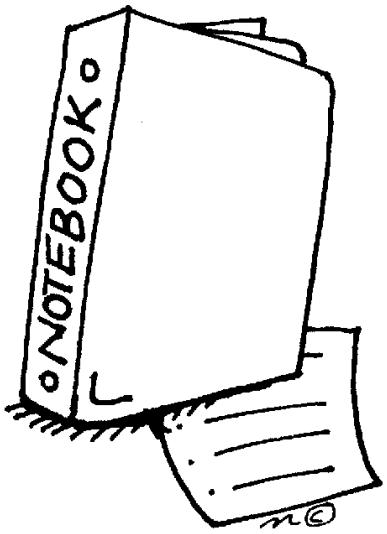
Elementary
Science Fair Notebook
Engineering Projects



Name: _____

Project Due Date: _____

Project Overview

What is a science fair project?

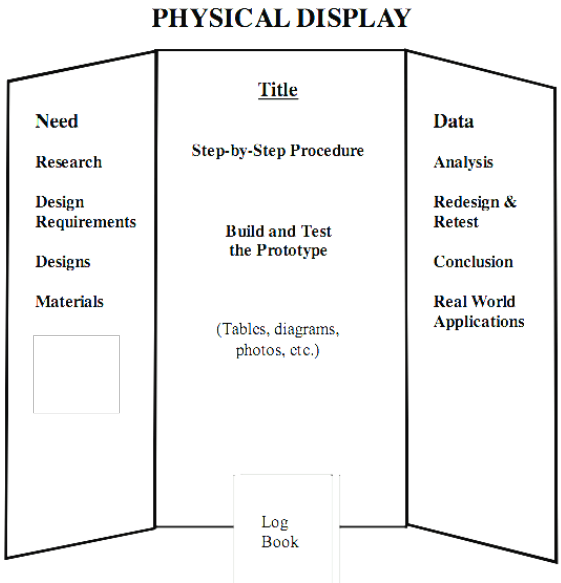
The science fair project is a long-term project where you will plan, build, and share results from your engineering design solution. The project includes defining a problem or need, research, designing and testing a prototype, recording your designs and data from testing in a science notebook, analyzing your data to improve your design, and creating a tri-fold poster to share your project. You can use this notebook to help you with the project process.

What makes a good project?

The first step to completing a good science fair project is to choose a topic that interests you. Students that have excellent projects do research before they begin. They really understand the need for their project, the science behind their topic and use their knowledge to design an interesting solution. Another thing that makes a great project is originality. Try to come up with your own idea. There are a lot of examples of projects on the Internet. If you are stuck, use these as jumping off points, but try to make the project your own. When you test your prototype, do multiple trials. The more data you collect, the better. Also, if something doesn't go as planned and you have an idea to test why or a way to redesign your prototype, keep going, this is what engineers do. Finally, you want your poster to be informative, clear, and attractive. You have put a lot of work into planning and conducting your experiment. A well-planned poster will help others see this.

What goes on an engineering project poster?

Posters for engineering projects should explain the problem you addressed, show your design process of building, testing, and redesigning, and include a conclusion that describes the importance of your project . Also be sure to have a science notebook that includes your research, sources, and design process.



Science Fair Timeline – Engineering Projects

Dates	Steps
	Select a Topic Read magazines, make observations, ask people about challenges or problems that they have to gather ideas for an engineering project.
	Purpose Define the need or the problem that you want to address in the project.
	Research After you have chosen a problem or a need research more about your topic. Come up with some questions related to your topic and search for the answers. Then write a paragraph about what you learned.
	Design Goal Use what you learned from research to develop a possible solution to your need or problem. Describe your design idea in detail, including materials you will need and costs.
	Teacher Approval Form Before you can begin to build a prototype your teacher must sign an approval form. The form is on the last page of this notebook.
	Build, Test, Revise Start by following your design goal, then make adjustments to your prototype after you have tested it. You will probably have to go through several cycles of building, testing, and redesigning. Be sure to record all of this process.
	Design Solution Once you have a prototype that addresses your need or problem, you need to develop a materials list and procedures for creating the final prototype.
	Conclusion Share what you learned from your experiment in your conclusion. Be sure to explain how your design effectively solves the problem, or meets the need. Your conclusion will be 1 – 3 paragraphs long.
	Poster Your poster should include all the sections of your project in a clear display. The goal of the poster is to teach others about your design solution and what you learned through the process.

Topic Brainstorm

In this section you will record ideas about your interests. This will help you to pick a topic and develop a plan for your science fair project. Fill in each text box.

1. What do you like to do outside of school? (examples: art, theater, sports, build things, cook, etc.)

2. What is your favorite thing you have done related to science? (examples: experiments, tv shows, museums, etc.)

3. Take the science interest survey on the next pages. List the disciplines that you are interested in.

4. Free Write: In the space below write about the topics you think you might be interested in for the science fair. What ideas do you have right now?

Science Interest Survey

Directions: Answer each question with "yes", "no" or "kinda"

1. Do you like building or repairing machines?
2. Do you enjoy gardening and working with plants?
3. Are you curious to understand things like gravity and magnetism?
4. Does observing the behavior of different people fascinate you?
5. Do you enjoy working on computers or learning about how computers work?
6. Do you like to go hiking or snorkeling so that you see different animals in their natural environment?
7. Do you enjoy learning about the forces of nature like weather and earthquakes?
8. Do you enjoy learning about memory and how our brain works?
9. Are you curious about the way different animals grow, develop, and live?
10. Are you interested in science fiction stories involving faster than light travel and "beams" that do amazing things?
11. Do you want to understand more about how people are affecting the environment?
12. Do you enjoy learning about outer space and astronauts?
13. Do you enjoy learning about lakes, rivers, the ocean, and beaches?
14. Have you built inventions or other things for fun and not a school project?
15. Do you enjoy learning about chemicals and things that bubble, fizz, or explode?
16. Do you enjoy discovering new ways to recycle, restore, or re-use old stuff?
17. Do you like to go on drives or hikes specifically so that you can see interesting mountains, rock, or caves?
18. Do you enjoy watching or participating in sports?
19. Do you like learning about what makes us healthy and what makes us sick?
20. Are you interested in how to build roads, bridges, and buildings?

What kinds of science are you interested in?

Directions: Circle the numbers that you answered "Yes" to on the other side. These are the kinds of science that you are interested in!

1. Engineering: Learning about how to build and design things, how things work
2. Plant biology: Learning about how plants grow and change
3. Physics: Learning about energy and forces, how things move and change
4. Psychology: Learning about how people and animals think and behave
5. Computer science: Learning about how computers and computer software works
6. Zoology: Learning about different kinds of animals
7. Meteorology: Learning about weather and how it changes
8. Psychology: Learning about how people and animals think and behave
9. Zoology: Learning about different kinds of animals
10. Optics (physics): Learning about how light behaves and interacts
11. Environmental science: Learning about ecosystems, living and nonliving things
12. Astronomy: Learning about outer space and our solar system
13. Oceanography: Learning about the oceans and other bodies of water
14. Engineering: Learning about how to build and design things, how things work
15. Chemistry: Learning about what matter is made of and how they change
16. Environmental science: Learning about ecosystems, living and nonliving things
17. Geology: Learning about the earth and what it is made of
18. Sports science: Learning about the physics of games and the biology of athletes
19. Biology: Learning about living things and how they grow and change
20. Engineering: Learning about how to build and design things, how things work

Now list the types of science you are interested in box #3 of the Topic Brainstorm page.

Purpose

The goal of an engineering project is to design and construct a prototype that addressed a need or solves a problem. Begin by thinking about a need or a problem. Could you design something to address that problem?

Excellent engineering projects are creative and meaningful. If you found your idea on the Internet, ask yourself if there is a way to make the project your own. As you think about your project make sure your idea is meaningful. What is the purpose of your project? Who might it help?

1. Write your question or describe the purpose of your engineering project in the space below:

2. A great way to get ideas for your science fair project is to share your initial ideas with others. In the space below record ideas or questions that others have shared with you about your project.

Research

Before you begin to design your prototype it is important that you do some research. For engineering projects, first you need to make sure that your idea or invention does not already exist. Then you should do some research on the need for your product. You may want to interview people for this. It is also a good idea to understand some of the scientific principles that are related to your problem or your idea for a design. For example, if you want to design a better hot chocolate cup, you should research cup designs that already exist, ask people what they want in a hot chocolate cup, and finally research information about thermal energy and heat transfer. The more you know, the better your project will be.

To help you with this process think of questions that you need to answer before you start to develop your solution. Record your questions in the boxes below, then research the answers. Do not forget to write down your source (Internet, book, expert) in the works cited section.

Question 1: **Answer:** **Works Cited:**
Question 2: **Answer:** **Works Cited:**
Question 3: **Answer:** **Works Cited:**

Background Research Paragraph

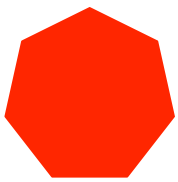
Synthesize the information that you learned while researching your topic to write a background research paragraph. The paragraph should include information about the need that your project will address. You should also explain the science concepts that are related to your engineering project.

In the space below write your background information paragraph.

Design Goal

The next step in your project is to create a design goal. Describe your initial ideas about what you will design to address the need. Be specific when you describe your prototype. Include information about the size of your prototype, the materials you will use to build the prototype, and an estimate of the costs. Also describe how you plan to test your prototype.

1. Write your design goal in the space below:



STOP: Before you start to build your prototype be sure that your teacher has signed and collected your science fair approval plan (the last page of this packet).

Build, Test, Redesign

In this section you need to build and refine your prototype. In your design goal you proposed a plan for your prototype. Start by following that plan, however chances are you will make adjustments as you go along. Be sure to record the materials that you used to build the prototypes, schematics and plans that you followed while building the prototypes, tests you used to evaluate your prototypes, data you collected while testing, and pictures or written descriptions of how you redesigned your protoypes based on tests. Remember, you need to keep going through the build, test, redesign process until you have developed a prototype or solution to the problem you identified. The next few pages of the notebook are blank so that you can record this process.

Build, Test, Redesign cont'd

Build, Test, Redesign cont'd

Build, Test, Redesign cont'd

Build, Test, Redesign cont'd

Design Solution

When you feel that the prototype has reached its greatest efficiency according to the need or problem, you are ready to develop a detailed description of your design solution. For this description you should include a picture and/or schematic of your design, materials used to build the prototype, and step-by-step procedures for building the prototype. Use the boxes below to record this information.

1. Draw or paste a picture or schematic of the design solution in the space below.

2. List your materials, include quantities.

3. Write step by step procedures for your prototype.

Conclusion

The conclusion is a place for you to share what you learned through the design process. Your conclusion should be one to three paragraphs long. In your conclusion you should answer the following questions:

- How does the prototype or design solution address the need or problem?
- What did you learn during the design process (testing and evaluating) that informed your final design solution?
- Why is your design solution important? How can it be applied to real life?
- How could your design solution be improved?

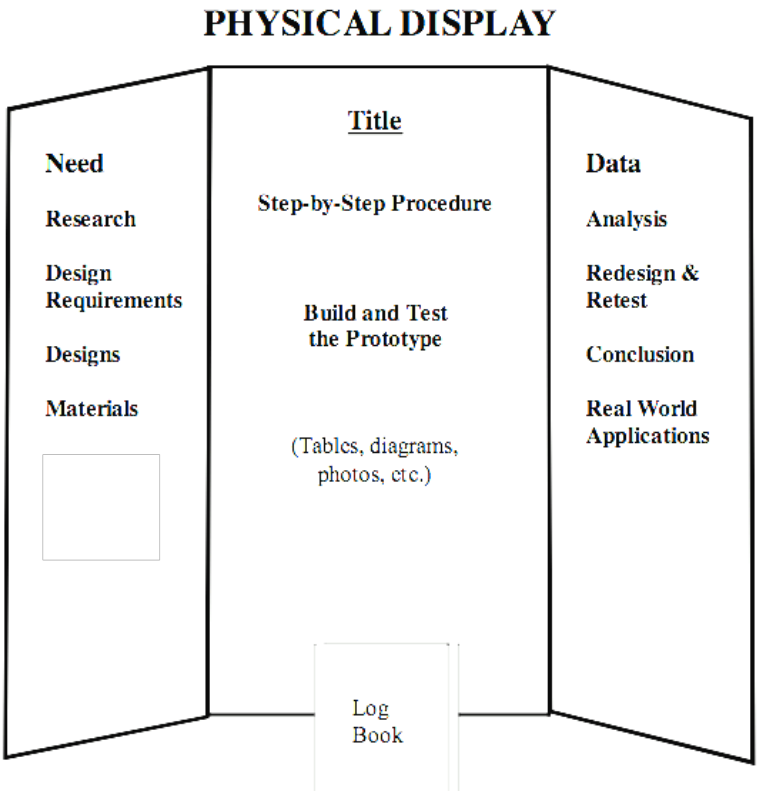
Write a rough draft of your conclusion in the space below.

Display Board

Your display board should demonstrate all of the hard work that you have put into your science fair project. Don't wait until the last minute! Use the information that you have recorded in this science fair notebook to help you decide what to write on each section of your board.

The picture shows one example of how to set up your board. Your board may look different, depending on the need your design addressed and the process you followed. Be sure that your poster includes adequate information about:

- The problem or need the project addresses
- Your building, testing, and redesigning process
- A clear description of the final design solution
- An explanation of why your project is important



You also need to display your science fair notebook or log book. You can use this packet as your science fair notebook or use a spiral notebook. In the notebook be sure to have the research you did in the beginning of the project, a list of your sources for research, and all of your notes, observations, diagrams, and data that you collected while designing, testing, and redesigning your prototype.

Pre Approval: Grades 5-8 School Common Sense Safety Approval-Page 1

All projects must be PRE-approved by the **school** before any project can get started. See the back of this sheet for ALL the details.

Students-fill the top out and give to your teacher. PRINT CLEARLY.

Name(s):
School:

My project uses:

- ☐ Animals
- ☐ People
- ☐ Bacteria/Pathogens
- ☐ Hazardous materials (weapons, fire, chemicals etc…)
- ☐ None of these

This is what my project is about:

- -

Teacher/Fair Coordinator

- ☐ Approved: I have reviewed the project and talked with the student (and parents if needed) and feel that it is safe and reasonable for the student to do. Steps are in place to get permission from participants, keep animals safe, avoid creating a pandemic of super-bacteria or burning down the school. I checked with the District or Regional Fair in case I wasn't sure. Signatures on back of document.

- ☐ Denied: I have reviewed the project and DO NOT approve it due to safety concerns. I checked with the District and Regional Fair and they concur that this project is going to get a student disqualified or worse, hurt. Pick another idea.

_____

Printed Name of School Fair Coordinator
(Coordinator: Send your entire school's forms to Stephanie Wood in a bundle)

PRE APPROVAL-GRADES 5-8 SAFETY APPROVAL SCIENCE FAIR PROJECT RULES PAGE 2

My Experiment will Involve the Following (check all that apply):

☐ Human Subjects

All human research projects must be **reviewed** and **approved** by a science teacher, a school administrator and one of the following: a psychologist, psychiatrist, medical doctor, physician's assistant or registered nurse **before the student begins experimentation**. If they determine that there is more than minimal psychological or physical risk to the human subjects involved in the project, the student must receive written consent from each of the participants and written parental consent for students under 18 years old. If they determine that there are unacceptable risks involved the student must revise his or her project. *Please attach a copy of the surveys or tests* you intend to use with your research plan. Students may not publish or display information that identifies the human subjects.

☐ Non-Human Vertebrate Animals

All projects involving non-human vertebrate animals must be **reviewed** and **approved** by two science teachers and a biomedical scientist (ex. a local veterinarian) **before the student begins experimentation.** Alternatives to the use of vertebrate animals must be explored and included in the student's research plan. Experiments involving laboratory animals (rats, mice, hamsters, gerbils, rabbits, etc) cannot be conducted in a student's home except for behavior studies on pets. Proper animal care must be provided daily, including weekends, holidays and vacations. Experimental procedures that cause unnecessary pain or discomfort are prohibited. Experiments designed to kill vertebrate animals are not permitted. Students may not perform euthanasia, except in emergency situations. Alcohol, acid rain, insecticide, herbicide and heavy metal toxicity studies are prohibited. Experiments with a death rate of 30 percent or higher are not permitted. Behavioral studies or supplemental nutritional studies involving pets or livestock may be done at home.

☐ Controlled Substances (Prescription Drugs, Tobacco, Alcohol, etc)

All projects involving controlled substances must be **reviewed** and **approved** by two science teachers and a school administrator or biomedical scientist **before the student begins experimentation**. Students must adhere to all federal, state and local laws when acquiring and handling controlled substances. Only under the direction of a qualified scientist or designated supervisor may a student use federally controlled or experimental substances for therapy or experimentation. Students under 21 may not handle or purchase smokeless powder or black powder for science projects.

☐ Hazardous Substances or Devices (Chemicals, Firearms, Welders, Lasers, Radioactive Substances, Radiation)

Students must adhere to federal and state regulations governing hazardous substances or devices. An adult must directly supervise experiments. Students working with hazardous substances or devices must follow proper safety procedures for each chemical or device used in the research.

☐ Potentially Hazardous Biological Agents

(Bacteria, Mold, Fungi, Viruses, Parasites, Recombinant DNA (rDNA), Human or Animal fresh tissues, blood or body fluids, etc)

All projects involving potentially hazardous biological agents must be **reviewed** and **approved** by two science teachers and a biomedical scientist **before the student begins experimentation**. It is the responsibility of the student and the adults involved with the project to conduct a risk assessment. Risk assessment defines the potential level of harm, injury or disease to plants, animals and humans that may occur when working with biological agents. Risk assessment involves:

1. Assignment of the biological agent to a biosafety level risk group. **Students in grades 5-8 may only conduct research with biological agents determined to be at Biosafety Level 1 (BSL-1).** BSL-1 agents pose low risk to students or the environment and are highly unlikely to cause disease in healthy people, animals or plants. Examples of BSL-1 Microorganisms include: *Agrobacterium radiobacter, Aspergillus niger, Bacillus thuringiensis, Escherichia coli strain K12, Lactobacillus acidophilus, Micrococcus leuteus, Neurospora crassa, Pseudomonas fluorescens, and Serratia marcescens.* **Studies involving unknown microorganisms can be determined BSL-1 if the organism is collected in a plastic Petri dish or other non-breakable container and is sealed and remains sealed during the entire experiment.** Examples of BSL-1 rDNA studies include: Cloning of DNA in *E. coli K12, S. cerevesiae*, and *B. subtilis* host vector systems. Examples of BSL-1 Tissue studies involve the collection of non-infectious fresh tissues (not including blood or blood products) with little likelihood of microorganisms present. Projects involving blood or blood products are considered Biosafey Level 2. Plant tissues, established cell lines and cultures, meat from food stores or restaurants or packing houses, hair, teeth that have been sterilized, and fossilized tissue do not need to be treated as potentially hazardous biological agents.

2. Determine the level of biological containment available to the student researcher. **Biosafety Level 1 projects can be performed in a school laboratory but are prohibited in the home environment.** Standard microbiological practices must be used and all hazardous agents must be properly disposed of at the end of experimentation. The experiment must be supervised by a qualified scientist or a trained designated supervisor.

***For a complete list of rules regarding all of the subjects listed above please visit the following website:**
http://www.societyforscience.org/page.aspx?pid=312
If your project will include any of the subjects listed above, you must get all these signatures before you begin.

_____	_____	_____
Science Teacher Date	**School Fair Coordinator Date**	**Other professional (i.e. doctor, vet, scientist)**