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Jeepers Creepers

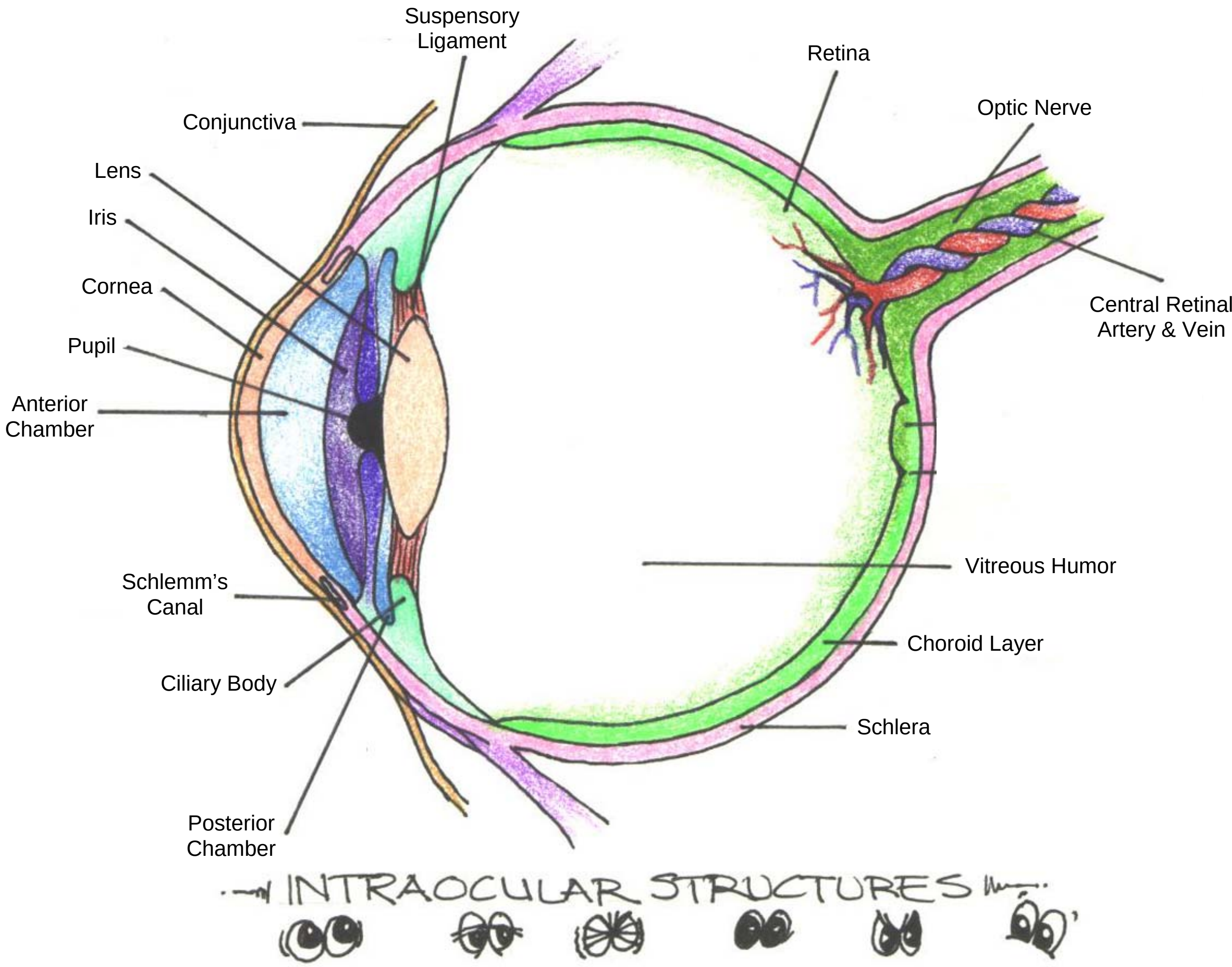

Figure 1: Basic Anatomy of the Human Eye

The eye is an extraordinary sensory organ that literally permits us to view the world in living color. Figure 1 illustrates the basic anatomy of the human eye, and its parts and functions are discussed in the following paragraphs:

Conjuctiva: a protective layer of mucous membrane covering the anterior surface of the eyeball and the posterior surface (inner portion) of the eyelid.

Cornea**:** a transparent, dense tissue with a curved surface that refracts (bends) rays of light entering the eye. Refraction causes the rays to converge inward through the lens, eventually to a focal point on the retina (if there are no problems with the shape of the eyeball!).

Anterior Chamber**:** A chamber between the cornea and the iris filled with fluid (aqueous humor). A smaller chamber behind the iris but still in front of the lens, the *posterior chamber* is also fluid filled. The fluid acts as a lubricant and protectant and is maintained at a specific volume and pressure. It is produced by the *ciliary body* and drains through the *canal of Schlemm*.

Iris**:** the colored part of the eye. It is actually a smooth ring-shaped muscle, the opening of which is known as the *pupil*. Primarily, this structure controls the amount of light entering the eyeball by contracting and relaxing, which tightens or widens the pupil in a fashion similar to a camera lens aperture.

Lens**:** This amazing biconvex structure is composed of clear fibers in an elastic membrane, and it refracts light rays to converge on the focal point of the retina, but it also changes shape in order to keep images in focus. The lens is suspended by ligaments and the tension of the lens is controlled by ciliary muscles (at the ciliary body). Contraction and relaxation of these muscles loosens or tensions the ligaments, causing the shape of the lens to either curve more or flatten out—the result is focus of the image on the retina. Near objects are in focus with a greater curve to the lens, far objects in focus with a flatter lens. The function of being able to change the shape of the lens is called *accommodation* of the image (and we usually lose much of this ability with aging). This allows us to keep objects in focus even when they are moving toward us or away from us.

***Retina*:** With five cell types (photoreceptor (PR), bipolar (BP), ganglion (G), horizontal, and amacrine) and three layers (photoreceptor layer, bipolar layer, and ganglion layer), the retina forms the neural tissue that receives light rays and transmits signals to the brain to eventually be perceived as a three-dimensional, colored image. Rods (sensitive to light) and Cones (sensitive to color) make up the photoreceptors. The PR layer receives light waves then transmits impulses to BP cells, which in turn transmit to G-cells, which then transmit impulses to the brain. The brain is able to construct a 3-D colored image from these impulses due to the way they are received (from a 2D optical "map" of sorts!). The eyeball interior is filled with a thick, gelatin-like fluid (vitreous humor) which serves to keep the retina in place and help maintain the spherical shape of the eyeball.

Optic Nerve: The axons of ganglion cells leaving each eye bundle up to form the optic nerve, converging in the middle of the head. Here, the nerve bundles split, half of each going in the opposite direction (half of right eye nerve feeding the left-side brain, and visa versa). The *optic disc* is the point at which the optic nerve joins with the retina.

Schlera: Outer fibrous layer of tissue, white in color, forming the 'walls' of the eyeball for structure and protection.

Choroid Layer: This layer contains many small arteries and veins to provide nutrients to and remove waste from the retina and other tissues of the eye.

Ideally, the shape of our eyeball and the elasticity of the lens contribute to our ability to see objects clearly. When all is in working order, light rays pass through and are gently refracted by the cornea, enter the pupil, and are further refracted and focused against the retina by the actions of the lens. But sometimes changes to the shape of the eyeball itself occur, resulting in either a longer shape or a shorter shape than normal, and sometimes the lens loses its elasticity. These changes affect the focal point, moving it closer to the lens (as in the case of near-sightedness, or myopia), or farther away from the lens (as though it should be on the other side of the retina, outside the back of the eyeball, resulting in far-sightedness, or hyperopia). If the shift in focal point is significant enough, corrective lenses are required. These lenses provide additional refraction of light rays to shift the focal point back to the retina, so the near or far images will be in proper focus.

Figure 2 illustrates the convex shape of a corrective lens required to correct for “over-shooting” the focal point in the case of far-sightedness, where near images cannot be seen clearly:

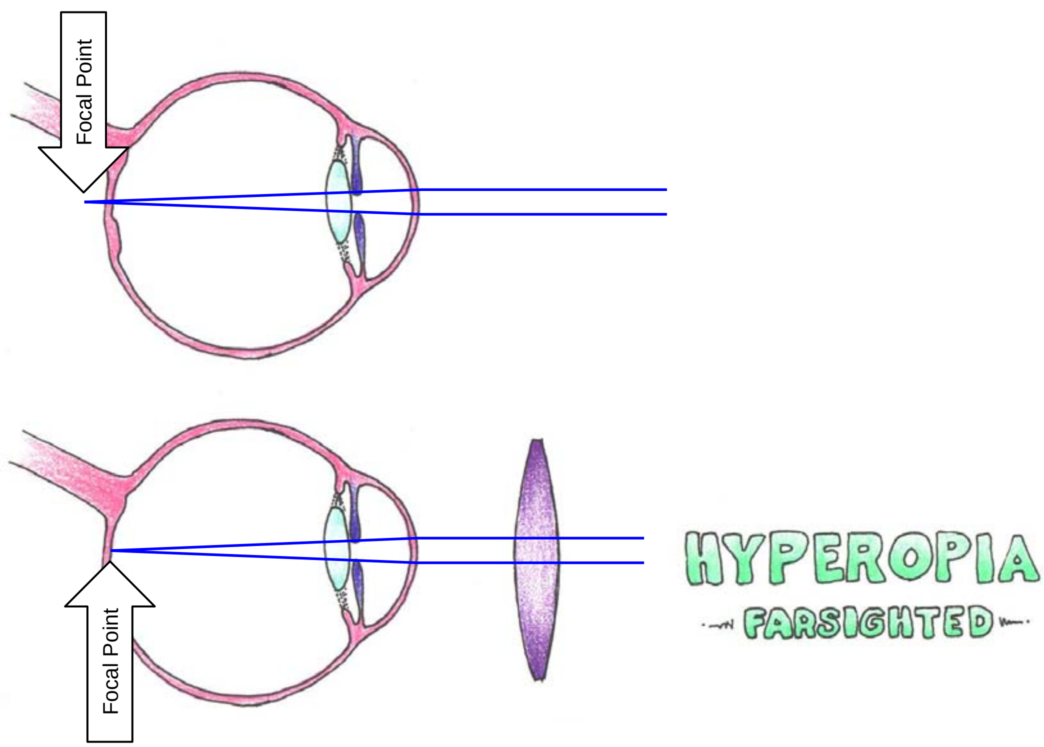

Figure 2: Convex Lens Correction for Hyperopia

In this case, the oval shape of the corrective lens is very similar to the shape of the lens inside the eye, and it bends the rays inward just enough to shorten the focal point to the retina where it should be. In far-sightedness, objects that are distant can be viewed in focus because for objects that are far away (greater than about six meters), the light rays enter the eye in parallel and passing through the cornea and the lens is enough for these images to remain in focus. But when the lens shape needs to change (increasing the curvature as the ligaments relax) to accommodate a near-image, it may not be able to either because of a loss of elasticity in the lens fibers or because the eyeball is simply too short and the lens is already fully relaxed (or perhaps a combination of both!).

For near-sightedness, a concave lens is necessary, which bends the rays outward just enough so that the extra length in the shape of the eyeball can be adjusted for, and the focal point is shifted back to the retina instead of falling short of it.

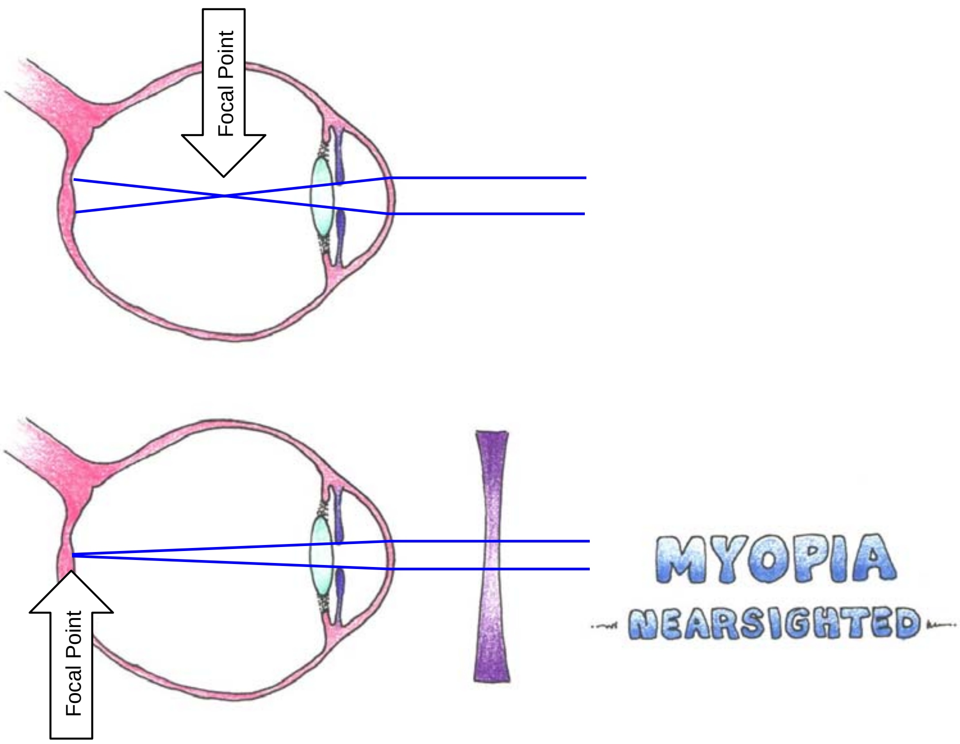

Figure 3: Concave Lens Correction for Myopia

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