Collective Perspectives on NYS P-12 Science Learning Standards

A Panel Presentation

New York State Board of Regents
December 12, 2016

Section 1: Building on the Past, Preparing for the Future

Okhee Lee, Professor, Steinhardt School of Culture, Education, and Human Development, New York University

Section 2: The Science Education Consortium: Teaching and Learning Science

Bruce Tulloch, Co-Facilitator of the New York State Science Education Consortium

Glen Cochrane, President, Science Teachers Association of New York State

Jen Gonyea, K-12 Science and Technology Supervisor, Bethlehem Central Schools

Section 3: Models of Collaborative Science Initiatives

Greg Borman, Director of Science, Department of STEM Office of Curriculum, Instruction & Professional Learning, NYCDOE

Laura Lehtonen, Managing Program Coordinator STEM & 21st Century Skills, Capital Region BOCES

Mary Loesing, President of the Long Island STEM Education Leadership Association, STEM Chairperson, Connetquot School District

Section 1: Building on the Past, Preparing for the Future

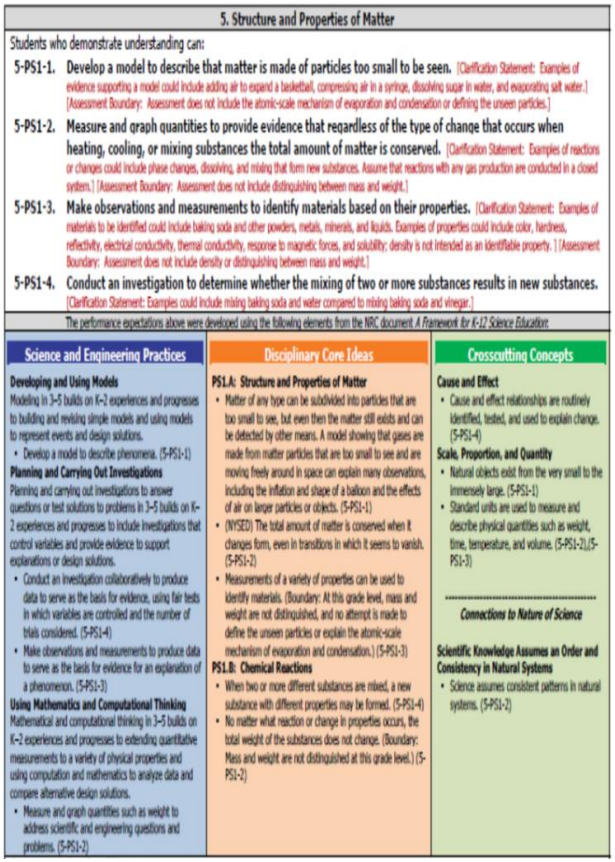
National Science Education Standards (1996)

Benchmarks for Science Literacy (1993)

A Framework for K-12 Science Education (2012)

Next Generation Science Standards (2013)

New York State P-12 Science Learning Standards



5. Structure and Properties of Matter

Students who demonstrate understanding can:

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances the total amount of matter is conserved. [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances. Assume that reactions with any gas production are conducted in a closed system.] [Assessment Boundary: Assessment does not include distinguishing between mass and weight.]

5-PS1-3. Make observations and measurements to identify materials based on their properties. [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing between mass and weight.]

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances. [Clarification Statement: Examples could include mixing baking soda and water compared to mixing baking soda and vinegar.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
- Develop a model to describe phenomena. (5-PS1-1)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4)
- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.
- Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)
- (NYSED) The total amount of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)
- Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)

PS1.B: Chemical Reactions
- When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)
- No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)

Crosscutting Concepts

Cause and Effect
- Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4)

Scale, Proportion, and Quantity
- Natural objects exist from the very small to the immensely large. (5-PS1-1)
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2),(5-PS1-3)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes consistent patterns in natural systems. (5-PS1-2)

Science and Integrated Language: Development of Language Focused Three Dimensional Science Instructional Materials to Support English Learners in Fifth Grade

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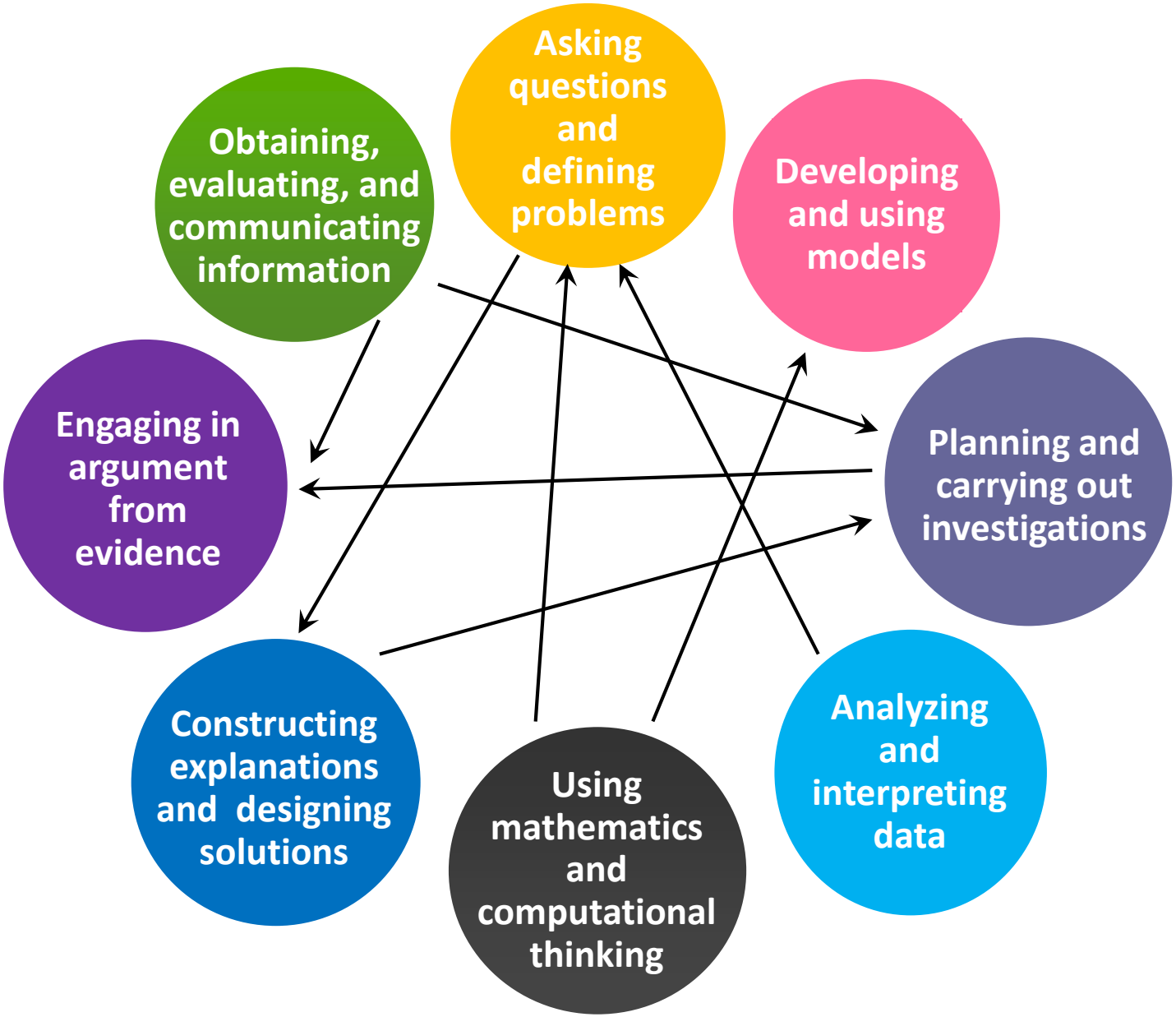
Science and Engineering Practices are language intensive and promote language learning



Garbage Unit – Phenomenon

Our school makes large amounts of garbage every day. This garbage persists in landfills over a long period of time.

Garbage Unit – Question

What happens to our garbage (in the real world)?

What happens to our garbage (in the classroom)?

New York State P-12 Science Learning Standards

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Garbage Unit – Performance Expectations

5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen

5-PS1-2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved

5-PS1-3: Make observations and measurements to identify materials based on their properties

5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances

5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost

Conceptual Shifts in Teaching and Learning Science

- K-12 science education should reflect the interconnected nature of the science as it is practiced and experienced in the real world.
- Science standards are student performance expectations – not curriculum.
- Science concepts build coherently from K-12 (learning progressions) & science and engineering are integrated K-12.
- Science content is focused on preparing students for the next generation workforce.

Section 2: The Science Education Consortium: Teaching and Learning Science

Bruce Tulloch

Co-Facilitator of the New York State Science Education Consortium

Glen Cochrane

President, Science Teachers Association of New York State

Jen Gonyea

K-12 Science and Technology Supervisor, Bethlehem Central Schools

Teaching and Learning Science

The new science standards:

- shift science teaching and learning to benefit all students.
- develop practices and skills all students need to be successful in college and career.
- are internationally benchmarked and research based.

Teaching and Learning Science

The new science standards:

- will be implemented using the New York State Strategic Plan for Science.

- were thoughtfully prepared by a transparent and inclusive process over several years.

Teaching and Learning Science

- Three-dimensional assessments will be designed to support and foster improved teaching and learning of science standards.

- The Consortium is prepared to support the roll-out of the Strategic Plan for Science.

Teaching and Learning Science Activity

A company that sells lunch coolers is asking students for input on how they can improve their products.

Students were posed the following question:

Which material will keep my lunch cooler?

New York State P-12 Science Learning Standards

2. Structure and Properties of Matter

Students who demonstrate understanding can:

2-PS1-1. **Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

2-PS1-2. **Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]

2-PS1-3. **Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

2-PS1-4. **Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** [Clarification Statement: An example of a reversible change could include freezing and melting. An example of an irreversible change could include cooking an egg.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-PS1-1)

Analyzing and Interpreting Data

Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3)

Engaging in Argument from Evidence

Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).

- Construct an argument with evidence to support a claim. (2-PS1-4)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Scientists search for cause and effect relationships to explain natural events. (2-PS1-4)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1)
- Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3)
- A great variety of objects can be built up from a small set of pieces. (2-PS1-3)

PS1.B: Chemical Reactions

- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed. (2-PS1-1)

Cause and Effect

- Events have causes that generate observable patterns. (2-PS1-4)
- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2)

Energy and Matter

- Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (2-PS1-3)

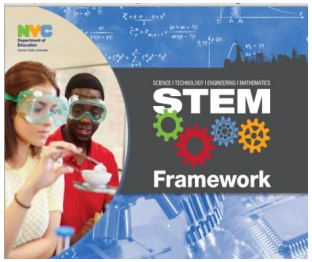
Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (2-PS1-2)

Section 3: Models of Collaborative Science Initiatives

New York City Department of Education STEM Framework & Initiatives



BOCES

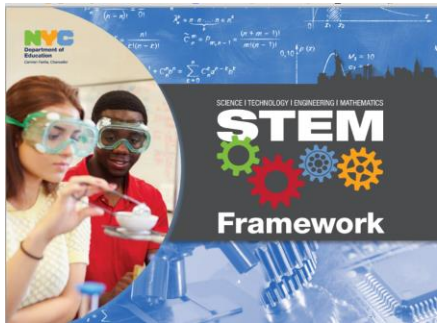
Capital Region BOCES
ALBANY • SCHOHARIE • SCHENECTADY • SARATOGA

Long Island (LISTEMELA)

LISTEMELA
Long Island Science • Technology • Engineering • Math
Education Leadership Association

New York City Department of Education Initiatives

- ✓ NYC STEM Framework



- ✓ STEM Institutes
- ✓ STEM professional learning opportunities
- ✓ STEM Partnerships (internal & external)
- ✓ STEM Summer School
- ✓ STEM Handbook

BOCES Science Initiatives

- ✓ K-12 professional learning to support the NYSP-12SLS is currently implemented or is being designed and supported in many BOCES across the State.
- ✓ BOCES partnerships with higher education, business and community stakeholders are in process.
- ✓ BOCES with science material centers have begun the transition of aligning resources to the NYSP-12SLS.
- ✓ BOCES sees the need for funding and resources to continue initiatives.

LISTEMELA: Initiatives

- ✓ Long Island is planning to develop a pathway for Grades 6-8 so that students who move from one district to another will still be exposed to all of the standards.

- ✓ Professional Development around three-dimensional learning will take place through the Science Coordinators Meetings, LISTEMELA Conferences, and through workshops conducted at BOCES by LISTEMELA members.

- ✓ Consortia of districts may be created to develop curriculum to share ideas and reduce the burden of this task so that it is not born by each individual district.

- ✓ Resources for three-dimensional learning are being shared so that districts have a place to begin curriculum development. Many resources are available free of charge. NSTA has extensive resources available to members and non-members.