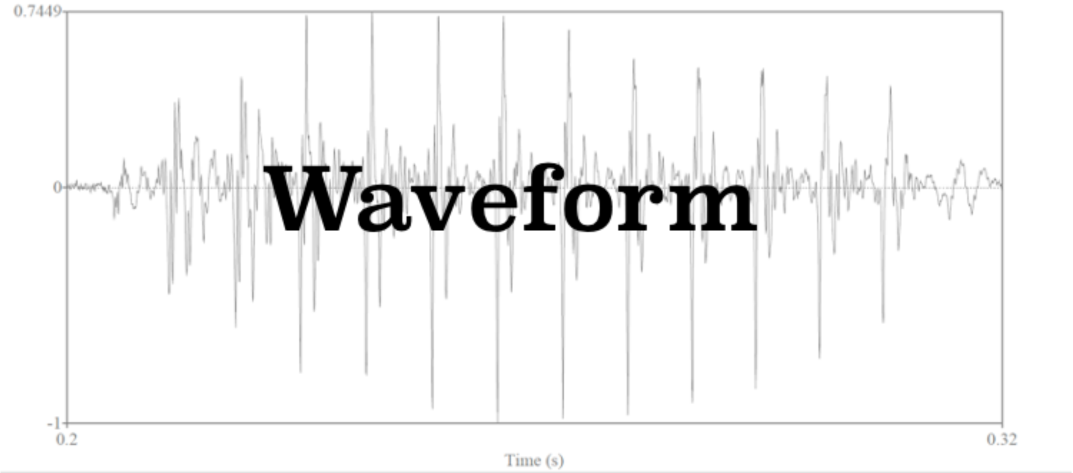
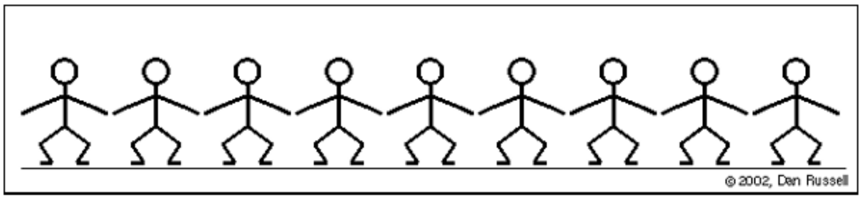
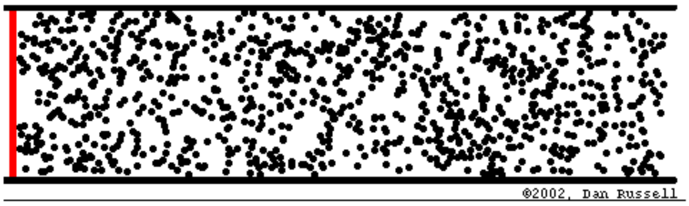
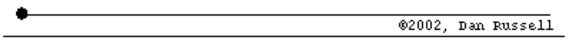
Waveform



What is a wave?



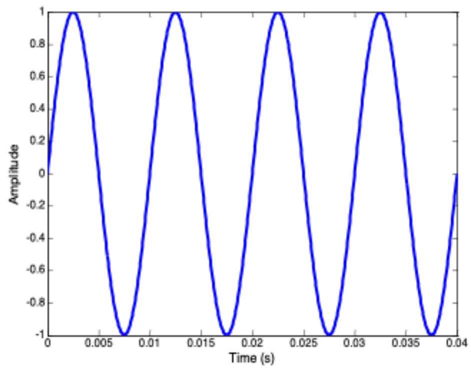


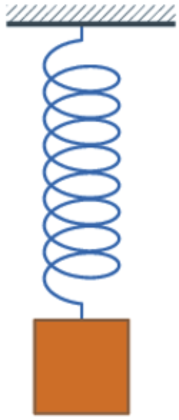


https://www.acs.psu.edu/drussell/demos.html

A disturbance which travels through a medium

Waveform





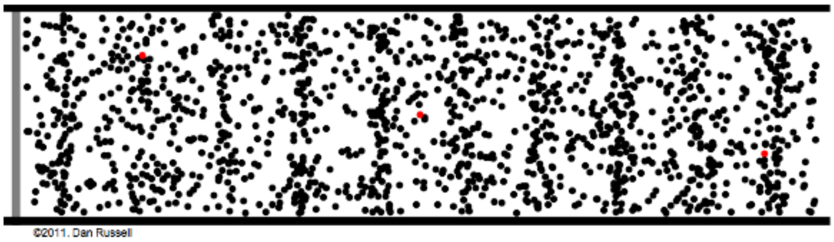
•Imagine we had a weight suspended from the ceiling on a spring. The weight has a marker attached to it, and is then set in motion by pulling down on the weight and releasing it . We could then pull a sheet of paper along so that the marker traces the up-and-down movement of the spring over time.

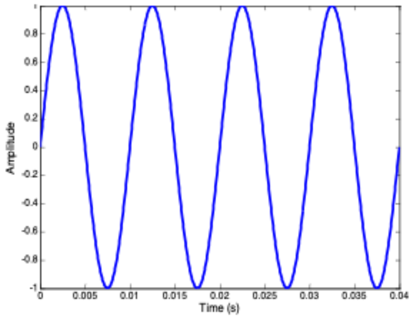
•The graph that we would wind up with would be a waveform such as the one shown here.

•In the example of the spring, the waveform represents the physical displacement of the spring in SPACE, but the axes of a waveform created from sound can represent many different things including velocity, air pressure or particle movement

•In this video, all of the waveforms that we will be looking at with have TIME on the x-axis, and amplitude on the y-axis. The amplitude refers to changes in AIR PRESSURE

Waveform

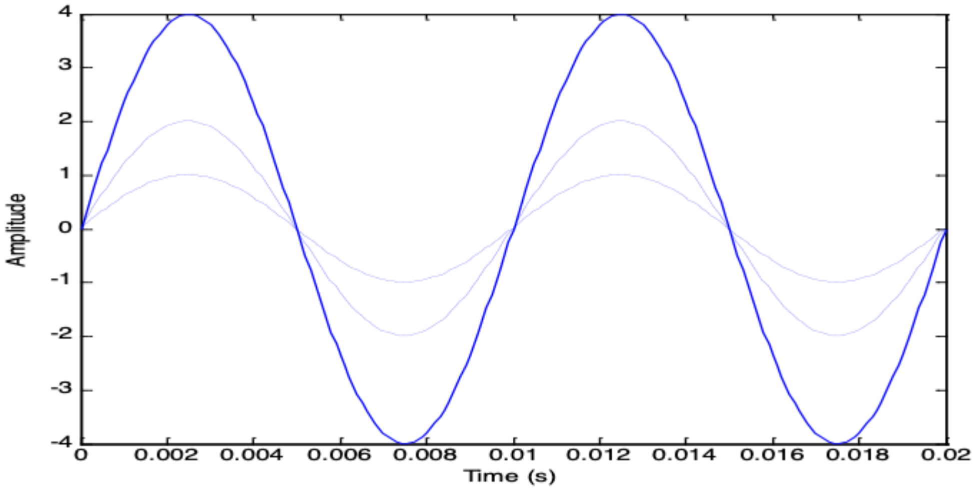




•In the example of the spring, the waveform represents the physical displacement of the spring in SPACE, but the axes of a waveform created from sound can represent many different things including velocity, air pressure or particle movement

•In this video, all of the waveforms that we will be looking at with have TIME on the x-axis, and amplitude on the y-axis. The amplitude refers to changes in AIR PRESSURE

Amplitude



The amplitude, or intensity, of a sound wave is related to our perception of **loudness.** Amplitude can be measured in decibels (dB) but it is important to remember that amplitude is *relative* to the ambient air pressure, and therefore cannot be directly compared between two different recordings.

This figure represents 3 sine waves that are identical to one another apart from their amplitudes. When reporting amplitude, we measure from the zero line to the point of greatest deviation (either maximum or minimum) and report that value. So here we have a wave with an amplitude of 1, another wave with an amplitude of 2, and a third wave with an amplitude of 4.

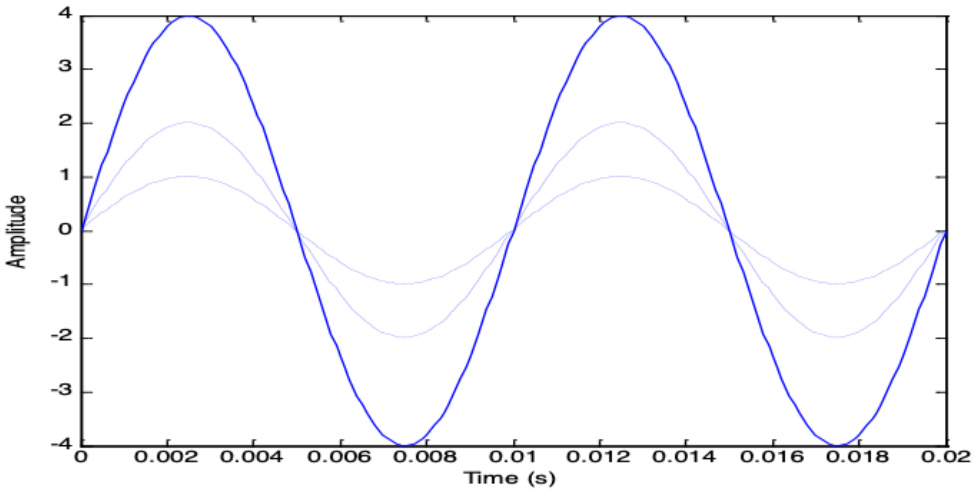
Notice how all three waves begin at the origin point (zero), and they all cross the zero line again at the same point in time.

More disturbance = more pressure = higher amplitude

Measured in decibels (dB)

We perceive amplitude as **loudness**

Oscillation cycle

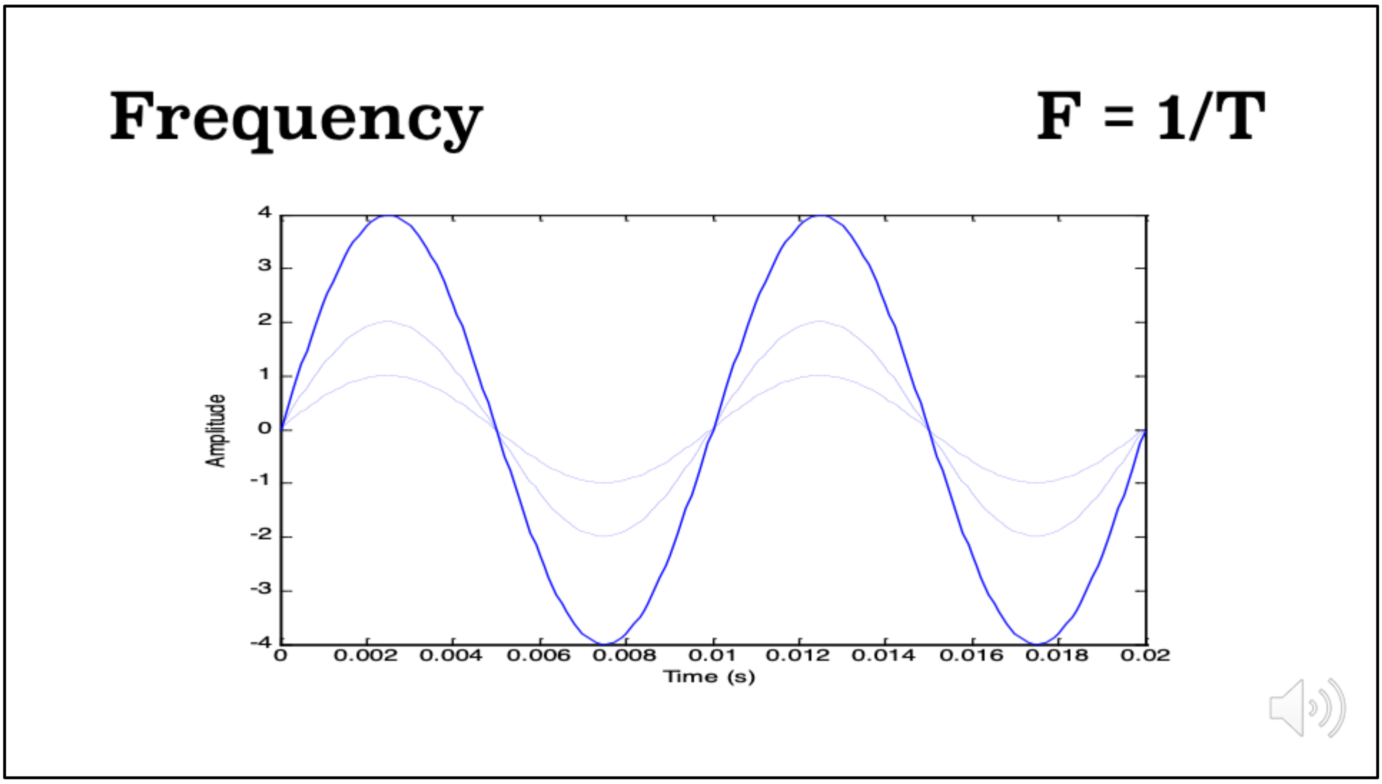


Notice how all three waves begin at the origin point (zero), and reach their peak amplitude at the same point in time. Then they all cross the zero line simultaneously, pass through a their amplitude trough and return to zero.

This path from zero to maximum, through zero to minimum, and back to zero represents one complete oscillation cycle of the wave.

The amount of time that it takes for the wave to complete this cycle is known as its period, which we can use to calculate the frequency of the wave.

Before we do any math though, we can conclude from the present graph that all three of these waves will have the same frequency because their cycle lengths are also identical.



To calculate the frequency, we first measure the length of the period, which is represented by the letter T

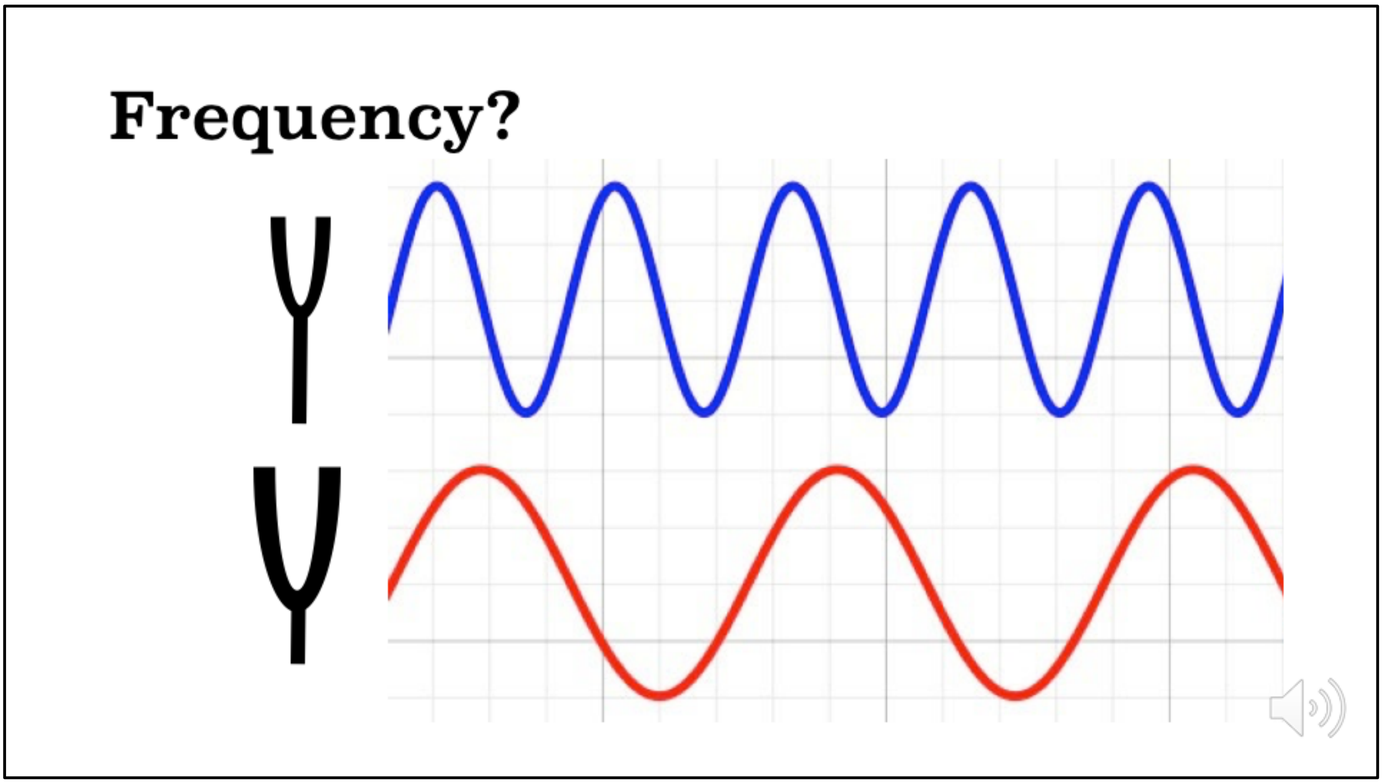
In this case, T = 0.01 s

The frequency, is equal to the inverse of the period, or 1/T

1/0.01 = 100

And we report the frequency using a unit called Hertz, which represents cycles per second

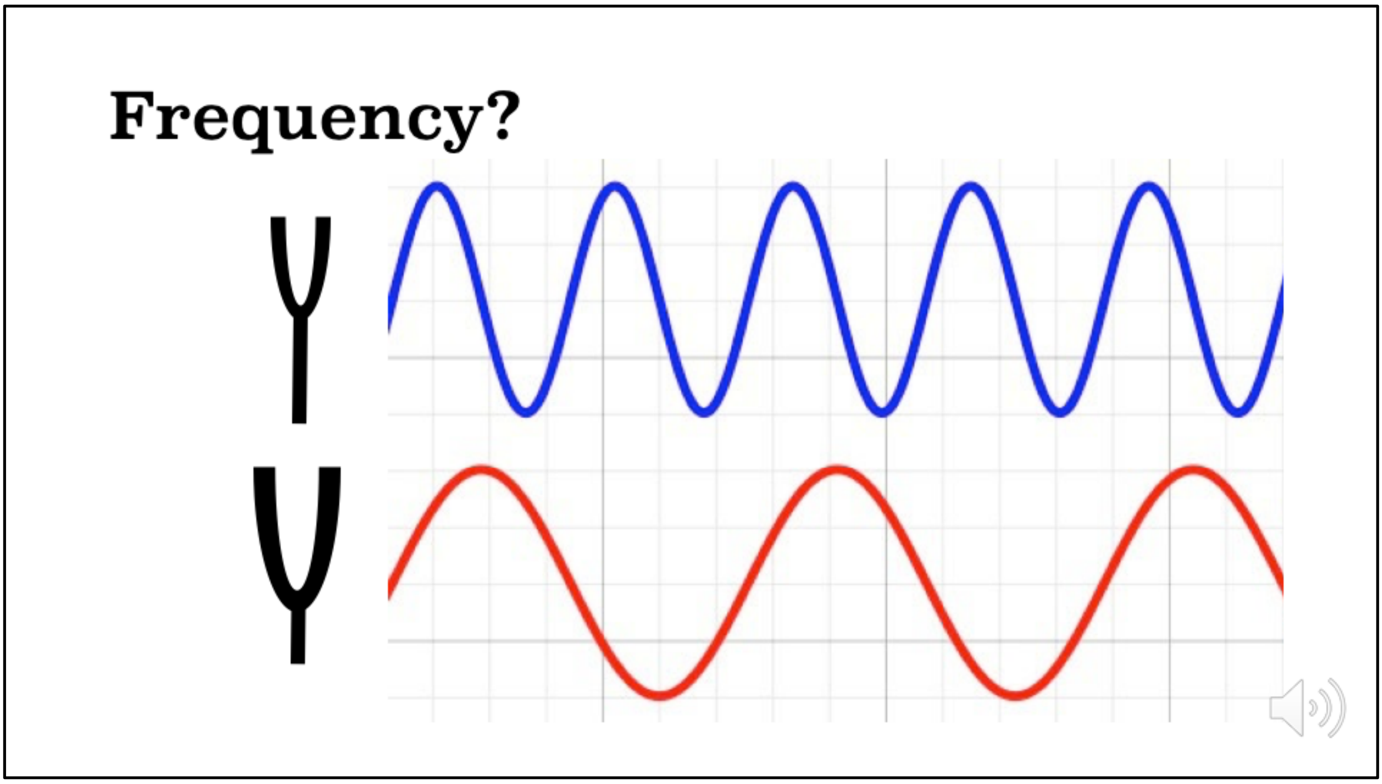
So all three of the waves presented here have a frequency of 100 Hz



Frequency is related to our perception of pitch. Generally larger objects will oscillate at lower frequencies.

Here we have a representation of two tuning forks, one larger than the other, and the waveform of the sound that each produces.

If the total time interval pictured is 200 ms, what is the frequency? of each wave?



First, we have to figure out the length of a single cycle of each wave.

To do that, count the number of complete cycles (to a rough approximation).

The blue wave completes 5 cycles, while the red wave completes 2.5 cycles

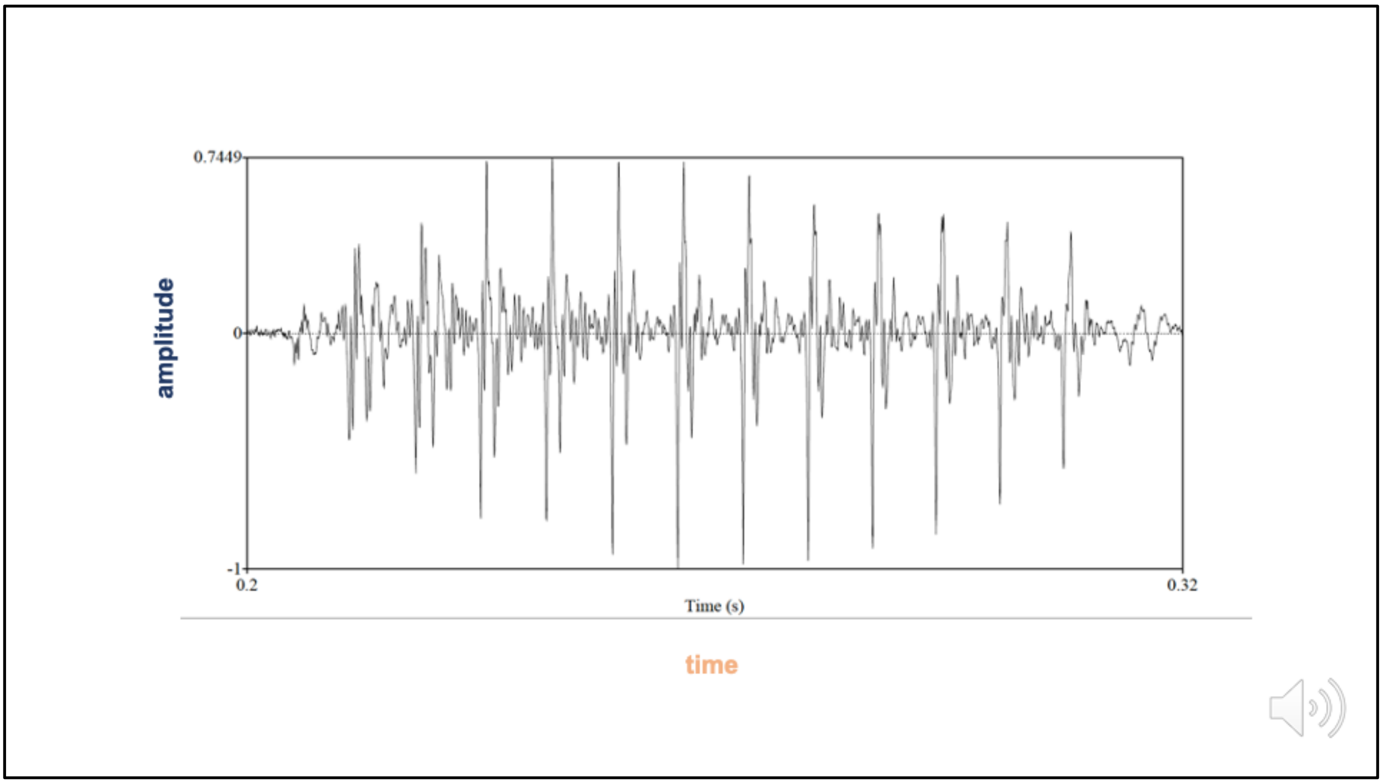
To determine the length of one cycle, divide the total duration (200 ms) by the number of cycles

The length of one cycle in the blue wave is 40 ms, while the length of one cycle in the red wave is 80 ms.

Now, we can use the formula F=1/T, but we need to take care to use the right unit of time.

40 ms = 0.04 s, while 80 ms = 0.08 s

So the frequency of the red wave is 25 Hz, while the frequency of the red wave is 12.5 Hz.



So far we've been looking only at simple sine waves, but most sounds are much more complex than this. even so, the waveform still shows changes in the **amplitude** of a wave over **time.**

A complex wave like this is made up of many different sine waves added together, each with their own frequency, but we can still determine what is called the **fundamental frequency** by identifying the start and end points of the repeating pattern in the waveform.

We then measure the duration of this period and calculate the frequency in the same way as we would for a simple sine wave. This frequency corresponds to our perception of pitch in speech.