Literature, STEM, Design

- Introduction
- Why are we doing this?
- What would you like to get out of this?
- Our program
- Next steps
- Questions

Bill Wolfson
Engineering lens
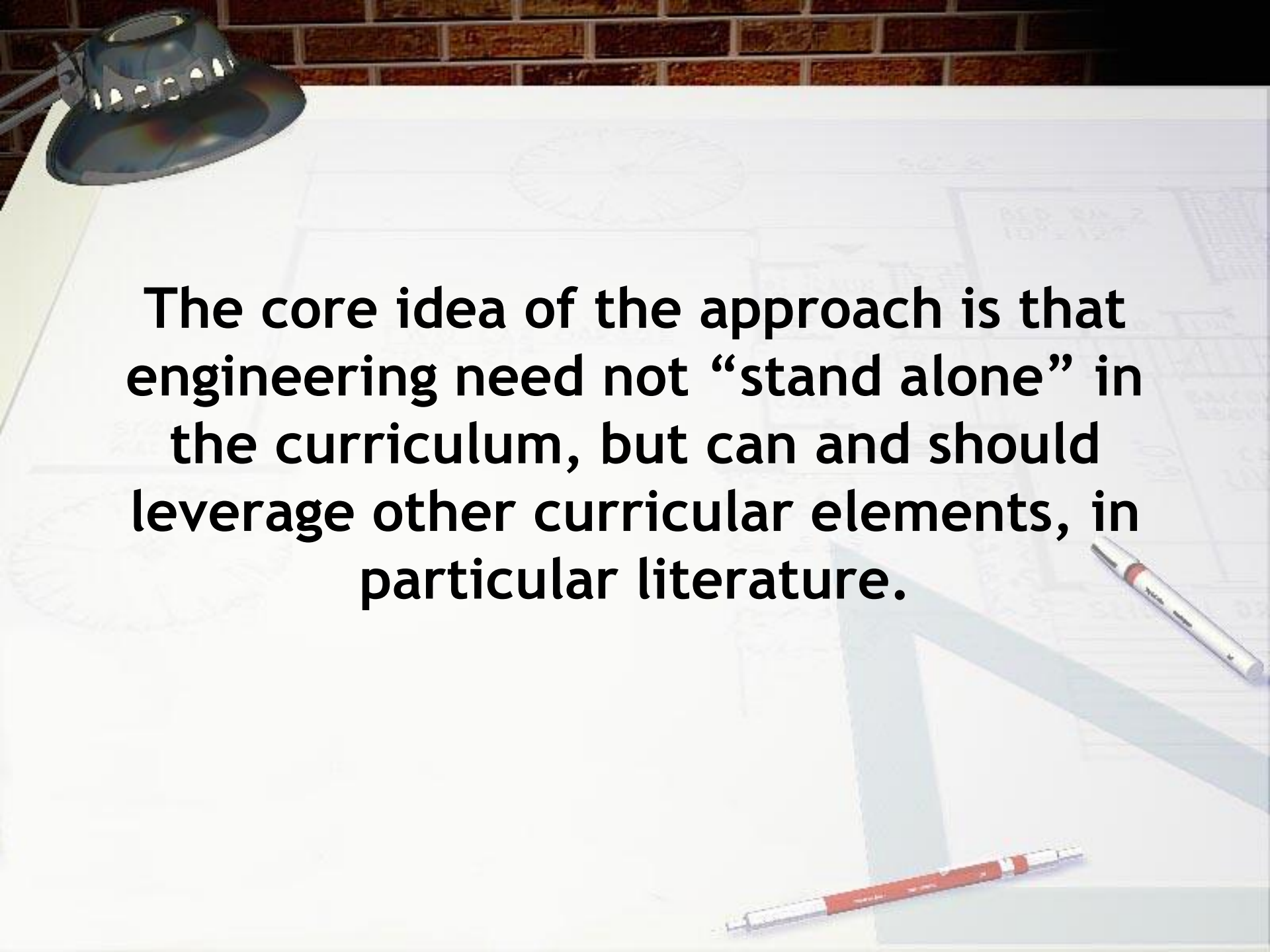billw@engineeringlens.org

Background

- We are losing out to other nations in educating Students in STEM.

- Our education system still operates in "Silo" versus interdisciplinary, making our students not see the relevance of what they are studying.

- Elementary teachers are often more comfortable with Language Arts than with STEM subjects.

Story

ARMONK, NY, - 18 May 2010: According to a major new IBM (NYSE: IBM) survey of more than 1,500 Chief Executive Officers from 60 countries and 33 industries worldwide, chief executives believe that -- more than rigor, management discipline, integrity or even vision -- **successfully navigating an increasing complex world will require creativity.**

21st century skills of creative and critical thinking and collaboration within the process.
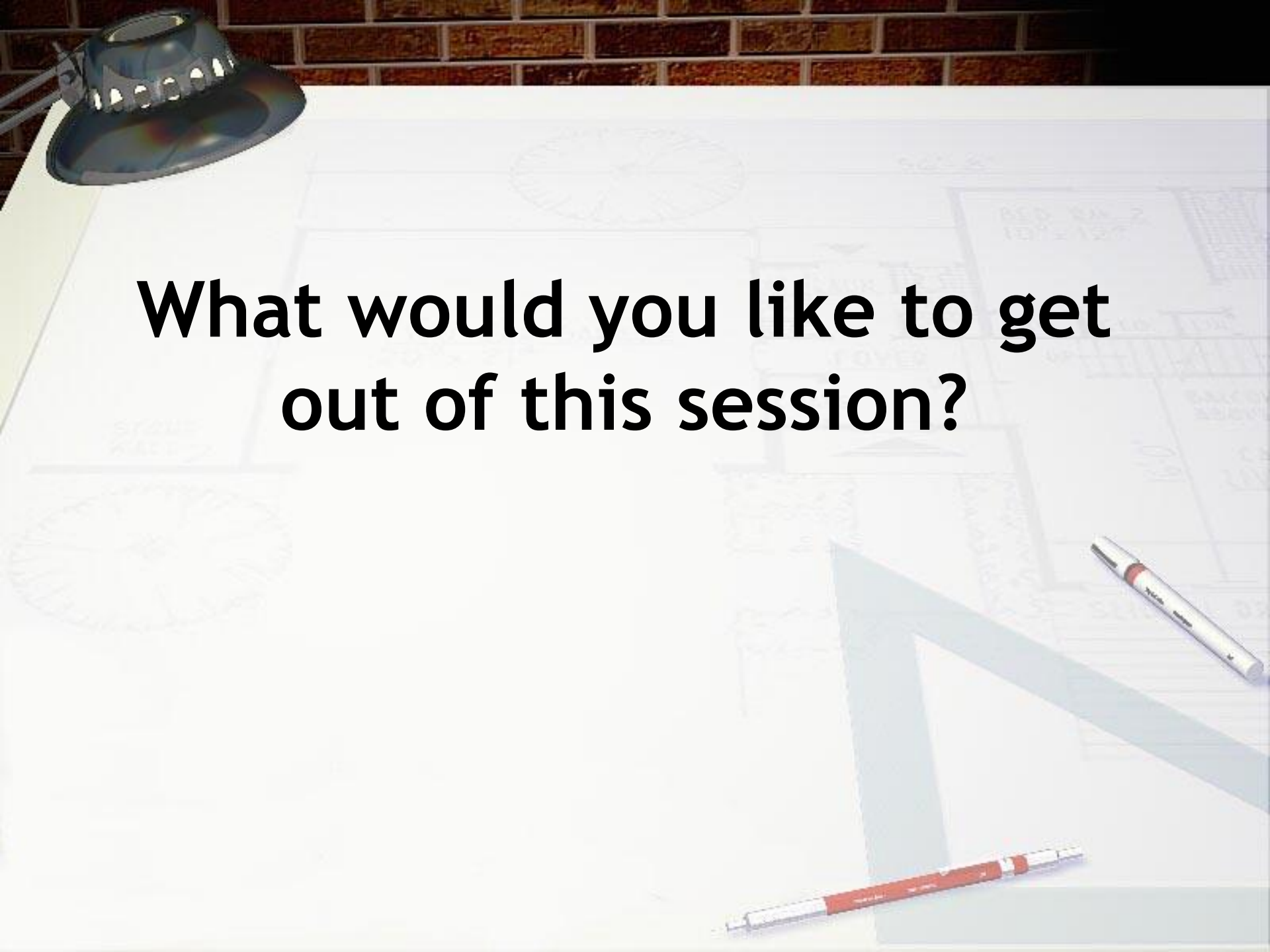
The core idea of the approach is that engineering need not "stand alone" in the curriculum, but can and should leverage other curricular elements, in particular literature.

Our method; Uniqueness

- Not another Silo.; Interdisciplinary
- Uses design to support learning.
- Students making decisions versus being highly scripted.
- Integrates the learning of thinking skills, system thinking and self assessment.
- Open source for educators.

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What would you like to get out of this session?

Why Interdisciplinary Learning

- Life is interdisciplinary and innovation crosses boundaries.
- Children see the relevance of math and science when done in a project
- Exposes children to 21st century skills of problem solving, collaboration and thinking skills

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WHY ENGINEERING?

Engineering is *ACADEMIC GLUE* – it binds complex math and science concepts to real-world experiences and leads to learning that sticks with students

Engineering is *CREATIVITY* – it brings out the best ideas from the students

Engineering is *GROUP WORK* –students learn to communicate and work together while they learn math and science

Engineering is *EVERYWHERE* –students learn that engineers have designed, created or modified nearly everything they touch, wear, see and hear in their daily lives

Thinking Skills are the Tools of Engineering
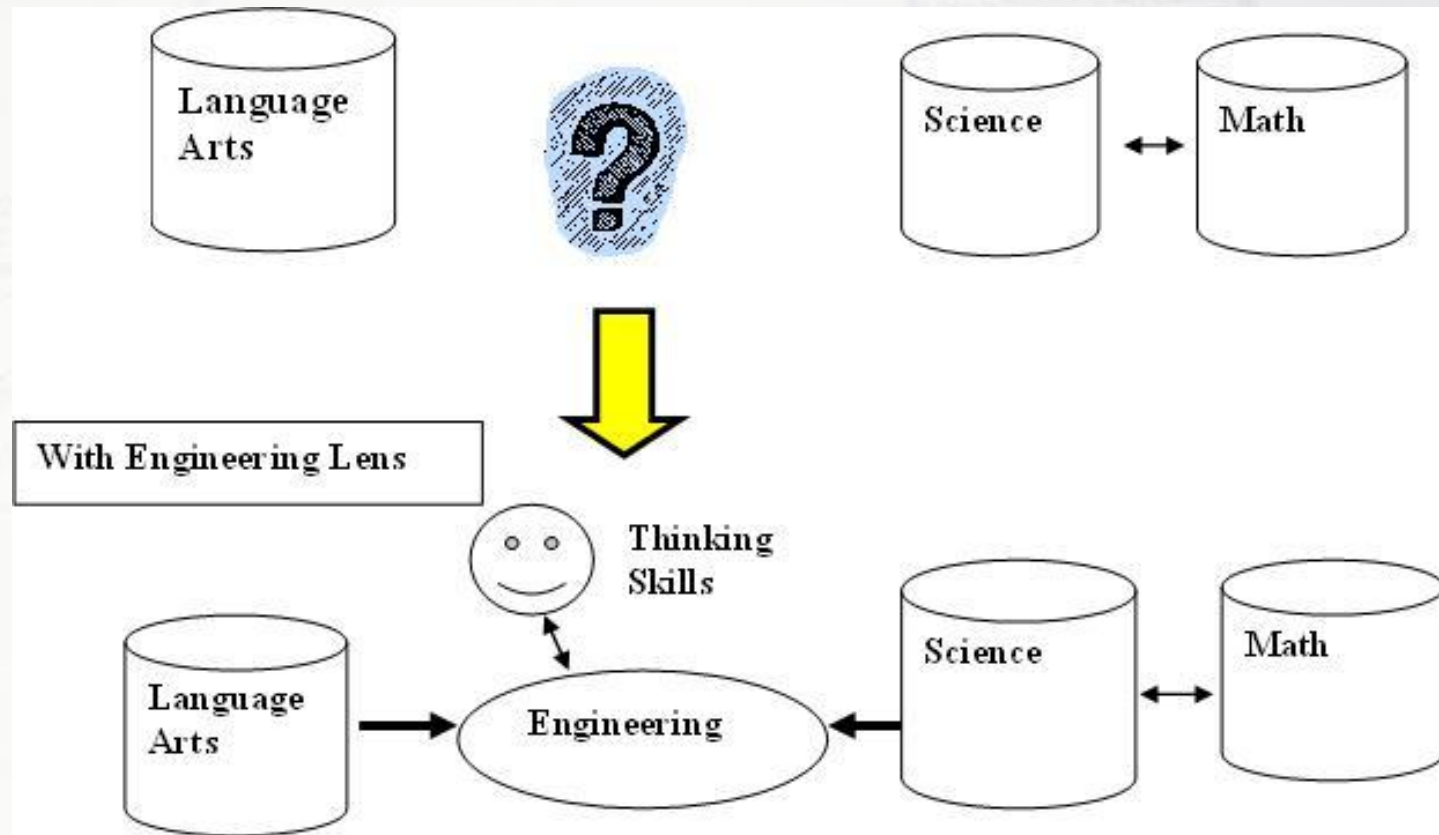
Creative thinking	Critical Thinking
Meta-cognitive reflection	Questioning

Building the connection ...

Designs useful product and processes for society based on all disciplines but mainly science and math.

Benefits

- **Meets all the learning principles of the Massachusetts Science Framework**

- **Promotes higher-order thinking skills using design learning.**

- **Invites the incorporation of instructional technology into the curriculum.**

- **Engineering is differentiated: offers an "in" for learners of all types.**

- **Rich cross-curricular possibilities.**

- **Integration with math is an important way to show students how and why math is relevant and useful in the world.**

- **Directly connected with improvement of living conditions/safety/health and welfare of people.**

- **Engages both students and teachers in an exciting learning process.**

Diana Mason, Missy Taft,

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We start with the definition of an engineer:

... Designs useful product and processes for society based on all disciplines but mainly science and math.

Also discuss:
❑Scientist
❑Technologists
❑Mathematicians
❑Artists
❑Entrepreneur

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Definitions:

- **Engineers** design useful products & Processes for society using all disciplines but mainly science and mathematics. (composite)

- **Science** is about explaining patterns in the universe. (composite)

- **Mathematics** is the language to manage/explain a design & account for the patterns in nature. (composite)

- **Entrepreneurship** is the practice of starting new organizations or revitalizing mature organizations, particularly new businesses generally in response to identified opportunities. The behavior of the entrepreneur reflects a kind of person willing to put his or her career and financial security on the line and take risks in the name of an idea, spending much time as well as capital on an uncertain venture. (Wikipedia) **Creating value where there was none!**

- **Artist:** a person whose creative work shows sensitivity and imagination. A follower of a pursuit in which skill comes by study or practice - the opposite of a theorist. people who use imagination, talent, or skill to create works that may be judged to have an aesthetic value. (Wikipedia)

- **Technologies** (products and processes) are the result of engineered designs. They are created by technicians to solve societal needs and wants. (Science Framework)
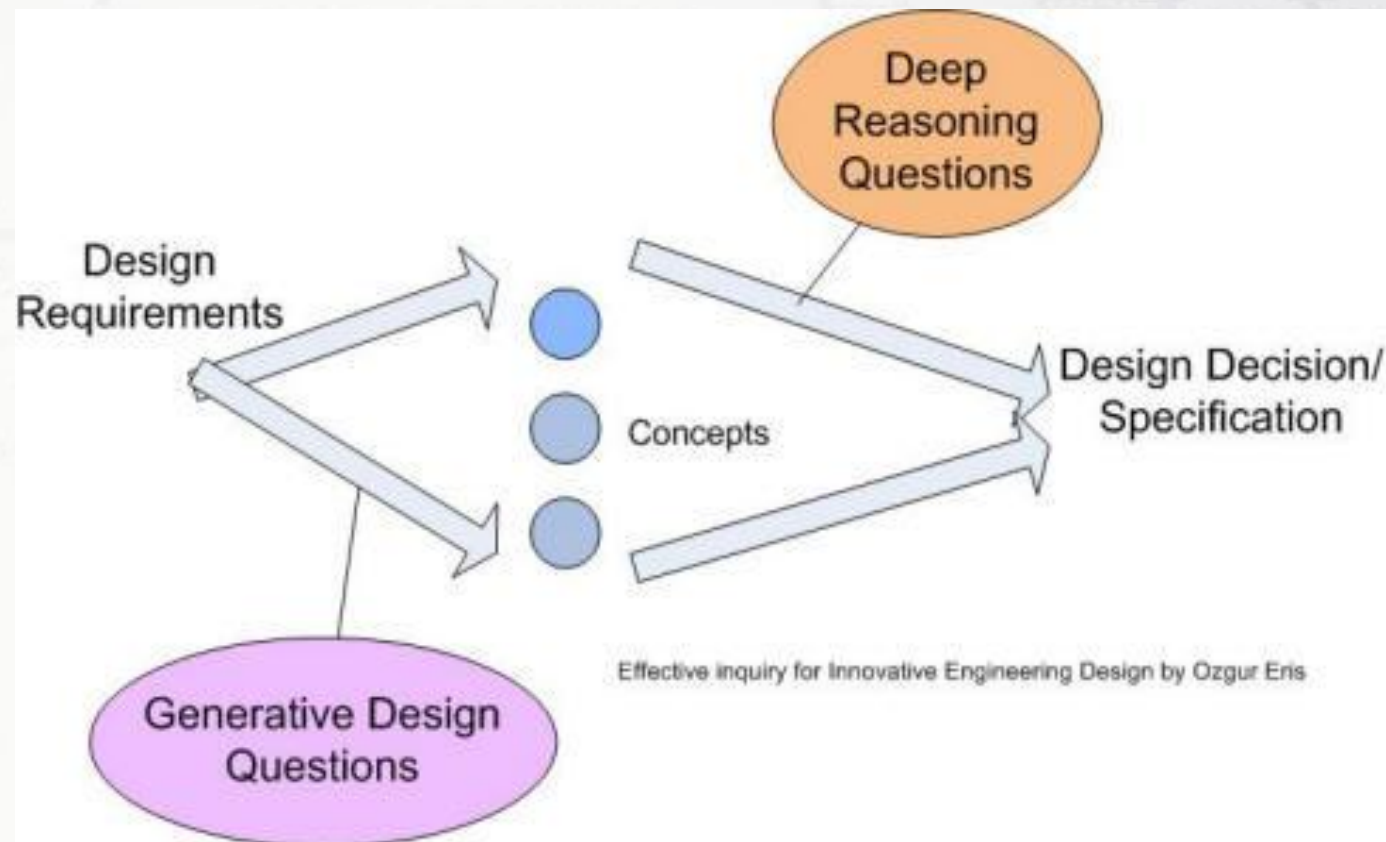
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MA Framework

Strand 4
Engineering & Technology
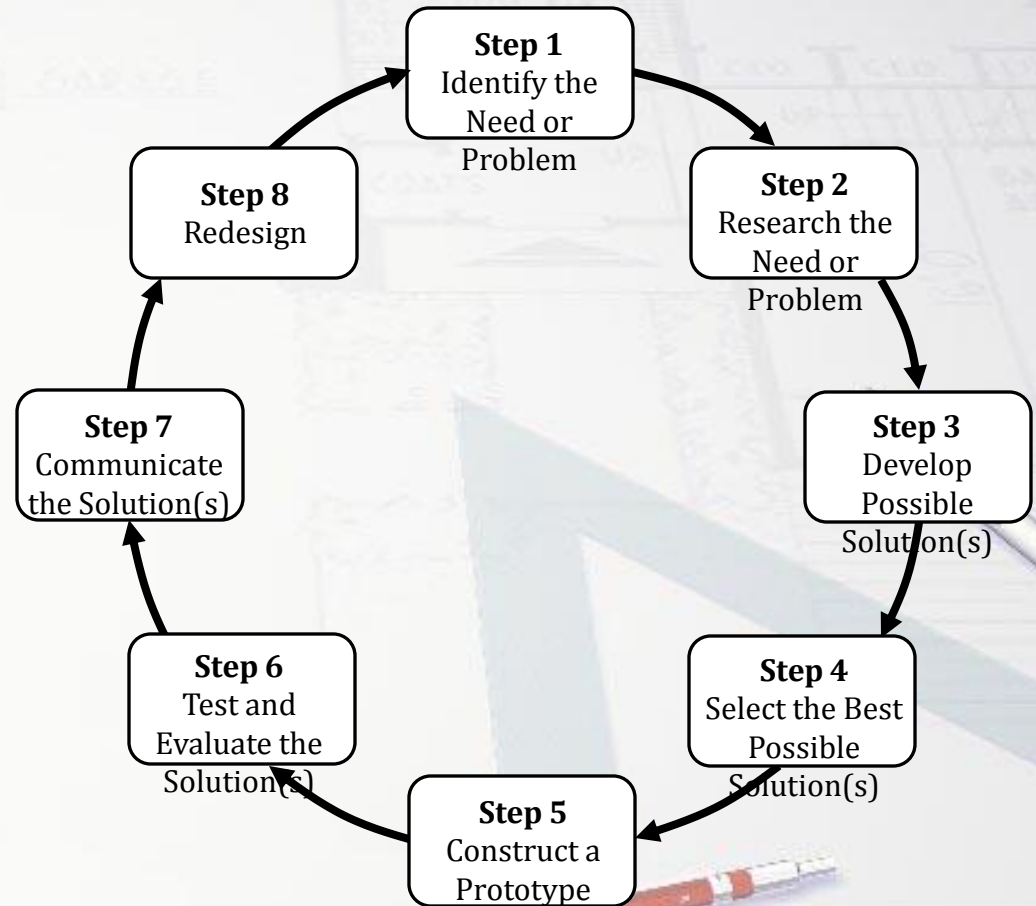
The design process is a series of questions.

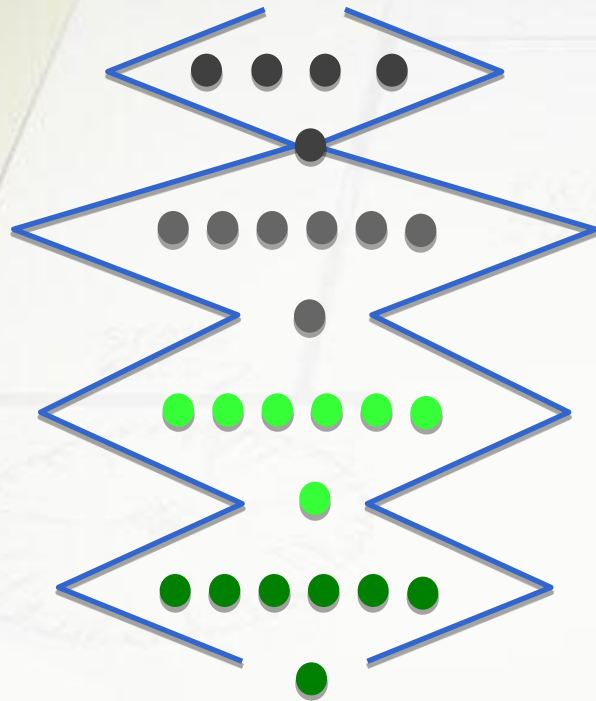Effective inquiry for Innovative Engineering Design by Ozgur Eris

Connecting literature

- Story/Characters

- Design Challenge

- Specification

- Designs

- Product

- Testing/ Feedback

Reporting

Divergent/Convergent thinking

Iterative process

Mark Somerville .. Olin College

EngineeringLens ©

"It bugs me when my coffee gets cold."

Divergent: Generate raw ideas

Use solar power!

Drink Tea!

Convergent: Define requirements

Coffee Warmer REQUIREMENTS

The design should…
Be no larger than...
Cost no more than…
Keep coffee at…

Divergent: Generate alternatives

SUPER MUG
SOLAR COFFEE WARMER

Convergent: Select an approach

SOLAR COFFEE WARMER

A simple desktop apparatus keeps coffee hot all day. Solar panel is located near a window; wire runs to pad.

Needs
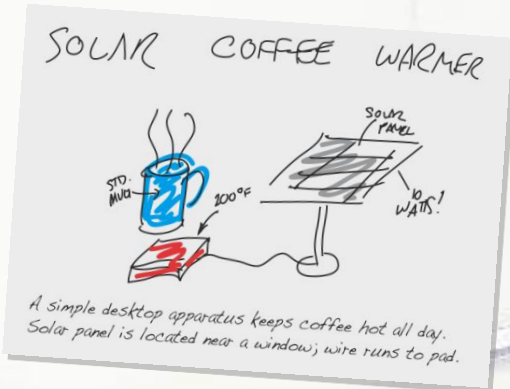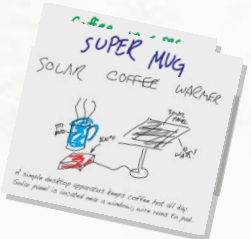
Requirements

Specification

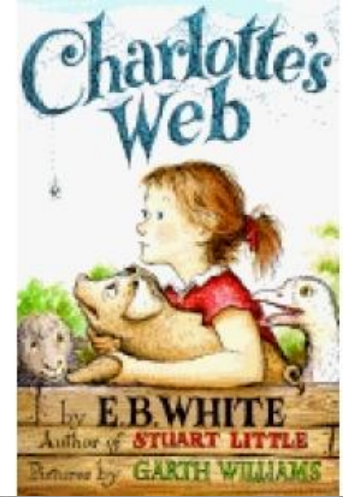Mark Somerville .. Olin College

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Questions?

Examples

❑Needs of the characters
❑Solving a know problem in the story

Engineering designs useful products or processes using all disciplines' but mainly science and math.

Design Challenges:

- Killing of the runt P1
- Keeping warm at night in the yard. P9
- Mr. Zuckerman knew that a manure pile is a good place to keep a young pig P14
- Wilber was lonely, he wanted love P27
- Have you ever tried to sleep while sitting on eight eggs asked the goose. P33
- "I happen to be a trapper", says Charlotte P39

Note: just thru pg 39 out of 184

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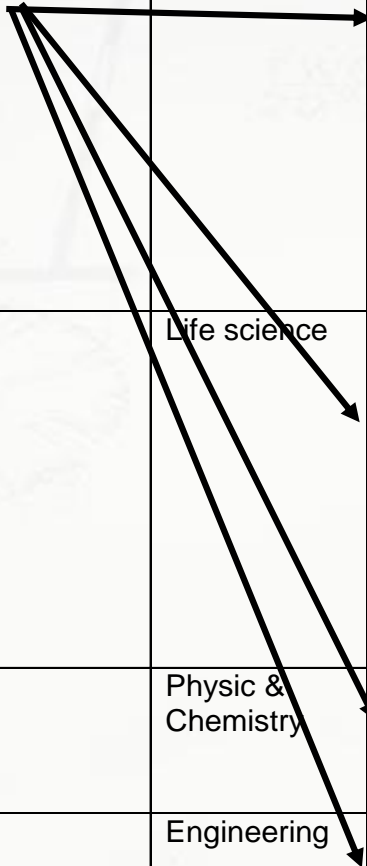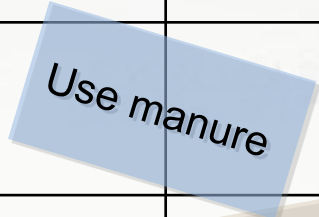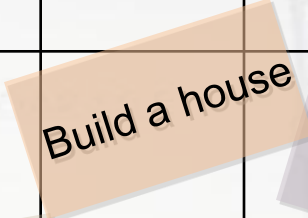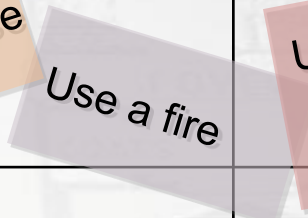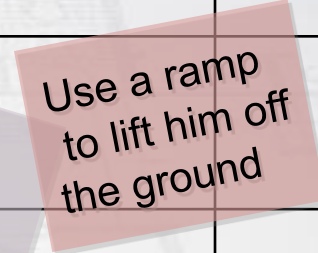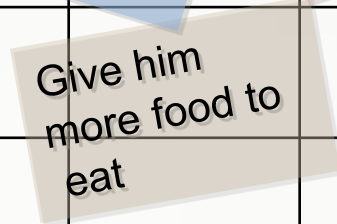# Use at least one science constraint when generating your design solutions

Design challenges	Sciences	Filters	Results
	Earth & Space	Energy in the Earth System	
		Materials and Energy Resources	
		Earth process and Cycles	
		Structure of the Earth	
		Earth in the Solar System	
	Life science	Characteristics of Living Things	
		Systems in living Things	
		Heredity	
		Evolution and Biodiversity	
		Living things and their environment	
	Physic & Chemistry	State of Matter	
		Position and motion of objects	
		Electricity & sound	
	Engineering	Tools	
		Materials	
		Engineering Design	

Charlottes Web

	Math	Life	Earth & Space	Physics & Chemistry	Simple Machines	????
Challenge						
Keeping warm at night		Use manure	Build a house	Use a fire	Use a ramp to lift him off the ground	
		Give him more food to eat				

Goldilocks

Design Challenges :

- Breaks into the house
- Finds the food cold or too hot
- Breaks a chair
- Finds the beds not comfortable
- Escapes by jumping from the house.
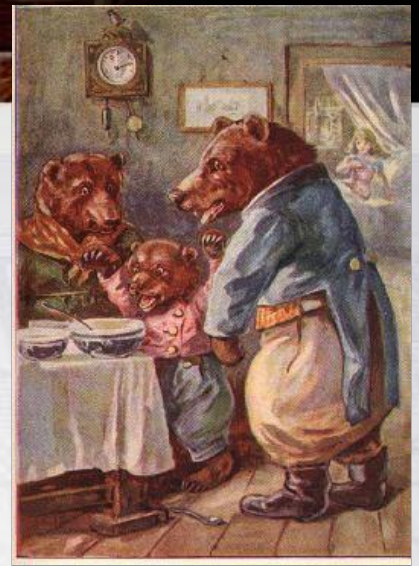
Did not find a room for the bears to hibernate.

Design challenges in the story " Goldilocks"

Habitate

Design a Room

Signs, art & math

Security system

tunnels, mechanical locks

Design food warmer

insulation, energy transfer

Bears hibernate

Entering the house

Eating the porridge

Goldilocks

Found sleeping

Sitting on the chair

Running out

Design a chair

3 leg chair?

Design a bed

Materials

Materials, structure

Slide, friction

Excape from upstairs

Trampoline, springs

9/17/09

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How does the program teach innovation or entrepreneurship?

This program explicitly addresses innovation and entrepreneurship in a number of ways.

- First, there is an explicit focus on needs finding. Students must identify with characters in literature, and decide what opportunities might exist to help those characters. As such, the program is as heavily focused on the entrepreneurial skill of opportunity identification and assessment.

- Second, because the program is heavily oriented toward the kinds of thinking skills that the engineering design process requires, it includes substantial emphasis on the kinds of thinking that lead to innovation. In particular, Teachers and students use divergent and convergent thinking processes and techniques (e.g., brainstorming, criteria-based idea selection) as they develop their ideas for how to respond to the needs of characters in literature.

- Finally, the design of the professional development workshop is meant to lead to curricular innovation. While participants will be introduced to various techniques and the framework, the participants will be responsible for designing their own projects, and will utilize innovation-oriented design techniques to do so.

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What about you?

Creative Problem Solving

Summary Process
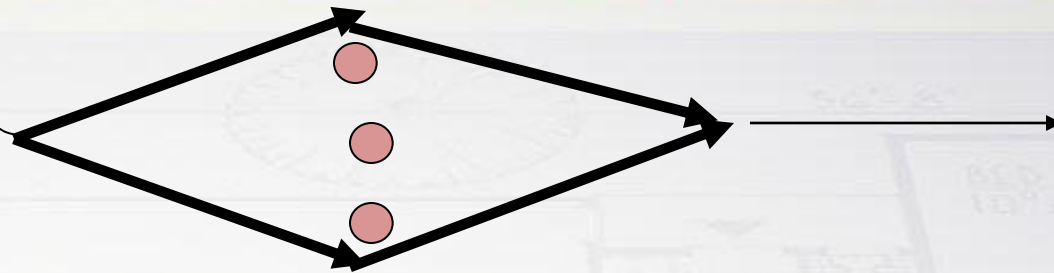
Priming	Generative	Convergent	Defining
History	Brain Writing	Discussion of Pro/Con	Gallery Sketches
Needs	Morphological Analysis	Shaping	Modeling/Building
Problem Framing	Shaping	Requirements	Posters
Values	Brain Storming	Decision Matrix	Presentation
OTHERS			

Listen to the needs and values of the customers

- **Generate raw ideas for a given challenge**
- **Select an idea that is particularly interesting**
- **Identify the requirements for that concept**
- **Come up with multiple solutions that meet the requirements**
- **Select a solution, based on the requirements**

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Movie

STANFORD
TECHNOLOGY
VENTURES PROGRAM

Tina Seelig

Executive Director,
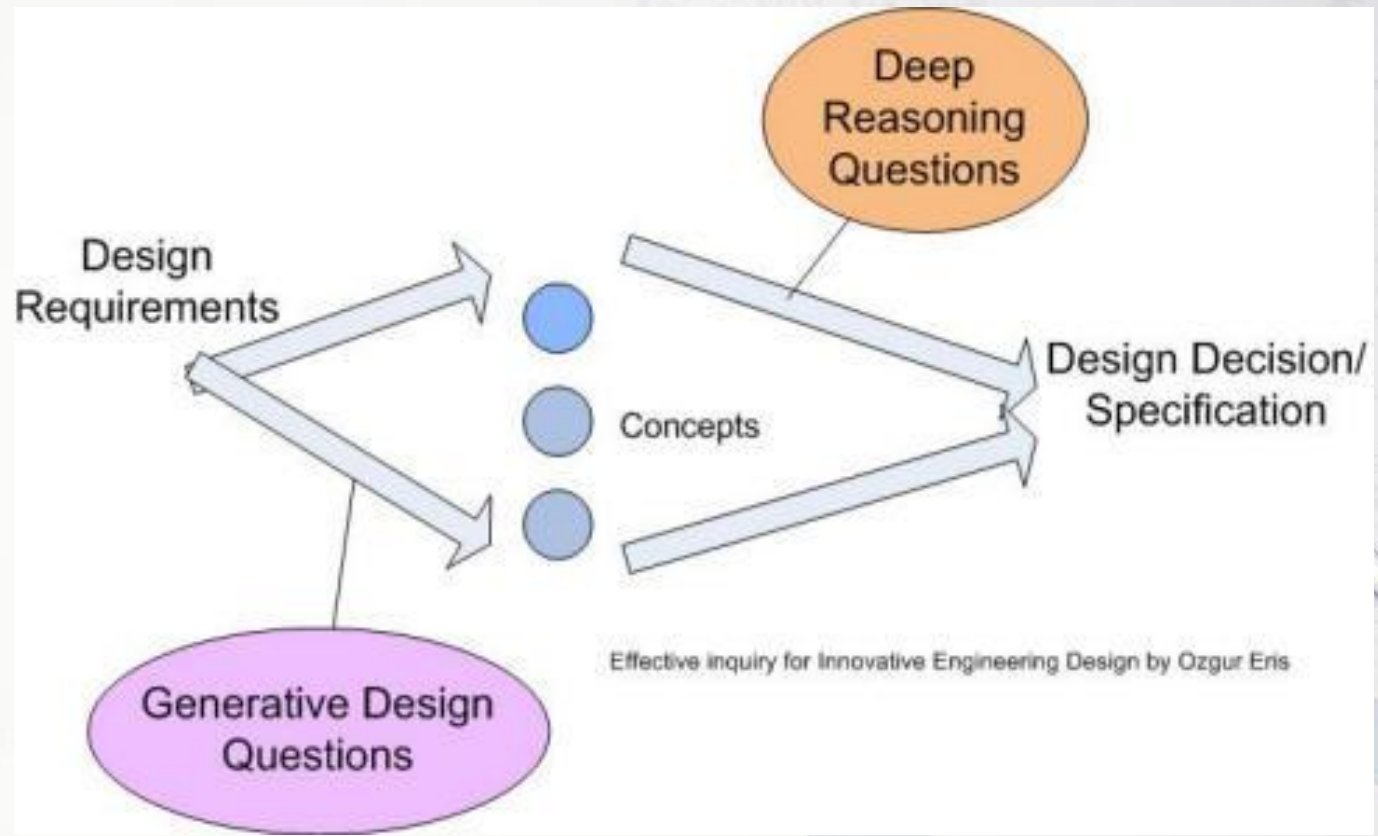Stanford Technology Ventures Program
May 27, 2009

Creative Problems Solving

- People
- Needs
- Research

- Generative ideas

- Requirements

- Reasoning

- Testing

- People

Design Requirements

Concepts

Deep Reasoning Questions

Design Decision/ Specification

Generative Design Questions

Effective inquiry for Innovative Engineering Design by Ozgur Eris

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What about us?

Activities

www.engineeringlens.org

- Created Syllabus for 3 credit course (FSC)
- One-credit on-line course FSC
- First major implementation in Millis Public Schools (9/2009 to 1/2010)
- Completed another two sessions this June/Aug.,2010, Hopedale/Millis and Milford PS
- Created on-line learning site in Moodle Learning software
- With Tufts CEEO, have won a NSF research grant(DRK-12) based on this concept.

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Call to Action

1. Started as a life goal to get children excited about engineering careers.
2. Team of academics, school teachers and a few retired engineers.
3. Goal is to create curriculum for PD for educators, assessment in urban, suburban and rural school districts.
4. Sustainability model is:
- taught as supplemental curriculum to teachers in college
- interactive web site for collaboration
- ownership by major NP education corp.

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Hi Bill and Karen -
I liked the summary for the grade level discussion. I can see options for the fifth grade, based on the learning from the earlier levels. I would suggest that by grade 5 (or, expanding it to 6/7/8), students could work the way we did in our class. That is, let them find a story and use it for analysis. This would add to the interdisciplinary factor by including library teachers, English teachers, writing/reading skills teachers, etc. It would also allow students to work with various reading levels and styles. Basically, using the 'problem-solving' approach, almost every story can find this engineering challenge.
Another approach would be to have the students provide an 'alternate ending' to the traditional story, with a variety of problem-solving tactics.
I am really enjoy this connection to literature!

Patsy

Hi Bill and Karen, Thank you Karen for doing such a concise summary of our age group engineering instructions. It's a usable document to share at our PLC leadership meeting tomorrow. One representative from each grade level attends the leadership meeting to discuss with our principal the items we undertake the following week at our grade level PLC meetings. With 5 classrooms for each grade level, K-5, this would be a nice way to promote the Engineering strand into more active use in our building. Thanks again, and see you on Tuesday.

Anne

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End
Thank you