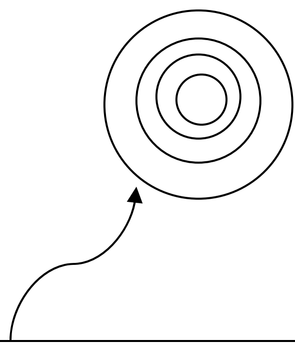
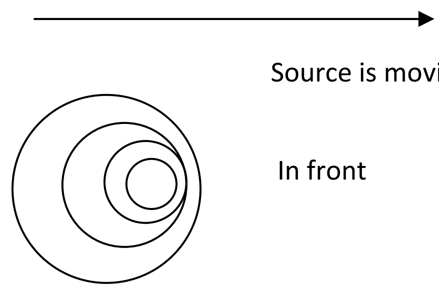
Doppler Effect

Let's say the siren of a fire truck produces sound with a frequency of 800 Hz. If it is parked and has its siren on and I stand still, I will hear the sound produced by air undergoing longitudinal vibration at 800 Hz (sound!). For simplicity sake, we will assume the fire truck siren is sending out 1 note (usually it's 2 – can you 'hear' the siren in your head?)

But usually the fire truck is moving will it produces this sound when it is moving. Have you ever noticed that the siren sound one way as the fire truck comes <u>towards</u> us and a different way when the fire truck speeds <u>away</u> from us? That is due to the <u>Doppler Effect</u>.

Doppler Effect – when a source of sound <u>approaches</u> an observer, the observed frequency of the sound <u>increases</u> whereas when the source of the sound <u>moves away</u> from the observer, the observed frequency of the sound <u>decreases</u>.





Sound wave crests – stationary source (think pebble dropped in calm water)

Moving source is produced sound waves. Source is moving towards right thus piling up sound waves in theat direction

Think: In front of the source, the waves are squished together and so…. λ decreases and f increases

Behind the source, the waves are stretched apart so… λ increases and f decreases

Remember: Frequency determines the sound. THAT'S WHY the CHANGE IN SOUND~!

When frequency increases (in front), the note goes UP

When frequency decreases (behind), the note goes DOWN.

$$F_{obs} = \frac{(v_{sound} + v_{detector})\ f_0}{(v_{sound} + v_{source})}$$

Where f_{obs} = observed frequency f_0 = original frequency

v_{sound} = speed of sound in that air (consider temperature)

v_{source} = how fast source is moving (-ve if towards detector, +ve if away)

$v_{detector}$ = speed of detector (usually at rest, so = 0 m/s)