Student Science Journal

For Middle School Scientists!

MINNESOTA ACADEMY OF SCIENCE

—Promoting Excellence in Science Since 1873—

Science Project Checklist

Find a Problem, Look for Info, & Ask a Question	○ You can begin with a problem. ○ Ask a question to begin your experiment design. ○ The best questions make a comparison that will allow the scientist (you) to control changes and observe the result of those changes. ○ How does_____affect _____? ○ Example: Which marble will travel farther down an incline, a marble with a mass of 10 grams or a mass of 30 grams?
Create a Hypothesis	○ The hypothesis is what you think will happen in your experiment. ○ Your experiment is testing your hypothesis. ○ Try and think of a reason why you think your hypothesis is going to occur.
Research	○ Find 3 sources. Your sources can be websites, magazines, or books. ○ Sources are places where you will find information about your topic and the question you are asking. ○ Get sources approved by teacher or mentor.
Procedures	○ The step by step method you will use to do your experiment. ○ Make sure someone else can follow your procedures. ○ Design a table to keep track of your results.
Materials	○ A list of what you need to complete this experiment. ○ Be specific. Include how much you need. ○ Make sure you have enough materials to recreate your experiment 3 times.
Identify Variables	○ Identify the different variables of your experiment.
Experiment & Record	○ Conduct your experiment. ○ Don't forget to repeat and record data for your experiment in your procedures. ○ Also record any observations you make during experimentation. ○ Record things that went wrong and why. ○ A good experiment has at least 3 trials.
Analyze Results	○ Present your results in a data table. Label and title your data table. ○ Average your data for the multiple trials. ○ Graph your results using your data table. Label and title your graph.
Conclusion	○ Answer the investigative question. ○ Include supporting data from your data table. ○ Explain how these data support your conclusion.
Final Report	○ Your final report will be everything you have written in your notebook typed in paragraph form.
Bibliography & Abstract	○ Your bibliography will give credit to the books, Internet sites, journals, and people who helped you in your investigation by citing sources properly in MLA format. ○ Your abstract will be a 250-word summary of your project
Display & Practice Judging	○ Your display is not just your board it is your journal, your report, and several copies of your abstract. ○ Your board needs a good title that grabs guests' and judges' attention. ○ Photographs of the experiment.

What is a Science Fair Project?

Fill in the blanks in the paragraph with words from the Word Bank below to learn more about what science fair projects are and how they work!

A science fair project is an investigation that is designed to _____ a _____ or answer a _____. You will use a procedure called the _____ to answer the question. The fair part takes place when everyone who has done a project gathers together to _____ their work. You will make a _____ and take it to science fair to explain your project. At the science fair you will talk to _____ about your project and they will score your project and the other projects. If you score high enough you may _____ some _____.

Word Bank

awards	scientific method
solve	judges
win	show
display board	problem
question	

Scientific Method Activity

The steps for the scientific method are in the word bank. Use the word back to correctly order the steps of the scientific method. Try it on your own and then do it with your class

WORD BANK:

Analyze Data	Form A Hypothesis	Experiment
Report Results	Ask A Question	Gather Information

ORDER THE STEPS:

Try it On Your Own	Try it With Your Class
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.

Science Fair Vocabulary

1. **conclusion** – your opinion about what happened during the experiment; inferences belong in the conclusion; the last step of the scientific method
2. **controls** – things that remain the SAME during the experiment
3. **data** – observations and measurements taken from your experiment – they should be listed in the form of a chart or graph so you can clearly see the results from the data
4. **dependent variable** – also called the responding variable – the change that happens in your experiment because of or as the result of the independent variable being changed
5. **display board**– backboard, three-paneled, on which is attached the title of the experiment, parts of the written report, graphs and charts, pictures, etc to tell the story of your entire experiment
6. **hypothesis** – an EDUCATED, testable response to the question you have posted as your problem – this is used to guide your entire experiment
7. **independent variable** – also called the manipulated variable – the ONE THING you change in your experiment to see what effect it has
8. **materials** – a list of ALL the supplies you use for your experiment
9. **observations** – things you see and witness during your experiment
10. **population** - the entire group the researcher is studying. If the researcher cannot gather data from the population, studying large random samples taken from the population may be used to estimate how the population would respond.
11. **procedure** – a list of the steps you go through to perform your experiment from start to finish – very specifically laid out so someone can redo your experiment
12. **question** – what you want to know about your topic that forms the basis for your hypothesis
13. **research** – any information you gather from different sources (books, the Internet, magazines, articles, interviews of specialists, etc) which helps you know more about your science project topic
14. **results** – a simple, factual summary of what happened in the experiment
15. **Science Journal** – a notebook that you can use to organize your experiment – in contains everything from your experiment; daily notes, doodles, brainstorming, questions, problems, procedures, EVERYTHING

Vocabulary Bingo

Science Fair Categories

Physical Science: Projects that study the nature and properties of nonliving matter, energy and/or force and motion.

Behavioral Science: Projects that observe the behavior of invertebrate animals. **The use of vertebrate animals** is not allowed except for human observational projects (example: Do boys have a faster reaction time than girls?).

Botany: Projects that use subjects such as plants (mosses, seed plants), agriculture, conservation, and forestry. **NO LIVE PLANTS** may be displayed. Experiments using **mold or fungi** are **NOT** allowed.

Chemistry: Projects that examine chemical reactions, the chemistry of living things, photosynthesis, solubility, heat capacity, etc. **No prescription drugs, dangerous or illegal substances should be used** in the experiments.

Earth and Space Science: These are projects investigating principles of geology (for example, weathering and erosion), geography, astronomy, meteorology, and related fields.

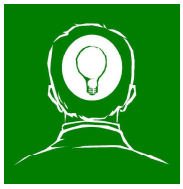
Engineering: Projects can develop technological devices, which are useful to the global society within an engineering-related field, such as electricity, mechanical, chemical, aeronautical, and geological.

Environmental Science: Projects that deal with global change, issues related to Earth, such as water, air, climate, waste and pollution, green living, human health, ecosystems and related fields.

Medicine and Health: The project's emphasis will be on human health. (STUDIES ARE LIMITED TO OBSERVATIONAL PROJECTS ONLY.)

Zoology: Projects that observe and record the growth or behavior of animals **(INVERTEBRATES).** VERTEBRATE STUDIES ARE LIMITED TO OBSERVATIONAL PROJECTS ONLY.

Mathematics: Projects are developed that demonstrate any theory or principle of mathematics.



Inventions: projects that uses design and engineering processes to find a practical solution to a problem that addresses a need that exists for people in general or a person with a specific handicap.

If you do not see something on this lists that interests you please discuss other options with your teacher or your mentor.

Doing Good Science - The Scientific Review Process

It is so important that all scientists run their experiments **safely**, so they avoid hurting themselves, other people, their equipment, and their environment. Scientists also need to practice science **ethically** by staying honest in their work, not lying about their results, and not stealing work from others. In other words, good scientists *do good science*.

Many science fairs around the world use the Scientific Review Committee (SRC) process designed by the International Science & Engineering Fair to guarantee safety and good ethics in science fair projects. This involves filling out and turning in SRC paperwork both before and after conducting experiments to show that all work was approved, supervised, and done safely. At the middle school level, not all the paperwork is needed. There are some forms that all students do need, and then you may need to include some extra info based on the type of project that you have.

ALL students need to turn in these SRC forms after they finish their projects:

- **Form 1** - Checklist for Adult Sponsor
- **Form 1A** - Student Checklist
- **Form 1B** - Approval Form

Each project should have one Form 1 and one Form 1A. If you are working on your science fair project in a team of 2 or 3 people, each student needs their own Form 1B.

Before you begin your experiments, you must also complete a **research plan** for your project. Your research plan should be a write-up that discusses the following:

- Research question
- Hypothesis
- Procedure
- Risk & safety
- Data analysis

You may be able to turn in your Project Summary Worksheet and Procedure For My Experiment Form along with your research plan so that some of these are already included - your teacher will let you know if that's okay.

When you talk about risk & safety for your project…

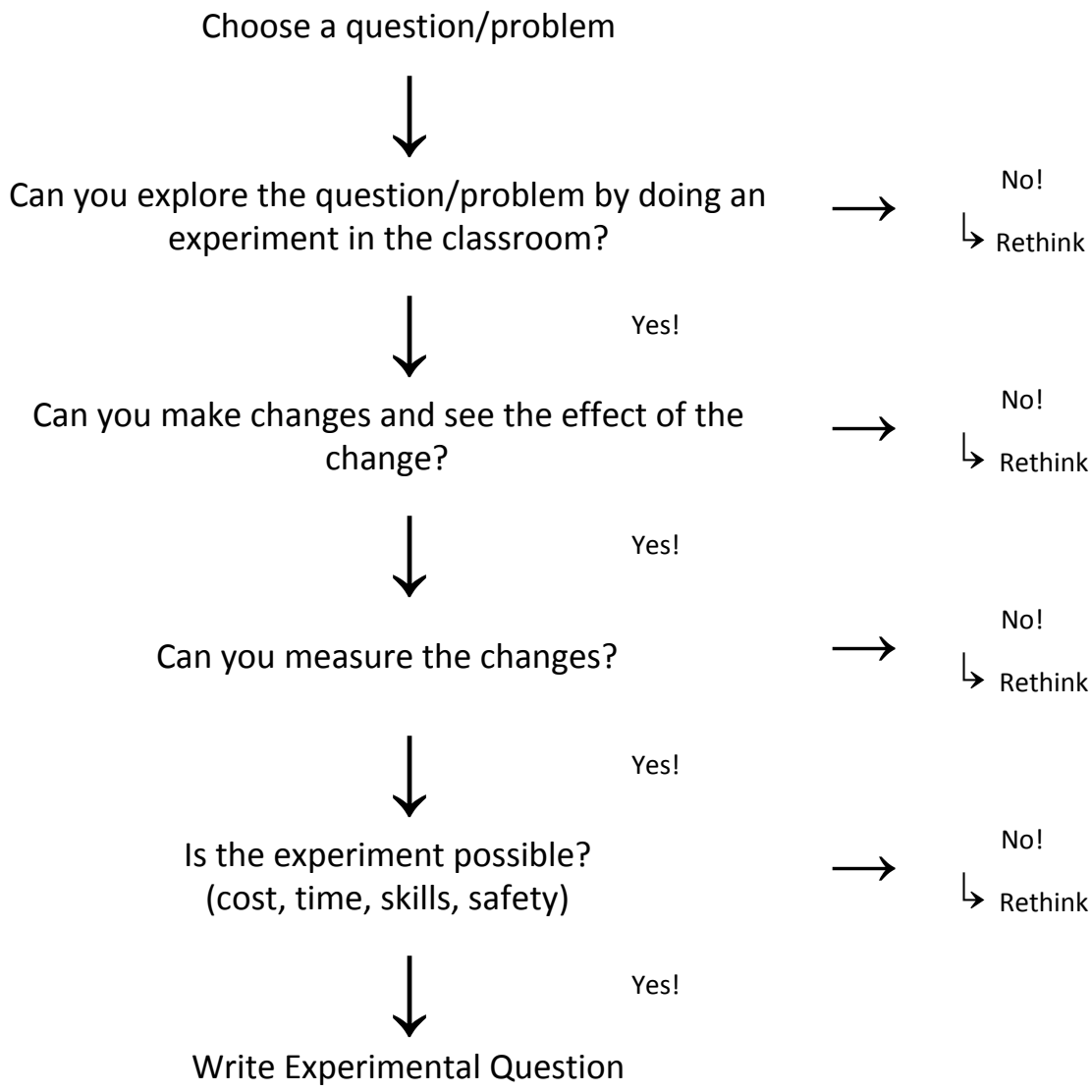
If your project has…	**Then you should discuss in your research plan…**
"Potentially hazardous biological agents" like bacteria or mold	Where will you work with them? How will you stay safe while handling them? How will you dispose of them safely? Will you be trained how to use them and supervised?
Dangerous chemicals, activities, machines, power tools, or other devices	Where will you work with them? How will you stay safe while handling them? How will you dispose of them safely? (for chemicals) Will you be trained how to use them and supervised?

Vertebrate animals	Why do you need to use vertebrate animals? How will they be taken care of? Will you be trained on how to care for them, and who is training you? What will you do to prevent harming the animals? What will happen to them after your project?
Human participants	What kinds of people are in your study? How will you invite them to participate? What are the risks and benefits of them participating? How will you keep their information anonymous? *You should also include a copy of your consent form, and a copy of your survey if you are using one

The full SRC rulebook and copies of the forms in English and Spanish can be found both in your Google classroom page and at this link: https://www.societyforscience.org/isef/international-rules/.

This may sound overwhelming or like a lot of work, but *don't worry!* Many of these ideas will be easier to understand as you learn more about your topic and get through more steps in your science fair project. Also, your mentor and teacher are here to help you. Scientific review can be tricky, but thinking about safety and solid procedure is one of the most valuable skills that a scientist can have, and this skill applies to many other jobs too. You got this!

Scientific Experimental Question Analyzer



Project Brainstorming Sheet

Coming Up with a Good Question…

Now that you have picked out a topic that you like and that you are interested in, it's time to write a question or identify a problem within that topic. To give you an idea of what we mean you can start off by filling in the blanks with the following list of words:

The Effect Question:

What is the effect of _____on _____?

sunlight	on the growth of plants
eye color	pupil dilation
brands of soda	a piece of meat
temperature	the size of a balloon
oil	a ramp

The How Does Affect Question:

How does the _____ affect _____?

color of light	the growth of plants
humidity	the growth of fungi
color of a material	its absorption of heat

The Which/What and Verb Question:

Which/What _____ (verb) _____?

paper towel	is	most absorbent
foods	do	mealworms prefer
detergent	makes	the most bubbles
paper towel	is	strongest
peanut butter	tastes	the best

Now it's your turn:

Create your Science Fair question using either the "Effect Question", the "How does Affect Question" or the "Which/What and Verb Question":

Researching Your Topic

So, you've picked your category and you've chosen a topic. You even wrote a question about your topic using the fill-in-the-blank template. Now it is time to research your project's topic in good detail. Becoming an expert at your topic will help you be ready to tackle your question.

So how do you become an expert?

YOU READ!

READ about your topic. READ encyclopedias. READ magazine articles and books from the library. READ articles from the internet. You can also watch videos and listen to interviews and podcasts. Take note of any new science words you learn and use them. Learning and using them will help you talk about your science more correctly.

Keep track of all the books and articles you read, and any other sources you use. It's important to record that info so that you can:

- Find the sources again in the future
- Share them with your mentor or teacher
- Give them credit by citing them in your bibliography

YOU DISCUSS!

Talk about it with your relatives. Talk about it with your teachers. Talk about it with experts like veterinarians, doctors, farmers, or others who work with the things you are studying. Sometimes websites will give you e-mail addresses to experts who can answer questions. (However, do not write to anyone on the internet without letting an adult supervise it.)

Whew ….

Feeling like you've learned a lot of good information about your topic? You are ready to write your hypothesis!

Writing a Hypothesis

Once you have researched your topic, it is time to PREDICT what you think will happen if you test your problem. This type of "smart guess" or prediction is what scientists call a HYPOTHESIS.

So how do you begin? Well, before you start your experiment, just answer this very simple question: *What do you think will happen?*

Example Problem: **Which paper towel is more absorbent, Brand X or Brand Y?**

Example Hypothesis: **I think Brand X will be more absorbent because it's a more popular brand, it is thicker, and the people I interviewed said that the more expensive brands would work better.**

(This hypothesis not only predicts what will happen in the experiment, but also shows that the scientist used research to back up their prediction.)

Now, write a hypothesis for your scientific question based on what you learned researching your topic.

Hypothesis: I think that…

because (my research shows)…

PROJECT SUMMARY WORKSHEET

Category
(Also tell why you chose this)

Question (Statement of Purpose)
(Written as a Question)

Hypothesis:
If……, then I think:

Research:

What type of research have you done? What are some interesting things you have learned about your topic?

Source #1

Type of Resource: _____

Website: http://_____

Author: _____

Title: _____

For books:

- Publishing Company: _____
- Location of Publishing Company: _____
- Date of Publication: _____

Information found in your own words:

Source #2

Type of Resource: _____

Website: http://_____

Author: _____

Title: _____

For books:

- Publishing Company: _____
- Location of Publishing Company: _____
- Date of Publication: _____

Information found in your own words:

Source #3

Type of Resource: _____

Website: http://_____

Author: _____

Title: _____

For books:

- Publishing Company: _____
- Location of Publishing Company: _____
- Date of Publication: _____

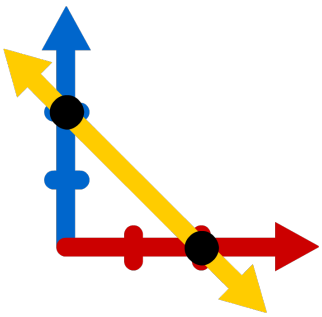
Information found in your own words:

PROCEDURE FOR MY EXPERIMENT

Identifying Variables

A **variable** is a property or number that changes in a science experiment. By knowing what exactly is changing in your experiment and why, you will be able to better understand your data and draw a meaningful conclusion from your results. Take a minute to review these three important definitions from your introduction to science projects:

Independent variable - the thing you change in your experiment to see what effect it has
Dependent variable - the change that happens in your experiment because of/as a result of the independent variable being changed
Control - a thing that remains the SAME during the experiment



The independent variable is what YOU as a scientist change, and the dependent variable is what you measure or observe happening as a result. The control is what you DON'T change *on purpose*, so that the only thing that could be causing changes in your data is the independent variable you are studying. Controls are important because they keep your data clearer and more accurate.

Typically, an experiment will have ONE independent variable and ONE dependent variable. If your project has multiple parts or is more complicated it may have more variables - your teacher or mentor can help you sort that out. Experiments will have multiple controls.

Here are two examples of science projects with their variables and controls listed:

	Example 1	Example 2
Topic	Sunlight for plants	Rocket science
Research Question	What is the effect of the amount of sunlight on tomato plant growth?	Which material makes the most powerful rocket?
Independent Variable	Time each day that the plant has sunlight (in hours)	Type of material used to make rocket
Dependent Variable	Plant height (in centimeters)	Maximum speed of rocket (in meters/second)
Controls	Type of plant, type of soil, and amount of water	Rocket size, shape, and fuel

Now you are ready to write out the variables and controls for your own science project!

LIST OF VARIABLES

Control(s):

Dependent Variable(s):

Independent Variable(s):

MATERIALS LIST

(Make sure your procedure and materials list are approved by your teacher/mentor)

TRIAL #1 EXPERIMENT OBSERVATIONS

TRIAL #1 EXPERIMENT MEASUREMENTS

TRIAL #1 ISSUES/CHANGES DURING EXPERIMENT

TRIAL #2 EXPERIMENT OBSERVATIONS

TRIAL #2 EXPERIMENT MEASUREMENTS

TRIAL #2 ISSUES/CHANGES DURING EXPERIMENT

TRIAL #3 EXPERIMENT OBSERVATIONS

TRIAL #3 EXPERIMENT MEASUREMENTS

TRIAL #3 ISSUES/CHANGES DURING EXPERIMENT

THINKING ABOUT HOW TO DISPLAY YOUR RESULTS

- When you have recorded all of your results, you need to design the way that you will report and display the data.

- Many students use **graphs**, **charts** and **written summaries** of what happened in the experiment. Which will **YOU** use?

- Determine **averages** or the **mean** when appropriate. Ask your teacher/mentor if you need to perform these calculations and ask them how.

- Use **photographs** whenever possible to show changes. *Example: To show plant growth over time or to show the before-and-after of a reaction.*

- You can use the charts, graphs or tables, that you used to record data in your science journal by making a **copy** (do not remove from your journal). Also make sure it is **neat**, **clean**, and **clear** so that it is **easy to read**.

- Make sure that you **understand what your results mean**. If you aren't sure ask your teacher/mentor for help.

- Take some time to practice **speaking out-loud** about your results to your classmates, mentor, teacher, or family. Do this to make sure you can put them into words and that another person will understand you.

- Display your results under the **heading "Results"** on your **display board**.

DRAWING CONCLUSIONS WORKSHEET

Answer the following questions to summarize what you have learned from the experiment.

1. What was the purpose of the investigation?

2. Was your hypothesis supported by the data?

3. What were the major findings?

4. What are the possible reasons for the results?

5. Sometimes not being able to prove a hypothesis is important because you still proved something. What did you prove?

6. (How does this apply to real life?) It's important to know about this experiment because.....

YOUR WRITTEN REPORT

The written report is a summary of everything that you did to investigate your topic. The written report provides others with vital information on what your project is about as well as its effect on your understanding of the topic. All information must be included in the written report. This report provides you with the opportunity to think about all the aspects of our project and share your ideas with others.

Your report should:

- ❑ Be at least 6 pages in length
- ❑ Be typed with one inch margins, a title page, 12 pt Times New Roman Font, and double-spaced
- ❑ Have headings/titles on all graphs/charts/tables
- ❑ Have captions on all photographs explaining their significance if/when you include them in your paper
- ❑ Have all calculations, spelling, and grammar double-checked
- ❑ Before handing in, reread, revise, and rewrite!

WRITTEN REPORT OUTLINE

You have basically already done everything for the report. Now it must be put it together into a report format. Report needs to include:

- ❑ ***Title Page*** - A page that contains the title and the author's name
- ❑ ***Introduction*** - sets the scene of your report and needs to include: your hypothesis, problem or goals, an explanation of your research, and what you hoped to achieve.
- ❑ ***Materials*** - type up your materials list from your science journal.
- ❑ ***Procedure*** - describe in detail the procedures you used to collect all the data, make observations, design apparatuses, etc. Your report needs to be detailed enough that someone can repeat your experiment from the information in your paper. Include detailed photographs or drawings of self-designed equipment.
- ❑ ***Results*** - should flow smoothly and logically from your data.
- ❑ ***Discussion*** - the essence of your paper. Compare your project design with what you learned from your research sources, commonly held beliefs, and/or expected results. Include discussion of possible errors. How did the data vary between repeated observations of similar events? How were your results affected by uncontrolled events?
- ❑ ***Conclusion*** - Briefly summarize your results. What would you do differently if you repeated this project? What other experiments should be conducted? Be specific, do not generalize.
- ❑ ***Acknowledgments*** - You should always credit those who assisted you, including, businesses, and educational and research institutions.
- ❑ ***Bibliography*** - Your reference list should include any documentation that is not your own (i.e. books, journal articles).

BIBLIOGRAPHY FOR DIFFERENT TYPES OF SOURCES

Below is a list of examples for different types of sources:

- **FOR A BOOK:**

Author (last name first). Title of the book. City: Publisher, Date of publication.

Example:

Dahl, Roald. The BFG. New York: Farrar, Straus and Giroux, 1982.

- **FOR A MAGAZINE:**

Author (last name first), "Article Title." Name of magazine. Volume number, (Date): page numbers.

Example:

Jordan, Jennifer, "Filming at the Top of the World." Museum of Science Magazine. Volume 47, No. 1, (Winter 1998): p. 11.

- **ONLINE RESOURCES:**

Author of message, (Date). Subject of message. Electronic conference or bulletin board (Online). Available e-mail: LISTSERV@ e-mail address

Example:

Ellen Block, (September 15, 1995). New Winners. Teen Booklist (Online). Helen Smith@wellington.com

ELEMENTS OF AN ABSTRACT

The following is a guide for how to create your abstract

Student's Name:_____

Project Title: _____

Abstract

Be sure to include the following in the abstract of a project:

1. The purpose of the project: Why did you choose to do this project or how did you get the idea to do it?

2. State briefly what you thought would happen. Also, describe how you conducted your project.

3. What happened? Tell the results of your experiment.

4. What was the conclusion? Was your hypothesis correct?

5. What are the applications of your project? How can the information you learned be used?

6. How could your project be improved if you were to repeat it? If you were to continue your project, what would you do?

Bibliography

There should be at least three (3) references. If the project concerns an animal, there should be one reference concerning the care of that type of animal.

ABSTRACT EXAMPLE

Student's Name: Jordan Web

Project Title: Wrap It Up!

Abstract

The purpose of this project is to determine if increasing the number of wraps around an electromagnet will increase the magnet's strength. It is hypothesized that increasing the number of wraps around the nail will increase the strength of the electromagnet.
Wire, a nail, a D battery, and a battery holder were the materials used to build an electromagnet. The wire was cut 90 cm long so that 10, 20, and 30 wraps could be wrapped around the nail. An electromagnet with 10 wraps was used to pick up paper clips three times. Then using the same steps the electromagnet was built using 20 wraps of wire, tested three times, and then tested with 30 wraps. The number of paper clips collected was recorded in a data table for all the trials.
Results showed that in all three trials, the average number of paper clips picked up the electromagnet increased as the number of wraps increased from 10 wraps to 20 wraps to 30 wraps. The hypothesis was correct.
This experiment shows that the number of wraps of wire on an electromagnet affects its strength, so that in real life if a stronger electromagnet is needed to separate metal from non metal objects, its strength can increased by increasing the number of wraps.
The project may have been improved and had better data if a new battery was used for each trial.

Bibliography

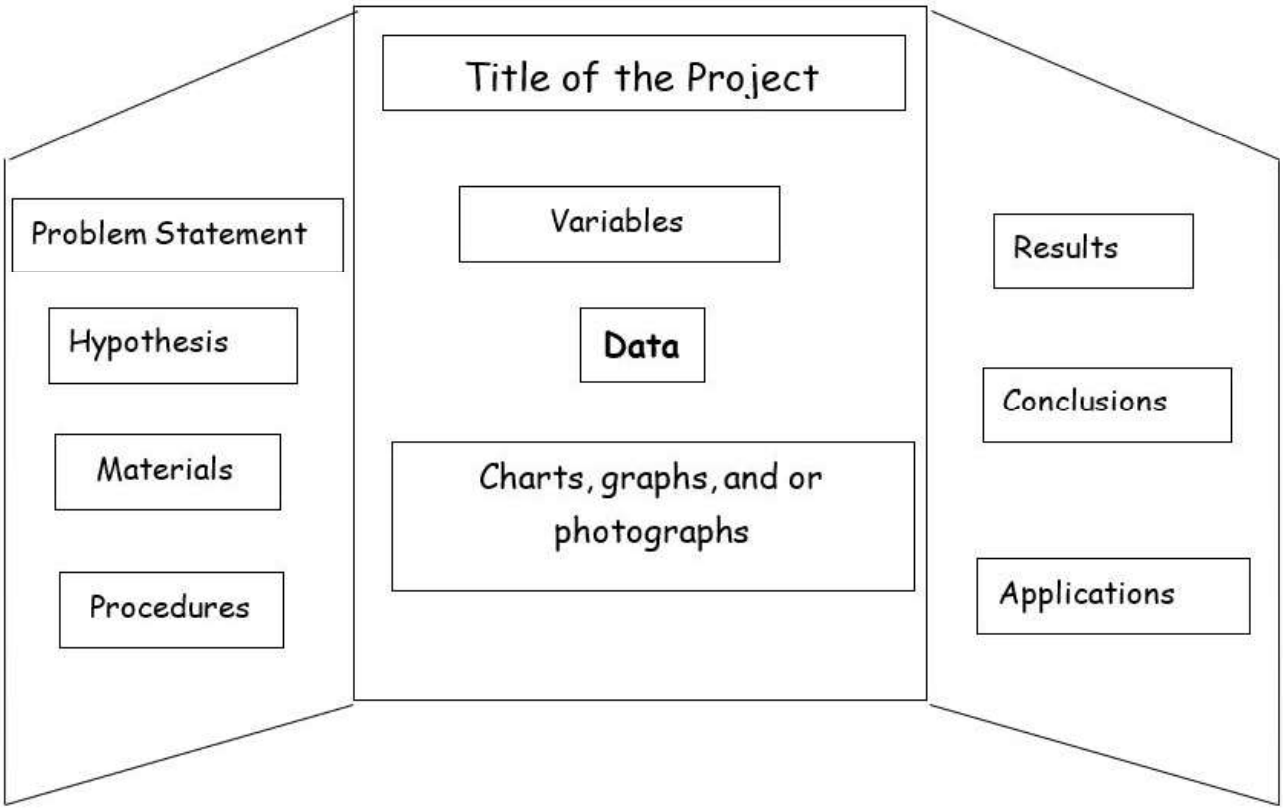
- Brain, Marshall. How Electromagnets Work. 2000. URL: http://science.howstuffworks.com/electromagnet.htm/printable

- ScienceSaurus: A Student Handbook. United States of America: Great Source Education Group.2005. p. 306

- Van Cleave, Janice. *Help My Science Project is Due Tomorrow*. Scholastic. 2002

DISPLAY BOARD LAYOUT EXAMPLE

Here is an example of how to organize your display board:



You don't have to organize your board exactly like this, but it would be helpful to do draw and organize a layout for your board on a piece of notebook paper before you create your display board.

DISPLAY BOARD CHECKLIST

The goal of a display board is to attract and inform spectators and judges. Below is a list of things to check for while you are creating your display board:

- ❑ Display needs to reflect current year's work only
- ❑ A good title that grabs spectators' and judges' attention
- ❑ Photographs of the experiment or other pictures
- ❑ Logical organization - a judge wants to be able to find the title, experiment, results, and conclusion
- ❑ Visual stimulation - use colorful headings, charts, graphs, etc
- ❑ Stick to the size limitations and safety rules
- ❑ Don't use every color of the rainbow; establish a theme or pattern for the colors, font, and layout
- ❑ Make sure that your charts, graphs, and tables are neat, clean, and easy to read
- ❑ Make sure that the lines you have cut are straight and that the glue that you used is hidden