15-1

- A wave is a disturbance that transfers energy from place to place.
- A medium is the material through which the wave travels.
- Waves that require a medium are called mechanical waves. They do not carry the medium with them. Breaking waves at the beach behave differently. When they hit the beach, the water actually moves along with the wave because the water near the beach is shallow. The bottom of the wave drags along the floor, the top continues to move forward.
- Electromagnetic waves, such as light, do not need a medium.
- Waves are created when a source of energy causes a medium to vibrate (back-and-forth and up-and-down motion).
- Types of waves: classified according to how they move see pictures on pg. 474-5

Transverse	Longitudinal	Surface
Wave moves the medium at right angles to the wave direction	Wave moves the medium parallel to the wave direction	Combination of transverse and longitudinal waves; occurs at the surface of two mediums such as water and air; each particle moves in a circle
Crest-highest part Trough-lowest part	Compression-parts where the coils are together Rarefactions-parts where the coils are spread out	
Ex. rope	Ex. spring toy	Ex. water; seismic

15-2
Properties of Waves

Amplitude

- the maximum distance the medium particles carrying the wave move from their rest positions, which is the place the wave is before it is disturbed. For transverse wave it is the distance from rest to a crest or trough (the higher it is the more the amplitude), for longitudinal it is a measure of how compressed or rarefied the medium becomes (the more crowded the compressions the higher the amplitude)
- direct measure of the energy of the wave

Wavelength

- the distance between two corresponding parts of a wave: for transverse it is the distance between two consecutive crests or troughs, for longitudinal it is the distance between two consecutive compressions or rarefactions

Frequency

- the number of complete waves that pass a given point in a certain amount of time
- to increase frequency of the waves on a rope, you need to move your hand up and down more often
- unit is Hertz, # of vibrations per second

Speed

- how far the wave travels in a unit of time (distance divided by time)
- waves in different mediums travel at different speeds
- waves in a given medium and under the same conditions will have the same speed. If the conditions change, the speed will change too.
- Speed = wavelength x frequency
  If the same wave travels at the same speed in the same medium, than increasing the frequency will decrease the wavelength.

15-3
Interactions of Waves

Reflection: see pg. 482, fig. 9

- when an object or wave hits a surface through which it can't pass, it bounces back. Ex. echo, seeing yourself in mirror, ball hitting wall
- the law of reflection: angle of reflection equals angle of incidence

Refraction

- when a wave moves form one medium to another at an angle, it changes speed and bends because one side of the wave enters the second medium before the other side and changes speed before the other. Ex. pencil in a glass of water appears bent.

Diffraction: see pg. 484, fig. 11

- when a wave passes a barrier or moves through a hole in a barrier, it bends and spreads out.

Interference

- when two or more waves meet and have an effect on each other.

- constructive interference happens when two waves combine to make a wave with higher amplitude, see pg. 485, fig. 12A
- destructive interference happens when one wave comes after the other and the amplitude on one cancels the amplitude of the other resulting in a destroyed wave, see pg. 485, fig. 12B. When the amplitudes of the two waves are not equal, then they will combine producing a wave with a smaller amplitude, see pg. 385, fig. 12C.
  - standing waves: if you tie a rope to a doorknob and continuously shake the free end, waves will travel down the rope, reflect at the end, and come back. The reflected and incoming waves will collide and interfere. If they combine at the right places, the combined wave appears to be standing still. The nodes are the points of zero amplitude and the antinodes are the points of maximum amplitude. See pg. 486, fig. 13.
  - Resonance: most objects have a natural frequency of vibration. Resonance occurs when vibrations traveling through an object match the object's natural frequency increasing the amplitude. In music, resonance adds a distinct quality to the sound. If an object is not flexible, resonance will cause it to shatter, ex. the marching troops on bridge need to break step, otherwise the bridge will break; or glass can be shattered with the opera singer's voice.

15-4
Seismic Waves

- Movement of earth's plates creates stress in the rocks. When the stress builds up enough, the rock breaks/changes shape releasing energy in the form of waves/vibrations called seismic waves.

- Types of seismic waves

Primary (P)	Secondary (S)	Surface
Longitudinal	Transverse	Combination
Fastest		Slowest
	Can't go through liquids	Produce most severe ground movements

- Earthquakes that occur underwater can cause huge surface waves called tsunamis. These can cause great damage when they reach land as they interfere constructively.

- Seismograph: instrument that records ground movements caused by seismic waves as they move through Earth.

- Since P waves move faster than S waves, P waves arrive at seismographs before S waves. By measuring the time between their arrivals, scientists can tell how far the earthquake was. They find the epicenter by comparing readings from at least 3 stations in different places.

- To find out about resources found underground, geologists may set off explosives to produce small earthquakes. The seismic waves produced reflect off structures deep inside.