Student Activity Sheet

Investigating Scientist _____

Scientific Method Planning Form

Planning Step #1: Brainstorming

Place Post It Notes in the squares below.

General Topic: _____

Things the scientist could measure or observe:

Things the scientist change or vary on purpose:

Planning Step #2: Choosing Variables

Place Post It Notes in the squares below.

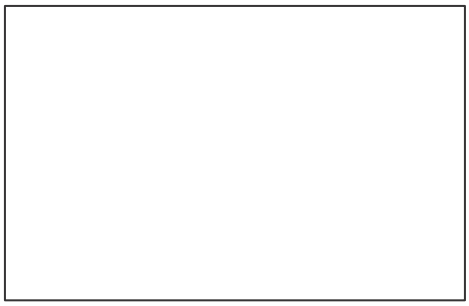
Part to change (independent variable):

Part to measure (dependent variable):

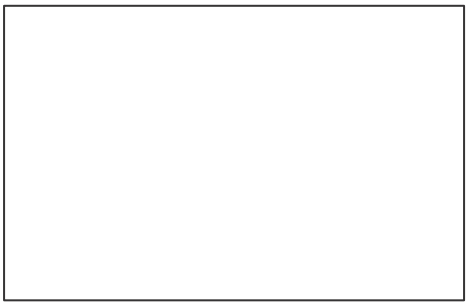
Part or parts to keep the same, where possible (controlled variables or constants):

Step 1: Problem

What is the question this experiment will try to answer? Include the independent and dependent variables in the question. For Example: *What fertilizer (independent variable) will grow a bean plant to the tallest height (dependent variable)?*



Independent Variable



Dependent Variable

Step 2: Information

What **background information** will be helpful to know?

Step 3: Hypothesis

Independent Variable	*If the <u>independent variable</u> changes...*
Dependent Variable	*...then this is what will happen to the <u>dependent variable</u>.*

Write your **hypothesis** below, using the boxes above as a guide.

If the _____ is _____,
Independent variable — describe how you will change it

then the _____ will _____.
dependent variable — describe the effect of the change

Step 4: Experiment

Write out your **experimental plan**.

MaterialsList:

Step-by-step instructions (like a recipe):

Step 5: Results - Data Table

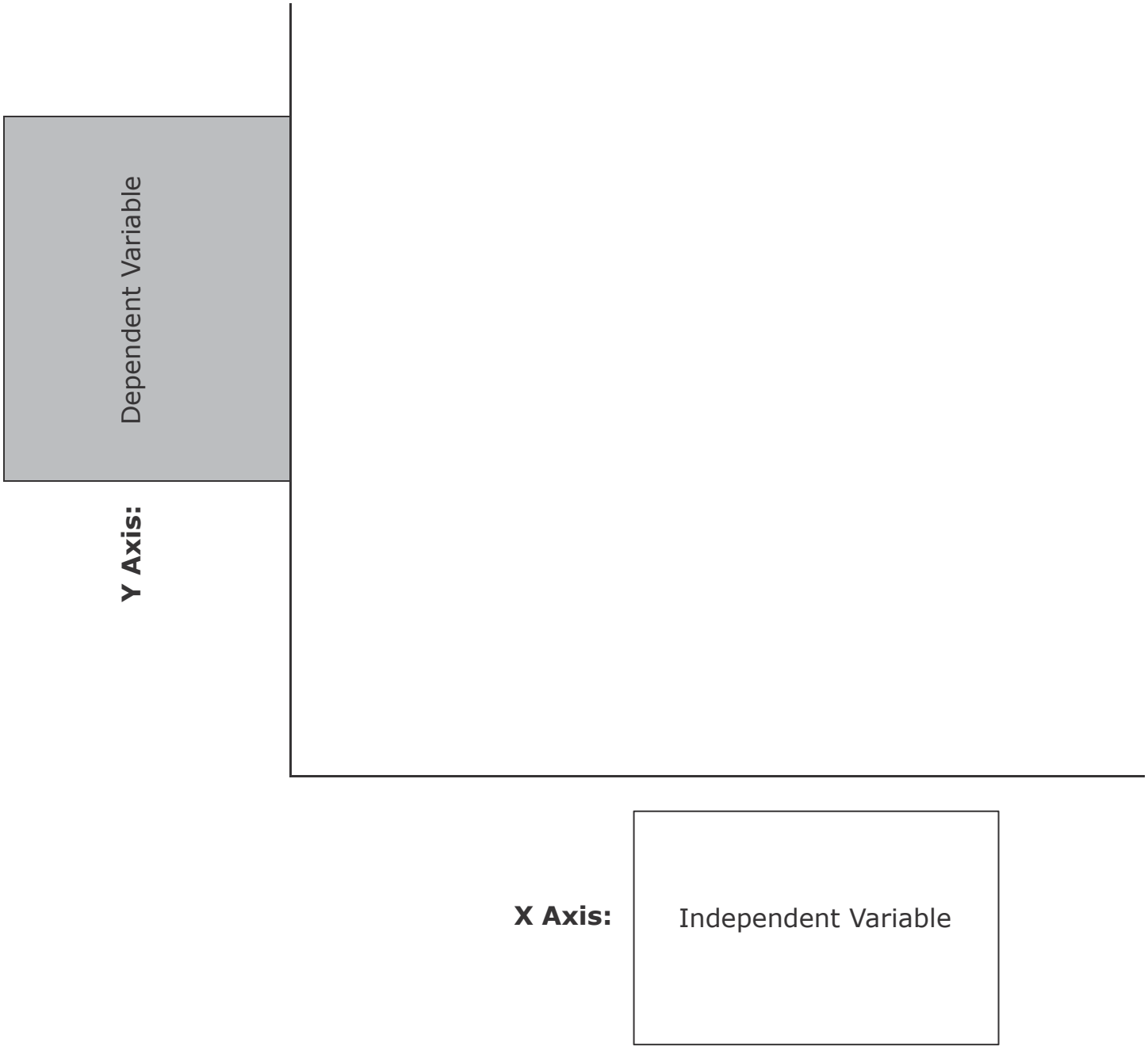
Place Post It Notes in the squares below.

Record your data in the data table below:

When the independent variable changed:	This was the result (dependent variable):
Independent Variable	Dependent Variable

Step 5: Results - Graphing

Title: The effect of _____ **on** _____.
(Independent variable) (Dependent variable)



Create a **graph** like the one above on a separate piece of graph paper.

Step 6: Conclusion - Finding Patterns

Write out your conclusion, answering these questions:

1. What was the purpose of the experiment?

2. What were the major findings? Include data examples.

3. Was the hypothesis supported by the data?

4. How did the findings compare with other research, other scientific facts you know, or other experimentation (classmates)?

5. What possible sources of error might have occurred?

6. How could the experiment be improved, or changed for further study? (See "New Design" below)

New Design: The next thing the scientist might want to know is:

The next variable to change	The next variable to measure

Notes: Scientific Method

Name _____

Date _____ Period _____

PIGS» **STEP 1**: PROBLEM - this is the question you want to answer.
Example: What fertilizer will grow a daisy plant to the tallest height?

IN» **STEP 2**: INFORMATION - gathering research to learn background information.
Read and record information on such topics as plant growth, fertilizers, daisy plants.

HAWAII» **STEP 3**: HYPOTHESIS - "educated guess." Can be an "if..., then" statement.
Be specific (state your best "guess" as to the answer to Step 1 question).

EAT» **STEP 4**: EXPERIMENT - test your hypothesis by using a step-by-step process.

1. In your write up, explain the steps so clearly that someone could repeat your experiment from your directions.
2. To design your experiment plan, set up two test groups.

(Note: Some types of Experiments do not have a control group).

TEST GROUPS

Experimental Group (s)

This is where you introduce the one variable you are testing.
(Example: types of fertilizer put in the different pots you are testing.)

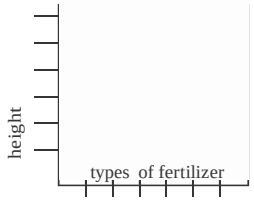
Controlled Variables

All other possible variables are kept the same. *(Example: water amount, sun, fertilizer amount, and soil are the same for each group)*

Control Group

Your standard for comparison.
(example: no fertilizer added in pot).

RAW» **STEP 5**: RESULTS - record the facts we learned from experimenting.
(data tables and graphs are useful)



CORN» **STEP 6**: CONCLUSION

A conclusion is a summary of the experiment. Someone who reads only the conclusion section of your report should be able to completely understand your experiment. The summary should give your results, describe what those findings mean, and suggest new questions that should be investigated. You should avoid using: "I" statements in your writing. Use phrases like "the data indicates...". A good conclusion can be written by answering six questions.

1. *What was the purpose of the experiment?*
2. *What were the major findings? Include data examples.*
3. *Was the hypothesis supported by the data?*
4. *How did the findings compare with other research, other scientific facts you know, or other experimentation (classmates)?*
5. *What possible sources of error might have occurred?*
6. *How could the experiment be improved, or changed for further study?*

What is a CONTROL?

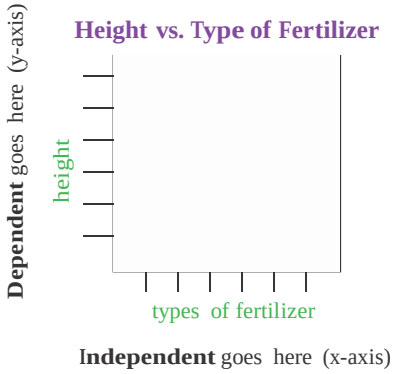
The control in an experiment is the standard for comparison, in which no variable is introduced.
Example: No fertilizer is added to one daisy planting so you can compare the fertilized pots to this unfertilized one.
Note: Not every experiment has a control, many will.

What is a VARIABLE?

There are actually three types: dependent, independent and controlled variables. It is important to testonlyONE variable at a time, and to keep all other things the same (in other words, they are controlled).

What is the INDEPENDENT VARIABLE?

This is the variable you change on purpose; it is also called the manipulated variable.
Example: We changed the kind of fertilizer on purpose (graph on the x-axis).



What is the DEPENDENT VARIABLE?

This is the variable that you measure or observe a change in as a result of changing the independent variable; also called the responding variable.
Example: We measure a change in height of our daisy plants (graph on the y-axis).

What is the HYPOTHESIS?

This is an educated guess about how changing the independent variable will affect the dependent variable. *Example: If you add different types of fertilizer to daisy plants, then you will find that the Erwin Essentials Fertilizer will grow the pionsettia plant the highest, followed by Reed's Richest and Clark's Concoction.*

What is a CONSTANT?

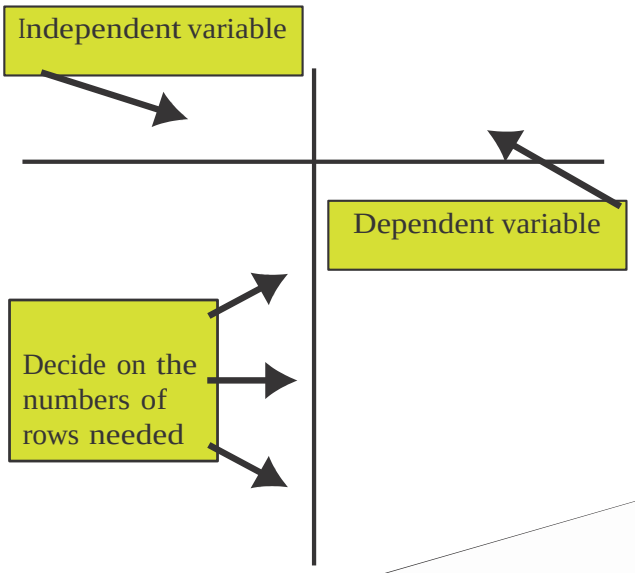
(controlled variables and constants refer to the same thing) Characteristics in an experiment that are kept unchanged in all trials.
Example: Amount of water, sunlight, soil types, amount of fertilizer (sometimes this is called controlling your variables).

What are TRIALS?

Trials are the number of times an experiment is repeated for each level or value of the independent variable. The more trials, the more reliable the results. To be considered dependable you should do a minimum of 3 trials.
Example: This is one trial; do at least 2 more for valid results.

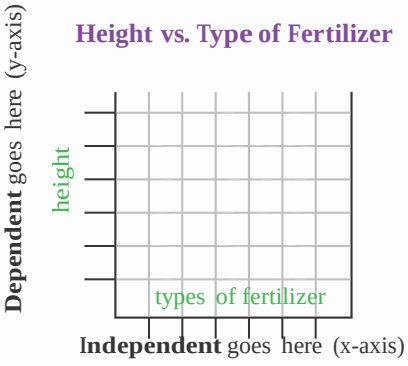
Data Table Self Check

- Does your table include columns and rows for all of the data you need to record?
- Did you put the independent variable inthefirstcolumn and label it? Does it need to be labeled with a "unit" of some type (cm, seconds, etc.) to make it more understandable?
- Did you put the dependent variable in the second column and label it (cm, seconds, etc.)? (It could be the third, fourth, etc. column depending on how much data needs to be recorded).
  Note: When recording your data, do not put the unit labels (cm, seconds, etc.) all the way down the column. Put it in the top box of the column which indicates the same unit for all numbers in that column.
- Did you give your data table a title?



Graphing Self Check

- Did you choose the correct type of graph? (Line graph for showing changes over time, temperature, etc. Bar graph is for comparing data that is "not connected.")
- Did you choose a correct scale? (This means that you made the range of the data a size that will fill up most of your graph and not just a small part of it). Did you use increments (the spacing of numbers or categories on the "x" or "y" axis) that are accurate and evenly spaced?
- Is your graph neat and accurate? Are all the points plotted correctly? Did you use colors or symbols in some way if it would help your graph to be more understandable? If the data on the "x" axis would be more understandable by using a color-coded key or a key that explains the symbols used, did you include the key (also called a legend)?
- Does your graph have a title that relates to the problem that is graphed? Is it across the top of the graph? (You can always create a title by stating the "x" axis vs. the "y" axis).
- Does the "x" axis have a clear, neat label that describes units and states the independent variable? (The independent variable is the one you decide on; you change it "on purpose").
- Is the "y" axis clearly labeled and does it describe the dependent variable? Are the units included on it, also? (The dependent variable is the one in which you "measure or observe" some change)



Helpful Hint on where to place variable on a graph:
Put your left hand up, thumb out. Your fingers represent the "dependent" variable and the thumb is by itself - "independent." Remember that you put your thumb out "on purpose" which is a hint for the independent variable.

Modified Lab Write-Up:

Name _____

STEP 1 Problem (Write your problem in the form of a question.)

STEP 2 (**Information** "gathering" -- Think of what you can research to help you learn more about some of the things with which you are experimenting. Write two good sentences)

STEP 3 Hypothesis (Predict what you think will happen. Use an "if.....then" sentence.)

STEP 4 Experiment (Write sentences that tell how to do the experiment. You may not need <u>all</u> of these numbers, or you may need more.)

1.

2.

3.

4.

5.

6.

7.

8.

STEP 5 Results (This is where you will make your data table to record your results. Also, you can put a graph of your results in this step.)

STEP 6 Conclusion (This is where you tell what you learned from your experiment. You should talk about the five things listed below. Use good sentences. Do not use the words "I, me, we, you" in your write-up. Use the word "the" in those places instead.)

*(Restatetheproblemquestion.)

*(Findings-whatweretheresultsoftheexperiment,givedataexamples.)

*(Tellifthehypothesis"wassupported"or"wasnot"supportedbytheexperimental results.)

*(ErrorAnalysis—weretheresomethingsinyourexperimentthatmightcausethedata tonotbe completelyaccurate?Listthosethingshere.)

*(FurtherStudies—Tellonewaythatyoumightchangesomethingintheexperimentto turnitinto anewexperimenttodoatanothertime.)

Grading Checklist for Lab Write-Up:

Step 1—Problem
- The problem is stated in the form of a question.
- The dependent and independent variables are mentioned
- This step is specific and clear with only ONE thing being tested

Step 2—Information "gathering"
- Appropriate topics are researched
- Depth of research is acceptable
- Quantity of research is acceptable

Step 3—Hypothesis
- Clearly gives the idea of what you predict will be the answer to the Step 1 Problem question. It is in the form and an "if…..then…" statement.
- Both the dependent and independent variable are mentioned.

Step 4—Experiment Step
- All experiment steps and materials are clearly listed and explained. (Someone else could do this experiment from your clear directions!)

Step 5—Results
- A data table clearly shows your results. The data table is labeled. The independent variable is in the first column, followed by the dependent variable in the next column.
- A graph (or other visual display) of the data is included. The correct type is chosen. (A bar graph is used for comparisons; a line graph is used for "continuous data" like changes over time.)
- The graph is labeled correctly: Title, x-axis (label units too), y-axis (label units too). A bar graph may include a "key".

Step 6—Conclusion
- The Step 1 Problem question is restated.
- Major findings are summarized and examples of the data are given.
- A statement about the hypothesis is made stating if it was supported or not supported?
- Possible explanations for the findings are given.
- Possible errors are explained.
- Recommendations for further experimentation are given.

Mechanics
- The neatness level is acceptable
- Complete sentences are used. The pronouns "I, me, my, we, you, and our" are NOT used.
- Spelling has been checked.
- QUALITY work is shown.