***Designing and Conducting an Experiment***

A critical step in conducting research is designing an experiment. The experiment needs to be well planned in order to test the hypothesis effectively. When designing an experiment, a researcher identifies variables. A variable is a characteristic by which an object or phenomenon may be described. It is something liable to change and is what the researcher pays close attention to when conducting the experiment. Experimental designs often have both independent and dependent variables.

An independent variable is a variable manipulated or changed by the researcher. The researcher expects the independent variable to affect other variables within the experiment.

The researcher also identifies the dependent variables. A dependent variable is a variable measured to determine the effects of an independent variable. The change of a dependent variable is the result of the independent variable. The change that occurs is observed and measured by the researcher.

It is important that an experiment be controlled. That is, factors in the experiment other than the independent and dependent variables must be held constant. Two experiments might be conducted simultaneously. One experiment would have an independent variable. The other would not. The second experiment would be the control and would serve as a basis of measure for results from the first experiment. The control is generally the closest to the natural way that things would happen.

Well-designed experiments can be replicated. In fact, the more times an experiment is conducted,

the more confidence the researcher can have in the results. At the highest levels of research, it is extremely important that other researchers be able to repeat an experiment. Duplicate outcomes are necessary to verify the initial results.

Let us look at components and examples of an experimental design.

**Problem:** Will spinach seeds have a higher rate of germination in cooler temperatures or

in warmer temperatures?

**Hypothesis:** The percentage of spinach seeds to germinate will be higher at 70°F (21°C)

than at 50°F (10°C).

**Independent variable:** The temperature given to the seeds.

**Dependent variable:** The percentage of germinating seeds.

**Constants:** All factors other than the temperature, including type and source of seeds,

handling, moisture levels, light, air, time limits, etc.

Let’s Practice!

1. I have 3 cats that are overweight and I need to change their food so they can lose some pounds! One cat receives “Fat Be Gone” brand food, the second cat eats “Slim and Skinny” brand food, and the third cat gets the same food he has always had. Each week for 6 weeks I weigh the cats.
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2. You water three sunflower plants with salt water. Each plant receives a different concentration of salt solution. A fourth plant receives pure water. After a two week period, the height of the plants is measured.
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3. Three redwood trees are kept at different humidity levels inside a greenhouse for 12 weeks. One tree is left outside in normal conditions. Every week, the height of the trees is measured.
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4. Pea plant clones are given different amounts of water for a three week period. The first pea plant receives 400 mL of water a day. The second pea plant receives 200 mL of water a day. The third pea plant receives 100 mL of water a day. The fourth pea plant does not receive any extra water; the plant only receives natural ways of receiving water. The height of the pea plants is recorded daily.
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5. One tank of goldfish is fed the normal amount of food once a day, a second tank of fish is fed twice a day, and a third tank of fish is fed four times a day. The study lasts for six weeks. Each day the fish are weighed and their weight is recorded.
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6. You decide to clean the bathroom. You notice that the shower is covered in a strange green slime. You decide to try to get rid of this slime by adding lemon juice. You spray half of the shower with lemon juice and spray the other half of the shower with water. After 3 days of spraying equal amounts, there is no change in the appearance of the slime on either side of the shower.
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