INTRODUCTION TO ANATOMY & PHYSIOLOGY OF THE EYE

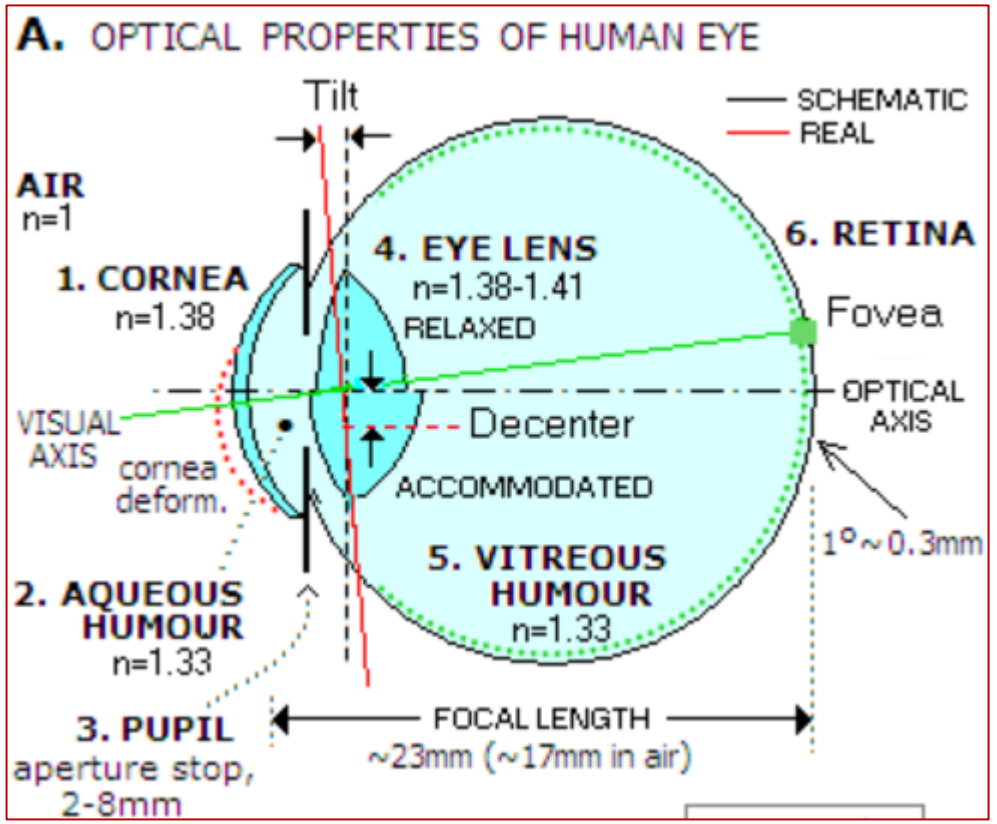
(Prelude to Electrooculography & Electroretinography)

ECE 331 – INTRODUCTION TO BIOMEDICAL ENGINEERING

Monday, November 17, 2025

WHY DO WE STUDY ANATOMY & PHYSIOLOGY OF THE EYE?

1. **The human eye is a complex optical system** that converts light into electrical signals interpreted by the brain.
2. For biomedical engineers, understanding the eye's structure and function is crucial for developing:
   a) Diagnostic tools
   b) Therapeutic devices
   c) Vision correction technologies.



ANATOMY OF THE EYE – EXTERNAL PARTS

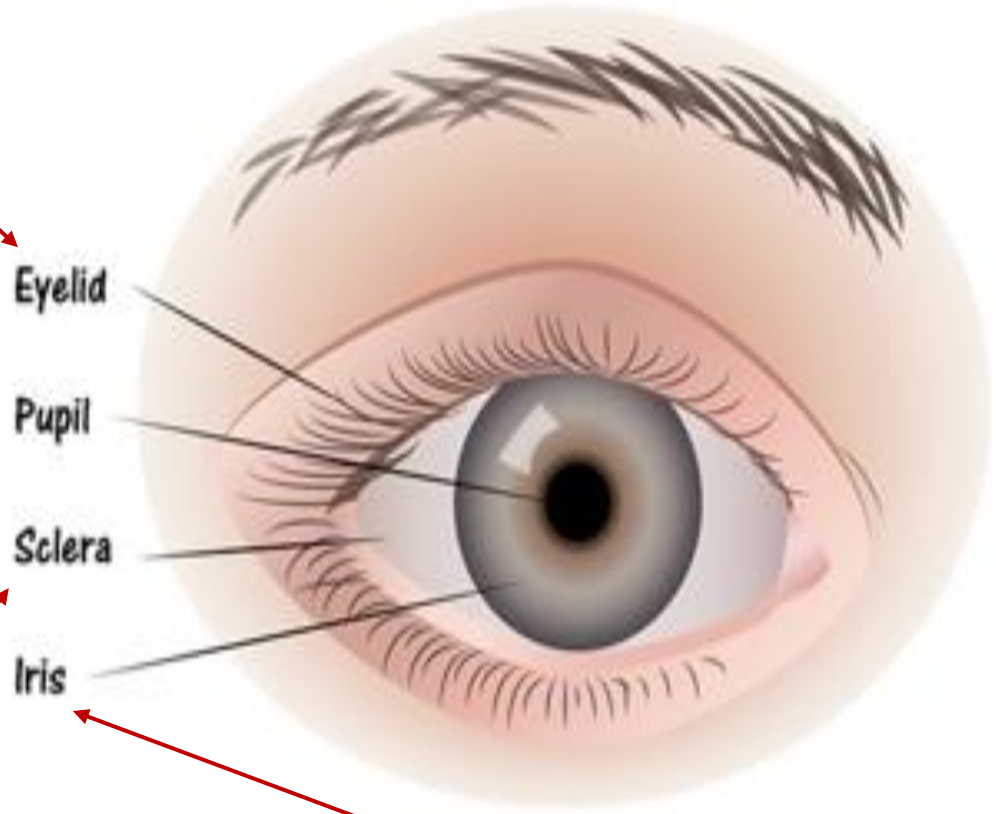
Eyelid is the outermost protective parts of the eye. It's boundaries are covered by tiny hairline termed as eyelashes.

- They act as primary barriers (shutters) against external environment.

Pupil dilates in dim light and constricts under bright light. It's functions are:
(i) to protect the lens and retina from damage due to high light intensity
(ii) Allow us to see clearly under dim conditions.

Sclera is the supporting wall for your eyeball.

- It's function is to maintain the eye's shape and protects it from injuries.



Iris is a pigmented structure that determines eye colour (black, brown, blue, etc.).

- Its function isto control the amount of light entering the eye.

ANATOMY OF THE EYE – INTERNAL PARTS

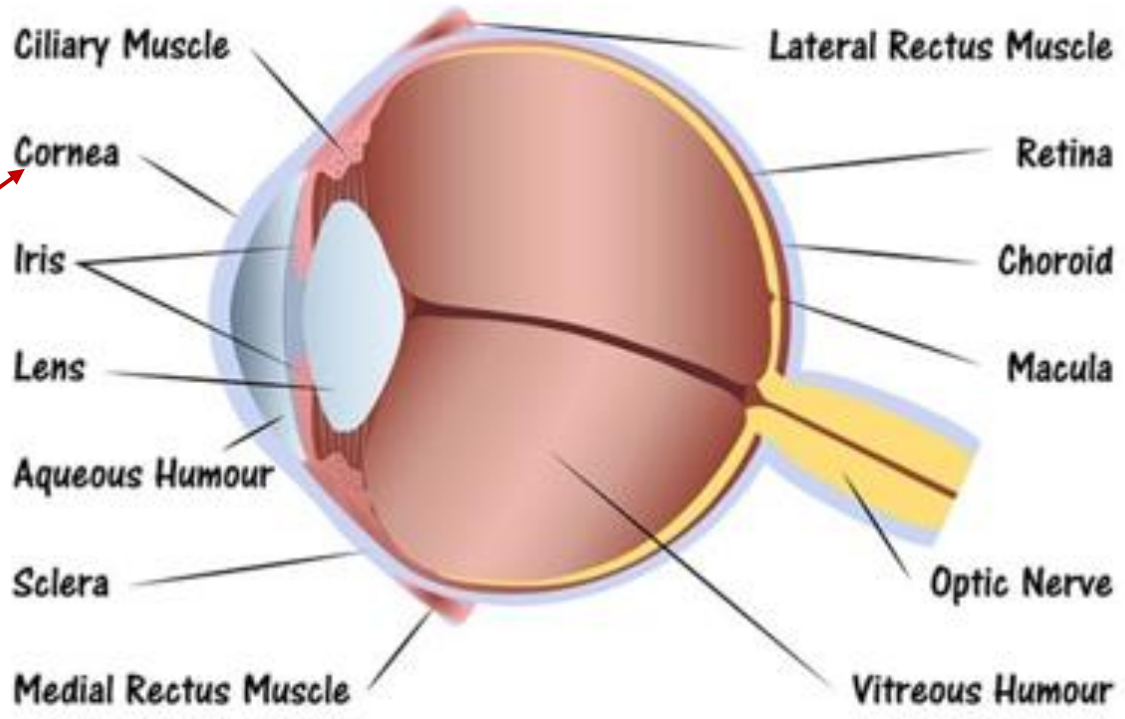
Ciliary muscle changes the shape of the lens enabling the eye to focus on near and far objects. It sits in the ciliary body.

Cornea is the first optical component of the eye machinery.

- Its function is of a primary filter and to focus light to the lens and onwards to the retina.

Lens is a clear, curved structure at the front of the eye behind the pupil.

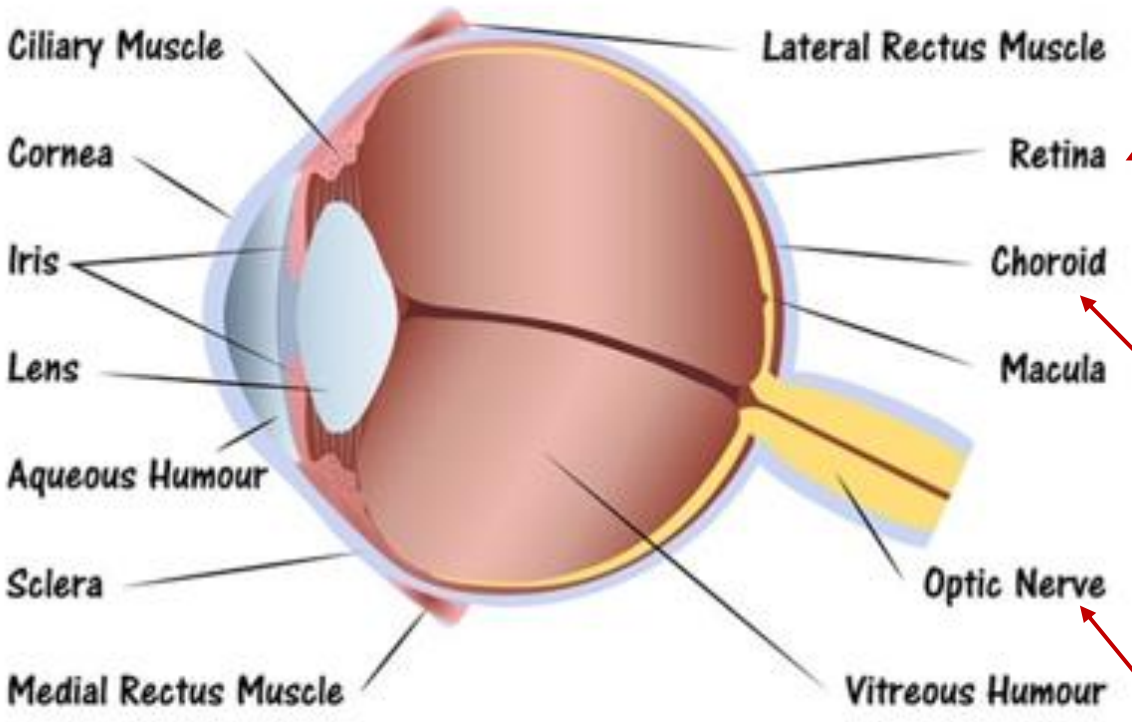
- **The function of the lens is to transmit light**, focusing it on the retina.
- The cornea contributes about 80% of total refraction, while the lens fine-tunes the focusing of light onto the retina.



Medial rectus is an adductor muscle.

- It moves the eye from side to side with the lateral rectus, an abductor.
- The globe can rotate 50° horizontally from the anterior midline.

ANATOMY OF THE EYE – INTERNAL PARTS



Retina is a layer of photoreceptors cells and glial cells at the back of the eye.

- It's function is to receive light that the lens has focused, convert the light into neural signals, and send these signals on to the brain for visual recognition.

Choroid is the layer of blood vessels and connective tissue between the white of the eye (Sclera) and retina.
It supplies nutrients to the inner parts of the eye.

Vitreous humour (vitreous fluid) is a clear gel-like substance that's located in your eye.

- It's function is to help the eye keep its shape.

Optic nerve connects the eye directly to the brain,

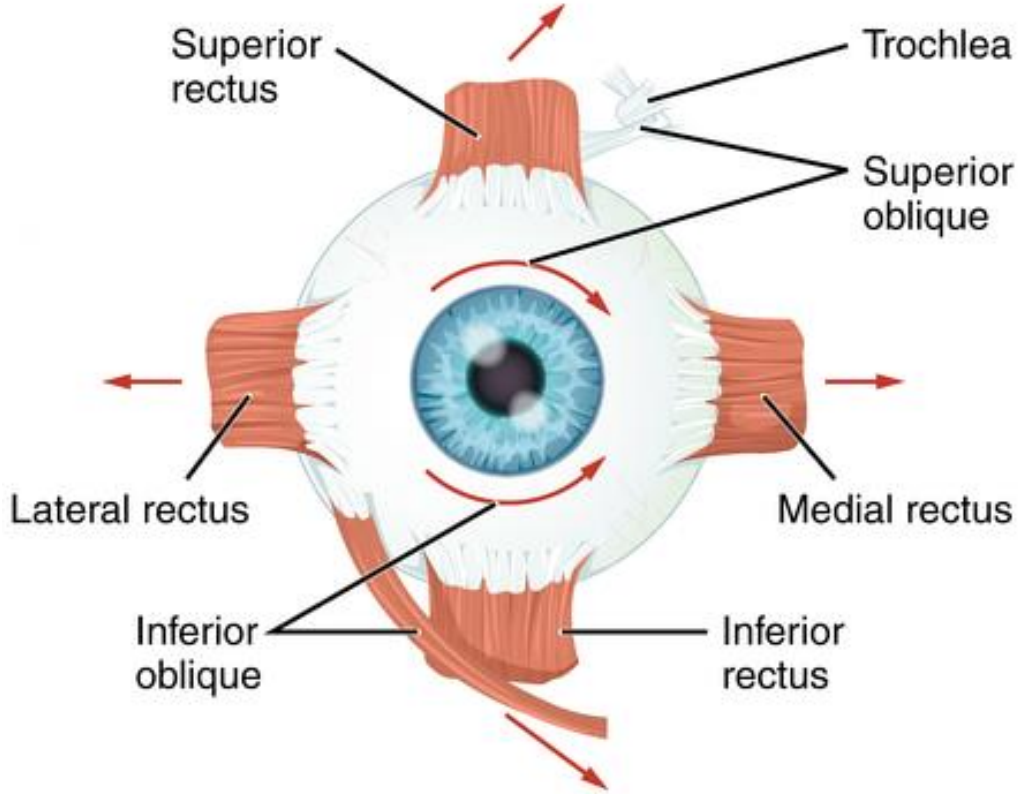
- It is comprised of millions of nerve fibers that send visual messages to your brain

MUSCLES OF THE EYE

There are **6 extraocular muscles** that control all of the movement of the eye.

These muscles are:

1. superior rectus
2. inferior rectus
3. lateral rectus
4. medial rectus
5. superior oblique
6. inferior oblique.



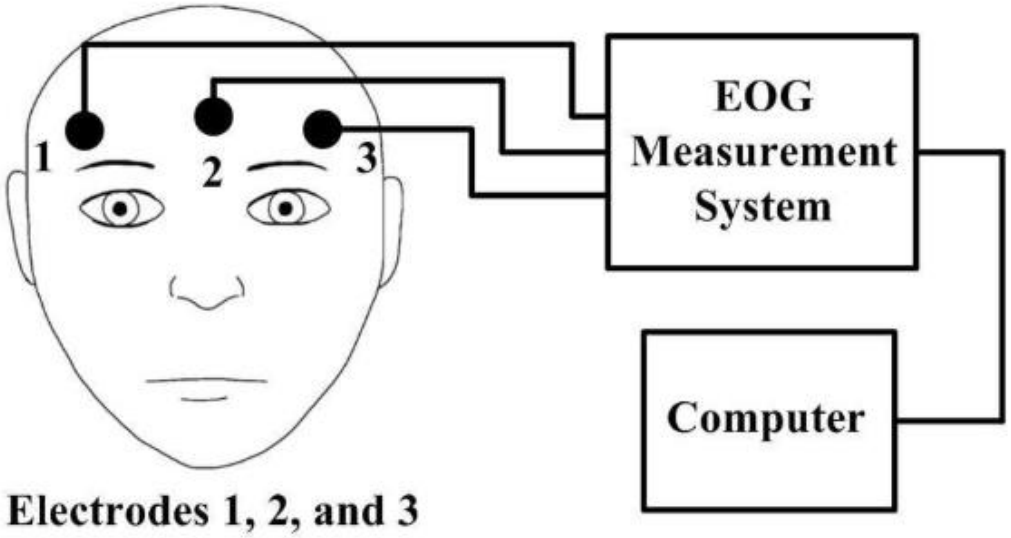
Anterior view of the right eye

Further Reading:

Eye Muscles (seevividly.com)

WHAT IS ELECTROOCULOGRAM? /01

Electrooculography is a technique for measuring the corneo-retinal standing potential that exists between the front and the back of the human eye.



(a) Three electrode electrooculogram

WHAT IS ELECTROOCULOGRAM? /02

1. **Electroretinogram (ERG)** is a diagnostic test that measures the electrical activity of the retina in response to a light stimulus.
2. ERG measures the electrical response of the eye's light-sensitive cells, called rods and cones.

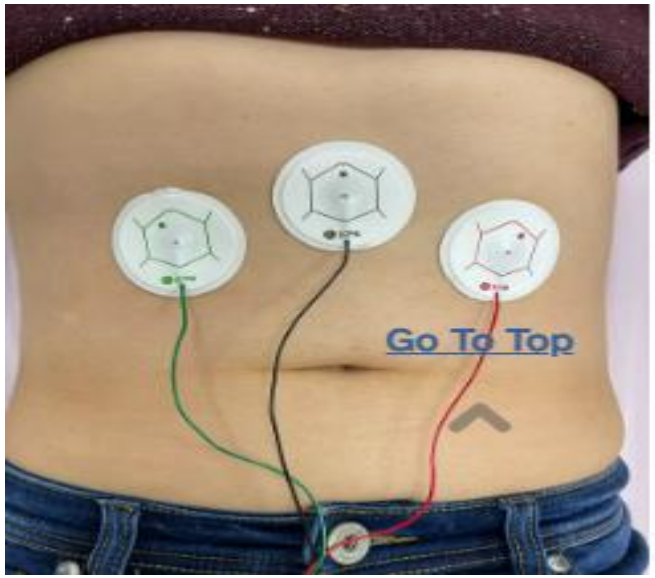
WHY IS ELECRORETINOGRAM NECESSARY?

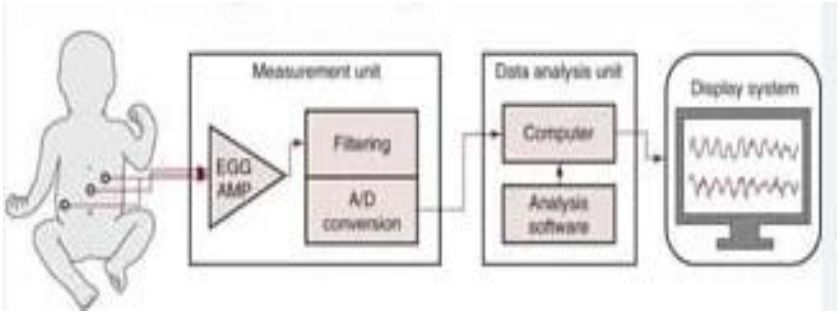
Electroretinogram (ERG) is usually required to do the following:

1. **Determine if you have an inherited or acquired disorder** of the retina, such as:
   a) **Retinitis pigmentosa**: A genetic disease which cause loss of peripheral and night vision.
   b) **Macular degeneration:** Loss of vision due to the death of cells in the macula.
   c) **Retinoblastoma:** Cancer of the retina
   d) **Retinal separation:** A detachment of the retina from the back of the eyeball.
   e) **Cone rod dystrophy (CRD):** Vision loss due to impaired cone and rod cells
2. **Help the doctor assess your need for retinal surgery** or other types of eye surgery, such as the removal of cataracts.

BIOLECTRIC SIGNALS - ELECTROGASTROGRAM

5. **Electrogastrogram(EGG):** A non-invasive technique for recording gastric myoelectrical activity using cutaneous electrodes placed on the abdominal skin over the stomach.
6. **Electrogastrogram** are produced by **e**lectrogastrography, which detects, analyzes and records the myoelectrical signal generated by the movement of the smooth muscle of the stomach, intestines and other smooth muscle.
7. Using EGG, **doctors can diagnose and treat illness** and **avoid operative and post-operative complications**.





NORMAL ELECTRORETINOGRAM

- **Normal ERG** shows an a-wave (photoreceptor activity) and b-wave (Muller and bipolar cells activity) pattern in dark-adapted (scotopic) and light-adapted (photopic) settings.