Welcome
Dr. Carla C. Johnson
Associate Dean
Purdue College of Education
What is a STEM School or Program?

- 21st Century Skills Focus
- Problem and Project Based Learning are main pedagogical focus
- STEM careers and content are integrated across the curriculum with specific focus in mathematics and science
- Community partners and STEM professionals are engaged with teachers and students
- Teacher collaboration and planning time
- Technology-rich
- Data-driven
- Ongoing professional development
- Real-world context for teaching
Opening Remarks
Glenda Ritz
State Superintendent of Instruction
Indiana Department of Education
Indiana Department of Education
-STEM-

• Jeremy Eltz-STEM
  jeltz@doe.in.gov
  Twitter: @jeremyeltz

• Bill Reed-Math
  wreed@doe.in.gov
  Twitter: @DOESecMath
Finding IDOE STEM Resources

- Go to: www.doe.in.gov
- In the search bar, search STEM
- Click the first link
- The 2 documents for today are under ‘Becoming a STEM School’:
  - STEM Implementation Rubric
  - STEM School Certification Application
IDOE-STEM School Certification

• The IDOE plans to begin providing an IDOE approved STEM Certification for schools that want to be recognized as STEM

• Our Goal is to create a STEM school network promoting collaboration of best practices in STEM classes

• A pilot application period should open in the fall of 2014 with certifications being awarded in spring of 2015
Purpose of Recognizing STEM Schools

• Increase the number of our graduates that are prepared to enter college and careers in the science, technology, engineering, and mathematics fields

• Form a network of IDOE recognized STEM schools that will be able to share resources and best practices in addition to collaborating on professional development, standards and curriculum

• IDOE STEM certified schools will have credibility within the community to enable partnerships with STEM businesses and industry

• Publically recognize the great and challenging work our schools are doing to educate our children for the 21st Century
Process

• Step 1: School should perform a self-evaluation using the STEM School Rubric and submit the pre-application to the IDOE STEM Coordinator. (August - September)

• Step 2: A representative from the IDOE will contact you to schedule a visit. (September - December)

• Step 3: School makes adjustments based on recommendations by the STEM Coordinator prior to completing full application. (December - January)

• Step 4: Complete the full application and submit to the STEM Coordinator. (January)

• Step 5: Site visit to the school from the STEM Review Team (February - April)

• Step 6: Review application and compare it with the evidence and supporting documentation from the site visit. (April - May)

• Step 7: If recommended for certification, school will develop an award ceremony where the IDOE will present you with a banner. (May - June)

All certified STEM schools will be expected to reapply for certification every 5 years. Evidence of growth in the STEM attributes will be expected.
Self- Evaluation Using the STEM Implementation Rubric

• School will evaluate themselves in four areas
  • Infrastructure – 8 Attributes
  • Instruction – 6 Attributes
  • Curriculum – 5 Attributes
  • Extended Learning – 3 Attributes

• Each Area and Attribute has detailed descriptors that show what level of implementation your school is currently achieving

• STEM Certified School will demonstrate full implementation of 85% of all the Indiana Department of Education STEM Attributes
STEM Implementation Rubric

- **Full immersion**: Highest level of implementation of a STEM program
- **Partial immersion**: Quality program meeting expectations
- **Minimal immersion**: Program has met some components, but still needs further development
- **Supplemental immersion**: STEM program discussions have occurred and program implementation in infancy
STEM Implementation Rubric – Infrastructure –

1 – Infrastructure:  **Is a structure and process in place to support the program’s mission, vision, and goals?** STEM school requires several leadership teams that collaborate and dialogue frequently about the program’s design and effectiveness. Teachers are highly collaborative and community members are included in decision-making.

<table>
<thead>
<tr>
<th>INDIANA DEPARTMENT OF EDUCATION STEM ATTRIBUTES</th>
<th>SUPPLEMENTAL IMPLEMENTATION</th>
<th>MINIMAL IMPLEMENTATION</th>
<th>PARTIAL IMPLEMENTATION</th>
<th>FULL IMPLEMENTATION</th>
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</thead>
<tbody>
<tr>
<td>1.1 Leadership Teams at the district and school levels</td>
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<td>1.2 School schedules</td>
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<td>1.3 Community Engagement</td>
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<td>1.4 School Environment</td>
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<tr>
<td>1.5 Technology Resources</td>
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<tr>
<td>1.6 Data (state, district, school, classroom)</td>
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<tr>
<td>1.7 Evaluation</td>
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<td>1.8 Equity</td>
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</table>
STEM Implementation Rubric – Infrastructure –

1 – Infrastructure: STEM programming requires leadership teams that collaborate and engage in dialogue frequently about the STEM program’s design and effectiveness. Teachers are highly collaborative and community members are stakeholders in decision-making. Is a structure in place that supports the program’s mission, vision, and goals?

<table>
<thead>
<tr>
<th>Key Element</th>
<th>SUPPLEMENTAL IMPLEMENTATION</th>
<th>MINIMAL IMPLEMENTATION</th>
<th>PARTIAL IMPLEMENTATION</th>
<th>FULL IMPLEMENTATION</th>
<th>Description of your program /Supporting Documentat ion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Leadership Teams at the district and school levels</td>
<td>- Administrative leadership and/or STEM teacher teams have determined the program’s purpose and content</td>
<td>- Administrative leadership provides support to STEM teacher teams by allocating resources towards implementation and professional development</td>
<td>- STEM leadership team in place to define and monitor and evaluate entire program</td>
<td>- STEM Leadership team in place to define, monitor, and evaluate entire program</td>
<td>- Administrative leadership provides support to STEM teacher teams by allocating resources towards implementation and professional development - STEM teacher teams meet with administration regularly to discuss program implementation. - Decision making is made by less than 25% of staff</td>
</tr>
</tbody>
</table>
2 – Instruction: Does the instruction environment provide time and professional development for educators to develop and improve their craft of pedagogy and content? Students in a STEM school engage in inquiry based learning that may include authentic problems. Classrooms are facilitated by teachers who are highly effective in this type of instruction and require professional development and collaboration time to help develop and improve their craft of pedagogy and content. In addition, teachers consistently use and model technology in classroom instruction and use creative assessment opportunities like science fair, portfolios, labs, debate, etc.

<table>
<thead>
<tr>
<th>INDIANA DEPARTMENT OF EDUCATION STEM ATTRIBUTES</th>
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<tr>
<td>2.1 Instructional Programming</td>
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<td>2.2 Integrated STEM</td>
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<td>2.3 Professional Development</td>
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<td>2.4 Instructional Technology</td>
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<td>2.5 Instructional Strategies</td>
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<td>2.6 Teacher Content Knowledge</td>
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<td>2.2 Integrated STEM</td>
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### STEM Implementation Rubric – Curriculum –

#### 3 – Curriculum: Is your STEM curriculum aligned to the adopted Indiana Academic Standards?

Courses/Classes are integrated across content and infused with community needs and content progresses from grade to grade and are aligned across content areas.

<table>
<thead>
<tr>
<th>INDIANA DEPARTMENT OF EDUCATION STEM ATTRIBUTES</th>
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<tbody>
<tr>
<td>3.1 Curriculum Integration</td>
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<tr>
<td>3.2 Curriculum Progression and Alignment</td>
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<tr>
<td>3.3 Community Engagement</td>
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<tr>
<td>3.5 Student Performance Assessments</td>
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<tr>
<td>3.1 Curriculum Integration</td>
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<tr>
<td>3.3 Community Engagement</td>
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</tbody>
</table>
4 - Extended Learning: Does the STEM program offer opportunities outside the school day? STEM program offers opportunities outside the school day that may or may not be held at the school. There are multiple opportunities for students to extend their STEM learning, but the program has a strong connection to the school curriculum and activities that lie within and processes to maintain connections.

<table>
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<tbody>
<tr>
<td>4.1 Programming</td>
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<tr>
<td>4.2 Program Alignment</td>
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<td>4.3 Community Engagement</td>
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</tbody>
</table>
STEM Implementation Rubric Attributes – Supporting Documentation and Evidence

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Supporting Documents/Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Leadership Teams</td>
<td>Leadership team members</td>
</tr>
<tr>
<td>1.2 School schedules</td>
<td>Master schedule including teacher time</td>
</tr>
<tr>
<td>1.3 Community Engagement</td>
<td>Letters of commitment or support</td>
</tr>
<tr>
<td>1.4 School Environment</td>
<td>Description school climate, culture, facilities</td>
</tr>
<tr>
<td>1.5 Technology Resources</td>
<td>List of technology</td>
</tr>
<tr>
<td>1.6 Data</td>
<td>Trend data, data walls, students trackers, etc.</td>
</tr>
<tr>
<td>1.7 Evaluation</td>
<td>Teacher and program evaluation protocol</td>
</tr>
<tr>
<td>1.8 Equity</td>
<td>Proof of equitable instruction and access</td>
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Timelines to Remember

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  wreed@doe.in.gov
  Twitter: @DOESecMath
STEM School Chattanooga

Innovation, Critical Thinking, and Collaboration
TSIN Platform School

• Tennessee STEM Innovation Network (TSIN) is the governing body establishing schools and HUBS across the state to improve overall networking and education.
• The school and Innovation HUB were funded in part through a grant from Race to the Top Federal funds.
• The school is a “platform school” where innovations can be tested with the goal of sharing them across the region.
• TN public high school part of Hamilton County Schools (one of the four largest school districts in Tennessee)
The school has no entrance requirements for incoming 9th grade students and holds a two-tier lottery to include seats from every high school zone.

The school is located on the Chattanooga State Community College campus. Total allocated dollars to building the school in an old warehouse on the campus: approximately $1.5 million.

School started in 2012-2013 with 9th grade. Building one grade level per year.

Serves students from rural, urban, and suburban areas. Approximately 50% economically disadvantaged population.
STEM PSA

https://www.youtube.com/watch?v=iF74yqr5QGk&safe=active
Mission

**STEM School Chattanooga**

To develop and share a new paradigm for world-class education using technology as a gateway to cultivate students’ inquisitive nature, **exercise innovation**, think critically, and collaborate to become leaders who are **self-sufficient learners** with the same passion as Chattanooga’s Renaissance.
Curriculum Design

- **STEAM**
  - Science, Technology, Engineering, Arts, Mathematics
- **Collaborative Teams**
  - Problem-based learning
  - Project-based learning
- **Individualized Structures**
  - Flipped classroom
  - Placement scheduling
Four Year Plan

- 23 credits for graduation
- PBL – project/problem based learning each year
- Senior capstone – internship or research project
- Foreign language – online (1st two years of language)
- College courses:
  - Required: Wellness, PE, Personal Finance, 4th year science
  - Optional: Core subject area courses in 11th/12th grade years
  - Enrichment: All college courses open to 11th/12th grade students for electives and/or increased core subject credits (must meet minimum entrance criteria for course)

http://www.stemschoolchattanooga.net/?PageName='Guidance’
PBL Units - Content Focused

- **9th Grade**: math, science, language arts, social studies, art
  - How do you prevent emerging strains of viruses?
  - Create a plan to mitigate the impact of 100 degree days in Chattanooga.
  - Design a new gaming platform.
  - Build a robot that can navigate an unknown maze.
  - Design an energy efficient, cost effective house.

- **10th Grade**: math, science, language arts, social studies
  - Volkswagen – How can a school Think Blue?
  - Hunter Art Museum – Digitally innovate a work of art.
  - Creative Discovery Museum – Design a K-5 STEM unit.
  - Unum – Create a text based game in Python.
  - UTC SimCenter – Design a simulation for a nuclear attack.
PBL Units - Process Focused

- 11th Grade: critical thinking, creative thinking, collaboration
  - TN Aquarium – Sustainable fisheries
  - Signal Power – Hybrid LED tower
  - Raccoon Mountain – White nose syndrome
  - EPB – Data patterns, Mechanical doll for Christmas window
  - TVA – Hydraulic energy
  - Engel Foundation – Fun theory stadium sustainability
  - Accelent – 3D print catheter for medical application
  - Chattanooga Wastewater – Wastewater treatment mechanism
  - Chatt State – Create machine, Invasive kudzu
  - Chatt Public Library – I want to teach, I want to innovate
  - Lamp Post – STEM business plan
  - UTC – Smart grid
  - ORNL – Tiny Titan
Technology and Maker Integration

- **1-to-1 school**
  - Each student has an iPad
  - Focus on tech use is on accessing, using, and applying information
  - Teacher role – facilitate vs disseminate
  - Edmodo

- **FabLab**
  - Create maker space
  - Patterned after MIT FabLab
  - Goal: Full Engineering Cycle
    - Idea, Design, Build, Test, Redesign
Moving Forward:
Core Area Focal Points

• Mathematics
  ▫ MDC (Math Design Collaborative)
  ▫ Mathematical Habits of Interaction

• Science
  ▫ 5 E’s (Engage, Explore, Explain, Elaborate, Evaluate)
  ▫ Inquiry Based Learning

• Language Arts:
  ▫ LDC (Literacy Design Collaborative)
  ▫ Stations (Centers)

• Social Studies
  ▫ LDC (Literacy Design Collaborative)
  ▫ CCSS Literacy Framework
INNOVATION academy
OF NORTHEAST TENNESSEE
Distinguished Program
Emphasizing that learning is empowerment, leadership, responsibility and ownership.
What’s this school all about?

- Fully integrated academic curriculum
- Special focus on Science, Technology, Engineering, and Math
- Problem-based, hands-on learning
- “Real life” projects with “real life” technical professionals involved
- Rigorous course work
- High expectations of students
- Opportunity for ALL students to succeed
Innovation Academy offers a new approach to education featuring a creative focus in the areas of Science, Technology, Engineering, and Math.
Our vision is that Innovation Academy will stimulate growth of STEM throughout the region by implementing a rigorous curriculum aimed at empowering students with the knowledge and resources they need today to become the leaders of tomorrow in the global community.

Rationale
Innovation Academy
Unit Plan Template

Unit 1: Leadership

Grade Level: 7th Grade
Unit Length: 2 Weeks
Week 1.2 & 1.3 (2 Weeks)
August 19th – 30th, 2013

Unit Overview
The Leadership Unit will engage students in the history of leadership to prepare students as leaders in the STEM community. Students will apply their knowledge and skills in leadership positions while completing STEM projects in small groups. These small groups will introduce students to projects that will utilize research, leadership skills, teamwork skills, forms of government, problem solving, graphing, and the scientific method. The projects included in this unit are "The Solar Cooker Project" and "Dock the Rock". Both of these projects are introductory level hands-on experiments that allow the students to practice the Scientific Method and the Engineering Design Process.

Unit Essential Question(s)
- What are our responsibilities and opportunities as STEM leaders?
- What are the different systems of governance and how are these systems reflected during STEM projects group projects?
- How can the scientific method and the engineering design process enable me to complete tasks more efficiently and effectively?
- How can I interpret and translate data in a table, graph, or diagram to communicate experimental findings and results?
- How can I form a conclusion that explains the cause and effect relationship between a set of variables?
- How do I reflect and examine the content included during the STEM projects and lessons to compile informative / explanatory text?

Culminating Event
The Culminating Event for week one of the Leadership unit will be the Project Day on Friday. During this project day students will apply their skills as leaders and team members serving in different roles. Students will complete an engineering project entitled Solar Oven Project. The students will also need to apply their knowledge of the scientific method and the engineering design process to document their problem solving steps and findings. Finally, students will reflect upon which one of the five forms of government their leadership most closely relates.
CURRICULAR UNITS GOALS

- Authentic & Engaging
- Problem Solving
- Hands-On Learning
- Collaborative
- Standards Based
- 21st Century Skills
"The most memorable project this year for me was Force or Friction, which is where we put different materials on our tracks to see how they affected the car's speed on the track," said Mia Higgins. "I chose this project because it was unlike something I had ever done before. It was interesting to see how the different surface materials changed the speed of the cars."

Mary Brooke Friant said, "The most memorable project that I have done here at LA has been Banking the Track. This is because it helped me learn things in a different perspective." 

"A memorable project for me was Banking the Track. I was a leader, which let me work with others, and I also got to use my engineering skills. I got to apply what I learned," said Allison Johns.
STEM Professionals
Writing Across Our Curriculum

DRILL AND DRIVER

Geology of the Earth

A Drill to the Center of the Earth
Multi-Media

The Capstone of STEM Projects
Student Presentations
Traveling West

Transportation Unit
IA integrates our STEM professionals in our STEM Curricular Units.

- Career Focused
- Career Experienced
Our Mission

The ETSU Northeast Tennessee STEM Innovation Hub will interconnect K-12 Schools, higher education institutions, businesses, foundations/non-profits, and community organizations to design, develop, and demonstrate innovative, sustainable and transferable STEM learning experiences. These STEM collaborations seek to engage students, develop a skilled workforce, and increase STEM literacy throughout the region.
“To remain competitive in the emerging knowledge economy, we need an education system capable of teaching higher-level competencies to all students.”

Carnevale, Smith, Melton (STEM, 2011)
Center on Education and the Workforce,
Georgetown University
Lafayette Sunnyside Intermediate School

http://youtu.be/pA2M1abHQPs
COE STEM Initiatives

STEM Planning Retreats
STEM Road Map
Integrated STEM
SLED Partnership
STEM Goes Rural
Types of STEM Schools

Enhanced STEM
• New courses often stand-alone
• Emphasize 21st Century Skills
• Problem/Project Based Learning (PBL)
• Technology-rich

Integrated STEM
• Integration across core content areas
• Infused 21st Century Skills
• PBL as primary instructional mode
• Technology-rich
STEM School Planning Retreats

Purdue STEM School Transformation Process Support
• Strategic Planning
• Development
• Implementation

Participating Teams will Receive:
• Introduction to STEM School models, approaches, and supports available for design, development and implementation
• Intensive STEM strategic planning support at retreat
• Follow-up support (8 hours)
• Pairing with existing STEM School

www.conf.purdue.edu/stemplanningretreat

September 25, October 23, November 20
INTEGRATED STEM

K-12 TEACHER EDUCATION INITIATIVES @ PURDUE

Lynn Bryan
Director, Center of Advancing the Teaching and Learning of STEM
Professor, Department of Curriculum & Instruction and Department of Physics
CATALYST CENTER FOR ADVANCING THE TEACHING AND LEARNING OF STEM
The teaching of science and mathematics through the integration of engineering and technological design for solving problems in culturally and socially relevant contexts.
Features

• Integration of STEM *content* and *practices*
• Engineering/technology design as integrators
• Culturally inclusive, authentic, relevant contexts
• Problem-based, project-based, and design-based pedagogies
• Aligned with Indiana science, mathematics and CTE standards, as well as NGSS
• Connections to language arts, social studies, fine arts, etc.
• Informed by current and time honored research on learning and cognition
K-12 Integrated STEM Teacher Education Initiatives
-initiatives-

- **K-12 Integrated STEM Specialization Program** (Preservice Teacher Education)
- **K-12 Integrated STEM Graduate Specialization**
- **Network of K-12 Partner Schools**
- **Inservice Teacher Professional Development**
- **CATALYST Research on teaching and learning of integrated STEM**
SPECIALIZATION PROGRAM
UNDERGRADUATE LEVEL TEACHER EDUCATION

ELEMENTARY
- Science Methods and Mathematics Methods with Integrated STEM Experiences
- Integrated STEM Methods
- Student Teaching with Integrated STEM teaching experience
- Capstone

SECONDARY
- Science, Mathematics, or Technology Methods with Integrated STEM Experiences
- Integrated STEM Methods
- Student Teaching with Integrated STEM teaching experience
- Capstone

Foundations of Integrated STEM
CONTACT
LYNN BRYAN, CATALYST DIRECTOR
LABRYAN@PURDUE.EDU
Integrating Engineering Design into Science Education: The SLED Partnership

Brenda M. Capobianco, Co-Director, Purdue University Lafayette School Corporation, Tippecanoe School Corporation, Taylor Community Schools, Plymouth Community Schools

This project is supported by the National Science Foundation Grant #0962840
What is SLED?

Science Learning through Engineering Design is a partnership project of Purdue University and four Indiana school districts designed to help improve students’ science learning in grades 3-6.
Targeted Math Science Partnership (MSP)

Focus on studying and solving issues within a specific grade range or at a critical juncture in education, and/or within a specific disciplinary focus in mathematics or the sciences.

• Partnership-Driven
• Teacher Quality, Quantity and Diversity
• Challenging Courses and Curricula
• Evidence-Based Design and Outcomes
• Institutional Change and Sustainability
Goal of the SLED Partnership

Our aim is to increase grade 3-6 student learning of science by developing an integrated, engineering design-based approach to elementary school science education.
SLED Partners

• Purdue University
  – Colleges of Education, Engineering, Science, and Technology
  – Discovery Learning Research Center

• School Districts
  – Lafayette Schools
  – Plymouth Community Schools
  – Taylor Community Schools
  – Tippecanoe Schools

• Community Partners
SLED Partners at Purdue

• Colleges of Education, Engineering, Science and Technology
• Discovery Learning Research Center houses the SLED project
SLED Partnership Goals

1. Create a partnership of university engineers and scientists, teacher educators, school teachers, school administrators, and community partners to improve science education in grades 3-6 through the integration of engineering design in science teaching and learning.

2. Enhance the quality and quantity, and diversity of in-service and pre-service teachers prepared to utilize engineering design as a means to teach science through authentic, inquiry-based, multi-disciplinary, design projects (TQ).
SLED Partnership Goals

3. Adapt, refine, and test existing project- and design-based curricular materials/tasks, and where necessary develop new ones, to support the teaching of elementary science through authentic, inquiry-based, multi-disciplinary, design projects.

4. Generate evidence-based outcomes that contribute to our understanding of how teachers teach science through the engineering design process and how young students effectively learn science concepts through design-based activities.
SLED’s working hypothesis

If elementary school teachers are given the necessary tools, resources, and support, they will implement, and possibly innovate and invent, their own instructional ideas for integrating the engineering design process in diverse ways, giving priority to different pedagogical or conceptual features (e.g., subject matter, academic standards, and processes).
Broader Impacts

• 60 STEM faculty
• 100 preservice and 200 inservice teachers
• 5,000 students
• Institutional change and sustainability:
  – New local teacher induction program
  – Cyber-enhanced repository of best practices, assessments, and curricular resources
  – Enhanced approach to teacher PD and preparation
SLED Project Components

1. Adaptation and/or development by STEM faculty design teams of grade-appropriate, standards–based, engineering design tasks used to teach science
2. In-service professional development focused on engineering design and science-rich content conducted by the SLED leadership team and faculty design teams.
SLED Project Components

3. Pre-service teacher professional development through the development and implementation of an integrated elementary science methods course
SLED Project Components

For more information

Visit sledhub.org
• Goals
  • Develop highly qualified STEM teachers for rural Indiana schools
  • Teach STEM content using problem-based approaches and with rural linkages
  • Create a rural schools network linked by distance technologies
  • Design new models for STEM instruction in rural Indiana schools

• Impact
  • More students pursuing STEM careers
  • Increased science literacy
  • Rural school/community development
Program & Curriculum Overview
Commitment to Teach for Three Years

• Indiana

• High Needs School

• Rural Community
Support for the First Three Years of Teaching

<table>
<thead>
<tr>
<th>Year 1</th>
<th>General Teaching Skills</th>
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<tbody>
<tr>
<td>Year 2</td>
<td>Content Coaches</td>
</tr>
<tr>
<td>Year 3</td>
<td>Funded Professional Development Plans</td>
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STEM Goes Rural Teaching Locations
2009 Cohort- Blue Pins
2010 Cohort- Red Pins
2011 Cohort Green Pins
2012 Cohort Yellow Pins

Purdue University
Benton Central Junior-Senior High School
Dustin Hughes: Benton Central Jr/Sr. High School, Oxford, IN
Physics, Algebra, Math Lab

Frankfort Senior High School
Kalie Hughes: Frankfort Senior High School, Frankfort, IN
BIC: http://frs.frankfortschools.org/

Heritage Hills Middle School
Timothy Jacobs: Heritage Hills High School, Lincoln City, IN
Algebra, Geometry, Calculus

Attica High School
Lauren Klemme Attica Jr./Sr. High School, Attica, IN
8th Grade: Algebra, Algebra II
Attica Junior-Senior High School 211 E. Syc St, Attica, IN 47918 Phone: (765)-762-7000 http://www.attica.in

Hamilton Heights School Corporation
Mark McCleming: Hamilton Heights Middle and Sr. High School 25802 State Rd 15 Arcadia, IN 46030 (317) 984-3551 http://www.hhs.k12.in.us/hhs/index.asp

Rochester Community High School
Laura Norm | Lafayette Rochester High School; Rochester, IN Biology

Raymond Park Middle School
Susan Reagen Raymond Park Middle School; Indianapolis, IN Engineering Technology (Grades 6-7)

Lowe Cass Junior Senior High School
**STEM Goes Rural Stats**

<table>
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<th>Cohort</th>
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<th># Complete</th>
<th>Yr 1</th>
<th>Yr 2</th>
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</table>
I teach STEM because . . .

Candice Kissinger
2010 Cohort
Purdue University
Questions and Answers
Break
• Indiana State Board of Education
• Indiana Education Roundtable
• Indiana Career Council
• Indiana Works Councils

STEM Responsibilities

Adopt science academic standards.
Adopt science assessments.
Develop state education-workforce strategic plan.
Administer STEM Teacher Recruitment Fund grants.  [$10 M]
Administer Career & Technical Education Alternative Curriculum Grants.  [$4.5 M]
Organize Mr. and Miss Math or Science awards.
Integrated STEM Education: Findings from a National Academies Study

Jennifer Hicks
K-12 Science Program Manager, I-STEM
i-STEM Committee Member, NRC
Study Objectives

1. Identify and characterize existing approaches to K-12 integrated STEM education in formal and informal settings.

2. Review evidence for impact on various student outcomes of interest.

3. Determine a set of priority research questions to advance understanding of integrated STEM education.
Sources of Evidence

• Data Gathering
  ➢ Five face-to-face committee meetings
  ➢ Commissioned reviews of education and learning research
  ➢ Commissioned review of selected STEM programs/projects
  ➢ In-depth papers by experts in social context of STEM learning, STEM interest development, STEM identity development, assessment of integrated STEM, and embodied cognition in STEM education
  ➢ Committee expertise
Report Contents

1. Introduction
2. Descriptive Framework
3. Review of the Research
4. Implications of the Research
5. Context for Implementing Integrated STEM
6. Findings, Recommendations, and Research Agenda
Framework for Integrated STEM

**GOALS**

Goals for Students
- STEM literacy
- 21st century competencies
- STEM workforce readiness
- Interest and engagement
- Making connections

Goals for Educators
- Increased STEM content knowledge
- Increased pedagogical content knowledge

**OUTCOMES**

Outcomes for Students
- Learning and achievement
- 21st century competencies
- STEM course taking, educational persistence, and graduation rates
- STEM-related employment
- STEM interest
- Development of STEM identity
- Ability to make connections among STEM disciplines

Outcomes for Educators
- Changes in practice
- Increased STEM content and pedagogical content knowledge

**NATURE AND SCOPE OF INTEGRATION**

Type of STEM connections
- Disciplinary emphasis
- Duration, size, and complexity of initiative

**IMPLEMENTATION**

Instructional design
- Educator supports
- Adjustments to the learning environment
Examples of Projects/Curricula

• In School:
  – Engineering is Elementary
  – Project Lead the Way
  – A World in Motion

• Out of school:
  – TechBridge
  – Lego robotics
  – MathAlive! (traveling exhibit showing math in context)
Commonly Used Approaches

• Problem-based
• Project-based
• Design-based

Common features:

– Student centeredness
– Small group work
– Teachers as facilitators or guides
– Problems/projects/design as the focus and stimulus for learning
Potential of integrated STEM

• Enhance learning in each of the disciplines
• Help students understand connections between the disciplines
• Increase interest in STEM

To achieve these outcomes, the experiences need to be designed with these outcomes in mind
Key Implications in the Design of Integrated STEM Education

• Make integration explicit
• Attend to students’ disciplinary knowledge
• Pay attention to social aspects of learning
• Consider how to support the development of interest
Make Integration Explicit

• Simply presenting a real-world context does not mean students will see the disciplinary connections

• Teachers/facilitators need to explicitly draw students’ attention to the connections
  – Examples: between different forms of representation; from one context to another
Example of multiple representations
Attending to students’ disciplinary knowledge

• Students need disciplinary knowledge in order to use it in the context of integration

• Students may not recognize when to use knowledge they already have

• Students may not revise their understanding based on integrated experiences
Social aspects of learning

• Integration often uses small group work and encourages discussion; social interaction is key
  – How are students grouped?
  – How is discussion supported or facilitated?
  – What is the role of teacher?
Support Interest

• Allow students to experience success and demonstrate competence
• Provide enough time for students to complete activities AND initiate activities they come up with themselves
• Build in interactions with other
• Real-world connections and connections to prior experiences
• More open learning environments – sustained inquiry experiences
Implementing STEM Integration

- Standards (and Curricula)
- Assessment
- Educator expertise
- Policies -- organization of courses, time devoted to instruction, certification of teachers, etc.
Standards
Assessment

• Current assessment is not adequate for integrated STEM
• Need to clearly identify the learning goals for an integrated program to develop assessments
• Use of information and computer technology shows promise for allowing assessment of integrated STEM
“It seems clear that implementing integrated STEM experiences in school and after-out-of-school settings will often require educator expertise beyond that required to teach any of the STEM disciplines alone.”
**Recommendation 8**

- Programs that prepare people to deliver integrated STEM instruction need to provide experiences that help these educators identify and make explicit to their students connections among the disciplines.

- These educators will also need opportunities and training to work collaboratively with their colleagues, and in some cases administrators or curriculum coordinators will need to play a role in creating these opportunities.

- Finally, some forms of professional development may need to be designed as partnerships among educators, STEM professionals, and researchers.
Policies

• Organization of courses – especially in middle and high school
• Time for problems, projects, design – in tension with press for “coverage”
• Distribution of teachers’ expertise – teaming, specialists, etc.
Access all NRC/NAE reports at:

www.nap.edu
Keynote Speaker
David Burns, Battelle Memorial Institute
Director of Battelle’s STEM Networks
Break-Out Session

STEM Strategic Planning
Concluding Remarks