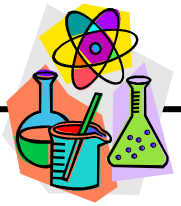
Scientific Inquiry



Scientific inquiry: Steps and strategies used to investigate a topic, question, problem or issue of a scientific nature.

There are three major stages in scientific inquiry.

INITIATE AND PLAN

Identify the topic, question, problem or issue:

- **formulate a question**
- **conduct background research**
- **generate a hypothesis**
- **plan experiment or investigation.**

PERFORM AND RECORD

Conduct the experiment or investigation:

- **gather data and record observations.**

Process and display data

- **organize data.**

ANALYZE AND INTERPRET

Interpret data:

- **draw conclusions**
- **make inferences.**

Generalize, extend and apply knowledge.

Initiate and Plan

Identify the topic, question, problem or issue

Look for everyday topics, questions, problems or issues at school, home, in the workplace and community.

Formulate a question

The question must be specific and *testable*—there must be a way to find the answer. Testable questions usually begin with the words *Do*, *Does*, *What* or *Will*.

Examples:

- Do salt water and fresh water freeze at the same temperature?
- Does stirring a liquid increase the rate at which it reaches the boiling point?
- What is the boiling point of milk?
- Will different types of fertilizer affect the growth of a bean plant in different ways?

Conduct background research

It is important to gather background information in order to make an informed hypothesis (prediction). This information may come from a variety of sources: class notes, textbooks, interviews, videos, magazines and newspaper articles. Background information should include definitions of words that are important to your investigation.

Generate an hypothesis

An hypothesis is a prediction of what will happen. It is a specific answer to the question or problem based on your background research and knowledge.

Example: Fertilizer A is the most likely to affect the growth rate of bean plants.

Plan an experiment or investigation

The experiment plan is a description of how you will test the hypothesis and find the answer to the question or problem. The plan should include a description of, or information about, each of the following.

Objective and/or question
A statement outlining what you are trying to find out or a question to guide your investigation.

Examples:

- To determine how four fertilizers affect the growth rate of bean plants.
- How will four fertilizers affect the growth rate of bean plants?

Variables
In a scientific investigation, there are three types of variables: manipulated, responding and controlled. These variables are identified to make sure the results are accurate (correct) and that the experiment could be repeated in exactly the same way, with the same results.

Manipulated variable: What is changed or being tested in order to see what the effect will be, e.g., the four types of fertilizer.

Responding variable: The results that occur because of the manipulated variable, e.g., the height of the plants.

Controlled variable: Factors that are kept the same to make sure the results are accurate, e.g.:

- the type of seeds used
- the amount of soil
- the amount of light received by the plant
- the amount of water per day
- the amount of fertilizer.

Materials
An experiment plan includes a list of the materials, the amounts of each and the equipment needed. List materials in the order they will be used.

Examples:

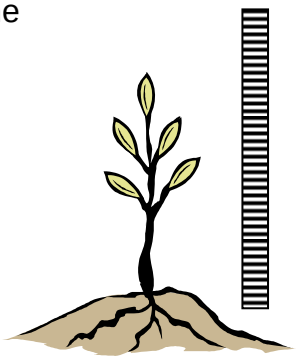
- 4 bean plant seeds
- 4 small pots
- 60 g potting soil
- 1 container each of four types of fertilizer
- 30 cm ruler

Procedure
An experiment plan includes specific steps that explain what will be done and when. The steps in the procedure should be written in the order in which they will be performed. Procedure includes methods for collecting, recording and displaying data or information.

Examples:

1. Place one bean plant seed in each pot.
2. Add 15g potting soil to cover each seed.

Diagram
An experiment plan may also include a scientific diagram of the equipment and materials used, and how they will be set up.



Perform and Record

Conduct the experiment or investigation

Conducting the experiment involves gathering the materials, setting them up and following the procedure outlined in your plan. As you conduct the experiment, gather data and record observations.

Gather data and record observations

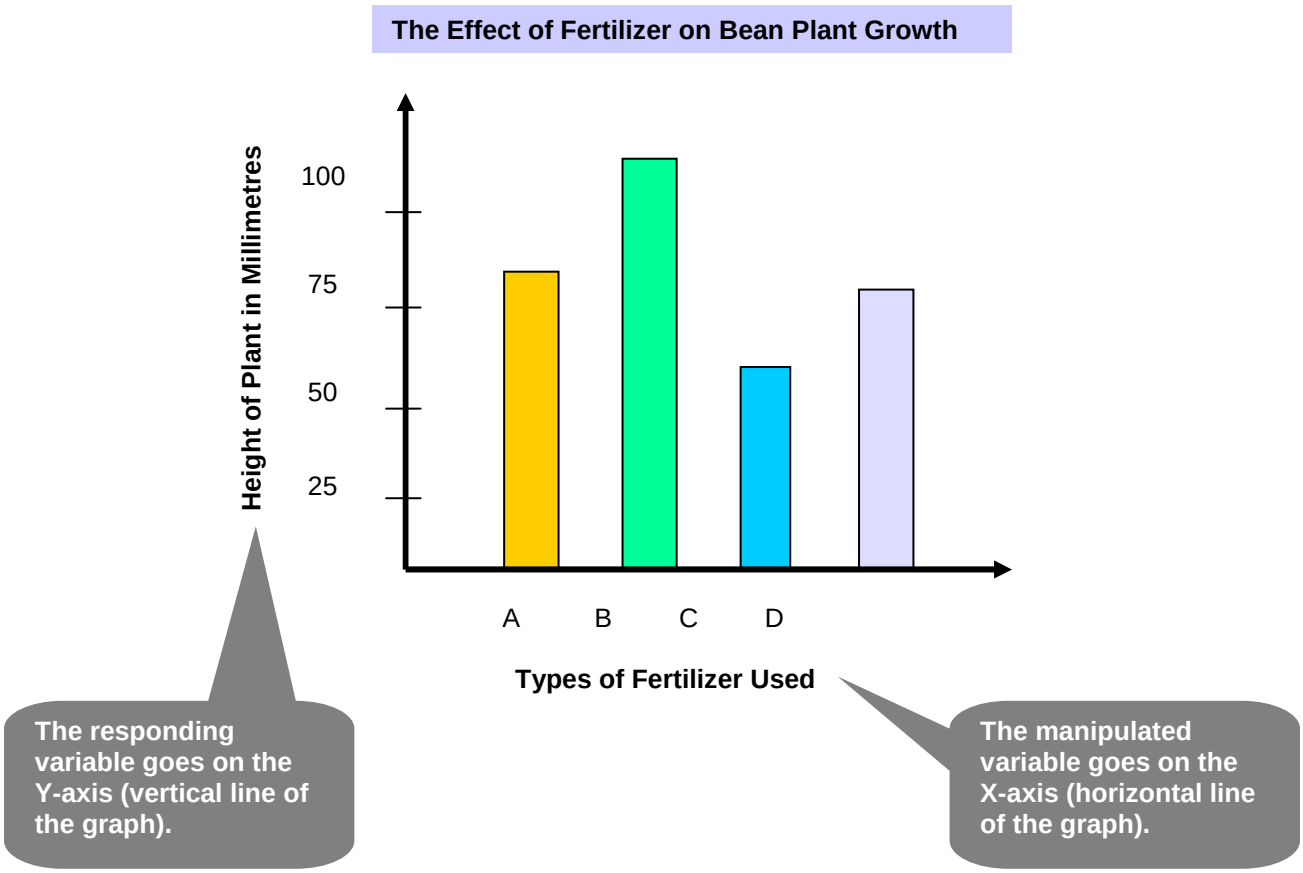
As you conduct the experiment, use notes, charts, diagrams and illustrations to record results, e.g., record heights of the bean plants each day on a chart.

Quantitative data: observations and facts that can be easily measured, e.g., the heights (in cm) of the plants.

Qualitative data: observations that cannot be easily measured, e.g., comparisons about how strong and healthy the bean plants seem to be.

Process, Organize and Display Data

Organize the data and information recorded during the experiment. This may involve doing mathematical computations and creating graphs, e.g., create a graph that shows the four types of fertilizer and the final height of each plant.



Analyze and Interpret

Interpret data

Interpreting data involves two main tasks:

- answering the question and responding to your hypothesis with information discovered by conducting the experiment
- drawing conclusions or inferences based on what you learned.

Conclusion statement: A statement that summarizes some or all of the findings of an experiment or investigation, e.g., fertilizers with high concentrations of ammonia nitrate increase the growth rate of bean plants while maintaining a strong stem and leaf system.

Inference statement: A statement that explains a reasonable cause for the findings of an experiment or investigation, e.g., ammonia nitrate helps bean plants grow faster and healthier.

Generalize, extend and apply knowledge

Generalizing, extending and applying knowledge involves two main tasks:

- identifying new problems or questions to investigate based on what you learned
- identifying how the information you learned may be used in other situations.

Examples:

- Do fertilizers with high concentrations of ammonia nitrate affect the quality of beans produced by the plant?
- Would it be more economical to use fertilizers with high concentrations of ammonia nitrate to grow beans for the public?
- How will fertilizers with ammonia nitrate affect the growth of other plants?

Use Tools Planning an Experiment, Experiment/Investigation Template I, Experiment/Investigation Template II and Analyzing and Interpreting Experiment Results to complete your scientific inquiry.