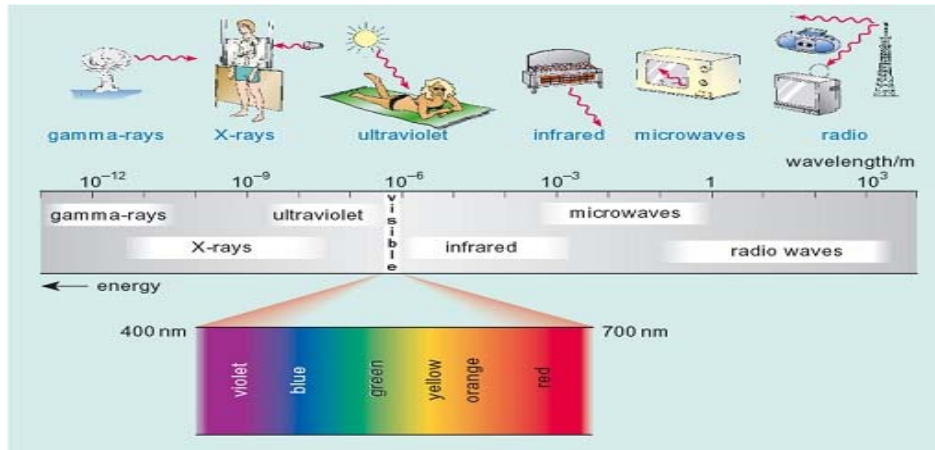


## Light and Other Radiations

**Visible light** is a form of **electromagnetic radiation**. X-rays, infrared, microwaves and gamma rays are other forms of this type of radiation which make up the **electromagnetic spectrum**.



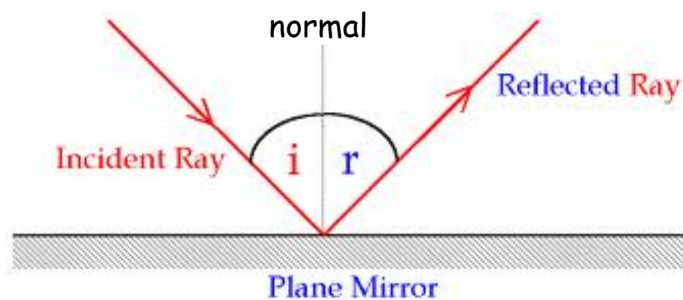
All forms of electromagnetic radiation move at the **speed of light** and in **straight lines**. They transfer energy. **Light can travel through a vacuum** (such as space) as particles are not needed to pass it on.

Light can pass through some materials, depending on whether they are:

- **Transparent** - all light passes through.
- **Translucent** - some light passes through and **some** is absorbed.
- **Opaque** - no light passes through and **all** is absorbed.

## Reflection of Light

Light is reflected off of many materials. Mirrors reflect **all** light.



The **normal** is an imaginary line drawn at right angles to the surface where the light hits it. The angle between the normal and the incident ray is known as the angle of incidence (labelled **i** in the diagram). The angle between the normal and the reflected ray is known as the angle of reflection (labelled **r**).

The Law of Reflection states:

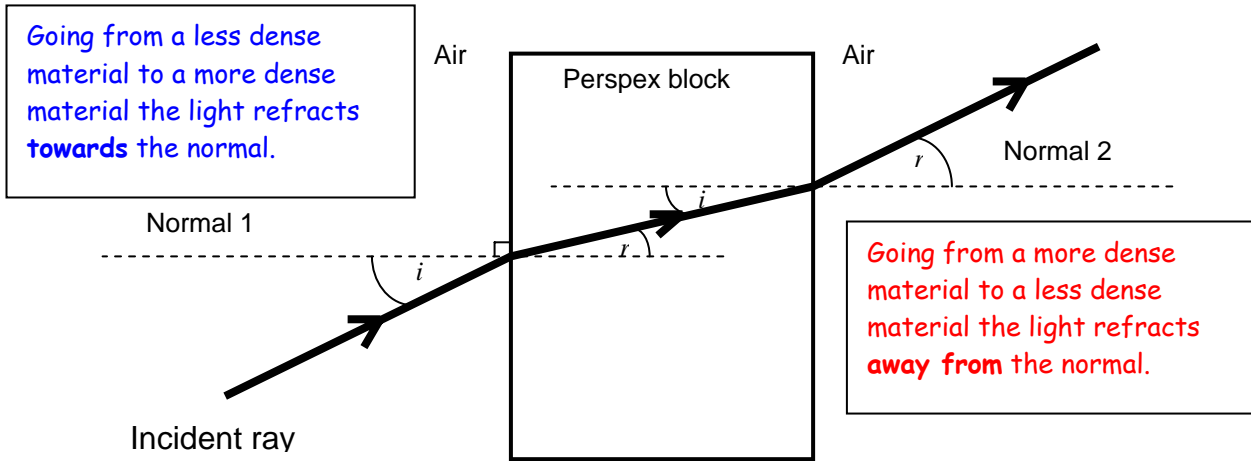
**the angle of incidence = the angle of reflection**

or

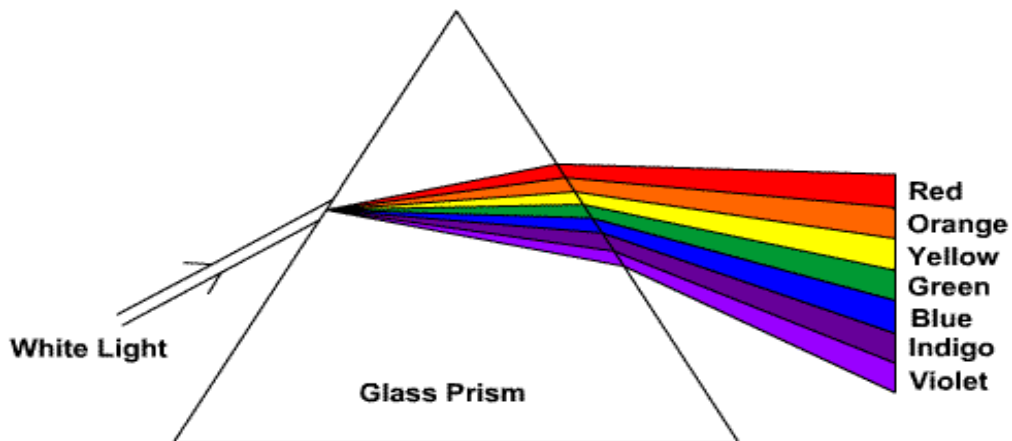
**angle  $i$  = angle  $r$**

## Refraction of Light

Light can change direction when it passes from one material into another. This is called **refraction**.



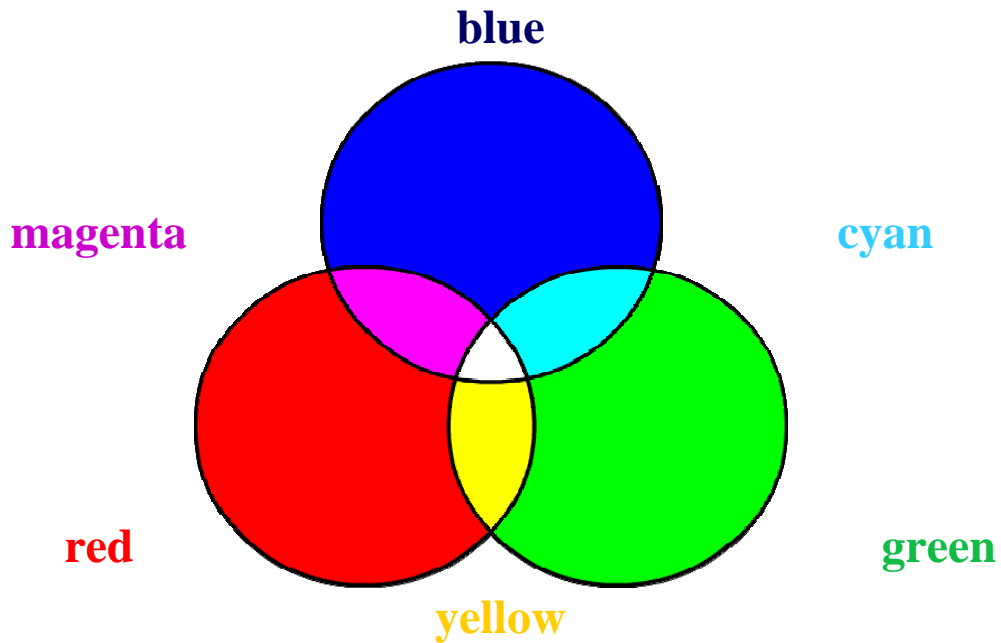
When white light passes through a triangular prism it is refracted twice and is split into all the colours of the **visible spectrum**. These are **Red, Orange, Yellow, Green, Blue, Indigo, Violet (ROY G. BIV).**



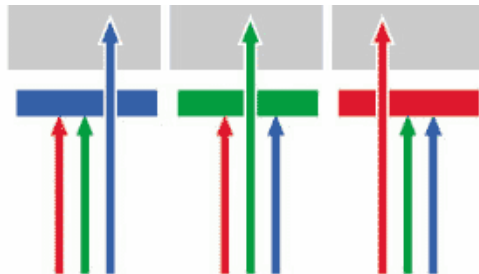
These are the colours we see in a rainbow. This is due to the light from the sun being refracted through water particles in the atmosphere.

## Colour Mixing

White light can be split into seven colours. However, really it is made up of only 3 colours. These are known as the **Primary Colours** and are **red**, **green** and **blue** (RGB). These can also mix in different combinations to make the **Secondary Colours** (yellow, cyan and magenta).



Coloured filters absorb all colours of white light except the one we see.

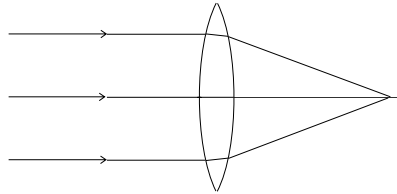


## Lenses

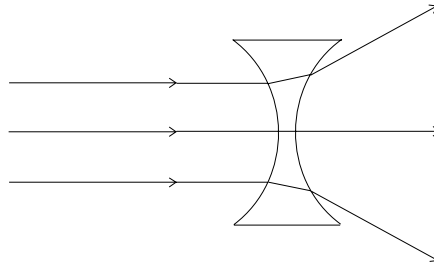
Lenses are used to change the direction of rays of light and help bring images into focus. There are two types of lens:

- Convex
- Concave

When rays of light pass through a **convex** lens the rays **converge** (move together).

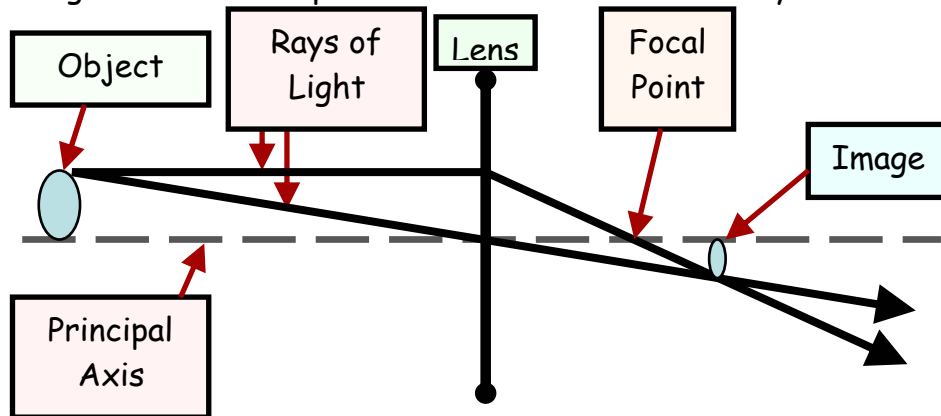


When rays of light pass through a **concave** lens the rays **diverge** (move apart).



Lenses have many uses, for example, in glasses, binoculars, microscopes, cameras.

Images are turned upside down and back to front by lenses.



## Other Types of Electromagnetic Radiation

All types of electromagnetic (EM) radiation move at the speed of light. However, they have different wavelengths, frequencies and therefore, different amounts of energy. Gamma rays have much more energy than TV and radio waves, which is why they are more dangerous to us.

## Infrared (IR) Radiation

- It is invisible and appears next to the red end of visible light on the EM spectrum.
- It has a **longer wavelength** and **lower frequency and energy** than visible light.
- It is emitted by all hot objects, including toasters and electric fires.
- It is how **remote controls** send signals to televisions and dvd players.
- Special infrared cameras can find people who may be trapped in smoke-filled or collapsed buildings or on the run from the police.
- It is used to make **thermograms** which show the different temperatures of the body. The hottest parts often indicate an area of infection or disease.



## Ultraviolet Radiation

- It is invisible and appears next to the violet end of visible light on the EM spectrum.
- It has a **shorter wavelength** and **higher frequency and energy** than visible light.
- It is in sunlight.
- It can cause **skin cancer**.
- Sun creams absorb it to protect the skin.
- It can get rid of **acne**.
- It can be used for security marking with invisible ink.
- It is absorbed by **fluorescent** chemicals which then glow. This can be used in detergents to make white clothes appear "whiter than white".

## X-Rays

- They are invisible.
- They have a **shorter wavelength** and **higher frequency and energy** than visible light and ultraviolet radiation.
- They are dangerous if exposed to them too often.
- They are used to detect **cracks in bones**.
- They turn photographic film grey when they hit it.
- They can be used to detect cracks in aeroplane wings.



## Gamma rays

- They have a very **short wavelength** and very **high frequency and energy**.
- They are very dangerous to cells in the body.
- They can be used to **kill cancer cells**.
- They can also be used to sterilise surgical instruments and kill harmful bacteria in food.