

AP Registration

Today is the last day to register without an added late fee!

There will be no registering after next week.

Simple Harmonic Motion

- Many things exhibit periodic motion.
 - Satellites orbiting the earth.
 - Playground swings
 - Water waves
 - Atomic Oscillations
- Certain vocabulary associated with periodic motion.


Vocabulary

Amplitude (A) - The maximum displacement from equilibrium.

Period (T) - The time it takes to complete one full cycle of motion.

Units = seconds (s)

Frequency (f) - The number of complete cycles or vibrations per unit of time.

Units = hertz (Hz)  $\text{Hz} = \frac{1}{\text{s}}$

$$T = 1/f$$

- Only certain periodic motion is simple harmonic motion.

> Examples:

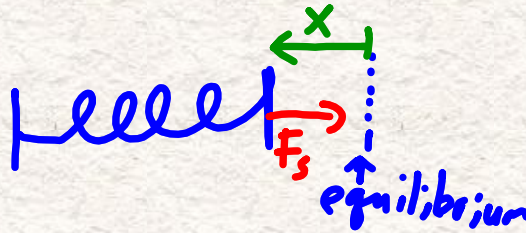
- Mass on a Spring
- Pendulums (at small amplitudes)
- Oscillating Molecules

Periodic
SHM Motion

- In order to be considered Simple Harmonic Motion, the motion must obey **Hooke's Law**.
 - Hooke's Law is used on springs.

Hooke's Law:

$$F_s = -kx$$



F_s = Force exerted by spring (N)

k = Spring constant (N/m) ← always positive

x = Distance the spring is stretched or compressed (m)

Recall energy of a spring:

$$PE_s = 1/2 kx^2$$

- Energy is shifting from *kinetic* to *potential* and back again.
- Energy of a system depends on amplitude.

Try to derive an equation for the velocity of the mass on a spring as a function of position?

**Hint - Use conservation of energy*

$$E_i = E_f$$

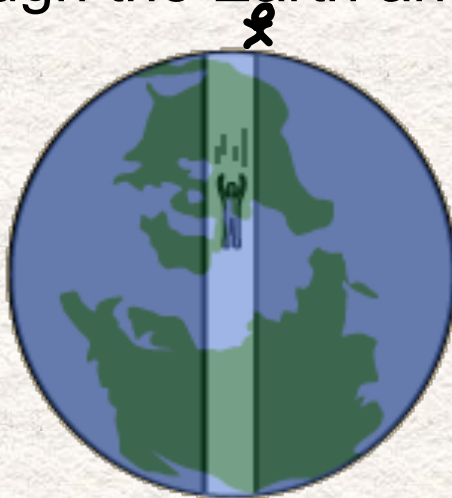
$$PE_{\max} = PE + KE$$

$$\frac{1}{2}kA^2 = \frac{1}{2}kx^2 + \frac{1}{2}mv^2$$

$$mv^2 = kA^2 - kx^2$$

$$v = \sqrt{\frac{k}{m}(A^2 - x^2)}$$

A satellite orbiting the Earth exhibits periodic motion, but what would happen if you dug a hole through the Earth and jumped in?



Discuss what you think would happen and why.

<http://www.pbslearningmedia.org/resource/oer08.sci.phys.maf.gravitynsn/gravity-at-earths-center/>