

Highlands Elementary Science Fair

INVENTIONS

An invention is a new product, system, or environment that has not existed before. Inventors use a series of steps called the engineering design process to create inventions.

The main steps of the engineering design process are to:

- Define the Problem
- Do Background Research
- Possible Solutions
- Build a Prototype
- Test and Redesign

Define the Problem

- Finding an idea for your engineering project requires you to identify the needs of yourself, another person, or a group of people. The act of looking at the world around you to identify these needs is called **need finding**.
- To help you find an idea for your engineering project:
 - Create a list of all the things that annoy or bother the people around you. Record this bug list in your Design Notebook.
 - Map possible design problems, ideas, or areas of interest to you.
- Once you have found an idea for your engineering project, describe the problem by writing a **problem statement**. Your problem statement must answer three questions:
 - **What** is the problem or need?
 - **Who** has the problem or need?
 - **Why** is it important to solve?
- The format for writing a problem statement uses your answers to the questions and follows these guidelines:
 - **Who** need(s) **what** because **why**.
 - ____ need(s) _____ because _____.

Background Research

Background research is especially important for engineering design projects, because you can learn from the experience of others rather than blunder around and repeat their mistakes. To make a **background research plan**— a roadmap of the research questions you need to answer -- follow these steps:

1. Identify questions to ask about your **target user** or customer.
2. Identify questions to ask about the products that already exist to solve the problem you defined or a problem that is very similar.
3. Plan to research how your product will work and how to make it.
4. Network with other people with more experience than yourself: your mentors, parents, and teachers. Ask them: "What should I study to better understand my engineering project?" and "What area of science covers my project?" Better yet, ask even more specific questions.

Possible Solutions

- #1 Rule when creating alternative solutions: **DON'T SETTLE FOR YOUR FIRST IDEA.**
- Good designers try to generate as many possible solutions as they can before choosing one that they feel is the best. This creative process of developing ideas is called **ideation**.
- Methods of ideation include:
 - Examining existing solutions
 - Creating and using analogies
 - Conducting brainstorming sessions
 - Sketching and doodling
- Look at whether each possible solution met your design requirements. Consider solutions that did a much better job than others, and reject those that did not meet the requirements.
- Some criteria apply to virtually every design. Good designers consider these **universal design criteria** when choosing which possible solution to implement:
 - Elegance
 - Robustness
 - Aesthetics
 - Cost
 - Resources
 - Time
 - Skill required
 - Safety
- It helps to compare solutions.
- If your requirements and solutions are relatively simple, you can sometimes just list the **pros** and **cons** for each solution. Pros are good things about a solution and cons are bad things.

Build a Prototype

- A **prototype** is an operating version of a solution. It is often made with different materials (cheaper and easier to work with) than the final version.
- Prototypes allow you to test how your solution will work and even show the solution to users for feedback.
- Creating prototypes may involve using readily available materials, construction kits, storyboards, or other techniques that help you to create your solution quickly and with little cost. Keep in mind that these are mockups of your final solution, not the real thing!

Test and Redesign

The design process involves multiple loops and circles around your final solution. You will likely test your solution—find problems and make changes—test your new solution—find new problems and make changes—and so on, before settling on a final design.

At this point, you have created prototypes of your alternative solutions, tested those prototypes, and chosen your final design. So you're probably thinking that your project is finished! But in fact, you have yet to complete the final and most important phase of the engineering design process—test and redesign.

Test and redesign requires you to go out and test your final design with your users. Based on their feedback and their interaction with your solution, you will redesign your solution to make it better. Repeat this process of testing, determining issues, fixing the issues, and then retesting multiple times until your solution is as successful as possible. Keep in mind that minor changes this late in the design process could make or break your solution, so be sure to be thorough in your testing!

Report your invention on a backboard

