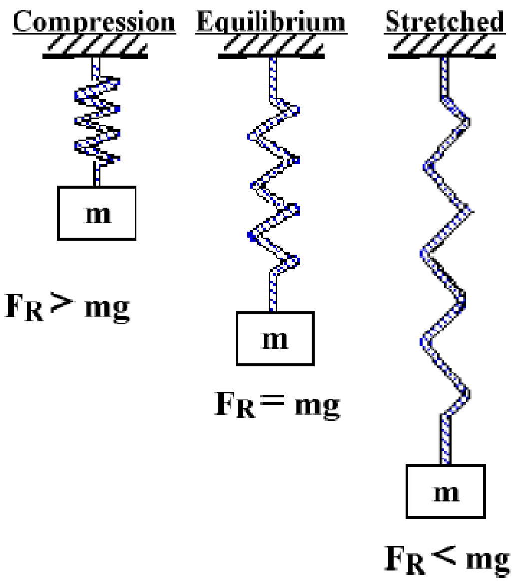
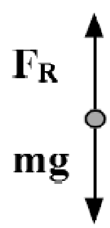
Notes on Hooke's Law & Elastic Potential Energy

Hooke's Law: The force exerted by a spring is proportional to the distance the spring is stretched or compressed from it's relaxed position. In equation form, **F = kx.**





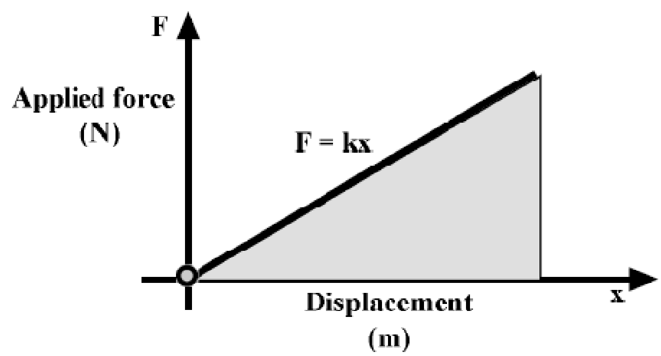
k = **spring constant** (units = N/m)
(This constant is a measure of the ***rigidity*** of the spring.)

x = **displacement** (units = m)
(*stretch* or *compression* of the spring)

> Actually, according to Newton's Third Law, there are *two* associated forces here. The **applied force**, that is, the amount of weight/force placed on the spring to make it stretch is equal and opposite to the **restoring force** applied by the spring to *restore* it to its equilibrium position. In other words:
>
> **the applied force:** $F_A = kx$
>
> **the restoring force:** $F_R = -kx$

Elastic Potential Energy = energy stored in the spring.

We need to find an expression to calculate the *potential energy* in the spring. To do this, we make use, once again, of the **area under the curve**. In this case, we use the formula for triangles, **A = 1/2 bh.**



Area = Work done on spring

$$= \frac{1}{2} x F = \frac{1}{2} x (kx) = \frac{1}{2} k x^2$$

$$E_{pe} = 1/2\, kx^2$$

= the elastic potential energy of the spring.
= the work done to *compress* or *stretch* the spring.

This method is very useful for calculating the work done on an object by a *variable* force, ie a force that's a function of time (or something else)... in essence, calculus.

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