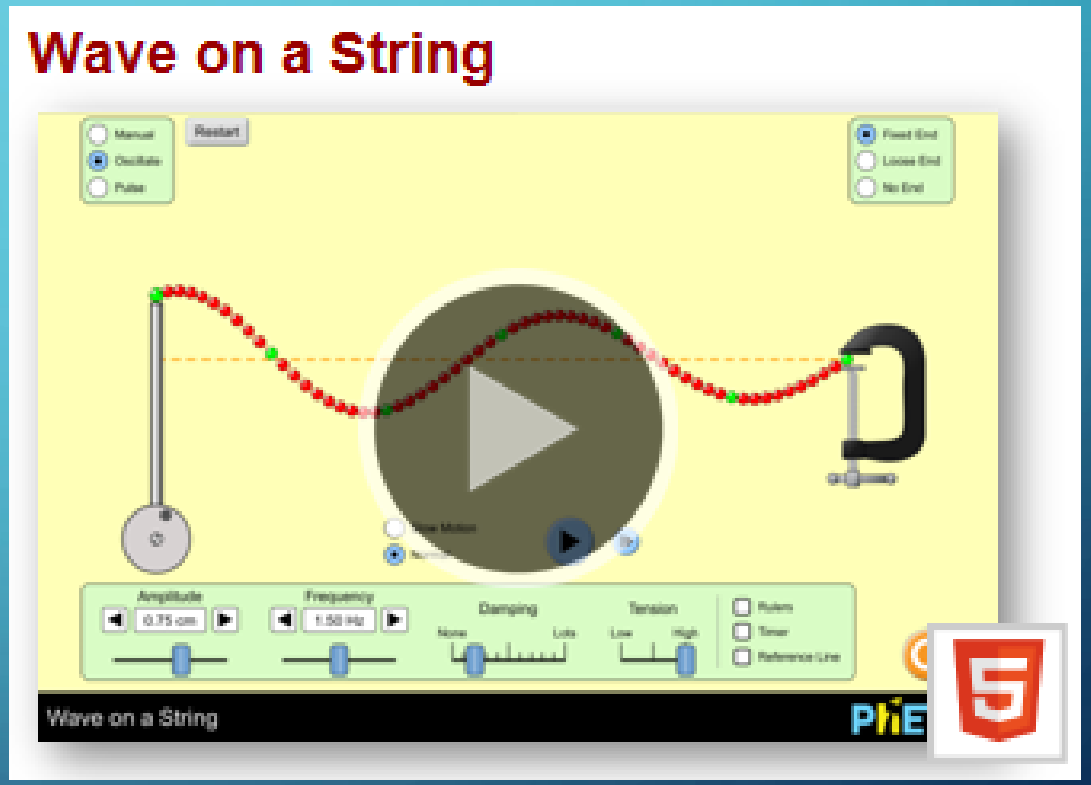
UNIT 1: LIGHT

LLT1 – WAVES

DESCRIBE THE PROPERTIES OF TRANSVERSE AND LONGITUDINAL WAVES, APPLY THE WAVE EQUATION AND DESCRIBE WAVE INTERFERENCE.

WAVES – A VISUAL

- Terms
  - Frequency
  - Period
  - Wavelength
  - Amplitude
  - Equilibrium Position
  - Speed
  - Tension



WAVES – SO MANY TYPES

- Water
- Sound
- Slinky (?!)
- Rope (?!)
- Pressure

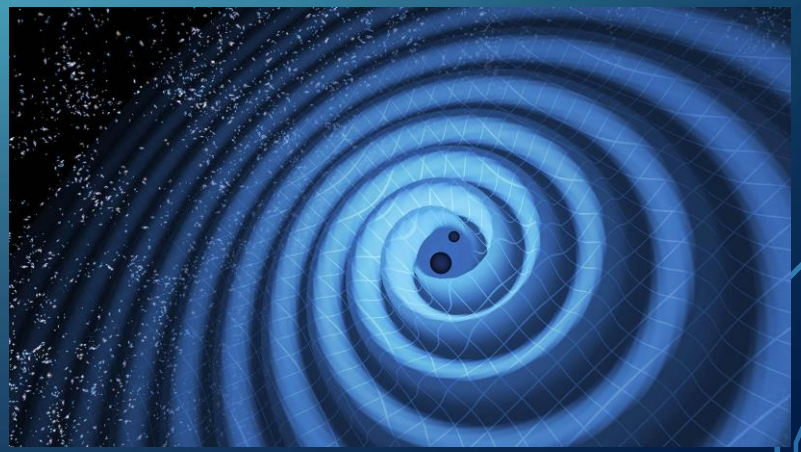
Mechanical Waves

Travel through matter

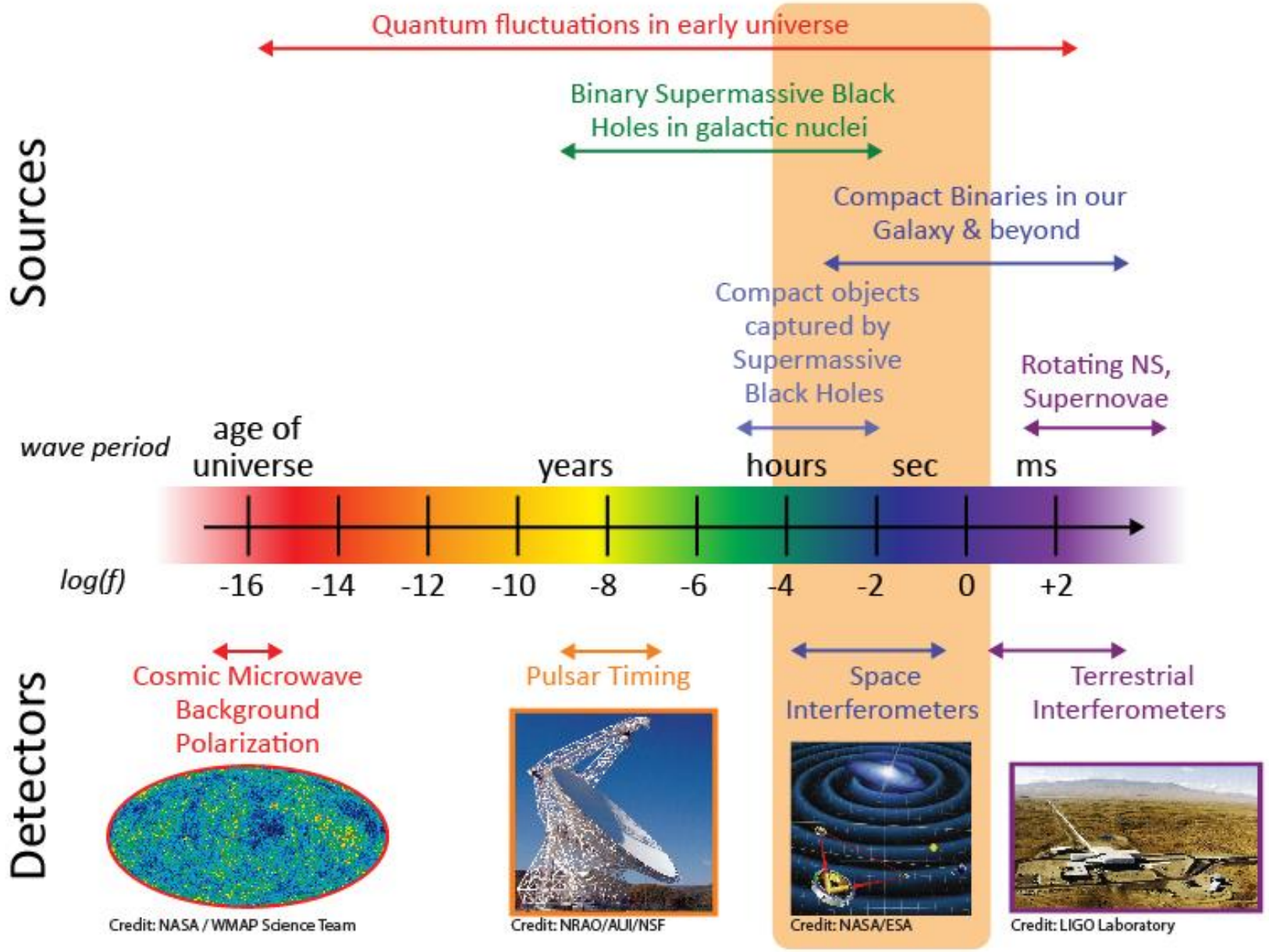
- Electromagnetic
- Gravity

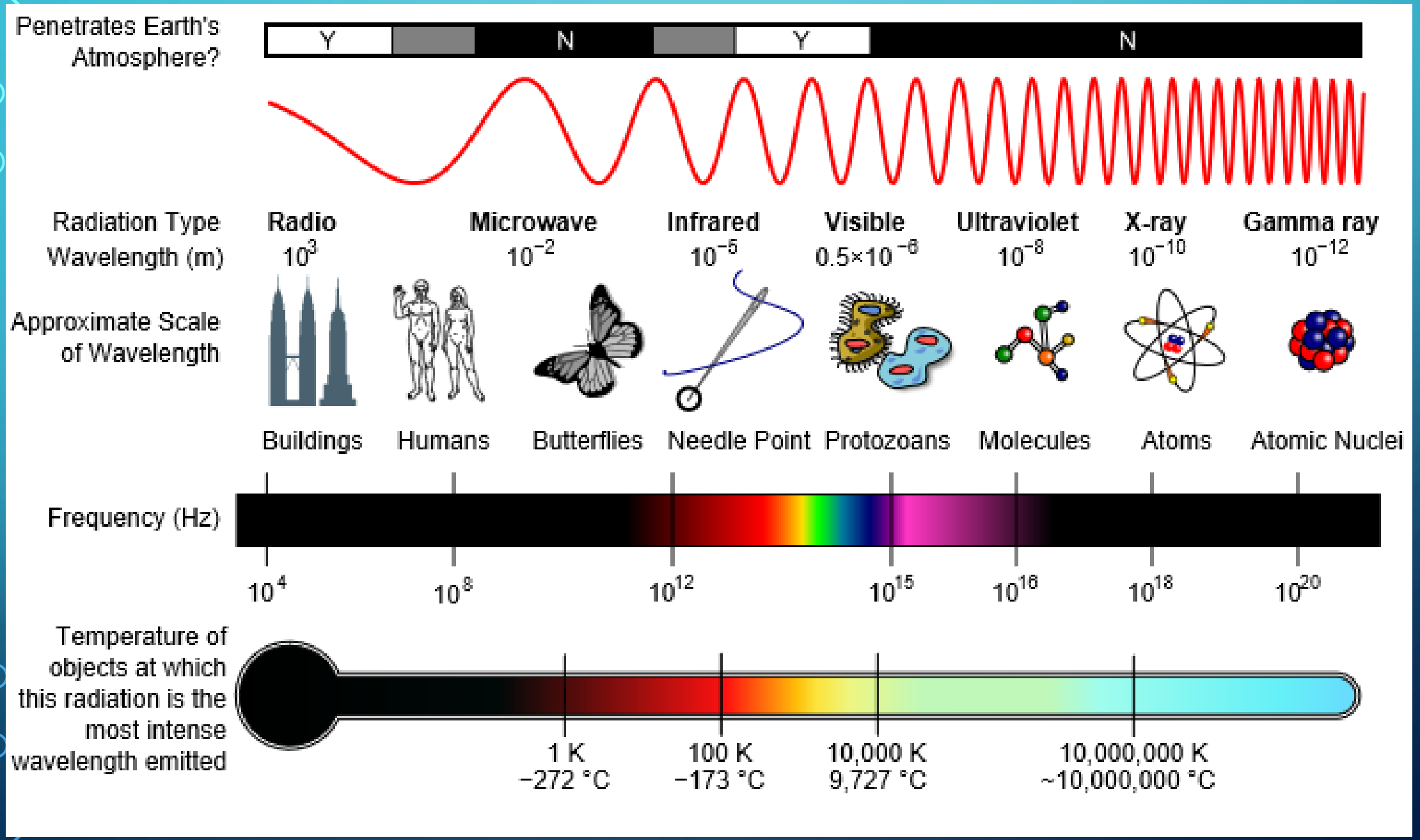
Travel through empty space

Wave:
A disturbance that transfers energy through a medium.

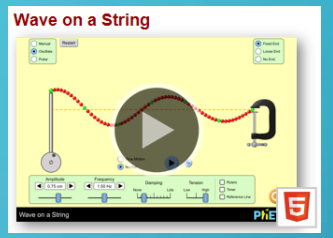


The Gravitational Wave Spectrum




Penetrates Earth's Atmosphere?
Y
N
Y
N
Radiation Type
Wavelength (m)
Radio
10^{3}
Microwave
10^{-2}
Infrared
10^{-5}
Visible
0.5×10^{-6}
Ultraviolet
10^{-8}
X-ray
10^{-10}
Gamma ray
10^{-12}
Approximate Scale of Wavelength
Buildings
Humans
Butterflies
Needle Point
Protozoans
Molecules
Atoms
Atomic Nuclei
Frequency (Hz)
10^{4}
10^{8}
10^{12}
10^{15}
10^{16}
10^{18}
10^{20}
Temperature of objects at which this radiation is the most intense wavelength emitted
1 K
−272 °C
100 K
−173 °C
10,000 K
9,727 °C
10,000,000 K
~10,000,000 °C

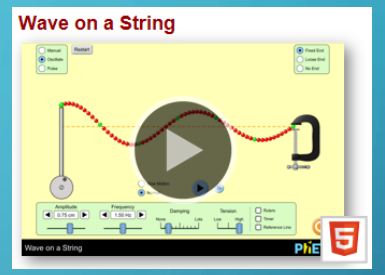
MECHANICAL WAVES – WAVE SPEED



- Wave speed is constant in a particular medium.
  - Independent of the size or amount of energy in a wave.
  - Does not change speed as it travels.
  - Wave speed within a medium is a physical characteristic of that medium; much like density or boiling point.
  - Wave speed is determined by the forces between and the mass of the medium particles.
  - For example, if everyone in the class talks then every single sound wave will have the same speed through the air. No matter the pitch or volume.

MECHANICAL WAVES – WAVE SPEED

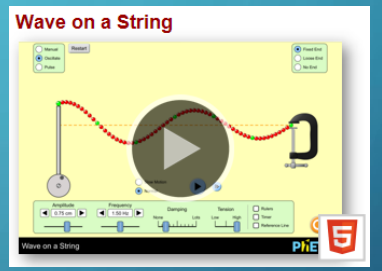
- The greater the force between particles, the more rapidly the particles return to equilibrium position.
  - Results in a faster wave speed.



- The greater the mass of the particles, the more slowly they return to equilibrium position because of their inertia.
  - Results in a slower wave speed.
- Friction: acts to dampen or reduce the amplitude of the wave, but has no effect on wave speed (unlike sliding something on a table).

MECHANICAL WAVES – FREQUENCY & PERIOD

- Frequency, *f*: The number of waves that are created per unit time.
  - If time is in seconds, the unit for frequency is measured in Hertz, Hz.
- Period, *T*: The time to create one wave.



- They are reciprocal functions: $T = \frac{1}{f}$ and $f = \frac{1}{T}$
- The mathematical relationship you use depends on the information given in the problem.

$T = \frac{\Delta t}{\#waves}$	$f = \frac{\#waves}{\Delta t}$	$T = \frac{1}{f}$	$f = \frac{1}{T}$

FREQUENCY & PERIOD PROBLEMS

- Example 1: Watching water waves, an observer notes that 25 waves pass by him in 175 seconds. Calculate the period and frequency of these waves.

FREQUENCY & PERIOD PROBLEMS

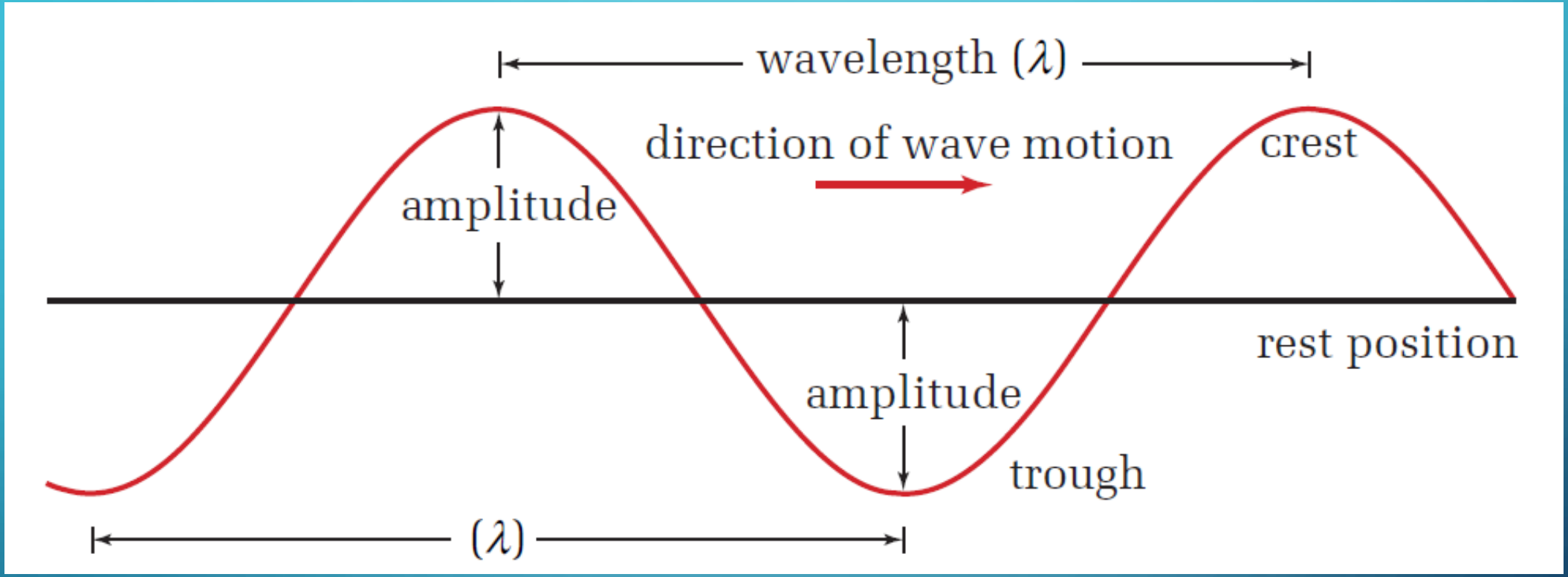
- Example 2: A basketball shoots 33 balls in 120 seconds. Calculate the frequency and period of the shots.

FREQUENCY & PERIOD PROBLEMS

- Example 3: The frequency of a sound wave is 252 Hz. Calculate the period of the wave.

MHR Practice Sheet

DESCRIBING WAVES

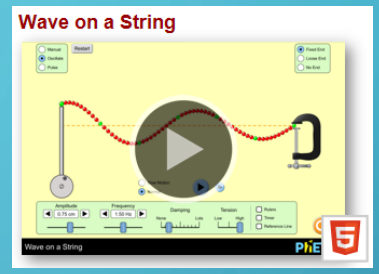


Wavelength, λ: The distance from a point on the wave to a corresponding point such that it includes one complete crest and trough.

- λ is the lowercase Greek letter, lambda.

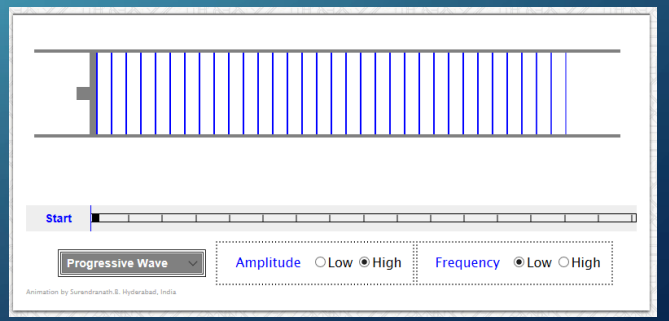
TRANSVERSE WAVES

- Particles of the medium vibrate perpendicular to the direction the wave is traveling.
  - Making waves in a rope/string.

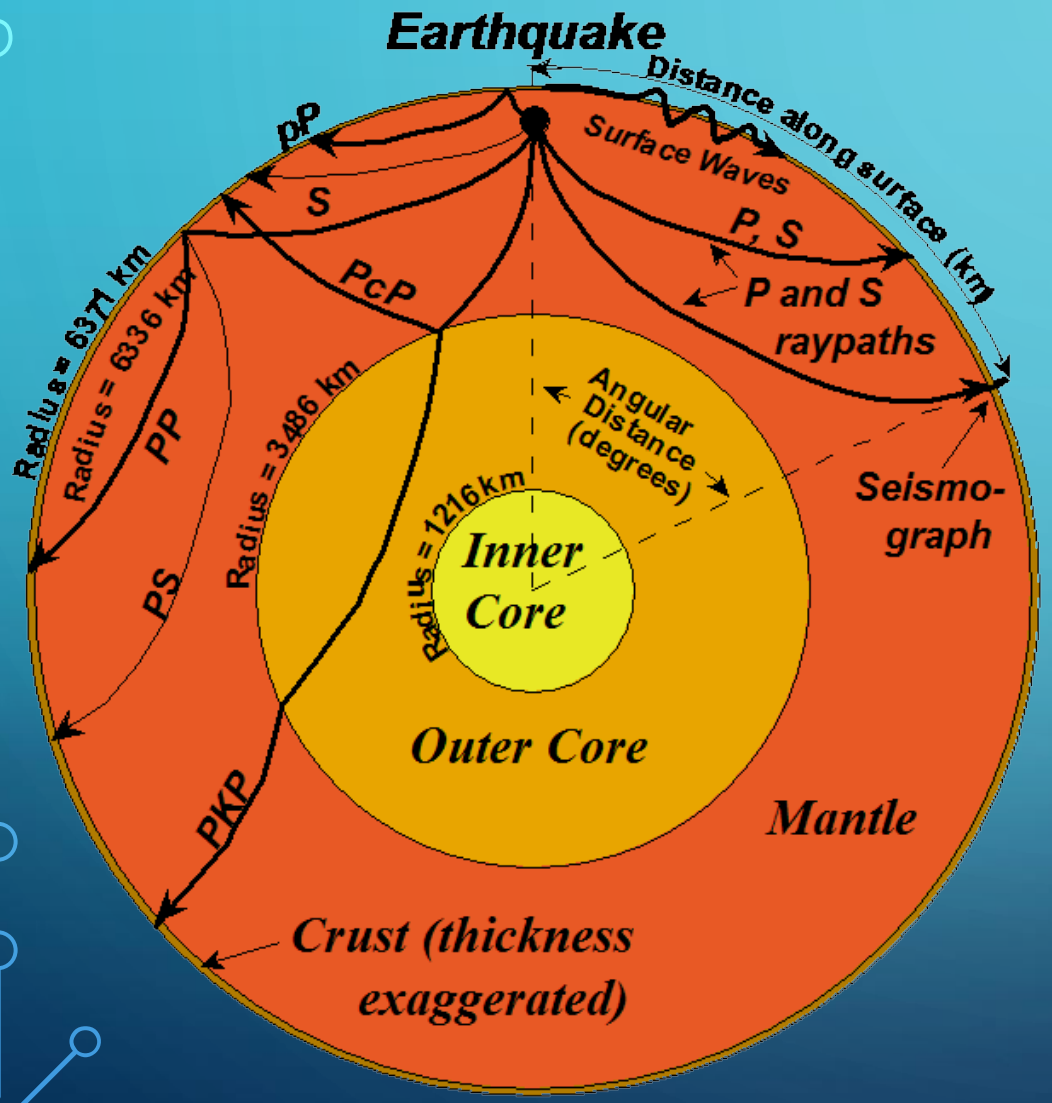


LONGITUDINAL WAVES

- Particles of the medium vibrate parallel to the direction the wave is traveling.
  - Sound/Pressure waves.

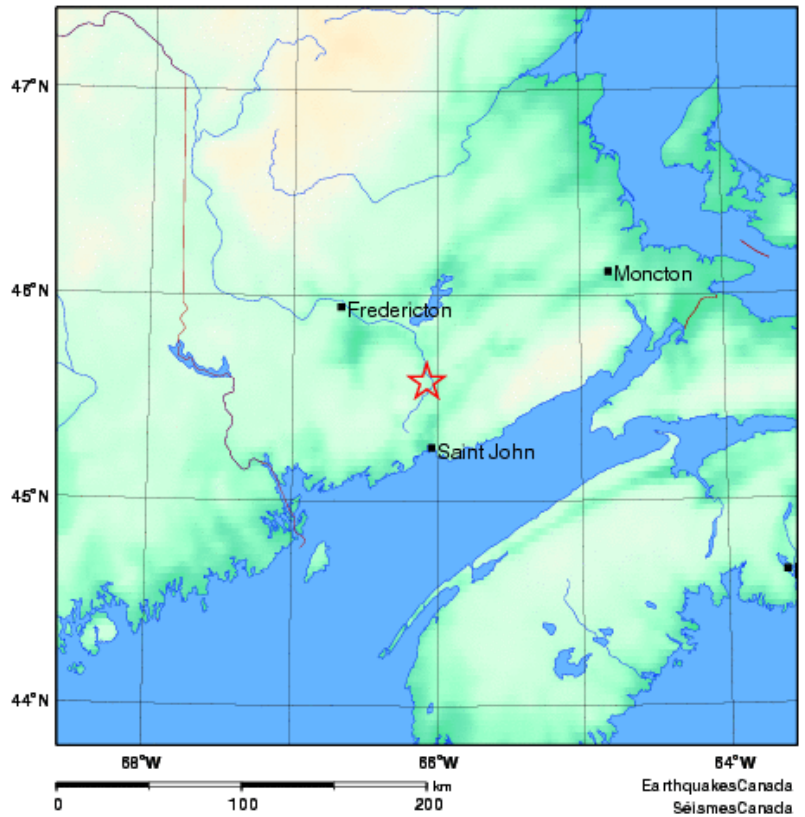


APPLICATION OF WAVES: SEISMOLOGY & ASTEROSEISMOLOGY



Local Time:	09:49:00 AST
Magnitude:	3.8 MN
Latitude:	45.36 North
Longitude:	66.24 West
Depth:	2 km
UT Date and Time:	2019/01/10 13:49:00 UT

Approximate Location of Earthquake: Strongly felt in Saint John, Grand Bay-Westfield, Rothesay.



APPLICATION OF WAVES: SEISMOLOGY & ASTEROSEISMOLOGY