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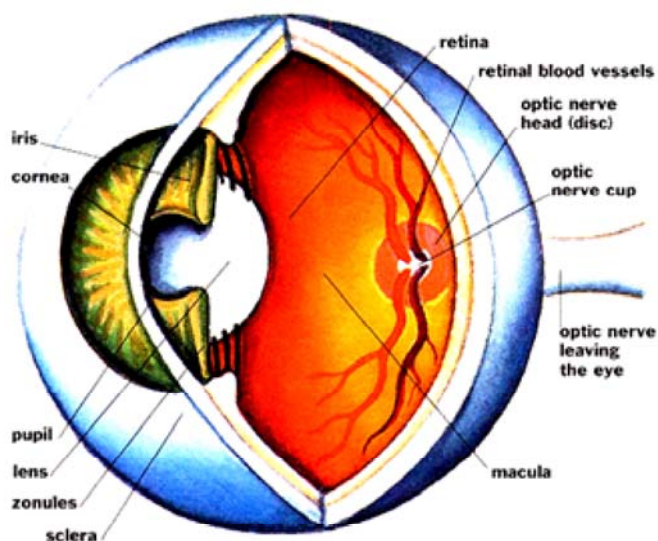
## THE HUMAN EYE

### Unit Overview

This unit will help you better understand what your eye is made of and exactly how it works. You will also learn common eye problems and some things you can do to prevent these problems. Good luck.

### How the Eye Works

Vision is a complex sense composed of many elements. The human eye, elegant in its detail and design, represents a gateway to the process we call vision. The eyeball, or globe, is spherical in shape and about 1 inch across. It houses many structures that work together to facilitate sight.



The human eye is comprised of layers and internal structures, each of which performs distinct functions. The outside layer of the eye is comprised largely of a tough, white, protective tissue called the sclera. The sclera helps maintain the shape of the eyeball. At the front of the eye is an equally tough but clear structure called the cornea, which is responsible for letting light into the eye and bending light.

Going from outside to inside, the next layer of the eye is the choroid, which carries the blood supply necessary to nourish the eye's internal structures. Finally, there is the layer called the retina, lining the inside of the eye, which is sensitive to light and receives stimulation to its specialized cells.

The eye has a number of protective features. The eyelids, eyelashes and eyebrows are all designed to protect the eye from dirt and dust that might enter it and cause damage. The globe sits inside the orbital cavity, a bony pocket lined with fatty tissue as a cushion. Together these provide additional protection against injury. Six muscles attach at various points to the sclera and enable the globe to move in many directions inside the orbit.

In order for vision to take place, a succession of processes must occur involving the structures within the eye and the brain:

The first part of this chain is that light rays must travel through the eye to ultimately focus on the retina. There are a number of structures involved in the bending or refracting of light so that it focuses properly. Light first passes through the clear cornea at the front of the eye, and then through a watery substance called the aqueous humor which fills the small chambers located behind the cornea. As light continues on its pathway it passes through the pupil, a round opening in the center of the iris. The iris is the part of the eye that gives the eye its color. It also is made up of specialized muscles that are able to change the size of the pupil from very small (about 2 mm) to large (about 8 mm), regulating the light that is entering.

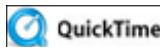
The next structure light will penetrate the lens, another clear, layered structure shaped like a large lentil (about 10 mm in diameter) that is attached to muscles which contract or relax to change the shape of the lens. The changing lens shape helps light to be focused in response to the need for clarity. (The loss of this focusing ability as humans age – a natural occurrence – is the reason that many adults over 40 years old need reading glasses.) Once through the pupil and lens, the light then passes through the larger posterior (back) portion of the eye that is filled with a clear, jelly-like substance called the vitreous humor. From there, the light will come to the retina, where the rod cells and cone cells will be stimulated to set off a chain of split-second chemical reactions converting light to electrical impulses. The cone cells (about 7 million in number) are located in greatest concentration in the small, central part of the retina called the macula. This area is responsible for producing sharp, detail vision and color vision. The rod cells (numbering about 100 million) are found in the peripheral retina, away from the macula. These cells provide vision in dim light.

Even if all of the structures of the eye work perfectly, what we know as vision cannot happen without the brain's interpretation of the electrical impulses sent by the retina. The optic nerve is the bundle of retinal fibers that exits the back of the eye and transports electrical impulses to the brain where they are interpreted in the primary visual cortex.

When all parts of the visual system are working, the eyes can move together, can adapt to light and dark, perceive color and accurately evaluate an object's location in space. They are sensitive to differences in contrast, and can also provide detail vision, which is measured as visual acuity. By convention, we know "normal" visual acuity to be reported as 20/20. As the bottom number of this expression gets higher, it tells us that the vision is poorer than "normal." For example, the start of the range known as "legal blindness" is represented by the visual acuity finding of 20/200. One way to understand the meaning of this finding is that the eye being tested sees at 20 feet what the "normal" eye would see at 200 feet. People whose vision is in the category of "legal blindness" may still be able to use vision to do some of the things they need to do.

All eyes are not the same, nor are they all perfect. Some eyeballs are too long or have too much focusing power, causing the person to be myopic (nearsighted). Others are too short or have too little focusing power, and the result is hyperopia (farsightedness). Some eyeballs may have uneven curvature, called astigmatism. Options for correcting these "mechanical" problems are standard eyeglasses, contact lenses or refractive surgery. Other problems may be caused by disease or injury, and are not correctable by conventional means. People whose vision is irreversibly impaired due to

diseases such as macular degeneration, glaucoma, cataract, diabetic retinopathy and others can be helped by vision rehabilitation.



Properties of Vision: How the Eye Senses Information (04:19)



**Now answer questions 1-7.**

## Common Eye Problems

Myopia (Nearsightedness) is a refractive error where distant objects come into focus in front of the retina of the eye as a result of longer than normal eye-ball, so the distant object appears blurred to the myopic eye. A bent concave lens is used to bring the focus on the retina to restore clear distance vision.

However, the myopic eye can still see near objects clearly without any correction depending on the distance of the near objects in relation to the degree of myopia.

## Hypermetropia (Long-sightedness)

Hypermetropia (Long-sightedness) is a refractive error where distant object comes into focus behind the retina when the eyes are relaxed. In adults, this condition will cause deterioration of distance vision and near visual problem due to the gradual loss of focusing ability of the eye. A bent convex lens is used to bring the focus back onto the retina. In children, distance vision is often not affected because of the active and strong focusing mechanism, the eyes have ability to bring the focus back onto the retina. However, for higher degrees of hypermetropia, it may cause blurred vision, headache, and even converging squints. These problems will be aggravated when doing near works which required greater focusing power. It's important to detect and correct the medium to high degrees of hypermetropia for children under 6 years old. If uncorrected, it can lead to Amblyopia. (lazy eye).

Click on the following link to learn more about Lazy Eye in Children.

<http://www.childrensvision.com/lazyeye.htm>

## Astigmatism

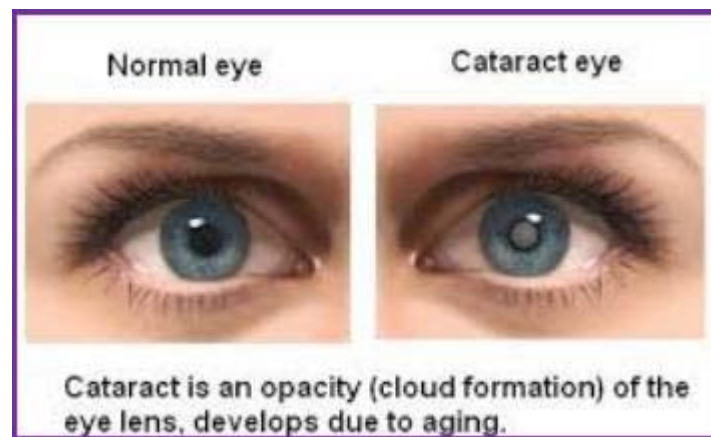
Astigmatism is a refractive error where distant object comes into two focal lines perpendicular to one another. These lines may lie in any orientation and any position in relation to the retina. This is primarily due to the aspherical (toroidal) corneal shape. A bent lens with a toric surface is used to correct this condition.

Astigmatism may occur by itself or may occur with one of the refractive errors but in most cases are less than 2.50 dioptres. Although for a similar degree of defect, astigmatic eyes suffer less blurriness than the other refractive errors, uncorrected astigmatism often leads to eyestrain and headache due to the focal lines formed in the eye cause the eye's focusing mechanism under strain as it constantly exert effort for best possible focus.

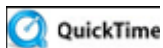
Uncorrected astigmatism on young children can also lead to Amblyopia.

## Cataracts

A cataract is a clouding in the eye's natural lens, which is normally crystal clear. It is not a tumor or growth over the eye. Most cataracts progress and eventually hamper vision. They develop as part of the aging process and are not usually a problem until the 60s or 70s. Studies have shown that prolonged exposure to sunlight can play a role in hastening cataract development. Everyone will get cataracts if they live long enough. If you have a cataract, you might notice blurring or dimming of vision, or a halo or haze around lights, especially at night. You may not notice even an advanced cataract if your other eye sees well. Eye pain, headaches, or eye irritation are not symptoms of cataracts.



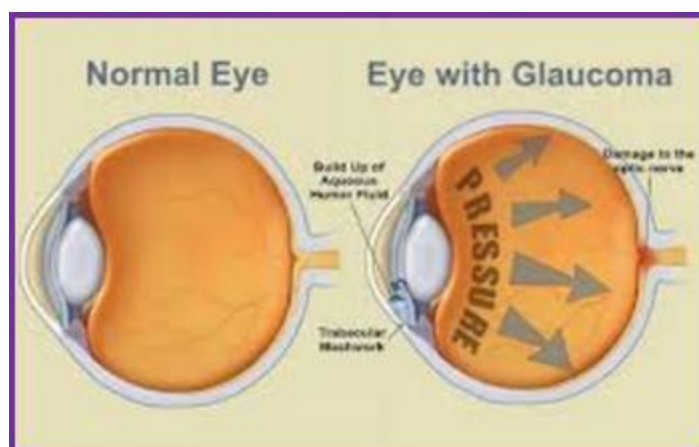
The only treatment for cataract is removal of the cloudy lens, replacing it with a new synthetic "intraocular lens implant". Cataract surgery is one of the safest and most effective operations today. The most modern "Clear Corneal Cataract Surgery" is performed by Dr. Craig as same day surgery at Henderson Memorial Hospital, Laird Memorial Hospital in Kilgore and East Texas Medical Center in Carthage. The surgery is performed under local or eye drop anesthesia. This state of the art surgery is 90-95% successful.



Eye Defects (02:04)

## Glaucoma

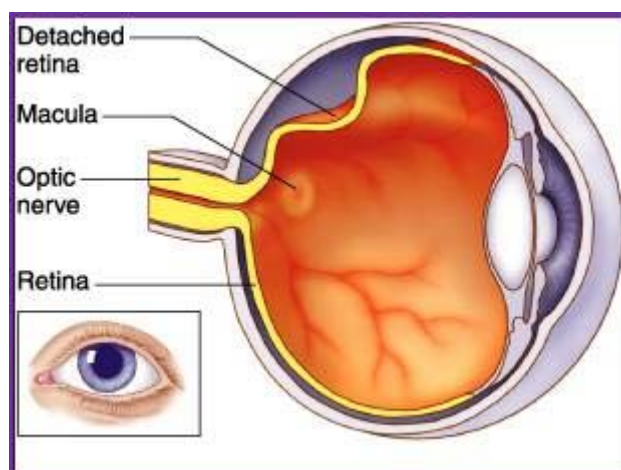
Glaucoma is the term given to the set of eye diseases in which the intraocular pressure within the eyeball may be increased and progressive damage to the optic nerve results. The optic nerve is like a main telephone trunk, transmitting images from the retina of the eye to the brain. As glaucoma slowly damages the optic nerve, blind areas develop that can progress to loss of vision or even total blindness, usually painlessly. That is why we call it "The Sneak Thief of Sight".



Ninety percent of patients with glaucoma have the open angle or chronic type. It usually affects both eyes, often one before the other and in mid or late life. It may be hereditary, is not contagious, and is not related to cancer. High pressure in the eyes is not the same as high blood pressure. As part of your routine eye exam, Drs. Craig and Pinkerton will do a painless test called tonometry to measure your eye pressure. Elevated pressure is one sign of glaucoma, but other tests to confirm this diagnosis may be needed. A visual field will measure your side vision and examination of the retina and optic nerves is an integral part of your exam. Appointments with Drs. Craig or Pinkerton every few months will follow, so that they can monitor your condition, in order to prevent progression of the disease. Eye drops to lower pressure can be prescribed and, in some cases, laser surgery or filtering surgery may be required.

## Detached Retina

Usually the retina is attached to the inner surface of the eye. if there is a tear or hole in the retina then fluid can get underneath. This weakens the attachment so that the retina becomes detached - rather like wallpaper peeling off a damp wall. When this happens the retina cannot compose a clear picture from the incoming rays and your vision becomes blurred and dim.





Now answer questions 8-12.

## Eye care

The following suggestions are for information purposes only and meant for healthy and normal eyes which do not have any complications. Those with specific eye related problems should consult their ophthalmologist or health care providers before doing any particular exercise.

1. Adequate rest and relaxation are very important for the proper care of your eyes. Stress and strain result in building up of pressure on the optic nerve, the eye muscles and the retina as well as cause changes in the flow of blood in the veins that supply blood to the eyes. So keep yourself and your eyes well relaxed most of the times. If you feel tired and stressed take rest, so that you will feel charged and ready to face the world again.
2. During the day, especially when you have no work to do, give rest to your eyes intermittently. You can do this even amidst busy schedule taking a moment off. The best way to rest your eyes is to temporarily close them. Do this whenever possible for a few minutes each time. By doing this you will be helping your eyes to work more efficiently and providing the nerve cells the much need temporary relief. (Well, you won't practice this when you are driving a car or walking down a road or climbing up or down a stair case, etc.!)
3. Do not practice self-medication when there is any problem in your eyes. Consult always a qualified ophthalmologist. Do not use any eye drops or ointments or medicines, unless prescribed and recommended by your ophthalmologist. This may not save your purse and your time, but definitely your eyes!
4. We do not like people staring at us, do we ? (Unless of course by a person whom you are attracted to!) Blink your eyes frequently and help your eyes relax and remain moistened. People with increased eye sight have a tendency not to blink for longer durations. See whether you too have developed this habit unconsciously.
5. Do some eye exercises if possible every day. There are many and your ophthalmologist can suggest you some specific ones. One good exercise I found useful is the palming exercise. In this exercise you sit comfortably, close both your eyes, cover your eyes lightly (no pressure whatsoever) with your palms and keep looking into the darkness in front of your eyes, in a complete state of relaxation, without forcing your mind to think any particular line of thoughts or subjecting yourselves to any strain. If you practice this exercise sincerely you will soon see the results for yourself.
6. If you have vision related problems, and if you are a middle aged person, keep your eyes examined by a qualified ophthalmologist at least once in a year.
7. Avoid looking at the sun directly even for a moment at any time of the day. The glaring light of the sun is said to be very harmful to your eyes, especially to the cells in your retina. It is also advisable to use sunglasses whenever you feel that the light is causing irritation in your eyes.8. But it is useful to close your eyes completely and turn your face towards the sun. The warmth of the sun light will increase the flow of blood in your eyes and stimulate the nerve cells in your eyes. When you do this please see that no light enters your eyes directly.



8. You must have read this a hundred times and even got tired of it. But I must state it here again. Eat plenty of vegetables and food items that contain Vitamin A : eggs, fish, milk, leafy vegetables, carrot, to suggest a few.

9. Keep sharp objects, harmful toys (like toy pistols that throw objects, dart boards, arrows and bows etc.) and similar devices away from your children, if you want to protect their eyes as well as yours. They have a tendency to play with them with great enthusiasm, without bothering about the consequences!

10. Regular exercise, moderation in your habits, positive state of mind, loving and caring nature, contentment in life, cleanliness, harmony in your environment and in your actions, a certain degree of interest in leading a meaningful and useful life, etc., also contribute greatly to your overall health and thereby to the general welfare of your eyes also.



**Now answer questions 13-15.**

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Below are additional educational resources and activities for this unit.

[Unit 7 The Human Eye Resource](#)

[Unit 7 The Human Eye Puzzle](#)

[Unit 7 The Human Eye Puzzle Key](#)