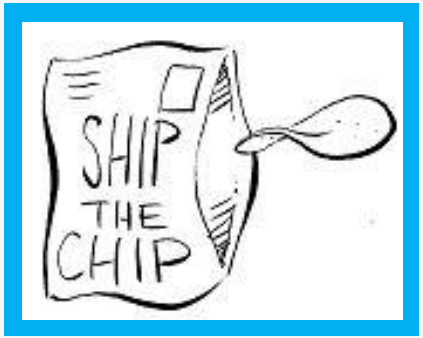
Powered by IEEE
TRY Engineering

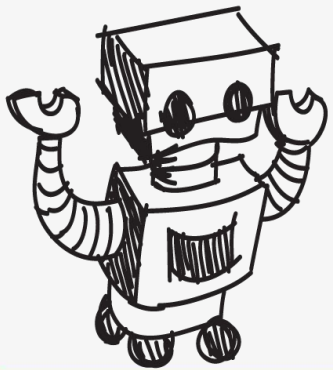
Lesson Plan:

Ship the Chip



IEEE

Real-World Application



What does a Packaging Engineer do?

- Get an inside look at what Packaging Engineers do. *(Video 2:18)*

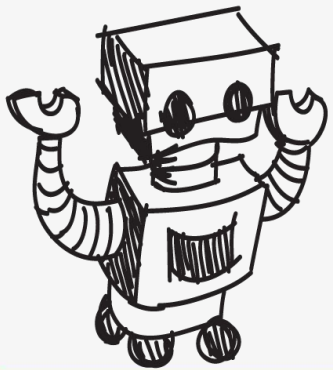
Source: Design Squad Global YouTube Channel: https://www.youtube.com/watch?v=POVCe_Plcso

Packaging You Can Eat!

- Packaging you can eat? Yes, researchers are developing ways to reduce waste with edible packaging. *(Video 2:02)*

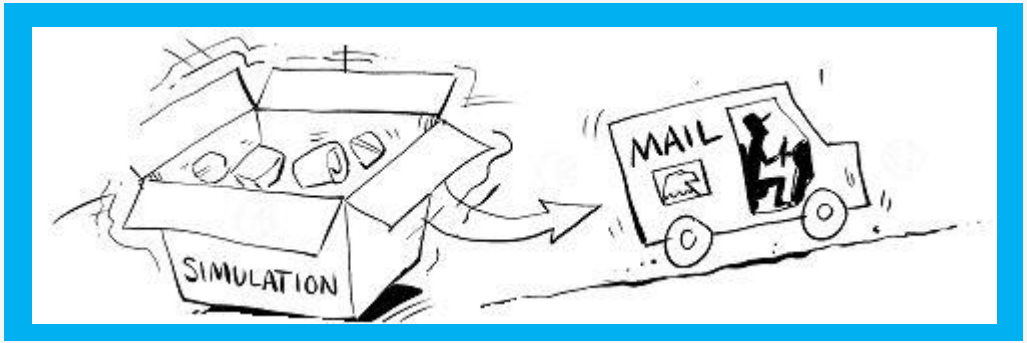
Source: American Chemical Society YouTube Channel: https://www.youtube.com/watch?v=wt32GgQGTcI

The Design Challenge



The Design Challenge

- You're a team of manufacturing engineers given the challenge of designing the smallest, lightest package possible using everyday materials. The package should be designed to protect a single potato chip if it were to be shipped through a postal service.



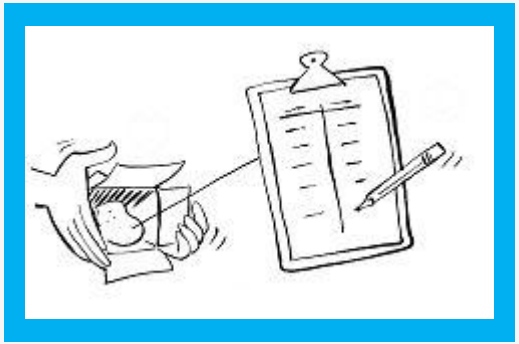
Defining the Challenge: Criteria & Constraints

Criteria

- Design the smallest, lightest package possible
- You may not eat the chips!

Constraints

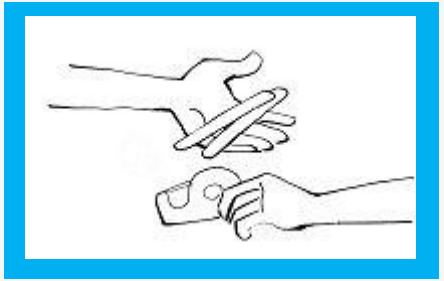
- Can use only the materials provided.
  - Unused materials may be shared with other teams or materials may be traded.



Material

Required for Build

- Potato Chip (Pringles® or Lay's Stax® work best)



Optional for Build – Trading/Table of Possibilities

- Paper/Cardstock
- Cardboard
- String
- Cotton balls
- Plastic wrap
- Tissues or paper towels
- Toothpicks
- Popsicle sticks

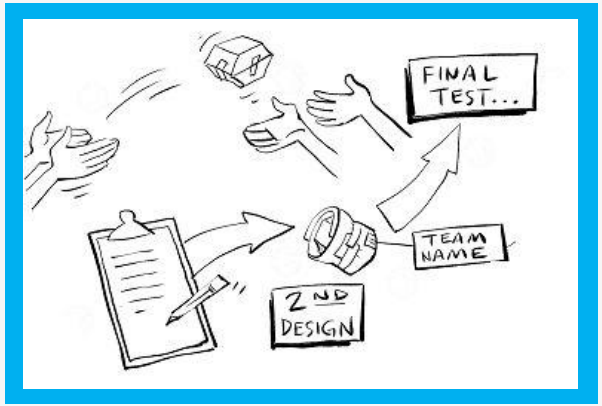
Testing Material and Process

Material

- Large box

Process

- Each team will design and build one package and test it by tossing it around within the team.
- Based on the testing results, each team should then build a second package that will be used during the final testing process.
- Each team should label their package with a team name



Testing Process

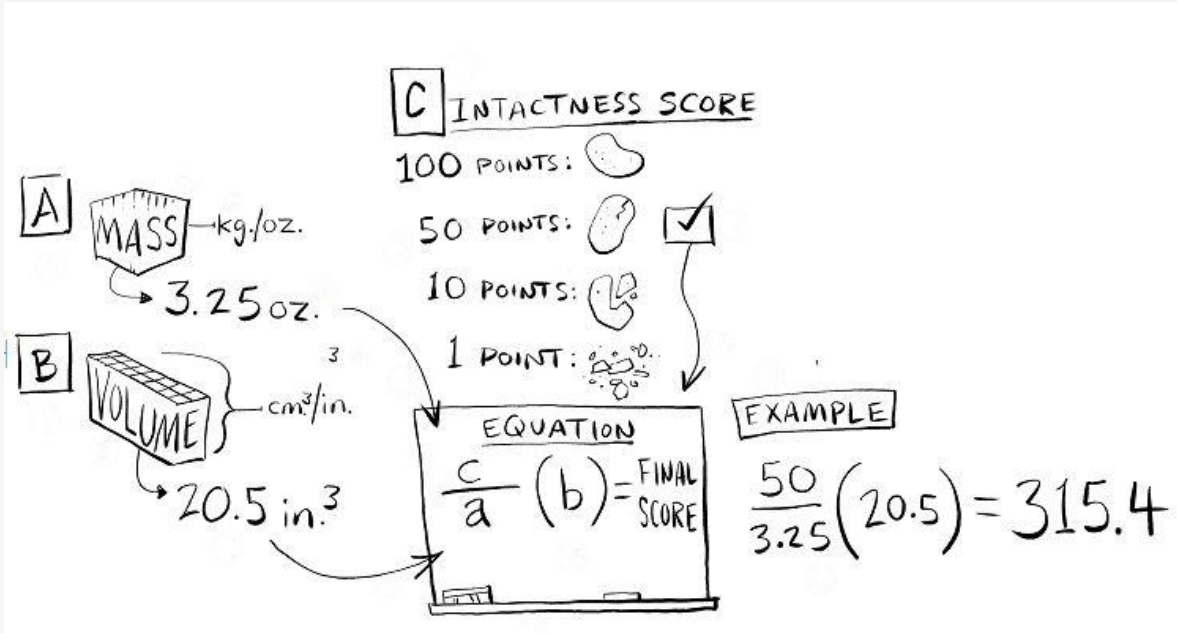
- All of the packages should then be collected, placed in one large box, and the entire classroom should participate in “bumping” the box around to simulate the mailing process.
- Once the “box bumping” test is complete, the teams should collect their packages and open them to inspect their chip. Each team should record a score based on the following:
  - The following three measurements must be made for each package:
    1. Mass of the package in kilograms/ounces to at least 3 significant figures.
    2. Volume of the package in cubic centimeters/inches to at least 3 significant figures.
    3. Intactness score of the chip on the following scale:

       100 Points: like new, perfect 50 Points: slightly damaged; cracked but still in one piece 10 Points: broken in 2 - 5 pieces 5 Points: broken in 6-20 pieces
       1 Point: broken into more than 20 pieces or crumbled

Powered by IEEE TRYEngineering | IEEE

Testing Process

- Determine the overall score for each package to determine the top scoring team. Use the following equation:



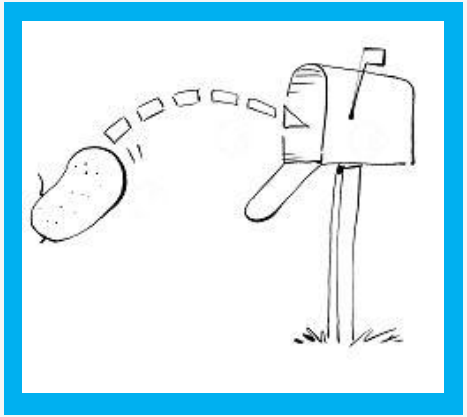
Consider...

Before you get started brainstorming and sketching your design...consider the following...

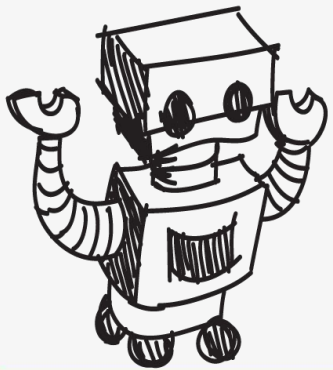
- How the size of the packaging relates to the item that is being shipped.
- How both the size and weight of the package factors into Post Office requirements and shipping costs.
- How well your package will survive if it finds itself at the bottom of a stack of heavy boxes during shipping.

Variations

- Ask teams to engineer a package for safely mailing the chip in a specific dimension six-sided box. Students are then challenged to design the interior to fit the chip.



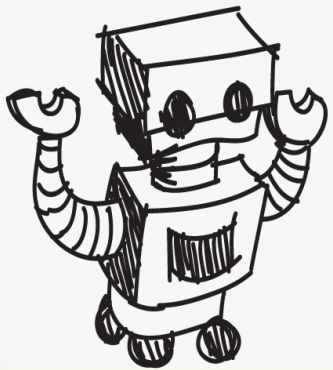
Reflect & Debrief



Reflection

- How similar was your design to the actual package you built?
- What aspect of the design of the package that had the best overall score do you think lead to its success?
- If you had a chance to do this project again, what would your team have done differently?

Engineering Design Process



The Engineering Design Process

Learn about the engineering design process (EDP). The process engineers use to solve problems.

(Video 1:47)

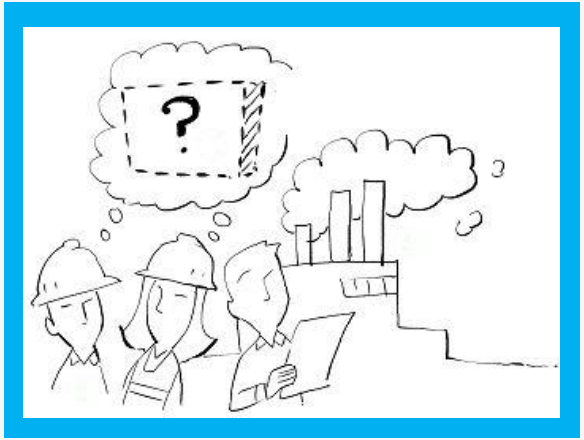
Source: TeachEngineering YouTube Channel http://www.youtube.com/watch?v=b0ISWaNoz-c

Engineering Design Process

- Divide into teams of two or three
- 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

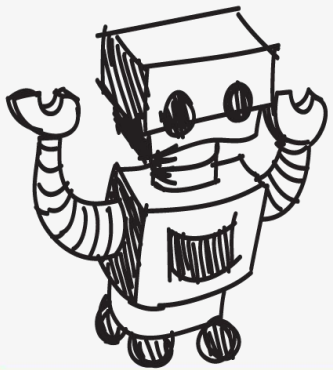
Productive Failure

- 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



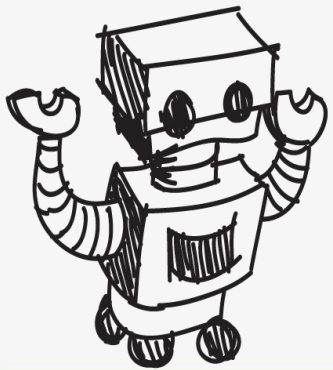
Vocabulary

- 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).
- 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).

Vocabulary

- Manufacturing Engineer: design, integrate, or improve manufacturing systems or related processes.
- Mass: Weight measured in grams (g) or kilograms (kg).
- Prototype: A working model of the solution to be tested.
- Volume: Size measured in cubic cm. Calculated multiplying length by width by height of an object.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Federal Express Packing Guidelines
- US Postal Service - How to Prepare a Package

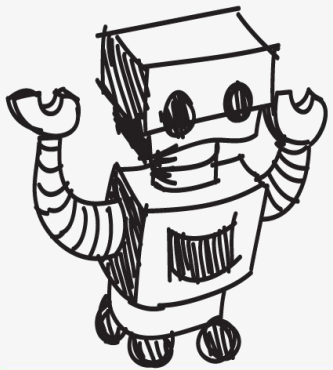
Recommended Reading

- Structural Package Designs (ISBN: 9057680440)
- Successful Food Packaging Design (ISBN: 2940361339)
- Special Packaging Designs (ISBN: 9057680548)

Writing Activity

- Write an essay or a paragraph about a packaging design that you think could be improved to either reduce the amount of plastic or other materials used, or take up less space on store shelves.

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)

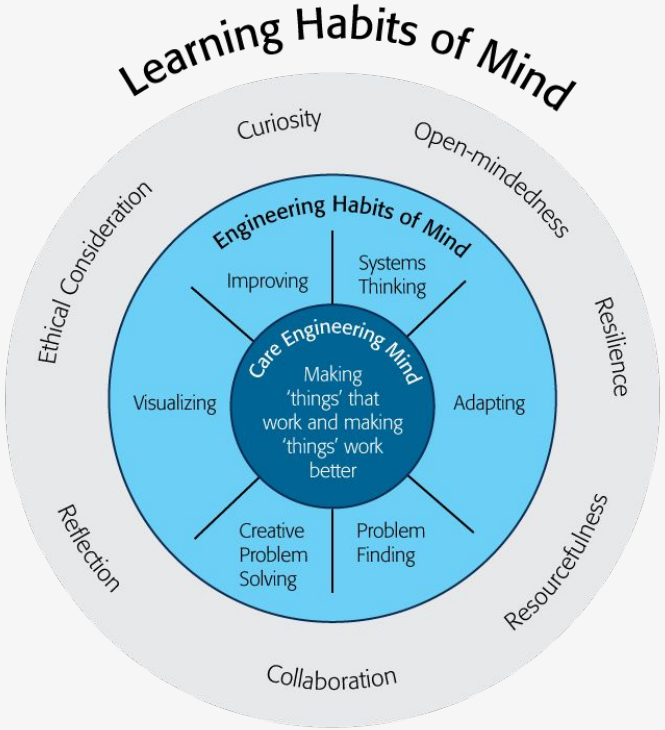
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- Learn more about manufacturing engineering:
  - Manufacturing Engineering
- Download the Engineering Fields Infographic
  How will **YOU** change the world?

Powered by IEEE TRYEngineering | IEEE

Engineering Habits of Mind



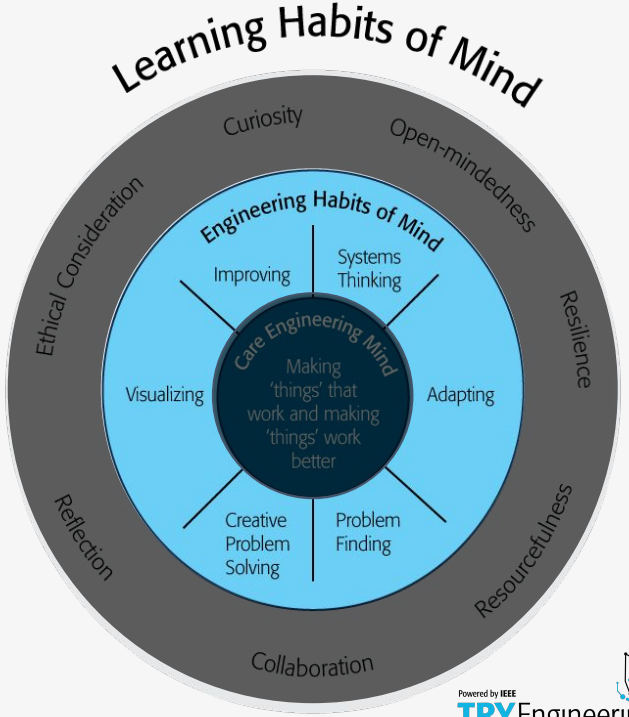
Engineering Habits of Mind (EHM) is about how engineers think everyday. The Core Engineering Mind is about making things that work and making them work better.

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

Powered by IEEE TRYEngineering | IEEE

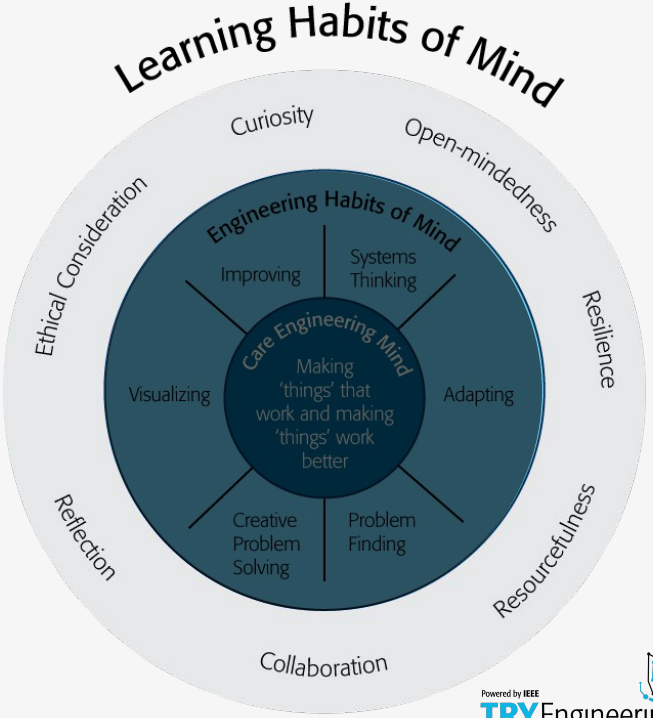
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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



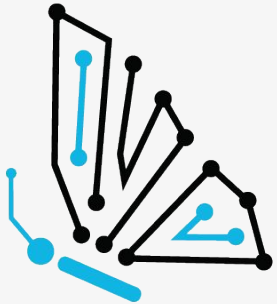
Greatest Engineering Achievements of the 20th Century

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

Powered by IEEE TRYEngineering | IEEE

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



Powered by IEEE

TRY Engineering