**Recording Raw Data – Aspect 1 (Data Collection and Processing)**

The best way to record data is by using data tables.  Give an identifying, specific title to each data table.  Number tables consecutively through the report.

***Types of Data***
Raw data is the actual data measured. The term “quantitative data”   refers to numerical measurements of the variables associated with the investigation.  Qualitative observations are just as important as quantitative measurements!  Make sure you take note of and record the physical characteristics of substances or solutions involved in the experiment, their changes, whether something is hot or cold, etc.  Some researchers like to organize these qualitative observations in a separate data table – intermingling them with
quantitative data is often confusing and hard to read.





**Units**
A measurement without units is meaningless!  The system of units used is the International
System of Units - SI units (Système International d’Unités). In the table below are some of the more common SI units used.



The following example shows different ways to express the same unit.

* Oxygen consumption (millilters per gram per hour)
* Oxygen  consumption (ml/g/h)
* Oxygen  consumption (ml g-1 h-1)

When measuring time, it is acceptable to use minutes, days or hours when the experiment spans over a significant period of time.  When showing length, it is acceptable to use the associated units shown in the table below.



***Precision***
Unless there is a digital display, always measure to one spot beyond the smallest unit of CERTAIN measurement of the tool.  For example, if you use a ruler that can accurately measure to the tenth of a centimeter, your measurement would be to the hundredth of a centimeter. The number of significant digits should reflect the precision of the measurement. There should be no variation in the precision of raw data. In other words, the same number of digits past the decimal place should be used. For data derived from processing raw data (i.e., means), the level of precision should be consistent with that of the raw data.

***Uncertainties***All measurements have uncertainties which must be indicated in the data table.  This is best done by paying attention to significant digits, and by using the ‘plus-or-minus” (+/-) notation.
Examples:

* Mass of a penny on a centigram balance:  3.12g (+/- 0.05g)
* Temperature using a typical lab thermometer:  25.5°C (+/-  0.5°C)

Always round the measurement or result to the same decimal place as the uncertainty. It would be confusing to suggest that you knew the digit in the hundredths (or thousandths) place when you admit that you unsure of the tenths place.

* Wrong: 1.237 s ± 0.1 s
* Correct: 1.2 s ± 0.1 s

For general purposes, the accuracy of a measurement device is one half of the smallest measurement possible with the device.  So, for example, the rulers in class measure to the millimeter (0.10 cm).  So, the ruler’s measurement uncertainty is +/- 0.05 cm.  Experimental **uncertainties should be rounded to one significant figure**.

Just as for units, in a column of data students can show the uncertainty in the column heading and don’t have to keep re-writing if for every measurement in the table.



**Processing Raw Data – Aspect 2 (Data Collection and Processing)**

This is the part of the report in which students take raw data and transform it into results that answer (hopefully!) the research question.  Here students show the calculations that give a numerical result. Statistics are useful mathematical tools which are used to analyze data.

Data processing involves, for example, combining and manipulating raw data to determine the value of a physical quantity (such as adding, subtracting, squaring, dividing), and taking the average of several measurements and transforming data into a form suitable for graphical representation. It might be that the data is already in a form suitable for graphical presentation, for example, distance traveled by woodlice against temperature. If the raw data is represented in this way and a best-fit line graph is drawn, the raw data has been processed. Plotting raw data (without a graph line) does not constitute processing data.

The recording and processing of data may be shown in one table provided they are clearly
distinguishable.

Show the units of measurements in all calculations and pay attention to significant digits!  Don’t lose accuracy by carelessly rounding off.  Round only at the end of a calculation.  Do not truncate.

**Presenting Processed Data – Aspect 3 (Data Collection and Processing)**

Students are expected to decide upon a suitable presentation format themselves (for example, spreadsheet, table, graph, chart, flow diagram, and so on). There should be clear, unambiguous headings for calculations, tables or graphs. Graphs need to have appropriate scales, labeled axes with units, and accurately plotted data points with a suitable best-fit line or curve (not a scatter graph with data-point to data-point connecting lines).

Students should present the working for processed data so that all the stages to the final result can be followed.  Show at least one example of the working required for each data processing calculation.  Use plenty of room; make sure working is clear and legible.  Inclusion of metric/SI units is expected for final derived quantities, which should be expressed to the correct number of significant figures.



