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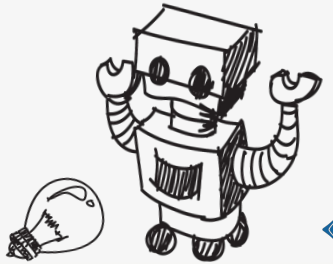
TRY Engineering

Lesson Plan:

Design and Build a Better Candy Bag



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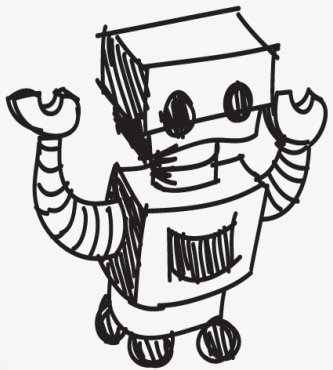
The Design Challenge



The Design Challenge

You are a team of engineers given the challenge of designing and building a sturdy, functional and attractive bag to hold candy. The bag should have a handle(s). You will predict the bag's volume and weight capacity.

Defining the Challenge: Criteria & Constraints

Criteria

- Bag must have a handle(s).
- Give attention to how attractive the design is.

Constraints

- Use only the materials provided.
- Teams may trade unlimited materials.

Material

Materials – Required (Table of Possibilities)

- 8” x 12” pieces of thin, plastic material (we suggest cutting either a plastic painters drop cloth or plastic sheeting)
- Scotch and Masking tape
- Twine
- Crayons/Markers

Testing Materials and Process

Testing Material

- Scale
- Measuring cups
- Candy, blocks, pebbles, rice or another item to use as weight

Testing Process

Test the strength of each team's bag design by having a team member hold the bag by the handle(s) while placing weight into the bag (piece by piece). The object is to force the bag to fail by adding too much weight. Once the

Testing Materials and Process

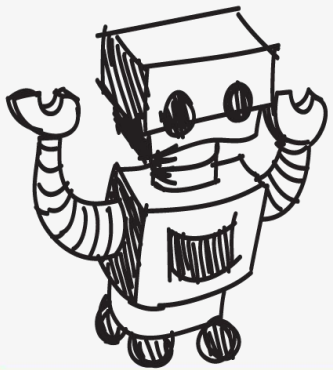
bag fails, weigh the bag and contents. Document the weight each bag was able to hold before falling apart and calculate the bag's volume for comparison between teams. The volume is calculated by measuring the length, width and height of each bag. Then, calculating the volume = length x width x height.

Each team will then redesign and build a second bag, then complete the testing process again. The goal is to have their second bag hold more weight than the first.

Consider...

- Before you get started building, have a discussion about the manufacturing of paper bags and provide several examples of bag designs to share. Ask students to compare the bag designs and guess which might hold the most volume and the most weight.

Reflect & Debrief



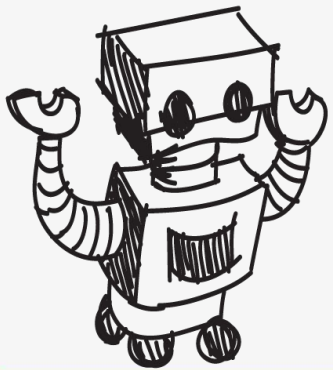
Reflection

- When you tested your prototype, what was the approximate volume of the bag?
- How much weight did your bag hold?
- Did you have to redesign your initial prototype? If so, why? What did you discover because of your redesign? If not, why do you believe your prototype worked so well the first time?
- What is one thing you liked about your design?
- What is one thing you didn't like about your design?

Reflection

- What is one thing you would change about your design based on your experience?
- What technology, science, and mathematics concepts did you use when you designed the prototype?

Engineering Design Process



The Engineering Design Process

Learn about the engineering design process (EDP). The process engineers use to solve problems.

(Video 1:47)

Source: TeachEngineering YouTube Channel http://www.youtube.com/watch?v=b0ISWaNoz-c

Engineering Design Process

- Divide into teams
- Review the challenge and criteria & constraints
- Brainstorm possible solutions (sketch while you brainstorm!)
- Choose best solution and build a prototype
- Test then redesign until solution is optimized
- Reflect as a team and debrief as a class

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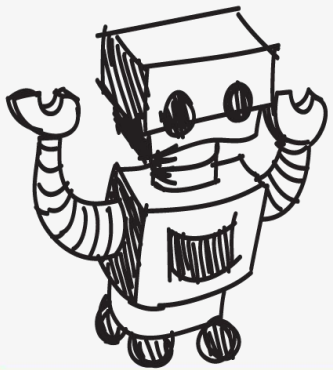
Productive Failure

- The engineering design process involves productive failure: test, fail, redesign. Iterate again and again until you have the best possible solution.
- It is important to document iterations to keep track of each redesign. Use the engineering notebook to sketch ideas, document iterations and any measurement and/or calculations.
- It’s also important to showcase the fact that there can be multiple solutions to the same problem. There’s no one “right” solution.

Vocabulary



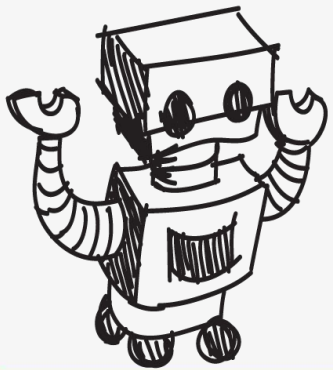
Vocabulary

- Constraints: Limitations with material, time, size of team, etc.
- Criteria: Conditions that the design must satisfy like its overall size, etc.
- Engineers: Inventors and problem-solvers of the world. Twenty-five major specialties are recognized in engineering (see infographic).
- Engineering Design Process: Process engineers use to solve problems.
- Engineering Habits of Mind (EHM): Six unique ways that engineers think.
- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).
- Prototype: A working model of the solution to be tested.

Vocabulary

- Volume: the amount of space the object takes up. In other words, volume is a measure of the size of an object, just like height and width are ways to describe size.
- Weight capacity: Amount of weight a container can hold.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Project Lead the Way (www.pltw.org)
- ITEA Standards for Technological Literacy: Content for the Study of Technology (www.iteaconnect.org/TAA)
- National Science Education Standards (www.nsta.org/publications/nses.aspx)
- National Council of Teachers of Mathematics' Principles and Standards for School Mathematics (www.nctm.org/standards)

Dig Deeper into the Topic

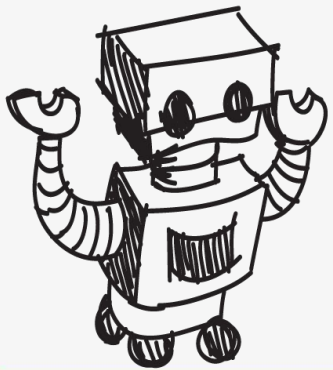
Recommended Reading

- Margaret Knight: Girl Inventor, by Marlene Targ Brill (Millbrook Press, ISBN: 0761317562)
- Packaging Prototypes: Design Fundamentals, by Edward Denison and Richard Cawthray (Rotovision, ISBN: 2880463890)
- 50 Trade Secrets of Great Design: Packaging, by Stafford Cliff (Rockport Publishers, ISBN: 1564968723)

Writing Activity

Write an essay (or paragraph) explaining how a cardboard milk carton has been designed to be strong enough to hold its liquid contents.

Engineering Fields



What is Engineering?

Learn about engineering and how engineers are creative problem solvers and innovators who work to make the world a better place.
(Video 3:43)

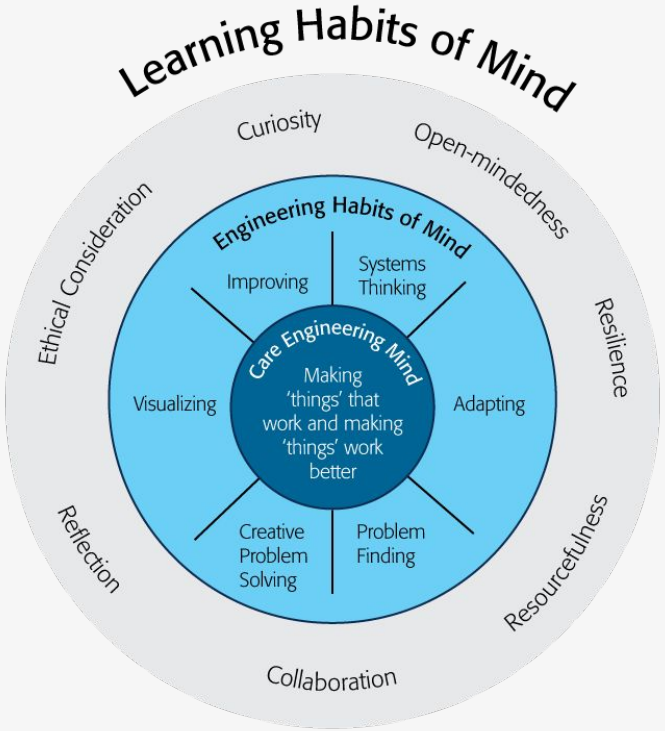
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- There are several types of engineering fields that are involved with materials. Here are just some of the related engineering fields.
  - Materials Engineering

- Download the Engineering Fields Infographic How will **YOU** change the world?

Engineering Habits of Mind



Engineering Habits of Mind (EHM) is about how engineers think everyday. The Core Engineering Mind is about making things that work and making them work better.

Source: https://online-journals.org/index.php/i-jep/article/view/5366)

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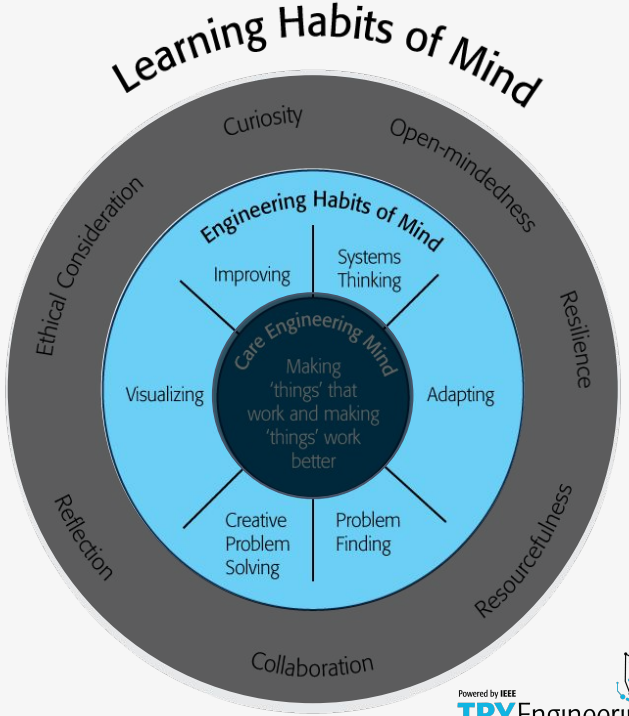
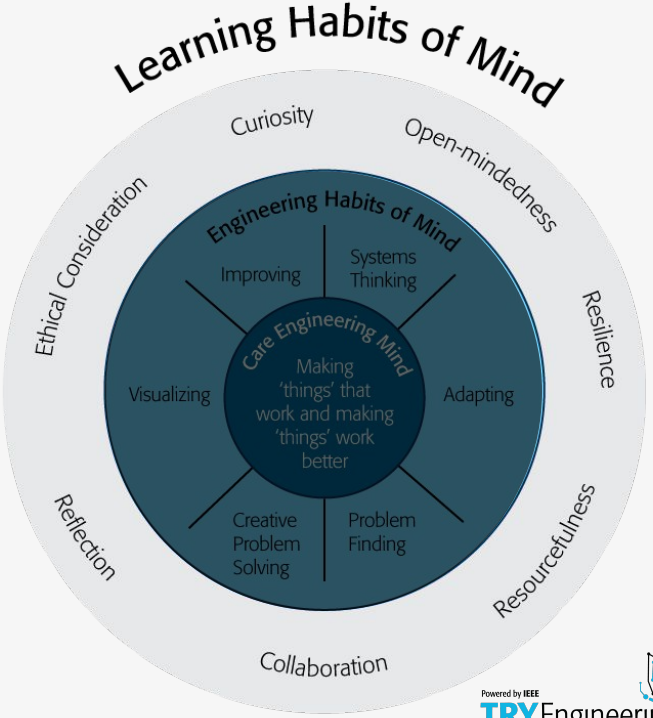
Engineering Habits of Mind Checklist

- ❑ **Systems thinking**
- ❑ **Problem-finding**
- ❑ **Visualising**
- ❑ **Improving**
- ❑ **Creative problem-solving**
- ❑ **Adapting**



Learning Habits of Mind Checklist

- Open-mindedness
- Resilience
- Resourcefulness
- Collaboration
- Reflection
- Ethical Consideration
- Curiosity

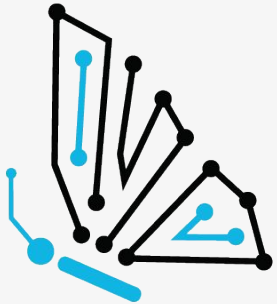


Greatest Engineering Achievements of the 20th Century

Source: http://www.greatachievements.org/

Learn more about how engineers make the world a better place

For more engineering lesson plans and resources like games, engineering careers, and STEM opportunities visit IEEE's TryEngineering.org



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