2016-2017 Engineering Project Instruction Packet

What is the Engineering Project?

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, which you may be more familiar with. If your project involves designing, building, and testing something, you should probably follow the Engineering Design Process.

Things to Remember

- While parent support is welcome, students are encouraged to be deeply involved in the process of developing and conducting their research through the design process. Students will conduct several trials and redesigns in order to accomplish their desired results.

The Steps to the Engineering Process:

- Define a need; express as a goal
- Establish design criteria and constraints
- Evaluate alternative designs
- Build a prototype of best design
- Test and evaluate the prototype using the design criteria
- Analyze test results, make design changes, and retest
- Communicate the design

Note: 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 Requirements

The Engineering Project has three parts, all of which are required and must be turned in to compete.

A. Backboard
B. Authentic Engineering Journal
C. Research Project

Procedures and Instructions for Engineering Project and Presentation for Science Fair

A. THE BACKBOARD

The backboard is a visual summary of the process you followed to create your purpose and problem, materials and procedures used during the design process, and the conclusions that were discovered. Make sure to write your name, school, grade, and teacher's name on the back of the backboard

- The **left side** of the backboard should include the following information:

1. **Purpose**---Tell why you are doing this project? What did you observe in the world that made you ask your question? What made you curious?
2. **Problem**---Describe what problem you discovered and who has the problem or need. Make it practical and obtainable.
3. **Design Requirements**---Make a list of characteristics that your solution must meet to be successful. The list should provide a complete description of the key features that will make your design successful. The list should be feasible. Think of what you might need…time, materials, etc… Explain possible constraints.

- The **center** of the backboard should include the following:

1. A **Title**---A clever title attracts attention, but also gives information about the project.
2. **Abstract**---Provide a concise paragraph summary of no more than 250 words about your Engineering project. Include the following: purpose, hypothesis, procedures used, data summary or analysis, and conclusions.
3. **Solutions**---Brainstorm possible solutions. Evaluate those solutions. Show notes, pictures, and other materials you used to brainstorm and evaluate. Describe the criteria you used to find the best possible solution.
4. **Materials**---Include all materials you used to build your prototype. Make sure you are specific in measurable amounts and substances. (*Note: Don't include the materials you used to create the backboard.*)
5. **Prototype**---Explain what process you used to create your prototype. Describe any challenges you encountered as you were building. Did you need to redesign it as you were building it? Explain.
6. **Pictures/Sketches/Photos/Graphs/Charts**---Include pictures/sketches of your design planning, include labeled diagrams and detailed drawings. Make sure to include photos of your prototype. Include any charts or graphs that illustrate data collected during your trials. (*Note: Do not include faces in your photos.*)

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The **right side** of the backboard should include the following:

1. **Test and Redesign**---Describe how you tested your final prototype. Explain how feedback from others helped you redesign. List the problems you encountered and how you fixed them. Describe which parts were successful and why. Make sure you have repeated the testing process several times until your solution is as successful as possible.
2. **Discussion**---Restate your problem. Summarize your research. Describe your process of designing, testing, redesigning, and retesting. Describe your project. Finally, explain and justify your conclusions with data and observations. Include in your discussion, the potential impact your project might have in Science, society and/or economics.
3. **Next Steps**---List what new questions you have as a result of your Engineering Design. Describe some ideas you have for future research or improved designs. List additional materials and resources you might need to make future designs successful.

B. THE AUTHENTIC ENGINEERING JOURNAL

Your Authentic Engineering Journal, written in a composition book or spiral notebook, is where you will write everything you did from start to finish for your project. This includes how you came up with the purpose, what problem or need are you trying to fulfill, design requirements, research and background, solutions, how you built your prototype, testing results and data, redesign elements and next steps. This journal is handwritten and authentic. (*Note: Don't include the information for preparing the backboard.*)

C. THE RESEARCH REPORT

The report should include the following items, in this order:

Research and Background---Research current solutions to the problem you have chosen. This can help you find out about existing solutions to similar problems and avoid mistakes that were made in the past. The research should cover two areas: 1. Users or customers; and 2. Existing solutions. Think about how this research will influence how you will approach your project. Think about how your project will further the research and design that has already been done.

1. **Title Page**---List the title of the project, your name, grade level, due date (January 2016), and teacher's name.
2. **Research and Background---**Provide a minimum of 500 words of information you researched about the subject of your problem and prototype. See above for more details. The information should be in your own words. Acceptable research items include: Internet, books, interviews, etc… (*Note: **Do Not** place articles and print outs from Internet Web pages in your research. Students need to read those items and synthesize the information into their own words.)*
3. **Abstract**--- Provide a concise paragraph summary of no more than 250 words about your Engineering project. Include the following: purpose, hypothesis, procedures used, data summary or analysis, and conclusions.

4. **Acknowledgement Page**---Give recognition to those who helped with the project. Example: I would like to thank my parents…, the Orville Reddenbacher popcorn company for sending me information and samples, Mrs. Bailey the Librarian for…, etc…)
5. **Table of Contents**---List the items in the report and the page numbers where they're found.
6. **Duplicate copies of everything on the backboard**---Purpose, problem, design requirements, solutions, photos of prototype, etc…
7**. Glossary**---List at least five words related to the project and include its definition. The words should be of appropriate difficulty, and the student should understand the meanings. Words like plant, soil, and prototype are not words with appropriate difficulty. Please do not copy the dictionary definition exactly.

(Good Example) aerodynamics: The design of an object in which air flows smoothly over its surface.

(Bad Example) aerodynamics: A science that studies the movement of air and the way that objects (such as airplanes or cars) move through air.

8. **Bibliography**---Create a list of sources you used to collect the research. Include a minimum of three sources.

Bibliography Sample Entrees

Encyclopedia (print)
Author (last name, first name). "Name of article." Name of Encyclopedia.
City: Publisher, Copyright Date.

Example:
"Bats."
World Book Encyclopedia. Chicago: World Book, Inc. 2005.

Books
Last Name, First Name. Name of the book. City of publication: Publisher's name, Copyright Date.

Example:
O'Henry, John. Space. New York: Scholastic, 2001.

On-Line Magazine Article
Author. "Title." Journal Date. Date you visit the URL, URL address

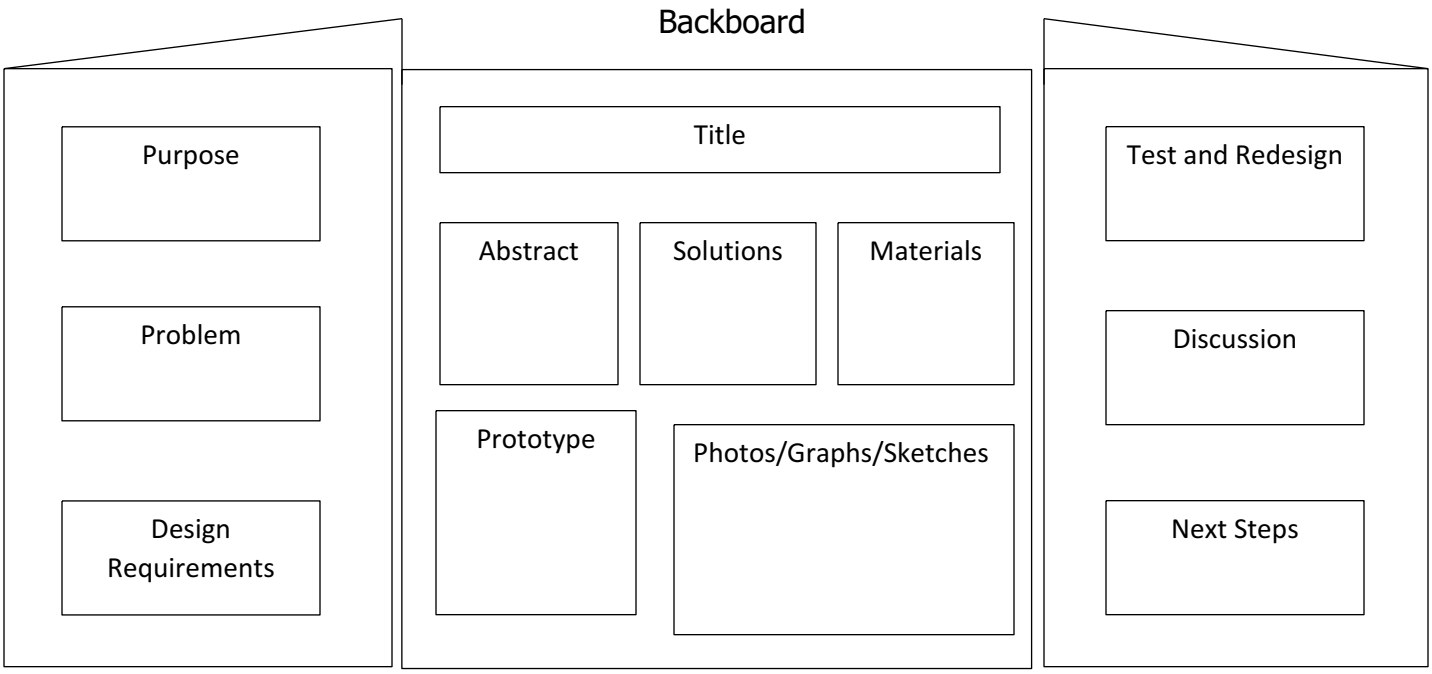
Example:
Halls, Kelly, "Juggling History." U.S. Kids June 1997 March 2000.
http://discover.sirs.com/cgi-bin/dis-article-display?

Magazine Article
Author. "Title of article." Name of magazine, date, pages.

Example:
Markham, Lois. "A Gallery of Great Native Americans." National Geographic for Kids, August 2001:6-7.

World Wide Web
Author (if available). "Title" Date created. Source. Date you saw it. URL

Example:
"The Victorian Web. Ed. George Landow." June 2000. Brown University. 25 Feb. 2004 http://landow.stg.brown.edu/victorian/victov.html.



Useful Websites:

Project-based Engineering
http://www.instructables.com/id/Project-Based-Engineering-for-Kids/

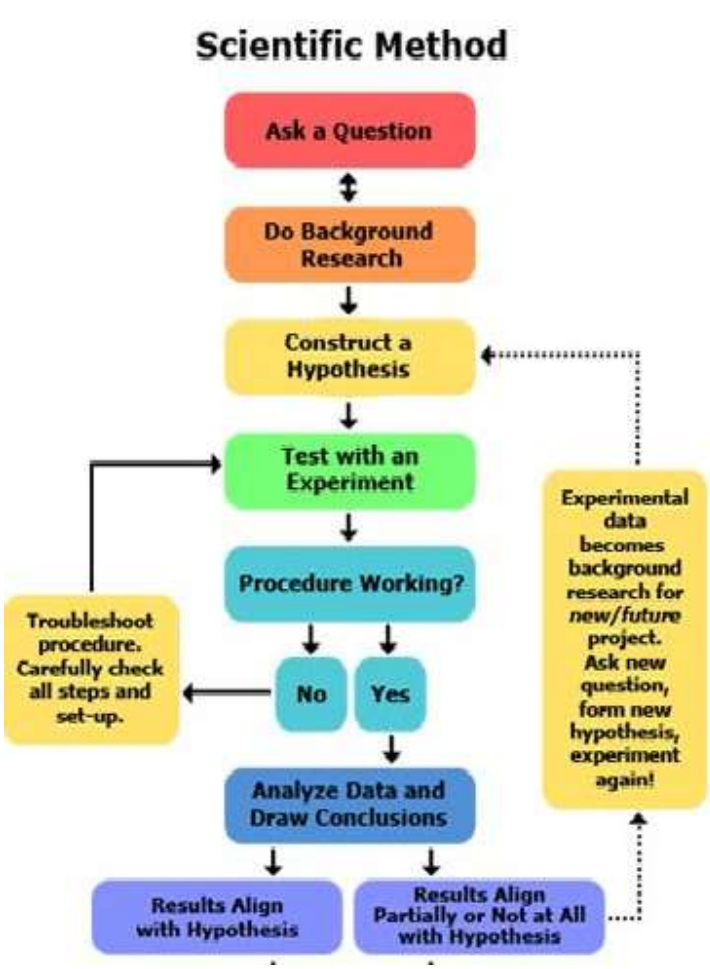
100 Engineering Projects for Kids
http://thehomeschoolscientist.com/100-engineering-projects-kids/

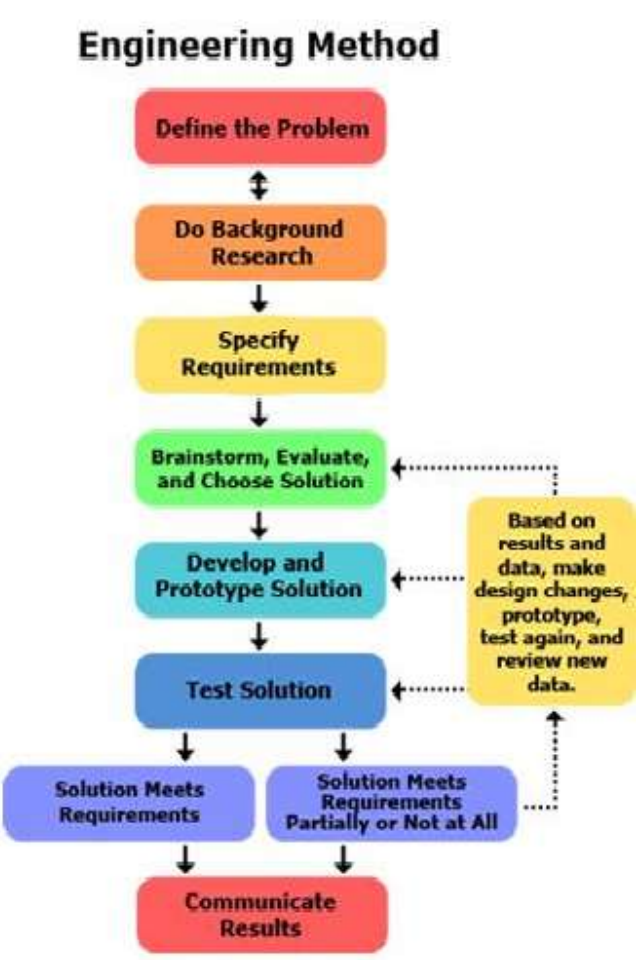
25 Engineering Projects for Kids: Science Sparks
http://www.science-sparks.com/2014/11/05/fun-engineering-projects-kids/

Engineering Science Fair Projects: Education.com
http://www.education.com/science-fair/engineering/

Science Buddies
http://www.sciencebuddies.org/science-fair-projects/Intro-Mechanical-Engineering.shtml

All Science Fair Projects
http://www.all-science-fair-projects.com/category33.html


Scientific Method
Ask a Question
Do Background Research
Construct a Hypothesis
Test with an Experiment
Procedure Working?
No
Yes
Troubleshoot procedure. Carefully check all steps and set-up.
Analyze Data and Draw Conclusions
Results Align with Hypothesis
Results Align Partially or Not at All with Hypothesis
Experimental data becomes background research for new/future project. Ask new question, form new hypothesis, experiment again!


Engineering Method
Define the Problem
Do Background Research
Specify Requirements
Brainstorm, Evaluate, and Choose Solution
Develop and Prototype Solution
Test Solution
Based on results and data, make design changes, prototype, test again, and review new data.
Solution Meets Requirements
Solution Meets Requirements Partially or Not at All
Communicate Results