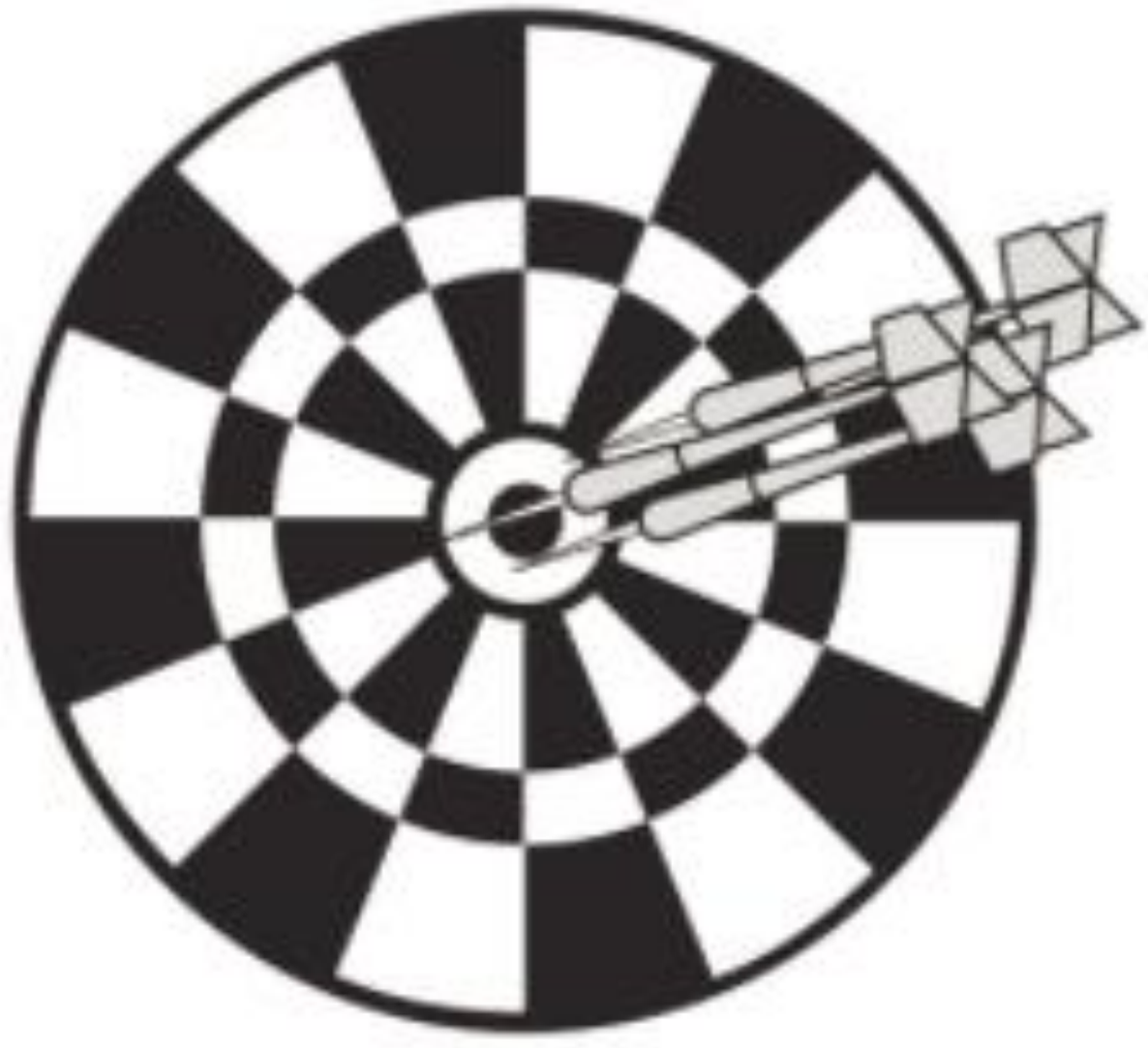
Accuracy

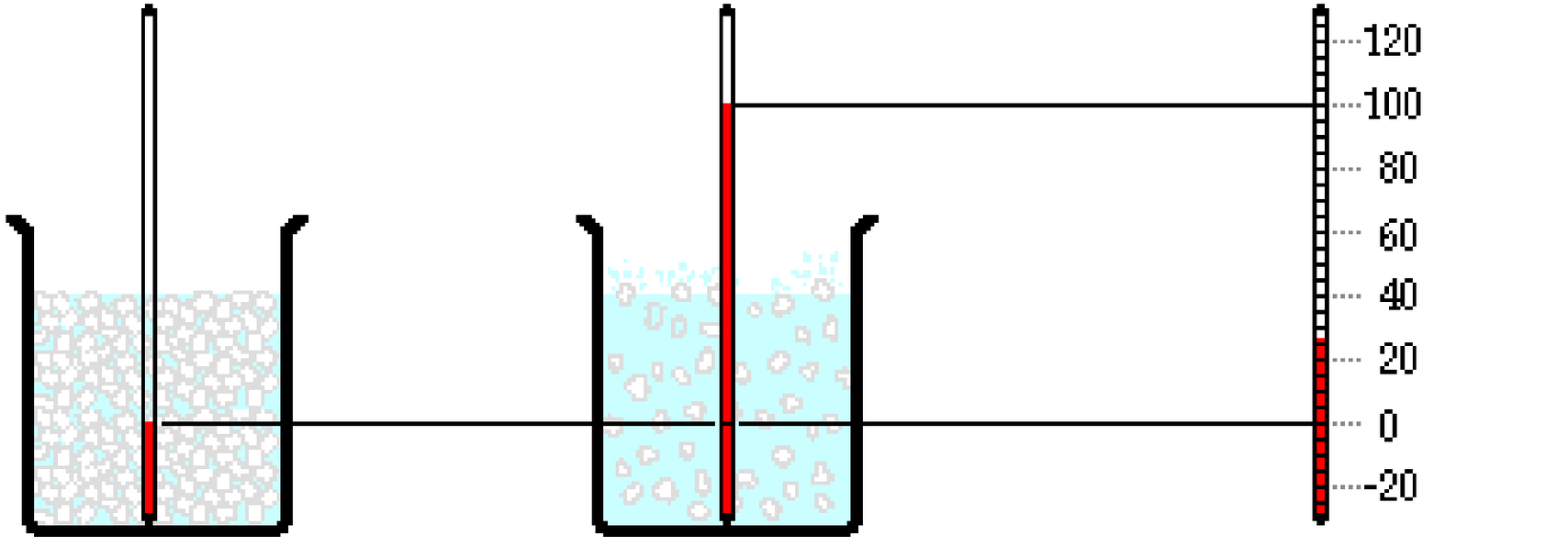
A measurement result is considered accurate if it is judged to be close to the true value



Calibration

Checking or setting a measuring instrument by comparing it to a known value.

E.g. placing a thermometer in melting ice to see whether it reads zero, in order to check if it has been calibrated correctly.



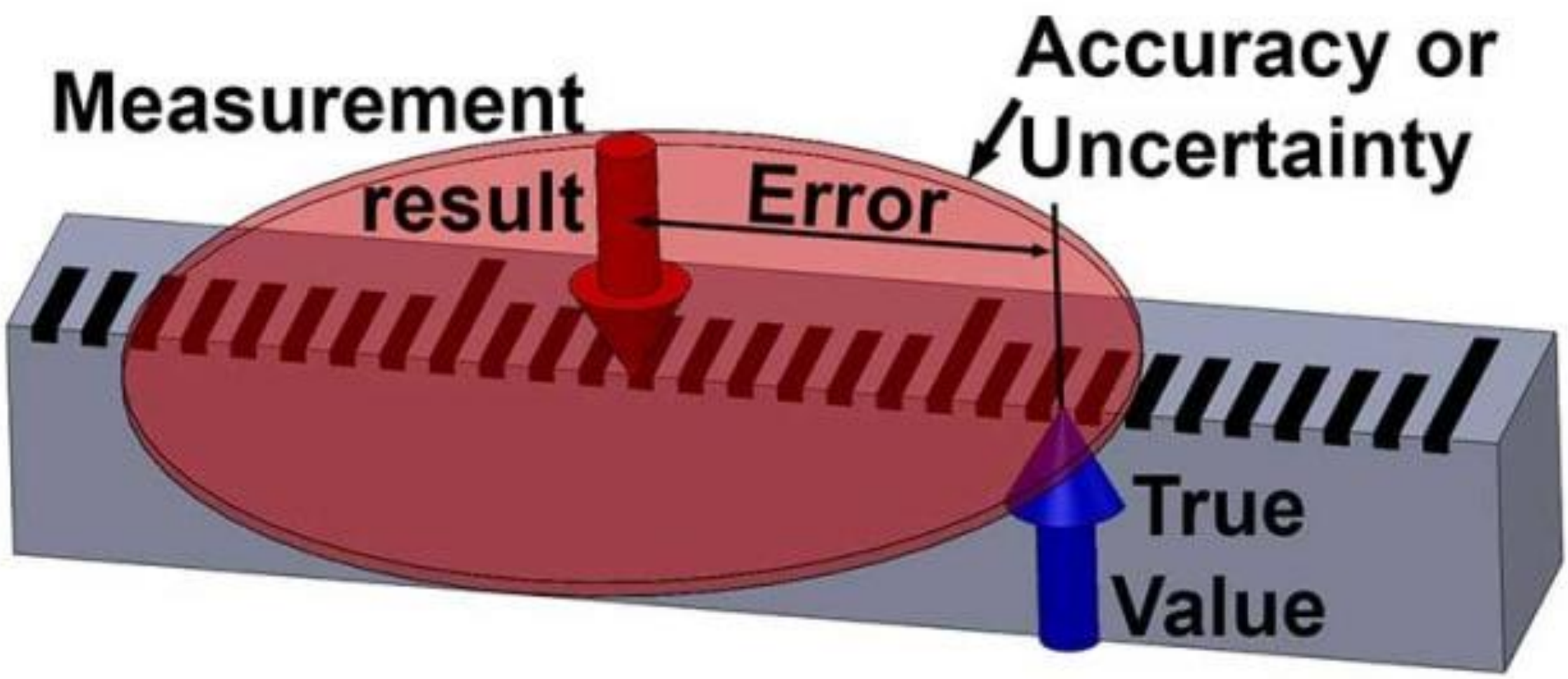
Data

Information, either qualitative or quantitative, that has been collected.



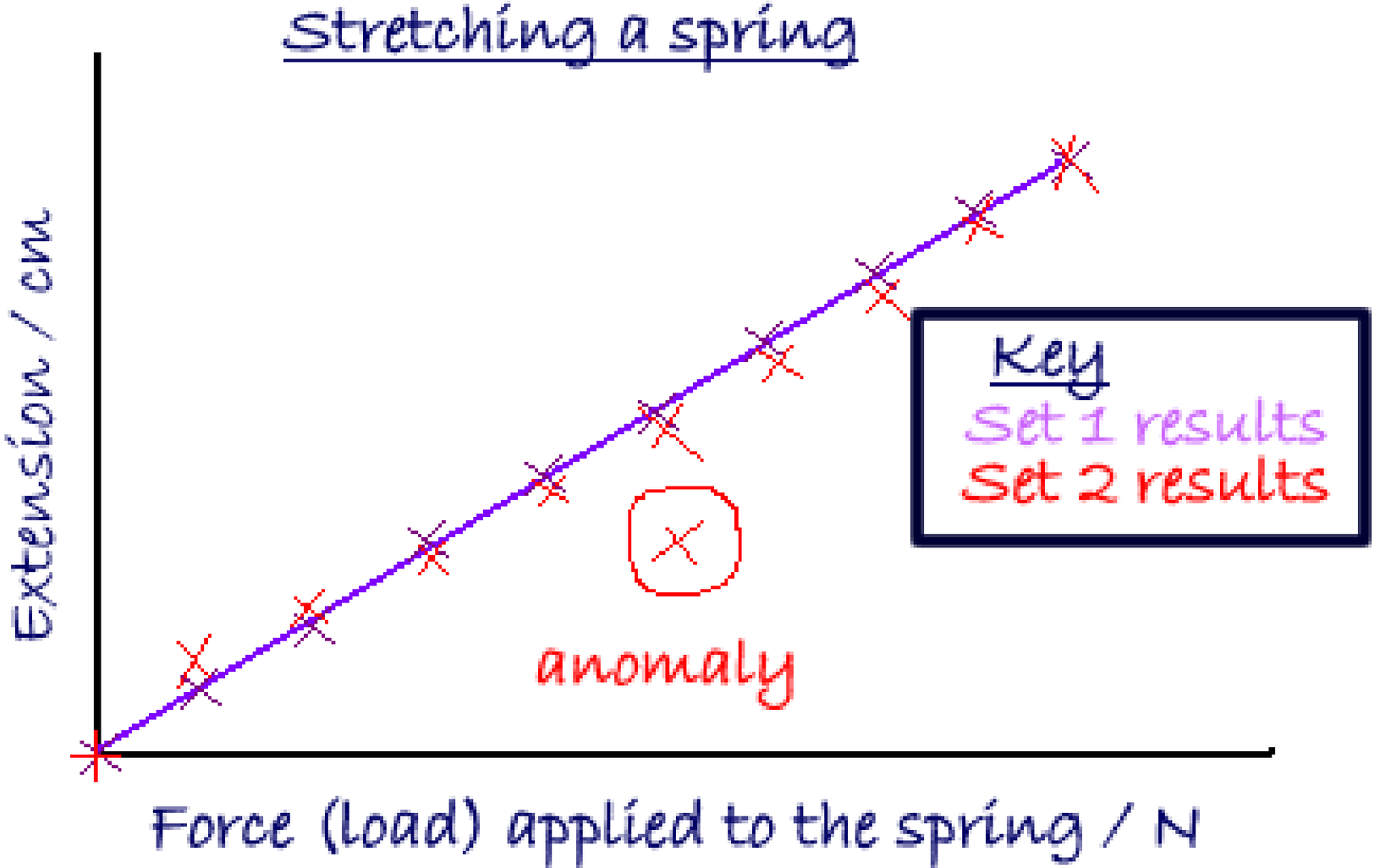
Measurement error

The difference between a measured value and the true value.



Anomalies

These are values in a set of results which are judged not to be part of the variation caused by random uncertainty. A result that doesn't fit the pattern.

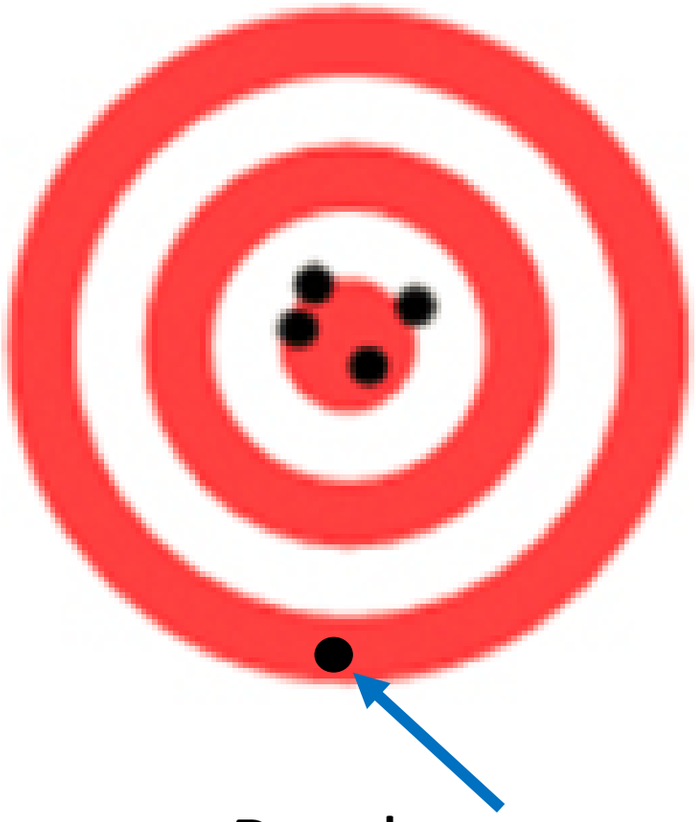


Random error

These cause readings to be spread about the true value, due to results varying in an unpredictable way from one measurement to the next. The effect of random errors can be reduced by making more measurements and calculating a new mean.

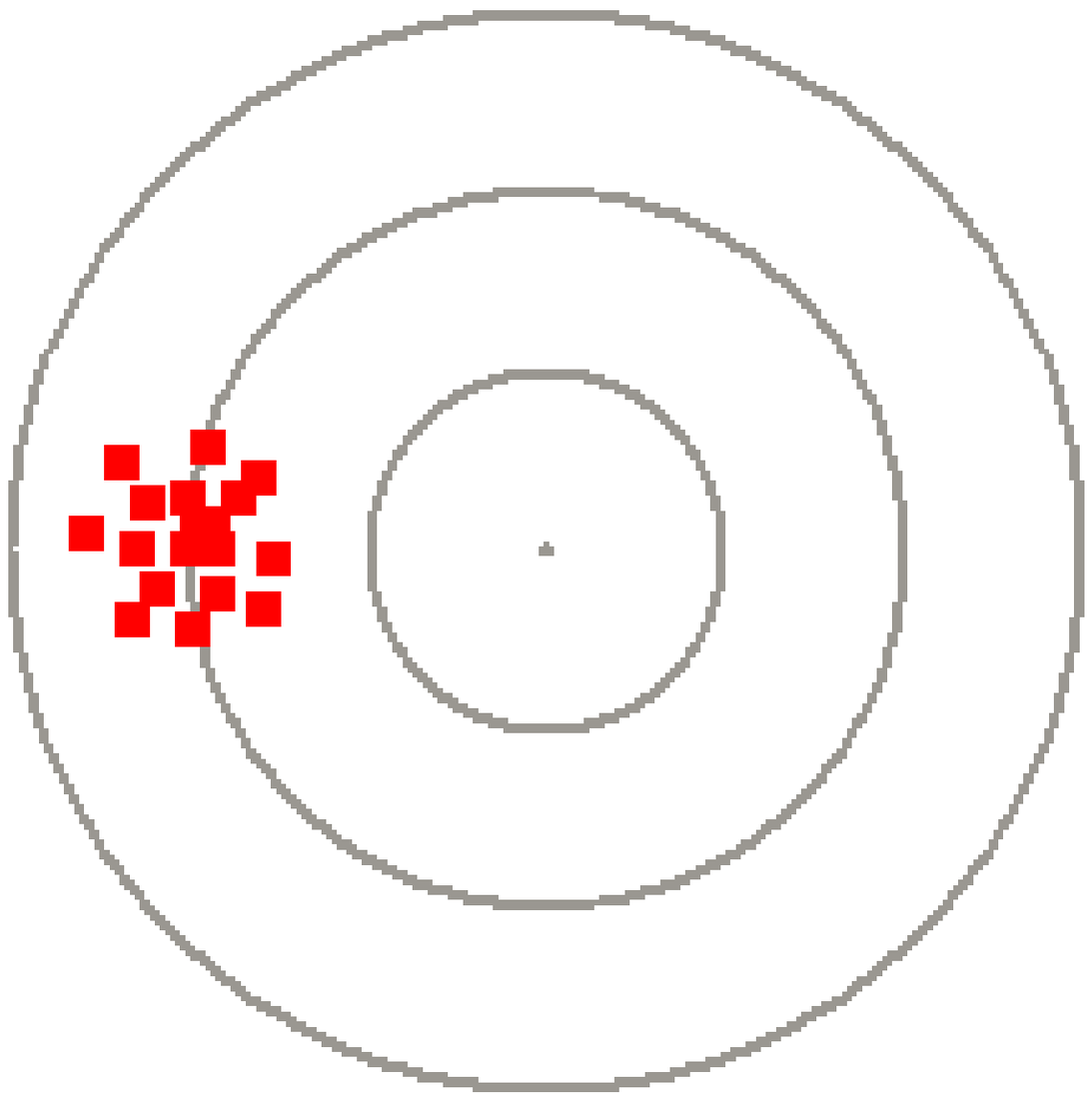
Concentration of mouthwash (%)	Diameter of clear area around mouthwash disc (mm)			
	1	2	3	Average
0	1	1	1	1
20	2	4	3	3
40	4	6	5	5
60	10	2	12	11

Not included in the mean



Random error

Systematic error



These cause readings to differ from the true value by a consistent amount each time a measurement is made. Sources of systematic error can include the environment, methods of observation or instruments used. Systematic errors **cannot** be dealt with by simple repeats. If a systematic error is suspected, the data collection should be repeated using a different technique or a different set of equipment, and the results compared

Zero error



Any indication that a measuring system gives a false reading when the true value of a measured quantity is zero, e.g. the needle on an ammeter failing to return to zero when no current flows. A zero error may result in a systematic uncertainty

Evidence

Data which has been shown to be valid.



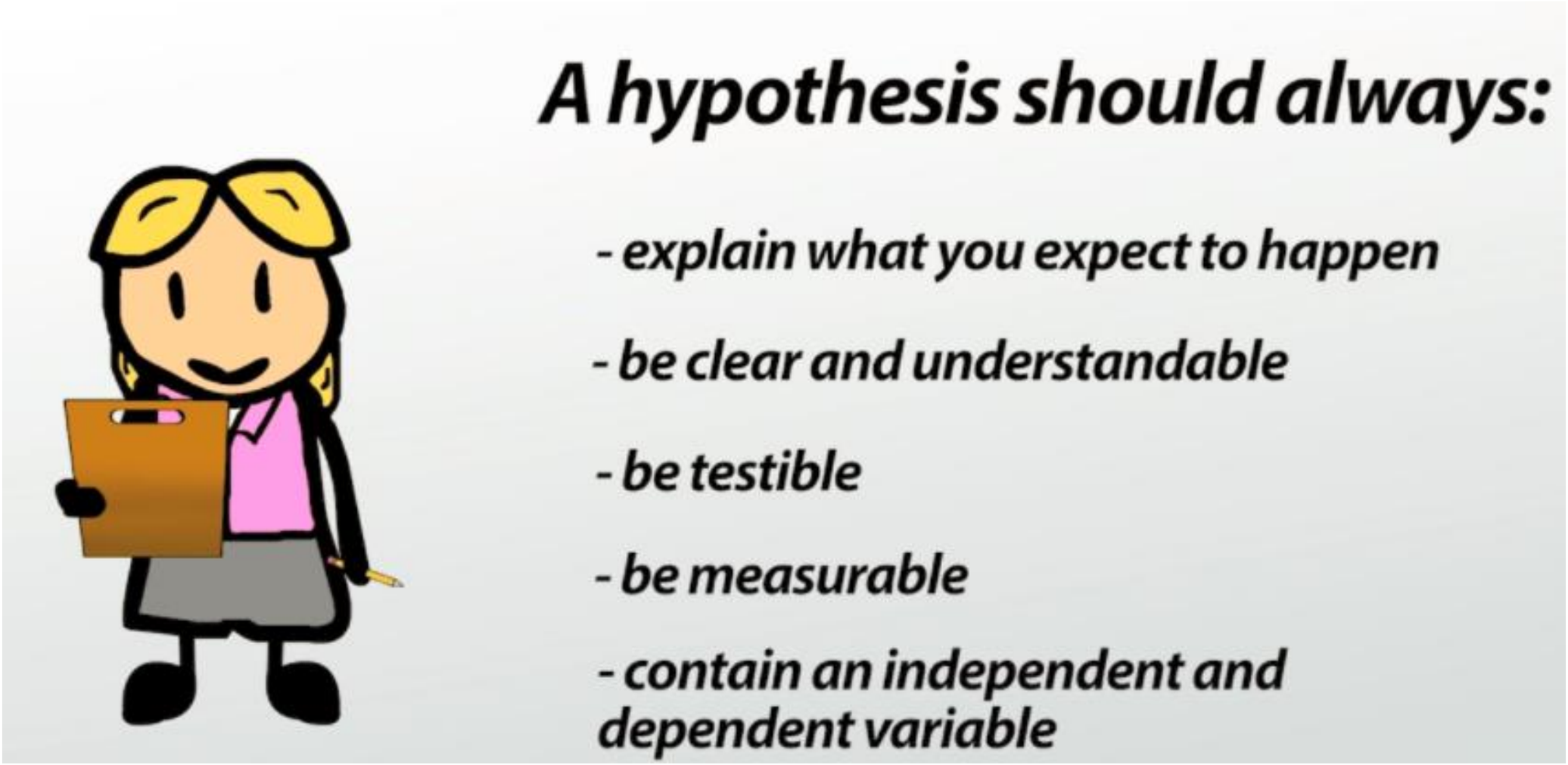
Fair test

A fair test is one in which only the independent variable has been allowed to affect the dependent variable.



Hypothesis

A proposal intended to explain certain facts or observations.



Interval

The quantity between readings, e.g. a set of 11 readings equally spaced over a distance of 1 metre would give an interval of 10 centimetres.

0 10 20 30 40 50 60 70 80 90 100

Interval = 10

0 5 10 15 20 25 30 35 40 45 50

Interval = 5

0 20 40 60 80 100 120 140

Interval = ?

Precision

Precise measurements are ones in which there is very little spread about the mean value. Precision depends only on the extent of random errors – it gives no indication of how close results are to the true value.



GOOD ACCURACY
GOOD PRECISION



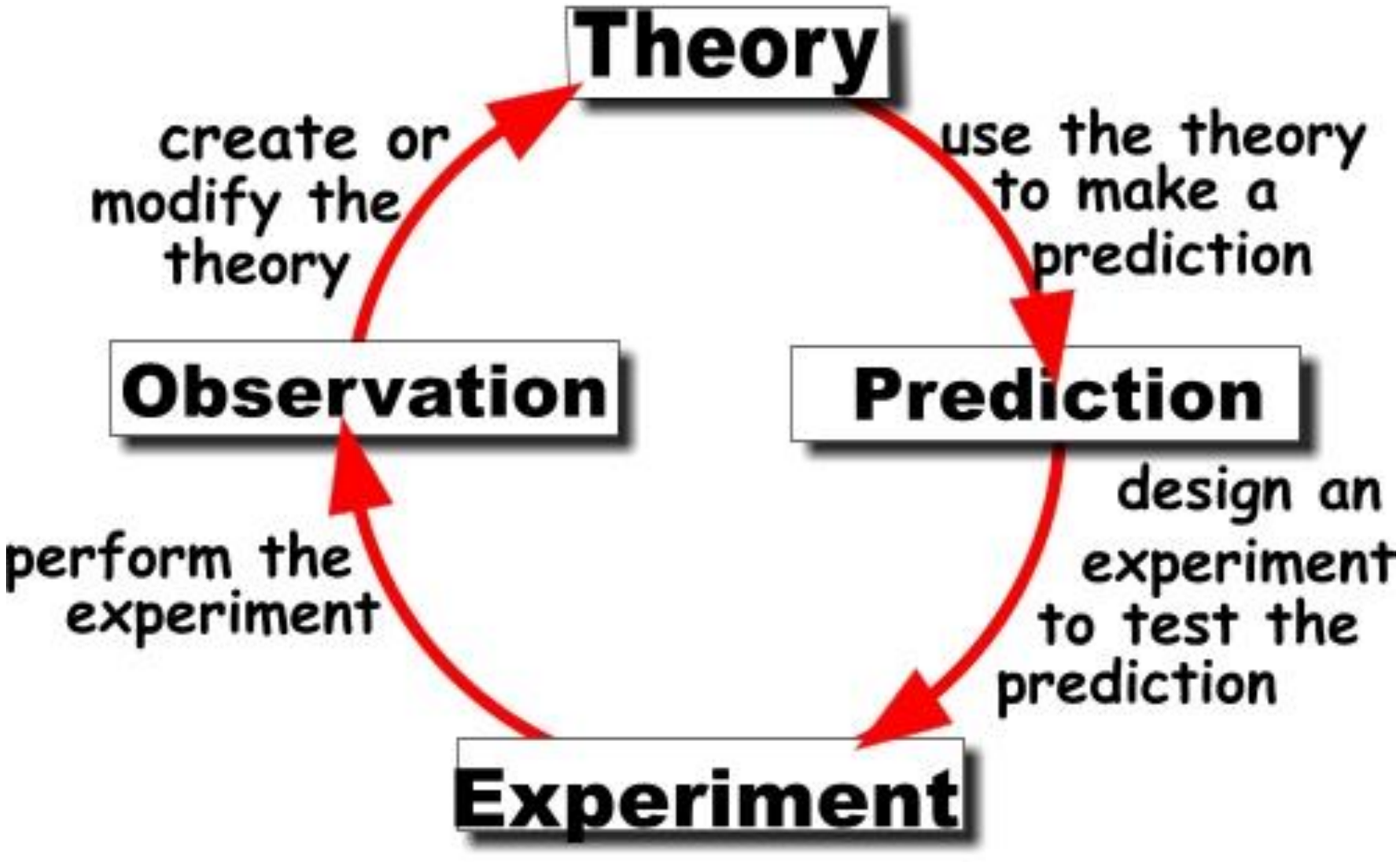
POOR ACCURACY
GOOD PRECISION



POOR ACCURACY
POOR PRECISION

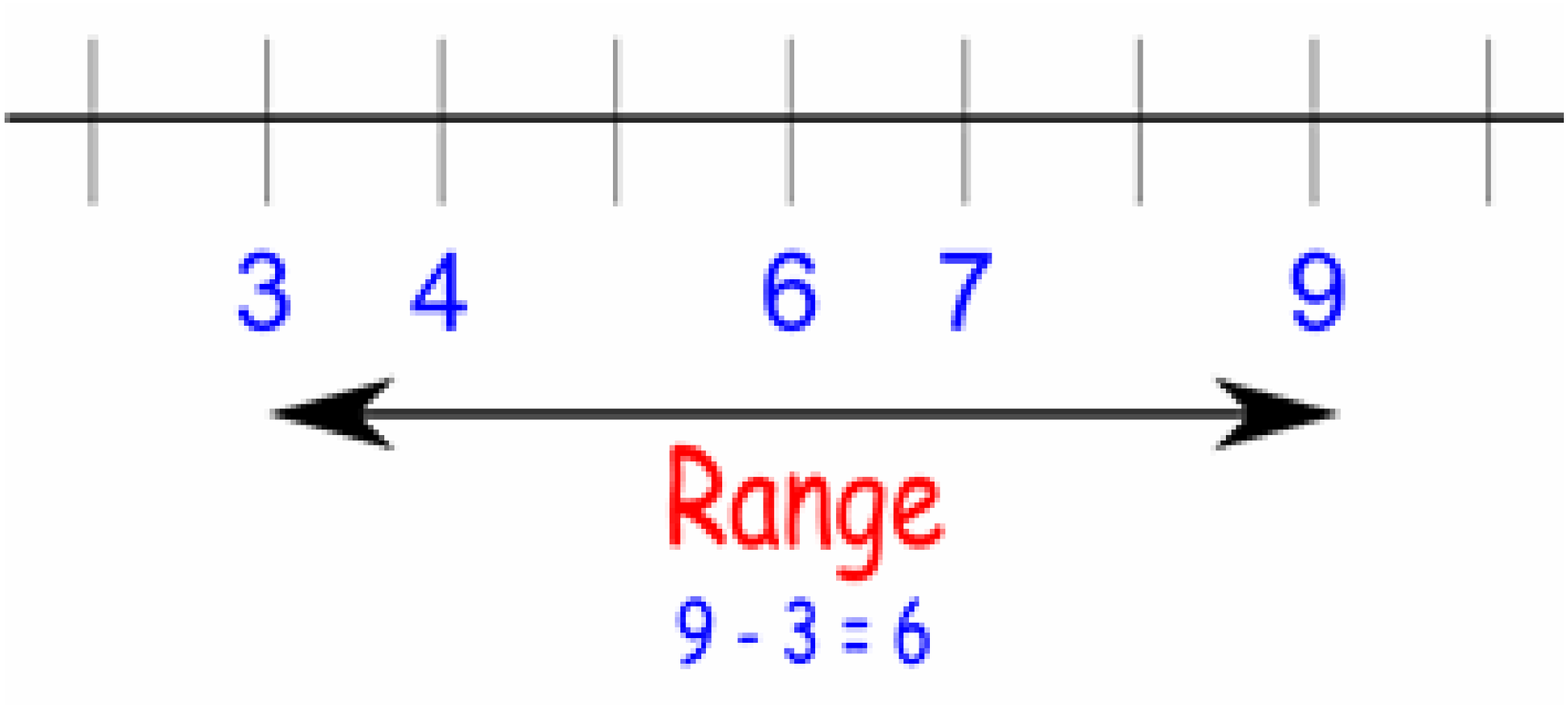
Prediction

A prediction is a statement suggesting what will happen in the future, based on observation, experience or a hypothesis.



Range

The maximum and minimum values of the independent or dependent variables; important in ensuring that any pattern is detected. For example a range of distances may be quoted as either: 'From 10 cm to 50 cm' or 'From 50 cm to 10 cm'.



Repeatable

A measurement is repeatable if the original experimenter repeats the investigation using the **same method and equipment** and obtains the same results.



ACCURATE BUT NOT REPEATABLE



REPEATABLE BUT NOT ACCURATE



ACCURATE AND REPEATABLE

Reproducible

A measurement is reproducible if the investigation is repeated by another person, or by using **different equipment or techniques**, and the same results are obtained.

If results are not ‘reproducible’ the results probably aren’t valid, and can’t be taken seriously. This is important for things like new drugs, or science that influences government policy

Key word

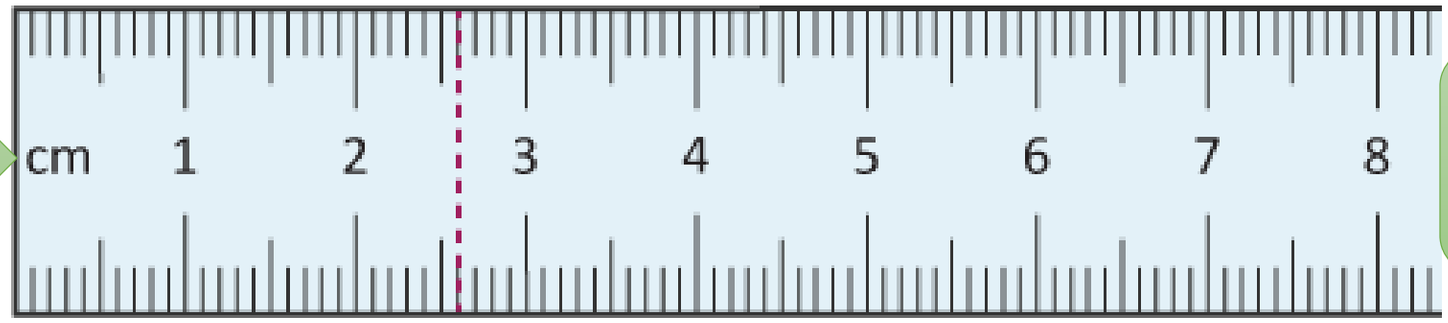
PEER REVIEW

(other scientists checking published results)

Resolution

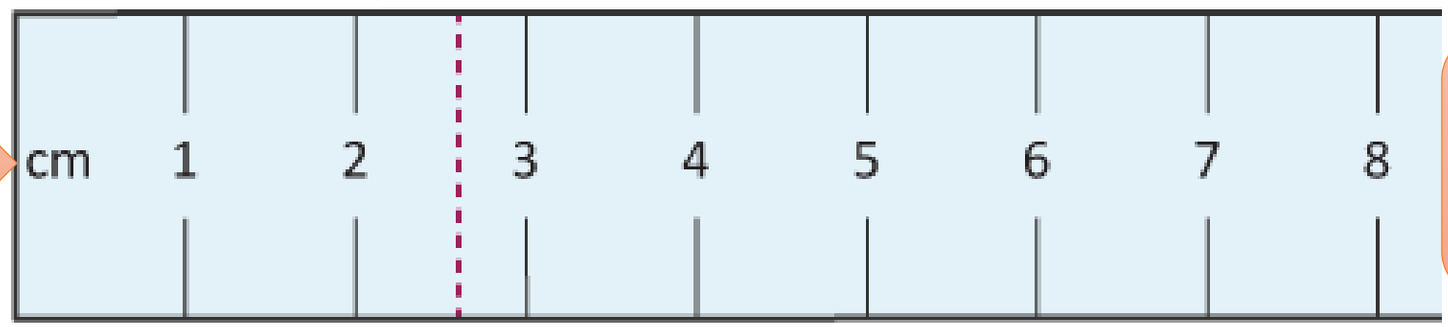
This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.

MORE precise



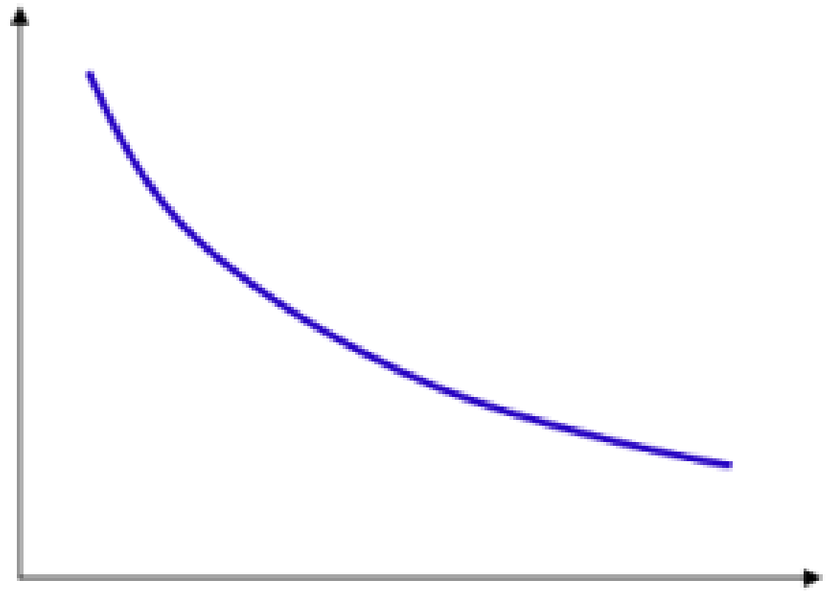
Resolution = 1 mm

LESS precise

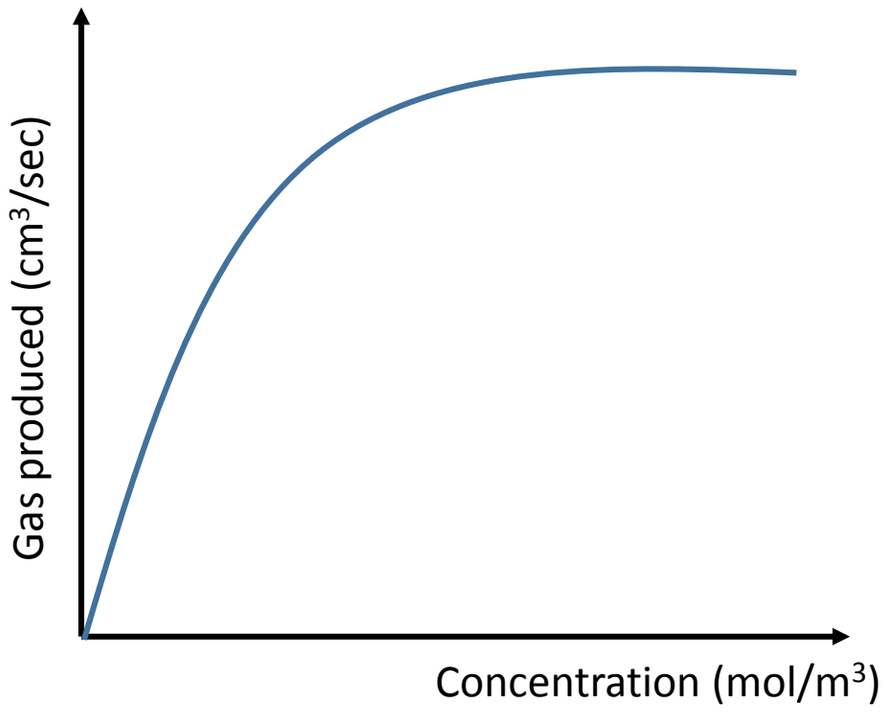


Resolution = 1 cm

Sketch graph



No labels



Labels, units and line of best fit

A line graph, not necessarily on a grid, that shows the general shape of the relationship between two variables. It will not have any points plotted and although the axes should be labelled they may not be scaled.

True value

This is the value that would be obtained in an ideal measurement





Error / Uncertainty

The interval within which the true value can be expected to lie, with a given level of confidence or probability, e.g 'the temperature decrease is **5.6°C ± 0.2 °C**.

	Trial 1	Trial 2	Trial 3	Trial 4	Mean
Initial temperature in °C	21.2	21.0	21.0	21.1	
Final temperature in °C	15.6	15.2	15.6	15.6	
Temperature decrease in °C	5.6	5.8	5.4	5.6	5.6

Uncertainty = 5.8 – 5.4 (largest – smallest)

= 0.4

Uncertainty

0.4 ÷ 2 = **± 0.2 °C**

Validity

Suitability of the investigative procedure to answer the question being asked. E.g. an investigation to find out if the rate of a chemical reaction depended upon the concentration of one of the reactants would not be a valid procedure if the temperature of the reactants was not controlled.



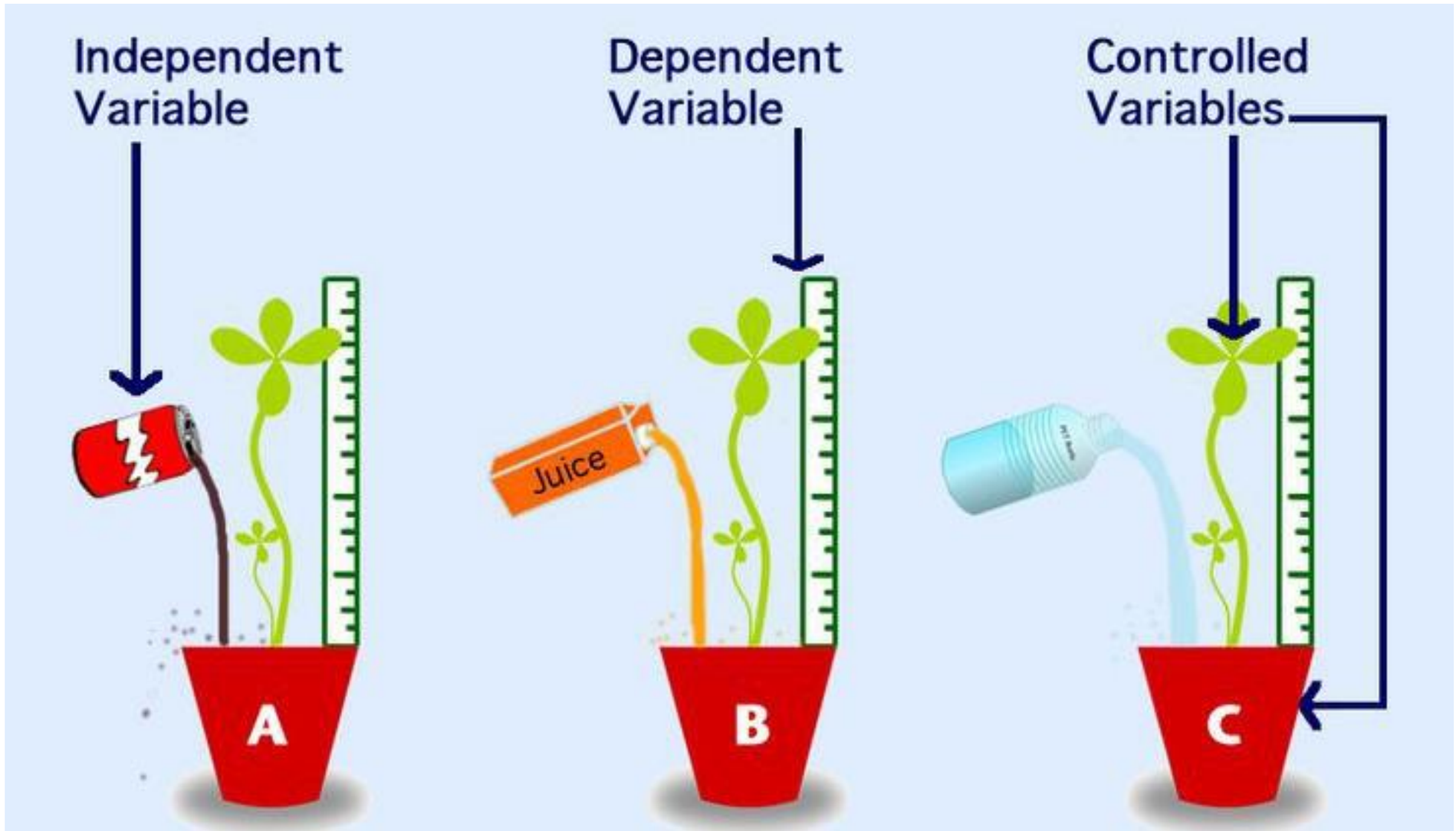
Valid conclusion

A conclusion supported by valid data, obtained from an appropriate experimental design and based on sound reasoning.



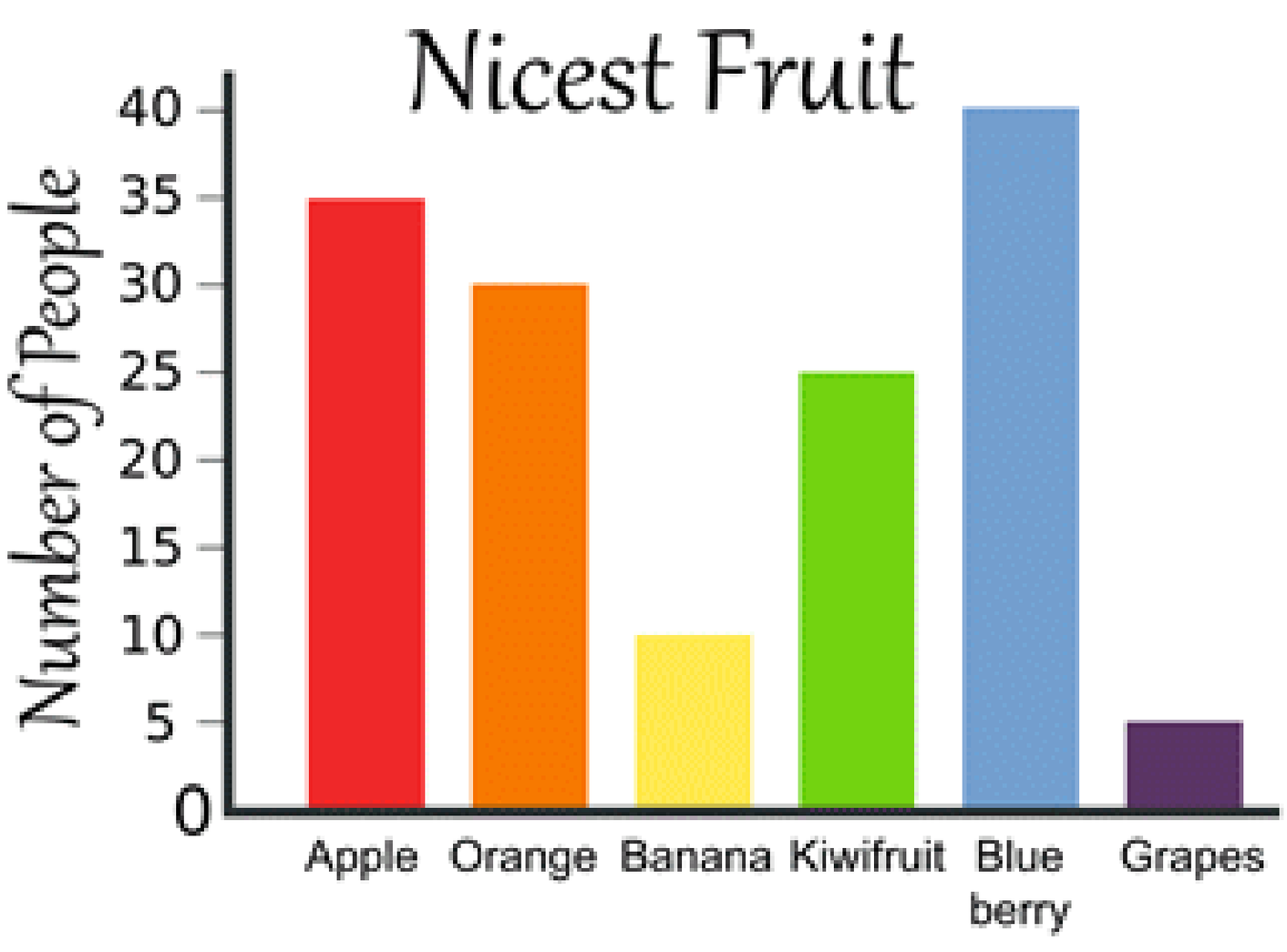
Variables

These are physical, chemical or biological quantities or characteristics.

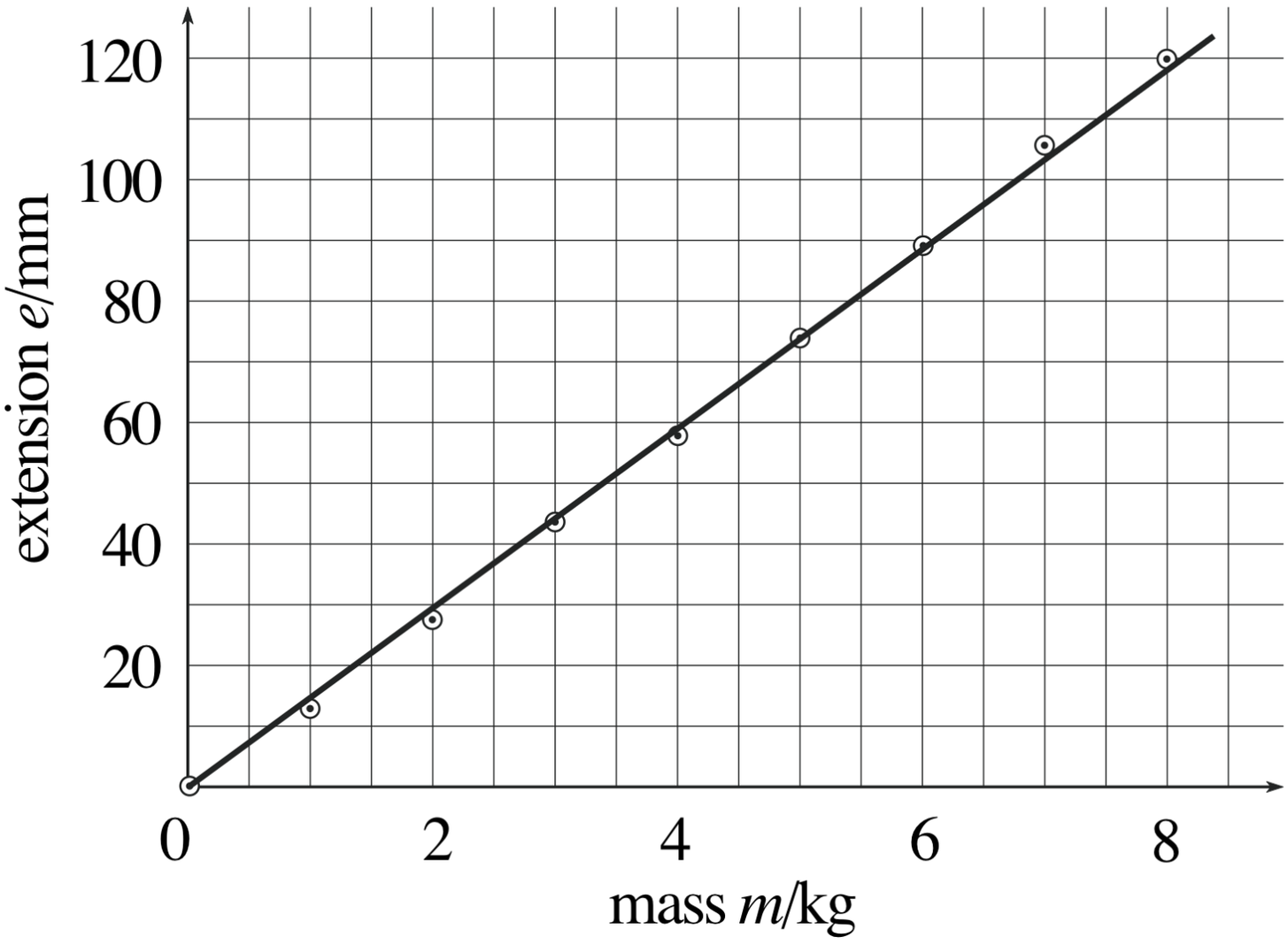


Categoric variable

Categoric variables have values that are labels, e.g. names of plants or types of material. A bar graph is drawn if an independent variable is categoric



Continuous variable



Continuous variables can have values (called a quantity) that can be given a magnitude either by counting (as in the case of the number of shrimp) or by measurement (e.g. light intensity, height, weight etc.). A **line/scatter graph** is drawn if the independent variable is continuous.

Control variable

Control variable is one which may, in addition to the independent variable, affect the outcome of the investigation and therefore has to be kept constant or at least monitored.

CONTROLLED VARIABLE

What I KEEP THE SAME

Dependent variable

Dependent variable is the variable of which the value is measured for each and every change in the independent variable

DEPENDENT VARIABLE

What I MEASURE



Independent variable

Independent variable is the variable for which values are changed or selected by the investigator

