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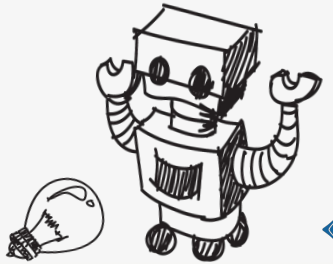
TRY Engineering

Lesson Plan:

Salamander Crossing



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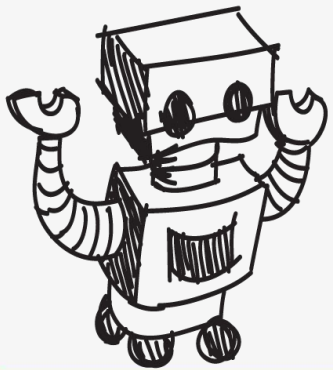
The Design Challenge



The Design Challenge

In the springtime, adult salamanders leave their forest homes and return to vernal pools where they breed and lay eggs. If a roadway exists between these two habitats, they have to cross the road to reach this very important destination.

You are a team of engineers working together to design a way to get a salamander safely from one side of the road to the other. You will first build a model habitat that includes a wooded area on one side, a vernal pool on the other side and a road running in between. Then, you will need to change your model into a salamander-friendly habitat by building a way for the salamander to get from the woods to the vernal pool without having to cross the road.

The Design Challenge

Remember that you may need to build something to help guide salamanders to your crossing as well. Salamanders also have to remain damp in order to survive. Think about how your crossing will allow for this.

Defining the Challenge: Criteria & Constraints

Criteria

- Habitat must have a wooded area on one side, a vernal pool on the other side and a road running in between
- Salamander has to remain damp to survive

Constraints

- Use only the materials provided.

Material

Materials – Required (Table of Possibilities)

- Student worksheets with photo of salamander (for students to cut out and color) or provide pre-cut salamanders
- Clay or play dough, in multiple colors (including blue, green, and black)
- Clay or play dough tools (rollers/rolling pins, cookie cutters)
- Paperclips
- String
- Strips of paper or cardstock

Material

- Paper towel and toilet paper tubes or sheets of cardboard to roll up
- Trays or small boxes or box tops
- Natural material, like twigs, pine needles, and leaves, which can be used to represent different natural areas in the model

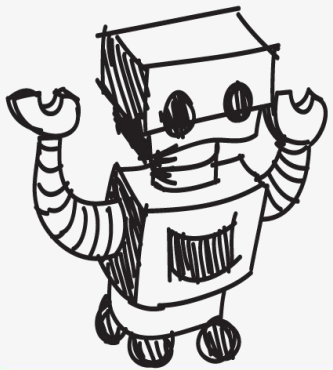
Testing Process

Students test their salamander crossing by attaching string to their salamander and placing it in the woods. They will then pull the salamander through or over the crossing (it can be pulled through tunnels, etc., if necessary).

Consider...

- Before you get started building, consider that you must first build a model habitat that includes a wooded area on one side, a vernal pool on the other side and a road running in between.
- Then, they will need to change the model into a salamander-friendly habitat by building a way for the salamander to get from the woods to the vernal pool without having to cross the road.

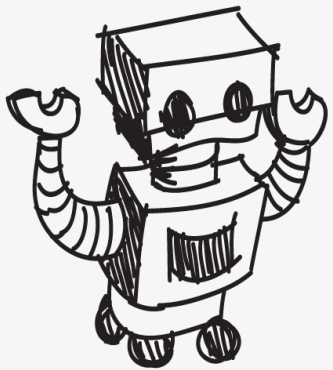
Reflect & Debrief



Reflection

- What method did you choose for your salamander crossing? Why? How will your design make sure salamanders can stay damp?
- How did your crossing work when you tested it? Were there any problems?
- How do you think you could improve upon your design? What changes would you make to it?
- What ideas did your classmates come up with that you liked? Are there any ideas you would want to incorporate into your design?

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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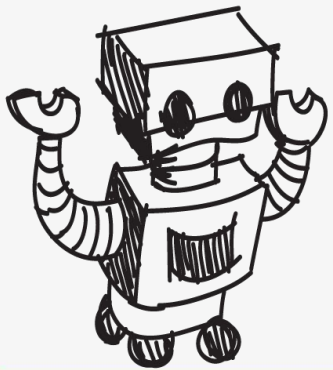
Productive Failure

- 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



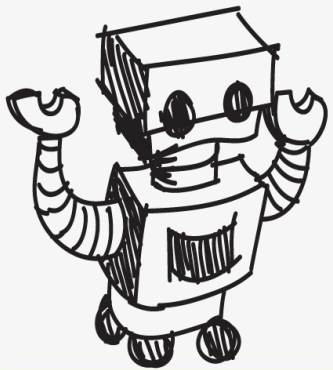
Vocabulary

- Conservationist: A person who tries many methods to help salamanders and other amphibians migrate safely.
- 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

- Method: Way to solve a problem or challenge.
- Migrate: To pass from one region to another on a regular basis. Many birds migrate south for the Winter.
- Prototype: A working model of the solution to be tested.
- Vernal pools: Where salamanders breed, lay their eggs, and the hatched larvae begin their lives living in the water.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- Animals Need Infrastructure Too (www.citylab.com/life/2018/07/wildlife-crossingsbridges-tunnels-animals-roads-highways-roadkill/566210/)
- Banff Wildlife Crossing (https://mymodernmet.com/wildlife-crossings/)
- Wildlife crossings stop roadkill. Why aren't there more? (www.youtube.com/watch?v=ND0D3bVbM7Y)
- Salamander Crossing Brigade (www.wmur.com/article/tuesday-may-9thsalamander-crossing-brigade/9604209)

Dig Deeper into the Topic

Internet Connections

- Salamander Crossing (www.youtube.com/watch?v=VbPIjRb4zc8)
- There Are Teeny Tiny Underpasses for Salamanders in Massachusetts (www.boston.com/cars/news-and-reviews/2015/03/25/there-are-teeny-tinyunderpasses-for-salamanders-in-massachusetts)

Recommended Reading

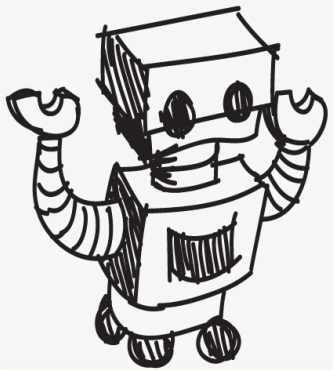
- Salamander Sky by Katy Farber (ISBN: 978-0999076644)
- Amphibian by Barry Clarke (ISBN: 978-0756613808)
- Salamander Dance by David FitzSimmons (ISBN: 978-1936607006)
- How Do Wildlife Crossings Save Animals? (ISBN: 978-1543541380)

Dig Deeper into the Topic

Writing Activity

Think about where you live and the types of wildlife you encounter. Are there areas where these encounters are problematic? Or where natural movements of animals are disrupted? What do you think should be done to help keep humans and animals safe? If you could design a new structure in your community, or change an existing one, what would it be?

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)

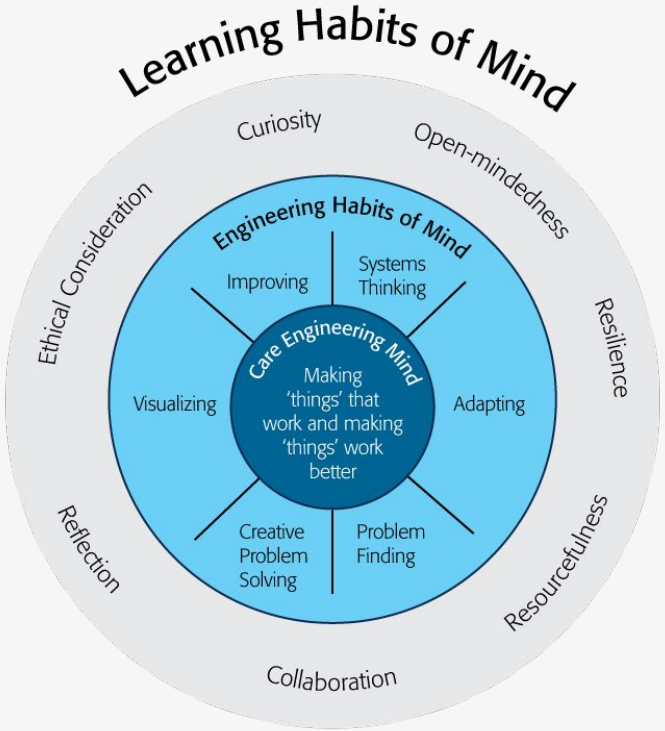
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- There are several types of engineering fields that are involved with designing safe ways to help animals. 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)

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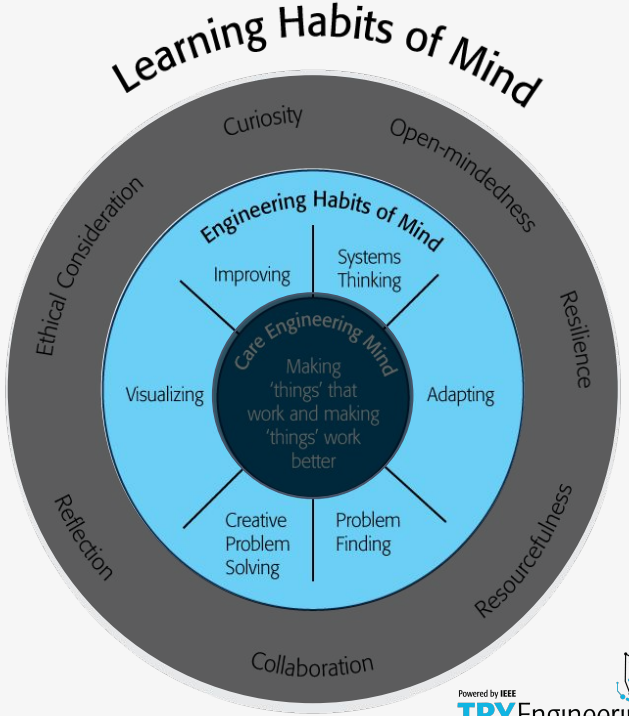
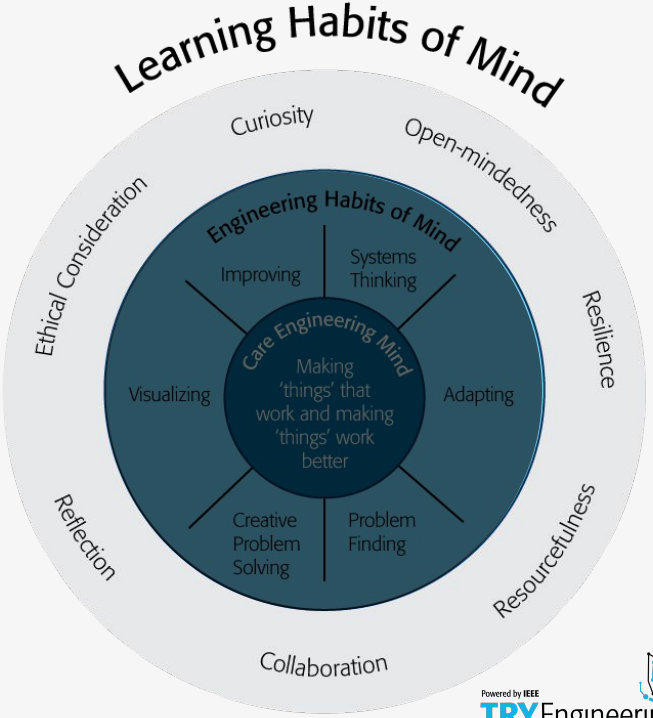
Engineering Habits of Mind Checklist

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



Learning Habits of Mind Checklist

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

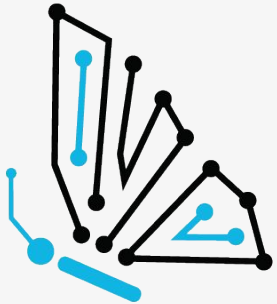


Greatest Engineering Achievements of the 20th Century

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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