Simple Harmonic Motion

most basic model back and forth (Oscillatory)
Aside on Potential Energy

Hooke's Law:

\[ F_{spring} = k \times x \]

where:

- \( F_{spring} \) is the spring force
- \( k \) is the spring constant
- \( x \) is the distance from the equilibrium point

\[ U_s = \frac{1}{2} k x^2 \]

\[ |F_s| \]

We used the area under the curve of the \( F \) vs \( x \) graph to get the potential energy. We can assume that the slope of a potential graph would give us the force.

The slope of the spring potential is always positive when \( x > 0 \) --> \( F \) spring should be negative when \( x > 0 \).
Definition of SHM

1. If the potential energy is quadratic, then you have SHM.

2. Differential Equation: An equation that relates the slope of a quantity to that quantity's value.

   \[ F_{\text{spring}} = -kx \quad F_{\text{net}} = ma \]

   \[ ma = -kx \]

   \[ a = \frac{k}{m}x \]

   \[ x'' = -\omega^2 x \]

   \[ a = -\omega^2 x \]

   \[ \omega = \sqrt{\frac{k}{m}} \]

3. If there is a linear restoring force, then you have simple harmonic motion.