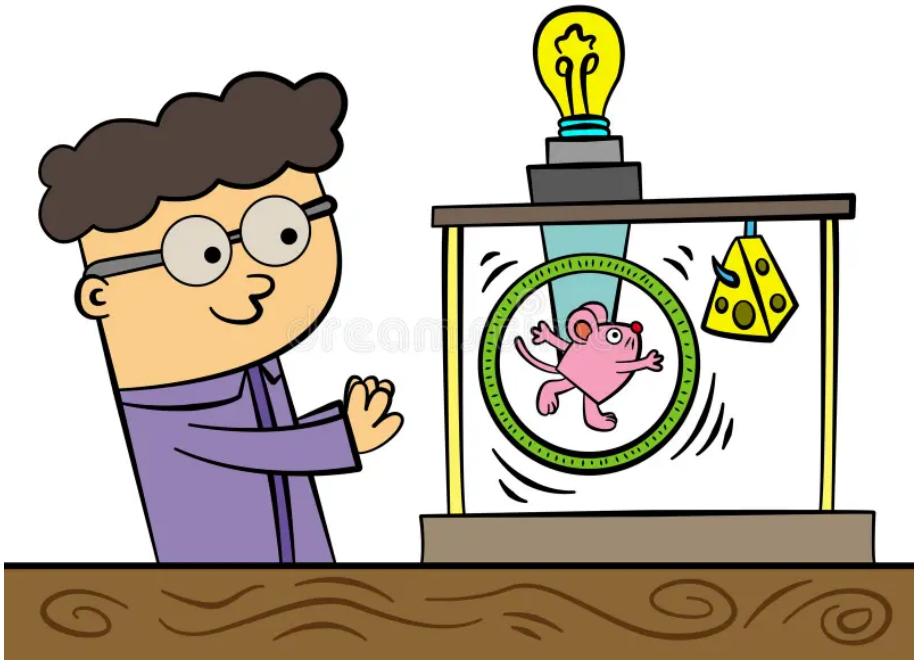
# STFX Science Fair

## Engineering Design Process Information



# Engineering Design Process Information

Engineering is the designing, building, and testing of a made-at-home product. It is the invention category of the science fair. A prototype is built according to the requirements set up by the student. After the prototype is built, it needs to be tested to see if it works. The data is analyzed. It is to be compared to the design requirements. If it doesn't perform according to the design requirements, the student needs to go back and redesign the prototype on paper. Adjustments are made on the prototype and retested. This process of redesigning and making adjustments continues until it works according to the design requirements. The engineering design results have to be useful and apply to real world situations, issues, or ideas. The prototype cannot be made from a kit. It has to be created by the student.

When using the Engineering Design process while doing a science fair project, all of these steps listed below are required in the order shown. During the process of completing each step, each step needs to be written in your project notebook and later put on your display board. A judge will ask you about the Engineering Design process in your interview.

## The Engineering Design Procedure

A type of process you can use for a science fair project is the Engineering Design process. The major objective is to understand the process of designing and building a prototype (model of the product). The engineering project should be one that is a new idea. It cannot be a purchased kit. The materials are to be things found around the house and/or purchased at a store. In order to build a prototype for the science fair, you are required to follow The Engineering Design process described below. As you follow the Engineering Design Process, you must write about each of the following steps in a Project Notebook. ***The Science Fair judge(s) can ask questions about anything that is in the Project Notebook.***

**1. Define a Need:**

Begin by writing a need for something you want to construct and to explain its purpose. It could be for a problem that needs to be solved or a situation that needs improvement. Write it so the need is clearly understood. The goal of this engineering project is to design and construct a prototype for someone to use to perform a useful function. Example: "The goal of this project is to design, build, and test a way to minimize waiting time at stop lights in the city."

**2. Research:**
You need to research your topic using library materials, internet sites, magazines, textbooks, encyclopedias, experts, and other available and reliable sources. At least three sources, one being a book, must be used for the research. A paragraph should be written in your Project Notebook telling what you learned from your three research sources. Be sure the paragraph goes deep into the content learned and you are not just telling knowledge that is already known. Copying a page from a book or Internet and placing it in the project notebook is not research. The research needs to be hand or typewritten. ***The judge(s) can question anything that is written in the Project Notebook.***

**3. Design Requirements:**
Next, you need to establish the requirements needed for the development of the prototype to decide how it will be built. Typical requirements related to shape, size, weight, appearance, physical features, performance, use, cost, time and money. Another part of the design requirements is to tell the prototype expectations and how it will be tested to meet the desired expectations.

**4. Preliminary and Final Designs:**

- **Beginning designs**
  - Here you need to draw the beginning designs of the prototype with labeled parts. They can be brainstorming designs showing two or three ideas.

- **Final designs**
  - As you focus into one type of design, you need to show the changes needed as the designs get closer to the requirements and expectations of the prototype. The changed designs need to show progress from design to design.

- **List of materials**
  - Make a list of all the materials and equipment you will use for building the prototype. Using descriptive words to describe the materials and equipment are important. Any materials that are measured should have the measurements listed. (Ex. wooden board 2" x 4" x 8")

**5. Step-by-step procedure**
Write a step-by-step procedure you will follow to build the prototype. Write it in the order you want to follow. Be very descriptive in your writing.

**6. Build, Test and Record, and Analyze the Results of the Prototype**

- ➔ **Building the prototype**
  - ◆ Build a prototype according to the design requirements, drawn designs, list of supplies and equipment, and the step-by-step procedure. You need to write about the experience building the prototype.

- ➔ **Testing and data recording**
  - ◆ After it is built you need to test the prototype to see if it works according to the testing procedure stated in the design requirements. You need to write down what is actually happening during the testing. You should be as descriptive as possible. Testing the prototype two or three times is important to make sure the test data is accurate.

- ➔ **Data is analyzed if redesigning is necessary**
  - ◆ Analyze the data. See if the results match the design requirements. If not, redesigning is necessary.

**7. Redesign, Retest, Record, and Analyze As Necessary**

- After the first tests you may need to make adjustments by redesigning parts of the prototype that need adjusting. You need to show the adjustments with diagrams and labeling. Keeping accurate notes of the changes is very important in this part of the engineering project.

- Retesting is always necessary after redesigning has occurred. When you are retesting, you need to write down data as to what is happening.

- Analyze the data. See if the results match the design requirements. If not, redesigning is necessary.

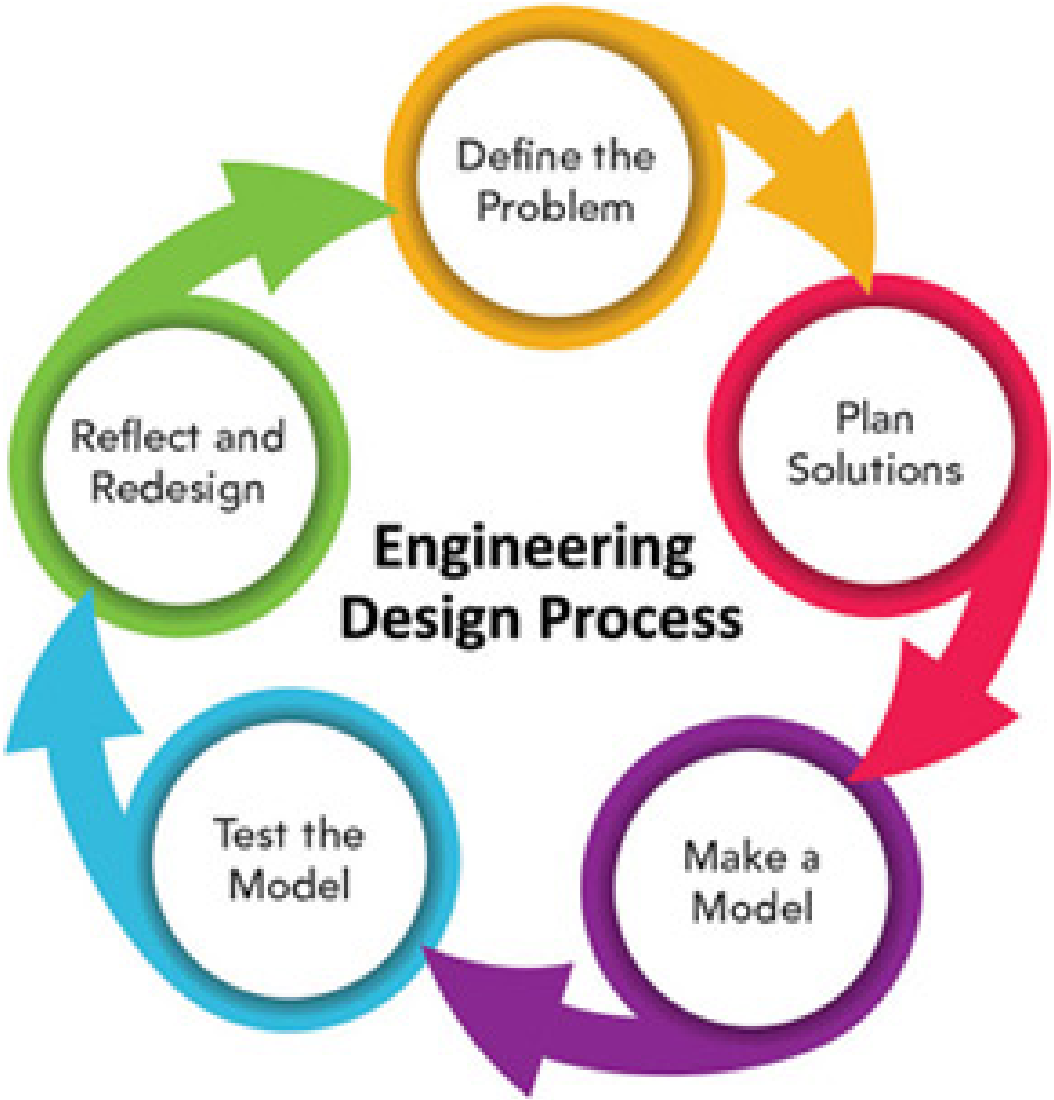
**(Redesigning and retesting of the prototype is a major part of the project. Keeping notes of the changes and the results are very important. You should be able to see at a glance what changes have been made and what happened when these changes are retested. You need to be able to recall the changes and results if needed.)**

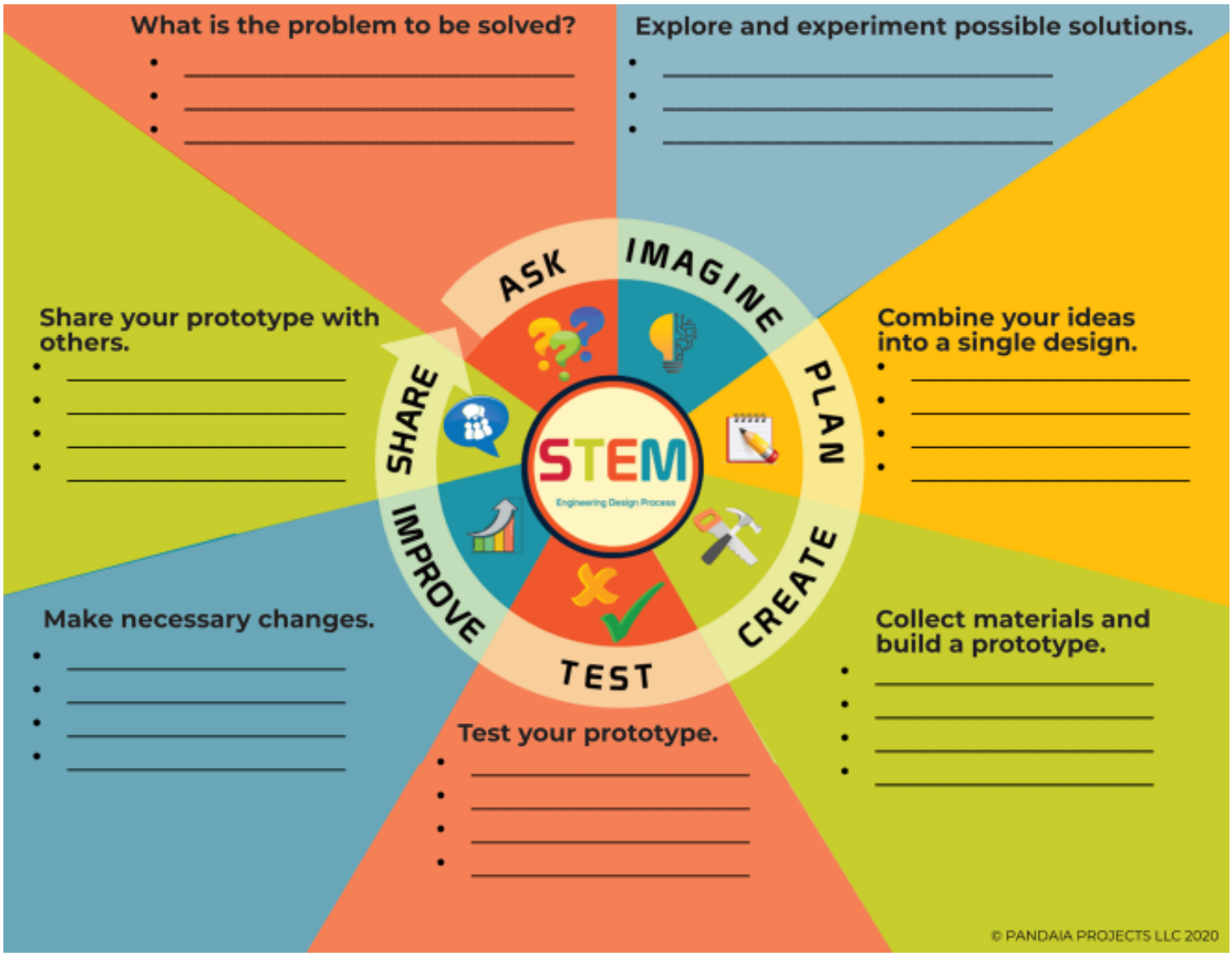
- When you feel that the prototype has reached its greatest efficiency according to the design requirements, you can then go on to the conclusion. If you feel that more designing and testing is needed, then you need to continue to redesign and retest, writing down the data until you feel the prototype is finished. The prototype needs to work and meet the design requirements.

**8. Conclusion:**

- When writing your conclusion you need to show evidence of what was learned. The conclusion summarizes the learning by answering some of these questions: How do the results validate what was expected to happen? What was learned from building the prototype? In what ways is this prototype important? Are there more things that could be done to improve the prototype? How does this prototype help people understand the world better? How can this information be applied to real life? What new insights were discovered? What knowledge was gained by designing and building to prototype?

- The conclusion needs to show the value of the project and the prototype and how it can apply to life and/or the real world. Write about the final prototype by looking at its merits, originality, and usefulness.




What is the problem to be solved?
Explore and experiment possible solutions.
Combine your ideas into a single design.
Collect materials and build a prototype.
Test your prototype.
Make necessary changes.
Share your prototype with others.
ASK
IMAGINE
PLAN
CREATE
TEST
IMPROVE
SHARE
STEM
Engineering Design Process
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# ASK

What is the problem to be solved?

- What is the criteria for this problem?
- What have others done?
- What are the constraints or limitations?
- _____
- _____
- _____

What is the best source of information about this problem?

- _____
- _____
- _____

# IMAGINE

Explore and experiment with possible solutions.

- What are some solutions?
- Brainstorm? Brainstorm... Brainstorm!
- _____
- _____
- _____
- _____

Gather sample materials to test & play.

- _____
- _____
- _____

# PLAN

Combine your ideas into a single design.

- Draw a sketch of your design.
- Make a list of materials you need.
- _____
- _____
- _____
- _____

Plan your steps and assign to team members.

- _____
- _____
- _____

# CREATE

Collect materials and build a prototype.

- Follow your design.
- If changes are needed, update the design.
- _____
- _____
- _____
- _____

Take your time and use craftsmanship.

- _____
- _____
- _____

# TEST

Test your prototype.

- Try it out!
- What works? What doesn't?
- _____
- _____
- _____
- _____

List the criteria for this project. Does the prototype meet all of them?

- _____
- _____
- _____

# IMPROVE

Think about how to make your design better.

- Modify your design to solve new problems.
- Make necessary changes.
- _____
- _____
- _____
- _____

Update your drawings and materials list.

- _____
- _____
- _____

# SHARE

Share your prototype with others.

- Get feedback on your prototype.
- Identify feedback that would be an improvement.
- _____
- _____
- _____
- _____

Remember: Some feedback is just another person's preference.

- _____
- _____
- _____

# Creating an Engineering Project Display Board

Create a display board so your findings can be shown at the science fair. It is a summary of your project and reflects your project notebook. This is your showcase. Make it creative and colorful. Below are ideas for a good display board.

- Physically sound and durably constructed, able to stand by itself.
- Title of your project at the top.
- Show all the steps of the Engineering Design process (except the research) with a brief explanation of each: the need, design criteria, preliminary and final designs, building, testing
- results and the analysis, redesigning and retesting results and the analysis as needed, and the conclusion. The research will be in the project notebook.
- Well-organized and easy to follow from one idea to the next.
- Neat, edited, and without scribbles and misspelled words.
- Creative, pleasing to look at, colorful, with different font sizes to show emphasis.
- Photos of the developing experiment. (Only the student doing the experiment and family members can be displayed on the board. Others need parent permission if under 18 years of age.)
- Drawn pictures, artwork, and icons that bring out the ideas of the experiment.
- The project notebook should be in front of the display.