Forces

3. Contact Forces

CONCEPT 3

LESSON GUIDE

TENSION AND COMPRESSION

PRECISE LEARNING POINTS

KNOW

I know how tension and compression forces affect an object.

APPLY

I can apply my knowledge of tension and compression to explain the behaviour of springs.

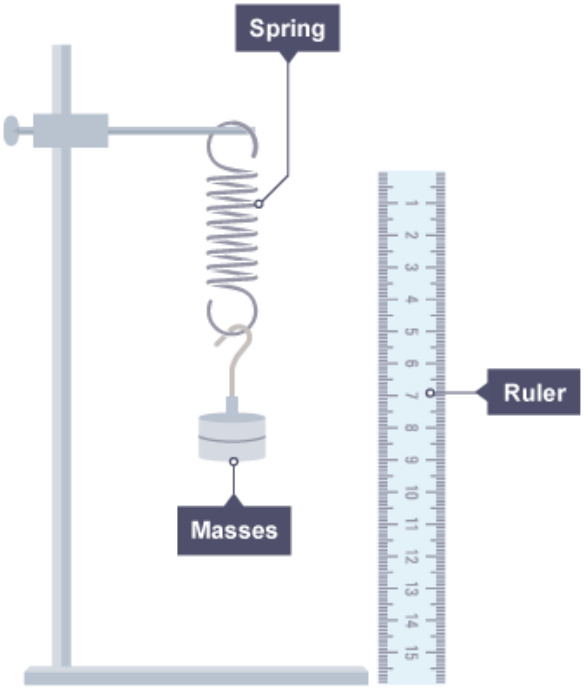
EXTEND

I can extend my knowledge of tension and compression to explain deformation of objects.

NOTES

Elastic materials, and objects such as springs, change shape when a force is exerted on them:

- stretching happens when the material or object is pulled, this is tension
- **compression** happens when the material or object is squashed



Some materials change by a tiny, unnoticeable amount even when a large force is applied for example the sole on your shoes when walking. Some can change with just a small force but then sometimes break, like a biscuit dipped in tea, these materials are **brittle**. And some materials are **elastic** this means they change shape when the force is applied but are then able to return to the original shape, such as an elastic band. This is called **elastic deformation**. However sometimes if you compress or a stretch an elastic material too much it is unable to return to its original shape. This is called **inelastic deformation**.

The **extension** of a material or a spring is its increase in length when pulled. Hooke's Law says that the extension of an elastic object is directly proportional to the force applied to it. In other words:

- if the force applied is doubled, the extension doubles
- if no force is applied, there is no extension

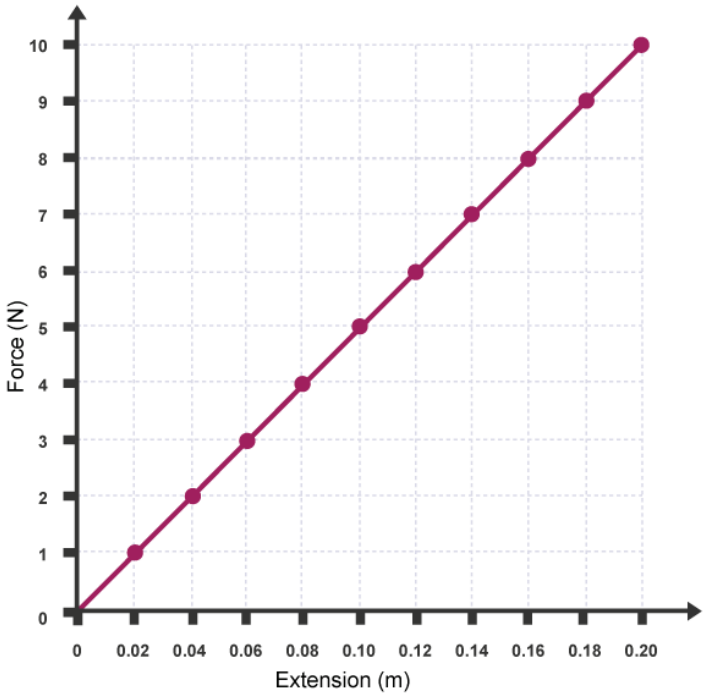
You can investigate Hooke's Law using a spring:

- hang the spring from a stand and clamp
- measure its length with a ruler
- hang an empty slotted mass carrier from the lower end and measure the new length of the spring
- keep adding more slotted masses, measuring the new length each time

For mass added, calculate the extension (new length – length at start). You can then plot a force-extension graph:

- plot force on the vertical (y) axis
- plot extension on the horizontal (x) axis

The graph should be a straight line that passes through the origin (0,0). The diagram shows an example of this.



On a force-extension graph:

- the steeper the line, the stiffer the spring
- the area under the line is the **work done** (energy needed) to stretch the spring.