# Waves

# 3. Wave Effects

## CONCEPT 3

## LESSON GUIDE

## ULTRAVIOLET AND INFRARED

### PRECISE LEARNING POINTS

KNOW

I know what the colour spectrum of white light is and how it can be made (same as 4.2.4).

APPLY

I can apply my knowledge to explain what infrared and ultraviolet are, and their respective dangers.

EXTEND

I can extend my knowledge to explain applications of infrared and ultraviolet.

### NOTES

Light travels as waves and we can measure the **wavelength** of a wave. Different colours of light have different wavelengths. If we alter the wavelength of light – we change its colour. Red light has the longest wavelength of any light we can see and violet has the shortest. If we have light waves longer than red we wouldn't see them and we call these waves **infrared**. If we have light waves shorter than violet we wouldn't see them and we call these waves **ultraviolet**.

The wavelengths we are talking about here are extremely small. Even the longest, red, has a wavelength of around 700 nm.

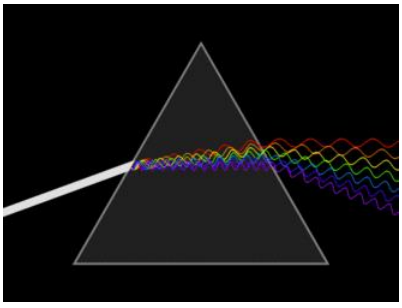
1 nm (nanometre) is the same as 0.000000001 m (metres)

OR 1 000 000 000 nm (nanometres) is the same as 1 m (metre)

This is tricky to think of when just looking at numbers. Take a ruler and find the length of 1 mm. You could fit 1 000 000 waves of red light in that 1 mm.

Violet wavelength is around 400 nm. There are many possible values for wavelength between red and violet. We reduce this number down to just 7 and we call the order of these 7 colours **the colour spectrum**. Remember though, there are millions of possibilities – we only list these as an order.

When white light is split up using a triangular prism the following colour spectrum is produced:



The colour spectrum order can be easily remember with the following help:

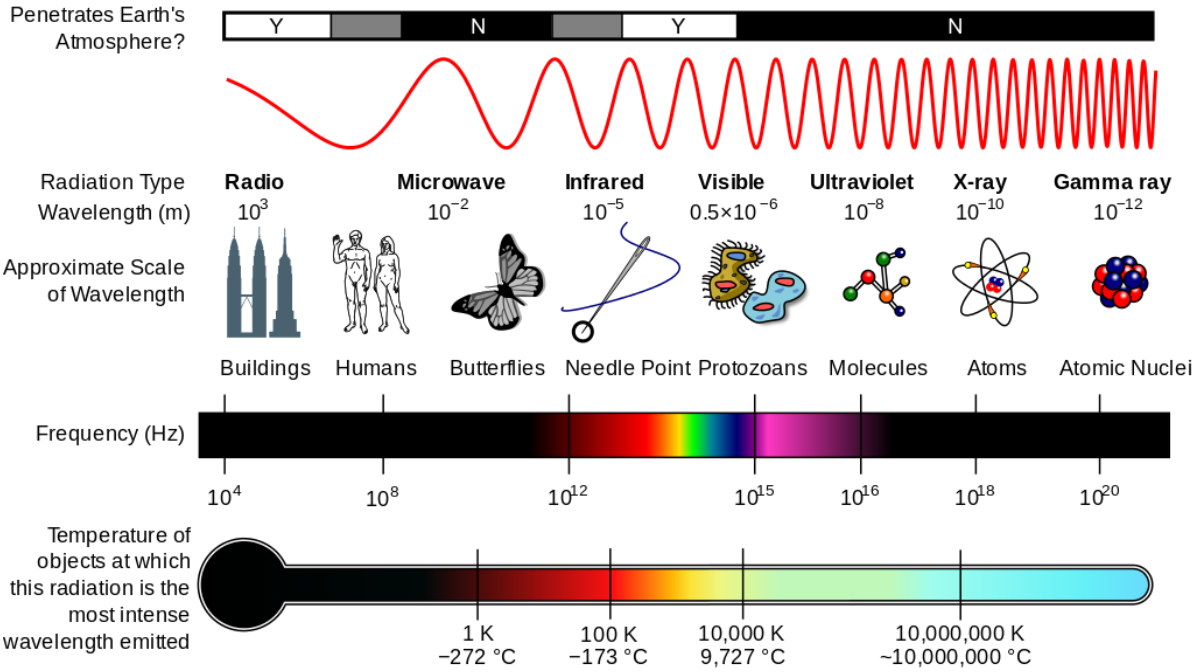
**ROYGBIV** or **R**ichard **O**f **Y**ork **G**ave **B**attle **I**n **V**ain

Whichever method you use, you need to know the order of the colours as:

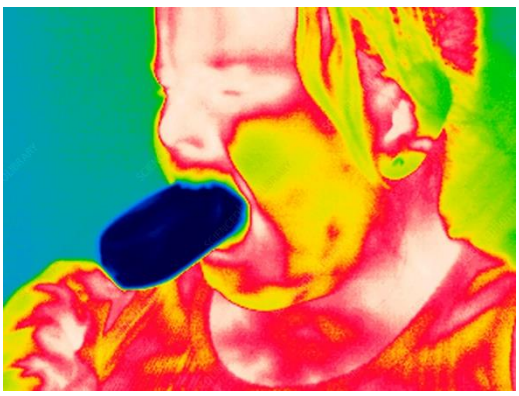
| Red | Orange | Yellow | Green | Blue | Indigo | Violet |
|---|---|---|---|---|---|---|

Just because we can only see these wavelengths doesn't mean that other wavelengths don't exist. As mentioned earlier infrared has wavelengths longer than red and ultraviolet has wavelengths shorter than violet. There are more wavelengths longer than infrared and shorter than ultraviolet.

We call all of these forms of light waves, **the electromagnetic spectrum**




Infrared waves that are just shorter than the colour red are invisible but we can use it for TV remotes or for LASERS. Longer wavelengths of infrared are given off by hot objects. This is how we are able to see hot objects like human bodies in the dark, or buried under buildings. We call these **thermograms**.



Ultraviolet (UV) can be both beneficial and dangerous. Large amounts of UV light travel from the Sun and most of it is filtered out by the upper atmosphere of the Earth. The small amount that does get through is important for healthy life in that it stimulates the production of vitamin D, which strengthens bones. However, it also causes suntans, sunburns and it can increase the likelihood of skin cancer.

Some chemicals can be used together with UV light. They absorb UV light that we can't see and emit the energy back out in wavelengths of visible light that we can see. This is called **fluorescence**.


Additional security features are added to banknotes. This is why money is often checked under UV lamps to make sure it has the correct fluorescent markings on it.

Insects such as bees see flowers differently to us. Where we see the coloured light reflected from the chemicals in the flower, a bee will see the reflected UV light from the chemical in the flower. Flowers have patterns of chemicals which reflect UV in different amounts and so a bee will see these patterns where we would not.