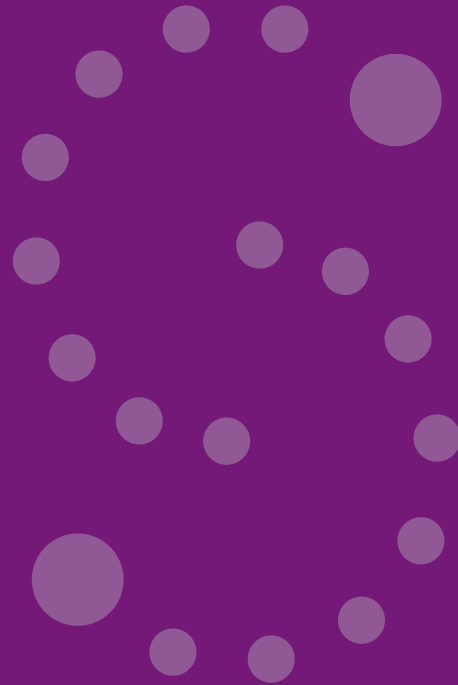


# Physical Science

**Content Standard B:**

As a result of the activities in grades K-4, all students should develop an understanding of

- Properties of objects and materials
- Position and motion of objects
- Light, heat, electricity, and magnetism



# Content Summary

National Science Education Content Standards	<b>K-4</b>	<p><b>Properties of objects and materials</b></p> <p><b>Position and motion of objects</b></p> <p><b>Light, heat, electricity, and magnetism</b></p>
	<b>5-8</b>	<p><b>Properties and changes of properties in matter</b></p> <p><b>Motions and forces</b></p> <p><b>Transfer of energy</b></p>
	<b>9-12</b>	<p><b>Structure of atoms</b></p> <p><b>Structure and properties of matter</b></p> <p><b>Chemical reactions</b></p> <p><b>Motions and forces</b></p> <p><b>Conservation of energy and increase in disorder</b></p> <p><b>Interactions of matter and energy</b></p>

Minnesota Graduation Standards	<b>Primary Level</b>	<p><b>Direct Science Experience:</b></p> <p>Understand basic science concepts through direct experience</p>
	<b>Intermediate Level</b>	<p><b>Living and Non-living Systems:</b></p> <p>Understand how individuals and objects interact in life, earth/space systems and physical systems</p>
	<b>Middle Level</b>	<p><b>Physical Systems:</b></p> <p>Evaluate interactions between physical systems encountered in everyday life</p>
	<b>High School Level</b>	<p><b>Concepts in Chemistry:</b></p> <p>Understand concepts, theories and principles in chemistry through investigation and analysis</p> <p><b>Concepts in Physics:</b></p> <p>Understand physics through interactions of matter, forces and energy</p>

## Focus K-12

Grade	Early	Late
<b>K-4</b>	The focus of instruction early in this grade range is on providing opportunities for all students to develop an awareness and understanding of the characteristics of objects and materials that they encounter daily through observation, manipulation, and classification.	The focus of instruction later in this grade range is on providing opportunities for all students to observe, describe, and measure properties of objects, the way they change over time, and changes that occur when objects interact.
<b>5-8</b>	The focus of instruction early in this grade range is on providing opportunities for all students to move from understandings about the properties of objects to the characteristic properties of the substances from which objects are made. Basic concepts of force, motion and energy transfer are introduced and explored.	The focus of instruction later in this grade range is on providing opportunities for all students to develop an operational understanding of elements and compounds and characteristic properties of common substances. The concepts of force, motion, and energy are developed through a variety of quantitative experiences.
<b>9-12</b>	<p>The focus of instruction in <i>chemistry</i> for all students at the high school level is on providing opportunities to develop an understanding of the relationship among the properties and structure of matter and to explore a variety of chemical reactions and their applications.</p> <p>The focus of instruction in <i>physics</i> for all students at the high school level is on providing opportunities to explore, develop, and use physical, conceptual and mathematical models as they develop qualitative and quantitative understanding of force, motion, energy, and matter, and apply their understandings to a variety of situations.</p>	<p>The focus of instruction for students pursuing further study in <i>chemistry</i> is on providing opportunities for students to develop a deeper understanding of atomic structure, explore the complex relationships among the structure and properties of matter, including mathematical relationships, and apply their understandings to a variety of situations.</p> <p>The focus of instruction for students pursuing further study in <i>physics</i> is on providing opportunities to explore, develop, and use conceptual and mathematical models as they develop a deeper understanding of force, motion, energy, and matter, and apply their understandings to a variety of situations.</p>

# Close-up K-4

The focus of instruction early in this grade range is on providing opportunities for all students to develop an awareness and understanding of the characteristics of objects and materials that they encounter daily through observation, manipulation, and classification.

The study of matter begins with examining and qualitatively describing objects and their behaviors. They compare, describe, group, and sort solid objects using simple tools such as magnifiers and simple measuring instruments. With the help of the teacher, students use their observations to identify patterns and group materials. They use words like up, down, in front, or behind to describe the position of objects. By exploring how things move, students learn that various kinds of forces control the motion of an object such as pulling or pushing. At this age, students note that mirrors reflect images and light and change the shape of letters or other objects, but developmentally they are not able to understand the science involved. Teachers guide students in exploration of light and shadow, hot and cold, and sound. Magnets are used to identify and sort objects. Students use a variety of methods, including simple pictures or written descriptions, to describe what they observe. Students and teachers observe established science safety procedures.

The focus of instruction later in this grade range is on providing opportunities for all students to observe, describe, and measure properties of objects, the way they change over time, and changes that occur when objects interact.

As teachers provide opportunities for students to explore matter, students develop the concept that solids, liquids, and gases have properties. All students examine and begin to quantitatively describe objects and their behaviors. They sort objects by size, weight, shape, and color. They observe how objects react with other substances. Teachers provide activities where students discover that the position and motion (change of position over time) of objects can be changed by pushing or pulling. They also learn that the size of the change is related to the strength of the push or pull. Teachers provide opportunities for independent exploration as well as guided group activities on the phenomena of light, electricity, magnetism, sound, and heat. Through these activities, students come to understand that these can be measured and controlled in various ways. Students at this age cannot distinguish between heat and temperature, so investigations should center on changes in temperature. Students and teachers observe established science safety procedures.

# On Location K-4

*This activity engages children in learning about changes of state as well as laying an appropriate foundation for understanding the particulate nature of matter. The National Science Education Standards include the study of water in the early grades because of the importance of the water cycle, and all children, regardless of their economic or cultural background, have had experiences with it. Later, they will apply what they have learned to other materials that are not so familiar.*

Students in Ms. S's class investigate solid and liquid water. On a snowy day in January the students, bundled up and armed with plastic jars with their lids, traipse outside and fill their bottles with snow. They then file back into the classroom and place their jars on the counter. After removing mittens, boots, and snowsuits, they begin to record observations about their jars.

After a while, when the snow is melted, the students compare their bottles. They are surprised to discover that some jars contain less water than the others. Ms. S asks, "How could this be, if all of the jars were full of snow, and the lids were tightly screwed on?" A lively discussion ensues about what "full" means. They come to understand that they had used a variety of methods to collect their snow — that some students had packed their snow in the jar while others had gathered fluffy snow and that this could make a difference in their results. As a class, they decide on one method of determining "full" and repeat their excursion the next day.

This time, when the snow melts, the water remaining in the jars is more or less at the same level in all of the students' jars, but they notice that the water level seems to be lower than the level of snow they had originally. They are puzzled by this and discuss ways to determine why there was a difference. They decide that by marking their jars with a permanent marker or rubber bands they can tell exactly where the snow and water levels are and measure the difference. In response to the questions about the lid being on, they also leave identical jars with the same amount of snow, overnight, but one with the lid off and the other on.

They find out that more water disappears with the lid off, but there is still less water in the jar than the amount of snow they began with. Leaving the "Where did the water in the open jars go?" question for another time, Ms. S. asks the students why there was less water than snow in the closed jars and how they might investigate that. They wonder if there is air in the snow and design further explorations to determine this.

The students collect snow under different environmental conditions. They investigate questions such as "Is the amount of water in light fluffy snow the same as in heavy snow?" and "Do equal weights of snow yield equal weights of water?"



# National Science Education Content Standards

## K-4 Content Standard B

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**Properties of Objects and Materials**

- Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. Those properties can be measured using tools, such as rulers, balances, and thermometers.
- Objects are made of one or more materials, such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made, and those properties can be used to separate or sort a group of objects or materials.
- Materials can exist in different states—solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling.

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**Position and Motion of Objects**

- The position of an object can be described by locating it relative to another object or the background.
- An object's motion can be described by tracing and measuring its position over time.
- The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.
- Sound is produced by vibrating objects. The pitch of the sound can be varied by changing the rate of vibration.

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**Light, Heat, Electricity, and Magnetism**

- Light travels in a straight line until it strikes an object. Light can be reflected by a mirror, refracted by a lens, or absorbed by the object.
- Heat can be produced in many ways, such as burning, rubbing, or mixing one substance with another. Heat can move from one object to another by conduction.
- Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete loop through which an electrical current can pass.
- Magnets attract and repel each other and certain kinds of other materials.



# Minnesota Graduation Standards

## Primary Level

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**Direct  
Science  
Experience:**

Understand basic science concepts through direct experience.

**What students should know:**

1. Understand concepts related to everyday life:
  - a. characteristic properties of objects (e.g., rocks, water, air, soil)
  - b. patterns and how they repeat (e.g., phenology, motion of the sun across the sky)
  - c. cycles (e.g., water, plant, life)
  - d. how basic needs of organisms are met (e.g., space, food, light)
  - e. response of organisms to changes in the environment (e.g., space, food, light)
2. Know how personal use of materials, energy and water impact the environment

**What students should do:**

1. Observe and describe characteristics of objects or phenomena
2. Measure changes that occur in objects or phenomena as a result of interaction
3. Sort and classify objects based on one or two properties
4. Display information using graphs (e.g., histograms, charts, pictures, narratives)
5. Describe how previously learned concepts apply to new situations

**In addition:**

Performance package should include tasks from earth, life, and physical science.

