Name _____ Date _____

A.P. Environmental Science Mr. Romano

Designing and Conducting a Controlled Experiment:
Salt Concentration and Radish Seed Germination

Toxicology is the science that studies the harm that different chemicals have on living things. One of the most significant way scientists can determine the toxicity of chemicals is through controlled laboratory investigations. In addition to furthering knowledge and understanding of toxicology, there are two main learning objectives built into this investigation. Your first objective is to design an experiment with given parameters that will produce results that are valid within the limitations of working within a classroom setting. The second objective is to collect data from that experiment and determine a conclusion based on quantitative observations. This will be accomplished in small groups, but also as a collaborative whole. We will share each group's findings in order to better see trends that may develop as a result of a greater availability of numerical data.

1. OBJECTIVE: (2 points)

The scientific objective of this investigation is to observe the effect that the concentration of a salt solution has on the germination of radish seed.

To accomplish this task, you will provided with the following materials:

saltwater solutions of the following concentrations (%): .001,.01,0.1,0.5,1.0, 4.0
distilled water
70 radish seeds
petri dishes with covers
botany cloth or paper towels
scissors
forceps
transfer pipettes
10mL graduated cylinder
storage tray

2. HYPOTHESIS: (3 points)

State a hypothesis as to how the concentration of salt solution may affect seed germination. This may be accomplished individually or as a group. The hypothesis could be a trend statement, or it could be more definitive by referencing how specific concentrations may affect germination. Just remember, as I will remind you again in writing later (and verbally, of course): Do not use pronouns! **DO NOT WRITE:** "I think", "We think", "My/our hypothesis is", "Me and my bro Johnny believe that…" Even writing "The hypothesis of the experiment…" is too rudimentary at this point, but if that's the only way you can figure to word it, it will do.

3. THE PROCEDURE: (25 points)

Your experimental design and all the steps performed will be written about in the procedure section of your report. The procedure should read like a detailed story specifically explaining everything that was done so that anyone reading it can clearly understand the process. The procedure is written in paragraph form, in past-tense, and once again, without the use of pronouns. Make sure that you take personal notes during the time your group is setting up the design of the experiment. This way, when you are ready to write the formal report, all you will have to do is convert your notes into sentences and paragraphs without worries that you will forget to include everything that had been accomplished during the planning and execution stages.

3. THE PROCEDURE (continued):

Remember, designing a controlled experiment that will produce valid, reproducible results requires attention to detail. An experiment must always be devised that eliminates the effects of all variables except the one that is being tested. The list below provides a refresher of important terminology related to the development of a scientific experiment. Make sure that, in your lab report procedure, you identify each of the following items indicated in bold print.

Independent Variable:
This is the "treatment" variable that the experimenter hypothesizes "has an effect" on some other variable.

Dependent Variable:
This is the variable that the experimenter hypothesizes is "affected by," or "related to," the independent variable. It is the "outcome" or "effect" variable, resulting from changes in the independent variable.

Experimental Group and **Control Group**:
The group receiving the treatment-present condition is called the **experimental group**, and the group receiving the treatment-absent, or no-treatment, condition (the other level of the independent variable) is called the **control group.** In some experiments, there are only two **levels of the independent variable**: the treatment-present condition and the treatment-absent condition. In some experiments, including this one, the treatment is applied in different amounts; the differing amounts are referred to as the **levels of the independent variable**.

Controlled Variables:
In scientific experimentation, the controlled variables are the elements which are constant and unchanged throughout the course of the investigation so as to not influence the outcome of the experiment.

4. OBSERVATIONS: (20 points)

You will construct a data chart and a graph to present ALL of the data collected. The data chart you will design yourself on a computer by using the organization and techniques that we have already talked about during previous investigations. If you still are having problems with software, and don't know how to manipulate rows, columns, etc., just see me and I will give you the tutorial one-on-one or in small groups.

You will be provided the graph to illustrate the data. The x- axis scale will be included and you can determine an appropriate y-axis scale. You will need to correctly plot data, label axes appropriately, and include a clear, distinct title. (Remember: a two-word title won't do the job, nor will just restating the labelled axes.)

5. CONCLUSIONS: (10 points)

State the findings of the investigation. Make references to the trends observed and use quantitative data to support. Confirm whether or not your original hypothesis was supported by the results. Discuss if the experiment produced results similar to the threshold or non-threshold model. If there is an apparent TLV, discuss what it is. Account for possible uncertainties or discuss circumstances that were encountered that may have had an effect on the outcome .

6. ABSTRACT: (10 points)

As a group, write an abstract according to the correct format. Use your notes and reference previous abstracts written or provided as models to refresh your memory as to proper abstract structure. The abstract will be hand-written by the group in class after the experiment has been completed. If you are absent the day that the group completes the abstract in class, you will be responsible for writing one on your own.

** As a good starting sentence for your abstract, as well as something to weave into the introduction or conclusion paragraph of your formal report, you should research salt and its effect on plant growth, soil quality, farming practices, etc. This will provide relevance for your study as it will make a real-world connection and/or application.**