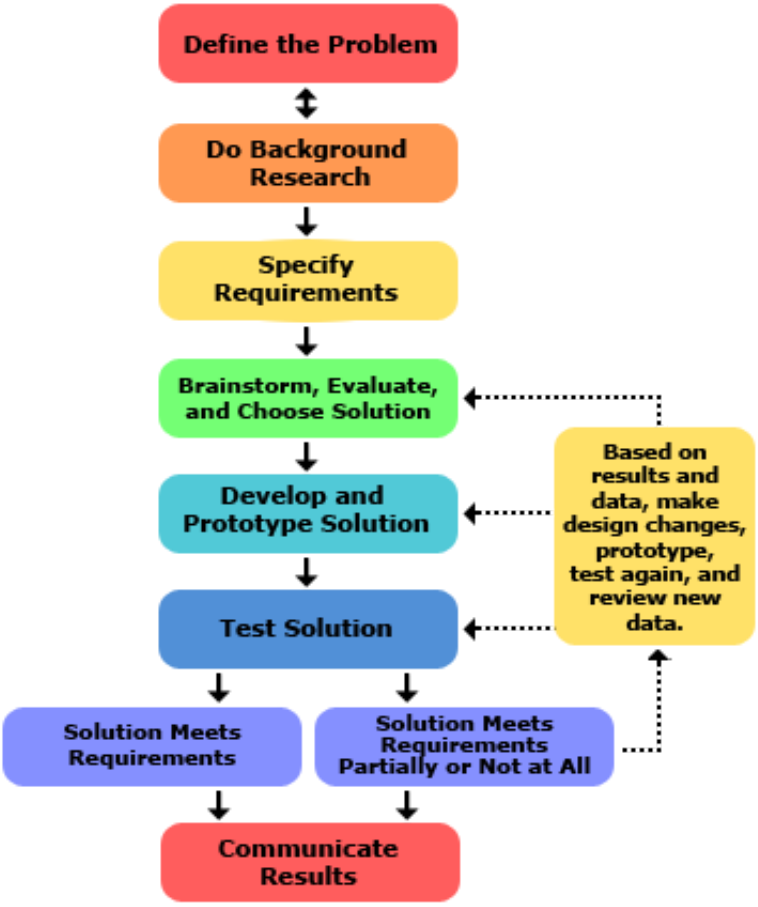
The Engineering Design Process

Key Info

- The engineering design process is a series of steps that engineers follow to come up with a solution to a problem. Many times the solution involves designing a product (like a machine or computer code) that meets certain criteria and/or accomplishes a certain task.
    - This process is different from the Steps of the Scientific Method (http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml), which you may be more familiar with. If your project involves making observations and doing experiments, you should probably follow the Scientific Method. If your project involves designing, building, and testing something, you should probably follow the Engineering Design Process. If you still are not sure which process to follow, you should read Comparing the Engineering Design Process and the Scientific Method (http://www.sciencebuddies.org/engineering-design-process/engineering-design-compare-scientific-method.shtml).
- The steps of the engineering design process are to:
    - **Define the Problem**
    - **Do Background Research**
    - **Specify Requirements**
    - **Brainstorm Solutions**
    - **Choose the Best Solution**
    - **Do Development Work**
    - **Build a Prototype**
    - **Test and Redesign**
- 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!

The Engineering Design Process

Engineers and designers use the engineering design process, shown in the diagram and table, to solve a problem by creating new products, systems, or environments.



The process rarely moves in a linear fashion. Instead, designers jump back and forth between the steps as they move toward the final solution.

Steps of the Engineering Design Process	Detailed Help for Each Step
Define the Problem. The engineering design process starts when you ask the following questions about problems that you observe: • What is the problem or need? • Who has the problem or need? • Why is it important to solve? [Who] need(s) [what] because [why].	• Define the Problem (http://www.sciencebuddies.org/engineering-design-process/engineering-design-problem-statement.shtml) • Design Notebook (http://www.sciencebuddies.org/engineering-design-process/engineering-design-notebook.shtml) • Mind Mapping (http://www.sciencebuddies.org/engineering-design-process/mind-mapping.shtml) • Engineering Project Proposal Form (http://www.sciencebuddies.org/engineering-design-process/engineering-project-proposal-form.pdf)
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 • Existing solutions	• Background Research Plan for an Engineering Design Project (http://www.sciencebuddies.org/engineering-design-process/background-research-plan.shtml) • Finding Information (http://www.sciencebuddies.org/science-fair-projects/project_finding_information.shtml) • Bibliography (http://www.sciencebuddies.org/science-fair-projects/project_bibliography.shtml) • Research Paper (http://www.sciencebuddies.org/science-fair-projects/project_research_paper.shtml) • Background Research Plan Worksheet (http://www.sciencebuddies.org/engineering-design-process/engineering-design-background-research-plan-worksheet.pdf)
	• Specify Requirements (http://www.sciencebuddies.org/engineering-design-process/engineering-design-

Specify Requirements: Design requirements state the important characteristics that your solution must meet to succeed. One of the best ways to identify the design requirements for your solution is to analyze the concrete example of a similar, existing product, noting each of its key features.	requirements.shtml) • Design Brief Worksheet (http://www.sciencebuddies.org/engineering-design-process/engineering-design-brief-worksheet.pdf) • Design Requirement Examples (http://www.sciencebuddies.org/engineering-design-process/design-requirements-examples.shtml) • How to Analyze a Physical Product (http://www.sciencebuddies.org/engineering-design-process/product-analysis.shtml) • How to Analyze a Software Product or Website (http://www.sciencebuddies.org/engineering-design-process/product-analysis-software-website.shtml) • How to Analyze an Environment (http://www.sciencebuddies.org/engineering-design-process/product-analysis-environment.shtml) • How to Analyze an Experience (http://www.sciencebuddies.org/engineering-design-process/product-analysis-experience.shtml) • How Many Design Requirements? (http://www.sciencebuddies.org/engineering-design-process/how-many-requirements.shtml)
Brainstorm Solutions: There are always many good possibilities for solving design problems. If you focus on just one before looking at the alternatives, it is almost certain that you are overlooking a better solution. Good designers try to generate as many possible solutions as they can.	• Brainstorm Multiple Solutions (http://www.sciencebuddies.org/engineering-design-process/alternative-solutions.shtml)
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.	• Choose the Best Solution (http://www.sciencebuddies.org/engineering-design-process/best-solution.shtml) • Decision Matrix Worksheet (http://www.sciencebuddies.org/engineering-design-process/engineering-design-decision-

	matrix-worksheet.pdf)
Develop the Solution: Development involves the refinement and improvement of a solution, and it continues throughout the design process, often even after a product ships to customers.	• Development Work (http://www.sciencebuddies.org/engineering-design-process/engineering-design-development.shtml) • Drawing (http://www.sciencebuddies.org/engineering-design-process/engineering-design-drawing.shtml) • Storyboards (http://www.sciencebuddies.org/engineering-design-process/storyboards.shtml)
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.	• Prototyping (http://www.sciencebuddies.org/engineering-design-process/engineering-design-prototypes.shtml)
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.	• Test and Redesign (http://www.sciencebuddies.org/engineering-design-process/testing-redesign.shtml)
Communicate Results: To complete your project, communicate your results to others in a final report and/or a display board. Professional engineers always do the same, thoroughly documenting their solutions so that they can be manufactured and supported.	• Final Report (http://www.sciencebuddies.org/science-fair-projects/project_final_report.shtml) • Abstract (http://www.sciencebuddies.org/science-fair-projects/project_abstract.shtml) • Display Board (http://www.sciencebuddies.org/science-fair-projects/project_display_board.shtml) • Science Fair Judging (http://www.sciencebuddies.org/science-fair-projects/project_judging.shtml)

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