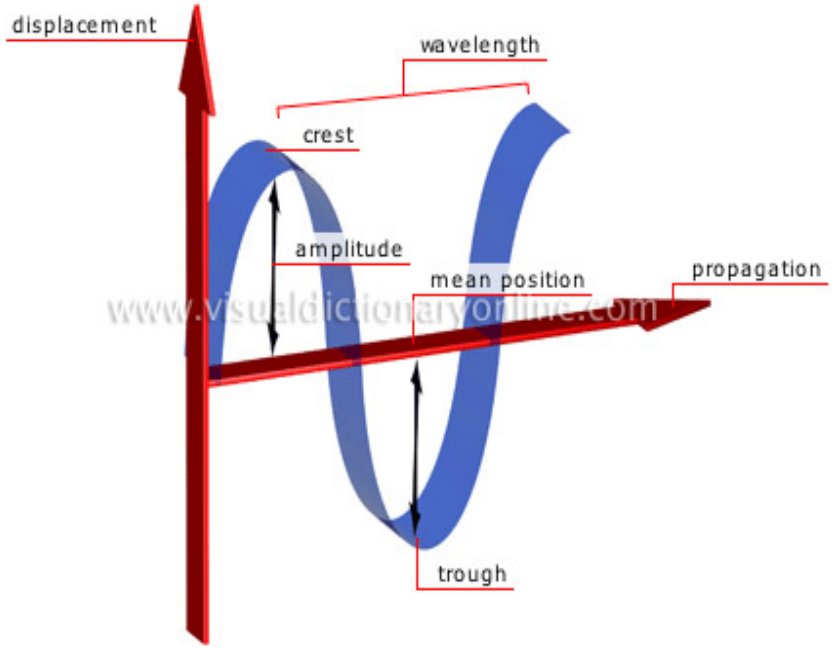
Do Now:

When you bob up and down in the ocean, where does the energy come from?

Mechanical Waves

A mechanical wave is a disturbance in matter that carries energy from one place to another.

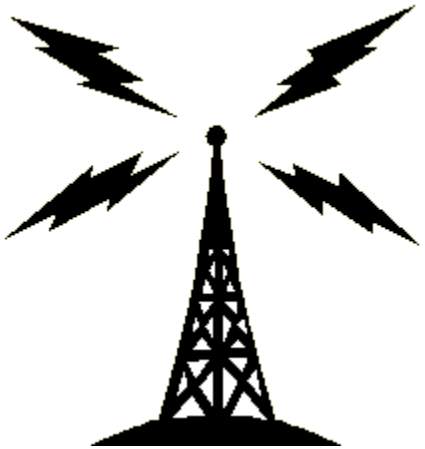
It is created when a vibration travels through a medium.



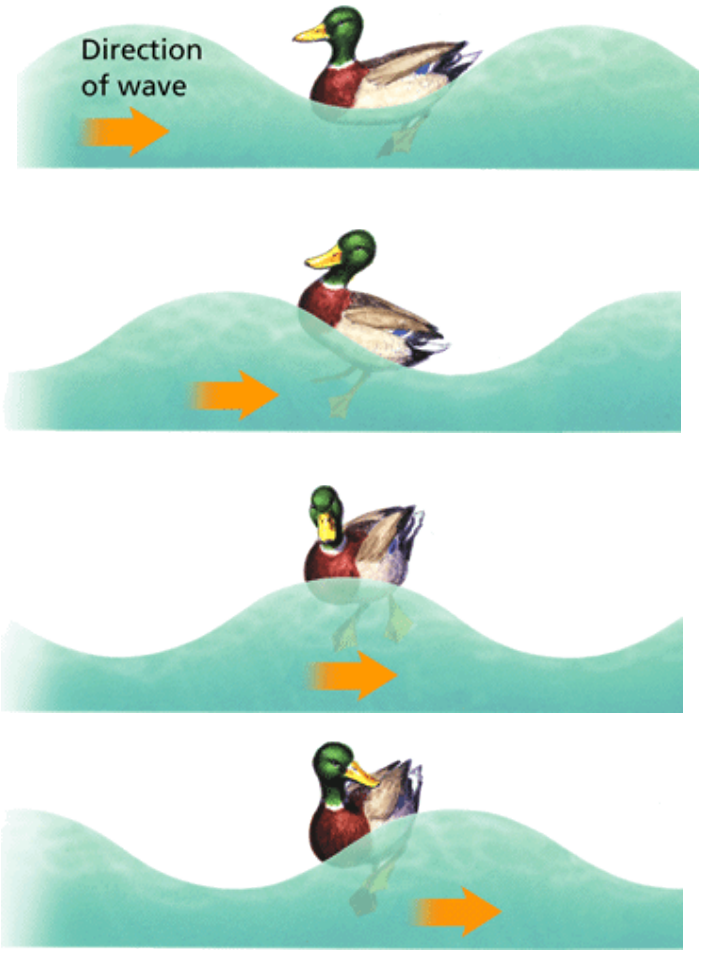
What is a medium?

A medium is any matter through which a mechanical wave can pass.

Mediums can be solid, liquid, or gas. In the ocean, the medium is water. With your car radio, the medium is the air.



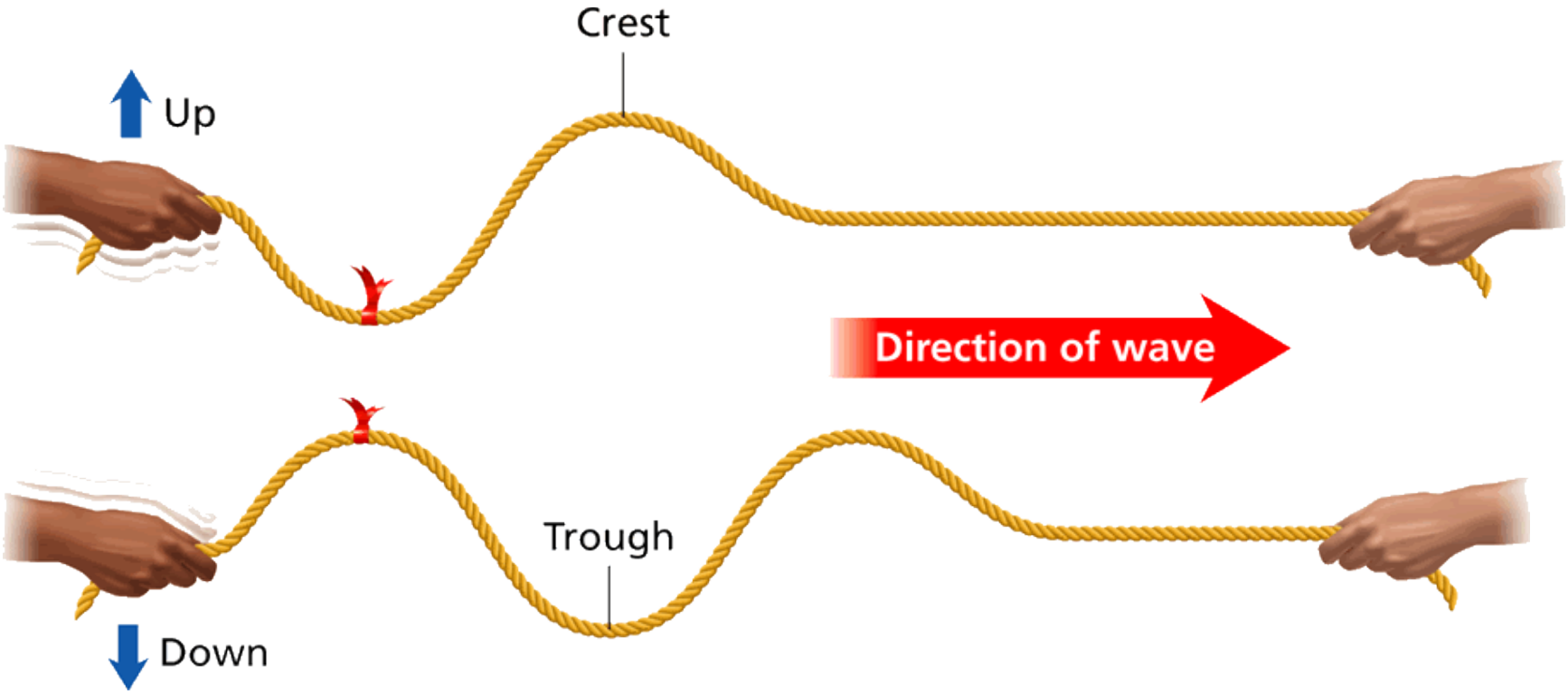
The energy in a wave does not carry the medium along with it. A mechanical wave MOVES THROUGH the medium. The medium will move as the wave passes by.



The duck appears to simply bob up and down as the wave passes under it.

Transverse Waves

Waves that move the medium at right angles to the direction in which the waves travel are called *transverse waves*.



Transverse Waves

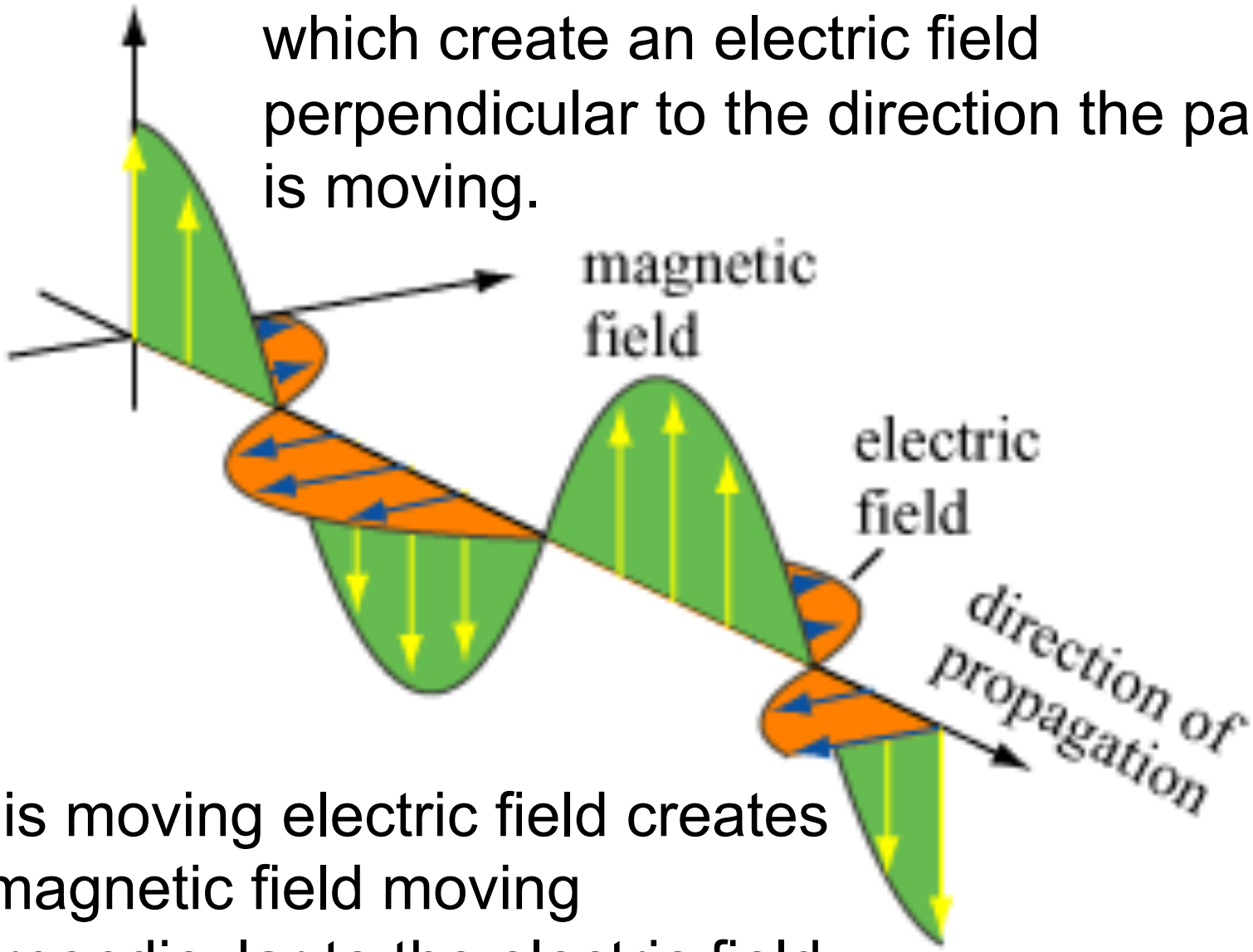
- The most common type of transverse wave is light

- Transverse waves can also travel in a vacuum, like space, without a medium

So, how does light move?

Thanks to Einstein and Bose we know that light is both a wave we know as electromagnetic radiation and a particle called a photon. The photon, because of its weird nature as a force carrier called a boson, has no mass. However it can still be absorbed, reflected, or refracted if it comes in contact with a medium. That is why, like sound, the speed of light slightly varies between when it is in our atmosphere and when it is in space.

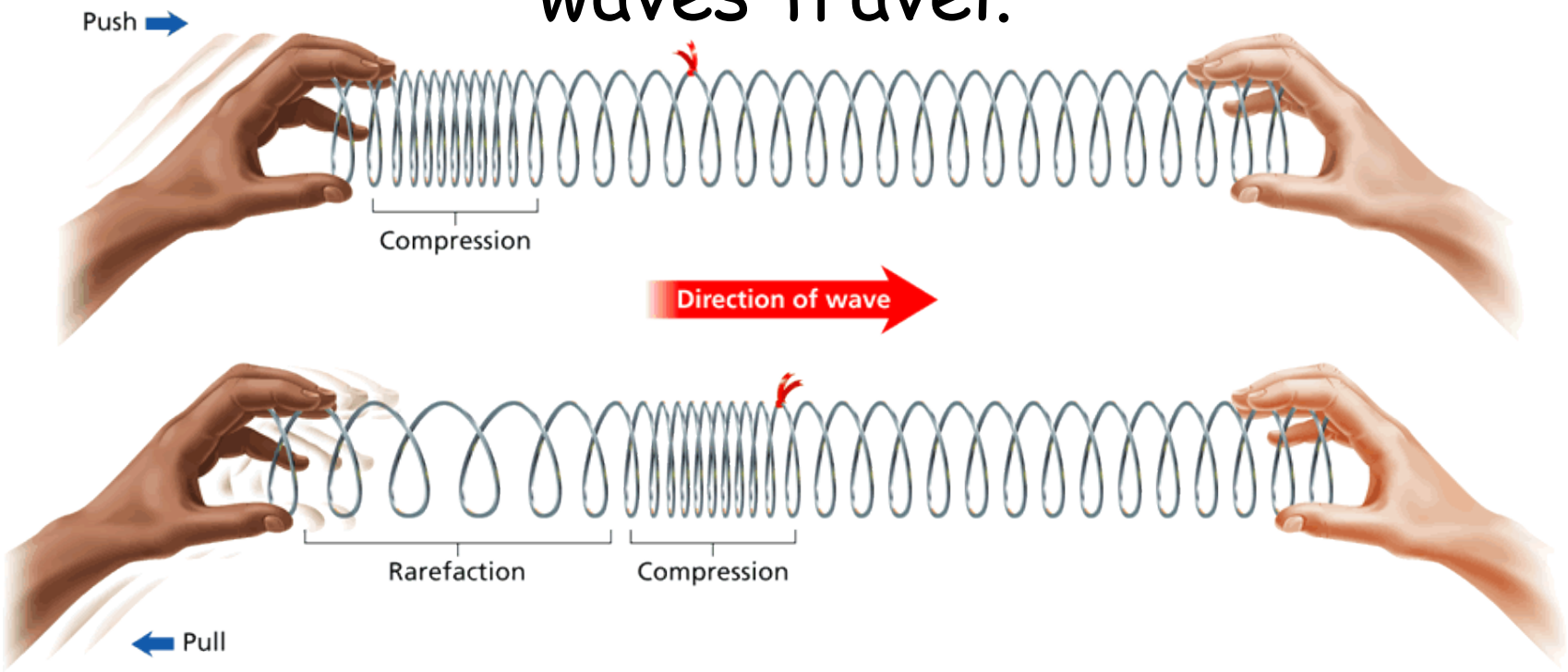
Photons are moving charged particles, which create an electric field perpendicular to the direction the particle is moving.



This moving electric field creates a magnetic field moving perpendicular to the electric field

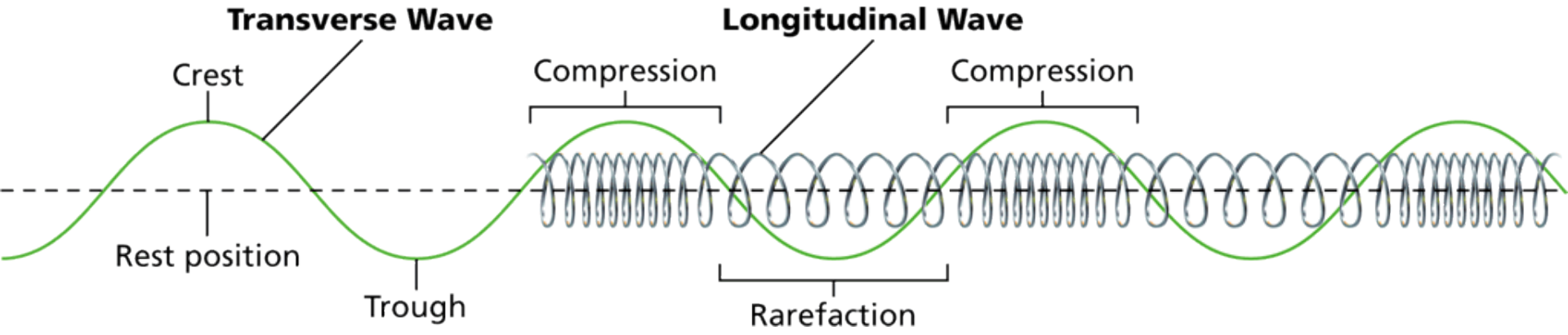
Longitudinal Waves

Longitudinal waves move the medium parallel to the direction in which the waves travel.



Longitudinal Waves

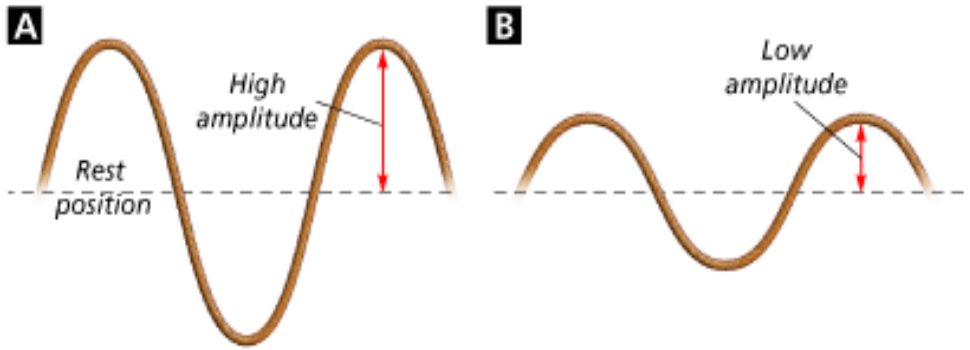
The compressions of a longitudinal wave correspond to the crest of a transverse wave. The rarefactions correspond to troughs.

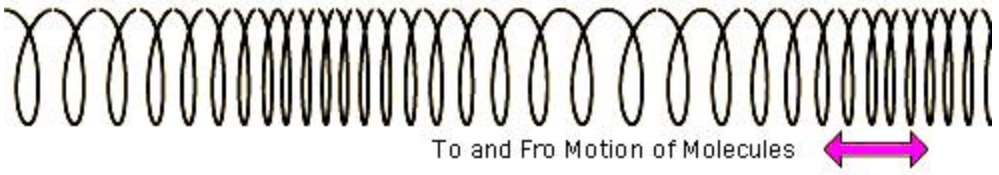


The most common type of longitudinal (compression) wave is sound

Amplitude

The amplitude of a transverse wave is the distance from rest to crest. The height of a wave is the distance from trough to crest. The amplitude of a longitudinal wave is the distance from rest to the end of a compression.



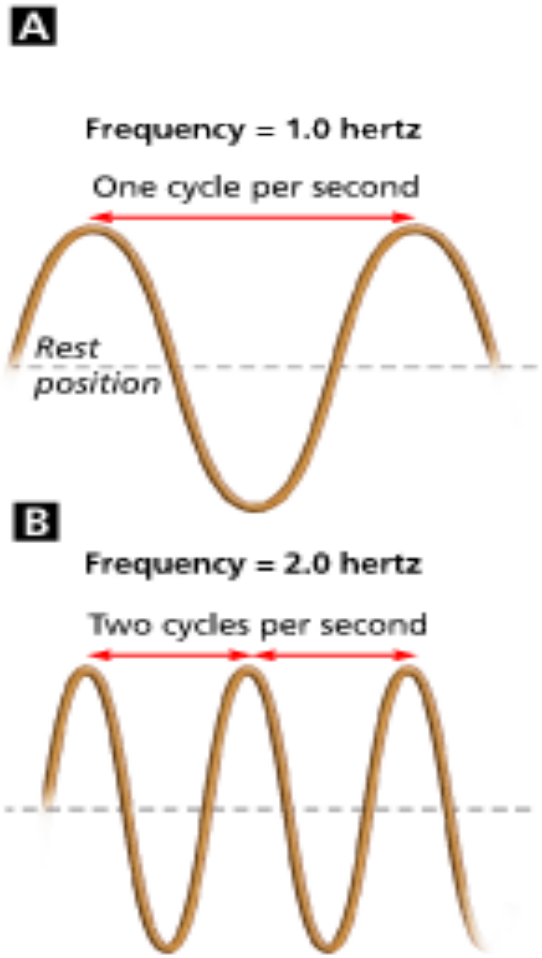


Frequency

Waves exhibit periodic motion – they repeat at regular intervals called periods.

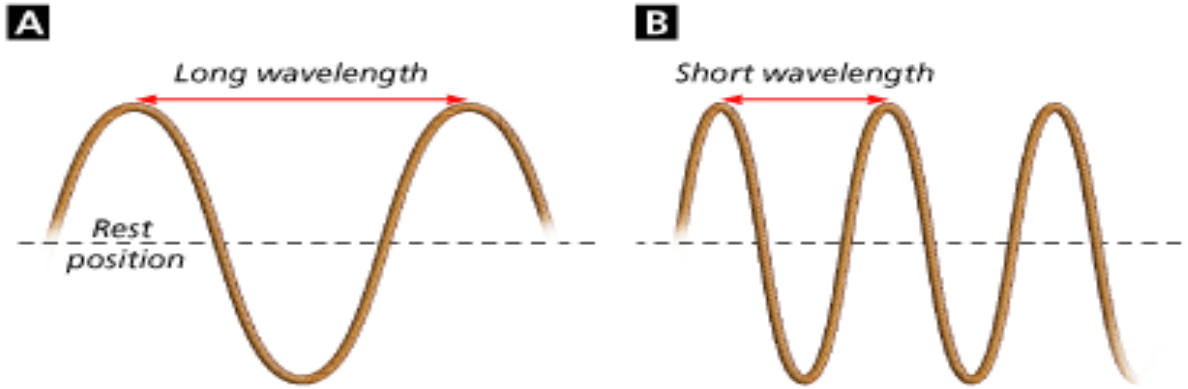
The number of waves that pass a certain point in a given amount of time is called frequency. (measured in Hertz)

(remember to count crest to crest NOT the number of crests)



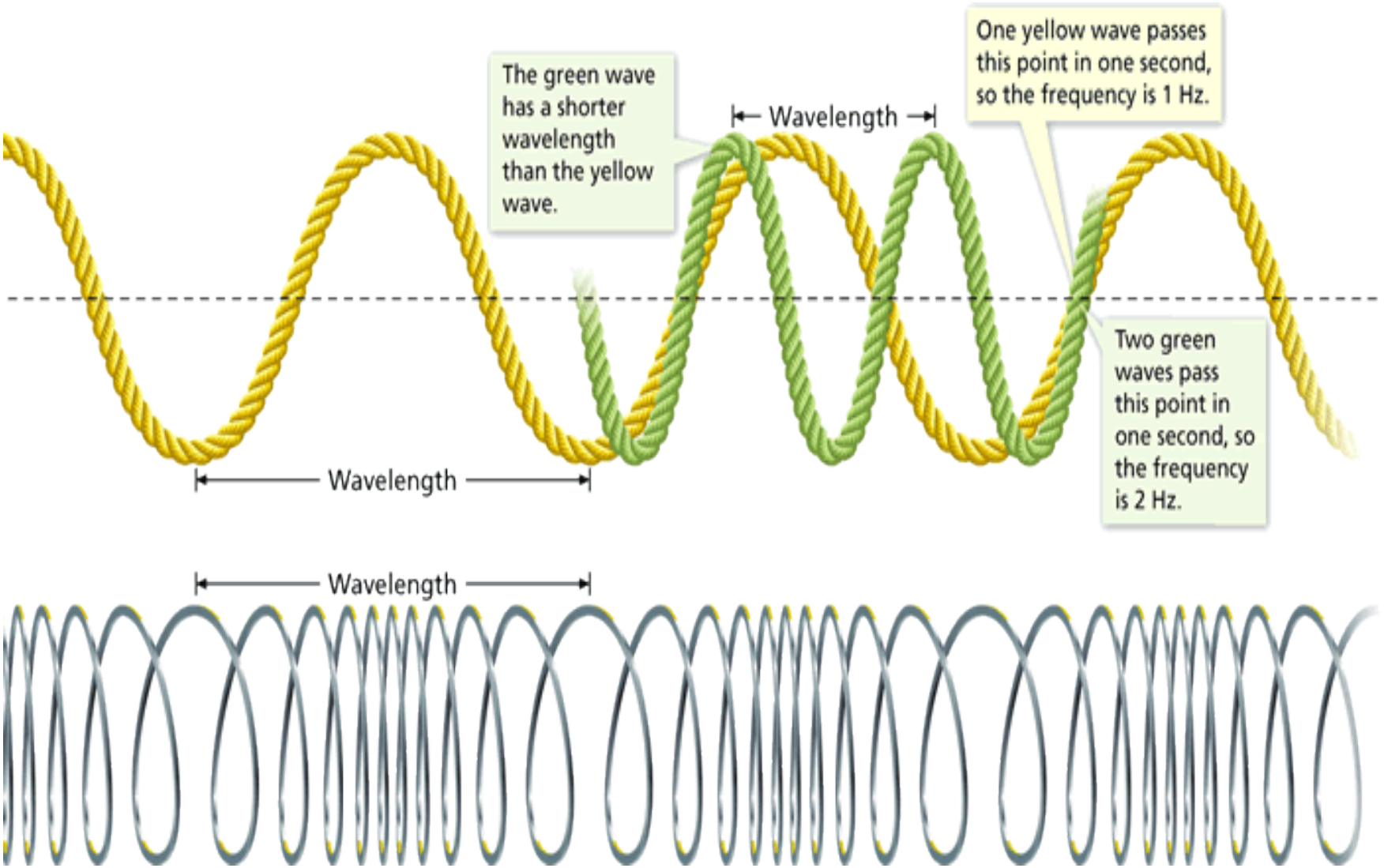
Wavelength

The distance between a point on one wave and the SAME point on the next wave is called Wavelength.



As you can see above, increasing the frequency of a wave decreases its wavelength

Wavelength

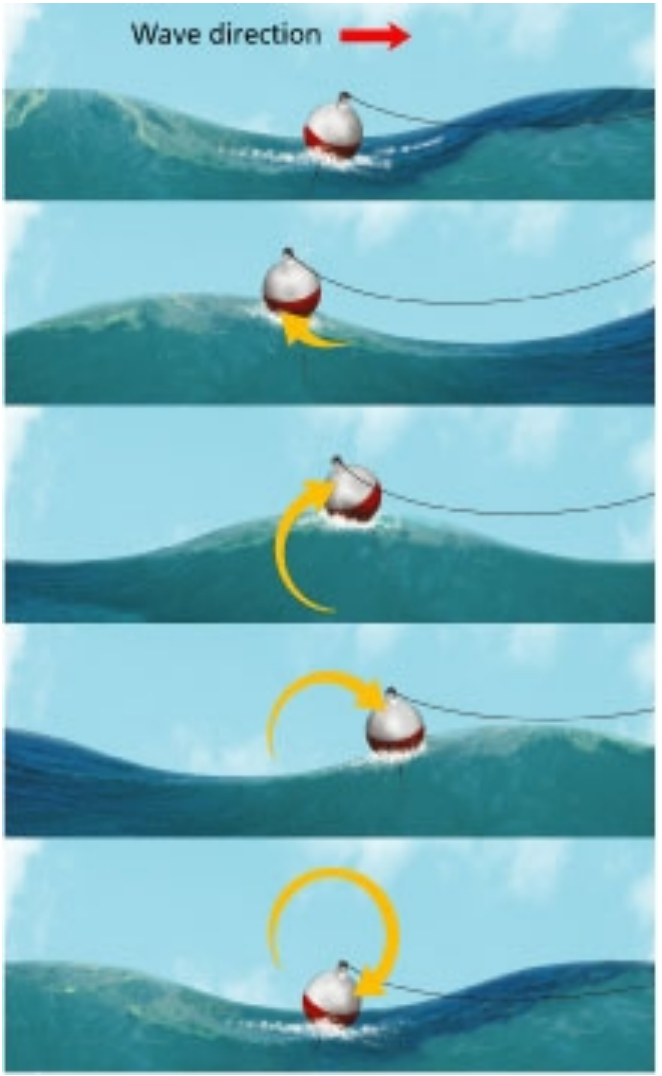

The green wave has a shorter wavelength than the yellow wave.
Wavelength
One yellow wave passes this point in one second, so the frequency is 1 Hz.
Two green waves pass this point in one second, so the frequency is 2 Hz.
Wavelength
Wavelength

Surface Waves

- These waves are best exhibited far out in the ocean. Surface waves only travel along a surface separated by two mediums (water and air)
- https://
- Surface wave animation

Surface Waves

An object floating on the surface of the ocean vibrates both UP and DOWN as well as BACK and FORTH (A CIRCULAR MOTION).



Calculating Wave Properties

One end of a rope is vibrated to produce a wave with a wavelength of 0.25 meters. The frequency of the wave is 3.0 hertz. What is the speed of the wave?

1. *What information are you given?*

   Frequency = 3.0 hertz
   Wavelength = 0.25 m

2. *What unknown are you trying to calculate?* **Speed**

3. *What formula contains the given quantities and the unknown?*

   Speed = Wavelength x Frequency

4. *Replace each variable with its known value.*

   Speed = 0.25m x 3.0 hertz

Speed = 0.75 m/s

Practice Problem:

What is the wavelength of an earthquake wave if it has a speed of 5 km/s and a frequency of 10 Hz? Remember that 1 km = 1000 m.