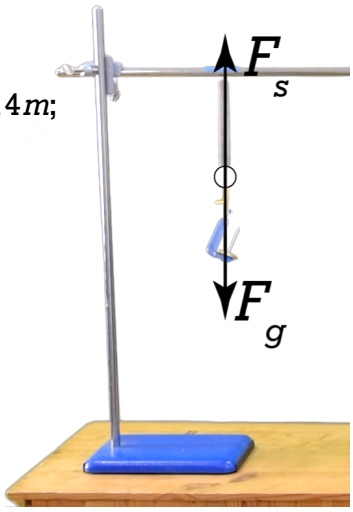
Flipping Physics Lecture Notes:

Determining the Spring Constant, k, with a Vertically Hanging Mass

Example: A vertically hanging spring with a natural length of 5.4 cm is extended to a length of 11.4 cm when 25 grams is suspended from it. What is the spring constant of the spring?



Knowns: $L_i = 5.4cm \times \frac{1m}{100cm} = 0.054m;\ L_f = 11.4cm \times \frac{1m}{100cm} = 0.114m;$

$m = 25g \times \frac{1kg}{1000g} = 0.025kg;\ k = ?$

$$\sum F_y = F_s - F_g = ma_y = m(0) = 0 \Rightarrow F_s = F_g$$

$$\Rightarrow kx = mg \Rightarrow k = \frac{mg}{x} = \frac{(0.025)(9.81)}{0.060} = 4.0875 \approx \boxed{4.1\frac{N}{m}}$$

Some things to realize:

- When plugging the equation into Newton's Second Law, use the magnitude of F_s, the spring force, because we already determined the direction of the spring force in the free body diagram.
- When plugging x, the displacement from equilibrium position, into the equation for the force of the spring, use the magnitude of x, because we already determined the direction of the spring force in the free body diagram.
- $x = L_f - L_i = 0.114 - 0.054 = 0.060m$