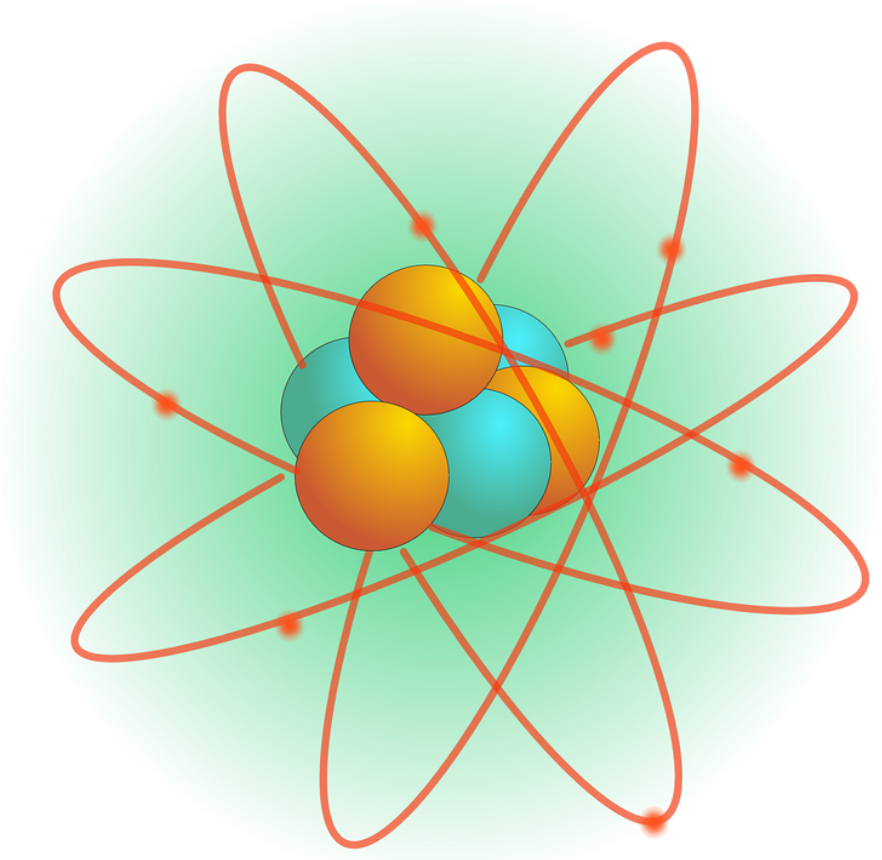
2019-2020 Mills Science Fair

Engineering Design Process
or Invention Project

http://millssciencefair.weebly.com



2019-2020 Mills Science Fair
Checklist for Project Completion

I know that I can find this packet and other important information on the Mills Science Fair website. The link:

http://millssciencefair.weebly.com

- I read the packet with my parents.
- I understand that all projects require display on a traditional tri-fold poster display following the rules and guidelines for my project type.
- I have brainstormed a list of topics that I am interested in investigating.
- I have a "burning question" or have discovered a problem that needs solving or a need that is not being met.
- My problem can be solved by following the steps of the Engineering Design Process
- I have reviewed the rubrics for the project type that I have chosen. I know that I must do the work with help from my parents.
- I will use and add to the provided timeline that will guide my work.
- My project will be ***completed and ready for display at the Mills Science Fair by January 23, 2020.*** **Grade levels may have different due dates for students' projects, so please confirm this with your teacher.**

Engineering Design Process
or Invention General Information

Please read this section carefully before planning your investigation.

1. Display and Safety Guidelines

All student projects must follow the guidelines listed below to be allowed to display at the Mills Science Fair.

Items Not Allowed

- **No organisms; living, dead or preserved (plants or animals)**
- No human/animal parts or body fluids (for example, blood, urine)
- No human or animal food
- No bacteria or mold cultures
- No liquids – laboratory/household chemicals including water
- No poisons, drugs, controlled or hazardous substances
- No sharp items (for example: syringes, needles, pipettes, knives, tacks, nails)
- No glass or glass objects unless encased or an integral and necessary part of a commercial product (for example, a computer screen)
- No pressurized tanks or containers
- No batteries with open top cells (so that battery acid can be seen)
- No dirt, soil, gravel, rocks, sand, waste product, etc.
- No project, device, activity, or substance that may be deemed hazardous to student health or safety
- No photographs or pictures of animals or people in surgical techniques, dissections or necropsies.

Discouraged Items

- Expensive, breakable or fragile items.

Allowed and Encouraged Items

- Photographs, drawings, stuffed animals/artificial plants or imitation (play) food should be used to depict the prohibited or discouraged items.
- Students should always plan on taking photographs of their project steps as a visual explanation of their effort. Students must ask permission before photographing any other individuals for display on project.
- Be sure to properly credit/acknowledge all sources of graphics and photographers on the display board (Photograph taken by . . .).
- Students may use a computer and printer for written parts of the project.
- Electrical projects may use batteries as sources of electricity.

2. Display Board

Project display should be on sturdy tri-fold board available at local craft and office supply stores. Written material, drawings and pictures should be securely attached to the display board.

3. Electricity for Your Display

- Electrical projects may use batteries as sources of electricity.
- If a project requires electricity, notify your child's teacher in advance.

4. Project Organization for the Mills Science Fair

Engineering Design Process or Invention Projects:

Students are identifying a problem that needs solving, or a need that is currently unmet.

Example of an EDP or Invention Project:

Student sees a friend who is temporarily in a wheelchair being unable to reach the upper shelves of their kitchen pantry. The student wishes there was a way to solve this problem. He/she does research to see if there are already fixes to this problem and does find mechanisms that are used in other situations that might be applicable to this problem. The student brainstorms solutions, perhaps surveys people, and settles on one potential solution. He/she then makes a model (not working) or actual prototype of their chosen solution, in this case, a Ferris-wheel type system that can rotate pantry shelves down to a reachable level. The student tests their design and tries to improve it. All along the way, the student has taken notes in a journal, which he/she uses to prepare the writing for the tri-fold display.

5. Parental Help

Some students are fortunate to have parents who have time to help them. However, parents who do the thinking or build the project for them do not really help students. Parents are encouraged to help their children in these ways:

- Read and discuss these provided guidelines and other helful information on our Patton SXSciWeek web site. See the link on the front cover of this packet.
- Help your child select projects which are appropriate for the child's age and grade level
- Plan and manage time spent on project work, documentation and clean-up times
- Take your child to the public library or other places for research
- Help draw straight lines for a young child
- Listen to your child's oral explanation of the project
- Ensure the child's safety

Students should list any parental help in the References and Acknowledgements section of the project.

Engineering Design Process / Invention Project Step-by-Step

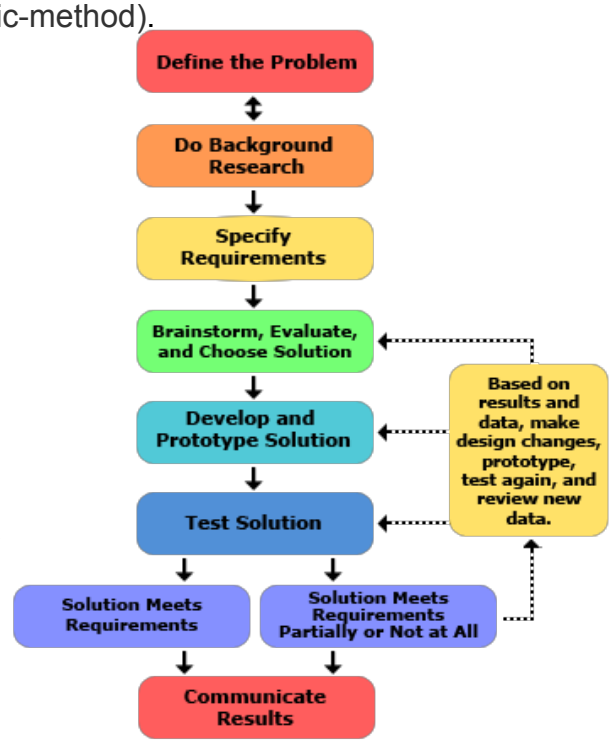
Adapted from Science Buddies

Important Note: The following pages include links to much-more detailed help pages. So, it will really be helpful to view this document online so you can click on these additional links.

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/science-fair/steps-of-the-scientific-method), 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/science-fair-projects/engineering-design-process/engineering-design- compare-scientific-method).
- 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 Re-design**



- 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/science-fair-projects/engineering- design-process/engineering-design-problem-statement) • Design Notebook (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/engineering-design-notebook) • Mind Mapping (http://www.sciencebuddies.org/science-fair-projects/engineering-design-process/mind-mapping) • Engineering Project Proposal Form (http://www.sciencebuddies.org/science-fair-projects/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/science-fair-projects/engineering-design-process/background-research-plan) • Finding Information (http://www.sciencebuddies.org/science-fair-projects/science-fair/finding-information-for-your-research-paper) • Bibliography (http://www.sciencebuddies.org/science-fair- projects/science-fair/writing-a-bibliography-examples-of-apa-mla-styles) • Research Paper (http://www.sciencebuddies.org/science-fair-projects/science-fair/writing-a-research-paper-for-your- science-fair-project) • Background Research Plan Worksheet (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/background-research-plan-worksheet.pdf)

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.

- Specify Requirements (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/engineering-design-requirements)
- Design Brief Worksheet (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/design-brief-worksheet.pdf)
- Design Requirement Examples (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/design-requirements-examples)
- How to Analyze a Physical Product (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/product-analysis)
- How to Analyze a Software Product or Website (http://www.sciencebuddies.org/science-fair- projects/engineering-design-process/product-analysis-software-website)
- How to Analyze an Environment (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/product-analysis-environment)
- How to Analyze an Experience (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/product-analysis-experience)
- How Many Design Requirements? (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/how-many-requirements)

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/science-fair-projects/engineering- design-process/alternative-solutions)

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/science-fair-projects/engineering- design-process/best-solution)
- Decision Matrix Worksheet (http://www.sciencebuddies.org/science-fair-projects/engineering- design-process/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/science-fair-projects/engineering-design-process/engineering-design-development)
- Drawing (http://www.sciencebuddies.org/science-fair- projects/engineering-design-process/engineering-design- drawing)
- Storyboards (http://www.sciencebuddies.org/science-fair- projects/engineering-design-process/storyboards)

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/science-fair- projects/engineering-design-process/engineering-design- prototypes)

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/science-fair-projects/engineering- design-process/testing-redesign)

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/science-fair/science-fair-project-final-report)
- Abstract (http://www.sciencebuddies.org/science-fair-projects/science-fair/how-to-write-a-science-fair-project-abstract)
- Display Board (http://www.sciencebuddies.org/science-fair- projects/science-fair/science-fair-project-display-boards)
- Science Fair Judging (http://www.sciencebuddies.org/science-fair-projects/science-fair/judging-tips-to-prepare-science-fair)

For more ideas and helpful websites, go to:
http://millssciencefair.weebly.com

Example Display Board:

Engineering Design Process / Invention