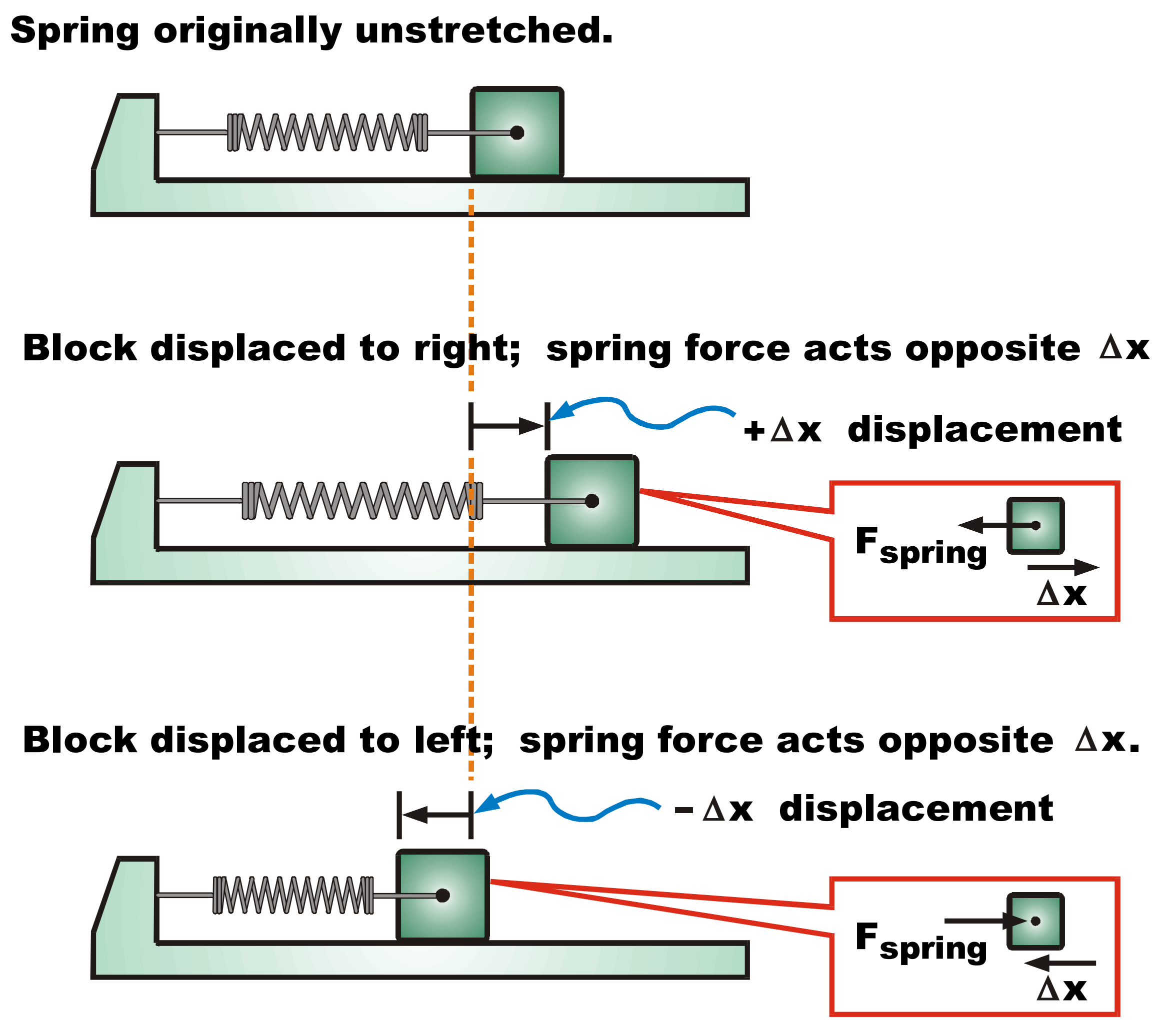
Work-Energy (WE) Equation for Particles

Comments about the sign on the work term for springs.

Consider an unstretched spring:

If the block is displaced to the right or the left, the spring force acts opposite either displacement. This, by definition, is negative work.



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Comments about the sign on the work term for springs.

Conclusion 1: A spring's natural action, when originally unstretched ($s_1 = 0$), is to do negative work.

$$\boxed{U_{Spring} = -\frac{1}{2}k\left[s_2^2 - \overset{0}{s_1^2}\right] = -\frac{1}{2}k\,s_2^2}$$

Conclusion 2: If some original stretch (s_1) is present, the spring may release stored energy to the system and do positive work. The standard form of the spring work term

$$\boxed{U_{Spring} = -\frac{1}{2}k\left[s_2^2 - s_1^2\right]}$$

will ensure the proper sign if the correct initial (s_1) and final (s_2) stretches are inputted.

For example, if a spring has stretch at the original position (s_1) but no stretch at the final position ($s_2 = 0$), then energy will be released from the spring to the system. The spring does positive work. The equation accounts for this.

$$U_{Spring} = -\frac{1}{2}k\left[\cancelto{0}{s_2^2} - s_1^2\right] = +\frac{1}{2}k\,s_1^2$$

Another example: If a spring has original stretch greater than the final stretch ($s_1 > s_2$), then the difference between the squared terms is negative, and the overall work is positive. The net effect is that energy is released from the spring to the system.

$$U_{Spring} = -\frac{1}{2}k\left[s_2^2 - s_1^2\right] = \text{Positive Work!}$$

$$\boxed{\text{if } s_1 > s_2}$$