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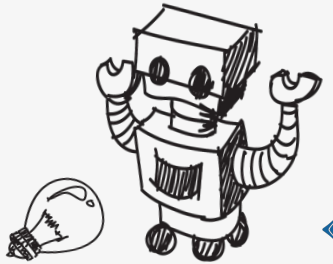
TRY Engineering

Lesson Plan:

Robot Basketball



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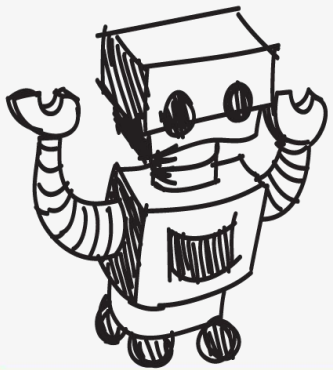
The Design Challenge



The Design Challenge

You are part of a team of engineers challenged to design and build a “robot” basketball player. The “robot” must be able to accurately shoot three free-throw shots into a net that is 2 feet above the floor and 6 feet from the “robot.”

Defining the Challenge: Criteria & Constraints

Criteria

- Net must be 2 feet above the floor (or desk) and 6 feet from the "robot."

Constraints

- Only get 3 free-throw shots for the tryout
- Use only the materials provided
- Teams may trade unlimited materials

Material

Materials – Required (Table of Possibilities)

- Pieces of corrugated cardboard (different sizes cut out of boxes)
- Card stock and/or file folders
- Cups and Plates (foam, plastic and paper all different sizes)
- Plastic spoons
- Rulers
- String
- Pipe cleaners
- Craft Sticks

Material

Materials – Required (Table of Possibilities)

- Straws
- Binder Clips (all sizes)
- Paper Clips (all sizes)
- Rubber Bands
- Craft Wire or pipe cleaners
- Wood skewers
- Clay
- Paper and/or Construction paper
- Optional: Basketball

Testing Materials and Process

Testing Material

- Chair, desk or small table (surface is 2 feet above the floor)
- Trash can (small)
- Plastic cups (different sizes)
- Masking tape
- Ping Pong Balls (3 or more, the ones painted like a basketball are fun or use a sharpie to add the lines yourself)

Testing Materials and Process

Testing Zone Set-up

Set up the Testing Zone with a “net” - small trash can or a plastic cup (depending on how challenging you would like it to be)

- Tape the “net” on a chair, desk or small table (2 feet above the floor)
- Place a piece of masking tape on the floor 6 feet away from the net - this is the starting line
- Place 3 ping-pong balls in a cup at the starting line
- Have each team use their robot design to make 3 free throw shots from the starting line

Testing Materials and Process

- Teams document how many of their shots go into the net and then calculate their percentage of accuracy (see below). They also note the precision of each shot (how close they land to each other)

Optional Testing Zone Set-up

- Tape a cup to the wall (2 feet above a desk)
- Place a desk 6 feet away - this is the starting line
- Place 3 ping-pong balls in a cup at the starting line
- Have each team use their robot design to make 3 free throw shots from the starting line

Testing Materials and Process

Calculating Accuracy

- Accuracy is how close a measured value is to the actual (true) value.
- Precision is how close the measured values are to each other.

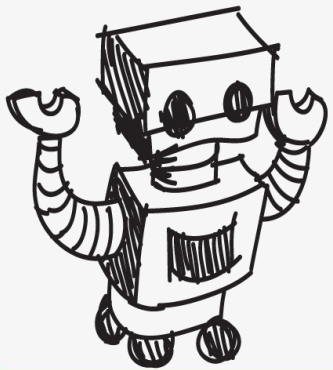
Each team calculates their percentage of accuracy by taking how many of their shots went into the net divided by 3 shots multiplied by 100.

Consider...

- Before you get started building, consider the different types of shots players make when shooting a basketball.

[The official types of shots involved in basketball are the mid-range shot, the layup, the three-pointer, the dunk, the alley-oop, the half-court shot, and the free-throw shot.]

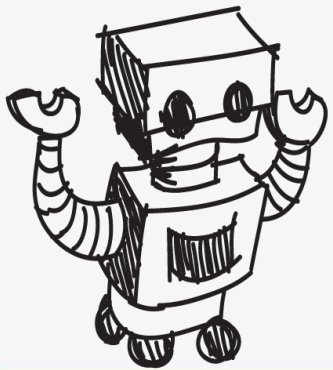
Reflect & Debrief



Reflection

- What went well?
- What didn't go well?
- Were there any trades-offs (an exchange that occurs as a compromise or concession) you had to make with your design? If so, explain.
- What is your favorite element of your "Robot"?
- If you had time to redesign again, what changes would you make?

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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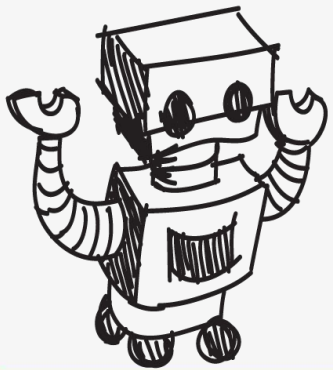
Productive Failure

- 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



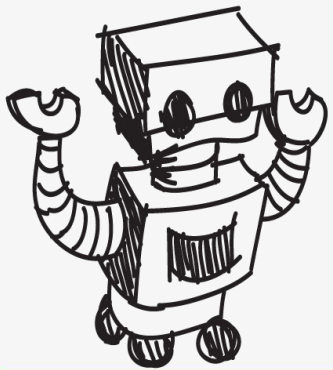
Vocabulary

- Accuracy: How close a measured value is to the actual (true) value
- Constraints: Limitations with material, time, size of team, etc.
- 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.
- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).

Vocabulary

- Lever: Levers are machines used to increase force.
- Precision: How close the measured values are to each other.
- Prototype: A working model of the solution to be tested.
- Simple machines: Any of several devices with few or no moving parts that are used to modify motion and the magnitude of a force in order to perform work.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Accuracy and Precision: (www.mathsisfun.com/accuracy-precision.html)
- Lever: (www.juniorengineering.usu.edu/workshops/machines/machines.php)

Recommended Reading

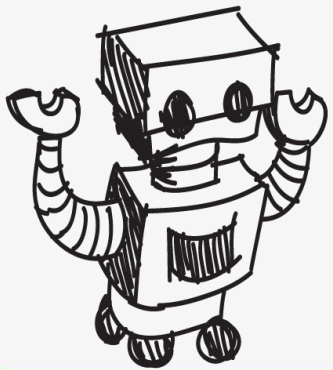
- Robot (DK Eyewitness Books) (ISBN: 978-0756602543)
- Levers (Simple Machines) (ISBN: 978-1403485632)
- Real World Math: Basketball (9781602792456)

Dig Deeper into the Topic

Writing Activity

Students could write short stories about their team's free-throw player and/or the World Robotic Basketball League (WRBL), personifying the "robot(s)." Students could create an ad that will promote the WRBL to draw more people to the games. Students could write an explanatory essay detailing the steps their robot takes to make an accurate free-throw shot.

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)

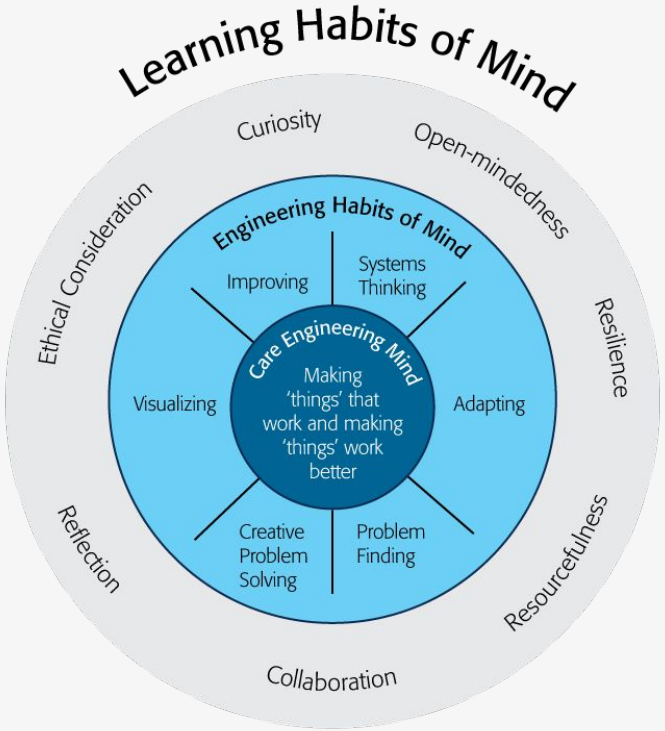
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- There are several types of engineering fields that are involved with the design of levers and simple machines. Here are just some of the related engineering fields.
  - Mechanical 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)

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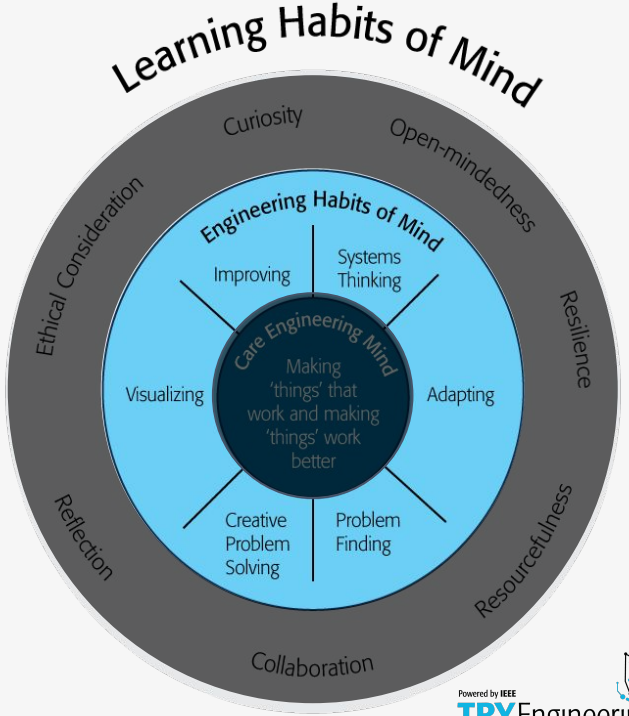
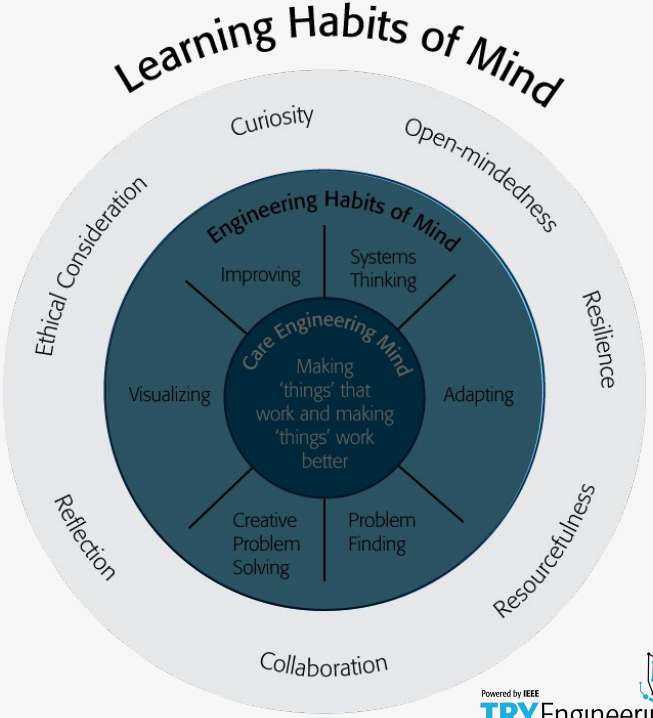
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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

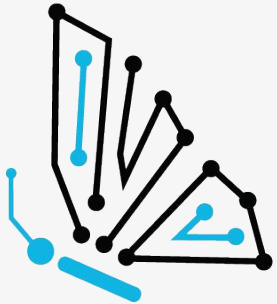


Greatest Engineering Achievements of the 20th Century

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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