

REQUIRED SKILL

Experimental Design

An experiment is an organized series of steps used to test a theory or an idea. Experimental design is a specific set of steps that is organized such that both the steps and the results are repeatable. This produces results that are as valid as possible.

The purpose of experimental design is to eliminate experimental error and to ensure that results are due to the factor or factors being tested. Defining variables (things that change) is crucial to the experimental design process.



Step 1: Stating the Purpose

What do you want to find out? Write a statement that describes what you want to do. It should be as specific as possible. Often, this is a research question and that will most likely be stated as “What are the effects of _____ on _____?”

Step 2: Defining Variables

This step in designing an experiment requires that the following things be identified:

- **INDEPENDENT VARIABLE (IV)** – The variable that is changed on purpose by the experimenter. It is sometimes called the manipulated variable. This is the “if” part of a hypothesis.
- **DEPENDENT VARIABLE (DV)** – The variable that acts in response to the manipulation of the independent variable. It is sometimes called the responding variable.
- **CONSTANTS (C)** – All factors which are not allowed to change throughout the entire experiment. Controlling constants is very important so that the experimenter may be assured that the changes are due only to the changes in the independent variable. Keeping a constant room temperature is one example.
- **CONTROL-** For some experiments, a control (standard of comparison for checking or verifying the results of an experiment) is necessary.
- **REPEATED TRIALS** – The number of times that the experiment is repeated. The more times you repeat the experiment, the more valid your results will be.

Step 3: Forming a Hypothesis

- Make a list of possible answers to the question you have. This is typically an “if..., then” statement.
- The hypothesis must be stated in a way that can be tested by an experiment.

Hypothesis

If independent variable + verb

then dependent variable + verb

Step 4: Designing an Experimental Procedure

You now need to test your hypothesis by making a step-by-step procedure of what you will do.

Guidelines

- Select only one thing to change in each experiment (independent variable).
- Change a variable that will help you test your hypothesis.
- The procedure must tell HOW you will change this variable.
- The procedure must explain how you will measure the amount of change.
- The procedure should indicate how many trials would be performed.

Step 5: Designing a Data Table

Construction Guidelines

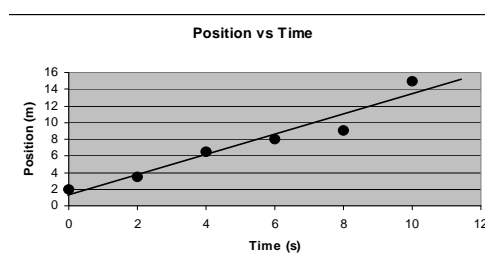
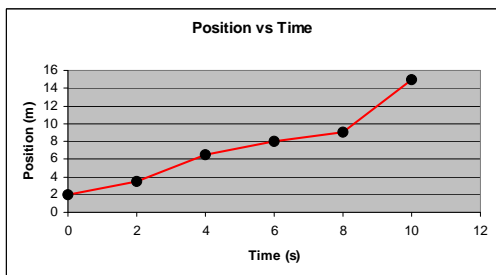
- Use a ruler
- Put a title on the data table.
- Include the independent and dependent variables with units at the top of each column.
- Include additional columns for calculated variables and units.
- Make sure you leave room to show any work you may have had to do.

Example Data Table

Independent Variable (units)	Dependent Variable (units)	Calculated Variable (units)

Step 6: Creating a Graph (Refer to the graphing skills sheet for specific instructions)

- Recall: The graph below is unacceptable. **NEVER** connect the dots!



Apply a best-fit curve.

This graph is acceptable.

A best-fit curve is a smooth curve that goes through as many data points as possible.

Step 7: Analysis of Data and Conclusion (Refer to the conclusion skills sheet more specific instructions)

Using the trends in the experimental data and observations, try to address your hypothesis.

Is your hypothesis correct? It is now time to pull it all together and assess the experiment you did.