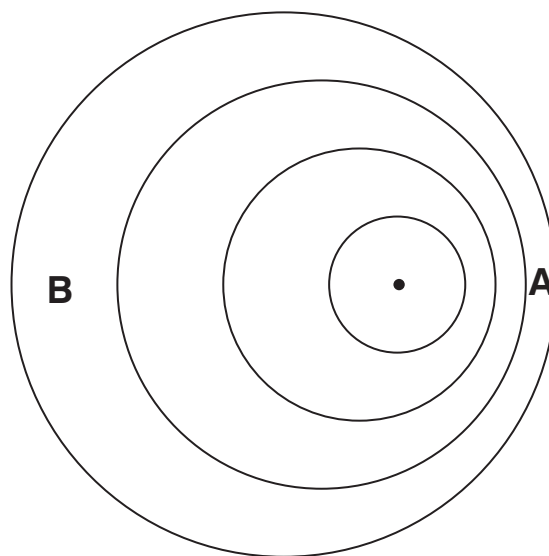
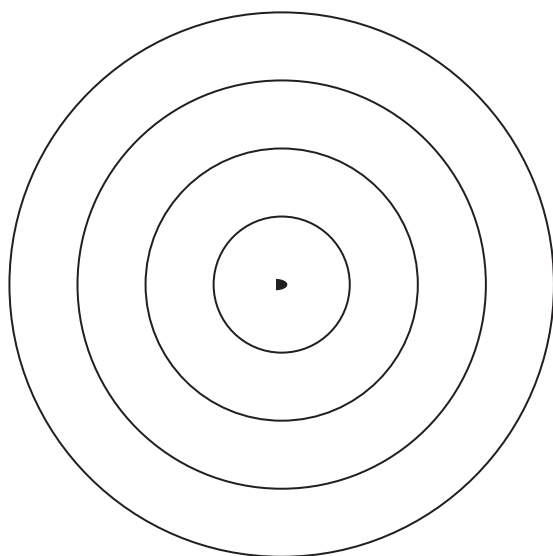
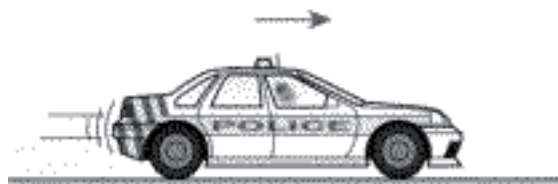


Think about a police car or ambulance passing you with its siren on.

Have you heard the change in pitch (frequency) as it passes?

The reason for this is that the **wavefronts** of sound are being squashed together or stretched apart.

Look at these diagrams of the wavefronts:



In the 1st diagram, the police car is stationary.
The wavefronts are concentric circles.

In the 2nd diagram, the car is moving to the right. You could be an observer at A, or at B.

At A, the wavefronts are squeezed closer together.
So the wavelength is shorter. The frequency (pitch) is higher.

At B, the wavefronts are stretched farther apart.
So the wavelength is longer. The frequency (pitch) is lower.

This is the **Doppler Effect**.

It happens with sound waves, and it also happens with light waves and microwaves.

Light waves

If a star is moving towards us at a very high speed, the light from the star is at a shorter wavelength (higher frequency) ...so it is slightly bluer.

If a star is moving away from the Earth at a very high speed, the light is at a longer wavelength. It is slightly redder. This is the Doppler **red shift** (see page 162).

The spectrum from most stars has a red-shift. So most stars are moving away from us.
So the Universe is expanding. This is supporting evidence for the Big Bang Theory.

Microwaves

Experiments show that the Universe is filled with microwaves. This is called the **Cosmic Microwave Background Radiation** (CMBR). It comes from radiation that was present shortly after the beginning of the Universe. Most scientists believe that this radiation has been red-shifted during the rapid expansion of the Universe after the Big Bang ...so that now the radiation has the wavelength of microwaves. This is supporting evidence for the Big Bang Theory.