



Medical Physics II

2nd semester

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Lectures 8

Applications of Light in Medicine

Applications of Light in Medicine

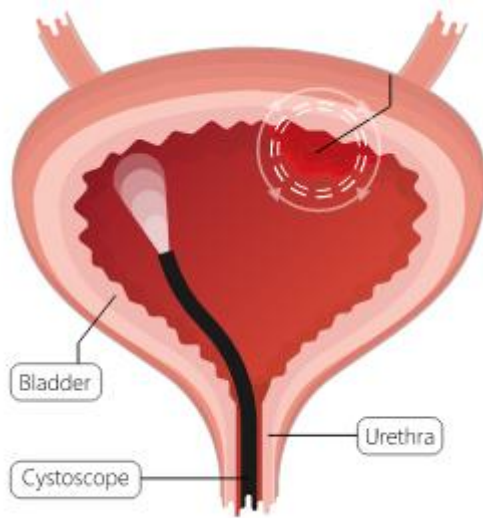
- Measurement of light and its units.
- Applications of visible light in medicine.
- Applications of ultraviolet and infrared light in medicine.
- Laser in medicine.
- Application of microscopes in medicine.

Visible light and Medicine

1. **Pediatricians** use **shining light** into the **bodies of infants** and observe the **amount of scattered light** produced to **detect** water–head or collapsed lungs.
2. **Treating jaundice** in premature **infants**.
3. The **light source** in the **endoscope** uses to see **inside the body**.
4. **Physicians** use **normal light** to **examine** the **skin**.

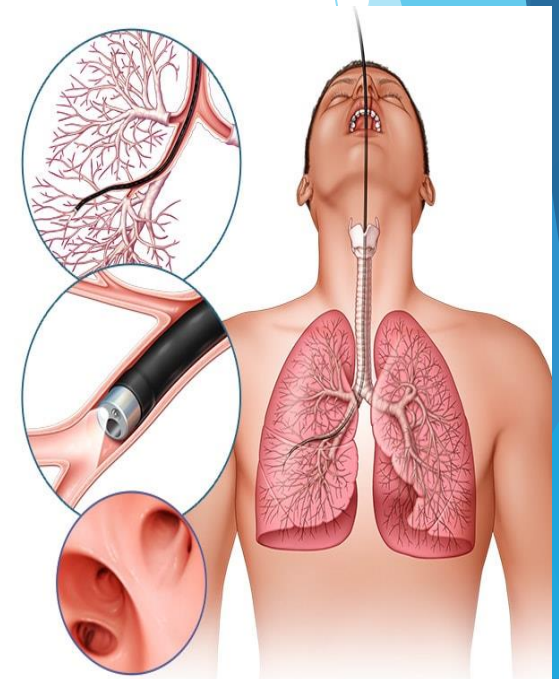
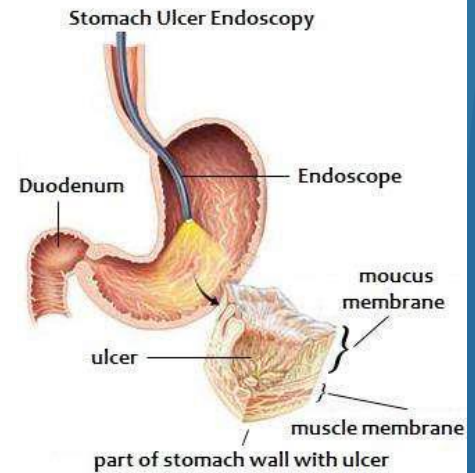
Visible light and Medicine

- ▶ **Endoscope:** a number of instruments are used for viewing internal body cavities.



CYTOSCOPES: are used to examine the bladder.

- ▶ **BRONCHOSCOPE:** Is used for examining the **air passages into the lungs**. Some endoscopes are **rigid tubes** with a **light source** illuminating the **area of interest**.
- ▶ **Flexible endoscopes** can obtain **information** from body regions that **cannot be** examined with rigid endoscopes, such as the **small intestine** and much of the **large intestine**.



APPLICATIONS OF UV AND IR LIGHT IN MEDICINE

- **UV photons** have **energies greater** than **visible and IR light**. Because of their higher energies, UV photons are **more useful than IR photons**.
- UV can **kill germs** and is used to **sterilize medical instruments**.
- UV **produces** more **reactions in the skin**. Some of these reactions are **beneficial**, and some are **harmful**.
- The beneficial effect of UV light from the sun is **converting molecular products** in the skin into **vitamin D**.
- The **harmful** effects of UV light can produce **sunburn and tan skin**.
- Solar UV light is also the cause of **skin cancer** in humans. There is a high incidence of skin cancer among people exposed to the sun, such as **fishermen** and **agricultural workers**.
- Maybe related to the fact that the UV wavelengths that produce **sunburn** are also very well **absorbed** by the **DNA** in the **cells**.

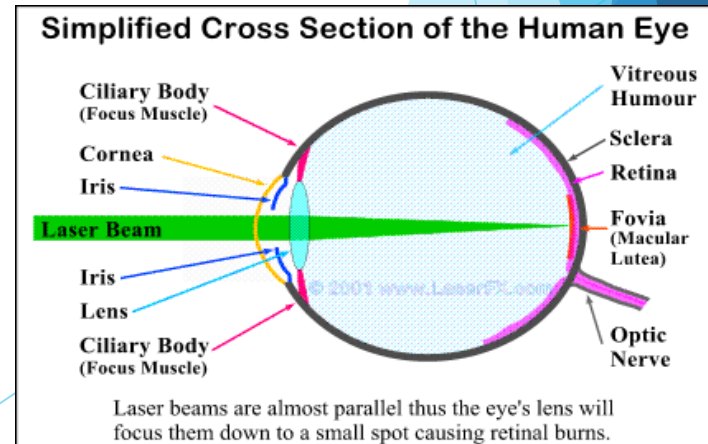
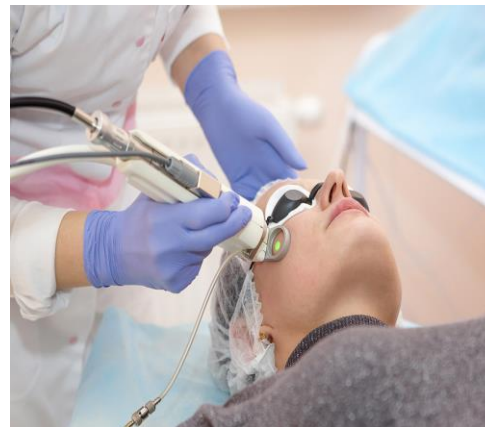
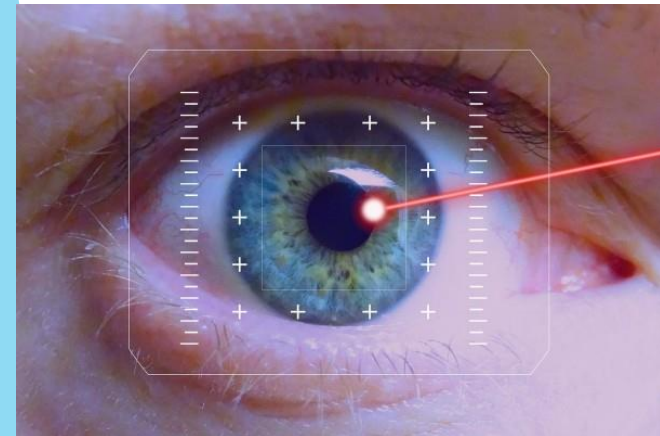
LASER IN MEDICINE

A laser is a **unique light** source that **emits a narrow light beam**.
Of a single wavelength (**monochromatic**), it's **coherent light**.

When **all of the energy of the laser** is **concentrated** in a **small area**, the **power density** (power per unit area) becomes **very large**.

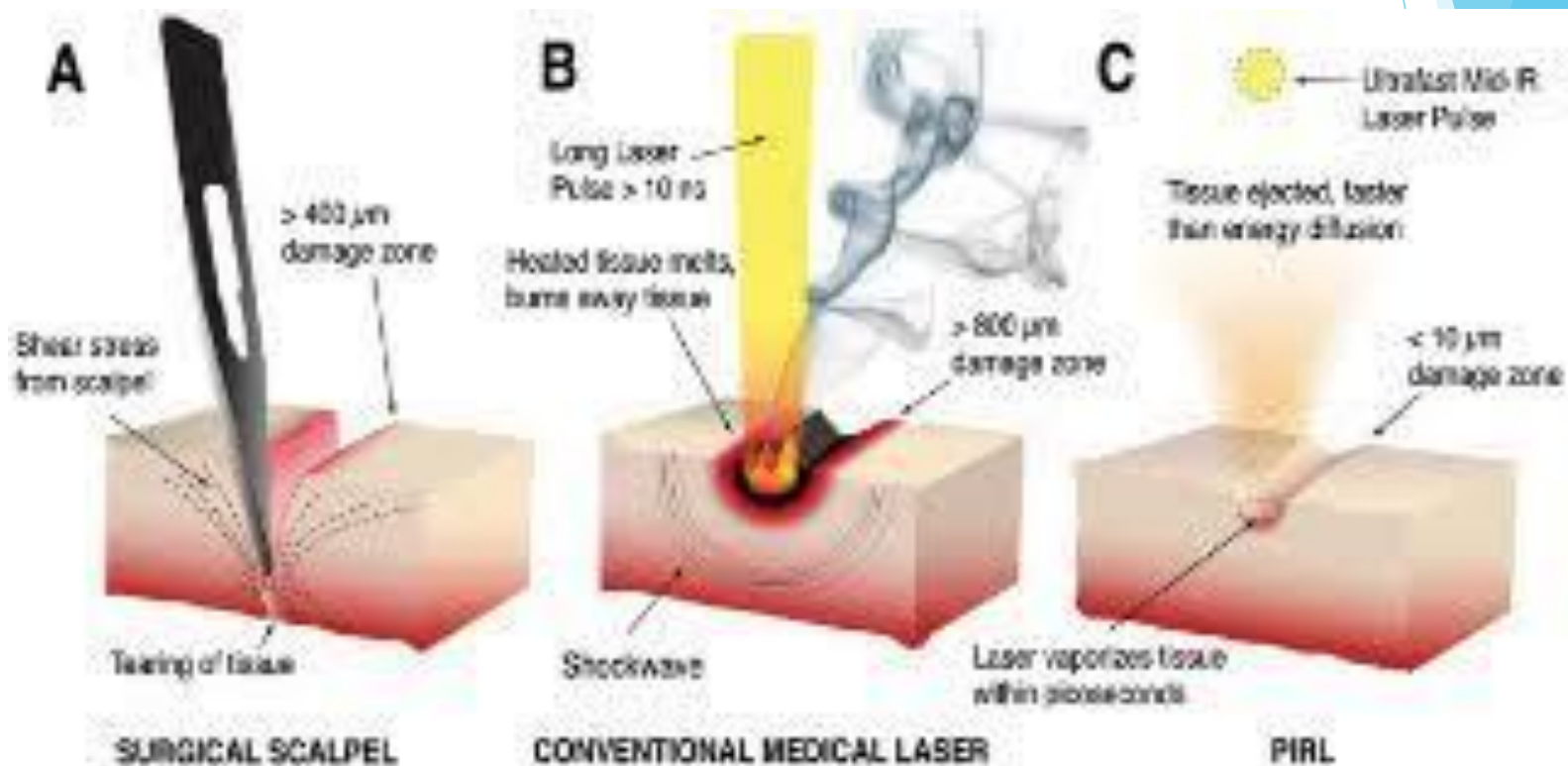
Experiments with monkey eyes indicate that a laser wavelength of **1064 nm** **damages the retina**.

In **ophthalmology**, the laser is used for **photocoagulation of the retina**, **heating blood vessels** to the point where the **blood coagulates and blocks the vessel**.



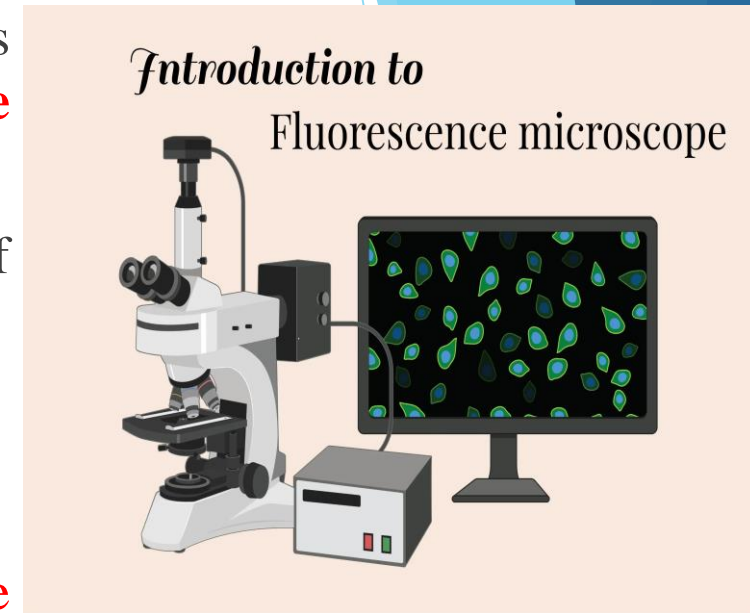
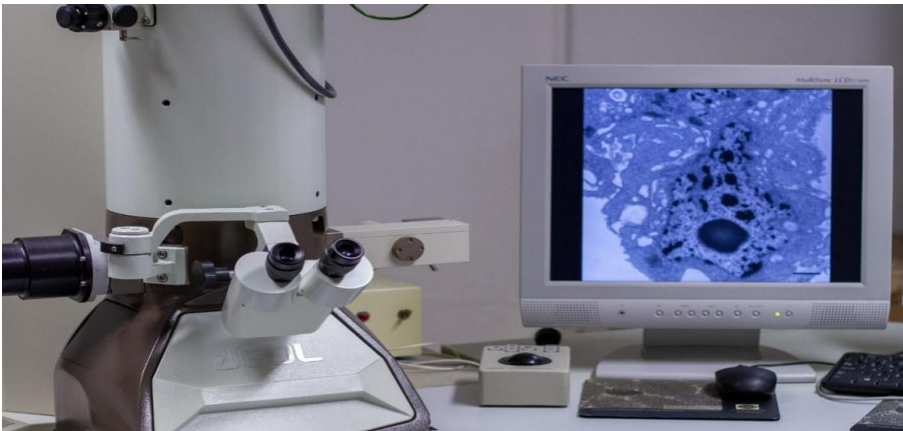
Bloodless Knife for Surgery Laser

At 441.6 nm used as **bloodless knife for surgery Laser** in **three dimensional imaging** is called **holography**. It can be focused by a lens to almost a mathematical point.



Applications of Microscope in Medicine

- ▶ The **magnification** of objects up to **1000** allows the study of **cells** (cytology) and **tissue** (histology).
- ▶ Microscopes **used different refractive index** of **different cell parts**.
- ▶ **Fluorescent** microscope used **UV light**.
- ▶ **Historadiography** used low energy **X-Ray**.
- ▶ **Electron microscopy** use get the detailed **structure** of tissues, cells, organelles and **macromolecular complexes**.



Harming and beneficial UV light reactions in the skin

- ▶ **UV light** with **wavelengths below 290 nm** is **germicidal** and it is sometimes **used to sterilize medical instruments**.
- ▶ One of the major **beneficial** effects of **UV light** from the sun is the **conversion of molecular products in the skin into vitamin D**. Dermatologists have also found that UV light **improves** certain skin conditions.
- ▶ Ultraviolet light from the sun affects the **melanin** in the skin to **cause tanning**. However, it can **produce sunburn** (around $\lambda = 300$ nm) as well as **tan in the skin**. Ordinary window glass permits some near UV to be transmitted but absorbs the sunburn component.
- ▶ **Solar UV** is also the **major cause of skin cancer in humans** (usually **appears** on the **tip** of the **nose**, the **tops** of the **ears**, and the **back** of the **neck**); may be related to the fact that the UV wavelengths that produce sunburn are also very well **absorbed by the DNA in the cells**.
- ▶ **On a summer day**, one can get a **sunburn** even when sitting in the shade because about **half of the UV light hitting the skin comes directly from the sun**, and the other half is scattered from the air in other parts of the sky.
- ▶ **UV light cannot be seen** by the **eye** because it is **absorbed before it reaches the retina**. The large percentage of near-UV light absorbed by the lens may cause some **cataracts** (**opacities of the lens**).