**Science-Specific Vocab**

**Introduction**

Many words have different meanings in science and non-science contexts. As a result, it is important to learn those meanings and use your vocabulary appropriately.

When communicating science to non-specialist audiences it is a good idea not to use these words at all to be sure to avoid confusion. When writing for a science-specific audience (e.g. perhaps you are writing journal articles or lab reports), it is very important that you use the vocabulary correctly.

The first sub-section outlines words that are potentially ambiguous if used in the different contexts, while the second one focuses on words that have a particular meaning in experimental scenarios in which data are analysed statistically and used to provide evidence for conclusions. Finally, the third sub-section lists words that appear frequently in exam and assignment questions, but which tend to cause confusion that leads to students dropping marks. These last words are not necessarily science-specific.

In all sub-sections, commonly misinterpreted meanings are also presented, along with tips for uses to avoid (in red), to help you see why the incorrect interpretations/uses are so problematic.

***Words that mean different things in science contexts:***

***Abstract:*** *A short summary of key information, usually including the main results of an experiment and their greater implications. Not something that is purely conceptual or theoretical (e.g. NOT: an artistic impression).*

***Chemical:*** *Technically, any matter (such as water) is a chemical, but most people refer to chemicals as substances that are the same in structure throughout. Not necessarily harmful or toxic in some way.*

***Control:*** *In an experimental setting, a* ***control group*** *is the group of individuals whose response is compared against those for which variables have been altered.* ***Controls*** *are therefore vital to provide baseline data, and to allow researchers to compare data with when looking to provide evidence that one or more variables cause a measurable effect. Not the group that is manipulated, or the subjects whose exposure to changed variables is somehow controlled (e.g. Not: the group that is given a set dosage of a pill, but the group that is given no pill).*

***De-Extinction:*** *Creating an organism or species that is extinct via cloning or some other artificial means (e.g. selective breeding of a closely related species to favour traits associated with the target species). Note that this can theoretically apply to organisms that went extinct yesterday, or millions of years ago. Not organisms that have been seen after they were believed to have gone extinct (e.g. NOT: the coelacanth fish).*

***Dependent/Independent: Dependent*** *variables are those that are purposefully manipulated in an experiment (e.g. food types offered to pet dogs), whereas* ***independent*** *variables are not changed (e.g. the age of the dogs being studied). To help you remember the right definition, think of* ***dependent*** *variables as* ***depending*** *on the researcher to change them.*

***Experiment:*** *The procedure followed to test the effect of one or more* ***variables*** *on each other. The key thing to remember is that for this procedure to be called an* ***experiment*** *it must be repeatable. This is important because similar results must be replicated a number of times to support the initial findings (and to refute the chance that they occurred randomly). Not simply trying things out, in the way that you might experiment with different titles before settling on the best one for your essay.*

***Hypothesis:*** *A* ***hypothesis*** *must actually be testable by an experiment (e.g. I hypothesize that doubling the dose of drug A will improve the speed at which patients recover from infection). Not simply an idea or belief (e.g. NOT: I hypothesize that we will have a cure for Alzheimer’s disease in the next five years).*

***Invasive:*** *Can either be used to 1) refer to organisms that are historically not native to an area or environment, and which spread rapidly, often wiping out biodiversity, or 2) rapidly spreading and harmful (e.g. viruses, cancers).*

***Law:*** *An explanation of phenomena that has been repeatedly and consistently backed up by experimental evidence over a long period of time. Because it will always apply under given circumstances, there must be a direct causational rule that governs the way variables interact. Not an explanation that is unchangeable (they often do as knowledge accrues over time).*

***Mutation:*** *A change in a sequence of DNA. This may have negative, neutral or positive effects, but it occurs randomly, and very commonly in all organisms. Not only applicable when a change has negative consequences, and not only referring to such a change that occurs as a result of an unnatural cause (such as exposure to excess radiation).*

***Natural:*** *This word can mean different things even within scientific circles. Historically, it means something that has not been created by mankind, but it can also mean something grown/bred without any intervention (e.g. without genetic modification). It has other uses, too (such as in referring to a species that has been present for a very long time in a given environment). Be sure to define this word if/when you need to use it. Not simply referring to a process that occurs under normal circumstances.*

***Organic/Inorganic: 1)*** *An* ***organic*** *molecule/compound contains the element carbon (C) whereas 2) an* ***inorganic*** *compound generally does not. Molecules like DNA and methane that are associated with organisms are organic. Not referring to something that happens 1) under normal circumstances (e.g. NOT: My love for science evolved organically) or 2) otherwise*

***Poisonous/Venomous:*** *These two words are often used interchangeably but there is a subtle difference: venomous organisms inject poison via fangs or some other device (e.g. snakes) whereas poisonous organisms may pass on their poison without injecting it (e.g. frogs).*

***Positive Feedback:*** *A cycle in which things spiral more and more. An effect is increased by its own influence (e.g. Nervousness before an exam makes you sleep badly, which makes you more nervous, which makes you sleep even worse...). Note that* ***positive feedback*** *cycles are not necessarily good things (they’re often bad).*

***Proof:*** *Science accrues evidence, and knowledge, over time to help construct theories and laws, but these are never final and are open to change. As a result,* ***proofs****, like those that exist in logic and mathematics, do not exist in science. Similarly, when conducting experiments, you may gather data that supports a hypothesis, but this is not the same as providing a proof. Not to be used to describe results that support an interpretation.*

***Theory:*** *An explanation of phenomena that has become accepted in the scientific community, but which is like a basket of knowledge that grows and adapts over time as the basket fills. Note that there is a significant body of work behind a theory. Not simply a guess or hunch, which is how non-scientists sometimes interpret the word (e.g. NOT: I have a theory that walking dogs before exams leads to better performance in exams).*

***Variable:*** *Changing quantities of something being measured (usually very specifically). These could be characteristics, types, or measurements. For example, an experimenter might wish to alter temperature and animal weight when assessing whether those variables affect the amount of time pet mice spend sleeping in a 24-hour period. Not used to casually describe change (e.g. NOT: the weather was variable today).*

***Volume:*** *Scientists typically use* ***volume*** *to describe the three-dimensional measure of something (solid, liquid or gas). Generally not a description of how loud a sound is.*

***-----------***

***Words that have specific statistical implications:***

***Bias:*** *The difference between the estimated value and true value of a measurement or metric. There can be lots of different types (such as* ***sample bias****, which occurs when certain individuals are more likely to be sampled than others), but the extent of the bias is usually unknown. Not describing an unfair preference for something (e.g. NOT: I am biased towards monitoring more colourful organisms when carrying out my surveys).*

***Confidence / Confidence Interval:*** *How likely is it that the estimated value you have obtained from what you are measuring would be similar to another estimated value if someone replicated the experiment? In science, we typically use 95% confidence intervals to make judgements; they mean we are 95% confident that the true value of what we are measuring would appear within the upper and lower limits of our sample’s interval. Not a subjective description or opinion (e.g. NOT: I am fairly confident that this new drug will speed up recovery time).*

***Error:*** *Similar to* ***bias*** *in that it is present in any estimate (such as a sample mean) or measurement (such as the weight of an egg) and in that it refers to the difference between the estimated value and the true value. Not a description of a mistake (e.g. NOT: Forgetting the lab equipment was a large error).*

***Model:*** *A set of rules that can be applied to a set of sampled data, and (theoretically) to a similar set sampled from the wider population.* ***Models*** *are usually explained by mathematical equations that describe the effect random and non-random variables have on the data/measurements being estimated. Not a physical structure that demonstrates something (e.g. NOT: This model of the human heart explains how blood is pumped around the body).*

***Positive/Negative Trend:*** *A* ***positive trend*** *is when two variables move in the same direction as each other (e.g. as human height increases, weight typically increases as well); a* ***negative trend*** *is when two variables move in the opposite direction to each other (e.g. as latitude increases, species richness typically decreases). Note that* ***positive*** *and* ***negative*** *does not relate to whether a trend shows something good or bad.*

***p-value:*** *The probability of obtaining at least as extreme results if the null hypothesis (that there is no true difference between what you are comparing) is true. So a p-value of 0.67 means there is a 67% likelihood of observing a difference as large as you observed even if the two population means are identical. We normally require the probability to be below 5% before we accept there is a difference between a comparison. Using the above example with a p-value of 0.67, NOT: there is a 33% chance that the difference you observed was due to chance.*

***Sensitivity vs Specificity: Sensitivity*** *refers to the number of true positives identified in a study, whereas* ***specificity*** *refers to the number of true negatives identified. These concepts are important in medical research (e.g. when drug trials assess the suitability of drugs to treat/cure patients). A good experiment/method will be both sensitive and specific, but one can be sensitive but not specific, or vice versa. Not used to describe how caring (sensitive) or targeted (specific) your study was.*

***Significant:*** *A* ***significant*** *result occurs when we are very confident an observed difference between groups/measurements equates to a real difference. In science, we typically compute* ***p-values*** *to assess significance, and usually set the value at 0.05. Only if the* ***p-value*** *is below this, do we reject the null hypothesis (that there is no difference) and support the alternate hypothesis (there is a difference). Not used to describe something subjectively, that seems large to you (e.g. NOT: The new budget means we will save a significant amount of money).*

***Trend:*** *A pattern in data that implies a relationship between the variables being compared (the closer the relationship, the stronger the trend). Note that this does not necessarily mean variations in one variable cause the observed variations in the other. Also note that there can be a lot of variation in trends (not all individual data follow a perfect linear pattern).*

***Uncertainty:*** *Because science gathers evidence to support hypotheses and laws, but doesn’t - and can’t - generally seek proofs, there is always a degree of uncertainty attached to any result or conclusion. This may be very small, but it requires scientists to phrase their words appropriately, especially when communicating to non-specialist audiences. Not to be phrased to suggest we are uncertain of the statistical significance that supports our conclusions, but to instead underline we are not presenting a proof/fact.*

*-----*

***Words that often confuse students in exam and assignments***

***Analyze:*** *Critically take apart a statement and examine it in detail, or find the meaning in a set of data by applying statistical tests to it. Not a brief response that only provides an outline of your thinking.*

***Assess:*** *Consider the strength of an argument or statement. This will require taking a balanced view and looking at both sides. Not a brief response or one that only justifies one side of a stance (e.g. you are not assessing the likely success of a new drug properly if you only consider the possible benefits).*

***Criticize:*** *Use evidence and strong, logical reasoning to point out the weaknesses attached to an argument or interpretation. Not a brief response or a simple list of weaknesses/beliefs (your logic in explaining your criticisms is the key requirement).*

***Critique:*** *Similar to* ***assess****, this prompt requires considering the strength of both sides of an argument or statement. Not to be confused by the similarity to* ***criticize****.*

***Describe:*** *Give details of something as though you are telling someone wearing a blindfold exactly what you see. Not a brief response, but one that links key pieces together so that someone knows exactly what you are referring to.*

***Explain:*** *Provide (likely) reasons for why something is the way it is, or why you might expect something to happen under a certain set of circumstances. Not a list of reasons that are not linked together (e.g. you must say A happens because of B…)*

***Illustrate:*** *Provide examples of something. Generally not in pictures or in sketches/drawings, but in words.*

***State:*** *Provide a brief answer to the prompt. Not a long response, or detailed reasoning.*