Pre-K Science, Technology, and Engineering Standards

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Why New Pre-K STE Standards?

- It is an opportunity to define the nature and substance of Pre-K STE
- It is an opportunity to emphasize the importance of STE in Pre-K
- A State Pre-K- 12 STE revision process is underway

Building on What We Know and Have

Frameworks

- The Curriculum Framework for English Language Arts and Literacy (March 2011): Standards for Pre-Kindergarten and Kindergarten
- The Curriculum Framework for Mathematics (March 2011): Standards for Pre-Kindergarten and Kindergarten
- Head Start Child Development and Early Learning Framework

Building on What We Know and Have

Guidelines

- The Early Learning Guidelines for Infants and Toddlers (November 2010)
- The Guidelines for Preschool Learning Experiences (April 2003) in all domains except English Language Arts and Mathematics
- The Kindergarten Learning Experiences (April 2008) in all domains except English Language Arts and Mathematics

Pre-K STE Standards

- Based in framework from *A Framework for K-12 Science Education, (NAP, 2011)* and the revision of the MA Frameworks for Science, Technology, and Engineering
- Three domains
  - Practices of science and technology
  - Cross-cutting concepts
  - Disciplinary core ideas

The Structure of a STE standard

What the structure will do:

- Identify STE learning outcomes
- Highlight content in the context of practices and cross-cutting ideas - not information
- Identify connections with the Math and ELA frameworks

What the structure will not do:

- Define curriculum
- Define pedagogy
- Explicitly connect to other development goals (e.g. physical, socio-emotional, etc.)

Dimension 1: STEM Practices

What are practices?

- What scientists do when they do science
- What children do when they do and learn science

What is the relationship between practices and inquiry skills

- Scientists and children engage in inquiry
- When they do so the use practices (inquiry skills)

How do we teach practices?

- By engaging children in using them

Dimension 1: STEM Practices

- Ask questions (science) and solve problems (engineering)

  Math Framework: Make sense of problems and persevere in solving them

- Plan and carry out investigations

  Math Framework: Reason abstractly and quantitatively

- Make meaning from experience and data

  Math Framework: Reason abstractly and quantitatively

Dimension 1: STEM Practices

- Use mathematics and computational thinking

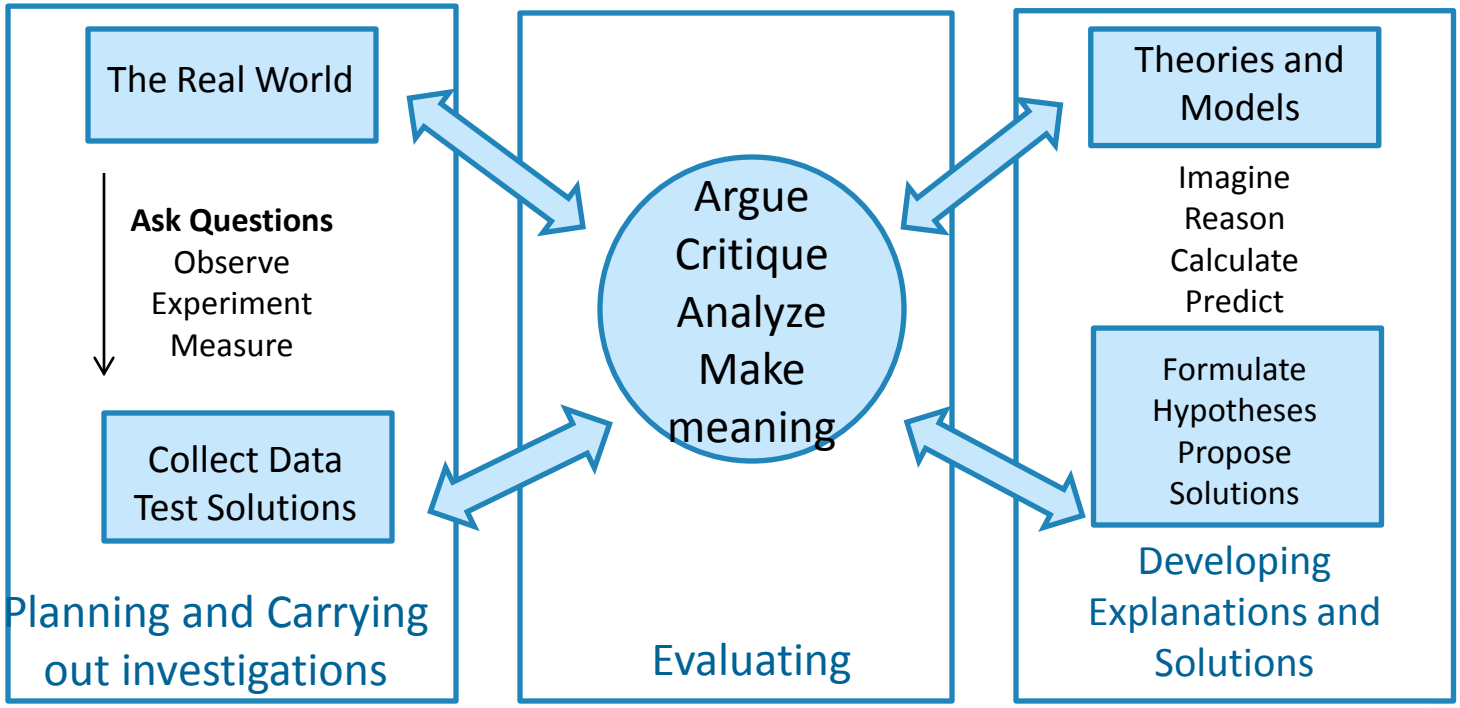
  Math Framework: Reason abstractly and quantitatively
- Construct explanations (science) and designing solutions (engineering)
- Develop and use models

  Math Framework: Model with mathematics
- Engage in discussion/argue from evidence

  Math Framework: Construct viable arguments and critique the reasoning of others
- Obtain, evaluate, and communicate information

Dimension 1: STEM Practices

The following diagram, taken from *A Framework for K-12 Science Education* suggests the way in which the practices interact and describe the scientific and engineering process.



Dimension 2: Cross-Cutting Concepts

What are they?

- Big ideas that cross science subject areas
- Big ideas that cross disciplines

How do we teach cross-cutting concepts?

- We design appropriate experiences for children
- We use the language in context
- We highlight the ideas in context

Dimension 2: Cross-Cutting Concepts

- Patterns
- Cause and Effect
- Systems
- Structure and Function
- Stability and Change

A Standard and its Elements

- The Standard
- Science and Engineering Practices
- Disciplinary Core Ideas
- Connections to:
    1. Other Disciplinary Core Ideas (DCIs) in pre-K:
    2. Articulation of DCIs across grade-bands
    3. Common Core State Standards

An Example from Earth and Space Sciences:

The Standard

PreK-ESS1. Earth's Place in the Universe

- **PreK-ESS1-1. Demonstrate awareness that the moon can be seen in the daytime and at night, and of the different apparent shapes of the moon over a month.** [Assessment Boundary: Assessment does not include names for moon phases or sequencing moon phases.]
- **PreK-ESS1-2. Observe and use evidence to explain that sun is in different places in the sky during the day.**

Elements

Science and Engineering Practices

Asking Questions and Solving Problems/Designing Things (Engineering)

- Observe and ask questions about observable phenomena (objects, materials, organisms or events). (PreK-ESS1-1), (PreK-ESS1-2)

Constructing Explanations/Theories and Evaluating Solutions (Engineering)

- Look for and describe patterns and relationships. (PreK-ESS1-2)

Disciplinary Core Ideas

- **ESS1.A: The Universe and Its Stars**
- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (PreK-ESS1-1, PreK-ESS1-2)

Connections

1. Other Disciplinary Core Ideas (DCIs) in pre-K:

2. Articulation of DCIs across grade-bands

3. Common Core State Standards

ELA/Literacy

- **Speaking and Listening: Presentation of Knowledge and Ideas**
- Describe people, places, things , and events with relevant details, expressing ideas and feelings clearly (PK.SL.MA.4.)

Mathematics

- **Geometry: Identify and Describe Shapes**
- Identify relative position of objects in space, and use appropriate language (PK.G. MA.1.)

An Example from Physical Science

The Standard

PreK-PS2. Motion and Stability: Forces and Interactions

- **PreK-PS2-1. Using evidence, discuss ideas about what is making something move the way it does and how some movements can be controlled.**
- **PreK-PS2-2. Through experience, develop awareness of factors that influence whether things stand or fall.** (Clarification statement: Examples of factors in children's construction play include using a broad foundation when building,, considering the strength of materials, and using balanced weight distribution in a block building.)

Elements

Science and Engineering Practices

Engaging in Discussion/Argument from Evidence

- Engage in discussion before, during and after investigations (PreK-PS4-1)
- Support thinking with evidence. (PreK-PS2-1)

Planning and Carrying Out Investigations

- Plan and implement investigations using simple equipment; designing/building a solution to a problem. (PreK-PS2-1, PreK-PS2-2)

Constructing Explanations/Theories and Evaluating Solutions (Engineering)

- Look for and describe patterns and relationships (PreK-PS2-2)

Elements

Disciplinary Core Ideas

PS2.A: Forces and Motion

- Objects pull or push each other when they collide or are connected. Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (PreK-PS2-1), (PreK-PS2-2)

PS2.B: Types of Interactions

- When objects touch or collide, they push on one another and can change motion or shape. (PreK-PS2-2)

An Example from Life Science

The Standard

PreK-LS1 From Molecules to Organisms: Structures and Processes

- **PreK-LS1-1. Compare, using descriptions and drawings, the external body parts of animals (including humans) and plants and explain functions of some of the observable body parts.** [Clarification Statement: Examples can include comparison of humans having two legs and horses four, but both use legs to move.]
- **PreK-LS1-2. Recognize that all plants and animals grow and change over time**
- **PreK-LS1-3. Explain that most animals have 5 senses they use to gather information about the world around them.**
- **PreK-LS1-4. Use their five senses in their exploration and play to gather information.**

Elements

Science and Engineering Practices

Developing and Using Models

- Represent (e.g., draw, use blocks, use clay, make a collage) findings. (PreK-LS1-1)

Constructing Explanations/Theories and Evaluating Solutions (Engineering)

- Look for and describe patterns and relationships (PreK-LS1-2, PreK-LS1-3)

Obtaining, Evaluating, and Talking about Information

- Document experiences and thinking to communicate with others. (PreK-LS1-4)

Planning and Carrying Out Investigations

- Use their senses and simple tools to observe, gather, and record data (e.g., dictate, draw, photograph, write). (PreK-LS1-4)

Elements

Disciplinary Core Ideas

- **LS1.A: Structure and Function**
- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive, grow, and produce more plants. (PreK-LS1-1)
- **LS1.B: Growth and Development of Organisms**
- Plants and animals have predictable characteristics at different stages of development. Plants and animals grow and change. (PreK-LS1-2, PreK-LS1-3)
- **LS1.D: Information Processing**
- Animals have body parts that capture and convey different kinds of information needed for growth and survival-for example, eyes for light, ears for sounds, and skin for temperature or touch. (PreK-LS1-4) (PreK-LS1-5)

Next Steps

- February-March: Information Sessions and Webinars

- April –May: Training of trainers