

CIE Biology International A-level

Evaluation of Methods and Data Practical Notes



Evaluate methods and quality of data and suggest improvements

Errors

The two types of errors are **random** and **systematic errors**. A **systematic** error is an error that is **consistently repeated** throughout the practical, often caused by a **fault in the apparatus** used. A **random** error is an **unpredictable, spontaneous error** that cannot be predicted. **Systematic** errors **do not affect the trend** in results, as each result is **affected in the same way** by the error, while **random errors** affect the trend as **not every result is affected the same way**.

Students may be asked to identify the **significant sources of error** in their practical. This will most likely not include simple measuring errors eg. parallax errors in apparatus but rather an error **concerning the method itself**. For example, in practicals that involve a **colour change to determine the end-point**, a likely error may be that the observation is difficult to determine and involves a degree of **subjectivity**.

Students should also understand how to calculate **uncertainty**. Uncertainty is **half the smallest division on the apparatus used**. For example, if the apparatus is a measuring cylinder with the smallest division of 1cm^3 , then the uncertainty is 0.5cm^3 . However, if two readings are taken using the same apparatus, eg. a syringe is used to transfer 1cm^3 of solution, moving the plunger from 3cm^3 to 2cm^3 , then the uncertainty is doubled. The **total uncertainty** is the **sum of the uncertainty of each individual reading**, hence if there are two readings, then the uncertainty is doubled.

Suggesting improvements

Students may be asked to **suggest improvements** regarding the **reliability** and **accuracy** of a practical.

One way to **increase reliability** is to do **repeats** of the same practical. With the results of the repeats, **anomalies can be identified and excluded** from the mean, hence minimising the effect of anomalies on the results. While repeats are more often performed to gain quantitative data, **qualitative data** eg. food tests may sometimes **require repeats** as well.

Another way to improve practicals is to **better standardise the controlled variables**, which are the variables **held constant** in a practical. Common controlled variables include: temperature, pH, mass, length. Better methods of standardising these variables may include using more **accurate or controlled** equipment, eg. a thermostatically controlled water bath to standardise temperature.

A method to improve the **accuracy** of students' results by using **different apparatus** to measure the **dependent variable**. This involves using more **accurate measuring equipment**, eg. a Vernier calliper as opposed to a ruler, or through using quantitative data rather than qualitative observations, eg. using a colorimeter to determine colour change rather than using sight.

Lastly, students may be asked to evaluate the **validity** of a method. Validity is a measure of how **sound or fair** the practical is, which is to measure if the variable measured is actually what the practical aims to. Validity is **lowered** due to **confounding variables**, which is a variable **other**



than the independent variable that also varies in the practical to **affect the dependent variable**.
Students may be asked to evaluate the validity of a practical by identifying the possible confounding variables.

