

Grades K-12

CPS Science Department Program Overview

The Cambridge Public Schools Science Department believes that **all** students can **do** science and **will** develop deep understanding of scientific concepts. The construction of understanding comes through constant interaction with objects and ideas. Science is the construction of new knowledge in its truest form. Science is the process of exploring the world, generating questions, collecting and interpreting data, and using that new information to either support or challenge ideas and to solve problems. Accepting the notion that understanding is shaped by the interaction of the learner's preconceived ideas and new observations, science classrooms must be intellectually safe environments where **all** students are encouraged to ask questions and are given the intellectual tools to collect and analyze data to support or challenge their ideas. Students, who are given the opportunity and support to ask their own questions and build their own understanding of scientific phenomena, become life-long learners who pursue understanding simply because they want to *know*. The Cambridge Public Schools Science Department strives to create learning environments where students do science as scientists do. Students do science as scientists do by posing questions they are curious about, formulating hypotheses, collecting and analyzing data, utilizing technology as a tool for data collection and analysis and use journals to document their intellectual journey. It is through rigorous scientific investigation and the collaborative pursuit of knowledge that **all** Cambridge Public Schools students will not only acquire a deep understanding of scientific phenomena, but also harness a joy of knowing and understanding the world better.

Grades K-5

Elementary Science Program Overview

All students in grades K-5 engage in opportunities to experience life, earth, and physical sciences and technology through the use of science curriculum units. These units include NSRC Science and Technology for Children (developed by the National Science Resource Center), Insights (developed by Education Development Center, Inc.), Full Option Science System (Lawrence Hall of Science, University of California), Project Aries (sponsored by Harvard-Smithsonian Center for Astrophysics), and Sand and Water (developed by Cambridge teachers). Each teacher receives three units during the year from the science department. Each unit contains a teacher's guide and all materials necessary to teach the curriculum. The units at each grade level have been chosen to provide age-appropriate concepts and skills in alignment with the Massachusetts Frameworks for Science and Technology. Inquiry, design technology, social implications, and habits of science are woven throughout the curriculum. Literacy skills including reading and writing, the use of technology including computer research and mathematical skills are also incorporated into the curriculum. In addition, all students receive a science notebook from the department in which to record his/her observations, thoughts, data, analyses and conclusions of these experiences. Two science mentor teachers provide curriculum and support to K-5 teachers to sustain a comprehensive, district-wide science curriculum, aligned with national, state, and district science and technology and engineering standards. Support includes mentoring, coaching, co-teaching, modeling, and professional development addressing specific science content, inquiry-based learning, literacy, and assessment of student learning.

Maynard Ecology Center

The Maynard Ecology Center is an environmental science education resource for teachers and students. Primarily, the Center is used as a base for students to explore the ecology and environment of Black's Nook (including microorganisms) and the area surrounding Fresh Pond. The Center itself provides an indoor classroom for students to work. Equipment for specimen collection and examination is also available. The Center and surrounding environment offers a great opportunity for students to engage in scientific fieldwork related to the classroom curriculum. Possible activities include an exploration of the diversity of life in and around the area, collection and analysis of water samples from Black's Nook, an opportunity to sketch and draw specimens and a chance to reflect on nature. Students may also explore the area through short nature walks and the sampling of local flora and fauna. Used as an extension to the classroom curriculum, the Center provides an opportunity for students to engage in scientific inquiry.

K-5

CPS Science Curriculum

Grade	Curriculum Unit	Resources	Major Concepts	Sample Assessment Question
K	Sand & Water	Curriculum developed by Cambridge teachers	<ul style="list-style-type: none"> • Sand and water have similarities and differences in their physical properties and behaviors • Students can raise and investigate questions 	TBA
K	Myself and Others The Senses	Insights (Education Development Center, Inc)	<ul style="list-style-type: none"> • Humans have similarities, differences, and variation in physical characteristics • Humans grow and develop over time. • Humans use senses to perceive the environment 	TBA
K	Animals 2 x 2	FOSS (Full Option Science System, Lawrence Hall of Science: University of California -- Pillbug Project (Burnett, 1992)	<ul style="list-style-type: none"> • Animals in the same class (e.g. fish, snails, worms) have similarities and differences in physical characteristics and observable behavior 	TBA
1	Weather & Me	STC (Science & Technology for Children. National Academy of Science)	<ul style="list-style-type: none"> • Weather has elements such as temperature, cloud cover, wind speed, and precipitation • Weather changes day to day, week to week, and month to month. • Weather impacts choices we make. 	Where does a puddle come from? Where does it go when it goes away?
1	Balls and Ramps	Insights (Education Development Center, Inc)	<ul style="list-style-type: none"> • Balls have different characteristics such as weight, size, and composition. • Gravity causes balls to fall. • Inertia, momentum, friction, velocity, and acceleration affect the movement of balls. • The size and weight of a ball and the steepness of a ramp affect the movement of a ball on an inclines plane 	Given a picture of a ball at the top of a ramp and grass at the bottom of the ramp: Draw an "X" on the picture where you think the ball will stop. Why did you draw the "X" there?

1	Living Things	Insights (Education Development Center, Inc)	<ul style="list-style-type: none"> • Living things have similarities, differences, and variation in physical characteristics. • Living things grow and develop over time. • Living things have needs that they meet in a variety of ways to survive. 	How are bean plants and trees the same?
2	Animal Life Cycles	STC (Science & Technology for Children. National Academy of Science)	<ul style="list-style-type: none"> • Animals have observable and predictable life cycles, including growth and death. • Some animals change appearance as they mature (metamorphosis) while other animals maintain a similar appearance and increase in size as they mature. • Mature offspring resemble their parents in physical characteristics and behavior. 	A caterpillar has jaws to eat its food. When it becomes a butterfly, it has a feeding tube. Explain why caterpillars have jaws, but when they are butterflies they have feeding tubes.
2	Soils	STC (Science & Technology for Children. National Academy of Science)	<ul style="list-style-type: none"> • Soils have different properties such as color, particle size, water absorbency and cohesion. • Plant germination and growth depend upon the properties of soil. • Organic matter decomposes and becomes part of the soil. 	If you wanted to grow a bean plant, which soil would you choose? Humus or Clay. Why?
2	Liquids	Insights (Education Development Center, Inc)	<ul style="list-style-type: none"> • All liquids pour and take the shape of their containers. • Different liquids vary in physical properties (such as color, cohesion or stickiness, viscosity or thickness, and density or “heaviness” • Solid objects in liquids either float on the surface or part way down or sink. • Floating depends on properties of the liquid and on the shape, size, and weight of the object. 	Usually iron sinks in water. How could you make a piece of iron float in water?
3	Rocks & Minerals	STC (Science & Technology for Children. National Academy of Science) Harvard Museum of Natural History	<ul style="list-style-type: none"> • Rocks are made form minerals. • Minerals have characteristic properties such as color, hardness, luminosity, light transmissivity, shape, and streak. • The properties of rocks determine how people use rocks. 	You are given a mystery mineral, which you have never before seen. Describe how you will go about trying to identify this mystery mineral.

3	Habitats	Insights (Education Development Center, Inc)	<ul style="list-style-type: none"> • Living things have survival needs that they meet in their habitats. • Local habitats have similarities, differences, and variations. • Plants and animals have adaptive structures and behaviors that help them survive in their particular habitats. 	Given pictures of organisms: Choose one that you might like to keep for a pet. Describe the habitat that you will create so that all of your pet's needs are met so that your pet will live and grow.
3	Plant Growth & Development	STC (Science & Technology for Children. National Academy of Science) Sunlab at the Museum of Science, Boston	<ul style="list-style-type: none"> • Plants have predictable stages of germination and growth. • Parts of plants have specialized structures, which relate to their function. • Pollination plays a crucial role in seed making (the reproduction of flowering plants). 	Explain how a bee and a flower depend on each other.
4	Circuit & Pathways	Insights (Education Development Center, Inc) Edgerton Center (Massachusetts Institute of Technology)	<ul style="list-style-type: none"> • Some materials conduct electricity (conductors) and some do not (insulators). • Electricity needs a complete circular pathway (circuit) to flow. • Some circuits have only one pathway (series), and some circuits have multiple pathways (parallel). • Series and parallel circuits have different behaviors. 	If you remove a bulb from series circuit, the other bulb will go out. Why does this happen? You can draw a picture to help your explanation.
4	Sun & Shadows	Project Aries (Harvard-Smithsonian Institute for Astrophysics)	<ul style="list-style-type: none"> • Outdoor shadows changes predictably in length and direction during the day. • Night occurs when the earth rotates through its own shadow. • The shadow of the earth changes predictably and accounts for the seasons. 	Given a picture of a playground with a flagpole: Draw the shadow that would be cast by the flagpole in the afternoon when you get home from school. <i>Why did you decide to draw the shadow that way?</i>

4	Investigating Changing Earth	Science T.R.A.C.S (BSCS)	<ul style="list-style-type: none"> • The surface of the Earth is constantly changing. • Some changes such as those caused by earthquakes and volcanoes, happen quickly while others are due to slow processes such as weathering and erosion. • The processes of weathering, primarily by wind and water, break down existing rock. • Erosion takes place when there is movement of weathered particles from one location to another. • As part of Earth's surface is broken down, other parts are built up by the deposition of the broken down particles. 	TBA
5	Ecosystems	STC (Science & Technology for Children. National Academy of Science)	<ul style="list-style-type: none"> • Living organisms in an ecosystem have roles that include producer, consumer, or decomposer. • Living organisms have independent and dependent relationships among other organisms and the physical environment. • A variety of factors affect the well being of an ecosystem. 	Explain in detail why it is important to have plants in the aquarium.
5	Magnets & Motors	STC (Science & Technology for Children. National Academy of Science)	<ul style="list-style-type: none"> • Magnets (and electromagnets) have distinct and measurable properties. • The flow of electricity creates a magnetic field. • Technological invention allows us to use magnets and electricity to turn electric motors and to generate electricity by moving wire through magnetic fields. 	Given a graph of number of paperclips held by a magnet and number of magnets used to hold the paperclips: Write a statement that summarizes the data in the graph.
5	Changes of State	Insights (Education Development Center, Inc)	<ul style="list-style-type: none"> • Water exists as a liquid, solid, and gas. • Melting, evaporation, condensation, freezing, and sublimation result from adding and removing heat. • Changes of state are reversible. 	One morning on the way to school you notice that all the cars parked on your street are wet, but the street is dry. It did not rain or snow during the night. Why is there water on the cars?

Grades 6-8

Middle Grade Science Program Overview

All students in grades 6, 7 and 8 participate in real, in-depth science experiences. As prescribed in the Cambridge Public Schools Middle Grade Science Curriculum, students pose questions, pursue those questions and share their work with each other in order to build an understanding of scientific phenomena. By doing so, students are armed with the knowledge, skills, thought processes, and compassion to be responsible, scientifically, literate citizens.

Students in grades six, seven and eight engage in hands-on inquiry based science explorations in order to construct an understanding of the world around them. The content at each grade level includes topics in life science, earth science, and physical science. This builds on the content sequence that has been learned in grades Kindergarten through fifth grade. Inquiry, design technology, and societal implication standards are woven throughout the curriculum. Computers are used as a tool for research, long distance science collaboration, data collection, and data analysis.

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Science Learning Expectations for Grade 6

Major Concepts	Curriculum Units	Sample Open Response Assessment Item
<ul style="list-style-type: none"> • To see an object, light must reflect off the object or be emitted by it and travel to the eye. • Light travels in a straight line. • Mirrors reflect light in predictable ways. • Prisms can scatter light into its component colors. 	Light and Color <i>Aries</i>	In warmer climates, houses tend to be painted white. In colder areas, like northern New England, houses tend to be painted darker colors. In the space below, explain why this is so.
<ul style="list-style-type: none"> • Food is digested in the body by chemical and mechanical means. • The respiratory and circulatory systems work together to bring oxygen to cells for respiration and to remove wastes. • The body is in balance. • Muscles and joints work together to create movement. 	Human Body Systems <i>STC</i>	As you observed during class, your pulse rate and breathing rate change in response to exercise. Describe below how they change and explain why this change takes place.
<ul style="list-style-type: none"> • The properties and characteristics (e.g., weight, strength, hardness, and flexibility) of materials (e.g., wood, paper, plastic, aggregates, ceramics, metals, solvents, adhesives) determine the suitability of those materials for construction of a product. • The engineering design process includes: the identification of the need or problem, researching the problem, developing possible solutions, selecting the best possible solution(s), constructing a prototype, testing and evaluating, communicating the solution(s), and redesigning. • The construction of a prototype requires the use of a range of tools, including those for measuring, cutting, and fastening. Each of these tools should be used safely and properly. 	Solar Car Design Unit <i>Junior Solar Sprint/Cambridge Public Schools Teachers</i>	Describe one design problem that you encountered while constructing your solar car. Include in your description what you observed, how you identified the source of the problem, and what you did to solve it.

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Science Learning Expectations for Grade 7

Term	Major Concepts	Curriculum Units	Prentice Hall Supporting Text	Sample Open Response Assessment Item
Earth Science	<ul style="list-style-type: none"> •The known universe contains billions of galaxies, one of which is the Milky Way, and each galaxy contains billions of stars, one of which is a medium-sized star, our sun. •Our solar system contains a central sun, nine known planets, their moons and many asteroids, meteors and comets in orbit. •Most objects in the solar system are in regular and predictable motion. 	Asteroid! <i>Event-Based Science</i>	<u>Exploring the Universe</u>	Explain why we in the Northern Hemisphere have seasons while those living on or near the equator do not. Include diagrams if they help you explain your answer.
Physical Science	<ul style="list-style-type: none"> •Characteristic properties allow materials to be distinguished from one another and often make them well suited to specific purposes. •The particulate model of matter explains the observable properties of a substance. •Heat moves in predictable ways. 	<i>Ice Cream Making and Cake Baking Cuisinare</i> Plastics in Our Lives SEPUP	<u>Matter: Building Blocks of the Universe</u> <u>Heat Energy</u>	Zoey has two beakers containing equal amounts of water. She heats the water in one beaker to a temperature of 80 degrees C. She then pours it into another beaker, which contains water at 20 degrees C. She stirs the mixture and reads the thermometer to find the new temperature. <ol style="list-style-type: none"> What do you think the new temperature will be? Explain why you think that. Describe the motion of the water molecules in each container both before and after they are mixed.

<p>Life Science</p>	<ul style="list-style-type: none"> •Of all the characteristics of life on Earth, none is so extraordinary as its sheer diversity. •All living things are unified in that they are made up of one or more cells and exhibit the same life processes. •Biodiversity, our life support system, is today increasingly threatened by human activity. 	<p>Biodiversity Counts <i>A National Project in Partnership with the American Museum of Natural History in NYC</i></p>	<p><u>Cell's:</u> <u>Building Blocks of Life</u></p> <p><u>Science Explorer:</u> <u>From Bacteria to Plants</u></p> <p><u>Science Explorer:</u> <u>Animals</u></p>	<p>At one point the classification of living things was split into only two kingdoms: Plants and Animals. What changes in technology and in our understanding of the make up of organisms have occurred that now causes scientists to classify living things into 5 or even 6 kingdoms?</p>
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Science Learning Expectations for Grade 8

Term	Major Concepts	Curriculum Units	Prentice Hall Supporting Text	Sample Open Response Assessment Item
Earth Science	<ul style="list-style-type: none"> •Weather can be studied in terms of properties of the atmosphere. •Human activities have changed the Earth's land, ocean, atmosphere, and planetary climate. 	Hurricane! <i>Event-Based Science</i> Fruitvale SEPUP	<u>Exploring Earth's Weather</u>	Describe what convection currents are, how they work and explain their importance in plate tectonics and weather phenomenon.
Physical Science	<ul style="list-style-type: none"> •Newton's Laws of Motion •Energy cannot be created or destroyed but exists in different interchangeable forms. 	Tops and Yo-yos Cuisinare Cars and Ramps Rollercoaster Cambridge Physics Outlet	<u>Motion, Forces, and Energy</u>	You are riding in a car. All of the windows are open. Your sunglasses are sitting on the dashboard of the car. The car turns left and your sunglasses fly out of the window. a. Out of which window do the sunglasses fly? b. Explain in detail (using a diagram if you wish) why this occurs.
Life Science	<ul style="list-style-type: none"> •Genetic information, carried on chromosomes, is passed from parent(s) to offspring. •Most living organisms go through organized stages of development from infancy to adulthood. •Reproduction allows all organisms to replace their numbers on earth. 	"Hairy's Inheritance" Wisconsin Fast Plants Genscope <i>Genetics Computer Simulation from BBN</i>	<u>Heredity: The Code of Life</u>	You have just measured the height of 200 Wisconsin Fast Plants. In the space below, describe what the graph will look like when you plot the frequency of each height. Also, describe in detail how you could make the next generation of plants have a taller average height.

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