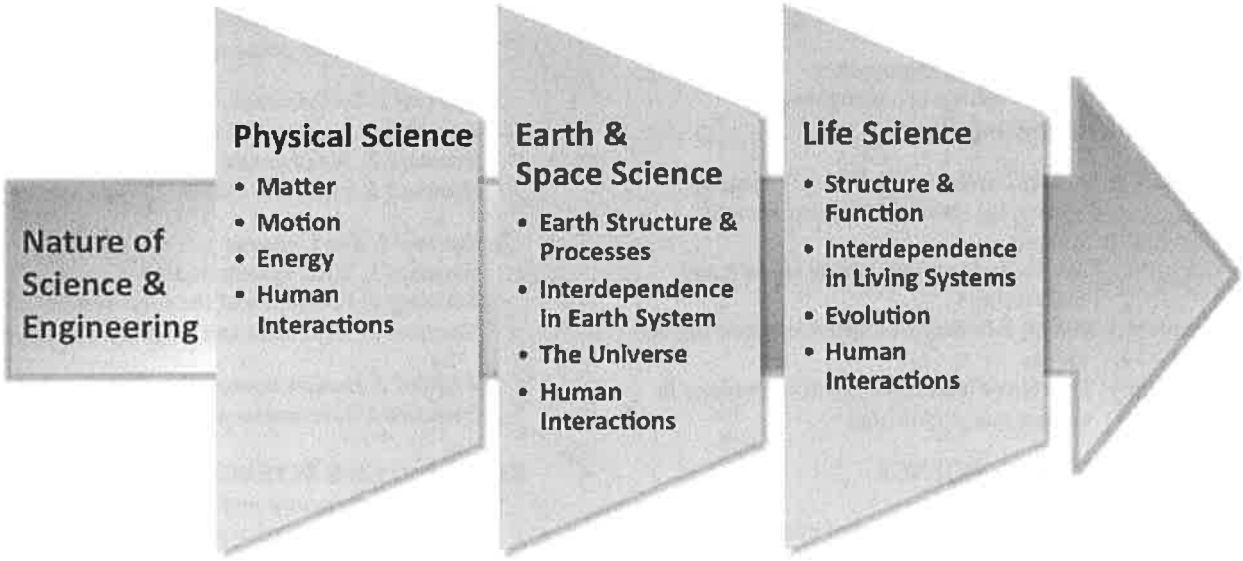
Minnesota Academic Standards

Science K-12

2009 version



This official standards document contains the science standards revised in 2009 and put into rule effective May 24, 2010.

Minnesota Department of Education

Minnesota Academic Standards in Science

Introduction

The 2009 *Minnesota Academic Standards in Science* set the expectations for achievement in science for K-12 students in Minnesota. The standards are grounded in the belief that all students can and should be scientifically literate. Scientific literacy enables people to use scientific principles and processes to make personal decisions and to participate in discussions of scientific issues that affect society (NRC, 1996). 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.

The *Minnesota Academic Standards in Science* are organized by grade level into four content *strands*: 1) The Nature of Science and Engineering, 2) Physical Science, 3) Earth and Space Science, and 4) Life Science. **It is important to note that the content and skills in The Nature of Science and Engineering are not intended to be taught as a stand-alone unit or an isolated course, but embedded and used in the teaching, learning and assessment of the content in the other strands**. Each strand has three or four *substrands*. Each substrand contains two or more *standards* and one or more *benchmarks*. 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. Not all standards are found at every 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 Function in Living Systems*
  - Standard 1. Levels of organization
  - Standard 2. Cells
- *Substrand 2. Interdependence Among 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

Minnesota Academic Standards in Science

Introduction (continued)

The standards are written as statements of content, and the benchmarks are written as learning outcomes. Each standard should be prefaced with the statement, ***"The student will understand that..."***.

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 or a comprehensive fulfillment of the benchmarks.

The benchmarks for each standard are designated by 5-digit codes. For example, in the code **3.1.1.2.1**—

- The **3** refers to grade *3*;
- The **first 1** refers to the first strand, *The Nature of Science and Engineering*;
- The **next 1** refers to the first substrand, *The Practice of Science*;
- The **2** refers to the second standard in that substrand, *Scientific inquiry is...*;
- The **last 1** refers to the first benchmark for that standard, *Generate questions that...* .

	Strand	Substrand	Standard Understand that...	Code	Benchmark
3	1. The Nature of Science and Engineering	1. The Practice of Science	2. Scientific inquiry is a set of interrelated processes incorporating multiple approaches that are used to pose questions about the natural world and investigate phenomena.	**3.1.1.2.1**	Generate questions that can be answered when scientific knowledge is combined with knowledge gained from one's own observations or investigations. *For example:* Investigate the sounds produced by striking various objects.
				3.1.1.2.2	Observe that when a science investigation is done the way it was done before, even in a different place, a similar result is expected.
				3.1.1.2.3	Maintain a record of observations, procedures and explanations, being careful to distinguish between actual observations and ideas about what was observed. *For example:* Make a chart comparing observations about the structures of plants and animals.
				3.1.1.2.4	Construct reasonable explanations based on evidence collected from observations or experiments.

Codes that begin with "9" indicate benchmarks that are to be mastered in grades 9-12. Benchmarks that satisfy the new one-credit requirement for chemistry or physics (effective for the graduating class of 2015 and beyond) are indicated by codes beginning with "9C," or "9P" respectively. Chemistry and physics have additional standards beyond those depicted in the chart on page 1.

These standards are to be implemented no later than the 2011-2012 school year. For further information, please refer to the *Frequently Asked Questions* (FAQ) document for the Minnesota Academic Standards in Science. The document can be found on the Minnesota Department of Education Website at http://education.state.mn.us/Academic Standards/Science.

National Research Council (1996). *National Science Education Standards.* Washington D.C.:National Academy Press.