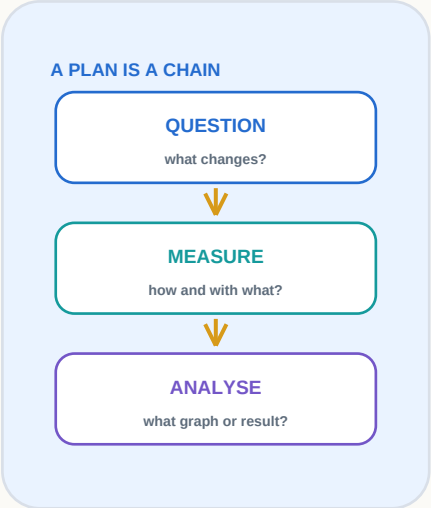
LESSON 3.1.1

Planning Investigations

from Units 1 and 2

A strong plan turns a physics question into a method that is measurable, controlled, safe and ready for analysis.



THE PLANNING SEQUENCE

AIM	VARIABLES	APPARATUS	METHOD	DATA	SAFETY
testable	IV, DV, controls	range + resolution	ordered actions	table + graph	hazard -> control

DEFINE THE VARIABLES

IV — INDEPENDENT VARIABLE

Change this deliberately across a useful range. State the values or intervals you will use.

DV — DEPENDENT VARIABLE

Measure the response with a named instrument and a clear technique.

C — CONTROL VARIABLES

Keep every relevant factor constant and explain how each one is controlled.

Write for this experiment: name the quantity, apparatus and action.

Generic phrases such as 'be careful' or 'repeat for accuracy' do not explain a method.

1 Choose measurements that can answer the aim

Select apparatus by range, resolution and technique - then make the readings repeatable and defensible.

APPARATUS CHOICE: QUANTIFY THE DIFFERENCE

MEASURING A 0.50 mm WIRE

Vernier calipers

resolution 0.10 mm

half-resolution uncertainty = ± 0.05 mm

percentage uncertainty = 0.05/0.50 × 100 = 10%

Micrometer

resolution 0.01 mm

half-resolution uncertainty = ± 0.005 mm

percentage uncertainty = 0.005/0.50 × 100 = 1.0%

CHOOSE MICROMETER

MEASUREMENT CHECKLIST

1 RANGE

The instrument must cover the smallest and largest expected readings.

2 RESOLUTION

Choose increments small enough to keep percentage uncertainty useful.

3 CALIBRATE

Check zero before use; record and correct a known zero error.

4 TECHNIQUE

Read scales at eye level; avoid parallax and use a set square where needed.

5 REPEATS

Repeat at each setting when scatter is possible; calculate a mean.

6 SAMPLING

Take at least six well-spaced values across the practical range.

RISK MANAGEMENT

HAZARD — What can cause harm? → **RISK** — How could harm occur? → **CONTROL** — What action reduces it?

Example: falling masses -> feet or hands may be struck -> use a catch tray and keep clear.

2 Plan the data before taking a reading

Example: determine the spring constant k by loading a spring and testing the model F = kx.

PREDICT THE ANALYSIS

Independent variable: mass m **Dependent variable: extension x**

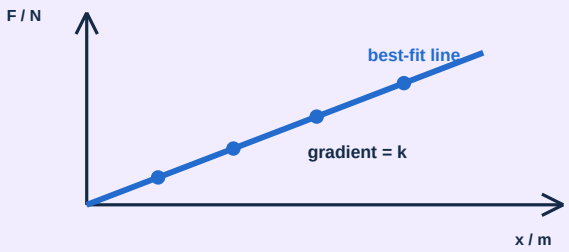
Controls: same spring, same reference point, same ruler position and stable support

DESIGN THE TABLE AND GRAPH

RAW AND PROCESSED DATA

mass m / kg	force F / N	mean x / m
0.050	0.49	0.012
0.100	0.98	0.024
...	...	...

PLOT F AGAINST x



$k = (F_2 - F_1)/(x_2 - x_1)$

TURN THE PLAN INTO A CONCLUSION

1 RECORD

Put units in the headings and use consistent decimal places for raw readings.

2 PROCESS

Calculate F = mg and extension x from the change in length; avoid early rounding.

3 PLOT

Use more than half the grid, plot points accurately and draw one line of best fit.

4 CONCLUDE

Use a large gradient triangle; state whether the data supports F proportional to x.

A complete plan explains how each reading becomes evidence for the stated aim.