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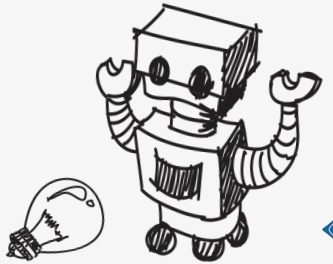
TRY Engineering

Lesson Plan:

Tinkering with Tops



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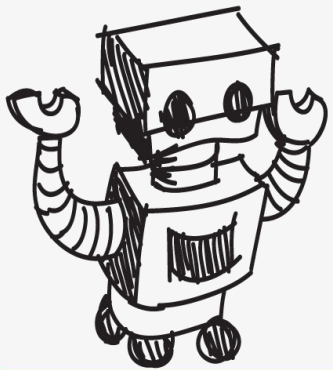
The Design Challenge



The Design Challenge

You are a team of engineers working together to design and build a spinning top out of everyday materials. The top must be designed to spin for at least 10 seconds within a circle 30 cm in diameter.

Defining the Challenge: Criteria & Constraints

Criteria

- Top designed to spin for at least 10 seconds within a circle 30 cm in diameter.

Constraints

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

Material

Materials – Trading/Table of Possibilities

- Sharpened pencils
- Pens
- Toothpicks
- CDs/DVDs
- Coffee stirrers
- Marbles
- Paper plates

Material

Materials – Trading/Table of Possibilities

- Plastic lids
- Pennies
- Metal washers
- String
- Clay

Testing Materials and Process

Testing Material

- Stopwatch or timer
- Ruler/Tape Measure

Testing Process

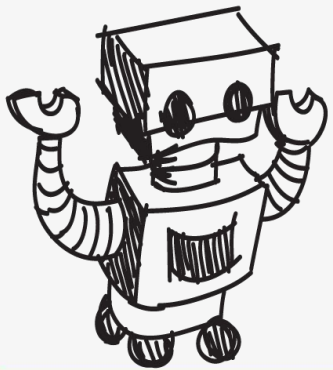
Teams test their designs by having each team spin their top within the circle and time how long their top can spin within the circle before stopping. Each team should test their top 4 times and document the amount of time their top could spin for each test. Teams should calculate the average amount of time their top could spin across all 4 tests.

Consider...

Before you get started building, consider

- Experimenting with different quantities of weights and the placement of those weights.
- How the distance between the body of the top and the point affects the design.

Reflect & Debrief



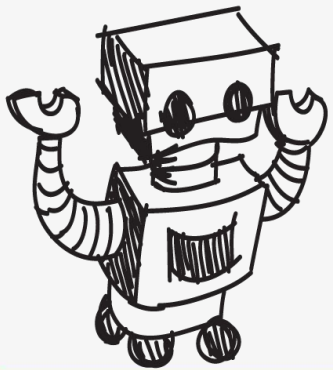
Reflection

- Did you succeed in creating a top that spun for at least 10 seconds within the 30 cm circle? If so, what was the maximum time it spun? If not, why did it fail?
- Did you decide to revise your original design or request additional materials while in the construction phase? Why?
- Did you negotiate any material trades with other teams? How did that process work for you?
- If you could have had access to materials that were different than those provided, what would your team have requested? Why?

Reflection

- Do you think that engineers have to adapt their original plans during the construction of systems or products? Why might they?
- If you had to do it all over again, how would your planned design change? Why?
- What designs or methods did you see other teams try that you thought worked well?
- Do you think you would have been able to complete this project easier if you were working alone? Explain…

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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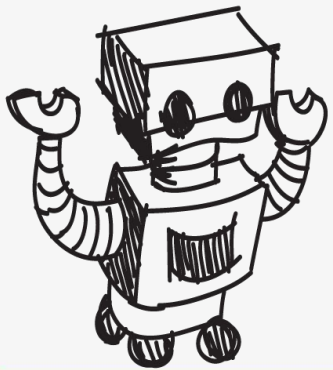
Productive Failure

- 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

- 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.
- Gyroscope: A device that can be used to tell when a moving object has changed direction. It is made up of a spinning wheel or disc, as well as (in some cases) many other moving parts.
- Gyroscope Effect: Ability (tendency) of a rotating body to maintain a steady direction of its axis of rotation.

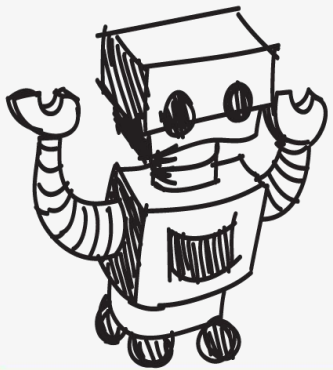
Vocabulary

- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).
- Prototype: A working model of the solution to be tested.
- Pump top: Has a crown that is pushed down or pumped several times to create the spin.
- Supported top: Is spun with a string while the top is held upright by a support.
- Throwing top: Has a string wrapped around its body which is attached to a stick. When the top is thrown causing the string to be rapidly released from its body, the top spins.

Vocabulary

- Top: A top is a toy made up of four basic elements, the tip or point, the shoulder, the crown and the body. The top spins on its tip or point.
- Twirling Top: Is spun by manually twisting the crown. A dreidel is a common example of a twirling top.
- Whip top: Is set into motion and kept spinning by whipping it with a whip.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Wikipedia Gyroscopic Effect (https://en.wikipedia.org/wiki/Gyroscope)
- Spinning Top & Yo-Yo Museum (http://www.topmuseum.org/)

Recommended Reading

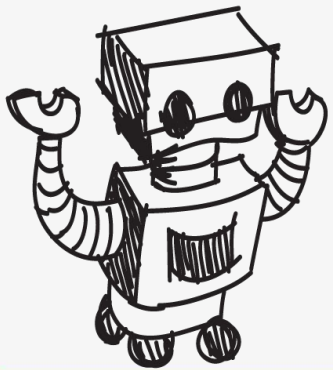
- Tops: Making the Universal Toy (ISBN: 978-1933502175)
- The Top-Universal Toy, Enduring Pastime (ISBN: 978-0517504161)
- The Little Book of Tops: Tricks, Lore, and More/Book and Top (ISBN 978-1561383108)

Dig Deeper into the Topic

Writing Activity

Write a paragraph or essay describing how engineering is applied in the toy industry.

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 gyroscopes. Here are just some of the related engineering fields.
  - Mechanical Engineering
  - Materials Engineering
  - Electrical Engineering

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

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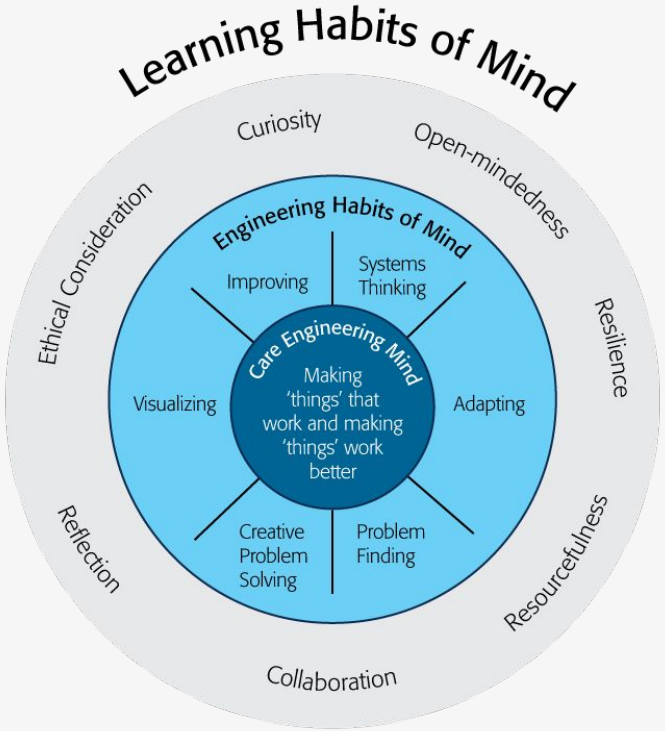
Engineering Habits of Mind



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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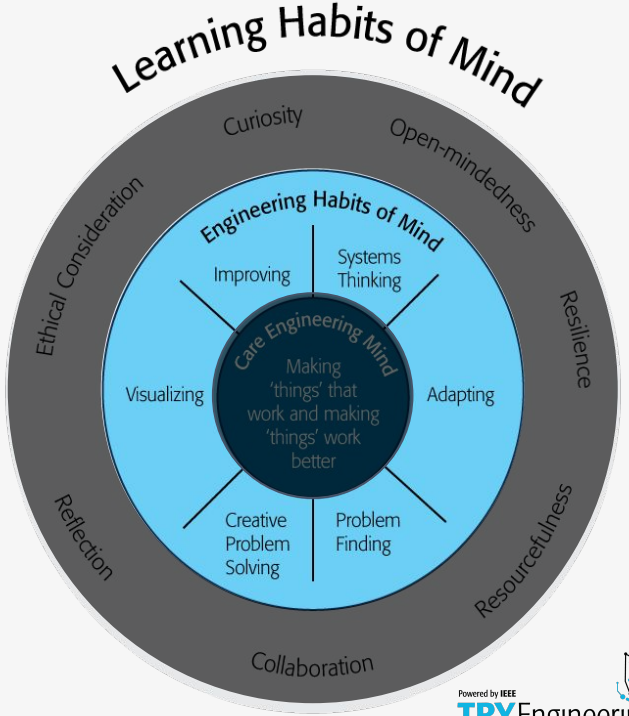
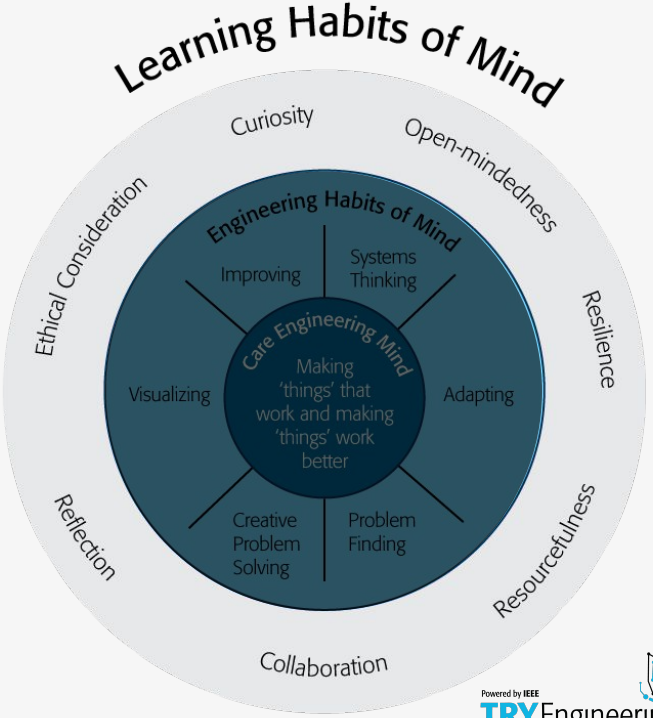
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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

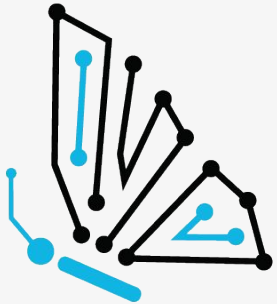


Greatest Engineering Achievements of the 20th Century

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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