Diocese of Knoxville Science Standards Framework

Disciplinary Core Ideas and Components

The basis of the standards is derived from the National Research Council's *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* The *Framework* describes the progression of disciplinary core ideas and provides grade level focus points. The *Framework* builds on the guiding assumptions from two prior works: *Benchmarks for Science Literacy* published by the American Association for the Advancement of Science (AAAS) and the *National Science Education Standards (NSES.* The *Framework* committee of writers and researchers further reviewed the *Science Framework for the 2009 National Assessment of Educational Progress, Science College Board Standards for College Success,* the National Science Teachers Association's Science Anchors and other various standards from the international arena. From this body of knowledge and research, the *Next Generation Science Standards (NGSS)* were created. The *NGSS* are distinct from previous science standards in three ways: performance, foundation, coherence. Prior standards identified what students should "know" or "understand". These ideas need to be translated into performances that need to be assessed to determine whether or not the student met the standard. *NGSS* developed **performance expectations** rather than standards. The performance expectation identifies what the student should be able to do to demonstrate the have met the standard. Secondly, each performance expectation incorporates all three dimensions from the *Framework*, a science or engineering idea, a crosscutting concept, and a core disciplinary idea. Finally, the *NGSS* establishes coherence with other disciplines by linking the science standard to engineering, literacy, and math standards.

After analyzing the research on science education and reviewing the *NGSS*, as well as, the proposed 2017 Tennessee State Science Standards, the Diocesan Science Curriculum Committee adapted the following Science Standards for the students being served in the Catholic schools in the Diocese of Knoxville. The Diocese of Knoxville credits the work done by the National Research Council and the State of Tennessee as the basis for the adapted science standards.

The progressions are designed to build on student understanding of science and appropriate developmental benchmarks. The science and engineering practices are integrated throughout the physical, life, and earth strands at each grade level.

Physical Sciences

PSI: Matter and Its Interactions
- **PS1.1 Structure and Properties of Matter**
- **PS1.2 Chemical Reactions**
- **PS1.3 Nuclear Processes**

PS2: Motion and Stability: Forces and Interactions
- **PS2.1 Forces and motion**

PS2.2 Types of Interactions

PS2.3 Stability and Instability in Physical Science

PS3: Energy

PS3.1 Definitions of Energy

PS3.2 Conservation of Energy and Energy Transfer

PS3.3 Relationship between Energy and Forces

PS3.4 Energy and Chemical Processes in Everyday Life

PS4.1 Waves and their Applications in Technologies for Information Transfer

PS4: Wave Properties

PS4.2 Electromagnetic Radiation

PS4.3 Information Technologies and Instrumentation

Life Science

LS1: From Molecules to Organisms

LS1.1 Structure and Function

LS1.2 Growth and Development of Organisms

LS1.3 Organization for Matter and Energy Flow in Organisms

LS1.4 Information Processing

LS2: Ecosystems: Interactions, Energy, and Dynamics

LS2.1 Interdependent Relationships in Ecosystems

LS2.2 Cycles of Matter and Energy Transfer in Ecosystems

LS2.3 Ecosystem Dynamics, Functioning, and Resilience

LS2.4 Social Interactions and Group Behavior

LS3: Heredity: Inheritance and Variation of Traits

LS3.1 Inheritance of Traits

LS3.2 Variation of Traits

LS4: Biological Change: Unity and Diversity

LS4.1 Evidence of Common Ancestry

LS4.2 Natural Selection

LS4.3 Adaptation

LS4.4 Biodiversity of Humans

Earth and Space Science

ESS1 Earth's Place in the Universe

ESS1.1 The Universe and its Stars

ESS1.2 Earth and the Solar System

Ess1.3 The History of the Planet Earth

ESS2 Earth's Systems

ESS2.1 Earth Materials and Systems
ESS2.2 Plate Tectonics and Large-Scale System Interactions
ESS2.3 The roles of Water in Earth's Surface Processes
ESS2.4 Weather and Climate
ESS2.5 Biogeology

ESS3 Earth and Human Activity
ESS3.1 Natural Resources
ESS3.2 Natural Hazards
ESS3.3 Human Impacts on Earth Systems
ESS3.4 Global Climate Change

Engineering, Technology, and Applications of Science

ETS1: Engineering Design
ETS1.1 Defining and Delineating Engineering Problems
ETS1.2 Developing Possible Solutions
ETS1.3 Optimizing the Solution Design

ETS2: Links Among Engineering, Technology, Science and Society
ETS2.1 Interdependence of Science, Technology, Engineering and Math (STEM)
ETS2.2 Influence of Engineering, Technology, and Science on Society and the Natural World.

Crosscutting Concepts

These are concepts that permeate all science and shows an interdependent connection among the sciences differentiated from grades K-12. The NGSS, Tennessee State Science Standards and the Diocesan Science Standards have explicitly designed the standard progression to include these crosscutting concepts:

1. Pattern observation and explanation
2. Cause and effect relationships that can be explained through a mechanism
3. Scale, proportion, and quantity that integrates measurement and precision of language.
4. Systems and system models with defined boundaries that can be investigated and characterized by the next three concepts
5. Energy and matter conservation through transformations that flow or cycle them into, out of, or within a system
6. Structure and function of systems and their parts
7. Stability and change of systems

Science and Engineering Practices

The science and engineering practices are used as a means to learn science by doing science. This application of skills is integral to realizing the vision of the science standards: to evoke

inquisitive minds that will result in the quest for knowledge and truth. These practices are embedded throughout the standards. Students should:

1. Ask questions and define problems
2. Develop and use models
3. Plan and conduct controlled investigations or experiments
4. Analyze and interpret data
5. Use mathematics and computational thinking
6. Construct explanations and design solutions
7. Engage in Argument from evidence
8. Obtain, evaluate, and communicate information

Structure of the Standards

Similar to other Diocesan Standards, the standards are organized on a template that will enable teachers to use as a living document throughout the year.

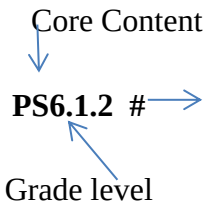
Teachers are encouraged to share these Standards with teachers from other disciplinary areas to engage in cross-curricular collaboration and dialogue

Catholic Identity

A section has been included to ensure cross referencing with the Standards to align and identify key areas where Catholic doctrine, social teaching, beliefs and practices can or should be taught through the content of science.

Standard Formatting

- Disciplinary Core Content area
- Grade level
- Standard number



Guiding Principles

Developing inquisitive, scientific minds requires students to be actively engaged in learning through hands-on experiences and observations. Science, engineering, technology, and mathematical reasoning permeate every facet of modern life.

PreK-2: Students are naturally interested in everything around them. This curiosity leads them to observe, collect, and record information about the Earth and about objects in the sky. Teachers should encourage their students' observations without feeling compelled to offer precise

scientific reasons for these phenomena. Young children bring these experiences to school and learn to extend and focus their explorations. In this process, they learn to work with tools like magnifiers and simple measuring devices.

While experience counts for much, academic content knowledge is also important. Understanding of content knowledge helps bring coherence and order to a child's scientific mind. Only when topics are presented systematically and clearly can children make steady and secure progress in their scientific learning. The child's development of scientific knowledge and understanding is in some ways a very disorderly and complex process, different for each child. But a systematic approach to the exploration of science, one that combines authentic experiences with academic content knowledge through books and media can help provide essential building blocks for deeper understanding at a later time. It should also promote a life-time interest in scientific study and inquiry.

As literacy is still a primary focus at the Preschool through grade two level, science books and informational readers in science should be used a great deal to continue to teach literacy through the study of science.

Grades 3-5

Students in grade three through five should gain increased content knowledge in science and have many practical experiences. Although science is a body of knowledge consisting of theories that explain data, science is also a set of practices that use analysis and argumentation to establish, extend, and refine knowledge. A systematic approach to science, one that combines academic learning with exploration and investigation are essential building blocks for deeper understanding later.

Grades 6-8

The science sequence in the middle school aims for more intensive and selective study of topics. Building on the foundation of the lower grades, the middle school science program should prepare students for the rigor of higher education and the challenge of content specific science in high school. Students are expected to research, investigate, experiment, write and present findings and understanding of content.

Standards Overview

The science academic standards establish the content knowledge and skills for the students in the Catholic schools of the Diocese of Knoxville in order to prepare them for the rigorous levels of higher education and for a future member of society.