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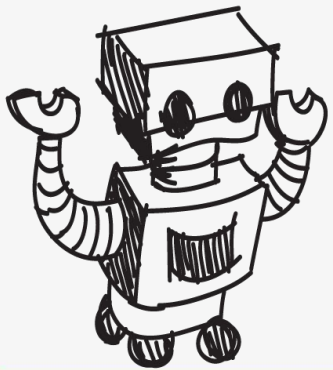
TRY Engineering

Lesson Plan:

Oil Spill Solutions

IEEE

The Design Challenge



The Design Challenge

You are part of a team of engineers who have been given the challenge of first containing and then cleaning up an oil spill. You will have many materials available to you, but will have to come up with a strategy to remove as much oil as possible.

Defining the Challenge: Criteria & Constraints

Criteria

- Contain as much oil as possible
- Clean up as much oil as possible

Constraints

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

Material

Materials – Required (Each team)

- Small plastic bowls or aluminum containers (to hold water and “oil”)
- Water
- “Oil” (use ½ cup vegetable oil - mix with cocoa powder for more realistic looking oil)

Material

Materials – Required (Trading/Table of Possibilities)

- Rubber bands
- Paper towels
- String
- Toothpicks
- Cotton balls
- Plastic wrap
- Popsicle sticks

Material

- Shredded wheat or puffed rice cereal
- Balloons
- Spoons
- Cooking basters, eye droppers, or suction tubes

Material

Optional Materials (Trading/Table of Possibilities)

- Cooked rice
- Garden peat moss
- Grass
- Cork

Testing Materials and Process

Testing Material

- Students use the container, water and “oil” listed in the required materials section

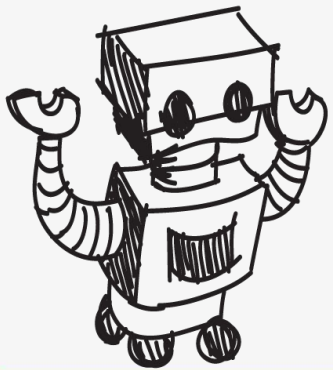
Testing Process

Using the containers, water, and “oil” - Each team first demonstrates how their system has contained the oil spill. Then, they demonstrate how their system cleans up the oil spill.

Consider...

- Before you get started building, outline your containment process and materials, and outline your clean up process and materials.

Reflect & Debrief



Reflection

- Did you succeed in removing all the oil from the "oil spill?" What was the score your team achieved?
- If your system failed, what do you think went wrong?
- Describe a system another student team created that you thought worked well. What did you do differently?
- How did your decisions on engineering trade-offs differ from that team? What goals or priorities for your system did you put above others?
- Did you decide to revise your plan while actually doing the containment or clean-up? Why? How?

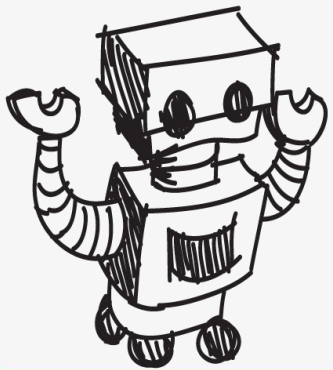
Reflection

- Why might a team of environmental engineers change their planned approach to an oil spill clean-up once they arrived on the site? Do you think it is common that professionals change their plans while on the job?
- If you had to do it all over again, how would your team have improved your containment system? Why?
- If you had to do it all over again, how would your team have improved your clean-up system? Why?
- Do you think that experience with prior oil spills would make a team of engineers more able to address the next unexpected one?

Reflection

- Now that you have learned about the different trade-offs engineers must factor into a product or system, if you were designing a new rail-based oil transportation system, what considerations would you have to balance in your new design (consider costs, environmental issues, public health, speed of transport)?
- What other materials do you think would have helped speed up your containment or clean-up?

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

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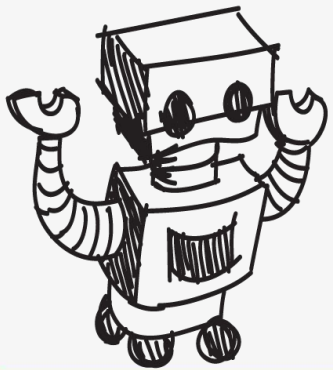
Productive Failure

- 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

- Bioremediation: Using microorganisms or biological agents to break down or remove oil
- Burning: Controlled burning can often eliminate a large proportion of oil in water, but of course requires great care to avoid having the fire spread. The burning oil can also cause air pollution.
- Constraints: Limitations with material, time, size of team, etc.
- Criteria: Conditions that the design must satisfy like its overall size, etc.
- Dispersion: Materials such as some detergents can disperse oil into smaller clusters that may be easier to remove than larger areas. However, the detergents can sink deeper into the water than oil does, so it may cause harm deeper in the water while reducing negative environmental impact on the surface.

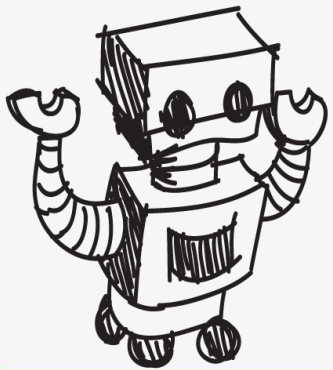
Vocabulary

- Dredging: Some oils are actually denser than water, and would sink. These would require cleaning below the surface of the impacted water.
- 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).
- Oil: A liquid found beneath the earth's surface, or the products made from this liquid and used for fuel or lubrication; petroleum

Vocabulary

- Oil spill: An accidental release of liquid petroleum hydrocarbons (usually during transportation of oil) into the environment
- Prototype: A working model of the solution to be tested.
- Skimming: Can be effective areas where the water is calm.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Oil Spill Recovery Institute (http://www.pws-osri.org/)
- NOAA's National Ocean Service Office of Response and Restoration (http://response.restoration.noaa.gov/)

Recommended Reading

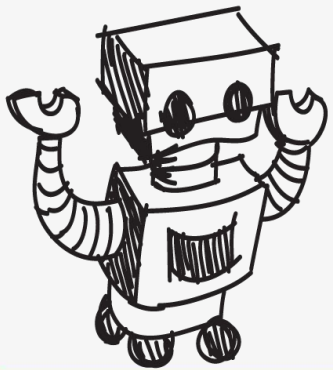
- The Oil Spill Recovery Institute: Past, Present, and Future Direction (ISBN: 0309085144)
- The Basics of Oil Spill Cleanup (ISBN: 1566705371)
- Oil Spills (Our Environment Series) (ISBN: 0737726296)

Dig Deeper into the Topic

Writing Activity

Write an essay or a paragraph about how systems developed by engineers in advance of a natural disaster (earthquake) or human-induced disaster (oil spill) can help speed recovery of both the environment and society.

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 cleaning up oil spills. Here are just some of the related engineering fields.
  - Environmental Engineering

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

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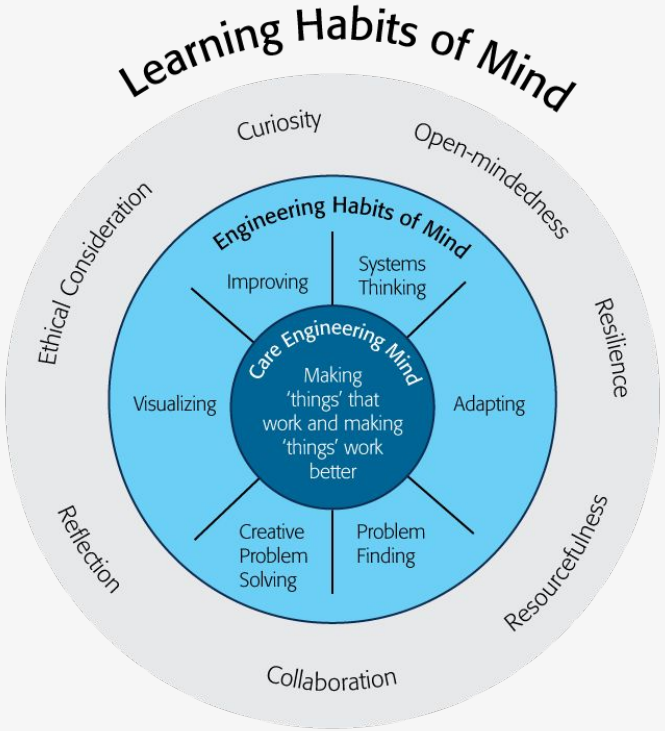
Engineering Habits of Mind



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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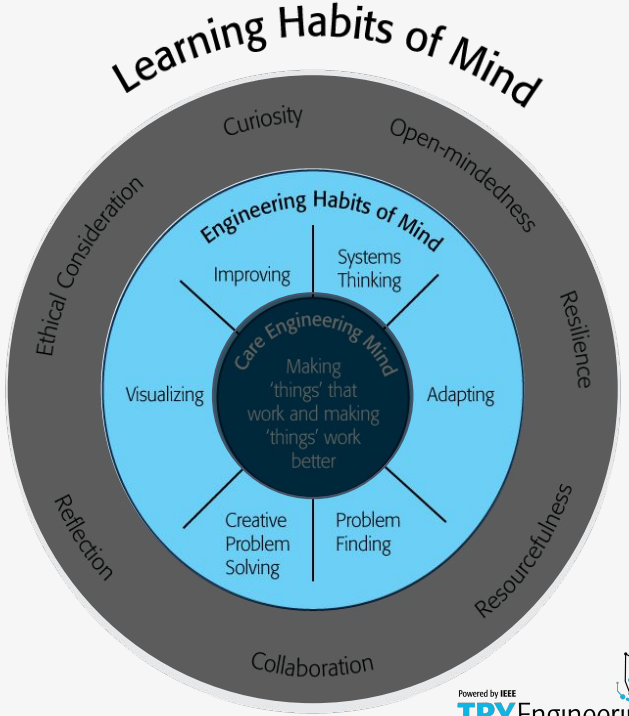
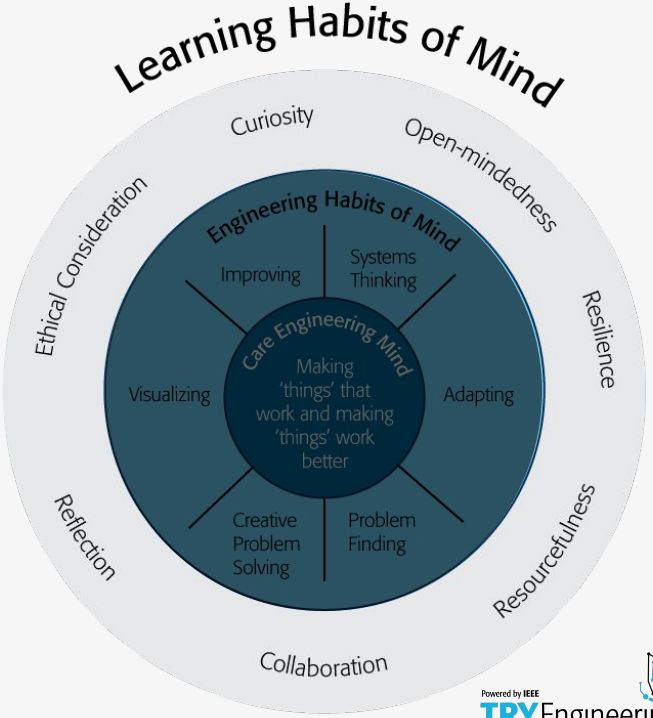
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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

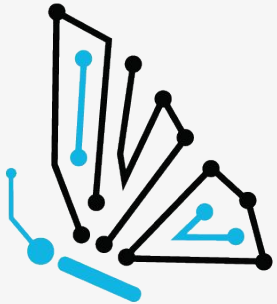


Greatest Engineering Achievements of the 20th Century

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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