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Scientific Method Unit

First of all, let's be honest. There are a lot of scientists out there that don't really use all the parts of the scientific method every time they do an experiment. That being said, we're still going to study it because it is the proper way to do it, and also the state mandates that all grade levels learn it. But keep in mind, some of the most important science work starts when people notice something funny, then start questioning why things are happening the way they do. Every single one of us is a scientist in our own way. The following pages should help you be a successful scientist – at least in the 7th grade classroom.

Step 1: Observation

The first step in the scientific method is **observation**. This isn't really a step at all, it just comes naturally by watching things going on around the world and noticing different trends and developing questions when you don't understand things. Also, keep in mind that you don't just use your eyes, you should use all of your senses to completely observe something (although tasting in the science lab is often dangerous, so only try this when told to do so by your teacher). The more you pay attention to your surroundings, the more you will start to become a scientist. You don't have to be observant about the typical "science" stuff. For instance, scientific observations don't have to be about chemicals or lab rats, they can be about people, clothes, food, whatever.

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Step 2: Develop a question

Not every question is a good question that can be tested. In this class, we're going to focus on "testable" questions, or questions that we can do experiments on. These are questions that can be answered by doing a laboratory investigation. They are NOT opinion questions or questions that can be answered by doing research in a book or on the internet. Developing a good question is important because it gives your experiment direction and lets other people know what question you are trying to answer in your experiment. It must be clear. A question such as "How do students learn best?" is not clear because there are too many different ways to test it. A better question might be, "Do students learn better before or after eating?" because it only tests one particular thing. **TIP: YOU MUST BE ABLE TO MEASURE THE RESULTS IN SOME WAY FOR IT TO BE CONSIDERED A TESTABLE QUESTION.**

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Scientific Method Unit **“Questions” Worksheet**

Circle the questions which are testable using scientific experimentation.

1. Are there more seeds in Fugi Apples or Washington Apples?
2. What types of apples grow in Missouri?
3. Why do people smoke?
4. How does talking to a plant affect a plants height?
5. Where are whales found in the world?
6. What happens if you do not eat breakfast?
7. Which planet is the most interesting one to study?
8. Which objects are attracted by a magnet: paperclip, penny, foil?
9. Will larger or smaller seeds germinate faster?
10. Do larger or smaller seeds make prettier flowers?
11. Do flying saucers really exist?
12. Which pill design – tablet, caplet, or capsule – will dissolve faster?
13. Does the color of a surface affect its temperature?
14. Why does doing homework help your grades?
15. How does the size of a helicopter’s blade length affect the speed and number of rotations?
16. Does the temperature of a classroom affect student performance?
17. How does talking to a plant affect the plant?

Change 2 of the NON-testable questions to TESTABLE questions in the space below or on the back of this page.

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“Questions” worksheet

Write a testable question for each of the following ideas for experiments.

1. You want to figure out how many pine cones are on the average branch of a pine tree.
2. You want to know whether or not a McDonald’s super-sized fry has more fries in it than a large fry.
3. You want to know whether or not people can taste the difference between different colored M&Ms.
4. You want to know what the most popular color for a car is.
5. You want to know what type of soda is preferred by 7th graders at VPMS.

Make up three of your own questions for new experiments you’d like to try.

- 1.
- 2.
- 3.

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Step 3: Hypothesizing

A hypothesis is a special kind of prediction that forecasts (predicts) how changing one part of an experiment will affect the results. It is NOT a guess. It is an informed and well-thought out prediction that requires background information. You can also think of it as a cause-effect statement.

A hypothesis is best written in the “If _____, then _____.” format. After the “if” is the part the scientist will change on purpose. After the “then” is the result of the change.

Here is an example of a hypothesis:

If the temperature of sea water increases, then the amount of salt that dissolves in the water increases.

Not all questions lend themselves well to the “If _____, then _____.” format. However, almost all of the experiments we will do in this class will work in this format and **I expect to see this format used during the entire year.**

The following are some investigative questions followed by a hypothesis:

Q: What type of pizza is preferred by fourth graders?

H: If fourth graders are questioned about pizza preference, then they will prefer pepperoni.

Q: How does the amount of daylight affect how many eggs laid by a chicken?

H: If the amount of daylight increases, then the chickens will lay more eggs.

Use the given question to write a hypothesis. Remember to use the correct format.

Q: How does room temperature affect student performance?

H:

Q: How does the color of a surface affect its temperature?

H:

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Hypothesis Writing Practice

For each of the following questions, write a reasonable hypothesis using the correct format.

1. How will batting practice affect a player's batting average?

HYPOTHESIS:

2. How does the depth of the Lake of the Ozark affect its temperature?

HYPOTHESIS:

3. How does advertising for can collection week affect the number of cans collected?

HYPOTHESIS:

4. How does the size of a paper towel affect the amount of water it can hold?

HYPOTHESIS:

5. Does fertilizer affect the growth of a plant?

HYPOTHEIS:

6. Does the volume of a container affect how quickly water will evaporate from it?

HYPOTHESIS:

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Coin Conundrums



QUESTION:

HYPOTHESIS:

PROCEDURE:

1. Predict how many drops of water the coins will hold. Record your predictions on the table below.
2. Determine the surface area of each coin. Record it in the space below.
3. Drop water on the penny. Record how many drops the penny held.
4. Dry the penny and repeat step 2 two more times. Record your findings below.
5. Average your three trials for a more accurate idea of how many drops of water a penny will hold.
6. Do the investigation using different coins. Record your results below.

Affect of Surface Area on Volume of Water Held				
Surface Area (cm ²)	Volume of water held (number of drops)			
	Trial 1	Trial 2	Trial 3	Average
Average				

Discuss your thoughts about predicting. Did your ability to predict become more accurate as you performed the investigation with the coins other than the penny?



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Step 4: Procedure

The procedure step is the writing of the materials used and the steps followed when conducting an investigation. The material list must be complete and the steps to follow must be understandable so the activity can be repeated. Other scientists should be able to look at your procedure and do the exact same procedure and get the same results without you telling them anything or giving them any clues.

Procedures are best written as a numbered sequence.

To practice writing a procedure, think back to our “Penny Predictions” activity involving the coins and water drops. In the space below, write the procedure for the activity.

PROCEDURE: PENNY PREDICTIONS

MATERIALS:

STEPS:

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Step 5: Variables

Variables are conditions that could affect the outcome of an experiment. For instance, think about all of the different things that might affect how well a student does on a test. Their amount of sleep, how long they studied, how well they paid attention in class, if they're feeling well, the behavior of the students around them, if they're having trouble at home or they don't like the teacher...all of these things, and more, could affect how well that student performs.

Develop at least 3 variables for each of the following situations.

- A) What variables can affect the number of fish in a lake?

- B) What variables can affect the speed of a runner in a 100-yd dash?

- C) What variables can affect attendance at a baseball game?

- D) What variables can affect the taste of soda?

- E) What variables can affect the amount of fruit an apple tree produces?

- F) What variables can affect student performance on a social studies quiz?

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Step 5 continued: Identifying the variables

It is important to identify the variables in any experiment. You want to have as few variables as possible when conducting your experiment, but you will always have three types of variables, independent, dependent, and constant (also called control).

The independent variable is WHAT YOU CHANGE ON PURPOSE IN AN EXPERIMENT.

The dependent variable is WHAT YOU MEASURE IN AN EXPERIMENT

What variables could affect the sprouting of a bean seed?

These could all be independent variables. What would be the dependent variable in the sprouting of a bean seed?

In addition to the independent and dependent variables, there is also a variable called the constant or control variable. It is the condition or conditions that remain the same in an investigation. You have to have controlled variables so that you can determine if the independent variable actually caused the result, or if it was something else. In a perfect world, all of the variables would be controlled except for the independent and dependent variables, but that doesn't happen very often.

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Another thing to remember is that when you graph your results, the independent variable goes on the y-axis (vertical), and the dependent variable goes on the x-axis (horizontal). This is true in almost every situation. Here is another way to help you remember:

Consider the following experiment:

Two groups of students were tested to compare their speed working math problems. Each group was given the same problems. One group used calculators and the other group computed without calculators.

What is the independent variable?

What is the dependent variable?

What is the constant variable?

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Students of different ages were given the same puzzle to assemble. The assembly time was measured.

What is the independent variable?

What is the dependent variable?

What is the control variable?

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Tables and Graphs

Tables and graphs are a way for people to see the data you have collected during an experiment and be able to analyze it quickly and accurately. In tables and graphs, data is arranged in such a way that it makes it easier for people to see and understand.

Tables

- Each table should have a **title** to say what type of information the table is showing.
- The **first column** in a table lists the items to be compared (the **independent variable**).
- The **first row** of the table lists the specific characteristics being compared (the **dependent variable**)
- Within the **grid** of the table, the collected **data** is recorded.

An example of a table is given below.

Amount of Liquid Absorbed by Paper Towels						
Towel Type	Towel Size (cm ²)	Trial 1 (cm ²)	Trial 2 (cm ²)	Trial 3 (cm ²)	Trial 4 (cm ²)	Average (cm ²)
A	225	25	28	24	31	27
B	225	26	27	23	22	24.5
C	225	28	20	23	21	20.5

In the above table, the independent variable is the towel type (listed in the first vertical column), and the dependent variable is the amount of liquid absorbed in cm² (listed in the first horizontal row).

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Graphs

There are two types of graphs that we will use most often to display your data, line graphs and bar graphs. Graphs help your data be seen quickly and easily and it makes it easier to see trends in the data rather than looking at large sets of numbers. You should **only graph the averages** if you have done more than one trial for a particular independent variable. Look back to the variables page if you don't remember which variables go on the x and y axes.

Line graphs should be used when

Bar graphs should be used when

Graph the data from the chart on the previous page on a piece of graph paper.

Remember, the **4 aspects that I will be grading on every graph** are:

- 1) Is the **title** descriptive and does it show a relationship between the independent and dependent variables? **NO FLUFFY TITLES!!!**
- 2) Are the **axes labeled** correctly? Did you give units when appropriate? Is the independent variable on the x-axis and the dependent variable on the y-axis?
- 3) Is the **number scale** correct? Are the numbers in even increments on both the horizontal and vertical axis? Are they all attached to a line? Did you start at zero?
- 4) Is your **data** graphed correctly? Did you **only graph the averages**? Does each bar correspond to the correct number on your chart?

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General Format for a Conclusion

1. State the facts!

Give the exact numbers (averages only) for each independent variable.

2. Say Why!

Make a statement explaining the trends you observed. Summarize your data if necessary. Why did you see those particular results? Was your hypothesis supported? Explain/interpret the data. What was the point of doing this experiment??

3. Wrap it up!

Discuss any questions you still have, what you might have done differently, some sources of error, and what future testing you might do to make your results more meaningful.

The conclusion is fairly long (at least a paragraph, sometimes more) and should be the most thoughtful part of the experiment. The conclusion is important because it explains the results of the lab and what you learned by doing it. If you don't have a conclusion you might as well not have done the experiment. Not including a conclusion with your lab will automatically drop your grade significantly!