Archdiocese of Washington Catholic Schools
Academic Standards
Science

6th Grade

Beginning with Grade 6, Archdiocese of Washington's academic standards for science contain seven standards, with the addition of Historical Perspectives. Each standard is described below. On the pages that follow, age-appropriate concepts are listed underneath each standard. These ideas build a foundation for understanding the intent of each standard.

Standard 1 — The Nature of Science and Technology
It is the union of science and technology that forms the scientific endeavor and that makes it so successful. Although each of these human enterprises has a character and history of its own, each is dependent on and reinforces the other. This first standard draws portraits of science and technology that emphasize their roles in the scientific endeavor and reveal some of the similarities and connections between them. In order for students to truly understand the nature of science and technology, they must model the process of scientific investigation through inquiries, fieldwork, lab work, etc. Through these experiences, students will practice designing investigations and experiments, making observations, and formulating theories based on evidence.

Standard 2 — Scientific Thinking
There are certain thinking skills associated with science, mathematics, and technology that young people need to develop during their school years. These are mostly, but not exclusively, mathematical and logical skills that are essential tools for both formal and informal learning and for a lifetime of participation in society as a whole. Good communication is also essential in order to both receive and disseminate information and to understand others' ideas as well as have one's own ideas understood. Writing, in the form of journals, essays, lab reports, procedural summaries, etc., should be an integral component of students' experiences in science.

Standard 3 — The Physical Setting
One of the grand success stories of science is the unification of the physical universe. It turns out that all natural objects, events, and processes are connected to each other. This standard contains recommendations for basic knowledge about the overall structure of the universe and the physical principles on which it seems to run, with emphasis on Earth and the solar system. This standard focuses on two principle subjects: the structure of the universe and the major processes that have shaped planet Earth, and the concepts with which science describes the physical world in general – organized under the headings of *Matter and Energy* and *Forces of Nature*. In Grade 6, students learn some of the relationships between physical objects, events, and processes in the universe.

Standard 4 — The Living Environment
People have long been curious about living things – how many different species there are, what they are like, how they relate to each other, and how they behave. Living organisms are made of the same components as all other matter, involve the same kinds of transformations of energy, and move using the same basic kinds of forces. Thus, all of the physical principles discussed in Standard 3 – The Physical Setting, apply to life as well as to stars, raindrops, and television sets. This standard offers recommendations on basic knowledge about how living things function and how they interact with one another and their environment. In Grade 6, students learn that plants and animals obtain energy in different ways and contain different structures for obtaining energy.

Standard 5 — The Mathematical World
Mathematics is essentially a process of thinking that involves building and applying abstract, logically connected networks of ideas. These ideas often arise from the need to solve problems in science, technology, and everyday life – problems ranging from how to model certain aspects of a complex scientific problem to how to balance a checkbook.

Standard 6 — Patterns in Science
Some important themes pervade science, mathematics, and technology, and appear over and over again, whether we are looking at ancient civilization, the human body, or a comet. These ideas transcend disciplinary boundaries and prove fruitful in explanation, in theory, in observation, and in design.
A focus on *Constancy and Change* within this standard provides students opportunities to engage in long-term and on-going laboratory and fieldwork, and thus understand the role of change over time in studying The Physical Setting and The Living Environment.

Standard 7 — Historical Perspectives
Examples of historical events provide a context for understanding how the scientific enterprise operates. By studying these events, one understands that new ideas are limited by the context in which they are conceived, are often rejected by the scientific establishment, sometimes spring from unexpected findings, and grow or transform slowly through the contributions of many different investigators. The historical events listed in Grade 6 are certainly not the only events that could be used to illustrate this standard, but they provide an array of examples. Through these examples, students will gain insight into the historical background of the development of the modern science of chemistry.

Standard 1 - The Nature of Science and Technology

Students design investigations. They use computers and other technology to collect and analyze data; they explain findings and can relate how they conduct investigations to how the scientific enterprise functions as a whole. Students understand that technology has allowed humans to do many things, yet it cannot always provide solutions to our needs.

The Scientific View of the World

6.1.1 Explain that some scientific knowledge, such as the length of the year, is very old and yet is still applicable today. Understand, however, that scientific knowledge is never exempt from review and criticism.

Scientific Inquiry

6.1.2 Give examples of different ways scientists investigate natural phenomena and identify processes all scientists use, such as collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses* and explanations, in order to make sense of the evidence.

6.1.3 Recognize and explain that hypotheses are valuable, even if they turn out not to be true, if they lead to fruitful investigations.

* hypothesis: an informed guess or tentative explanation for which there is not yet much evidence

The Scientific Enterprise

6.1.4 Give examples of employers who hire scientists, such as colleges and universities, businesses and industries, hospitals, and many government agencies.

6.1.5 Identify places where scientists work, including offices, classrooms, laboratories, farms, factories, and natural field settings ranging from space to the ocean floor.

6.1.6 Explain that computers have become invaluable in science because they speed up and extend people's ability to collect, store, compile, and analyze data; prepare research reports; and share data and ideas with investigators all over the world.

Technology and Science

6.1.7 Explain that technology is essential to science for such purposes as access to outer space and other remote locations, sample collection and treatment, measurement, data collection and storage, computation, and communication of information.

6.1.8 Describe instances showing that technology cannot always provide successful solutions for problems or fulfill every human need.

6.1.9 Explain how technologies can influence all living things.

Standard 2 - Scientific Thinking

Students use computers and other tools to collect information, calculate, and analyze data. They prepare tables and graphs, using these to summarize data and identify relationships.

Computation and Estimation

6.2.1 Find the mean* and median* of a set of data.

6.2.2 Use technology, such as calculators or computer spreadsheets, in analysis of data.

* mean: the average obtained by adding the values and dividing by the number of values
* median: the value that divides a set of data, written in order of size, into two equal parts

Manipulation and Observation

6.2.3 Select tools, such as cameras and tape recorders, for capturing information.

6.2.4 Inspect, disassemble, and reassemble simple mechanical devices and describe what the various parts are for. Estimate what the effect of making a change in one part of a system is likely to have on the system as a whole.

Communication Skills

6.2.5 Organize information in simple tables and graphs and identify relationships they reveal. Use tables and graphs as examples of evidence for explanations when writing essays or writing about lab work, fieldwork, etc.

6.2.6 Read simple tables and graphs produced by others and describe in words what they show.

6.2.7 Locate information in reference books, back issues of newspapers and magazines, CD-ROMs, and computer databases.

6.2.8 Analyze and interpret a given set of findings, demonstrating that there may be more than one good way to do so.

Critical Response Skills

6.2.9 Compare consumer products, such as generic and brand-name products, and consider reasonable personal trade-offs among them on the basis of features, performance, durability, and costs.

Standard 3 - The Physical Setting

Students collect and organize data to identify relationships between physical objects, events, and processes. They use logical reasoning to question their own ideas as new information challenges their conceptions of the natural world.

The Universe

6.3.1 Compare and contrast the size, composition, and surface features of the planets that comprise the solar system, as well as the objects orbiting them. Explain that the planets, except Pluto, move around the sun in nearly circular orbits.

6.3.2 Observe and describe that planets change their position relative to the background of stars.

6.3.3 Explain that Earth is one of several planets that orbit the sun, and that the moon, as well as many artificial satellites and debris, orbit around Earth.

Earth and the Processes That Shape It

6.3.4 Explain that we live on a planet which appears at present to be the only body in the solar system capable of supporting life.

6.3.5 Use models or drawings to explain that Earth has different seasons and weather patterns because it turns daily on an axis that is tilted relative to the plane of Earth's yearly orbit around the sun. Know that because of this, sunlight falls more intensely on different parts of Earth during the year (the accompanying greater length of days also has an effect) and the difference in heating produces seasons and weather patterns.

6.3.6 Use models or drawings to explain that the phases of the moon are caused by the moon's orbit around Earth, once in about 28 days, changing what part of the moon is lighted by the sun and how much of that part can be seen from Earth, both during the day and night.

6.3.7 Understand and describe the scales involved in characterizing Earth and its atmosphere. Describe that Earth is mostly rock, that three-fourths of its surface is covered by a relatively thin layer of water, and that the entire planet is surrounded by a relatively thin blanket of air.

6.3.8 Explain that fresh water, limited in supply and uneven in distribution, is essential for life and also for most industrial processes. Understand that this resource can be depleted or polluted, making it unavailable or unsuitable for life.

6.3.9 Illustrate that the cycling of water in and out of the atmosphere plays an important role in determining climatic patterns.

6.3.10 Describe the motions of ocean waters, such as tides, and identify their causes.

6.3.11 Identify and explain the effects of oceans on climate.

6.3.12 Describe ways human beings protect themselves from adverse weather conditions.

6.3.13 Identify, explain, and discuss some effects human activities, such as the creation of pollution, have on weather and the atmosphere.

6.3.14 Give examples of some minerals that are very rare and some that exist in great quantities. Explain how recycling and the development of substitutes can reduce the rate of depletion of minerals.

6.3.15 Explain that although weathered* rock is the basic component of soil, the composition and texture of soil and its fertility and resistance to erosion* are greatly influenced by plant roots and debris, bacteria, fungi, worms, insects, and other organisms.

6.3.16 Explain that human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and farming intensively, have changed the capacity of the environment to support some life forms.

* weathering: the breaking down of rocks and other materials on Earth's surface by such processes as rain or wind
* erosion: the process by which the products of weathering are moved from one place to another

Matter* and Energy*

6.3.17 Recognize and describe that energy is a property of many objects and is associated with heat, light, electricity, mechanical motion, and sound.

6.3.18 Investigate and describe that when a new material, such as concrete, is made by combining two or more materials, it has properties that are different from the original materials.

6.3.19 Investigate that materials may be composed of parts that are too small to be seen without magnification.

6.3.20 Investigate that equal volumes* of different substances usually have different masses as well as different densities*.

* matter: anything that has mass* and takes up space
* mass: a measure of how much matter is in an object
* energy: what is needed to make things move
* volume: a measure of the size of a three-dimensional object

* density: the density of a sample is the sample's mass divided by its volume

Forces of Nature

6.3.21 Investigate, using a prism for example, that light is made up of a mixture of many different colors of light, even though the light is perceived as almost white.

6.3.22 Demonstrate that vibrations in materials set up wavelike disturbances, such as sound and earthquake waves*, that spread away from the source.

6.3.23 Explain that electrical circuits* provide a means of transferring electrical energy from sources such as generators to devices in which heat, light, sound, and chemical changes are produced.

* wave: a traveling disturbance that carries energy from one place to another
* circuit: the complete path of an electric current

Standard 4 - The Living Environment

Students recognize that plants and animals obtain energy in different ways, and they can describe some of the internal structures of organisms related to this function. They examine the similarities and differences between humans and other species. They use microscopes to observe cells and recognize cells as the building blocks of all life.*

Diversity of Life

6.4.1 Explain that one of the most general distinctions among organisms is between green plants, which use sunlight to make their own food, and animals, which consume energy-rich foods.

6.4.2 Give examples of organisms that cannot be neatly classified as either plants or animals, such as fungi and bacteria.

6.4.3 Describe some of the great variety of body plans and internal structures animals and plants have that contribute to their being able to make or find food and reproduce.

6.4.4 Recognize and describe that a species comprises all organisms that can mate with one another to produce fertile offspring.

6.4.5 Investigate and explain that all living things are composed of cells whose details are usually visible only through a microscope.

6.4.6 Distinguish the main differences between plant and animal cells, such as the presence of chlorophyll* and cell walls in plant cells and their absence in animal cells.

6.4.7 Explain that about two-thirds of the mass of a cell is accounted for by water. Understand that water gives cells many of their properties.

* species: a category of biological classification that is comprised of organisms sufficiently and closely related as to be potentially able to mate with one another
* chlorophyll: a substance found in green plants that is needed for photosynthesis*
* photosynthesis: a process by which green plants use energy from sunlight to make their own food

Interdependence of Life

6.4.8 Explain that in all environments, such as freshwater, marine, forest, desert, grassland, mountain, and others, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter. Note that in any environment, the growth and survival of organisms depend on the physical conditions.

6.4.9 Recognize and explain that two types of organisms may interact in a competitive or cooperative relationship, such as producer*/consumer*, predator*/prey*, or parasite*/host*.

6.4.10 Describe how life on Earth depends on energy from the sun.

* producer: an organism that can make its own food
* consumer: an organism that feeds directly or indirectly on producers
* predator: an organism that kills and eats other organisms
* prey: an organism that is killed and eaten by a predator
* parasite: an organism that feeds on other living organisms
* host: an organism in which or on which another organism lives

Human Identity

6.4.11 Describe that human beings have body systems for obtaining and providing energy, defense, and the coordination of body functions.

6.4.12 Explain that human beings have many similarities and differences and that the similarities make it possible for human beings to donate blood and organs to one another.

6.4.13 Give examples of how human beings use technology to match or exceed many of the abilities of other species.

Standard 5 - The Mathematical World

Students apply mathematics in scientific contexts. They use mathematical ideas, such as relations between operations, symbols, shapes in three dimensions, statistical relationships, and the use of logical reasoning in the representation and synthesis of data.

Numbers

6.5.1 Demonstrate that the operations addition and subtraction are inverses and that multiplication and division are inverses of each other.

6.5.2 Evaluate the precision and usefulness of data based on measurements taken.

Shapes and Symbolic Relationships

6.5.3 Explain why shapes on a sphere* like Earth cannot be depicted on a flat surface without some distortion.

6.5.4 Demonstrate how graphs may help to show patterns — such as trends, varying rates of change, gaps, or clusters — which can be used to make predictions.

* sphere: a shape best described as that of a round ball, such as a baseball, that looks the same when seen from all directions

Reasoning and Uncertainty

6.5.5 Explain the strengths and weaknesses of using an analogy to help describe an event, object, etc.

6.5.6 Predict the frequency of the occurrence of future events based on data.

6.5.7 Demonstrate how probabilities and ratios can be expressed as fractions, percentages, or odds.

Standard 6 – Patterns in Science

Students use mental and physical models to conceptualize processes. They recognize that many systems have feedback mechanisms that limit changes.

Systems

6.6.1 Describe that a system, such as the human body, is composed of subsystems.

Models and Scale

6.6.2 Use models to illustrate processes that happen too slowly, too quickly, or on too small a scale to observe directly, or are too vast to be changed deliberately, or are potentially dangerous.

Constancy and Change

6.6.3 Identify examples of feedback mechanisms within systems that serve to keep changes within specified limits.

Standard 7 - Historical Perspectives

Students gain understanding of how the scientific enterprise operates through examples of historical events. Through the study of these events, they understand that new ideas are limited by the context in which they are conceived, are often rejected by the scientific establishment, sometimes spring from unexpected findings, and grow or transform slowly through the contributions of many different investigators.

6.7.1 Understand and explain that from the earliest times until now, people have believed that even though countless different kinds of materials seem to exist in the world, most things can be made up of combinations of just a few basic kinds of things. Note that there has not always been

agreement, however, on what those basic kinds of things are, such as the theory of long ago that the basic substances were earth, water, air, and fire. Understand that this theory seemed to explain many observations about the world, but as we know now, it fails to explain many others.

6.7.2 Understand and describe that scientists are still working out the details of what the basic kinds of matter are on the smallest scale, and of how they combine, or can be made to combine, to make other substances.

6.7.3 Understand and explain that the experimental and theoretical work done by French scientist Antoine Lavoisier in the decade between the American and French Revolutions contributed crucially to the modern science of chemistry.