NEXT GENERATION SCIENCE STANDARDS (NGSS)

The Promise of Tomorrow

"The nation's capacity to innovate for economic growth and the ability of American workers to thrive in the modern workforce depend on a broad foundation of math and science learning, as do our hopes for preserving a vibrant democracy and the promise of social mobility that lie at the heart of the American people."

There will be 94,000 STEM related job vacancies to fill in the District of Columbia by the year 2018.

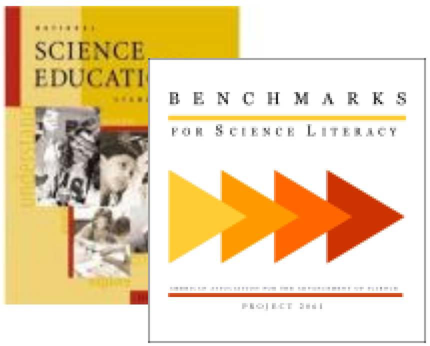
Next Generation Science Standards

Together with the Common Core State Standards in Mathematics and English Language Arts, the Next Generation Science Standards hold the promise of transforming science education and preparing all DC students to succeed, in education, work, and their daily lives.

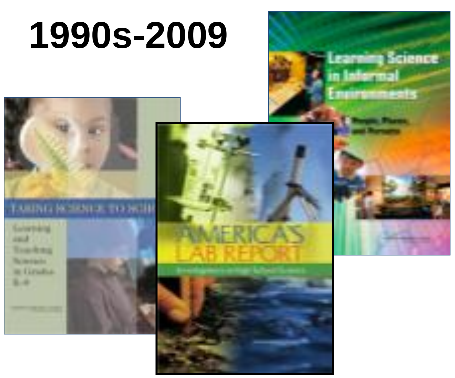
What are the Next Generation Science Standards?

- K-12 Science Standards
- Created through a **collaborative**, state-led process, and informed by community stakeholders
- Drafted based on the Framework for K-12 Science Education, which was developed by the NRC
- Identifies what students need to know and be able to do to be a functional citizen, which includes being **scientifically literate** and an effective member of the U.S Workforce

Building on the Past; Preparing for the Future

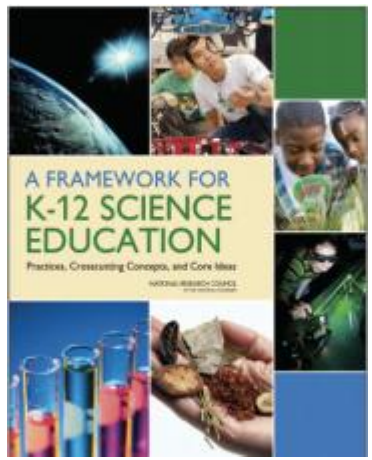


1990s



1990s-2009

Phase I



1/2010 - 7/2011

Phase II

NEXT GENERATION
SCIENCE
STANDARDS
For States, By States

7/2011 – April 2013

WHY DO WE NEED NEW SCIENCE STANDARDS?

Current DC Standards

Benefits	Costs
Strong content driven science standards	Scientific Practice and Content are not combined so are taught in isolation
Vertical alignment across content areas	Not Aligned with Common Core State Standards or 21st Century Learning Skills
Performance expectations are defined	Performance expectations suggest a passive classroom environment
Standards are succinct and clear	No clear connections between content areas

8th Grade Physical Science

Standard 3: Structure of Matter

Strand 2	Matter and Reactions
Standard 3 Structure of Matter	Students at this level will be refining their understandings around concepts of Structure of Matter. Students should be able to:
Performance Expectation	**8.3. 1.** Explain that all matter is made up of atoms that are far too small to see directly through an optical microscope. **8.3. 2.** Construct a model of an atom and know the atom is composed of protons, neutrons, and electrons. **8.3.3.** Explain that an object can be electrically charged either positively or negatively; objects with like charges repel each other, or objects with unlike charges attract each other. **8.3.4.** Know that density is mass per unit volume. **8.3.5.** Explain that equal volumes of different substances usually have different masses and, therefore, different densities. **8.3.6.** Determine the density of substances (regular and irregular solids, and liquids) from direct measurements of mass and volume, or of volume by water displacement.

NGSS Middle School Physical Science Standards: Matter and Its Interactions

MS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]

MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

Conceptual Shifts in the NGSS

1. K-12 Science education should reflect the interconnected nature of science as it is practiced and experienced in the real world

2. The Next Generation Science Standards are student performance expectations – NOT curriculum

3. The science concepts build coherently from K-12

4. The NGSS Focus on deeper understanding of content as well as application of content

5. Science and Engineering are integrated in the NGSS from K–12

6. The NGSS and Common Core State Standards (English Language Arts and Mathematics) are aligned

Benefits of Adopting NGSS

Success for ALL students.	**The District of Columbia is a diverse learning community; we need standards that allow our educators the flexibility to teach effectively to all students.** • **Currently, our students are not meeting the cutoff for "proficient performance" on the National Assessment of Educational Proficiency, as of 2011.**
Connecting the Dots	Parents and students will be able see a clear connection between what they learn from each year to the next. Their understanding of science will get more detailed as they grow.
21st Century Skills for 21st Century Jobs	Learning how to think critically about the world, problem-solve, and communicate effectively, are all important skills for us to know how to do. We need standards that support the development of these skills.
DC College and Career Ready	All students graduating college and career-ready is the goal of NGSS. The standards are designed to prepare students for success in whatever they choose to do after graduation and in life, and are aligned with the Common Core Standards.
Increased Access to Learning Resources	Standards will be the same for students in states that adopt NGSS. Families with children transferring to new schools will not have to adjust to new learning expectations. We can share experiences, methods of assessment, teaching practices, instructional materials, and approaches to helping parents support and reinforce learning at home.

What Does NGSS Look Like?

3-5-ETS1 Engineering Design

3-5-ETS1 Engineering Design

Students who demonstrate understanding can:

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.**

3-5-ETS1-2. **Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**

3-5-ETS1-3. **Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**

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

Asking Questions and Defining Problems

Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

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.

- Plan and 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

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

Crosscutting Concepts

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

- People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Breaking Down the Box

3-5-ETS1 Engineering Design

3-5-ETS1 Engineering Design

Students who demonstrate understanding can:

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.**

3-5-ETS1-2. **Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**

3-5-ETS1-3. **Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**

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

Asking Questions and Defining Problems
Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.
- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

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.
- Plan and 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. (3-5-ETS1-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems
- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions
- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Crosscutting Concepts

Influence of Engineering, Technology, and Science on Society and the Natural World
- People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Connections to 3-5-ETS1.A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4
Connections to 3-5-ETS1.B: Designing Solutions to Engineering Problems include:
Fourth Grade: 4-ESS3-2
Connections to 3-5-ETS1.C: Optimizing the Design Solution include:
Fourth Grade: 4-PS4-3

Articulation of DCIs across grade-bands: **K-2.ETS1.A** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **K-2.ETS1.B** (3-5-ETS1-2); **K-2.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3)

Common Core State Standards Connections:
ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(3-5-ETS-2)*
RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(3-5-E 2)*
RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS-2)
W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3)
W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-1),(3-5-ETS1-3)*
W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1),(3-5-ETS1-3)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.4 Model with mathematics. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.5 Use appropriate tools strategically. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
3-5.OA Operations and Algebraic Thinking *(3-5-ETS1-1),(3-5-ETS1-2)*

Student Performance Expectations

Foundation Box

Common Core State Standards

Supporting 21st Century Learning

Science and Engineering Practices	• Students practice being scientists and engineers in their classrooms!
Disciplinary Core Ideas	• Students study big ideas in the Sciences
Cross Cutting Concepts	• Students will be making connections across all science content areas

What changes should we see in the classroom?

- Teachers work to develop student's abilities to think, speak, and act like scientists
- Students are designing experiments and conducting research that address problems in the real-world
- Students are active participants in their learning
- Focus on college and career readiness and developing students resiliency in STEM subjects

THE ROAD TO ADOPTION

Vision and Mission

Vision

To provide a quality science education that is based on standards that are rich in content and practice; to all K-12 students that is developed and supported with a collaborative framework that includes, education, business, and community leaders dedicated to ensuring that all DC students are college and career ready.

Mission

- All DC students have full and ready access to the standards; and student achievement data meets college and career ready expectations
- All DC teachers are prepared to effectively teach the Next Generation Science Standards
- To increase all DC student’s level of scientific literacy
- DC students will develop perseverance toward problem-solving and a positive disposition toward STEM subjects and careers

NGSS Proposed Implementation Timeline

Cycle 1 : Awareness

SY' 2013-2014

- Community Outreach and Strategic Planning
- Standards Adoption Winter, 2013*
- Instructional Resources
- Professional Development
- Stakeholder Feedback

Cycle 2: Implementation

SY' 2014-2017

- Implementation of Strategic Plan
- Instructional Resources
- Strategic Professional Development
- Assessment Development
- Stakeholder Feedback

Cycle 3: Sustainability and Monitoring

SY' 2017-Onward

- Strategic Planning
- Strategic Professional Development
- Full Implementation with aligned Assessment
- Stakeholder Feedback

NGSS Communication

How is OSSE Getting Feedback?

In addition to holding public meetings, OSSE is convening sessions to gather feedback from local community partners and key stakeholders.

These targeted sessions are focused on capacity building and support for NGSS implementation across the District of Columbia.

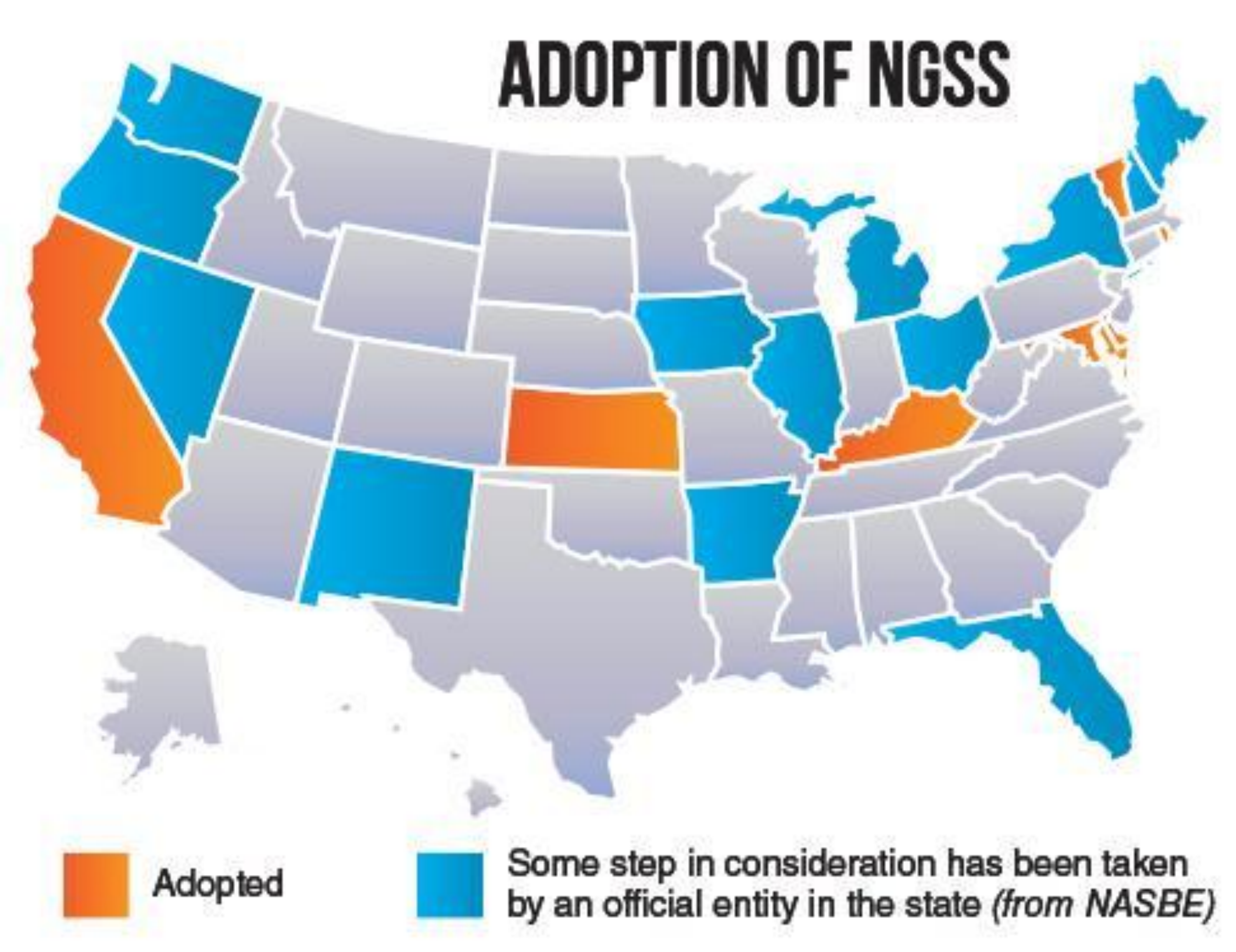
PUBLIC MEETINGS AND FEEDBACK SESSIONS

- 10/4 – OSSE Webinar (Public)
- 10/7 – OSSE Public Feedback Session
- 10/12 – Ward 5 COE Meeting
- 10/23- SBOE Public Meeting
- 10/24 – OSSE Webinar (LEAs)
- 11/2 – Tiger Woods STEM College & Career Conference
- 11/13- OSSE Public Feedback Session
- 11/20 – SBOE Public Meeting

More community based meetings TBA

Stakeholder Group	Outreach Methods
Parents and Families	• **OSSE Website** • Learn DC • **Parent and Family Engagement Summit** • Tiger Woods STEM College and Career Conference • **NGSS for Parents Handouts** • **OSSE Twitter** • Public Meetings • Letters of Endorsement
Students	• OSSE Scholars Workshop • Learn DC • Public Meetings • Letters of Endorsement
Teachers	• DCSTA Teacher Feedback Sessions • Google Doc Survey • Learn DC • **DCPS PD Days** • Science Educator Leadership Cadre • **State Leadership Team** • **Public Meetings** • Letters of Endorsement
Lead Education Agencies	• **OSSE Website** • **Webinar** • **State Science Leadership Team** • **LEA Look Forward** • Public Meetings
Colleges and Universities	• **State Science Leadership Team** • Public Meetings • Letters of Endorsement
Industry Partners	• Public Meetings • **OSSE Website** • DC STEM Learning Network • **State Science Leadership Team** • Letters of Endorsement

8 States Officially Adopted NGSS



Q & A