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TRYEngineering



Lesson Plan:

Engineer a Dam



The Design Challenge



The Design Challenge

- You are part of a team of engineers working together to design and build a system to dam up 5 liters of water in a classroom trough. The system must completely hold back the water and it must have a way of executing a controlled release (releasing a little, stopping it, and releasing again).



Defining the Challenge: Criteria & Constraints

Criteria

- System must completely hold back the water
- System must have a way of executing a controlled release (releasing a little, stopping it, and releasing again)

Constraints

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



Material

Required for Build – per team

- Water trough or long plastic planter box
- Gravel or sand (for "river" base)
- Water

Optional for Build – Trading/table of possibilities

- Cardboard
- PVC pipes
- Tape
- Foil



Material

- Plastic wrap
- Cups
- Straws
- Paper
- Clips
- Wooden dowels
- Cotton balls
- Plastic sheets
- Clothespins



Material

- Wire
- String
- Screen
- Fabric
- Springs



Testing Materials and Process

Testing Material

- Use water trough or long plastic planter box from the “build” materials
- Water

Testing Process

Test each dam system design by operating the system and looking to see if any water escapes through the dam. Also see if you are able to stop - start - and stop the flow. Be sure to watch as the dams made by other teams are tested so you can evaluate their designs.

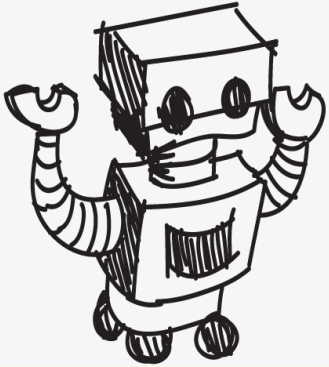


Consider...

- Before you get started building, consider showing sharing and discussing the information from the PBS Building Big - All about Dams website <http://www.pbs.org/wgbh/buildingbig/dam/index.html>.



Reflect & Debrief



Reflection

- How similar was your original design to the actual dam you built?
- If you found you needed to make changes during the construction phase, describe why your team decided to make revisions.
- If you had a chance to do this project again, what would your team have done differently?
- Do you think you could have achieved the goal of this lesson using fewer parts or pieces of material than you did?
- Do you think that this activity was more rewarding to do as a team, or would you have preferred to work alone on it? Why?

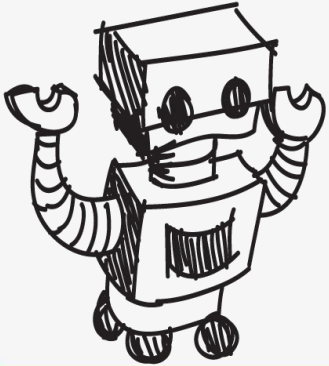


Reflection

- If you could have used one additional material (tape, glue, wood sticks, foil -- as examples) which would you choose and why?
- Can you think of any possible negative effects of a new dam on the ecosystem of a region?



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

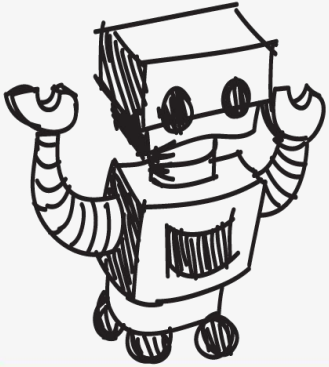


Productive Failure

- 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.
- Dam: A barrier constructed to hold back water and raise its level, forming a reservoir used to generate electricity or as a water supply
- 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.
- Flow: How a fluid, gas, or electricity moves along steadily and continuously in a current or stream.

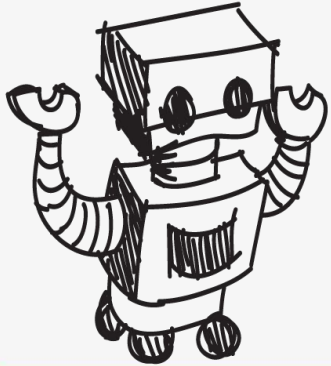


Vocabulary

- Hydroelectric power plants: Produce power using the flow of water that is then delivered to homes and businesses via power line
- 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

- Building Big - All About Dams (www.pbs.org/wgbh/buildingbig/dam)
- GeoGuide: Dams (geoknow.net/pages/dams.html)
- Hydroelectric Power
(www.eia.doe.gov/kids/energy.cfm?page=hydropower_home-basics)
- Tennessee Valley Authority
(www.tva.gov/Energy/Our-PowerSystem/Hydroelectric)



Dig Deeper into the Topic

Recommended Reading

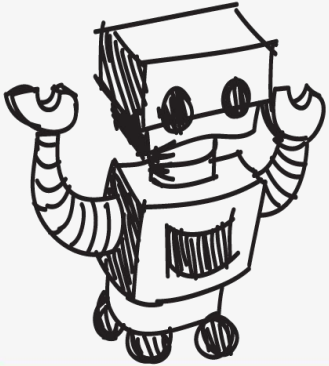
- Dams (Library of Congress Visual Sourcebooks) (ISBN: 978-0393731392)
- Hoover Dam: An American Adventure (ISBN: 978-0806122830)
- Hydroelectric Power: Power from Moving Water (ISBN: 978-0778729341)

Writing Activity

Students can write an essay or a paragraph about how dam construction can impact the environment. What are the ethical considerations an engineering team must consider when constructing a dam or any other structure that has an impact on the environment.



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.

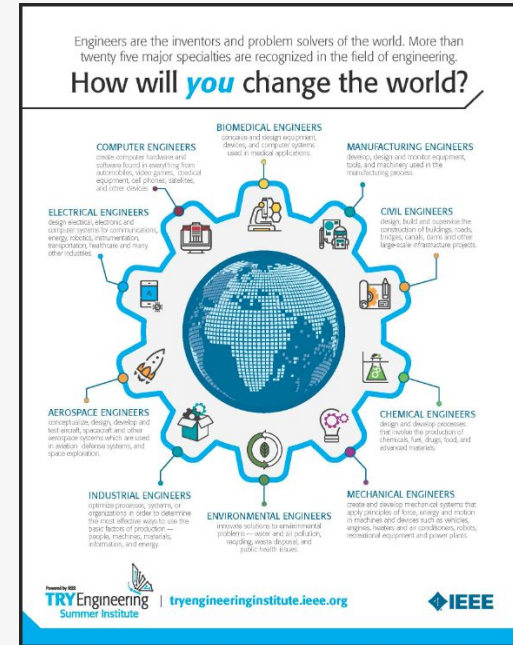
(Video 3:43)



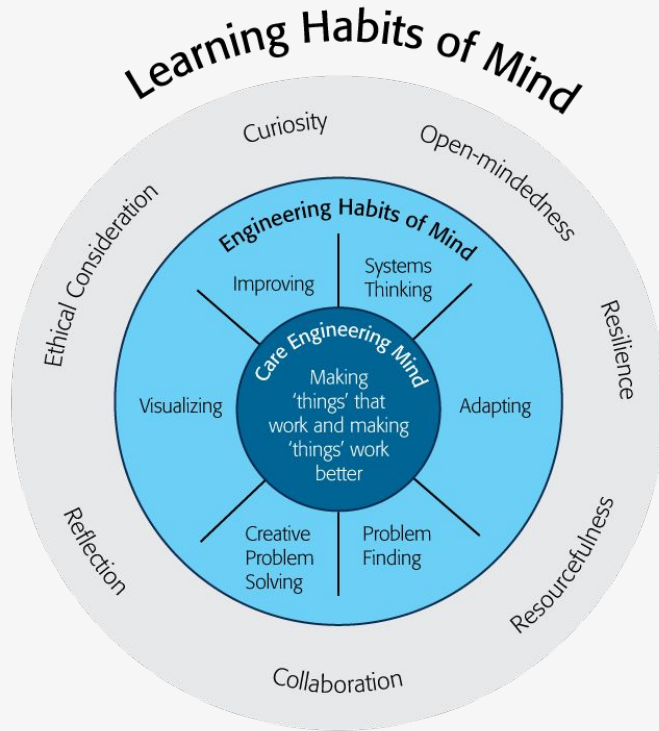
Source: TeachEngineering YouTube Channel - <http://www.youtube.com/watch?v=H9VDkvGmVo>

Related Engineering Fields

- There are several types of engineering fields that are involved with the engineering and design of dams. Here are just some of the related engineering fields.
 - Mechanical Engineering
 - Civil Engineering
 - Electrical 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.

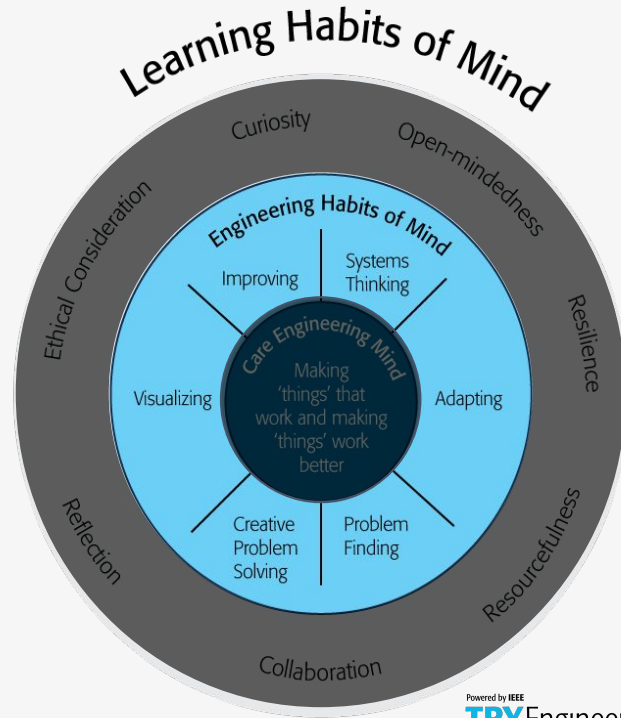
Source:

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



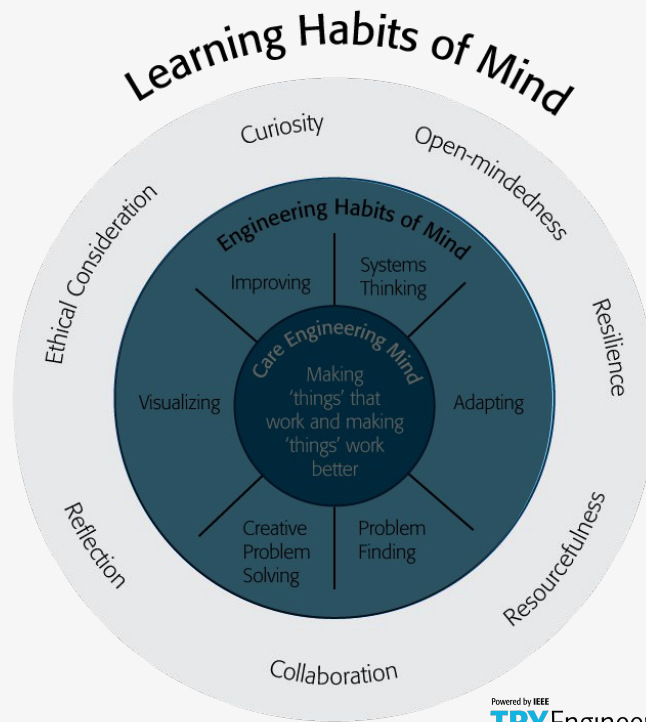
Engineering Habits of Mind Checklist

- ❑ 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 20TH 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/>

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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" and "NATIONAL ACADEMY OF ENGINEERING". Navigation buttons for "Challenges", "News", and "Community" are in green. The main visual is a green puzzle piece with a nuclear fusion icon, set against a background of glowing green lines and dots. 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 a smartphone, VR, a lightbulb, a bridge, a water drop, a nuclear symbol, a CO2 canister, a microscope, a brain, a laptop, a padlock, a gear, a circular arrow, and a DNA helix.

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)

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