The Value of Interdisciplinary Learning to STEM Skills and Creativity

STEM/STEAM

The TA3 Conference, June 2014

What is Our Focus?

- One "charismatic adult"
- "I will never give up on you."

Definition of College & Career Readiness

ACT has long defined college and career readiness as *the acquisition of the knowledge and skills a student needs to enroll and succeed in **credit bearing** first-year courses at a postsecondary institution (such as a two- or four year college, trade school, or technical school) without the need for remediation.**

(also adopted by the Common Core)
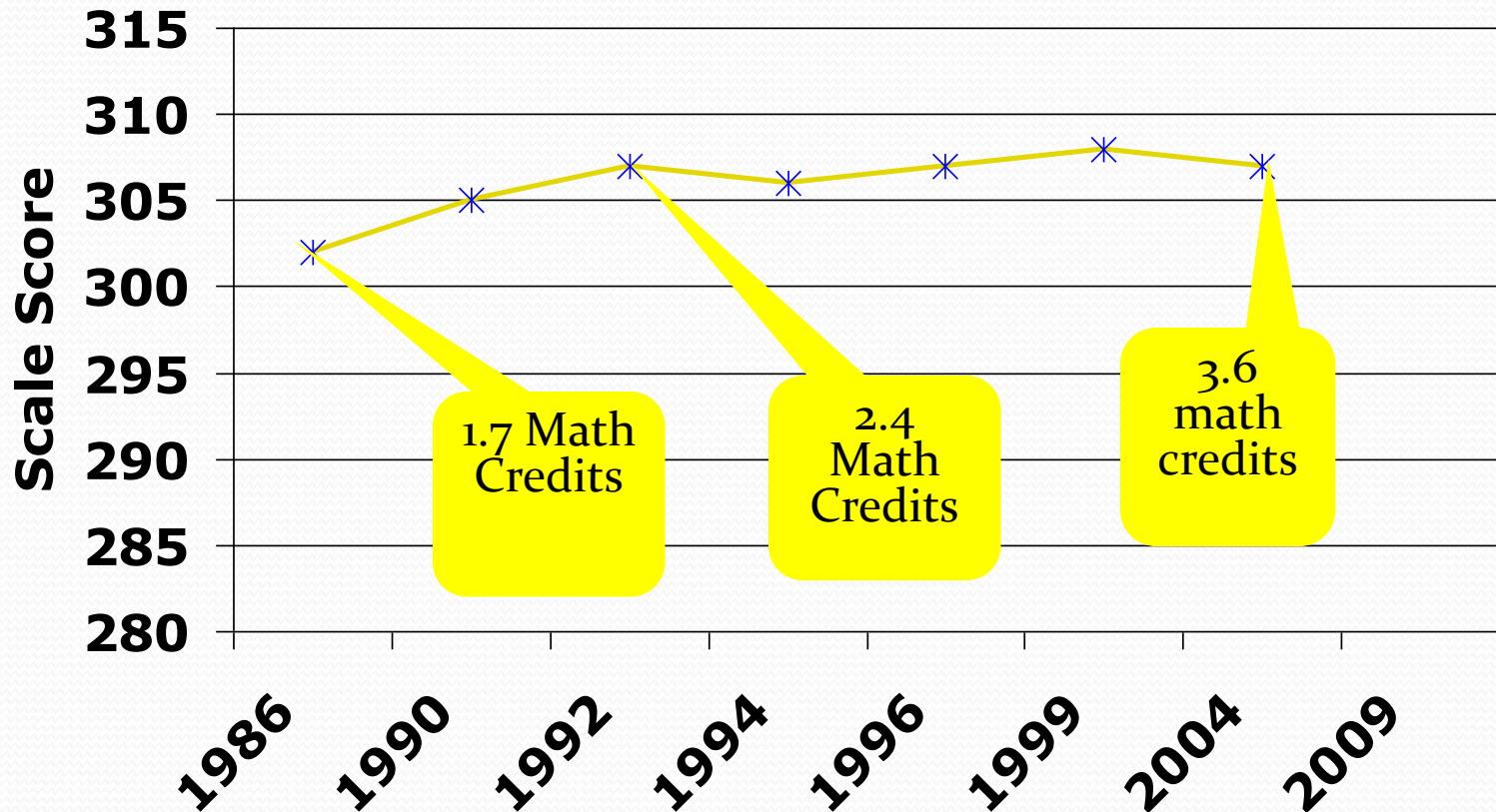
*as determined by entrance exams

Why does an entrance exam (testing theoretical math and memorization of facts) determine college or *career* ready?

Do students "need more math" (or reading/writing)?

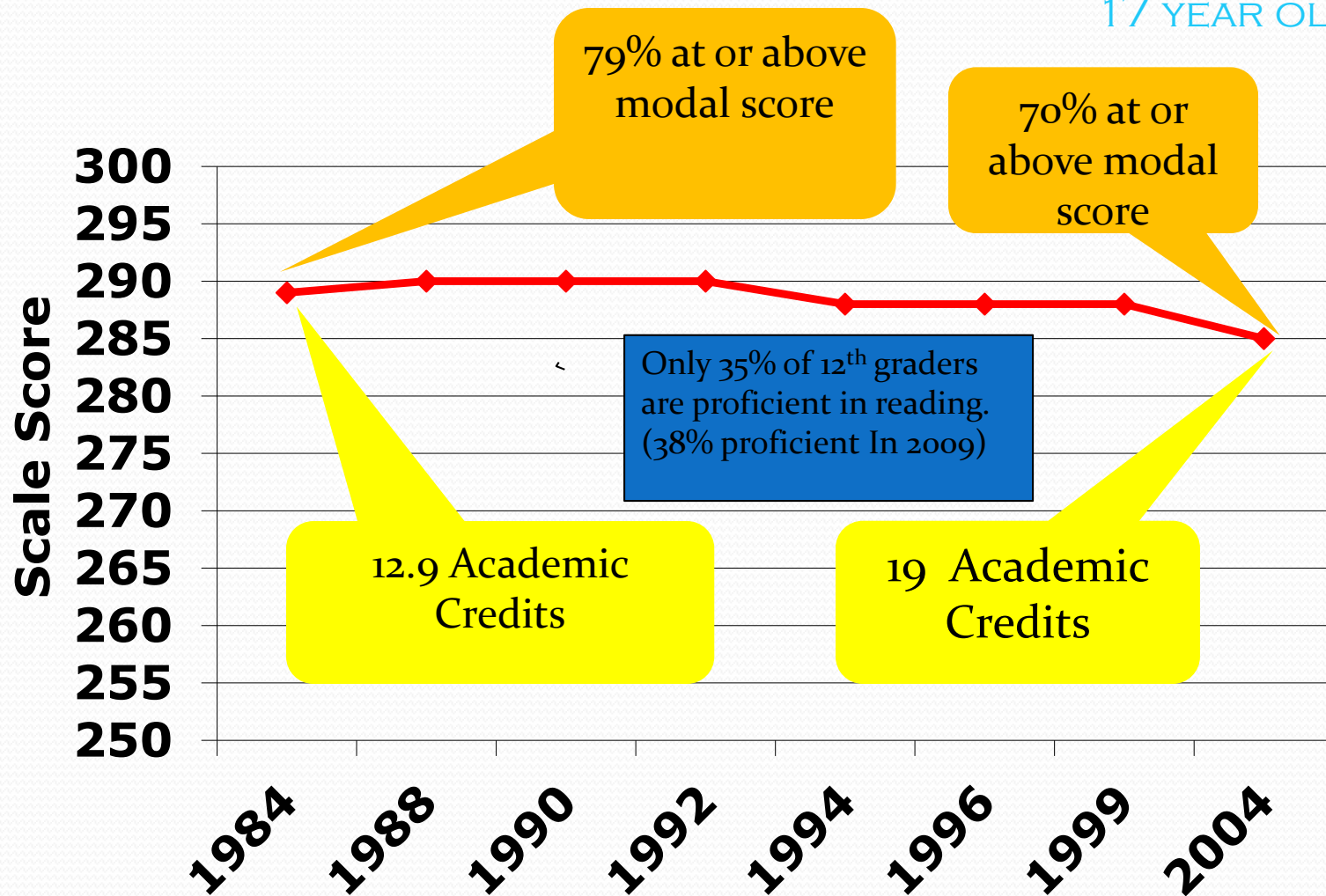# NAEP *MATH* SCORES - HIGH SCHOOL

Note: Long-Term Trends NAEP

Source: NAEP 2004 Trends in Academic Progress and NAEP 1999 Trends in Academic Progress.

ACHIEVEMENT FLAT OR DECLINING IN *READING*

79% at or above modal score

70% at or above modal score

Only 35% of 12th graders are proficient in reading. (38% proficient In 2009)
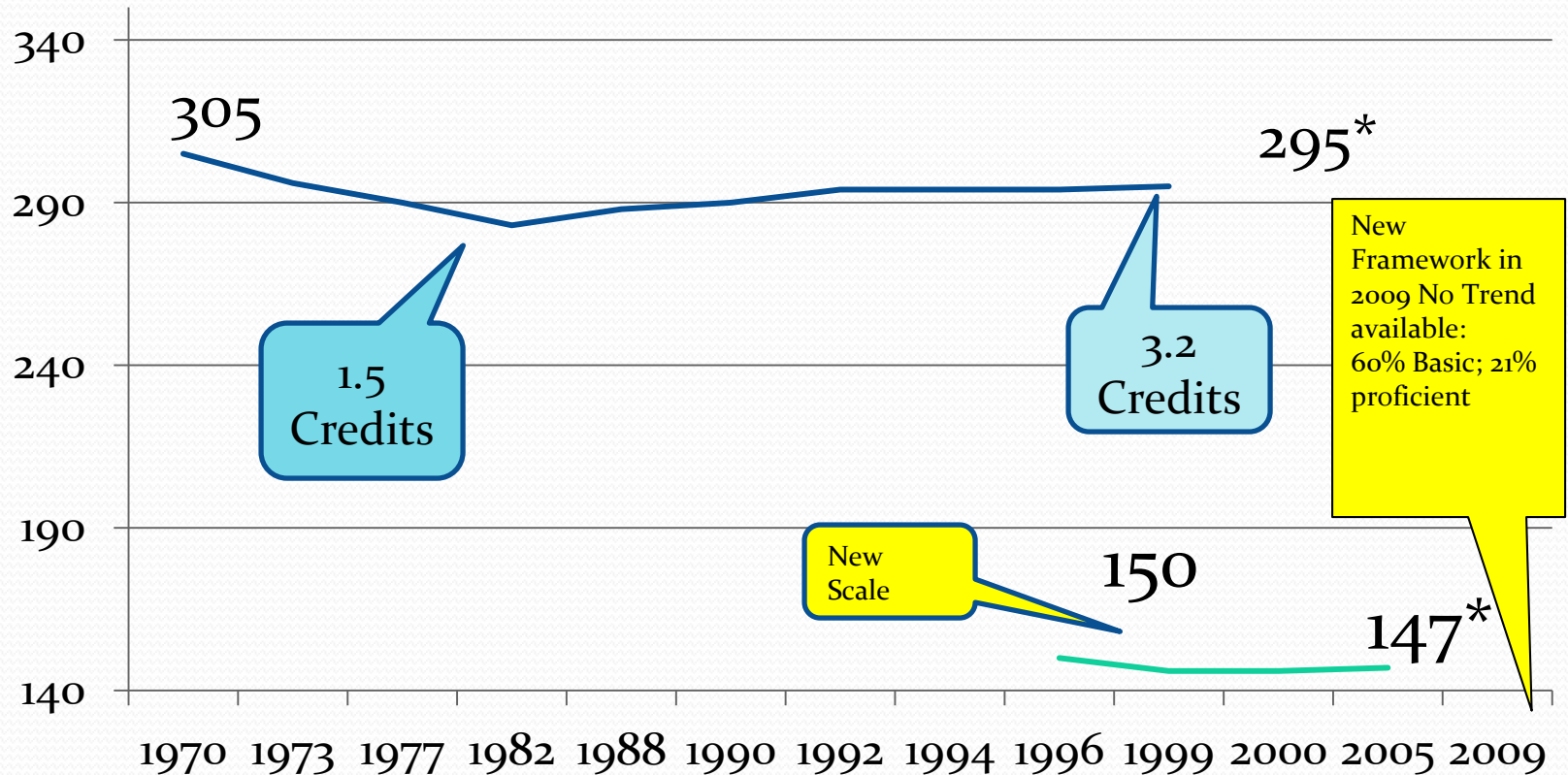
12.9 Academic Credits

19 Academic Credits

Note: Long-Term Trends NAEP

Source: NAEP 2004 Trends in Academic Progress.

NAEP *SCIENCE* SCORES– HIGH SCHOOL

WHAT BUSINESSES THINK THE GOAL OF EDUCATION SHOULD BE

To prepare students for careers in my industry/business.

WHAT EDUCATORS THINK THE JOB OF EDUCATION IS

- To create educated young adults (who score well on tests and pursue a baccalaureate degree).

WHERE EDUCATION FUNCTIONS

➤ Knowledge in one discipline (what is tested)
➤ Application within discipline
➤ Application across disciplines (sometimes)

WHERE BUSINESS FUNCTIONS

➤ *Application to real-world predictable situations*
➤ *Application to real-world unpredictable situations*

The Importance of Business Partnerships

- Developing a common language

  - More math classes or more math that is used in a business environment?

- Creating compatible goals

- Realizing one another's goals.
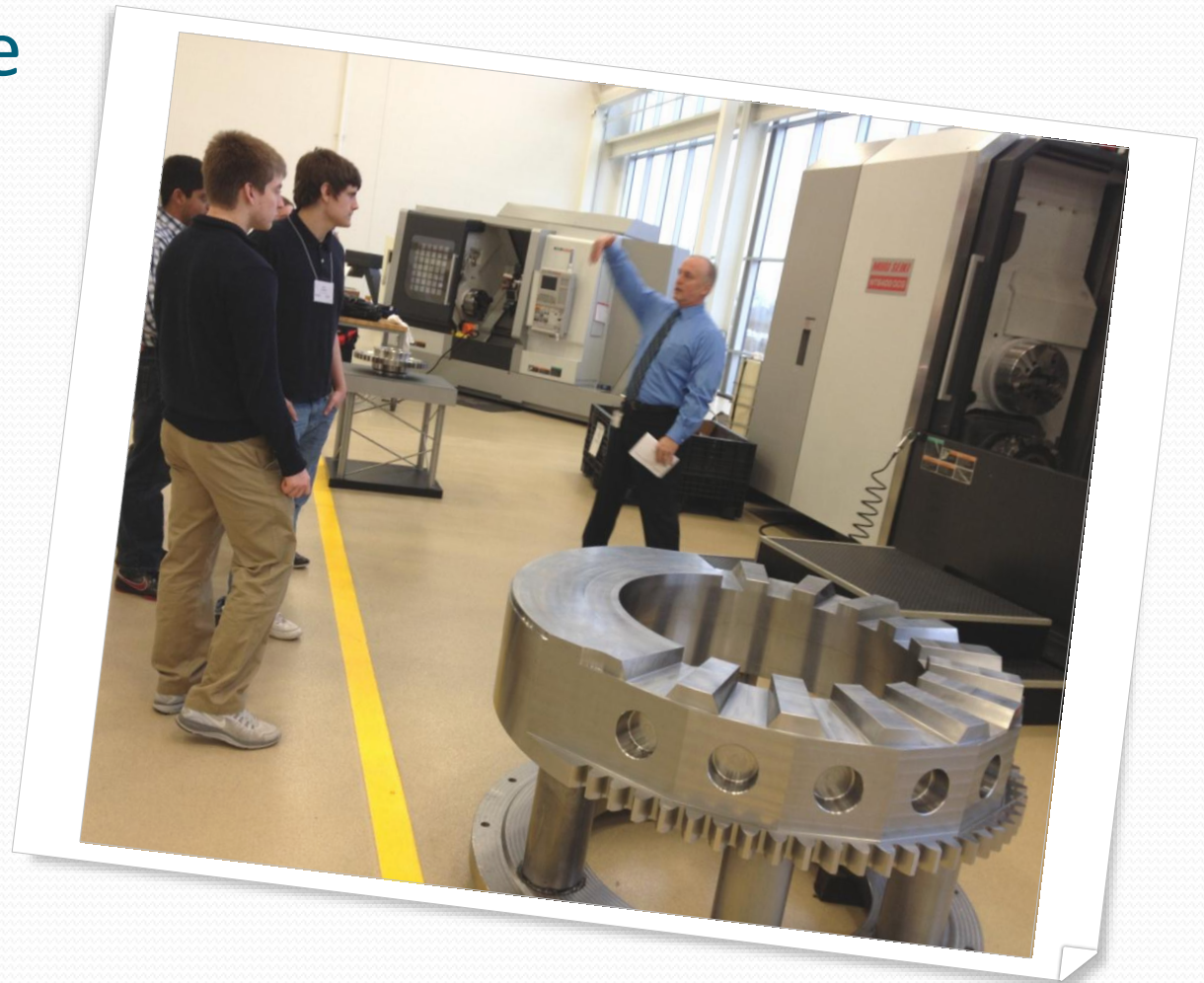
STEM Has Four Letters

...and it is most successful when all four work together.

WHAT WORKS

- PLTW
  - "I hate math but I love POE."
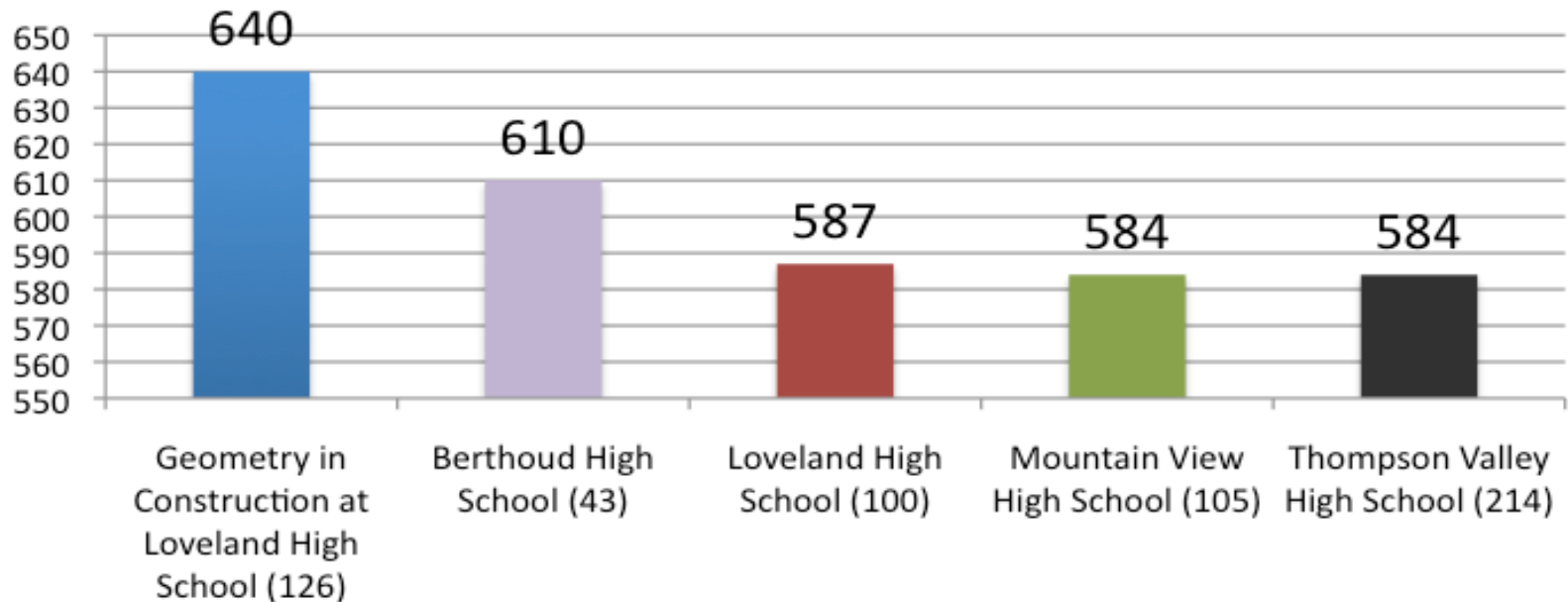- Geometry in Construction/Algebra in Engineering
- NE3i
  - Nanotechnology Employment, Education and Economic Development Initiative

STATE STANDARDIZED TEST SCORES

Average of Geometry CSAP Scores from Spring 2010 (Excludes Honors and IB)
N = 588 Students

Geometry in Construction at Loveland High School (126)	640
Berthoud High School (43)	610
Loveland High School (100)	587
Mountain View High School (105)	584
Thompson Valley High School (214)	584

Berthoud – Math & Science Academy, PLTW School
Loveland – Traditionally taught Geometry
Mountain View – PLTW School, School of the Arts
Thompson Valley – District's "AP" School

What Happens When You Add STEAM?

It is easy to dismiss design – to relegate it to mere ornament, the prettifying of places and objects to disguise their banality. But that is a serious misunderstanding of what design is and why it matters – especially now.

Daniel Pink, *A Whole New Mind*

Broad Institute – Harvard and MIT

- Committed to meeting the most critical challenges in Biology and Medicine.

- Even before the Broad Institute had a physical home, artists were invited into the Broad community. This was done because the interactions between artists and scientists - the sharing of views and the disparate approaches to solving problems – possess the potential to inspire both science and art.

- The Broad's *artist-in-residence* program lies at the intersection of science and art. The program is designed to stimulate collaborative problem-solving using an interdisciplinary approach.

One of design's most potent *economic effects* is the capacity to create new markets. The only way to survive is by constantly developing new innovations, inventing new categories – *giving the world something it didn't know it was missing.*

Daniel Pink – *A Whole New Mind*

Winzeler Gear

February 2012 saw the project begin with an introduction to gears, gear design, and gear manufacturing by way of a class taught by me and gear engineer Mike Cassata at the school and here in our art gallery at the Winzeler Gear plant. Mike instructed the students on the complexity and beauty of the involute curve (shown here), a key element of gear design.

We don't just have fun with gear art, Winzeler surrounds everyone with Gear Art. It is just another way to foster a creative atmosphere that encourages people to find new ways to look at gears. And it is how we continually help our partners solve complex challenges for gears and gear assemblies.
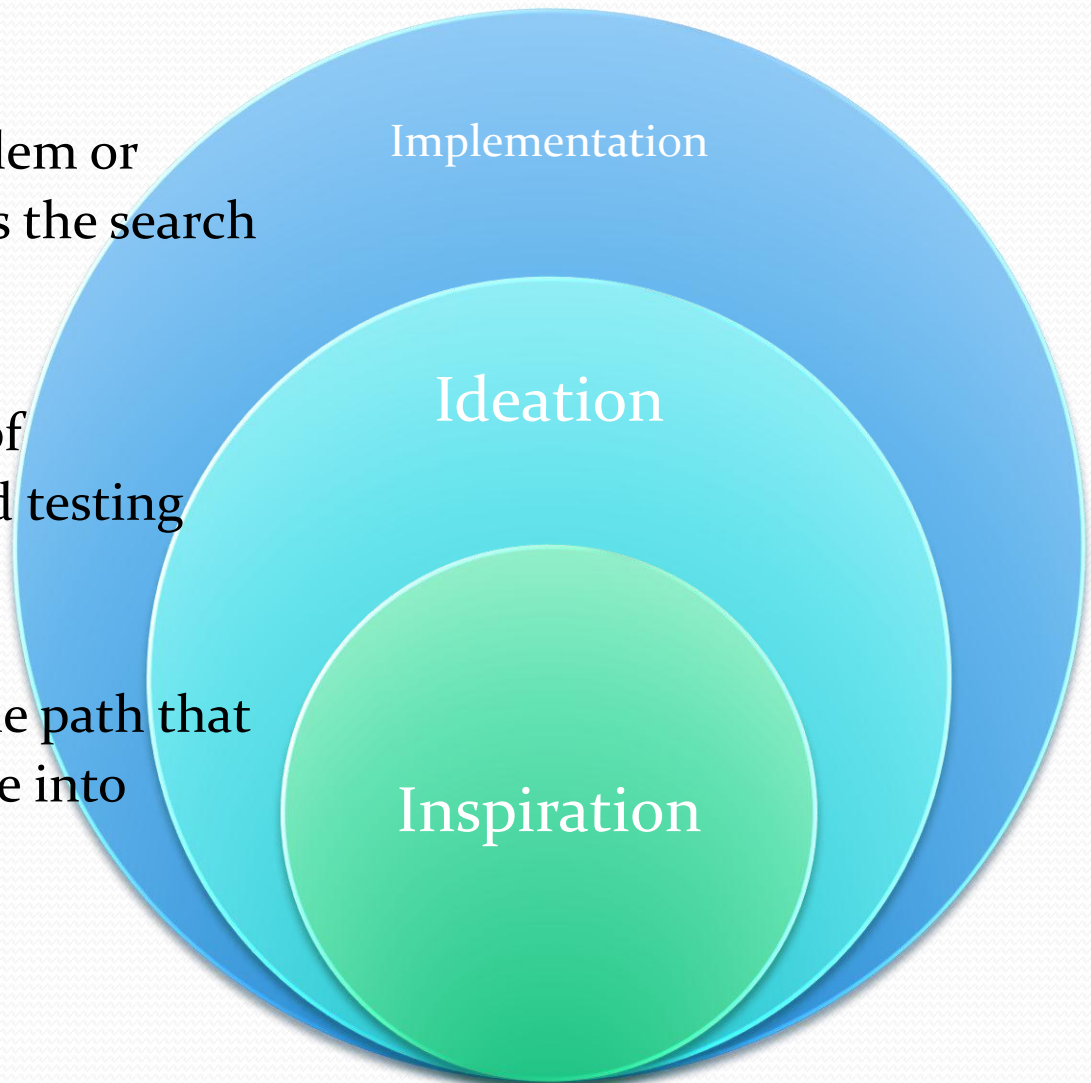
Design Thinking in STEM
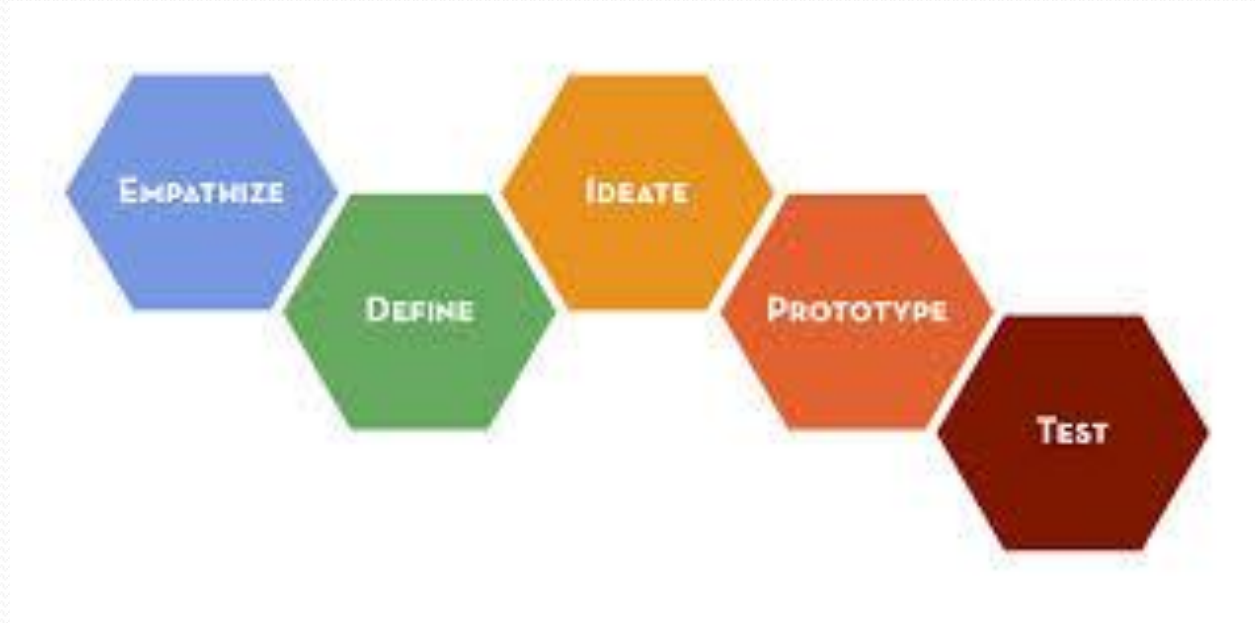
New Trier Design Thinking
Crutch Project

Design Thinking In STEM - IDEO

Inspiration – the problem or opportunity that motivates the search for solutions

Ideation – the process of generating, developing and testing ideas.

Implementation – the path that leads from the project stage into people's lives.

Implementation

Ideation

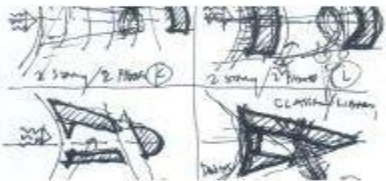Inspiration

Discover Design

Discover Architecture

- Society
- Site
- Spaces
- Systems
- Structure
- Skin
- Stuff

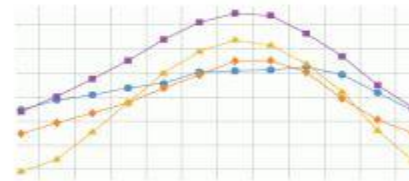## Choose a Design Project *– judged by architects from around the world*

Student Gallery

My Discover Design

http://discoverdesign.org/

The Design Process

Architects and engineers use the design process to solve problems and figure out new solutions. LEARN MORE

Math + Science Connections

Wondering what your math and science classes have to do with architecture? LEARN MORE

FUSE - Northwestern University
Office of STEM Education Partnerships

Program Design
(Maker Movement)

➢Hanging Out

➢Messing Around

➢Geeking Out

Local and online collaborative communities for STEAM education

- 20+ challenges that can be done individually or in groups
- Engineers, scientists, graduate students as mentors.
- Designed to appeal to students who don't think of themselves as "good at" math and science.
- STEAM Challenges
- Mobile apps, jewelry design, solar cars, 3D modeling, designing a dream home

Design Thinking & Communication

Segal Design Institute – Northwestern University

- Required freshman engineering course.
- *Puts students to work on real design problems submitted by individuals, non-profits, entrepreneurs and industry.*
  - Study a problem from multiple perspectives.
  - *Frame the design challenge properly.*
  - Ideate, Prototype and Iterate solutions.
  - *Communicate to the customer in design reviews, reports and presentations.*
  - Learn from the design process how to create value and prepare for careers.

Bedside Button Buddy

Enables case managers to determine when residents are awake or asleep without infringing on their privacy.

Evanston High School

Innovating Through Design in Our Community

Students will learn and use "Design Thinking," a process used by Engineering and Design schools across the country. They will work in interdisciplinary teams and use art, engineering, math, technology, and science to design innovative solutions to problems. Students will choose design challenges focusing on problems we face every day in our community or around the globe, and present their design solutions to multiple user groups.

Functional Focus Areas

| Technology	Design	Lean Start-up* Methods	Entrepreneurship

• Computing
• Robotics
• Networking
• Mobile tech
• Biotech
• Nanotech
	• Human-centered design
	• Problem solving:
	  • Product
	  • Service
	  • Process
		• Learn
		• Test
		• Ideate
		• Prototyping & MVPs (minimal viable product)
		
		• *The Lean Start-Up* by Eric Ries
			• Business formation
			• Fundraising
			• Development

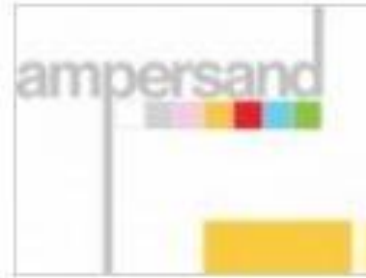Dr. Eric James and Tim Lavengood

High Tech High
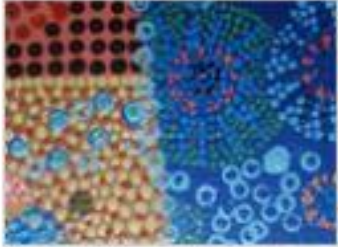
Aboriginal Art
Middle school students created an animal self-portrait using the traditional dotting technique and abstract design elements used by aborigines.

Ampersand
In January 2010, HTHMA juniors left the traditional school structure and became interns in the working world of San Diego. These students took on professional roles and identities as they developed software, wrote for local…

Actually, it is Rocket Science
Working in teams, you will design and build rockets powered by water and pressurized air. Using what you learn about the fundamentals of force and motion, you will design and build a fully functional rocket including: …

Analog Flash for Windows
An engineer, artist, and a physicist develop a Senior Project where students create mechanical interactive displays that fit window frames at HTH.
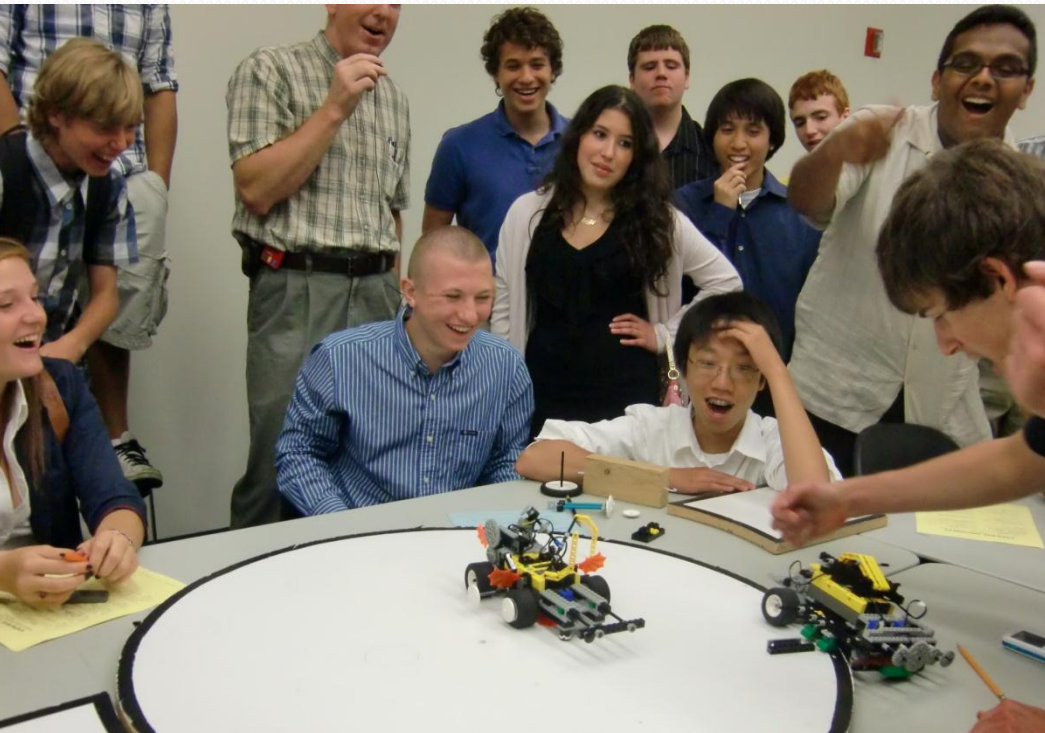
- http://vimeo.com/88923503

You really need to understand it, and you really need to understand **why** you *need to know* this, to be able to complete the project.

Keeping It Real

NSERVE Career Exploration Courses
- Engineering, Robotics & Nanotech
- Healthcare
- Business and Law

Career Speakers
Job Shadowing
Site visits
Internships
E-mentors

Glenbrook South High School's Electric Car
Partnership with high school
Physics,
Automotive,
Oakton Community College, and
Illinois Tool Works
Three 1st place, One 2nd place
(7 categories – Innovative Vehicle Design
national competition)

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