“No child is too young to play and therefore to engage in engineering, albeit of a primitive kind.”

- Henry Petroski
Professor of Civil Engineering and professor of history, Duke University
The Role of Play in Elementary Engineering

Lora K. Hine
Xraise, CLASSE
Cornell University
Interactive Science Centers

“Distinction between playing and learning is a false one.”
(Wellingtong, 1990 p.249)
No consensus on what it means to “play”
Features of Play

1. Child-led and voluntary, with no extrinsic goals
2. Focus on activity (process) rather than on the final product
3. Low risk (high success)
4. Highly engaging
5. Potential to contribute to both procedural and conceptual knowledge

(Morgan & Kennewell, 2006)
Features of Play (cont.)

Play is FUN! (Morgan & Kennewell, 2006)
Learning Through Play

• Through play children can develop social and cognitive skills, mature emotionally, and gain the self-confidence required to engage in new experiences and environments (Kahn & Wright, 2013)

• Play provides a context in which children construct knowledge about physical and social worlds (Goldhaber, 1994)

• “Playful learning” - children actively engage, explore and discover the world around them (Zosh, Fisher, Golinkoff & Hirsh-Pasek, 2013)
Through Play, students learn to:

- self-initiate
- explore materials
- participate in hands-on activities
- collaborate and communicate
- solve problems
- invent new things
- act on intrinsic motivation
- extend prior knowledge
- engage deeply in efforts

(based on Morgan & Kennewell, 2006)
“Formal education has become a serious business, defined as success at abstract thinking and high stakes testing, that there is no time and no context for play” (Dougherty, 2013, p.8)

Designing spinners with fifth graders
Effective Learning Practices in College Engineering

Students learn to:
Though K-12 Engineering Practices, students learn to:

- define problems
- develop & use models
- use math & computational thinking
- analyze & interpret data
- design, iterate & test solutions
- obtain, evaluate & communicate info
- engage in argument from evidence
- reach consensus

(NRC, 2012, p.43)
A learning continuum exists for students engaged in the overlapping practices of play and engineering (Honey & Kanter, 2013).
The idea of playfulness is embedded in engineering through concepts of invention and design. (Petroski, 2003 p. 206)

The learning continuum overlap includes aspects of design, innovation and exploration.
Guided Play: adults create flexible interest-driven, child-centered experiences that encourage children’s thinking and scaffold their discoveries (Zosh et al. 2013)

Engineering design challenges presented in the primary grades are examples of Guided Play
3rd Grade Design Challenge

Build a wind-o-meter that will measure two different wind speeds, 12” from fan using recycled materials
Testing the First Design

Guided play or engineering design?
Testing the Second Design

Introduction of a bearing
Guided Engineering-based Learning activities help develop students’:

- problem solving abilities
- conceptual understanding
- planning, construction and testing skills
- self-confidence
- sharing of ideas

The Framework’s emphasis on the practices of science and engineering represents a new opportunity to conceptualize and recognize how expansive forms of pedagogy and learning activities can create deep insights, identification, and understanding for the learner (Bevan et al., 2013).
A new vision for formal science education!

“In some ways, children are natural engineers....they use a variety of tools and materials for their own playful purposes”. Students’ building efforts progress from free play to solving design problems (NRC, 2012)
“I could solve my most complex problems in Physics if I had not given up the ways of thinking common to children at play.”

- J. Robert Oppenheimer