

# THE ELECTROMAGNETIC SPECTRUM

Michael Faraday, James Maxwell

The infinite range of frequencies of electromagnetic radiation - an effect of **electromagnetism** that travels by **photon wave particles** at the **speed of light** and carries **radiant energy**.

Increasing energy, frequency (Hz), & danger

Increasing wavelength (m)

Radio Waves	Microwaves	Infrared	Visible Light	Ultraviolet	X-Rays	Gamma Rays
3 Hz - 300 GHz 100 km - 1 m	300 MHz - 300 GHz 1 m - 1mm	300 GHz - 400 THz 1 mm - 750 nm	400 THz - 770 THz 750 nm - 390 nm	750 THz - 30 PHz 400 nm - 10 nm	30 PHz - 30 EHz 10 nm - .01 nm	>15 EHz <.02 nm
AM, FM, TV, radar, communications	Wi-Fi, microwave oven	remote, night vision	vision, photography, illumination	suntan, sunburn, dental curing	baggage screen, medical x-ray	PET imaging, cosmic rays
Heinrich Hertz	Heinrich Hertz	William Herschel		Johann Ritter	Wilhelm Rontgen	Paul Villard, William Henry Bragg, Ernest Rutherford, Edward Andrade

$f$  = frequency

$\lambda$  = wavelength

$E$  = photon energy

$c$  = speed of light  
299,792,458 m/s

$h$  = Planck's constant  
6.62606957(29)  $\times 10^{-34}$  Js

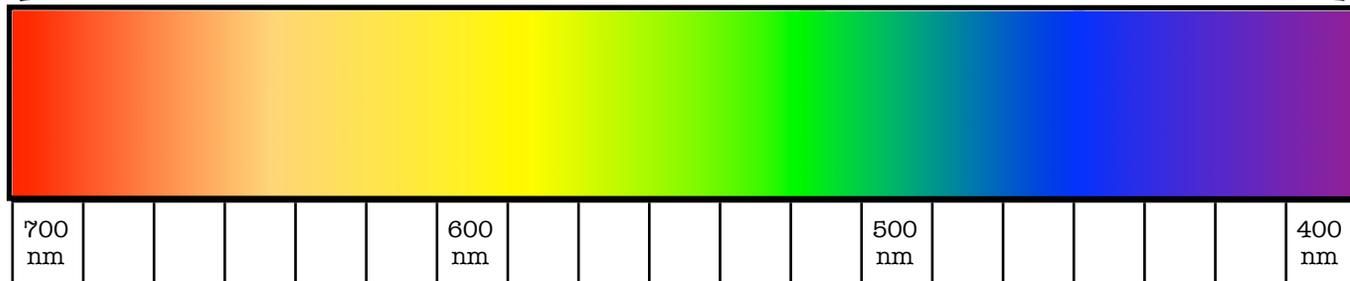
$$f = c/\lambda$$

$$f = E/h$$

$$E = hc/\lambda$$

**ROY G. BIV**

R = red  
O = orange  
Y = yellow  
G = green  
B = blue  
I = indigo  
V = violet

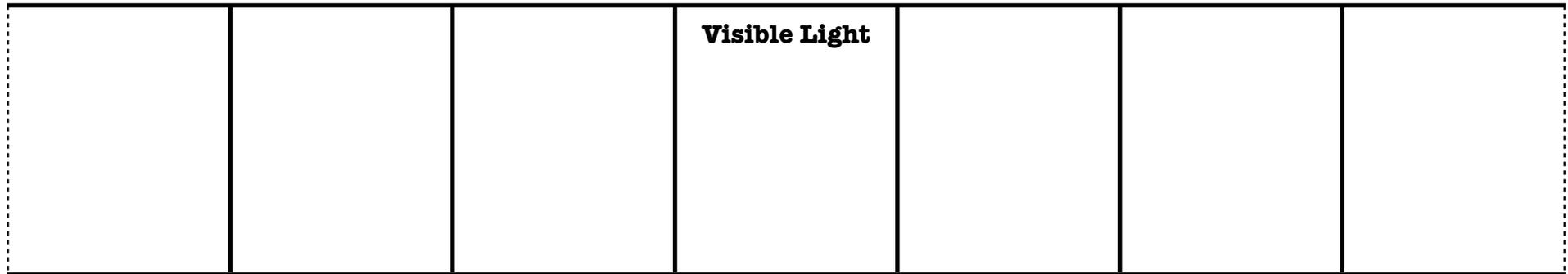
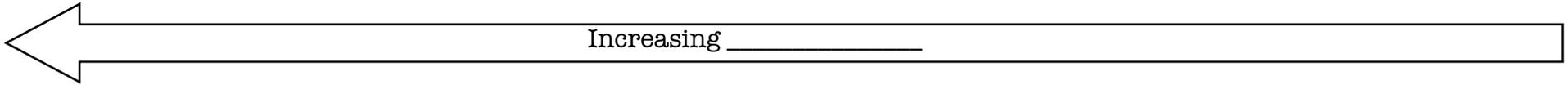
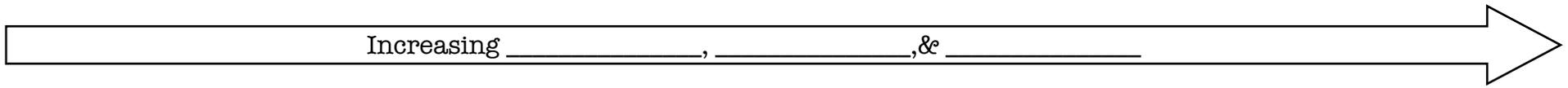


- **White light** is the combination of all the different wavelengths in the visible range of the spectrum.
- When white light is passed through a **prism** it is split into the different colors, as in a rainbow.
- Our perception of the world is based on the eye's detection of this range of **electromagnetic radiation**.
- Colors containing only one wavelength are called **pure colors**.
- Mixes of multiple wavelengths are called **unsaturated**.
- Objects appear colored because of light **absorption, reflection, or emission**.
- **Redshift** indicates that an object is moving away from an observer.
- **Blueshift** indicates that an object is moving towards an observer.



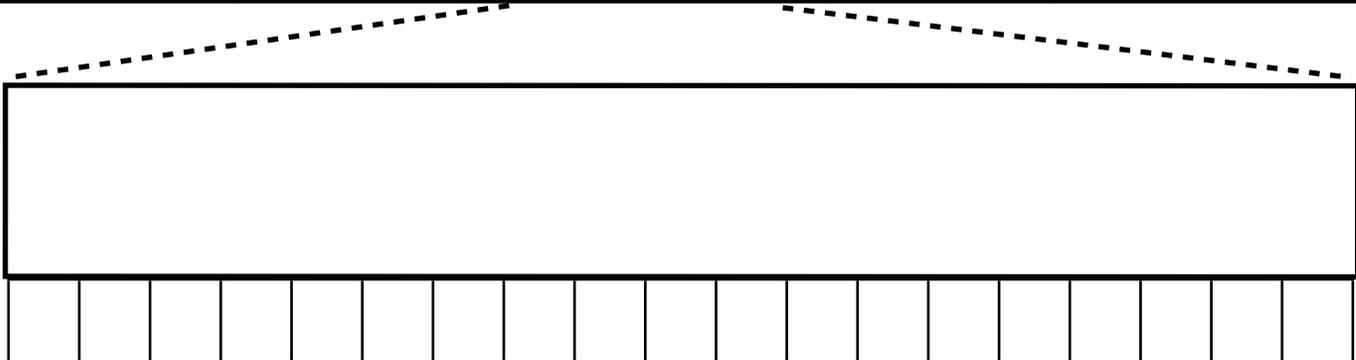
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The infinite range of frequencies of electromagnetic radiation - an effect of \_\_\_\_\_ that travels by \_\_\_\_\_ at the speed of \_\_\_\_\_ and carries \_\_\_\_\_ energy.



$f =$   
 $\lambda =$   
 $E =$   
 $c =$   
 $h =$

$f = \_ / \_$   
 $f = \_ / \_$   
 $E = \_ / \_$



**ROY G. BIV**

R =  
 O =  
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- When white light is passed through a \_\_\_\_\_ it is split into the different colors, as in a rainbow.
- Our perception of the world is based on the eye's detection of this range of \_\_\_\_\_.
- Colors containing only one wavelength are called \_\_\_\_\_.
- Mixes of multiple wavelengths are called \_\_\_\_\_.
- Objects appear colored because of light \_\_\_\_\_, \_\_\_\_\_, or \_\_\_\_\_.
- \_\_\_\_\_ means an object is moving away from an observer.
- \_\_\_\_\_ means an object is moving towards an observer.

