K-12 SCIENCE EDUCATION VISION

A K-12 Dublin City Schools science education engages *all students* in critical thinking and problem solving as they experience science and engineering. We believe that students can become scientifically literate citizens equipped with the knowledge and skills demanded by the ever-changing future, whether in the workforce or higher education.

We believe in developing our learners through high quality experiences that include:

- A challenging, collaborative and inquiry based environment.
- Opportunities to solve and investigate real-world problems that require critical and global thinking.
- Opportunities for students to build an identity as a scientist, able to interpret the natural world, participate productively in scientific practices and contribute to society in meaningful ways.
- Opportunities to research, generate and evaluate evidence and explanations that uphold or refute scientific data.

We believe these learning experiences will grow independent, confident students who will become creative, innovative adults that are capable of using informed scientific judgement to improve their world.

Instructional Agreements for Science Learning within the Dublin City Schools

1. Learning goals will be communicated to guide students through the expectations of science learning using a variety of instructional techniques and technology integration.
2. Teachers will ensure a safe, challenging learning environment focused on inquiry and science exploration.
3. Teachers will provide support to students as they learn to frame questions, assess and analyze data, and create and critique explanations – all important components of scientific and engineering practices.
4. Content standards will be learned in partnership with Ohio's Cognitive Demands for Science, Science and Engineering Practices and Nature of Science practices.

Dublin City Schools Science Graded Course of Study

Nature of Science	
One goal of science education is to help students become scientifically literate citizens 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 and to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact both themselves and others.	
Scientific Inquiry, Practice and Applications	All students must use these scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas.
Science is a Way of Knowing	Science assumes the universe is a vast single system in which basic laws are consistent. 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 Human Endeavor	Science has been, and continues to be, advanced by individuals of various races, genders, ethnicities, languages, abilities, family backgrounds and incomes.
Scientific Knowledge is Open to Revision in Light of New Evidence	Science is not static. Science is constantly changing as we acquire more knowledge.

Scientific and Engineering Practices:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Ohio's Cognitive Demands for Science	
Cognitive Demand	**Description**
DESIGNING TECHNOLOGICAL/ ENGINEERING SOLUTIONS USING SCIENCE CONCEPTS	Requires students to solve science-based engineering or technological problems through application of scientific inquiry. Within given scientific constraints, propose or critique solutions, analyze and interpret technological and engineering problems, use science principles to anticipate effects of technological or engineering design, find solutions using science and engineering or technology, consider consequences and alternatives, and/or integrate and synthesize scientific information.
DEMONSTRATING SCIENCE KNOWLEDGE	Requires students to use scientific practices and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather and organize data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments. (Slightly altered from National Science Education Standards)
INTERPRETING AND COMMUNICATING SCIENCE CONCEPTS	Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.
RECALLING ACCURATE SCIENCE	Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

GRADE 3

Grade 3 Course Goals:

Students in Grade 3 will focus on exploring the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry. Students will learn about the Earth's resources and matter and forms of energy and behavior, growth and changes.

Strand Connections:

Matter is what makes up all living and nonliving 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 for materials and energy. There are many different forms of energy. Each living component of an ecosystem is composed of matter and uses energy.

EARTH AND SPACE SCIENCE (ESS)	
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.	
Content Statement	**Content Elaboration**
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 soils 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.	The properties of air and water are introduced in the early elementary grades, so the focus at the third grade level is on soil and rocks. Air and water are present within rocks and soil. Air and water also play an important role in the formation of rocks and soil. All are considered nonliving resources. The characteristics of rocks and soil are studied through sampling, observation and testing. This testing includes the ability of water to pass through samples of rock or soil and the determination of color, texture, composition and moisture level of soil. Measurable and observable characteristics of rocks include size and shape of the particles or grains (if present) within the rock, as well as, texture and color or the rock. Age-appropriate tools are used to test and measure the properties. The characteristics of the rock can help determine the environment in which it formed. Technology can be used to analyze and compare test results, connect to other classrooms to compare data or share samples and document the findings.
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	Distinguishing between renewable and nonrenewable resources through observation and investigation is the emphasis for this content statement. This can be connected to learning about the different forms of energy (PS grade 3). Electrical circuits or solar

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.	panel models can be used to demonstrate different forms of energy and the source of the energy. The conservation of energy is explored within the content statement. Some of Earth's resources are limited. Specific energy sources in Ohio are introduced, such as fossil fuels found in Ohio, new energy technologies and the development of renewable energy sources within Ohio. Ohio can be compared to other states regarding energy sources.
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.	Within third grade, the focus is on the different types of Earth's resources, how they are used and how they can be conserved. Scientific data should be used to evaluate and compare different methods of conservation (e.g., effectiveness of different kinds of recycling such as paper vs. metal). The concentration is the science behind the conservation of resources and why certain resources are limited. Reducing or limiting the use and/or waste of resources should be emphasized (rather than concentrating only on recycling of resources).

PHYSICAL SCIENCE (PS)	
Topic: Matter & Forms of Energy - Changing States of Matter 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.	
Content Statement	**Content Elaboration**
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.	Objects are composed of matter and matter has observable properties. Matter is anything that has mass and takes up space. All solids, liquids and gases are made of matter. The atomic and subatomic nature of matter is not appropriate at this grade level. Mass is defined as a measure of how much matter is in an object. The more matter there is in an object, the greater the mass. Volume is a measure of the amount of space an object occupies. Provide opportunities to investigate and experiment with different methods of measuring mass and liquid volume using the metric system and nontraditional units (e.g., nails, paper clips). Objects are made of smaller parts, some too small to be seen even with magnification. Matter continues to exist, even when broken into pieces too tiny to be visible.
3.PS.2: Matter exists in different states, each of	Gases, liquids and solids are different states of matter that have different properties.

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.	Liquids and solids do not compress into a smaller volume as easily as do gases. Liquids and gases flow easily, but solids do not flow easily. Solids retain their shape and volume (unless a force is applied). Liquids assume the shape of the part of the container that they occupy (retaining their volume). Gases assume the shape and volume of their containers. Only solids, liquids and gases are appropriate at this grade level, even though other phases have been identified. Heating may cause a solid to melt to form a liquid or cause a liquid to boil or evaporate to form a gas. The differences between boiling and evaporation are not appropriate at this grade level. Cooling may change a gas into a liquid or cause a liquid to freeze and form a solid. Conducting experiments or investigations that demonstrate phase changes, such as the melting or freezing of substances other than water (e.g., vinegar, vegetable oil, sugar, butter), can be used to reinforce the concept that materials other than water also go through phase changes.
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.	Examples of energy causing motion or creating change include a falling rock causing a crater to form on the ground, heating water causing liquid water to change into a gas, light energy from the sun contributing to plant growth, electricity causing the blades of a fan to move, electrically charged objects causing movement in uncharged objects or other electrically charged objects, sound from a drum causing rice sitting on the drum to vibrate and magnets causing other magnets and some metal objects to move. Investigations (3-D or virtual) are used to demonstrate the relationship between different forms of energy and motion. It is not appropriate at this grade level to explore the different types of energy in depth or use wave terminology when discussing energy. These will be developed at later grades. There often is confusion between the concepts of force and energy. Force can be thought of as a push or pull between two objects and energy as the property of an object that can cause change. If forces actually push or pull something over a distance, then there is an exchange of energy between the objects. The differences between force and energy will be developed over time and are not appropriate for this grade level. The word “heat” is used loosely in everyday language, yet it has a very specific scientific meaning. Usually what is called heat is actually thermal or radiant energy. An object has thermal energy due to the random movement of the particles that make up the object. Radiant energy is that which is given off by objects through space (e.g., warmth from a fire, solar energy from the sun). “Heating” is used to describe the transfer of thermal or radiant energy to another object or place. Differentiating between these concepts is not appropriate at this grade. However, the word “heat” has been used with care so it refers to a transfer of thermal or radiant energy.

LIFE SCIENCE (LS)	
Topic: Behavior, Growth and Changes - Plant and Animal Life Cycles 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.	
Content Statement	**Content Elaboration**
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.	Organisms are similar to their parents in appearance and behavior but still show some variation. Although the immature stages of some living things may not resemble the parents, once the offspring matures, it will resemble the parent. At this grade level, the focus is on establishing, through observation, that organisms have a reliable mechanism for ensuring that offspring resemble their parents. It is not appropriate or necessary to introduce the genetic mechanisms involved in heredity; however, care should be taken to avoid introducing the misconception that the individual organism has a way to select the traits that are passed to the next generation. As part of the study of the life cycle of organisms, the physical appearance of the adults will be compared to the offspring (e.g., compare butterflies to determine if offspring look exactly like the parents). A considerable amount of animal behavior is directly related to getting materials necessary for survival (e.g., food, shelter) from the environment and this influences what an animal learns. The focus at this grade level is on examples provided through observation or stories of animals engaging in instinctual and learned behaviors. Some organisms have behavioral traits that are learned from the parent (e.g., hunting). Other behavioral traits are in response to environmental stimuli (e.g., a plant stem bending toward the light). At this grade level, the definition of either instinctual or learned behavior is not necessary. The focus is on making observations of different types of plant and animal behavior. Technology (e.g., a webcam) can be used to observe animals in their natural or human-made environments. Note: Human genetic study is not recommended since not all students may have information available from their biological parents.
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 and animals have certain	Organisms have different structures and behaviors that serve different functions. Some plants have leaves, stems and roots; each part serves a different function for the plant. Some animals have wings, feathers and beaks; each part serves a different function for the animals. The observation of body parts should be limited to gross morphology and not microscopic or chemical features. Comparison across species is not appropriate at this grade level; only observation of variation within the same species is expected. This

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.	content statement can be combined with the observation of the life cycles of organisms and/or the observation of the similarity between offspring and parents. There may be variations in the traits that are passed down that increase the ability of organisms to survive and reproduce. Some variations in traits that are passed down may reduce the ability of organisms to survive and reproduce. Some variations in traits that are passed down may have no appreciable effect on the ability of organisms to survive and reproduce. Variations in physical features among animals and plants can help them survive in different environmental conditions. Variations in color, size, weight, etc., can be observed as the organism develops. Plants and animals that survive and reproduce pass their features (traits) on to their offspring and future generations. Some grade-appropriate organisms to study are plants (e.g., radishes, beans) and animals (e.g., butterflies, moths, beetles, brine shrimp). Comparisons can be made in nature or virtually. Tables and diagrams (e.g., Venn) can be used to illustrate the similarities and differences between individuals of the same type.
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.	Plants and animals have life cycles that are adapted to survive in distinct ecosystems (e.g., trees lose their leaves in the winter to conserve water). Most life cycles start with birth, budding or germination, then progress to growth, development, adulthood, reproduction and death. The process can be interrupted at any stage. The details of the life cycle are different for different organisms. Observation of the complete life cycle of an organism can be made in the classroom (e.g., butterflies, mealworms, plants) or virtually. Hand lenses, magnifying lenses, metric rulers and scales are some of the tools that can be used to question, explore and investigate the physical appearance of living things. When studying living things, ethical treatment of animals and safety must be employed. Respect for and proper treatment of living things must be modeled. For example, shaking a container, rapping on insect bottles, unclean cages or aquariums, leaving living things in the hot sun or exposure to extreme temperatures (hot or cold) must be avoided. The National Science Teachers Association (NSTA) has a position paper to provide guidance in the ethical use and treatment of animals in the classroom for review.