Frequency vs. Period
Lesson Notes

Learning Outcomes
- What is the meaning of the terms frequency and period and how are they related?
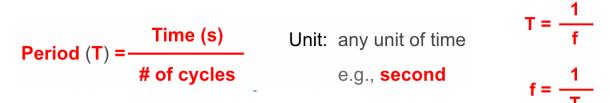- How are frequency and period calculated?

Frequency of a Wave
- The source of all waves is a vibrating object. Particles of the medium vibrate at the same frequency as the source.
- **Frequency (f)** = the number of occurrences of a periodic event per time.
- Frequency describes *how often* events occur.
- If a periodic and repeating even has a frequency of 4.0 Hz, then that event takes place four times per second.

$$f = \frac{\text{\# of cycles}}{\text{Time (s)}}$$ Units: **cycles/second**

Hertz (abbrev. **Hz**)

Period of a Wave
- **Periodic events**: events that occur repeatedly at a predictably regular rate
- **Examples**: Earth's rotation on its axis, Earth's orbit about the Sun, the rotation of the hands on a clock, the back-and-forth vibrations of a pendulum
- The **period** is the time for one complete cycle to occur.
- Waves are periodic - regular and repeated disturbances that travel through a medium.
- Period (**T**) and frequency (**f**) are reciprocals of each other.

$$\text{Period (T)} = \frac{\text{Time (s)}}{\text{\# of cycles}}$$ Unit: any unit of time

e.g., **second**

$$T = \frac{1}{f}$$

$$f = \frac{1}{T}$$

Frequency is NOT Speed
- Don't be fooled! The **frequency** of a wave does not convey any information about the **speed** of a wave.
- *"How fast"* does not describe a wave's frequency.
- **Speed** refers to the distance an object travels per unit of time. Words like fast and slow describe the speed of objects.
- An object could have a speed of 0 m/s and have a high frequency. How fast ≠ How often!!!

$$\text{speed} = \frac{\text{distance}}{\text{Time (s)}}$$ $$f = \frac{\text{\# of cycles}}{\text{Time (s)}}$$

Practice

$$f = \frac{\text{\# of cycles}}{\text{Time (s)}} \qquad\qquad T = \frac{\text{Time (s)}}{\text{\# of cycles}}$$

Example 1: A wave machine completes 150 vibrational cycles in 30 seconds. Determine the frequency and the period.

$$f = \frac{150 \text{ cycles}}{30 \text{ s}} = \textbf{5 Hz} \qquad\qquad T = \frac{30 \text{ s}}{150 \text{ cycles}} = \textbf{0.2 s}$$

Example 2: Frieda the fly flaps its wings 500 times in 5 seconds. Determine the frequency and the period.

$$f = \frac{500 \text{ cycles}}{5 \text{ s}} = \textbf{100 Hz} \qquad\qquad T = \frac{5 \text{ s}}{500 \text{ cycles}} = \textbf{0.01 s}$$