Vibrating Objects
Lesson Notes

Learning Outcomes

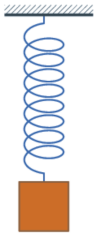
- What are the fundamental features of vibrational motion?
- Why does a vibrating object return to its original position?

Bobblehead Dolls and the Physics of Vibrating Objects

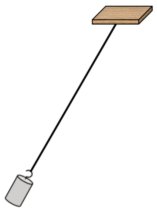
- The head assumes its usual resting position until it is pushed, pulled, or somehow disturbed.
- Once disturbed, the head starts *doing the back and forth* (wiggles, vibrates, oscillates)
- The head is vibrating about a fixed position. (Vibrational motion ≠ translational motion)
- The vibrations tend to die out due to friction (sometimes referred to as **damping**).

Examples of Vibrating Objects

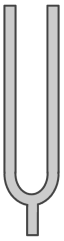
Mass on a Spring



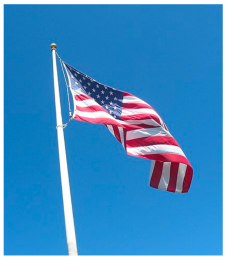
Vibrating Pendulum



Tines of a Tuning Fork



Flag "waving in the wind".



Sources:

1) Spring: https://commons.wikimedia.org/wiki/File:Simple_harmonic_oscillator.gif
2) Flag: https://commons.wikimedia.org/wiki/File:An_American_flag_waving_in_the_wind_on_a_flagpole.jpg

What is Damping?

- A vibrating object possesses mechanical energy.
- The amount of mechanical energy is dependent upon the *amplitude* of vibration.
- Over the course of time, the vibrating object interacts with the surroundings through friction, air resistance, or other forces … causing a **dissipation** of vibrational energy.
- As energy is lost, the vibrational amplitude gradually decreases … until finally the object stops vibrating and its energy is fully dissipated.
- The gradual reduction in the amplitude of vibration is referred to as **damping**.

The Restoring Force

- A pushed object is set into translational motion and continues moving at constant speed once the push ceases.
- A vibrating object is different, because once disturbed and set in motion, a **restoring force** acts on the object to slow it down and eventually return it towards its original resting position.
- The further the object moves from the resting position, the greater the restoring force becomes.
- The restoring force is always directed towards the resting position. So when an object moves past the resting position, the restoring force begins resisting its *wayward* motion to return it back towards the resting position.

A Vibration vs. a Wave

A vibration is …	A wave is …
A wiggle in time.	A wiggle in time spread across space.
A single wiggler.	A collection of interdependent wigglers.