

So, what is the Scientific Method, anyway?

Well ... simply put, the scientific method is a series of steps that scientists take to acquire, test and describe the stuff of our world.

The Scientific Method – in theory and in practice

Here are the steps you must take to be sure that you are using the scientific method:

SELECT A QUESTION you can answer by conducting an experiment. Use the library for ideas and information. You will find commonly done experiments, but you may also get some ideas about new topics and how to set-up your own experiment. Your question should be asked in such a way that it cannot be answered with a simple yes or no. For example, "How does salt affect the freezing point of water?" is a better question than, "Does salt affect the freezing point of water?" Be careful! Many science fair books suggest science fair questions that are really demonstrations. Make sure that YOU cannot answer the question with a simple yes or no. Also be sure that you will change something (have a manipulated variable) and measure something when answering the question. If you cannot figure out what you will be changing in doing the experiment, you probably have a demonstration or model and not an experiment question.

FORM A HYPOTHESIS This is a prediction about what will happen as a result of your experiment. Forming a hypothesis will help you design your procedure, and the experiment will prove or disprove your hypothesis. This step can be easier if you have done some research and found other experiments that are similar to the one that you want to do.

PLAN & PERFORM THE EXPERIMENT

- Plan the details of your experiment.
- Select the manipulated and responding variables.
- Decide what things you must keep the same - these are your controls.
- Determine what you will be measuring and what instrument you will use.
- Select the materials to form the test equipment.

- Plan how the tests will be done:
- Which test will you do first?
- How many tests will you do?
- What will be recorded?
- How many times will each test be repeated?
- Assemble the equipment to be used in the experiment.
- Prepare and file ISEF paperwork if you are in 6-12th grades & wish compete further. Ask your science fair director about this !!
- Prepare data sheets in a record (log) book for recording measurements and for your comments. (The logbook should also be used for plans and ideas.)
- As you perform the tests, enter all measurements on your prepared data sheets.
- Take careful notice of what happens at all times and write down what you observe.
- It is important that you repeat each test several times. That way you can be sure of your results.

PREPARE THE RESULTS of your tests from the measurements. Group and organize the measurements you have made. Make charts, graphs and tables to show what happened. Wherever possible, use numbers to show your results. You may find that you will have to do more tests or perhaps make different measurements if you notice something happening that you cannot explain in one of your measurements. If one measurement is very different from all the others, check your comments in your logbook to be sure that nothing unusual happened to that test. For example, if you were testing the affect of temperature change on batteries and you dropped the flashlight, your results from that test might not be accurate. Try to understand the problem so that you can explain unusual results.

EXPLAIN THE RESULTS of your tests. It is a good idea to spend some time thinking about your results and talking to other people about them. Think about what the charts, tables and your comments mean. Note patterns and amounts. Try to explain how or why the results came out as they did. What was the cause? Do the results agree with your hypothesis?

DRAW CONCLUSIONS: What can you say about your experiment in general? What can you count on happening again if someone else does a similar experiment? Again note patterns and amounts in your conclusions. If possible, try to describe how your results might apply to everyday experiences. For example, in the battery experiment, you might decide that it is better to store extra batteries in the refrigerator or freezer. Or even think about what might have happened to the results if you had made a really big change in the manipulated variable.

Using all of these steps will make for an orderly experiment with reliable measurements and results. Follow this scientific method, and, like any good detective, you can trust your findings

SOOOO, what does a good project look like??

Three EXAMPLES (without detailed results)

1. Effect of light direction on plant growth

QUESTION

What effect does side lighting have on plant growth

HYPOTHESIS

Plants may grow to different heights if light comes from the top, sides or both. Top lighting should be better than lighting from the sides.

MANIPULATED VARIABLE

Direction of light

EXPERIMENTAL RESULTS

Height plant grows in a certain length of time

CONTROLS

Type of plant, length of time in light, amount of light, size of pot, type of soil, amount of water

2. Effect of use rate on battery life

QUESTION:

What effect does the rate of use have on total battery energy?

HYPOTHESIS:

Batteries tend to provide more energy when used slowly.

MANIPULATED VARIABLE

Size (*watts*) of flashlight bulb

EXPERIMENTAL RESULTS

Time the battery powers a flashlight

CONTROLS

Kind of battery, kind of flashlight, age of batteries

3. Effect of the size of a parachute's hole on the time it falls

QUESTION

What effect does the shape of the hole in a parachute have on its falling speed?

HYPOTHESIS:

Shapes that interfere with the passage of air should cause a slower fall if the chute remains stable.

MANIPULATED VARIABLE

Shape of the hole

EXPERIMENTAL RESULTS

Time for parachute to fall

CONTROLS

Hole area, size of parachute, length of fall, shape of the parachute