VISION

A Big Look at the Eye

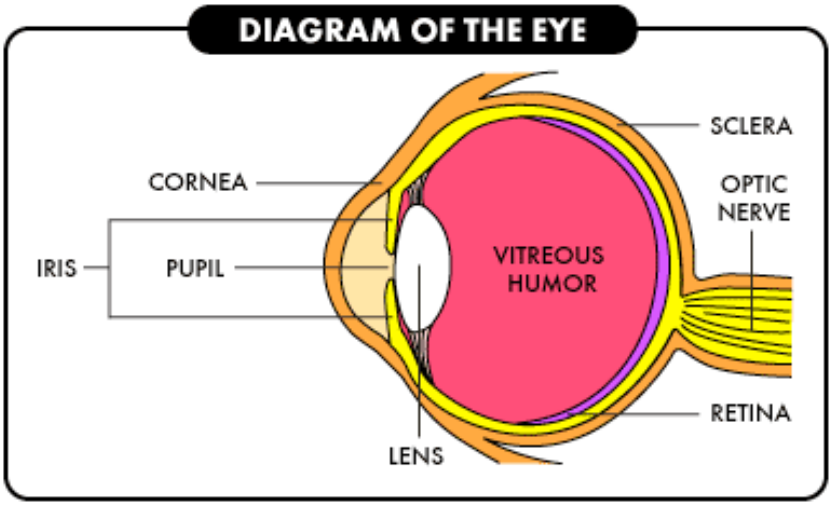
Which part of your body lets you read the back of a cereal box, check out a rainbow, and see a softball heading your way? Which part lets you cry when you're sad and makes tears to protect itself? Which part has muscles that adjust to let you focus on things that are close up or far away? If you guessed the eye, you're right!

Your eyes are at work from the moment you wake up to the moment you close them to go to sleep. They take in tons of information about the world around you — shapes, colors, movements, and more. Then they send the information to your brain for processing so the brain knows what's going on outside of your body.

You can see that the eye's pretty amazing. So, come on — let's take a tour of its many parts.

Eye See

You can check out different parts of the eye by looking at your own eye in the mirror or by looking at (but not touching) a friend's eye. Some of the eye's parts are easy to see, so most friends will say OK. Most friends won't say OK if you ask to see their liver!



The eye is about as big as a ping-pong ball and sits in a little hollow area (the **eye socket**) in the skull. The front part is protected by the **eyelid**. The eyelid helps keep the eye clean and moist by opening and shutting several times a minute. This is called **blinking**, and it's both a voluntary and involuntary action, meaning you can blink whenever you want to, but it also happens without you even thinking about it.

The eyelid also has great reflexes, which are automatic body responses, that protect the eye. When you step into bright light, for example, the eyelids squeeze together tightly to protect your eyes, until they can adjust to the light. And if you flutter your fingers close (but not too close!) to your friend's eyes, you'll be sure to see your

friend's eyes blink. Your friend's eyelids shut automatically to protect the eye from possible danger. And speaking of fluttering, don't forget **eyelashes**. They work with the eyelids to keep dirt and other unwanted stuff out of your eyes.

The white part of the eyeball is called the **sclera** (say: **sklair**-uh). The sclera is made of a tough material and has the important job of covering most of the eyeball. Think of the sclera as your eyeball's outer coat. Look very closely at the white of the eye, and you'll see lines that look like tiny pink threads. These are blood vessels, the tiny tubes that deliver blood, to the sclera.

The cornea, a transparent dome, sits in front of the colored part of the eye. The cornea (say: **kor**-nee-uh) helps the eye focus as light makes its way through. It is a very important part of the eye, but you can hardly see it because it's made of clear tissue. Like clear glass, the cornea gives your eye a clear window to view the world through.

Behind the cornea are the iris, the pupil, and the anterior chamber. The iris (say: **eye**-riss) is the colorful part of the eye. When we say a person has blue eyes, we really mean the person has blue irises! The iris has muscles attached to it that change its shape. This allows the iris to control how much light goes through the pupil (say: **pyoo**-pul).

The pupil is the black circle in the center of the iris, which is really an opening in the iris, and it lets light enter the eye. To see how this works, use a small flashlight to see how your eyes or a friend's eyes respond to changes in brightness. The pupils will get smaller when the light shines near them and they'll open wider when the light is gone.

The anterior (say: an-**teer**-ee-ur) chamber is the space between the cornea and the iris. This space is filled with a special transparent fluid that nourishes the eye and keeps it healthy.

Light, Lens, Action

These next parts are really cool, but you can't see them with just your own eyes! Doctors use special microscopes to look at these inner parts of the eye, such as the **lens**. After light enters the pupil, it hits the **lens.** The lens sits behind the iris and is clear and colorless. The lens' job is to focus light rays on the back of the eyeball — a part called the **retina** (say: **reh**-tin-uh). The lens works much like the lens of a movie projector at the movies. Next time you sit in the dark theater, look behind you at the stream of light coming from the projection booth. This light goes through a powerful lens, which is focusing the images onto the screen, so you can see the movie clearly. In the eye's case, however, the film screen is your retina.

Your retina is in the very back of the eye. It holds millions of cells that are sensitive to light. The retina takes the light the eye receives and changes it into nerve signals so the brain can understand what the eye is seeing.

The lens is suspended in the eye by a bunch of fibers. These fibers are attached to a

muscle called the **ciliary** (say: **sil**-ee-air-ee) **muscle**. The ciliary muscle has the amazing job of changing the shape of the lens. That's right — the lens actually changes shape right inside your eye! Try looking away from your computer and focusing on something way across the room. Even though you didn't feel a thing, the shape of your lenses changed. When you look at things up close, the lens becomes thicker to focus the correct image onto the retina. When you look at things far away, the lens becomes thinner.

The biggest part of the eye sits behind the lens and is called the **vitreous** (say: **vih**-tree-us) **body**. The vitreous body forms two thirds of the eye's volume and gives the eye its shape. It's filled with a clear, jelly-like material called the **vitreous humor**. Ever touch toy eyeballs in a store? Sometimes they're kind of squishy — that's because they're made to feel like they're filled with vitreous humor. In a real eye, after light passes through the lens, it shines straight through the vitreous humor to the back of the eye.

Rods and Cones

The retina uses special cells called rods and cones to process light. Just how many rods and cones does your retina have? How about 120 million rods and 7 million cones — in each eye!

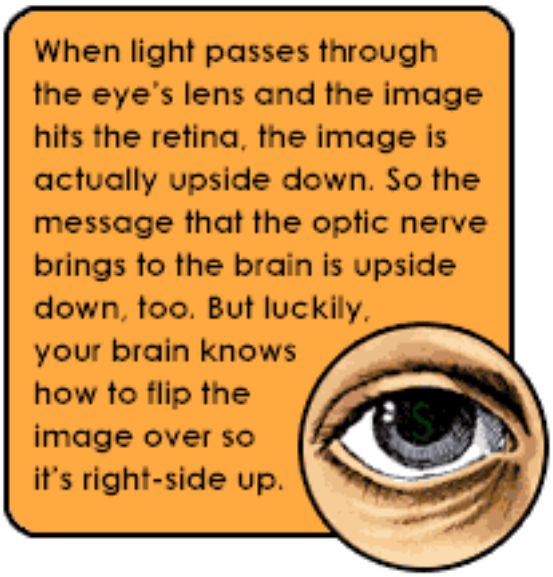
Rods see in black, white, and shades of gray and tell us the form or shape that something has. Rods can't tell the difference between colors, but they are super-sensitive, allowing us to see when it's very dark.

Cones sense color and they need more light than rods to work well. Cones are most helpful in normal or bright light. The retina has three types of cones. Each cone type is sensitive to one of three different colors — red, green, or blue — to help you see different ranges of color. Together, these cones can sense combinations of light waves that enable our eyes to see millions of colors.

Rods and cones process the light to give you the total picture. You're able to see that your friend has brown skin and is wearing a blue hat while he tosses an orange basketball.

Sometimes someone's eyeball shape makes it difficult for the cornea, lens, and retina to work perfectly as a team. When this happens, some of what the person sees will be out of focus.

To correct this fuzzy vision, many people, including many kids, wear glasses. Glasses help the eyes focus images correctly on the retina and allow someone to see clearly. As adults get older, their eyes lose the ability to focus well and they often need glasses to see things up close or far away. Most older people you know — like your grandparents — probably wear glasses.



To the Brain!

Think of the **optic nerve** as the great messenger in the back of your eye. The rods and cones of the retina change the colors and shapes you see into millions of nerve messages. Then, the optic nerve carries those messages from the eye to the brain! The optic nerve serves as a high-speed telephone line connecting the eye to the brain. When you see an image, your eye "telephones" your brain with a report on what you are seeing so the brain can translate that report into "cat," "apple," or "bicycle," or whatever the case may be.

Have No Fear, You Have Tears

For crying out loud, the eye has its own special bathing system — tears! Above the outer corner of each eye are the **lacrimal** (say: **lah**-kruh-mul) **glands**, which make tears. Every time you blink your eye, a tiny bit of tear fluid comes out of your upper eyelid. It helps wash away germs, dust, or other particles that don't belong in your eye. It also keeps your eye from drying out. Then the fluid drains out of your eye by going into the **lacrimal duct** (this is also called the tear duct). You can see the opening of your tear duct if you very gently pull down the inside corner of your eye. When you see a tiny little hole, you've found the tear duct.

Your eyes sometimes make more tear fluid than normal to protect themselves. This may have happened to you if you've been poked in the eye, if you've been in a dusty or smoking area, or if you've been near someone who's cutting onions.

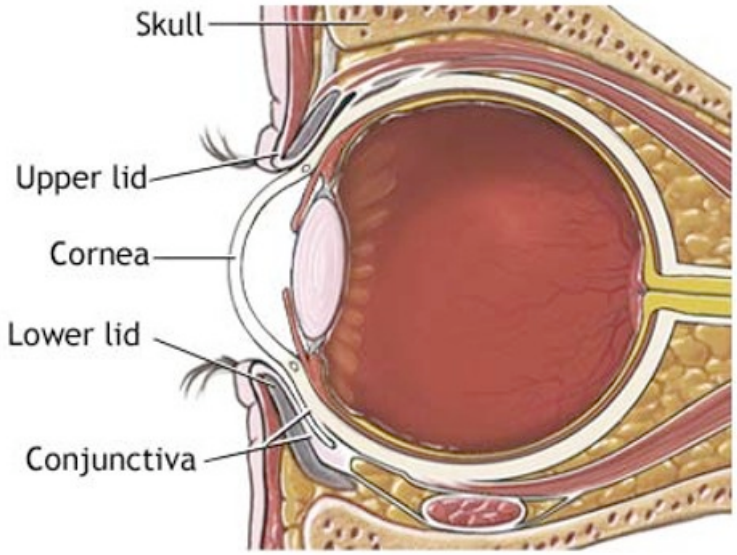
And how about the last time you felt sad, scared, or upset? Your eyes got a message from your brain to make you cry, and the lacrimal glands made many, many tears.

Your eyes do some great things for you, so take these steps to protect them:

- Wear goggles in classes where debris or chemicals could go flying, such as wood shop, metal shop, science lab, or art.
- Wear eye protection when playing racquetball, hockey, skiing, or other sports that could injure your eyes.
- Wear sunglasses. Too much light can damage your eyes and cause vision problems, such as **cataracts**, later in life. If the lens gets cloudy, it's called a cataract. A cataract prevents light from reaching the retina and makes it difficult to see.

The eyes you have will be yours forever — treat them right and they'll never be out of sight!

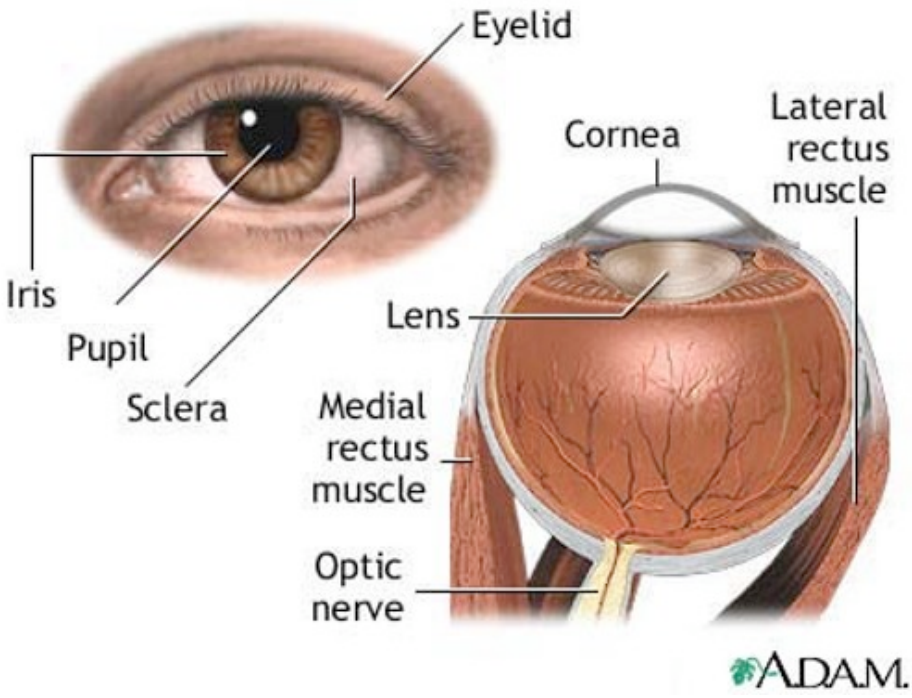
Reviewed by: Elana Pearl Ben-Joseph, MD Date reviewed: November 2006



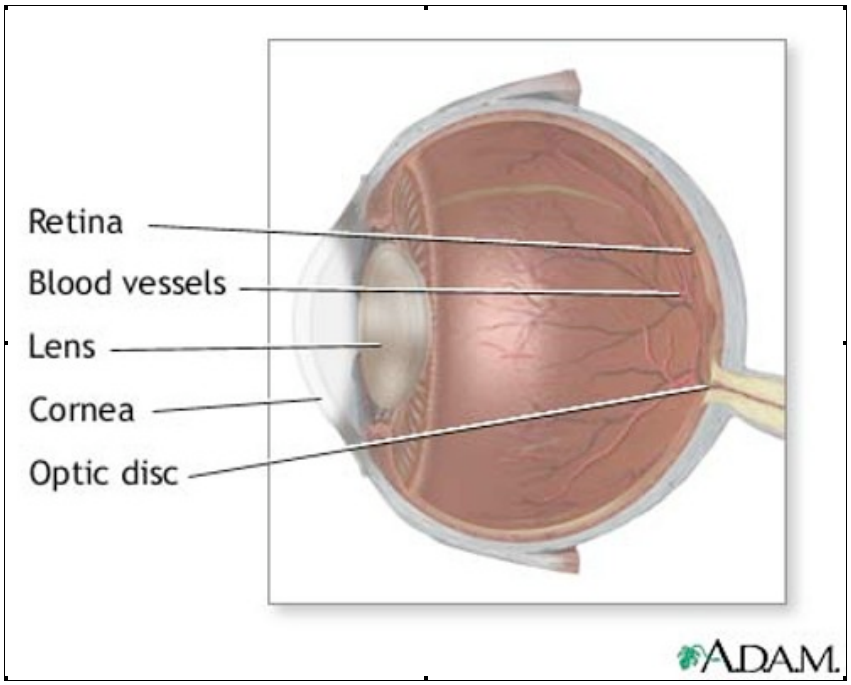
Anatomy of the Eye

Light enters the eye through the cornea, the clear layer covering the front of the eye. The cornea works with the lens of the eye to focus images on the retina. The upper and lower eyelids protect the eye from injury, with the eyelashes forming a protective barrier.

External and Internal Eye Anatomy

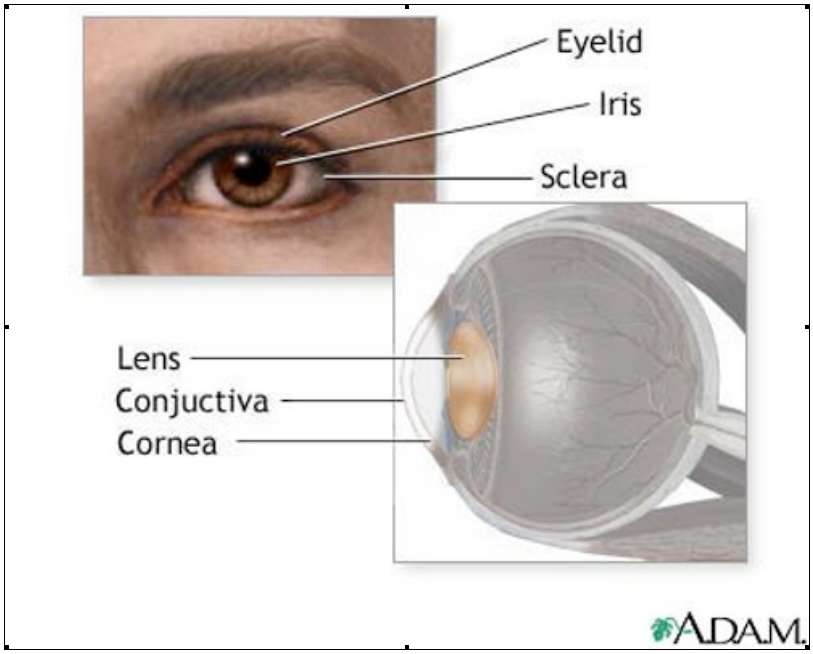


The cornea allows light to enter the eye. As light passes through the eye, the iris changes shape by expanding and letting more light through. Or, it constricts and lets less light through to change the size of the pupil. The lens then changes shape to allow the accurate focusing of light on the retina. Photoreceptors in the eye transmit nerve signals through the optic nerve to the brain. The brain processes these nerve impulses into sight.



Lateral Eye Anatomy

The cornea is the clear watch glass covering in the front of the eye. The cornea works with the lens of the eye to focus images on the retina. The retina captures the image and sends it to the brain to be developed. The retina is normally red due to its rich blood supply.



Eye Lens Anatomy

The lens is responsible for making sure light rays come to a sharp focus on the retina. The lens of the eye is normally clear. If the lens becomes cloudy or is opacified, it is called a cataract.

12 Signs Of Vision Loss

1. Over cautious driving habits.
2. Find lighting either: too bright or too dim.
3. Frequent eye glass prescription changes.
4. Holding books or reading material close to face or at arm's length.
5. Squinting or tilting the head to see.
6. Difficulty in recognizing people.
7. Changes in leisure time activities.
8. Change in personal appearance.
9. Changes in table etiquette.
10. Moving about cautiously.
11. Bumping into objects.
12. Acting confused or disoriented.

If you, or a loved one, are experiencing any of these consider seeing an eye doctor. Many forms of vision loss are preventable if caught early enough.

Types of Eye Care Professionals

- **Ophthalmologists** are medical doctors that specialize in eye care. They must complete four years of premedical school; plus four years of medical school; complete a one-year internship; and a three-year residency in ophthalmology. They detect and treat eye diseases, prescribe drugs and perform eye surgery. They also prescribe eyeglasses or contact lenses.

- **Optometrists** must complete four years of undergraduate school, plus four years of graduate training in a school of optometry. They receive a doctorate of optometry. They can prescribe eyeglasses or contact lenses. They can detect diseases, but they are not medical doctors. Some Optometrists have special training in fitting low-vision aids; they are called low-vision specialists.

- **Opticians** have a two-year technical degree. They interpret prescriptions and fit eyeglasses. They can adjust repair and reproduce previously ordered contacts, eyeglasses and frames. They cannot examine or test your eyes.

There is a group of professionals that most people do not know about. They help people adapt to living with uncorrectable vision loss. They go by titles like: Low Vision Specialist, Orientation and Mobility Instructor, Rehabilitation Teacher, Vocational Rehabilitation Councilor. They work in the field of rehabilitation of the blind and visually impaired.

Myths About Vision Loss

Myth: Safety goggles are more trouble than they are worth. **Fact:** There are 500,000 eye injuries every year in the USA. 50% of these accidents occur at home. The leading cause of blindness in children is eye injury. 90% of injuries can be avoided by using proper eye protection.

Myth: There is no need to have your vision checked before you turn 40. **Fact:** There are treatable eye diseases; glaucoma is one of them, which can show up before you turn 40.

Myth: Wearing poorly fit glasses damages your eyes. **Fact:** The right eyeglass prescription is required for good vision. Poor fitting glasses do not damage your eyes.

Myth: Poorly fit contacts do not harm your eyes. **Fact:** Poorly fit contact lenses can damage your cornea. If you use contact lenses, have them checked regularly.

Myth: Eating carrots will improve your vision. **Fact:** Carrots are high in Vitamin A, which is important for a balanced diet. Eating carrots or other foods high in Vitamin A will not improve your vision. Taking large amounts of Vitamin A can be very harmful. People that do not eat a balanced diet can develop vision problems along with other problems as they age.

Myth: Sitting close to the television will harm your eyes. **Fact:** There is no evidence that sitting close to the television will damage your eyes. If this were true, office workers that sit 8 hours a day 17 inches from their computer screens, would all be blind. Sit wherever you are most comfortable when watching TV.

Myth: Doctors can transplant eyes. **Fact:** Doctors can transplant the cornea, but not the eye its self. The retina and optic nerve are part of the brain. When doctors figure out how to transplant the brain, they will be able to transplant the eye.

Myth: Scientists have created a Bionic Eye. **Fact:** Scientists have been working on a microchip to replace damaged retina cells in a person's central vision. Other scientists have been trying to figure out a way to connect a camera directly to the brain. The eye and the brain do not work the same way a camera and computer do. Even after someone figures out how to make a bionic eye, they still have to figure out how to connect it to the neural circuitry of the brain. What they have created so far is a crude form of vision consisting of several dots of light.

Myth: Reading in dim light will damage your vision. **Fact:** Reading in dim light can make your eyes feel tired. It is not harmful and cannot damage your vision.

Myth: Eye exercises will improve your vision. **Fact:** Eye exercises will not improve your vision. This myth has made many people wealthy. Rolling your eyes around has no effect on your vision.

Myth: It is not harmful to look at the sun if you squint or use dark glasses. **Fact:** The

sun's ultra-violet light will still get to your eyes, damaging the cornea, lens and retina. Never look directly at a solar eclipse. The direct light from the sun can blind a person in less then a minute.

Myth: You can cure a black eye by putting a raw steak on it. **Fact:** Putting a steak on your eye will do nothing except expose your eye to any organisms living on the raw meat. Get immediate medical attention, a black can be a sign of serious eye injury.

Myth: You can weir your eyes out by using them too much. **Fact:** You cannot wear your eyes out by using them. Cutting down on reading or close work, will not help or harm your eyesight.

Myth: Doctors can only remove cataracts after they ripen. **Fact:** Cataracts, unlike fruit, do not "ripen." It is up to you, and your doctor, to decide when to remove a cataract. Most people have them removed when the decrease in vision starts bothering them.

Myth: Too much sex, especially masturbation, can make you go blind. **Fact:** Syphilis, a sexually transmitted disease, if left untreated can lead to blindness, dementia and death. This is where this myth came from.

Myth: Blind people have a sixth sense or extra ordinary talents. **Fact:** Most People with (20/20) vision do not pay much attention to their other senses. Blind people have worked hard to develop their other senses to compensate for their vision loss. There is no sixth sense.

Myth: Blind people live in a world of total darkness. **Fact:** Only a small percentage of Legally Blind people see nothing at all. Darkness is the eye telling you that there is no light on. People who are (totally blind) do not have the ability to see light, or darkness. They see nothing at all.

Myth: Strong enough glasses will help anyone who is visually impaired. **Fact:** Refractive lenses (glasses) cannot correct all visual impairments. Glasses cannot fix eye conditions that involve the retina, optic nerve, or brain.

Myth: A dog-guide knows how to get its master where he wants to go. **Fact:** The blind person knows where they are going, and how to get there, not the dog. The dog's trainer teaches it to respond to traffic, street travel, and the commands their master will give them. A blind person goes through a month long training program to learn how to use the dog.

Myth: All blind people read Braille. **Fact:** Only 10% of Legally Blind people read Braille. Developing the sense of touch it takes to read Braille is difficult for older people who make up 66% of the blind population. Ninety percent of Legally Blind people have some usable vision and most of them can read print or magnified print.

Myth: You need to speak louder when talking to a blind person. **Fact:** Blind people have poor eyes not ears. Talk to them as you would to anyone else. When in a room with several other people use their name so they know you are speaking to them and not

someone else.

Myth: Blind people can always identify you by your voice. **Fact:** When answering your phone, do you know everyone by voice? It is a good idea to identify your self when meeting a blind person.

Myth: In order to travel independently, a blind person needs a guide dog. **Fact:** To travel independently most Legally Blind people do not even need to use a White Cane. Very few use dog guides. Approximately 1,300,000 Americans are (Legally Blind); 109,000 of them use white canes; 7,000 use dog guides.

Myth: All blind people are alike. **Fact:** "The Blind" is a term used by groups with political and social agendas. People with poor or no vision come from all races and ethnic groups, rich and poor alike. Being Legally Blind is a bit more then a nuisance for the 76-year-old women loosing vision from Macular Degeneration. A college student, who has had 18 years of training in how to function without vision, and knows no other way, may think of it differently. A 45-year-old truck driver going blind from glaucoma may go back to school and get an office job, or he may retire early and collect disability. A 39-year-old lawyer loosing his vision will get training in Braille, find readers and learn to rely on public transit to do his job. The 52-year-old stock clerk, that rides a bike to work every day, has been legally blind all his life. Everyone finds there own answers in life its no different for people that have poor or no eye sight.

Myth: Blind people, to maintain secrecy and security, staff the snack bars at the CIA. **Fact:** Under the Randolph-Sheppard Act, blind people are allowed to operate all food service and vending facilities in government buildings. This act was one the first government programs to help employ the blind. The program has nothing to do with secrecy or security in government buildings.