DUBLIN
CITY SCHOOLS

K-12 SCIENCE
Graded Course of Study
2025

A K-12 Dublin City Schools science education aims to create lifelong learners who are curious, critical thinkers, and effective collaborators, equipped with the scientific knowledge and skills necessary to navigate and shape a complex and ever-changing world.

Our vision is to inspire students to develop a deep appreciation for science and its applications, empowering them to:

- Ask questions, seek answers, and explore the natural world with a sense of wonder and curiosity.
- Think critically and creatively to solve problems and make informed decisions as a scientifically literate citizen.
- Communicate and collaborate effectively in our diverse community and beyond to address common challenges and create innovative solutions.
- Build their own identity as a scientist in order to apply scientific concepts and methods to understand and address real-world issues competently and confidently.
- Develop the resilience, adaptability, and perseverance needed to succeed in a rapidly evolving world.

Instructional Agreements for Science Learning within the Dublin City Schools

- Teachers will provide opportunities for students to engage in hands-on experiences, projects, and real-world simulations to provide context and relevance to science concepts.
- Teachers will create an environment that emphasizes the importance of effort, perseverance, and reflection in order to learn and grow from both success and failure.
- Content standards will be learned in conjunction with best practices regarding science education.

Together, we will cultivate resourceful, adaptable, and collaborative individuals with the ability to tackle real-world challenges with resilience and innovation.

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	
Educators will refer to "Ohio's Cognitive Demands for Science" to create experiences for students to engage in science content and demonstrate understanding of scientific concepts in ways that align with current research about how people learn.	
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.

Advanced Research in Science

Course Description:
This course will facilitate advanced learning of the philosophy of science, research methods, science writing and reporting, statistical analysis of results, lab and/or fieldwork methods, and ethical concerns. This is an individual research course in which students will develop and complete an experimental research project.

ADVANCED RESEARCH TOPICS	
Content Statement	**Content Elaboration**
Select sufficient and relevant sources of information.	• The reliability of the source must be considered.
Formulate research questions and hypotheses.	• The research question must be specific to identify relevant variables and systems being investigated. • Null and alternative hypothesis.
State and explain predictions using scientific understanding.	• Background knowledge of scientific principles and their relation to hypotheses.
Demonstrate creativity in the designing, implementation and presentation of the investigation.	• Research questions demonstrate personal interests or relevance.
Develop investigations that involve hands-on laboratory experiments, databases, simulations and modelling.	• Research can be performed using a variety of methods.
Identify and justify the choice of dependent, independent and control variables.	
Justify the range and quantity of measurements.	• Reasoning for the selection of the range of the independent variable should be provided.

Design and explain a valid methodology.	• Developed methods should clearly demonstrate validity, reliability, specificity and accuracy. • Developed methods should be clearly written to allow for procedures to be repeated and verified by others. • All relevant variables that could impact the results are controlled.
Appreciate when and how to reduce bias in study design.	• Blind and double-blind studies • Placebo effec • Randomization of groups and selection of test subjects
Appreciate when and how to reduce the confounding effects of human factors on physiological performance.	• Various factors (age, sex, menstrual cycle, nutrition, motivation, etc.) can impact the results of human studies.
Appreciate when and how to calibrate measuring apparatus.	• Calibrating measuring devices increases the accuracy of the data.
Identify and record relevant qualitative observations.	• Qualitative data, although not analyzed using statistical methods, can provide important information related to the measurements.
Collect and record sufficient relevant quantitative data.	• Large sample sizes help strengthen the confidence that what is being measured is a true representation of the population.
Identify and address issues that arise during data collection.	• Both internal and external factors can influence measurements. • Many factors are confounding, while others can be controlled by performing experiments within lab settings.
Compare the outcomes of an investigation to the accepted scientific context.	• Relate outcomes to previously cited research that was also used to provide context for the investigation. • Agreement or disagreement with accepted scientific context, should be identified and explained.
Relate the outcomes of an investigation to the stated research question or hypothesis.	• The research question and the resulting hypotheses are the driving force for any investigation. • Collected data should address the question, and scientific principles should be applied to the data to explain the results of the investigation.

Discuss the impact of uncertainties on the conclusions.	• Uncertainties lead to variation within the measurements, impacting both the precision and accuracy of the data. • Decreasing uncertainties increases the reliability of the data.

Identify and discuss sources and impacts of random and systematic errors.	• Random errors are usually based upon the precision of the measuring device.
	  ○ For instance, hand timing has a random uncertainty of ± 0.2 seconds.
	  ○ Using a laser-timing system can increase the precision and reliability of the measurement.
	• Systematic errors are usually procedural issues with data collection or controlling variables.
	  ○ These can be corrected to increase the precision and accuracy of the measurements.

Evaluate the implications of methodological weaknesses, limitations and assumptions on conclusions.	• Identification of the major weaknesses, limitations and assumptions of the method that likely had an impact on the results of the investigation, and discussion of their impacts on the results.
Explain realistic and relevant improvements to an investigation.	• These should be explained from the perspective of a scientist who may seek to retry the investigation, and should suggest revisions to the method that would strengthen the investigation in light of the weaknesses, limitations and assumptions that were identified throughout the process.