Helping Kids Learn – Post #6 4/14/20

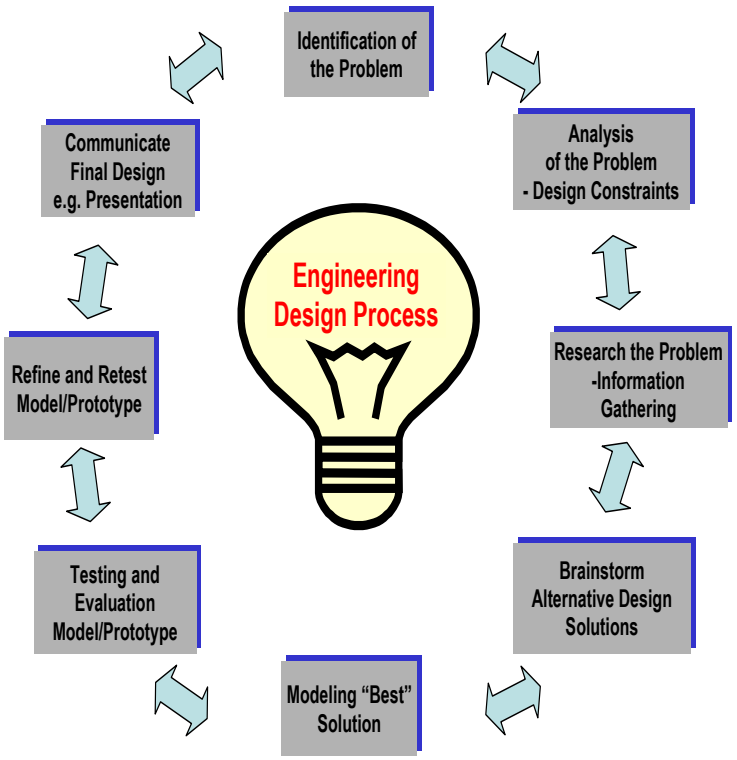
STEM: Engineering – Engineering Design Process

If you have a problem to solve, whether it's in your math assignment or conquering Mount Everest, you can go about it one of two ways: randomly trying things until you (maybe) find a solution or in a step-by-step, organized manner. In this investigation, you'll learn the method that engineers use. It can be done by learners of many ages. See Lift the Level below.

Be an Engineer – Solving Problems

Engineers solve many kinds of problems that make people's lives safer and better. There are dozens of kinds of engineers – Civil Engineers build bridges and roads and water systems and more, Electrical Engineers design and build everything electronic, Chemical Engineers use chemistry to solve problems like safe ways to put out fires and Industrial Engineers build machines that can make thinks from alphabet soup to fences in zoos. The list goes on and on. Regardless of what special field of engineering they use, all engineers learn a process that helps them be organized and have a system that will (most of the time) get them a useful result. It's called the Engineering Design Process (EDP).

Here is an EDP you can use to solve the problems below:



Start at the top and move clockwise around the steps for the first problem solving investigation.

You are an Aeronautical Engineer who makes airplanes, rockets, hot air balloons – anything that can fly. You have been hired to make and fly a new design for a paper airplane for a distance of 10 feet (25 feet if you're older and have made a lot of paper airplanes!). **Never fly it toward a person.**

EDP Step 1 – What is the problem you have to solve? _____

EDP Step 2– Analyze the problem; List the things you must use and the things your airplane must do:

_____

_____

EDP Step 3 – Gather information (research). Try https://www.wikihow.com/Make-a-Paper-Airplane. Or make a paper airplane using your old method. You may want to sketch and/or make notes.

_____

_____

_____

EDP Step 4 – Brainstorm: This is really important, don't skip it. Think of other ways you could make a plane look or what you could do for it to fly farther. What kind of paper do you think you can use? Ask your friends or family. Sketch and make notes.

_____

_____

_____

EDP Step 5 – Decide on one idea and make a model.

EDP Step 6 – Fly your model. Remember the distance it has to fly. No ruler or tape measure? Standard vinyl floor tiles are 12 inches long; ceramic are probably 3 or 4 inches. The mattress on your bed is probably between 6 and 7 feet from head to foot.

EDP Step 7 – Refine your model. Does it need to fly farther? What can you do to "fix" it? Would changing the paper make a difference? Would adding or subtracting weight help? Make your new model and test it. You might have to do this more than once! The Wright Brothers, first people to fly an airplane across a distance, make at least 21 different models and 2 more of their designs were made – and changed! – by someone else.

EDP Step 8 – Communicate. Tell your family or a friend about your work. Show your best model. Tell what you had to do, what you changed, what you want to try next.

Lift the Level You can make this lesson deeper and/or suitable for older students by any of the following:

1. Imposing more or more restrictive design constraints on any problem can make it more challenging. For the paper airplane problem, for instance, you might
   - increase the distance flown,
   - fly it outside (away from other people) where the wind or other conditions have to be considered,
   - use newspaper or tissue paper,
   - add a paperclip or a penny to increase the weight (where to put it becomes a problem within the problem),
   - use very stiff paper such as the cardboard from a cereal box,
   - add an additional design constraint such as the plane turning in flight. See Immelmann Turns for example. https://en.wikipedia.org/wiki/Immelmann_turn (this is Step 3!)
2. Design a better face mask to cover your nose and mouth, allow you to breath freely and keep air from getting in. **Never, ever use plastic against anyone's nose or mouth! Never tie anything around a person's neck.**
3. Identify a problem in your home that can be solved with better engineering.
4. Figure out the best way to move a box from one point to another for the least effort (work) and at the lowest cost.
5. Build a better liquid soap dispenser.
6. Make a container that will pour milk or water without spilling.
7. Research England's most famous civil engineer, Isambard Kingdom Brunel (1806-1859). In 2002 people who watched the BBC voted him the 2nd most famous Briton in history.

Maidenhead Railroad Bridge designed & built by I.K. Brunel in 1838 and still in use

STEM Online

Take a virtual tour of the Brunel Museum in London. It's famous for more than engineering. (There's also one in Bristol. Figure out why.) This will get you started: https://www.thebrunelmuseum.com/

NJ Student Learning Standards Yes, New Jersey has learning standards for engineering and also career awareness.

Technology Standard 8.2 Technology Education, Engineering, Design and Computational Thinking-Programming is based upon the International Technology and Engineering Educators Association Standards for Technological Literacy

21st Century Life and Careers Standard 9.2 Career Awareness, Exploration, and Preparation