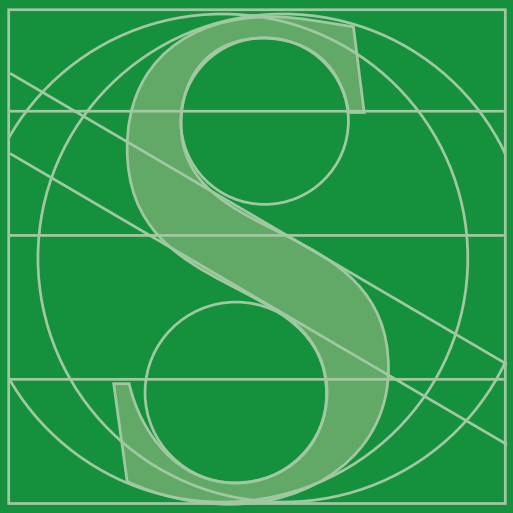
5TH GRADE-8TH GRADE

History and Nature of Science



Content Standard G:

As a result of activities in grades 5-8, all students should develop understanding of

- **Science as a human endeavor**
- **Nature of science**
- **History of science**

Content Summary

National Science Education Content Standards

K-4

Science as a human endeavor

5-8

Science as a human endeavor

Nature of science

History of science

9-12

Science as a human endeavor

Nature of scientific knowledge

Historical perspectives

Minnesota Graduation Standards

Primary Level

Intermediate Level

Historical Events:

Understand historical events and contributions of key people from different time periods

Middle Level

Career Exploration:

Explore career and education options to make informed decisions for future life choices

High School Level

History of Science:

Understand the interaction between social, economic, technological, and/or environmental factors and the occurrence of scientific advances

Cultures Across Time:

Understand the significance of events and themes across cultures and time

Focus K-12

Grade	Early	Late
K-4	The focus of instruction for all students early in this grade range is on developing an awareness that science is something that students do and relating that to what scientists do.	The focus of instruction for all students later in this grade range is on developing an understanding that science is an ongoing process and that many men and women are involved in the advancement of scientific understandings.
5-8	The focus of instruction early in this grade range is on providing all students opportunities to understand the nature of science by examining their own inquiry investigations and historical examples.	The focus of instruction for all students later in this grade range is on using student investigations, case studies, and historical examples from a variety of cultures to help students understand scientific inquiry, the nature of scientific knowledge, and interactions between science and society.
9-12	The focus of instruction for all students at the high school level is on using historical examples to understand the human dimension of science and technology, the nature of scientific knowledge, and the enterprise of science and technology in a variety of historical and cultural perspectives.	The focus of instruction for students pursuing further study is on providing opportunities for students to analyze and replicate historical and contemporary scientific investigations and explore their cultural and historical implications.

Close-up 5-8

The focus of instruction early in this grade range is on providing all students opportunities to understand the nature of science by examining their own inquiry investigations and historical examples.

Guided by the teacher, students spend time analyzing their inquiry investigations to further their understanding of the nature of science. Working in small groups, students compare their observations, evaluate the evidence from which they formed their conclusions, and consider alternative explanations of the evidence. When conclusions are in doubt, the teacher provides opportunities for students to repeat the investigation and re-examine the evidence. Students compare their own experiences with those of practicing scientists. They learn that the men and women who engage in science activities work in teams and sometimes alone, have diverse talents, are from a variety of social and ethnic backgrounds and that they communicate extensively with each other. Students and teachers observe established science safety procedures.

The focus of instruction for all students late in this grade range is on using student investigations, case studies, and historical examples from a variety of cultures to help students understand scientific inquiry, the nature of scientific knowledge, and interactions between science and society.

All students develop an understanding that science is done by all kinds of people with differing abilities, interests, backgrounds, and cultures. Based on an understanding of their own inquiry experiences, students begin to understand that the basic nature of science is to question, to investigate those questions, and develop answers based on evidence from the investigation. Through class discussions of their investigations, students learn that all scientific conclusions are open to review and criticism by other scientists and that experiments are replicated to provide further support for or deny the validity of the idea. Students begin to understand that scientific knowledge changes, and may even contradict what has been learned. While some laws or principles are well established and unlikely to change, new scientific concepts or theories that differ from the current beliefs of the time are controversial because the evidence is not always clear and/or may be interpreted in a variety of ways. Students and teachers observe established science safety procedures.

On Location 5-8

The 5-8 National Science Education Content Standards ask that students learn about the earth's history and the earth in the solar system. Students in this class do this by making direct observations of the heavens and by gathering information from secondary sources. They compare the scientific way of knowing with the belief systems of the ancients that evolved from observations they made of the heavens.

Students in Mr. H's class study the way ancient cultures organized their astronomical observations as they learn about current scientific theories and concepts of modern astronomy. From a wide variety of cultures, Mr. H selects the cultures of several Native American groups and the Yucatan Mayans as a focus for their study. Throughout the unit Mr. H works cooperatively with the teachers in the language arts department.

The students study sites of Native American observatories such as the Medicine Wheel in Wyoming where there is a solar calendar and star location circle, the Sundance Lodge which was built with 28 rafters in the roof of the arbor to mirror the 28 days of the lunar cycle, Woodhenge in Collinsville, Illinois, where people built a solar calendar, and the Mayan Temples on the Yucatan Peninsula which portrayed the solar and lunar cycles that the Mayans used to order their day-to-day lives.

Students observe pictures of each site and look for similarities. At the same time they make observations of the moon during the day, when they can see it, and at night. They note the moon's 28 day cycle and guess that the Cheyenne site might be an observatory. In addition, students read about how each site was used to make observations. They discover that the observatories were built to track the path of the sun throughout the seasons and at each site there is an observation point for sun alignment. Students simulate these observation points by measuring the length of the shadows at the beginning and end of the trimester at the same time of the day to discover that the sun's striking the earth is different. They track sunrise and sunsets as well.

Students learn why the ancients believed as they did and how the ancient shamans/priests used their observations to affect the daily lives of the people. They compare how information was used by the ancients to how scientific information is used today. Students begin to understand how the belief systems a person holds affect the way he/she interprets observations.

National Science Education Content Standards

5-8 Content Standard G

Science as a Human Endeavor

- Women and men of various social and ethnic backgrounds—and with diverse interests, talents, qualities, and motivations—engage in the activities of science, engineering, and related fields such as the health professions. Some scientists work in teams, and some work alone, but all communicate extensively with others.
- Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill, and creativity—as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.

Nature of Science

- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.
- In areas where active research is being pursued and in which there is not a great deal of experimental or observational evidence and understanding, it is normal for scientists to differ with one another about the interpretation of the evidence or theory being considered. Different scientists might publish conflicting experimental results or might draw different conclusions from the same data. Ideally, scientists acknowledge such conflict and work towards finding evidence that will resolve their disagreement.
- It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. Evaluation includes reviewing the experimental procedures, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. Although scientists may disagree about explanations of phenomena, about interpretations of data, or about the value of rival theories, they do agree that questioning, response to criticism, and open communication are integral to the process of science. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists.

History of Science

- Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.
- In historical perspective, science has been practiced by different individuals in different cultures. In looking at the history of many peoples, one finds that scientists and engineers of high achievement are considered to be among the most valued contributors to their culture.
- Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time to reach the conclusions that we currently take for granted.

Minnesota Graduation Standards

Intermediate Level

Historical Events:

Understand historical events and contributions of key people from different time periods.

What students should know:

1. Read and construct timelines of key events and the actions of important people
2. Understand the contributions of key historical people
3. Explain cause and effect relationships of events over an extended period of time

What students should do:

1. Describe a past event from the point of view of a local community member
2. Reconstruct a historical account of an event using primary and secondary sources (e.g., documents, letters, diaries, maps, textbooks, photographs)
3. Describe how technology has changed the lives of people in the home, at work, in transportation and communication
4. Give examples of conflict, cooperation and interdependence among individuals, groups and nations

In Addition:

Presentations should be accompanied by timelines.

Minnesota Graduation Standards

Middle Level

Career Exploration:

Explore career and education options to make informed decisions for future life choices.

What students should do:

1. Determine areas of individual interest and ability
2. Determine at least two possibilities for career/education options which reflect personal interests and abilities
3. Gather information for career options from a variety of sources (e.g., print sources, interviews, simulations, mentoring)
4. Describe how each career might affect personal, family and community life

In Addition:

Presentation may be written or oral.