

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

λ = wavelength

E = photon energy

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

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

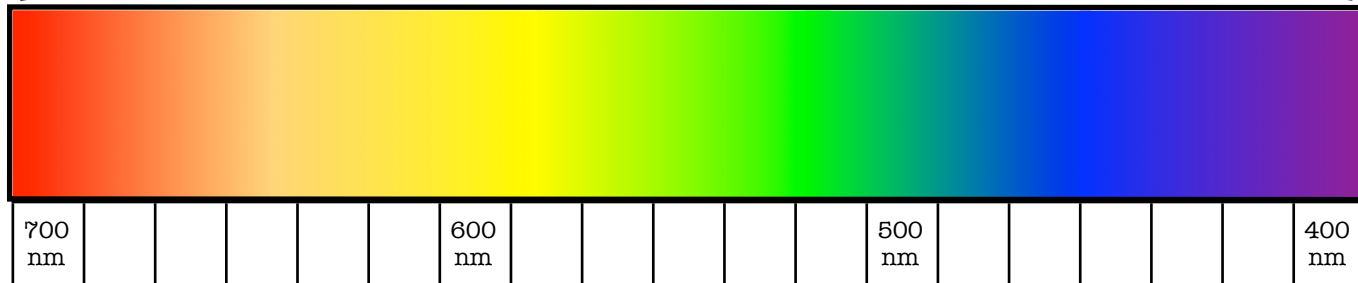
$$f = c/\lambda$$

$$f = E/h$$

$$E = hc/\lambda$$

ROY G. BIV

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

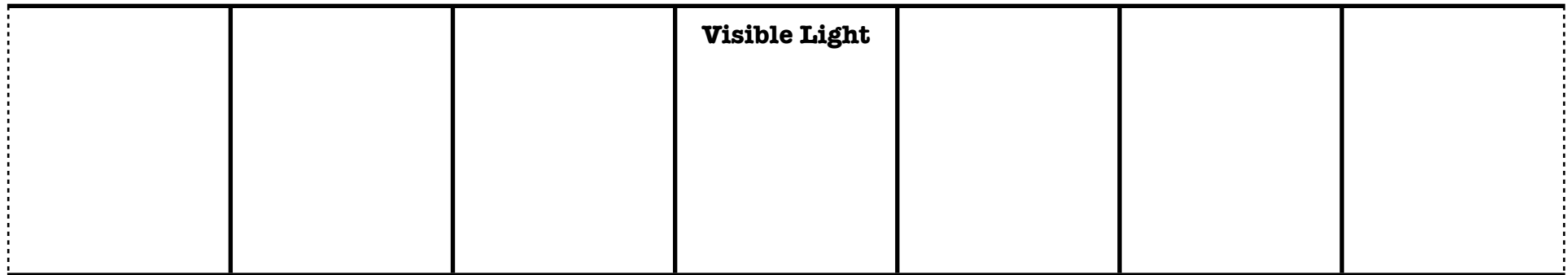
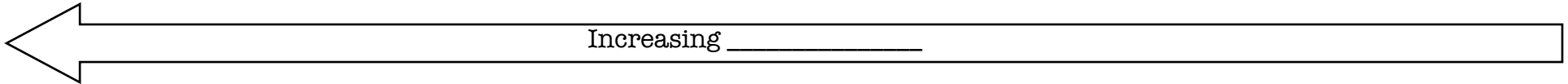
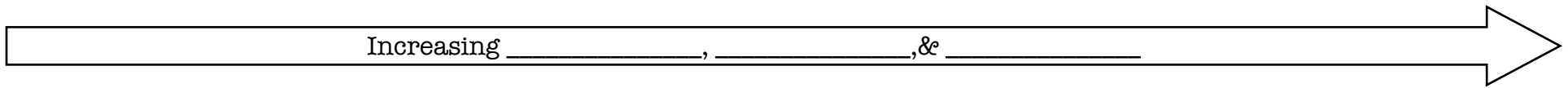


- **White light** is the combination of all the different wavelengths in the visible range of the spectrum.
- When white light is passed through a **prism** it is split into the different colors, as in a rainbow.
- Our perception of the world is based on the eye's detection of this range of **electromagnetic 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.



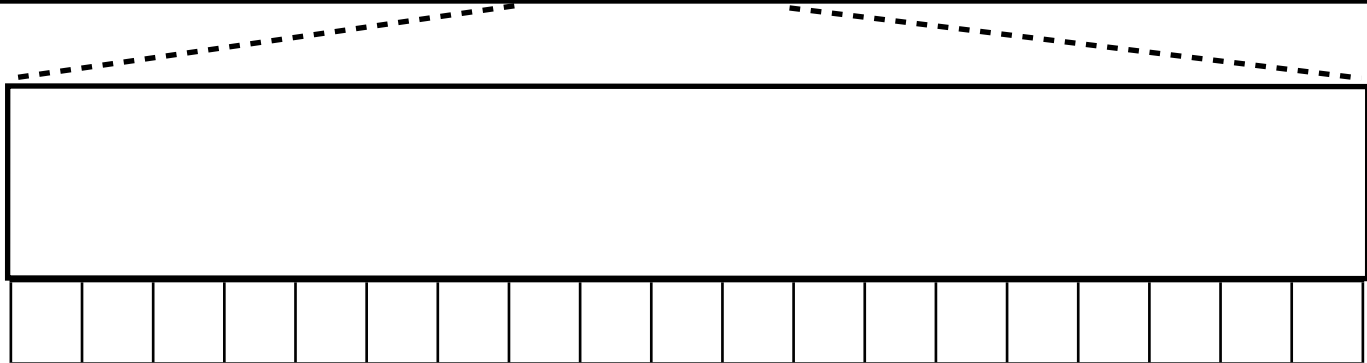
THE ELECTROMAGNETIC SPECTRUM

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 =
 Y =
 G =
 B =
 I =
 V =

- _____ is the combination of all the different wavelengths in the visible range of the spectrum.
- 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.

