# Chapter 1: Getting Started

So your teacher has asked you to do a science project…**NOW WHAT?**

There's no need to panic! The instructions you will receive will break down the steps to doing a science fair project into manageable parts.

This chapter will help you to identify the differences between a science research project and an experiment. You will need to know this information in order to meet the requirements of the science fair.

**Fourth Graders will be expected to complete a research project. Fifth & Sixth Graders will be expected to complete an experiment.**

This chapter will also describe the three main parts of a science fair project; the display board, the report and the exhibit materials.

Finally, this chapter will help you to select a science topic for your project. You will explore your interests and take a short survey to determine what science topic you might want to choose for your science fair project.

**Read on to learn about the differences between a research project and an experiment!**

## So what is the difference between a research project and an experiment?

**Research Project**

Includes a written report, display board and can also include any or all of the following: demonstrations, collections or other display materials. This type of project shows how something works or explains a science concept but you don't test or experiment with anything.

**Experiment**

Includes a written report, a display board and MIGHT include other display materials. This type of project includes variables, something that can be changed and measured. This type of project uses the steps of the Scientific Method.

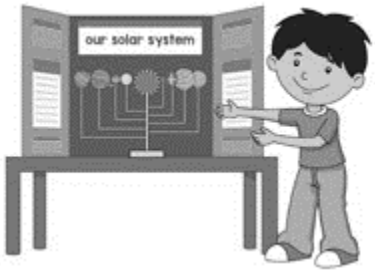

So, let's learn a little bit more about research projects!

A ***research project*** means that you have chosen a science, technology or engineering topic which you would like to learn more about. You will be gathering information about this topic from various sources and writing a report about what you've learned. Then, you will create a display board to highlight the important information you learned. Finally, you will decide if you are also going to include a demonstration, collection or other display materials on the table in front of your display board.

**What is a demonstration?**

In a demonstration, you create a model that illustrates a science principle or fact. For example, you might build a model to show the location of the planets in our solar system. If you research electricity, you might choose to build a model of an electric circuit. If you chose to research bees, you could create a model to show what the inside of a beehive looks like.

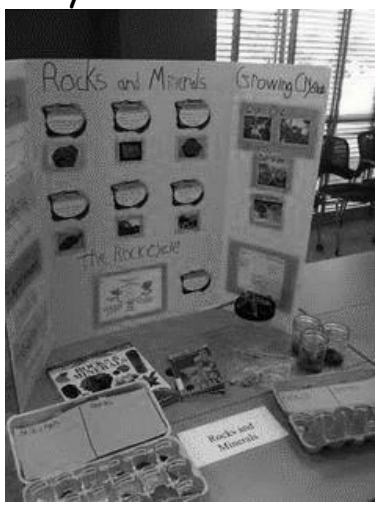
Sometimes, it is easy to get demonstrations confused with experiments. Just remember a demonstration shows how something works, but it is NOT a true experiment where you are changing or testing something.




Can you think of any other examples of demonstrations?

## What is a collection?

In a collection, you assemble a group of items that have to do with the topic of your research report. For example, if you did your research report on birds in Pennsylvania, you might assemble a collection of birds' nests. Other collections you might put together could include seashells, rocks, minerals, fossils, feathers, leaves, seeds or crystals.




Can you think of any other examples of collections?

## What are other display materials?

If you used any scientific equipment you can include this as part of your display. This might include thermometers, barometers, petri dishes, beakers, etc… Remember to think about safety and don't display anything that could injure someone!

# Now that you know a little more about research projects, let's learn something about experiments!


An ***experiment*** is different from a research project in one **main** way.

AN EXPERIMENT ANSWERS A QUESTION!

In an experiment, you will ask a question or pose a problem. You will then design an experiment to find possible answers for this question. During your experiment, you will record data and at the end of the experiment you will use that data to make conclusions.

**Will I have to look for any research?**

The answer to this question is yes! When you do an experiment for a science fair, you will still include a section in your report that is similar to the written report that you would prepare for a research project. This section is called the literature review. In a literature review, you read research information about the topic of your experiment and you share this background information in your report.

**How do I know if my topic is an experiment?**

In order for something to be an experiment, there must be a something that can be *changed* and something that can be *measured*.

We call these the **variables**. These two kinds of variables are called independent *(what is changed)* and dependent *(what is measured)*.

Be careful! Many books that are designed to help you do science fair projects will call all projects experiments. In these instructions, a project will only be called an experiment if it has something that can be changed (independent variable) and something that can be measured (dependent variable). Any project that does not have something that can be changed or measured is a research project!!

Let's see if you've been paying attention!

Go to the next page and test your knowledge of the difference between science fair research projects and experiments.

Read these examples of science fair topics and decide if they are experiments or research projects. Write E for experiment or RP for Research Project.

*(Answers can be found at the bottom of the next page.)*

- 1. A look at the planet Jupiter
- 2. Which kind of liquid causes plants to grow faster?
- 3. What is a honeybee?
- 4. Electric circuits in your home
- 5. Do different brands of popcorn have different amounts of un-popped kernels?
- 6. Explain the tilt of the Earth
- 7. Does the number of turns in the wire on an electromagnet affect its strength?
- 8. Dolphins
- 9. Using a model to show how earthquakes occur
- 10. Is colored or black and white text easier to remember?

**Okay, now I know the difference between a research project and an experiment, and I know which one I am doing.**
**What are the parts of my science fair project?**

Most science fair projects will have three parts: The written report the display board and exhibit or display materials.

## PART ONE: THE WRITTEN REPORT

This is a summary of all of the research you found on your topic. If you are doing a research project, your report will summarize all of the important information you learned.
If you are doing an experiment, your written report will include information found through **both** research and from your experiment.

Your written report needs to be in your own words! If you copy information directly from another source this is plagiarism. Plagiarism is stealing another person's work!

A works cited page will be included at the end of the written report. This shows all of the resources you used to write the report.
*(A chapter later in these instructions will help you to write your written report!)*

## PART TWO: THE DISPLAY BOARD

This is a three sided sturdy board on which you will display your report as well as information about your research project or your experiment.

The display board is usually made of a sturdy cardboard or foam material.
These display boards can be purchased at craft and office supply stores. The standard size is 36"x48".

Some students ask for parent help and create their own display board out of wood or other sturdy material. Using a material such as poster board or light card board will not work. Your display will collapse and all of your hard work will be lost!

The display includes information about your topic, pictures, graphs, drawings and any other visual aids you feel show your audience the important information you have learned.
*(A chapter later in these instructions will show you how to set up your display.)*

**PART THREE: EXHIBIT/DISPLAY MATERIALS**

Usually, science research projects will include materials that sit on the table in front of the display board. These materials may include models you have built or scientific instruments or tools you have used. Experiments **MAY** have exhibit materials but sometimes they only have a written report and display board.

## GUESS WHAT?????

Now that you've read all of this information about the differences between science fair projects, and you know the three main parts of a science fair project, you are ready to decide what topic you will do for either your research project or experiment.

*Answers to questions from page 5. RP= Research project E=Experiment*
*1.RP 2.E 3.RP 4.RP 5.E 6.RP 7.E 8.RP 9.RP 10.E*

## How should I choose a topic?

First think about the science topics that you are interested in. You will be working on your science fair project for many weeks so you want your topic to be something that will interest you.

Read the following statements. Place a check mark next to any statements that are true for you.

1. ___ I like learning about plants.

2. ___ I like learning about animals or insects.

3. ___ I like learning about the weather.

4. ___ I like learning about rocks and minerals or the Earth.

5. ___ I like learning about chemical reactions.

6. ___ I like learning about the human body and its functions.

7. ___ I like finding out more about how machines work.

8. ___ I like learning about bacteria.

9. ___ I like learning about the environment.

10. ___ I like learning about animals that live in the ocean.

11. ___ I like to learn about electricity or magnets.

12. ___ I like to learn about the quality of things people purchase.

Now that you've taken this short survey to find out what your interest areas are, read below to find out the fields of science that you are interested in.

If you checked #1 you are interested in botany, the study of plants. You might want to pick a topic that deals with types of plants, plant processes or plant growth.

If you checked #2, #6, #8 or #10 you are interested in biology, entomology, anatomy, psychology, microbiology and marine biology. You might want to pick a topic that deals with an animal or a function of human body.

If you checked #3, #4 or #9 you are interested in meteorology, Earth Science, geology, or ecology. You might want to pick a topic that involves the weather, rocks, minerals, or the environment.

If you checked #5 you are interested in chemistry. You might want to pick a topic that deals with matter, physical or chemical changes or how matter reacts to other types of matter.

If you checked #7 or #11 you may be interested in physical science. You might want to pick a topic related to electricity, forces, or motion.

If you checked #12 you are interested in consumer science. You might want to pick a topic that includes information about how science is used to make products that people purchase.

**Okay, I know what science fields I'm interested in what do I need to do next?**

Now that you have determined some of the science fields you are interested in, you can begin to look at possible topics for your science

fair project. Read over the examples on the next few pages. Remember that this is only a very small list of the science fair projects you could do.

**BE CREATIVE**!

Think of a new idea for a research project or experiment that no one has thought of yet!

***RESEARCH PROJECTS WILL BE MARKED WITH AN (RP)***
***EXPERIMENTS WILL BE MARKED WITH AN (E)***

Botany Projects

Monocot and Dicot Seeds and Flowers (RP)
Desert Plants (RP)
Plants of Pennsylvania (RP)
Coniferous and Deciduous Trees (RP)

Will vitamins affect the growth of a plant? (E)
Does the amount of light a plant receives affect its growth? (E)
What color light makes plants grow faster? (E)
In what kind of material (sand, clay etc…) do seeds germinate fastest? (E)
Will plants grow faster in soil or water? (E)
Does the pH of water affect plant growth? (E)
What is the effect of ultraviolet light on the germination of a seed? (E)
What is the effect of caffeine on plant growth? (E)

Biology/Zoology Projects

The Bottle-Nosed Dolphin (RP)
Animals of the Rainforest (RP)
The Human Eye (RP)
Ants (RP)
Animal Adaptations (RP)

Biology/Zoology Projects continued..

The Digestive System (RP)
Spiders (RP)
Animal Communities (RP)
The Human Heart (RP)
Hamsters (RP)
The Senses (RP)

Does the temperature of the water affect a fish's breathing rate? (E)
What is the effect of background music on memory? (E)
Does gender affect reaction times? (E)
Does the color of the text improve memory? (E)
How does music affect a student's math performance? (E)
What is the effect of music on a person's heart rate? (E)
What is the effect of video games on a person's respiration rate? (E)
Do video games affect an adult or a child's heart rate more? (E)
Do women have better peripheral vision than men? (E)

Earth Science Projects

The Earth's Layers (RP)
Model the ocean floor (RP)
Formation of Coal (RP)
Rocks and Minerals (RP)
Constellations (RP)
Wastewater Treatment Plants (RP)
Acid Rain (RP)
Life Cycle of a Star (RP)
The Solar System (RP)
Hurricanes (RP)
Snow (RP)
Biomes (RP)
Fossil Formation (RP)
The Seasons (RP)

## Earth Science Projects continued

Is rainwater absorbed at the same rate in different kinds of soil? (E)
Does freshwater hold heat longer than salt water? (E)
What is the effect of temperature on evaporation? (E)
What affects evaporation most, air temperature or water temperature? (E)

## Physical Science Projects

Magnets (RP)
Electricity and Electric Circuits (RP)
Simple Machines (RP)
Electromagnets (RP)
Sources of energy (RP)
Light (RP)
Sound (RP)
Electric Motors (RP)

What is the effect of heat when dissolving substances? (E)
How does the weight of a pendulum affect its swing? (E)
On what type of surface will a ball roll the fastest? (E)
What materials provide the best insulation? (E)
Does the design of a paper airplane affect the distance it will fly? (E)
What factors affect the height of the bounce of a dropped ball? (E)
What materials make the best insulators? (E)
How does the air pressure inside a basketball affect how high it will bounce? (E)
Which liquids evaporate fastest? (E)
Does the temperature of the water affect the buoyancy of objects floating in it? (E)
Does the color of a candle affect how fast it will burn? (E)
Which type of string will stretch the most? (E)
Does the size of a rubber band affect its elasticity? (E)
Does the amount of salt in water affect the temperature at which it boils? (E)
What is the best packaging material? (E)
Does the temperature of water affect the freezing rate? (E)
Does the kind of paper affect how far a paper airplane will fly? (E)

Consumer Science Projects

Biodegradable and Non-biodegradable materials (RP)
Recycling (RP)

Which brand of popcorn has the highest amount of un-popped kernels? (E)
Which brand of battery lasts the longest? (E)
Which additive makes cut flowers last longer? (E)
Which candy bar melts faster? (E)
Which paper towel is strongest when wet? (E)

***Remember there are thousands of ideas out there!***
***Look for other ideas in books or on the Internet.***


**I'm pretty sure I've chosen the topic I want to use for my science fair project. What should I do now?**

Now that you've decided on a topic for your research project or your experiment, it is time to ask yourself a few important questions!

Think about the topic you've chosen.

1. Is it a topic that you will be able to understand?

2. Will you be able to work on a project using this topic for at least the next twelve weeks without losing interest?

3. Do you need any special tools or equipment to do this project? Will you be able to get these items?

4. Can your parents afford to purchase the materials needed to do your project or can you borrow them?

5. Will you be able to do most of the work for this project yourself? (With parent help of course!)

6. Are any of the tools, equipment or materials you are planning to use dangerous? Will you have proper supervision to ensure your safety?

7. Is there time for you to gather all of the materials you need for your project?

8. Can you find enough resources about this topic so that you can write the literature review section of your report?

9. Are you willing to put forth effort to do this project well?

10. Will this topic meet the requirements of the school science fair?

***If you answered yes to all of these questions then you have selected a good topic for your science fair project!***

**How do I let my teacher know that I've chosen a topic?**

Fill in the topic approval form on the next page and give it to your teacher. Once you receive approval, you are ready to begin the next step in completing your science fair project!

# TOPIC APPROVAL FORM

Name_____ Grade level _____

**Fourth Graders who are doing research projects, please fill in this section!**

The topic of my research project is_____

I chose this topic because _____
_____

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**Fifth & Sixth Graders who are doing an experiment, please fill in this section!**

My experimental question/problem is_____
_____

The independent variable (what will be changed or manipulated) is _____.

The dependent variable (what will be measured) is_____.

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Due date for this topic approval form is _____.

Your signature_____

Parent Signature_____
(Please remember that your teacher may ask you to make changes to your topic or experiment!)

# Chapter 2: Researching Your Topic

Now that you've chosen a topic and you've had it approved by your teacher it's time to begin the real work on your science fair project!

Wait…don't look so worried. You will receive detailed instructions that will explain how to do each step of your science fair experiment and written report.

This chapter will help you locate information on your topic as well as take notes and keep them organized. This chapter will also explain how to make a works cited card for each source. This information will be used later to create your works cited page.
*(A chapter later in the book will tell you how to write the works cited page!)*

**I'm ready to start researching my topic, what should I do first?**
A large part of your science fair written report is the literature review. In the literature review you share with your 'audience' what you have learned about your topic. You give your reader important background information about your topic.

To write a good literature review, you want to find as much information on your topic as you can. Be sure to look for a variety of resources such as books, magazines, newspaper articles, videos, materials found online etc… You can also interview people who are knowledgeable about your topic.

Start by going to your local library and looking for information that relates to your topic.

Let's say that you are doing a research project on Bats.
When you go to the library look for books on bats. Ask the librarian to help you find books and articles about your topic.

Next you want to search online for information about your topic. **Be very careful!** A lot of information online is incorrect!
The best sites to use are those that end in 'edu', 'org' or 'gov'. These are websites that are sponsored by an educational institution, an organization or a government agency.
For example, if you were researching bats you would want to be careful about using websites that someone put together simply because they love bats.

**Okay, I went to the library and I got books and magazine articles about my topic. Then I looked online and I found a few good sites to use.**
**What should I do now?**

Now that you have found some reading materials, it is time to select one that you would like to start reading. As you read you will be taking notes on the important facts and ideas that you find.

First, think about what material might be important for you to use as part of your literature review. Think about what background information would be helpful to the people who are reading your report. The literature review helps them to understand your project but it also shows them that you spent time learning about your topic!

Make sure that you understand what you are reading! As you take notes, remember to put all of the information in your own words. Your teacher and the judges will know if you've just copied information

directly from a resource. You should never copy information directly from a resource because this is against the law. It is called plagiarism and it is a form of stealing!

Don't let this be you!!! Rewrite all notes in your own words!

**I've started reading my first resource, but I don't know how to take notes. What should I do?**

Don't panic! The rest of this chapter will help you learn how to take notes and organize them. It will also show you how to set up your works cited cards so that you can keep track of the resources you have used. You will need this information later to write the works cited page.

## So Many Sources So Little Time…

Now that you've started to read some information from one of your resources, you want to start taking notes.
On page fifteen you read about the importance of making sure that all notes are in your own words. Remember this as you read about how to take notes from your resources.

While you are reading information and taking notes, you need to do two very important things.

***First*** you need to organize your notes so that it will be easier for you to use them to write your literature review.

***Second*** you need to keep track of some important information about your resources so that when your literature review is finished you can write your works cited page. This page will list all the resources you used to gather information in order to write your literature review.

Let's start by talking about organizing your notes. We are going to discuss one possible way for you to organize your notes. If you think of your own way to organize your notes, that's wonderful! Just make sure that you have some system of organization. If you don't, you may end up feeling a little stressed!

# NOTE ORGANIZATION

## NOTECARDS

***If you choose this option you will need to purchase index cards of any size***

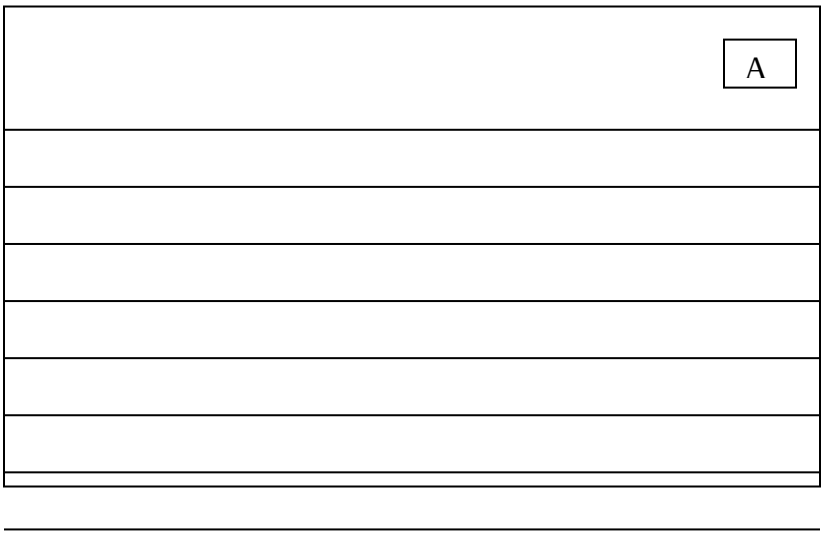
Step 1: Choose a resource.

Choose a resource (book, article, website etc…) that you would like to start with. Before you begin reading it and taking notes, you need to set up a works cited card for this resource.

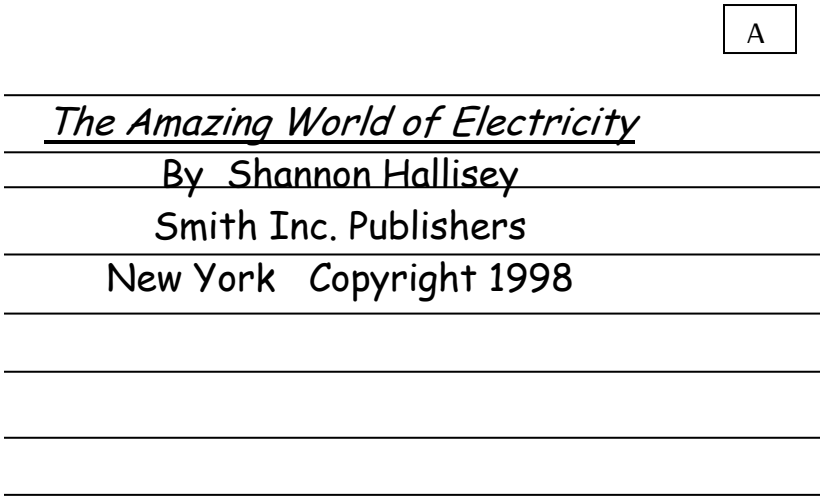
The works cited card will help you keep your notes for this resource organized and will help you when you write your works cited page.

Step 2: Set up a works cited card.

Begin with a blank note card. In the upper right hand corner label this card with the letter 'A'. All of the cards that contain notes from this particular resource will be labeled with an A.




Now you will write the works cited information for this resource on the card. Look at the example below to see how to set up information for a book.



## Step 3: Taking Notes

After you have set up your works cited card put it aside and begin with a second blank index card. Write the letter 'A' in the upper right corner of this index card. Use this card to write the notes from your first resource. If you run out of room on this index card label a new card with the letter 'A' and continue with your notes.

*****REMEMBER TO PUT YOUR NOTES IN YOUR OWN WORDS!!!**

A

Electricity is the flowing motion of electric charges.

Voltage is a way of using numbers to describe an electric field.

There are two types of electric charges positive and negative.

Continue taking notes from your first resource until you are satisfied that you have gotten all the information you need from that source. Then go on to Step 4.

## Step 4: Choose another resource.

After you have finished the notes for your first resource, choose a new resource. Complete Steps 1-3 for this resource. This means you will set up a new works cited card. The index cards for your second resource will be labeled with the letter 'B'.)

## Other Ideas for Organizing Your Notecards

Instead of using letters to label your cards, you could use numbers, colors or even shapes.
The important thing is that you keep them organized!

Instead of using note cards you could use a piece of loose leaf paper or you could type your notes.

Just be sure to put the works cited information at the top of the page and keep the pages for each resource organized!

## Works Cited Information

More information on writing the works cited page will be presented later!
This information is what you need to write on your works cited card (or sheet) before you take notes from each resource!

**For books:**

Write the author or authors name, the title of the book, the publisher, where it was published and the copyright date.
**If no author is listed write the name of the first editor.

Ex: Snakes By: Shannon Hallisey Smith Publishing Inc. New York 1996

**For Magazines:**

Write the title of the magazine, the name of the article and the name of the author. Also write the date of the magazine and the volume and/or issue number (if there is one).

Ex: Time "The Plight of the Sea Lion" By James Brown Dec. 2001 Vol. #3

**For Internet Sites:**

Write down the name of the complete site and the title of the article or page you used. List the author of the page if known. Also write down the full URL address and the date that you visited the website.

Ex: American Heart Association. "Heart Association Guidelines for CPR"
www.americanheart.org January 1, 2006

**For Videos, computer CD-ROM's etc…**

Write the title of software, the company that produced it, the city of publication and the copyright/publication date.

Ex: The Magic School Bus Human Body CD-ROM, Scholastic Inc, Chicago, 1995

**For Interviews:**

Write the name of the person you interviewed, their position and the date you interviewed them. Be sure to tell if it was a telephone or a personal interview.

Ex: Becky Jones, Biologist, December 20, 2005. Telephone Interview.

**Pamphlets:**

These usually don't have an author! Tell who publishes, distributes or edits the pamphlet. Give the title of the pamphlet.

Go ahead…start taking notes!

# Chapter 3: Writing The Hypothesis

**I've gotten my experimental question approved and I know what my independent, dependent and constant variables are. What should I do now?**

Now that you know what your question is and you've started to read some background information on it, you are ready to write your hypothesis.

- A hypothesis is the possible answer to your experimental question. You will either prove your hypothesis or disprove it.

- The hypothesis is an educated opinion about the outcome of your experiment.

- If you find that you can't come up with a possible answer to your question it may be because something in your experiment cannot be measured. You may need to rephrase or redo your question.

- It is based on the facts collected during research.

- It is based on the best information available at the time the experiment is being planned.

- The hypothesis will not be changed after it is written!

- A well written hypothesis **identifies the subjects of the experiment**, **states what is being measured, the conditions of the experiment and the results that are expected.**
  This means that the hypothesis should include the independent and dependent variables.

**Examples of Good Hypotheses**

*If our experimental question was:*

"How does different colored light affect plant growth?"

*A hypothesis for this question might be:*

I believe that plants grown in red light will not grow as tall, in centimeters, as the plants grown in blue or white light.

Remember that a "good" hypothesis identifies the subject of the experiment (plants), what is being measured (the height of the plant), the conditions of the experiment (different colored light sources) and the results expected (plants grown in red light will grow more slowly than those grown in blue or white light.)

Here is a second example of a hypothesis.

*If our experimental question was:*

"Will the number of paper clips, on the nose of a paper airplane, affect the distance that it will fly?"

*A hypothesis for this question might be:*

I believe that five paper clips on the nose of paper airplane will make the plane fly farther in meters than the plane with none, one or three paper clips.

Here is a third example of a hypothesis.

*If our experimental question was:*

"Will listening to different kinds of music affect a student's math performance?"

*A hypothesis for this question might be:*

I believe that students who listen to classical music will have better math scores than those that listened to country or rock music.

**What if I finish my experiment and my results are different from my hypothesis? Should I change it?**

The answer to this question is NO! Once you have written your hypothesis, you will not change it no matter what the results of your experiment are! At the end of your experiment you will **compare** your results with your hypothesis. A hypothesis is not right or wrong it is either proved or disproved.

**Name**_____

Now its time for you to write your hypothesis. Think about your experimental question and make your best educated prediction as to what you think will happen at the conclusion of the experiment. Remember to include the subject of the experiment, state what is being measured, the conditions of the experiment and your prediction as to what you think will happen at the end.

Fill in the form below and give it to your teacher!

My experimental question is

_____

_____

My independent variable (what will be tested)
is_____

My dependent variable (how the independent variable will be measured)
is_____

The variables that I will keep constant are: (list at least three)

1._____

2._____

3._____

My hypothesis for this experiment is

_____
_____
_____

I am making this prediction
because_____
_____

Now that you've written your question and your hypothesis, it is time to start the really exciting part of your science fair project…
BEGINNING YOUR EXPERIMENT!!!!

Before you read the next chapter on how to begin your experiment take a minute to look back over the tasks you should have completed by now.

1. You've chosen a topic and had it approved by your teacher.

2. You've gathered resources that will help you learn about your topic.

3. You've started to read and take notes from these resources to prepare for the literature review section that will be part of your written report.

4. You've written a good experimental question and identified the independent, dependent and constant variables.

5. You've thought about what you know about your topic and written a good hypothesis.

The next chapter will help you to begin to plan your experiment. Once you start your experiment, you will be finished with half of the work that you need to do for your science fair project!

Keep reading to find out what you need to do next!

# Chapter 4: Beginning Your Experiment

## I'm ready to begin my experiment. What should I do first?

**First:** If you haven't already, you should get a notebook or a binder to keep all of your experiment information together.

**Second:** Divide your notebook or note sheets into four sections labeled materials/procedure, observations, data and conclusions.

**Third:** In the materials section of your notebook write any materials you will need. Include everything! In the procedure section of your notebook, list your experimental question as well as your independent and dependent variables. (Independent= What is changed or tested. Dependent=how the change will be measured.)
Next make a list of constant variables. These are the variables that you will try to control during the experiment.
You might think of more constant variables as you begin to set up your experiment. When you do, be sure to write them in the procedure section of your notebook.
Also list your hypothesis or predicted outcome.

## I've labeled these sections in my notebook or binder. What should I do now?

Before you begin your experiment you need to write the purpose statement. The purpose explains what you are trying to prove or discover.

The purpose should clearly explain:

1. The problem you are trying to solve with your experiment.
2. Why you want to do the experiment.
3. How you think the information gained from your experiment will help either yourself or other people.

When you share your purpose with the people reading your report, it helps them to understand how you arrived at the decision to do the experiment you have chosen.

Here is an example of a purpose statement for the experimental question "Will colored light affect plant growth?"

Purpose:

The purpose of this experiment was to find out how different colored light affects plant growth. I became interested in this experiment when I saw a television advertisement for a light used to grow plants indoors. The information from this experiment will help people determine the best way to grow large plants indoors.

Here is an example of a purpose statement for the experimental question "Will the number of paper clips on the nose of a paper airplane affect the distance it will fly?"

Purpose:

The purpose of this experiment was to discover how applying different numbers of paper clips to the nose of a paper airplane will affect the

distance it will fly. I became interested in this experiment when my brother borrowed a book on paper airplanes from our local library. The information from this experiment will help my brother and I build paper airplanes that can fly longer distances.

Fill in the blanks below to set up your purpose statement.

The purpose of this experiment was to

_____

_____

_____

I became interested in this experiment when_____

_____

_____

The information gained from this experiment will help myself or others by_____

_____

**I've written my hypothesis and my purpose and I'd like to start my experiment. Am I ready yet?**

You're not quite ready yet! There's one more step you need to do before you can begin your actual experiment. You need to create a materials list.

The materials list is a complete list of all the materials you will use during your experiment. It includes specific details and amounts. Be sure to include quantities (how much), length, volume, mass etc…

It is best to list the amounts on your materials list using metric units. The table below gives you some common metric units and their symbols.

| Quantity Measured | Metric Unit | Symbol |
|---|---|---|
| Length, width, distance, thickness etc… | Millimeter, Centimeter, Meter, Kilometer | mm cm m km |
| Mass | Milligram, Gram, Kilogram | mg g kg |
| Time | Seconds or Minutes | sec. min. |
| Temperature | Degrees Celsius | °C |
| Volume | Milliliter, Liter | mL L |

The materials list should:

1. Be **VERY** specific with your amounts, sizes, brand names etc…
2. List amounts in metric units when appropriate.
3. List all of the materials needed to carry out your experiment.

Think back to the experimental question " Will colored light affect plant growth?" Think about what materials you might need if you were going to carry out this experiment. Look at the two materials lists on the next page. Materials List A is not specific enough while Materials List B is very specific. You want the materials list for your experiment to be more like Materials List B.

Materials List A

1. Water
2. Ruler
3. Potting Soil
4. Clay pots

Materials List B

1. 20 Liters of Distilled Water
2. Metric ruler with millimeters listed
3. 1 two pound bag of Miracle Grow Fertilized Potting Soil
4. 12 three inch clay pots with drainage holes

If you were asked to duplicate this experiment which materials list would be easier for you to use?

If you said Materials List B, you're absolutely right! This list is very specific and easy to follow.

In the table below write a materials list for your experiment. Remember to include specific amounts and use metric units where appropriate! If you need more space use another sheet of paper.

| Quantity | Description of Item |
|---|---|
| | |
| | |
| | |
| | |

| | |
|---|---|
| | |

## What is experimental procedure?

Once you have decided on an experiment and you've written a purpose, a hypothesis and a materials list it is time to set up your experiment. The steps you take to set up and carry out your experiment are the procedure.

The procedure is a step-by-step listing of all the tasks you will do to complete your experiment. It is like a recipe. If someone wanted to duplicate your experiment, they should be able to do so using your procedure.

The easiest way to write the experimental procedure is to write down all of the steps that you complete as you set up and run your experiment.
***Remember to be **VERY SPECIFIC** with your amounts and instructions.

As you continue to run your experiment, you will work on refining your procedure and making it very specific, so that the person reading your report knows exactly how you completed your experiment.

Start by listing the preparations you made before your actual experiment begins. Be sure to tell if you needed to design, assemble or build anything.

Next, you will describe the steps that you took to carry out your experiment.
Give exact amounts and measurements for everything that you used. Be sure to list brands, sizes, quantities, contents and temperatures of the items that were used in your experiment.

Be sure to tell how you carried out each step of creating and running your experiment.

Test only your independent variable. Be sure to explain how you are going to measure the change that is taking place. Tell what unit of measurement you used.

As you run your experiment make additions to your procedure section as needed.

If you ran more than one trial of your experiment be sure to note this in your procedure! Make sure that you follow exactly the same procedure each time you run a trial of your experiment.

The procedure should:

1. Label each step with a number.
2. Write the steps you took in carrying out your experiment. The steps should be written like those in a recipe.
3. Be very specific with quantities, amounts, and the order that steps need to be completed.

Read the procedure below written for the experiment "Will different colored light affect plant growth?" Notice that each step is very specific and gives amounts, sizes, quantities etc…

Sample Procedure

1. Using the materials list go to the store and purchase all materials needed.
2. Prepare twelve clay pots (3 inch diameter) by filling them with $\frac{1}{4}$ cup of Miracle Grow Fertilized Potting Soil.
3. Plant a marigold seed in the center of each pot. Place the seed into the soil at a depth of 4 centimeters. Cover each seed with the soil.
4. Water each of the twelve pots with 30 milliliters of distilled, room temperature water.
5. Using masking tape and a marker, label three of the pots with labels that read "Control".
6. Place the three pots labeled "control" on a sunny windowsill. The pots should be at least 10 centimeters away from the window pane and 15 centimeters away from each other.
7. Using masking tape and a marker, label three of the remaining pots with labels that read "Red Light".
8. Place the three pots labeled "Red Light" in a separate room, on a table, that is placed approximately one meter under a light containing a 75 watt red light bulb.
9. Using masking tape and a marker, label three of the remaining pots with labels that read "Blue Light".
10. Place the three pots labeled "Blue Light" in a separate room, on a table, that is placed approximately one meter under a light containing a 75 watt blue light bulb.

****Please note that this is only part of the procedure for this experiment!