



STEM: Engineering Is at the Heart of It

Pramod P. Khargonekar
NSF Directorate for Engineering
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STEMSmart



HOW TO INTEGRATE ENGINEERING?

What is Engineering?

- The engineering process, according to Engineering is Elementary



Kids love to do these things!

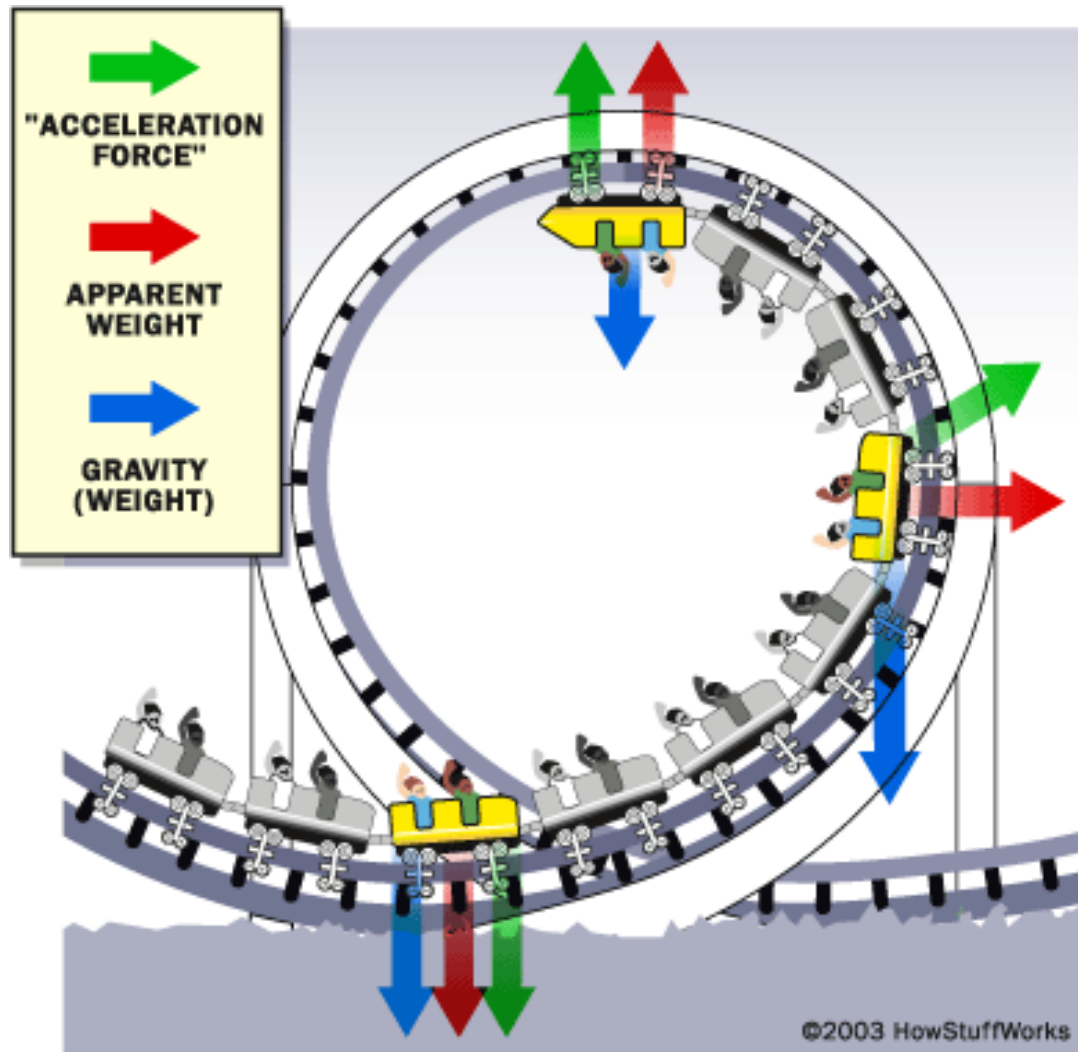
Engineering in the K-12 Classroom

- Start with core math, science, and technology
- Build on these when introducing engineering design activities into existing curricula
- Use existing resources and appropriate engineering examples – engineering serves as a unifying topic, emphasizes the interconnectedness of STEM subjects

Engineering Activities

- Project-based learning
 - Best if real-world projects
 - Even better if projects include service learning (helping people with disabilities, helping the environment)
- Work done in teams
 - Students learn collaboration and compromise
 - They learn to use their own strengths to fit a specific situation, using their talents to be valued by the team
- Open-ended problems
 - No “one right solution”
 - Special needs students thrive in these settings

It's Roller Coaster Season!



The Physics of Roller Coasters

(from www.teachengineering.org/)

- Grade 7 activity
- Uses students' existing physics knowledge of forces, gravity and friction, Newton's Second Law of Motion, position, velocity, acceleration, and kinetic and potential energy
- Students explore the most basic physical principles of roller coasters, which are crucial to the initial design process for engineers building roller coasters
- Students explore the physics used by engineers in designing today's roller coasters, including potential and kinetic energy, friction, and gravity
- Afterwards, students will be able to analyze the motion of any existing gravity-driven coaster and design the basics of their own roller coasters
- During an associated activity, the students design, build, and analyze a roller coaster for marbles out of foam tubing



**WHAT ENGINEERING RESOURCES
ARE THERE?**

Informal Education

- Maker Movement (<http://makerfaire.com>)
- Hacker Scouts (www.Hacker-Scouts.org)
- Industry activities
 - Intel Science Talent Search
- Professional Societies
 - National Engineers Week (www.futurecity.org)

NSF Example Projects

- Integrating Engineering and Literacy at Tufts University
- Studio STEM at Virginia Tech
- UTeach Engineering at University of Texas at Austin
- There is lots more ...

NSF Partnerships – RETs

- NSF Research Experiences for Teachers
 - STEM teachers perform engineering and computer science research and translate their research experiences and new knowledge into classroom activities
 - 90 sites, 500 teachers per year
 - www.ret-eec.org

NSF Partnerships - ERCs

- NSF Engineering Research Centers
 - Build relationships with K-12 teachers and students to help integrate engineering concepts into precollege education
 - Over 46,000 K-12 students participated in ERC outreach programs in 2012.
 - www.erc-assoc.org

Classroom Resources

- Engineering is Elementary www.eie.org
- Engineering, Go for It! www.egfi-k12.org
- Engineering Pathway
www.engineeringpathway.org
- Engineer Your World
www.engineeryourworld.org
- Teach Engineering www.teachengineering.org

Conclusions

- Infusing engineering into K-12 STEM education offers a novel direction to address a critical educational and societal challenge
- NSF is supporting and catalyzing this change
- Engineering community will engage
- We will all benefit from the change

Questions?

pkhargon@nsf.gov