Teacher Resource Bank

GCE Biology 1411/2411

Other Guidance:

Glossary: How Science Works

GLOSSARY: HOW SCIENCE WORKS

Accuracy An accurate measurement is one which is close to the **true value**.

Anomalous data Anomalous data are those measurements that fall outside the normal, or expected, range of measured values. Variation is a characteristic of all living organisms, and it is often difficult in biological investigations to distinguish between data that reflect this variation and those that are genuinely anomalous. A large number of readings allows anomalous data to be identified with greater certainty.

Calibration When using a measuring instrument, calibration involves fixing known points and constructing a scale between these fixed points.

Causal link A change in one variable that results from or is caused by a change in another variable.

Chance Chance is essentially the same as luck. If a coin is tossed in the air, whether it comes down heads or tails is purely due to chance. The results of any investigation could have a genuine scientific explanation but they could be due to chance. Scientists carry out **statistical tests** to assess the **probability** of the results of an investigation being due to chance.

Confounding variable A confounding variable is one that may, in addition to the **independent variable**, affect the outcome of the investigation. Confounding variables must be kept constant or the investigation will not be a **fair test**. In some investigations, ecological investigations in particular, it is not always possible to keep confounding variables constant. In such cases, these variables should be monitored. In this way it may be possible to decide whether or not the factor concerned affects the outcome of the experiment. Confounding variables are sometimes referred to as control variables.

Control experiment A control experiment is one that is set up to eliminate certain possibilities. In a well designed investigation, the **independent variable** is changed and all **confounding variables** are kept constant. The possibility exists, however, that something else other than the independent variable might have produced the results that were obtained. A control experiment is one that is designed to eliminate this possibility.

Control group A control group is one that is treated in exactly the same way as the experimental group except for the factor that is being investigated. This allows scientists to make a comparison. It ensures that the data that are collected are **valid** because any differences between the results for the experimental group and those for the control group will be due to a single **independent variable**.

Control variable See **confounding variable**

Correlation	A correlation shows that there is a relationship between two variables, however, it might not be a causal one.
Dependent variable	The dependent variable is the variable the value of which is measured for each change in the **independent variable**.
Double-blind trial	A trial, usually used in the context of medicine, when assessing the effects of a new drug or treatment on humans. Neither the patients nor the scientists concerned know which treatment a particular individual is receiving until after completion of the trial. This helps to avoid bias and increase the **validity** of the trial.
Errors	Errors cause readings to be different from the **true value**.
Evidence	The data or observations that are used to support a given hypothesis or belief.
Fair test	A fair test is one in which only the **independent variable** has been allowed to affect the **dependent variable**. A fair test can usually be achieved by keeping all other variables constant or controlled.
Hypothesis	Sometimes known as an experimental hypothesis, this is a possible explanation of a problem that can be tested experimentally.
Independent	The independent variable is the variable for which values are changed **variable** by the investigator.
Null hypothesis	A **statistical test** requires a clear **hypothesis** to test. It is often difficult to predict what would happen as the result of an investigation. It is much easier to phrase a hypothesis in terms of there being no difference or no association. A hypothesis worded in this way is called a null hypothesis. As the result of carrying out a statistical test, a decision can be made about whether to accept or reject this null hypothesis.
Placebo	A placebo is a dummy pill or injection given to members of a **control group** in medical trials. Where a placebo is in the form of a pill, it should be identical to the pill used with the experimental group. The only difference should be that that the placebo does not contain the drug being trialled. The use of placebos helps to ensure that the data collected from a trial are **valid**.
Precision	Precision is related to the smallest scale division on the measuring instrument that is being used. A set of precise measurements will have very little spread about the mean value.
Probability	Probability is the likelihood of an event occurring. It differs from **chance** in that it can be expressed mathematically. In **statistical tests**, probabilities are usually expressed as a decimal fraction of one. Thus a probability of 0.05 means that an event is likely to occur 5 times in every 100.
Protocol	Once an experimental method has been shown to produce **valid** and **reliable** results, it becomes a protocol used by other scientists.

Random distribution	A random distribution is one that arises as a result of **chance**. When investigating, for example, variation in living organisms, the data collected will only be **valid** if they have been collected at random. This avoids observer bias and allows **statistical tests** to be used in an analysis of the results of the investigation.
Random errors	Random errors occur in an unpredictable way. They may be caused by human error, faulty technique in taking measurements or by faulty equipment.
Raw data	Raw data are instrument readings and other data collected at the time of the investigation. These data may subsequently be processed and used to calculate percentages and standard deviations.
Reliability	The results of an investigation may be considered reliable if they can be repeated. If other scientists get the same results, then the results of the initial investigation are more likely to be reliable. The reliability of data within a single investigation can be improved by carrying out repeat measurements.
Systematic errors	These errors cause readings to be spread about some value other than the **true value**. In other words, all the readings are shifted in one direction from the true value. Systematic errors may occur when using a wrongly **calibrated** instrument.
True value	This is the accurate value which would be found if the quantity could be measured without any **errors**.
Validity	Data are only valid if the measurements that have been made are affected by a single **independent variable** only. They are not valid if the investigation is flawed and **control variables** have been allowed to change or there is observer bias. Conclusions are only valid if they are supported by valid and **reliable** data measured to an appropriate level of **accuracy**.
Zero errors	Zero errors are caused by instruments that have an incorrect zero. A zero error may occur when the needle on a colorimeter fails to return to zero or when a top-pan balance shows a reading when nothing is placed on the pan.