6E Learning byDeSIGN™
A Model for Integrated STEM Education
Roger Skophammer
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March 26, 2015
Introductions

- Name & where you are from:
- Why you are here (what do you want to get out of this session)
- Something about yourself you would like to share:

Roger Skophammer, PhD
Apple Valley, MN

Develop relationships with educators interested in integrated STEM Education.
The Big Idea #1

The 6E Learning byDeSIGN™ instructional model supports integrated STEM education and i-STEM FocalPoints.
The Big Idea #2

Integrated STEM learning activities provide an effective and efficient method for learning STEM subjects.
The Big Idea #3

Engineering learning activities provide a natural integrator for integrated STEM education.
Today’s activities

- Explore STEM FocalPoints and how Focal Points relate to national standards
- Review the 6E Learning byDeSIGN instructional model for integrated STEM education
- 6E Learning byDeSIGN development resources
- Discussion on today’s activities.
The Premier Guide to Implementing Integrative STEM

Coming Fall 2015

The Premier Guide to Implementing Integrative STEM
Domains

Knowing:
Taking in information, organizing it and understanding relationships.

Thinking:
Making sense by combining and targeting information.

Doing:
Acting, performing, and executing or acquiring knowledge in an applied manner.
Themes

Knowing

- **I-STEM Content**: Knowledge and skills identified within standards documents as well as additional content derived from STEM integration.

- **Nature of I-STEM**: The Nature of integrated science, Technology, Engineering and Mathematics is the idea that these academic content areas are naturally connected. In the iSTEM classroom, a student should understand that these areas of study have traditionally been considered separate but realizes that all areas are required to understand content, and think about how they use (or do something with) the information that they learn in class.
Thinking

• **I-STEM Impacts:** STEM Impacts humans and the environment in a variety of ways. These impacts can be on the individual, societal, or global levels and often have both positive and negative, as well as intentional and unintentional consequences within any given system.
Themes

Doing

- **Real World Applications and Connections (I-STEM Context):** Authentic emphasis on situated applications of STEM knowledge and skills.

- **Processes of I-STEM:** Primary problem-solving practices in and across STEM domains that can be identified as inquiry (S), design (TE) and modeling (M).
<table>
<thead>
<tr>
<th>ORGANIZATIONAL THEME</th>
<th>I-STEM Content</th>
<th>Nature of I-STEM</th>
<th>I-STEM Impacts</th>
<th>I-STEM Context</th>
<th>Processes of I-STEM</th>
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<tbody>
<tr>
<td><strong>FocalPoint™</strong></td>
<td>1.0 (Matter, Measurement, and Problem Solving) Understand structures and properties of matter (Content NGSS 5-PS1-1) through experimentation in problem solving (STL 10) using volumetric measurement (5-MD-C3) to solve an engineering problem (ESTS1) I-STEM Context (secondary)</td>
<td>5.0 (Discoveries and Inventions) Recording and graphing (5-G-A-2) the patterns of daily changes associated with the orbits of the Earth and Moon (5ESS1-2) and the influence of these discoveries to create new technology in history (sun dial, sextant, compass, time) (STL-7) See also STL 13 for using information to identify patterns I-STEM Content (secondary)</td>
<td>2.0 (Impacts of Earth and Human Activities) Investigating impacts of technology on the environment that effect (STL-5) Earth and Human activity (5-ESS3-1NGSS) by integrating information from multiple print or digital sources (RI-5-7).</td>
<td>6.0 (Natural and Human made systems) The Earth systems interact in multiple ways to affect its surface materials and processes (5-ESS2-1) that lead to technologies to monitor these natural systems (radar for weather, sea floor mapping, glacier movement, maps (STL 13).</td>
<td>3.0 (Designing with substances) Applying the design process (STL 11) to combine two or more substances to create a new substance (NGSS 5-PS1-4) for solving a problem or meet a need using evidence within multiple reference texts as sources (W-5-9)</td>
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<td>ORGANIZATIONAL THEME</td>
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### Grade 5 - Draft

<table>
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<th>Knowing</th>
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<tbody>
<tr>
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<td><strong>I-STEM Content</strong></td>
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<td><strong>Essential Questions</strong></td>
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1. How can technology be used to provide evidence to explain that matter exists on a very small scale even when it can’t be seen?
2. Why are mass and volume measurements important to understanding properties of matter?
3. How can technology be designed and used to measure properties of matter?
4. How can the properties of matter be used to solve problems and create new technologies?
**FocalPoint #1:**

*(Humans, Nature, and Technological Impacts)*

Understand the positive and negative consequences of the use of technology (STL: 7E), and that human activities have significantly altered the Earth's biosphere (NGSS: MS ESS3.C) by gathering relevant information from multiple print and digital sources (CCSS-ELA: WHST.6-8.8) to identify and use variables to measure human effects on the Earth (CCSS-M: 7.EE.4.B). Students should understand that there are ethical consequences to the use of technology (NAE Habits of Mind: Ethical Considerations).

**ENDURING UNDERSTANDING:** Students will understand that the impact of humans on society and the environment can be positive or negative.

**ESSENTIAL QUESTIONS:**

1. How can human impacts on the environment be measured and analyzed?
2. What is the relationship between humans' use of technology and impacts on the environment?
3. How can a human decision have both positive and negative impacts?
4. What is the role of society in the development and use of technology?

**PERFORMANCE EXPECTATIONS:** *Students who demonstrate an Understanding can:*

1. Measure human impacts on the environment.
2. Identify the relationship between humans' use of technology and its impact on the environment.
3. Determine the impacts of humans' decisions.
4. Define the role of society in the development of technology.

<table>
<thead>
<tr>
<th>Performance Elements</th>
<th>Student Performance Indicators</th>
<th>Teacher Performance Indicators</th>
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<tbody>
<tr>
<td>ENVIRONMENTAL IMPACTS</td>
<td>• Measures human impacts on the environment.</td>
<td>• Introduces methods to measure and analyze human impacts on the environment.</td>
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<tr>
<td>RELATIONSHIPS</td>
<td>• Identifies the relationship between humans' use of technology and its impact on the environment.</td>
<td>• Produces examples of how humans' use of technology has impacted the environment.</td>
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<td>POSITIVE AND NEGATIVE IMPACTS</td>
<td>• Determines the impacts of humans' decisions.</td>
<td>• Instructs on students on how decisions have had positive and negative impacts.</td>
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<td>ROLE OF SOCIETY</td>
<td>• Defines the role of society in the development of technology.</td>
<td>• Discusses technological determinism.</td>
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**6E Learning byDeSIGN™**

Student Centered Instructional Model

<table>
<thead>
<tr>
<th>Engage</th>
<th>experience, question, stimulate</th>
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</thead>
<tbody>
<tr>
<td>Explore</td>
<td>predict, experiment, observe, discover, record, retest, discuss</td>
</tr>
<tr>
<td>Explain</td>
<td>develop, progress, grow</td>
</tr>
<tr>
<td>eNGINEER</td>
<td>apply, conceptualize, informed design, modeling, create</td>
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<tr>
<td>Enrich</td>
<td>interact, question, hypothesize, experiments, record observations, draw conclusions</td>
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<tr>
<td>Evaluate</td>
<td>analysis, synthesis, re-visit</td>
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Maximizing Design & Inquiry In the Integrative STEM Classroom

www.iteea.org/LbD

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Engage

The purpose for the ENGAGE phase is to pique student interest and get them personally involved in the lesson, while pre-assessing prior understanding.
The purpose for the EXPLORE phase is to provide students with the opportunity to construct their own understanding of the topic.
Explain

The purpose for the EXPLAIN phase is to provide students with an opportunity to explain and refine what they have learned so far and determine what it means.
eNIGINEER

The purpose for the eNIGINEER phase is to provide students with an opportunity to develop greater depth of understanding about the problem topic by applying concepts, practices and attitudes. They use concepts learned about the natural world and apply them to the man-made (designed) world.
Enrich

The purpose for the ENRICH phase is to provide students with an opportunity to explore in more depth what they have learned and to transfer concepts to more complex problems.
Evaluate

The purpose for the EVALUATION phase is for both students and teachers to determine how much learning and understanding has taken place.
Further Develop the **6E Learning byDeSIGN** to include:

- Lesson planning tools
- Curriculum developer resources
- Assessment and rubric templates for 6E
- Professional Development
- Author Development Institutes
- Converting EbD courses during the revision process
Discussion

• What resources would you utilize concerning 6E Learning byDeSIGN
• Would you be interested in Professional Development/Author Development Institutes
• Would you like to learn more about the EbD Model using 6E and i-STEM FocalPoints

Questions?
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www.engineeringbydesign.org