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.

KINDERGARTEN

Kindergarten Course Goals:
Students in kindergarten will focus on developing the skills for systematic discovery to understand the science of the physical world around them in greater depth by using scientific inquiry. Students will learn about daily and seasonal changes, properties of everyday objects and materials and physical and behavioral traits of living things.

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 AND SPACE SCIENCE (ESS)	
Topic: Daily & Seasonal Changes in the Weather and Sky This topic focuses on observing, exploring, describing and comparing weather changes, patterns in the sky and changing seasons.	
Content Statement	**Content Elaboration**
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.	Wind, temperature and precipitation are components of the weather that can be observed and measured for kindergarten. The measurements collected and tools used can be nonstandard and must be age appropriate. For example, the temperature may be above or below a given point (warmer or colder) or the amount of snow may be marked on a dowel rod to check the depth. Weather measurements should be collected on a regular basis throughout the school year and then compared, explained and discussed each week and each month. At the end of the school year, a comparison can be made and seasons can be identified by the patterns that were measured throughout the year. Consistent review and questioning to deepen understanding are essential. Use technology to study weather events, record classroom data, compare classroom data to local data, communicate and share data with other classrooms.
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.	Changes in the position of the sun in the sky can be measured and recorded at different times during the school day. Observations can also be made virtually. This data can be compared from month to month to monitor changes. Stars, groups of stars and different phases of the moon can be observed through books or virtually and documented throughout the month. The names of the stars, constellations or moon phases are not appropriate for kindergarten; only the changes in appearances

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.	that can be observed are included. At times, the moon can be observed in the daylight. Drawings, photographs or other graphics can be used to document student observations. Demonstrating (either 3-D or virtual) and testing/experimenting (through kits or models) can be used to explain the changing positions (in the sky) of the sun, stars and moon. Review, question and discuss the demonstrations and observations to deepen understanding.

LIFE SCIENCE (LS)	
Topic: Physical and Behavioral Traits of Living Things This topic focuses on observing, exploring, describing and comparing living things in Ohio.	
Content Statement	**Content Elaboration**
K.LS.1: Living things have specific characteristics and traits. Living things grow and reproduce. Living things are found worldwide.	The emphasis of this content statement is to build a grade-appropriate understanding of what it means to be living, not to distinguish living and nonliving. Nonliving things often share some characteristics with living things (e.g., a fire uses energy and grows). Simply listing the characteristics that distinguish living things from nonliving things is not appropriate at this grade level. There are different kinds of living things. The focus is on familiar organisms (e.g., grass, trees, flowers, cats, dogs, horses). Some grade-appropriate characteristics include that living things grow, reproduce, require energy and respond to stimuli. Animals need food for energy; plants acquire energy from the sun. Living things respond to stimuli (e.g., fish in an aquarium respond to the addition of food). Living things grow (e.g., seedlings placed in soil grow). Conduct experiments and explorations to observe what happens when plants are placed in different classroom habitats (e.g., on the floor, in a closet, on a desk). Some observations can also be done virtually. When studying living things, ethical treatment of animals, safety procedures and proper hygiene 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.
K.LS.2: Living things have physical traits and behaviors, which influence their survival. Living	At this grade level, providing exposure through personal observation and stories to a large variety of living things is required. The focus is not on naming the structures of

things are made up of a variety of structures. Some traits can be observable structures. Some of these structures and behaviors influence their survival.	living things but associating through interaction and observation that living things are made of structures, and because of those structures, living things can do specific activities. Identify and discuss examples, such as: birds having wings for flying and beaks for eating; dogs having eyes for seeing, teeth for chewing and legs for moving; trees having leaves to capture sunlight and trunks for support. Concrete experiences are necessary to deepen knowledge of the traits and behaviors of living things. Technology can be used to compare data on the number of honeybees observed in the schoolyard with other schools. Additional inquiry investigations include conducting observations of pond water (focusing on macroscopic organisms), raising a classroom pet (check for student allergies), bird watching, noting differences between different types of plants and planting seeds and watching them grow.

PHYSICAL SCIENCE (PS)	
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.	
Content Statement	**Content Elaboration**
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.	In kindergarten, the concept that objects are made of specific materials (e.g., clay, cloth, paper, metal, glass) is reinforced. Objects have certain properties (e.g., color, shape, size, temperature, odor, texture, flexibility) that can be described, compared and sorted. Students should not use the sense of taste as a way of observing an unknown substance. Observations are limited to descriptors such as hot, warm, cold, heavy and light. Comparisons of objects are a precursor to measurement. Comparisons are used to sort and describe objects (e.g., is the wooden block heavier or lighter than the plastic block?). Standard and nonstandard measuring tools can give additional information about the environment and can be used to make comparisons of objects and events. Magnifiers can be used to see detail that cannot be seen with the unaided eye. Familiar objects from home, the classroom or the natural environment can be explored and investigated.
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	Sound can be made in many ways. Objects like cymbals, the tabletop or drums can be tapped to produce sound. Objects like a rubber band or a guitar string can be plucked to produce sound. Objects like a bottle or a trumpet can be blown into to produce

are produced vary depending on the properties of objects. Sound is produced when objects vibrate.	sound. A wide variety of sounds can be made with the same object (e.g., a plastic bottle could be tapped or blown into). The connection between sound energy and the vibration of an object must be made. Vibrations can be made visible as water splashes when a cymbal or triangle is placed in water or when rice vibrates on the top of a banging drum. The concepts of pitch (low vs. high notes) and volume (loudness) are introduced. Sound needs to be experienced, investigated and explored through observations and experimentation. Standard, virtual and student-constructed instruments can be used to explore sound. Wave descriptions of sound and the propagation of sound energy are not appropriate at this grade level.