New Haven Public Schools

SCIENCE

CURRICULUM

OVERVIEW

New Haven Public Schools Science Curriculum Vision

SCIENCE IS FOR ALL STUDENTS

All students, regardless of age, sex, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain high levels of scientific literacy. Excellence in science education embodies the ideal that all students can achieve understanding of science if they are given the opportunity. Our goal is to ensure that all students at all levels achieve science literacy, for science is the key to their future.

SCIENCE LITERACY

Science literacy is a combination of understanding major science concepts and theories, using scientific reasoning, and recognizing the complex interactions between science, technology and society. Scientific literacy requires the ability to apply critical thinking skills when dealing with science-related issues. A scientifically literate person is able to transfer knowledge of the academic theories and principles of science to practical applications in the real world. Scientific literacy also implies having the capacity to pose and evaluate arguments based on evidence and to apply logical conclusions from such arguments. Scientific literacy means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. It means that a person has the ability to describe, explain, and predict natural phenomena. Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed.

LEARNING SCIENCE IS AN ACTIVE PROCESS

Learning science is something students do, not something that is done to them. In learning science, students describe objects and events, ask questions, acquire knowledge, construct explanations of natural phenomena, test those explanations in many different ways, and communicate their ideas to others. This term "active process" implies physical and mental activity. Hands-on activities are not enough—students also must have "minds-on" experiences. Science teaching must involve students in inquiry-oriented investigations in which they interact with their teachers and peers. Students establish connections between their current knowledge of science and the scientific knowledge found in many sources; they apply science content to new questions; they engage in problem solving, planning, decision making, and group discussions; and they experience assessments that are consistent with an active approach to learning. Emphasizing active science learning means shifting emphasis away from teachers presenting information and "covering" science topics. The perceived need to include all the topics, vocabulary, and information in textbooks is in direct conflict with the central goal of having students learn scientific knowledge with understanding. Inquiry into authentic questions generated from student experiences is the central strategy for teaching science.

TEACHERS OF SCIENCE GUIDE AND FACILITATE LEARNING In doing this, teachers:

-Display and demand respect for the diverse ideas, skills, and experiences of all students.
-Focus and support inquiries while interacting with students.
-Encourage, model, and emphasize the skills, attitudes, and values of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science.
-Orchestrate discourse and ongoing discussion among students about scientific ideas.
-Challenge students to accept and share responsibility for their own learning and the learning of all members of the community.
-Recognize and respond to student diversity and encourage all students to participate fully in science learning
-Enable students to have a significant voice in decisions about the content and context of their work.
-Nurture collaboration among students.

SCIENCE INSTRUCTION

Science uses instructional strategies and resources to promote thinking about the content, and students are encouraged to critically discuss ideas, seek information, and validate explanations.

Concepts: The overall instructional strategy for teaching science skills and concepts is that of learning by doing. Abstract concepts in science are explained in class using diagrams, models, simulations, and a variety of media. Students take notes in class, and participate in class discussions. There are questions asked of the students daily, both written and oral, that ask them to explain concepts and relate scientific behavior to real life phenomena. The teacher models the use of quantitative and qualitative analysis through some problem solving strategies in class, which the students then practice, both in groups and individually.

Labs/Activities: In each unit of study, students participate in laboratory investigations at least once a week. The lab investigations are sometimes set procedures in which the students practice the skills of observation, measurement, and data analysis. Many other lab experiences ask the students to design their own safe experiment: formulating hypothesis, controlling variables, and communicating and explaining their results and conclusions. The lab experiences directly relate to the concepts as well as show real life applications of science concepts. Students explore phenomena and collect empirical evidence to support their own explanations.

Real Life: Students apply the knowledge they have learned by using science concepts to make decisions about current issues in each unit. They write persuasive essays, conduct collaborative and independent research, and participate in forums and debates. The students are expected to synthesize information from various resources and construct carefully reasoned opinions about the issue. There are case studies and simulations that require students to learn and apply their science knowledge and make judgments.

The emphasis in all the instructional activities is to promote higher order thinking skills and making connections. Students learn how to use resources, rather than memorizing many facts, and apply their laboratory experiences to other situations.

A useful structure for inquiry-based learning units follows a **LEARNING CYCLE** model. One such model, the "5-E Model", engages students in experiences that allow them to observe, question and make tentative explanations before formal instruction and terminology is introduced. Generally, there are five stages in an inquiry-learning unit:

Engagement: stimulate students' interest, curiosity, and preconceptions.
Exploration: first-hand experiences with concepts without direct instruction;
Explanation: students' explanations followed by introduction of formal terms and clarifications;
Elaboration: applying knowledge to solve a problem. Students frequently develop and complete their own well-designed investigations.
Evaluation: students and teachers reflect on change in conceptual understanding and identify ideas still "under development".

KEY RESEARCH BASED SCIENCE INSTRUCTIONAL STRATEGIES
(Strategies adopted from Marzano, Journal of Research in Science Education, others)

-**Create a Climate for Learning**: well planned lessons, positive teacher attitude, safe, secure, enriching environment.

-**Follow a Guided Inquiry** Learning Cycle Model→ Open Ended Inquiry: Guided Inquiry into a teacher posed question by students leads to students investigating their own questions.

-**Generating and Testing Hypotheses**: students given the opportunity to investigate their ideas.

-**Setting Objectives/Providing Feedback**: Objectives are always clear for all class activities, students always know how they are meeting objectives.

-**Use Warm Up Activities, Questions, Cues, Advance Organizers**: Starter questions generate interest, cue students as to learning activities, and provide a reference throughout a lesson

-**Assess Prior Knowledge/Misconceptions**: Students have to construct their internal model of science concepts and reconcile it with previous experience, often leading to hard to overcome misconceptions.

-**Self-Explanation/Discussion**: Students given the opportunity to explain and discuss ideas are better able to connect prior and new knowledge and experiences.

-**Opportunities to Communicate/Cooperative Learning**: Science is a group endeavor, as is it's learning. Students learn best by communicating and learning from each other.

-**Vary the Way Students Work**: Lab groups, learning centers, projects, and other alternatives to traditional lecture allow for individualized instruction.

-**Practice Effective Questioning Techniques**: Questions are the tool to move towards a student-centered classroom, and different types of questions help guide instruction and learning.

-**Vary the Structure of Lessons**, Use Research Based Strategies: Lesson structure depends on the concepts and skills being learned and assessed. Brain based research in learning points to specific effective varying structures.

-**Identify Similarities and Differences/Graphic Organizers**: Science concepts are often organized into structures by humans attempting to understand nature. Help students understand the classification and organization of knowledge by continually comparing, classifying, as well as describing analogies and relationships.

-**Scaffolded Writing Practice**: Students can move from oral explanation to written explanation through careful guidance/practice, including both expository and persuasive writing in science.

-Strengthen Comprehension for Content Area Reading Text: provide guided focus question, organizers, response and discussion questions, summarize, evaluative prompts based on reading.

-**Non-Linguistic Representations**: Models, drawings, and pictures all can help understand science.

-Allow Opportunities for Peer Review: Students are frequently asked to evaluate others' work on standardized testing and must be given regular opportunities as part of their science experience.

-**Create and Embed Science, Technology and Society** (STS), issues, and other items relevant to students' lives. These interdisciplinary learning activities are designed to engage students in the applications of science using their critical thinking skills and content knowledge. They afford students the opportunity to examine ideas and data related to historical, technological, and/or social aspects of science concepts and content.

ASSESSMENT:

Assessment Strategies:

Students are assessed with a variety of methods on their knowledge of science concepts and skills and how they apply to the real world.

Diagnostic assessment can be used to determine the learning needs of students.
Formative assessment can be used during instruction in order to guide students and increase learning.
Summative assessments are used to identify achievement of goals and objectives.

Daily classwork and homework is used to check for understanding of main ideas and application of the techniques and skills of science. These daily assessment tools include a mixture of written explanations, diagrams, model building, and problem solving. Students are assessed on their laboratory skills using rubrics and class monitoring. Students are assessed on their ability to explain unit-related concepts and their conclusions on experimentation results by written lab reports, written explanations on quizzes and tests, as well as occasional oral explanation of laboratory ideas and procedures.

There are periodic unit quizzes and tests, which assess students' skills and knowledge in a similar manner to their daily instructional activities. The written quizzes and tests include a mixture of knowledge and comprehension questions, as well as questions which require students to demonstrate knowledge of inquiry skills, explanation of concepts, as well as making connections to other concepts and everyday experiences. The assessment tools include questions about cause and effect, steps of scientific processes, and explanation of phenomena, and are not focused on just vocabulary and word problem solving. Tests and quizzes, as well as midterm and final exams, may include a lab performance component.

Students are assessed on their ability to explain science ideas, do research, and defend decisions about scientific issues by the use of projects and class simulations. Projects require some level of judgment and thinking by the students and extend beyond research into analysis and synthesis. Group and interpersonal skills are included. Rubrics detailing students' ability to present, discuss, and use scientific research, both lab results and issues, are used by students, peers, and the teacher.

SCIENCE CURRICULUM MODEL:

Each science grade K-6, and each science course 7-12, follows the essential same format, and is linked in content, skills, and format to the CT State Science Frameworks, standardized test guidelines, and Grade Level Expectations. ***Revised versions and update found at www.newhavenscience.org***

The state of Connecticut has published State Science Frameworks, which have specific content standards, in four units per grade level K-10, as well as 9-10 overall skill/inquiry standards. Further unwrapping has produced specific performance expectation standards (10-18) per grade level, and a further 10-20 list of specific grade level concept expectations per unit. There is one CT state required embedded performance task in grades 3-8, and 10 in grades 9-10. Currently, standardized testing is conducted in grades 5, 8, and 10, each testing students' knowledge and skills on science content in previous grades.

For New Haven Public Schools:

Each science course/grade has:

-Overview and Pacing Guide

-Course Goals/ Objectives

UNIT:
Each unit, 4 units in grades K-6, and 7 units each year in grades 7-12 have the format:

-Unit Goal/Introduction Description/Essential Question

-Power Standards, link to applicable CT State Performance Expectations.

-Essential Concepts/ Essential Skills: The essential content and concepts for each unit, leading to the unit standards. Linked to CT State Grade Level Expectations where available.

-**Science Misconceptions:** linked to essential concepts, based on research

-Essential Vocabulary: To be used as a guide for teachers.

-Outline of Suggested Sequence of Instructional Activities: In each unit, some activities are references, and some are required. Links to some teacher and student templates are provided.

-Reading for Information Piece In some 7-12 units, a suggested reading for information piece is provided.

-Significant Task: A learning activity that addresses the essential power standard and concepts of the units. Student and teacher materials are provided, along with assessment tools.

-Suggested Assessments: Other suggested assessment tools

-Resources: A list of unit related resources, websites, and activities. This will be constantly edited and revised as feedback is given.

-Quarterly Assessments: In grades 7-12, district wide quarterly assessments are given in science courses, focusing on skills and concepts to be found on CT standardized tests and are required.

NEW HAVEN PUBLIC SCHOOLS SCIENCE CONTENT OUTLINE

www.newhavenscience.org

(Note, K-6 content order subject to change and is dependent on kit supply and school specific rotation)

	Quarter One		Quarter Two	Quarter	Three	Quarter Four	
K	Weather		Object Properties		Seasons	Living Things: characteristics	
1	Compare/ Contrast Measurement		Motion		Light Properties	Living Things: Structure	
2	Solids/ Liquids		Soil		Nutrition	Animal Life Cycles	
3	Rocks		Material Properties *ET		Recycling/ Conservation	Plant Life Cycles	
4	Force and Motion		Ecosystems		Water	Electricity *ET	
5	Sound	Light and Color	Light and Uses (Lenses)	Senses *ET	Sun, Earth, Moon **(CMT TEST FOLLOWS)**	Health Topics	
6	Ecosystem Populations		Weather Systems		Water Resources *ET	Simple Machines	
7	Properties of Matter	Chemical Properties	Cells	Genetics/ Reproduction	Life Systems Musculo-Skeletal	Life Systems Biochemical *ET	Microbes/ Food Preservation
8	Forces/ Bridges	Forces/ Motion *ET	Solar System Motion	Landforms/ Earth Forces	Tectonic Plates **(CMT TEST FOLLOWS)**	Rock Cycle	Natural Disasters
9 PhyChem	Heat/Phase Changes	Atoms/ Bonding *ET	Polymers *ET	Earth chemical cycles *ET	Earth Materials/ Environment Impact *ET	Energy/ Electricity *ET	Energy Sources/ Impacts *ET
10 Bio	BioChemistry *ET	Cells/ Bacteria/ Viruses *ET	Heredity/ Genetics *ET	Evolution	Diseases/ Populations *ET **(CAPT TEST FOLLOWS)**	Organism Interdependence	Organism Behavior/ Structure
11 Chem	Chemical Properties	Atomic Structure	Nuclear	Compounds/ Bonding	Reactions/ Equations	Gas Behavior	Organic Chemistry
12 Physics	Motion	ACCEL	2 D Motion	Forces/Work	Energy/ Electric	Wave/Sound/ Light	Mod Physics

*ET = CT Embedded Task, NHPS District Unit Tasks and Quarterly Assessments Also Required Grades 7-12,

New Haven City Wide
Science Fair May 11,12,13