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The effect of forces on the extension of a spring

Dr George Dransfield: What's the effect of a force on the extension of a spring?

We can measure this with a spring, a clamp stand, a ruler, and some masses.

Hooke's law, shown on this graph, tells us the force applied to extend a spring is directly proportional to extension.

This is a linear relationship expressed with the equation force in newtons equals spring constant in newtons per metre multiplied by extension in metres.

Now I'm going to do an experiment to demonstrate Hooke's law.

First, measure the initial length of the spring with a ruler.

That's 28 millimetres.

Now, add a mass and measure the new length.

On Earth, each 10 gram mass exerts a force of approximately 0.1 newtons on the spring.

The new length is 32 millimetres.

The extension is the difference between the new length and the original.

So, 32 millimetres minus 28 millimetres, which equals 4 millimetres.

Next, draw a table like this and record the force in newtons, the length of the spring in millimetres, and the extension in millimetres.

And in metres.

Now, repeat this process as you add each mass to the spring.

Then you can create a graph of force against extension from your data.

The line is straight and passes through the origin.

This means that the force is directly proportional to the extension as we would expect based on Hooke's law.

That is, until you stretch the spring past its limit of proportionality.

Then the line starts to curve so the spring no longer obeys Hooke's law.

To find the spring constant, you can substitute in the values from the experiment.

For example, when the force was 0.5 newtons, the extension was 0.02 metres.

First, rearrange the formula to be spring constant equals force divided by extension.

Next, substitute the values from the experiment and calculate the spring constant.

This gives a spring constant of 25 newtons per metre for this particular spring.

To find the extension, always subtract the original length from the new length for each mass added.