

## Section 2.5: Hooke's Law

In this lesson you will carry out an experiment in which you will relate the extension of a spring to the applied force.

To be successful in this lesson, you have to know the difference between weight and mass.

Recall: weight = mass x gravitational field strength

$$F_g = mg$$

As well, you need to know what is meant by a **direct proportion**.

**Direct Proportion** - A *direct proportion* occurs when the quotient of two numbers is a constant.

For example, if you are paid by the hour then your earnings are directly proportional to the number of hours worked. The **quotient** of the earnings and the number of hours worked will always be the same number (in this case the hourly rate of pay).

**Direct proportions** are normally written as  $y = mx$  where  $x$  and  $y$  are the two quantities in proportion and  $m$  is the **common ratio** (that is, the quotient  $y/x$  is the constant "m").

The graph of **y vs. x** is a linear one with **slope m**.

**Examples of quantities in direct proportion include:**

- wages and #hours worked
- commissions and quantity of goods sold
- amount of water in the tub and time the tap has been left on
- distance and time (for uniform motion)
- weight and mass.

[https://www.cdli.ca/courses/phys2204/unit02\\_org01\\_ilo04/b\\_activity.html](https://www.cdli.ca/courses/phys2204/unit02_org01_ilo04/b_activity.html)

## Questions

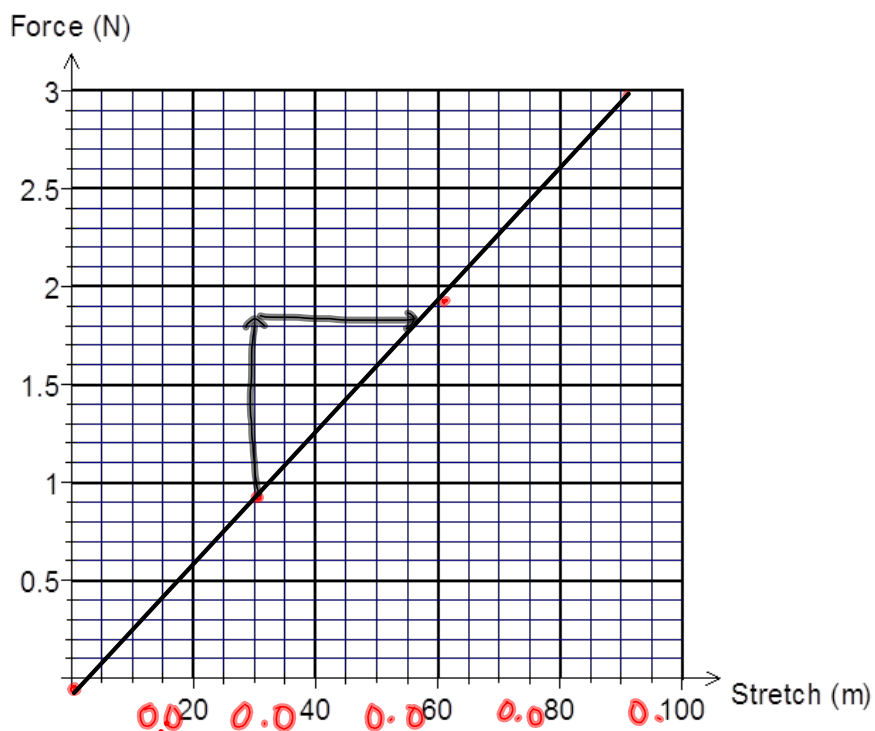
### 1. Table of Force vs Stretch

$y (L_2)$ Force (N)	$x (L_1)$ Stretch (m)
0	0
0.98 N	0.030
1.96 N	0.060
2.94 N	0.090
3.92 N	0.115

Sample Calculation:

$$F_g = (0.100 \text{ kg})(9.8 \text{ m/s}^2) = 0.98$$

### 2. Graph of Force vs Stretch



3. Construct the line of best fit. Use your calculator to perform a linear regression. Enter the stretch data in  $L_1$  and enter the force data in  $L_2$ . At this point you can calculate the regression equation.

Stat  $\rightarrow$  Calc  $\rightarrow$  4: Lin Reg. Enter  $L_1, L_2$

Vars  $\rightarrow$  y-Vars  $\rightarrow$  Enter 3 times.

$$y = mx + b$$

$$y = 33.75x$$

$$F = 33.75x$$

$\uparrow$   
spring constant (slope)  
(N/m)

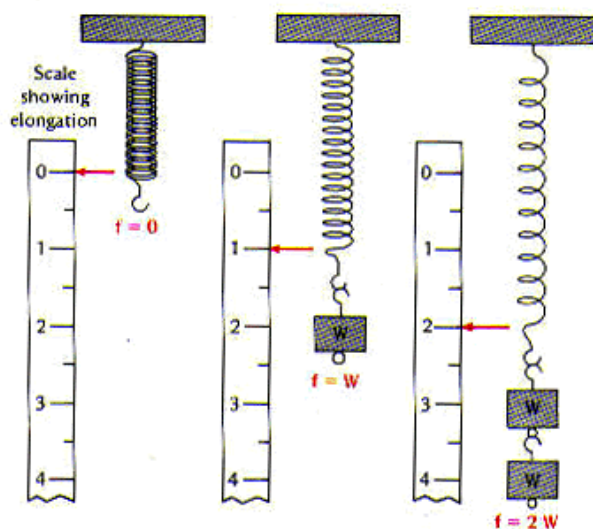
4. Hooke's Law states that stretch is proportional to the applied force and suggests that the relation  $F = k\Delta x$  can be used to relate the two, where  $k$  is the spring constant that is unique to the spring you are dealing with.

Explain why Hooke's Law applies here.

What is the value of  $k$  for the spring in the animation?

[http://www.4physics.com/phy\\_demo/HookesLaw/HookesLaw.html](http://www.4physics.com/phy_demo/HookesLaw/HookesLaw.html)





**Hooke's Law - Force proportional to Stretch**