SCIENTIFIC METHODS
SECTION 1-2

A Scientific Investigation

Key Idea: Most scientific investigations begin with observations that lead to questions.

- Observation is the act of noting or perceiving objects or events using the senses.
- A hypothesis is a possible explanation that can be tested by observation or experimentation.

Making Observations

- Most scientific investigations begin with observations that lead to questions.

Formulating a Hypothesis

- To answer a question, scientists first formulate a hypothesis that leads to scientific investigation.

Scientific Experiments

Key Idea: Scientists conduct controlled experiments or perform studies in order to test a hypothesis.

- An experiment is a procedure that is carried out under controlled conditions to test a hypothesis.
- A control group serves as a standard for comparison in an experiment.

Controlled Experiments

- A controlled experiment tests one factor at a time and uses a control group and an experimental group.
- The experimental groups are identical to the control group except for one factor, called a *variable*.
  - *Independent variable* is the single factor that scientists change in an experiment.
  - *Dependent variables* are factors that may change in response to the independent variable.

Study Without Experimentation

- There are often cases in which experiments are not possible or not ethical.
- In these cases, researchers perform studies and gather data about a system by making observations rather than by manipulating independent variables.

Analyzing Results

- Analyze the results to learn whether the results support the hypothesis or not.

Drawing Conclusions and Verifying Results

- Conclusions explain the results of the experiments.
- Verifying conclusions by conducting experiments many times and by checking to see if other scientists have found similar results.

Considering Bias

- A bias is particular point of view.
- Sources of funding, personal involvement in a product, and other conflicts of interest can affect an experiment.
- Scientists try to prevent bias from affecting their work, but bias can still influence an experiment.

Scientific Theories

Key Idea: The main difference between a theory and a hypothesis is that a hypothesis is a specific, testable prediction for a limited set of conditions and a theory is a general explanation for a broad range of data.

- A theory is a system of ideas that explains many related observations and is supported by a large body of evidence.

- The steps involved in developing a theory are:
  1. Questions
  2. Predictions and hypotheses
  3. Experimentation
  4. Hypotheses are supported or rejected.
  5. Many other experiments support the hypotheses.
  6. Theory

Constructing a Theory

- Constructing a theory often involves considering contrasting ideas and conflicting hypotheses.
- If the results of a scientific experiment can be reproduced many times, the research may help develop a new theory.
- Future research may cause a theory to be revised or even rejected.