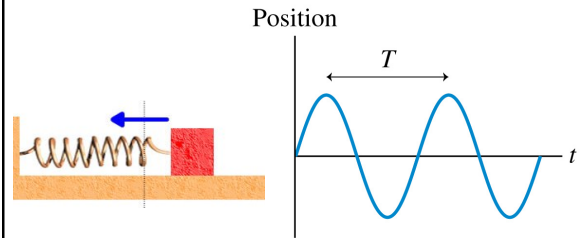


## PHY132H1F Introduction to Physics II – Jason Harlow

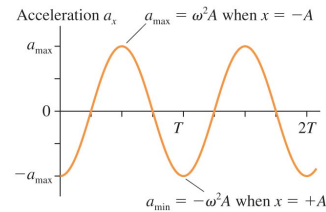
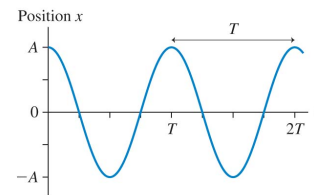
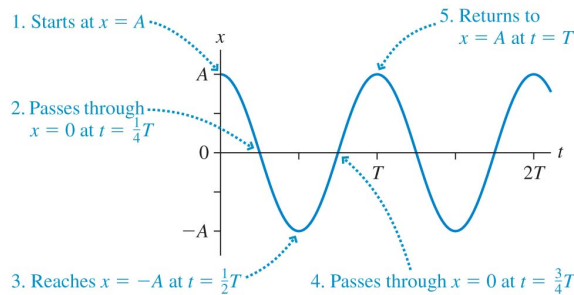
- Hello and welcome!
- This is the follow-up course to be taken after PHY131.
- We will study waves, sound, light, electricity, magnetism and special relativity.
- Required Text: **“Physics for Scientists and Engineers”** 2nd Edition (Copyright 2008) by Randall Knight.

## Sinusoidal oscillations = Simple Harmonic Motion (SHM)



## Simple Harmonic Motion

The position-versus-time graph for simple harmonic motion.



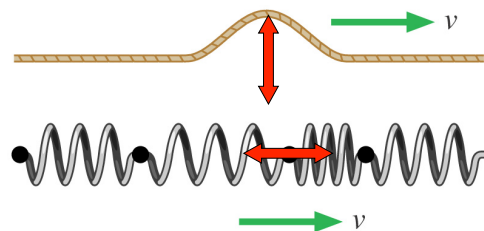
## Chapter 20. Traveling Waves

You may not realize it, but you are surrounded by waves, some of which are passing through your body right now! The “waviness” of a water wave is readily apparent, from the ripples on a pond to ocean waves large enough to surf. It’s less apparent that sound, light and radio are also waves.

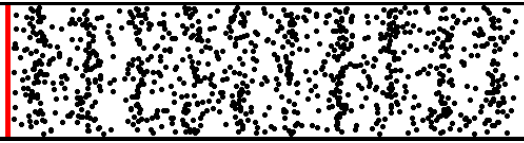


**Chapter Goal:** To learn the basic properties of traveling waves.

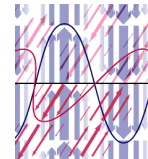
## Transverse versus Longitudinal



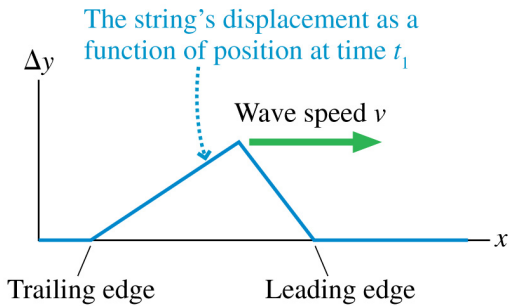
**Sound Waves** result from periodic oscillations of air molecules, which collide with their neighbours and create a disturbance which moves at the speed of sound.



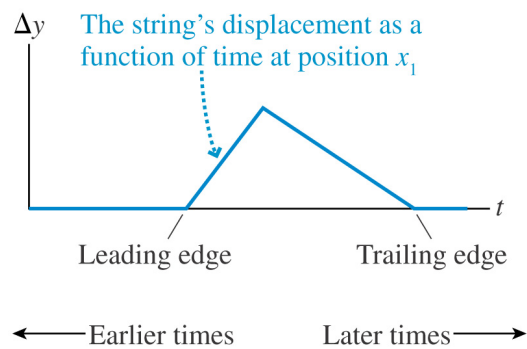
**Electric and Magnetic** fields, when oscillated, can create waves which carry energy. At the right frequency, we see electromagnetic waves as **Light**. At other frequencies, we call it radio, X-rays, and more.



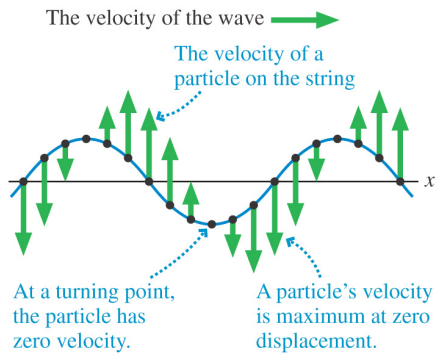
### Snapshot Graph



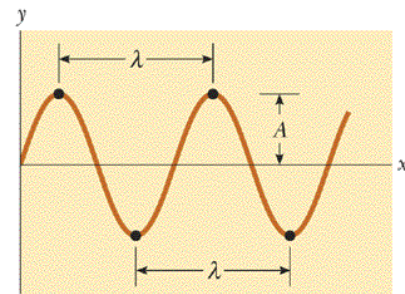
### History Graph



### Sinusoidal Waves

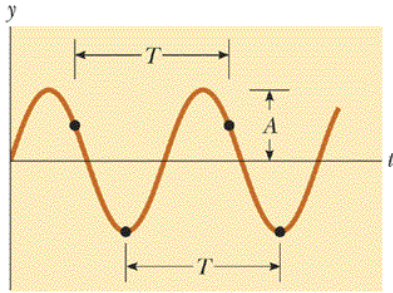


### Sinusoidal Wave Snapshot Graph



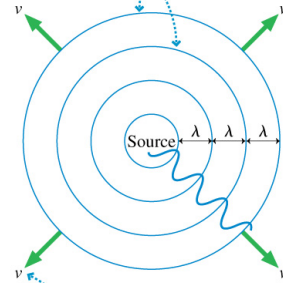
$k = 2\pi/\lambda$  is the wave number

### Sinusoidal Wave History Graph



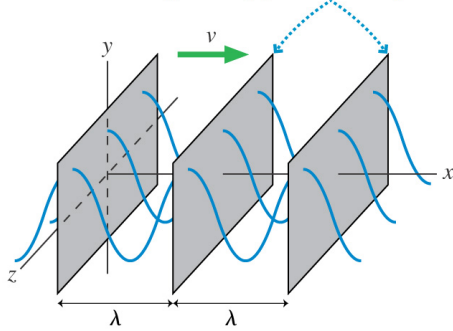
$\omega = 2\pi/T$  is the angular frequency

Wave fronts are the crests of the wave. They are spaced one wavelength apart.

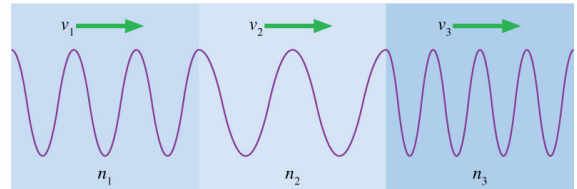


The circular wave fronts move outward from the source at speed v.

Very far from the source, small segments of spherical wave fronts appear to be planes. The wave is cresting at every point in these planes.



A light wave travels through three transparent materials of equal thickness. Rank is order, from the largest to smallest, the indices of refraction  $n_1$ ,  $n_2$ , and  $n_3$ .



- A.  $n_2 > n_1 > n_3$
- B.  $n_3 > n_1 > n_2$
- C.  $n_1 > n_2 > n_3$
- D.  $n_3 > n_2 > n_1$
- E.  $n_1 = n_2 = n_3$

### Reflection of Transverse Wave Pulse



- A pulse traveling to the right on a heavy string attached to a lighter string
- Speed suddenly increases

### Reflection of Transverse Wave Pulse

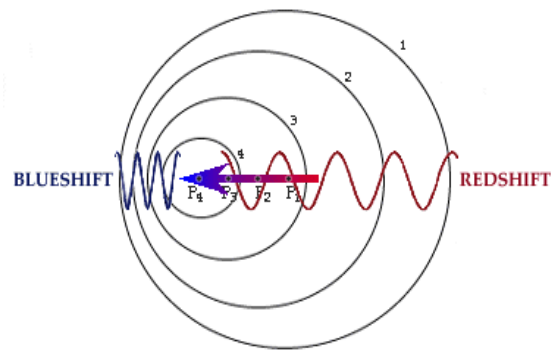


- A pulse traveling to the right on a light string attached to a heavier string
- Speed suddenly decreases

### Speed of sound in humans

Tissue	Sound Speed (m/s)
Air	350
Fat	1450
Brain	1540
Blood	1570
Bone	4080
Muscle	1585

### Doppler Effect



### Which statement is true?

Valerie is standing in the middle of the road, as a police car approaches her at a constant speed,  $v$ . The siren on the police car emits a “rest frequency” of  $f_0$ .

- A. The frequency she hears rises steadily as the police car gets closer and closer.
- B. The frequency she hears steadily decreases as the police car gets closer and closer.
- C. The frequency she hears does not change as the police car gets closer.

### Which statement is true?

Valerie is standing still as a police car approaches her at a constant speed,  $v$ . Daniel is in his car moving at the same constant speed,  $v$ , toward an identical police car which is standing still. Both hear a siren.

- A. The frequency Daniel hears is lower than the frequency Valerie hears.
- B. The frequency Daniel hears is higher than the frequency Valerie hears.
- C. The frequencies that Daniel and Valerie hear are exactly the same.