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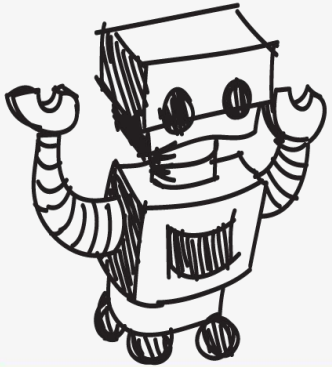
TRY Engineering

Lesson Plan:

Design a Dome

IEEE

The Design Challenge



The Design Challenge

- You are a team of engineers working together to design a dome structure with an internal frame and optional exterior decorations that is strong enough to support 120 grams of weight on top. Your structure must be at least 14 cm tall measured from the top of the dome to the bottom.

Defining the Challenge: Criteria & Constraints

Criteria

- Dome must be at least 14cm tall measured front he top of the dome to the bottom

Constraints

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

Material

Required for Build – trading/table of possibilities

- Cardboard
- Wooden dowels
- Aluminum Foil
- Construction paper
- Tissue paper
- String
- Rubber bands
- Wire or pipe cleaners

Material

Required for Build – trading/table of possibilities

- Popsicle sticks
- Paper cups
- Plastic/Paper Straws
- Screen
- Fabric

Testing Material Process

Testing Material

- Paper cup
- 120 grams of weight (coins, candy, legos, etc./1 US Penny = 1 gram)

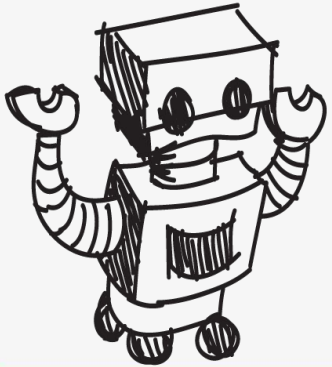
Testing Process

Test by placing each team's design on a table or desk. Place weight in a paper cup and place the cup on top of the dome design. Gradually add weight to the cup until the structure collapses or until 120 grams is reached (1 US Penny = 1 gram). Each team should document how much weight their dome could withstand.

Consider…

- Before you get started building, consider discussing the wide range of shapes and sizes of buildings and have the class consider the advantages or disadvantages of different shapes. Discuss the geodesic dome and have the group consider why domes can be a good shape choice for some projects and environments, examples are the South Pole dome and dome shaped camping tents.
- Refer to topics in the Background Concepts section.

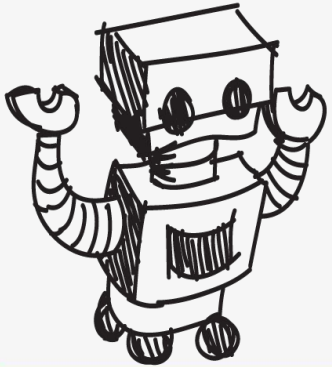
Reflect & Debrief



Reflection

- How similar was your original design to the actual dome you built?
- If you found you needed to make changes during the construction phase, describe why your team decided to make revisions.
- Which dome that another team made was the most interesting to you? Why?
- 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 dome would have been able to hold 600 grams of weight? Why or why not?

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

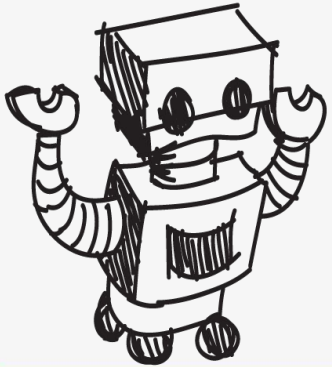
Engineering Design Process

- 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

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



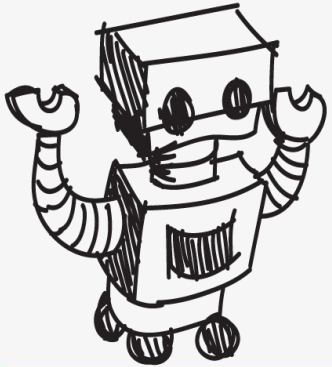
Vocabulary

- 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.
- Geodesic Dome: A spherical or partial-spherical shell structure or lattice shell based on a network of great circles (geodesics) lying on the surface of a sphere.

Vocabulary

- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).
- Prototype: A working model of the solution to be tested.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Buckminster Fuller (www.pbs.org/wnet/americanmasters/r-buckminster-fullerabout-r-buckminster-fuller/599/)
- Buckminster Fuller Archive at Stamford University (http://library.stanford.edu/collections/r-buckminster-fuller-collection)

Recommended Reading

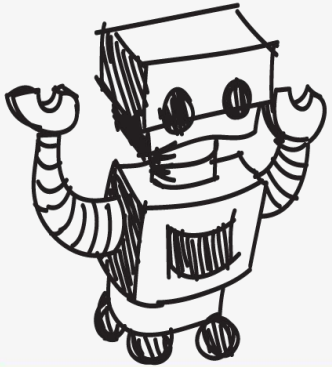
- Fuller Houses: R. Buckminster Fuller's Dymaxion Dwellings and Other Domestic Adventures (ISBN: 978-3037781418)
- Ultimate Guide to House Framing (ISBN: 978-1580114431)

Dig Deeper into the Topic

Writing Activity

Write an essay or a paragraph about why sturdy framing is so important to construction. How have the materials used for building framing changed as buildings have become taller and taller?

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 domes. 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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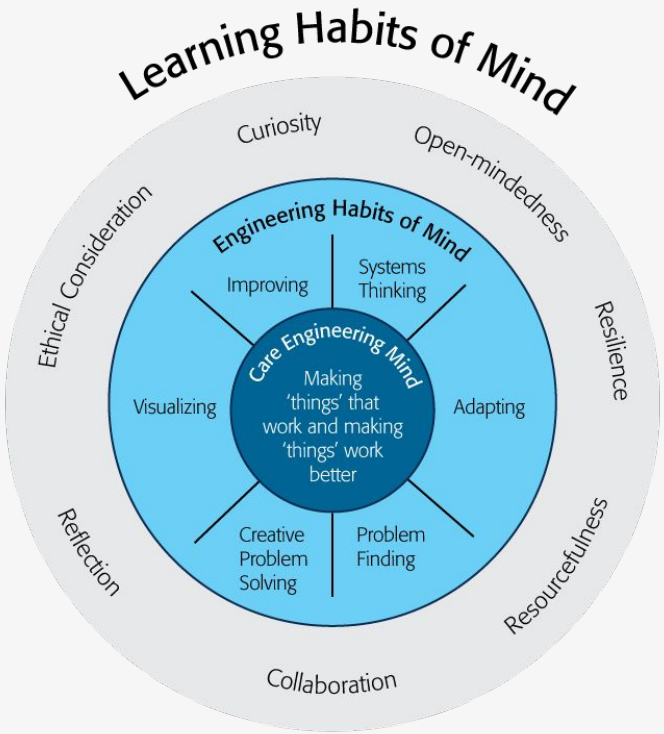
Engineering Habits of Mind

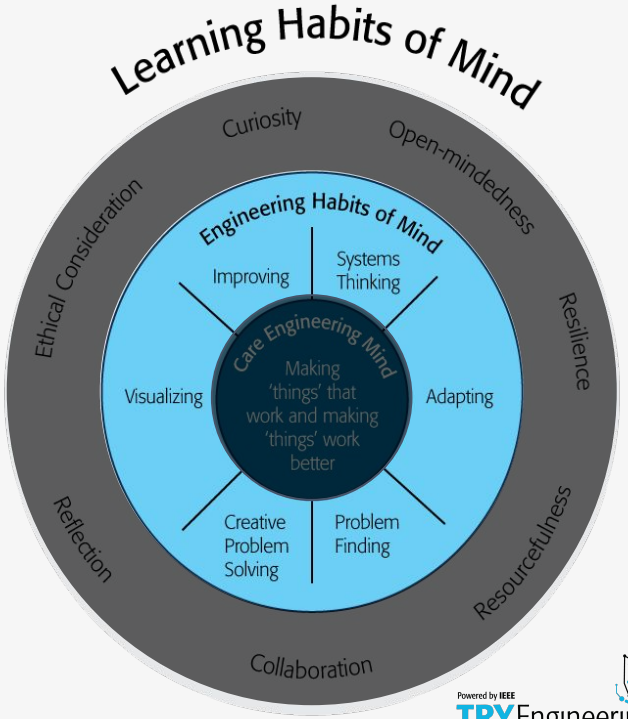


Engineering Habits of Mind (EHM) is about how engineers think everyday. The Core Engineering Mind is about making things that work and making them work better.

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

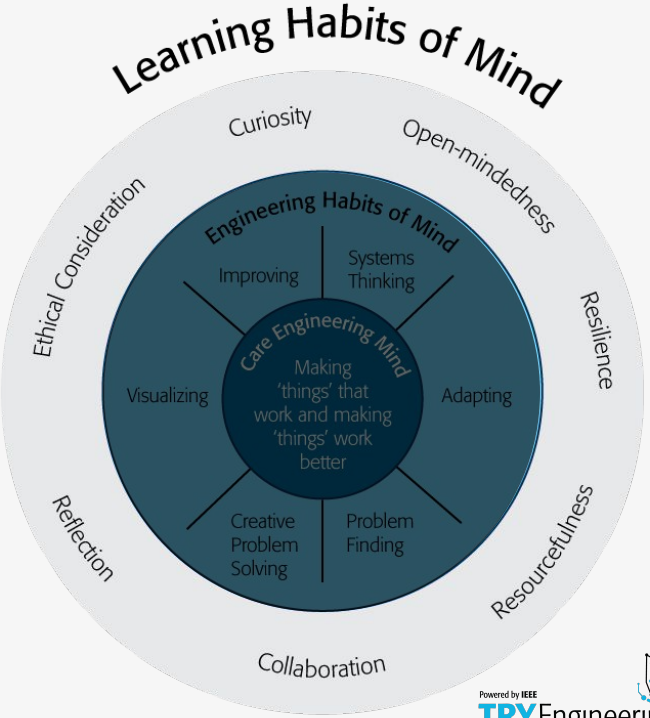
Engineering Habits of Mind Checklist

- ❑ **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

Greatest Engineering Achievements OF THE 20TH CENTURY

Welcome!
How many of the 20th century's greatest engineering achievements will you use today? A car? Computer? Telephone? Explore our list of the top 20 achievements and learn how engineering shaped a century and changed the world.

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household Appliances
16. Health Technologies
17. Petroleum and Petrochemical Technologies
18. Laser and Fiber Optics
19. Nuclear Technologies
20. High-performance Materials

LinkEngineering

Greatest Achievements

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

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