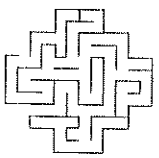
Name _____ Date _____

Three Kinds of Variables



In a scientific investigation there are three kinds of variables. A *manipulated variable* (sometimes called the independent variable) is a factor or condition that is intentionally changed by an investigator in an experiment. A *responding or dependent variable* is a factor or condition that might be affected as a result of that change. A variable that is not changed is called a *controlled variable.* Consider the example below.

A student wanted to test how the mass of a paper airplane affected the distance it would fly. Paper clips were added before each test flight. As each paper clip was added, the plane was tested to determine how far it would fly. The mass of the plane (number of paper clips added) was the manipulated variable. The responding variable was the distance flown. A controlled variable in the experiment was the fact that the same plane was used for each trial.

For each experiment below, specify the manipulated, responding, and controlled variables.

- Two groups of students were tested to compare their speed working math problems. Each group was given the same problems. One group used calculators and the other group computed without calculators.

  Manipulated variable _____

  Responding variable _____

  Controlled variable _____

- Students of different ages were given the same puzzle to assemble. The puzzle assembly time was measured.

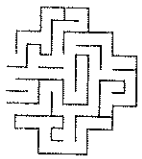
  Manipulated variable _____

  Responding variable _____

  Controlled variable _____

(1)

Name _____ Date Scientific Method Process Skills Practice



- A study was done to find if different tire treads affect the braking distance of a car.

  Manipulated variable _____

  Responding variable _____

  Controlled variable _____

There can be several controlled variables. If an experiment is to be useful, only one variable at a time can be manipulated intentionally. All other variables must be controlled throughout all parts of the experiment. If more than one variable is altered, the results of an experiment cannot be interpreted with any validity.

Here is some practice with experiments having more than one controlled variable.

- An experiment was performed to determine how the amount of coffee grounds could affect the taste of coffee. The same kind of coffee, the same percolator, the same amount and type of water, the same perking time, and the same electrical source were used.

  Manipulated variable _____

  Responding variable _____

  Controlled variable _____

  Controlled variable _____

  Controlled variable _____

- A study was done with an electromagnet system made from a battery and wire wrapped around a nail. Different sizes of nails were used and the number of paper clips that the electromagnet could pick up was measured.

  Manipulated variable _____

  Responding variable _____

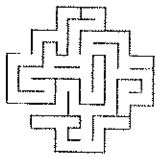
  Controlled variable _____

  Controlled variable _____

  Controlled variable _____

(2)

Name _____ Date _____



A study was attempted to find if the length of the string in a string telephone effected its sound clarity.

Manipulated variable _____

Responding variable _____

Controlled variable _____

Controlled variable _____

Controlled variable _____

Controlled variable _____

In your own words, define manipulated, responding, and controlled variables.

_____

_____

_____

_____

_____

_____

_____

3

Hypothesizing

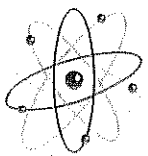
You have learned that variables are important not only in writing research questions but also in making predictions. Predicting is the process of using observations or data along with other kinds of scientific knowledge to forecast future events or relationships. A hypothesis is a special kind of prediction that forecasts how one variable will affect a second variable. These variables are the manipulated variable, which is changed intentionally by the investigator, and the responding variable, which is observed or measured to determine if or how much it is affected. Hypotheses express a logical explanation that can be tested. Investigators find them useful because they specify an exact focus for an experiment. Here is an example of a hypothesis.

If the temperature of sea water increases, **then** the amount of salt that will dissolve in that water increases.

Water temperature and amount of dissolved salt are the variables used in this hypothesis. The investigator is predicting that warmer water will have more dissolved salt than colder water. An investigator can design an experiment that manipulates the temperature of several samples of water from the same source. Dissolved salt levels can then be measured in each sample. Analysis of the data would indicate the extent to which dissolved salt levels are related to water temperature.

Notice that the sample hypothesis is expressed as an "If . . . , then . . ." sentence. This form, while not always necessary, is a helpful way to learn to write a hypothesis. Here are two examples.

Example One
Some students want to find out what kind of pizza is preferred by their classmates.



4

Research Question
What kind of evidence indicates that middle school students prefer one kind of pizza more than another? (*type one* question)

Hypothesis
If middle school students are questioned about pizza preference, then they will prefer pepperoni over cheese pizza.

Example Two
An investigator has observed that chickens lay more eggs at certain times of the year. It has also been observed that this occurs during the late spring and summer months. An inference has been made that the extra eggs are due to longer daylight hours. Amount of daylight and chicken egg production are the variables the investigator has decided to investigate.

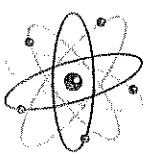
Research Question
To what extent does the length of daylight affect chicken egg production? (*type two* question)

Hypothesis
If the length of daylight increases, then chicken egg production will increase.

Steps for Writing a Good Hypothesis

- Identify variables in a given event or relationship.
- Identify a pair of variables that might be logically related.
- Identify the manipulated and responding variables.
- Write the hypothesis using the following format.

If the [manipulated variable] increases or decreases, then the [responding variable] will increase or decrease.



5

Date _____

Writing Hypotheses

PART ONE Write hypotheses for the following.

1. Manipulated variable: length of paper helicopter blades

Responding variable: rotational speed

Hypothesis _____

_____

2. Manipulated variable: length of string telephone

Responding variable: clarity of sound

Hypothesis _____

_____

3. Manipulated variable: baseball batting practice

Responding variable: batting average

Hypothesis _____

_____

4. Manipulated variable: amount of gas bubbles

Responding variable: number of raisin round-trips

Hypothesis _____

_____

5. Manipulated variable: temperature of solution

Responding variable: dissolving time of powdered drink mix

Hypothesis _____

_____

6. Manipulated variable: depth of Lake Conroe

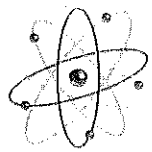
Responding variable: water temperature

Hypothesis _____

_____

6

Name _____ Date _____



7. Manipulated variable: number of recycling posters

Responding variable: amount of aluminum cans in courtyard

Hypothesis _____

_____

PART TWO Try writing your own variables and hypotheses.

1. Manipulated variable _____

Responding variable _____

Hypothesis _____

_____

2. Manipulated variable _____

Responding variable _____

Hypothesis _____

_____

3. Manipulated variable _____

Responding variable _____

Hypothesis _____

_____

4. Manipulated variable _____

Responding variable _____

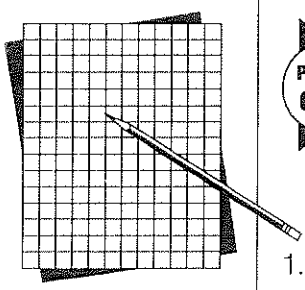
Hypothesis _____

_____

7

Name _____ Date _____

Data Tables and Graphs



PART ONE

This activity will give you more practice making data tables and graphs.

Create a data table below for each data set. Next, determine whether a line graph or a bar graph would best represent the data in each set. Finally, create the appropriate graph on graph paper. Write a title for each graph and label the x-axis and y-axis.

1. The number of bears was counted in a park over time.

1930 - 45 bears, 1940 - 41 bears, 1950 - 35 bears, 1960 - 30 bears, 1970 - 26 bears, and 1980 - 19 bears.

2. The height of a tree was measured over a number of years.

4 years - 1 meter, 8 years - 2 meters, 12 years - 3 meters, 16 years - 9 meters, 18 years - 16 meters.