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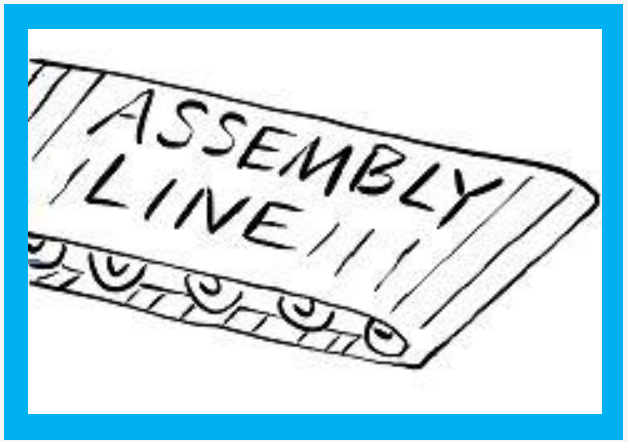
TRY Engineering

Lesson Plan:

Assembly Line



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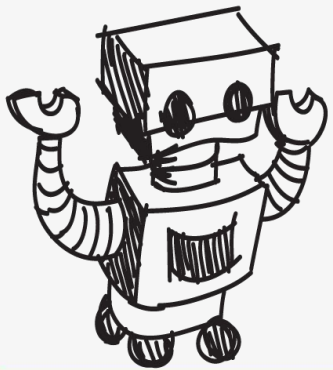
Real-World Application



Working the Assembly Line

Did you ever wonder what it's like to work on an assembly line? Here's a peek into what it would be like to work on a car assembly line. *(Video 3:48)*

Source: Jeff Gilbert, News Reporter YouTube Channel: https://www.youtube.com/watch?v=6umIEl6Sv8A

1.7 Million LEGO Bricks an Hour!

Go inside a Swedish LEGO plant to learn how 1.7 million bricks are manufactured on an assembly line in just one hour. *(Video 5:36)*

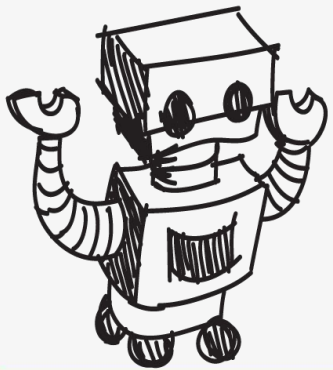
Source: How It's Made YouTube Channel: https://www.youtube.com/watch?v=zrzKih5rqD0

Coca-Cola Assembly Line In Action!

Watch as Coca-Cola's holiday North Pole cans roll off the assembly line.
(Video 1:21)

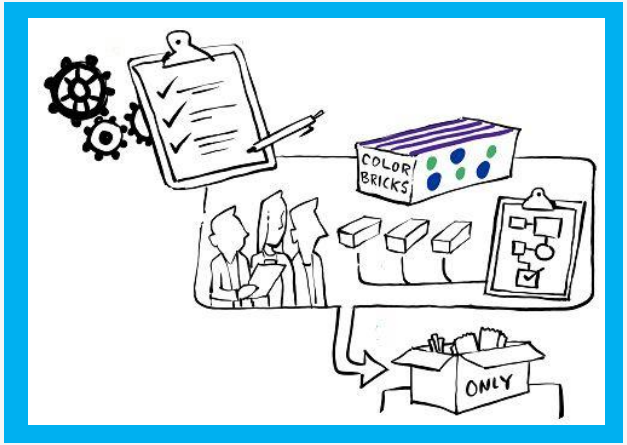
Source: The Coca-Cola Company YouTube Channel: https://www.youtube.com/watch?v=nYKrnuz17jg

The Design Challenge



The Design Challenge

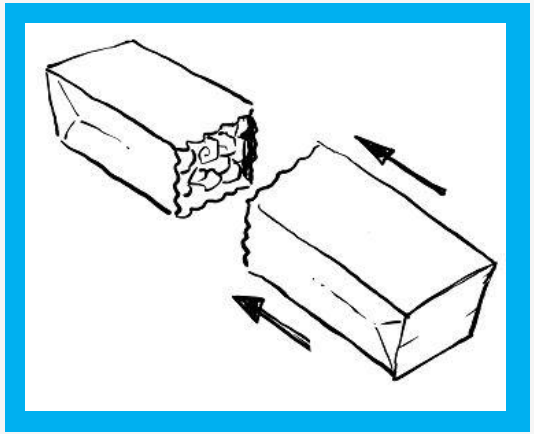
- You are a team of engineers working to help a local toy company implement time savings methods to manufacture “color bricks.” Each member of your team will design and construct their own brick as quickly as possible. Then, the team will work together to design an assembly line to manufacture bricks as quickly and efficiently as possible.



Defining the Challenge: Criteria & Constraints

Criteria for Quality Control

- Brick must be made from 2 brown bags. One bag must be filled with 4 pieces of lightly crunched up recycled paper. The other bag will cover this bag.
- The largest sides of the brick must be filled with polka dots (3 large - 1” circles & 3 medium - 1/2” circles scattered per side). One side must have 3 blue and 3 green circles. The other side must have 3 red and 3 orange circles.



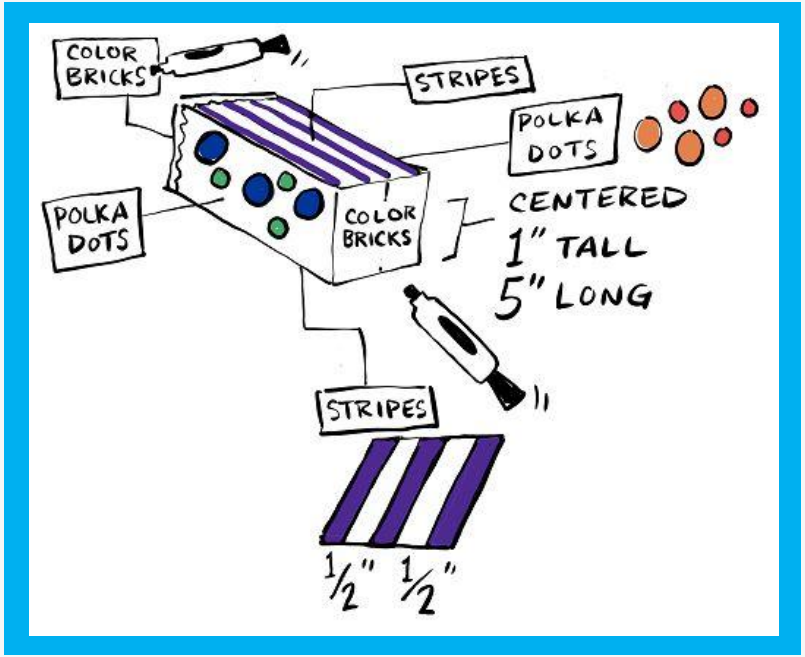
Defining the Challenge: Criteria & Constraints

Criteria for Quality Control

- The top and bottom of the brick must have 4 vertical 1/2” purple stripes with 1/2” in between each stripe.
- Both sides of the brick must have “Color Bricks” written in black marker. Letters must be centered on the sides and 1” in height and 5” long.

Constraints

- Use only the materials provided.



Material – Activity 1

Required per student – Activity 1

- 2 brown paper bags
- 5 pieces of recycled paper 8”x 11”
- 1 full set of colored markers or crayons (be sure to include blue, green, red, orange, purple)
- 1 black marker
- 2 cups of different sizes or other objects that can be traced to make circles (i.e. compass)
- 1 ruler
- “Assemble one color brick” worksheet or write brick criteria on a shared board

Required for Teacher – Activity 1

- Sample Color Brick
- Stopwatch, phone or other timer

Material – Activity 2

Required per team – Activity 2

- 30 brown paper bags (30 per team)
- Stack of recycled paper 8”x 11”
- 1 full set of markers or crayons (be sure to include blue, green, red, orange, purple)
- 1 black marker
- 2-4 sets of 2 cups of different sizes or other objects or that can be traced to make circles (i.e. compass)
- 4 Rulers
- 1 stop watch

Required for Teacher – Activity 2

- Stopwatch, phone or other timer

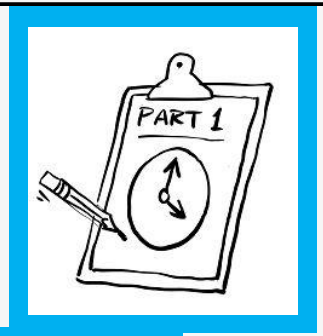
Testing Process

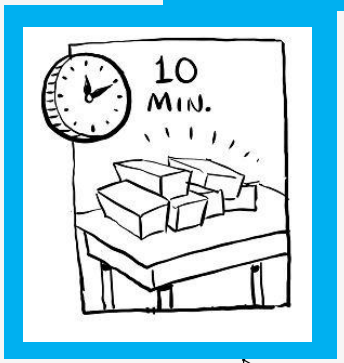
Activity 1

- Start timer counting up, as you instruct students to begin building their brick.
- Record the name and time as each student completes their brick.

Activity 2

- Set a countdown timer for 10 minutes.
- Record how many bricks each team completes.





Consider...

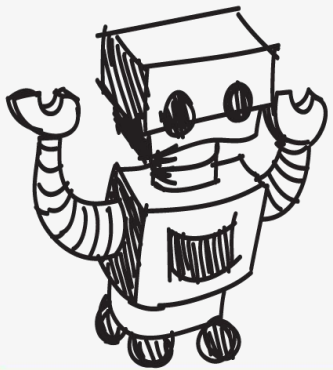
Before you get started brainstorming...consider the following...

- How to keep quality control, while maintaining efficiency
- What order or sequence do your steps need to be in to make the brick?
- The number of people on your team and the number of tasks that need to be completed
- The differences between assembling a product individually versus with an assembly line

Variations

- Change the size of the brick (use large brown grocery paper bags).
- Play some fun, fast music during the assembly line testing.
- Add more tasks, such as packaging bricks into a box to ship.
- Instead of seeing how many bricks each team makes in 10 minutes, tell students they have to make a certain number of bricks and see how long it takes each team.

Reflect & Debrief



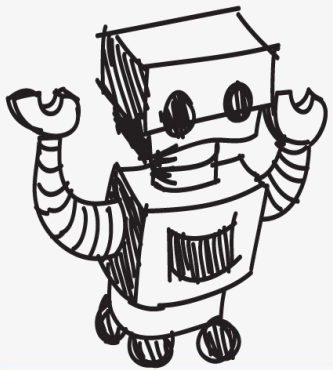
Reflection

- Was the order of your assembly line tasks successful? If not, why?
- Did you have enough people in your assembly line to have experts in one task? If not, how would it have changed your assembly line if you had more people?
- Did your group meet the quality control criteria? If not, why?

Reflection

- Was it hard to go fast and still meet the quality control criteria? What would it take to improve?
- What are the benefits of the assembly-line method when compared to assembling a product individually?

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

Activity 2

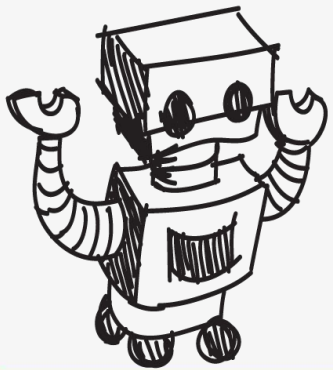
- Divide into teams of 10 to 12 students
- Review the challenge and criteria & constraints
- Brainstorm possible solutions (sketch while you brainstorm!)
- Choose best solution and build a prototype
- Test then redesign until solution is optimized
- Reflect as a team and debrief as a class

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



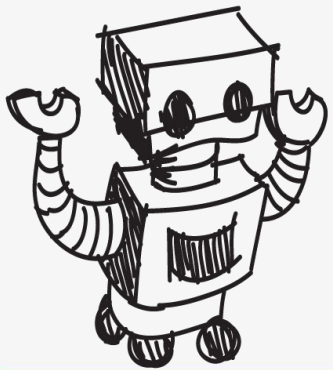
Vocabulary

- Assembly Line: A manufacturing process where a product is assembled by adding parts in sequence.
- Quality Control: is a procedure or set of procedures intended to ensure that a manufactured product adheres to a defined set of quality criteria.
- Constraints: Limitations with material, time, size of team, etc.
- Conveyor Belt: A belt moved by rollers which is used to transport objects from one place to another.
- Criteria: Conditions that the design must satisfy like its overall size, etc.
- Efficiency: The ability to avoid wasting materials, energy, efforts, money, and time in producing a product.

Vocabulary

- 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).
- Manufacturing: The use of people, machines and tools to turn raw goods into finished products.
- Mass Production: The large scale manufacturing of a product.
- Prototype: A working model of the solution to be tested.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Crayola Factory Assembly Line: How Crayons are Made
- PBS American Experience Assembly Line
  - https://www.pbs.org/video/american-experience-ford-assembly-line/

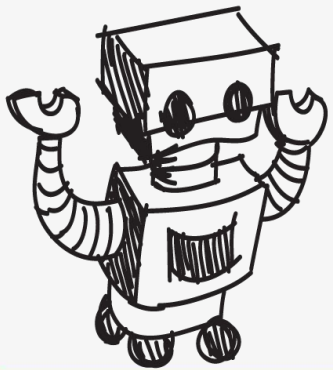
Recommended Reading

- Henry Ford and the Assembly Line (ISBN: 978-1584151739)
- The Assembly Line (ISBN: 978-0618484379)
- Lean Assembly: The Nuts and Bolts of Making Assembly Operations Flow (ISBN: 978-1563272639)

Writing Activity

- Write an "explanatory essay" describing the steps of the assembly line process.

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)

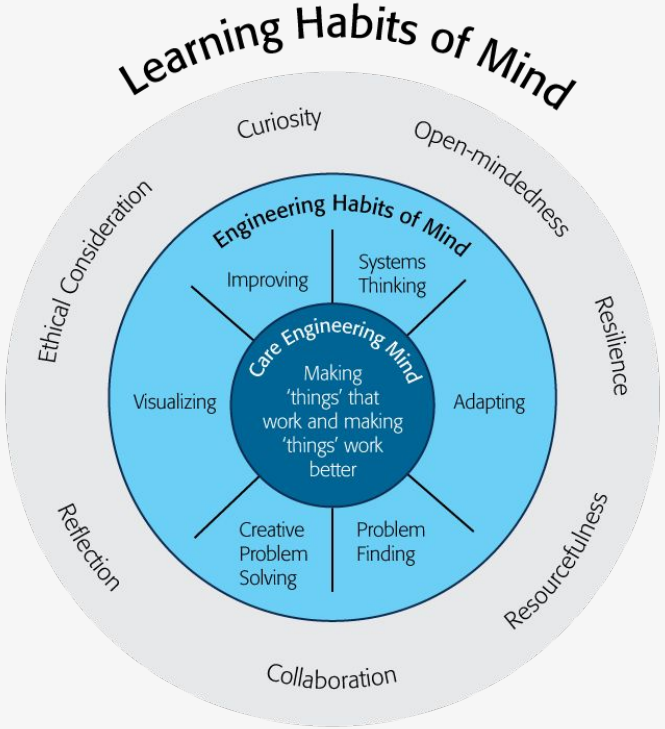
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- There are several types of engineering fields that focus on manufacturing and quality control. Here are just some of the related engineering fields.
  - Manufacturing Engineering
  - Industrial Engineering
  - Mechanical 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)

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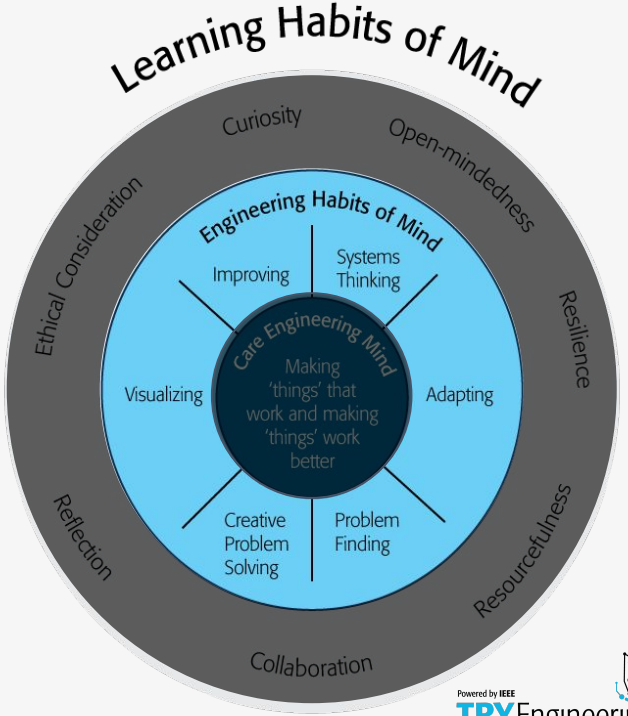
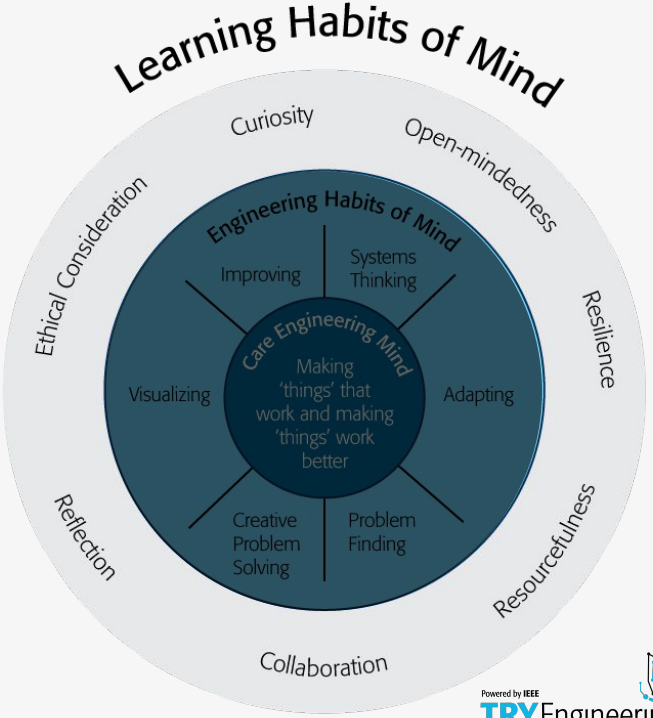
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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

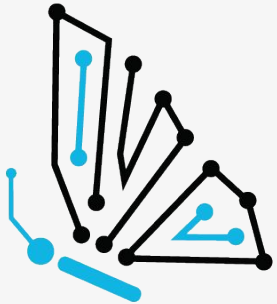


Greatest Engineering Achievements of the 20th Century

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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