Family
Eye Care Center
& Optical Gallery

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Glaucoma
Cataracts
Diabetic Eye Disease
Laser Surgery

EYESIGHT, OPTICS and YOU

The eye of "sight animals" (i.e. humans and birds) is an amazingly complex and sophisticated organ. Although each eye effectively acts as a miniature camera, an eye is far more complicated and advanced than a camera.

Did you know?

1. The optic nerve is the "electronic cable" that carries electric signals to each side of the brain that in turn, allows a person or animal to see. The optic nerve is 1.5mm in diameter and is comprised of 1.5 million tiny nerve fibers.

2. Two eyes are needed to obtain "depth perception". Although looking at the same object, the image from each eye is slightly different than the other due to a phenomenon known as 'parallax'. These two slightly different images are fused by the brain create a stereoscopic single image. A "one-eyed" person thus does not have depth perception.

3. The eye has two different refracting surfaces. The cornea is responsible for roughly 2/3 of the eye's ability to refract and the lens is responsible for roughly 1/3. The length of an average eye is approximately 22mm thus the power of the cornea-lens complex is slightly less than 50 diopters (a diopter is 1 divided by the focal length of the lens in meters).

4. Although the shape of the cornea is constant, the shape of the eye's internal lens can change. This phenomenon is known as "accommodation". When one looks at an object closer than 20 feet, the ciliary muscle within the eye contracts thus reducing (zonular) tension on the lens. The lens, in turn, becomes more round (globular) thus allowing the close object to be focused on the macula clearly. The eye initially has the ability to increase its focal power by 15 diopters. Unfortunately, the amplitude of accommodation declines with age thus when one reaches 40 years old, reading glasses are needed for near vision.

5. Using a "pinhole" allows one to see clearly regardless of one's refractive error. This is because a pinhole allows only the central rays of light to enter the eye that are not bent. These rays pass directly through the center of the cornea-lens complex onto the macula. The other non-central rays that would not be in focus in a non-emmetropic (nearsighted, farsighted or astigmatic) eye are eliminated by the pinhole thus creating a clear image. The pinhole image is dimmer due to less light entering the eye and there is reduced field of vision. An ophthalmologist uses a pinhole to quickly check the potential vision of a patient. If a patient's vision improves after being "pinholed" then the doctor realizes that the reduced vision is due to a refractive error (corrective lenses are needed) and there is not a more serious problem with other aspects of the eye.

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6. Due to the nature of optics, all images that reach the back of one's eye are “inverted”. The image is turned “right side up” by the brain when the signal reaches the portion of the brain responsible for sight (occipital cortex).

7. The retina is a 10-layered tissue lining the inside back portion of the eye. The retina functions in a manner similar to that of film in the back of a camera. The photoreceptor layer of the retina is comprised of two different types of cells: rods and cones.

    1. Rods are found outside the fovea and are responsible for seeing black and white vision. (The fovea is the small, central-most area of the macula directly in the back of an eye. The fovea is responsible for the finest, detailed vision). Rods can function in low light conditions.
    2. Cones are concentrated in the fovea and are responsible for color vision. Cones require brighter light.
    3. Rods and cones are connected through intermediate cells in the retina to the 1.5 million nerve fibers of the optic nerve
    4. Due to the fact that there are no rods in the fovea, one cannot see a lit star on a dark, clear night when looking through a pinhole.

8. The retina in the back of the eye reflects light in a manner similar to a concave mirror. For this reason, when a direct picture is taken of a person (whose pupils are large enough), the person appears to have “red eyes”. This “red reflex” is used extensively in ophthalmology. Since this aspect of the eye acts as a concave mirror, the knowledge of optics is critical in order to determine one's refractive error. This can be accomplished either manually (using a retinoscope) or in an automated fashion (using an autorefractor) by “neutralizing” the red reflex using various lenses. This, in turn, determines what eyeglass prescription a person needs to wear in order to see clearly.

9. The pupil of the eye acts as an automatic aperture setting of a camera- enlarging in dim conditions and becoming smaller in bright conditions.