Chapter 02: Reading Comprehension

Part I: Scientific Method

What is the scientific method ?

- The Scientific Method is a process for asking and answering questions using a specific set of procedures.
- The scientific method helps scientists gather facts to prove whether an idea is true.
- Using this method, scientists come up with ideas and then test those ones by observing facts.
- It even helps scientists check each other's work by following the same steps to see whether they get the same results (Reproducibility)

➢ The basic process involves making an **observation**, forming a **hypothesis**, **making a prediction**, **conducting an experiment** finally **analyzing the results** and **draw conclusions.**

Steps of Scientific method

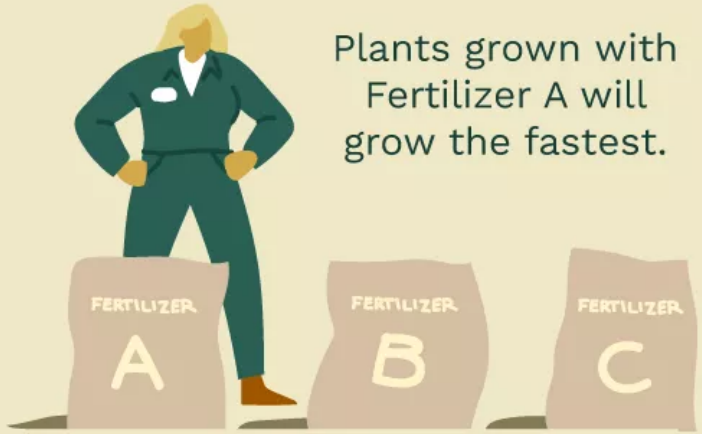
Step 1: The Observation and Questioning

- ✓ A scientist must define the question to be answered before beginning any inquiry.
- ✓ Observing some interesting natural events is a vital initial step in the scientific method. This observation ought to raise several inquiries on the phenomenon.
- ✓ This stage often calls for reviewing prior research on related topics and background information in order to comprehend the subject (peruse the literarture)
- ✓ Scientists can improve their research questions and more precisely fill in knowledge gaps by going over and analyzing prior studies.

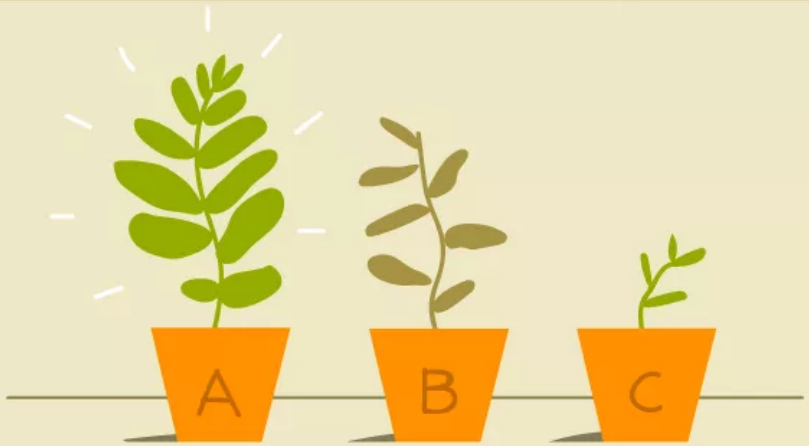
Steps of the Scientific Method

Observation

Question



Hypothesis



Results

Conclusion

ThoughtCo.

Step 2: The Hypothesis

- ✓ Developing a hypothesis based on past information is the next stage.
- ✓ An "uncertain explanation“ or an unproven supposition that aims to explain a phenomenon using information gleaned (collected) from carrying out further tests or observations is called a hypothesis.
- ✓ To answer their questions, scientists typically create several hypotheses and conduct methodical testing on them.

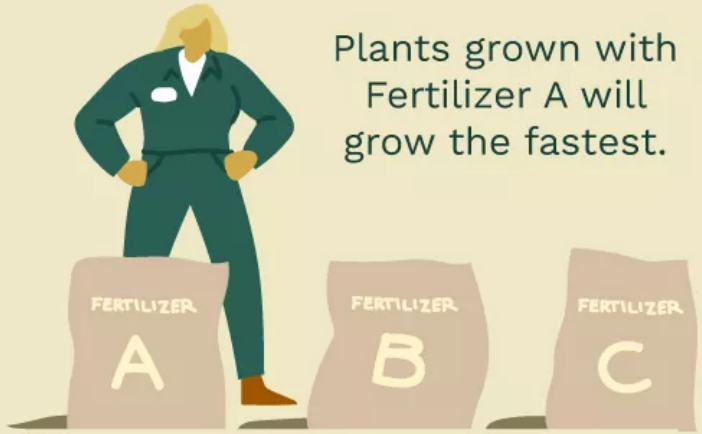
For the scientific method to function, every hypothesis needs to fulfill a set of requirements.

- ➢ A hypothesis must first be verifiable and able to be tested.
- ➢ When a hypothesis can be verified by observations or tests and produces testable predictions, it is considered testable.
- ➢ A falsifiable hypothesis is one that can be disproven by observation of contradictory results.

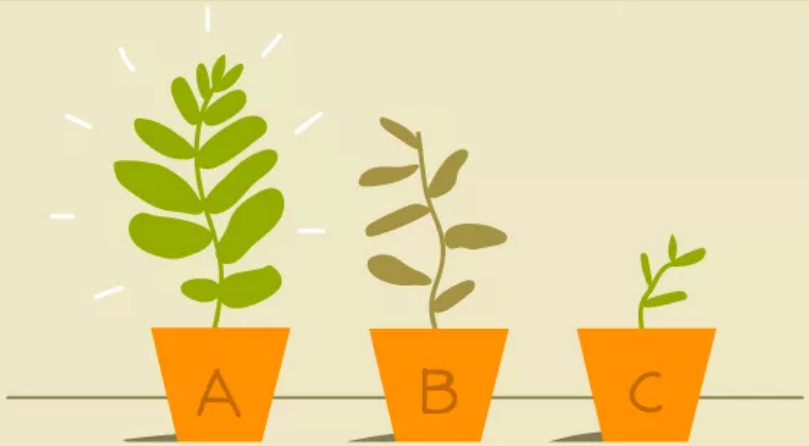
Steps of the Scientific Method

Observation

Question



Hypothesis



Results

Conclusion

ThoughtCo.

- ✓ Another crucial phase in the scientific method is experimental design, which has a significant impact on the findings and interpretations of an investigation.
- ✓ Every variable or factor that could affect the experiment's outcome should be controlled by the researcher during its design.
- ✓ An experiment's conditions are described by two different kinds of variables: the independent variable and the dependent, or response, variable.

INDEPENDENT VS DEPENDENT VARIABLES

INDEPENDENT

An independent variable is the factor in an experiment that the researcher intentionally manipulates or changes to observe its effect. It's considered the cause or reason for an observed effect. Any changes in the dependent variable are hypothesized to be directly caused by variations in the independent variable.

DEPENDENT

The dependent variable is what the researcher measures to see if it changes as a result of the manipulation of the independent variable. It represents the outcome or effect in an experiment. Changes in the dependent variable are considered to be dependent on variations in the independent variable.

INDEPENDENT VARIABLE

VARIABLE THAT IS CHANGED

Amount of Water

DEPENDENT VARIABLE

VARIABLE AFFECTED BY THE CHANGE

Size of Plant
Number of Leaves
Living or Dead?

Step 3: Experimentation and Data Collection

- ✓ Further observations or experiments that result in conclusions are needed to move forward.
- ✓ Scientists plan and carry out experiments to test their ideas after they are formulated.
- ✓ The data from these trials will either confirm or refute the hypothesis.
- ✓ Both qualitative and quantitative observations can be used to gather data.
  - ❑ Observations that can be made just by using one's senses—whether they be taste, smell, touch, sound, or sight—are referred to as qualitative information.
  - ❑ Quantitative observations are those in which a hypothesis is investigated using exact measurements of some kind (attribute a number)

- ❖ An experiment is a process used to ascertain whether real world observations support or contradict the hypothesis's deduced predictions.
- ❖ When a hypothesis is supported by data from an experiment, it gains greater validity

Step 4: Results and Data Analysis

- ✓ Finding the meaning of the experiment's results is the next stage in the scientific method.
- ✓ To see if they can reject the null hypothesis (the likelihood that the observation may be true is due to chance), scientists compare the predictions made by their alternative hypothesis to those made by their null hypothesis.
- ✓ When the null hypothesis is rejected, it indicates that there is a considerable possibility that the dependent variable's values in the control and experimental treatments differ from one another.
  - ❑ The alternative hypothesis can be accepted and the null hypothesis rejected if there are notable differences.
  - ❑ On the other hand, if the null hypothesis is accepted, it means that the treatment has no bearing (no relation) on the outcomes.

Step 4: Results and Data Analysis (suite)

- ✓ Statistical tests are necessary to confirm the validity of the data and allow for further data interpretation before scientists can draw any conclusions about their null hypothesis based on their observations or experimental data.
- ✓ Researchers can use statistical tests to ascertain whether the control and experimental treatments really differ from one another.
- ✓ They can then produce tables and figures to support their conclusions.

Step 5: Conclusion

- ✓ Giving explanations for the findings and any logical inferences that can be made from them constitutes the final step of the scientific method.
- ✓ This stage of the scientific method typically calls for a review of the literature and a comparison of the findings with those of other studies or observations on related subjects.
- ✓ This enables researchers to expound on the significance of specific results and place their experiment in a broader context.
- ✓ It also enables them to explain how their work fits into the discipline's broader context.

- This is not the end of the scientific process!
- The scientific method operates over time as our understanding of specific mechanisms or processes that explain natural phenomena is shaped by the accumulation of knowledge on scientific subjects.
- If our null hypothesis is not rejected, we must go back to the beginning of the scientific method, try to rephrase our questions, and figure out why the expected result was not obtained.