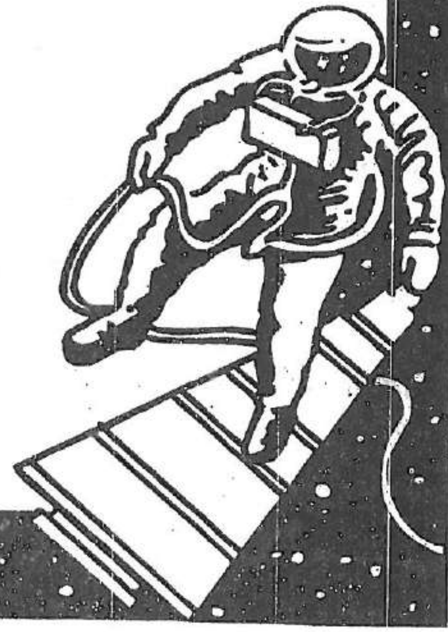
Science & Engineering Fair

Project Guide



This link takes you to the district website that has everything you need to know about the science fair.

https://www.cnusd.k12.ca.us/cms/one.aspx?portalId=211960&pageId=1253275

This link is an excellent video on how to make a science fair or engineering fair project. Please note that they are different. A science fair project is where you have a question that you want to test to see if what you think will happen actually does. This is your hypothesis. The project is the result of the hypothesis. The other component of the science fair is the engineering project. This is where you create by building or engineering a prototype an experiment to test your hypothesis with a result. They are different types of projects. BECAUSE THEY ARE DIFFERENT, THEY WILL HAVE A DIFFERENT DISPLAY BOARD SET UP. PLEASE NOTE THAT THE EXAMPLES OF DISPLAY BOARDS ARE ONLY THAT, EXAMPLES! YOUR BOARD MAY NOT HAVE ALL THE INFORMATION DISPLAYED ON THE SAMPLE BOARDS. YOU MAY NOT HAVE VARIABLES OR GRAPHS. PLEASE DO NOT THINK THAT EVERYTHING ON THE SAMPLE BOARDS HS TO BE DISPLAYED ON YOUR SCIENCE BOARD. THESE ARE EXAMPLES.

https://youtu.be/kKsGonHI0GE

This is a quick link to take you to the district office site, but you must copy and paste it in your browser.

http://bit.ly/CNUSDScience

Science Fair Websites

1. **California State Science Fair:** Read about this science fair which has been going on since 1952! You can learn how to enter, get help with your own project, or see a directory of past projects. http://www.usc edu/CSSF/

2. **Cyber Fair:** See sample fair projects, look through other student's examples, and see the steps involved in judging projects. http://www.isd77.k12.mn.us/resources/cf/welcome.html

3. **Experimental Science Projects:** Outlines steps in preparing a project (complete with an ideas list), and suggests the best ways to prepare one at different grade levels. http://www.isd77.k12.mn.us/resources/cf/SciProjIntro.html

4. **Science Buddies:** Use the topic selection wizard to help you figure out what science projects interest you most. Once you have a topic, get help doing research, setting up the experiments, and completing them. http://www.sciencebuddies.org/

5. **Science Fair Central:** Includes cool project ideas, a science fair handbook, reviews of students' experiments, and more from Discovery Channel School. http://school.discovery.com/sciencefaircentral/

6. **Science Fair Project Resource Guide:** Samples, ideas, magazines, resources, and more. Includes a list of sites that explain the Scientific Method. http://www.ipl.org/div/kidspace/projectguide/

7. **Scientific Method:** Describes the five steps of the Scientific Method that are helpful when creating a science fair project. Includes examples of wording and sample projects to explain certain steps. http://school.discoveryeducation.com/sciencefaircentral/Getting-Started/Investigation.html

8. **Super Science Fair Projects:** Guide to projects, topics, experiments, and tips for successfully completing a science project, including the six steps of the Scientific Method. http://www.super-science-fair-projects.com/

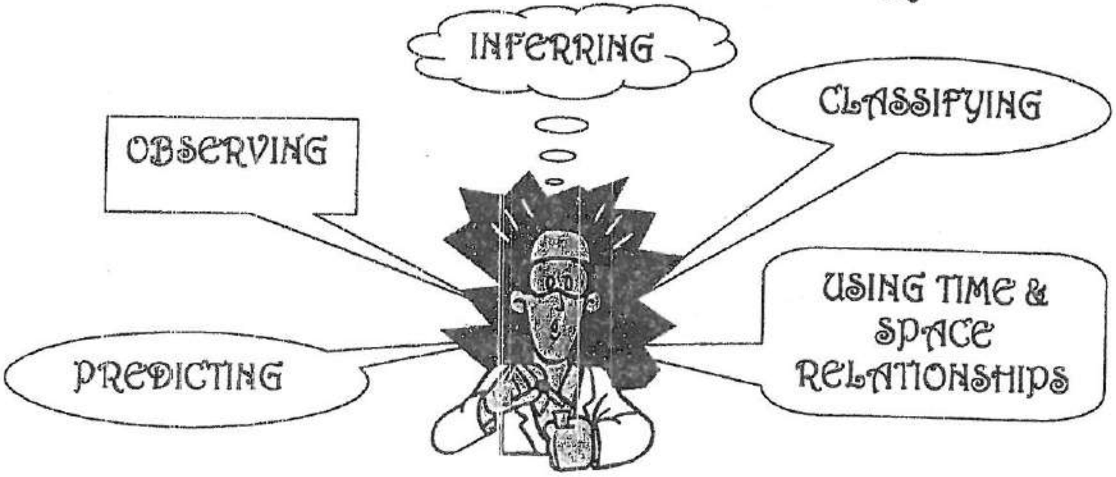
9. **What Makes a Good Science Fair Project?:** Short guide written by a group of experienced judges for the California State Science Fair. http://www.usc.edu/CSSF/Resources/Good_Project.html

III QUESTIONS TO STIMULATE SCIENTIFIC INQUIRY

As you work with students in regular science lessons and with science fair projects, ask these open-ended questions:

1. What changes have been brought about?
2. Why do you think so?
3. How can we find the answer?
4. What do we need?
5. What has happened?
6. What can you see?
7. What might we do to find out more about this?
8. What changes should we make in our experiment?
9. Why did it change?
10. Why is it inaccurate?
11. How shall we begin?
12. How do we know this to be true?
13. How can we show that what we say is true?
14. What changes do we see?
15. Why is this important?
16. What records did you make about what you saw?
17. What conclusions can you make from what you saw and tried?
18. How does this compare with what we already know?
19. How can you tell that the source is reliable?
20. What can we do about this problem?

Skills of a Scientist!



STEPS AND TIMELINE CHART
FOR
DEVELOPING A SCIENCE FAIR PROJECT

STEPS FOR SCIENTIFIC [illegible]		DATE DUE
1.	Choose a problem to investigate. (state problem as a question)	
2.	Conduct research: get advice from experts.	
3.	Develop a purpose and hypothesis.	
4.	Decide on the procedure to be used.	
5.	Make a list of materials needed; gather materials.	
6.	Conduct investigation; collect data.	
7.	Organize data and results.	
8.	Draw conclusions.	
9.	Complete abstract.	
10.	Write research report.	
11.	Proofread report.	
12.	Design exhibit.	
13.	Construct visual aids and exhibit backdrop.	
14.	Turn project in.	
15	Present project.	

RCSEF Project Categories – All Grade Levels/Divisions

Category Number	Category	Description
01	Animal Sciences	This category includes all aspects of animals and animal life, animal life cycles, and animal interactions with one another or with their environment. Examples of investigations included in this category would involve the study of the structure, physiology, development, and classification of animals, animal ecology, animal husbandry, entomology, ichthyology, ornithology, and herpetology, as well as the study of animals at the cellular and molecular level which would include cytology, histology, and cellular physiology. *(Animal Behavior; Cellular Studies; Development; Ecology; Genetics; Nutrition and Growth; Physiology; Systematics and Evolution)*
02	Behavioral and Social Sciences	The science or study of the thought processes and behavior of humans and other animals in their interactions with the environment studied through observational and experimental methods. *(Clinical and Developmental Psychology; Cognitive Psychology; Neuroscience; Physiological Psychology; Sociology and Social Psychology)*
03	Biochemistry	The study of the chemical basis of processes occurring in living organisms, including the processes by which these substances enter into, or are formed in, the organisms and react with each other and the environment. *(Analytical Biochemistry; General Biochemistry; Medicinal Biochemistry; Structural Biochemistry)*
04	Health and Biomedical Sciences	This category includes studies designed to address issues of human health and disease, the application of engineering principles and design concepts to medicine and biology for healthcare purposes including diagnosis, monitoring, and therapy. As well as projects that aim to improve human health and longevity by translating novel discoveries in the biomedical sciences into effective activities and tools for clinical and public health use. *(Biomaterials and Regenerative Medicine; Biomechanics; Biomedical Devices; Biomedical Imaging; Cell and Tissue Engineering; Synthetic Biology)*
05	Cellular and Molecular Biology	This is an interdisciplinary field that studies the structure, function, intracellular pathways, and formation of cells. Studies involve understanding life and cellular processes specifically at the molecular level. *(Cell Physiology; Cellular Immunology; Genetics; Molecular Biology; Neurobiology)*

Category Number	Category	Description
06	Chemistry	Studies exploring the science of the composition, structure, properties, and reactions of matter not involving biochemical systems. *(Analytical Chemistry; Computational Chemistry; Environmental Chemistry; Inorganic Chemistry; Materials Chemistry; Organic Chemistry; Physical Chemistry)*
07	Computational Biology and Bioinformatics	Studies that primarily focus on the discipline and techniques of computer science and mathematics as they relate to biological systems. This includes the development and application of data-analytical and theoretical methods, mathematical modeling and computational simulation techniques to the study of biological, behavior, and social systems. *(Computational Biomodeling; Computational Epidemiology; Computational Evolutionary Biology; Computational Neuroscience; Computational Pharmacology; Genomics)*
08	Earth and Environmental Sciences	Studies of the environment and its effect on organisms/systems, including investigations of biological processes such as growth and life span, as well as studies of Earth systems and their evolution. *(Atmospheric Science; Climate Science; Environmental Effects on Ecosystems; Geoscience; Water Science)*
09	Embedded Systems	Studies involving electrical systems in which information is conveyed via signals and waveforms for purposes of enhancing communications, control and/or sensing. *(Circuits; Internet of Things; Microcontrollers; Networking and Data Communications; Optics; Sensors; Signal Processing)*
10	Energy: Chemical and Physical	Chemical Energy: Studies involving biological and chemical processes of renewable energy sources, clean transport, and alternative fuels. *(Alternative Fuels; Computational Energy Science; Fossil Fuel Energy; Fuel Cells and Battery Development; Microbial Fuel Cells; Solar Materials)* Physical Energy: Studies of renewable energy structures/processes including energy production and efficiency. *(Hydro Power; Nuclear Power; Solar; Sustainable Design; Thermal Power; Wind)*
11	Engineering Mechanics	Studies that focus on the science and engineering that involve movement or structure. The movement can be by the apparatus or the movement can affect the apparatus. *(Civil Engineering; Computational Mechanics; Control Theory; Ground Vehicle Systems; Industrial Engineering-Processing; Mechanical Engineering; Naval Systems)*
12	Environmental Engineering	Studies that engineer or develop processes and infrastructure to solve environmental problems in the supply of water, the disposal of waste, or the control of pollution. *(Bioremediation; Land Reclamation; Pollution Control; Recycling and Waste Management; Water Resources Management)*

Category Number	Category	Description
13	Materials Science	The study of the integration of various materials forms in systems, devices, and components that rely on their unique and specific properties. It involves their synthesis and processing in the form of nanoparticles, nanofibers, and nanolayered structures, to coatings and laminates, to bulk monolithic, single-/poly-crystalline, glassy, soft/hard solid, composite, and cellular structures. It also involves measurements of various properties and characterization of the structure across length scales, in addition to multi-scale modeling and computations for process-structure and structure-property correlations. *(Biomaterial; Ceramic and Glasses; Composite Materials; Computation and Theory; Electronic, Optical, and Magnetic Materials; Nanomaterials; Polymers)*
14	Mathematics	The study of the measurement, properties, and relationships of quantities and sets, using numbers and symbols. The deductive study of numbers, geometry, and various abstract constructs, or structures. *(Algebra; Analysis; Combinatorics, Graph Theory, and Game Theory; Geometry and Topology; Number Theory; Probability and Statistics)*
15	Microbiology	The study of micro-organisms, including bacteria, viruses, fungi, prokaryotes, and simple eukaryotes as well as antimicrobial and antibiotic substances. *(Antimicrobial and Antibiotics; Applied Microbiology; Bacteriology; Environmental Microbiology; Microbial Genetics; Virology)*
16	Physics and Astronomy	Physics is the science of matter and energy and of interactions between the two. Astronomy is the study of anything in the universe beyond the Earth. *(Atomic, Molecular, and Optical Physics; Astronomy and Cosmology; Biological Physics; Condensed Matter and Materials; Mechanics; Nuclear and Particle Physics; Theoretical, Computational, and Quantum Physics)*
17	Plant Sciences	Studies of plants and how they live, including structure, physiology, development, and classification. Includes plant cultivation, development, ecology, genetics and plant breeding, pathology, physiology, systematics and evolution. *(Agriculture and Agronomy; Ecology; Genetics and Breeding; Growth and Development; Pathology; Plant Physiology; Systematics and Evolution)*
18	Robotics and Intelligent Machines	Studies in which the use of machine intelligence is paramount to reducing the reliance on human intervention. *(Biomechanics; Cognitive Systems; Control Theory; Machine Learning; Robot Kinematics)*
19	Systems Software	The study or development of software, information processes or methodologies to demonstrate, analyze, or control a process/solution. *(Algorithms; Cybersecurity; Databases; Human/Machine Interface; Languages and Operating Systems; Mobile Apps; Online Learning)*

The obvious answer is because your teacher requires it. But why would your nice teacher put you through the torture of doing a project? Science is different from many other ways of learning because of the way it is done. Science relies on testing ideas with evidence gathered from the natural world. Doing a long term science project is perhaps the best way to learn how to think like a scientist and make decisions through the lens of evidence. It is as much about learning a process as producing a product.

Where Do I Start?

A science fair project is different from a school report on a special topic like whales, planets, or climate change. It is also different from making a model such as a volcano or solar system. A science fair project involves ***conducting an experiment to answer a question or solve a problem***.

1) Follow your interest–are you interested in sports, technology, music, food, gaming, solar energy, or another field. Select area of interest.
2) Brainstorm topic ideas within your area of interest.
3) Need more inspiration or ideas? Look at the list of sample projects that have been done in the past. You can also go to the Topic Selection Wizard and answer 25 questions and get more customized ideas just for you (http://www.sciencebuddies.org/science-fair-projects/recommender_register.php.) Another good site is: https://www.exploravision.org/sample-projects

What's Next After I Choose A Project?

The California State Science Fair, The Riverside County Science Fair and the Corona-Norco Unified School Science Fair all highly recommend writing a research report on your topic before you start your laboratory investigation. Your classroom teacher will give you the specific details about your report.

Now That My Research Is Completed

STEP 1: Based on research and observations, ask a question

STEP 2: Predict the answer to the question (we call that prediction a hypothesis)

STEP 3: Design an experiment to generate data to test the hypothesis (easier than it sounds). The experiment should have a control and experimental group with the only difference between them being the variable you are testing. It is a good idea to keep a daily journal or log recording your work on your project.

STEP 4: Analyze the data to determine if the prediction should be accepted or rejected. Make your conclusion on your hypothesis using and citing evidence from the data from your experiment.

In all cases the *independent variable* (aka manipulated or explanatory variable) is the one you will manipulate (for example the size of a pumpkin) and the *dependent variable* (aka response variable) is the one you will measure (the number of seeds inside the pumpkin) in your experiment(s).

The DEPENDENT VARIABLE (must be quantitative), you could measure…

• size
• speed
• concentration
• frequency (how often something happens)
• angles and/or direction

The INDEPENDENT VARIABLE can be either quantitative (i.e. measurable with numbers) or qualitative (i.e. describable with adjectives).

Examples of qualitative variables would include:

• color: red, blue, green, yellow, orange
• gender: male, female
• size: small, medium, large

STUDENT SCIENCE & ENGINEERING FAIR PROJECT CHECK LIST

PROBLEM:

1. Is it written in the form of a question?
2. Is it identified?

RESEARCH:

1. Axe the facts set up in outline form or brief statements?
2. Do you have sufficient information?
3. Does your information pertain to the problem?
4. Is it clear, easy to read? Understand?

HYPOTHESIS:

1. Does your prediction address the problem?
2. Is your prediction justified (explained)?
3. Is your explanation based on information found in the research section?
4. Have you avoided using I, my, me, or mine?

EXPERIMENTAL PLAN:

1. Have you identified all the materials required to do this experiment?
2. Have you identified the quantities of each item on your material list?
3. Have you written a set of directions on how to do the experiment?
4. Did you set up the experiment in a step-by-step fashion, and not paragraph form?
5. Did you identify the control group and the experimental groups?
6. Did you make it detailed?

OBSERVATIONS:

1. Did you identify the date and time they were made?
2. Did you write them in such a way that others could understand what you have written?

ANALYSIS:

1. Did you organize your observations into a chart?
2. Did you title your chart?
3. Did you graph your data?
4. Do your graphs have a title?
5. Axe the axis labeled correctly?
6. Numbered correctly?
7. Did you write a summary of what each graph shows the reader?
8. Did you graph only the averages for each group and not individual data when possible?

CONCLUSION:

1. Did you begin with stating whether you support or reject your hypothesis or are inconclusive?
2. Do you go on to explain why you answered this way?
3. Do you use your data (numbers) to support your explanations?
4. Do you discuss all of the possible factors that might have influenced your results?
5. Do you suggest ways to improve on the experiment, if you were to do it over again?
6. Do you make recommendations for other experiments related to this topic?

Special Notes on Experimentation:

1) If you are going to use humans, animals or tissue cultures there are special forms to fill out and rules to follow (they are included in the end of this booklet)
2) You may not use tobacco, consumable alcohol, firearms, explosives, or illegal drugs in your experiment.
3) For detailed rules please read through the attached Riverside County Science and Engineering Fair Regulations and Information Packet 2017-18.
4) **Please read over the categories and rules as they have radically changed from 2016-17 Science Fair.**

Project Categories:

1. Riverside County Science and Engineering Fair has changed their categories that have been in place for 20 years to new categories identical to those used by the California State Science Fair and the Intel International Science and Engineering Fair. You will find a detailed description of these categories in the RCSEF Regulation and Information Packet. All categories will used in the CNUSD District Science Fair for Junior and Senior Divisions.
2. Elementary Division projects are eligible to compete at the County Fair but not the California State Science Fair or the Intel ISEF so they will compete in the following categories at the CNUSD Science Fair: (RCSEF Information Packet for descriptions of each of the categories)

   Animal Science
   Behavioral and Social Science
   Biomedical and Health Science
   Chemistry
   Earth and Environmental Science
   Energy
   Engineering
   Materials Science
   Microbiology
   Physics and Astronomy
   Plant Science

Link to Riverside County Science and Engineering Fair Information Packet: http://www.rcoe.us/student-events/files/2014/06/RCSEF-Science-and-Engineering-Fair-Guidelines-complete-document.pdf

How to Layout Your Science Fair Display Board

Helpful Hints:

- Use a font large enough to read from a distance (minimum 16pt)
- Only readable fonts are to be used.
- Arrange everything BEFORE you glue.
- Use rubber cement, not Elmer's!
- Check and double check for spelling errors-have an adult proofread your work.
- Do not write directly on the board.
- Do not use glitter glue or other distracting items.
- Be precise-cut straight (use a paper cutter) and glue straight.
- Data notebook should sit in **front** of your board on the table-it is not glued onto your board.
- Be creative and have fun. Show your audience what you did and that you are proud of your work.
- Pictures of your experiment really improve the quality of the display board. Be sure to write
- captions under the pictures to explain what they are.
- If you take an image and use it on your board you must give that image credit by listing where you got it, as a caption, under the picture.
- You may not put pictures of people's faces on the board. Data needs to be anonymous.
- You only need one board per project. Be sure BOTH your names are written clearly on the back of the board if you have a partner.
- When you get to the science fair you will place the project number on the top right hand corner of the board so judges can find you.

KEY: Connections to the NGSS Scientific and Engineering Practices — Connections to the Common Core State Standards — Guiding Questions/Notes

PURPOSE
- Asking Questions and Defining Problems
- Make sense of problems and persevere in solving them
- Why are you doing the experiment?
- What did you observe in the world that made you ask your question?
- What made you curious?

QUESTION/PROBLEM
- Asking Questions and Defining Problems
- Make sense of problems and persevere in solving them
- Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation
- What are you trying to figure out?
- What problem are you trying to solve?

HYPOTHESIS
- Developing and Using Models
- Constructing Explanations and
- Designing Solutions
- Construct viable arguments and critique the reasoning of others
- Write arguments to support claims using valid reasoning

What do you think a likely answer or solution to your question/ problem could be? Why?

RESEARCH & BACKGROUND
- Obtaining, Evaluating and Communicating Information
- Attend to precision
- Integrate and evaluate content presented in diverse media and formats, including visually and quantitative, as well as in words
- Gather relevant information from multiple print and digital source, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism
- Draw evidence from informational texts to support analysis, reflection, and research
- What have others said about the topic of your inquiry?
- How does this research influence how you will approach your project?
- Have others done this experiment before?
- How will your project further the research and experimentation that has already been done?

Project Title

A good title attracts attention, but also gives information about the project.

ABSTRACT
Provide a concise paragraph summary of your project including: purpose, hypothesis, procedures used, data summary or analysis, and conclusions.

MATERIALS
Record everything you use for your project. You do not include the materials for the board.

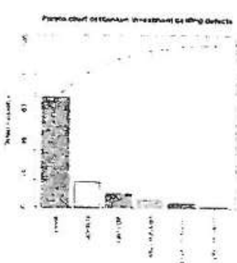
PROCEDURE
Record the steps you did during your experiment. Make sure others can follow them.

DATA
Visually communicate your data in the format that matches the type of data you collected. You can show both raw and interpreted data. For example: spreadsheets, photos, diagrams, charts, maps, graphs, models, etc.

- Planning and Carrying Out Investigations
- Developing and Using Models
- Using Mathematics and Computational Thinking

- Make sense of problems and persevere in solving them
- Model with mathematics
- Use appropriate tools strategically
- Attend to precision

- Integrate and evaluate content presented in diverse media and formats, including visually and quantitative, as well as in words



Write down everything you do from start to finish for your project. Do not include preparing the board. Journal should be hand written and authentic. Be sure to have your journal on display with your board.

RESULTS
- Analyzing and Interpreting Data
- Obtaining, Evaluating and Communicating Information
- Reason abstractly and quantitatively
- Attend to precision
- Look for and make use of structure
- Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective analysis of content

This is a summary of results from the experiment. Explain your Data, Photos, Charts, Graphs and models in paragraph form.

CONCLUSION
- Engaging in Argument from Evidence
- Obtaining, Evaluating and Communicating Information
- Construct viable arguments and critique the reasoning of others
- Draw evidence from informational text (including student data) to support analysis, reflection, and research
- Write arguments to support claims using an analysis (of all components of process and research) using valid reasoning and valid and sufficient evidence

Restate question

Describe your observations: before, during & after the experiment

Summarize your research

Describe your experiment

Explain and justify your conclusion with your data and observations.

NEXT STEPS
- Obtaining, Evaluating and Communicating Information
- Asking Questions and Defining Problems
- Make sense of problems and persevere in solving them
- Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation
- What new questions do you have as a result of your inquiry?

This is only a guide, there is no one "correct" format for a successful project. The key is for the learner to understand what it is like to "do" science and engineering, and have fun doing it. ©

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2015

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Guiding Questions/Notes

Engineering Project Title

A good title attracts attention, but also gives information about the project.

PURPOSE

* Why are you doing this project?
* What did you observe in the world that made you ask your question?
* What made you curious?

PROBLEM

* What is the problem or need?
* Who has the problem or need?
* Why is it important to solve?

DESIGN REQUIREMENTS

* State characteristics that your solution must meet to be successful.
* List should provide a complete description of the key features that will make your design successful.
* List should be feasible. Think of what you might need... time, materials, etc.

RESEARCH & BACKGROUND

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. Research two areas:

1. Users or customers
2. Existing solutions

* How does this research influence how you will approach your project?
* How will your project further the research and design that has already been done?

ABSTRACT

Provide a concise paragraph summary of your project including: purpose, hypothesis, procedures used, data summary or analysis, and conclusions.
250 words maximum

SOLUTIONS

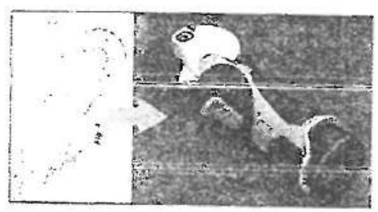
* Brainstorm possible solutions
* Evaluate possible solutions
* Show notes, pictures, etc.
* What criteria did you use to find the best possible solution?

MATERIALS

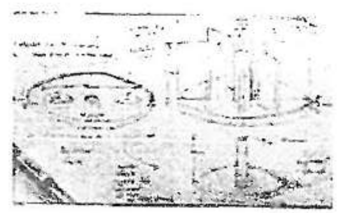
*Record everything you use for your building your prototype.
*Do not include the materials for the board.

PROTOTYPE

*What process did you use to create your protoype?
*Did you encounter any challenges as you built?
* Did you need to redesign it as your were building it?



Include Pictures
* Sketches
* Labeled diagrams
* Detailed drawings
* Photos of your protoype



Write down everything you do from start to finish for your project. Do not include preparing the board. Journal should be hand written and authentic. Be sure to have your journal on display with your board.

TEST & REDSESIGN

* Go out and test your final design
* How did feedback from others help you redesign?
* What problems occurred and how did you fix them?
* Which parts were successful and why?
* Repeat process and retest multiple times until your solution is as successful as possible.

DISCUSSION

* Restate your problem.
* Summarize your research
* Describe your process of designing, testing, redesigning, testing...
* Describe your project
* Explain and justify your conclusion with data and observations.

NEXT STEPS

*What new questions do you have as a result of your Engineering Design?
*What are some ideas for future research or improved designs?
*What additional materials and resources would you need to make future designs successful?

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