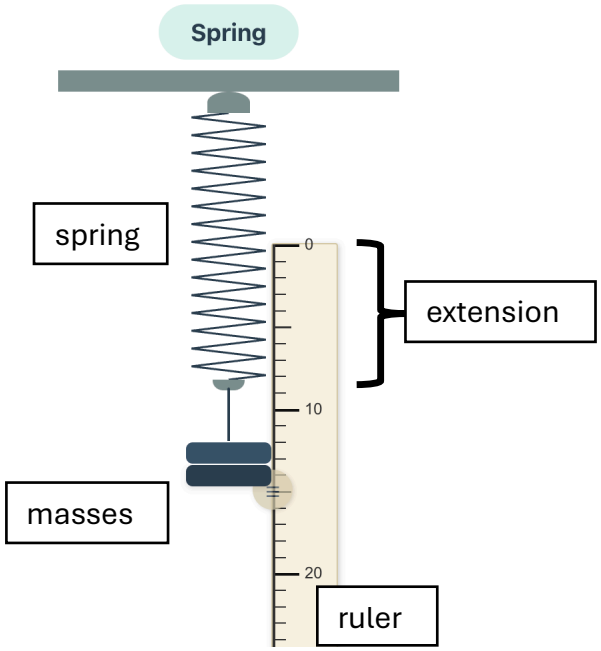
Investigating Extension

Aim: The aim of this experiment is to investigate the relationship between force and extension for a spring and a rubber band



Method:

1. Align the ruler with the bottom of the spring.
2. Add a 100g mass to the spring
3. Record the force (W = m x g) and the extension
4. Repeat this process for 4 more 100g masses
5. In a real-world scenario his should be repeated 3 times and a mean taken but no randomness has been built into this simulation
6. Plot a graph of Force (N) against Extension (cm)

Analysis of results:

- Plot a graph of the force against extension for the spring / rubber band / metal wire
- Draw a line or curve of best fit
- If the graph has a linear region (is a straight line), then the force is proportional to the extension. You can calculate the gradient, which will be the spring constant

Results:

Material	Mass (kg)	Force (N)	Extension (cm)

Repeat the process using a rubber band. This time you need to record the extension while loading (adding masses) and unloading (removing masses) as rubber behaves differently in these situations

Material	Mass (kg)	Force (N)	Loading Extension (cm)	Unloading Extension (cm)

Notes on the method:

The force, *F* added to the spring / rubber band / metal wire is the weight of the mass
The weight is calculated using the equation:

$$W = m \times g$$

Where:

- W = weight in newtons (N)
- m = mass in kilograms (kg)
- g = gravitational field strength on Earth in newtons per kg (N/kg)

Therefore, multiply each mass by gravitational field strength, *g*, to calculate the force, *F*
The force can be calculated by multiplying the mass (in kg) by 10 N/kg

NB: In some versions of this investigation you are asked to measure the full length of the spring and calculate extension from:

e = new length – original length

Extension

- Repeat the experiment for different stiffnesses of spring

Evaluation (for exam questions about the real investigation)

Systematic errors

- Make sure the measurements on the ruler are taken at eye level to avoid parallax error

Random errors

- The accuracy of such an experiment is improved with the use of a pointer (a fiducial marker)
- Wait a few seconds for the spring / rubber band / metal wire to fully extend when a mass is added, before taking the reading for its new length
- Make sure to check whether the spring has not gone past its limit of proportionality otherwise, it has been stretched too far

Safety

Wear safety glasses in case the spring breaks
Keep feet away from below the masses in case any fall
Use a mat or soft cushion below the masses to prevent damage
Use a G clamp to fix the clamp stand to the table to prevent it from tipping over