



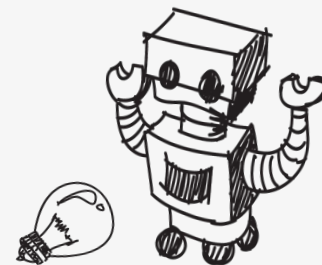
Powered by IEEE

**TRY**Engineering

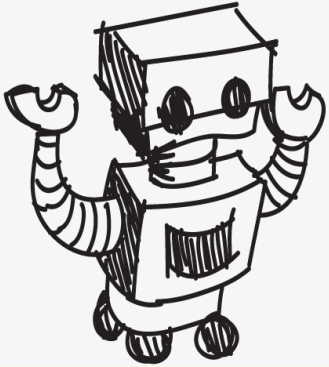


**Lesson Plan:**

# Ship the Chip



# 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](https://www.youtube.com/watch?v=POVCe_Plcso)

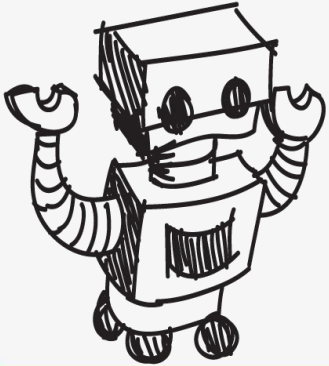
# Packaging You Can Eat!

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



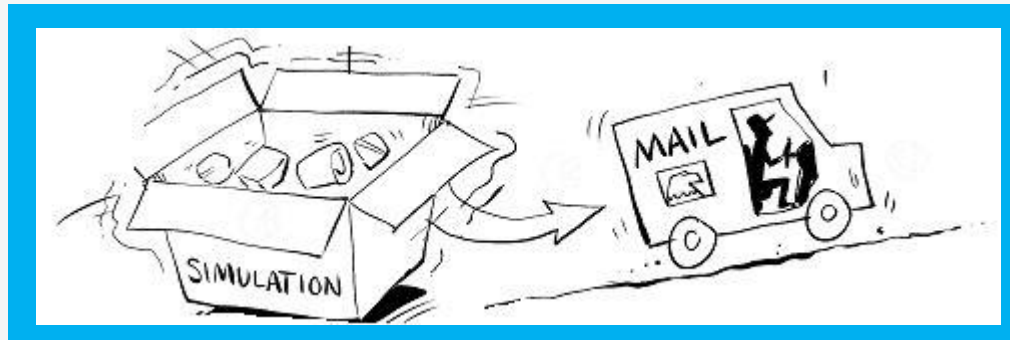
Source: American Chemical Society YouTube Channel: <https://www.youtube.com/watch?v=wt32GgQGTCI>

# 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.



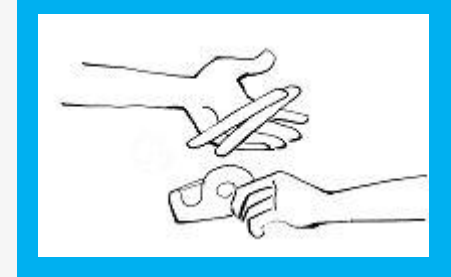
# Material

## 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





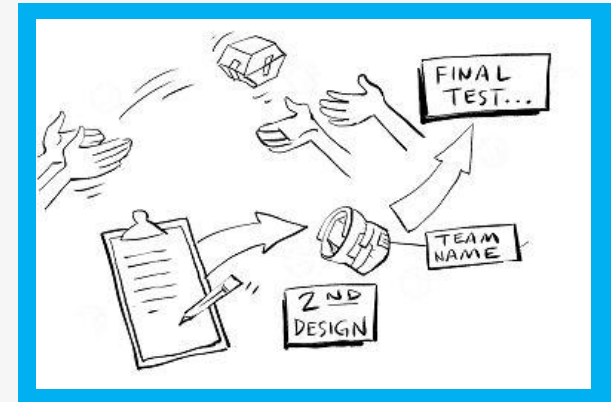
# Testing Material and Process

## 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



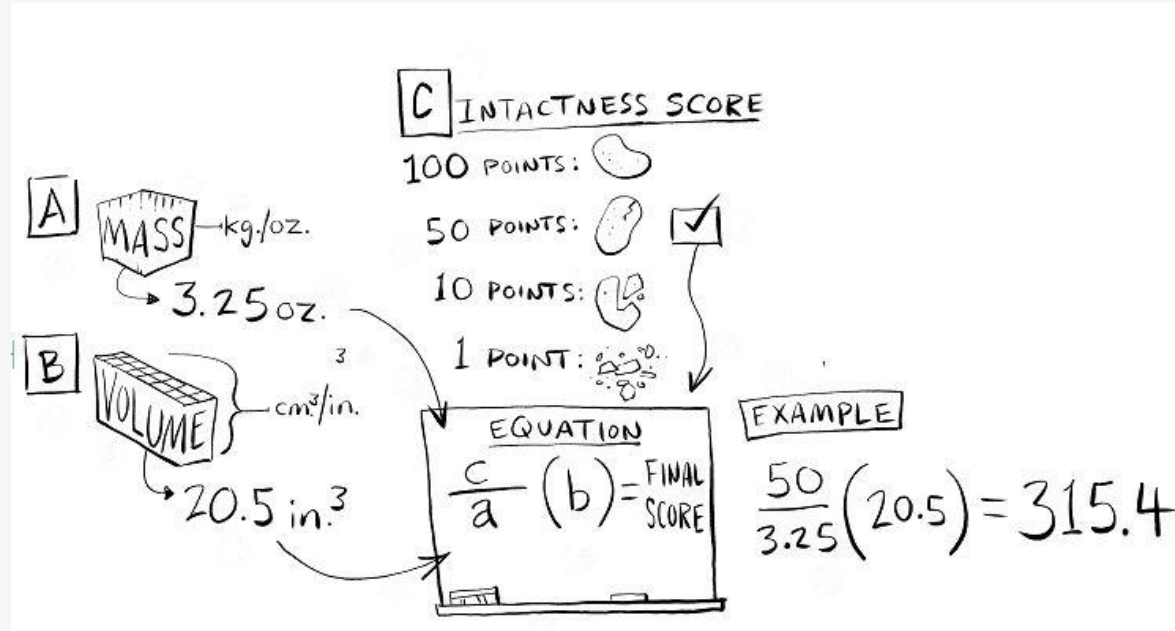
# Testing Process

- 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



# Testing Process

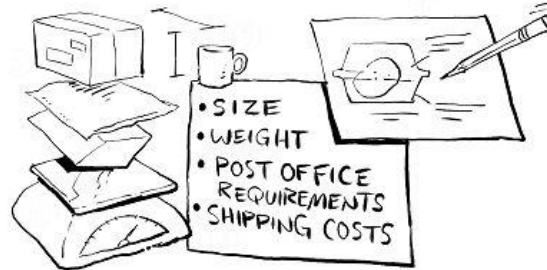
- Determine the overall score for each package to determine the top scoring team. Use the following equation:



# Consider...

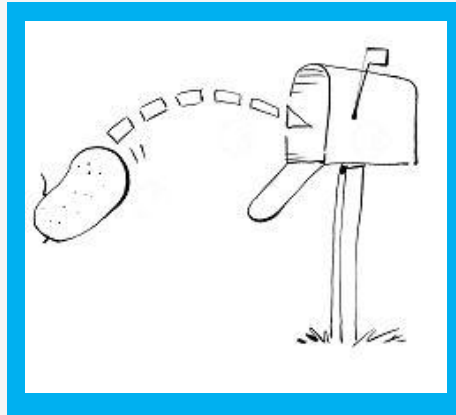
Before you get started brainstorming and sketching your design...consider the following...

- 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.

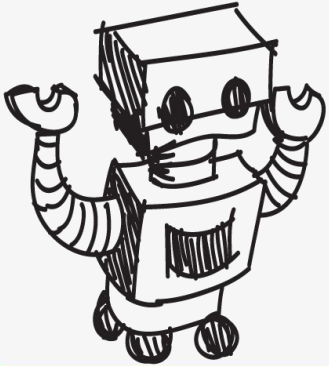


# Variations

- 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

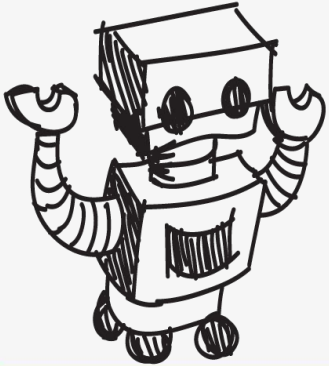


# Reflection

- 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>

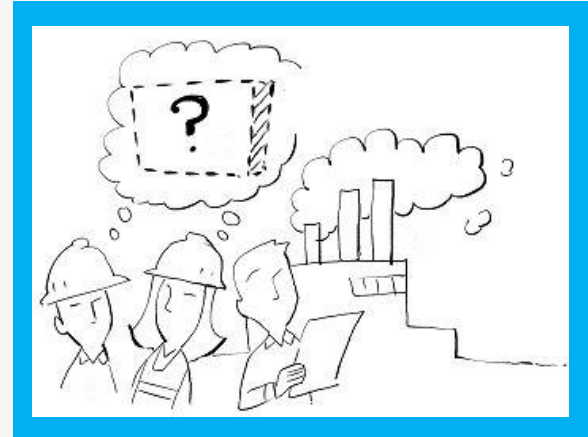
# Engineering Design Process

- 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

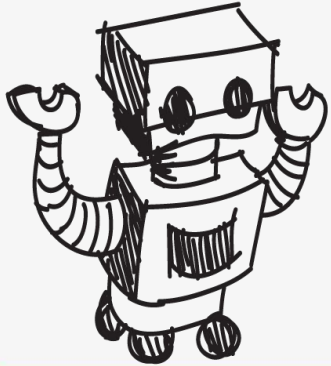


# Productive Failure

- 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).

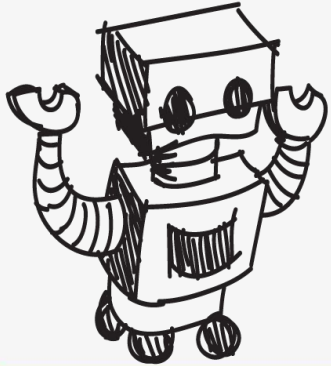


# Vocabulary

- 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)

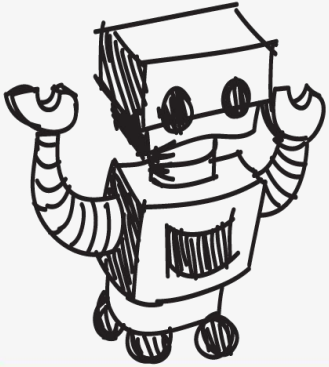
## Writing Activity

- 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.

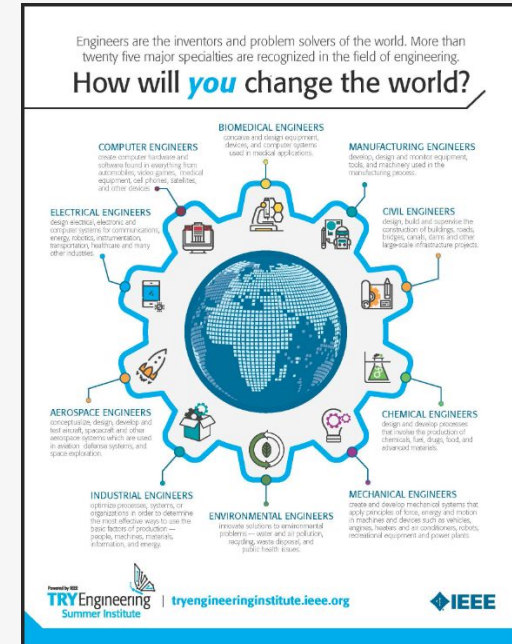
*(Video 3:43)*



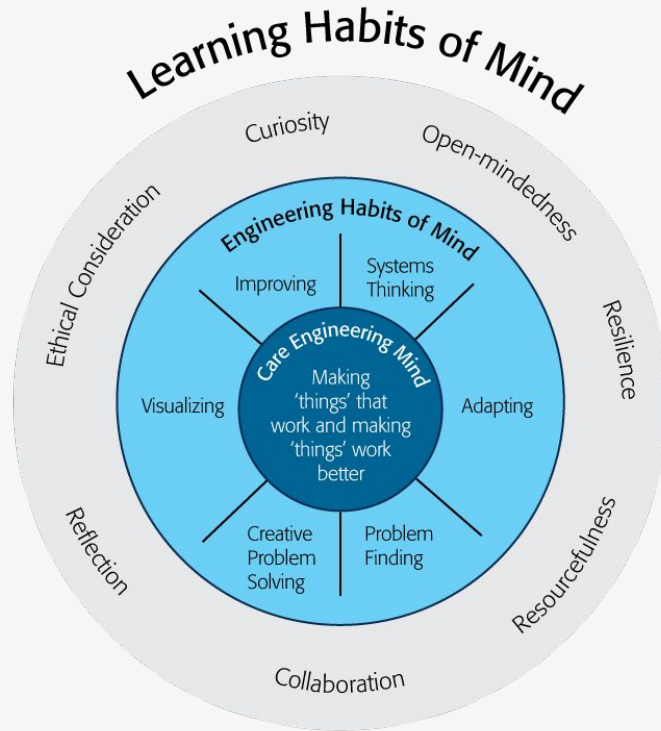
Source: TeachEngineering YouTube Channel - <http://www.youtube.com/watch?v=H9VDkvGmVo>

# Related Engineering Fields

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



# 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.

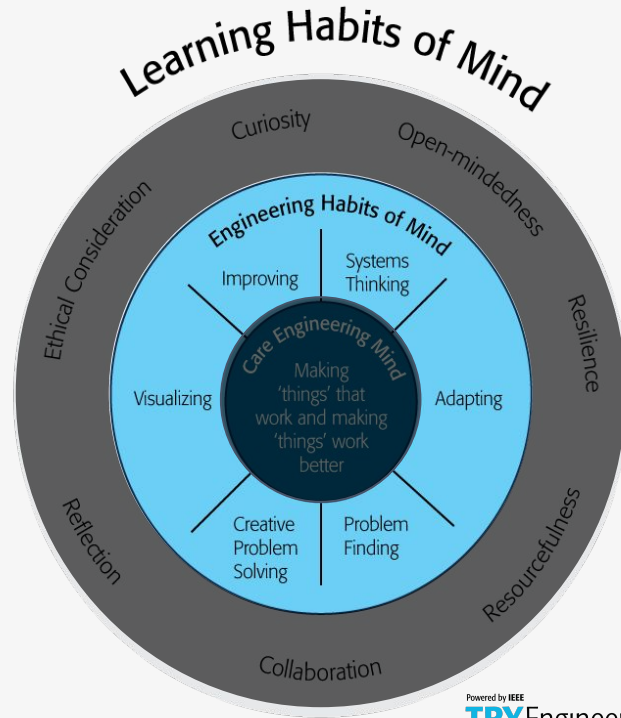
Source:

<https://online-journals.org/index.php/i-jep/article/view/5366>



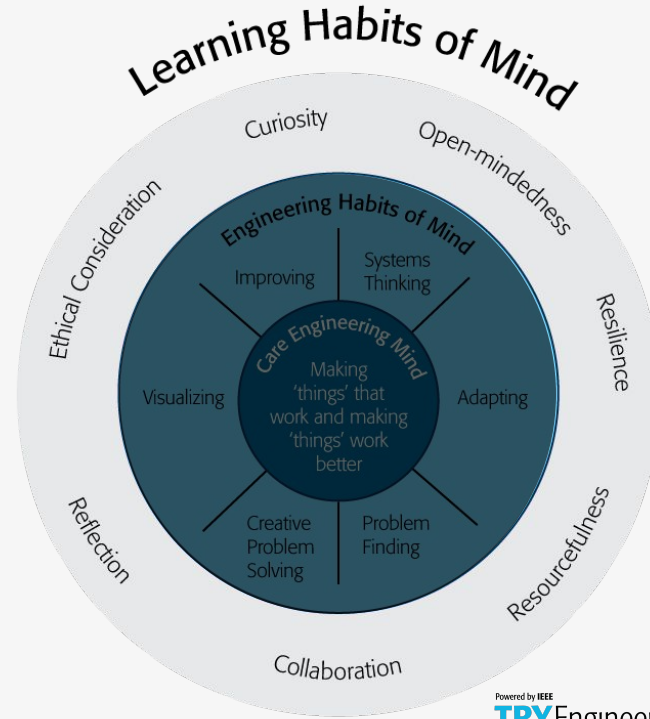
# Engineering Habits of Mind Checklist

- ❑ 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 20<sup>TH</sup> 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



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

Powered by IEEE  
**TRY**Engineering



**IEEE**

# Learn more about how engineers make the world a better place



The banner features the NAE logo (three interlocking puzzle pieces in blue, green, and yellow) and the text "NAE GRAND CHALLENGES FOR ENGINEERING" and "NATIONAL ACADEMY OF ENGINEERING". Navigation buttons for "Challenges", "News", and "Community" are in green. The main visual is a large green puzzle piece on the left with a fusion symbol, and a network of glowing green lines radiating from a central point on the right. Below the puzzle piece, the text "Provide energy from fusion" is displayed, followed by a paragraph about scaling up fusion technology. A row of 14 diamond-shaped icons represents various engineering challenges, including VR, a brain, a laptop, a padlock, a gear, a water drop, a CO2 canister, a microscope, a recycling symbol, a nuclear symbol, a bridge, a gear with a lightbulb, a sun, and a document.

NAE GRAND CHALLENGES  
FOR ENGINEERING  
NATIONAL ACADEMY OF ENGINEERING

Challenges News Community

Provide energy from fusion

Human-engineered fusion has been demonstrated on a small scale. The challenge is to scale up the process to commercial proportions, in an efficient, economical, and environmentally benign way.





For more engineering lesson plans and  
resources like games, engineering careers,  
and STEM opportunities visit IEEE's  
[TryEngineering.org](https://www.tryengineering.org)

Powered by IEEE

**TRY**Engineering

