Scientific Investigation and Data Analysis Practice Exercises:

The objective of this exercise is to introduce you to the process of scientific inquiry. Regardless of which science discipline, these methods are used by all. the contents of these exercises will lay the groundwork for not only work you will do in this course, but also for future science courses as well as many life questions.

Objective specifics:

1. Recognize and develop a question that can be addressed through scientific investigation.
2. Recognize and develop a testable hypothesis.
3. Identify and describe the components of a good scientific study.
4. Develop an experimental design for a scientific investigation.
5. Present the results of a scientific study graphically and defend your findings.

Introduction:

Science consists of two parts. The first part being the acquisition of knowledge that has been built upon since humans first started gathering information about the world around them. The second part being adding to this knowledge through scientific investigation. The two parts are not independent of each other since we need to know and understand the past to understand how to proceed in the future.

The **scientific method** can be broken down into these 5 general steps (in this order):

1. observation
2. questioning
3. hypothesis
4. testing
5. explanation

Observation examples:

- You are walking in the woods and see that a single bird takes on a different color depending on where the bird is located
- It seems that the students in a particular classroom of are out sick more often than any other classroom.

Question examples: Questions for scientific method must be **testable**!

- Why is the color of the bird changing in such a small area?
- Why are the kids in one room out sick more often than any other classroom?

Hypothesis: A hypothesis is a preliminary answer to your question. If you know the answer then it is not a question, therefore how is a hypothesis established?

1. Gather information from past scientific investigations
2. Draw from your own experiences and knowledge
3. Best guess
4. Must be **testable**

Hypothesis examples:

- If I place the bird on different colored paper then the bird will match the color of the paper.
- If I test the tables in the classrooms then I will find more bacteria in the classroom with sick kids.

Testing:

1. Decide what you are testing and establish a **variable** to be tested and test a range of treatments. Repeat the testing multiple times with multiple subjects.
    a. example: variable to test is background color so make sure you use at least 3 or 4 color variations for the bird to stand and be surrounded by. Since this is the variable you have decided to test it is considered the **independent variable.** You will also want to test multiple birds of the same species multiple times.
2. Identify the specific variable you will collecting data on (the **dependant variable**) and include quantity and unit when applicable
    a. example: bird color and intensity of color when on the different colored pieces of paper
3. **Constants** must be addressed. Constants are variable that might influence the dependant variable being kept the same.
    a. example: species of bird, temperature of surroundings, time of day, etc.
4. Some experiments also involve a **control**. The control is data gathered about the dependant variable before the independent variable is manipulated.
    a. example: the color of the bird before placing it on the colored paper.

Practice Exercise #1: Question, Hypothesis, and Testing

Follow the procedures written below. Fill in the practice exercise investigation sheet as you go. Investigation sheets are to be placed in your classroom binder under journal tab after completion and class discussion.

Procedure:

1. Pick up some 8.5 x 11 and 8.5 x 5.5 paper from the center lab table.
2. You want to know how many times you can fold a sheet of 8.5 x 11 paper in half until it no longer can be folded.
3. Fill in questions 1 and 2.
4. Determine how best to proceed with your experiment so that you reach your conclusions without **bias**. Perform experiment.
5. Answer questions 3 - 5.
6. Repeat steps 2-4 but with 8.5 x 5.5 paper.
7. Answer questions 6 - 11.

Practice Exercise #2: Developing an Experimental Design

Follow the procedures written below. Fill in the practice exercise investigation sheet as you go. Investigation sheets are to be placed in your classroom binder under journal tab after completion and class discussion.

Procedure:

1. Each group will be assigned a scientific question.
2. Develop a hypothesis and an experiment that would be suitable for testing your hypothesis. (pay attention to the example we discuss together in class)
    a. be sure to identify the independent variable, dependant variable, necessary constants, and the control (if applicable)
    b. write the procedures to the experiment in numbered steps
    c. be careful that you design a valid experiment.

Practice Exercise #3

Follow the procedures written below. Fill in the practice exercise investigation sheet as you go. Investigation sheets are to be placed in your classroom binder under journal tab after completion and class discussion.

Procedure:

1. Each group will be given a set of data that might have been generated by an experiment similar to the one you were assigned above. Present the data in the appropriate graphical format with an appropriate data table.
2. Write a brief summary (3 to 4 sentences) of the findings from the study. Your summary should include:
    a. Do you accept or reject your hypothesis?
    b. State specific numerical data explaining why you accepted or rejected your hypothesis.
    c. Describe any inconsistencies, surprises, questions that arose.....etc.