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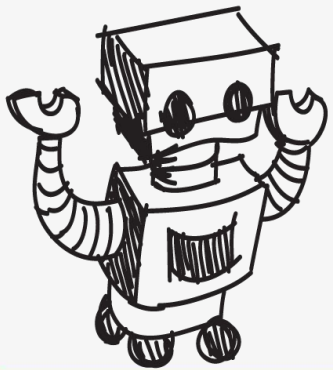
TRY Engineering

Lesson Plan:

Life Vest Challenge

IEEE

The Design Challenge



The Design Challenge

You are part of a team of engineers given the challenge of developing a personal flotation device (PFD) or life vest out of everyday materials that can provide enough support to float an unopened can of soup or vegetables for at least one minute.

Defining the Challenge: Criteria & Constraints

Criteria

- Device must be one attached piece
- Device is able to be attached to a can or the can placed on/in it within a 20 second period
- Some part of the can itself must be touching the water and get wet

Constraints

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

Material

Materials – Required (Table of Possibilities)

- Soup or vegetable cans (must be identical for each team)
- Paper cups
- Straws
- Paper towels
- Rubber bands
- Paper clips
- Balloons
- Plastic bags or lunch bags

Material

Materials – Required (Table of Possibilities)

- Corks
- Foam pieces
- String
- Aluminum foil
- Hose or tubes
- Small containers
- Paper towels

Testing Materials and Process

Testing Material

- Water source
- Bucket or sink area

Testing Process

Test each team's flotation device by placing it in a tub or sink with water. The can must be attached to or placed on/in the device in no more than 20 seconds. Score the team's results based on the following and compare each team's total scores.

Testing Materials and Process

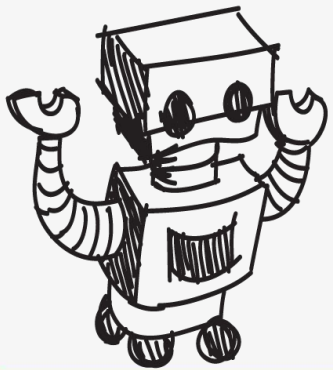
Testing Process, continued

- PFD attached to can within 20 seconds?
  - Yes - 30 points
  - No - 0 points
- Float time:
  - 1 minute: 70 points
  - 45 seconds: 45 points
  - 30 seconds: 30 points
  - 15 seconds: 15 points
  - Never floats: 0 points

Consider...

- Before you get started building, consider whether you have ever worn a life vest and if you have heard of anyone whose life was saved by using one.

Reflect & Debrief



Reflection

- Were you able to design a PFD for the can that you could put on the can in 45 seconds? Was this part of the challenge harder than you thought? Why or why not?
- Did you redesign your PFD after presenting your drawing to the class? Why or why not?
- How similar was your final drawing to the actual PFD your team built to support the can?
- If your team found it needed to make changes during the construction phase, describe why the group decided to make revisions.

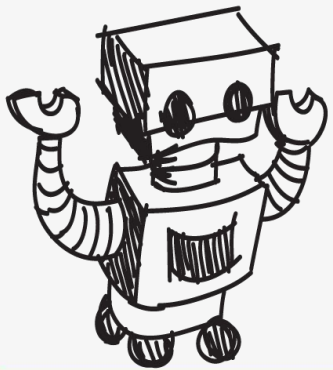
Reflection

- Which PFD in your class worked best? What was it about that design that made it superior?
- Do you think that this activity was more rewarding to do as a team, or would you have preferred to work alone on it? Why?
- If you could have used one additional material (tape, glue, wood sticks, foil -- as examples) which would you choose and why?
- Do you think your design is scalable? Would it work efficiently if it had to float a brick or a bicycle? Why or why not?

Reflection

- If your design were scaled up to a real pipeline, do you think you would need pumps to keep the materials flowing through your system? Why or why not? And, if so, how many pumps would you add, and where would you put them?
- Do you think your pipeline design would work if you used it to transport water? Feathers? Butter? Why or why not?
- Did you find that there were many ways to solve this challenge? If so, what does that tell you about the engineering designs of real pipelines?

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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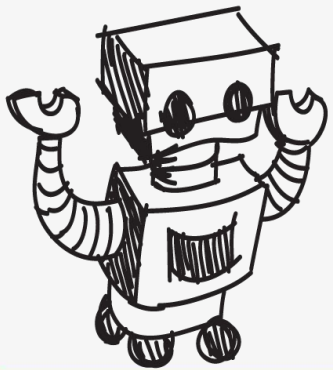
Productive Failure

- 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



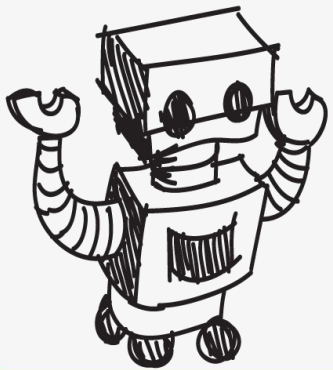
Vocabulary

- Buoyant: Able to rise and float on top of a liquid
- 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.
- Float: To rest on the surface of a liquid
- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).

Vocabulary

- PFD: Personal flotation device (i.e. life jacket) is a device designed to help keep a person or animal afloat - whether they are conscious or not
- Prototype: A working model of the solution to be tested.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Personal Flotation Device Manufacturers Association (www.pfdma.org)
- BoatUS Foundation Life Jacket Design Competition (https://www.boatus.org/design/)

Recommended Reading

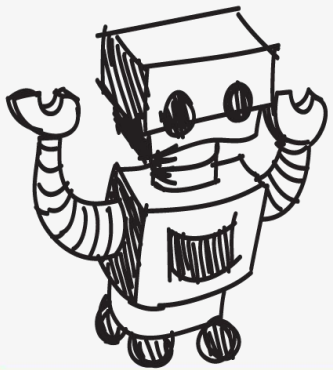
- What Floats? What Sinks?: A Look at Density (ISBN: 978-0761360551)
- Experiments with Water: Water and Buoyancy (ISBN: 978-1432923204)

Dig Deeper into the Topic

Writing Activity

Write an essay or a paragraph describing how life vests have changed over the past 50 years as new technologies and materials have become available.

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)

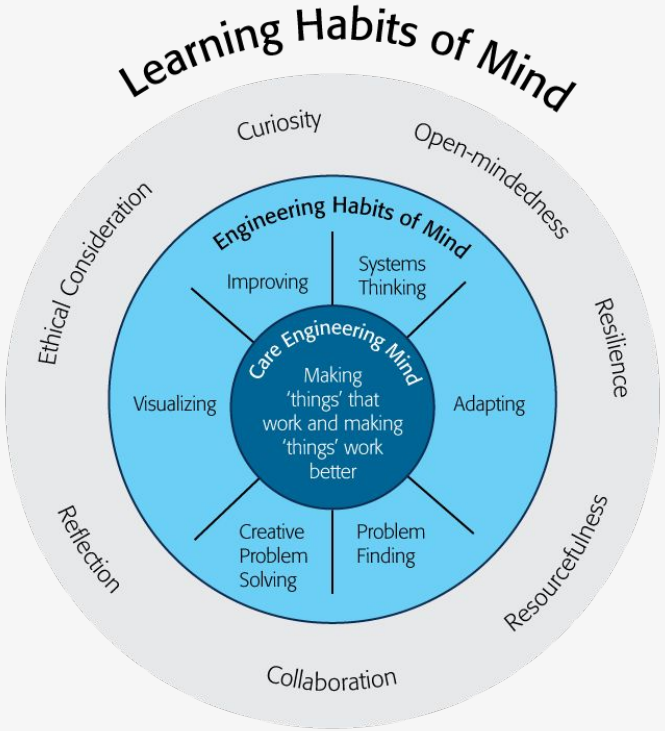
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- There are several types of engineering fields that are involved with the design of flotation devices. 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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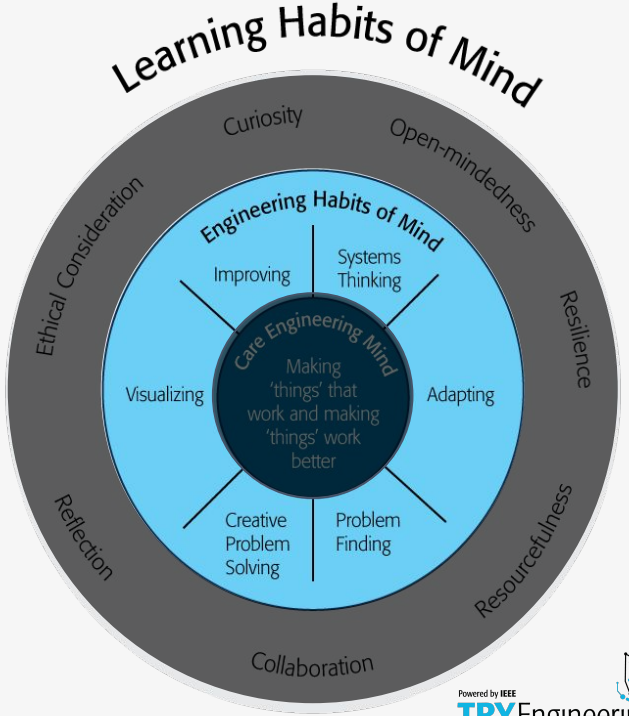
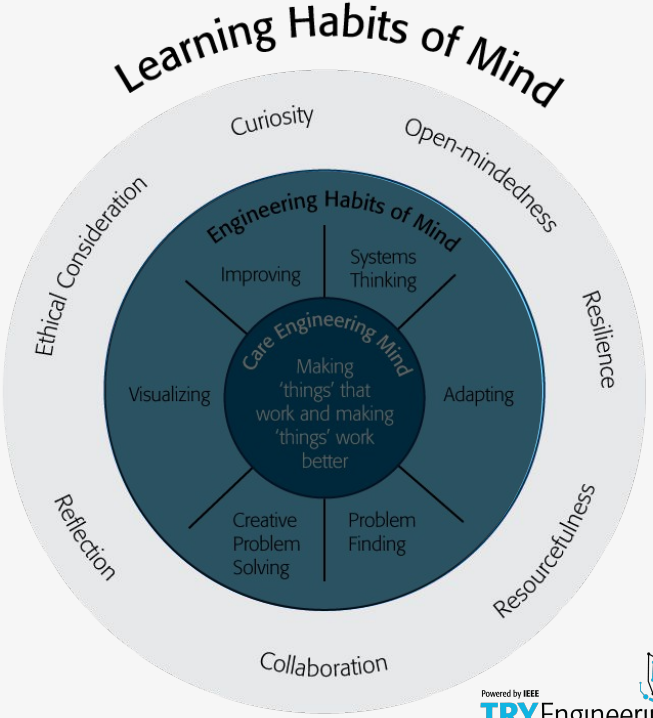
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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

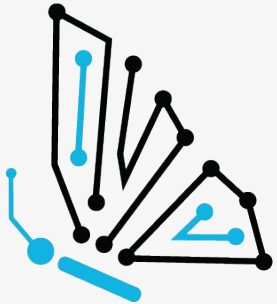


Greatest Engineering Achievements of the 20th Century

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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