

## WHAT MAKES A GOOD EXPERIMENT?

An **experiment** is a controlled procedure designed to test a hypothesis. There are several parts of any good scientific experiment.

A good experiment is one that is:

- Interesting
- Important
- Organized
- Valid
- Repeatable

**HYPOTHESIS:** How \_\_\_\_\_ affects \_\_\_\_\_.  
Cause (IV) and Effect (DV).

More than a prediction about the outcome of an experiment, a hypothesis provides an explanation for why phenomena occur. A valid hypothesis includes the property that is changed (the cause or the independent variable) and the property that is measured (the effect or dependent variable) which may change as a result. In a good experiment, there is only one cause for the effect.

*Example: Increasing the amount of light (cause) increases a plant's height (effect). (Light affects height)*

Both of these properties can be measured. When they are graphed, the independent variable is placed on the bottom (x) axis, and the dependent variable is placed on the side (y) axis.

**INDEPENDENT VARIABLE (IV):** This is the factor, or variable, that you change. This is the physical property that you have direct control over to change. It should be the **ONLY** difference between the two groups for it to be a good experiment. It is the **CAUSE** property mentioned in the hypothesis.

*Example: the amount of light.*

**DEPENDENT VARIABLE (DV):** This is the factor, or property, that you measure for, or the result. It could be different between the groups, or it could be the same. You don't know the value of this variable until the end of the experiment. This is the **EFFECT** property mentioned in the hypothesis.

*Example: how high the plant grows, the height*

**CONSTANTS/CONTROLLED EXPERIMENT:** All other properties and factors should be the **SAME** in all groups, or they should be **CONTROLLED**.

*Example: the amount of food, the amount of air, the type of plant, are all kept the same.*

**A CONTROL GROUP:** The group that is used as the basis for comparison. It could be: the **BEFORE** part of a before and after experiment (mixing two chemicals to see a color change, the control group is the set up before they were mixed). It could be: the "normal," or it could be the group in which the value of the independent variable is zero.

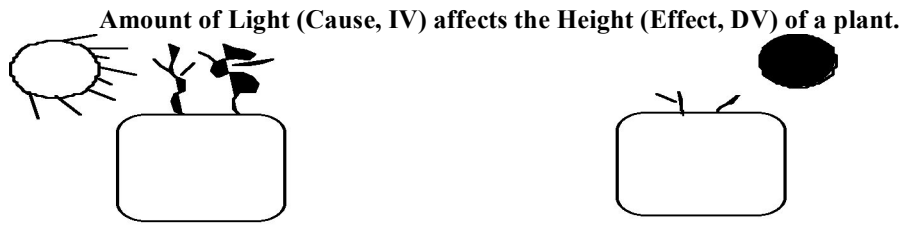
*Example: a plant set in a room with no light bulb.*

**EXPERIMENTAL GROUP (S):** The experimental group differs from the control group in just **ONE** factor or variable. This is the group that is usually mentioned in the prediction. It can also be the "after" part of a before and after experiment. It is the actual physical set of objects that you have changed or are doing something to. A good experiment usually has at least two or three experimental groups, or data points.

*Example: a plant set in a room with twenty light bulbs.*

**CONCLUSION:** You organize your results and data and summarize patterns in the data. The conclusion statement should indicate whether the evidence supports your initial expectations and describes what you found out about the hypothesis and prediction. The conclusion should also discuss the validity and reliability of your experimental results.

**EXAMPLE of WHAT MAKES A GOOD EXPERIMENT?**



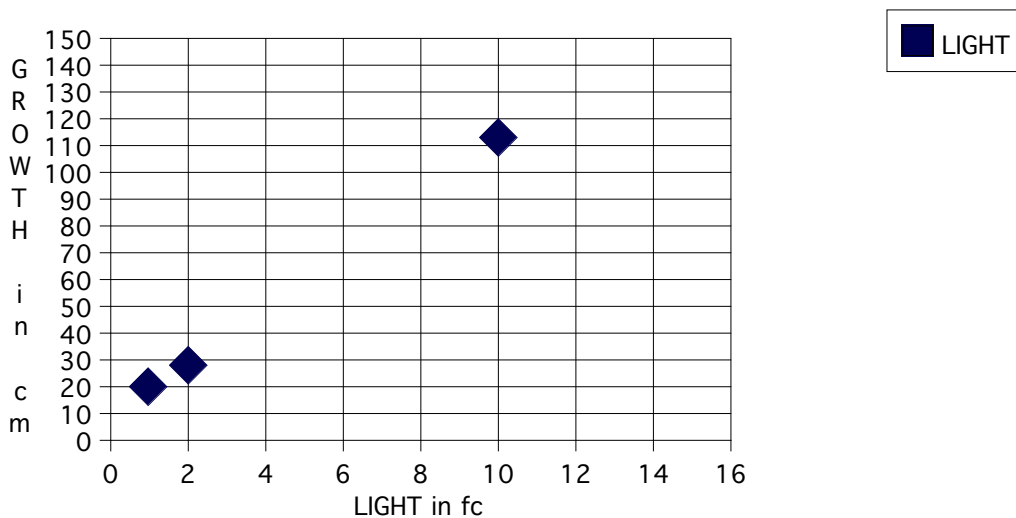
A good experiment, besides having careful observations, and using instruments, will always have a control group to compare to. It is also very important to have groups in which only ONE property or variable is changed at a time, so that you can be sure that the property is the cause of whatever effect you are measuring.

Amount of Light

- 1 foot candle
- 2 foot candle
- 10 foot candles

Average Height of plant after 24 hours

- (19 cm, 20cm, 21 cm) 20 cm
- (30 cm, 25 cm, 29 cm) 28 cm
- (110 cm, 113 cm, 119 cm) 114 cm



To determine the relationship, a student could find a "best fit" line or curve.

$Y = 2X + 10$ , so with NO light, the plant would be at 10 cm (Control Group= Y Intercept)

If there is more than one independent variable, bad experiment = Not a Function!

## Examples of Good Experiment Questions

### What factors:

- about materials (sand, potting soil, limestone) or combination change the acidity and percolation rate of acid rainfall?
- about materials (type, amount, covering) best insulate a cup of water?
- about rock salt (type, amount, surface area) causes ice to melt? (speed, amount)
- about water (amount, temperature, salinity) change how plant cells respond?
- change the metabolism of a frog?
- (mass, angle of ramp, shape, lubrication, etc...) change how (speed, distance after, straightness) toy cars go down ramps?
- (color, filters, distance, angle, power) change the brightness of a light?
- change the temperature in the classroom?
- (temperature, amount, bubbles, purity) change how fast water freezes?
- (angle, mass, shape, material, color) change how (speed, distance, path) a sphere is thrown?
- (shape, bottom, materials, purity of water, ) change how (speed, turbulence) a river/stream flows?
- (surface area, density, composition) affect the water retention (speed, amount in soil)?
- cause a human's pulse rate to change?
- (light, temperature, food) cause a meal worm to change?
- (concentration, temperature) cause a yeast/peroxide reaction to change (rate, amount of bubbles)?
- (air pressure, amount of water, shape of bottle) cause a bottle rocket to change its flight? (speed, height, distance, path)
- (angle, distance, time) cause a light on a surface to change (brightness, temperature)
  - about water (temperature, oxygen) affect the movement of fish?
  - (mass, height, angle, composition) affects the (depth, width, shape) of craters?
  - concentration, catalyst, surface area, temperature) affects reaction rates?
  - about populations (density, competition, food supply) affects growth?
  - about air (purity, volume, flow) affects respiration rates?
  - about salts (type, concentration, temperature) affects solubility?
  - about an environment (temperature, barometric pressure, humidity, light, wind speed) affects some other factor?
  - about a planet (rotation rate, inclination angle, distance, eccentricity) affects the seasons (temperature, duration, severity)?
  - about a magnet (strength, composition, distance) affects its magnetic field?
  - about a person (gender, height, weight, genes) affects some other factor?
  - about an object (composition, volume, shape, height) affects its resonant frequency?
  - about water (composition, salinity, movement) affects how things float the ocean?
  - about the room (air, light, sound volume, temperature, light color, radiation) affects how a plant grows (height, color, cell structure)