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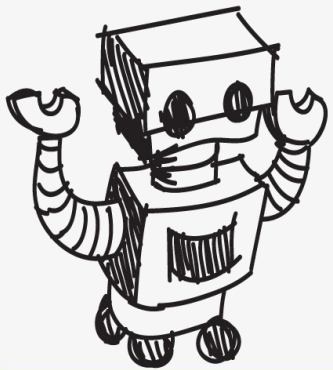
TRY Engineering

Lesson Plan:

Downhill Skier

The Design Challenge



The Design Challenge

- You are a team of engineers working together to design and build a downhill skier out of everyday materials. Your goal is to have your skier reach the bottom of the ski ramp in the fastest time.

Defining the Challenge: Criteria & Constraints

Criteria

- Not allowed to push the skier down the ski ramp

Constraints

- Use only the materials provided.

Material

Required for Build – per team

- Video*: https://www.youtube.com/watch?v=BAV3DEfB7cM
- 4 Craft sticks
- 4 Plastic/Paper straws
- 2 Sheets Plastic wrap (8x12 inches)
- 4 Pipe cleaners
- Scotch tape
- 2 Sheets Aluminum foil (8x12 inches)

**Video Source: NBC News Learn YouTube Channel*

Testing Material Process

Testing Material

- 2 Ski Ramps (smooth wood or plastic boards about 5 x 40 inches)
- Stopwatch or timer

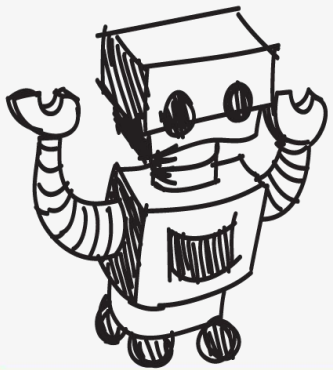
Testing Process

Test the skiers by launching them down the ski ramp and timing how long they can get from the top to the bottom. Mark the start and finish points with tape.

Consider...

- Before you get started building, consider showing the NBC News Learn's Downhill Science of Alpine Skiing Video https://www.youtube.com/watch?v=BAV3DEfB7cM so students can learn about the forces that impact skiing and then lead a discussion about what the students learned from the video.

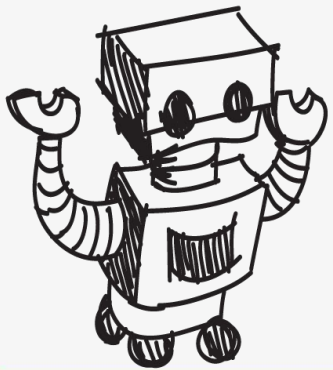
Reflect & Debrief



Reflection

- What worked best about your design?
- What could you have improved?
- What did you learn from other team's designs?
- How did you work as a team?

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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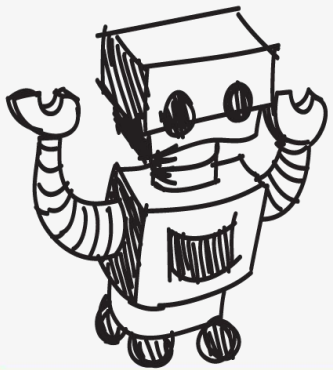
Productive Failure

- 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



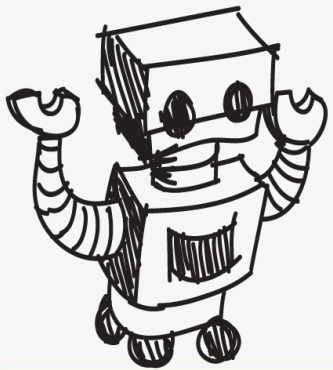
Vocabulary

- Acceleration: Increasing the rate or speed of something
- 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.
- Force: A push or pull acting on an object
- Friction: Resistance of one object when moving against another

Vocabulary

- Gravity: The force that pulls an object toward the center of the earth
- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).
- Prototype: A working model of the solution to be tested.
- Wind Resistance: A force an object will need to overcome to move through the air

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- NBC News Downhill Science: Alpine Skiing (http://nbclearn.com/portal/site/learn/cuecard/47275)

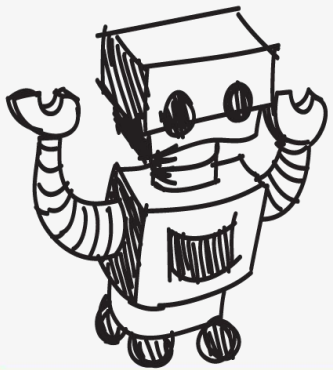
Recommended Reading

- Downhill Skiing by Cynthia Amoroso (ISBN-13: 978-1567664560)

Writing Activity

Students can write a paragraph about the safety equipment skiers use.

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 ski ramps. Here are just some of the related engineering fields.
  - Civil engineering
  - Mechanical Engineering
  - Electrical Engineering

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

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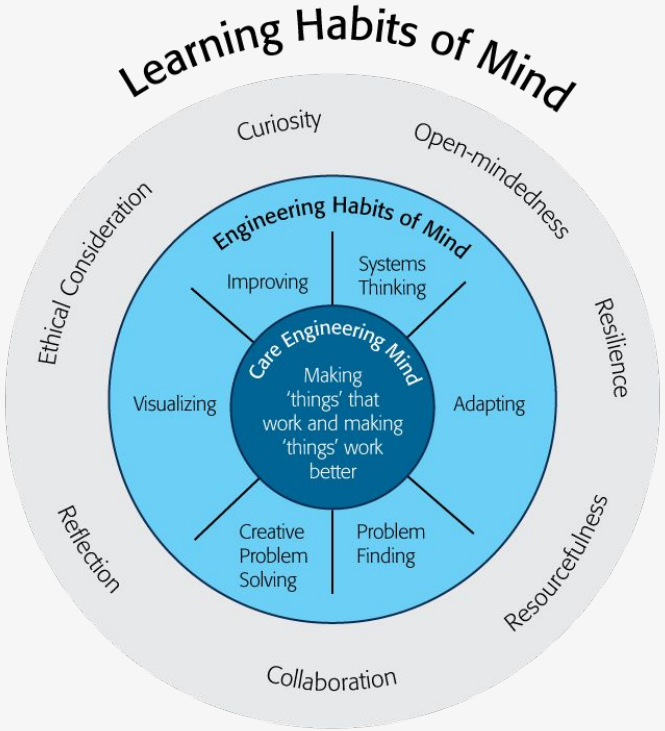
Engineering Habits of Mind



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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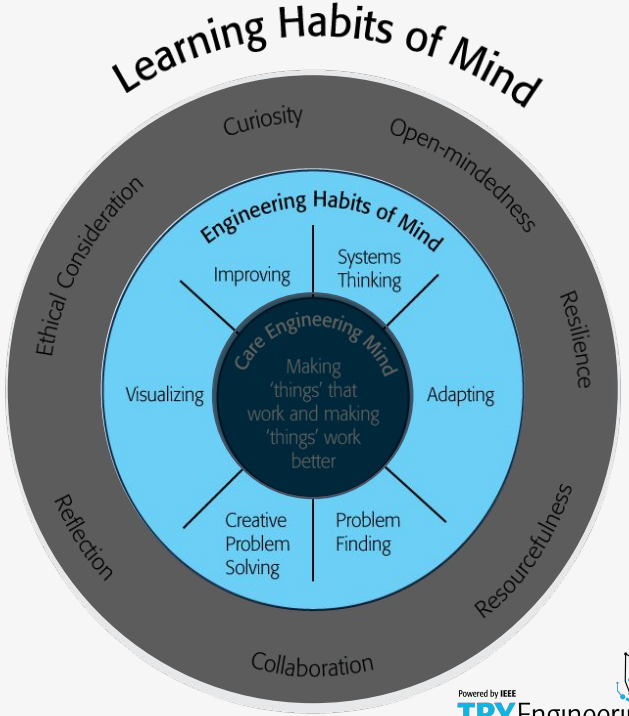
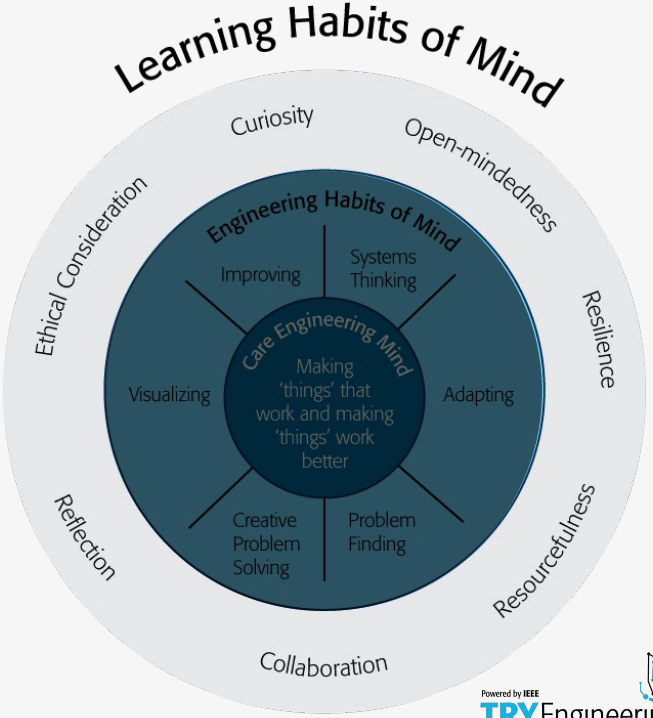
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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

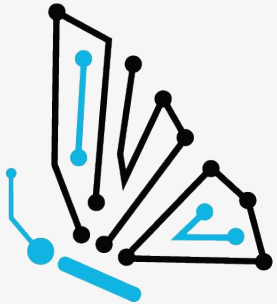


Greatest Engineering Achievements of the 20th Century

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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