

An experiment should:

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|---|-------------------------|
| • Be valid. | Very (Valid) |
| • Be reliable. | Reliable (Reliable) |
| • Have repeat trials to minimize random error. | Repeat (Repeat trials) |
| • Identify and eliminate sources of random error. | Reduce (Random error) |
| • Be precise. | Precisely and (Precise) |
| • Be accurate. | Accurately (Accurate) |

Validity:

- A valid experiment **tests what it aims to test**.
- Was the experiment well designed?
- Does the experiment clearly show that one variable **caused** the change in another?

Reliability:

- A reliable experiment produces the **same results** that **can be replicated** by another observer in a different lab using the same experimental setup.
- A reliable experiment **returns to the same answer** regardless of who conducts the experiment and where it's conducted.

Random error:

- Caused by **unknown and unpredictable changes** in an experiment.

Examples – Electronic noise in the circuits of electronic equipment; irregular changes in air pressure, temperature, humidity, etc in the experiment area; **parallax error** (always viewing from a slightly different angle); **sampling** (selecting a sample rather than testing the whole population); **estimating** a value between graduations.

P Parallax error.

- I Irregular changes.
- E Electronic noises.
- S Sampling.
- S Estimating a value.

Systematic error:

- Usually caused by the **measuring equipment or experimental design**.

Examples – Incorrectly zeroing a scale and parallax error (constantly viewing from the same angle).

I Incorrectly zeroing a scale

P Parallax error

(Ip Man).

Precision:

- Size of spread in repeat measurements; **high precision = small range**.
- Related to the **fineness of the scale** of the instrument.

*The absolute uncertainty for a time interval is often 0.2s.