

62: THE EYE (anatomy)

The eye is so complicated we need to take two lessons to cover it. This lesson is about anatomy: drawing and naming all the parts. The next lesson will be about physiology, which is how the parts work.

The eye is a round sphere about an inch (3 cm) in diameter. We only see the front part of the sphere, peeking out from between our eyelids. The outside covering of the eye is made of white connective tissue (collagen type 1, plus elastin) and is called the **sclera**. ("Scler" means "tough or hard.") The colored part of the eye is called the **iris**. ("Iris" is Greek for "rainbow.") Humans have an iris that is fairly small, so that the white sclera is seen all around it. If you've ever looked at a dog's eye, the colored area is so large that you have to peel back the skin around the eye to see any white. The fact that our eyes have a visible iris makes it much easier for us to tell from a distance in what direction someone is looking. The iris is like a donut with a hole in the middle. The hole is called the **pupil**. The pupil's job is to let light into the eye. If there is very little light, the pupil opens and becomes very large so that as much light as possible comes in. If there is too much light, the pupil shrinks and becomes very small. The size of the pupil is controlled by a ring of muscles inside the iris.

The color of the iris is caused by the amount of **melanin** produced by melanocytes. Human eyes contain various amounts of melanin, which is always brown or black. A small amount of melanin will produce light brown eyes and a lot of melanin will produce eyes that are almost black. Blue eyes are caused not by a pigment, but by the scattering of light—the same phenomenon that makes the sky blue. Green and hazel eyes are caused by a combination of the light scattering effect and a very small amount of melanin. If the melanocytes are non-functional or are completely missing, this causes a condition called **albinism**. Albino eyes look pink. People with albinism usually have little or no pigment in their hair and skin, as well.

The iris and pupil are protected by the **cornea**, a clear layer that is connected to the sclera. The cornea is made of connective tissue that is similar to the sclera. The main difference is that the cornea tissue is dryer, causing it to be transparent. Between the cornea and the iris there is fluid called **aqueous humor**. (Remember, "humor" means "fluid.") There is also a very small chamber between the iris and the lens, which is also filled with this fluid. The fluid is produced by the **ciliary body**, which is behind the lens. There are tiny drain holes to drain off old fluid as new fluid comes in to replenish the old. These drain holes are called **Schlemm's canals**. These canals are very similar to lymph vessels, taking away extra fluid and recycling it. If these drain holes become clogged, too much fluid will build up behind the cornea, causing a condition called **glaucoma**. Glaucoma can be very damaging and can even cause blindness.

Behind the pupil is the **lens**. The lens has a central core and a tough outer capsule. If the core becomes cloudy it can cause a condition called **cataracts**. An eye surgeon must drill into the lens and replace the defective tissue. The lens is connected to the ciliary body by thin ligaments called **zonules**. The ciliary body is flat and circular and goes all the way around the lens. It contains a ring-shaped muscle that can change the shape of the lens when it tightens or relaxes. When it is relaxed, the lens is more flat and will focus on things that are far away. When the muscle tightens, the lens gets more round and will focus on things that are close to the eye. The ciliary body is also responsible for making the aqueous fluid that fills the chambers in front of the lens.

The space behind the lens is filled with a "gel" called **vitreous humor**, or the **vitreous body**. "Vitreous" means "glass-like." This gel fills the interior space and keeps all the parts in place. There is a small canal, the **hyaloid canal**, that runs down the middle, from the lens to the back of the eye. When the lens thickens to focus on something close to the eye, its volume increases just a bit. This increased volume could cause problems as it presses on the vitreous body. The fluid in the canal is able to absorb this pressure, so no harm is done. This is a trim detail of design that most people don't know about.

Another lesser-known detail of the eye is the presence of oil glands in the eyelid. Inside the eyelid is a flat piece of connective tissue called the **tarsal plate**. ("Tarsos" is Greek for "flat surface.") This plate makes the eyelid just stiff enough to keep its shape, while still allowing it to be soft and flexible. Inside this plate are microscopic oil glands that make a special kind of oil for lubricating the eye. The oil keeps the water on the surface of the eyeball from evaporating too quickly. It also makes the edge of the eyelid just oily enough to form a slight barrier that keeps normal amounts of water from running down your cheeks. Of course, when you cry, the system is overloaded and tears do roll down your cheek. However, small daily amounts of water are held back. The inside of the eyelid and the visible part of the sclera are covered with a protective layer called the **conjunctiva**. Infections of the conjunctiva are very common and are often called "pink eye."

The movements of the eyeball are controlled by six muscles. Four of them are called **rectus** muscles. "Rectus" means "straight" so the rectus muscles move the eye either straight up and down or side to side. The rectus muscles are **superior** (meaning "on top"), **inferior** (meaning "on the bottom"), **lateral** (meaning "on the side"), and **medial** (meaning "towards the middle"). There are two **oblique** muscles that rotate the eye clockwise or counterclockwise, allowing for diagonal motion. The superior (top) oblique muscle goes through a little loop called the **trochlea**. The trochlea acts like a pulley, letting the muscle be attached behind the eye instead of to the side. Five of these muscles attach to an area of connective tissue at the back of the **orbit** (the space where the eyeball sits). Only the inferior oblique does not. Also, the muscles that pull the eyelid up and down attach to the back of the orbit. Only the front part of these muscles is shown in the diagram.

The **lacrimal gland** is located above the eye, on the side away from the nose. The lacrimal gland makes tears that keep the eye moist and clean. ("Lacrima" is Latin for "tears.") The little indented place at the "corner" of the eye is called the **lacrimal caruncle**, or just the **caruncle**. The caruncle contains some sweat glands and sebaceous glands covered with a layer of protective tissue. Near the caruncle on both upper and lower lids are tiny holes called the **puncta**. (One punctum, two puncta.) The puncta lead to the **lacrimal ducts** that go down into the nose. These ducts are drains for the tears after they have washed the eyeball.