

Title: -The Metric System, Unit Conversions & Statistical Analysis

Objective(s): -

- To use the international system of units (metric system) to measure mass, temperature, volume and mass.
- To learn the three temperature scales.
- To learn to convert from one temperature scale to another.
- To learn to convert within the different units of measurement.
- To learn how uncertainty in a measurement arises.
- To learn to indicate a measurement's uncertainty by using significant figures.
- To show how very large or very small numbers can be expressed as the product of a number between 1 and 10 and a power of 10.
- To show how to write very large, and very small numbers, in scientific notation.
- To learn how statistics is used in analyzing data.

Description: - This lab will investigate various units of measurement, within the International System of Units {SI} {Metric System} that are utilized in science, scientific notation and statistical analysis.

Instruction: -Students will conduct various measurements, complete conversions within the units of measurements and set up a visual representation of data via graphs. Students will complete the lab exercise by visiting eight stations that will be set up within the lab. The exercise, and data to be recorded at each station, is found below. Before completing the lab, students should read, and take notes on, class notes packets #1 and #3, found on the course website located under the tab for Research I class notes **AND** statistics packet #7, located on the statistics tab, on correlation and linear regression. Students should also view, and take notes, based on the Khan Academy video links that are also provided. Students should become familiar with writing very large, or very small, numbers using scientific notation.

Station #1...Unit Conversion & Statistical Correlation – Length & Weight of a Pencil

- Use unit conversion calculations to answer each of the following questions. Students MUST show their work, within the lab report, for the calculation(s).
- Find the length of the 10 pencils provided in miles.
 - There are 1.6 kilometers in a mile.
- Find the weight of the ten pencils provided.
- Draw a graph comparing length vs. weight and then determine the type of correlation displayed by the data.

Station #2...Unit Conversion – Mass of a paper clip

- Use unit conversion calculations to answer each of the following questions. Students MUST show their work, within the lab report, for the calculation(s).
- Find the mass of the paper clip in tons.
- There are 2.2 pounds in a kilogram and 2000 pounds in a ton.

Station #3...Unit Conversion – Volume of liquid provided.

- Use unit conversion calculations to answer each of the following questions. Students MUST show their work, within the lab report, for the calculation(s).
- Find the volume of the liquid in gallons.
- There are 0.26 gallons in a liter. 12

Station #4...Unit Conversion – Temperature of Armpit

- Use unit conversion calculations to answer each of the following questions. Students MUST show their work, within the lab report, for the calculation(s).
- Find the temperature of your armpit in Kelvin.
- The temperature of a substance in Kelvins is equal to its temperature in Celsius plus 273.

Station #5...Unit Conversion – Length of Time One Can Hold Breath (10 trials)

- Use unit conversion calculations to answer each of the following questions. Students MUST show their work, within the lab report, for the calculation(s).
- Find the mean, mode, median and range for which a student can hold their breath in minutes AND in years.
 - Students will have to convert from minutes to years AND show their work.
- There are 365 days in one year.
- **WARNING: - DO NOT TRY TO BE SUPERMAN/AQUAMAN. KNOW YOUR LIMITS. USE PROPER DISCRETION WHEN COMPLETING THIS PART OF THE**

LAB. IF THE STUDENT STARTS TO FEEL DIZZY, HE/SHE IS TO STOP IMMEDIATELY AND NOTIFY INSTRUCTOR. STUDENTS WITH ASTHMA, OR ANY OTHER REPSIRATORY AILMENTS, SHOULD NOT ENGAGE IN THIS EXERCISE.

Station #6...Unit Conversion – Area of a Paper Towel

- Use unit conversion calculations to answer each of the following questions. Students **MUST** show their work, within the lab report, for the calculation(s).
- Find the area of a paper towel in square meters.

Station #7...Statistical Correlation – Spaghetti Noodles

- In this lab students will determine the relationship between the mass and length of spaghetti noodles.
- Students **MUST** research, and be able to describe, the different types of statistical correlation **AND** how correlations are shown graphically.
 - Positive correlation
 - Negative correlation
 - No statistical correlation
- Students will complete this task by making a data table where the lengths and masses of small pieces of spaghetti is recorded.
 - In order to make the best possible graph, students **SHOULD** use widely varying lengths of spaghetti.
 - While in class conducting the lab exercise, students are to record the data in a table within their **LAB NOTEBOOK** and **THEN** transfer the information to a **DATA TABLE** within their group lab report.
- Students are to then create a **SCATTERPLOT** graph based on the length and mass of the spaghetti noodles. Students, when making a hypothesis for this part of the lab, should make it clear what the independent and dependent variables are.
 - (Hint: - Students will decide whether the length, or mass, of the spaghetti noodles is their independent or dependent variables).
- Students are to construct a **BEST FIT** line, within the scatterplot and then determine the type of correlation the data presents.
 - Remember, the independent variable is located on the x axis and the dependent variable on the y axis.
- Students are to measure, and weigh, a **MINIMUM** of 30 pieces of spaghetti.

Station #8...Statistical Correlation {@ Classroom desks using data provided below}

- Students, within their group lab reports, are to complete the following for each set of data, for mini-experiments examples, shown below.
 - Students are to read each description for each experiment provided.
 - Determine and identify the independent and dependent variables based upon information provided (from description).
 - Create a hypothesis that the scientists may have developed.
 - This is to be completed before investigating or reading the data.
 - Place the data provided in a table within group lab report.
 - Use the data provided to create a graph indicating the independent variable on the x axis and the dependent variable on the y axis.
 - Answer the questions after each graph.
- Students MUST research and be able to describe the different types of statistical correlation.
 - Positive correlation
 - Negative correlation
 - No statistical correlation
 - This will help in answering some of the questions provided.

1. Mini-Experiment Example #1

- a. Baby chickens, like all baby birds, require a constant source of food. As chick grow, more energy is required for daily activities, and their food requirements increase. The following data table reports the average food eaten by a group of 10 chickens over a 5-day period.

Baby Chicken Food Consumption

Day	Food Consumed (g)
0	0.0
1	1.0
2	3.2
3	6.5
4	10.6
5	15.4

Questions

1. Identify the independent and dependent variables.
2. How much grain will the chicks eat on day 6?
3. On day 7?
4. Statistically, what type of relation (correlation) does the graph represent?

2. Mini-Experiment Example #2

- a. Elodea, a water plant commonly found in aquariums, gives off bubbles of oxygen when placed in bright light. Students in a biology class noted that if a light were placed at different distances from the plant in an aquarium, the rate of bubble production varied. The following data table shows the average results from several trials.

Elodea Bubble Production

Distance from Light (cm)	Bubble Production Rate (bubbles/min)
10	40
20	20
30	10
40	*
50	3

Questions

1. Identify the independent and dependent variables.
2. Estimate the O₂ production at 25 cm.
3. At 35 cm?
4. Statistically, what type of relation (correlation) does the graph represent?

*They forgot to record this distance!

3. Mini-Experiment #3

- a. The data below summarizes the results of a scientific experiment on the effects of a growth hormone (gibberellic acid) on plant height. A 0.1 molar solution was used in all experiments.

Gibberellic Acid and Plant Height

Gibberellic Acid (0.1 M) (mL)	Plant Height at 1 Week (cm)
20	18.5
30	20.7
40	45.2
50	62.3
60	10.6

Questions

1. Identify the independent and dependent variables.
2. Estimate the plant height at 10 mL gibberellic acid.
3. Estimate the plant height at 25 mL? =.
4. Explain why the plant height at 60 mL is not consistent with the rest of the data.

4. Mini-Experiment #4

- a. A team of scientists wanted to test the effects of temperature on the germination rate of pinto beans. They placed three sets of 100 pinto bean seeds in temperature controlled chambers: Chamber A was set at 15° C, chamber B at 20°C, and chamber C at 25°C. Their results are shown in Table 1 below:

Germination Rates of Pinto Beans

Day	% Germination (15° C)	% Germination (20° C)	% Germination (25° C)
0	0	0	0
2	2	10	10
4	10	30	50
6	20	40	80
8	20	60	90
10	35	70	90

Questions

1. Identify the independent and dependent variables.
2. Compare and contrast the growth rate of pinto beans at the different temperatures.
3. Summarize the experimental results.

Information within the group lab report's introduction, discussion and conclusion should include information on the international system of units {SI} {Metric System}, unit conversions, scientific notation and statistical analysis.