

## 15.2: Hooke's Law

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If a mass is attached to a spring and the spring is extended or compressed, then the spring will exert a force on the mass that's proportional to the distance that the mass is moved from its “natural” position (the *equilibrium position*). This fact was discovered by English physicist Robert Hooke, and is known as *Hooke's law*. It is expressed mathematically as

$$F = -kx, \quad (15.2.1)$$

where  $F$  is the force,  $x$  is the distance the mass is moved away from the spring's equilibrium position. The constant  $k$  is called the *spring constant*, and is a measure of the stiffness of the spring. The spring constant has units of N/m.

Hooke's law is an example of an *empirical law*: it's something that has been found, by experiment, to be at least approximately true over some range of physical conditions. In the case of a spring, Hooke's law applies over a range of positions  $x$ , but it breaks down if you compress the spring to the point that the turns of the spring are touching, or if the spring is extended beyond its elastic limit.

Hooke's law may be used to describe not only forces due to springs, but can also describe the reaction of elastic materials. It can also be used to *approximately* describe many other forces over a small range of displacements  $x$ .

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