

The Importance of Identifying Variables, Constants, and Controls

Scientists design an experiment so that changes to one item cause something else to vary in a predictable way. Variables are the parts of an experiment that change.

The **Independent Variable** is the change that a scientist does on purpose. This change is observed very closely and measured in some way. (This may also be called the manipulated variable.)

The **Dependent Variable** changes according to the change in the Independent Variable. The change in the dependent variable is caused by and depends on the change of the independent value.

Experiments also have **Variables** that are held **Constant**. These values are quantities that a scientist wants to remain constant or unchanged. Constants must be observed as carefully as the Independent and Dependent Variables. This allows a scientist to study the effect of one variable at a time.

What makes a variable a good variable?

- ✚ The **independent variable** is measurable.
- ✚ You can change the **independent variable** during the experiment.
- ✚ You have identified all important **dependent variables** and they are all caused by and depend on the **independent variable**.
- ✚ You have identified all important **constants**.
- ✚ All **constants** should be held unvarying during the experiment.

Three Examples of Variables:

1. Apple trees that receive the most water will produce the largest apples.
The amount of water can be changed to determine its effect on the size of the apples grown.
Independent Variable-amounts of water used
Dependent Variable-size of the apple
Constants-type of water, time of day watered, water delivery system, temperature of water, type of tree, size of tree, growth measurements completed at the same time
2. Students will score better on spelling tests by increasing the number of minutes each student studies.
The amount of time can be changed to determine its effect on the spelling scores.
Independent Variable-amount of time students study
Dependent Variable-score on individual spelling tests
Constants-age of student, gender of student, time of test, test giver, study method
3. An electromagnet will pick up more nails if more batteries are put in the circuit.
The number of batteries can be changed to determine its effect on the electromagnet.
Independent Variable-number of batteries in a circuit
Dependent Variable-number of nails the electromagnet picks up
Constants-type of battery, size and amount of wire, type of connection, type of circuit, size and type of paper clips, procedure for picking up the clips

Most scientists use a comparison called a **control** or **control group**. Some experiments use a **no treatment** control to compare the changed independent variable in the trials, to the unchanged variable in the experiment. In other experiments, all groups receive a change of the independent variable and the experimenter chooses one level of the independent variable to be the control group. This **experimenter selected control** level is usually the normal or typical case.

Examples of Controls:

1. What is the effect of the amount of salt on the height an egg floats? One trial would be a **no treatment** experiment. This means no salt is added to one trial.
2. What is the effect different liquids have on an object floating in liquid? The liquids used are corn oil, milk, soda pop, water, orange juice, and tomato juice. The experimenter needs to choose an **experimenter selected control**. The normal or typical choice would be water. All the other results are compared to the results of the water.