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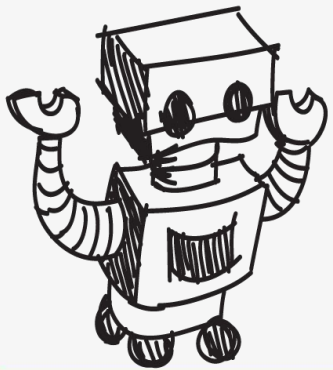
TRY Engineering

Lesson Plan:

Me and My Shadow

The Design Challenge



The Design Challenge

Activity 1 - Shadow Walk

- You are a team of engineers learning how to compare shadows. You will learn why shadows are bigger or smaller and why they can be different shapes.

Activity 2 - Design and Build a Structure

- You are a team of engineers working together to design and build a structure to keep a groundhog from seeing its shadow. Your structure needs to have a door so the groundhog can enter for shelter.

Defining the Challenge: Criteria & Constraints

Design and Build a Structure

Criteria

- Structure needs to have a door

Constraints

- Use only the materials provided.

Material

Required

Activity 1 - Shadow Walk Materials

- Clipboard
- Piece of paper labeled “shadows”
- Crayons

Activity 2 – Build a Structure Materials

- Stuffed or plastic toy animal (2-3 inches in size)

Material

Optional for Structure Build – Table of possibilities

- Plastic wrap
- Cotton balls
- Craft Sticks
- Rubber bands
- Straws
- Paperclips
- Paper towel rolls (not paper towels)

Material

- Balloons
- Crayons
- Pipe cleaners
- Clear Tape
- Ruler

Testing Materials and Process

Testing Material for Structure Build

- Flashlight

Testing Process for Structure Build

Shut off all the lights, have the students put the groundhog in their structure and test the opacity of the structure using a flashlight.

Consider...

- Before you get started building, consider finding some interesting shadows that are close to each other. Have students compare shadows, consider which ones are bigger, or different shapes, and why. Ask students to see whether all shadows are the same size as its object.

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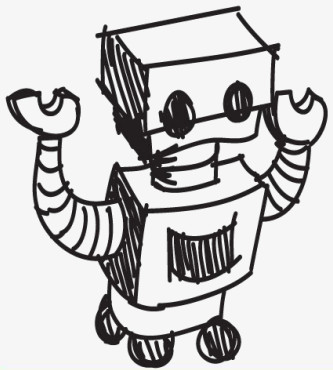
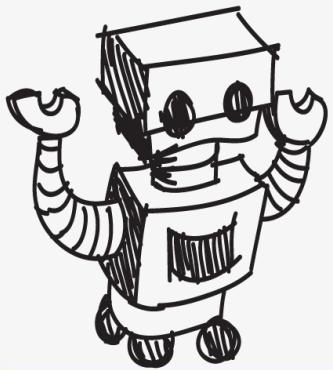
Reflect & Debrief



Reflection

- What materials did your group use? Why?
- After testing your structure, would you have changed the original design?
- How? What could have been improved?
- Which designs of other teams inspired you? Why?

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.

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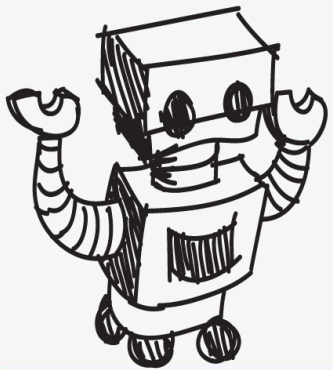
Vocabulary



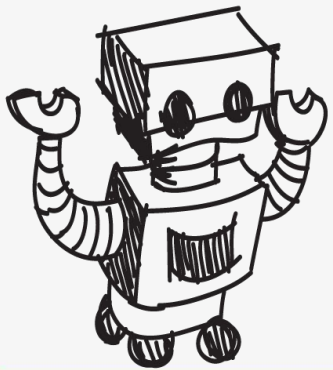
Vocabulary

- 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).
- Opaque: A material that does not allow light to pass through it
- Prototype: A working model of the solution to be tested.

Vocabulary

- Shade: Darkness and coolness caused by shelter
- Shadow: A dark shape made when an object comes between light and surface
- Solar Power: Energy that comes from the sun
- Sun: A ball of gas that gives us heat and light

Dig Deeper

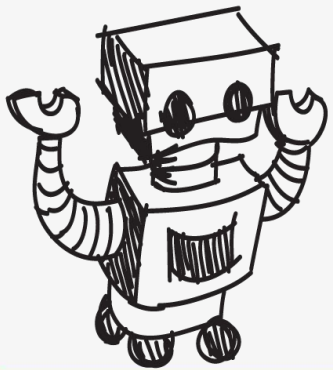


Dig Deeper into the Topic

Recommended Reading

- “Groundhog's Runaway Shadow,” by David Biedrzycki (ISBN-13: 978-1580897341)
- “What Makes a Shadow?,” by Clyde Robert Bulla (ISBN-13: 978-0060229160)

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)

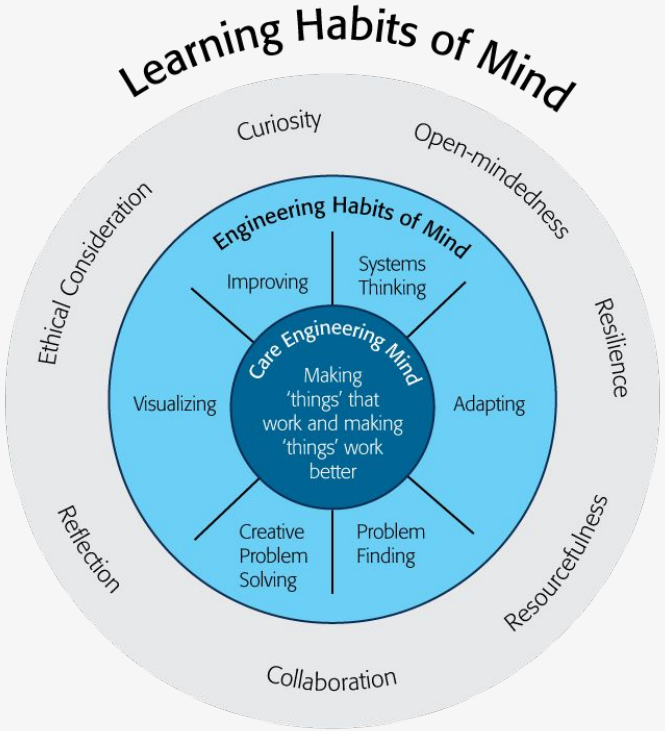
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- There are several types of engineering fields that are involved with the engineering and design of structures. Here are just some of the related engineering fields.
  - Civil Engineering
  - Mechanical Engineering
  - Electrical Engineering
  - Environmental 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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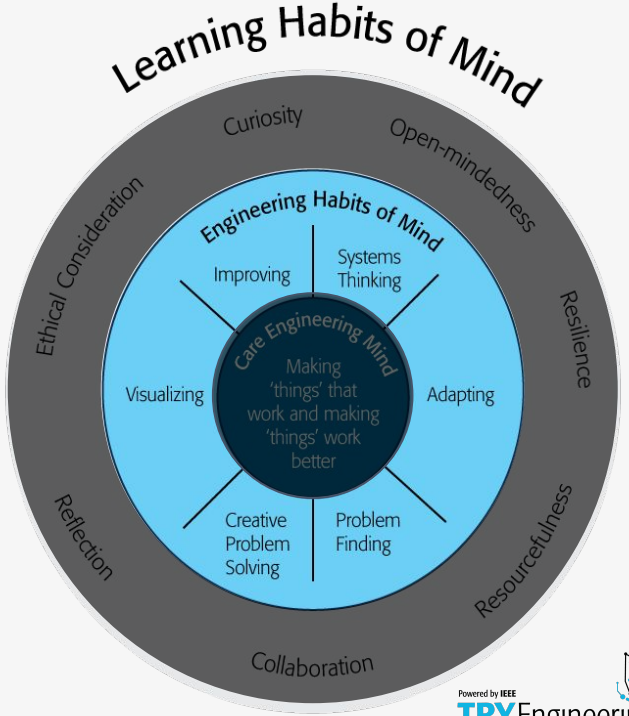
Engineering Habits of Mind Checklist

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



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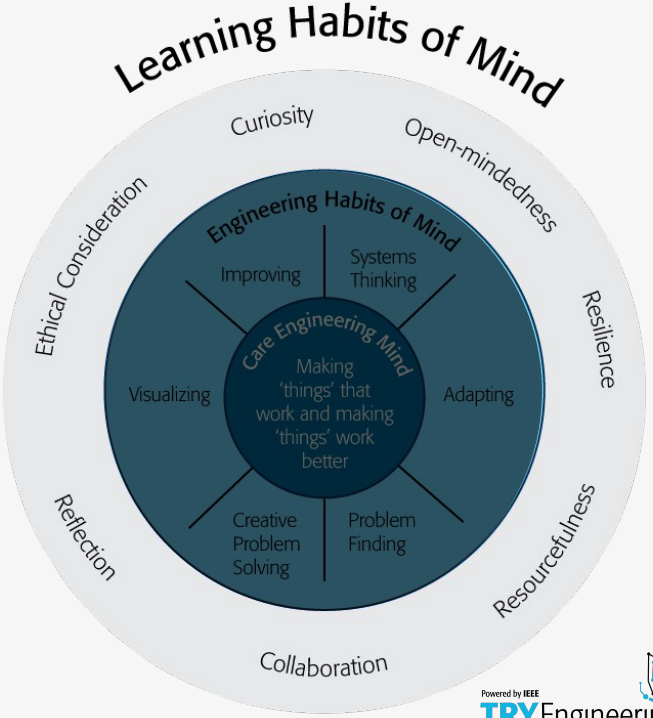
Learning Habits of Mind Checklist

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



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Greatest Engineering Achievements of the 20th Century

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

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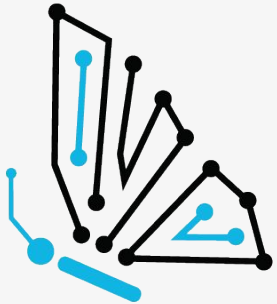
Learn more about how engineers make the world a better place

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



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