Amplitude, Wavelength, Period, and Frequency

`Picture of travelling 2m wave`

Imagine that the dot moving up and down is creating the wave that's travelling to the right.

Look at the following two waves. How are they different?

At first sight:

1. the first one is "taller" than the second one. That is, it goes up and down higher and lower.
2. the first one is also "longer" than the second one. That is, it stretches sideways more. It's not as "tight".

These two observations can be quantified very precisely as:

1. the *amplitude*: **vertical** height from the centre of the wave to its highest (or lowest) point.
2. the *period*: **horizontal** length of one complete cycle.

So the previous two waves have:

1. Amplitude = 2, Period = 0.05 ms
2. Amplitude = 1, Period = 0.02 ms

The amplitude is normally related to the strength of the signal (like the volume for sound).

Since the period (*T*) is the amount of time it takes to complete one cycle, and the frequency (*f*) is the number of cycles in one second, the period and the frequency are inverses of each other:

<latex> \qquad $$f = \frac{1}{T} \qquad \Leftrightarrow \qquad T = \frac{1}{f}$$</latex>

<box 80% blue> In this course, we'll see a few formulas and it'll be tempting to memorize them but let's instead understand what they really mean... </box>

For example:

- if the period is half a second, we can fit 2 full cycles in one second.
- If the period is a quarter of a second, the frequency is 4.
- If the period is a tenth of a second, the frequency is 10.
- If the period is T seconds, the frequency is $\frac{1}{T}$ ($\frac{1}{0.5} = 2, \quad \frac{1}{0.25} = 4, \quad \frac{1}{0.1} = 10$)

Right?

So for the previous two waves, the frequencies would be:

- <latex>$$f = \frac{1}{0.05 \text{ ms}} = \frac{1}{0.00005 \text{ s}}$$</latex> = 20,000 Hz = 20 kHz

- <latex>$$f = \frac{1}{0.02 \text{ ms}} = \frac{1}{0.00002 \text{ s}}$$</latex> = 50,000 Hz = 50 kHz

Recall that *Hz* means "cycle per seconds". That's why when we divide a number of cycles by time, we get Hertz.

Let's now look at three different ways to encode a signal on a radio wave.

🔧 Fix Me! : add $f=\frac{c}{\lambda}$