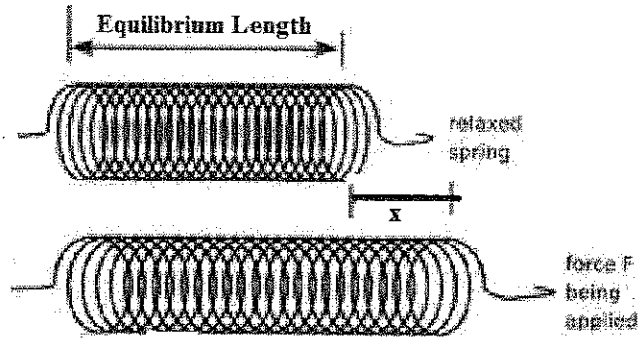
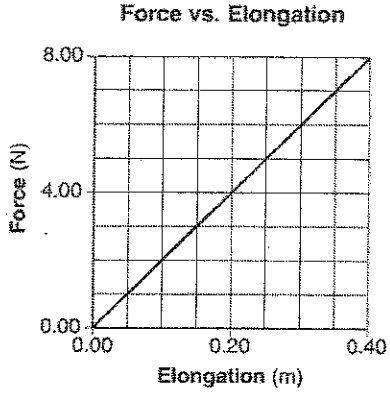
Skill 24: Spring Force (Hooke's Law)

A push or pull applied to a spring is known as the Spring Force (F_s). The Spring Force (F_s) is directly related to the change in length of a spring (x) and the spring constant (k).

$$F_s=kx$$

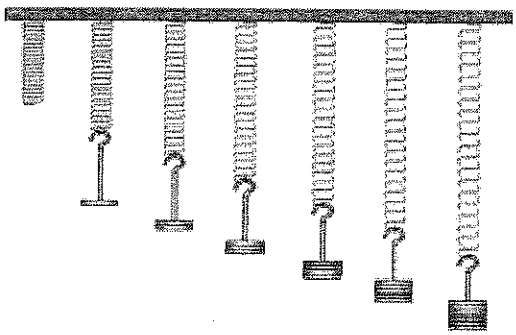
- Change in the length of spring (x) is the difference between the equilibrium length of a spring due to stretch or compression by a force. (also known as elongation or displacement)
- Spring Constant is the "stretchiness" of the spring which tells us how much force is needed to cause a stretch. A spring that stretches easily has a low "k" (Slinky) and a spring that is difficult to stretch has a high "k" (Garage door spring).





When Spring Force (F_s) is plotted versus elongation (x) for any given spring it reveals the graph to the right. Notice that a doubling in the independent variable, elongation (x) causes a doubling of the dependent variable, Force (F) and that slope of the line is the constant (k).

In the image below the mass is placed on a spring on the vertical axis which means the mass applies a force equal to weight (F_g). This means that in a vertical scenario, $F_s=F_g$ so $kx=mg$.



In the vertical
$F_s=F_g$
where
$F_s=kx$ and $F_g=mg$
which means
$kx=mg$
for a mass on a spring

Example:

A mass of 5kg is attached to a vertically aligned spring causing it to stretch 70cm. Determine the spring constant of the spring.

Given:	**Equation and substitution:**	**Solution:**
m=5kg	$F_s=kx$	k=70.07N/m
$F_s=F_g=mg=49.05$ N	49.05N=k(0.7m)	
x=70cm=0.7m		