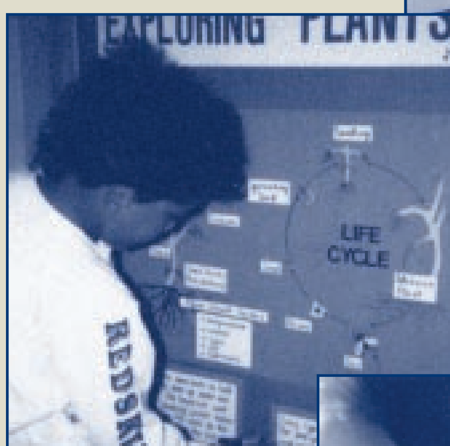
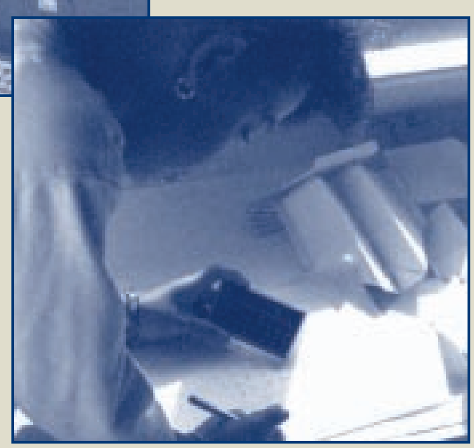
A student's guide to

Keeping the SCIENCE in Your SCIENCE Project





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Introduction

Every year, students from elementary, middle, and high schools participate in science fairs. There are good reasons for this growing interest. Your success at the local science fair may lead to stronger competition, more recognition and better prizes, as you go on to compete in regional or state fairs. Participation in science fairs is rewarding because nearly everything we do — from cooking to health care to planting a garden — involves science.

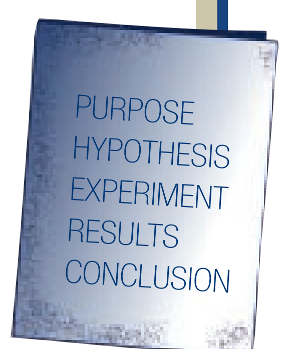
Besides the challenge, there are many other reasons to participate in science fairs. Some students may be interested in winning prizes and developing new skills. Others may realize that a science fair project gives them a chance to publicly display the results of their creativity and knowledge. And many teachers assign students a project as a class requirement, and students' participation in a science fair may play a role in the grades they receive.

This guide will help to improve your chances of producing a high-quality project. Even if you do not win first, second, or third place with your project, don't feel bad. Neither you nor your project is a loser! Your experiences while working on a project will be useful many times during your life. So, don't worry! Replace your worries with the excitement of doing something challenging and fun.

Before you begin

One of the secrets to a high-quality science project is how well you use and understand the scientific method.

What is this scientific method? It is a series of logical steps used to answer questions and solve problems. The scientific method includes the following key elements: purpose, hypothesis, experiment, results and conclusion. The scientific method will help you every step of the way through your project. And once you learn to use this decision-making process, you will see that there are no wrong ideas, wrong experiments, wrong results, wrong conclusions or wrong answers.



This guidebook will introduce you to the steps you should follow when using the scientific method, and it will be a valuable tool for students preparing their first science fair project as well as students who have previous experience with science fair projects. The guidebook outlines an example of a winning project. However, the elements used in this example are merely tidbits that you are encouraged to sample, not duplicate for your own project. Remember: Nobody wins if a project is copied straight out of a book. Now let's get busy!

Getting started

Begin your search for an idea for a science project with a topic which interests you. It doesn't have to be a topic from science class. Clothes, cars, cosmetics, cameras ... any topic you can think of can become an idea for a science project.

Answer question 1 on page 7

The next step is to study your topic for a problem: something you don't understand. Explore your topic at the library — in books and magazines. Explore it on the Internet if you can. Explore it by finding out if there are people you can talk to who know a lot about the topic, and ask them to recommend sources of information. Explore your topic until you come across something you don't understand, or something you would like to know more about.

Answer question 2 on page 7

For example, if your topic is trees, you might not understand why some trees lose their leaves in the fall. Or maybe your topic is music, and you don't understand how your favorite musical instrument works.

Most science fair projects involve research and testing to arrive at specific conclusions. A project that does not include these basic points is a "model" or "demonstration." For example, building a model volcano just to show how one combination of chemicals can cause a reaction is not a research project.

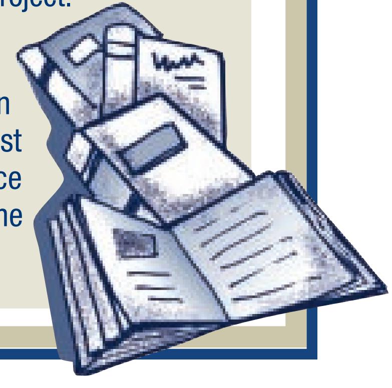
Unless there is a specific category in the science fair for such projects, do not expect demonstrations to be ranked as highly as true experiments or research projects. Science fair judges, usually professionals from the scientific community, often base up to 80 percent of your final score on scientific thought, creative ability, technical skill and thoroughness. The remaining 20 percent of the score is usually based on the display's visual appeal, design and organization, and the impression the student makes in an interview.

Stephanie's topic

Stephanie has a favorite nylon jacket that she likes to wear regardless of the weather. One very cold winter day, her mother said, "You have five jackets. Why don't you wear one of the heavier ones today? Your nylon jacket will not keep you warm enough." Although Stephanie suspected her mother was right, she nonetheless wondered if coats made of heavy fabrics really do keep people warmer than coats made of light fabrics? The question became the topic for her science project.

Her background work

Stephanie spent some time at her school's library looking up information on various types of fabrics, and she contacted the Clothing and Textiles Specialist with the A&T Cooperative Extension Program for some additional reference materials. Stephanie put the finishing touches on her research by using her home computer to "surf" the Internet.



Decision time

Are you ready to turn an idea you've come up with into a problem to solve? Here is how you can tell:

Complete activity 3 on page 7

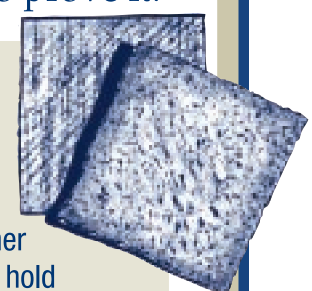
After you have done enough background research to be sure that you will be able to test your idea, you will have come up with a problem to solve. If your research is complete and you are ready to move forward, you will be able to write a problem statement at this point.

Complete activity 4 on page 7

Next comes a purpose statement. The purpose statement gives you a reason for what you plan to do. It answers the question "why?" The purpose statement becomes your project's foundation. Be sure your purpose isn't too general.

Answer question 5 on page 7

This brings us to the hypothesis. The hypothesis is an "educated guess." It is your prediction of what will happen during your experiment. The hypothesis will be your guide for planning tests. If your hypothesis was: cold weather causes trees to lose their leaves, then you would set up your experiment to prove it.



Stephanie's problem

Stephanie doesn't want to wear heavy, bulky jackets when she goes outside to play.

Her purpose

The purpose of Stephanie's experiment is to find out if one of the five types of fabric her coats are made of is better than the others. Her purpose was to "find out if heavy fabrics hold heat longer than lightweight fabrics."

Her hypothesis

Stephanie decided her hypothesis would be: Wool will retain heat longer than other fabrics.

Watch your variables

Before you begin testing anything, you need to understand what "experimental groups" and "control groups" are. You also need to understand the relationship between the two groups. Most good experiments have both a "control group" as well as an "experimental group."

If your experiment's purpose is to see how magnets affect plant growth, you would grow plants without a magnet hung over them, as well as plants with magnets hung over them. The plants without the magnet would be the control; those with the magnet would be the experimental group.

The experimental group should be as alike the control group as possible, except for a variable — something you change because you think the change will have a measurable impact on the experimental group. Because this variable is selected by the scientist, it is called the independent variable.

Sometimes experiments have more than one independent variable: the

Stephanie's control

Stephanie's purpose is to find out if heavy fabrics hold heat longer than lightweight fabrics, and the plan for her experiment is to wrap five types of fabric around five cups of water, which have been heated to the same temperature in a microwave. She plans to use a thermometer to check the water temperature to see which cup of water is slowest to cool. For her control, she needs to check how long it will take for a cup of heated water to cool down when it is not wrapped with any fabric at all.

Her independent variable

Stephanie decided to use fabric type as her independent variable. Fabric type is an independent variable because Stephanie will control and change it during the experiment. She will test nylon, wool and three other fabrics. As she conducts her tests on the five fabrics, the water temperature she starts with, the amount of water and all other variables will be the same: the only change will be the type of fabric she is testing.

Her dependent variable

Stephanie decided to use water temperature as her dependent variable. Water temperature will be the same at the start of each test, when hot water is put in a cup with a fabric wrapped around it. As the water temperature decreases, the change will be in response to the ability of the fabric to retain heat. Water temperature is a good dependent variable because it is measurable (with a thermometer) and it changes only in response to the independent variable (fabric type).

scientist does two or more things to the experimental group that are not done to the control group. This makes for a more complicated experiment: you will have to compare the results in the experimental group to results in the control group when you introduce your first independent variable, then repeat the experiment and compare experimental group to control group for each independent variable. Try to have only a single independent variable in your experiment.

Complete activity 6 on page 7

Scientists must also realize their experiments have variables which may or may not influence the results of their experiments. In addition to coming from different raw materials, the fabrics Stephanie tests contain dyes, and different processes were used to manufacture them. As she came up with her hypothesis, Stephanie didn't think these other variables would affect the results of the experiment. A list of independent variables which may or may not influence the results of your experiment is nonetheless important. You may need to analyze these other variables if your results don't match your hypothesis.

Complete activity 7 on page 7

Experiments also have a "dependent variable." In your search for a dependent variable, you find something which depends on what you're going to do to the experimental group — something which can be measured. If your experiment's hypothesis is "plants grow faster with magnets over them," then what results are going to be dependent, and how can you measure them? (If you choose height as your dependent variable, you will be able to measure the plants with a ruler as they grow. If you choose color, you have selected a dependent variable which won't be easy to measure.)

Complete activity 8 on page 7

Answer question 9 on page 7

Is it time to experiment?

Take another look at your purpose, hypothesis, control and variables. Is everything complete? Make sure you take another look at your science fair instructions and guidelines. Will your experiment fit all the regulations? Do you have access to all the equipment and supplies you will need? Is there going to be enough time for your experiment to be completed by the science fair? You may have to repeat your experiment more than once to make careful observations and get accurate measurements, so allow yourself plenty of time.

Complete activity 10 on page 8

Stephanie's experiment

Stephanie carefully measured and cut five different fabrics. (They were wool, nylon, polyester, denim and a blend of polyester and nylon.) She wrapped five cups with the five fabrics. For her control, Stephanie used a sixth cup, just like the others except it was not wrapped in any fabric whatsoever. She filled the six cups with six ounces of water each, and heated them to 100^{o}F in a microwave. She checked the temperature of each cup every 30 minutes for a period of two hours. The room temperature remained constant at 69^{o} F throughout the experiment. Stephanie found that her control, with no fabric wrapped around it, cooled down faster than all the cups with fabric. She also found that the water in the cup with wool fabric around it took longer to cool than the other cups.

Collect your data

During an experiment, certain information must be collected. These pieces of information are the "data." In most experiments the data are numbers which reflect changes in the dependent variable. (For Stephanie's experiment, the data consisted of the temperature readings she was taking every thirty minutes from the five cups of heated water with pieces of fabric around them, and th control.)

It is important to collect all your data as carefully as possible. Why? This strengthens the accuracy of your findings. Record your data in a notebook, or use another convenient method. Collecting and interpreting your data will allow you to answer more questions about your hypothesis when you finish.

As you get more data, you might begin to realize that it is not supporting the hypothesis you stated. THIS IS OKAY! Just because your data does not support what you thought would happen does not mean that you have a bad experiment. Continue with your experiment.

Describe your results

Complete activity 11 on page 8

Once you collect all of your data and analyze it, you are ready to state your results. Charts, graphs, and tables are a good way to show your data.

Once you have the results of your experiment, you can draw some conclusions based on what you have learned. Remember that even if the results do not support the hypothesis, the experiment is not wrong! It simply means that there are probably variables, other than the treatments, which may affect the outcome.

Complete activity 12 on page 8

Answer question 13 on page 8

Stephanie's results

After conducting her experiment, Stephanie discovered that the cup wrapped in wool retained heat longer than any of the other cups. This was followed in order by cups wrapped in: polyester and nylon blend, denim, polyester, and nylon.

Her conclusion

Stephanie concluded that the wool fabric retained heat longer than the other fabrics tested.

Her recommendation

Stephanie told her mother, "Mom, you were right! The wool fabric holds heat better than nylon." On the next cold day, Stephanie recommended a wool jacket to her sister, Laura, because it would keep her warmer than jackets made of other fabrics.

CONGRATULATIONS!
YOU HAVE MASTERED THE SCIENTIFIC METHOD

1. What topic are you going to explore for your science fair project?

2. How are you going to research your science fair topic?

3. Write a short statement explaining the problem you have come across, which you believe some experiment will solve.

4. Write a short purpose statement for your project.

5. What will be the hypothesis for your experiment?

6. Describe the control group for your experiment. Explain how your experimental group and the control group will be different.

7. Describe your independent variable.

8. List the independent variables which may or may not influence the results of your experiment.

9. What is the dependent variable for your experiment and how will you measure changes in it?

10. Describe how you will conduct your experiment.

11. Describe the results of your experiment.

12. Describe how you plan to show your results.

13. Review the results of your experiment. What is your conclusion?

Ten Steps to a Winning Science Fair Project

1. Although many TV commercials are presented as “scientific experiments,” few of them really are. Those that are usually require elaborate, expensive equipment, so forget about duplicating experiments you hear about in commercials.

2. Follow guidelines or instructions you receive from your teacher. If a parent or another adult is going to help you with your project, share your teacher’s guidelines and instructions before you do anything else.

3. Don’t wait until the last minute to start the project.

4. Flashy displays without valid information will not impress many science fair judges.

5. Don’t change the project results to fit a hypothesis.

6. Do the work yourself, with limited support from an adult.

7. Be creative.

8. Select a project suitable for your age, skills, and knowledge.

9. Have **FUN**, and **LEARN SOMETHING NEW**.

10. USE THE SCIENTIFIC METHOD!!!!