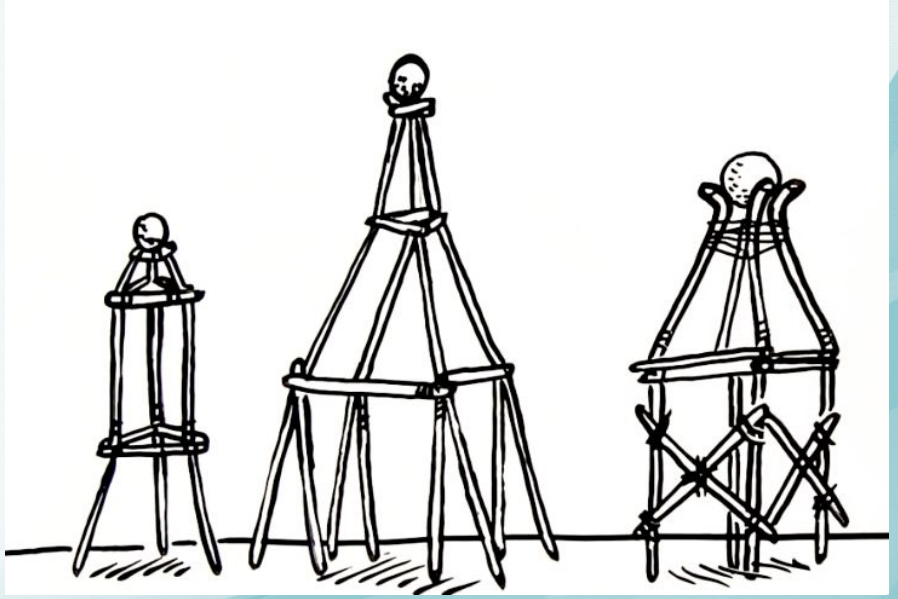
Tall Tower Challenge



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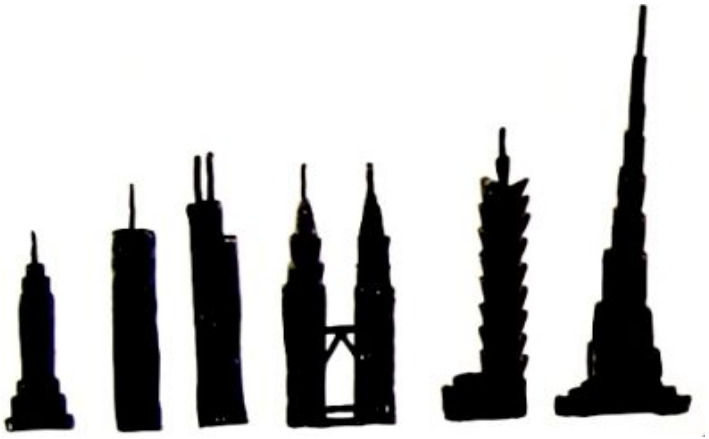
Real-World Application

Great Towers of The World

Look at the following site to learn about the tallest towers in the world:

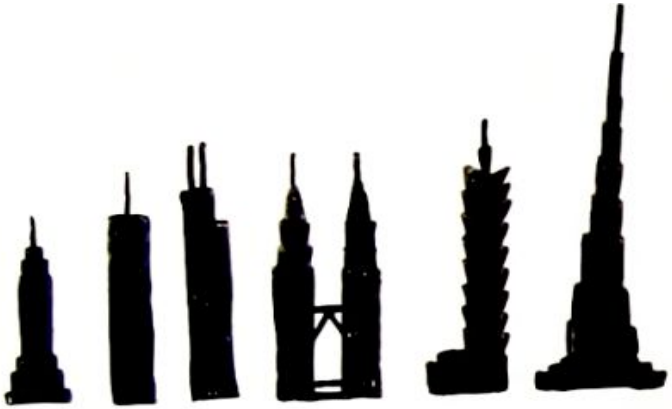
- Burj Khalifa Great Towers of The World: (www.burjkhalifa.ae/en/the-tower/GreatTowers.aspx)

How long do you think it will take before a building is constructed that surpasses the height of the Burj Khalifa? Where do you think it will be built? Why?



Buildings in your Community

Consider the buildings in your community.
Look at how they have increased in height over the years.
What is tallest building now in your community?



The Design Challenge

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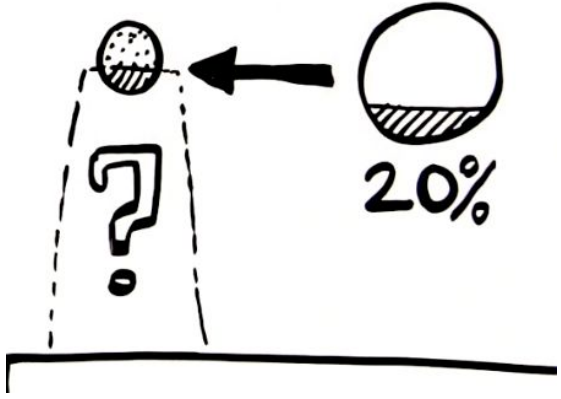
The Design Challenge

You are part of a team of engineers given the challenge of building the tallest tower possible that will support the weight of a golf ball for 2 minutes.

Defining The Challenge: Criteria & Constraints

Criteria:

- Tower must support the weight of a golf ball for 2-minutes.
- The weight of the golf ball must be supported near the top of the tower, with the bottom of the ball no more than 20% below the upper height of the tower.



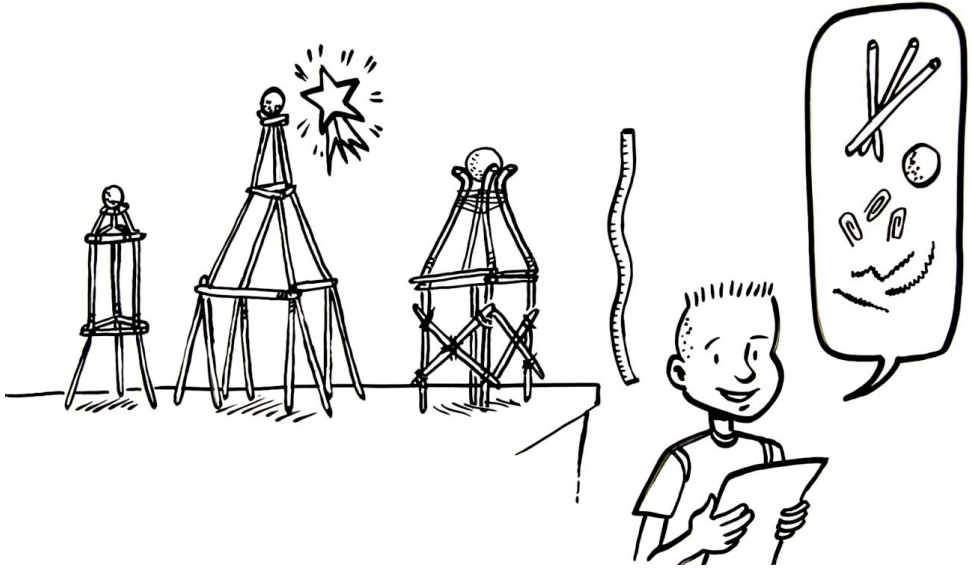
Constraints:

- Can only use 50 straws, 50 pipe cleaners, and 25 paper clips for your design.
- You can not use tape to connect materials.
- Design a solution in the time given.

Materials

Each team receives:

- Plastic Straws (50)
- Pipe Cleaners (50)
- Paperclips (25)
- Golf Ball (1)



Dig Deeper

Vocabulary

- **Engineers:** Inventors and problem solvers of the world. Twenty five major specialties are recognized in engineering (see infographic).
- **Engineering Habits of Mind (EHM):** Six unique ways that engineers think.
- **Engineering Design Process (EDP):** Process engineers use to solve problems.
- **Criteria:** Conditions that the design must satisfy like its overall size, etc.
- **Contarints:** limitations with material, time, size of team, etc.
- **Prototype:** A working model of your solution to be tested.
- **Iteration:** Test & redesign is one iteration. Repeat (multiple iterations).
- **Weight:** The force exerted on the object by gravity. (Units: lbs/Newtons).
- **Percentage:** Part of a whole expressed in hundreds (½ = 50%).
- **Height:** The distance from bottom to top or how tall an object is (Units: in/cm).

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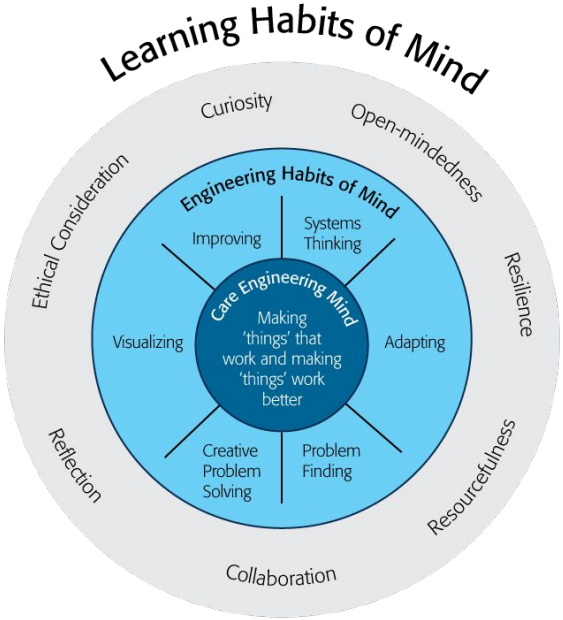
Engineering Habits of Mind (EHM)

EHM is about how engineers think everyday. The core of the engineering mind is about making things that work and making things work better.

- **Systems thinking:** Seeing whole systems and parts and how they connect.
- **Problem-finding:** identifying and defining a problem.
- **Visualising:** manipulating materials and sketching- mental rehearsal of practical design solutions.
- **Improving:** Relentlessly trying to make things better by experimenting, designing, sketching, and prototyping.
- **Creative problem-solving:** generating ideas and solutions with others with many iterations.
- **Adapting:** Testing, analysing, reflecting, & rethinking.



Source: B. Lucas and J. Hanson, *Thinking Like an Engineer: Using Engineering Habits of Mind and Signature Pedagogies to Redesign Engineering Education.* (International Journal of Engineering Pedagogy, Vol 6, No. 2 (2016): https://online-journals.org/index.php/i-jep/article/view/5366)

Engineering Design Process

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The Engineering Design Process

Source: TeachEngineering YouTube Channel

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

Engineering Design Process

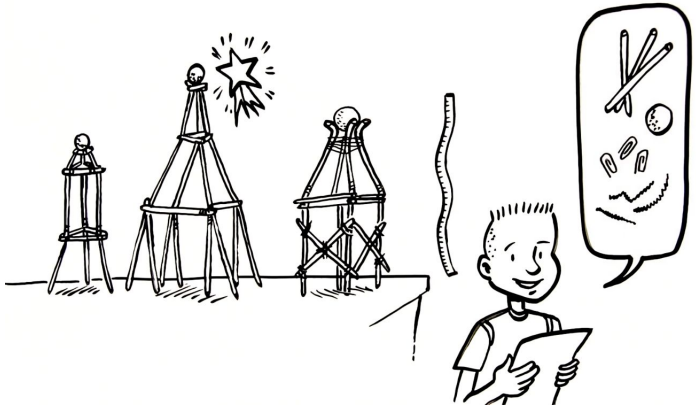
- Divide into teams of two (or more- up to 4 max)
- Review the challenge and criteria & constraints
- Brainstorm possible solutions (sketch while you brainstorm!)
- Choose best solution and build a prototype
- Test then redesign until solution is optimized
- Reflect as a team and debrief as a class

Productive Failure

The engineering design process **involves failure**: test, fail, redesign. Iterate again and again until you have the best possible solution.

It is important to **document your iterations** so they can keep track of each redesign. Use your **engineering notebook** to sketch ideas, document interations and any measurement and/or calculations.

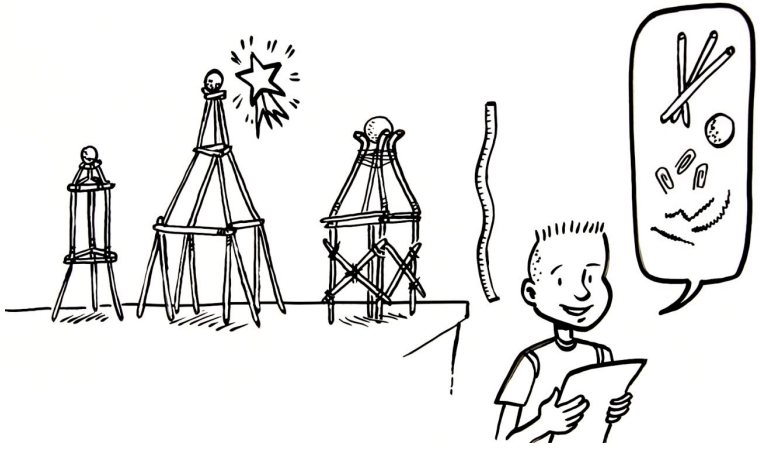
It's also important to showcase the fact that there can be **multiple solutions** to the same problem. There's no one "right" solution.



Consider…

Before you get started brainstorming…consider the following…

- What are the different ways you can bend or change the shape of your materials?
- What is the strongest shape?
- How might you reinforce the materials to make them stronger?
- How will you connect your materials without tape?



Engineering Fields

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Related Engineering Fields

There are many different types of engineering fields that are involved with designing buildings. Here are just some of the related engineering fields.

- Civil Engineering
- Architectural Engineering
- Environmental Engineering

Download the Engineering Fields Infographic.
How will **YOU** change the world?

What is Engineering?

Source: TeachEngineering YouTube Channel

Learn about engineering and how engineers are creative problem solvers and innovators who work to make the world a better place.

Greatest Engineering Achievements of 20th Century

- Electrification
- Automobile
- Airplane
- Water Supply and Distribution
- Electronics
- Radio and Television
- Agricultural Mechanization
- Computers
- Telephone
- Air Conditioning and Refrigeration
- Highways
- Spacecraft
- Internet
- Imaging
- Household Appliances
- Health Technologies
- Petroleum/Petrochemical Technologies
- Laser and Fiber Optics
- Nuclear Technologies
- High-performance Material

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

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Do you know any Engineers?

- How many engineers do you know? Your teammates? Your class?
- What do they do? What engineering degrees do they have?
- What items in your classroom and your school did engineers have a part in creating?

Check out the NAE Grand Challenge for Engineering to help you learn more about how engineers make the world a better place:

- NAE Grand Challenge for Engineering

Reflect & Debrief

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Reflection & Debrief

- How similar was your design to the actual tower you built?
- Which item was most critical to your tower design?
- What material do you wish you had for the challenge?
- How did working as a team help in the design process?
- What did you learn from the designs developed by other teams?
- What would you do different next time?

For more engineering lesson plans and resources like games, engineering careers, and STEM opportunities visit IEEE's TryEngineering.org

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