Integrated STEM Education: What Is It, What Should It Be?

Presentation & Facilitated Discussion
NSTA STEM Forum

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Session Overview

- Introductions
- About the National Academies
- STEM and iSTEM
- The Study
- Your Feedback

A Bit of History

The National Academy of Sciences was born in the travail of the Civil War. The Act of Incorporation, signed by President Lincoln on March 3, 1863, established service to the nation as its dominant purpose. The act also named 50 charter members.

And Then Came . . .

- National Research Council – 1916
- National Academy of Engineering – 1964
- Institute of Medicine – 1970

Membership and Organization

- Members elected by peers
- NAS and NAE have about 2300 each; IOM about 1600
- NRC is organized into 5 major divisions
- NAE has a separate Program Office

Scale of Work

- 10,000 volunteer experts
- 700 studies
- About 260 reports each year
- 1,100 staff
- 85% of $290 mil. annual budget comes from the federal government

STEM and iSTEM

Cell Cultures or Plant Parts?
What is STEM Anyway?

Seriously!

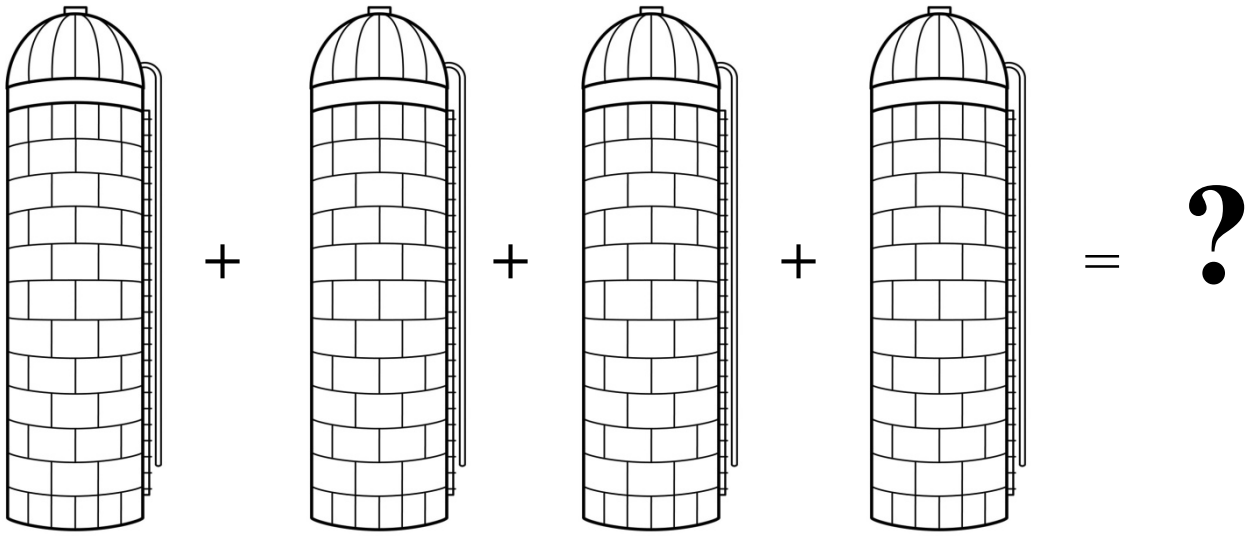
In a recent survey of 5,000 people working in the aerospace industry, 85 percent said they did not know what STEM education is. Most associate the acronym with either plants or stem-cell research.

But More Seriously

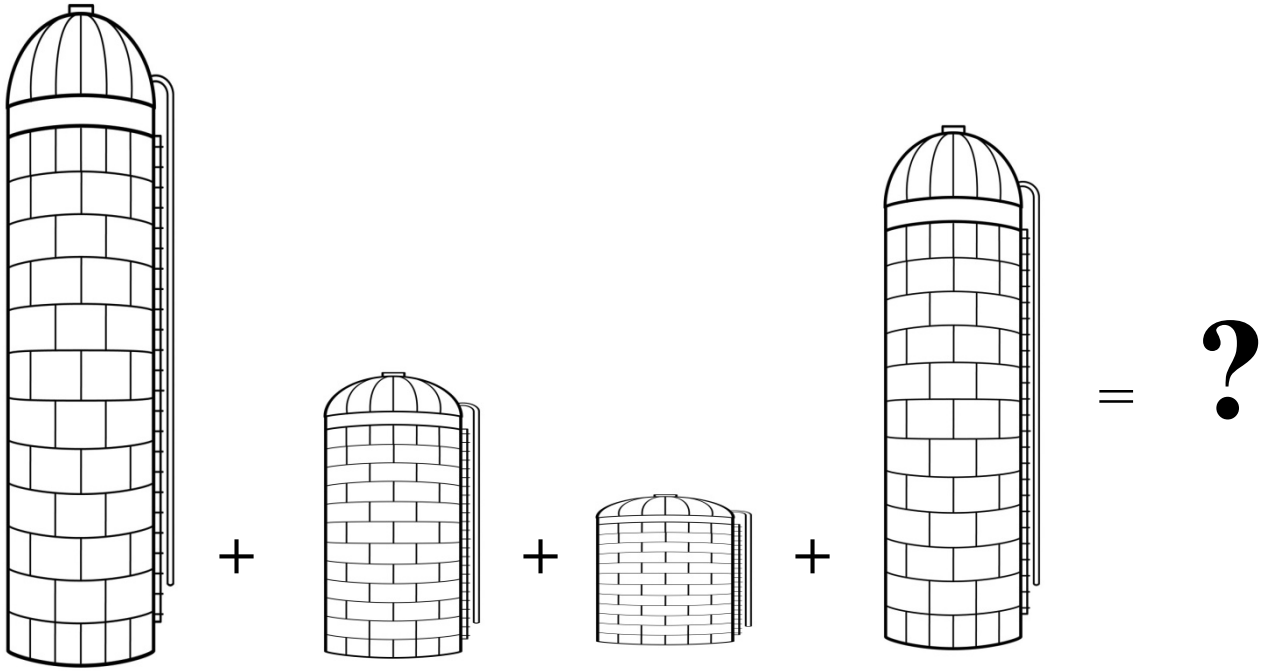
STEM has become ubiquitous in education policy discussions, for good reason:

- Key to the U.S. innovation engine
- Supports quality of life
- Creates economic value
- Ties to broader scientific and technological literacy

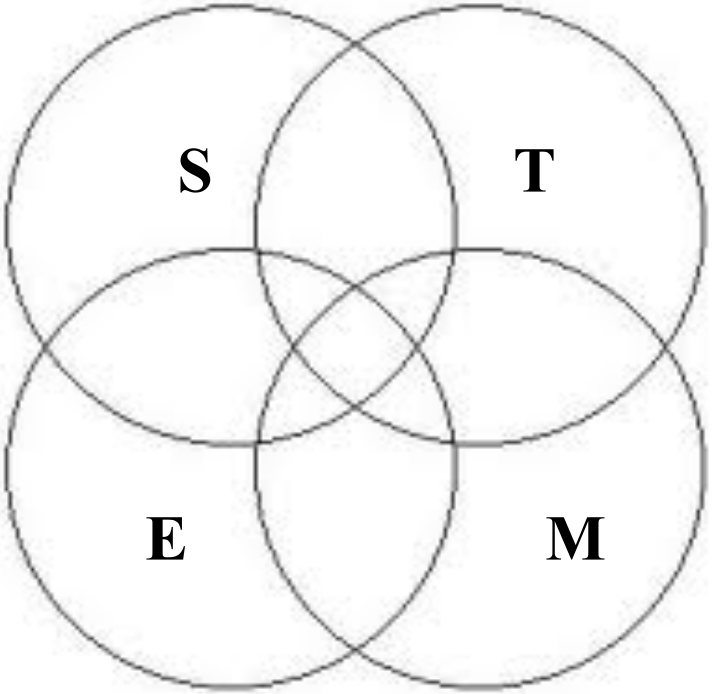
Reality Check on An "Accidental Acronym"



Or is it Perhaps . . . ?



Or Maybe Some Version of This . . . ?



And is the "T" This?

Or This?

Back to the Future . . .

"By 'science,' Project 2061 means basic and applied natural and social science, basic and applied mathematics, and engineering and technology, and their interconnections—which is to say the scientific enterprise as a whole. The basic point is that the ideas and practice of science, mathematics, and technology are so closely intertwined that we do not see how education in any one of them can be undertaken well in isolation from the others."

-*Benchmarks for Science Literacy* (1993)

Education vs. the "Real World"

"Although the term 'STEM education' is used in national education policy, it is not implemented in a way that reflects the interdependence of the four STEM subjects."

-NAE/NRC Committee on K-12 Engineering Education (2009)

What Some (Would Like to) Believe

Making connections between math and science can improve student learning and interest in both

<u>And/or</u> . . .

Science inquiry (now "practices") provides motivation to learn science and provides a way to make math more relevant

<u>And/or</u> . . .

Engineering and technological design provide concrete application opportunities for math and science

Academies Study on Integrated STEM Education

GOAL

Craft a research agenda for determining the value —in terms of student learning, achievement, motivation, career aspirations, and other factors —of integrated K-12 STEM (iSTEM) education in the United States.

Study on Integrated STEM Education

OBJECTIVES

- **Develop a descriptive framework, or taxonomy, for iSTEM education that can guide the work of the project committee and provide a structure for data gathering, analysis, and reporting.**

- **Propose a research agenda that prioritizes a set of research questions, identifies possible methodologies for answering them, and suggests organizations that might conduct the work.**

Committee

Margaret Honey, *Chair*
New York Hall of Science

Linda Abriola
School of Engineering, Tufts University

Sybilla Beckmann
University of Georgia

Susan Hackwood
California Council on Science and Technology

Alfred L. Hall II
University of Memphis

Jennifer Hicks
Purdue University

Steve Krak
Ohio STEM Learning Network

Bill Kurtz
Denver School of Science and Technology

Richard Lehrer
Peabody College, Vanderbilt University

Beth McGrath
Stevens Institute of Technology

Barbara Means
Center for Technology in Learning. SRI

Donna Migdol
Oceanside School District, NY

Mitchell Nathan
University of Wisconsin, Madison

Mark Sanders
Virginia Tech

Michael Town
High School Science Teacher
Redmond, WA

Study Status

The study committee is in the discovery/learning phase. Key challenges to-date:

1. **Definitional confusion surrounding the terms "integrated" and "STEM"**
2. **The existence of multiple models of iSTEM**
3. **Gap between promotional descriptions of programs and what is actually implemented**
4. **A relatively weak research base.**

Three of five planned meetings have been held.

Report expected to be published in spring 2013.

Our Questions for You!

1. **What is iSTEM?**
2. **What is its "value proposition?"**
3. **What education research is needed to better determine the benefits of iSTEM?**
4. **Who should we be targeting as audiences for the project report?**

What is iSTEM?

Notes From Group Discussion

- Highly contextual – problems that would draw from all STEM disciplines
- STEM can include more letters – Art, Reading, LA, Social Studies
- Integration with other subjects
- STEM is not just content – but processes/behaviors/ skills/practices
- Interrelated aspects
- iSTEM in practice increases critical thinking and problem-solving
- Critical thinking piece needs more research
- Authentic problems – meaningful and relevant
- Discrepancy between inquiry and problem-solving process
- iSTEM should have boundaries – not try to include all other subjects
- Integration of engineering design process, scientific inquiry, technology design so that we all have same understanding
- iSTEM better link to future career development
- All levels – starting young
- STEM literacy for all – careers and citizens
- Has to link to higher education needs
- STEM is a meta-cognitive process – a way of thinking and knowing how to apply STEM disciplines appropriately and effectively
- Creating a flexible tool kit of skills

What is the iSTEM "value proposition"?

Notes From Group Discussion

- Career prep
- Research in learning shows that making connections between disciplines is important and effective strategy
- Cultivating innovation
- STEM literate society – understanding/knowledge and ability to solve probl
- Understanding the interconnectedness of all disciplines (STEM and beyond) how they relate to real life
- Social capital
- Contributes to economic stability
- Different values to different sectors
- iSTEM could break the mold in current education system
- Create a generation of better thinkers
- Kids highly engaged – gut feeling that it will bring positive results
- Chance to bring underrepresented groups into STEM
- Social confidence in problem-solving abilities
- Opportunity to move into the "innovation age"
- Increase interest in STEM
- Chance for more exploratory learning and nurturing curiosity
- Teaching ways to approach and solve problems

What education research is needed to better determine the benefits of iSTEM?

Notes From Group Discussion

- How often do students need to be engaged in STEM for it to be effective?
- Does STEM actually increase engagement?
- How can current practitioners be supported to collect data?
- How should we prepare pre-service and in-service teachers?
- Impacts of putting iSTEM into schools. Does it increase retention of interest?
- Are standards for engineering needed?
- Still need to know what STEM integration is. Need a more universal understanding of iSTEM.
- Gather existing information/data and identify the gaps
- Find out who wants to know
- Gather corporation/workforce data
- How do we assess an iSTEM perspective, ability, curriculum
- Reconciliation with policy, k-20 practice, and implementation

Who should we target as audiences for the iSTEM project report?

Notes From Group Discussion

- State level STEM councils
- Colleges of Education
- School administrators
- Politicians
- Corporate America
- Workforce Development
- Curriculum Developers
- State Boards of Education
- State Departments of Education
- Governors Office and Associations
- Science and engineering community
- iSTEM employers
- Parents/families
- School Boards
- Educators
- Informal education community
- Career counselors
- Be sure to tailor the report to various audiences

For Questions or More Information

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