Integrated Faith Standards for Academic Curriculum

Science Curriculum

Kindergarten – Grade 8

*Revised 2022

"Education is an important mission, which draws young people to what is good, beautiful, and true."

Pope Francis

Science is crucial for all students to master; not only those who seek careers in science, engineering, and medicine, but all citizens who live in the 21st century. These standards are created for students who live in a world where scientific understanding is not just an asset, but a necessity.

In studying science, we desire that our students in Catholic Schools will be able to:

- Demonstrate the mental practices of precise, determined, meticulous, and accurate questioning, inquiry, and reasoning of the Scientific Method.
- Learn that science involves exploration and particular procedures and ways of developing and organizing knowledge in an ongoing journey of discovery.
- Respond to the beauty, harmony, proportion, and wholeness existing in Nature.
- Appreciate how scientific hypothesis, investigation, and experimentation relate to other areas of study, especially the interplay of scientific research and theological and philosophical analysis.
- Articulate how scientific theories such as the Big Bang and evolution reflect the glory of the Creator.
- Communicate the significant contributions that the Catholic Church has made to the advancement of science, including the sponsorship of the first universities and such acclaimed scientists as Fr. Gregor Mendel, Fr. Georges Lemaître, Louis Pasteur, Nicholas Copernicus, Blaise Pascal, Galileo Galilei, Luigi Galvani, and Leonardo da Vinci.

The proposed Diocesan Curriculum Standards for Science adapted and reprinted from the *Indiana Academic Science Standards* will guide us in creating a science and engineering curriculum modeled on Design Process and the Scientific Method, enabling our students to approach the world with logic, reason, inquiry, and wonder. "Every scientist, through personal study and research, completes himself and his own humanity. ... Scientific research constitutes the way for the personal encounter with truth, and perhaps the privileged place for the encounter itself with God, the Creator of heaven and earth. Science shines forth in all its value as a good capable of motivating our existence, as a great experience of freedom for truth, as a fundamental work of service. Through research each scientist grows as a human being and helps others to do likewise." – Pope Saint John Paul II.

Scientific Process Standards

The Nature of Scientific knowledge is scientists' best explanations for the data from many investigations. Ideas about objects in the microscopic world that we cannot directly sense are often understood in terms of concepts developed to understand objects in the macroscopic world that we can see and touch. Student work should align with this process of science and should be guided by those principles. Students should also understand that scientific knowledge is gained from observation of natural phenomena and experimentation by designing and conducting investigations guided by theory and by evaluating and communicating the results of those investigations according to accepted procedures. These concepts should be woven throughout daily work.

- Develop explanations to inquiries based on reproducible data and observations gathered during laboratory investigations.
- Recognize that their explanations must be based both on their data and other known information from investigations of others.
- Clearly communicate their ideas and results of investigations verbally and in written form using tables, graphs, diagrams and photographs.

- Regularly evaluate the work of their peers and in turn have their work evaluated by their peers.
- Apply standard techniques in laboratory investigations to measure physical quantities in appropriate units and convert quantities to other units as necessary.
- Use analogies and models (mathematical and physical) to simplify and represent systems that are difficult to understand or directly experience due to their size, time scale or complexity. Recognize the limitations of analogies and models.
- Focus on the development of explanatory models based on their observations during laboratory investigations.
- Explain that the body of scientific knowledge is organized into major theories, which are derived from and supported by the results of many experiments and allow us to make testable predictions.
- Recognize that new scientific discoveries often lead to a re-evaluation of previously accepted scientific knowledge and of commonly held ideas.
- Describe how scientific discoveries lead to the development of new technologies and conversely how technological advances can lead to scientific discoveries through new experimental methods and equipment.
- Explain how scientific knowledge can be used to guide decisions on environmental and social issues.

Basic Principles Underlying All Standards to be Used for the Planning of Curriculum for the Diocese of Manchester

- A passion for mission should inform every curriculum decision.
- All knowledge reflects God's Truth, Beauty, and Goodness.
- Curriculum and instruction enable deeper incorporation of the children into the Church, the formation of community within the school, and respect for the uniqueness and dignity of each person as created in the image and likeness of God.
- Education fosters growth in Christian virtue and contributes to development and formation of the whole person for the good of the society of which he/she is a member, and in recognition of their destiny, an eternal life in Christ.
- Each subject is to be examined in the context of the Catholic faith through Scripture and Tradition and is to be illuminated by Gospel values.
- Learning and formation are interconnected, as are the natural and spiritual development of each student.
- Curriculum and instruction seek to promote a synthesis of faith, life, and culture, forming students as disciples of Jesus.
- All curricula must support a commitment to strong and consistent Catholic identity.
- Curriculum will assist the student's ability to think critically, problem solve, innovate, and lead towards a supernatural vision.

In a Catholic School, Curricular Formation…

1. Involves the integral formation of the whole person, body, mind, and spirit, in light of his or her ultimate end and the good of society.[i]
2. Promotes human virtues and the dignity of the human person as created in the image and likeness of God and modeled on the person of JesusChrist.[ii]
3. Seeks to know and understand objective reality, which includes transcendent Truth, is knowable by reason and faith, and finds its origin, unity, and end in God.
4. Develops a Catholic worldview and enables a deeper incorporation of the student into the heart of the Catholic Church.[iii]
5. Encourages a synthesis of faith, life, and culture.[iv]

Posing Questions for Science and Defining Problems for Engineering

K-8.EP.PQ-1.0 A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work, and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.

Developing and Using Models and Tools

K-8.EP.MT-1.0 A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions, and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include but are not limited to the following: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include but are not limited to the following: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.

Constructing and Performing Investigations

K-8.EP.CPI-1.0 Scientists and engineers construct and perform investigations in the field or laboratory, working collaboratively and individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters, generating quality data. Scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.

Analyzing and Interpreting Data

K-8.EP.AID-1.0 Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering make analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to the following: “Does this make sense?” “Could my results be duplicated?” and/or “Does the design solve the problem with the given constraints?”

Using Mathematics and Computational Thinking

K-8.EP.MCT-1.0 In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.

Constructing Explanations (for Science) and Designing Solutions (for Engineering)

K-8.EP.CEDS-1.0 Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, and connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.

Engaging in Argument from Evidence

K-8.EP.AE-1.0 Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.

Obtaining, Evaluating, and Communicating Information

K-8.EP.OEC-1.0 Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Kindergarten through Grade 6 Science Catholic Integrated Faith Standards

Scientific Topics – General Standards

K6.S.IF-GS.1.1	Exhibit care and concern at all stages of life for each human person as animage and likeness of God.
K6.S.IF-GS.1.2	Describe the unity of faith and reason with confidence that there exists no contradiction between the God of nature and the God of faith.
K6.S.IF-GS.1.3	Value the human body as the temple of the Holy Spirit.

Scientific Topics – Intellectual Standards

K6.S.IF-IS.2.1	Explain what it means to say that God created the world and all matter outof nothing at a certain point in time; how it manifests His wisdom, glory, and purpose; and how He holds everything in existence according to His plan.
K6.S.IF-IS.2.2	Describe the relationships, elements, underlying order, harmony, andmeaning in God's creation.
K6.S.IF-IS.2.3	Explain how creation is an outward sign of God's love and goodness and, therefore, is ,"sacramental" in nature.
K6.S.IF-IS.2.4	Give examples of the beauty evident in God's creation.
K6.S.IF-IS.2.5	Explain the processes of conservation, preservation, overconsumption, and stewardship in relation to caring for that which God has given to sustain and delight us.
K6.S.IF-IS.2.6	Describe God's relationship with man and nature.
K6.S.IF-IS.2.7	Describe how science and technology should always be at the service ofhumanity and, ultimately, to God, in harmony with His purposes.
K6.S.IF-IS.2.8	Explain how science properly limits its focus to how things physically exist and is not designed to answer issues of meaning, the value of things, or the mysteries of the human person.
K6.S.IF-IS.2.9	Describe how the use of the scientific method to explore and understand nature differs, yet complements, the theological and philosophical questionsone asks in order to understand God and His works.
K6.S.IF-IS.2.10	Analyze the false assumption that science can replace faith.
K6.S.IF-IS.2.11	List the basic contributions of significant Catholics to science such as Galileo, Copernicus, Mendel, and others.

Scientific Topics – Dispositional Standards

K6.S.IF-IS.3.1	Display a sense of wonder and delight about the natural universe and itsbeauty.
K6.S.IF-IS.3.2	Share concern and care for the environment as a part of God's creation.
K6.S.IF-IS.3.3	Accept the premise that nature should not be manipulated simply at man's will or only viewed as a thing to be used, but that man must cooperate withGod's plan for himself and for nature.
K6.S.IF-IS.3.4	Accept that scientific knowledge is a call to serve and not simply a meansto gain power, material prosperity, or success.

Literacy in Science/Technical Subjects: Read and Comprehend Science and Technical Texts Independently and Proficiently and Write Effectively for a Variety of Discipline-Specific Tasks, Purposes, and Audiences

6-8.SSO.LST-1.0	Read and comprehend science and technical texts within a range of complexity developmentally appropriate for grades 6-8 independently and proficiently by the end of grade 8.
6-8.SSO.LST-2.0	Write over a variety of timeframes for a range of discipline-specific tasks, purposes, and audiences.

Key Ideas and Textual Support (Reading): Extract and Construct Meaning from Science and Technical Texts Using a Variety of Comprehension Skills

6-8.SSO.ITS-1.0	Demonstrate information literacy by citing specific textual evidence to support analysis of science and technical texts, and exercise academic integrity by attending to the precise details of explanations or descriptions, especially when citing source material.
6-8.SSO.ITS-2.0	Determine the central ideas or conclusions of a text; provide an accurate, objective summary of the text.
6-8.SSO.ITS-3.0	Follow a precise multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Structural Elements and Organization (Reading): Build Understanding of Science and Technical Texts, Using Knowledge of Structural Organization and Author's Purpose and Message

6-8.SSO.SEO-1.0	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
6-8.SSO.SEO-2.0	Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
6-8.SSO.SEO-3.0	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

Synthesis and Connection of Ideas (Reading): Build Understanding of Science and Technical Texts by Synthesizing and Connecting Ideas and Evaluating Specific Claims

6-8.SSO.SCI-1.0	Integrate quantitative or technical information expressed in words from scientific literature and present the information visually (e.g., in a flowchart, diagram, model, graph, or table).
6-8.SSO.SCI-2.0	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text to determine information literacy.
6-8.SSO.SCI-3.0	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Writing Genres (Writing): Write for Different Purposes and to Specific Audiences or People

6-8.SSO.WG-1.0 Write arguments focused on discipline-specific content.

6-8.SSO.WG-2.0 Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

The Writing Process (Writing): Produce Coherent and Legible Documents by Planning, Drafting, Revising, Editing, and Collaborating with Others

6-8.SSO.WP-1.0 Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach; and edit to produce and strengthen writing that is clear and coherent, with some guidance and support from peers and adults.

6-8.SSO.WP-2.0 Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

The Research Process (Writing): Build Knowledge about the Research Process and the Topic under Study by Conducting Short or More Sustained Research

6-8.SSO.RP-1.0 Conduct short research assignments and tasks to answer a question (including a self-generated question) or test a hypothesis, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

6-8.SSO.RP-2.0 Demonstrate academic integrity and information literacy by gathering relevant information from multiple sources, using search terms effectively; annotating sources; assessing the credibility and accuracy of each source; and quoting or paraphrasing the data and conclusions of others while avoiding plagiarism and following a standard format for citation (e.g., *APA* or *CSE*).

6-8.SSO.RP-3.0 Draw evidence from informational texts to support analysis, reflection, and research.

Physical Science

6.SC.PS-1.0	Understand that the properties and behavior of matter can be explained by a model that depicts particles representing atoms or molecules in motion.
6.SC.PS-2.0	Explain the properties of solids, liquids and gases using drawings and models that represent matter as particles in motion whose state can be represented by the relative positions and movement of the particles.
6.SC.PS-3.0	Using a model in which matter is composed of particles in motion, investigate that when substances undergo a change in state, mass is conserved.
6.SC.PS-4.0	Describe and demonstrate how potential and kinetic energy can be transferred from one form to another.
6.SC.PS-5.0	Explain that energy may be manifested as heat, light, electricity, mechanical motion, and sound and is often associated with chemical reactions.
6.SC.PS-6.0	Investigate the properties of light, sound, and other energy waves and how they are reflected, absorbed, and transmitted through materials and space.
6.SC.PS-7.0	Distinguish between the terms position, distance, and displacement, as well as the terms speed and velocity.
6.SC.PS-8.0	Describe the motion of an object graphically showing the relationship between time and position.

Earth and Space Science

6.SC.ESS-1.0	Describe the role of gravity and inertia in maintaining the regular and predictable motion of celestial bodies.
6.SC.ESS-2.0	Design models to describe how Earth's rotation, revolution, tilt, and interaction with the sun and moon cause seasons, tides, changes in daylight hours, eclipses, and phases of the moon.
6.SC.ESS-3.0	Compare and contrast the Earth, its moon, and other planets in the solar system, including comets and asteroids. (Comparisons should be made in regard to size, surface features, atmospheric characteristics, and the ability to support life.)

Life Science

6.SC.LS-1.0	Investigate and describe how homeostasis is maintained as living things seek out their basic needs of food, water, shelter, space, and air.
6.SC.LS-2.0	Describe the role of photosynthesis and cellular respiration in the flow of energy in food chains, energy pyramids, and food webs. Create diagrams to show how the energy in animals' food used for bodily processes was once energy from the sun.
6.SC.LS-3.0	Describe specific relationships (predator/prey, consumer/producer, parasite/host) and symbiotic relationships between organisms. Construct an explanation that predicts how patterns of interactions develop between organisms in an ecosystem.
6.SC.LS-4.0	Investigate and use data to explain how changes in biotic and abiotic components in ecosystems can be beneficial or detrimental to native species.
6.SC.LS-5.0	Research invasive species and discuss their impact on ecosystems.

Engineering

6.SC.EN-1.0	Identify the criteria and constraints of a design to ensure a successful solution, accounting for relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
6.SC.EN-2.0	Evaluate competing design solutions using a systematic process to identify how well they meet the criteria and constraints of the problem.
6.SC.EN-3.0	Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
6.SC.EN-4.0	Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.

Engineering

6-8.CS.EN-1.0 Identify the criteria and constraints of a design to ensure a successful solution, accounting for relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

6-8.CS.EN-2.0 Evaluate competing design solutions using a systematic process to identify how well they meet the criteria and constraints of the problem.

6-8.CS.EN-3.0 Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

6-8.CS.EN-4.0 Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.

Data and Information

6-8.CS.DI-1.0 Use the basic steps in problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, and evaluation).

6-8.CS.DI-2.0 Represent data in a variety of ways (e.g., text, sounds, pictures, and numbers), and use different visual representations of problems, structures, and data (e.g., graphs, charts, network diagrams, flowcharts).

6-8.CS.DI-3.0 Demonstrate interdisciplinary applications of computational thinking and interact with content-specific models and simulations to support learning and research.

Computing Devices and Systems

6-8.CS.CDS-1.0 Demonstrate an understanding of the relationship between hardware and software.

6-8.CS.CDS-2.0 Apply troubleshooting strategies to identify and solve routine hardware and software problems that occur during everyday computer use.

6-8.CS.CDS-3.0 Describe the major components and functions of computer systems and networks.

6-8.CS.CDS-4.0 Describe what distinguishes humans from machines, focusing on human intelligence versus machine intelligence and ways we can communicate, as well as ways in which computers use models of intelligent behavior (e.g., robot motion, speech and language understanding, and computer vision).

Programs and Algorithms

6-8.CS.PA-1.0 Select appropriate tools and technology resources to support learning and personal productivity, publish individual products, and design, develop, and publish data, accomplish a variety of tasks, and solve problems.

6-8.CS.PA-2.0 Implement problem solutions using a programming language that includes looping behavior, conditional statements, logic, expressions, variables, and functions.

6-8.CS.PA-3.0 Demonstrate dispositions amenable to open-ended problem solving and programming (e.g., comfort with complexity, persistence, brainstorming, adaptability, patience, propensity to tinker, creativity, accepting challenge).

Networking and Communication

6-8.CS.NC-1.0	Collaboratively design, develop, publish, and present products (e.g., videos, podcasts, websites) using technology resources that demonstrate and communicate curriculum concepts.
6-8.CS.NC-2.0	Exhibit dispositions necessary for collaboration: providing useful feedback, integrating feedback, understanding and accepting multiple perspectives, and socialization.

Impact and Culture

6-8.CS.IC-1.0	Exhibit academic integrity and informational literacy when using technology and information and discuss the consequences of misuse.
6-8.CS.IC-2.0	Analyze the positive and negative impacts of technology on one's personal life, society, and our culture.
6-8.CS.IC-3.0	Evaluate the accuracy, relevance, appropriateness, comprehensiveness, and biases that occur in electronic information sources.
6-8.CS.IC-4.0	Describe ethical issues that relate to computers and networks (e.g., security, privacy, ownership, and information sharing), and discuss how unequal distribution of technological resources in a global economy raises issues of equity, access, and power.