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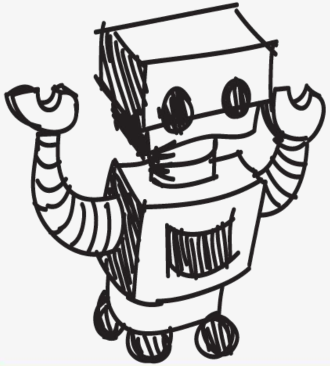
TRY Engineering

Lesson Plan:

Solving a Simple Maze

IEEE

The Design Challenge



The Design Challenge

You are a team of engineers given the challenge of selecting materials and building a maze. The maze design will be provided. The finished maze should be no more than 30cm square and 2 inches tall. It should contain 16 cells and have a start (source) and finish (destination).

Defining the Challenge: Criteria & Constraints

Criteria

- Contains 16 cells
- Copied from the design provided
- Has a source (start) at the bottom left of the maze and a destination (finish) at the top right of the maze

Constraints

- No more than 30 cm square and 2 inches tall
- Use only the materials provided
- Teams may trade unlimited materials

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Material

Materials – Required (enough materials for each team to build a 12 inch square by 2 inch high maze)

For base:

- Cardstock
- Cardboard

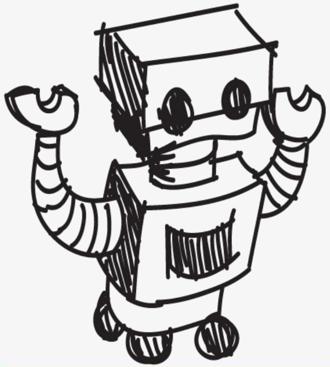
For walls:

- Foam sheets
- Corrugated cardboard
- Styrofoam
- Cardstock

Consider…

- Before you get started building, consider the steps it will take for a robot to complete the maze and document how those steps are numbered. They should also determine a start and end to the maze.

Reflect & Debrief



Reflection

- Did you succeed in building the maze based on the figure given to you? If not, why?
- Did you succeed in arriving at the solution for the maze? In other words, were you able to give the robot proper ‘instructions’ such that it could reach the destination? If not, why?
- Did you negotiate any material trades with other teams? How did that process work for you?
- Once you started building the maze, did you decide to change materials or add more materials?

Reflection

- Do you think that engineers have to stick to their original plan during the building stage? Why?
- Do you think that the “building” stage helped you visualize the problem very clearly? If yes, how did it help you in solving the problem?
- If you were working alone, would you have been able to complete the project easier? Explain.
- Based on this activity, what do you think of algorithm development? Explain.

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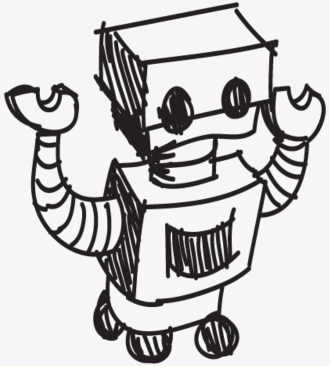
Engineering Design Process



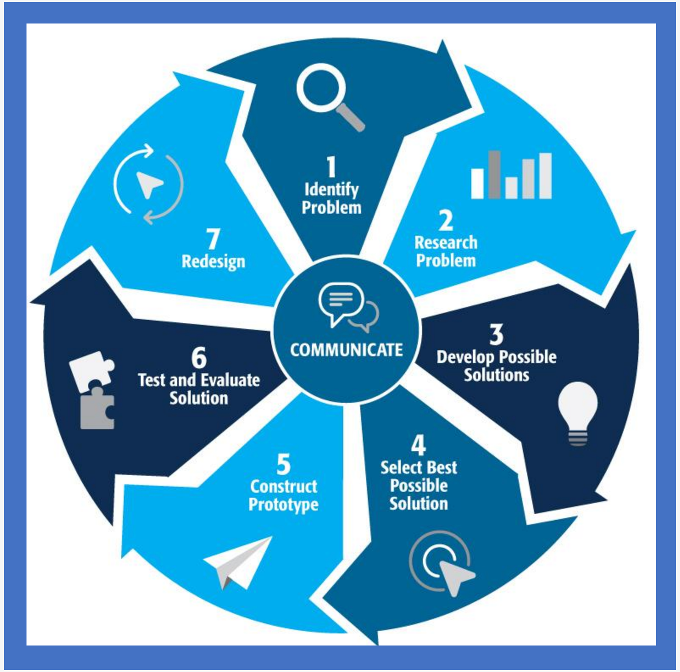
The Engineering Design Process

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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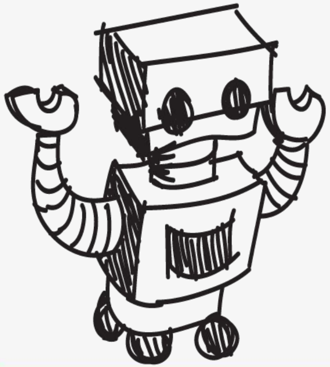
Productive Failure

- 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



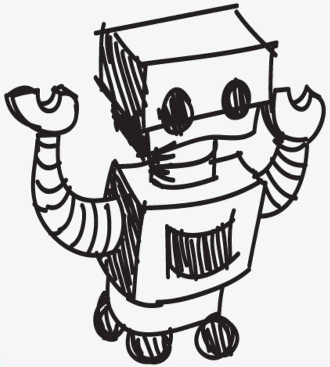
Vocabulary

- Algorithm: A set of guidelines that describes how to perform a task. Think of an algorithm as step-by-step instructions that create a predictable pattern in a set of numbers or in lines of code.
- Artificial Intelligence: The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.
- 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).

Vocabulary

- 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).
- Maze: A path or collection of paths, typically from an entrance to a goal.
- Prototype: A working model of the solution to be tested.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- http://www.youtube.com/watch?v=xrF4v28AOlc
- http://www.youtube.com/watch?v=H5F1nfFgBdI

Recommended Reading

- http://en.wikipedia.org/wiki/Maze_solving_algorithm
- http://www.astrolog.org/labyrnth/algrithm.htm#solve

Dig Deeper into the Topic

Writing Activity

Read the Wikipedia page on maze solving algorithms and the Astrolog page on types of mazes and write a summary of the different approaches. Pick one of the approaches and list its strengths in terms of criteria such as complexity (simple is better) and speed (faster is better).

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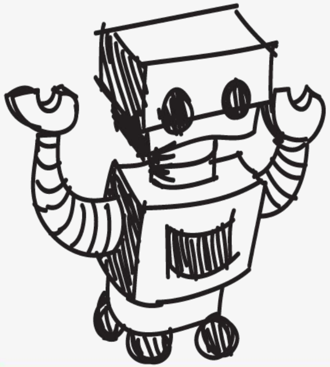
Engineering Fields



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=H9VDkvgGmVo

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Related Engineering Fields

- There are several types of engineering fields that are involved with complex designs. Here are just some of the related engineering fields.
    - Mechanical Engineering
    - Environmental Engineering
    - Materials Engineering
    - Civil Engineering

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

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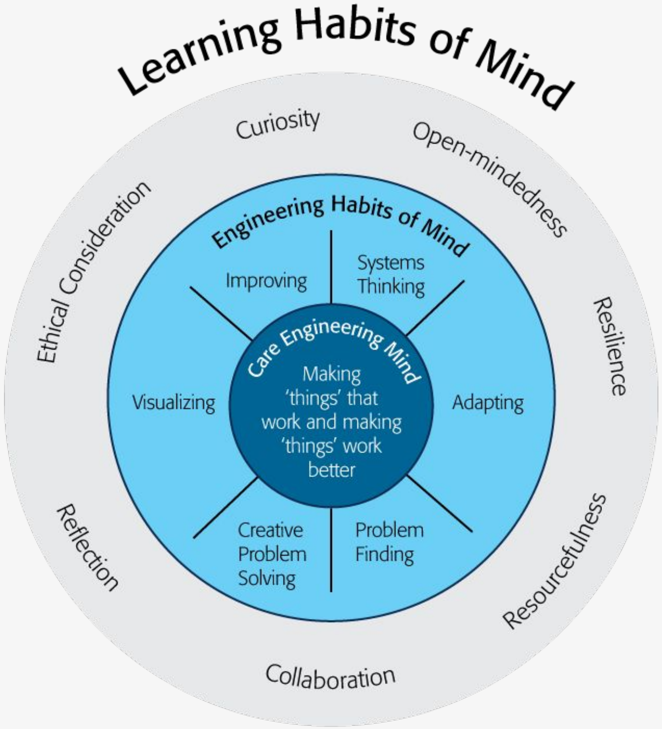
Engineering Habits of Mind

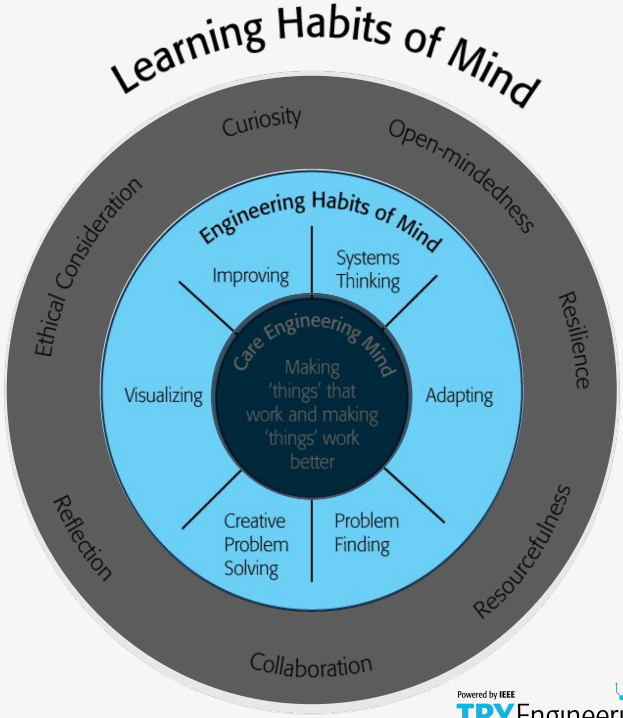


Engineering Habits of Mind (EHM) is about how engineers think everyday. The Core Engineering Mind is about making things that work and making them work better.

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

Engineering Habits of Mind Checklist

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



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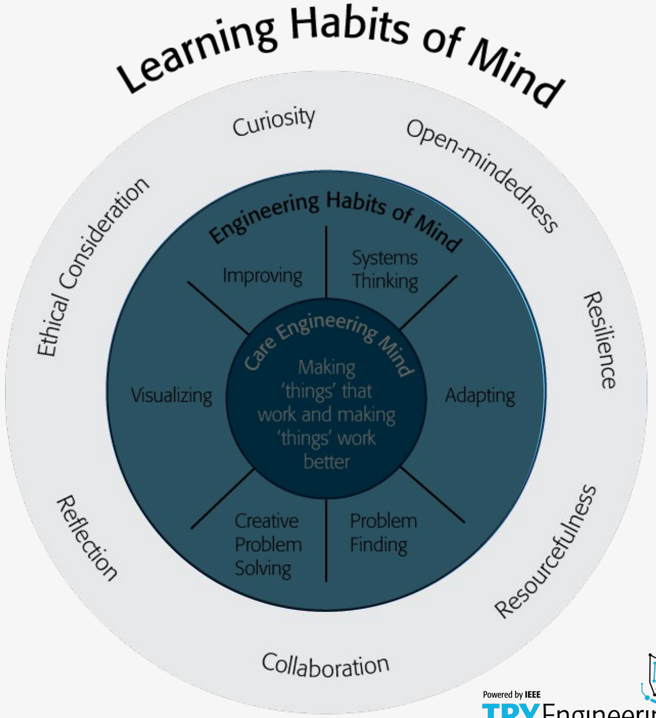
Learning Habits of Mind Checklist

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



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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