



Tishk
International University



TISHK INTERNATIONAL UNIVERSITY
FACULTY OF APPLIED SCIENCE
MEDICAL ANALYSIS DEPARTMENT

Light in Medicine

Fall Semester

Course Name : Medical Physics

Stage : First

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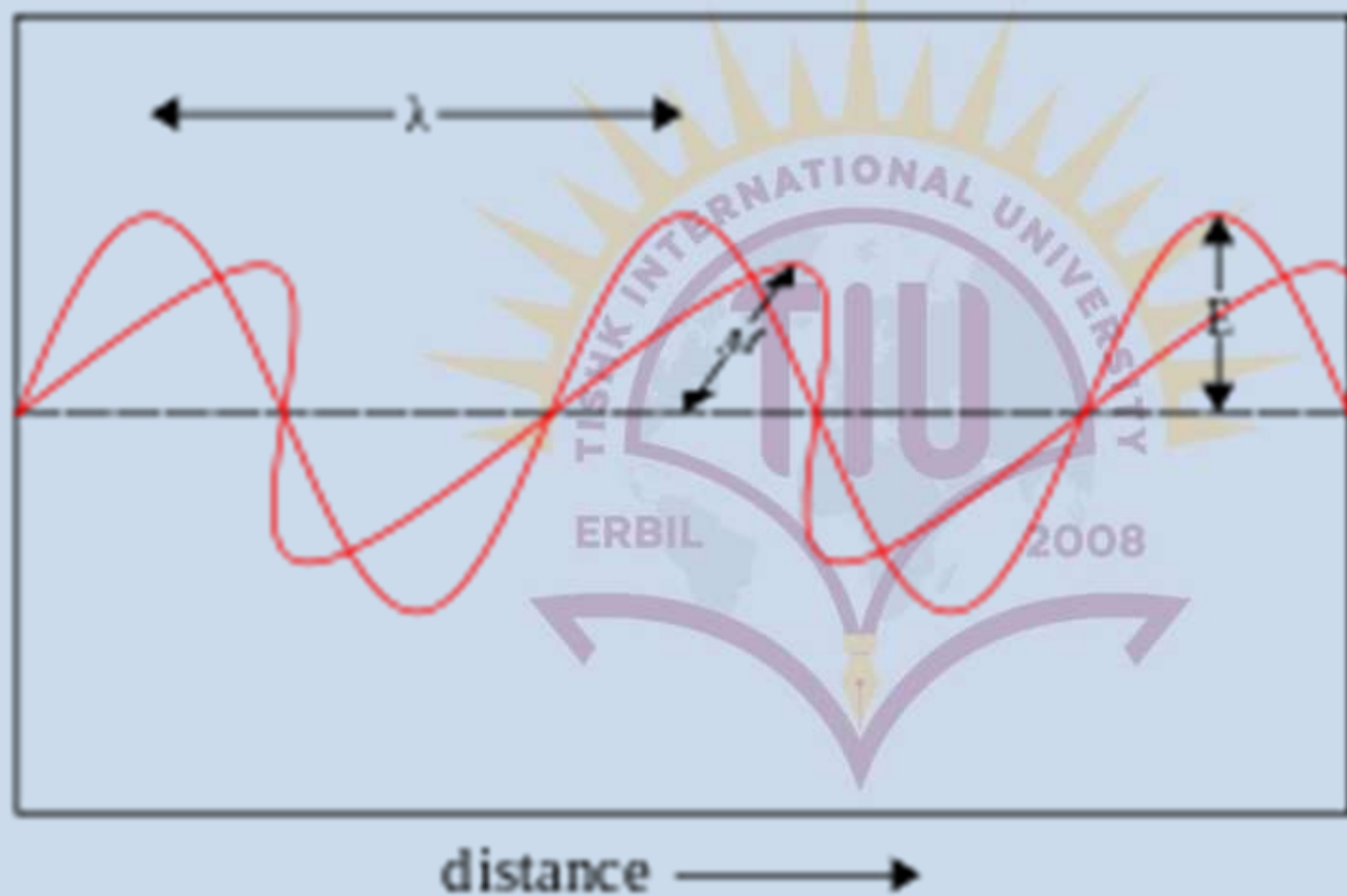
Light behaves both as a **wave** and as a **particle**. As a wave it produces interference and diffraction. As a **particle** it can be absorbed by a single molecule. When a light photon is absorbed its energy is used in various ways. It can cause a chemical change in the molecule that in turn can cause an electrical change.

Note:-

In physics, interference is a phenomenon in which two coherent waves are combined by adding their intensities or displacements with due consideration for their phase difference. The resultant wave may have greater intensity or lower amplitude if the two waves are in phase or out of phase, respectively.

What Is Diffraction? when light is always traveling in straight lines, but when light waves pass near a barrier they tend to bend around that barrier and become spread out. The definition of diffraction is the spreading of waves as they pass through or around an obstacle.

Light wave



λ = wave length

E = amplitude of electric field

M = amplitude of magnetic field

Light behaves both as a and as a.....

a. Photon, particle

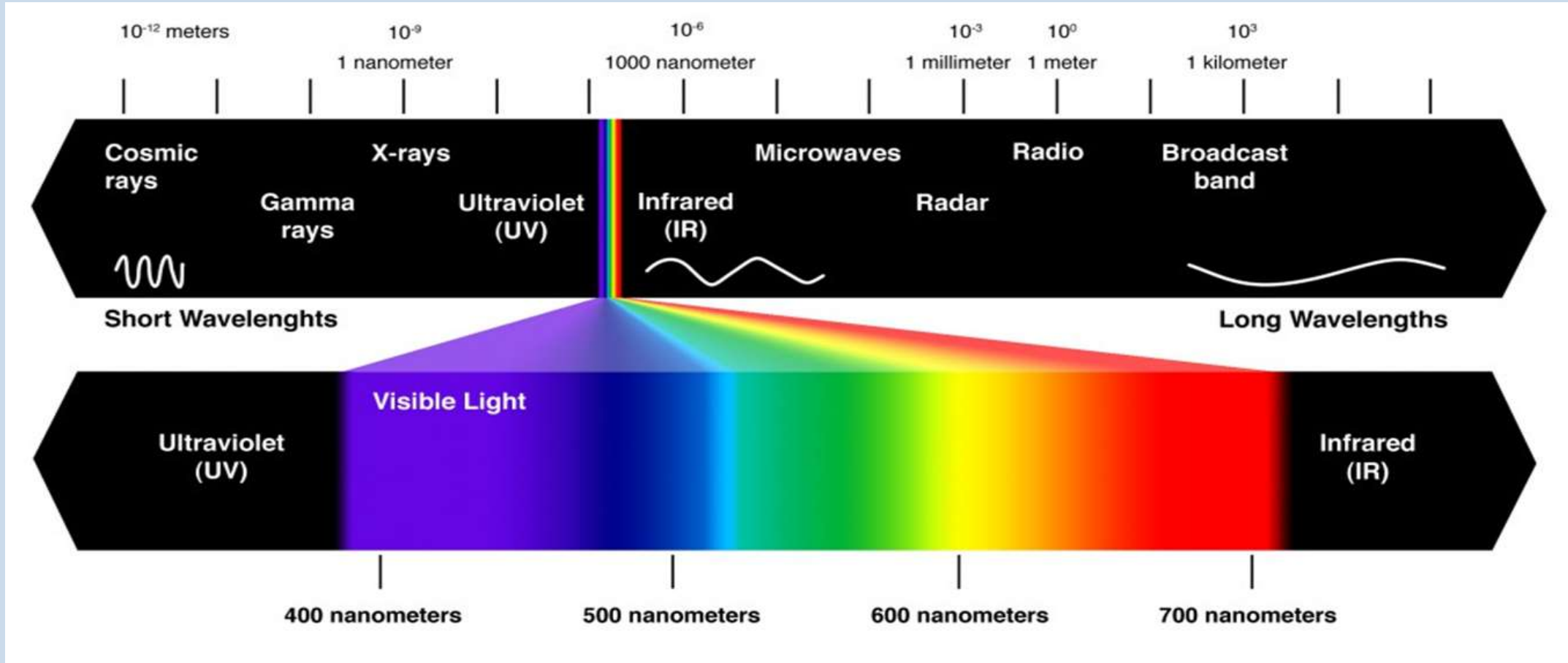
b. Wave, sound

c. Wave, particle

d. Particle, sound



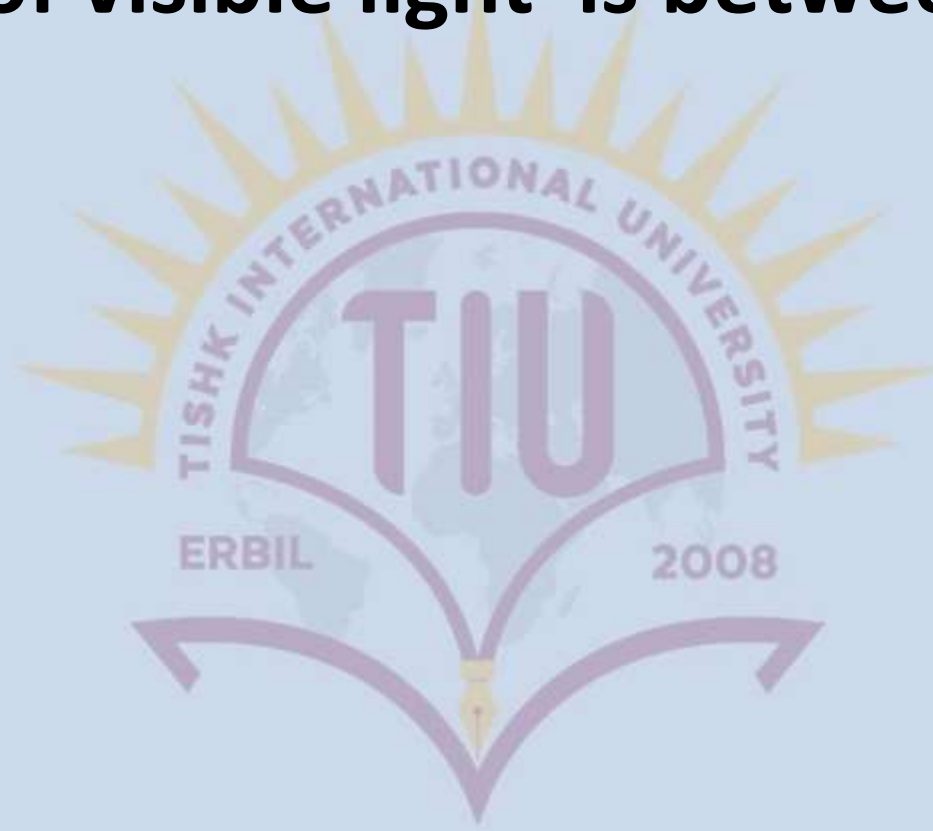
Spectrum of light



- Even though man is now very efficient at making artificial light, the sun is still the major source of light in the world.
- The sun is both beneficial and hazardous to our health.

**The wave length of visible light is between
nanometers**

- a. 400-600
- b. 400-700**
- c. 100-400
- d. 200- 300
- e. 50-100



The units of light is

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- ▶ micrometer(μm) = 10^{-6}
- ▶ angstrom (\AA) = 10^{-8}
- ▶ Nanometer(nm) = 10^{-9}

The properties of light are:

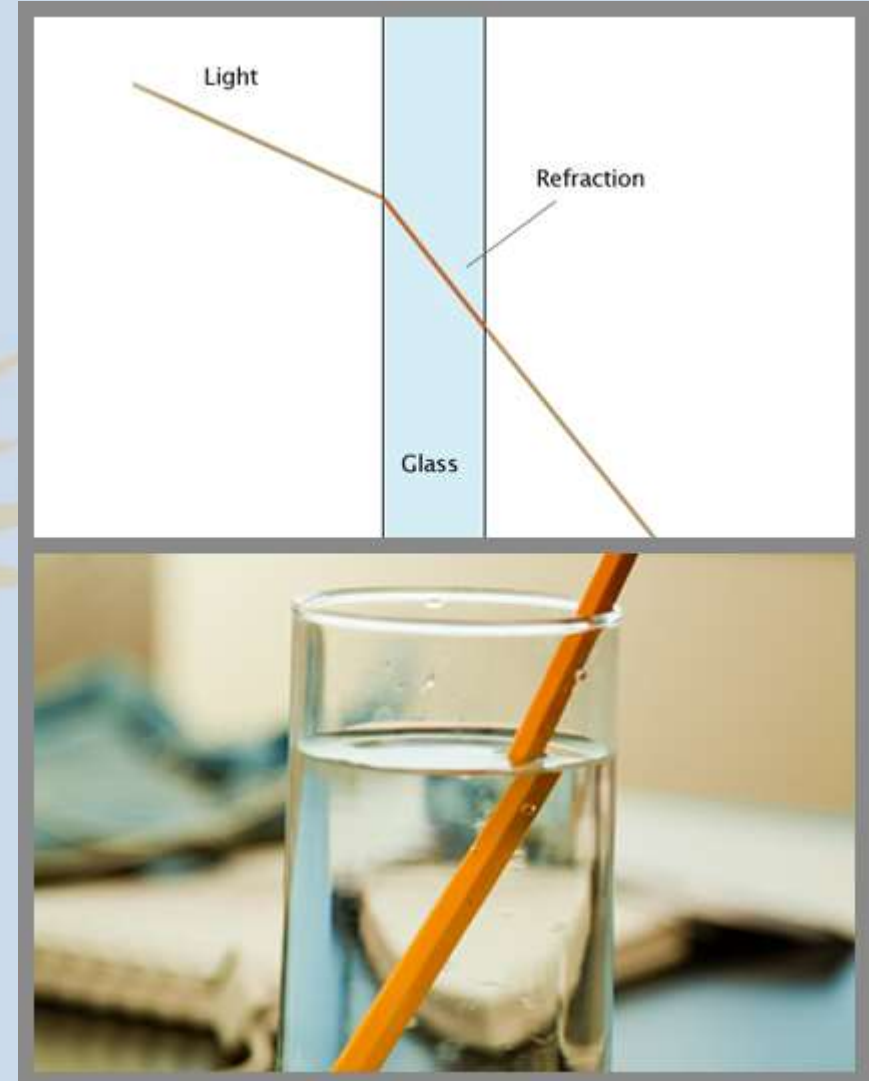
Light has some interesting properties, many of which are used in medicine: -

The speed of light changes when it goes from material into another.

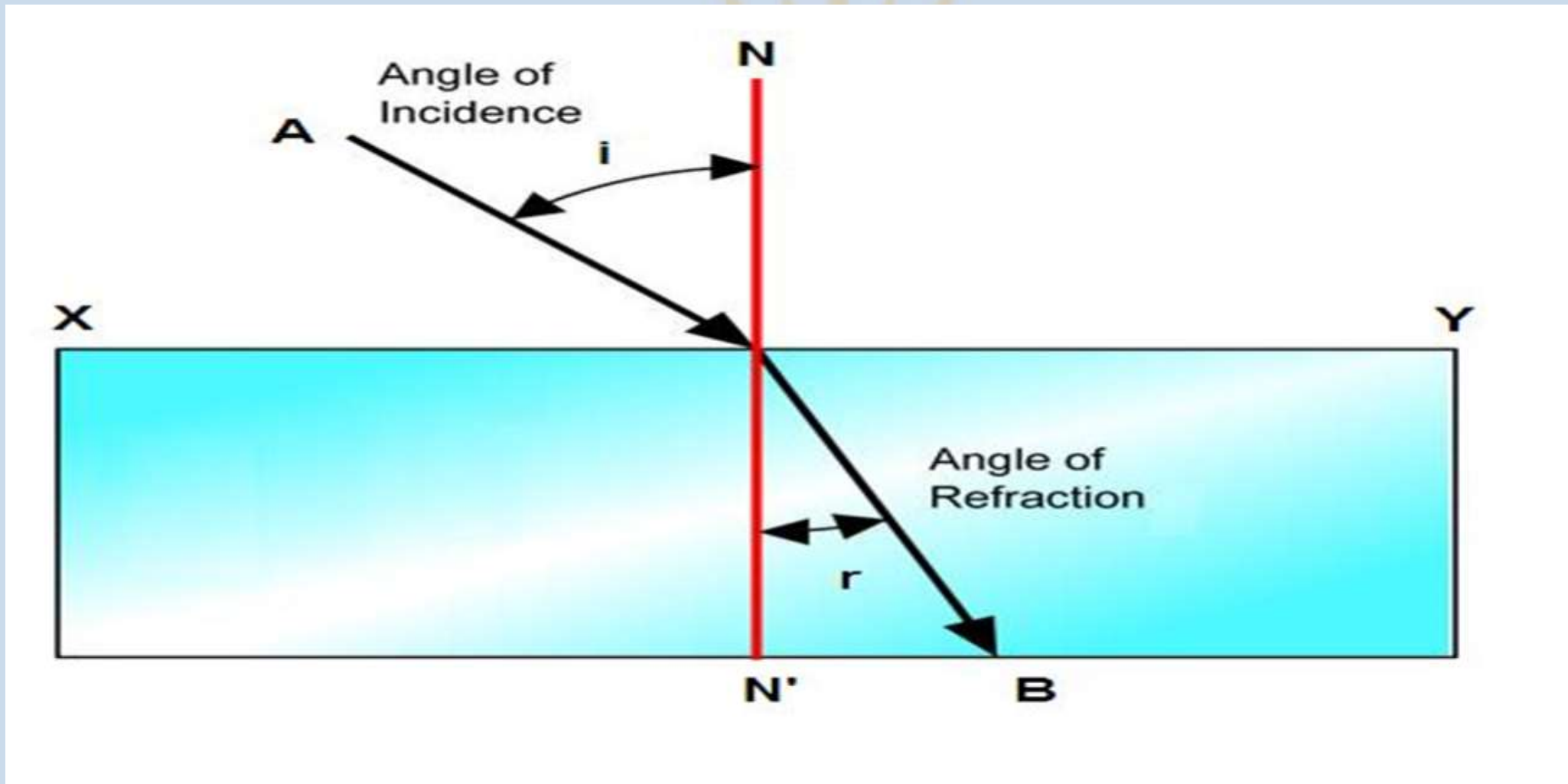
The ratio of the speed of light in a vacuum to its speed in a given

material is called **the index of refraction**

= (the speed of light in a vacuum / the speed of light in a given material).

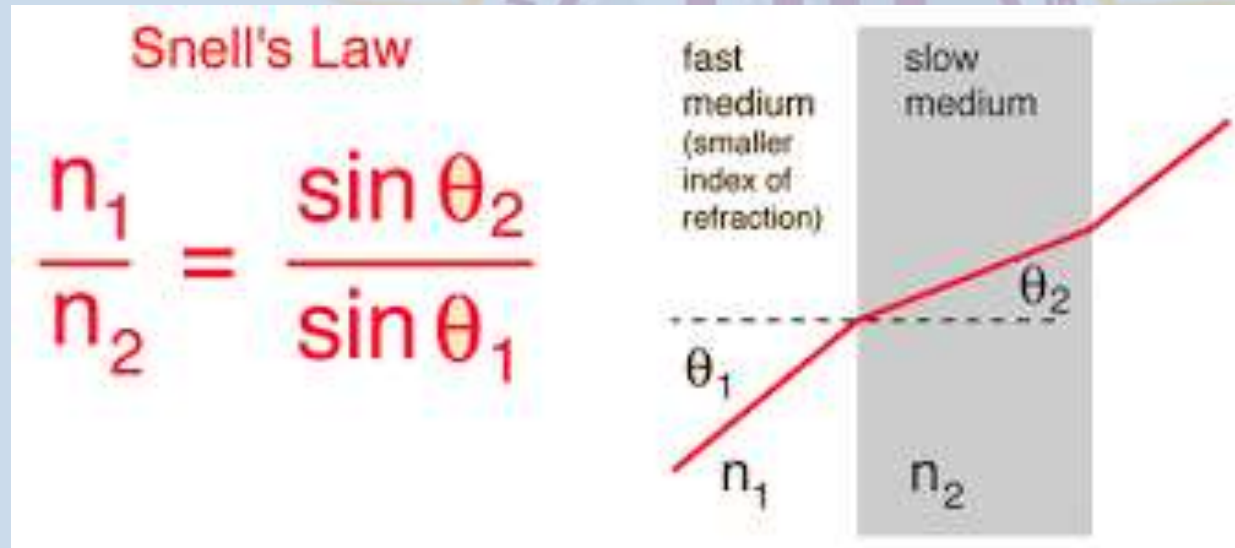


If a light beam meets a new material at an angle other than perpendicular. It bends, or refracted .

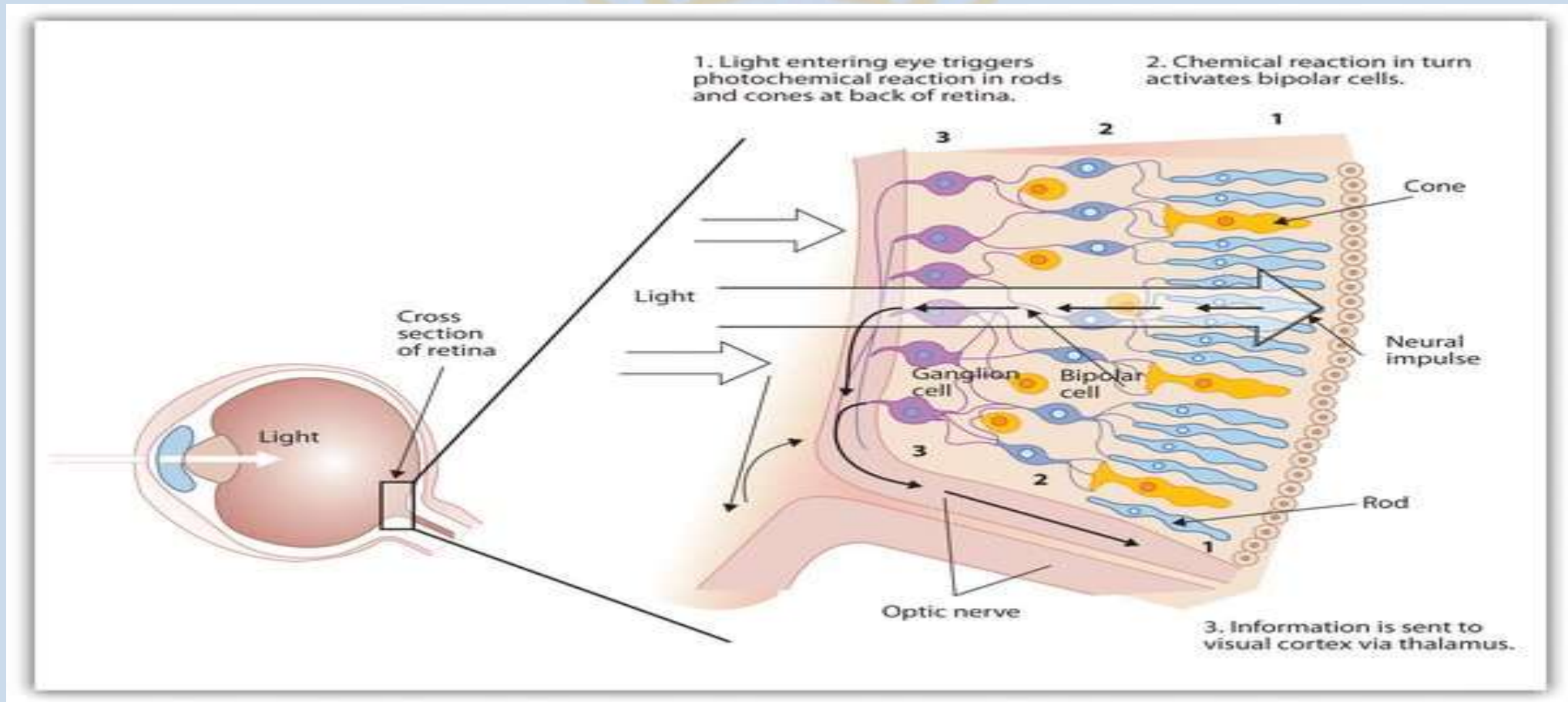


Define the index of refraction

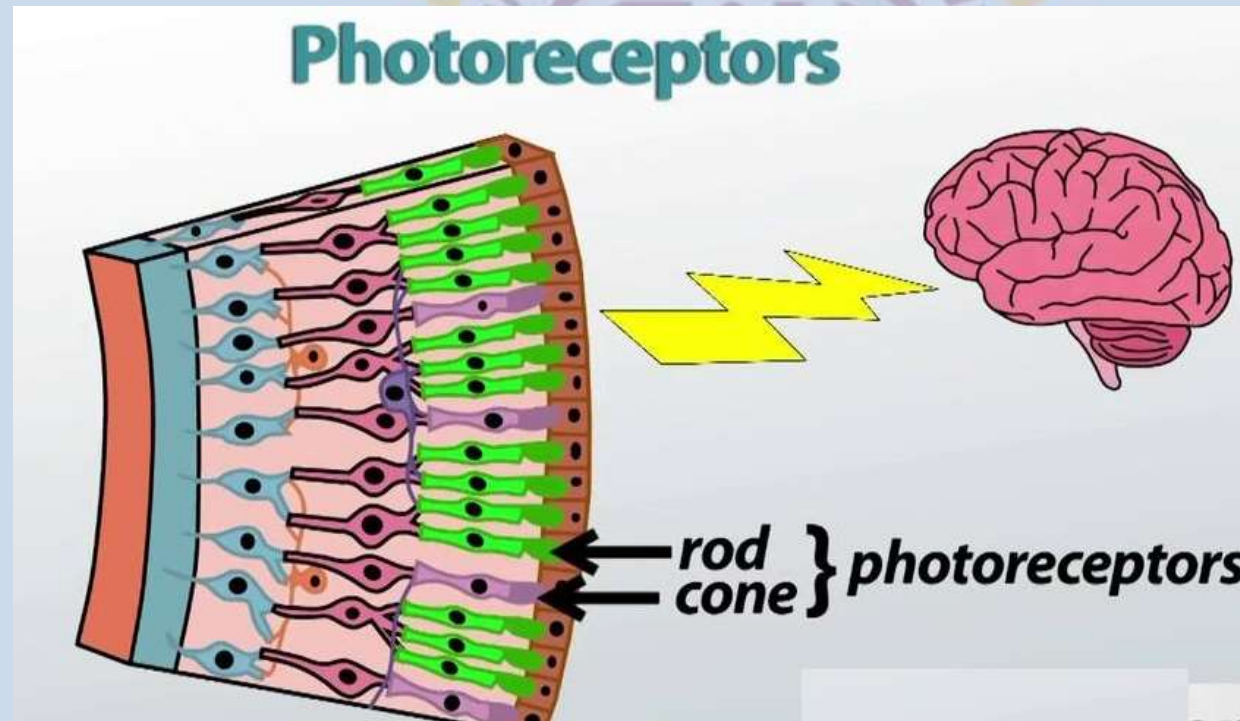
(the speed of light in a vacuum/ the speed of light in a given material)



- ▶ A light photon can be absorbed by a single molecule. When a light photon is absorbed its energy is used in a various ways.
- ▶ It can cause an electrical change.



Explain: A light photon can cause an electrical change.



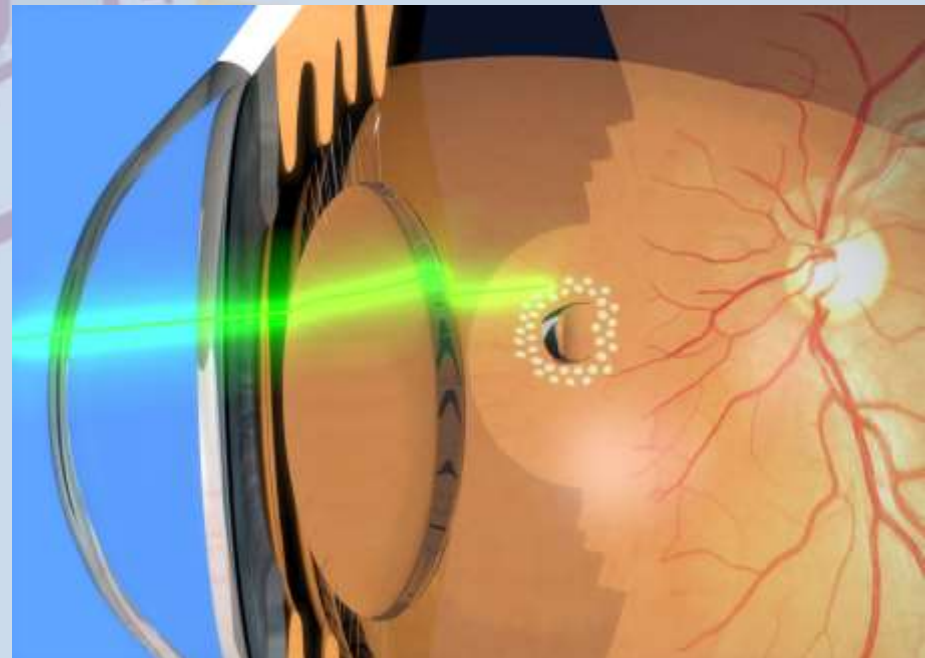
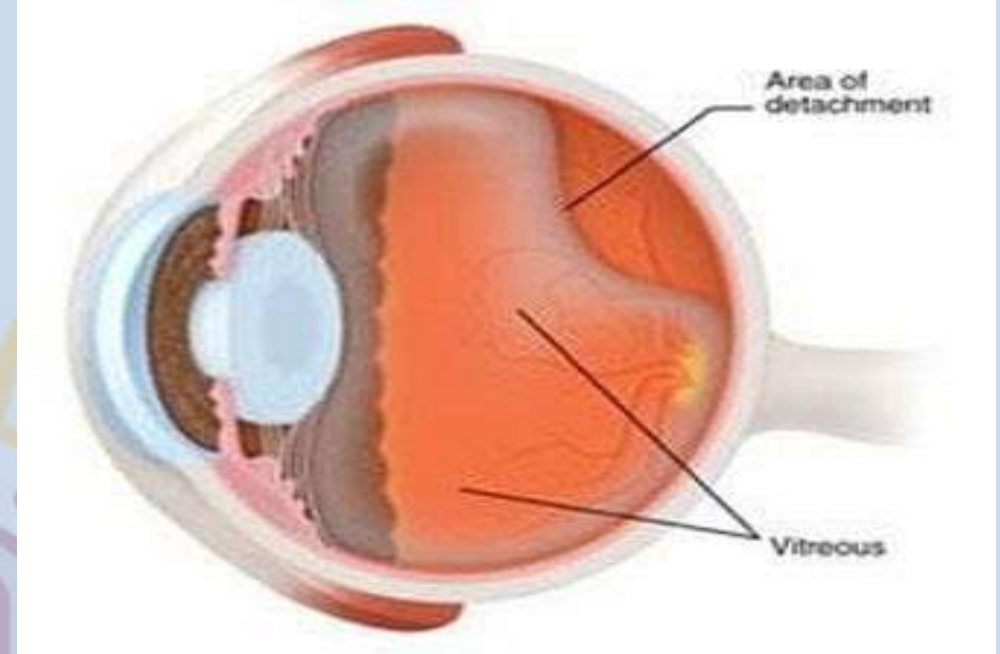
When light is absorbed, its energy generally appears as heat

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This property is the basic for the use in medicine of IR light to heat tissues.



Also, the heat produced by laser beams is used to "weld" a detached retina to the back of the eyeball and to coagulate small blood vessels in the retina.



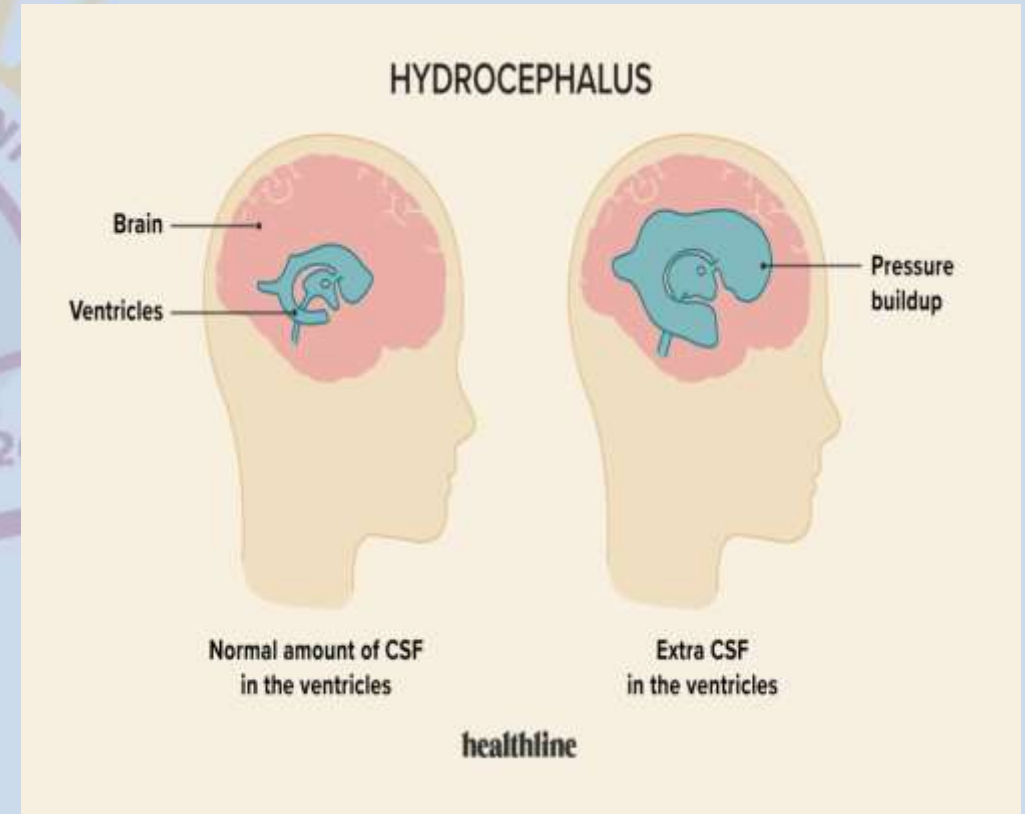
Give example about a light photon appears as heat in human body



Medical uses of visible light

- ▶ Pediatricians use a shine light into the bodies of infants (Transillumination) and observe the amount of scattered light produced in order to detect water – head

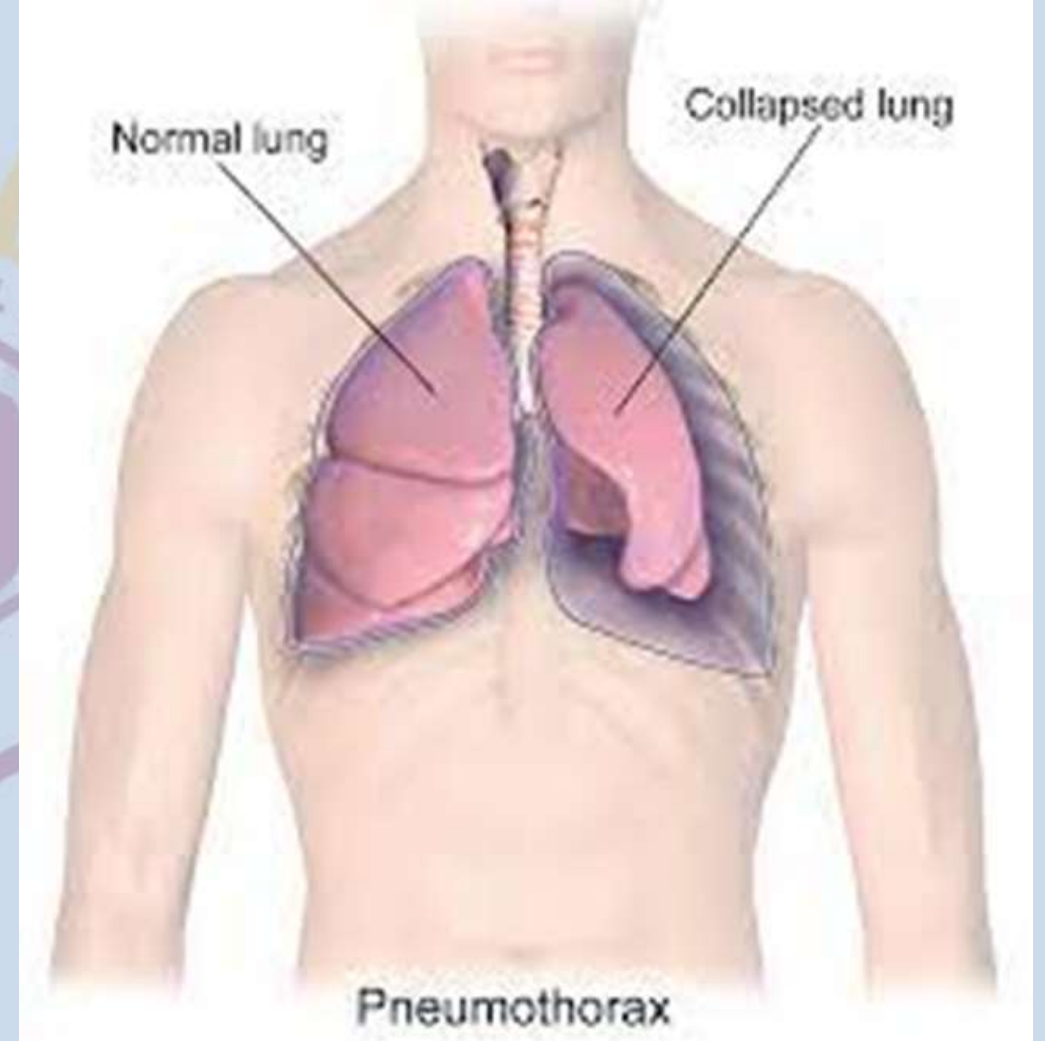
Transillumination is used clinically in the detection of **hydrocephalus** (water-head) in infants. Since the skull of young infants is not fully calcified, light is able to penetrate to the inside of the skull; if there is an excess of relatively clear **cerebrospinal fluid** (CSF) in the skull, light is scattered to different parts of the skull producing patterns characteristic of hydrocephalus. The special transilluminating device uses a 150W projection bulb as the light source.



Note:-Transillumination is the shining of a light through a body area or organ to check for abnormalities

Collapsed lung.

Transillumination is also used to detect pneumothorax (collapsed lung) in infants. The bright light penetrates the thin front chest wall and reflects off the back chest wall to indicate the degree of pneumothorax. The physician can then insert a needle attached to a syringe into the area of collapse to remove the air between the lung and chest wall, causing the lung **to reinflate**.



Pediatricians use a shine light to detect and

- a. Hydrocephalus , collapsed liver
- b. Water lung, collapsed liver
- c. Water head, collapsed liver
- d. Hydrocephalus, collapsed lung**

- ▶ Pediatricians use IR and UV for treating jaundice in premature infants. However, because of their higher energies, UV photons are more useful than IR photons

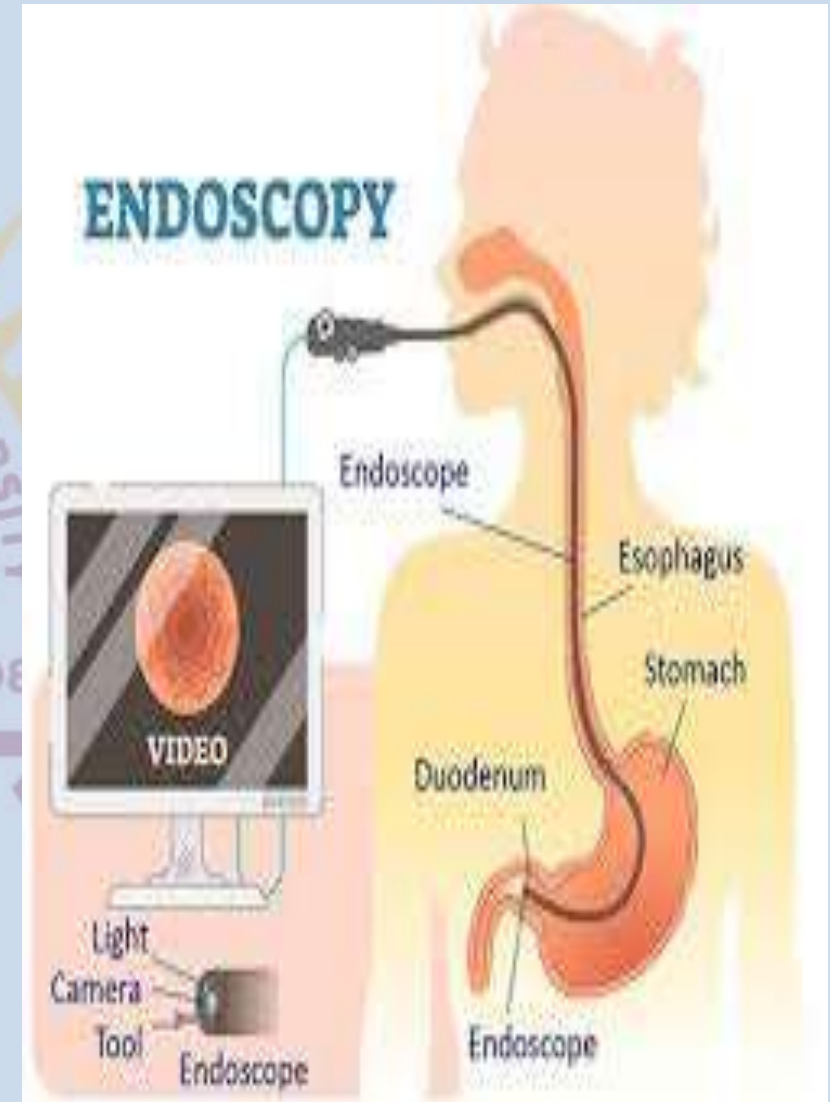


Explain , how IR or UV treat jaundice in premature infants

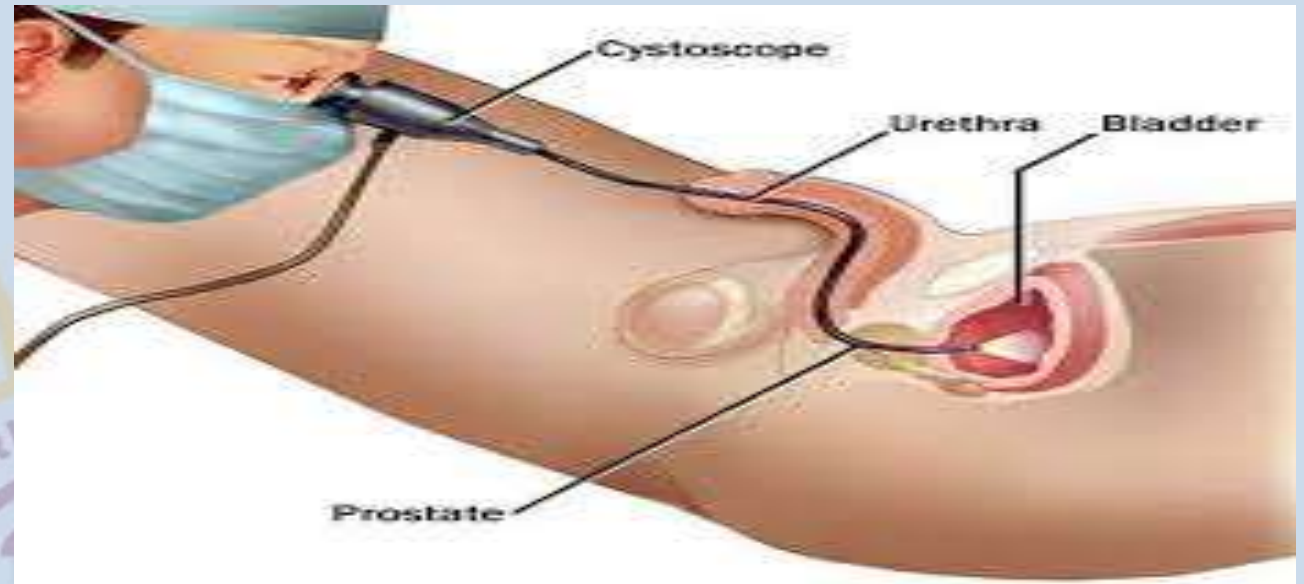
Phototherapy is treatment with a special type of light (not sunlight). It's sometimes used to treat newborn jaundice by making it easier for a baby's liver to break down and remove the bilirubin from a baby's blood. Phototherapy aims to expose a baby's skin to as much light as possible.

- ▶ **Light source in endoscope uses to see inside the body.**

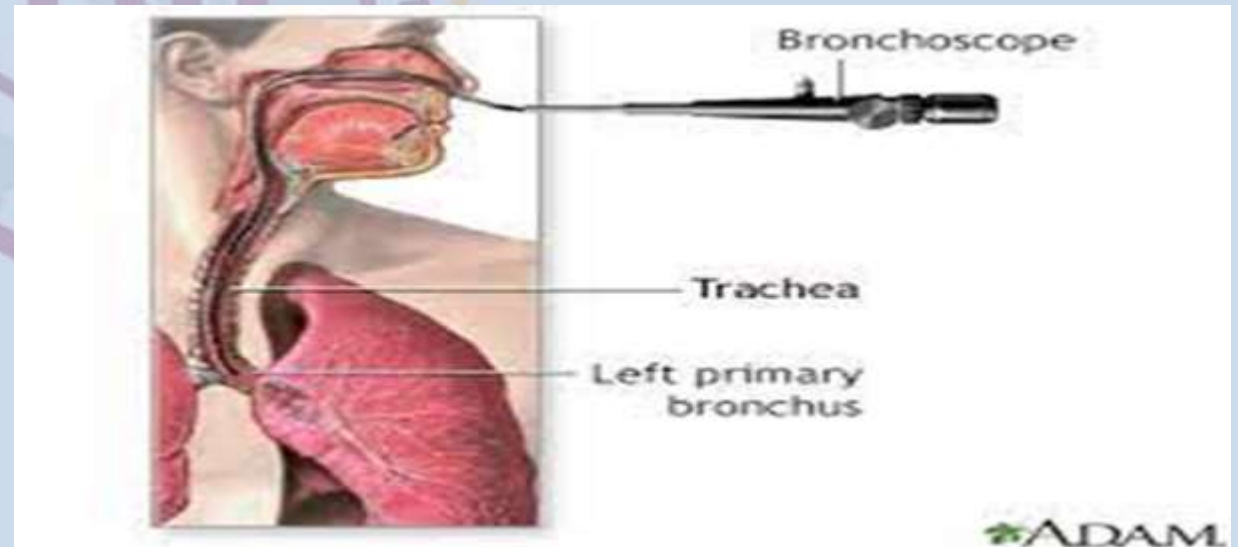
A number of instruments, called endoscopes, are used for viewing internal body cavities. Special purpose endoscopes are often given names indicating their purpose



For example, **cystoscopes** are used to examine the **bladder**.



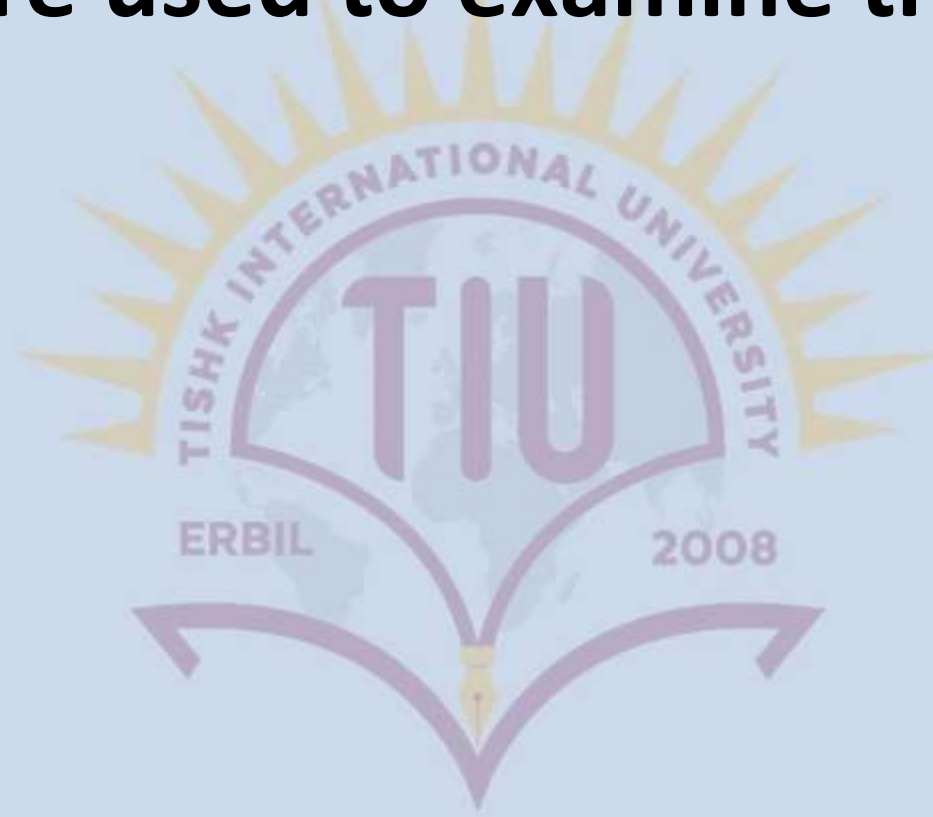
Bronchoscope are used for examining the air passages into **the lungs**.



Proctoscopes are used for examining the **rectum**

cystoscopes are used to examine the.....

- a.Lungs
- b.Rectum
- c.Bladder**
- d.head



proctoscopes are used for examining the

a.Lungs

b.Rectum

c.Bladder

d.head



**bronchoscope are used for examining the air passages
into the**

a.Lungs

b.Rectum

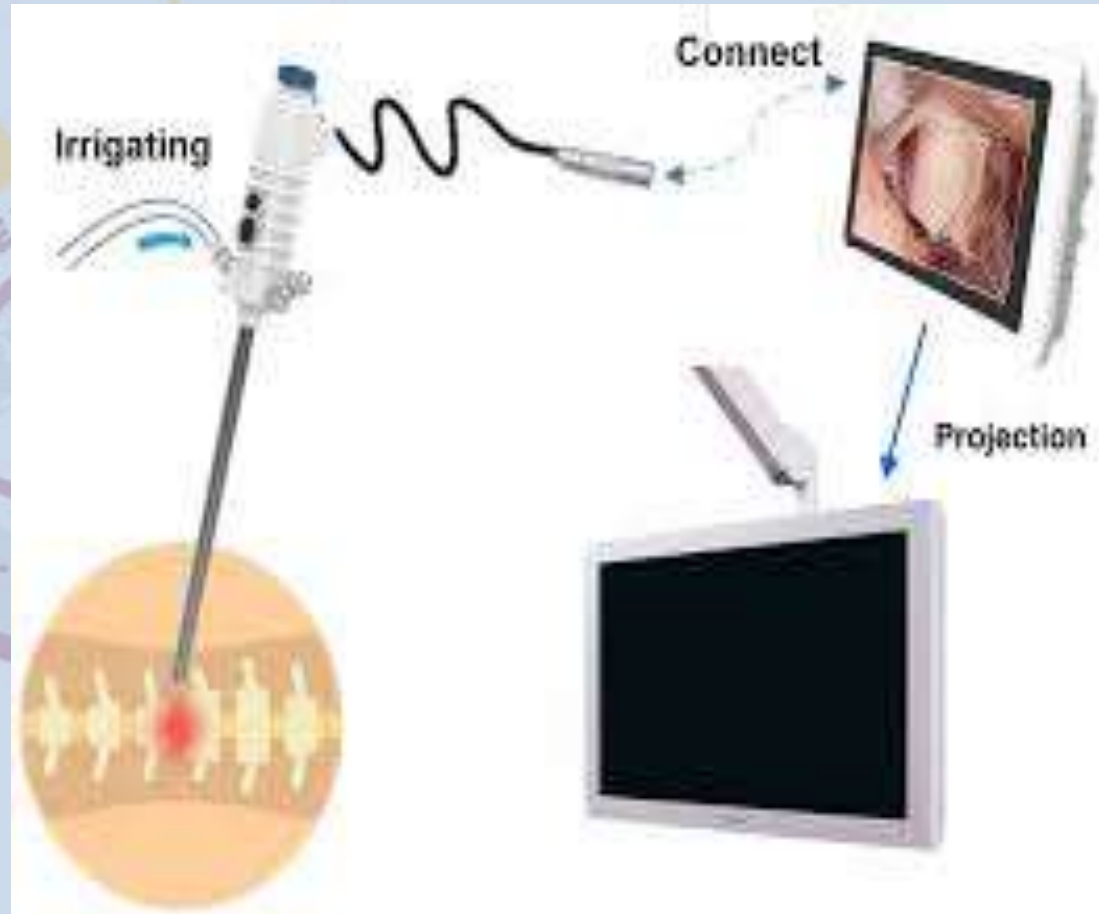
c.Bladder

d.head

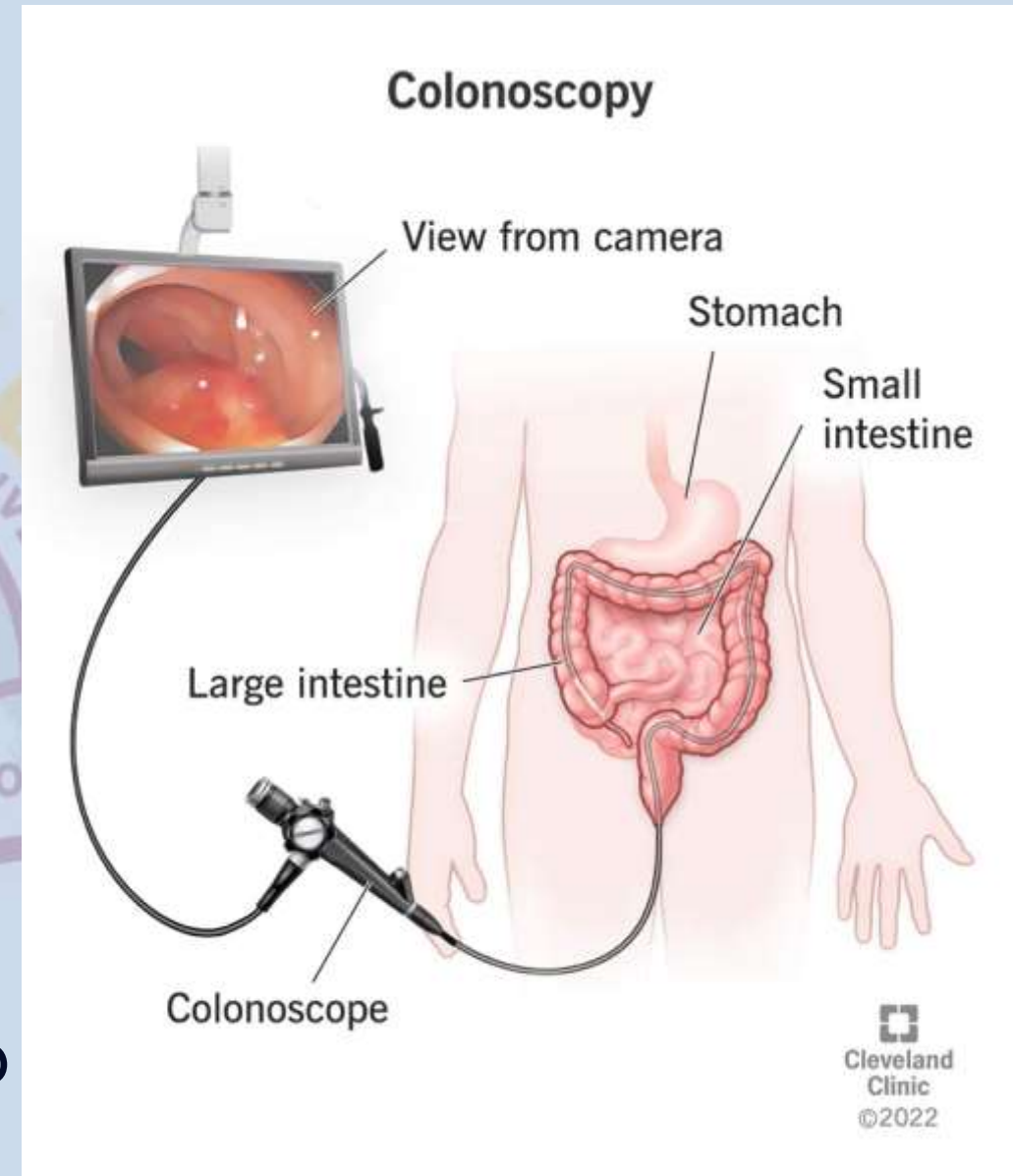


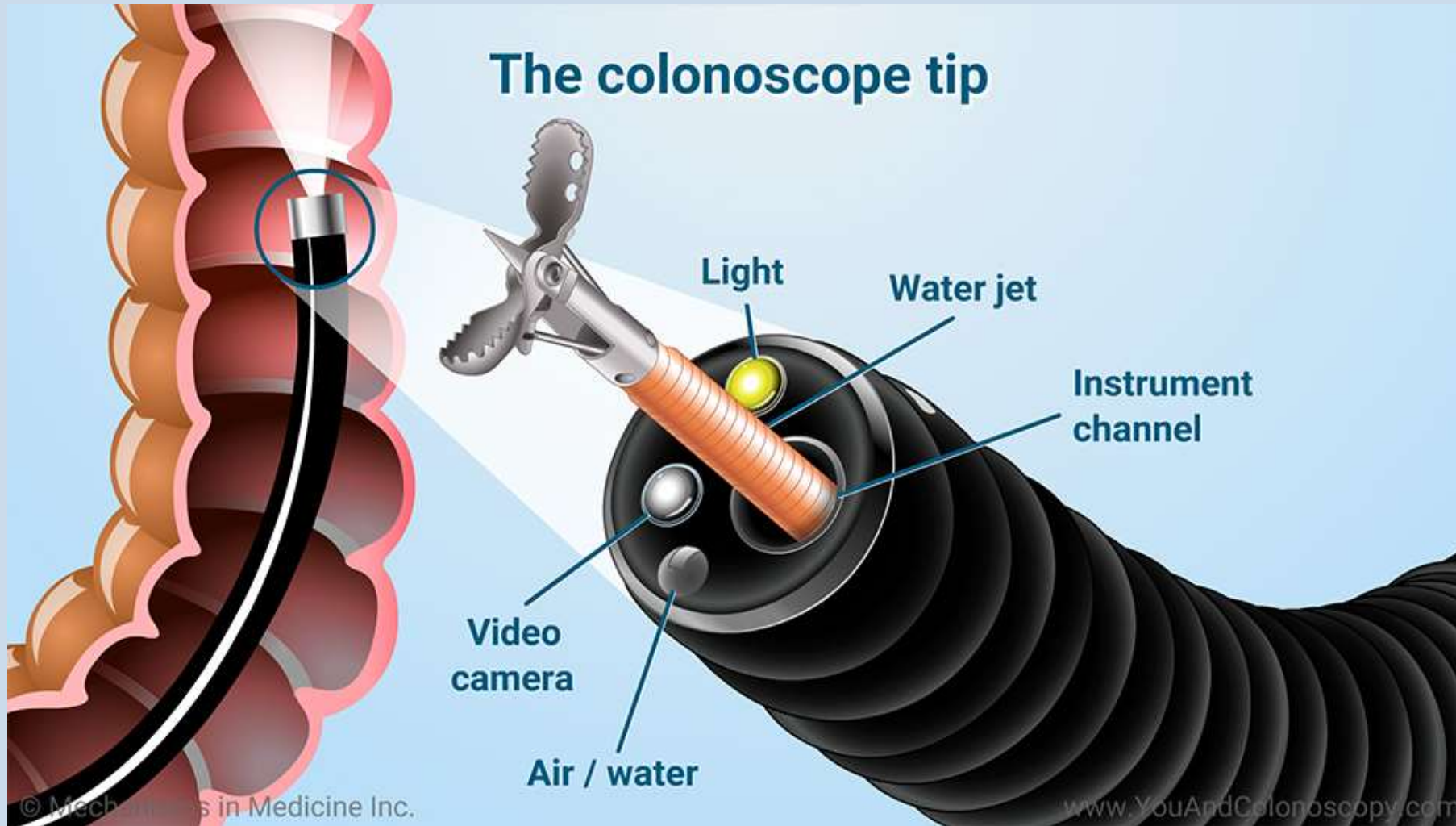
Some endoscopes are **rigid tubes** with a light source to illuminate the area of interest.

Many of them are equipped with **optical attachments** to magnify the tissues being studied.



Colonoscopy is used to look inside **rectum and colon**. Colonoscopy can show irritated and swollen tissue, ulcers, polyps, and cancer. The colonoscope is a long, flexible tube, typically around 1 cm in diameter, equipped with an imaging system at its tip based on a camera and a source of light.





Biopsy channel, an air channel, a water channel, and, in colonoscopes, a CO₂ channel.

Thank you

