Science
K-8 Course of Study
2019

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OVERVIEW

This overview restates the visions and goals of the *Columbus Diocese 2019 Science Course of Study*. The Course of Study is based upon the *Ohio's Learning Standards and Model Curriculum for Science* and the *Science-Ohio Learning Standards-Extended*. It also includes the guiding principles that framed the development and contains definitions of terms used in the document.

STANDARDS

These standards for Science outline what all students should know and be able to do to become scientifically literate citizens. This includes the knowledge and skills they need for the 21st century workforce and higher education. The standards provide the Columbus Diocese educators with the content and expectations for learning they can use to develop science curriculum at each grade level. By the end of high school, students should be proficient in science in order to:

- Know, use and interpret scientific explanations of the natural world;
- Generate and evaluate scientific evidence and explanations, distinguishing science from pseudo-science;
- Understand the nature and development of scientific knowledge; and discourse.
- Participate productively in scientific practices and discourse.[1]

"Knowledge of science can enable us to think critically and frame productive questions. Without scientific knowledge, we are wholly dependent on others as "experts." With scientific knowledge, we are empowered to become participants rather than merely observers. Science, in this sense, is more than a means for getting ahead in the world of work. It is a resource for becoming a critical and engaged citizen in a democracy." -Ready, Set, SCIENCE! (2008)[2]

The K-8 and high school document offers guidance for educators who teach science in the Columbus Diocese. Each Content Statement and Content Elaboration presents what students should know about a given discipline of science. The accompanying Evidence of Learning in this document provide a structure for teachers to reflect on their plans for teaching science, to monitor observable evidence of student learning, and to develop summative and formative assessments. The correlation to the Next Generation Science standards have also been added for additional instructional support.

The *Ohio Learning Standards* also provide more support through the Visions into Practice section, which offer optional examples of tasks students can perform to learn about science and demonstrate their understanding of the grade-level materials. The Diocesan committee decided to include the Visions into Practice information as suggestions for students to demonstrate their evidence of learning. The Ohio Leaning Standards also included an Instructional Supports section which includes subsections on Instructional Strategies and Resources, Common Misconceptions, Diverse Learners, and Classroom Portals.

[1] Taking Science to School Learning and Teaching Science in Grades K-8. National Research Council of the National Academies
[2] Michaels S., Shouse, A.W., & Schweingruber H. A. (2008). Ready, Set, SCIENCE! Washington DC: The National Academies Press.

GOALS

The goal of revising the standards was to improve K-12 science education by providing clarity, focus and a logical, vertical progression in each discipline. All Ohio students deserve rigorous, scientifically accurate instruction that makes them college or career ready and scientifically literate. These standards serve as a road map for Ohio science teachers to use as they customize instruction to fit individual student needs.

Ohio's student-centered goals (Duschl et. al., 2007; Bell et.al., 2009) for science education include helping students:

1. Experience excitement, interest and motivation to learn about phenomena in the natural and physical world.
2. Come to generate, understand, remember and use concepts, explanations, arguments, models and facts related to science.
3. Manipulate, test, explore, predict, question, observe and make sense of the natural and physical world.
4. Reflect on science as a way of knowing; on processes, concepts and institutions of science; and on their own process of learning about phenomena.
5. Participate in scientific activities and learning practices with others, using scientific language and tools.
6. Think about themselves as science learners and develop an identity as someone who knows about, uses and sometimes contributes to science.

These goals are consistent with the expectations of Ohio law.

GUIDING PRINCIPLES

Ohio's Learning Standards for Science and subsequently, the Diocesan Course of Study reflect knowledge drawn from international and national studies, education stakeholders and academic content experts. The guiding principles include:

- **Definition of Science:** Science is a systematic method of continuing investigation based on observation, scientific hypothesis testing, measurement, experimentation and theory building. It leads to explanations of natural phenomena, processes or objects that are open to further testing and revision based on evidence.[3] Scientific knowledge is logical, predictive and testable and expands and advances as new evidence is discovered.

- **Scientific Inquiry:** There is no science without inquiry. Scientific inquiry is a way of knowing and process of doing science. Scientific inquiry includes the diverse ways scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities that help students develop knowledge of scientific ideas and understanding of how scientists study the natural world.[4] Teachers model scientific inquiry throughout their instruction.

[3] National Research Council (1996), National Science Education Standards (Washington, DC: National Academy Press) and including excerpts with minor revision, of The Ohio Academy of Science (2000) definition of science: http://www.ohiosci.org/s/whatisscience.pdf

[4] Research Council (1996), National Science Education Standards (Washington, DC: National Academy Press), p 192.

- **21st Century Skills:** According to Ohio law, 21st century skills include creativity and innovation; critical thinking, problem-solving and communication; information, media and technological literacy; personal management, productivity, accountability, leadership and responsibility; and interdisciplinary, project-based, real-world learning opportunities.[5]

  21st century skills are integral to the revised science standards and model curriculum. The model curriculum incorporates and integrates these skills through scientific inquiry, science skills and process, and technological and engineering design.

- **Technological Design:** Technological design is a problem-or project-based way of applying creativity, science, engineering and mathematics to meet a human want or need. Modern science is an integrated endeavor. Technological design integrates learning by using science, technology, engineering and mathematics and fosters 21st century skills.

- **Technology and Engineering:** Technology modifies the natural world through innovative processes, systems, structures and devices to extend human abilities. Engineering is design under constraint that develops and applies technology to satisfy human wants and needs. Technology and engineering, coupled with the knowledge and methods derived from science and mathematics, profoundly influence the quality of life.

- **Depth of Content:** It is vital that the Content Statements and Content Elaborations within the *Course of Study* communicate the most essential concepts and the complexity of the discipline in a manner that is manageable and accessible for teachers. The focus is on what students must know to master the specific grade-level content. The Evidence of Learning provide the means by which students can demonstrate this grade-level mastery.

- **Internationally Benchmarked:** Ohio's Learning Standards and Model Curriculum for Science incorporate findings from research on the science standards of:
  - Countries whose students demonstrate high- performance on both the Trends in International Mathematics and Science Studies (TIMSS) and Program in Student Assessment (PISA) tests; and
  - States with students who perform well on the National Assessment of Education Progress (NAEP).

  As a result, the revised standards and model curriculum are rigorous, relevant, coherent and organized, emphasizing horizontal and vertical articulation of content within and across disciplines.

- **Assessment:** Ohio's StateTests will align with the Content Statements, Content Elaborations and Expectations for Learning in the *2018 Ohio Learning Standards for Science*.

- **Standards and Curriculum:** The *2018 Ohio Learning Standards for Science* provide a framework for developing local curricula. They do not constitute the local curriculum. The *2019 Science Course of Study* is the curriculum for the Columbus Diocese.

[5] http://www.battelleforkids.org/networks/p21

STANDARDS FORMAT AND DEVELOPMENT

The standards are web-based resources that provide the content to be taught in science classrooms. The standards define what all students should know and be able to do, not how teachers should teach. While the standards focus on what is most essential, they do not describe all that teachers can or should teach. Teachers and curriculum developers maintain a great deal of discretion in this area. The model curriculum will offer information and support for planning, developing, implementing and evaluating instruction directly aligned to standards.

Work to revise Ohio's Learning Standards Science took place from November 2016 through September 2017, with input from stakeholders around the state. The Ohio Department of Education started the process by seeking public comment on the existing standards in fall 2016. An advisory committee of representatives from various Ohio agencies and organizations related to science and science education reviewed this public feedback. The advisory committee forwarded suggestions for revisions to working groups consisting of K-12 and higher education professionals. There were three main working groups based on the individual science disciplines: life sciences, Earth and space sciences, and physical sciences.

When comment on the initial public survey pointed to the need for a new human anatomy and physiology course, the Department formed a related subcommittee of the life science working group. These four groups constructed the proposed 2017 standards with Ohio students in mind. The Department presented the proposed standards revisions for public feedback through a summer 2017 survey. The Department made more revisions based on that feedback. The State Board of Education reviewed the revised science standards during its October 2017 meeting and adopted them in February 2018.

In the 2018/2019 school year, various educators across the Columbus Diocese volunteered to update and revise the Diocesan Course of Study for Science based on these new Ohio Learning Standards. The committee also reviewed *the Next Generation Science Standards* and the *Science-Ohio Learning Standards-Extended* to incorporate more instructional supports for diocesan educators.

TRANSITION PERIOD

Ohio allows districts until the 2019-2020 school year to fully implement the revised Ohio's Learning Standards Science to give them time to align instruction and resources to the standards. State tests aligned to the standards will be available in spring 2020.

The *Diocesan Science Course of Study* was updated in 2018-2019 and will be put into practice in 2019-2020. Diocesan educators added a section titled Evidence of Learning to provide concrete examples of what students should be able to do at the end of the grade level or course for that particular standard or topic. These examples were aligned to specific cognitive demands which reflect the revised Bloom's Taxonomy and Webb's Depth of Knowledge. The committee decided to add them to provide clarification on not only the content requirements but the skill requirements of the standards as well. Most of these examples were taken directly out of the Ohio's Model Curriculum for Science.

COLUMBUS DIOCESE SCIENCE COURSE OF STUDY

INTRODUCTION

Following is the revised Science Course of Study for the Catholic Diocese of Columbus. This course of study reflects the Science Standards set forth by the Ohio Department of Education.

PHILOSOPHY

We believe the purpose of science education in Catholic Schools is to help students become scientifically literate citizens that are able to use science as a way of knowing about the natural and material world and to actively apply scientific knowledge and skills to contemporary, technological, moral, and social issues. This will be accomplished by recognizing God's design and promoting personal responsibility. All students should have sufficient understanding of scientific knowledge and scientific processes to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact not only themselves but others too.

We believe the science curriculum will provide minds-on, as well as hands-on, opportunities for students to practice scientific literacy, critical thinking and problem solving skills. It will also build a foundation for life-long discovery in sciences that will carry over into other disciplines.

We believe that students have a natural curiosity and appreciation of science. Teachers will encourage students by using the many scientific methods, providing a variety of learning experiences and assessment strategies, and utilizing various materials, technologies, and community resources as well as Catholic values.

PROGRAM GOALS

Students, utilizing a broad-based curriculum, will acquire higher-level thinking skills and in-depth knowledge necessary to solve problems in creative and productive ways.

Students will be able to engage intelligently in public discourse and to debate matters of scientific and technological concern.

Students will use their scientific knowledge and Catholic values to lead well-balanced and ethical lives. Students will use scientific literacy to enhance life and career opportunities.

PRINCIPLES OF COURSES OF STUDY- DIOCESE OF COLUMBUS CATHOLIC SCHOOLS

Equity. Excellence in education requires equity – high expectations and assessable content for all students based on the new Ohio Learning Standards.

Curriculum. A curriculum is more than a collection of activities. It must be coherent, focused, well-articulated, and integrated with our Catholic values.

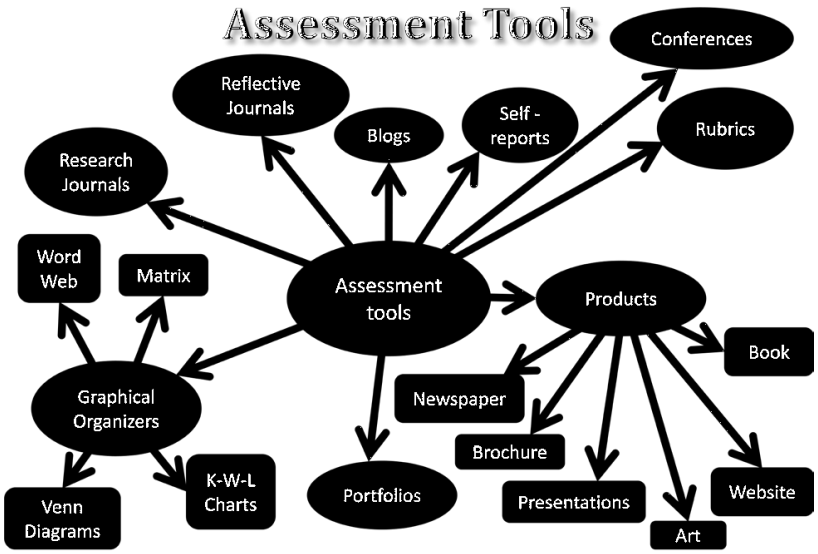
Teaching. Effective teaching requires understanding what students know and need to learn and be able to do while supporting them as they learn.

Learning. Students must learn with understanding by actively building new knowledge from prior knowledge and experiences.

Technology. Technology is essential in teaching and learning and should be integrated in the teaching and learning process. The technology should influence and enhance students' learning.

Assessment. Assessment should support the learning of important skills and content, be formative as well as summative, and furnish useful information to teachers, students and parents.

Assessments need to be aligned to the standards in the Course of Study both in what a student needs to know and be able to do. Assessments should match what the student is expected to learn. There are many tools (e.g. portfolios, rubrics, interviews) other than the standard paper and pencil tests to assess a student's understanding of the material.



One method that has continued to increase student achievement is involving them in the assessment process. Students should be involved in all steps of this process. At the most basic level, students can simply understand how their grades will be determined. As assessment becomes more student- centered, the students can develop rubrics, maintain their own assessment records, self- assess, and communicate their achievement to others (student-led conferences).

INQUIRY-BASED SCIENCE AND PRACTICES

The Diocesan Catholic Schools will continue to focus on inquiry based learning. Inquiry based learning is based on the philosophy of constructivist learning, that students must be able to create their own understanding of concepts.

There are several levels to inquiry based learning. These range from no inquiry to open inquiry. When there is no inquiry, teachers tell the students the facts and they are expected to repeat these facts to prove their knowledge. Guided inquiry includes various levels of guidance from the teacher and in open inquiry, students are given the materials to learn with minimal teacher direction. The students are expected to create their own knowledge. This will lead them to a greater understanding and long-term retention of the material.

Think of a time when you wanted to understand something in greater depth. It is rare that the learning process is a linear one. As an example, imagine trying to figure out why ice melts in the sun. In trying to understand this, you make judgments based on both previous knowledge and personal experiences. You wonder why this happens. You research, experiment and observe. Through this process, you see that the sun and melting ice fit together, but you are not exactly sure how that happens. You come to the conclusion that the sun melts the ice. However, sometimes old ideas must be broken down and reconstructed. The ice still melted at night; why? You continue to experiment. It is through these experiences that understandings are extended. An idea is tested and if it does not work, we go back and retest it. If we go back to the ice example, you realize through your observations that the ice will melt on a warm night just as it will during a warm day. You realize that it is not the sun by itself that melts the ice, instead, it is the heat that causes ice to melt. In the Columbus Diocese, we have adopted the research-based 5E instructional model. This model provides a structure for teachers for planning and using the inquiry-based science approach.

Engage	This lesson mentally engages students with an activity or question. It captures their interest, provides an opportunity for them to express what they know about the concept or skill being developed, and helps them to make connections between what they know and the new ideas.
Explore	Students carry out hands-on activities in which they can explore the concept or skill. They grapple with the problem or phenomenon and describe it in their own words. This phase allows students to acquire a common set of experiences that they can use to help each other make sense of the new concept or skill.
Explain	Only after students have explored the concept or skill does the teacher provide the concepts and terms used by the students to develop explanations for the phenomenon they have experienced. The significant aspect of this phase is that explanation follows experience.
Elaborate	This phase provides opportunities for students to apply what they have learned to new situations and so develop a deeper understanding of the concept or greater use of the skill. It is important for students to discuss and compare their ideas with each other during this phase.
Evaluate	The final phase provides an opportunity for students to review and reflect on their own learning and new understandings and skills. It is also when students provide evidence for changes to their understandings, beliefs and skills.

Engage

A question, problem or activity can engage students in an inquiry lesson. This piece sets the stage for future exploration. It is important that the teacher starts any inquiry lesson with something that “hooks” the students.

Explore

Students explore the concepts through hands-on activities. They are directly involved with the materials. This is where they develop the experiences to build their knowledge. The classroom teacher is necessary to provide the materials and guided focus.

Explain

After the students have completed their explorations, they need to explain what they have learned through the activities and connect these learnings to the scientific concepts they are studying. During the explanation process, teachers have a vital role of correcting misconceptions or introducing formal vocabulary. As an example, a student who learned that a ball will continue rolling until friction and gravity act upon it will have something concrete to think of when Newton’s First Law of Motion is mentioned.

Elaboration

The students must then extend their learning new situations. They can now knowledgeably predict and then, test out their predictions. It is not possible to explore every situation, but the knowledge the students gained during the exploration stage will help them extend their learning based on the scientific concepts. It is important for the teacher to plan for students to collaborate and work together as they discuss their learnings. The teacher can also raise questions that were not brought up in the exploration stage to deepen their knowledge.

Evaluate

Finally, there is the evaluate piece. This is where the students review and reflect on their learning. It allows the teacher to determine whether the students truly understand the material. Students can provide evidence of their learning through a variety of ways. Some examples include summative assessments, performance tasks, interviews, demonstrations, and portfolios. Assessments must guide future lesson planning and may even be cause for modification in the future. For example, if there is a misconception with many students, the teacher can revisit the concept. If there is high student interest in a specific area, the class can be refocused to take advantage of this high level of interest.

SCIENCE AND ENGINEERING PRACTICES

In addition, the Columbus Diocese recognizes the importance of students engaging in the practices of science. According to the *Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas,* engaging in the practices of science helps students understand how scientific knowledge develops as well as knowledge of the wide range of approaches that are used to investigate, model and explain the world. It makes the students' knowledge more meaningful and embeds it more deeply into their worldview. The actual doing of science or engineering can awaken their sense of curiosity, capture their interest and motivate them to continue to study. Students may also recognize that by actively applying scientific and engineering knowledge and skills, they can contribute to solving many complex contemporary, technological, moral, and social issues. Students may then recognize that science and engineering can contribute to meeting many of the major challenges that confront society today, such as generating sufficient energy, preventing and treating disease, maintaining supplies of fresh water and food, and addressing climate change.[6]

These practices might look differently when applied in an engineering context versus a scientific one. The table below lists the eight practices and examples of how they would be applied in each context.

PRACTICES FOR K-12 SCIENCE CLASSROOMS		
PRACTICES	**SCIENCE APPLICATION**	**ENGINEERING APPLICATION**
Develop and Use Models	**Science** often involves the construction and use of a wide variety of models and simulations to help develop explanations about natural phenomena. Models make it possible to go beyond observables and imagine a world not yet seen. Models enable predictions of the form "if … then … therefore" to be made in order to test hypothetical explanations.	**Engineering** makes use of models and simulations to analyze existing systems so as to see where flaws might occur or to test possible solutions to a new problem. Engineers also call on models of various sorts to test proposed systems and to recognize the strengths and limitations of their designs.
Ask questions (for science) and define problems (for engineering)	**Science** begins with a question about a phenomenon, such as "Why is the sky blue?" or "What causes cancer?" and seeks to develop theories that can provide explanatory answers to such questions. A basic practice of the scientist is formulating empirically answerable questions about phenomena, establishing what is already known, and determining what questions have yet to be satisfactorily answered.	**Engineering** begins with a problem, need, or desire that suggests an engineering problem that needs to be solved. A societal problem such as reducing the nation's dependence on fossil fuels may engender a variety of engineering problems, such as designing more efficient transportation systems, or alternative power generation devices such as improved solar cells. Engineers ask questions to define the engineering problem, determine criteria for a successful solution, and identify constraints.

[6] *A Framework for K-12 Science Education*. (2012). https://doi.org/10.17226/13165

PRACTICES	SCIENCE APPLICATION	ENGINEERING APPLICATION
Plan and Carry Out Investigations	**Scientific investigation** may be conducted in the field or the laboratory. A major practice of scientists is planning and carrying out a systematic investigation, which requires the identification of what is to be recorded and, if applicable, what are to be treated as the dependent and independent variables (control of variables). Observations and data collected from such work are used to test existing theories and explanations or to revise and develop new ones.	**Engineers** use investigation both to gain data essential for specifying design criteria or parameters and to test their designs. Like scientists, engineers must identify relevant variables, decide how they will be measured, and collect data for analysis. Their investigations help them to identify how effective, efficient, and durable their designs may be under a range of conditions.
Analyze and Interpret Data	**Scientific investigations** produce data that must be analyzed in order to derive meaning. Because data usually do not speak for themselves, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Sources of error are identified and the degree of certainty calculated. Modern technology makes the collection of large data sets much easier, thus providing many secondary sources for analysis.	**Engineers** analyze data collected in the tests of their designs and investigations; this allows them to compare different solutions and determine how well each one meets specific design criteria—that is, which design best solves the problem within the given constraints. Like scientists, engineers require a range of tools to identify the major patterns and interpret the results.
Use Mathematics and Computational Thinking	In **science**, 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, statistically analyzing data, and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable predictions of the behavior of physical systems, along with the testing of such predictions. Moreover, statistical techniques are invaluable for assessing the significance of patterns or correlations.	In **engineering**, mathematical and computational representations of established relationships and principles are an integral part of design. For example, structural engineers create mathematically based analyses of designs to calculate whether they can stand up to the expected stresses of use and if they can be completed within acceptable budgets. Moreover, simulations of designs provide an effective test bed for the development of designs and their improvement.

PRACTICES	SCIENCE APPLICATION	ENGINEERING APPLICATION
Construct, Explain and Design Solutions	The goal of **science** is the construction of theories that can provide explanatory accounts of features of the world. A theory becomes accepted when it has been shown to be superior to other explanations in the breadth of phenomena it accounts for and in its explanatory coherence and parsimony. Scientific explanations are explicit applications of theory to a specific situation or phenomenon, perhaps with the intermediary of a theory-based model for the system under study. The goal for students is to construct logically coherent explanations of phenomena that incorporate their current understanding of science, or a model that represents it, and are consistent with the available evidence.	**Engineering design,** a systematic process for solving engineering problems, is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technological feasibility, cost, safety, esthetics, and compliance with legal requirements. There is usually no single best solution but rather a range of solutions. Which one is the optimal choice depends on the criteria used for making evaluations.
Engage in Argument from Evidence	In **science,** reasoning and argument are essential for identifying the strengths and weaknesses of a line of reasoning and for finding the best explanation for a natural phenomenon. Scientists must defend their explanations, formulate evidence based on a solid foundation of data, examine their own understanding in light of the evidence and comments offered by others, and collaborate with peers in searching for the best explanation for the phenomenon being investigated.	In **engineering,** reasoning and argument are essential for finding the best possible solution to a problem. Engineers collaborate with their peers throughout the design process, with a critical stage being the selection of the most promising solution among a field of competing ideas. Engineers use systematic methods to compare alternatives, formulate evidence based on test data, make arguments from evidence to defend their conclusions, evaluate critically the ideas of others, and revise their designs in order to achieve the best solution to the problem at hand.
Obtain, Evaluate, and Communicate Information	**Science** cannot advance if scientists are unable to communicate their findings clearly and persuasively or to learn about the findings of others. A major practice of science is thus the communication of ideas and the results of inquiry—orally, in writing, with the use of tables, diagrams, graphs, and equations, and by engaging in extended discussions with scientific peers. Science requires the ability to derive meaning from scientific texts (such as papers, the Internet, symposia, and lectures), to evaluate the scientific validity of the information thus acquired, and to integrate that information.	**Engineers** cannot produce new or improved technologies if the advantages of their designs are not communicated clearly and persuasively. Engineers need to be able to express their ideas, orally and in writing, with the use of tables, graphs, drawings, or models and by engaging in extended discussions with peers. Moreover, as with scientists, they need to be able to derive meaning from colleagues' texts, evaluate the information, and apply it usefully. In engineering and science alike, new technologies are now routinely available that extend the possibilities for collaboration and communication.

DEFINITIONS

Standards

Strands: *These are the science disciplines: Earth and space sciences, physical sciences; life science. Overlaying all the content standards and embedded in each discipline are science inquiry and applications.*

Themes: *These are the overarching ideas that connect the strands and the topics within the grades. Themes illustrate a progression of increasing complexity from grade to grade that is applicable to all the strands.*

Connections*: Overarching ideas that connect the strands and topics within a grade. Connections help illustrate the integration of the content statements from the different strands.*

Topics: *The Topics are the main focus for content for each strand at that particular grade level. The Topics are the foundation for the specific content statements.*

Content Statements: *The science content to be learned. These are the "what" of science that should be accessible to students at each grade level to prepare them to learn about and use scientific knowledge, principles, and processes with increasing complexity in subsequent grades.*

Content Elaboration: *This piece will provide more in-depth information and detail about the "what" that should be taught in the classroom and what is eligible for assessment*.

Evidence of Learning: *This section will provide recommendations for how students may be assessed. It will provide a range of examples of the various cognitive levels and depth of learning that students can be expected to demonstrate at grade level for a particular science content statement. The Expectations for Learning will provide guidance for developing assessments***.**

Model Curriculum (Ohio Department of Education website)

The Model Curriculum is a web-based resource that will incorporate information on "how" the material in the Content Statement may be taught. It is not included in this document, but it is highly suggested that all science teachers have an understanding of at least the Content Elaboration and the Expectations for learning. You can find the model curriculum at the Ohio Department of Education's website.

CONNECTIONS TO THE CATECHISM OF THE CATHOLIC CHURCH

This is a teacher reference for topics, issues, and/or questions that may arise while teaching science class at any grade level.

Topic	Section
Science and Faith	159
The Natural Moral Law	1954-1960
Abortion	2270-2275
Suicide	2280-2283
Respect for the person and scientific research	2292-2296
Research aimed at reducing human sterility	2375-2379
Care for Creation and Ethical Use	2415
Scientific experiments using animals	2417-2418
Evolution	279-289

SCIENCE INQUIRY AND APPLICATIONS

During the years of **K to grade 4**, all students must develop the ability to: Observe and ask questions about the natural environment; Plan and conduct simple investigations; Employ simple equipment and tools to gather data and extend the senses; Use appropriate mathematics with data to construct reasonable explanations; Communicate about observations, investigations and explanations; and Review and ask questions about the observations and explanations of others.

THEMES	GRADE	THE PHYSICAL SETTING		THE LIVING ENVIRONMENT
		EARTH AND SPACE SCIENCE	PHYSICAL SCIENCE	LIFE SCIENCE
Observations of the Environment This theme focuses on helping students develop the skills for systematic discovery to understand the science of the natural world around them in greater depth by using scientific inquiry.	K	Living and nonliving things have specific physical properties that can be used to sort and classify. The physical properties of air and water are presented as they apply to weather.		
		Daily and Seasonal Changes	**Properties of Everyday Objects and Materials**	**Physical and Behavioral Traits of Living Things**
	1	Energy is observed through movement, heating, cooling and the needs of living organisms.		
		Sun, Energy and Weather	**Motion and Materials**	**Basic Needs of Living Things**
	2	Living and nonliving things may move. A moving object has energy. Air moving is wind and wind can make a windmill turn. Changes in energy and movement can cause change to organisms and the environments in which they live.		
		The Atmosphere	**Changes in Motion**	**Interactions within Habitats**
Interconnections within Systems This theme focuses on helping students explore the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry.	3	Matter is what makes up all substances on Earth. Matter has specific properties and exists in different states. Earth's resources are made of matter. Matter can be used by living things and can be used for the energy they contain. There are many different forms of energy. Each living component of an ecosystem is composed of matter.		
		Earth's Resources	**Matter and Forms of Energy**	**Behavior, Growth and Changes**
	4	Heat and electrical energy are forms of energy that can be transferred from one location to another. Matter has properties that allow the transfer of heat and electrical energy. Heating and cooling affect the weathering of Earth's surface and Earth's past environments. The processes that shape Earth's surface and the fossil evidence found can help decode Earth's history.		
		Earth's Surface	**Electricity, Heat and Matter**	**Earth's Living History**

SCIENCE INQUIRY AND APPLICATIONS

During the years of **grades 5 through 8**, all students must have developed the ability to: Identify questions that can be answered through scientific investigations; Design and conduct a scientific investigation; Use appropriate mathematics, tools and techniques to gather data and information; Analyze and interpret data; Develop descriptions, models, explanations and predictions; Think critically and logically to connect evidence and explanations; Recognize and analyze alternative explanations and predictions; and Communicate scientific procedures and explanations.

THEMES	GRADE	THE PHYSICAL SETTING		THE LIVING ENVIRONMENT
		EARTH AND SPACE SCIENCE	PHYSICAL SCIENCE	LIFE SCIENCE
Interconnections within Systems This theme focuses on helping students explore the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry.	5	Cycles on Earth, such as those occurring in ecosystems, in the solar system, and in the movement of light and sound result in describable patterns. Speed is a measurement of movement. Change in speed is related to force and mass. The transfer of energy drives changes in systems, including ecosystems and physical systems.		
		Cycles and Patterns in the Solar System	**Light, Sound and Motion**	**Interactions winthin Ecosystems**
Order and Organization This theme focuses on helping students use scientific inquiry to discover patterns, trends, structures and relationships that may be inferred from simple principles. These principles are related to the properties or interactions within and between systems.	6	All matter is made of small particles called atoms. The properties of matter are based on the order and organization of atoms and molecules. Cells, minerals, rocks and soil are all examples of matter.		
		Rocks, Minerals, Soil	**Matter and Motion**	**Cellular to Multicellular**
	7	Systems can exchange energy and/or matter when interactions occur within systems and between systems. Systems cycle matter and energy in observable and predictable patterns.		
		Cycles and Patterns of Earth and the Moon	**Conservation of Mass and Energy**	**Cycles of Matter and Flow of Energy**
	8	Systems can be described and understood by analysis of the interaction of their components. Energy, forces and motion combine to change the physical features of Earth. The changes of the physical Earth and the species that have lived on Earth are found in the rock record. For species to continue, reproduction must be successful.		
		Physical Earth	**Forces and Motion**	**Species and Reproduction**

K-2 NATURE OF SCIENCE

Nature of Science One goal of science education is to help students become scientifically literate citizens that are able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science, to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact not only themselves but others too.	
Categories	**K-2**
Scientific Inquiry, Practice and Applications All students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas.	• Knowledge of science content can be applied to real world challenges; • Based on their own explorations, observations and questions, students plan and conduct simple scientific investigations; • Employ simple equipment and tools to gather data and extend their senses; • Use data and mathematical thinking to construct reasonable explanations; and • Communicate about their investigations and data with others. • Apply Catholic values to development and application of science concepts.
Science is a Way of Knowing Science assumes the universe is a vast single system in which basic laws are consistent. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.	• Through exploration, you discover the world around you. • Exploration leads to observation. You can ask questions about what you observe. • Students perceive that natural events happen today as they happened in the past. • Students observe events happening in regular patterns and cycles in the natural world.

Categories	K-2
Science is a Human Endeavor	• All students can explore. All students can ask questions. All students can communicate their observations and questions with others. • Students address questions through collaboration with peers and continued exploration. • Students begin to see that the answer is not always as important as the process. Questions often lead to other questions. • All students will begin to see themselves as scientists.
Scientific Knowledge is Open to Revision in Light of New Evidence	• Students learn how to identify credible scientific evidence. • Students start to revise their ideas based on new, credible scientific evidence.

K-2 STANDARDS

GRADE LEVEL	EARTH/ SPACE SCIENCE (ESS)	LIFE SCIENCE (LS)	PHYSICAL SCIENCE (PS)
K	**Topic: Daily and Seasonal Changes** This topic focuses on observing, exploring, describing and comparing weather changes, patterns in the sky and changing seasons. **K.ESS.1:** Weather changes are long-term and short-term. **K.ESS. 2:** The moon, sun and stars can be observed at different times of the day or night.	**Topic: Physical and Behavioral Traits of Living Things** This topic focuses on observing, exploring, describing and comparing living things in Ohio. **K.LS.1:** Living things have specific characteristics and traits. **K.LS.2:** Living things have physical traits and behaviors, which influence their survival.	**Topic: Properties of Everyday Objects and Materials** This topic focuses on the production of sound and on observing, exploring, describing and comparing the properties of objects and materials with which the student is familiar. **K.PS.1:** Objects and materials can be sorted and described by their properties. **K.PS.2:** Some objects and materials can be made to vibrate to produce sound.
1	**Topic: Sun, Energy and Weather** This topic focuses on the sun as a source of energy and energy changes that occur to land, air and water. **1.ESS.1:** The Sun is the principal source of energy. **1.ESS.2:** Water on Earth is present in many forms.	**Topic: Basic Needs of Living Things** This topic focuses on the physical needs of living things in Ohio. Energy from the sun or food, nutrients, water, shelter and air are some of the physical needs of living things. **1.LS.1:** Living things have basic needs, which are met by obtaining materials from the physical environment. **1.LS.2:** Living things survive only in environments that meet their needs.	**Topic: Motion and Materials** This topic focuses on the changes in properties that occur in objects and materials. Changes of position of an object are a result of pushing or pulling. **1.PS.1:** Properties of objects and materials can change. **1.PS.2:** Objects can be moved in a variety of ways, such as straight, zigzag, circular and back and forth.

GRADE LEVEL	EARTH/ SPACE SCIENCE (ESS)	LIFE SCIENCE (LS)	PHYSICAL SCIENCE (PS)
2	**Topic: The Atmosphere** This topic focuses on air and water as they relate to weather and weather changes that can be observed and measured. **2.ESS.1:** The atmosphere is primarily made up of air. **2.ESS.2:** Water is present in the atmosphere. **2.ESS.3:** Long- and short-term weather changes occur due to changes in energy.	**Topic: Interactions within Habitats** This topic focuses on how ecosystems work by observations of simple interactions between the biotic/living and abiotic/nonliving parts of an ecosystem. Just as living things impact the environment in which they live, the environment impacts living things. **2. LS.1:** Living things cause changes on Earth. **2. LS.2:** All organisms alive today result from their ancestors, some of which may be extinct. Not all kinds of organisms that lived in the past are represented by living organisms today.	**Topic: Changes in Motion** This topic focuses on how ecosystems work by observations of simple interactions between the biotic/living and abiotic/nonliving parts of an ecosystem. Just as living things impact the environment in which they live, the environment impacts living things. **2. PS.1:** Forces change the motion of an object.

GRADES 3-5 NATURE OF SCIENCE

Nature of Science One goal of science education is to help students become scientifically literate citizens that are able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science, to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact not only themselves but others too.	
Categories	**3-5**
Scientific Inquiry, Practice and Applications All students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:	• Observe and ask questions about the world that can be answered through scientific investigations; • Design and conduct scientific investigations; Use appropriate mathematics, tools, and techniques to gather data and information; • Develop and communicate descriptions, models, explanations, and predictions; • Think critically and ask questions about the observations and explanations of others; • Communicate scientific procedures and explanations; • Knowledge of science content can be applied to real world challenges; • Apply Catholic values to development and application of science concepts.
Science is a Way of Knowing Science assumes the universe is a vast single system in which basic laws are consistent. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.	• Science is both a body of knowledge and processes to discover new knowledge. • Science is a way of knowing about the world around us based on evidence from experimentation and observations. • Science assumes that objects and events occur in consistent patterns that are understandable through measurement and observation.

Categories	3-5
Science is a Human Endeavor	• People from many generations and nations contribute to science knowledge. • People of all cultures, genders, and backgrounds can pursue a career in science. • Scientists often work in teams. • Science affects everyday life. • Science requires creativity and imagination.
Scientific Knowledge is Open to Revision in Light of New Evidence	• Science develops theories based on a body of scientific evidence. • Science explanations can change based on new scientific evidence.

GRADES 3-5 STANDARDS

GRADE LEVEL	EARTH/ SPACE SCIENCE (ESS)	LIFE SCIENCE (LS)	PHYSICAL SCIENCE (PS)
3	**Topic: Earth's Resources** This topic focuses on Earth's resources. While resources can be living and nonliving, within this strand, the emphasis is on Earth's nonliving resources, such as water, air, rock, soil and the energy resources they represent. **3.ESS.1**: Earth's nonliving resources have specific properties. **3.ESS.2**: Earth's resources can be used for energy. **3.ESS.3:** Some of Earth's resources are limited.	**Topic: Behavior, Growth and Changes** This topic explores life cycles of organisms and the relationship between the natural environment and an organism's (physical and behavioral) traits, which affect its ability to survive and reproduce. **3.LS.1**: Offspring resemble their parents and each other. **3.LS.2:** Individuals of the same kind of organism differ in their inherited traits. These differences give some individuals an advantage in surviving and/or reproducing. **3.LS.3:** Plants and animals have life cycles that are part of their adaptations for survival in their natural environments.	**Topic: Matter and Forms of Energy** This topic focuses on the relationship between matter and energy. Matter has specific properties and is found in all substances on Earth. Heat is a familiar form of energy that can change the states of matter. **3.PS.1**: All objects and substances in the natural world are composed of matter. **3.PS.2**: Matter exists in different states, each of which has different properties. **3.PS.3:** Heat, electrical energy, light, sound and magnetic energy are forms of energy.

GRADE LEVEL	EARTH/ SPACE SCIENCE (ESS)	LIFE SCIENCE (LS)	PHYSICAL SCIENCE (PS)
4	**Topic: Earth's Surface** This topic focuses on the variety of processes that shape and reshape Earth's surface. **4.ESS.1:** Earth's surface has specific characteristics and landforms that can be identified. **4.ESS.2:** The surface of Earth changes due to weathering. **4.ESS.3:** The surface of Earth changes due to erosion and deposition.	**Topic: Earth's Living History** This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors. **4.LS.1:** Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful. **4.LS.2:** Fossils can be compared to one another and to present-day organisms according to their similarities and differences.	**Topic: Electricity, Heat and Matter** This topic focuses on the conservation of matter and the processes of energy transfer and transformation, especially as they relate to heat and electrical energy. **4.PS.1:** When objects break into smaller pieces, dissolve, or change state, the total amount of matter is conserved. **4.PS.2:** Energy can be transferred from one location to another or can be transformed from one form to another.

GRADE LEVEL	EARTH/ SPACE SCIENCE (ESS)	LIFE SCIENCE (LS)	PHYSICAL SCIENCE (PS)
5	**Topic: Cycles and Patterns in the Solar System** This topic focuses on the characteristics, cycles and patterns in the solar system and within the universe. **5.ESS.1:** The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics. **5.ESS. 2:** The sun is one of many stars that exist in the universe. **5.ESS. 3:** Most of the cycles and patterns of motion between the Earth and sun are predictable.	**Topic**: **Interactions within Ecosystems** This topic focuses on foundational knowledge of the structures and functions of ecosystems. **5. LS.1:** Organisms perform a variety of roles in an ecosystem. **5.LS. 2:** All of the processes that take place within organisms require energy.	**Topic: Light, Sound and Motion** This topic focuses on the forces that affect motion. This includes the relationship between the change in speed of an object, the amount of force applied and the mass of the object. Light and sound are explored as forms of energy that move in predictable ways, depending on the matter through which they move. **5.PS.1:** The amount of change in movement of an object is based on the mass of the object and the amount of force exerted. **5.PS. 2:** Light and sound are forms of energy that behave in predictable ways.

GRADES 6-8 NATURE OF SCIENCE

Nature of Science One goal of science education is to help students become scientifically literate citizens that are able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science, to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact not only themselves but others too.	
Categories	**6-8**
Scientific Inquiry, Practice and Applications All students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas.	• Knowledge of science content can be applied to real world challenges; • Identify questions that can be answered through scientific investigations; • Design and conduct scientific investigations; • Use appropriate mathematics, tools and techniques to gather data and information; • Analyze and interpret data; • Develop descriptions, models, explanations, and predictions; • Think critically and logically to connect evidence and explanations; • Recognize and analyze alternative explanations and predictions; • Communicate scientific procedures and explanations; • Design technological/engineering solutions; • Apply Catholic values to development and application of science concepts.
Science is a Way of Knowing Science assumes the universe is a vast single system in which basic laws are consistent. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.	Science is a way knowing about the world around us based on evidence from experimentation and observations. Science is a continual process and the body of scientific knowledge continues to grow and change. Science assumes that objects and events occur in consistent patterns that are understandable through measurement and observation. Science should carefully consider and evaluate all data including outliers. Science is limited to observable phenomena and empirical evidence. Science disciplines share common rules of obtaining and evaluating empirical evidence.
Science is a Human Endeavor	Individuals from different social, cultural, and ethnic backgrounds work as scientists and engineers. Scientists and engineers are guided by habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism and openness to ideas. Scientists and engineers rely on human qualities such as persistence, precision, reasoning, logic, imagination, and creativity.
Scientific Knowledge is Open to Revision in Light of New Evidence	Science explanations are subject to revision and improvement in light of scientific evidence or new understanding of scientific evidence.

GRADES 6-8 STANDARDS

<table>
<tr><th>GRADE LEVEL</th><th>EARTH/ SPACE SCIENCE (ESS)</th><th>LIFE SCIENCE (LS)</th><th>PHYSICAL SCIENCE (PS)</th></tr>
<tr><td>6</td><td>
Topic: Rocks, Minerals and Soil

This topic focuses on the study of rocks, minerals and soil, which make up the lithosphere. Classifying and identifying different types of rocks, minerals and soil can decode the past environment in which they formed.

6.ESS.1: Minerals have specific, quantifiable properties.

6.ESS.2: Igneous, metamorphic and sedimentary rocks have unique characteristics that can be used for identification and/or classification.

6.ESS.3: Igneous, metamorphic and sedimentary rocks form in different ways.

6.ESS.4: Soil is unconsolidated material that contains nutrient matter and weathered rock.

6.ESS.5: Rocks, minerals and soils have common and practical uses.
</td><td>
Topic: Cellular to Multicellular

This topic focuses on the study of the basics of Modern Cell Theory. All organisms are composed of cells, which are the fundamental unit of life. Cells carry on the many processes that sustain life. All cells come from pre-existing cells.

6.LS.1: Cells are the fundamental unit of life.

6.LS.2: All cells come from pre-existing cells.

6.LS.3: Cells carry on specific functions that sustain life.

6.LS.4: Living systems at all levels of organization demonstrate the complementary nature of structure and function.
</td><td>
Topic: Matter and Motion

This topic focuses on the study of foundational concepts of the particulate nature of matter, linear motion, and kinetic and potential energy.

6.PS.1: Matter is made up of small particles called atoms.

6.PS.2: Changes of state are explained by a model of matter composed of particles that are in motion.

6.PS.3: There are two categories of energy: kinetic and potential.

6.PS.4: An object’s motion can be described by its speed and the direction in which it is moving.
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GRADE LEVEL	EARTH/ SPACE SCIENCE (ESS)	LIFE SCIENCE (LS)	PHYSICAL SCIENCE (PS)
7	**Topic: Cycles and Patterns of Earth and the Moon** This topic focuses on the characteristics, cycles and patterns in the solar system and within the universe. **7.ESS.1:** The hydrologic cycle illustrates the changing states of water as it moves through the lithosphere, biosphere, hydrosphere and atmosphere. **7.ESS.2:** Thermal-energy transfers in the ocean and the atmosphere contribute to the formation of currents, which influence global climate patterns. **7.ESS.3:** The atmosphere has different properties at different elevations and contains a mixture of gases that cycle through the lithosphere, biosphere, hydrosphere and atmosphere. **7.ESS.4:** The relative patterns of motion and positions of Earth, moon and sun cause solar and lunar eclipses, tides and phases of the moon. **7.ESS.5:** The relative positions of Earth and the sun cause patterns we call seasons.	**Topic: Cycles of Matter and Flow of Energy** This topic focuses on foundational knowledge of the structures and functions of ecosystems. **7.LS.1:** Energy flows and matter is transferred continuously from one organism to another and between organisms and their physical environments. **7.LS.2:** In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.	**Topic: Conservation of Mass and Energy** This topic focuses on the forces that affect motion. This includes the relationship between the change in speed of an object, the amount of force applied and the mass of the object. Light and sound are explored as forms of energy that move in predictable ways, depending on the matter through which they move. **7.PS.1:** Elements can be organized by properties. **7.PS.2:** Matter can be separated or changed, but in a closed system, the number and types of atoms remains constant. **7.PS.3:** Energy can be transformed or transferred but is never lost. **7.PS.4:** Energy can be transferred through a variety of ways.

GRADE LEVEL	EARTH/ SPACE SCIENCE (ESS)	LIFE SCIENCE (LS)	PHYSICAL SCIENCE (PS)
8	**Topic: Physical Earth** This topic focuses on the physical features of Earth and how they formed. This includes the interior of Earth, the rock record, plate tectonics and landforms. **8.ESS.1:** The composition and properties of Earth's interior are identified by the behavior of seismic waves. **8.ESS.2:** Earth's lithosphere consists of major and minor tectonic plates that move relative to each other. **8.ESS.3:** A combination of constructive and destructive geologic processes formed Earth's surface. **8.ESS.4:** Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.	**Topic: Species and Reproduction** This topic focuses on continuation of the species. **8.LS.1:** Diversity of species, a result of variation of traits, occurs through the process of evolution and extinction over many generations. The fossil records provide evidence that changes have occurred in number and types of species. **8.LS.2:** Every organism alive today comes from a long line of ancestors who reproduced successfully every generation. **8.LS.3:** The characteristics of an organism are a result of inherited traits received from parent(s).	**Topic: Forces and Motion** This topic focuses on forces and motion within, on and around the Earth and within the universe. **8.PS.1:** Objects can experience a force due to an external field such as magnetic, electrostatic, or gravitational fields. **8.PS.2:** Forces can act to change the motion of objects.

GRADE K

Strand Connections: Living and nonliving things have specific physical properties that can be used to sort and classify. The physical properties of air and water are presented as they apply to weather.

EARTH SCIENCE

CONTENT STATEMENT	EVIDENCE OF LEARNING	NGSS CORRELATION
K.ESS.1: Weather changes are long-term and short-term. Weather changes occur throughout the day and from day to day. Air is a nonliving substance that surrounds Earth and wind is air that is moving. Wind, temperature and precipitation can be used to document short-term weather changes that are observable. Yearly weather changes (seasons) are observable patterns in the daily weather changes. *Note: The focus is on observing the weather patterns of seasons. The reason for changing seasons is not appropriate for this grade level; this is found in grade 7.*	• Observe and record wind, temperature, and precipitation with age-appropriate tools (e.g. really windy, windy or not windy, temperature can be warmer or cooler, snow can be measured with a dowel rod) to document short-term weather changes throughout the day, from day to day and from season to season. • Observe daily weather changes and identify the seasons by these weather patterns (e.g. cold and snow in the winter, hot and rain in the summer). Note: The focus is on observing the weather patterns of seasons. The reason for changing seasons is not appropriate for this grade level; this is found in grade 7. • Recognize that temperature, wind and precipitation are different ways to measure weather. Weather measurements must be collected on a regular basis throughout the school year and then compared, explained and discussed each week and each month. • Use technology to compare classroom data to local data, study weather events, communicate and share data with other classrooms, and record classroom data.	K-ESS2-1 Use and share observations of local weather conditions to describe patterns over time. K-ESS3-2 Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to severe weather.

CONTENT STATEMENT	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
K.ESS. 2: The moon, sun and stars can be observed at different times of the day or night. The moon, sun and stars appear in different positions at different times of the day or night. Sometimes the moon is visible during the night, sometimes the moon is visible during the day and at other times the moon is not visible at all. The observable shape of the moon changes in size very slowly throughout the month. The sun is visible only during the day. The sun's position in the sky appears to change in a single day and from season to season. Stars are visible at night, some are visible in the evening or morning and some are brighter than others.	• Recognize that the sun changes position in the sky during the day. • Measure and record changes of the position of the sun in the sky at different times during the school day through a combination of drawing, dictating, and writing. • Observe stars, groups of stars and moon phases throughout the month (Note: This can be done virtually and through books) and record changes through a combination of drawing, dictating and writing. Only the changes in appearances and what can actually be observed are included. • Compare the differences throughout the month and then determine if the same pattern exists the next month.	1-ESS1-1 Use observations of the sun, moon and stars to describe patterns that can be predicted. 1-ESS1-2 Make observations at different times of the year to relate the amount of daylight to the time of year.

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
K.LS.1: Living things have specific characteristics and traits. Living things grow and reproduce. Living things are found worldwide.	• Describe characteristics of living things with a focus on things found in Ohio through drawings, dictations, and writing. Some grade-appropriate characteristics include that living things respond to stimuli, grow, reproduce and require energy. • Observe the effects of different classroom environments to plant life through experiments and explorations. • Observe nature multiple times a year. If possible, observe multiple ecosystems. • Model respect for and proper treatment of living things.	K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive.
K.LS.2: Living things have physical traits and behaviors, which influence their survival. Living things are made up of a variety of structures. Some traits can be observable structures. Some of these structures and behaviors influence their survival.	• Observe and identify parts of animals and describe how those parts help the animal to survive (e.g., birds have wings for flying and beaks for eating. Dogs have eyes for seeing, teeth for chewing and legs for moving. Trees have leaves to capture sunlight and trunks for support). • Give an example of a structure and tell how it helps an organism survive.	1-LS1-1 Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. 1-LS1-2 Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
K.PS.1: Objects and materials can be sorted and described by their properties. Objects can be sorted and described by the properties of the materials from which they are made. Some of the properties can include color, size and texture.	• Sort and describe objects by the properties (e.g. color, size and texture) of the materials from which they are made. • Categorize observable (touch, see, hear, smell) information by creating a system of organization (e.g., objects can be identified by color, shape, texture, smell).	2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. 2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
K.PS.2: Some objects and materials can be made to vibrate to produce sound. Sound is produced by touching, blowing or tapping objects. The sounds that are produced vary depending on the properties of objects. Sound is produced when objects vibrate.	• Explain how sound is produced (vibrations). • Compare different sounds and describe how the sounds are different. • Predict what happens to the pitch of sound when the vibration rate changes. • Explore different ways sound can be made from an object (e.g. horn, cymbals, rubber band, guitar, plastic bottle). • Make sounds by tapping, blowing or plucking objects. • Describe ways to change the loudness of a sound (e.g. blow more air through a whistle, bang harder on a drum).	1-PS4-1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. 1-PS4-4 Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.

GRADE 1

Strand Connections: Energy is observed through movement, heating, cooling and the needs of living organisms.

EARTH SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
1.ESS.1: **The Sun is the principal source of energy.** Sunlight warms Earth's land, air and water. The amount of exposure to sunlight affects the amount of warming or cooling of air, water and land.	• Build a model (kit) that can collect or use solar energy (simple, small devices, such as a solar oven, solar wind chimes or solar water heating devices). Investigate what colors or materials work best. Ask and answer questions such as where does the device work best? What can be done to make the device work better? • Measure temperature changes of soil, water and air in different settings and/ or exposures to sunlight. Describe and analyze the results by making a graph, chart or table and/or in writing or orally. • Identify the sun as a primary source of energy.	K-PS3-1 Make observations to determine the effect of sunlight on Earth's surface. K-PS3-2 Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.
1.ESS.2: **Water on Earth is present in many forms**. The physical properties of water can change. These changes occur due to changing energy. Water can change from a liquid to a solid and from a solid to a liquid. *Note: Water as a vapor is not introduced until grade 2; the water cycle is reserved for later grades.*	• Make a graph, chart or table to compare the temperatures during rainfall, snow or sleet. Discuss the patterns that are observed. • Determine cause and effect of heating and freezing water (changes it from a solid to a liquid or liquid to a solid). • Locate key facts or information about where water is found on earth. • Investigate what happens to water as it freezes and thaws. Collect measurements, take temperature readings and record the length of time to freeze or thaw.	2-ESS2-3 Obtain information to identify where water is found on Earth and that it can be a solid or liquid. 2-PS1-4 Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
1.LS.1: Living things have basic needs, which are met by obtaining materials from the physical environment. Living things require energy, water, and a particular range of temperatures in their environments. Plants get energy from sunlight. Animals get energy from plants and other animals. Living things acquire resources from the living and nonliving components of the environment.	• Identify the basic survival needs of plants and animals (classroom pets, plants used in classroom experiments). • Design a bird feeder and blend of birdseed that will attract the most birds of one kind or the greatest variety of birds. AND/OR plan and implement a classroom investigation that answers the question: Does the type of food influence what type of birds will come to a bird feeder? • Based on observations of birds in the field, compare the food choices of birds in the study and create a chart to communicate findings.	K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive. K-ESS2-2 Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. 1-LS1-1 Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. 2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow.
1.LS.2: Living things survive only in environments that meet their needs. Resources are necessary to meet the needs of an individual and populations of individuals. Living things interact with their physical environments as they meet those needs. Effects of seasonal changes within the local environment directly impact the availability of resources.	• Match pictures of local plants and animals to the environment in which they can be found. • Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. • Explain, draw, journal and photograph what happens to local living and nonliving environments over the course of a school year. • Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all	K-ESS2-2 Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. K-ESS3-1 Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. K-ESS3-3 Communicate solutions that will reduce the impact of humans on the land, water, air,

	• Use illustrations and details to communicate solutions that will reduce the impact of humans on the land, water, air or other living things in the local environment.	and/or other living things in the local environment. 1-LS1-1 Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. 2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats. 3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
1.PS.1: Properties of objects and materials can change. Objects and materials change when exposed to various conditions, such as heating or cooling. Changes in temperature are a result of changes in energy. Not all materials change in the same way.	• Recognize and classify various types of changes that objects or materials can go through to change observable properties (e.g., freezing, melting, tearing, wetting). • Compare different ways of changing an object or material (e.g., tearing, heating, cooling, mixing, taking apart, putting together). • Plan and implement an investigation to test various clay shapes (e.g., a clay ball, a clay block, flattened clay with edges) to determine how shape affects the ability of a material to float or sink in water. • Design and build a small boat out of recycled materials and can float in water for a specific period of time. • Create instructions for building a spaceship out of Legos, Knex, etc.	2-PS1-3 Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. 2-PS1-4 Construct an argument with evidence that some changes caused by heating and cooling can be reversed and some cannot.
1.PS.2: Objects can be moved in a variety of ways, such as straight, zigzag, circular and back and forth. The position of an object can be described by locating it relative to another object or to the object's surroundings. An object is in motion when its position is changing. The motion of an object can be affected by pushing or pulling. A push or pull is a force that can make an object move faster, slower or go in a different direction. Changes in motion are a result of changes in energy.	• Describe how motion of an object can be affected by a push or pull. • Investigate ways to change the motion of an object. • Represent the different motions of a toy in words, pictures and diagrams. • Identify an object's position with respect to another object or the background. • Plan and conduct an investigation to compare the effects of different strentghs of pushes and pulls on the motion of an object.	K-PS2-1 Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. K-PS2-2 Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull. 3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to produce future motion.

GRADE 2

Strand Connections: Living and nonliving things may move. A moving object has energy. Air moving is wind and wind can make a windmill turn. Changes in energy and movement can cause change to organisms and the environments in which they live.

EARTH SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
2.ESS.1: The atmosphere is primarily made up of air. Air has properties that can be observed and measured. The transfer of energy in the atmosphere causes air movement, which is felt as wind. Wind speed and direction can be measured.	• Define wind speed. • Recognize that air takes up space and can be weighed. • Plan and implement an experiment to illustrate that air has mass and takes up space (has volume). • Take measurements of wind speed and wind direction each day for two weeks. Record the measurements and plot results on a graph. Find and interpret patterns • Explain what an anemometer does. • Design and construct an instrument that can measure wind speed and wind direction. Properties of the chosen materials and design must be evaluated as part of the testing and decision making process. Demonstrate final product to the class.	Understanding these concepts are important to understanding more advanced NGSS standards (MS-ESS2-5), but are not addressed independently in a lower level NGSS standard.
2.ESS.2: Water is present in the atmosphere. Water is present in the atmosphere as water vapor. When water vapor in the atmosphere cools, it forms clouds, fog, rain, ice, snow, sleet or hail. *Note: The emphasis at this grade level is investigating condensation and evaporation, not memorizing the water cycle itself.*	• Plan and implement an experiment to investigate what happens when pollution is in a body of water that evaporates. Use a simple model that utilizes sediment, vinegar or vegetable oil as a contaminant. • Design an experiment to investigate what affects condensation and evaporation. • Compare the different appearances of clouds (shapes, sizes, shades of white/ gray). Document the observations over a period of time to find if there is a relationship between the characteristics of the clouds and the weather.	Understanding these concepts are important to understanding more advanced NGSS standards (MS-ESS2-4), but are not addressed independently in a lower level NGSS standard.

Note: The emphasis is not in naming cloud types, but in relating the characteristics of the clouds with weather.	• Identify that clouds, steam, fog, hail, snow, sleet and hail are examples of water in the atmosphere. • Identify clouds as droplets of water and the droplets can combine and form into raindrops. • Recall that water can change from liquid to vapor and/or vapor or liquid.	
2.ESS.3:Long- and short-term weather changes occur due to changes in energy. Changes in energy affect all aspects of weather, including temperature, precipitation, and wind.	• Recognize that weather changes occur due to energy changes. • Measure, collect and document weather data over a period of time and connect to observable forms of energy (e.g., wind causes a sailboat to move, the sun can heat the sidewalk). • Design an experiment to demonstrate the connection between weather and energy. • Recognize that a weather front is an area where different air masses collide. • Design and construct an instrument that can measure wind speed and wind direction. Determine the best material for the specific purpose. Discuss/share findings with the class. • Research the long-term or short-term changes in weather that occur at specific weather fronts. Be able to answer what happens when warm, moist air collides with cold, dry air. Represent the findings graphically or present findings to the class. • Plan and implement an investigation to determine the factors or characteristics that contribute to the changes in day-today weather (storms, fronts).	3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. 3-ESS2-2 Obtain and combine information to describe climates in different regions of the world. 3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
2.LS.1: Living things cause changes on Earth. Living things function and interact with their physical environments. Living things cause changes in the environments where they live; the changes can be very noticeable or slightly noticeable, fast or slow. *Note: At this grade level, discussion is limited to changes that can be easily observed.*	• Observe environmental changes caused by living things. • Plan and conduct an investigation that will compare identical soil samples, one with earthworms and one without earthworms, over an extended period of time. Include data about temperature, amount of moisture, appearance, materials added, materials removed and/or odor. • Design and build (with teacher help) a working worm composting bin or an ant farm (whichever is most appropriate for the classroom) that can be used to observe activity and actions of the worms or ants.	4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind or vegetation.
2.LS.2: All organisms alive today result from their ancestors, some of which may be extinct. Not all kinds of organisms that lived in the past are represented by living organisms today. Some kinds of organisms become extinct when their basic needs are no longer met or the environment changes.	• Define extinct and fossil. • Name an organism that was once abundant in the local in the local area that now is extinct. • Analyze and interpret datafrom fossils to provide evidence of the organisms and the environments in which they lived long ago. • Make “fossils” of animal tracks using different kinds of soils (silt, sand, clay). Plaster of Paris can be used to make a cast or mold. Be able to answer which soil worked best to make the fossil and why. • Compare features of animals alive today with those from the past (e.g. an elephant and a mammoth).	3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and environments in which they lived long ago.

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
2.PS.1: Forces change the motion of an object. Motion can increase, change direction or stop depending on the force applied. The change in motion of an object is related to the size of the force. Some forces act without touching, such as using a magnet to move an object or objects falling to the ground.	• Define force. • Identify a noncontact force that can affect the motion of an object. • Plan and implement ascientific experiment to wxplore the effects some objects have on others even when the two objects might not touch (e.g. magnets). • Design and construct a device to move a matchbox car from one position to another without touching it. • Plan and implement a scientific experiment to explore how to change how something is moving (e.g., push, pull, speeding up, slowing down, changing direction, stopping). Represent the observations from the experiment orally and in writing. • Give examples of how a force can be appied to an object. • Explain the relationship between forces and motion. • Predict the changes in motion that a moving object or an object at rest experiences when acted on by a force (e.g., push, pull, gravity). • Identify contact/noncontact forces that affect motion of an object (e.g., gravity, magnetic force, contact). • Recognize that greater changes in the motion of an object require larger forces • Describe how motion can increase, change direction, or stop depending on the force applied.	K-PS2-1 Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. K-PS2-2 Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull. 3-PS2-3 Ask questions to determine cause and effect relationships of electrical or magnetic interactions between two objects not in contact with each other. 3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.

GRADE 3

Strand Connections: Matter is what makes up all substances on Earth. Matter has specific properties and exists in different states. Earth's resources are made of matter. Matter can be used by living things and can be used for the energy it contains. There are many different forms of energy. Each living component of an ecosystem is composed of matter and uses energy.

EARTH SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
3.ESS.1: **Earth's nonliving resources have specific properties.** Soil is composed of pieces of rock, organic material, water and air and has characteristics that can be measured and observed. Use the term "soil", not "dirt". Dirt and soil are not synonymous. Rocks have specific characteristics that allow them to be sorted and compared. Rocks form in different ways. Air and water are also nonliving resources. *Note: Rock classification is not the focus for this grade level; this is found in grade 6. At this grade, the observable characteristics of rocks can be used to sort or compare, rather than formal classification.*	• Identify rock, soil, air and water as examples of non-living resources. • Recognize that soil can have different texture, composition or color depending on the environment in which it formed.Identify a measurable component of soil (e.g. water, particle size, weight). • Make a chart, identification key or a local soil map that can be used to interpret soil composition (sand, silt, clay organic material) and/or compare soil types (based on soil properties). A similar chart or map can be made for the characteristics of rocks. • Plan and implement an investigation to test specific properties of different types of soil (or rocks), such as ability to absorb (hold) water, matching/designating soil color, the ability for water to pass through the soil, the filtering properties of soil. • Design and construct a pond, water garden or a wetland environment in a terrarium. Evaluate different soil types to ensure that the chosen soil is able to hold water and support plant life. Present the explanation of the process and the findings to the class. • Sort and classify rocks by specific characteristics.Recall that rocks can be sorted based on characteristics such as grain-size (texture), color and patterns.	Understanding these concepts are important to understanding more advanced NGSS standards (MS-LS2-3, MS-ESS2-1), but are not addressed independently in a lower level NGSS standard.

STANDARD	EVIDENCE OF LEARNING • **Students who demonstrate understanding can:**	NGSS CORRELATION
3.ESS.2: Earth's resources can be used for energy. Renewable energy resources, such as wind, water or solar energy, can be replenished within a short amount of time by natural processes. Nonrenewable energy is a finite resource, such as natural gas, coal or oil, which cannot be replenished in a short amount of time.	• Distinguish between renewable and nonrenewable energy. Provide examples of each. • Research the efficiency and cost of different types of energy resources (renewable and/or nonrenewable). Compare and contrast the findings. Present or discuss findings with the class. • Develop a plan to determine the most effective method of collecting renewable energy (e.g., shapes/number/materials used in wind or water turbines, locations that allow solar panels to collect the most energy from the sun). • Research, design and/or construct a model of a simple energy collection system for a specific location (use locations in Ohio or areas near water/ prairies/rivers/mountains). Provide a selection of everyday materials for the model (rather than a preplanned kit), such as PVC piping and Mylar to make a windmill or water wheel to allow student-led investigation and design.	4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
3.ESS.3: Some of Earth's resources are limited. Some of Earth's resources become limited due to overuse and/or contamination. Reducing resource use, decreasing waste and/or pollution, recycling and reusing can help conserve these resources.	• Recognize that some of Earth's resources are limited and need to be conserved. • Research different types of recycling (paper, plastics, metals, glass) and make a comparison table to document methods, effectiveness, recycling rates, benefits and/or problems. • Plan and implement an investigation to collect and analyze data pertaining to the school's recycling rate. Graph and present the findings to school administrators or community officials. • Design and carry out a plan to reduce the use of specific resources at the school or local community. Present findings to school and/or community officials.	5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
3.LS.1: Offspring resemble their parents and each other. Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next. Some behavioral traits are learned through interactions with the environment and are not inherited.	• Explain why you can expect that offspring to have similar physical traits to the parent. • Explain why a trait is either a learned/environmental behavior or inherited. • Give examples of variations among individuals of a local population of dandelions (e.g., height, color, weight). • Conduct a real-time observational study of a familial grouping of organisms. Use webcams to view animals in their natural habitat or simulated environments to observe and record physical characteristics of the animals as well as behavioral traits that are taught from parent to offspring. • Develop a chart that compares features such as stages of development, food sources, where it is found in the environment, and physical appearance to emphasize the similarity and differences between offspring and parents. • Design an enriched environment that will support a classroom pet and provide for all of its needs. • Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.	1-LS3-1 Make observations to construct an evidence-based account that young plants and animals are alike, but not exactly like, their parents. 3-LS2-1 Construct an argument that some animals form groups that help members survive. 3-LS3-1 Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. 3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.
3.LS.2: Individuals of the same kind of organism differ in their inherited traits. These differences give some individuals an advantage in surviving and/or reproducing. Plants and animals have physical features that are associated with the environments where they live. Plants	• Name some physical features of plants and animals that are associated with the environment in which they live (e.g., coloration, location of eyes, and type of feet). • Explain why one physical or behavioral trait within a species would be an advantage in a given environment. • Describe how a variation in a physical or behavioral trait would give an individual an advantage.	3-LS4-2 Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates and reproducing. 3-LS4-3

and animals have certain physical or behavioral characteristics that influence their chances of surviving in particular environments. *Note: The focus is on the individual, not the population. Adaption is not the focus at this grade level.*	• Write a report explaining how the behavioral or physical characteristic is an advantage of a specific animal or plant for surviving in its environment (e.g., what adaptations does a pine tree have for living in colder environments?) • Plan and conduct an experiment to find out the optimal conditions for seed germination. Include in the conclusions scientific information about why not all seeds germinated. • Conduct a comparative study of a population of plants in the school yard, measure and compare some of the following: root size (width and depth) leaf size (length and width) flower color, number of petals, time of year when plant blooms, number of seeds produced or when seeds are produced.	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS-LS1-4 Use argument based on empirical evidence and scientific reasoning to support and explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.
3.LS.3: Plants and animals have life cycles that are part of their adaptations for survival in their natural environments. Worldwide, organisms are growing, reproducing, dying and decaying. The details of the life cycle are different for different organisms, which affects their ability to survive and reproduce in their natural environments. *Note: The names of the stages within the life cycles are not the focus.*	• Describe how a specific environment supports a specific organism's life cycle (e.g. flowering plants do not flower outside in the winter). • Given labeled photographs of stages of animal or plant life cycles, place them in sequence from egg to adult. • Explain why some animals have offspring in the spring and some plants produce seeds in the fall. • Plan and conduct an experiment to find out the optimal conditions for seed germination. Include in the conclusions scientific information about why not all seeds germinated. • Plan and conduct an investigation to study the life cycle of a butterfly. Compare and contrast each stage of development. • Design a butterfly garden to demonstrate which environmental characteristics make up a favorable butterfly habitat.	3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
3.PS.1: All objects and substances in the natural world are composed of matter. Matter takes up space and has mass. Differentiating between mass and weight is not necessary at this grade level.	• Define matter. • Recognize that matter continues to exist when broken into pieces too tiny to be visible. • Name observable differences between the three states of matter. • Identify one or more characteristics of matter (takes up space and has mass). • Distinguish between weight and volume. Represent the differences in words and visual models. • Given three different items, measure as many properties for each item as possible. Record the measurements for each item on a separate index card. Switch samples with another group and identify which set of measurements belong with which item.	5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen.
3.PS.2: Matter exists in different states, each of which has different properties. The most recognizable states of matter are solids, liquids and gases. Shape and compressibility are properties that can distinguish between the states of matter. One way to change matter from one state to another is by heating or cooling.	• Match a given property to its state of matter. Explain why the property matches its state of matter. • Identify three different states of matter and corresponding properties. • Plan and conduct experiments or investigations to demonstrate phase changes in substances other than water. • Predict the fastest way for ice to form. Design an investigation to determine what parameters ensure the fastest formation (e.g., change temperature of the starting water using cold, room-temperature and very hot water, condition the starting water with salt or sugar, change the starting water by adding food coloring). • Explain how a substance would change if heated or cooled.	5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen.

3.PS.3: Heat, electrical energy, light, sound and magnetic energy are forms of energy. There are many different forms of energy. Energy is the ability to cause motion or create change. The different forms of energy that are outlined at this grade level should be limited to familiar forms that a student is able to observe.	• Explain the difference between the types of energy. • Identify a change in each form of energy. • Recognize that energy can cause motion or create change. • Identify objects with energy in the environment (e.g., moving water, windmill, water wheel, sunlight) and determine what types of energy they have. • Investigate ways a pot of warm water can cause motion or create change. Be able to explain why. • Design, construct and test a small boat or aircraft that can move in different directions (or against the flow of air/water) in nature. Document the forms of energy and resulting motion as the boat or aircraft is being demonstrated to an authentic audience. • Explain how a magnet can cause motion or create change. Examples of possible answers include: a magnet can cause other magnets and some metallic items to move toward it, a magnet can cause other magnets to move away from it.	4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.

GRADE 4

Strand Connections: Heat and electrical energy are forms of energy that can be transferred from one location to another. Matter has properties that allow the transfer of heat and electrical energy. Heating and cooling affect the weathering of Earth's surface and Earth's past environments. The processes that shape Earth's surface and the fossil evidence found can help decode Earth's history.

EARTH SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
4.ESS.1: Earth's surface has specific characteristics and landforms that can be identified. About 70 percent of the Earth's surface is covered with water and most of that is the ocean. Only a small portion of the Earth's water is freshwater, which is found in rivers, lakes, groundwater and glaciers. Earth's surface can change due to erosion and deposition of soil, rock or sediment. Catastrophic events such as flooding, volcanoes and earthquakes can create landforms.	• Identify the processes that can change the surface of Earth (e.g., erosion, deposition, volcanic activity, earthquakes, glacial movement and/or weathering). • Using visual or actual field observations describe specific landform features. • Recognize that 70 percent of Earth's surface is water, which is why Earth is known as the Blue Planet. • Identify common landforms from maps or graphics. • Using topographic or aerial maps, locate areas that have been formed through deposition and erosion. Include areas of Ohio that have been impacted by glacial ice or movement. Discuss findings with the class. • Research a specific weathering feature (such as a sinkhole or cave). Evaluate the risk of collapse and methods of prevention of collapse (using actual data) and recommend one solution based on the scientific data. Create a model (virtual, graphic or 3-D) of the actual cave or sinkhole and demonstrate the risk of collapse and how the suggested preventative measure or solution impacts that risk. • Explain how a surface process has changed an area of the Earth's surface.	2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly. 2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area. 4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rocks to support an explanation for changes in a landscape over time. 4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features. 4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

4.ESS.2: The surface of Earth changes due to weathering. Rocks change shape, size and/or form due to water or glacial movement, freeze and thaw, wind, plant growth, acid rain, pollution and catastrophic events such as earthquakes, flooding, and volcanic activity. *Note: Differentiating between chemical and physical weathering is not the focus at this grade level.*	• Recognize that weathering can occur at different rates. • Recognize that water, wind, pollution/ gases in the air, ice movement, earthquakes, volcanoes, freezing/ thawing and plant action can all weather rock and soil. • Describe ways that weathering affects landforms. • Identify a variety of differences between weathering and erosion. • Plan and implement an experiment to model and compare different types of weathering and/or rates of weathering that can occur. • Using geologic, topographic or aerial maps, research areas in the U.S. that are impacted by natural sinkholes, caverns or caves. Collect data regarding the characteristics of these regions. Compare and contrast the data to determine common characteristics that are present in each area. Represent findings graphically. • Research a specific weathering feature (e.g., sinkhole, cave). Evaluate the risk of collapse and methods of prevention of collapse (using actual data) and recommend one solution based on the scientific data. Create a model (virtual, graphic or 3-D) of the actual cave or sinkhole and demonstrate the risk of collapse and how the suggested preventative measure or solution impacts that risk.	2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. 4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind or vegetation.
4.ESS.3:The surface of Earth changes due to erosion and deposition. Liquid water, wind and ice physically remove and carry rock, soil and sediment (erosion) and deposit the material in a new location (deposition).	• Identify erosion as a process that transports rock, soil or sediment to a new location. • Identify deposition as the settling or coming to rest of transported rock, soil or sediment. • Predict the effect on a landform when a natural force is introduced. • Identify a variety of differences between weathering and erosion. • Compare and contrast erosion and deposition.	2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. 4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering

Gravitational force affects movements of water, rock and soil.	• Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. • Make observations and/or measurements to provide evidence of the effects of weathering. • Use actual geologic data from a specific location, such as the Grand Canyon. Research the formation of the canyon. Ask: Why does some rock weather and erode faster than others? What caused the weathering and erosion in the canyon? How can the age of the canyon be estimated? Use the research data to make a geologic cross section (3-D or virtual model or a graphic) to model the canyon. • Using a surficial geology map of Ohio, trace the patterns of glacial movement that can be recognized by a variety of glacial deposits or erosion. Build a model to investigate the movement of glacial ice that creates a similar pattern. Ask: What factors must exist to support the movement of glaciers? Why is glacial movement erosional and depositional?	or the rate of erosion by water, ice, wind or vegetation.

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
4.LS.1: Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful. Ecosystems can change gradually or dramatically. When the environment changes, some plants and animals survive and reproduce and others die or move to new locations. Ecosystems are based on interrelationships among and between biotic and abiotic factors. These include the diversity of other organisms present, the availability of food and other resources, and the physical attributes of the environment.	• Compare/contrast biotic and abiotic factors including examples. • Describe the relationship between biotic and abiotic factors. • Describe the immediate consequences of rapid ecosystem changefor organisms within an ecosystem and describe the consequences this change will have on an ecosystem a decade or more later (e.g., flooding, wind storms, snowfall, volcanic eruptions). • Describe major changes in Ohio's environments over time and the organisms supported in each (e.g., oceanic, glacial, wetlands, forests). • Research a major geologic event (e.g., Mt. St. Helens volcanic eruption, tsunami). Develop a timeline depicting the environment before the event, immediately after the event and in designated time intervals until a stable community is established (e.g., 30 or more years). • Read a firsthand description, view drawings of Ohio ecosystems as first observed by explorers and compare the historical environmental descriptions to the current environment. Explain the changes that occurred in the biotic and abiotic components of the ecosystem. • Conduct an investigation to determine if removing or adding plants to an area increases or decreases erosion. Ask: How does this impact other organisms in that environment? • Write a newspaper article in support or against the reintroduction of the species based upon scientific facts.	3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

4.LS.2: Fossils can be compared to one another and to present-day organisms according to their similarities and differences. The concept of biodiversity is expanded to include different classification schemes based upon shared internal and external characteristics of organisms. Most species that have lived on Earth are extinct. Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.	• Identify evidence that can be used to determine the existence of an organism. • Observe fossils and compare them to similar plants and animals that live today, using simple classification schemes. • Analyze and interpret data from fossils to provide evidence of the organisms and environments in which they lived long ago. • From observation of fossils in rock layers, infer the environmental conditions that existed when the fossils were formed (e.g., fish fossils would indicate a body of water existed at the time the fossils formed). • Experiment with making fossils to determine some of the necessary (living and nonliving) conditions for making fossils and to determine if similar conditions exist today. Materials used should include clay, dough, sand, mud, etc. Conditions should include moist, wet and dry. Representations of living organisms used should include those with hard body parts (exoskeletons, bones) and those with soft body parts (plants). • Propose and test multiple ways that living things with soft body parts can leave fossil evidence.	3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and environments in which they lived long ago.

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
4.PS.1: When objects break into smaller pieces, dissolve, or change state, the total amount of matter is conserved. When an object is broken into smaller pieces, when a solid is dissolved in a liquid or when matter changes state (solid, liquid, gas), the total amount of matter remains constant. *Note: Differentiation between mass and weight is not necessary at this grade level.* *Note: Mass* is an additive property of objects and volume is usually an additive property for the same material at the same conditions. However, volume is not always an additive property, especially if different substances are involved. For example, mixing alcohol with water results in a volume that is significantly less than the sum of the volumes.*	• Describe what will happen to the mass of an object after a change of state occurs. • Recognize that the amount of matter stays constant during any change. • Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. • Explain why the volume of water decreases when placed in an open container and left to sit for an extended period of time. • Investigate what happens to the total amount of mass during many types of changes (e.g., ice melting, salt dissolving, paper tearing, candle burning, Alka-Seltzer® in water). Propose reasons for any difference in the final mass. Design a revised experiment to test proposals.	5-PS1-2 Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
4.PS.2: Energy can be transferred from one location to another or can be transformed from one form to another. Energy transfers from hot objects to cold objects as heat, resulting in a temperature change. Electric circuits	• Identify the different ways energy can be transferred. • Define conductors and insulators. Give examples. • Describe how one form of energy is transformed to another form. • Demonstrate how energy can be transformed.	4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electrical currents. 4-PS3-3

require a complete loop of conducting materials through which electrical energy can be transferred. Electrical energy in circuits can be transformed to other forms of energy, including light, heat, sound and motion. Electricity and magnetism are closely related.	• Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electrical currents. • Design a device involving energy transfers. • Ask questions and predict outcomes about the changes in energy that occur when objects collide. • Design and construct a device that causes a small cart to roll and involves energy trasnfers between four objects (e.g. push a ball off a table so it falls on an object that release a rubberband cart). • Recognize that a working circuit requires a continuous loop of electrical conductors. • Build a circuit that contains two light bulbs. • Pictorially represent ways to assemble a circuit and note which are able to light the bulbs and which are not. • Analyze the differences between working and nonworking circuits and determine patterns and trends in the experimental evidence. • Design and construct a switch that can turn a light on and off in a circuit.	Ask questions and predict outcomes about the changes in energy that occur when objects collide. 4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

GRADE 5

Strand Connections: Cycles on Earth, such as those occurring in ecosystems, in the solar system, and in the movement of light and sound result in describable patterns. Speed is a measurement of movement. Change in speed is related to force and mass. The transfer of energy drives changes in systems, including ecosystems and physical systems.

EARTH SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
5.ESS.1:The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics. The distance from the sun, size, composition and movement of each planet are unique. Planets revolve around the sun in elliptical orbits. Some of the planets have moons and/or debris that orbit them. Comets, asteroids and meteoroids orbit the sun.	• Identify a telescope as a tool that can be used to magnify the appearance of objects in the solar system. • Recognize that there are eight major planets in the solar system and they all orbit the sun. • Recognize that other celestial bodies also orbit the sun. These can include dwarf planets, comets, asteroids, meteoroids and comets. • Make a table, chart or graphic that interprets the general characteristics of the major planets in the solar system. Use real data (current) to compare and contrast the findings. • Compare different celestial bodies including composition and size. • Explain the effect of gravitational force on orbits. • Compare the composition and sizes of the major planets. • Research the history of the exploration of the solar system or a recent space discovery. Make a timeline or write a report to interpret and clarify the major events, the tools and technology used, and the discoveries made. Share findings with the class. • Choose a major planet. Plan and build a scaled model that can demonstrate the planet size and rotation orbit in relationship to the sun and the Earth. Conduct the demonstration (with explanation) to the class. • Choose a planet (other than Earth) and research and develop a plan to colonize the planet with humans. Evaluate current conditions and what would be needed to meet the basic requirements for humans to live on Mars. Present recommendations to the class.	MS-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system.

5.ESS.2: The sun is one of many stars that exist in the universe. The sun appears to be the largest star in the sky because it is the closest star to Earth. Some stars are larger than the sun and some stars are smaller than the sun.	• Identify the sun as a medium-sized star and the only star in the solar system. • Recall that there are many other stars in the universe and they are different sizes, but the sun appears larger because it is closer to the Earth. • Differentiate between the sun and a red dwarf or blue giant star. Make a table or chart to represent the comparison. • Compare the characteristics of different stars. • Explain the relationship of our Sun to our Solar System and our universe. • Choose a major planet. Plan and build a scaled model that can demonstrate the planet size and rotation orbit in relationship to the sun and the Earth. Conduct the demonstration (with explanation) to the class.	5-ESS1-1 Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.
5.ESS.3: Most of the cycles and patterns of motion between the Earth and sun are predictable. Earth's revolution around the sun takes approximately 365 days. Earth completes one rotation on its axis in a 24-hour period, producing day and night. This rotation makes the sun, stars and moon appear to change position in the sky. *Note: Moon phases should not be the focus.*	• Explain the difference between revolution and rotation. • Identify the relationship between the Earth's movement and the Sun. • Recognize that the rotation of Earth on its axis produces day and night, which is why the sun, stars and moon appear to change position in the sky. • Represent the sun, moon and Earth and their orbits graphically and to scale. Use actual data and measurements for the representation. • Using a simple model, investigate the positions of the sun, moon and Earth to detect and test the reasons why the moon and sun appear to change position in the sky and the phases of the moon.	5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
5.LS.1: Organisms perform a variety of roles in an ecosystem. Populations of organisms can be categorized by how they acquire energy. Food webs can be used to identify the relationships among producers, consumers and decomposers in an ecosystem.	• Define what producers, consumers and decomposers are. Give examples. Explain the role of a producer, consumer, or decomposer in a food web. • Explain what a food web is and what it is used for. • Recognize what a symbiotic relationship is and describe the different types of relationships. • Given a list of organisms and a description of their interactions within an environment, classify them as producers, consumers, decomposers or by type of symbiotic relationships (mutualism, commensalism and parasitism). • Build a food chain with given organisms. • Investigate change in an established model of an ecosystem over time (e.g., terrarium, aquarium). Design experiments to observe what actually happens when one species is changed. • Compare the roles of producers, consumers and decomposers and explain how they work together within an ecosystem. • Design and build a self-sustaining ecosystem (e.g., terrarium, bottle biology). Considerations for the ecosystem include the size of the container, the location to create the proper temperature, light and humidity, and organisms that will support one another.	5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
5.LS.2: All of the processes that take place within organisms require energy.	• Identify that producers transform sun energy into energy it uses to grow and that consumers get their energy to grow by a transfer of energy from another organism. • Trace the flow of energy through a food web.	5-PS3-1 Use models to describe that energy in animals' food was once energy from the sun.

For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy is used or stored by the producer and can be passed from organism to organism as illustrated in food webs.	• Explain the process of photosynthesis as it relates to energy transfer. • Identify the three types of consumers (herbivore, omnivore, and carnivore). • Given a list of common organisms and a description of their environmental interactions, draw a food web using arrows to illustrate the flow of energy. Properly identify the producers and consumers. • Build an energy chain with given organisms that includes the main source of energy in the ecosystem. • Explain ways that humans can improve the health of ecosystems (e.g., recycling wastes, establishing rain gardens, planting native species). • Investigate change in an established model of an ecosystem over time (e.g., terrarium, aquarium). Design experiments to observe what actually happens when one environmental factor is changed.	

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
5.PS.1: The amount of change in movement of an object is based on the mass of the object and the amount of force exerted. Movement can be measured by speed. The speed of an object is calculated by determining the distance (d) traveled in a period of time (t). Any change in speed or direction of an object requires a force and is affected by the mass of the object and the amount of force applied. *Note: Differentiating between mass and weight is not necessary at this grade level.*	• Recognize that increasing the force acting on an object will result in greater changes in motion. • Recognize that objects with greater mass will change their motion less than objects with less mass. • Recall the mathematical relationship between distance, time and speed. • Explain the effect that change of mass or force will have on the speed of an object. • Define and be able to calculate speed.(Although mathematics is applied to the concept of speed at this grade level, its use should support deeper understanding of the concept of speed and not be taught as the primary definition of speed.) • Identify what factors must be measured to determine speed. • Clarify specifically how data will be measured and how it will be used to determine the speed of the car. • Identify three ways the motion of an object can be changed (e.g., speed up, slow down, change direction). • Identify two factors that influence the amount of change in motion of an object. • Compare and rank the relative change in motion for three objects of different masses that experience the same force. • Plan and implement a scientific experiment that determines how the mass of an object (or amount of force acting on an object) affects how the motion of an object changes. • Design a system by which police officers could make observations from an airplane to determine the speed of a car. Give an example of how the speed could be calculated from the measurements.	5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down.

5.PS.2: Light and sound are forms of energy that behave in predictable ways. Light travels and maintains its direction until it interacts with an object or moves from one medium to another and then it can be reflected, refracted or absorbed. Sound is produced by vibrating objects and requires a medium through which to travel. The rate of vibration is related to the pitch of the sound. *Note: At this grade level, the discussion of light and sound should be based on observable behavior. Waves are introduced at the middle school level.*	**LIGHT** • Recognize that the angle that light approaches a reflective surface affects the direction in which light is reflected. • Recognize that refraction involves bending of light when passing into a new medium. • Draw a picture of the periscope design and trace the path of light as it travels from the object to the eye. • Plan and implement a scientific investigation to determine the ideal angle to place a reflective surface to bend light through a right angle. • Design a mirror system to use when building a periscope. • Explain how an object will change the path of light (e.g., a mirror will reflect, a dark cloth will absorb light, etc.). • Pictorially represent the path light takes when traveling from one medium to another. • Plan and implement a scientific experiment to investigate what happens when light enters a new medium (e.g., passing from air to water, passing from Jell-O® to air). • Draw a picture of a pencil half submerged in a cup of water. Trace the path of light as it travels from a submerged part of the pencil to the eye. Use this picture to explain why the pencil appears to be bent or broken when placed in water. • Design, construct and test a laser tag game prototype system that uses a system of mirrors and lenses to direct light through a simple maze to strike targets.	1-PS4-2 Make observations to construct an evidence-based account that objects can be seen only when illuminated. 1-PS4-3 Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. 1-PS4-4 Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. 4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electrical currents. 4-PS4-2 Develop a model to describe that light reflecting from objects and entering the eyes allows objects to be seen. 4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information

	SOUND • Identify properties of sound and how they affect and change pitch. • Recall that increasing the rate of vibration can increase the pitch of a sound. • Recognize that longer tubes produce lower pitches and shorter tubes produce higher pitches. • Verbally explain how the design of the instrument allows different pitches to be produced. • Plan and implement a scientific investigation to investigate how the length of PVC tubing affects the pitch of the sound. • Design two different musical instruments, one using blowing and one using plucking, that can create the same three notes.	

GRADE 6

Strand Connections: All matter is made of small particles called atoms. The properties of matter are based on the order and organization of atoms and molecules. Cells, minerals, rocks and soil are all examples of matter.

EARTH SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
6.ESS.1: Minerals have specific, quantifiable properties. Minerals are naturally occurring, inorganic solids that have a defined chemical composition. Minerals have properties that can be observed and measured. Minerals form in specific environments. *Note: The emphasis is on learning how to identify the mineral by conducting tests (not through memorization).*	• Observe and measure mineral properties such as color, luster, hardness, and density through testing. • Identify properties, using tests, of common rock-forming minerals (e.g.,calcite, halite, dolomite, gypsum, quartz, feldspars, micas, talc, kaolinite, chalk, topaz, corundum, pyrite, magnetite, epidote, horneblende). • Sort minerals by identifying common properties such as luster, hardness,streak, cleavage, magnetism,fluorescence and/or crystal shape. • Identify the different processes and/or environments in which minerals can form (e.g., evaporation, chemicalprocesses, sedimentary, igneous ormetamorphic). • Explain that minerals have measurable properties that can beused for identification and/orclassification. • Explain the likely environmental conditions that existed when a specified mineral was formed based on its properties (e.g., halite and gypsum in the Lake Erie area). • Make a dichotomous key of mineral properties for testing and identifying minerals. • Compare rocks and minerals. • Use maps to study the different environments in which minerals are formed. • Given a variety of minerals, design an investigation to determine the best one to use to polish a surface (e.g., make an arrowhead, sand wood, polish marble).	MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

6.ESS.2: Igneous, metamorphic and sedimentary rocks have unique characteristics that can be used for identification and/or classification. Most rocks are composed of one or more minerals, but there are a few types of sedimentary rocks that contain organic material, such as coal. The composition of the rock, types of mineral present, and/or mineral shape and size can be used to identify the rock and to interpret its history of formation, breakdown (weathering) and transport (erosion).	• Recognize that each type of rock has a unique history based upon the environmental conditions that existed when it formed. • Identify the rock using the composition of the rock, minerals present, or mineral shape/size. • Describe how some rocks can contain organic material instead of minerals (e.g., coal). • Make a chart, table or key to use in the classification of common rocks within each division of rock (sedimentary, igneous, metamorphic). • Identify the history of formation of a rock using the processes of weathering and erosion. • The unique characteristics of rocks can be used to determine how the rock formed or how the rock can be used. Plan and implement an investigation that analyzes the characteristics of rocks used locally (e.g., in landscape projects, buildings, floors, statues, gravestones, patios/walls). Ask: What characteristics allow the rock to work well/not work well in that environment? • Determine, using a scientific experiment, the best mineral or rock to use to solve a problem or serve a specific function. Ask: What is the best mineral or rock to use to neutralize acidic soil? What is the best rock to use to make a statue? What is the best mineral to use for sandpaper? Evaluate the results and use the data to draw a conclusion. Share findings with an authentic audience.	MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
6.ESS.3: Igneous, metamorphic and sedimentary rocks form in different ways. Magma or lava cools and crystallizes to form igneous rocks. Heat and pressure applied to existing rock forms metamorphic rocks. Sedimentary rock forms as existing rock weathers chemically and/or physically and the weathered material is compressed and then lithifies. Each rock type can provide information about the	• Identify the likely environments or conditions of formation of igneous, sedimentary, and metamorphic rocks. • Illustrate the process of formation of igneous, sedimentary, and metamorphic rock using a rock cycle. • Identify the main components and processes of the rock cycle. • Use the rock cycle to describe the formation of igneous, sedimentary andmetamorphic rocks. • Using a geologic map of a region to determine what types of rocks are represented (igneous, sedimentary, metamorphic). Explain why those types of rocks might be found in that area. • Based on the environment required for specific rock types to form, develop a hypothesis regarding the geologic history of a specific region. Cite evidence to support the hypothesis.	MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

environment in which it was formed.	• Compare multiple rock samples andhypothesize the environment or conditions in which they likely formed. • Make a geologic map of the local community. Use existing geologic data, historic (geologic) data and field exploration to analyze types of formations that are present. Use the finished map to evaluate possible land and resource uses. Present the map and recommendations to an authentic audience.	
6.ESS.4: Soil is unconsolidated material that contains nutrient matter and weathered rock. Soil formation occurs at different rates and is based on environmental conditions, types of existing bedrock and rates of weathering. Soil forms in layers known as horizons. Soil horizons can be distinguished from one another based on properties that can be measured. The terms dirt and soil are not synonymous, use the term “soil”. *Note: The emphasis should be on properties of soil rather than memorization.*	• Recognize that soil layers are called horizons and each horizon has properties that can be measured. • Identify the properties that can be measured in soil. • Identify the characteristics of each horizon that makes up soil. • Identify the types of conditions that may contribute to the formation of soil or lack of formation of soil. • Use specific tools to measure soil characteristics and properties (e.g., permeability, porosity, texture, color). • Research and lead a discussion on how soil depletion impacts different soil horizons which in turn impacts the environment (e.g., the dust bowl, desertification, mass movement, erosion). • Compare the different soil horizons (O, A, B and C) using the standard composition of each. • Compare a specific and identifiable soil horizon in different locations within a community. Compare the depth of the soil horizons. Explain the differences that are measured. Identify appropriate land uses for each location. • Plan and implement an investigation to determine which types of soil (sand, clay, loam, silt, gravel) are most likely to fail in a landslide event. Use the total volume of water added to calculate the percent saturation for each sample. Analyze the data and write a conclusion. • During some flooding events, sandbags are used to slow down or redirect floodwaters. Develop a list of criteria required for the bags. Using four or five unknown soil samples, design and conduct an investigation to determine which soil is best to use inside the sandbags. Analyze the soil data and test results to make the final determination. Share findings and the decision with the class.	MS-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales

6.ESS.5: Rocks, minerals and soils have common and practical uses. Nearly all manufactured material requires some kind of geologic resource. Most geologic resources are considered nonrenewable. Rocks, minerals and soil are examples of geologic resources that are nonrenewable.	• Identify uses of rocks, minerals, and soil in manufactured materials. • Identify examples of different ways that soil, rocks and minerals can be used. • Recognize that the characteristics of soil, rocks and minerals determine how they can be used. • Categorize rocks, minerals, and soil as non-renewable resources. • Research different uses of minerals, soil and rock within the community and within Ohio. Represent findings graphically and discuss/present to the class. • Make a map or 3-D model of Ohio that illustrates the major geologic resources that are found. Share the final product with the class. • Plan and implement an investigation to compare a specific and identifiable soil horizon in different locations within the community. Compare and contrast the depth and width of the soil horizons. Research and explain the differences that are measured. • Design an investigation that can test slope stability and landslides, by creating mountains out of different materials (e.g., sand, gravel, clay). Water is added to test the stability of each material. Analyze data and write a conclusion to represent the findings. • During some flooding events, sandbags are used to slow down or redirect floodwaters. Develop a list of criteria required for the bags. Using four or five unknown soil samples, design and conduct an investigation to determine which soil is best to use inside the sandbags. Analyze the soil data and test results to make the final determination. Share findings and the decision with the class.	4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
6.LS.1: Cells are the fundamental unit of life. All living things are composed of cells. Different body tissues and organs are made of different kinds of cells. The ways cells function are similar in all living organisms. *Note: Emphasis should be placed on the function and coordination of cell organelles as well as their roles in overall cell function. Specific information about the organelles that need to be addressed at this grade level will be found in the model curriculum.*	• Recognize that cells are the fundamental unit of life. • Describe how the structure and form relates to the function that the cells perform. • Identify organelles within cells. Emphasis should be placed on those organelles involved in the following cellular functions: transport of materials, energy capture and release, protein building, waste disposal, information feedback and movement. • Observe a variety of cells (using microscopes or online pictures/models). Label the visible cellular structures and explain how the structure is related to the function of the organelle and the cell as a whole. • Explain how the cellular structures and their functions contribute to the survival of the cell. Consider models or authentic analogies to express understanding. Compare the organelles of a cell to a familiar working system (e.g. school, city, factory). • Build a model of a plant or animal cell and explain how the cellular structures and their functions contribute to the the survival of the cell. • Using microscopes, micrographs, models or illustrations, observe a singlecelled organism. Label the visible cellular structures and explain how a singlecelled organism carries out all functions required for life. • Predict what will happen when a cell is placed in solutions of varying concentration levels. Then plan and conduct a scientific investigation to prove or disprove predictions. • Design a microscope using used lenses. • Analyze and evaluate scientific tradeoffs (e.g. environmental, projected research required to move from current knowledge to application) for use of microbes to produce alternative energy or clean up environmental spills.	MS-LS1-1 Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

6.LS.2:All cells come from pre-existing cells. Cells repeatedly divide resulting in more cells and growth and repair in multicellular organisms. *Note: This is not a detailed discussion of the phases of mitosis or meiosis. The focus should be on reproduction as a means of transmitting genetic information from one generation to the next, cellular growth and repair.*	• Explain that every cell contains information about traits that can be passed to the next generation through reproduction or cell division. • Describe the role of mitosis in singlecelled organisms and multicellular organisms. • Model the movement of chromosomes during plant cell division and explain why this process ensures genetic information is passed from one generation to the next. • Do an observational study of the growth of an organism from zygote through embryogenesis in both plants and animals. • Analyze and evaluate scientific tradeoffs (e.g., environmental, projected research required to move from current knowledge to application) for use of microbes to produce alternative energy or clean up environmental spills.	HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
6.LS.3: Cells carry on specific functions that sustain life. Many basic functions of organisms occur in cells. Cells take in nutrients and energy to perform work, like making various molecules required by that cell or an organism. Every cell is covered by a membrane that controls what can enter and leave the cell. Within the cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback and movement. *Note: Emphasis should be placed on the function and coordination of cell components, as well as on their roles in overall cell function.*	• Describe the function of a given cell part. • Explain that each cell part has a distinct structure and function that is critical to life. • Describe how different organ systems interact to enable complex multicellular organisms to survive. • Compare sample cells from different tissues (e.g. muscle, skin, root, stem, leaf) in plants and animals. • Conduct an investigation to determine the rate of respiration in yeast cells by varying sugar concentrations or other variables to determine the maximum release of carbon dioxide. (Note: do not conduct a splint test for carbon dioxide) • Predict and then test what happens to a cell when placed in a variety of solutions (e.g. an ELodena cell placed in tap water, distilled water and salt water). • Test the effectiveness of a cellular leavening agent (yeast) for making bread under different conditions (e.g. vary the amount of sugar, the type of flour, the type of sugar). After multiple trials, determine which recipe maked the least dense bread (as represented by air spaces).	MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

6.LS.4: Living systems at all levels of organization demonstrate the complementary nature of structure and function. The level of organization within organisms includes cells, tissues, organs, organ systems and whole organisms. Whether the organism is single-celled or multicellular, all of its parts function as a whole to perform the tasks necessary for the survival of the organism. Organisms have diverse body plans, symmetry and internal structures that contribute to their being able to survive in their environments.	• Explain how cells are organized to form multicellular organisms (e.g., cells make up tissues such as muscle). • Identify similarities and differences between single-celled and multicellular organisms. • Identify general distinctions among the cells of organisms that support classifying some as plants, some as animals and some that do not neatly fit into either group (e.g. fungi, bacteria). • Given a group of organisms, classify them based on internal structures, body system, and symmetry. Provide justification for the classifications. • Compare the four major types of tissues (epithelial, connective, nerve and muscle tissue). • Compare a variety of plant and animal cells, tissues (i.e. xylem, phloem, connective, muscle, nervous), and organs (i.e. leaf, stem, flower, spore, ganglia, blood vessels, eyes). • Given a particular environment, describe specific internal structures, body plan, and symmetry an organism would need for optimal success of survival. • Conduct an investigation to determine the rate of photosynthesis in plants to maximize oxygen production. • Conduct a study to compare organisms that are living in an aquatic environment to those living in a terrestrial environment. Hypothesize how the structure can put limits on the size and shape of the organisms in each environment.	4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. 4-LS1-2 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. MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
6.PS.1: Matter is made up of small particles called atoms. Matter has mass, volume and density and is made up of particles called atoms. Elements are a class of substances composed of a single kind of atom. Molecules are the combination of two or more atoms that are joined together chemically.	• Define mass, volume, and density. • Determine the mass and volume of an object. • Using two objects with either the same mass or volume, determine which object has a greater density. • Define elements and molecules. • Graph mass vs. volume for water and a variety of other substances to compare their densities. • Devise a method to prove or disprove the statement "The density of a given substance remains constant". Share evidence to support your conclusion. • Design and construct a hot air balloon or floating lantern to demonstrate the relationship between temperature and density.	5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen. MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.
6.PS.2: Changes of state are explained by a model of matter composed of particles that are in motion. Temperature is a measure of the average motion of the particles in a substance. Heat is a process of energy transfer rather than a type of energy. Energy transfer can result in a change in temperature or a phase change. When substances undergo changes of state, atoms change their motion and position. *Note: It is not the intent of this standard to encourage vocabulary*	• Identify three states of matter. • Describe the motion and arrangement of atoms for each state of matter. • Describe the changes in atoms' motion and position when substances undergo changes of state. • Describe the relationship between temperature and thermal energy. • Describe how mass affects thermal energy (e.g., compare the thermal energy of two samples of the same material with different masses which are at the same temperature). • Explain in terms of the atomic theory why gases can be easily compressed, while liquids and solids cannot. • Explain how the arrangement of atoms determines the specific properties (e.g., compressibility, ability to take the shape of a container) of solids, liquids and gases. • Develop and test a hypothesis about the behavior of three different states of matter in a closed retractable space (e.g., using a syringe, observe and record data when a solid, like a marshmallow, and a liquid is placed inside the chamber).	MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

identification (matching definitions with heat, temperature, and thermal energy). Instead, these are provided as conceptual tools for understanding the role of energy in physical, biotic, atmospheric, oceanic, and geologic systems covered in grade 6 and subsequent grades and courses.	• Observe and graph the change in temperature during phase changes. Measure mass before and after a phase change. Discuss molecular position and motion in a substance as the phase change occurs. • Draw a model/pictorial representation that depicts the behavior of atomic particles for each state of matter (solid, liquid, gas). Explain the molecular motion for each state. • Describe the changes in atoms' motion and position when substances undergo changes of state. • Evaluate the ratio of helium to air in party balloons and devise a claim referencing the behavior of molecules for the most cost-efficient and/or highestperformance (increased flotation, least leakage over time). • Use experimental data to investigate the behavior of atoms as a sample goes through three distinct phase changes (e.g., solid to liquid to gas). Measure the temperature and construct a graphical representation to aid in devising a plausible explanation for what happens during the phase changes. • Evaluate the preparations of two remedies for an upset stomach, both containing the same medication in the same amount. One preparation involves a tablet to be chewed and swallowed. The other preparation involves a liquid to be swallowed. Ask: Which preparation would provide the fastest relief and why? Use data found on the Internet to support conclusions. Defend the reliability of research sources.	
6.PS.3: There are two categories of energy: kinetic and potential. Objects and substances in motion have kinetic energy. Objects and substances can have energy as a result of their position (potential energy). *Note: Chemical and elastic potential energy should not be included at*	• Explain that an object can have potential energy due to its position relative to another object and can have kinetic energy due to its motion. • Recognize that increasing height increases gravitational potential energy. • Classify the energy at each stage in the function of a waterwheel as kinetic, potential or a combination of the two. • Explain the changes in energy that occur when a waterwheel is in operation. • Use the waterwheel to investigate the relationship between a variable (e.g., flow rate, volume of water) and the spin rate of the wheel.	4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object. MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and the speed of an object. MS-PS3-2

this grade; this is found in PS grade 7.	• Outline and explain the energy changes involved in dropping an object onto the floor. • Compare objects as they fall from various heights. Analyze the data to determine patterns and trends. Formulate a conclusion about the relationship between height and gravitational potential energy. • Design and build a system that uses moving water to cause a wheel to turn. Describe how this can be used to perform work. Develop evaluation criteria and use them to compare the effectiveness of the waterwheels built by the class. Determine which design features are most effective and propose an explanation for why these features are effective. Redesign the water wheel to incorporate the best design practices. • Design a roller coaster to demonstrate energy transformation between potential and kinetic.	Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).
6.PS.4: An object's motion can be described by its speed and the direction in which it is moving. An object's position and speed can be measured and graphed as a function of time. *Note: Velocity and acceleration rates should not be included at this grade level; these terms are introduced in high school.*	• Given the distance traveled and the elapsed time, calculate the average speed of an object. • Describe motion as the change over time in the position of an object compared to a reference point. • Recognize that faster objects have steeper lines on position vs. time graphs and slower objects have less steep lines. • Collect and graph an object's motion by measuring and recording its position over time. • Analyze data to determine patterns and trends about objects that move with constant speed and objects that move with different constant speeds. • Graphically represent the data collected from an object moving at constant speed. • Identify what is changing and what is not changing for an object moving at a constant speed. Justify the answer with references to a distance vs. time graph. • Compare the position vs. time graphs for fast- and slow-moving objects. • Use the unit rate of a position vs. time graph to determine the speed of an object moving at constant speed. • Use data (e.g., from motion detectors) to produce distance vs. time graphs to investigate the effects of changes (e.g., steeper	No comparable NGSS Standard

	ramp, more batteries, harder push, heavier object) made to a moving object. Compare the graphs to determine relative speeds. • Given a mousetrap car and a recording method (e.g., motion detector), redesign the car so it will move to produce a steeper or less steep position vs. time graph.	

GRADE 7

Strand Connections: Cycles on Earth, such as those occurring in ecosystems, in the solar system, and in the movement of light and sound result in describable patterns. Speed is a measurement of movement. Change in speed is related to force and mass. The transfer of energy drives changes in systems, including ecosystems and physical systems.

EARTH SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
7.ESS.1: **The hydrologic cycle illustrates the changing states of water as it moves through the lithosphere, biosphere, hydrosphere and atmosphere.** Thermal energy is transferred as water changes state throughout the cycle. The cycling of water in the atmosphere is an important part of weather patterns on Earth. The rate at which water flows through soil and rock is dependent upon the porosity and permeability of the soil or rock.	• Describe the movement of water through all four spheres of Earth (e.g., lithosphere, hydrosphere, atmosphere, biosphere). • Identify the changes in thermal energy as water changes state in the hydrologic cycle. • Recognize that the sun is the source of energy that drives the hydrologic cycle. • Using GPS/GIS programs, topographic maps and/or aerial maps, identify regions where surface water run-off and/or acid rain could impact ground or surface water quality. Illustrate the results graphically. • Research and investigate an area in Ohio that exhibits a unique water contamination problem (e.g., acid mine drainage in southeastern Ohio, mercury contamination and algae blooms in Lake Erie). Document recent discoveries, case studies, cleanup technologies or field investigations that are occurring. • Research and evaluate the effectiveness of different tools, models and methods to collect groundwater and surface water data (e.g., rate of flow, direction of movement, types of contamination). Present recommendations orally, graphically or in writing. • Design and conduct a scientific investigation to measure and analyze surface-water discharge rates. • Build a model to represent a cross section of Earth's surface (soil, rock, surface, ground water) that can	5-ESS2-1 Develop a model using an example to describe ways in which the geosphere, biosphere, hydrosphere, and/or atmosphere interact. MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

	enable investigation of multiple water pathways. Explain and demonstrate to the class. • Investigate and use different methods and tools that measure water flow and water quality, and evaluate which methods and tools are most effective for the desired outcome. • Produce and test solutions for reducing acid rain, erosion and/or surface runoff rates in specific regions (e.g., urban, agricultural, construction). Present findings/plan to school. • Develop, test and evaluate plans outlining a specific method to reduce storm water flow at a specific site in the local community (e.g., a housing construction project, the school parking lot). Present findings/plans to school.	
7.ESS.2: Thermal-energy transfers in the ocean and the atmosphere contribute to the formation of currents, which influence global climate patterns. The sun is the major source of energy for wind, air and ocean currents and the hydrologic cycle. As thermal energy transfers occur in the atmosphere and ocean, currents form. Large bodies of water can influence weather and climate. The jet stream is an example of an atmospheric current and the Gulf Stream is an example of an oceanic current. Ocean currents are influenced by factors other than thermal energy, such as water density, mineral content (such as salinity), ocean floor topography and Earth's rotation. All of these factors delineate global climate patterns on Earth.	• Identify the factors that contribute to the global climate. • Adopt a drifter buoy (NOAA), record its movement and record water temperature data over time. • Represent the oceanic data on a graph or chart to assist in the analysis and interpretation found under Demonstrating Science Knowledge. • Analyze real-time drifter buoy data to determine the pattern of the Gulf Stream. Compare the present pattern with documented seasonal patterns over a five-year period. Using quantifiable data, outline factors that contribute to the changing patterns and influence the Gulf Stream. • Based on the interpretation and analysis of drifter buoy data (Demonstrating Science Knowledge), develop a list of criteria (including cost) for successful buoy deployment and life span. Design, build and test a buoy that can sample water temperatures or another water-quality test (e.g., pH, turbidity levels) of a local lake, pond, pool or stream. Deploy the buoy and collect/ analyze data. Compare	5-ESS2-1 Develop a model using an example to describe ways in which the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth

	and discuss results with the class. Find additional information about buoys under Instructional Strategies and Resources. • Identify the general patterns of the Jet Stream and the Gulf Stream using a world map. • Adopt drifter buoy velocity data in a graph or chart. Use the velocity data to make a simple map showing the general patterns of the Gulf Stream. Research the documented patterns of the Jet Stream. • Using adopt a buoy data (NOAA) calculate the average buoy velocities at specific segments of the year. Predict where ocean current patterns change and may result in climate changes (based on the data). How does this relate to Jet Stream patterns and changes? Present findings to the class and be prepared to defend the predictions using evidence and data. • Analyze data from hurricane debris in the Atlantic Ocean to map currents. • Analyze data from tsunami and materials falling off of ships in the Pacific to track and map currents in the ocean. • Using the analytical data from Demonstrating Science Knowledge, evaluate and map the fastest and most effective route to travel from Spain to Florida. Document all scientific data, data analysis and steps in the evaluation process (everything that supports the chosen route).	cause patterns of atmospheric and oceanic circulation that determine regional climates. MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effect.
7.ESS.3: The atmosphere has different properties at different elevations and contains a mixture of gases that cycle through the lithosphere, biosphere, hydrosphere and atmosphere.	• Define the properties of the layers of the atmosphere (e.g., temperature, chemical composition, physical characteristics). • Identify the components of gases in the atmosphere.	5-ESS2-1 Develop a model using an example to describe ways in which the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

The atmosphere is held to the Earth by the force of gravity. There are defined layers of the atmosphere that have specific properties, such as temperature, chemical composition and physical characteristics. Gases in the atmosphere include nitrogen, oxygen, water vapor, carbon dioxide and other trace gases. Biogeochemical cycles illustrate the movement of specific elements or molecules (such as carbon or nitrogen) through the lithosphere, biosphere, hydrosphere and atmosphere. *Note: The emphasis is on why the atmosphere has defined layers, not on naming the layers.*	• Illustrate the biogeochemical cycles. (e.g., Carbon and Nitrogen cycles) • Using ozone data from the stratospheric level, generate a graph that illustrates the changes in the ozone over a specific period of years. • Research and document the types of everyday activities that generate the highest and lowest amount of air pollution. Compare the results with the class. • Plan and implement an investigation to collect and test ground levels of ozone or carbon monoxide in a local area. Compare results to statewide data. Determine the existing factors that contribute to these levels. Explain and defend the investigation and the results to an authentic audience. • Plan and implement an investigation to test the relationship between air pressure, elevation and temperature. Determine where to find reliable datasets that can be used to verify the hypothesis. Analyze the data and make a final determination. Write a final analysis and conclusion to share with the class. • Develop a method of testing and evaluating the best material to use in a physical filtration mask used by humans that are exposed to particulate matter (e.g., mold, dust, soil, ash). Compile and analyze test methods and data. Present final recommendations (based on the scientific evidence) to the class.	MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. HS-LS2-5 Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
7.ESS.4: The relative patterns of motion and positions of Earth, moon and sun cause solar and lunar eclipses, tides and phases of the moon.	• Model how the positions of the Earth, Moon, and Sun cause the phases of the moon. • Model how the positions/gravitational pull of the Earth, Moon, and Sun causes tides (e.g., spring and neap). • Illustrate the positions of the Sun, Earth, and Moon that result in solar and lunar eclipses.	MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

The moon's orbit and its change of position relative to Earth and sun result in different parts of the moon being visible from Earth (phases of the moon). A solar eclipse is when Earth moves into the shadow of the moon (during a new moon). A lunar eclipse is when the moon moves into the shadow of Earth (during a full moon). Gravitational force between Earth and the moon causes daily oceanic tides. When the gravitational forces from the sun and moon align (at new and full moons) spring tides occur. When the gravitational forces of the sun and moon are perpendicular (at first and last quarter moons), neap tides occur.	• Make a chart or graph that illustrates moon phases. Earth's rotation, sun position, and resulting tidal data for one month. Include specific data about Spring and Neap tides. Use actual data to document the graphic representation. • Design and conduct an experiment using 3-D modeling, drawing or technology to represent the factors that must exist for a full or partial solar or lunar eclipse. Use actual data to create the model. Present with detailed explanation to the class • Research the availability of tidalgenerated power facilities. Outline the requirements and output. Critique and analyze all collected data. Using tidal and current requirements (and other physical requirements, such as ocean depth, geographic location), make a determination of a recommended location for maximum effectiveness within the United States.	
7.ESS.5: The relative positions of Earth and the sun cause patterns we call seasons. Earth's axis is tilted at an angle of 23.5°. This tilt along with Earth's revolution around the sun, affects the amount of direct sunlight that the earth receives in a single day and throughout the year. The average daily temperature is related to the amount of direct sunlight received.	• Recognize that Earth's spin axis is fixed and tilted at 23.5° relative to its orbit around the sun. • Interpret that the rotation of Earth on its tilted axis, in conjunction with its revolution around the sun, affects the amount of direct sunlight that each portion of Earth receives in a single day and throughout the year. • Infer that the average daily temperature is related to the amount of direct sunlight received. • Understand that the seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. • Use actual data and measurements for the amount of direct sunlight that the earth receives in a single day, to identify patterns over a period of time. • Differentiate between weather and seasons based on the amount and intensity of sunlight.	5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

	• Create a physical model (including an axis tilted 23.5°) to demonstrate how the angle of sunlight striking Earth's surface causes seasons and varies for different locations at different points in Earth's orbit. • Solar energy collection is most effective in areas that receive direct sunlight for long periods of time. Research specific locations on Earth that receive direct sunlight. Evaluate the data and make a recommendation (using the scientific data) for a location of a solar energy facility. Share and defend the recommendation with the class.	

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
7.LS.1: Matter is transferred continuously between one organism to another and between organisms and their physical environments. Plants use the energy in light to make sugars out of carbon dioxide and water (photosynthesis). These materials can be used and immediately stored for later use. Organisms that eat plants break down plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms. Energy can transform from one form to another in living things. Animals get energy from oxidizing food, releasing some of its energy as heat. The total amount of matter and energy remains constant, even though its form and location change. *Note 1: Chemical reactions are presented as the rearrangement of atoms in molecules.* *Note 2: Chemical reactions in terms of subatomic structures of atoms are not appropriate.*	• Identify the cellular structures primarily responsible for photosynthesis and respiration. • Distinguish between photosynthesis and respiration and illustrate how the two processes are connected. Create a chart that compares the reactants and products of both processes. • Compare and record the reactants and products of both photosynthesis and cellular respiration. • Trace and explain how matter and energy are transferred through an ecosystem. • Plan and conduct an investigation to determine what factors impact photosynthesis in plants that live in aquatic environments (Elodea). • Ethanol, a plant product, is used in place of fossil fuels. Evaluate the pros and cons of using biomass products such as ethanol vs. traditional fossil fuels. Include in the evaluation anticipated real-world effects for production and usage of biomass products vs. traditional fossil fuels.	5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. HS-LS1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds of new

		compounds are formed, resulting in a net transfer of energy. HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
7.LS.2: In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors. The variety of physical (abiotic) conditions that exists on Earth gives rise to diverse environments (biomes) and allows for the existence of a wide variety of organisms (biodiversity). Biomes are regional ecosystems characterized by distinct types of organisms that have developed under specific soil and climatic conditions. Ecosystems are dynamic in nature; the number and types of species fluctuate over time. Disruptions, deliberate or inadvertent, to the physical (abiotic) or biological (biotic) components of an ecosystem impact the composition of an ecosystem. *Note: Predator-prey and producer-consumer relations are addressed in grade 5.*	• Identify the biotic and abiotic elements of the major biomes and describe how they are connected. • Research an endangered species and examine environmental conditions that may contribute to that population's classification. Determine if any conservation efforts have been employed and document whether or not any efforts have been successful. Use evidence to support responses. • Monitor the local environment (e.g., stream, river, construction site) for the impact Ohio's wetland mitigation plans have on water quality (e.g., oxygen levels, pH, phosphorus levels, nitrogen levels) and how the plans will impact living organisms (e.g., algae, diatoms, mussels, insect larvae). • Analyze or critique the impact of Ohio's wetland mitigation plans on a local community or the state as a whole. Include real-world data from the sites in the analysis or critique. Anticipate future trends on the flora and fauna in the ecosystem based upon the real-world data.	MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
7.PS.1: Elements can be organized by properties. Elements can be classified as metals, non-metals and metalloids, and can be organized by similar properties such as color, solubility, hardness, density, conductivity, melting point and boiling point, viscosity, and malleability. *Note: This is the conceptual introduction of the Periodic Table of Elements and should be limited to classifications based on observable properties; it should not include the names of the families.*	• Recognize that the periodic table is organized based on physical properties. • Given a set of elements identify similar properties (for example melting and/or boiling points, conductors of heat and electricity, luster, and brittle) and classify these elements as metals, nonmetals, and metalloids. • Provide students with element samples, tools to conduct tests (brittle vs malleable, electrical conductivity, luster) and facts (melting and/or boiling points) about elements. Have students create a classification system and provide rationale for classification system. • Students present arguments based on a venn diagram to compare and determine which element (by row or column) has the most appropriate properties for a material function. • Students choose the best materials to make a virtual product (for example - a pan, a battery, a chair) that meets specific criteria. • Students will design a virtual fireworks display including which element(s) they would use and what criteria they used for selecting each element. • Identify characteristics of metals, non-metals, and metalloids.	5-PS1-3 Make observations and measurements to identify materials based on their properties. 5-PS1-4 Conduct an investigation to determine whether the mixing of two or more substances results in new substances. MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. HS-PS1-1 Use the periodic table as a model to predict the relative properties of elements. *While not specifically in Ohio Standards, this NGSS standard could be used as a classroom example for this content statement.

7.PS.2: Matter can be separated or changed, but in a closed system, the number and types of atoms remains constant. When substances interact and form new substances the properties of the new substances may be very different from those of the original substances, but the amount of mass does not change. Physically combining two or more substances form a mixture, which can be separated through physical processes.	• Recall the distinguishing properties of elements. • Identify properties of compounds, molecules, and mixtures. • Define open and closed systems. • Identify types of mixtures (eg. solutions, suspensions, and colloids). • Label a diagram to illustrate that energy is required to break a molecule apart in a chemical equation. (See an example in the resources section below) • Distinguish the unique properties and number of atoms of different elements and compounds (hydrogen and oxygen vs. water). (This is not atomic mass). • Display a simple balanced equation using pictorial representations of reactants and products. • Create models of unique compound compositions, including the accurate number elements and atoms. • Investigate why mass is always conserved in a closed system, but volume is not (e.g. Mixing isopropyl alcohol 90% with water). • Design and implement a process in which you create and then separate a mixture using a physical process. (e.g. magnets, screens, separated by physical by appearance) • Analyze an unknown mixture then create and implement a plan to separate the mixture using a physical process.	5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen. 5-PS1-2 Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling or mixing substances, the total weight of matter is conserved. 5.PS1-3 Make observations and measurements to identify materials based on their properties. 5.PS1-4 Conduct an investigation to determine whether the mixing of two or more substances results in new substances.. MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
7.PS.3: Energy can be transformed or transferred but is never lost. When energy is transferred from one system to another, the	• Recognize that energy can change forms but the total amount of energy remains constant. • Make a series of bar graphs that show kinetic energy, potential energy and thermal energy for eight different positions on the roller coaster.	HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

quantity of energy before transfer equals the quantity of energy after transfer. When energy is transformed from one form to another, the total amount of energy remains the same. *Note: Further discussion of energy transformation is addressed at the high school level.*	• Place each set of bar graphs on a different index card for each position and shuffle the cards. Switch index cards and roller coaster designs with another group in the class. Organize the index cards. • Given a project or situation (playing football or a solar powered calculator) students will be able to trace the energy transformations that occur starting with the sun and ending with the object/event. • Design and construct a roller coaster so a marble will travel over a track that involves at least three hills. • Apply the Law of Conservation of Energy to the roller coaster design. • Design and build a solar powered oven. Trace the energy transformations that occurs. • Use design software to make a labeled pictorial representation of the design. • Explain the solutions to problems encountered during testing. • Trace all the energy transformations that occur as the machine performs its task. • Design and construct a machine that performs a simple task in many steps. Use materials that are lying around the classroom and the home. • Test the machine as each additional component is added. • Redesign to solve problems encountered during the testing. • Record any problems encountered as well as the changes made to the machine to overcome these problems.	

7.PS.4: Energy can be transferred through a variety of ways. Mechanical energy can be transferred when objects push or pull on each other over a distance. Mechanical and electromagnetic waves transfer energy when they interact with matter. Thermal energy can be transferred through radiation, convection and conduction. Electrical energy transfers when an electrical source is connected in a complete electrical circuit to an electrical device. *Note 1: Energy transfers should be experiential and observable. This builds upon PS grade 4 and is directly connected to ESS grade 7 (thermal energy transfers in the hydrologic cycle).* *Note 2: Electricity can be measured through current, voltage and resistance. In addition, renewable energy systems should be included (such as wind, geothermal, water or solar).* *Note 3: The types of waves used within this topic include seismic, oceanic, sound and light. Seismic*	• Recognize that thermal energy can be converted to mechanical energy. • Represent the design with a labeled picture constructed with design software. • Orally present the design to the class, explaining how energy is transferred at each step. • Compare the designs of different groups with the effectiveness of the designs. • Use a particle model of matter to explain how energy can be transformed through convection. • Analyze data to determine patterns and trends between design and effectiveness. • Formulate a hypothesis about what design features are most effective. • Evaluate a Rube Goldberg system (from 7.PS.3) and incorporate and identify energy transfers. • Design and construct a candle wheel that will turn a maximum number of times in one minute. • Test the designs from the class to determine the effectiveness of each one. • Anticipate two applications in which the concepts addressed in this design could be used in the real world. • Recognize that the flow of current is the same at all parts of a series circuit. • Organize and clearly represent the data from the experiment. • Compare the results for parallel and series circuits. • Support conclusions with evidence from the experiments. • Explain why the flow of current is the same at all parts of a series circuit. • Plan and implement a scientific experiment to investigate the amount of electric current owing through different positions of both series and parallel circuits.	4-PS4-1 Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. MS-PS3-3 Apply scientific principles to design, construct and test a device that either minimizes or maximizes thermal energy transfer. MS-PS3-5 Construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. MS-PS4-3 Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform

waves also are found in ESS grade 8.	• Analyze the data for series circuits to determine patterns and trends. • Formulate a conclusion that states what happens to the ow of electric current in a series circuit. • Analyze the data for parallel circuits to determine patterns and trends. • Formulate a conclusion that states what happens to the flow of electric current in a parallel circuit. • Compare the design features to determine what features affect the amount of potential energy given to the ball. • With the class, plan a scientific investigation to test and compare the amount of energy of the designs of the different groups in the class. • Implement the test on the class designs. • Formulate a hypothesis about which design features provide the marble with the most potential energy. • Design a way to give a steel marble the most possible potential energy in a pinball machine before it is launched. • Recognize that gravitational potential energy increases with height. • Represent the data graphically. • Support the conclusion with data from the experiment. • Plan and implement a scientific experiment to determine the relationship between the height of a metal sphere and the amount of change it can make to sand that is held in a container. Determine how to quantify the changes to the sand. • Formulate a conclusion about how the height of an object is related to its potential energy.	energy distribution among the components in the system (second law of thermodynamics). HS-PS4-1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

GRADE 8

Strand Connections: Systems can be described and understood by analysis of the interaction of their components. Energy, forces and motion combine to change the physical features of the Earth. The changes of the physical Earth and the species that have lived on Earth are found in the rock record. For species to continue, reproduction must be successful.

EARTH SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
8.ESS.1: The composition and properties of Earth's interior are identified by the behavior of seismic waves. The refraction and reflection of seismic waves as they move through one type of material to another is used to differentiate the layers of Earth's interior. Earth has an inner and outer core, an upper and lower mantle, and a crust. The formation of the planet generated heat from gravitational energy and the decay of radioactive elements, which are still present today. Heat released from Earth's core drives convection currents throughout the mantle and the crust. *Note: The thicknesses of each layer of Earth can vary and be transitional, rather than uniform and distinct as often depicted in textbooks.*	• Identify properties of earth's four main layers (inner core, outer core, mantle, crust) • Demonstrate seismic wave motions and speeds using a slinky. • Use a density column to illustrate how the Earth's layers differentiated during formation. • Interpret Earth's interior using a variety of cross sections, models, seismic data, and charts. • Demonstrate that Earth can't be homogenous by analyzing a seismic record station to predicted arrivals from a homogenous Earth model. • Create a model to compare the Earth's chemical layers with the physical layers. • Use data from seismic waves to draw conclusions about the Earth's core. • Test how the speed of a wave changes when traveling through different densities by measuring how fast a set of dominos at varied spacing fall. • Research current technologies that are used to study the interior of the earth (e.g. satellites, gps, tomography). Evaluate if seismic data is the most effective way to identify the Earth's interior.	HS-ESS2-3 Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
8.ESS.2: Earth's lithosphere consists of major and minor	• Describe the historical evidence of plate tectonics, including the early observations, discoveries and ideas that combined to eventually lead to the modern theory of plate tectonics.	MS-ESS2-2 Construct an explanation based on evidence for how geoscience

tectonic plates that move relative to each other. Historical data and observations such as fossil distribution, paleomagnetism, continental drift and seafloor spreading contributed to the theory of plate tectonics. The rigid tectonic plates move with the molten rock and magma beneath them in the upper mantle. Convection currents in the crust and upper mantle cause the movement of the plates. The energy that forms convection currents comes from deep within the Earth. There are three main types of plate boundaries: divergent, convergent and transform. Each type of boundary results in specific motion and causes events (such as earthquakes or volcanic activity) or features (such as mountains or trenches) that are indicative of the type of boundary.	• Use rock and fossil data to recreate the position of the continents at various points in history. • Graph the age of the Hawaiian Islands and other seamounts and their distance from Kilauea to determine the speed and direction the Pacific Plate is moving due to plate tectonics. See Instructional Resources - Hawaiian Island Age. • Use current data to map the age of the seafloor at spreading center such as the Mid-Atlantic Ridge. Model seafloor spreading at mid-ocean ridges. • Investigate, using magnetic data from new technology and the rock record, the pattern of reversing magnetism within Earth's core. Generate a chart or graph to represent findings. Using historical data, predict a time range for when the next reversal could occur. Share findings with the class and be prepared to discuss what impact the reversal could have for humans. • Model the mechanism for plate movement (e.g. convection currents in the asthenosphere). • Explore extenuating circumstances that cause earthquakes to occur on the interior of the plate (e.g. fracking, movement along faults). • Recognize that oceanic crust is more dense and thinner than continental lithosphere. Observe the depths of earthquake foci for different types of plate boundaries. *See Instructional Resources - Iris IEB* • Model movements at different plate boundaries (convergent, divergent, and transform) and lithospheric interactions (continental-continental, continental-oceanic, and oceanic-oceanic) using manipulatives. • Identify the standard geologic features or events that occur at each of the boundaries (e.g., oceanic trenches are formed at converging plate boundaries, oceanic ridges form at diverging plate boundaries).	processes have changed Earth's surface at varying time and spatial scales. MS-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effect. HS-ESS1-5 Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. HS-ESS2-1 Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

	• Measure the difference in density between granite and basalt; analyze the role of density in lithospheric interaction. • Determine types of plate boundaries based on geologic data (location and magnitude of earthquakes and volcanoes, elevation, and age of ocean crust). • Differentiate between plate tectonics and continental drift. • Using a world map, mark the locations of all earthquakes and volcanoes that are recorded each week for one month (or longer). Use a different color or pattern so that earthquakes and volcanoes can be differentiated. Outline the boundaries of where the concentrations are located. Compare/contrast this map with a map of plate boundaries. Ask: What types of boundaries are found in the volcano areas? What types are found in earthquake areas? Discuss findings with the class. • Research the implications of plate tectonics and produce an artifact to answer one or more of the following questions: 1. What consequences might be encountered if the continents joined together again (Pangaea Ultima)? 2. What will the Earth look like in 250 million years? How will life be different than today? 3. Where is the best place to live to avoid natural disasters caused by tectonic plates? • Research the most recent measurements of North America. Using this data and the movement of North America throughout geologic time, predict where North America will be in 600 million years or more. Create a model to demonstrate that movement. • Research and determine the effectiveness of current warning systems in tectonically active regions. Suggest changes or improvements.	

8.ESS.3: A combination of constructive and destructive geologic processes formed Earth's surface. Earth's surface is formed from a variety of different geologic processes, including but not limited to plate tectonics. *Note: The introduction of Earth's surface is found in ESS grade 4.*	• Using a topographic map or simulation, explain the processes that created the features moraines, outwash, fills, erratics, kettles, eskers. • Recognize the difference between weathering and erosion. • Identify features of a surface using a topographic map. • Compare and contrast gradual and catastrophic destructive processes (erosion vs landslide). • Construct a topographic map to identify land features. • Devise a stream table to model factors (e.g. glacial activity, tectonic activity, gradient, discharge rate, load) that affect the rates of erosion and deposition in a stream meander over time. • Research and develop a regional solution to minimize the impacts of mass-wasting events (e.g. flooding, landslides, mudflows, sinkholes, rockfalls).	MS-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. HS-ESS2-1 Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
8.ESS.4: Evidence of the dynamic changes of Earth's surface through time is found in the geologic record. Earth is approximately 4.6 billion years old. Earth history is based on observations of the geologic record and the understanding that processes observed at present day are similar to those that occurred in the past (uniformitarianism). There are different methods to determine relative and absolute age of some rock layers in the geologic record. Within a sequence of undisturbed	• Research Siccar Point, Scotland, where James Hutton developed the theory of uniformitarianism. • Conduct a gallery walk of different rock types (coal, sandstone, limestone, and shale, granite, and basalt). • Analyze ice core data to reconstruct a region's past environmental and climate conditions. • Identify patterns in ice core data to hypothesize the relative composition of present-day and future ice cores. • Conduct a local field study or research the geological record of Ohio (virtual/digital) to deconstruct the past geologic record and make a claim as to how events in the past shaped present-day Ohio. Provide evidence to support your claim. See Instructional Resources - Ohio Geologic Record Data.	MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history. HS-ESS1-5 Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. HS-ESS1-6

sedimentary rocks, the oldest rocks are at the bottom (superposition). The geologic record can help identify past environmental and climate conditions. *Note: Environmental and climate conditions also can be documented through the cryosphere as seen through ice cores.*	• Explain why certain industries are located in Ohio by deconstructing the Ohio geologic record virtually or through local field studies. (quarries, mines, etc.) • Describe the methods used by scientists to determine that the age of Earth is approximately 4.6 billion years. • Arrange Rock Layers based on index fossils. See Instructional Resources - Rock Layers & Index Fossils. • Model relative dating principles with colored layers with manipulatives (e.g. gelatin, pancakes and frosting, clay). • Conduct an online simulation to determine which radiometric dating method would be best to use for a given fossil and determine that fossil's age. See Instructional Resources - Radiometric Dating Phet Simulation. • Choose a specific geologic time period and location on Earth that has geologic rock record data. Represent the geologic time period graphically (using technology or manually). Include specific formation information. Share the final product with the class. • Identify the relative ages of rock by building a model from layers of clay or other material that can be layered and take core samples with straws. • Research geologic features and determine if they could be utilized or adapted to investigate the geologic record. • Using technology, investigate the geologic record virtually to collect data and conduct scientific investigations through 60-70 million years of geologic time. Analyze data and document all changes verified by the data. Discuss conclusions and findings with the entire class.	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

LIFE SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
8.LS.1: Diversity of species, a result of variation of traits, occurs through the process of evolution and extinction over many generations. The fossil records provide evidence that changes have occurred in number and types of species. Fossils provide important evidence of how life and environmental conditions have changed. Changes in environmental conditions can affect how beneficial a trait will be for the survival and reproductive success of an organism or an entire species. Throughout Earth's history, extinction of a species has occurred when the environment changes and the individual organisms of that species do not have the traits necessary to survive and reproduce in the changed environment. Most species (approximately 99 percent) that have lived on Earth are now extinct. *Note: Population genetics and the ability to use statistical mathematics to predict changes in a gene pool are reserved for grade 10.*	• Define and give examples of index fossils. • Define and give examples of transitional fossil forms. • Use evidence from geologic and fossil records to infer what the environment was like at the time a specific organism lived. • Recognize that approximately 99% of all species that have ever existed on Earth are extinct. • Compare and contrast the ability of organisms to survive under different environmental conditions. Allow students to investigate structural differences in organisms of past and present that have enabled some species to survive while others have become extinct due to environmental changes (sudden or gradual) that have occurred in the past (e.g. peppered moths, crayfish fossils found in Antarctica).	MS-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and difference among modern organisms and between modern and fossil organisms to infer evolutionary relationships. HS-LS2-8 Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

8.LS.2: Reproduction is necessary for the continuation of every species. Every organism alive today comes from a long line of ancestors who reproduced successfully every generation. Reproduction is the transfer of genetic information from one generation to the next. It can occur with mixing of genes from two individuals (sexual reproduction). It can occur with the transfer of genes from one individual to the next generation (asexual reproduction). The ability to reproduce defines living things.	• Describe the features of sexual and asexual reproduction related to the transfer of genetic information from parent to offspring. • Observe microscopic organisms that reproduce asexually and/or sexually (e.g. paramecium, hydra, aphids, human sex cells). • Compare sexual and asexual reproduction and discuss the advantages and disadvantages. • Explain why genetic variation is a survival advantage. • Examine offspring in plants that are produced sexually. Note and record variations that appear. Determine how the variations may help an organism to survive if the environment should change (e.g., warmer or cooler temperatures, increase or decrease in precipitation). • Research cloning in the biotechnology industry. Select one practice and determine whether or not it is a biologically sound practice. Justify your position with scientific evidence. • Create a concept map comparing and contrasting the end products of Mitosis and Meiosis.	MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
8.LS.3: The characteristics of an organism are a result of inherited traits received from parent(s). Expression of all traits is determined by genes and environmental factors to varying degrees. Many genes influence more than one trait, and many traits are influenced by more than one gene. During reproduction, genetic information (DNA) is transmitted between parent and offspring. In asexual reproduction, the lone	• Analyze a pedigree chart to determine whether a given trait is dominant, codominant, or recessive. • Research artificial selection (genetic modification, animal husbandry, gene therapy) in society. Select one practice and determine how that practice has changed the way humans influence the inheritance of desired traits in organisms. Justify your position with scientific evidence.	MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

parent contributes DNA to the offspring. In sexual reproduction, both parents contribute DNA to the offspring. *Note 1: The focus should be the link between DNA and traits without being explicit about the mechanisms involved.* *Note 2: The ways in which bacteria reproduce is beyond the scope of this content statement.* *Note 3: The molecular structure of DNA is not appropriate at this grade level.*		

PHYSICAL SCIENCE

STANDARD	EVIDENCE OF LEARNING Students who demonstrate understanding can:	NGSS CORRELATION
8.PS.1: Objects can experience a force due to an external field such as magnetic, electrostatic, or gravitational fields. Magnetic, electrical and gravitational forces can act at a distance. *Note: Direct contact forces were addressed in the elementary grades*	• Describe the behavior of objects in a gravitational field. • Recognize that all objects with mass are attracted to each other. • Explain how mass and distance affect the magnitude of the gravitational force acting on two objects. • Differentiate between the concepts of mass and weight. • Investigate real world data to make predictions of the impacts on Earth (e.g. tides, earth's tilted axis, rotation speed) if the Moon's orbital distance or mass should increase or decrease. • Build a device, such as a homemade electroscope, that can detect the presence of an electrical charge. • Observe and document the patterns of magnetic fields around magnets (include examples of repulsion and attraction). • Build a simple electromagnet to investigate how an electrical current generates a magnetic field. • Design an experiment to test factors that affect the strength of an electromagnet (e.g. number and tightness of coils, size and type of core, current and voltage of circuit, wire type). • Design and build a prototype of a device that uses the force of attraction to lift and release an object of a certain mass to assist in the sorting of materials at a recycling center or salvage center. • Identify the behavior of objects with charge in an electrical field. (include examples of repulsion and attraction). • Differentiate between electrical charges and magnetic poles. • Construct a visual representation of the forces on objects as the type of electrical charge and/or distance between them change. • Design and build a game that moves an object using electrical charges (e.g. obstacle course, hockey). • Recognize that a magnetic object can exert a magnetic force on other objects located in the magnetic field. • Recognize that the magnetic force increases as the strength of the magnet increases. • Recognize that the magnetic force decreases when the distance from the magnet increases.	MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. HS-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. HS-PS3-5 Develop and use a model of two objects interacting through electrical or magnetic fields to illustrate the forces between objects and the

	• Create labeled diagrams and descriptions to communicate how various charged and uncharged objects react in the presence of an electric field. • Using the simulation titled Coulomb's Law, plan and implement a scientific investigation to determine the relationship between either distance and force or charge and force for two charges. Analyze the data to determine patterns and trends. Formulate a conclusion about the relationship. • Recognize that objects with mass can exert a gravitational force on other objects located in the gravitational field. • Recognize that gravitational force is directly proportional to mass. • Recognize that gravitational force decreases when the distance when the distance between the two masses increases. • Design an experiment to investigate the size and strength of the magnetic field around magnetic objects. The investigation can be done hands on (with materials such as a compass, iron filings, and/or magnetic field sensor) or using virtual technology. The investigation should include magnets of different size and strength. • Students design a magnetometer to measure the Interplanetary Magnetic Field (IMF). • Plan an investigation to determine how the arrangement of objects interacting at a distance impacts the amount of gravitational potential energy that is stored in the system. • Design and build a prototype of a device that can be attached to a crane to lift and move cars made of iron. The force of attraction lifting the car must be able to be released to deposit the cars in the desired location. • Test the designs of different groups in the class to determine which design can lift the largest mass.	changes in energy of the objects due to the interaction.
8.PS.2: Forces can act to change the motion of objects.	• Recognize that the motion of objects is determined with respect to a reference point.	3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of

The motion of an object is always measured with respect to a reference point. Forces can be added. The net force on an object is the sum of all of the forces acting on the object. The net force acting on an object can change the object's direction and/or speed. When the net force is greater than zero, the object's speed and/or direction will change. When the net force is zero, the object remains at rest or continues to move at a constant speed in a straight line.	• Explain the motion of an object based on multiple reference points. • Recognize that an unbalanced force acted on an object changes that object's speed and/or direction. • Recall that friction opposes the motion of objects. • Create a force/free body diagram to illustrate the combined forces acting on an object. • Investigate the effects of kinetic friction on moving objects (e.g. experiment with moving objects across various surfaces). • Design an experiment to test the effect of multiple forces on the motion of an objects (e.g. cars or marbles and ramps, student tug-o-war, spring launchers with different force amounts and objects). • Design and build a prototype to reduce the effects of friction on a moving object.	balanced and unbalanced forces on the motion of an object. MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

Approved textbook and material list

Grades K-5

Level 1 – Excellent quality - scored mostly 3's with one or two 2's on all criteria of the review rubric.
Level 2 – High quality - scored mostly 3's and some 2's on the criteria of the review rubric.
Level 3 – Good Quality - scored a mixture of 3's, 2's and 1's on the criteria of the review rubric. Either the program was incomplete, unclear on alignment to standards or didn't seem to meet Diocesan needs based on feedback.

Program	Level	Contact
National Geographic / Cengage, K-6	1	Ashley Grove Learning Consultant | Ohio | Grades K-8 National Geographic Learning | Cengage Learning (cell) 513-306-6967 ashley.grove@cengage.com
Interactive Science, K-5	1	Sarah Baker North America School Services Pearson 614.531.7601 sarah.baker@pearson.com
Science Fusion, K-5	2	Jackie Grisvard Ohio Account Executive Houghton Mifflin Harcourt Mobile: 614.783.6363 Jackie.Grisvard@hmhco.com
Inspire Science, K-5	2	Barbara Hopkins Catholic Diocesan Sales Rep OH & KY C: 614.216.0725 barbara.hopkins@mheducation.com
*Amplify	3	Jackie Roper, M.Ed. Sr. Account Executive Amplify.com | 312.202.2598 jroper@amplify.com
*Science A-Z	3	Jane Harlamert, M. Ed. Field Account Executive Ohio and Kentucky Cell: 614-783-4244 Office: 866-889-3731 X 5076

Program	Level	Contact
		Fax: 520-618-3723 jane.harlamert@learninga-z.com
*Discovery Techbook	3	Joseph Rotondo Manager | Ohio/Mid-Atlantic Education Partnerships Discovery Education M: 614.202.2532

*These are online textbook/resources only.

Grades 6-8

Level 1 – Excellent quality-scored mostly 3's with one or two 2's on all criteria of the review rubric.
Level 2 – High quality-scored mostly 3's and some 2's on the criteria of the review rubric.
Level 3 – Good Quality- scored a mixture of 3's, 2's and 1's on the criteria of the review rubric. Either the program was incomplete, unclear on alignment to standards or didn't seem to meet Diocesan needs based on feedback.

Program	Level	Contact
Interactive Science, 6-8	1	Sarah Baker North America School Services Pearson 614.531.7601 sarah.baker@pearson.com
Science Fusion, 6-8	2	Jackie Grisvard Ohio Account Executive Houghton Mifflin Harcourt Mobile: 614.783.6363 Jackie.Grisvard@hmhco.com
*Inspire Science, 6-8	3	Barbara Hopkins Catholic Diocesan Sales Rep OH & KY C: 614.216.0725 barbara.hopkins@mheducation.com
*Amplify	3	Jackie Roper, M.Ed. Sr. Account Executive Amplify.com | 312.202.2598 jroper@amplify.com
*Discovery Ed Techbook	3	Joseph Rotondo Manager | Ohio/Mid-Atlantic Education Partnerships Discovery Education M: 614.202.2532

*With reservations, Amplify is only aligned to NGSS standards, Discovery Techbook is only digital, and McGraw-Hill will not have the Ohio aligned textbooks available until the start of the school year.

High School

Level 1 – Excellent quality-scored mostly 3's with one or two 2's on all criteria of the review rubric.
Level 2 – High quality-scored mostly 3's and some 2's on the criteria of the review rubric.
Level 3 – Good Quality- scored a mixture of 3's, 2's and 1's on the criteria of the review rubric. Either the program was incomplete, unclear on alignment to standards or didn't seem to meet Diocesan needs based on feedback.

Program	Level	Contact
McGraw-Hill content-specific textbooks	1	Barbara Hopkins Catholic Diocesan Sales Rep OH & KY C: 614.216.0725 barbara.hopkins@mheducation.com
HMH content-specific textbooks	2	Jackie Grisvard Ohio Account Executive Houghton Mifflin Harcourt Mobile: 614.783.6363 Jackie.Grisvard@hmhco.com
Pearson content-specific textbooks	2	Sarah Baker North America School Services Pearson 614.531.7601
National Geographic/ Cengage	3	Adam Clausen Learning Consultant National Geographic Learning | Cengage Learning Cell: 727.488.2257 Check Out Our Catalog All K-12 Resources Your Solution for AP & CTE courses
Discovery Ed Techbook	3	Joseph Rotondo Manager | Ohio/Mid-Atlantic Education Partnerships Discovery Education M: 614.202.2532