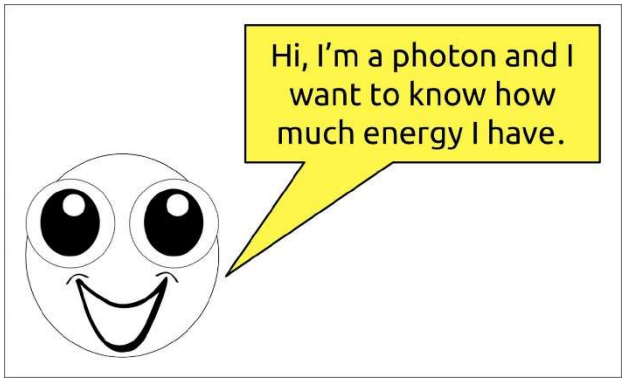
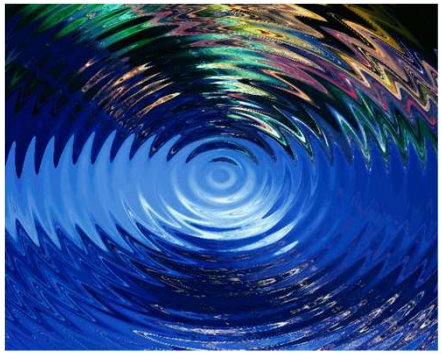
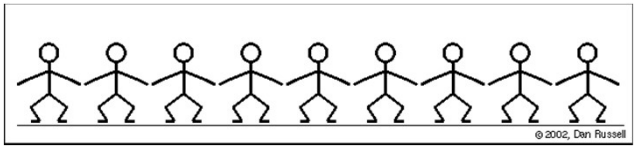
Light: 3 things to remember

Light is made of particles, packets of pure energy called **photons**



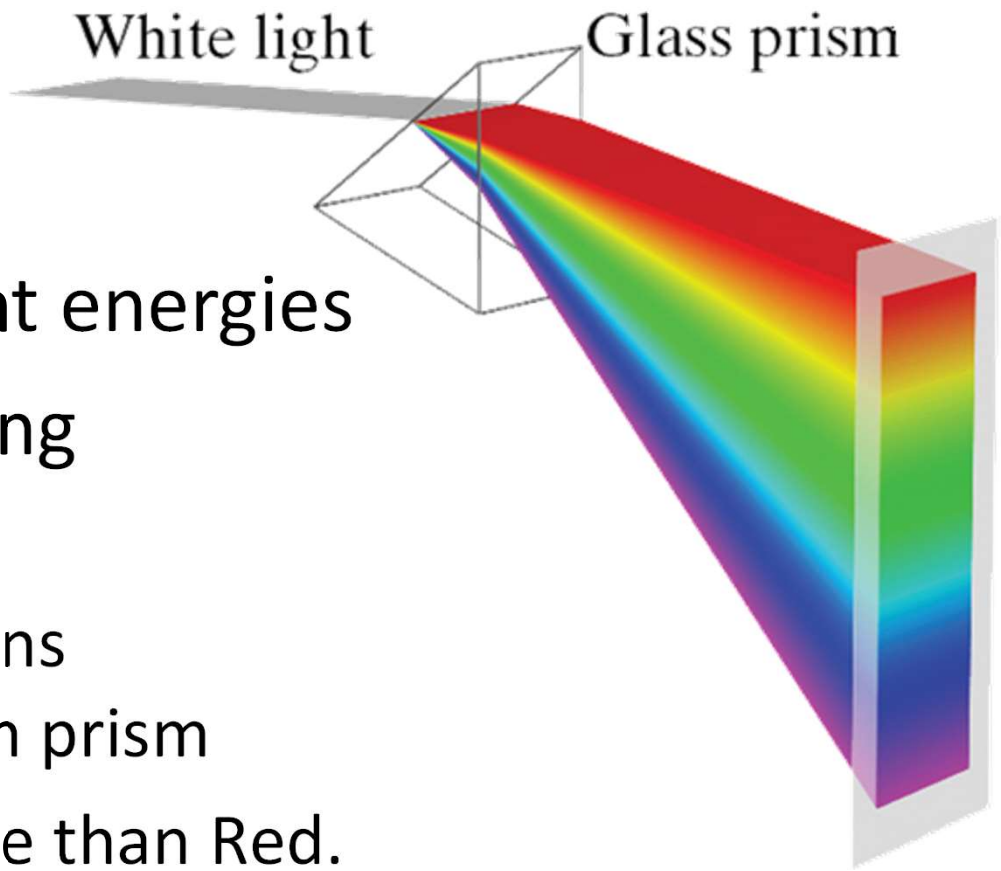
Light is also a **wave**



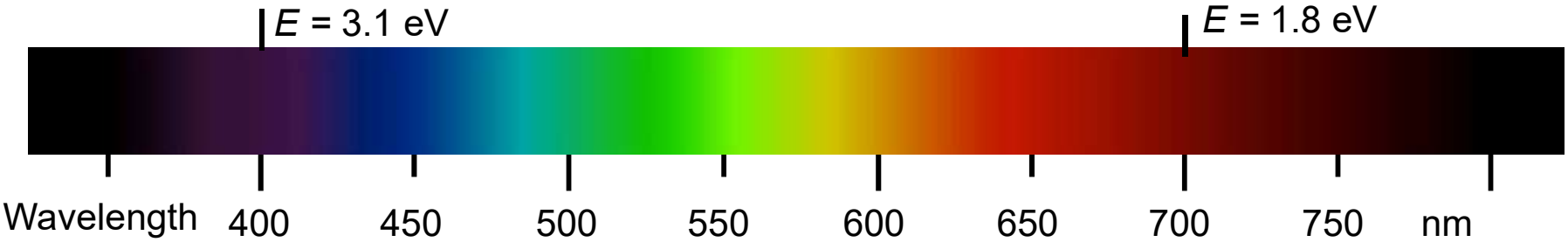


Light is the **fastest thing** in the universe

WHITE LIGHT

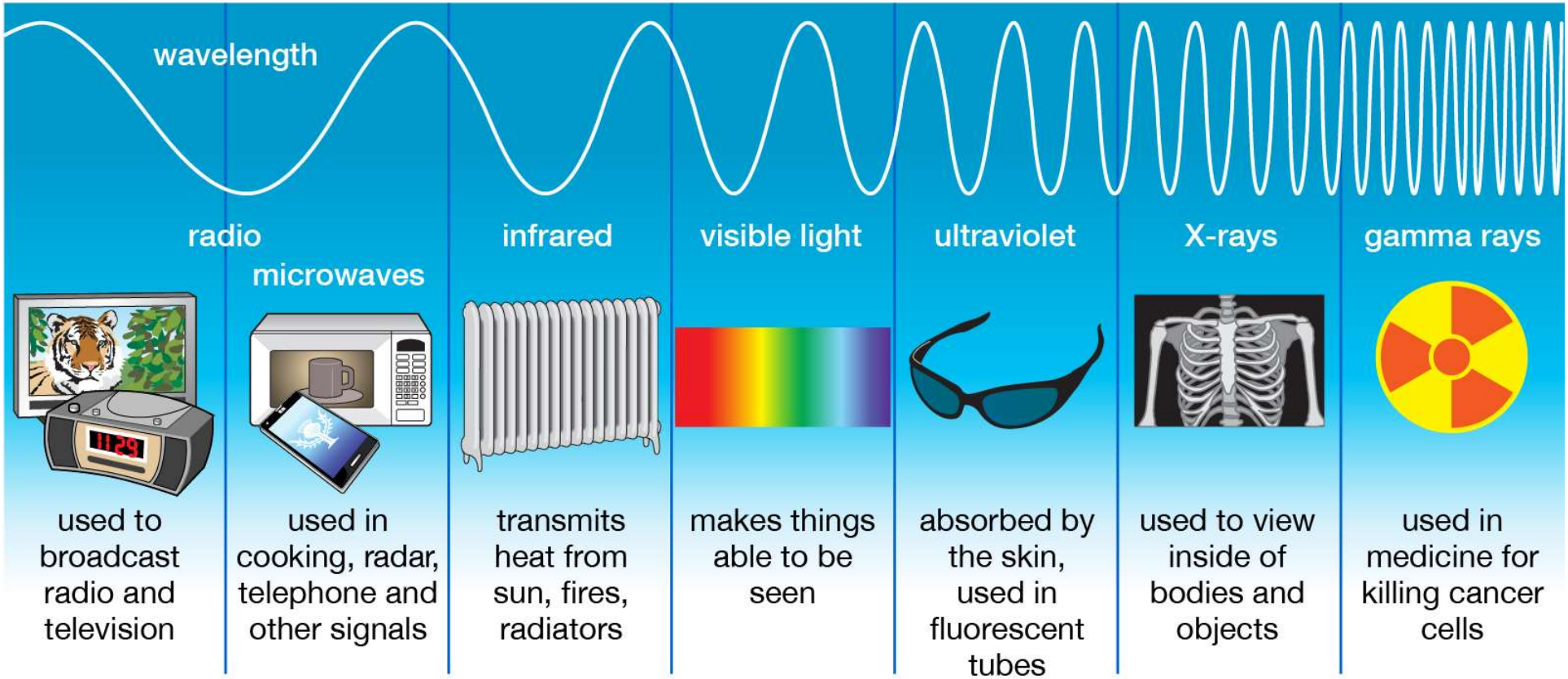


- White Light contains light of many different energies
- Can separate by passing through a glass prism
  - Different energy photons interact differently with prism
  - Violet slows down more than Red.
  - Violet bends more than Red.



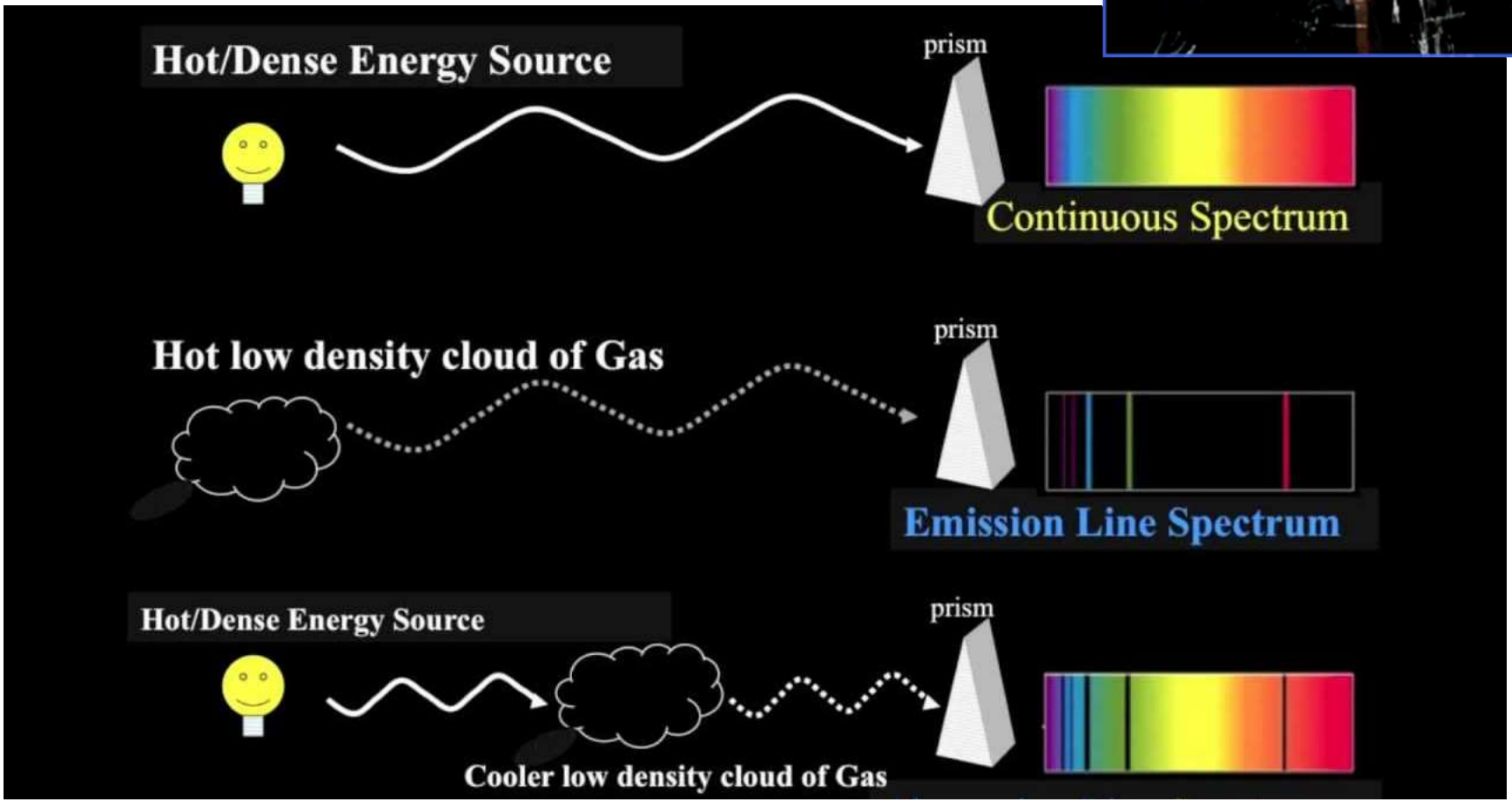
Light

Types of Electromagnetic Radiation

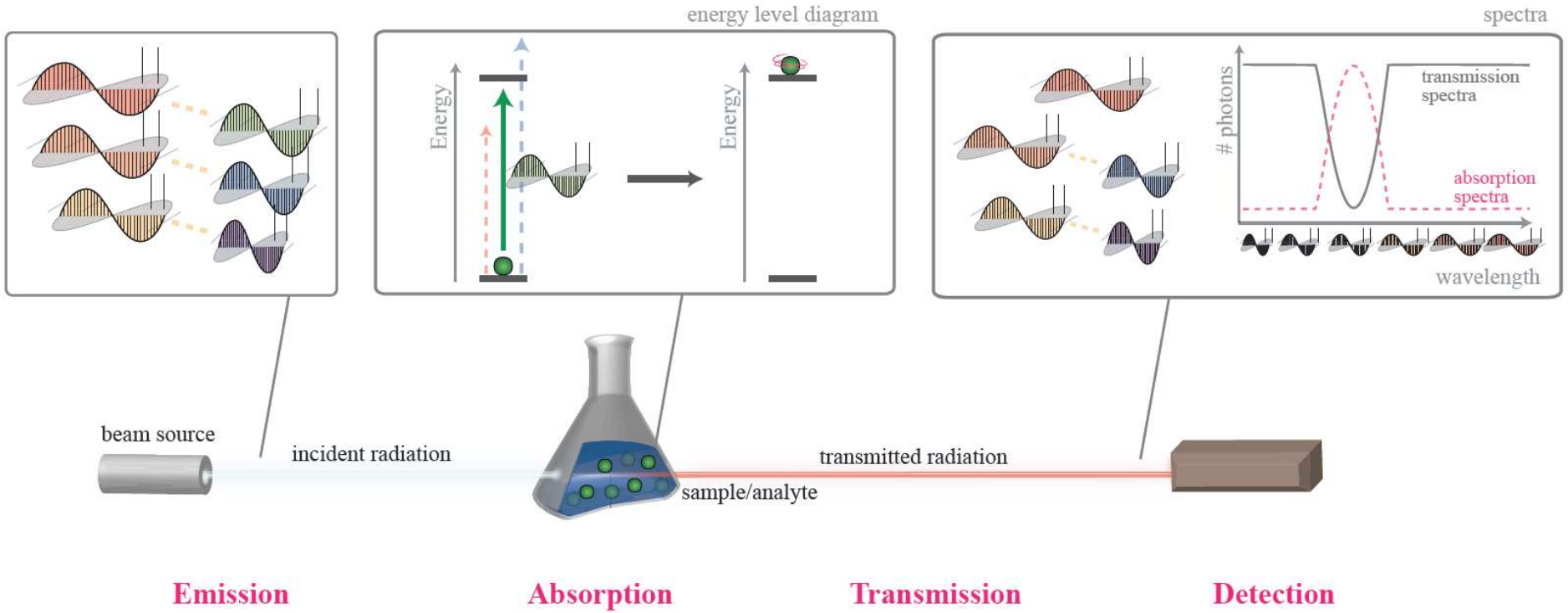


Light as a tool:

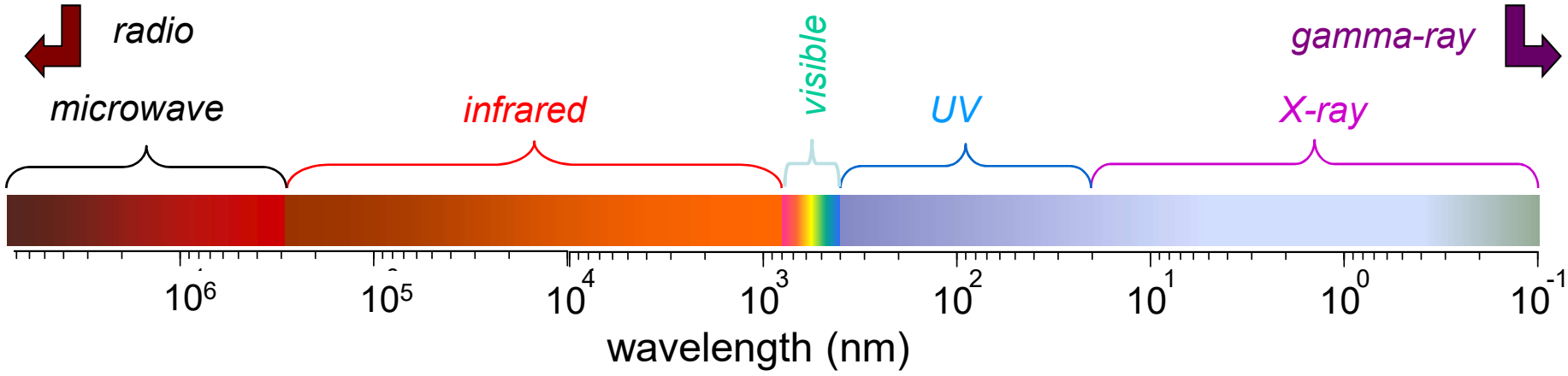
Spectroscopy

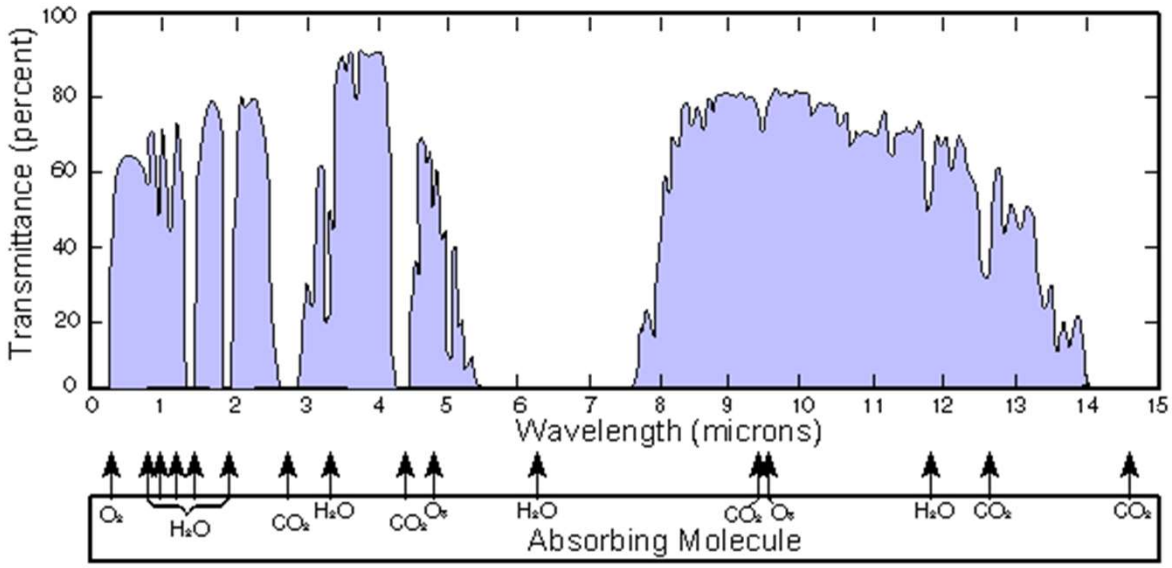


Light as a tool: Absorption spectroscopy

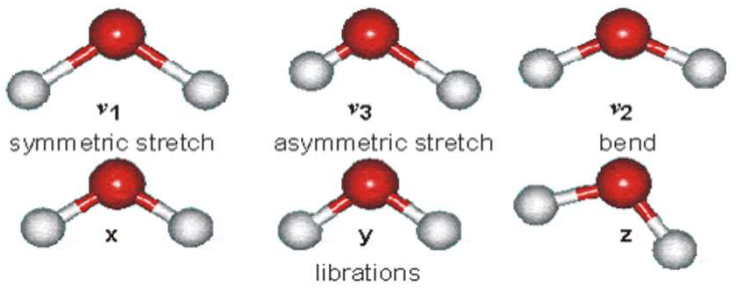


Why IR? IR spectroscopy





Water vibrations



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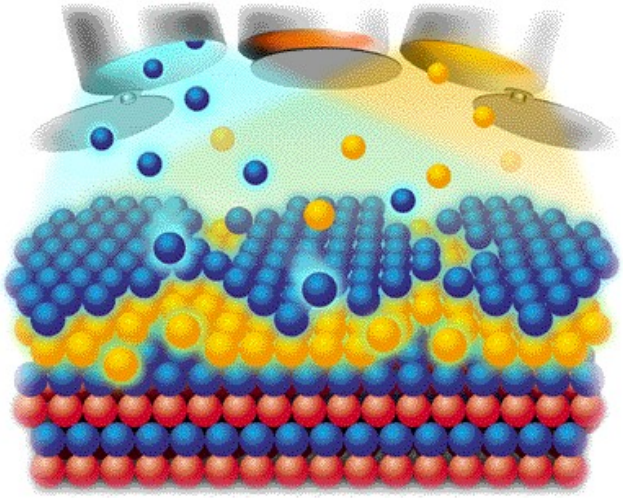
What do I do? New materials for IR lasers

Material growth: The materials are deposited one atomic layer at a time



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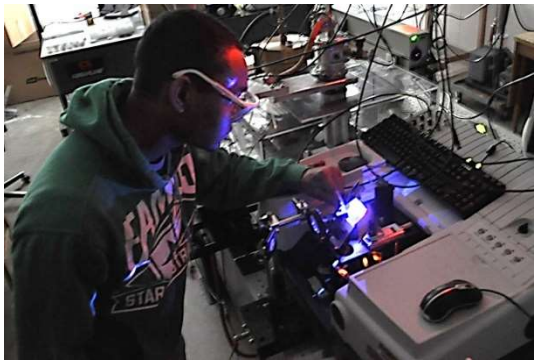
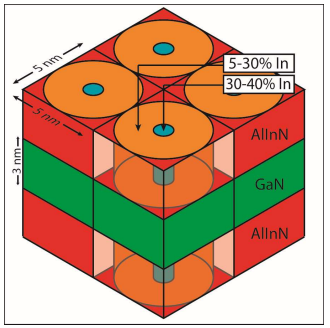
What do we do?

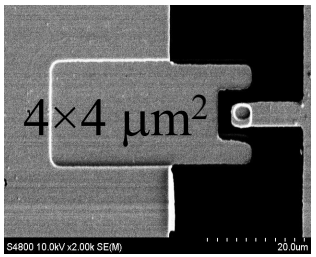
- Design of new materials



- Infrared spectroscopy
- Computer modeling of material properties

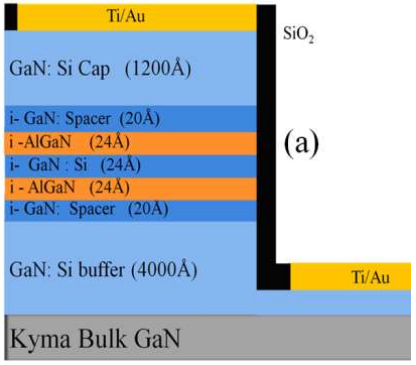


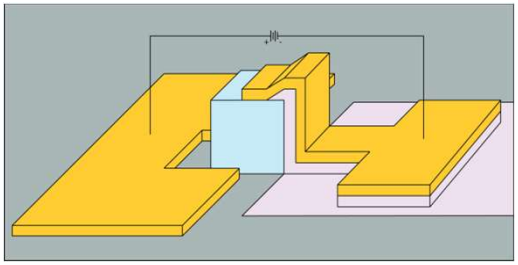
- Device fabrication and device measurements

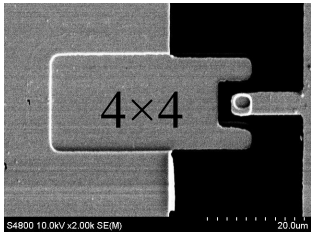


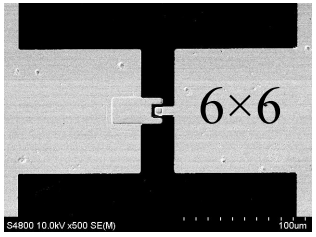
Device design, fabrication and testing

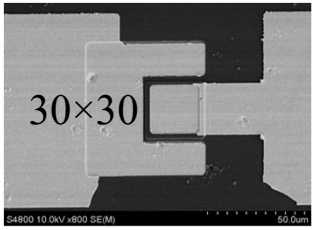
Device fabrication at the Birck Nanotechnology Center

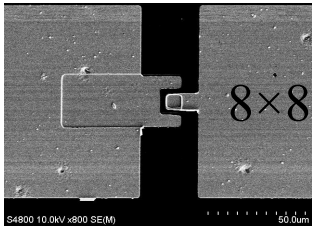


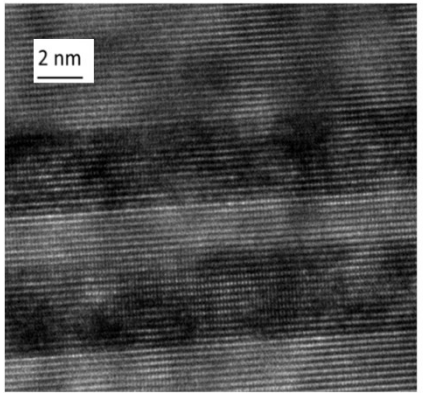




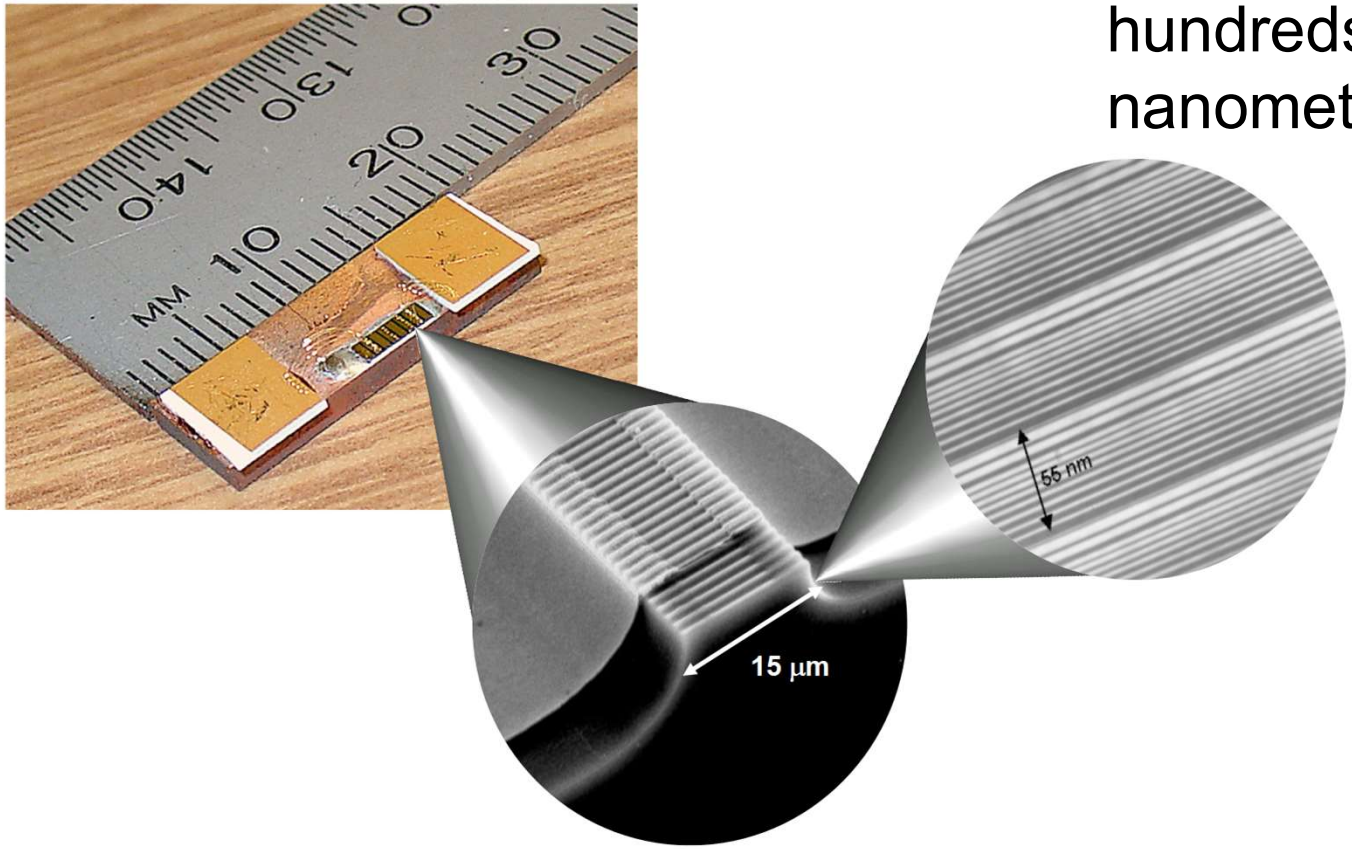








Infrared laser devices



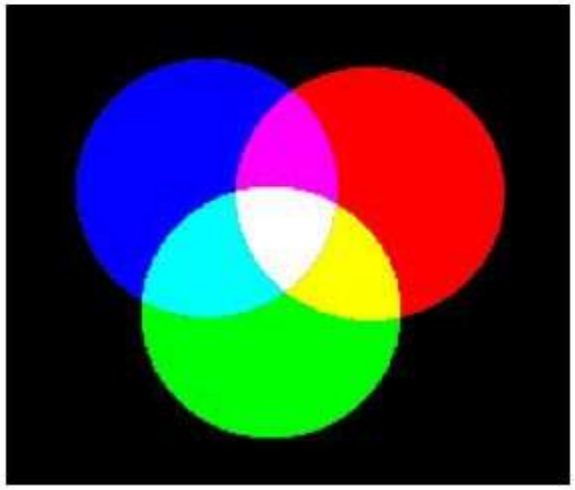
hundreds of
nanometer-size layers

Devices the size of a
human hair

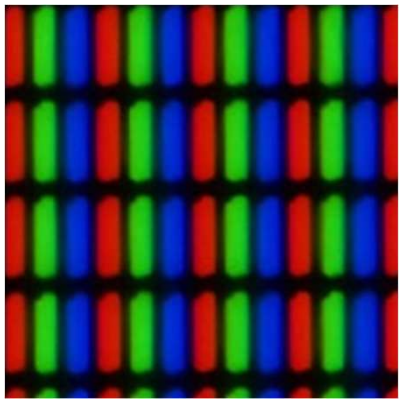
How many colors do I need to get white light?

RGB

red, green, blue--
used in CRTs
Additive mixing of light sources



LCD in your screen



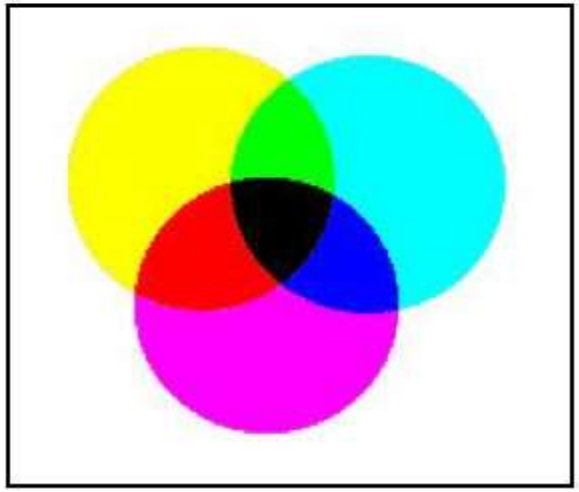
Microscope picture of screen

How many colors do I need to print a color picture?

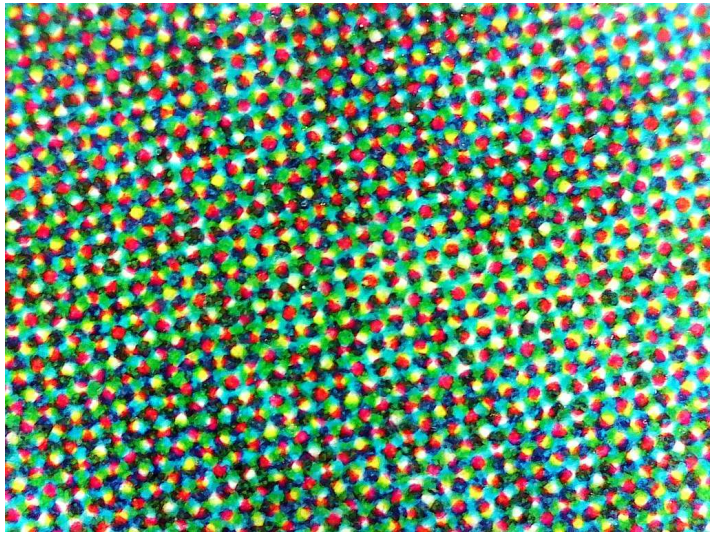
CMYK

cyan, magenta, yellow, black–used in printing

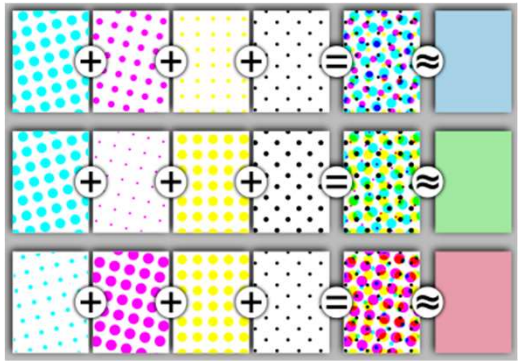
Subtractive mixing of absorbing pigments



Color printing with pigments

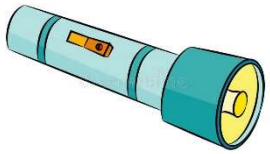


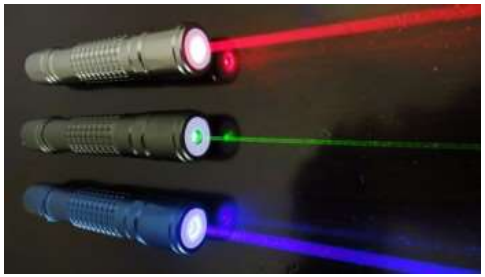
Microscope image of printed paper

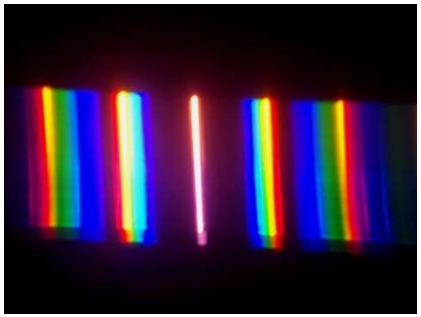


Visible light: experiments

Light source + **Diffraction glasses** ➡ **Light spectrum**







Visible light: experiments

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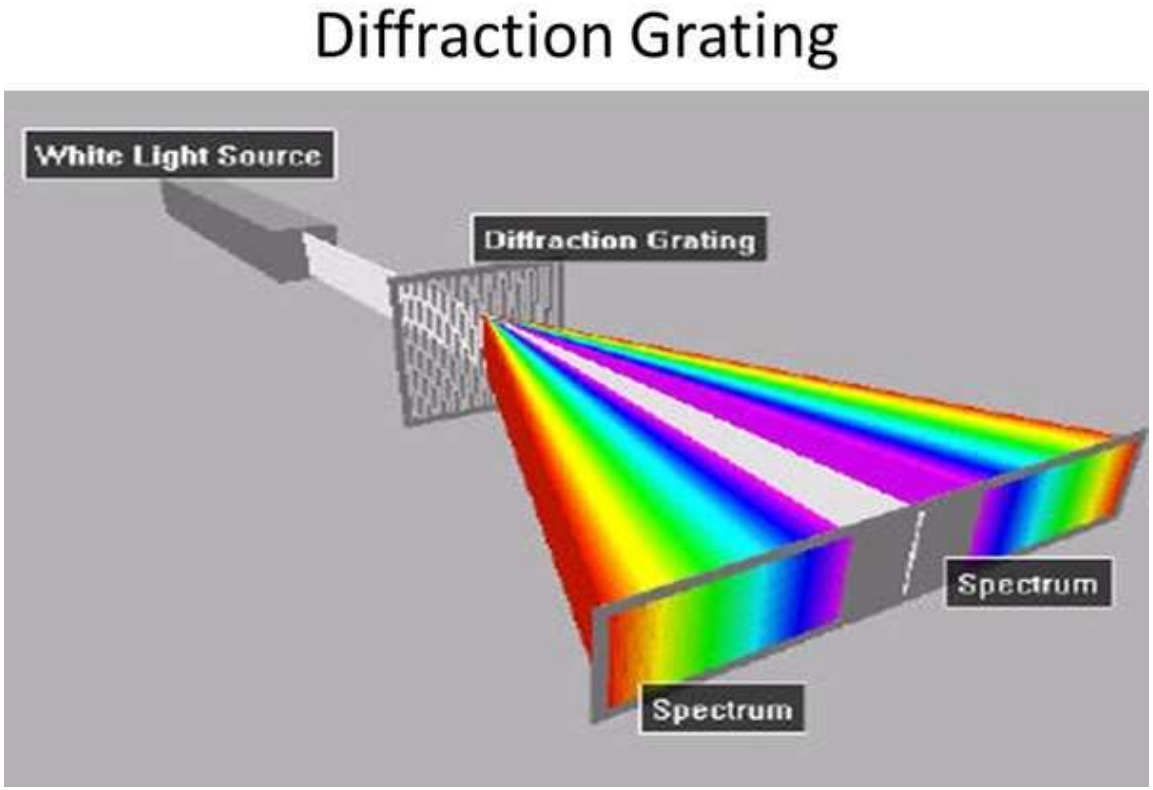
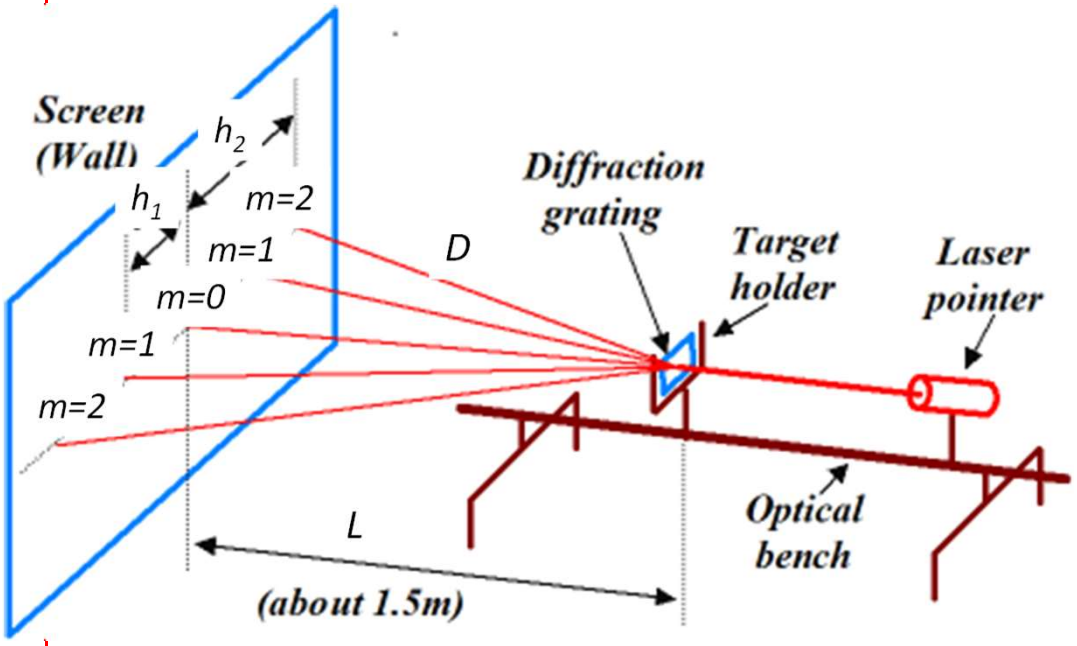


Visible light: diffraction grating experiments



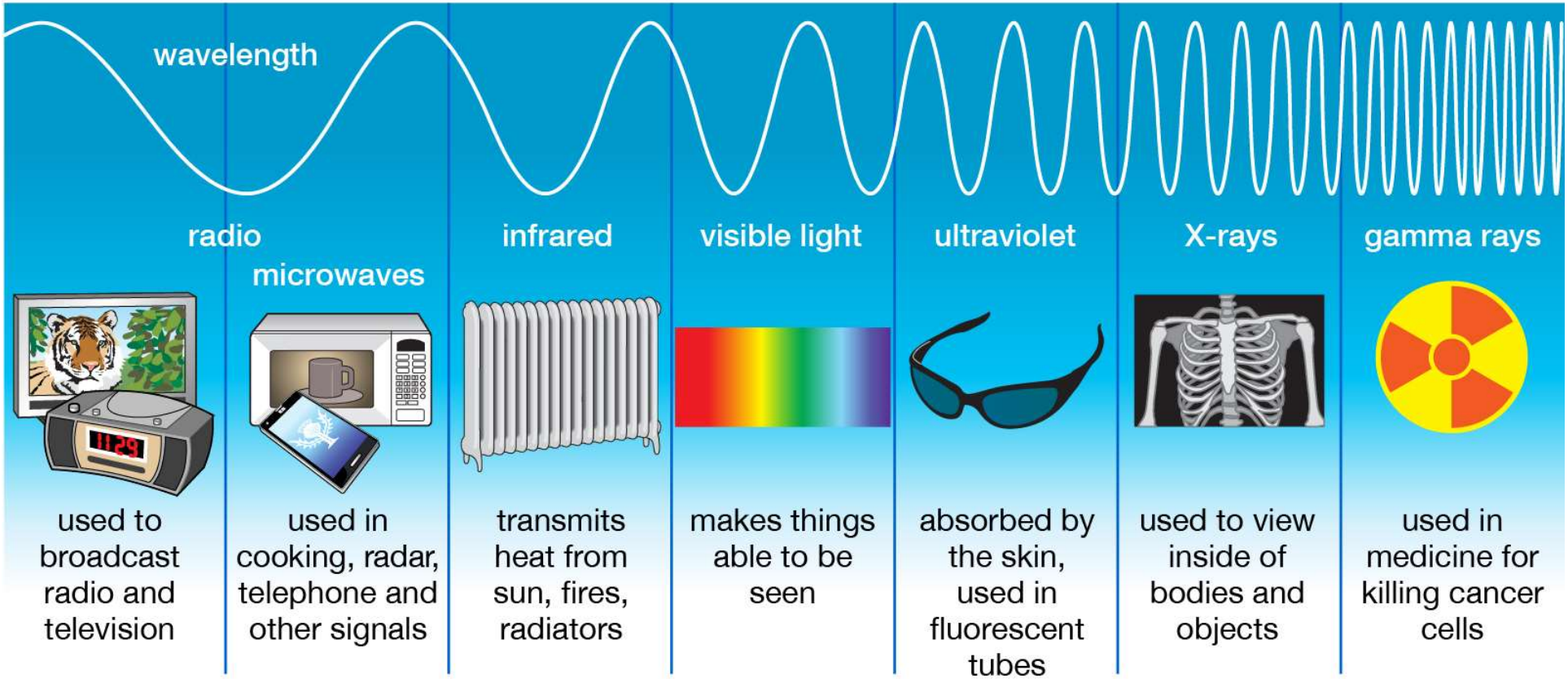
$$m\lambda = d \times \sin\theta$$

λ = wavelength of light
θ = angle of light
d = distance between 2 slits
m = 0, 1, 2, .. diffraction order

Example: grating has 1,000 lines/mm $\Rightarrow$ d =1/1,000 lines/mm = 10^{-6} m

Light

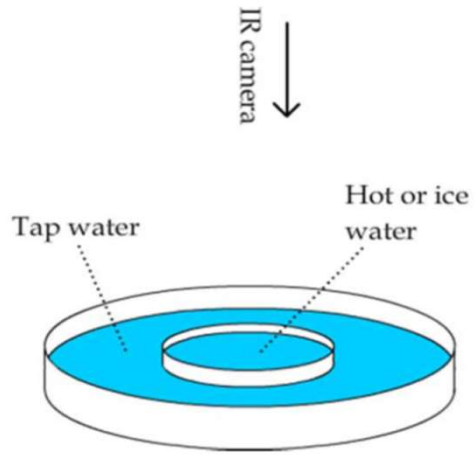
Types of Electromagnetic Radiation



Invisible light Part 1: Infrared radiation

https://www.youtube.com/watch?v=iOVZBJ8CuZU

Experiment: Infrared imaging of heat transfer



In this activity, you will put a cup of hot or ice water into a dish of tap water and observe what happens under an IR camera.

Invisible light Part 2: Ultraviolet radiation

https://www.youtube.com/watch?v=NJhuf0Um-Eo