



**DUBLIN**  
CITY SCHOOLS

**K-12 SCIENCE**  
**Graded Course of Study**  
**2025**



## **Dublin City Schools K-12 Science Graded Course of Study**

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.



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**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



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**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.



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**Grade 4**

**Course Goals**

Students in Grade 4 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 surface electricity, heat and matter, and Earth's living history.

**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 AND SPACE SCIENCE (ESS)                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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| Topic: Shaping Earth's Surface<br>This topic focuses on the variety of processes that shape and reshape Earth's surface. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Content Statement                                                                                                        | Content Elaboration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>4.ESS.1: Earth's surface has specific characteristics and landforms that can be identified.</b>                       | <p>Earth is known as the Blue Planet because about 70 percent of Earth's surface is covered in water.</p> <ul style="list-style-type: none"><li>• Most of the water covering Earth's surface is the ocean.</li><li>• Only a small portion of the Earth's water is freshwater, which is found in rivers, lakes, groundwater and glaciers.</li></ul> <p>There are many different processes that continually build up or tear down the surface of Earth.</p> <ul style="list-style-type: none"><li>• These processes and catastrophic events include erosion, deposition, flooding, volcanic activity, earthquakes, glacial movement and weathering.</li><li>• Beginning to recognize common landforms or features through field investigations, field trips, topographic maps, remote sensing data, aerial photographs, physical geography maps and/or photographs are important ways to understand the formation of landforms and features.</li></ul> |



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|                                                                             | <ul style="list-style-type: none"> <li>○ Common landforms and features include streams, deltas, floodplains, hills, mountains/mountain ranges, valleys, sinkholes, caves, canyons, glacial features, dunes, springs, volcanoes and islands.</li> <li>● Connecting the processes that occur to the resulting landform, feature or characteristic is emphasized.</li> <li>● This can be demonstrated through experiments, investigations (including virtual experiences) or field observations. Technology can help illustrate specific features that are not found locally or demonstrate change that occurred (e.g., using satellite photos of an erosion event such as flooding).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>4.ESS.2: The surface of Earth changes due to weathering.</b>             | <p>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.</p> <ul style="list-style-type: none"> <li>● Different types of rock weather at different rates due to specific characteristics of the rock and the exposure to weathering factors (e.g., freezing/thawing, wind, water). <ul style="list-style-type: none"> <li>○ Weathering is defined as a group of processes that change rock at or near Earth's surface.</li> <li>○ Note: Differentiating between chemical and physical weathering is not the focus at this grade level.</li> </ul> </li> <li>● Some weathering processes take a long time to occur, while some weathering processes occur quickly.</li> <li>● The weathering process is observed in nature, through classroom experimentation or virtually. Seeing tree roots fracturing bedrock or the effect of years of precipitation on a marble statue can illustrate ways that rocks change shape over time.</li> <li>● Investigations can include classroom simulations, laboratory testing and field observations.</li> </ul> |
| <b>4.ESS.3: The surface of Earth changes due to erosion and deposition.</b> | <p>Liquid water, wind and ice physically remove and carry rock, soil and sediment (erosion) and deposit the material in a new location (deposition).</p> <ul style="list-style-type: none"> <li>● Weathering is the breakdown of large rock into smaller pieces of rock.</li> <li>● Erosion is a process that transports rock, soil or sediment to a different location.</li> <li>● Erosion is what carries the weathered material to a new location.</li> </ul> <p>Gravity plays an important role in understanding erosion, especially catastrophic events like mass movement (e.g., mudslides, avalanches, landslides) or flooding.</p> <ul style="list-style-type: none"> <li>● Erosion is a “destructive” process and deposition is a “constructive” process.</li> <li>● Erosion and deposition directly contribute to formation of the landforms and features</li> </ul>                                                                                                                                                                                                                                                                                                                                |



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- that are included in grade 4.
- Topographic maps and aerial photographs can be used to locate erosional and depositional areas in Ohio.
  - Surficial geology maps also can illustrate the patterns of glacial erosion and deposition that have occurred.
  - Field trips and field investigations (may be virtual) are recommended as erosional and depositional features that can be seen locally or within the state can help to connect the concept of erosion and deposition to the real world.

**PHYSICAL SCIENCE (PS)**

Topic: Conservation of Matter & Changes in Energy

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.

| Content Statement                                                                                                          | Content Elaboration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| <b>4.PS.1: When objects break into smaller pieces, dissolve, or change state, the total amount of matter is conserved.</b> | <p>Some properties of objects may stay the same even when other properties change.</p> <ul style="list-style-type: none"><li>• The total amount of matter remains constant.<ul style="list-style-type: none"><li>○ For example, water can change from a liquid to a solid, but the mass of the water remains the same (matter changing state: solid, liquid, gas).</li><li>○ Parts of an object or material may be assembled in different configurations but the mass remains the same.</li><li>○ When an object is broken into smaller pieces, the sum of the mass of all parts in an object equals the mass of the object.</li><li>○ When a solid is dissolved in a liquid, the mass of the mixture is equal to the sum of the masses of the liquid and solid.</li><li>○ Note: Differentiation between mass and weight is not necessary at this grade level.</li></ul></li></ul> <p>At this grade level, the discussion of conservation of matter should be limited to a macroscopic, observable level.</p> <ul style="list-style-type: none"><li>• Conservation of matter should be developed from experimental evidence collected in the classroom.</li><li>• After the concept has been well established with experimental data and evidence using closed systems (i.e., systems where matter cannot enter or leave the system),</li></ul> |



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|                                                                                                                              | <p>investigations can include interactions that are more complex where the mass may not appear to stay constant (e.g., fizzing tablets in water).</p> <ul style="list-style-type: none"> <li>• Mass is an additive property of objects and volume is usually an additive property for the same material at the same conditions.</li> <li>• However, volume is not always an additive property, especially if different substances are involved. <ul style="list-style-type: none"> <li>◦ For example, mixing alcohol with water results in a volume that is significantly less than the sum of the volumes.</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p><b>4.PS.2: Energy can be transferred from one location to another or can be transformed from one form to another.</b></p> | <p>Energy transfers from hot objects to cold objects as heat, resulting in a temperature change.</p> <ul style="list-style-type: none"> <li>• Energy transfer (between objects or places) should not be confused with energy transformation from one form of energy to another (e.g., electrical energy to light energy).</li> <li>• The addition of heat may increase the temperature of an object.</li> <li>• The removal of heat may decrease the temperature of an object.</li> <li>• There are materials in which the entire object becomes hot when one part of the object is heated (e.g., in a metal pan heat flows through the pan on the stove transferring the heat from the burner outside the pan to the food in the pan).</li> <li>• There are other objects in which parts of the object remain cool even when another part of the object is heated (e.g., in a Styrofoam® cup, very little of the warmth from hot liquid inside the cup is transferred to the hand holding the cup).</li> </ul> <p>Note: The word “heat” is used loosely in everyday language, yet it has a very specific scientific meaning.</p> <ul style="list-style-type: none"> <li>• Usually what is called heat is actually thermal or radiant energy. <ul style="list-style-type: none"> <li>◦ An object has thermal energy due to the random movement of the particles that make up the object.</li> <li>◦ Radiant energy is that which is given off by objects through space (e.g., warmth from a fire, solar energy from the sun).</li> </ul> </li> <li>• “Heating” is used to describe the transfer of thermal or radiant energy to another object or place.</li> <li>• 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.</li> </ul> <p>Electric circuits require a complete loop of conducting materials through which electrical energy can be transferred.</p> <ul style="list-style-type: none"> <li>• Electrical conductors are materials through which electricity can flow easily.</li> </ul> |



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- Electricity introduced to one part of the object spreads to other parts of the object (e.g., copper wire is an electrical conductor because electricity flows through the wires in a lamp from the outlet to the light bulb and back to the outlet).
- Electrical insulators are materials through which electricity cannot flow easily.
  - Electricity introduced to one part of the object does not spread to other parts of the object (e.g., rubber surrounding a copper wire is an electrical insulator because electricity does not flow through the rubber to the hand holding it).
- Electrical conductivity is explored through testing common materials to determine their conductive properties.
- In order for electricity to flow through a circuit, there must be a complete loop through which the electricity can pass.
  - When an electrical device (e.g., lamp, buzzer, motor) is not part of a complete loop, the device will not work.
  - Electric circuits are introduced in the laboratory by testing different combinations of electrical components.

Electrical energy in circuits can be transformed to other forms of energy, including light, heat, sound and motion.

- When an electrical device is a part of a complete loop, the electrical energy can be transformed into light, sound, heat or magnetic energy.
- Electrical devices in a working circuit often get warmer.
- When a magnet moves in relation to a coil of wire, electricity can flow through the coil.

Electricity and magnetism are closely related.

- When a wire conducts electricity, the wire has magnetic properties and can push and/or pull magnets.
- The connections between electricity and magnetism can be explored in the laboratory through experimentation.
- Knowing the specifics of electromagnetism is not appropriate at this grade level. At this point, the connections between electricity and magnetism are kept strictly experiential and observational.



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**LIFE SCIENCE (LS)**

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.

| Content Statement                                                                                                                   | Content Elaboration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| <b>4.LS.1: Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.</b>                 | <p>Ecosystems can change rapidly (e.g., volcanic activity, earthquakes, fire) or very slowly (e.g., climate change).</p> <ul style="list-style-type: none"><li>• Ohio has experienced various climate patterns.</li><li>• Glaciers covered parts of Ohio and other parts of Ohio were submerged with water as indicated by Ohio's fossil record.</li></ul> <p>When the environment changes, some plants and animals survive and reproduce and others die or move to new locations.</p> <ul style="list-style-type: none"><li>• Major changes, both natural and human caused, over a short period of time can have significant impacts on ecosystems and populations of plants and animals.</li><li>• The changes that occur in the plant and animal populations can impact access to resources for the remaining organisms, which may result in migration or death.</li></ul> <p>Ecosystems are based on interrelationships among and between biotic and abiotic factors.</p> <ul style="list-style-type: none"><li>• These include the diversity of other organisms present, the availability of food and other resources, and the physical attributes of the environment.</li><li>• Specific ecosystems in Ohio (e.g., rivers, streams, meadows, bogs, lakes, moraines, other natural areas) can be researched and investigated via field studies and virtual field trips.</li><li>• The relationships between current and past ecosystems, the changes that have occurred over time in those ecosystems, and the species that lived there are explored.</li></ul> |
| <b>4.LS.2: Fossils can be compared to one another and to present-day organisms according to their similarities and differences.</b> | <p>Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.</p> <ul style="list-style-type: none"><li>• Fossils provide evidence that many plant and animal species are extinct and other species have changed over time.</li><li>• Most species that have lived on Earth are extinct.</li><li>• The types of fossils that are present provide evidence about the nature of an</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |



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ecosystem at that time.

- As an ecosystem changed, so did the types of organisms that could survive in that ecosystem.
- The opportunity to learn about an increasing variety of living organisms, both the familiar and the exotic, should be provided.

The concept of biodiversity is expanded to include different classification schemes based upon shared internal and external characteristics of organisms.

- The observations and descriptions of organisms should become more precise in identifying similarities and differences based upon observed structures.
- Emphasis can still be on external features; however, finer detail than before should be included.
- Hand lenses and microscopes should be routinely used.
- Microscopes are used not to study cell structure but to begin exploring the world of organisms that cannot be seen by the unaided eye.
- Non-Linnaean classification systems should be developed that focus on gross anatomy, behavior patterns, habitats and other features.