

EXPERIMENTAL VOCABULARY & WRITING HYPOTHESES

INDEPENDENT VARIABLE (A) - the one you, the "scientist" control or change

DEPENDANT VARIABLE (B)- the one that you observe and/or measure the results after changes made

The observed outcome of the dependent variable *depends* on how you manipulate the independent variable.

Hypothesis statement format: **"If A (independant variable) is related to B (dependent variable), then ____ (prediction).**

The structure of a formalized hypothesis is useful because it makes you focus on two variables that may be related. Furthermore, it forces you to make a prediction of how manipulating one variable (*independent*) will affect the other variable (*dependent*). Let's take example from biology.

Example:

If the *molecular size*, (independent variable) is related to *diffusion rate* (dependent variable) through a membrane, **then the smaller the molecule the faster it will pass through a membrane (prediction).**

The variables here are diffusion rate and molecular size. In the experimental design, we can manipulate molecular size by simply selecting soluble substances of different molecular size, e.g., iodine, glucose, starch. The experimenter will know what the dependent variable is because it is the thing she/he watches for results, i.e. movement of iodine (color), glucose (indicator change), and starch (indicator change).

Another value of a formalized hypothesis is that when a scientist is given such a hypothesis, he can be asked to design an experiment that will test the hypothesis. For example, describe an experiment that would test the following hypothesis.

If the *wave length of light* is related to *rate of photosynthesis*, then exposing a plant to different colors of light will produce different amounts of oxygen.

Beware! Not all "if-then" statements are hypotheses. For example, "If you warm yeast, then more gas will be produced." This is a simple prediction, not a hypothesis! The problem with this statement is that there is no proposition to test. What is related to what? Is temperature a variable? Is yeast a variable? Is gas production a variable?

Some Hypotheses For Biology Labs

In each of the following examples, the independent variable is **blue** while the dependent variable is **red**. These variables are identified in the “if” clause only, however, you can treat the variables in the same way in the “then” clause. Also, each example given can be composed in a variety of ways. For example, there is nothing incorrect with reversing the order of the independent and dependent variables. I just do it one way for consistency. As far as the independent variable is concerned, it can be varied by increasing, decreasing or removing it entirely. Finally, the two variables in question do not actually have to be related. Observations from testing the independent variable will reveal the nature of the relationship such as direct, indirect, limited, or no relationship at all.

If ratio of surface to volume is related to the **diffusion efficiency**, **then** changing the S/V ratio will change the rate of diffusion. {decreasing the S/V (increasing volume of a cell mass) will decrease the rate of diffusion into a cellular mass}

If annual rainfall is related to the **thickness of annual growth rings in trees**, **then** examining wood samples will reveal correlations in the growth rings to the historical records for rainfall in its environment.

If **various types of chlorophyll** are related to **food making in plants**, then non-green appearing plants such as purple plum will contain several types of chlorophyll in addition to green. {green as well as purple pigments.}

If the presence of **chlorophyll** is related to **food making**, then starch will be found only in the green portions of a variegated leaf.

If the presence of **light** is related to active **photosynthesis**, then portions of a leaf shaded from light will test negative for starch.

If the wavelength of light (or concentration of carbon dioxide, or temperature) is related to **rate of photosynthesis**, then varying the color of light will vary the rate of oxygen production.

If **temperature** is related to **animal metabolism rate**, then increasing ambient temperature will increase animal metabolism (carbon dioxide gas production).

If **plant availability** is related to **animal metabolism**, then isolating plants from animals will result in decline in animal metabolism.

If **exposure time (or concentration)** is related to **effectiveness of disinfectants**, then the longer the exposure (or the higher the concentration) the less bacterial growth will result.

If **turgor pressure** is related to **rigidity** of herbs, then increasing the water content of cells will result in firmer plant tissue.

If **stomate density** is related to **rate of water loss**, then drought resistant plants will have a lower density of stomates on their leaves than will non drought resistant plants.

If **humidity** (light or temperature or wind velocity) is related to **transpiration rates**, then increasing humidity will decrease water loss.

If **gravity** is related to **root growth**, then roots will always turn toward the earth regardless of a seed's orientation.

If **gravity** is related to **shoot growth**, then shoots will always grow upward even in the absence of light.

If **salinity** (or temperature) is related to **hatching of brine shrimp**, then the greater the salt concentration, the higher the hatching rate.

If **temperature** (or pH or quantity of substrate) is related to **enzyme activity**, then increasing the temperature will increase the products of an enzymatic reaction.