Science Fair Project: How to Guide

(source: Wilder Elementary PTSA)

There are 3 main types of science fair projects which are described below – **observation, experiment,** and **invention** projects. Below you will also find information on the scientific method, the invention process, displaying your project, and ideas of possible topics.

1. Science Fair Project Types

- **Observation Projects**

  Observation projects describe what you have observed about a topic. They are more appropriate for younger students and do not require a full understanding of the *Scientific Method*. Students will identify a purpose, provide background information, form a hypothesis, describe the methods used, analyze results, and draw conclusions. Observation projects also include projects that are purely *descriptive* in nature (example: the history of computers, description of a rock collection) and may not require the use of the Scientific Method. However, students should be thorough in presenting any scientific information that explains the topic.

  Examples of observation projects include:

  - Rock collection – where they are from and how they were formed
  - Casts of animal tracks – compare the differences between species
  - Pressed flowers – show what determines a classification of a flower
  - Computers – chart and diagram the history
  - Solar system – build a model showing how the planets rotate around the sun
  - Pizza – a survey of what type of pizza kids like best
  - Birds – what type of bird is most prevalent near my house?
  - Stoplights – how many cars run red lights?
  - Ben Franklin (or another famous inventor) – show their inventions and how they are used; maybe even assume the identity of the person and explain what he/she did

- **Experiment Projects**

  Experiment projects involve manipulating a variable and collecting data in order to answer a question and requires an understanding of the *Scientific Method*. Students will identify a purpose, provide background information, form a hypothesis, describe the methods used, analyze results, and draw conclusions.

  Examples of experiment projects include:

  - Car speed – which type of lubricant makes a toy car go faster down a ramp?
  - Boat sail – which material makes the best sail on a toy boat?
  - Freezing liquids – do freezing temperatures change with different solutions?
  - Dog food – which dog food do dogs really like best?
  - Cereal – which types of cereals get soggy the quickest or slowest?
  - Crystals – what conditions form the best crystals?
  - Gum – which brand of gum is most viscous?

- **Invention Projects**

  Invention projects will develop or create something (or a way of doing something) that solves a problem or satisfies a need. It can be a completely unique and innovative design, or a redesign and improvement of something that already exists.

  Examples of things to invent include:
  - A gadget to help you clean up your room
  - A mechanical device to feed your dog
  - A new board game to play with your classmates
  - What is a better way of doing dishes?
  - How can you make a strong baby's diaper?

2. The Scientific Method

The ***Scientific Method*** is a tool that scientists use to find answers to questions for Experiment projects and some types of Observation projects (that are not purely descriptive in nature). The Scientific Method involves the following steps:

1) **Ask a Questions/Determine the Purpose**
   Why are you doing your project? What do you want to know or explain?
2) **Gather Background Information**
   Research and gather information on the topic from various sources and summarize the most important facts.
3) **Form a Hypothesis**
   The ***hypothesis*** is simply an educated, testable guess at the answer to your question based on the information you have gathered. It is usually presented as a statement about the relationship between two or more variables.
4) **Design and Perform the Observation *or* Experiment**
   Design and perform an observation *or* experiment to test your hypothesis. Write down the methods you used. Record your findings in a logbook. Analyze the data you collected by making charts and graphs that make your results easy to understand. Explain what you think happened based on scientific principles. If possible, repeat your observation *or* experiment to make sure your first findings are correct.
5) **Draw a Conclusion**
   The conclusion is a summary of what you have learned. Describe how your data answered your question and whether your hypothesis was correct. Is more work needed? What could you do better next time? Although you may initially be disappointed, it is actually perfectly acceptable for a hypothesis to be proven wrong based on experiment because the original question has successfully been answered.

Examples of the Scientific Method in an Observation Project: in an observation project, ***observations*** are made and recorded to test the hypothesis. The following example shows how the *Scientific Method* is used in an observation project.

Question/Title	What type of bird is most prevalent near my house?
Purpose	To determine the most prevalent type of bird near my house.

Background Information	Common feeder birds in western North America include Chickadees, Nuthatches, Finches, Blackbirds, Thrushes, Sparrows and more
Hypothesis	I hypothesize that there are more Red-winged Blackbirds than other types of birds near my house.
Methods	Using a bird identification chart, I will record the numbers and types of birds I see near my yard and at my bird feeder. I will do this every morning before school and every afternoon after school for 1 week.
Results	Altogether, I saw 44 birds including 5 species. There were: 20 Varied Thrushes 11 Red-winged Blackbirds 9 Black-capped Chickadees 2 Western Scrub Jays 2 Cassin's Finch
Conclusion	The most common bird was the Varied Thrush, at least during the spring when I took these recordings. They live in a tree in my yard and visit the bird feeder a lot. My hypothesis was not correct. Red winged Blackbirds were the second most common bird, not the most common. This made me think of another question – if we changed the kind of bird food in the feeder, would different birds come to visit? This would be my next question to observe.

<u>Examples of the Scientific Method in an Experiment Project</u>: in an experiment project, one variable is changed while everything else stays the same in order to determine the effect of that one variable. The ***independent variable*** is the one that is changed. The ***dependent variables*** change in response to the independent variable. An experiment project may have a ***control*** (or a sample that has not been changed). The following example shows how the *Scientific Method* is used as an experiment project.

Question/Title	In which type of environment will marigolds grow best?
Purpose	To determine which type of environment marigolds will grow best in.
Background Information	Several different soils and media are available for growing plants. Some are rich in nutrients, some let water drain quickly through them, and some are light and fluffy.
Hypothesis	I hypothesize that if I plant marigolds in best store-bought potting soil and a control group in a cheap potting mix, then the expensive marigolds will grow best.

Methods	I purchased 5 marigold plants as close in size as possible, rinsed the roots, and repotted them in 5 different environments – the original cheap soil it came in, sand, vermiculite, topsoil from our garden, and best store-bought potting soil. Water, sunlight, and temperature were the same for all 5 plants over a 6-week period. Plant fullness, height, leaf color, and blossoms were measured.
Independent Variable	Planting environment
Dependent Variable	Plant fullness, height, leaf color, and blossoms.
Control Sample	A marigold in the cheap soil that is originally came in.
Experimental Sample	A marigold in sand. A marigold in vermiculite. A marigold in topsoil from our garden. A marigold in best store-bought potting soil.
Results	The marigold in the best store-bought potting soil was fuller and taller, the leaves were darker green, and it had more blossoms.
Conclusion	My hypothesis was correct. The expensive store-bought potting soil was best for growing marigolds. Maybe this is because it contains a mixture of the different media that provide nutrients and good drainage. My experiment is important because it will help us to choose a good soil for planting flowers this spring.

3. The Invention Process

For Invention projects, follow the steps in the ***Invention Process*** to develop an idea into a product:

1) **Look for a Problem that Needs Solving**
   A problem that affects you or your family might be a good place to start. Determine the purpose of your invention.
2) **Gather Background Information**
   You should research existing projects (the Internet is a great resource). This will help you avoid duplicating existing inventions and allow you to improve upon them.
3) **Design and Develop Your Invention**
   Be creative and use your imagination! Getting around existing problems will often require you to think outside of the box. Make a detailed drawing (or several drawings) and label all your

parts so that others will be able to understand how your invention works. Make a model of your invention.

4) **Test Your Invention**
   You may need to test multiple prototypes before you have a successful invention. How effective or useful is your invention? How is your invention original and how could you improve it further?

5) **Keep a Log**
   Write down all of your ideas, research, setbacks, and successes. This is the written record of your invention process. Bring this to the science fair as part of your display.

6) **Name Your Invention**
   Have fun with this! You can use rhyming words or your name in some form. Make it silly or serious – it's up to you.

4. Display Your Project

Your display must be free standing and your space is limited to 36 inches in width by 15 inches depth.) Tri-fold poster boards (size 36"x48" is preferred) can be purchased at Hobby Lobby, Michaels, Office Max, Staples, or Office Depot. Tables will be provided for each project. If your display will require electricity, please note it on the Registration Form.

Displays for <u>Observation Projects</u> should include:

- Title of your project or question you are answering (your name, grade, and teacher)
- Purpose
- Background information (if appropriate, include charts, illustrations, photos, etc.)
- Hypothesis (if it applies)
- Methods (if it applies)
- Results (if it applies; bring your collection or model for purely *descriptive* projects)
- Conclusions
- Sources of information

Displays for <u>Experiment Projects</u> should include:

- Title of your project or question you are answering (and your name, grade, and teacher)
- Purpose
- Background information
- Hypothesis
- Experimental Methods (explain your experiment and identify the variables and control)
- Results (include observations, charts, and graphs, and bring your log book)
- Conclusion
- Sources of information

Displays for <u>Invention Projects</u> should include:

- Title of your invention (and your name, grade, and teacher)
- Purpose
- Background information (include other existing projects or methods that have the same purpose)
- Design and Development (include a drawing or diagram of your invention and a description of how it work and bring your logbook)
- Bring your invention or a model of your invention – you should also include pictures of all your major prototypes (and their problems) before achieving your final product.

- Summary (include how successful your invention was, who will use it, and improvements you would make next time)
- Sources of information

Below is a suggested layout of your poster for an Observation or Experiment project. Observation projects that are purely *descriptive* in nature will look a little different, but all displays should be neatly organized and easy to follow. Include drawings and photos in your displays to make it more interesting. Students may use the 36 inches x 15 inches of display space in front of your poster to show your items, materials, models and/or collections.

PURPOSE	**TITLE**	**RESULTS**
	NAME, GRADE, TEACHER	**DATA & GRAPHS**
BACKGROUND	**HYPOTHESIS**	**CONCLUSION**
Photos	**METHODS**	**SOURCES**

5. A few possible topics *(there are countless more)*

- Food preferences in gerbils
- Does adding salt to water change the temperature at which it boils?
- The effect of different light intensities on the growth of sunflower plants
- Which bird feed do birds like best?
- The effect of sugar water on the survival of cut flower stems.
- Bacterial growth in apple juice vs. apple cider
- Can magnesium affect seed germination?
- The effect of friction on velocity
- Packaging eggs and shock resistance
- An investigation of the mysteries of Fibonacci
- A comparison of water content of different kinds of fruit
- Learning styles and memory retention
- Comparing the tensile strength of different metals
- An investigation of the lung capacity of smokers vs. non-smokers
- Which form of insulation is most effective?
- How to grow the best crystals
- Which brand of gum is most viscous?
- Designing the most efficient propeller
- An analysis of the sugar content of breakfast cereals
- How does watching fish affect people's blood pressure?
- The history of electricity