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**TRY**Engineering



**Lesson Plan:**

# A Century of Plastics



# The Design Challenge



# The Design Challenge

You are a team of engineers given the challenge of coming up with a list of four machines or products that you think would be impossible without the invention of plastics. Then, you will decide which plastic parts you will replace in one of those products or machines to make recycling easier. What materials will you use instead and how will it impact performance, price, or aesthetics?



# Material

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## Materials – Required

- Student Worksheets
- Background Topics Section of Lesson Plan



# Consider...

- Before you get started, think about items you can find in your home, classroom, or on the playground. Identify and document any items that have no component parts made of plastic.



# Step One

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Work as a team to complete Step One of the second student worksheet - You Be the Engineer:

- Come up with a list of four machines or products that you think would be impossible without the invention of plastics. For each, answer these questions:
- What % of the product is plastic?
- Why would this be impossible without plastic?
- How has this machine or product impacted the world?



## Step Two

Work as a team to complete Step Two of the second student worksheet - You Be the Engineer:

- Replace some of the plastic in any of the four products or machines you identified in Part One to make them easier to recycle. Discuss what materials you will use instead, how it will impact performance, price, or aesthetics. Then present your ideas to the class:
- Describe what your product does, and the percentage of it you think is plastic.
- Explain which components you will replace with other materials; describe how you selected the replacement materials and how the new materials will impact weight, cost, and functionality of the product.



## Step Two

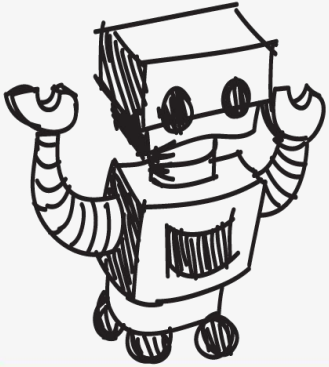
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- Predict whether this product will be as effective as the current design, whether it might cost more to manufacture, and how it would be easier to recycle.
- Describe how your team believes that the engineering of plastics into common products has impacted the world.





# Reflect & Debrief

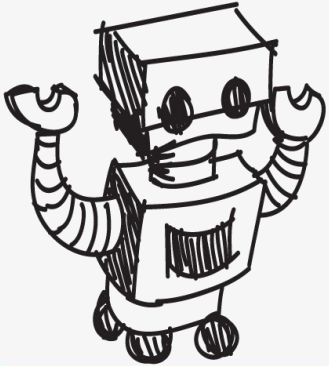


# Reflection

- Was it harder than you thought to find products that contained no plastic?
- Of the products you found with no plastic, what did they have in common?
- If you were reengineering one of the products you found, would you change any of the component parts to plastic? Why? Why not?
- Do you think CDs would be possible without plastics? Why? Why not?
- Why is recycling important?



# 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

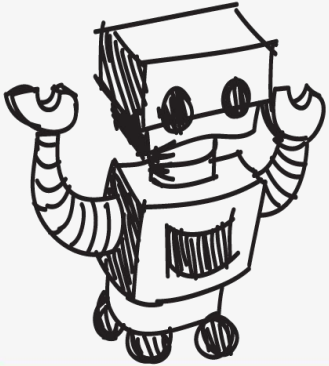


# Productive Failure

- 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



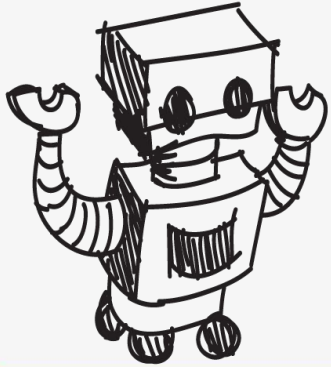
# Vocabulary

- 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).
- Prototype: A working model of the solution to be tested.
- Recycling: Process of taking materials ready to be thrown away and converting (changing) them into reusable materials.





**Dig Deeper**



# Dig Deeper into the Topic

## Internet Connections

- History of Plastics  
([www.bpf.co.uk/Plastipedia/Plastics\\_History/Default.aspx](http://www.bpf.co.uk/Plastipedia/Plastics_History/Default.aspx))

## Recommended Reading

- American Plastic: A Cultural History by Jeffrey L. Meikle (ISBN: 978-0813522357) Plastics Engineering by R J Crawford (ISBN: 978-0750637640)



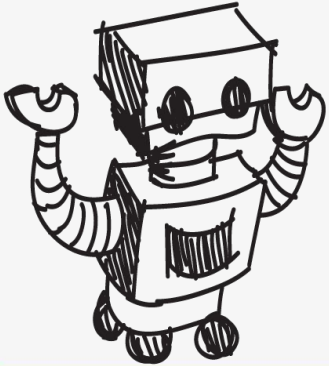
# Dig Deeper into the Topic

## Writing Activity

- Write an essay or a paragraph describing whether you think spaceflight would be possible without the introduction of plastics. Give examples to support your point of view.
- Write an essay or a paragraph describing how recycling works in your town. Give examples of how engineers incorporate recycled materials into new products.



# 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.

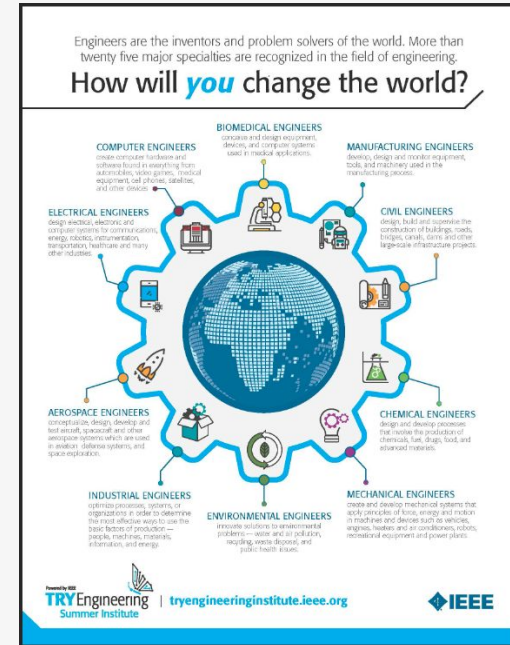
*(Video 3:43)*



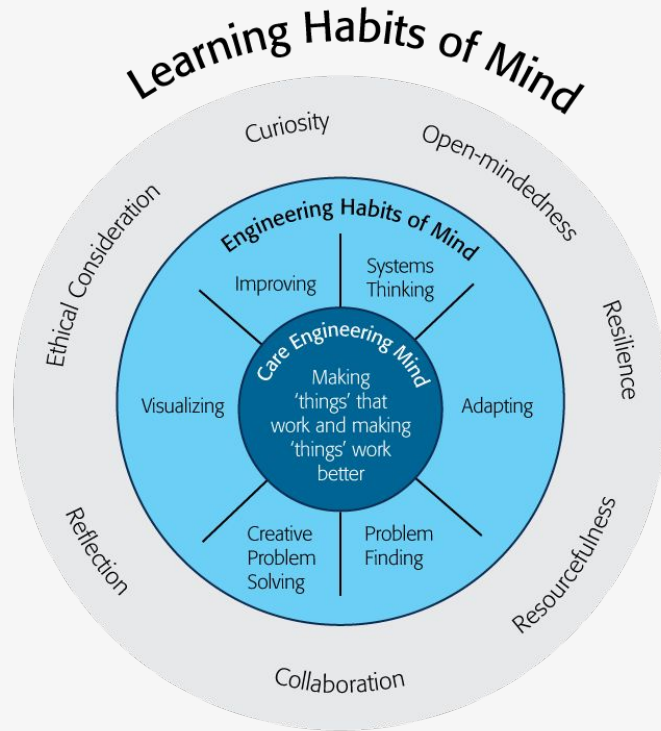
Source: TeachEngineering YouTube Channel - <http://www.youtube.com/watch?v=H9VDkvGmVo>

# Related Engineering Fields

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

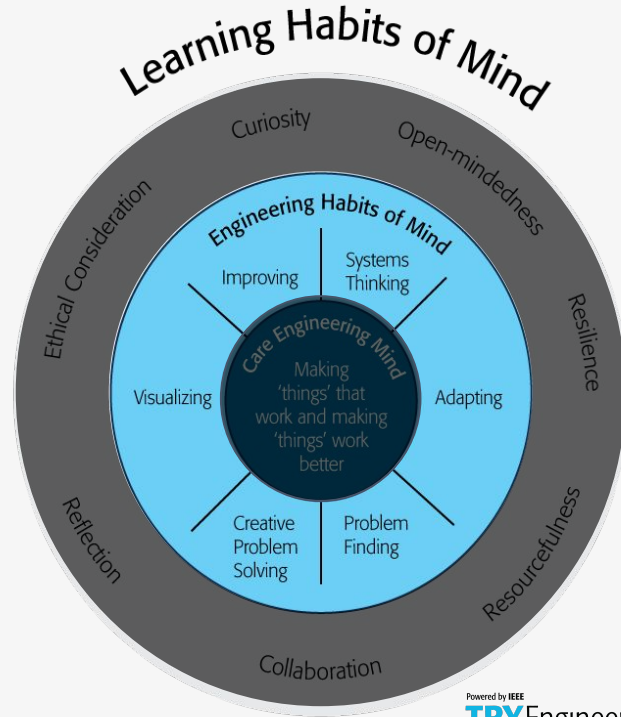
Source:

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



# Engineering Habits of Mind Checklist

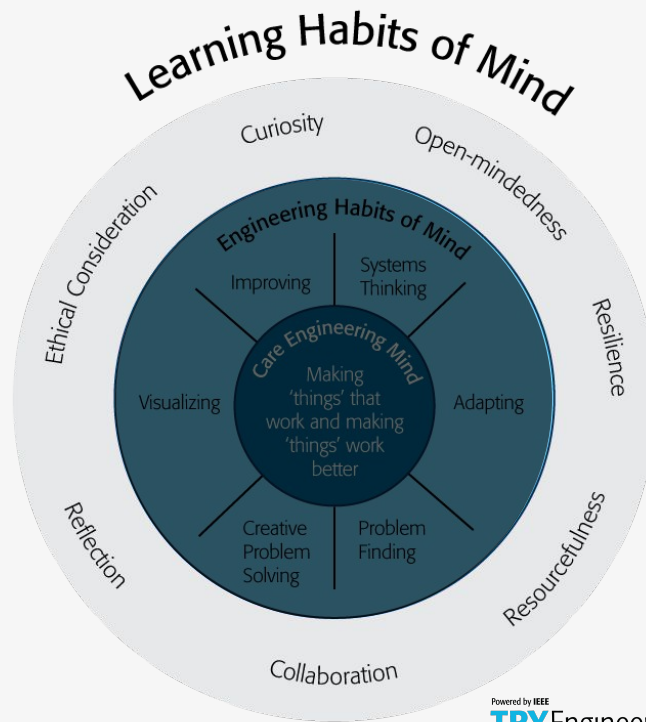
- ❑ Systems thinking
- ❑ Problem-finding
- ❑ Visualising
- ❑ Improving
- ❑ Creative problem-solving
- ❑ Adapting





# 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

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

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# 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" with "NATIONAL ACADEMY OF ENGINEERING" in smaller text below. To the right are three green buttons labeled "Challenges", "News", and "Community". The main visual is a large green puzzle piece on the left containing a white atomic symbol, set against a dark background with a complex network of glowing green lines and dots radiating from a central point. Below this, the text "Provide energy from fusion" is displayed in a large, white, sans-serif font. Underneath this text is a paragraph: "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." At the bottom of the banner is a row of twelve diamond-shaped icons containing various symbols: a smartphone, a VR headset, a lightbulb, a bridge, a water drop, a nuclear symbol, a CO2 molecule, a microscope, a brain, a laptop, a padlock, and a gear.

NAE GRAND CHALLENGES  
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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)

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