Archdiocese of Washington Catholic Schools
Academic Standards
Science

8th 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 8, students refine their knowledge about 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 8, students trace the flow of matter and energy through ecosystems and recognize that the total amount of matter stays constant.

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 8 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 chemistry, specifically that of nuclear chemistry.

Standard 1 - The Nature of Science and Technology

Students design and carry out increasingly sophisticated investigations. They understand the reason for isolating and controlling variables in an investigation. They realize that scientific knowledge is subject to change as new evidence arises. They examine issues in the design and use of technology, including constraints, safeguards, and trade-offs.

The Scientific View of the World

8.1.1 Recognize that and describe how scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory* leads to looking at old observations in a new way.

8.1.2 Recognize and explain that some matters cannot be examined usefully in a scientific way.

* theory: an explanation supported by substantial evidence

Scientific Inquiry

8.1.3 Recognize and describe that if more than one variable changes at the same time in an experiment, the outcome of the experiment may not be attributable to any one of the variables.

The Scientific Enterprise

8.1.4 Explain why accurate record keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society.

8.1.5 Explain why research involving human subjects requires that potential subjects be fully informed about the risks and benefits associated with the research and that they have the right to refuse to participate.

Technology and Science

8.1.6 Identify the constraints that must be taken into account as a new design is developed, such as gravity and the properties of the materials to be used.

8.1.7 Explain why technology issues are rarely simple and one-sided because contending groups may have different values and priorities.

8.1.8 Explain that humans help shape the future by generating knowledge, developing new technologies, and communicating ideas to others.

Standard 2 - Scientific Thinking

Students use computers to organize and compare information. They perform calculations and determine the appropriate units for the answers. They weigh the evidence for or against an argument, as well as the logic of the conclusions.

Computation and Estimation

8.2.1 Estimate distances and travel times from maps and the actual size of objects from scale drawings.

8.2.2 Determine in what units, such as seconds, meters, grams, etc., an answer should be expressed based on the units of the inputs to the calculation.

Manipulation and Observation

8.2.3 Use proportional reasoning to solve problems.

8.2.4 Use technological devices, such as calculators and computers, to perform calculations.

8.2.5 Use computers to store and retrieve information in topical, alphabetical, numerical, and keyword files and create simple files of students' own devising.

Communication

8.2.6 Write clear, step-by-step instructions (procedural summaries) for conducting investigations, operating something, or following a procedure.

8.2.7 Participate in group discussions on scientific topics by restating or summarizing accurately what others have said, asking for clarification or elaboration, and expressing alternative positions.

8.2.8 Use tables, charts, and graphs in making arguments and claims in, for example, oral and written presentations about lab or fieldwork.

Critical Response Skills

8.2.9 Explain why arguments are invalid if based on very small samples of data, biased samples, or samples for which there was no control sample.

8.2.10 Identify and criticize the reasoning in arguments in which fact and opinion are intermingled or the conclusions do not follow logically from the evidence given, an analogy is not apt, no mention is made of whether the control group is very much like the experimental group, or all members of a group are implied to have nearly identical characteristics that differ from those of other groups.

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

8.3.1 Explain that large numbers of chunks of rock orbit the sun and some of this rock interacts with Earth.

Earth and the Processes That Shape It

8.3.2 Explain that the slow movement of material within Earth results from heat flowing out of the deep interior and the action of gravitational forces on regions of different density*.

8.3.3 Explain that the solid crust of Earth, including both the continents and the ocean basins, consists of separate plates that ride on a denser, hot, gradually deformable layer of earth. Understand that the crust sections move very slowly, pressing against one another in some places, pulling apart in other places. Further understand that ocean-floor plates may slide under continental plates, sinking deep into Earth, and that the surface layers of these plates may fold, forming mountain ranges.

8.3.4 Explain that earthquakes often occur along the boundaries between colliding plates, and molten rock from below creates pressure that is released by volcanic eruptions, helping to build up mountains. Understand that under the ocean basins, molten rock may well up between separating plates to create new ocean floor. Further understand that volcanic activity along the ocean floor may form undersea mountains, which can thrust above the ocean's surface to become islands.

8.3.5 Explain that everything on or anywhere near Earth is pulled toward Earth's center by a gravitational force.

8.3.6 Understand and explain that the benefits of Earth's resources, such as fresh water, air, soil, and trees, are finite and can be reduced by using them wastefully or by deliberately or accidentally destroying them.

8.3.7 Explain that the atmosphere and the oceans have a limited capacity to absorb wastes and recycle materials naturally.

* density: the density of a sample is the sample's mass* divided by its volume
* mass: a measure of how much matter* is in an object
* matter: anything that has mass and takes up space

Matter and Energy*

8.3.8 Explain that all matter is made up of atoms* which are far too small to see directly through an optical microscope. Understand that the atoms of any element* are similar but are different from atoms of other elements. Further understand that atoms may stick together in well-defined molecules or may be packed together in large arrays. Also understand that different arrangements of atoms into groups comprise all substances.

8.3.9 Demonstrate, using drawings and models, the movement of atoms in a solid*, liquid*, and gaseous* state. Explain that atoms and molecules are perpetually in motion.

8.3.10 Explain that increased temperature means that atoms have a greater average energy of motion and that most gases expand when heated.

8.3.11 Describe how groups of elements can be classified based on similar properties, including highly reactive metals*, less reactive metals, highly reactive nonmetals*, less reactive nonmetals, and some almost completely nonreactive gases.

8.3.12 Explain that no matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. Understand that the atomic theory explains the conservation of matter: if the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.

8.3.13 Explain that energy cannot be created or destroyed but only changed from one form into another.

8.3.14 Describe how heat* can be transferred through materials by the collision of atoms, or across space by radiation*, or if the material is fluid, by convection* currents that are set up in it that aid the transfer of heat.

8.3.15 Identify different forms of energy that exist in nature.

* energy: what is needed to make things move
* atom: the smallest particle of an element that has the properties of that element
* element: the simplest type of pure substance; a substance consisting entirely of atoms having identical chemical properties
* solid: matter with a definite shape and volume
* liquid: matter with no definite shape but with a definite volume
* gas: matter with no definite shape or volume
* metals: one class of substances that are mostly shiny, bendable, and good conductors of heat and electricity
* nonmetals: one class of substances that does not have metallic properties; usually a poor conductor of heat and electricity
* heat: a form of energy characterized by random motion at the molecular level
* radiation: energy transfer through space
* convection: heat transfer in liquids and gases by transport of matter from a region of one temperature to a region of a different temperature

Forces of Nature

8.3.16 Explain that every object exerts gravitational force on every other object and that the force depends on how much mass the objects have and how far apart they are.

8.3.17 Explain that the sun's gravitational pull holds Earth and the other planets in their orbits, just as the planets' gravitational pull keeps their moons in orbit around them.

8.3.18 Investigate and explain that electric currents and magnets can exert force on each other.

8.3.19 Investigate and compare series and parallel circuits.

8.3.20 Compare the differences in power consumption in different electrical devices.

Standard 4 - The Living Environment

Students trace the flow of matter and energy through ecosystems. They understand that the total amount of matter remains constant and that almost all food energy has its origin in sunlight.*

Diversity of Life

8.4.1 Differentiate between inherited traits, such as hair color or flower color, and acquired skills, such as manners.

8.4.2 Describe that in some organisms, such as yeast or bacteria, all genes* come from a single parent, while in those that have sexes, typically half of the genes come from each parent.

8.4.3 Recognize and describe that new varieties of cultivated plants, such as corn and apples, and domestic animals, such as dogs and horses, have resulted from selective breeding for particular traits.

* ecosystem: a group of organisms in an area that interact with one another, together with their nonliving environment
* gene: basic unit of heredity

Interdependence of Life

8.4.4 Describe how matter is transferred from one organism to another repeatedly and between organisms and their physical environment.

8.4.5 Explain that energy can be transferred from one form to another in living things.

8.4.6 Describe how animals get their energy from oxidizing their food and releasing some of this energy as heat.

8.4.7 Recognize and explain that small genetic differences between parents and offspring can accumulate in successive generations so that descendants are very different from their ancestors.

8.4.8 Describe how environmental conditions affect the survival of individual organisms and how entire species may prosper in spite of the poor survivability or bad fortune of individuals.

Standard 5 - The Mathematical World

Students apply mathematics in scientific contexts. Students use mathematical ideas, such as symbols, geometrical relationships, statistical relationships, and the use of key words and rules in logical reasoning, in the representation and synthesis of data.

Numbers

8.5.1 Understand and explain that a number must be written with an appropriate number of significant figures (determined by the measurements from which the number is derived).

Shapes and Symbolic Relationships

8.5.2 Show that an equation containing a variable may be true for just one value of the variable.

8.5.3 Demonstrate that mathematical statements can be used to describe how one quantity changes when another changes.

8.5.4 Illustrate how graphs can show a variety of possible relationships between two variables.

8.5.5 Illustrate that it takes two numbers to locate a point on a map or any other two-dimensional surface.

Reasoning and Uncertainty

8.5.6 Explain that a single example can never prove that something is always true, but it could prove that something is not always true.

8.5.7 Recognize and describe the danger of making over-generalizations when inventing a general rule based on a few observations.

8.5.8 Explain how estimates can be based on data from similar conditions in the past or on the assumption that all the possibilities are known.

8.5.9 Compare the mean*, median*, and mode* of a data set.

8.5.10 Explain how the comparison of data from two groups involves comparing both their middles and the spreads.

* 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
* mode: the most common value in a given data set

Standard 6 - Patterns in Science

Students analyze the parts and interactions of systems to understand internal and external relationships. They investigate rates of change, cyclic changes, and changes that counterbalance one another. They use mental and physical models to reflect upon and interpret the limitations of such models.

Systems

8.6.1 Explain that a system usually has some properties that are different from those of its parts but appear because of the interaction of those parts.

8.6.2 Explain that even in some very simple systems, it may not always be possible to predict accurately the result of changing some part or connection.

Models and Scale

8.6.3 Use technology to assist in graphing and with simulations that compute and display results of changing factors in models.

8.6.4 Explain that as the complexity of any system increases, gaining an understanding of it depends on summaries, such as averages and ranges*, and on descriptions of typical examples of that system.

* range: the difference between the largest and the smallest values

Constancy and Change

8.6.5 Observe and describe that a system may stay the same because nothing is happening or because things are happening that counteract one another.

8.6.6 Recognize that and describe how symmetry may determine properties of many objects, such as molecules, crystals, organisms, and designed structures.

8.6.7 Illustrate how things, such as seasons or body temperature, occur in cycles.

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.

8.7.1 Understand and explain that Antoine Lavoisier's work was based on the idea that when materials react with each other, many changes can take place, but that in every case the total amount of matter afterward is the same as before. Note that Lavoisier successfully tested the concept of conservation of matter by conducting a series of experiments in which he carefully measured the masses of all the substances involved in various chemical reactions, including the gases used and those given off.

8.7.2 Understand and describe that the accidental discovery that minerals containing uranium darken photographic film, as light does, led to the discovery of radioactivity.

8.7.3 Understand that and describe how in their laboratory in France, Marie Curie and her husband, Pierre Curie, isolated two new elements that were the source of most of the radioactivity of uranium ore. Note that they named one radium because it gave off powerful invisible rays, and the other polonium in honor of Madame Curie's country of birth, Poland. Also note that Marie Curie was the first scientist ever to win the Nobel Prize in two different fields, in physics, shared with her husband, and later in chemistry.

8.7.4 Describe how the discovery of radioactivity as a source of Earth's heat energy made it possible to understand how Earth can be several billion years old and still have a hot interior.