

Why sTEm?

science **Technology** Engineering math

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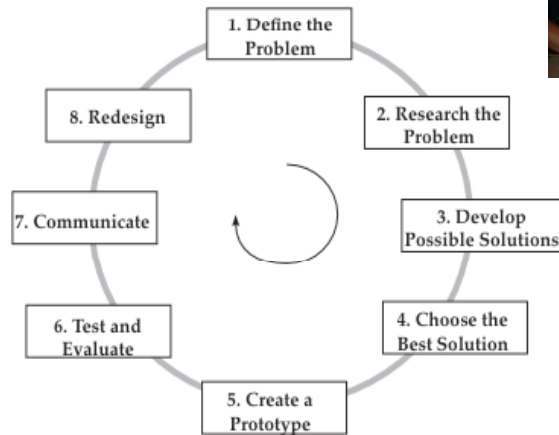
*In Previous Lives: LEGO Robotics Coach & Camp Director;
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**What Does Research Tells Us About How to Encourage Girls in
Math and Science ~ April 22, 2009**

Why sTEm?

- **Science:** knowing more and knowing it more thoroughly, reliably and repeatably
- **Technology:** not just computers and phones but the study of the tools and processes that are used to make stuff that solves problems. Oil painting, pottery and dressmaking each have an associated technology.
- **Engineering:** making stuff that solves problems. Taking risks to solve problems with imperfect knowledge and limited resources – time, money, materials.
- **Math:** a tool to describe patterns which may or may not apply to phenomena in the real world. When it does apply, math can widen one's understanding of a problem and help predict behaviors under changing conditions.

Engineering is a Way of Thinking



The Engineering Design Process

Similar Processes—Different Goals

Science

- Identify a question
- Research the question
- Generate ideas
- Formulate a hypothesis
- Conduct an experiment
- Communicate results
- Identify a new question

Engineering

- Define a problem
- Research the problem
- Generate solutions
- Create a prototype
- Test the prototype
- Communicate product
- Redesign

Adapted from Engineering Professor Chris Rogers, Tufts University; thanks to Cary Sneider

On Thinking Like an Engineer

Advice from 12 year old participants of a workshop with picoCrickets, devices used to build projects with motion, light and sound using LEGOS and other materials

- Start simple
- Work on things that you like
- If you have no clue what to do, fiddle around
- Don't be afraid to experiment
- Find a friend to work with, share ideas!
- It's OK to copy stuff (to give you an idea)
- Keep your ideas in a sketch book
- Build, take apart, rebuild
- Lots of things can go wrong, stick with it

*From "All I Really Need to Know (About Creative Thinking) I Learned (By Studying How Children Learn) in Kindergarten" by M. Resnick, MIT Media Lab, 2007.
Downloadable at <http://scratch.mit.edu/pages/research>*

"Science seeks to understand the world as it is; only engineering can change it. ...But the truth is that full scientific understanding isn't always necessary for technological advancement."

from "Want to Engineer Real Change? Don't Ask A Scientist", by Henry Petroski, Duke University Professor, civil engineer, historian, and failure analyst, Washington Post, January 25, 2009

Why sTEem?

Connecting to the IES Practice Guide "Encouraging Girls in Math and Science"

- Kids want to get their hands on something, do something, make something that matters and to connect to what they already know.
- Technology and Engineering put problems into kids' hands and give them a reason to apply math and science using critical and analytical thinking.
- There is no more prescriptive, informational feedback than a robot doing what you tell it to do rather than what you want it to do. (*Recommendation #2*)
- "Real world" problems and the use of tools for a goal's sake (vs. tools/toys are cool for themselves) interest both boys and girls (*Recommendation #4*)

Strategies in the trenches

Recommendations #1, #4

- Wait for answers
 - reward thorough thinking as well as fast thinking
- Ask leading questions
 - To lead students to successful solutions and deeper understanding
 - To lead mentors to understanding student thought processes
 - To encourage students to ask each other questions
- Reward effort and explanation as well as results
 - Encourage good process: research, experimentation, documentation, discussion, conclusion

Want More?

- The OPAS Initiative home page at <http://opas.ous.edu//>
- “In the OPASsphere” e-newsletter at <http://opas.ous.edu//OPASsphere/index.html>
- Network of Oregon Informal STEM Educators (NOISE) listserv (automagically subscribes you to “In the OPASsphere” – contact Jo)
- More Informal STEM education programs at <http://www.technosciencesupersite.org/>
- Handouts “Learnings on Program Development and Accountability” & “Encouraging Girls in Math, Science & Engineering”

Thank you for fighting the good fight!

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