The Scientific Method

1. Question

Why Ask Questions?
It is important to clearly define the question being answered or the problem being solved by the scientific investigation.

Tips for Questioning
Scientific questions should be narrow and specific. Avoid broad or vague questions.

2. Research

Why Do Research?
Research is needed to find out what others have discovered relating to your question.

Tips for Research
Use a variety of reliable sources. Document all your sources.

Definition
The scientific method is a logical problem-solving process used by scientists. The exact steps may vary depending on the scientific question. Steps can be repeated, modified, and reordered. Generally, scientists follow the same basic process.

3. Hypothesis

What is a Hypothesis?
It is a possible answer and explanation to your question based on knowledge, observations, and research.

Tips for Hypothesizing
A hypothesis should by a clear and simple statement that can be tested.

Hypotheses Can Be Written 3 Ways

1) Cause & Effect/ If… Then
   a) Predicts the outcome if a certain action is applied
2) Correlation
   a) Predicts a relationship between two variables
3) Comparison
   a) Predicts the difference in performance between two groups

Can a Hypothesis Be Wrong?
No! Instead, it is either supported or rejected by the data. Never change a hypothesis if the results don't support it. A rejected hypothesis can reveal information about the scientist's question.

4. Experiment

Variables
Variables are what change in an experiment. The variable being tested or changed by the scientist is the *independent or manipulated variable*. Normally, there is only one of these at a time so that experimental results can be attributed to that variable. *Dependent or responding variables* are what the scientist is measuring or observing. If there is a direct link between independent and dependent variables, there may be a cause and effect relationship. *Controlled variables* are factors that the scientist keeps constant, which allows him to attribute the results to the independent variable alone.

What is an Experiment?
It is a detailed procedure designed to test a hypothesis. It describes how to perform the test and the type and amount of materials needed. It should be clear enough for other scientists to duplicate the experiment exactly.

5. Analyze Data

Analyzing Data
Scientists study data to look for meaning. They look for differences in the dependent variable between control and test groups. If differences exist, the independent variable may have had an effect. If not, the independent variable may not have had any effect.

Tips for Recording Data
Record data in an organized, accurate manner. This makes it easier to identify patterns/ trends, make predictions, and draw conclusions. Use a scientific journal, tables, charts, and graphs.

What is Data?
Data are the results of the experiment. They can include number measurements like time, temperature, and mass, or they can be observations.

6. Conclusion

What is a Conclusion?
A conclusion is a statement based on experimental measurements and observations. It includes a summary of the results, whether or not the hypothesis was supported, the significance of the study, and future research.

7. Communicate

How to Communicate
Scientist communicate their results through journals, magazines, websites, television, radio, lectures, and posters.

Why Communicate?
Communicating discoveries advances the knowledge of the scientific community, and it improves future studies.