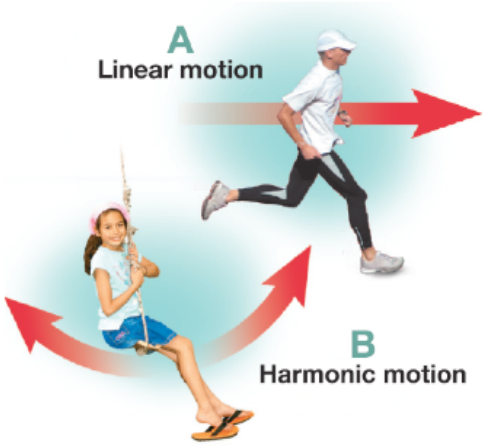
UNIT EIGHT: Waves

- Chapter 24 Waves and Sound

Chapter Twenty-Four: Waves and Sound

- 24.1 Waves and Sound
- 24.2 Properties of Waves
- 24.3 Sound

24.1 Harmonic motion

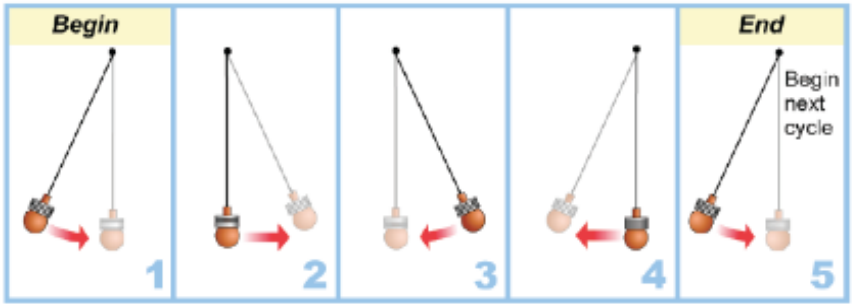


A. **Linear motion gets us from one place to another.**

B. **Harmonic motion is motion that repeats over and over.**

24.1 Harmonic motion

- A pendulum is a device that swings back and force.
- A cycle is one unit of harmonic motion.



24.1 Harmonic motion

- Harmonic motion can be fast or slow, but speed constantly changes during its cycle.
- We use period and frequency to describe how quickly cycles repeat themselves.
- The time for one cycle to occur is called a period.

24.1 Harmonic motion

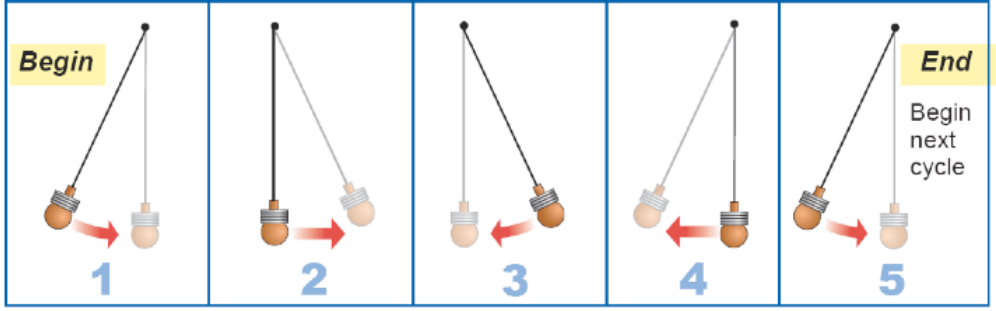
- The frequency is the number of complete cycles per second.
- Frequency and period are inversely related.
- One cycle per second is called a hertz, abbreviated (Hz).

Period and Frequency

Period (seconds) → $T = \frac{1}{f}$ ← *Frequency* (hertz)

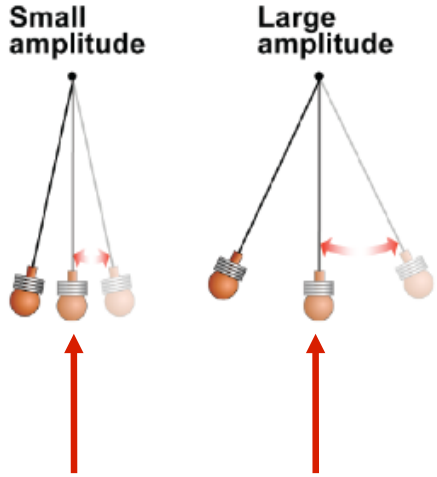
Frequency (hertz) → $f = \frac{1}{T}$ ← *Period* (seconds)

A period is the time to complete one cycle of harmonic motion.



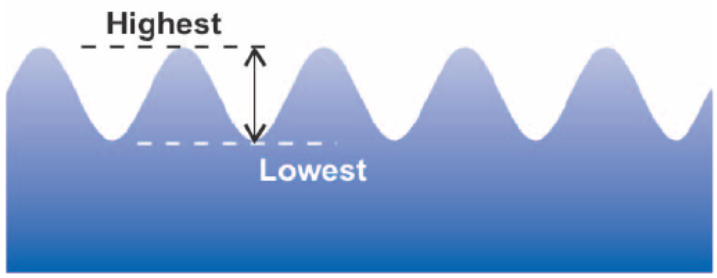
24.1 Amplitude

- Amplitude describes the "size" of a cycle.
- The amplitude is the maximum distance the oscillator moves away from its equilibrium position.



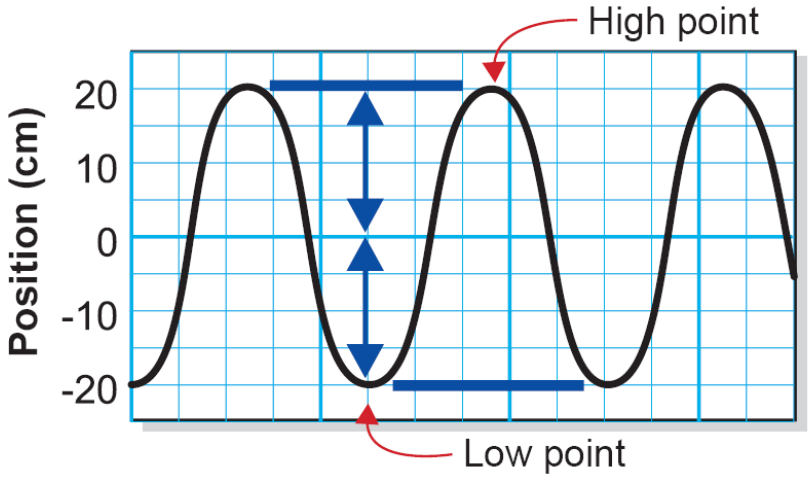
24.1 Amplitude

- The amplitude of a water wave is found by measuring the distance between the highest and lowest points on the wave.
- The amplitude is <u>half</u> this distance.



Amplitude

$$Amplitude = \frac{1}{2}\left(\begin{matrix}\text{high}\\ \text{point}\end{matrix} - \begin{matrix}\text{low}\\ \text{point}\end{matrix}\right)$$

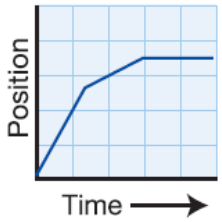


24.1 Damping

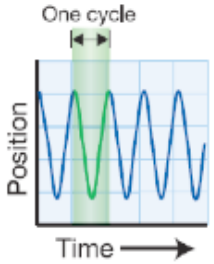
- Friction slows a pendulum down, just as it slows all motion.
- Damping is the gradual loss of amplitude.

24.1 Graphs of harmonic motion

Typical Linear Motion Graph

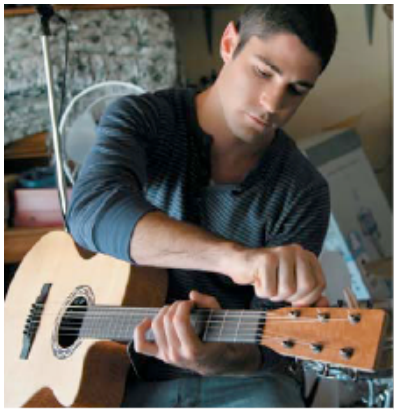


Typical Harmonic Motion Graph



- A graph is a good way to show harmonic motion because you can quickly recognize cycles.
- Graphs of linear motion do not show cycles.

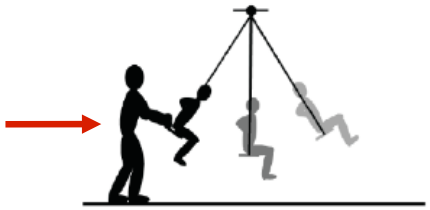
24.1 Natural frequency and resonance



- The natural frequency is the frequency (or period) at which a system naturally oscillates.
- Every system that oscillates has a natural frequency.

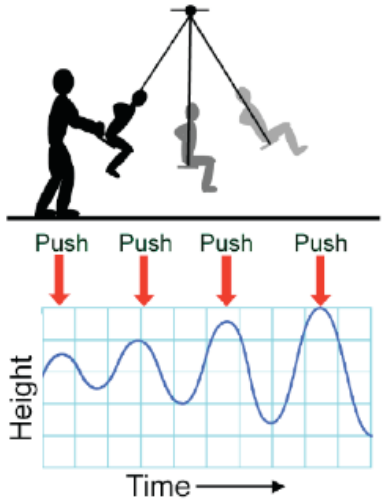
24.1 Natural frequency and resonance

- You can get a swing moving by pushing it at the right time every cycle.



- A force that is repeated over and over is called a periodic force.

24.1 Natural frequency and resonance



- Resonance happens when a periodic force has the same frequency as the natural frequency.
- When each push adds to the next one, the amplitude of the motion grows.