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Unit P6

Model of Radiation

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The topics in this unit are:

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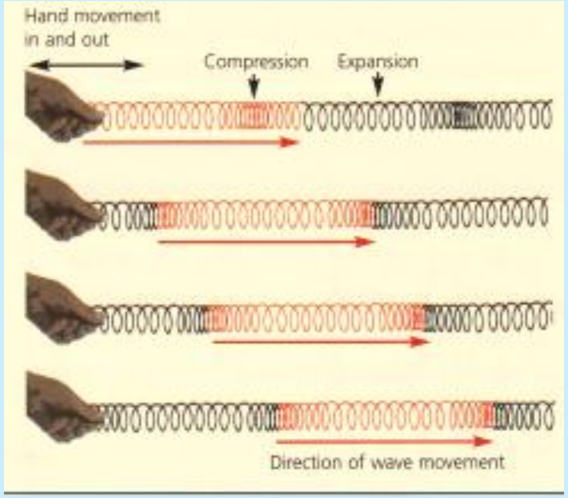
Types of Waves

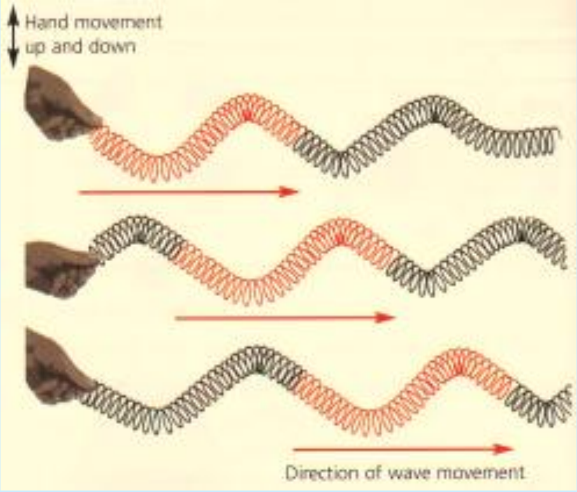
Waves are **regular** patterns of **disturbance**.

They transfer **energy** in the direction of the wave, without transferring **matter**



Longitudinal Waves

The particles move backwards and forwards in the same plane as the wave



Transverse Waves

Each particle moves up and down at right angles to the direction of the wave

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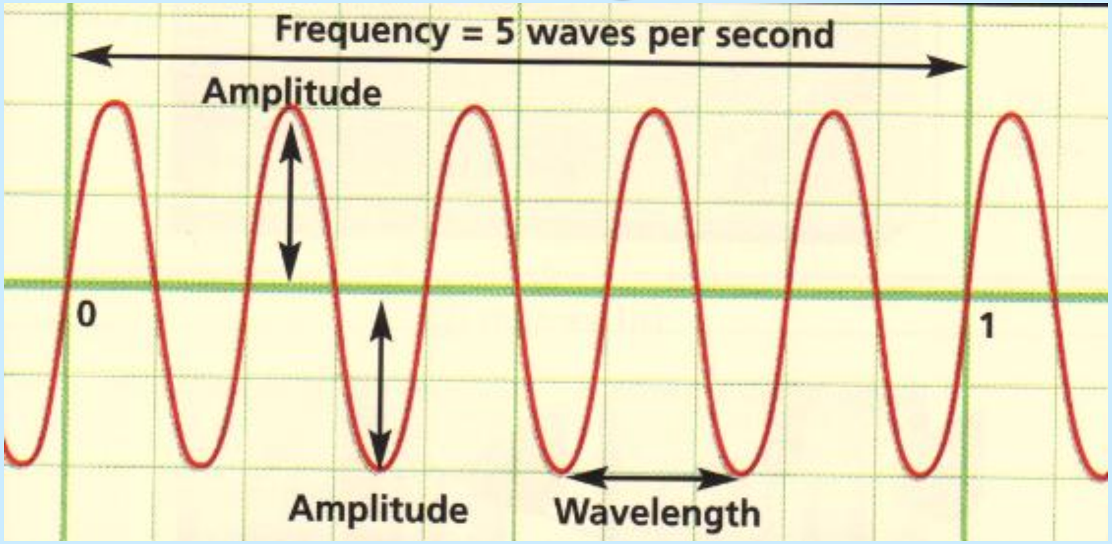
Describing Waves



Amplitude is the maximum disturbance caused by a wave. Measured from the undisturbed position to the crest or trough of the wave

Wavelength is the length of a complete wave. It is the distance between corresponding points on a wave.

Frequency is the number of waves produced in one second. It is measured in hertz (Hz)

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Wave Equations

The **frequency**, **wavelength** and **wave speed** are related.

Wave speed (m/s) = Frequency (Hz) x Wavelength (m)

Example

A tapped tuning fork of frequency 480Hz produces sound waves with a wavelength of 70cm. What is the speed of the wave?

wave speed = frequency x wavelength

= 480 x 0.7

= 336 m/s

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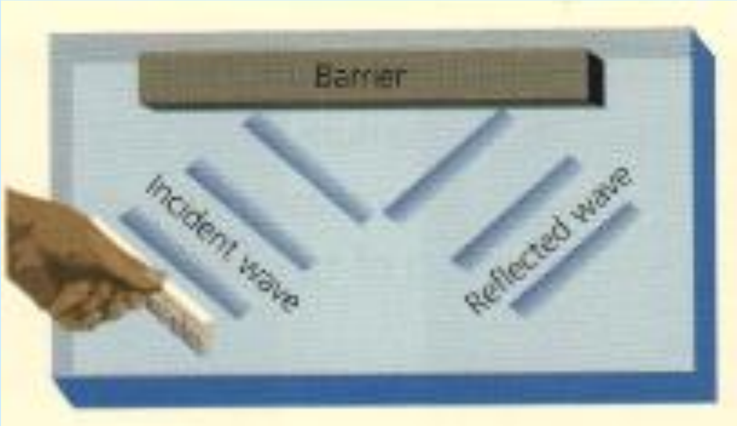
Reflection of Waves

Waves can be **reflected**

They do this when a **barrier** is placed in their path.

This means the wave bounces of the barrier.



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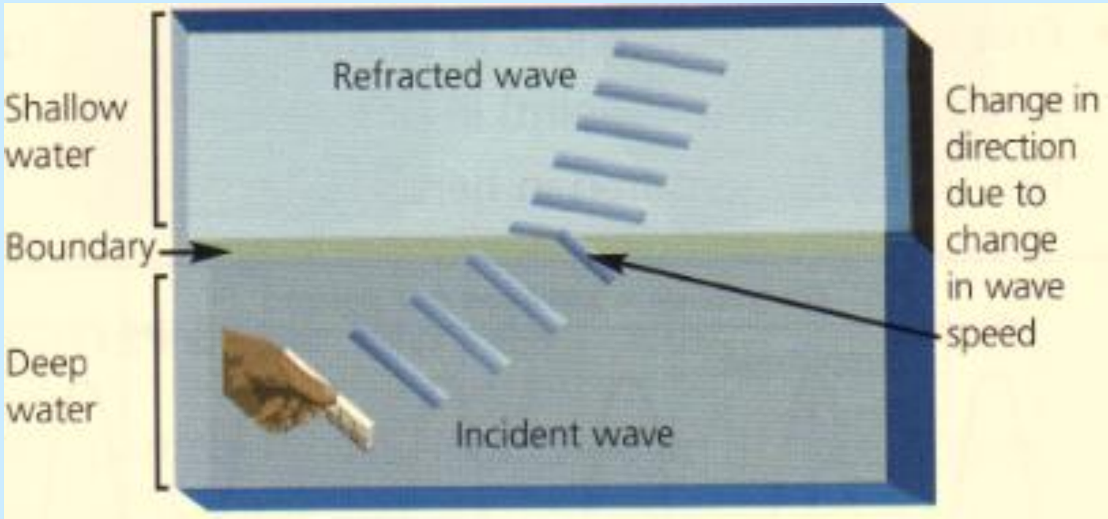
Refraction

When a wave passes from one **medium** to another, there is a change in **wavelength**.

This leads to a change in **wave speed** and a change in **direction**.

This is called **refraction**



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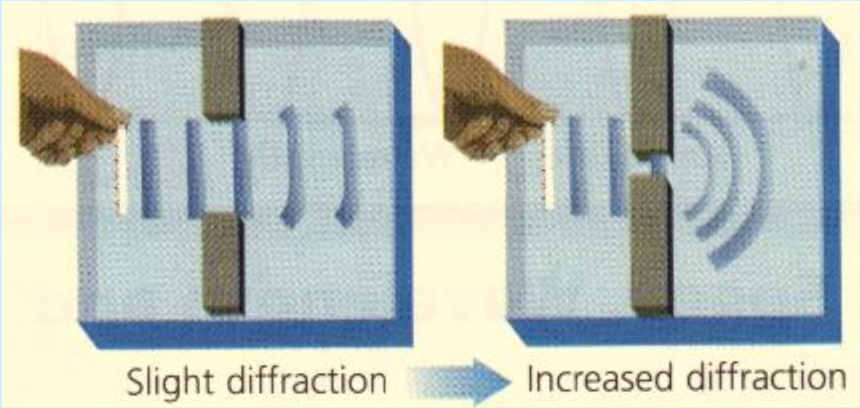
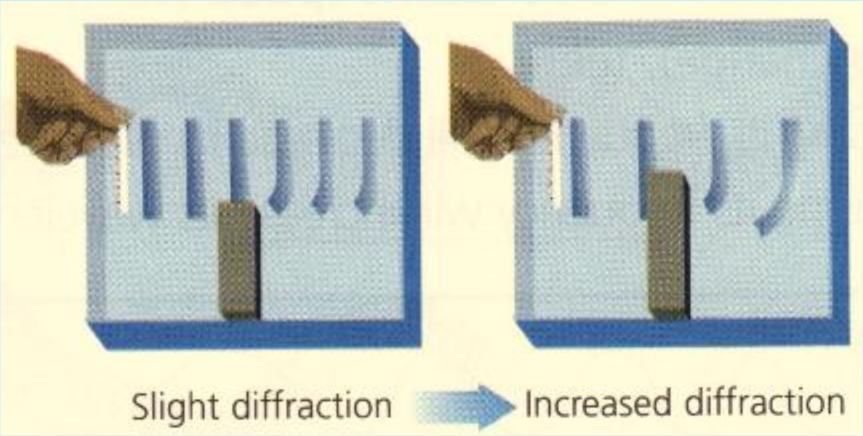
Diffraction

When waves pass through a **narrow gap** or past an **obstacle**, they **spread out** at the edges.

This is called **diffraction**





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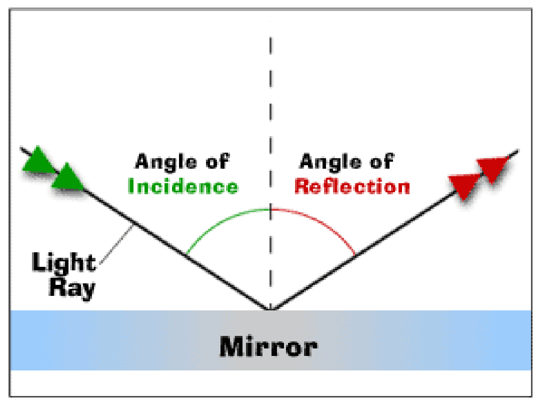
Light Waves - Reflection

When light hits a surface it is reflected.



angle of incidence = angle of reflection

The **normal** is a perpendicular line to the surface.

The **incident ray** is the light travelling **towards** the mirror.

The **reflected ray** is the light ray travelling **away** from the mirror

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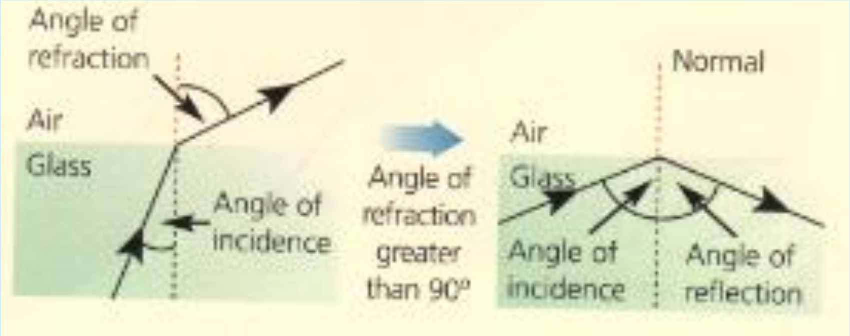
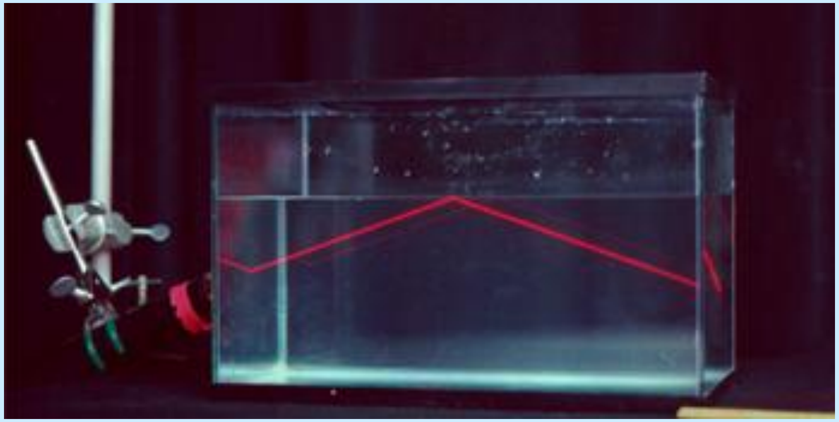
Total Internal Reflection

When the angle of refraction is **greater than 90°** the light cannot escape from the medium and is **reflected** instead.





This is called **total internal reflection** (TIR)

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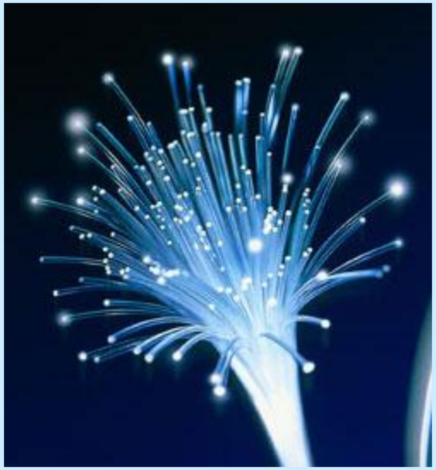
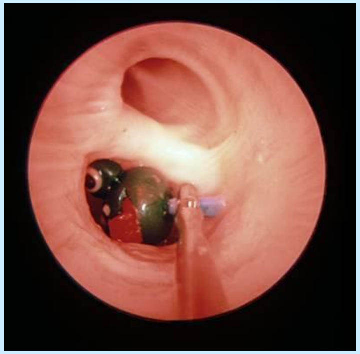
Optical Fibres

Optical fibre are important in **communication**



They make use of **total internal reflection**. Light entering one end is reflected all the way along until it comes out the other end.

Optical fibres are used by **doctors** to look inside the body without using surgery



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Electromagnetic Spectrum

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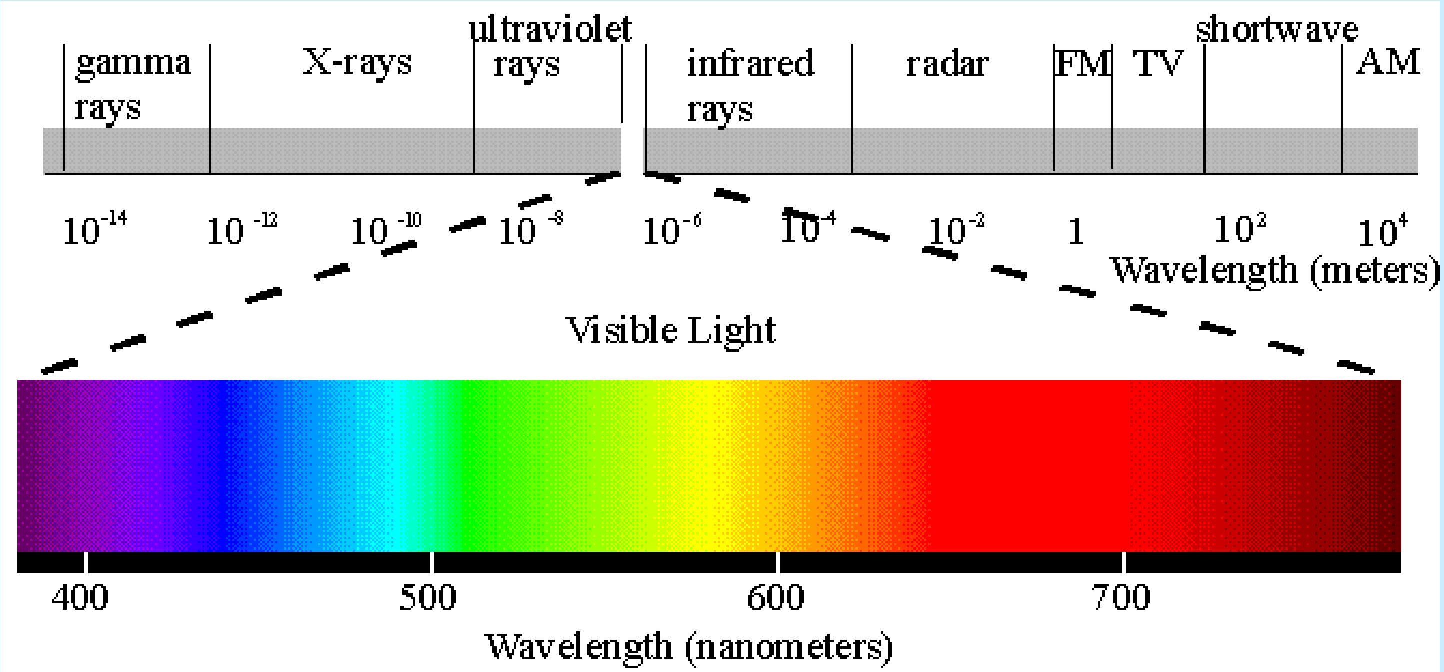
There are **different** types of waves.

Together they make the **electromagnetic spectrum**.



Electromagnetic waves are much **faster** the sound waves.

They can travel through **empty spaces**.

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Uses of the Electromagnetic Spectrum

Different electromagnetic waves have **different frequencies**. They can be **used** for lots of different things.

Radio waves

Used for transmitting radio and TV programmes. Also radio telescopes used in astronomy

Microwaves

contain water e.g. food

Infrared rays

Carry information down optical fibres. Used in grills, toasters, remote controls

Ultraviolet rays

Used in sun beds

X-rays

Used in security checks at airports and in hospitals to check the skeleton

Gamma rays

They are radioactive and can be used in the treatment of cancer

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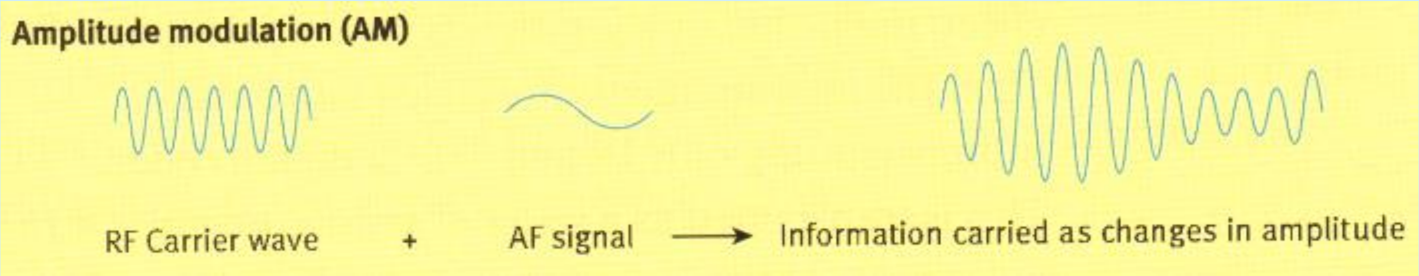
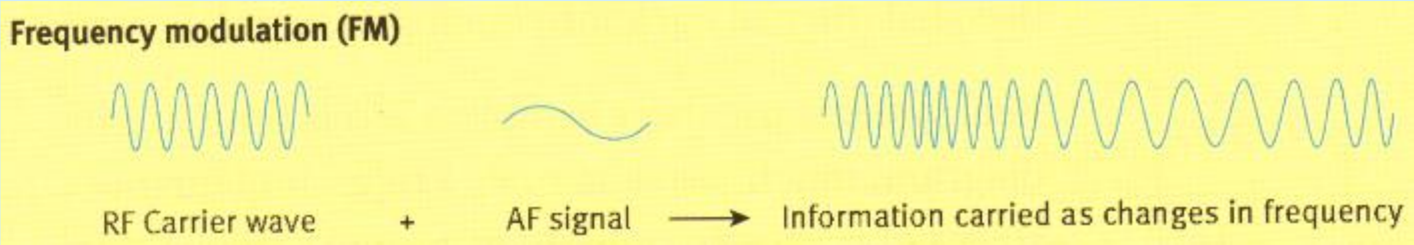
Analogue Signals

In **analogue** signals, the signal varies in exactly the same way as the information it is carrying.

In **amplitude modulation (am),** the amplitude of the wave is changed by the signal.



In **frequency modulation (fm),** the signal causes the frequency of the wave to change



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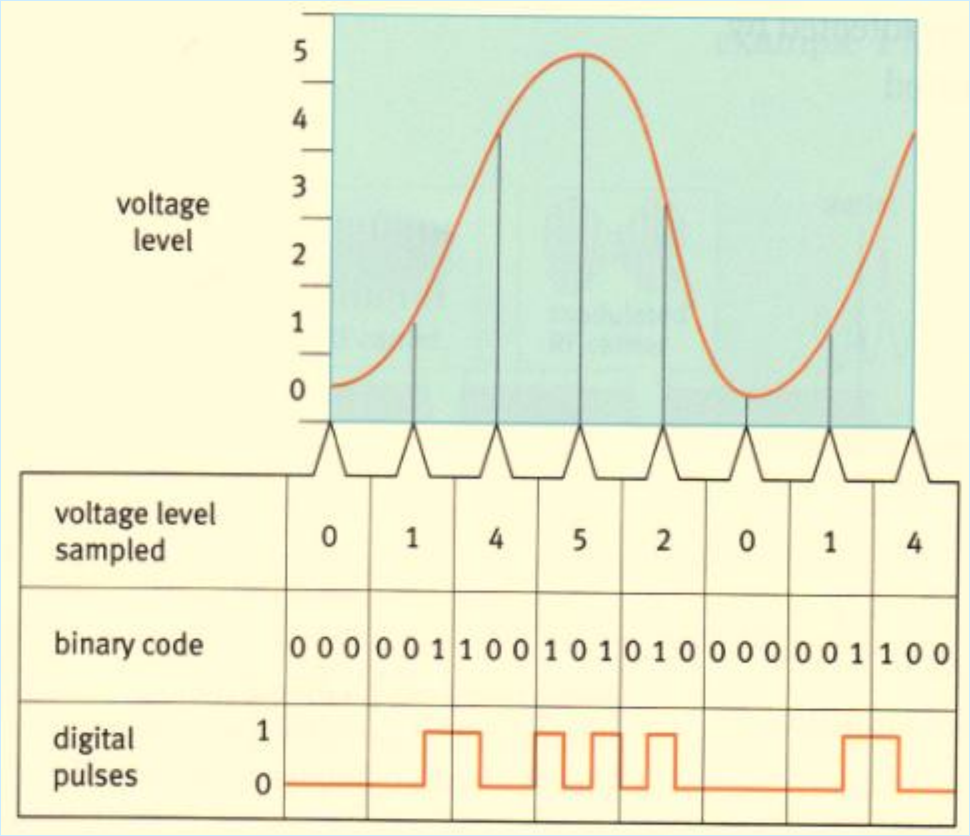
Digital Signals

Information can be transmitted digitally.

The signal is converted into a **digital** code

It uses 0 or 1 where **0 = no pulse and 1 = pulse**



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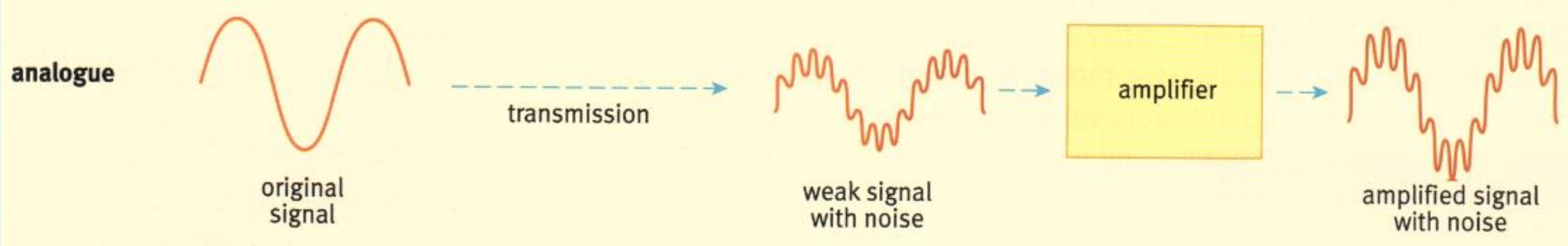
Benefit of Digital Signals

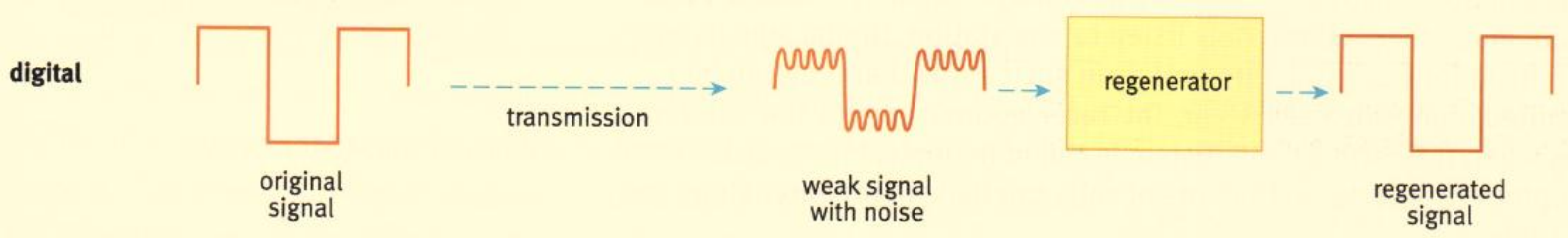
Analogue and digital signals can become **weaker** as they are transmitted.

The signals have to be **amplified** to counteract any weakening

Analogue signals can have many different values and it can be hard to distinguish between **added noise** and the **original** signal



Because digital signals only have two values (0 and 1) it is easy to **remove** the noise and **'clean up'** the signal.



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