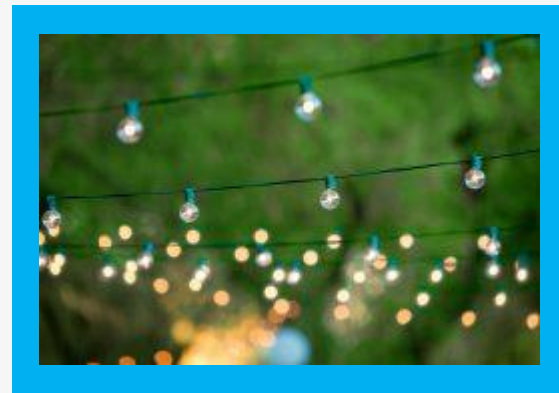




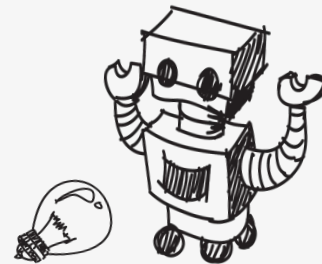
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TRYEngineering



Lesson Plan:

Series and Parallel Circuits



The Design Challenge



The Design Challenge

You are a team of engineers working together to design a system where one switch can turn on multiple lights. An example might be a string of lights.



Defining the Challenge: Criteria & Constraints

Criteria

- Must diagram a parallel circuit
- Must build and test both a series and parallel circuit

Constraints

- Use only the materials provided.



Material

Materials – 2 Sets for each Team

- 6 pieces of bell wire (6" each) with ends stripped
- Battery holder
- Socket
- Three or more 1.5 volt bulbs
- Size D batteries

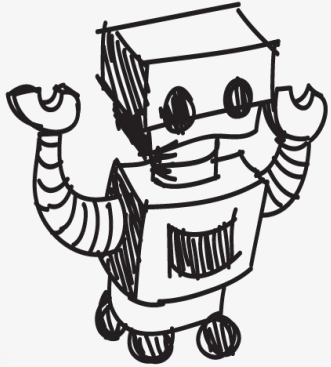


Consider...

- Before you get started building, consider providing definitions of Series and Parallel circuits and discuss the differences.
 - Series Circuits: Electricity has only one path on which to travel.
 - Parallel Circuits: Electricity has more than one path on which to travel.



Reflect & Debrief

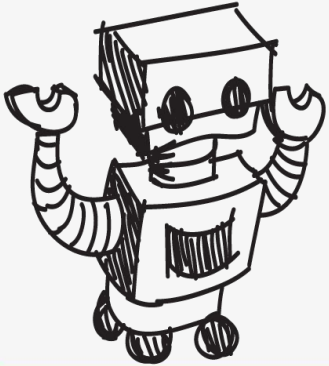


Reflection

- Were your predictions about the brightness of the bulbs accurate? If not, what happened that was different from what your group expected?
- Were your predictions about what happened if a bulb was removed from the parallel and serial circuits accurate? If not, what happened that was different from what your group expected?



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

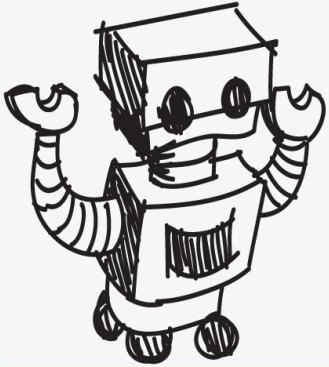


Productive Failure

- 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

- Circuit: The loop that electricity flows through. A circuit begins at a power source, such as a battery, and flows through wires and electrical components (such as lights, motors, etc.).
- Conductor: Material that allows electricity to flow through it.
- 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.

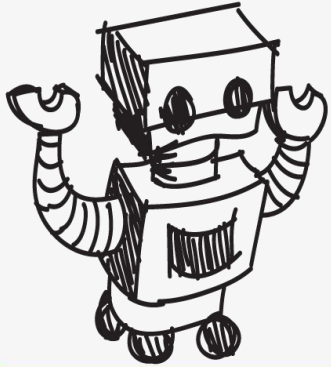


Vocabulary

- Insulator: Material that does not allow electricity to flow through it.
- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).
- Parallel Circuit: Allows multiple paths for electricity to flow through.
- Prototype: A working model of the solution to be tested.
- Resistance: Insulation is measured in resistance. The more insulating a material, the more resistance it has.
- Series Circuit: Allows one path for electricity to flow through.
- Short Circuit: When wires that are not supposed to come in contact with each other touch.



Dig Deeper



Dig Deeper into the Topic

Recommended Reading

- DK Eyewitness Series: Electricity (ISBN: 0751361321)
- Make Cool Gadgets for Your Room by Amy Pinchuk and Teco Rodriques (ISBN: 1894379128)
- My World of Science: Conductors and Insulators by Angela Royston (Heinemann Educational Books, ISBN: 0431137269)



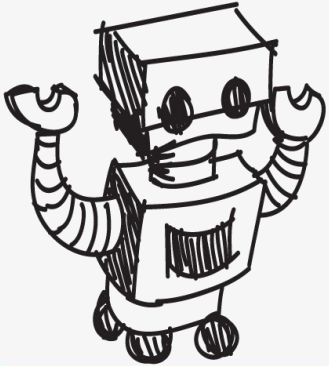
Dig Deeper into the Topic

Writing Activity

- Write an essay (or paragraph depending on student age) describing how replacing one light on a string of bulbs with a "blinking" light would cause all the lights in the string to also blink. Is this an example of a parallel or series circuit? Why?



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.

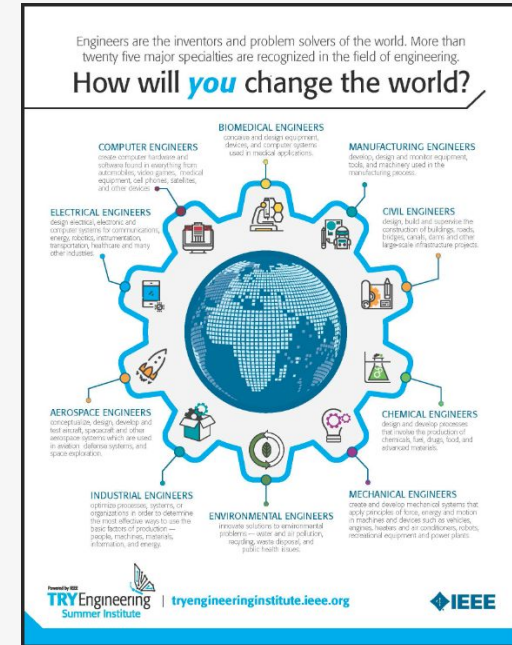
(Video 3:43)



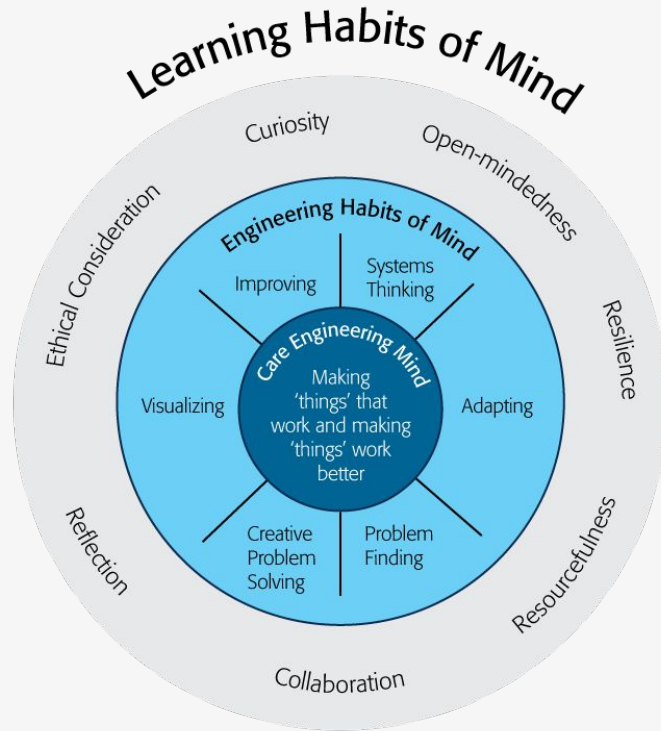
Source: TeachEngineering YouTube Channel - <http://www.youtube.com/watch?v=H9VDkvqGmVo>

Related Engineering Fields

- There are several types of engineering fields that are involved with electrical circuits. Here are just some of the related engineering fields.
 - 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.

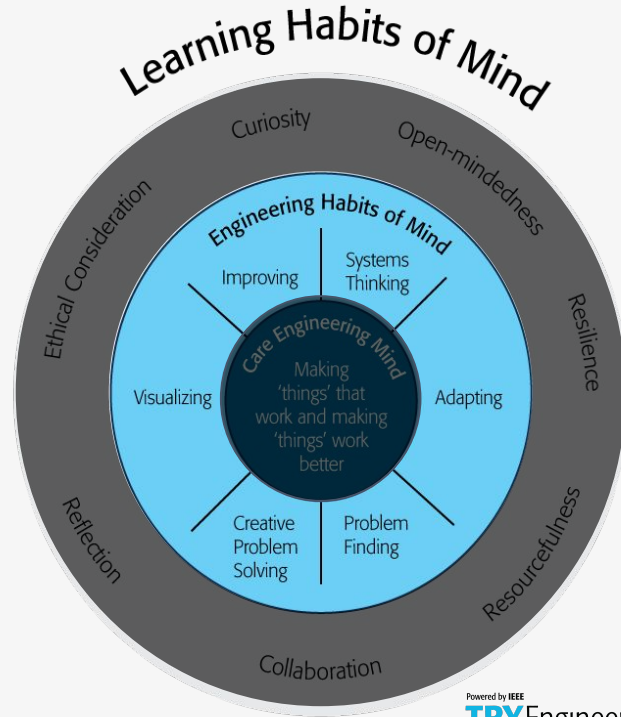
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<https://online-journals.org/index.php/i-jep/article/view/5366>



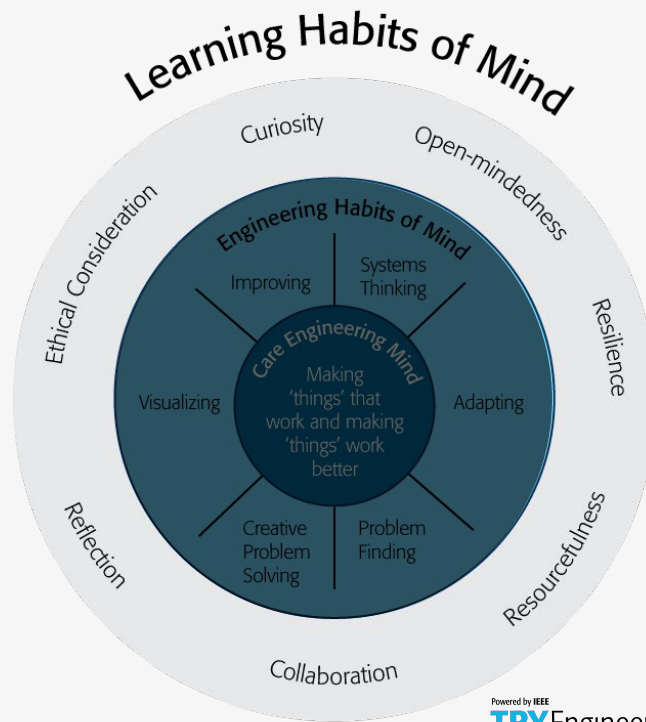
Engineering Habits of Mind Checklist

- ❑ 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 large green puzzle piece on the left with a white atomic symbol, and a network of glowing green lines radiating from a central point on a dark background. Below this, the text "Provide energy from fusion" is displayed, followed by a paragraph about scaling up fusion. A row of 15 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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