

Creative by Design

Using Engineering Design and Art to Nurture Creativity
in STEM



Developing Leaders of Innovation

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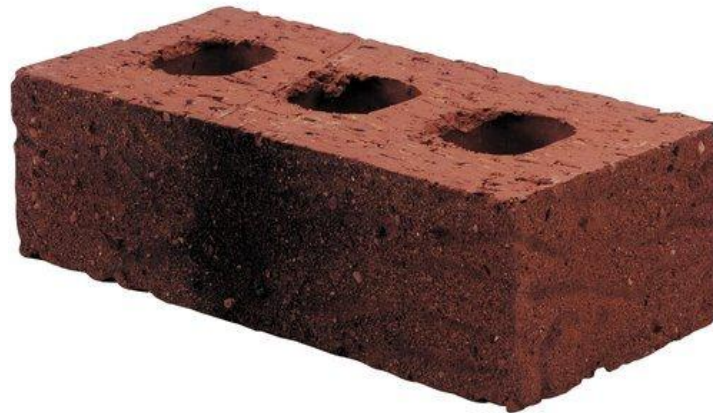
9 June 2012

What We'll Do Today

- Getting our “creative” on
- What is creativity?
- How do you see intelligence? Talent?
 - Carol Dweck’s Mindset
- Engineering design process models
- STEAM to success!
- Closing discussion

Warm Up!

- You may have done the exercise “What can I do with this brick?”



- Let's turn it around: What CAN'T you do with this brick?

Creativity

- Divergent
 - Considered by most to be “creative thinking”
 - Think broadly
 - Develop many alternatives
- Convergent
 - Narrow a broad set of alternatives to a feasible set of solutions
- And, for scientific creativity, logical thinking
- Used interchangeably with “innovation” and “problem solving”
- Roles of curiosity and expertise

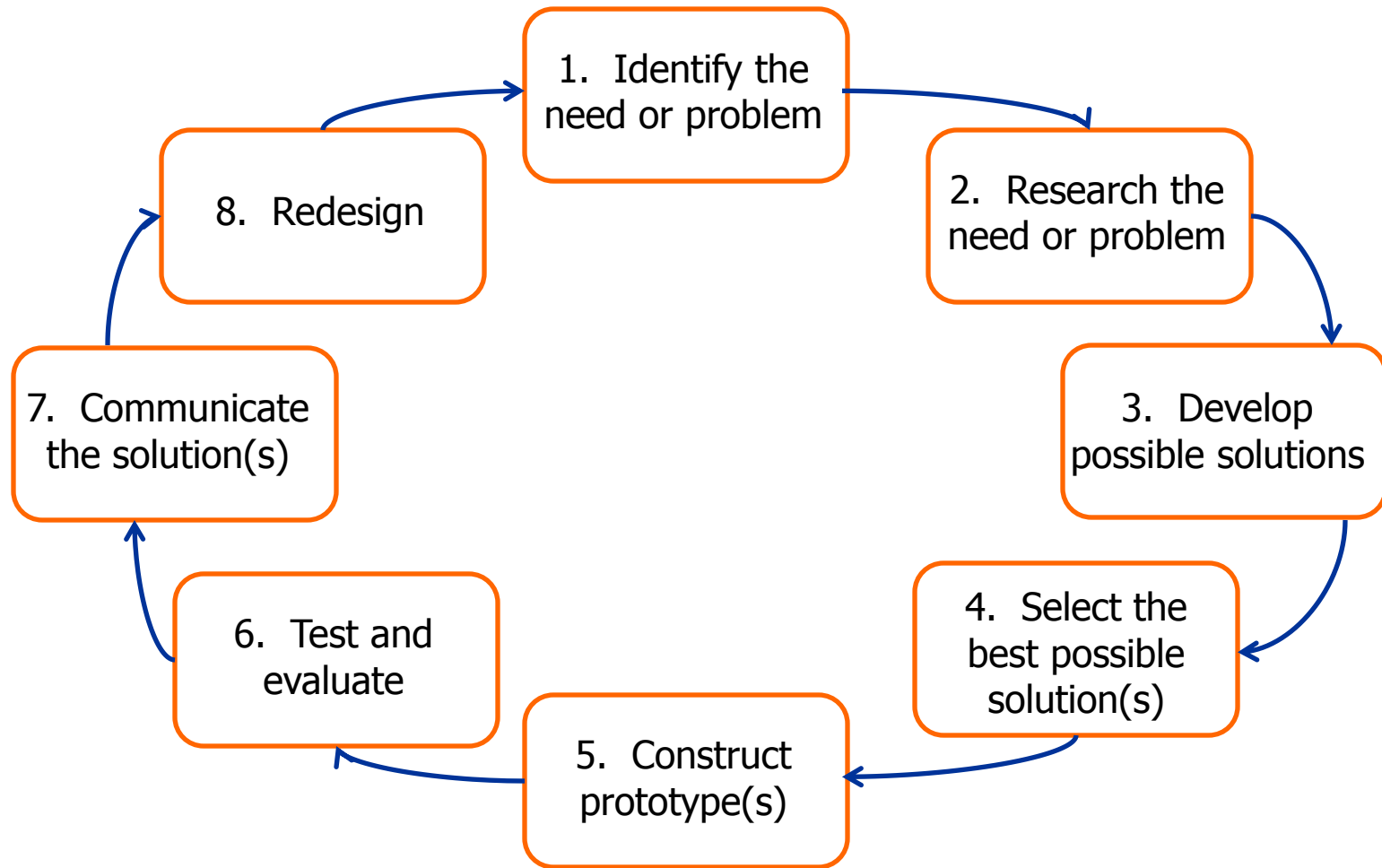
Carol Dweck's Mindset

Achievement Goals and Achievement Behavior

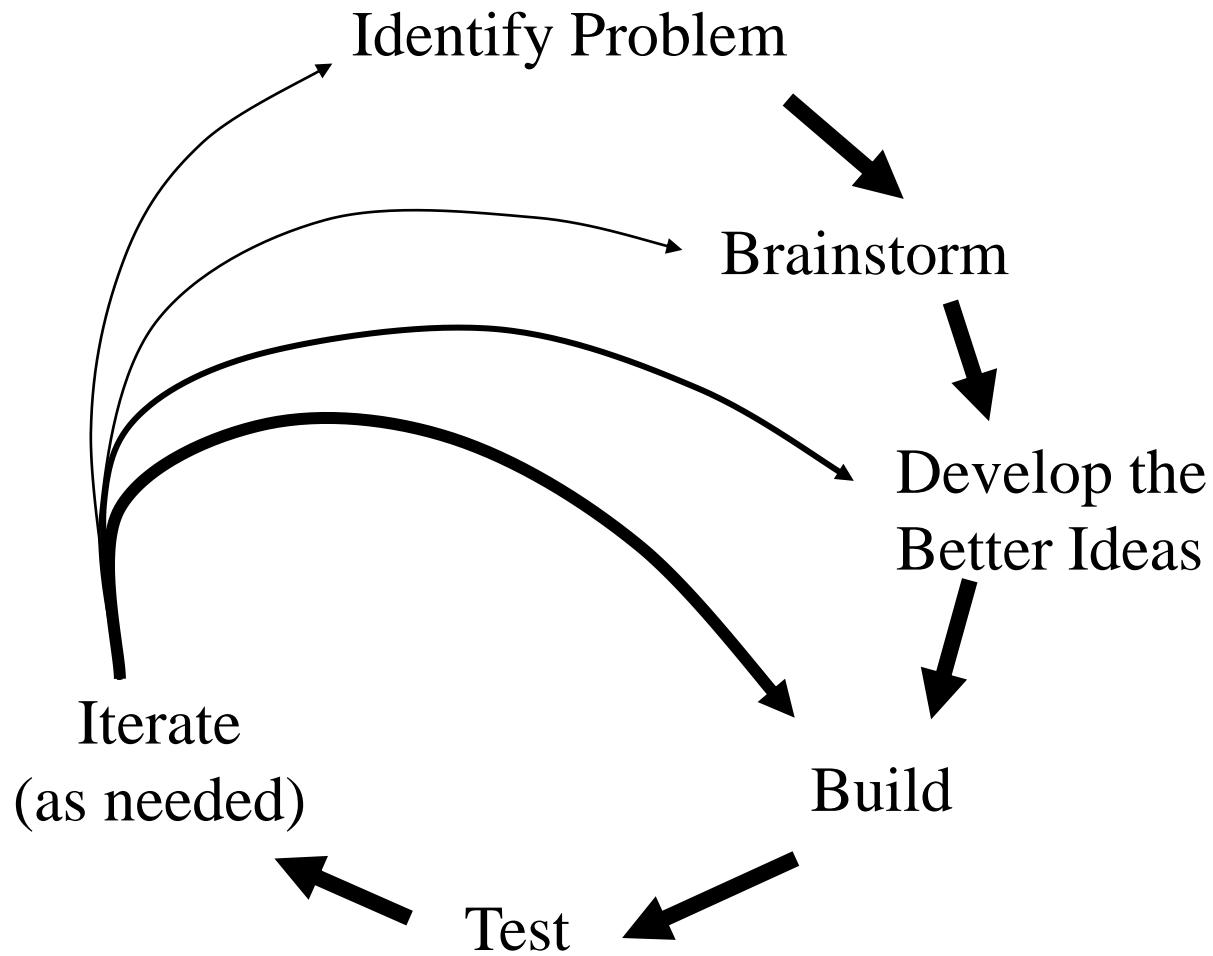
Theory of Intelligence	Goal Orientation	Confidence in Present Ability	Behavior Pattern
Entity Theory (Intelligence is fixed)	Performance (Gain/avoid judgments of competence)	High	Mastery oriented High persistence
		Low	Helpless Low persistence
Incremental Theory (Intelligence is malleable)	Learning/Mastery (Increase competence)	High OR Low	Mastery oriented High persistence

After Dweck, 1986, p. 1041

Engineering Design Process Models

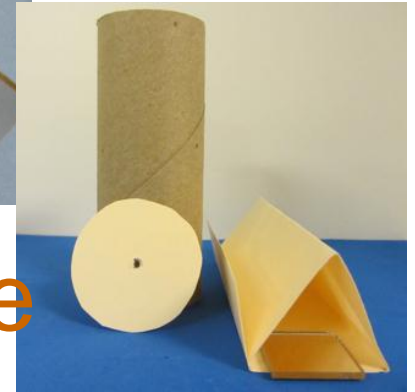
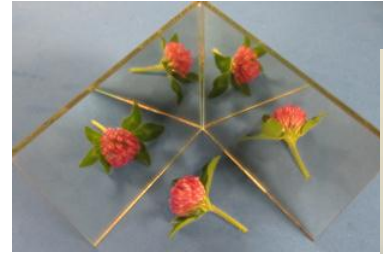
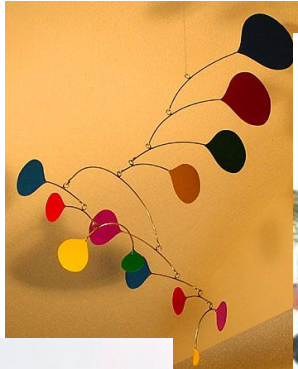


Engineering Design Process Models



Courtesy R. Reid Bailey

STEAM to Success!



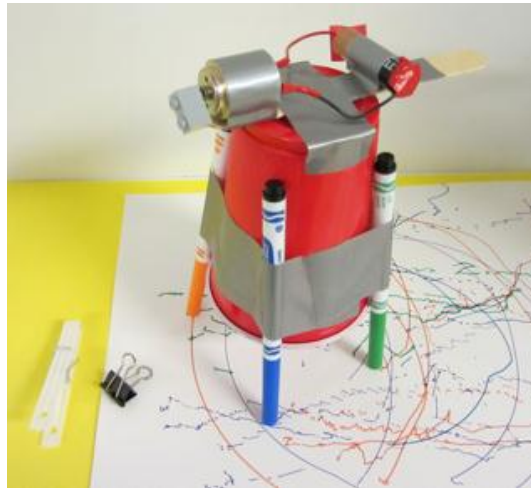
Kaleidoscope

Hoos' EYE ETK



Kinetic Sculpture

Come Sail Away and
Against the Wind ETKs



Scribblebot

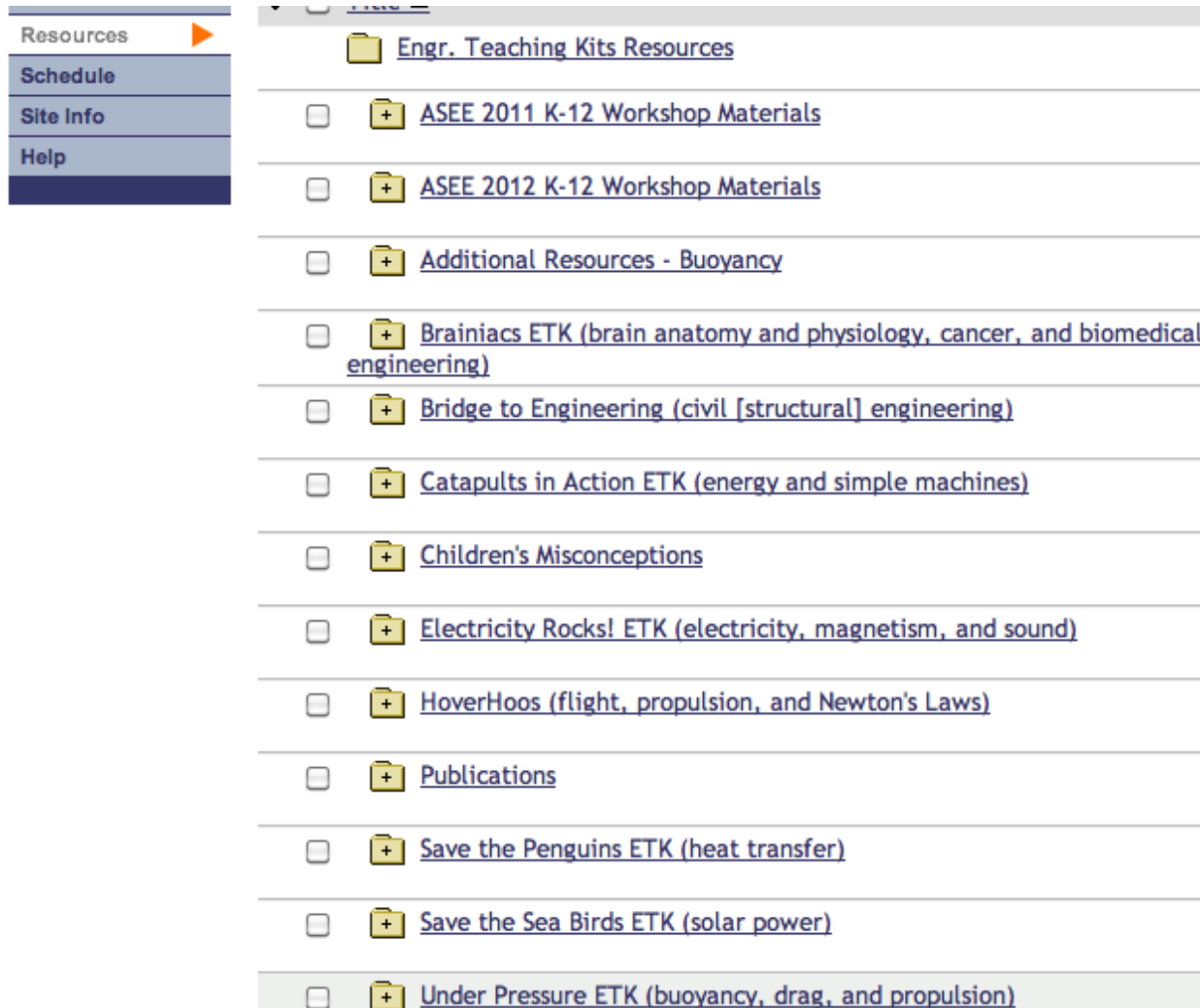
HoverHoos and
Under Pressure ETKs



What Can I Do in My Classroom?

- Encourage **discovery** learning
 - Keep a cache of “found items”
 - Have students brainstorm repurposing them
- Encourage **mastery** learning
 - Create a penalty-free failure zone
 - We learn from what we can’t do as well as what we can do!
- Promote **design-build-test**
- Use both **top-down** and **bottom-up** approaches
- Conduct both **structured** and **unstructured** creativity activities and exercises

Engineering Teaching Kits



The image shows a screenshot of a website. On the left is a vertical navigation menu with the following items: Resources (with an orange arrow), Schedule, Site Info, and Help. To the right is a list of Engineering Teaching Kits (ETKs) under the heading "Engr. Teaching Kits Resources". Each item in the list is preceded by a small folder icon with a plus sign and a checkbox. The list includes:

- [Engr. Teaching Kits Resources](#)
- [+ ASEE 2011 K-12 Workshop Materials](#)
- [+ ASEE 2012 K-12 Workshop Materials](#)
- [+ Additional Resources - Buoyancy](#)
- [+ Brainiacs ETK \(brain anatomy and physiology, cancer, and biomedical engineering\)](#)
- [+ Bridge to Engineering \(civil \[structural\] engineering\)](#)
- [+ Catapults in Action ETK \(energy and simple machines\)](#)
- [+ Children's Misconceptions](#)
- [+ Electricity Rocks! ETK \(electricity, magnetism, and sound\)](#)
- [+ HoverHoos \(flight, propulsion, and Newton's Laws\)](#)
- [+ Publications](#)
- [+ Save the Penguins ETK \(heat transfer\)](#)
- [+ Save the Sea Birds ETK \(solar power\)](#)
- [+ Under Pressure ETK \(buoyancy, drag, and propulsion\)](#)

Questions / Comments?

Thank you!

