Variables in Experimentation:
Independent vs. Dependent vs. Controlled

DIRECTIONS: Read the following articles. Then, answer the questions on the next pages. (15pts)

What Is a Variable in Science?
By: Anne Marie Helmenstine, Ph.D.

Variables are an important part of science projects and experiments. What is a variable? Basically, a variable is any factor that can be controlled, changed, or measured in an experiment. Scientific experiments have several types of variables. The independent and dependent variables are the ones usually plotted on a chart or graph, but there are other types of variables you may encounter.

Types of Variables
- **Independent Variable**
  The independent variable is the one condition that you change in an experiment. 
  Example: In an experiment measuring the effect of temperature on solubility, the independent variable is temperature.

- **Dependent Variable**
  The dependent variable is the variable that you measure or observe. The dependent variable gets its name because it is the factor that is dependent on the state of the independent variable.
  Example: In the experiment measuring the effect of temperature on solubility, solubility would be the dependent variable.

- **Controlled Variable**
  A controlled variable or constant variable is a variable that does not change during an experiment.
  Example: In the experiment measuring the effect of temperature on solubility, controlled variable could include the source of water used in the experiment, the size and type of containers used to mix chemicals, and the amount of mixing time allowed for each solution.

- **Extraneous Variables**
  Extraneous variables are "extra" variables that may influence the outcome of an experiment but aren't taken into account during measurement. Ideally, these variables won't impact the final conclusion drawn by the experiment, but they may introduce error into scientific results. If you are aware of any extraneous variables, you should enter them in your lab notebook. Examples of extraneous variables include accidents, factors you either can't control or can't measure or factors you consider unimportant. Every experiment has extraneous variables.
  Example: You are conducting an experiment to see which paper airplane design flies longest. You may consider the color of the paper to be an extraneous variable. You note in your lab book that different colors of papers were used. Ideally, this variable does not affect your outcome.

What Is the Difference Between Independent and Dependent Variables?

By: Todd Helmenstine

The two main variables in an experiment are the independent and dependent variable.

An independent variable is the variable that is changed or controlled in a scientific experiment to test the effects on the dependent variable.

A dependent variable is the variable being tested and measured in a scientific experiment.

The dependent variable is 'dependent' on the independent variable. As the experimenter changes the independent variable, the effect on the dependent variable is observed and recorded.

For example, a scientist wants to see if the brightness of light has any effect on a moth being attracted to the light. The brightness of the light is controlled by the scientist. This would be the independent variable. How the moth reacts to the different light levels (distance to light source) would be the dependent variable.

The independent and dependent variables may be viewed in terms of cause and effect. If the independent variable is changed, then an effect is seen in the dependent variable. Remember, the values of both variables may change in an experiment and are recorded. The difference is that the value of the independent variable is controlled by the experimenter, while the value of the dependent variable only changes in response to the independent variable.

When results are plotted in graphs, the convention is to use the independent variable as the x-axis and the dependent variable as the y-axis.


DIRECTIONS: Answer the following Questions.

1. In an experiment, the amount of pollution produced by cars was measured for cars using gasoline containing different amounts of lead.
   a. What is the independent variable? types of gas/amount of lead
   b. What is the dependent variable? amount of pollution
   c. Name 2 controlled variables: type of car, geographic location, hybrid vs. normal, etc.

2. Students in a science class carried out an investigation in which a flashlight was pointed at a screen. They wanted to find out if the distance from the light to the screen had any effect on the size of the illuminated area.
   a. What is the independent variable? distance from the screen
   b. What is the dependent variable? size of illuminated area
   c. Name 2 controlled variables: size of flashlight bulb, battery power, etc.
3. A study was done with white rats to see if the number of offspring born with birth defects was related to the number of minutes of exposure to x-rays by the mother rats.
   a. What is the independent variable? **minutes of x-ray exposure**
   b. What is the dependent variable? **number of offspring with defects**
   c. Name 2 controlled variables: **age of rats, food + water, cage size, etc.**

4. Five groups of rats are fed identical diets except for the amount of vitamin A that they receive. Each group gets a different amount. After three weeks on the diet, the rats are weighed to see if the amount of vitamin A received has affected their weight.
   a. What is the independent variable? **amount of vitamin A**
   b. What is the dependent variable? **weight**
   c. Name 2 controlled variables: **diets, age of rats, cage size, etc.**

5. Based on the graph below, identify:
   a. Dependent variable **percent of total air being oxygen or carbon dioxide**
   b. Independent variable **time**

![Relative Percentages of Oxygen and Carbon Dioxide in Plant Chamber](image)

6. Based on the graph below, identify:
   a. Dependent variable **life span of the fly**
   b. Independent variable **pH of fly food**

![pH of Fly Food Affects Fly Lifespan](image)

*The scientist makes food w/ different pH values.*