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OSSE

It Takes a City

It Takes a City to Knock it Out of the PARCC!

Understanding the Shifts: Translating the NGSS into Practice

OSSE

Presenter: Maya M. Garcia
Division of Elementary, Secondary and Specialized Education
OSSE

January, 2015

Objectives

- Increase our understanding of the NGSS
- Understand the rationale for the conceptual shifts in NGSS
- Reflect on the shifts benefit student learning.
- Analyze the impact on implementation planning.

Agenda

- Intro to the NGSS and DC
- The Architecture of a Standard
- Understanding the Shifts
- Implementation Considerations
- Debrief and Closing

Activity

With your team, develop a device that will transport 2 passengers safely to their destination.

STEM skills are 21st Century Skills

- STEM can be defined as the hard and soft skills that are necessary for science, technology, engineering, and math.

THE NEXT GENERATION SCIENCE STANDARDS AND D.C.

The Promise of Tomorrow

The U.S. Department of Labor has projected that by 2018, the U.S. will have more than 1.2 million job openings in STEM fields.

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

Community Opportunity

Science, Engineering, Math, & Technology	Information Technology	Business Management & Administration	Architecture & Construction
Law, Public Safety, Corrections, & Human Services	Marketing	Transportation, Distribution, & Logistics	Finance
Education & Training	Health Science	Arts, AV Technology, & Communications	Hospitality & Tourism

Half of the Priority Career Sectors are directly related to STEM, but most will require knowledge of STEM subjects.

Community of Opportunity

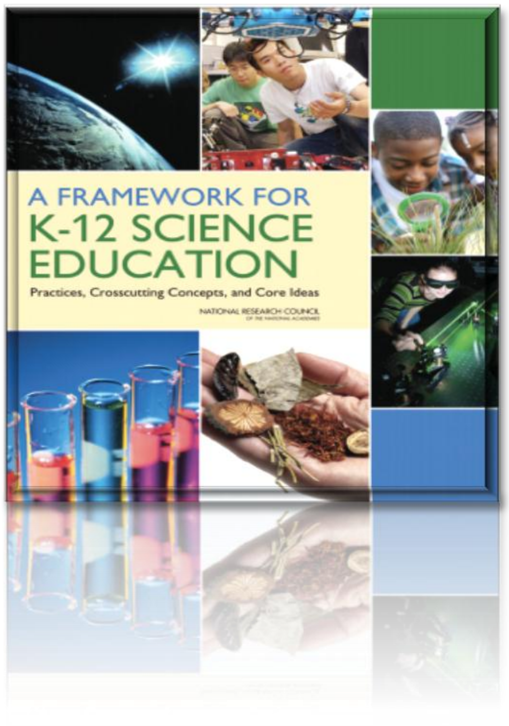
"Human communities depend on a diversity of talent, not on a single ability."

-Sir Ken Robinson, Ted Talk, 2010

We need more experiences…

1. Spark, sustain, and deepen their interest in science, technology, engineering, and mathematics (STEM).
2. Develop and expand their understanding of STEM.
3. Advance an awareness of and commitment to pursuing academic, career, and lifelong pathways in STEM-related fields

Why the NGSS?



1. Children are born investigators
2. Understanding builds over time
3. Science and Engineering require both knowledge and practice
4. Science connects to students' interests and experiences
5. Instruction focuses on core ideas and practices
6. Science learning standards promote equity
7. Created through a **collaborative**, state-led process, and informed by community stakeholders.

Strengthening the Pipeline to College and Careers

College and Career

Career and Technical Education Pathways

(DC CTE Strategic Plan, 2012)

International Baccalaureate and Advanced Placement Courses

K-12

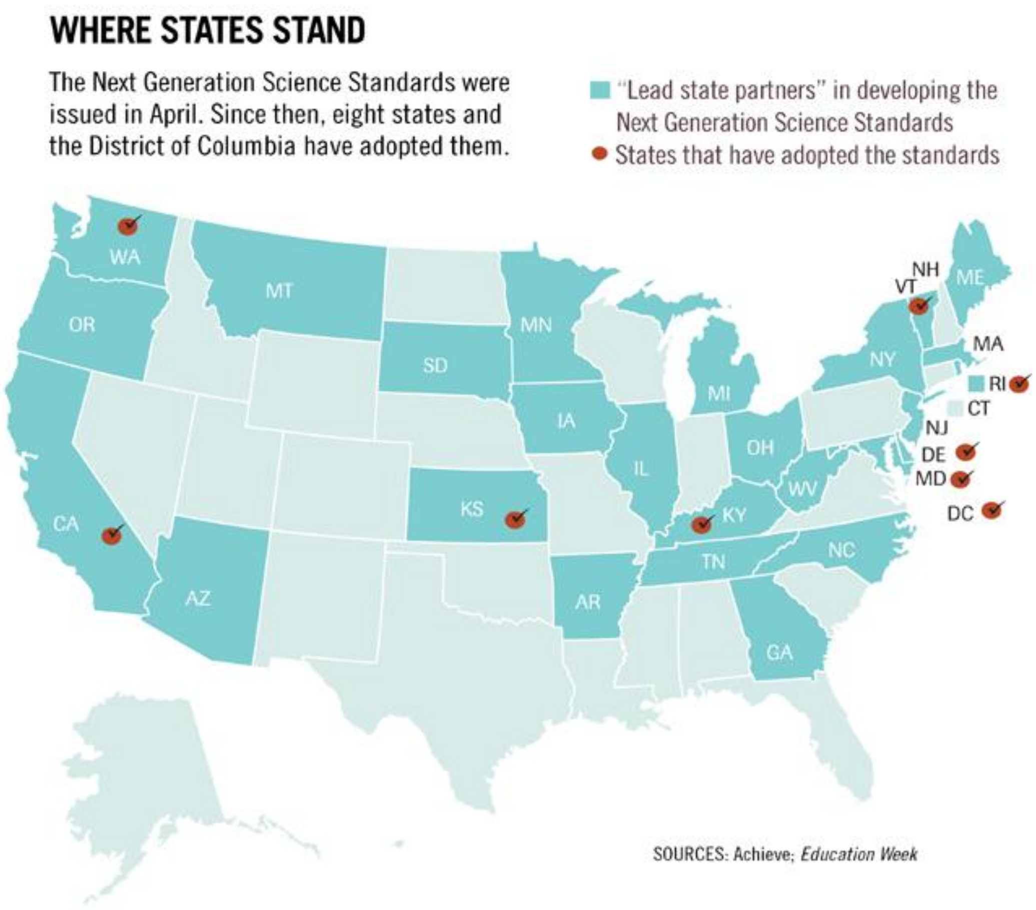
K-12 Common Core State Standards *(Adopted, 2010)*	**Next Generation Science Standards (Adopted, 2013)**

Early Learning Standards

(Adopted, 2012)

NGSS State Adoption Update

- Rhode Island
- Kentucky
- Kansas
- Maryland
- Vermont
- California
- Delaware
- Washington State
- Washington, D.C.
- Nevada
- Oregon
- New Jersey
- West Virginia



NGSS Readiness Timeline

Phase 1 : Awareness

SY' 2013-2014

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

Phase 2: Readiness and Transition

SY' 2014-2017

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

Phase 3: Sustainability and Monitoring

SY' 2017-Onward

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

Taking an NGSS Pulse

- Use the post-its to write down the following:
  - Concerns about the NGSS
  - Questions you may have about the NGSS
  - Opportunities associated with the NGSS

EXAMINING THE ARCHITECTURE OF A STANDARD

NEXT GENERATION SCIENCE STANDARDS

What is an NGSS Standard?

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.**

Student Performance Expectations

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)

Foundation Box

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 inform… solve a problem efficiently. *(3-5-ETS-2)*
RI.5.9 Integrate inform…)
W.5.7 Conduct short r… 3-5-ETS1-1),(3-5-ETS1-3)
W.5.8 Recall relevant … e information in notes and finished work, and provi…
W.5.9 Draw evidence …
Mathematics –
MP.2 Reason abstract…
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)*

Common Core State Standards for Math and ELA

Connections Box

The Foundation Box

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 real-world connections.

OSSE

NGSS Performance Expectation Example
Layers of an Earth and Space Science (ESS)

HS-ESS3-4 Earth and Human Activity

Students who demonstrate understanding can:

HS-ESS3-4. **Evaluate or refine a technological solution** that **reduces** **impacts of human activities on natural systems**.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. • Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of ev idence, prioritized criteria, and tradeoff considerations.	**ESS3.C: Human Impacts on Earth Systems** • Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. **ETS1.B: Developing Possible Solutions** • When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary)*	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system. - ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and

Connections to other DCIs in this grade-band:
HS.LS2.C ; HS.LS4.D
Articulation of DCIs across grade-bands:
MS.LS2.C ; MS.ESS2.A ; MS.ESS2.E ; MS.ESS3.B ; MS.ESS3.C ; MS.ESS3.D
Common Core State Standards Connections:
ELA/Literacy -

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS3-4)
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS3-4)

Mathematics -

MP.2	Reason abstractly and quantitatively. *(HS-ESS3-4)*
HSN.Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS3-4)
HSN.Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. *(HS-ESS3-4)*
HSN.Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *(HS-ESS3-4)*

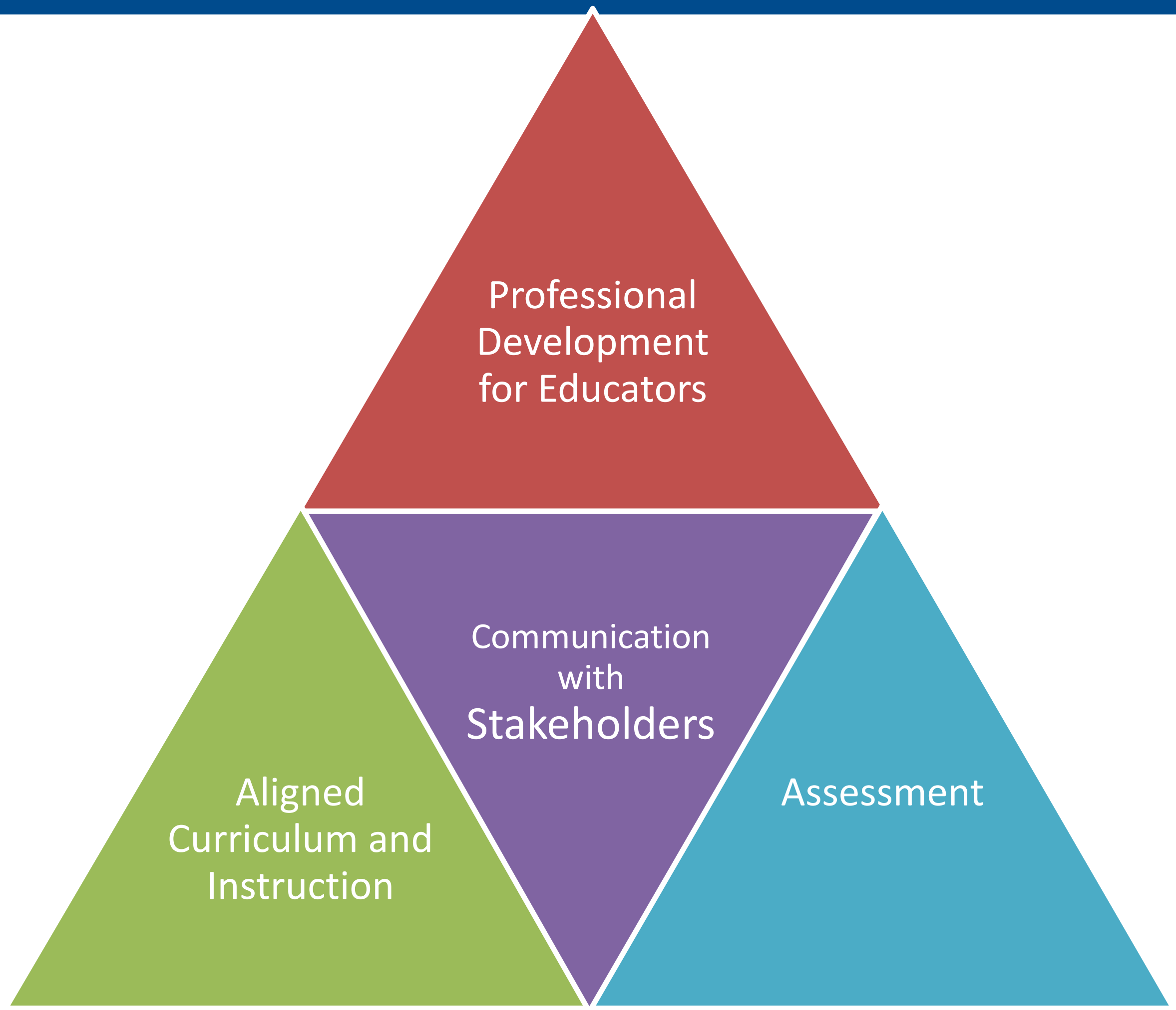
EXPLORING THE SHIFTS

The Shifts

1. K-12 science should reflect the interconnected nature of science as it is practiced in the real world.
2. The NGSS focus on deeper understanding of content as well as the application of content.
3. The science concepts build coherently from K-12
4. Science and engineering are integrated in the NGSS from K-12
5. Aligned to the Common Core State Standards
6. College, Career, and Citizenship Readiness

-Appendix A, The Next Generation Science Standards Volume 2

Implications for Implementation



K-12 Science Education Should Reflect the Interconnected Nature of Science as it is Practiced and Experienced in the Real World

The NGSS focus on deeper understanding of content as well as application of content.

The science concepts build coherently from K-12.

College and Career Ready

Career and Technical Education Pathways

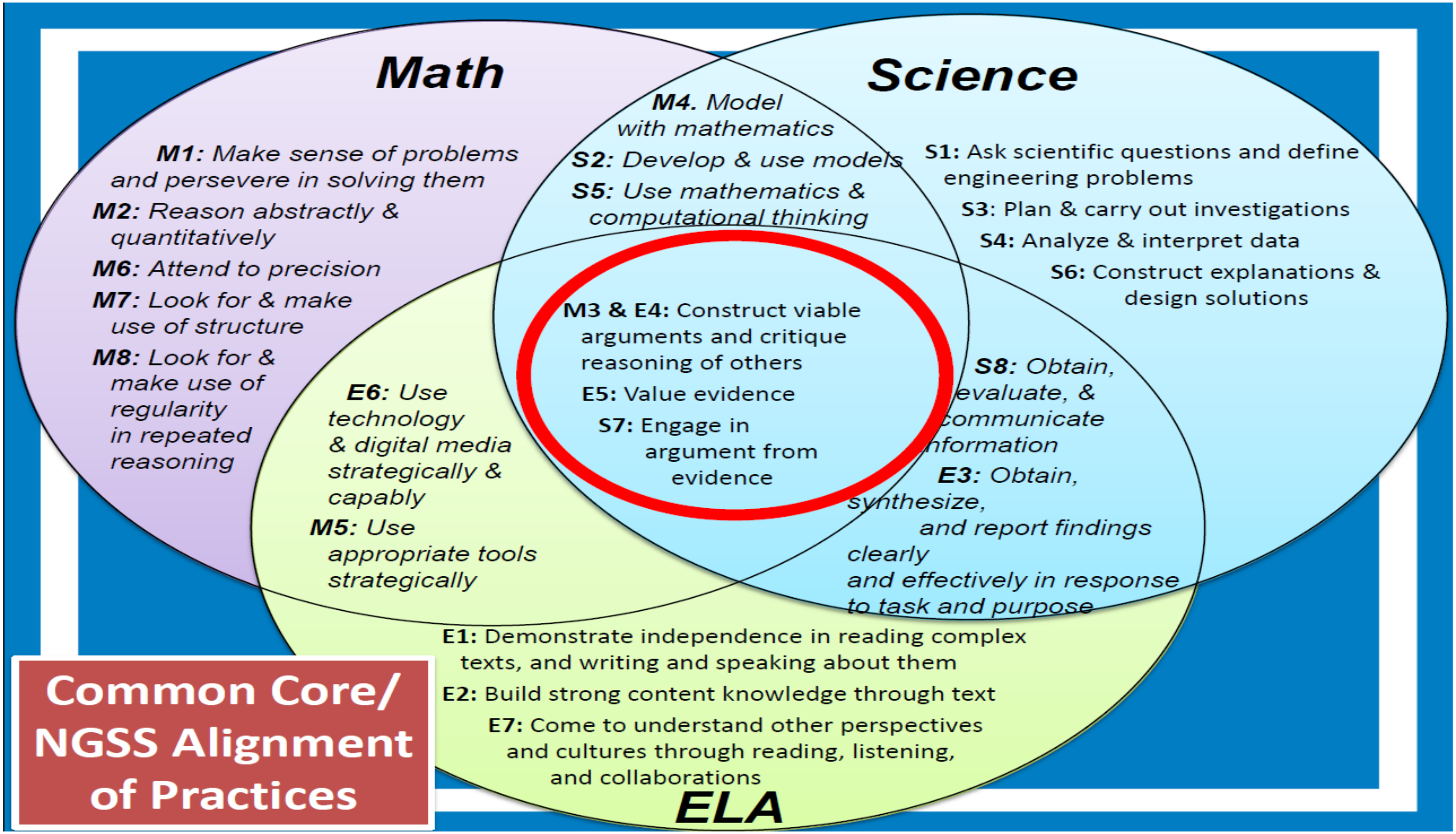
IB and Advanced Placement Courses

K-12 College and Career Ready Standards

Early Learning

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

The NGSS are Common Core Aligned



What does this mean for students?

ELA/Literacy

- Read sufficiently complex texts independently
- Write effectively to sources
- Build and present knowledge through evidence based research

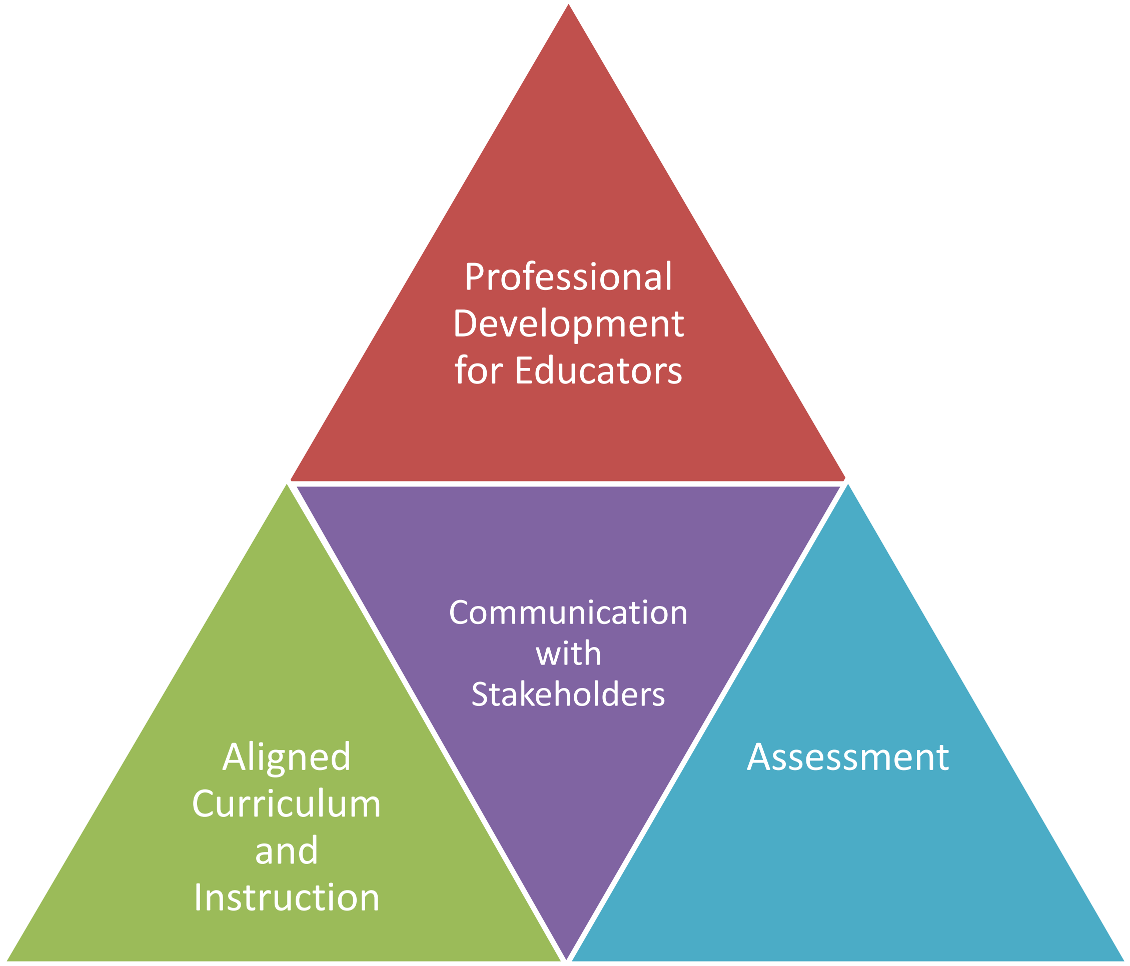
Math

- Solve problems: content and practice
- Reason mathematically
- Model real-world problems
- Have fluency with mathematics

Science

- Build and present knowledge from evidence based research and practice.
- Solve problems: content and practice
- Reason scientifically
- Model real world problems

Implications for Implementation



PROFESSIONAL LEARNING

Instructional Shifts

DC Science Standard

Scientific Thinking and Inquiry

- **K.1.2. Raise questions about the natural world and know that scientific inquiry can be used to seek answers to questions about it.**
- **K.1.3. Gather information about objects through the use of one or more of the senses, such as sight, smell, touch, and (under supervision) taste.**

Physical Science

- **K.4.1. Compare the position of an object in relationship to another object.**
- **K.4.2. Explain that things move in many different ways, such as straight, zigzag, round and round, back and forth, and fast and slow.**
- **1.3.1. Observe and describe that the way to make something move (faster or slower or in a different direction) is by giving it a push or a pull, which is called a force.**
- **1.3.2. Explain that the greater the applied force, the greater the change in the motion of the object.**

STUDENTS IN THIS CLASSROOM…

- **Make observations around movement and how things move.**
- **Compare the position of one object to the position of another object in a room.**
- **Explain how force affects motion.**

OUTCOMES

- **The moves faster when I push it harder.**
- **It moves slower when I don't push it as hard.**

Instructional Shifts

Next Generation Science Standards

<u>Motion and Stability: Forces and Interactions</u>

- **K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.**
- **K-PS2-2. Analyze data to determine if a design solution works as intended to change the spe or direction of an object with a push or a pull.**

Scientific Thinking and Inquiry standards have been integrated.

Students in this classroom…

- **Make observations around movement and how things move.**
- **Compare the position of one object to the position of another object in a room.**
- **Explain how force affects motion.**
- **Plan and conduct an investigation around how force affects the motion of an obje**
- **Analyze and report the results of their experiment.**

More rigorous expectations for students will be doing.

OUTCOMES (Teacher/Student Conversation)

T: Wow, how did you make the car move faster?
S: I pushed it harder!
T: How do you know that?
S: Well when I push it lightly it doesn't move as far, but when I pushed it harder it moves further and faster.
T: Do you think that it works for all things like that?
S: I'm not sure..
T: How could we find that out?
S: Maybe I could look at how a few things in the classroom move and then we could see…..

Outcomes are more focused on a students "sense-making."

Professional Development Planning

- Deconstructing the Standards
- Understanding the Shifts
- Connecting to the Common Core
- Translating the Standards for Instruction
- Lesson Study Collaborative

Implementation of NGSS in Schools and Learning Environments

- Assess Your Needs
- Create a Program Plan
- Implement and Evaluate

COMMUNICATION AND OUTREACH

Communication with Stakeholders

- Parent and family engagement and outreach
- Community outreach events and opportunities.
- Learn DC

CURRICULUM AND INSTRUCTION

NGSS Aligned Instructional Resources

- Don’t reinvent the wheel!
- Achieve EQUiP Rubric
- Lesson study collaborative or professional learning communities
- Compare programs of study with recommended course pathways.

ASSESSMENT IMPLICATIONS

A New Era

- NGSS different from prior standards
- Focuses on students at all levels thinking and working like scientists
- Pose unique opportunity to create new assessments that are
  - Authentic
  - Capture multiple facets of learning
  - Measure the whole student

Integration of the 3 Dimensions

4-PS3-3 Energy

Students who demonstrate understanding can:

4-PS3-3. **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*]

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

Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.	**PS3.A: Definitions of Energy** • Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **PS3.B: Conservation of Energy and EnergyTransfer** • Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. **PS3.C: Relationship Between Energy and Forces** • When objects collide, the contact forces transfer energy so as to change the objects' motions.	**Energy and Matter** • Energy can be transferred in various ways and between objects.

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels:
K.PS2.B ; **3.PS2.A** ; **MS.PS2.A** ; **MS.PS3.A** ; **MS.PS3.B** ; **MS.PS3.C**

Common Core State Standards Connections:
ELA/Literacy -
W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-3)
W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-3)

Starting points for assessments

Classroom Assessment

- Because of the multi-dimensional approach – teachers will need to devise a structured framework for collecting student evidence of learning across the dimensions
  - Discourse-based assessment of learning
  - Performance assessments
  - Constructed response assessments

Classroom Assessments

- Align to NGSS performance expectations
- Have the following qualities:
  – Learning objective is identified
  – Authentic task is incorporated into the assessment
  – Criteria for the task is identified
    - (Mueller, 2011)

- PD on appropriate performance assessment and rubric development is a must!

NGSS Assessment Update

- Moving to computer based assessment
- Allows tech-enhanced item types
- New proficiency levels will be set through a standard setting process.
- Built on:
  - Existing science questions when appropriate
  - Licensed questions from assessment banks
  - New questions developed by the vendor
- Assessment window – May 18th - June 19th

Taking an NGSS Pulse

Look at the questions concerns and opportunities you wrote down previously and discuss with a partner whether your questions or concerns have been addressed, and what questions or concerns still remain.

Transitioning to the NGSS

Transitioning to the NGSS	
Learn Online	Introduction – OSSE NGSS Learn more on Learn DC
Communities of Practice	• Science Educator Leader Cadre • NGSS LEA Intensive – Beginning Feb, 2015 • Exploring Common Core Alignment- Summer 2015
Educator Training	National Science Teachers Association NGSS Professional Development Planning Guide and Session for LEA's NGSS 1.0- Webinar Introduction to the NGSS NGSS 2.0- Exploring the Shifts in Practice NGSS 3.0- 5 Tools for Translating the NGSS into Instruction

National Current and Upcoming NGSS Projects that will benefit DC

- Evidence Statements – Winter, 2014
- Additional Model Course Maps – Winter, 2014
- Science EQuIP Rubric – Spring, 2015- Training for LEA representatives.
- State of Science Education Research – Winter, 2014
- Translating the NGSS into Classroom Practice
- NGSS District Implementation Guide, NRC- Winter, 2014
- NGSS Assessment Publication, Winter, 2013
- Publishers Criteria – Summer,2014 In Progress

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