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.

Physical Science

5.SC.PS-1.0	Describe and measure the volume and mass of a sample of a given material.
5.SC.PS-2.0	Demonstrate that regardless of how parts of an object are assembled the mass of the whole object is identical to the sum of the mass of the parts; however, the volume can differ from the sum of the volumes (Law of Conservation of Mass).
5.SC.PS-3.0	Determine if matter has been added or lost by comparing mass when melting, freezing, or dissolving a sample of a substance (Law of Conservation of Mass).
5.SC.PS-4.0	Describe the difference between weight and mass. Understand that weight is dependent on gravity and mass is the amount of matter in a given substance or material.

Earth and Space Science

5.SC.ESS-1.0	Analyze the scale of our solar system and its components: our solar system includes the sun, moon, seven other planets and their moons, and many other objects like asteroids and comets.
5.SC.ESS-2.0	Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
5.SC.ESS-3.0	Investigate ways our community, scientific organizations, and federal agencies monitor and educate us on balancing the needs of our planet and the needs of mankind as stewards of the Earth.
5.SC.ESS-4.0	Identify the four major Earth systems (geosphere, biosphere, hydrosphere, and atmosphere), describe the composition of each, and develop a model describing ways they interact.

Life Science

5.SC.LS-1.0	Develop a model to describe how matter is transferred and transformed among plants, animals, decomposers, and the environment.
5.SC.LS-2.0	Observe and classify common local organisms as producers, consumers, decomposers, or predator and prey based on their relationships and interactions with other organisms in their ecosystem.
5.SC.LS-3.0	Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Engineering

5.SC.EN-1.0	Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.
5.SC.EN-2.0	Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
5.SC.EN-3.0	Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Diocesan Standards for Computer Science allow for students to be prepared in the ever-changing computer science areas providing inquiry-based, hands-on experiences based on two components: Concepts and Practices. The expectation is for students who attend schools with the capacity to support Computer Science and/or Robotics to work through the standards in multi-subject areas. As students move through grade levels, they will work with and experience the standards at those grade bands.

Data and Information

3-5.CS.DI-1.0	Understand and use the basic steps in algorithmic problem solving (e.g., problem statement and exploration, examination of sample instances, design, implementation, and testing).
3-5.CS.DI-2.0	Develop a simple understanding of an algorithm (e.g., search, sequence of events, or sorting) using computer-free exercises.
3-5.CS.DI-3.0	Demonstrate how a string of bits can be used to represent alphanumeric information and how 1's and 0's represent information.
3-5.CS.DI-4.0	Describe how a simulation can be used to solve a problem.
3-5.CS.DI-5.0	Understand the connections between computer science and other fields.

Computing Devices and Systems

3-5.CS.CDS-1.0	Demonstrate proficiency with keyboards and other input and output devices.
3-5.CS.CDS-2.0	Understand the pervasiveness of computers and computing in daily life (e.g., voicemail, downloading videos and audio files, microwave ovens, thermostats, wireless Internet, mobile computing devices, GPS systems).
3-5.CS.CDS-3.0	Apply troubleshooting strategies for identifying simple hardware and software problems that may occur during use.
3-5.CS.CDS-4.0	Recognize that computers model intelligent behavior (as found in robotics, speech and language recognition, and computer animation).

Programs and Algorithms

3-5.CS.PA-1.0	Use technology resources (e.g., calculators, data collection probes, mobile devices, videos, educational software, and web tools) to solve problems, keep on task, collaborate, and communicate.
3-5.CS.PA-2.0	Use digital tools to gather, manipulate, and modify data for use by a program.
3-5.CS.PA-3.0	Implement problem solutions using a block-based visual programming language (e.g., begin coding).

Networking and Communication

3-5.CS.NC-1.0	Use online resources (e.g., online discussions, collaborative web environments) to participate in collaborative problem-solving activities for the purpose of developing solutions or products.
3-5.CS.NC-2.0	Use productivity technology tools (e.g., word processing, spreadsheet, presentation software) for individual and collaborative writing, communication, and publishing activities.

Impact and Culture

3-5.CS.IC-1.0	Discuss basic issues related to academic integrity, informational literacy when using technology and information, and the consequences of inappropriate use.
3-5.CS.IC-2.0	Identify the impact of technology (e.g., social networking, cyber bullying, mobile computing and communication, web technologies, cyber security, and virtualization) on personal life and society.
3-5.CS.IC-3.0	Evaluate the accuracy, relevance, appropriateness, comprehensiveness, and biases that occur in electronic information sources.
3-5.CS.IC-4.0	Understand ethical issues that relate to computers and networks (e.g., equity of access, security, privacy, copyright, and intellectual property).