Name_____

Date_____ **Pd**____

UNIT 1CP LAB 1 - Spaghetti Bridge

The basis of this physics class is the ability to design an experiment to determine the relationship between two quantities and to interpret and apply the results of these experiments to future problems and situations. In this lab you will make a spaghetti "bridge" and determine the maximum load in can hold before breaking.

Prelab:

Below is the lab set-up:

Top View

Side View

What are things can you measure about the bridge?

When scientists set up experiments they often attempt to determine how a given variable affects another variable. This requires the experiment to be designed in such a way that when the experimenter changes one variable, the effects of this change on a second variable can be measured. If any other variable that could affect the second variable is changed, the experimenter would have no way of knowing which variable was responsible for the results. For this reason, scientists always attempt to conduct **controlled experiments**. This is done by choosing only one variable to manipulate in an experiment, observing its effect on a second variable, and *holding all other variables in the experiment constant*.

There are only two variables that area allowed to change in a well-designed experiment. The variable manipulated or changed by the experimenter is called the **independent variable.** The **dependent variable** is the one that responds to or depends on the variable that was manipulated. Any other variable which might affect the value of the dependent value must be held constant. These are the **control variables.** When an experiment is conducted with one (and only one) independent variable and one (and only one) dependent variable while holding all other variables constant, it is a **controlled experiment**.

What is your independent variable?

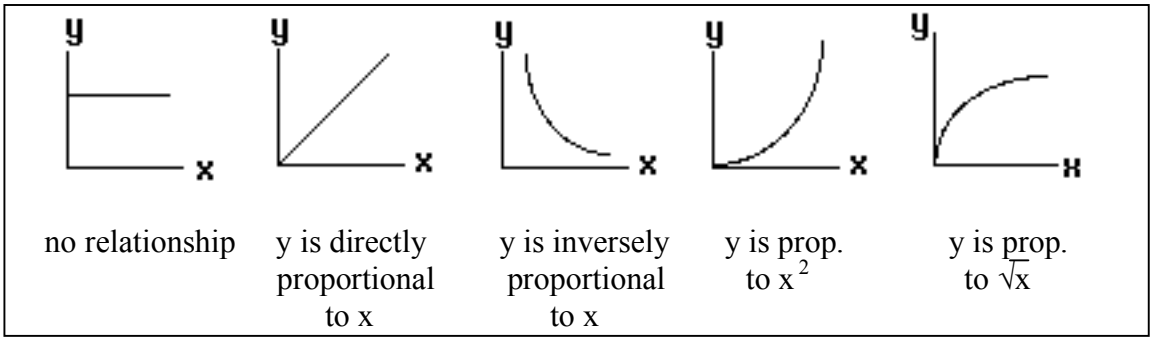
What is your dependent variable?

What are your control variables?

Now you are ready to write the purpose statement that will direct your experimental design:

Purpose: To find the relationship between _____ (dependent variable) and _____ (independent variable) before the bridge breaks.

The ability to interpret a relationship between variables graphically is one you will find useful in the study of physics. Fortunately for us, most all the physical phenomena we can measure fall into one of the following relationships between variables: none, direct, inverse, square, and square root. So, there are basically five shapes of graphs we will encounter in class.



no relationship	y is directly proportional to x	y is inversely proportional to x	y is prop. to x^2	y is prop. to $\sqrt{x}$

For this lab, let's consider only the first three cases. In the first graph, the independent variable has no effect on the dependent variable. In the second graph, as the independent variable gets larger, the dependent variable gets larger. In the third graph, as the independent variable gets larger, the dependent variable gets smaller.

Hypothesis (complete the statement and explain why you think this is true):

The _____ (dependent variable) is

not related / *directly proportional* / *inversely proportional* (circle one)

to the _____ (independent variable) before the bridge breaks.

This is true because:

Procedure Notes:

- ✓Don't get the tables too far apart!
- ✓Measure and record the value for all of your control variables
- ✓Assign a "catcher" for the cup, otherwise there will be potentially dangerous marbles scattered all over the floor.
- ✓Increase the number of marbles until the bridge breaks. Record the last number of marbles actually supported in your data table.
- ✓Do two trials for each number of spaghetti strands.

Data:

Control variables:

(write the name and unit of the independent variable above)	(write the name and unit of the dependent variable above)	
		Average = _____
		Average = _____
		Average = _____
		Average = _____
		Average = _____
		Average = _____

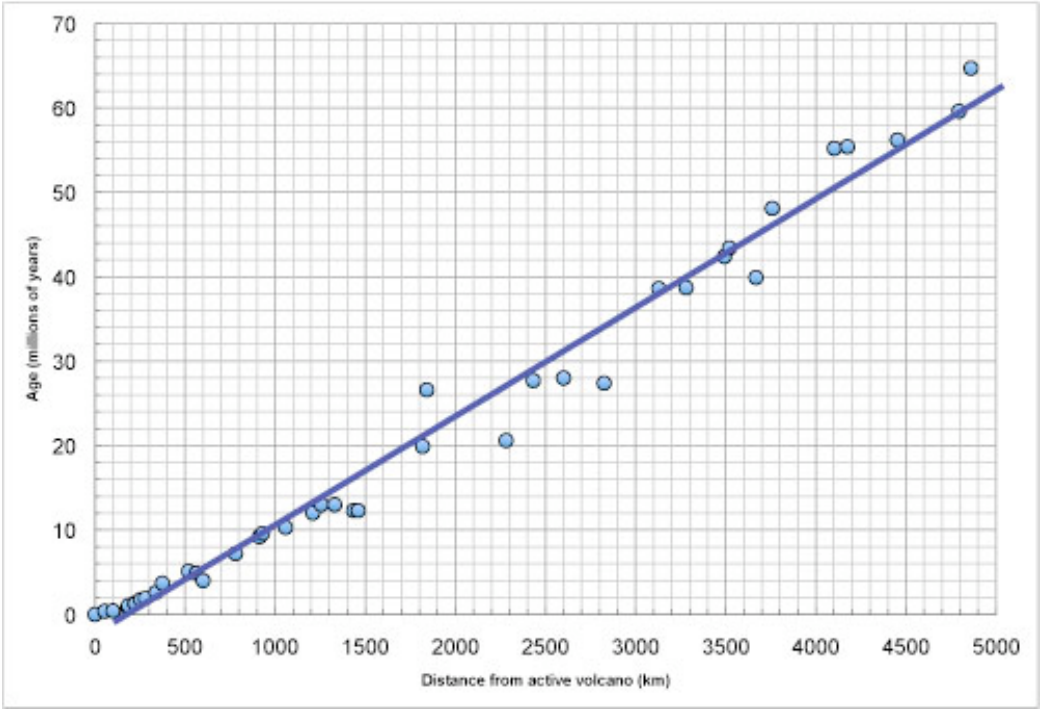
Data Analysis: Graph your data (see *Characteristics of a Good Graph below)*

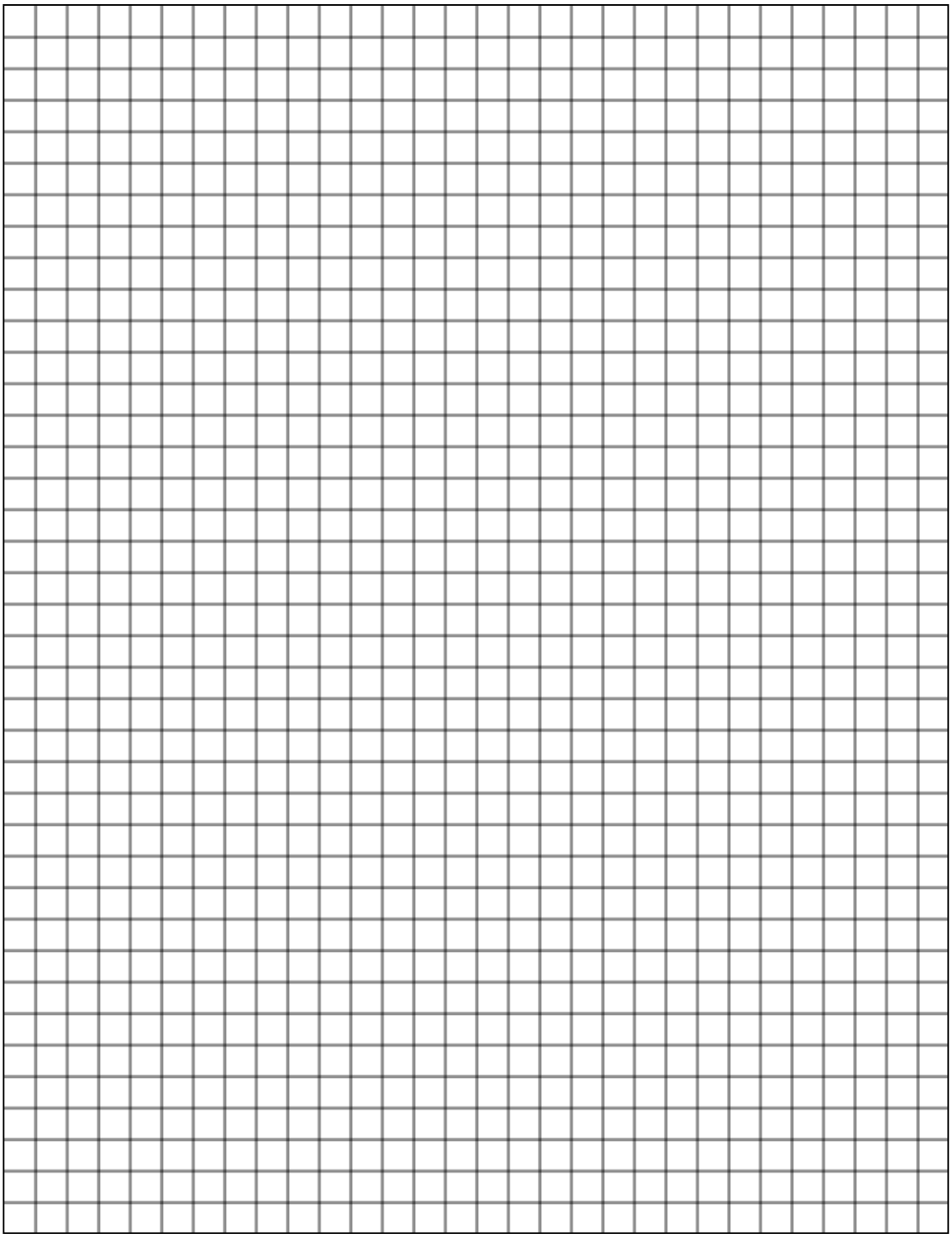
Characteristics of Good Graphs

- ✓ It is plotted on a grid (graph paper)
- ✓ The axes are highlighted (darker than the rest of the grid lines) and are drawn with a ruler.
- ✓ Both axes are labeled with the variable name and its units. Note that we do not label them x or y!
- ✓ The independent variable is plotted on the horizontal (x) axis (generally).
- ✓ The dependent variable is plotted on the vertical (y) axis (generally).
- ✓ The axes are properly scaled so that the graph fits the space, the grids are consistently scaled, and all of the data fits on the graph.
- ✓ A line of best fit is drawn which shows the trend of the data. The line of best fit may have some points above it, some below it, and some on it. If the trend of the data is linear, the line of best fit is drawn with a ruler. If the trend of the data is curved, a smooth curve should be drawn.
- ✓ The graph is clearly titled using the convention dependent variable vs. independent variable.

Example of a properly done graph:

Age of Rock vs Distance from Active Volcano





Conclusions: (write your answers in complete sentences)

1. How are your dependent and independent related? How do you know (discuss the shape of your graph)?

2. Does this agree with your hypothesis? Why or why not?

3. All experiments have experimental error, which occurs because no measurement can be made perfectly. An example of experimental error could be when making timings with a stopwatch. Sometimes you may stop the watch too soon, sometimes too late. Sometimes the measuring tool itself may not be precise. This is also a source of error in measurements. What are areas of experimental error in this experiment?

4. How could this experiment be improved if you were to do it again?