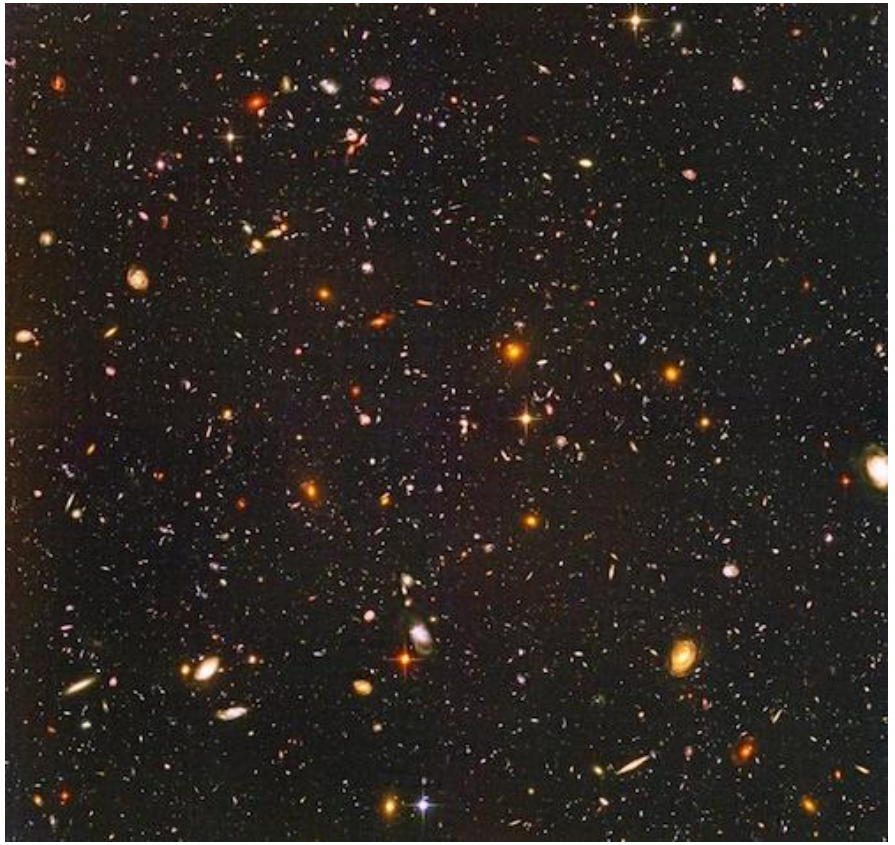
Human Vision

Lesson 22a

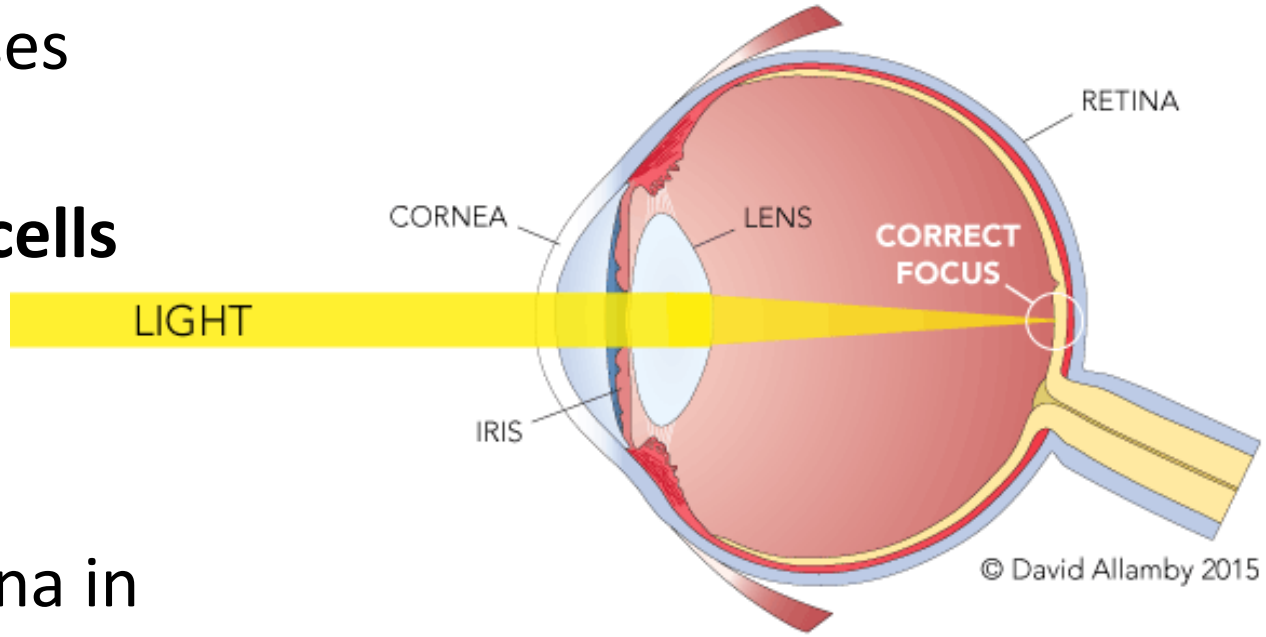
Human vision can be corrected and extended using optical systems

This photograph is of the most distant objects ever observed by humans using visible light. Why is this photograph so amazing? Consider that it is a photograph, not a drawing or a painting or an artist's imagination of what might be in space. Every swirl and every point of light is a real object. However, non of the points of light are individual stars. Every dot and swirl is a complete galaxy, which means that each and every dot is made of up of billions of stars. Human sight and the development of optical systems such as the Hubble Space Telescope have made it possible for us to see objects in more detail than ever before. We can peer into distant galaxies, view the inside of a beating heart, and examine our home planet from both close up and far away.

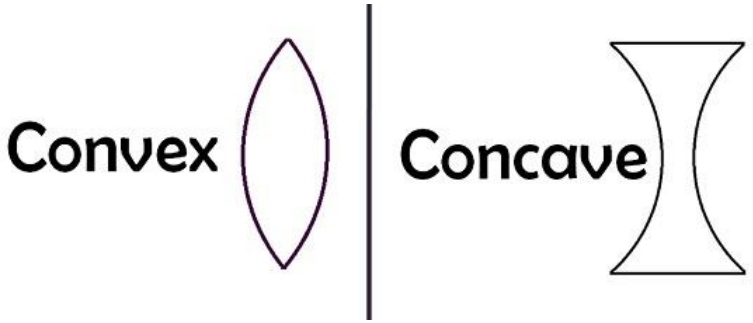


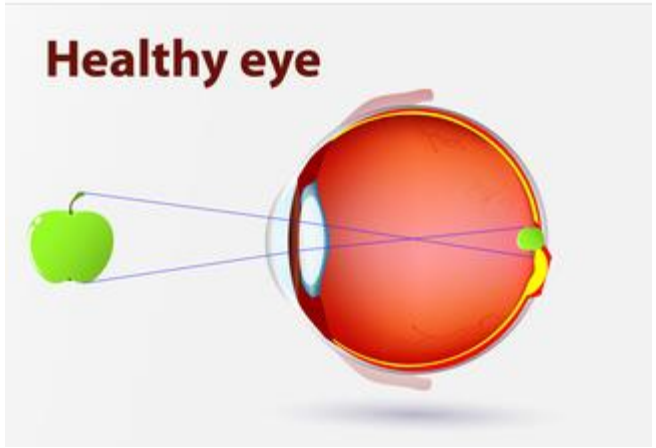
Human Vision

- The **cornea-lens-retina** system focuses light at the back of the eye
- Special cells in the retina called **rod cells** and **cone cells** convert light into electrical signals that are sent to the brain
- Light does not always fall on the retina in perfect focus

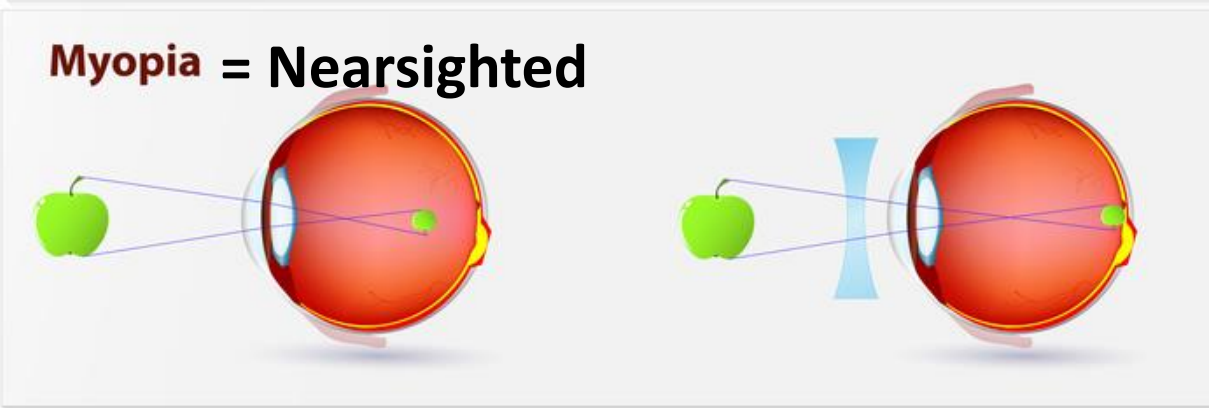


Human Vision





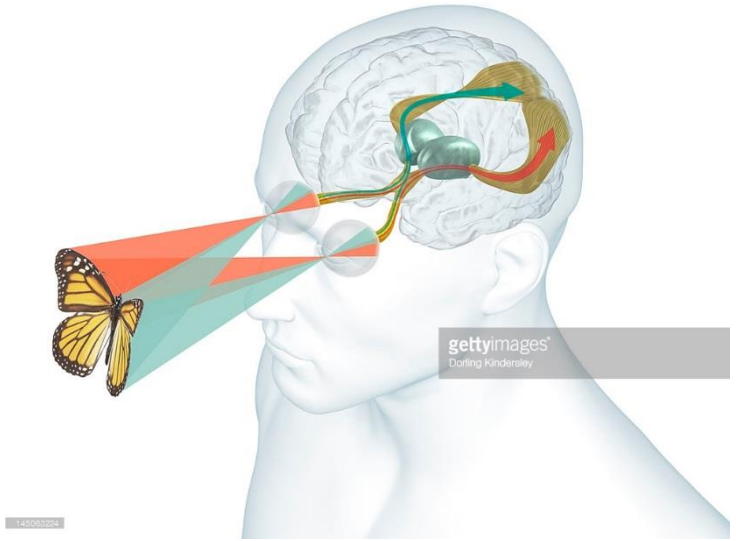
- *Near-sightedness* results when the eye cannot form a sharp image of distant objects
- *Near-sightedness* can be corrected by placing a *concave lens* in front of the eye
- Far-sightedness results when the lens of the eye cannot form a sharp image of nearby objects
  - Can be corrected by placing a convex lens in front of the eye



Human Vision

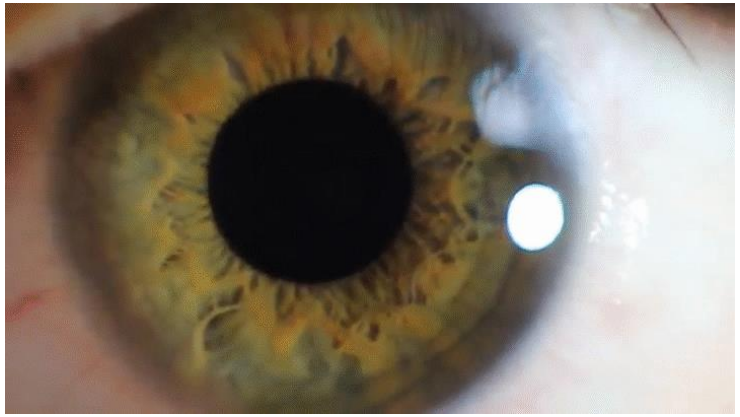
- With one glance you might see the words on this slide, the colour illustrations, and a classmate sitting next to you
- Human eyes can focus on objects both near and far and adapt to blazing sunlight and the dimmest of moonlight
- We have one vision system to see in colour and another to see only in shades of grey

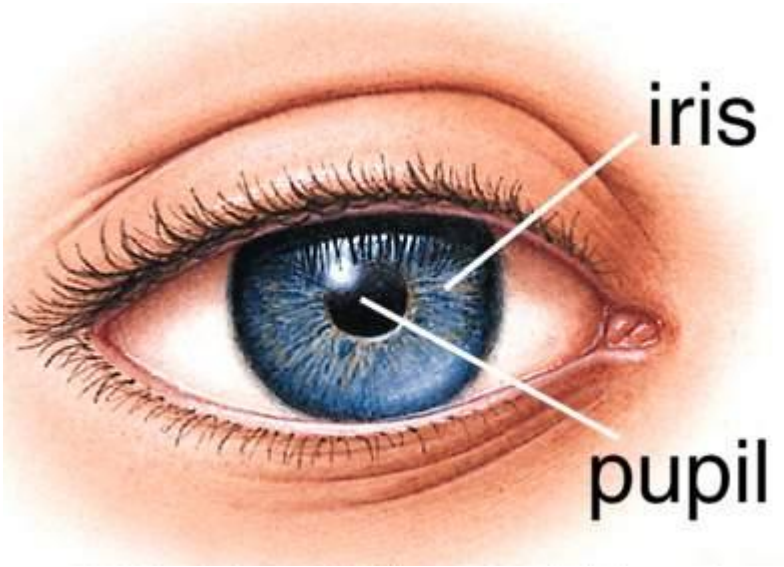
How is all of this possible?



Parts of the eye & How Light Enters the Eye

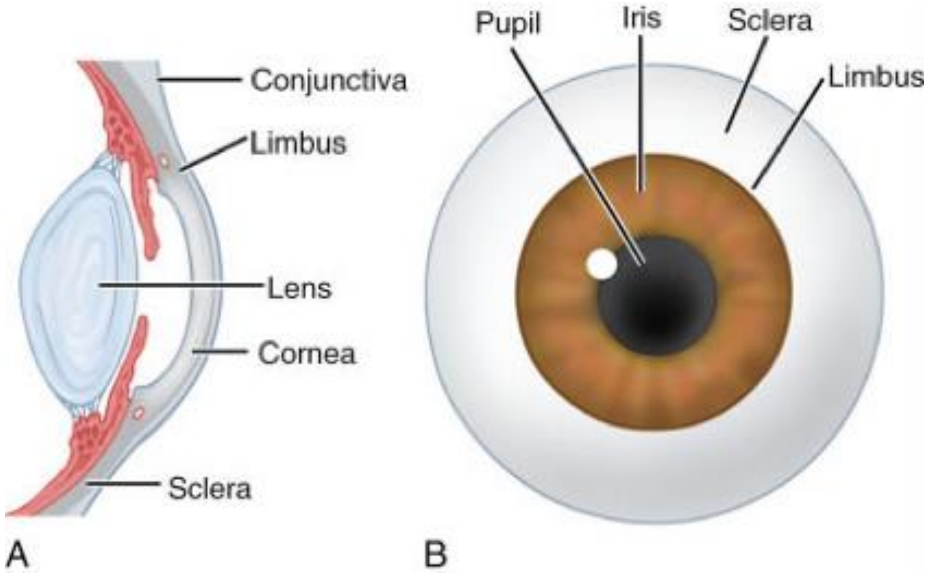
- Light enters the eye through the pupil
- The **pupil** is an opening that appears dark because light passes through it without reflecting back
- The **iris** is the coloured circle of muscle surrounding the pupil
  - Controls the amount of light entering the eye
  - In dim light, the iris dilates, or expands the pupil to allow more light to enter
  - In bright light, the iris contracts the pupil to reduce the amount of light entering the eye





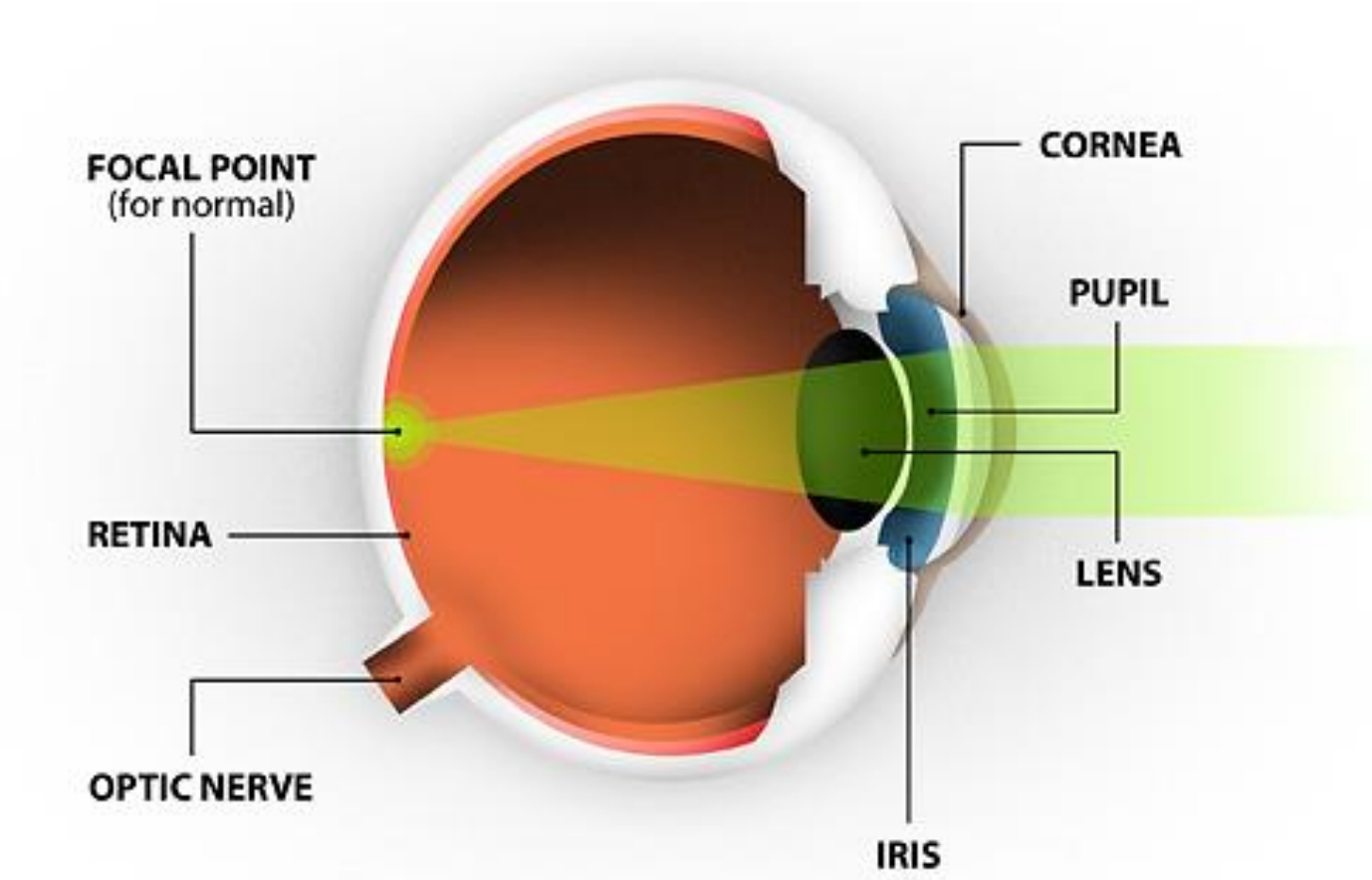
Parts of the eye & How Light Enters the Eye

- Covering the iris and pupil is a transparent tissue called the **cornea**
  - Made up of cells that are transparent enough to let light pass through, yet tough enough to hold the eye together
- Surrounding the cornea is an opaque tissue called the **sclera**
  - We see the **sclera** as the white region surround the iris



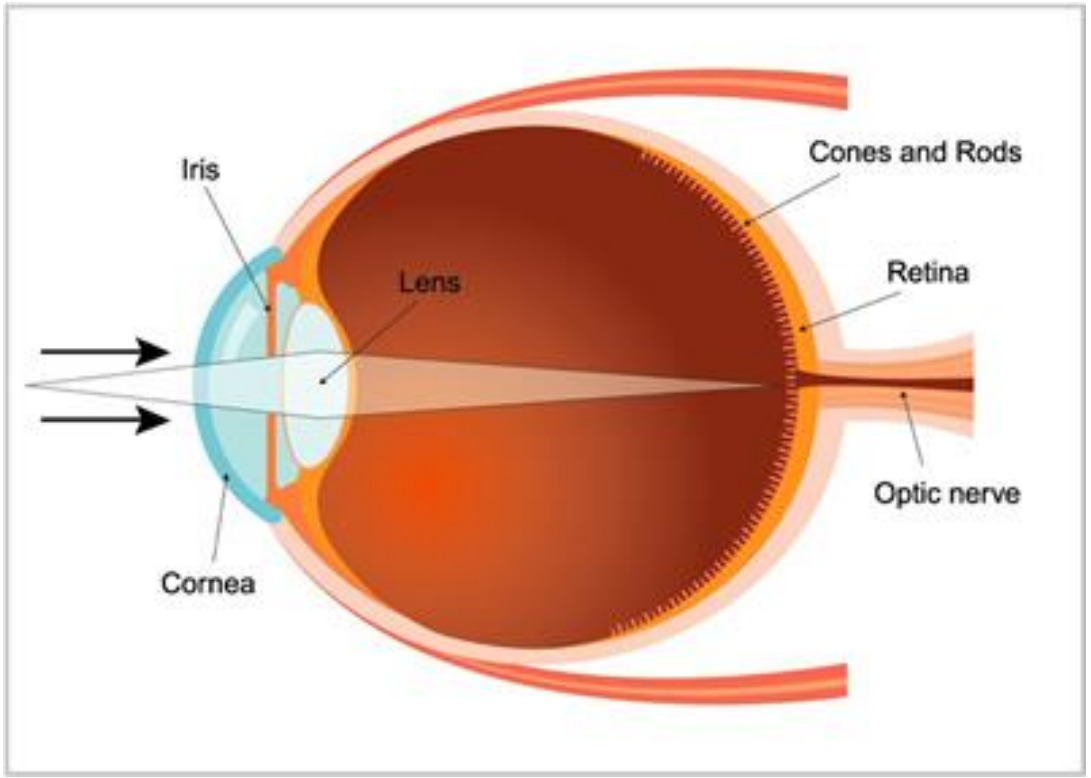
Parts of the eye & How Light Enters the Eye

- Behind the pupil is a flexible convex **lens**
  - The light rays pass through the lens and are focused on a screen at the back of the eye called the **retina** where an image is formed
- Special light sensitive cells in the retina detect the image
- Other cells in the retina convert the light rays into electrical signals that are sent to the brain through a thick nerve called the **optic nerve**



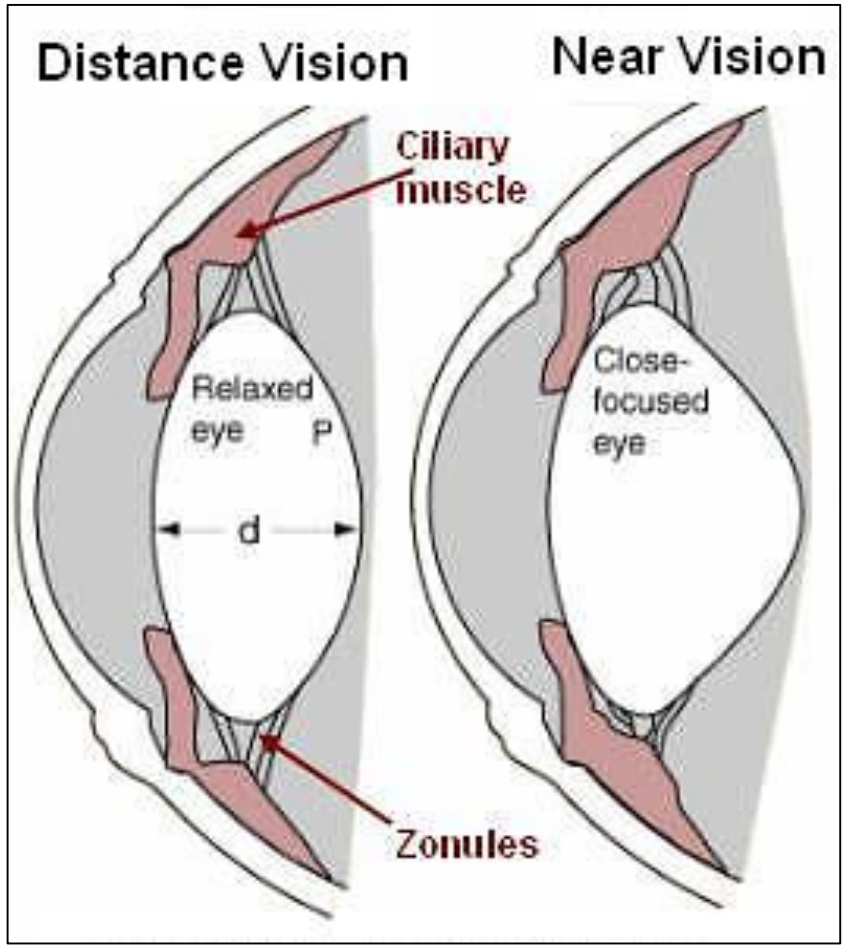
The Cornea-Lens-Retina System

- Light rays pass through a focusing system involving the **cornea,** the **lens,** and spaces in the eye filled with watery fluid
- Light rays begin to be focused as soon as they pass into the cornea
  - The cornea refracts incoming light rays so that they converge toward the retina
  - Most of the focusing is done by the cornea
- The lens does the remaining focusing



The Cornea-Lens-Retina System

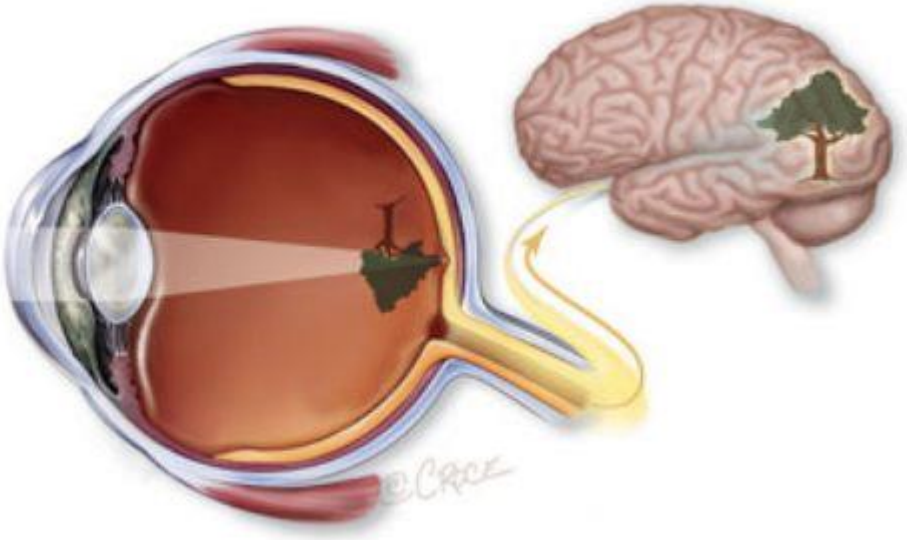
- The lens has the ability to fine-tune our focus by automatically changing its shape
  - When certain muscles in the eye contract, there is less tension on the lens, allowing the lens to become thicker
  - A thicker lens can focus on near objects
  - When you look at distant objects, these same muscles relax, increasing tension on the lens and making it thinner



Forming and image

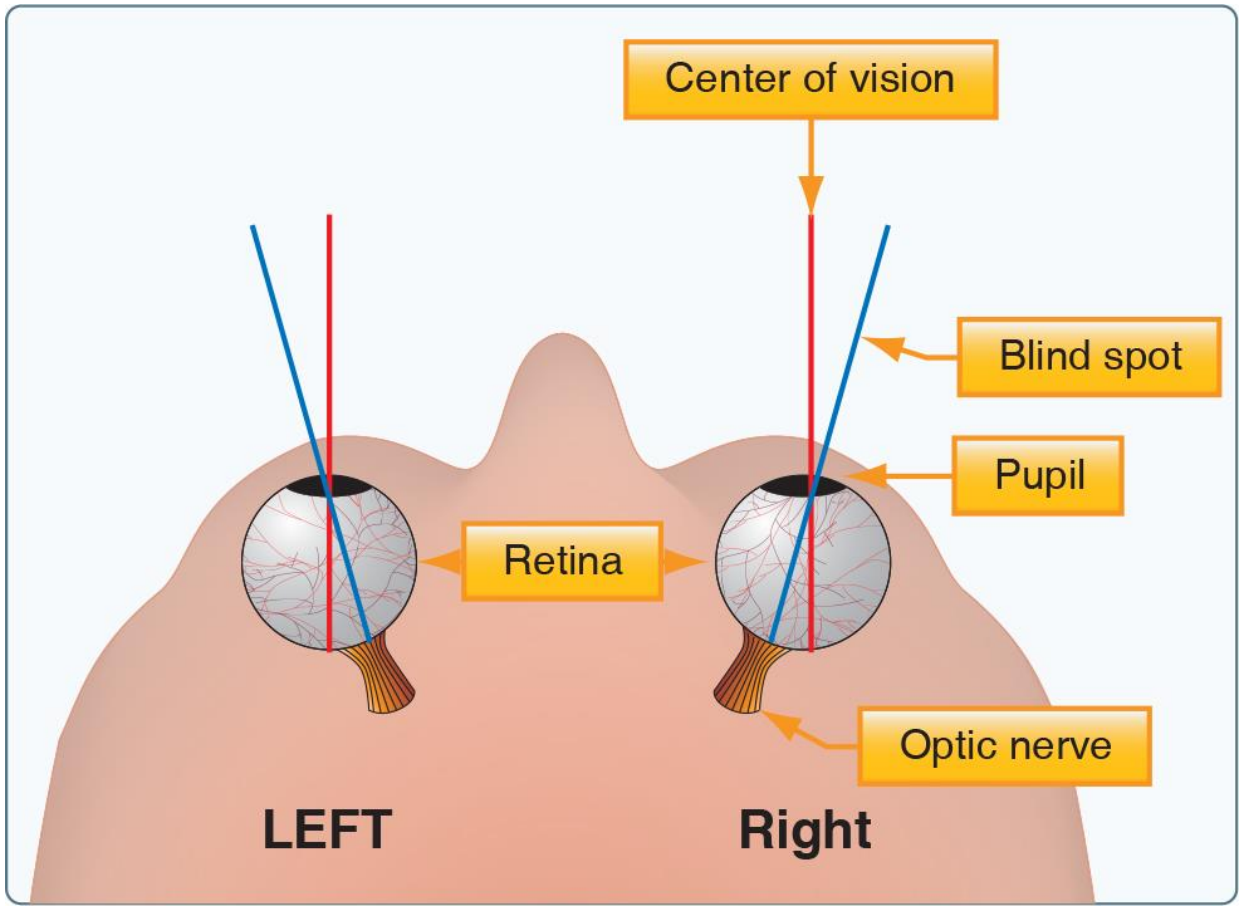
The Cornea-Lens-Retina System

- All the light rays that enter the eye from one spot on the base of an object come together again in one place at the top of the retina
- Similarly, all the light rays that enter the eye from a spot at the top of an object come together at one place at the bottom of the retina
- THEREFORE, the image formed by the lens is inverted (upside down)
  - However, we do not need to stand on our head to see upright
  - Our brain interprets the image as being upright



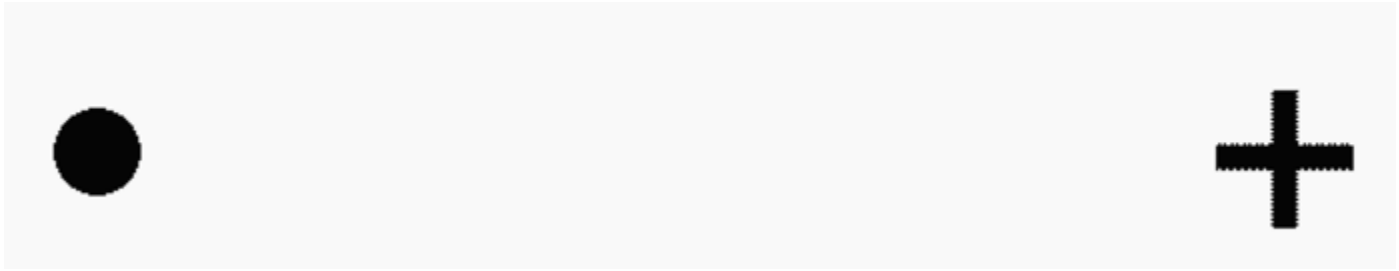
Blind Spot

- The area where the optic nerve enters the retina does not have any light-sensing cells
  - This area is known as the **blind spot**
- Both eyes have a blind spot, however, each eye sees what the other misses because the blind spots are not in the same place



Blind Spot

To locate your blind spot, hold this paper at arm's length. Cover your right eye with your hand. Stare at the + while you move the paper slowly toward yourself. The dot should disappear and then reappear as its image moves onto your blind spot and then off again.



Lesson Check

1. What happens to light rays after they enter the eye through the pupil?
2. Where does most of the focusing in the eye occur?
3. How does the lens change to focus on objects that are close?
4. How does the lens change to focus on objects that are distant?
5. Why is the image of an object inverted when it strikes the retina?

Answer the above questions to prepare for a REVIEW Q on **Wed. Jan. 15, 2020**