Making Time for Science: K-5

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Session Goals:

- Establish a common language
- Gain comfort with the shifts and expectations of the ILS for Science
- Explore tools to help us implement the ILS for Science
- Experience an activity
How has science been taught?
What was your experience like?

Work with your elbow partner to make a list of what you would expect to see in a “traditional” science classroom.
7 Significant Shifts of 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 NGSS are Student Performance Expectations – NOT curriculum.
3. The Science Concepts in the NGSS 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 are Designed to Prepare Students for College, Career, and Citizenship.
7. The NGSS and Illinois Learning Standards for ELA and Math are Aligned.

In Summary…

Our lessons need to be PHENOMENA DRIVEN.
- shared experiences that inspire questions in our students

Our lessons must be three-dimensional.
- STUDENTS must engage in the SEPs, CCCs, and DCIs in every lesson

The teacher will have a very different role!
- Shift from direct instructor to FACILITATOR

2 Main Types of Phenomena

- Unit (Anchoring)
- Focus (Investigative)
What makes good phenomena?

- Is the phenomena **aligned** to the Performance Expectation?
- Will the phenomena **engage** students in all 3 **dimensions** of science (SEP, CCC, DCI)?
- Is the phenomena **approachable/appropriate** for your grade-level?
- Can students **observe** and/or **investigate** the phenomena either firsthand or through someone else’s experiences?
- Does the activity **justify** the costs?
Why is this so important?

- Equity in Science Education
- Shared experiences
- Rich conversation
- Opportunities to revise thinking/questioning
- “Student”-led educational experiences
- To get students to **write** about science, they need to **talk** about science
Three-Dimensional Learning

Integrating
- Scientific and Engineering Practices
- Crosscutting Concepts
- Disciplinary Core Ideas
Scientific and Engineering Practices

1. Asking Questions and Defining Problems
2. Developing and Using Models
3. Planning and Carrying Out Investigations
4. Analyzing and Interpreting Data
5. Using Mathematics and Computational Thinking
6. Constructing Explanations and Designing Solutions
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information

How students are learning about content... Skills to be developed in every grade level.

Crosscutting Concepts

1. Patterns
2. Cause and Effect
3. Scale, Proportion, and Quantity
4. Systems and System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Why students are learning about content...
Underlying themes that permeate content in every grade level.

http://www.bozemanscience.com/next-generation-science-standards/
http://www.ilclassroomsinaction.org/ccc-tables.html
Disciplinary Core Ideas

**Physical Science**
- Matter and Its Interactions
- Motion and Stability: Forces and Interactions
- Energy
- Waves and Their Applications in Technologies for Information Transfer

**Life Science**
- From Molecules to Organisms: Structures & Processes
- Ecosystems: Interactions, Energy, & Dynamics
- Heredity: Inheritance & Variation of Traits
- Biological Evolution: Unity & Diversity

**Earth & Space Science**
- Earth’s Place in the Universe
- Earth’s Systems
- Earth and Human Activity

**Engineering, Technology, & Applications of Science**
- Engineering Design
- Links Among Engineering, Technology, Science and Society

http://www.bozemanscience.com/next-generation-science-standards/
Performance Expectation

Students who demonstrate understanding can:

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly. [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]

2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area. [Assessment Boundary: Assessment does not include quantitative scaling in models.]

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education.
Three-Dimensional Lessons

• Video – 2nd Grade:
  https://www.youtube.com/watch?v=XJBN6BX04Ms

ACTIVITY:
• Write down the SEPs, CCCs, and DCIs covered by this lesson.
• Write down the significant shifts you observe.
Why do we resist?

- we tend to teach the way we were taught
- there is a hidden "power barrier" which literally dams up the notion that children might be treated in any way other than as inferior, less intelligent, less knowing - and of course they are in one sense, and yet... "the child is father of the man"
- we sense that telling information is faster - which would be true if students were like computers and learned best through direct input
- direct linear teaching is easier to plan, evaluate and objectify
- researchers in the past suggested teachers learn to teach in one best style and stick with it
- it is frightening for some teachers to "let go of students" for there is a sensation that there may be no way to get "control" again, and there isn’t in the same fashion
- we have never had a teacher run a classroom using this format or role, so we have no inherent moves to model
- one philosophy suggests that people are basically unmotivated and don’t want to be at school anyway, so if allowed to choose they will choose to do nothing
- since so many districts use scores to show teaching ability it is frightening to make a change with no assurance that students will score higher

What this shift looked like in my classroom...

- MS-ESS2-6
Iterative cycle of design that offers the greatest potential for applying science knowledge, results in technology.

Not a stand alone concept; engineering design is integrated throughout the standards.

Not an engineering curriculum.
Engaging Young Students in Engineering Design Process

- Children naturally look for solutions to problems
- Did Jon engage in the complete engineering design process?
- What could we do differently?

[Link to Google Drive document]
Tools for your classroom...
DQB: What happens to stars?

- Do they burn out?
- Do they burn? How?
- How long does it take to get information about stars?
- Why will it ever end? Earth? (Sun) different colors?
- What are they made of?
- How do stars form?
- Lifespan?
- How do stars affect planet formation?
- Solar flare? Temperature? Atmospheres on stars?
Driving Question Boards

- Exploring Essential Questions, allowing for:
- Making Connections
- Getting Organized
- Scaffolding Question-Asking
- Imparting Ownership
- *Fortus et al 2008- paper on DQBs*
Driving Question Boards

- Making Connections
  - Visual reminder
  - Allows students to share prior knowledge
  - Creates a coherent story from disconnected experiences
  - Connects small ideas to essential question
Getting Organized:
- Assists in connecting and synthesizing ideas
- Similar to concept maps
Scaffolding Question-Asking:
- Anchoring phenomena serves as a trigger for question generation
- Sorting questions into categories creates focus, helps connect them to the main idea and allows them to vary the type and level of questions asked
- Students can ask questions at higher levels of complexity
Driving Question Boards

- Imparting Ownership
  - Students develop the questions and investigations, creating a sense of ownership over the process and learning
  - DQBs vary between class to reflect the learning of the groups
Driving Question Board

The Driving Question Board
A visual organizer for project-based science

It was helpful to keep track of questions we had so
by integrating in we knew what we were trying to
find out. With these words, a student described
her activity of using a Driving Question Board (DQB)
in a project-based science (PBS) unit. This instruc-
tional tool is designed to support inquiry and projec-
t-based learning by organizing and focusing students’
questions and linking them to content learning goals.
We have used this tool in both physics and chemistry
clases, but it can be used with any subject matter. This
article describes the purpose and process of the DQB.
Claim, Evidence, Reasoning (CER)

What do you know?  How do you know that?

Claim + Evidence + Reasoning = Explanation

Why does your evidence support your claim?

https://www.youtube.com/watch?v=faSAI0Anf9E
https://www.youtube.com/watch?v=5KKsLuRPsvU
http://www.activatelearning.com/claim-evidence-reasoning/
**Claim** – What do you know?
- Air is matter.

**Evidence** – How do you know that?
- As we added air to the basketball, the mass of the basketball increased.

**Reasoning** – Why does your evidence support your claim?
- This shows that air has mass which is one of the characteristics of matter.

Together these build an explanation.
5E Instructional Model for Science Inquiry

Engage Lesson ➤ Exploration Lesson(s) ➤ Explanation Lesson(s) ➤ Elaboration Lesson(s) ➤ Evaluation Lesson(s)

5E Lesson Plan Template

## 5E Instructional Model

### 5E Definition

<table>
<thead>
<tr>
<th>Teacher Behavior</th>
<th>Student Behavior</th>
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<tbody>
<tr>
<td>Engage</td>
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<tr>
<td>Explore</td>
<td></td>
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<tr>
<td>Explain</td>
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<tr>
<td>Extend/Elaborate</td>
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<td>Evaluate</td>
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</tbody>
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### motivated
- Engage
  - Generates interest
  - Access prior knowledge
  - Connect to past knowledge
  - Set parameters of the focus
  - Frame the idea

### Explore
- Experience key concepts
- Discover new skills
- Probe, inquire, and question experiences
- Examine their thinking
- Establish relationships and understanding

### Explain
- Connect prior knowledge and background to new discoveries
- Communicate new understandings
- Connect informal language to formal language
- Encourages students to explain their observations and findings in their own words
- Provides definitions, new words, and explanations
- Listens and builds upon discussion form students
- Asks for clarification and justification
- Accepts all reasonable responses

### Extend/Elaborate
- Apply new learning to a new or similar situation
- Listen and explain concept being explored
- Communicate new understanding with formal language
- Uses previously learned information as a vehicle to enhance additional learning
- Encourages students to apply or extend the new concepts and skills
- Encourages students to use terms and definitions previously acquired
- Applies new terms and definitions
- Uses previous information to probe, ask questions, and make reasonable judgments
- Provides reasonable conclusions and solutions
- Records observations, explanations, and solutions

### Evaluate
- Assess understanding (Self, peer and teacher evaluation)
- Demonstrate understanding of new concept by observation or open-ended response
- Apply within problem situation
- Show evidence of accomplishment
- Observes student behaviors as they explore and apply new concepts and skills
- Demonstrates an understanding of knowledge of concepts and skills
- Evaluates his/her own progress
- Answers open-ended questions
- Provides reasonable responses and explanations to events or phenomena

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The Inquiry Project is a research project exploring the use of inquiry and investigative practices to deepen student understanding of matter for students in grades 3-5. Talk Science is web-based professional development to specifically build educators skills for productive discussion in the science classroom.
ILLINOIS CONTENT SPECIALISTS

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Tools and Resources for:
- ELA
- MATH
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- Social Emotional Learning
- Technology
- Fine Arts