**EXPERIMENTAL DESIGN TERMINOLOGY**

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| **TERM** | **MEANING** | **EXAMPLE** |
| **Hypothesis** | Educated guess | The temperature of the solution containing the enzyme will have no effect on the rate of the reaction |
| **Prediction**  **Testable Hypothesis** | If “change in independent variable” then “change in dependent variable” i.e. an IF ..... and ..... THEN statement | If the temperature of the solution containing the enzyme is changed, then there will be no change in the rate of the reaction |
| **Variables** | Any factor that could influence the result of the experiment | Temperature, concentration of enzyme, type of substrate, inhibitors, amount of substrate, time, surface area |
| **Independent variable** | The factor that is deliberately altered during the experiment | Temperature |
| **Dependent variable** | The variable being measured during the experiment i.e. the results being recorded | The rate of reaction |
| **Controlled variables** | All the factors that are kept the same during the experiment because we know they may affect the result | All the variables expect temperature |
| **Experimental variable** | Those groups in which the independent variable is altered. i.e. the groups which test the hypothesis | The group with different temperatures |
| **Control Group** | The group against which you make comparisons | If the enzyme is found in humans, your control group would be carried out at 370C and comparisons made with this rate |
| **Sample size** | Sample size refers to the number of samples in the experimental group. Increasing the number of samples allows averages to be calculated and minimise random errors. | Testing each temperature several times when conducting the practical |
| **Reliability** | Reliability refers to the extent which an experiment yields the same results on repeated trials under the same conditions each time. It is achieved by minimising the effect of random errors. | The experiment was conducted previously. Each experimental group is tested several times and the results averaged. Individuals were attentive and careful when taking and recording measurements. |

**Experimental Discussion Terminology**

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| **Accuracy** | **Precision** |
| The degree to which a measurement is close to the true value.  Accuracy depends on the extent to which systematic errors are ‘accounted for’ hence affected by systematic error. | The ability of a measuring instrument to provide true and consistent readings to a prescribed number of significant figures. Precision is identified by the degree of scatter in the value of the measurements.  When there is least amount of scatter in the results the measurements are more precise, or precision is high (generally suggests the same type of random error).  When there is a large amount of scatter in the results the measurements are less precise, or precision is low (generally suggests different random errors occurring).  Precision depends on how well random errors are ‘minimised’ hence affected by random error. |

**Resolution of the measuring instrument:** Is the smallest increment measurable by the measuring instrument, e.g. 0.01g, 0.1mL.

**Significant figures:** The number of significant figures is determined by the reproducibility of the measurements and the resolution of the measuring instrument. The final answer cannot be given to any more significant figures than the least number of significant figures in the data.

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| **Repetition** | **Replication (reliability)** |
| Carrying out the experiment on a second or subsequent occasion, in an attempt to **validate results**.  Repeating the experiment at another time with new set of apparatus for validity of the results hence experimental design.  Repeating an experiment **helps identify** systematic errors. | Duplicating the procedure at the same time of an experiment in order to minimise the effect of random errors measurement by calculating an average. |

**Sample size:** Sample size refers to the number of samples in the experimental group. Increasing the number of samples allows averages to be calculated, minimise the effects of random errors and increases reliability of the data.

**Reliability:** Reliability refers to the extent which an experiment yields the same results on repeated trials under the same conditions each time. It is achieved by minimising the effect of random errors. Note **it is not** determined by high or low precision.

**VALIDITY OF THE EXPERIMENT:** Thisrefers to the method of an experiment and if it is designed well. The experiment can be validated by repeating the method and obtaining similar results, hence the method is well designed and valid.

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| **Systematic error** | **Random error** |
| Errors that are the result of experimental conditions or design or faulty equipment/instruments.  These errors are consistent throughout the experiment and **cannot** **be** ‘minimised’ by replication or averaging.  Systematic errors are present when measured values differ consistently from the true value.  Conditions include-  Thermometers may always be one degree out, balances, timing devices, pipettes, measuring cylinders etc.  These affect the accuracy of your results.  Systematic errors can be ‘accounted for’ by repeating the experiment on another day. | Errors that are the result of measurements made by the experimenter. The experimenter taking measurements can expect results that differ slightly each time.  Random errors are evident when there is scatter in the measured values.  The effect of random errors can be minimised by replication and calculating an average, and/or drawing a line or curve of best fit in the graph.  Hence increased sample size will increase the occurrence of random errors, but the effects of random error can be minimised by calculating and average thus increasing reliability of the data. |

**Note:** Some errors in experiments can be either a random or systematic error depending on how it is discussed by the student.

**Investigation terminology**

Below is a list of terms used in practical design and write up. While the terms relate to the design and write-up of a practical they have been grouped according to their relation to one another.

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| **The design of the experiment** | **The conducting of the experiment and the results** | |
| Variables | Validate |  |
| Independent variable | Validation |  |
| Dependant variable | Validity |  |
| Controlled variables | Repeat | Replicate |
| Uncontrolled variables | Repetition | Replication |
| Hypothesis (educated guess) | Accuracy | Precision |
| Prediction (IF and THEN statement) | True value | Level of scatter |
| Limitations (of practical) | Actual value | Sample size |
|  | Systematic error | Random error |
|  |  | Reliability |
|  |  | Range |
| Resolution | | |
| Significant figures | | |