Six Steps of the Scientific Method

Learn What Makes Each Stage Important

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The scientific method is a systematic way of learning about the world around us and answering questions. The key difference between the scientific method and other ways of acquiring knowledge are forming a hypothesis and then testing it with an experiment.

The Six Steps

The number of steps can vary from one description to another (which mainly happens when *data* and *analysis* are separated into separate steps), however, this is a fairly standard list of the six scientific method steps that you are expected to know for any science class:

1. **Purpose/Question**Ask a question.
2. **Research**
   Conduct background research. Write down your sources so you can cite your references. In the modern era, a lot of your research may be conducted online. Scroll to the bottom of articles to check the references. Even if you can't access the full text of a published article, you can usually view the abstract to see the summary of other experiments. Interview experts on a topic. The more you know about a subject, the easier it will be to conduct your investigation.
3. **Hypothesis**
   Propose a hypothesis. This is a sort of educated guess about what you expect. It is a statement used to predict the outcome of an experiment. Usually, a hypothesis is written in terms of cause and effect. Alternatively, it may describe the relationship between two phenomena. One type of hypothesis is the null hypothesis or the no-difference hypothesis. This is an easy type of hypothesis to test because it assumes changing a variable will have no effect on the outcome. In reality, you probably expect a change but rejecting a hypothesis may be more useful than accepting one.

4. **Experiment**
   Design and perform an experiment to test your hypothesis. An experiment has an independent and dependent variable. You change or control the independent variable and record the effect it has on the dependent variable. It's important to change only one variable for an experiment rather than try to combine the effects of variables in an experiment. For example, if you want to test the effects of light intensity and fertilizer concentration on the growth rate of a plant, you're really looking at two separate experiments.
5. **Data/Analysis**Record observations and analyze the meaning of the data. Often, you'll prepare a table or graph of the data. Don't throw out data points you think are bad or that don't support your predictions. Some of the most incredible discoveries in science were made because the data looked wrong! Once you have the data, you may need to perform a mathematical analysis to support or refute your hypothesis.
6. **Conclusion**
   Conclude whether to accept or reject your hypothesis. There is no right or wrong outcome to an experiment, so either result is fine. Accepting a hypothesis does not necessarily mean it's correct! Sometimes repeating an experiment may give a different result. In other cases, a hypothesis may predict an outcome, yet you might draw an incorrect conclusion. Communicate your results. The results may be compiled into a lab report or formally submitted as a paper. Whether you accept or reject the hypothesis, you likely learned something about the subject and may wish to revise the original hypothesis or form a new one for a future experiment.

When Are There Seven Steps?

Sometimes the scientific method is taught with seven steps instead of six. In this model, the first step of the scientific method is to make observations. Really, even if you don't make observations formally, you think about prior experiences with a subject in order to ask a question or solve a problem.

Formal observations are a type of brainstorming that can help you find an idea and form a hypothesis. Observe your subject and record everything about it. Include colors, timing, sounds, temperatures, changes, behavior, and anything that strikes you as interesting or significant.

Variables

When you design an experiment, you are controlling and measuring variables. There are three types of variables:

Controlled Variables: You can have as many controlled variables as you like. These are parts of the experiment that you try to keep constant throughout an experiment

so that they won't interfere with your test. Writing down controlled variables is a good idea because it helps make your experiment *reproducible*, which is important in science! If you have trouble duplicating results from one experiment to another, there may be a controlled variable that you missed.

Independent Variable: This is the variable you control.

Dependent Variable: This is the variable you measure. It is called the dependent variable because it *depends* on the independent variable.