Powered by IEEE

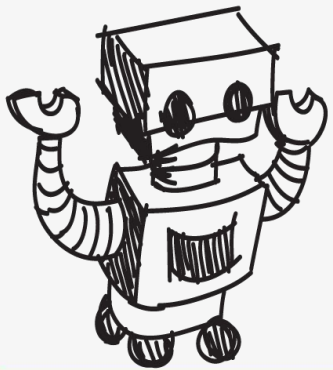
TRY Engineering

Lesson Plan:

Irrigation Ideas

IEEE

The Design Challenge



The Design Challenge

- You are a team of engineers working together to design and build an irrigation system that will carry two cups of water a distance of three feet and split the water into two separate destination containers. If your system works, you'll end up with exactly one cup of water in each of your destination containers.

Defining the Challenge: Criteria & Constraints

Criteria

- Must carry two cups of water a distance of three feet
- Must split the water into two separate destination containers

Constraints

- Use only the materials provided.
- Teams may trade unlimited materials.

Material

Optional for Build – Trading/table of possibilities

- Straws
- Cardboard
- Paper cups or bowls
- Clay
- Tubes
- Aluminum foil
- Rubber bands

Material

Optional for Build – Trading/table of possibilities

- Jars
- Toothpicks
- Paperclips
- Plastic piping

Testing Materials and Process

Testing Material

- 1 Water basin (at least 3 feet long)
- Water
- 1 Cup - Measuring Cup
- 2 Plastic bowls or cups (for destination containers)

Testing Process

- Test each team's irrigation system by placing the system in the water basin and pouring 2 cups of water into the system. Use 2 plastic cups

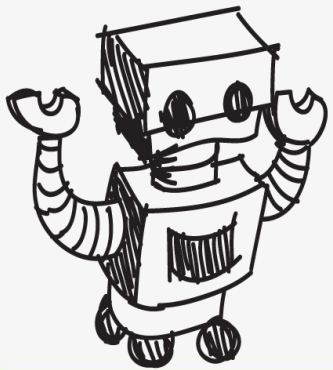
Testing Material Process

or bowls as destination containers. Each team will have three chances to test their irrigation system. At the end of each test, they will measure the amount of water in each of the destination containers. The goal is to end up with one cup of water in each. Each team's best attempt will be recorded.

Consider...

- Before you get started building, consider discussing what irrigation is by using the topics in the Background Concepts section of the lesson plan.

Reflect & Debrief



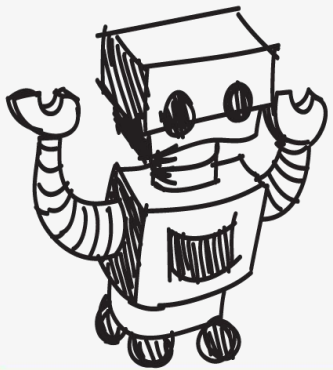
Reflection

- Did you succeed in creating an irrigation system to split the two cups of water into two separate destination containers? What was your best result?
- If your system failed, what do you think went wrong?
- What was unique about either the design or construction of the irrigation system that had the best results on this challenge in your classroom?
- Did you decide to revise your original design while in the construction phase? Why? How?

Reflection

- Do you think that engineers have to adapt their original plans during the construction of systems or products? Why might they?
- If you had to do it all over again, how would your planned design change? Why?
- How do you think your design would have had to change if the material you were distributing was honey?
- Do you think you would have been able to complete this project easier if you were working alone? Explain…

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

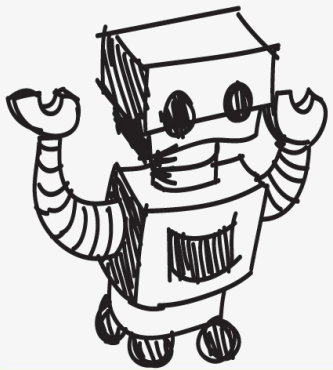
Engineering Design Process

- 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



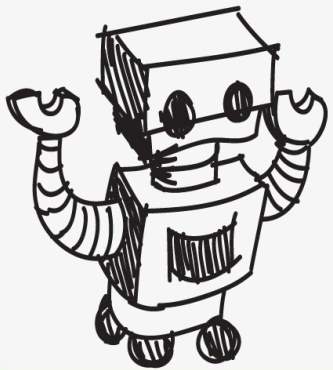
Vocabulary

- 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.
- Ethical considerations: Decisions on what use of resources is most important.
- Irrigation: A system that artificially routes water to an area where it is not naturally present.

Vocabulary

- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).
- Prototype: A working model of the solution to be tested.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Land and Water Development Division of the Food and Agriculture Organization of the United Nations (http://www.fao.org/land-water/land-water/en/)
- Water Science for Schools - U.S. Geological Survey (https://water.usgs.gov/edu/)

Recommended Reading

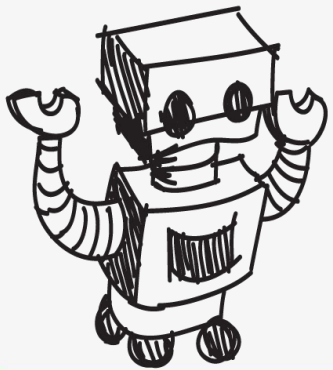
- Irrigation Engineering (ISBN: 1408626241)
- Irrigation: Its Principles And Practice As A Branch Of Engineering (ISBN: 1408626306)

Dig Deeper into the Topic

Writing Activity

Write an essay or a paragraph about how irrigation is impacting life in South Africa, where "water poverty" is widespread. About a third of the country's 36 million people do not have adequate supplies of drinking water.

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)

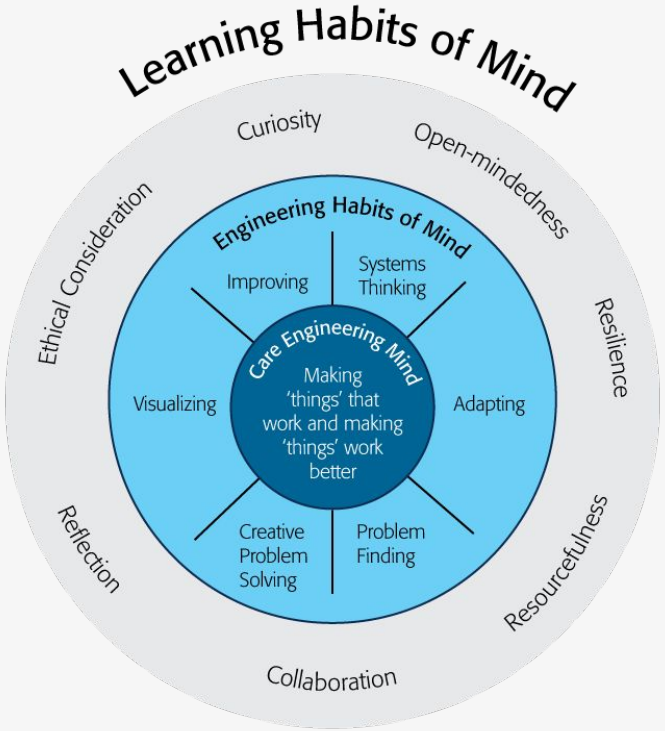
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- There are several types of engineering fields that are involved with the engineering and design of irrigation systems. Here are just some of the related engineering fields.
  - Mechanical Engineering
  - Environmental Engineering

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

Engineering Habits of Mind



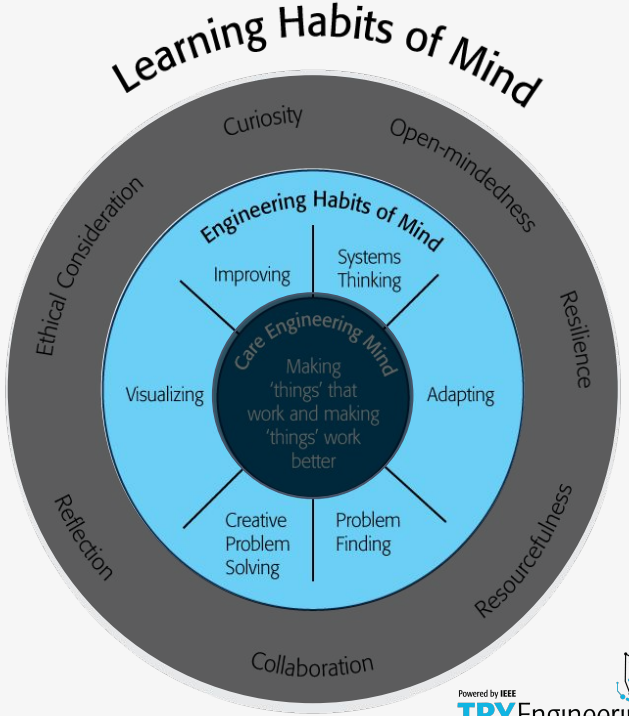
Engineering Habits of Mind (EHM) is about how engineers think everyday. The Core Engineering Mind is about making things that work and making them work better.

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

Powered by IEEE TRYEngineering | IEEE

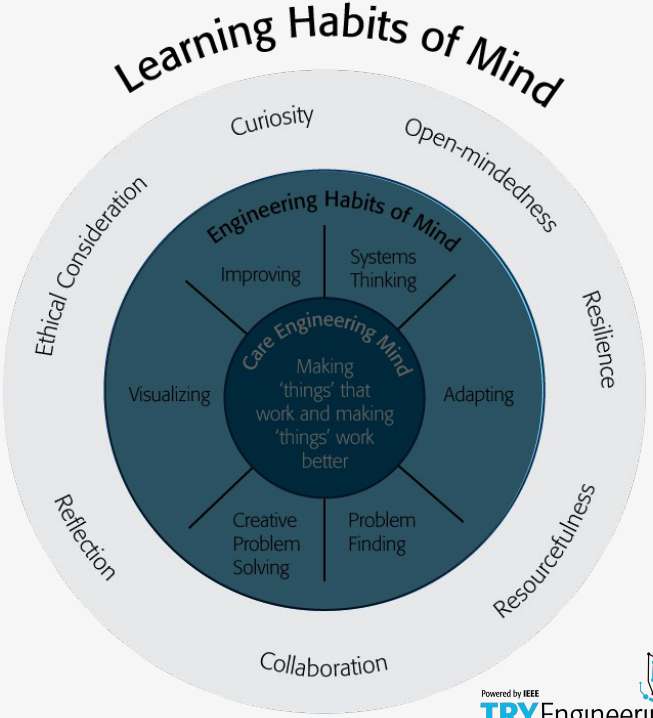
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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

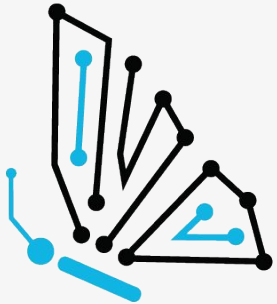


Greatest Engineering Achievements of the 20th Century

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

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