Why Teach Engineering and Design?

From Engineering is Elementary (a program of the Museum of Science, Boston)
If you've ever watched children at play, you know they're fascinated with building things—and with taking things apart to see how they work. In other words, children are natural-born engineers. When children engineer in a school setting, research suggests several positive results:

Building Science and Math Skills
Engineering calls for children to apply what they know about science and math—and their learning is enhanced as a result. At the same time, because engineering activities are based on real-world technologies and problems, they help children see how disciplines like math and science are relevant to their lives.

Classroom Equity-- Research suggests engineering activities help build classroom equity. The engineering design process removes the stigma from failure; instead, failure is an important part of the problem-solving process and a positive way to learn. Equally important, in engineering there's no single "right" answer; one problem can have many solutions. When classroom instruction includes engineering, all students can see themselves as successful.

21st Century Skills-- Hands-on, project-based learning is the essence of engineering. As groups of students work together to answer questions like "How large should I make the canopy of this parachute?" or "What material should I use for the blades of my windmill?" they collaborate, think critically and creatively, and communicate with one another.

Career Success-- Classroom engineering activities often require students to work in teams where they must collaborate and communicate effectively. In the 21st century, these skills will be critical for career success in any field.
Research also shows that when engineering is part of elementary instruction, students become more aware of the diverse opportunities for engineering, science, and technical careers—and they are more likely to see these careers as options they could choose.
This finding is important at a time when the number of American college students pursuing engineering education is decreasing. Early introduction to engineering can encourage many capable students—but especially girls and minorities—to consider engineering as a career and take the necessary science and math courses in high school.

Engaged Citizens-- Finally, consider some of our nation's most pressing policy issues—energy, healthcare, the environment. Engineering and technological literacy will be critical for all American citizens to make informed decisions in the 21st century.

What Does the Engineering Design Process Look Like?

It looks messy! There are lots of nice diagrams out there, but if you're really doing what engineers and scientists do, it won't follow a neat path.

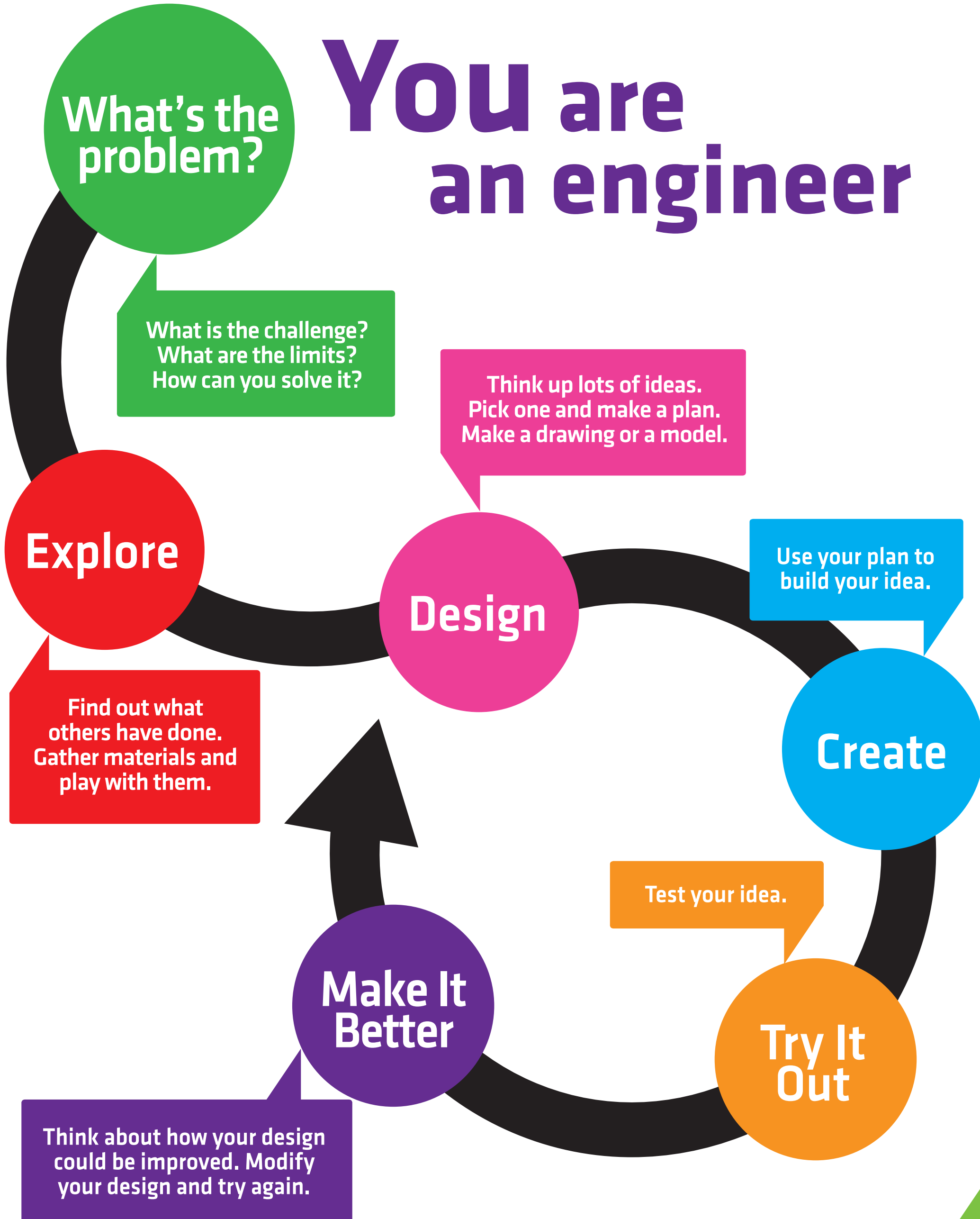
From Engineering Buddies
This process is different from the Steps of the Scientific Method, which you may be more familiar with and is more linear. If your project involves designing, building, and testing something, you should probably follow the Engineering Design Process.

The steps of the engineering design process are to:

- **Define the Problem:** The engineering design process starts when you ask the following questions about problems that you observe:
  - o What is the problem or need?
  - o Who has the problem or need?
  - o Why is it important to solve?
  - o [Who] need(s) [what] because [why].
- **Do Background Research**: Learn from the experiences of others — this can help you find out about existing solutions to similar problems, and avoid mistakes that were made in the past. So, for an engineering design project, do background research in two major areas: Users or customers and Existing solutions
- **Specify Requirements:** Design requirements state the important characteristics that your solution must meet to succeed.
- **Brainstorm Solutions:** There are always many good possibilities for solving design problems. Good designers try to generate as many possible solutions as they can.
- **Choose the Best Solution**: Look at whether each possible solution meets your design requirements. Some solutions probably meet more requirements than others. Reject solutions that do not meet the requirements.
- **Do Development Work:** Development involves the refinement and improvement of a solution, and it continues throughout the design process, often even after a product ships to customers.
- **Build a Prototype:** A prototype is an operating version of a solution. Often it is made with different materials than the final version, and generally it is not as polished. Prototypes are a key step in the development of a final solution, allowing the designer to test how the solution will work.
- **Test and Redesign:** The design process involves multiple iterations and redesigns of your final solution. You will likely test your solution, find new problems, make changes, and test new solutions before settling on a final design.
- **Communicate Results:** To complete your project, communicate your results to others in a final report and/or a display board. Professional engineers always document their solutions so that they can be manufactured and supported.

- Engineers do not always follow the engineering design process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change to your design. This way of working is called **iteration**, and it is likely that your process will do the same!

You are an engineer



Engineering Design Process

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