Practice-Practice-Practices!
Aligning teaching to Place-Based Integrated STEM

Anne L. Seifert, EdS
Idaho National Laboratory

Lyndon Oswald
Idaho National Laboratory

Brenda Greenhalgh
Idaho National Laboratory
GOALS

• Set the Stage
  – Workforce Needs
  – Disconnect between Education and Workforce

• Student Learning
  – Share Time

• Introduction to i-STEM Teacher PD
  – Model
  – Active Engagement using i-STEM Tools
  – Value
What Does this Suggest to You?
STEM Jobs


View of STEM Domains in the Community vs Schools

Comparison of emphasized STEM domains in community and in schools
Education

- Content for more content
- Content driven

Workplace

- Content for solving problems
- Context driven

Society

- Content for understanding
- Issues driven
Think-Pair-Share

• What are you doing in your STEM teaching that deepens student understanding and engagement of STEM content?

• How do you address STEM:
  • Curriculum
  • Content/Discipline Integration
  • Pedagogy
  • Career Awareness
  • Assessment Practices
  • Instructional Technology
  • Industry-Business Involvement
  • Other Areas of Emphasis?

• What does this look like? What materials, products, and practices do you use?

• What is your greatest success and greatest challenge when teaching STEM?
i-STEM Video
Place Based STEM

- Collaborative
- Many Stakeholders
- Relevant
- Application
- Local Resources
- Integrated
- Purposeful Learning

Purposeful Learning
Integrated
Relevant
Application
Local Resources
Many Stakeholders
Collaborative
Place Based STEM
Defining STEM

**STEM Continuum**

- **Shorthand S-T-E-M**
  - Foundational
  - Knowledge Level
  - Direct Instruction
  - Content Level
  - Top Down
  - Highly Structured
  - Lower Order Thinking
  - Literacy

- **Mixed S-T-E-M**
  - Applications
  - Problem Level
  - Guided or Modeled
  - Mix of Top Down and Bottom Up
  - Some Structured
  - Mixture of Order Thinking
  - Competency

- **Integrated STEM**
  - Synthesis
  - Project Level
  - Discovery Based
  - Bottom Up
  - Open End
  - Ill Structured
  - Higher Order Thinking
  - Proficiency
Make Your Own Balloon Rocket!

- One plastic drinking straw
- Rubber band
- Paper
- Scissors
- Tape

1. Place your balloon on the top end of the drinking straw. Fasten a rubber band securely around the balloon so that it is sealed to the end of your straw.

2. Cut out two paper fins. Slip first fin into the slot on second fin and tape them together. Now tape them to the bottom of your straw. Leave a little room at the bottom so you can put your lips around the straw.

3. While holding the rubber band against the balloon (so it doesn’t fly off), blow up your balloon.

4. Blastoff! Let your balloon-rocket fly! Try different sizes of fins and balloons. See how high you can make your rocket go.
Integrated STEM Balloon Rocket Concept Based Activity

Developed by Louis S. Nadelson and Anne Seifert ©
An Integrated STEM Challenge

Balloon Car

Redesign and modify your balloon rocket to serve as the engine for a balloon car.
Integrated STEM Balloon Car Concept Based Activity

Science
- Air pressure
- Gravity
- Laws of motion
- Velocity
- Capacity – lungs, balloon
- Surface tension
- Aerodynamics
- Air/gases
- Static electricity

Engineering
- Ratio
- Design
- Criteria
- Constraints
- Materials – plastics, rubber
- Optimization

Technology
- How plastic is made
- Manufacturing
- Tape/adhesive
- Scissors
- Rubber bands
- Camera/phone
- Computer/projector
- Electricity

Math
- Fin design/geometry
- Ratios
- Velocity
- Optimization
- Measurement
- Air flow/calculus
- Trajectory
- Gas laws
- Lift
- Radius, diameter, circumference, volume, SA
- Lift vs weight
- Vectors
- Graphing data collection

Developed by Louis S. Nadelson and Anne Seifert ©
Balloon Challenge
Problem Based Lesson

- Creativity & Innovation
- Critical Thinking & Problem Solving
- Collaboration
- Competency
- Computational Thinking
- Capacity to Lead
- Cross-Cultural Sense
- Confidence
- Commitment
- Communication
- Computing & Technology

Key:
- No Utilization
- Low Utilization
- Moderate Utilization
- High Utilization

Competency
Methods of Science

Mathematical Modeling

INNOVATIVE THINKING

Technology Application

Engineering Design
Start with the problem....
Why STEM in context?

Zone of Optimal Learning Practices

- Identify/Recognize/Classify
- Modeling/Simulation
- Design/Experimentation
- Repurposing/Restructuring
- Inventing/Creating
- Theorizing/Critiquing/Validating
- Innovation

CONTENT

(Level of STEM Content Knowledge)
Power of Practices

NGSS
- Problem Solving
- Questioning
- Interpreting Data

CCSS-M
- Modeling
- Argumentation
- Investigation and Tool Use
- Computational Thinking and Quantitative Reasoning
- Explaining and Reasoning

Look For and Make Use of Structure
Attend to Precision
STEM Reflection – STEM Practices

**Directions:** Complete the rubric by providing the indicators for student performance for each of the STEM Practices associated with your lesson.

<table>
<thead>
<tr>
<th>STEM Practices</th>
<th>12 Exemplary</th>
<th>9 Proficient</th>
<th>6 Developing</th>
<th>3 Minimal</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving</td>
<td>Student implements a solution to benefit other people</td>
<td>Student can generate real world solutions with a specific content and audience</td>
<td>Student can solve a real world problem with guided support</td>
<td>Student can reiterate solution</td>
<td></td>
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<tr>
<td>Questioning</td>
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<tr>
<td>Interpreting data</td>
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<tr>
<td>Modeling</td>
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<tr>
<td>Argumentation</td>
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<tr>
<td>Investigation and tool use</td>
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<tr>
<td>Computational thinking</td>
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<tr>
<td>Explaining and reasoning</td>
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<td></td>
<td></td>
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<tr>
<td>Look for and use structures</td>
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<tr>
<td>Attend to precision</td>
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### STEM Reflection - Learning Objectives

**Directions:** Complete the rubric by providing the indicators for student performance for each of your lesson *learning objectives*.

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<th>12 Exemplary</th>
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<tr>
<td>Student will be able to formulate conclusions that are logically tied to inquiry findings and consider applications, limitations, and implications</td>
<td>The stated conclusion thoroughly evaluates and organizes all essential information and is the logical outcome of inquiry.</td>
<td>The stated conclusion evaluates and relates logically to all essential information.</td>
<td>The stated conclusion minimally evaluates and relates logically to some essential information.</td>
<td>The stated conclusion is absent or weakly evaluates essential information.</td>
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<tr>
<td>Ability to Define Concept in Context</td>
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<td>Application Prior Knowledge</td>
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<td>Use of Evidence in Learning</td>
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STEM Reflection – 21\textsuperscript{st} Century Skills

**Directions:** Complete the rubric by providing the indicators for student performance for each of the 21\textsuperscript{st} Century Skills as associated with your lesson.

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STEM Reflection – 21st Century Skills

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</thead>
<tbody>
<tr>
<td><strong>Critical Thinking and Problem Solving</strong></td>
<td>• Not only develops a logical, consistent plan to solve problem, but recognizes consequence of solution and can articulate reason for choosing solutions.</td>
<td>• Having selected from among alternative s, develops a logical plan to solve problem.</td>
<td>• Considers and rejects less acceptable approaches to solving problems.</td>
<td>• Only a single approach is considered and is used to solve the problem.</td>
<td>• Reformulates a collection of available ideas.</td>
</tr>
<tr>
<td></td>
<td>• Extends a novel or unique idea, question, format, or product to create new knowledge that crosses boundaries.</td>
<td>• Creates a novel or unique idea, question, format, or product.</td>
<td>• Experiments with creating a novel or unique idea, question, format or product.</td>
<td></td>
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Directions: Complete the rubric by providing the indicators for student performance for each of the 21st Century Skills as associated with your lesson.
How to Begin the Implementation Process

• Involve your administrators and colleagues
• Set a goal
• Keep it simple
• Repeated exposure
• Scaffold, model, and practice with students
• Utilize time…think outside of the box
• Start small and focus on a few areas at a time
• Do a little bit and learn it well, then expand
• Collaborate
• Self Reflection
• Keep in mind the process of continuous improvement.
Integrating STEM in place-based settings…

• Is more efficient
• Is what Common Core and Next Generation Science is supposed to be
• Enhances student:
  • Engagement/motivation
  • Retention of learning
  • Deeper understanding
• Makes learning math purposeful
• Builds partnerships and deepens relationships
• Meets workforce needs in local area
• Fun to teach!

Addresses multiple aspects of STEM
Allows for attention to the STEM practices
Promotes 21\textsuperscript{st} Century skills.
Some Publications:


Questions or Comments
THANK YOU!

Anne.Seifert@inl.gov
oswaldl@d93.k12kid.us
Brenda.Greenhalgh@inl.gov