Name _____ Date _____

A.P. Environmental Science Romano/Schneck

Designing and Conducting a Controlled Experiment:

Infiltration of Water into the Ground

Groundwater recharge is an essential component of the hydrologic cycle. This would be especially true in populated areas that rely on aquifers as a water source. After water infiltrates the surface soil and then percolates through the upper unsaturated zone, plants' roots absorb the water needed to carry on life processes. Any excess water will travel farther downward to the water table, which is the upper boundary of groundwater. Below the water table, all the openings in the soil/rocks are full of water that moves through the aquifer to streams, springs, or wells from which water is being withdrawn. Natural refilling of aquifers at greater depths is a slow process because ground water moves slowly through the unsaturated zone and the aquifer. The rate of recharge is also weather and climate dependent. Areas that receive little precipitation can take centuries to refill exhausted aquifers. In contrast, a shallow aquifer in an area of considerable precipitation may be replenished almost immediately. Aquifers can be replenished artificially as well. For example, large volumes of groundwater used for air conditioning are returned to aquifers through recharge wells right here on Long Island.

This experiment has many objectives beyond the understanding of infiltration rates and the factors affecting it. The first objective, of course, is to explore and understand infiltration. You might already remember the relationships between the properties of sediments and their effects on infiltration and therefore question the point of completing this task. Well … that's where objectives two and three come in. The second objective is to design a controlled experiment with given parameters that will produce results that are valid within the limitations of working within a school setting. Luckily, we can at least take this one outside and use more realistic environmental conditions, rather than just working in the confines of a lab simulation. The third objective is to collect data from that experiment, organize and analyze it, and determine a conclusion based on quantitative observations. The conclusion that you state in your abstract may not just be a relationship stating "what happened"; you must emphasize the quantifiable differences observed. (Do not worry if you don't understand what this means, it will be explained to you.)

To get things started, here's what you need to know up front:

1. OBJECTIVE:

The scientific objective of this investigation is to observe the effect that sediment size has on the infiltration of water into the ground.

2. MATERIALS:

- 4" diameter PVC pipe (8" in length)
- water
- stopwatch
- ruler
- digging tool
- wax pencil
- plastic graduated pitcher
- beds of different sediment sizes

Lab Grade: 40 points

PARTICIPATION : (5 points)

You must stay on task during class time. You will be given one warning. After that, points will be deducted from individuals that are off-task. Being off task includes, but is not limited to: socializing, not contributing to group discussion, not doing hands-on work during data collection or writing report, socializing, inappropriate phone use, discussing religion, politics, and/or fantasy football, socializing, chanting the word "percolation" without purpose… um…you get the idea.

Your final lab submission worth a total of 35 points will include the following:

1. **GROUP ABSTRACT: (5 points)**

   Your group will collaborate to write and abstract according to the correct format already provided to you when we did the "Tragedy of the Goldfish" lab. Of course, this will be the last thing you do, but it will be the first section in your written report.

2. **EXPERIMENTAL DESIGN AND PROCEDURE: (20 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 (not in numbered steps), in past-tense, and, just like an abstract, without the use of first-person 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.

   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. Also, multiple trials are necessary to establish enough evidence to support a conclusion. You don't have to go crazy here because we do have a time constraint; 5 trials will suffice. 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.

   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.

3. **OBSERVATIONS/CALCULATIONS: (10 points)**

   You will construct a data chart and a graph to present ALL of the data collected. The data chart must be designed on a computer using whichever software program you are comfortable with. Make sure that all data, headings, calculations, and units are clearly shown and organized. Also make sure to be consistent with your rounding of measured infiltration times and calculations such as averages and infiltration rates.