Vision

Objectives
• Students will identify the different parts of the eye and understand their functions.
• Students will explain colorblindness, astigmatism, and adaptation.
• Students will examine and dissect a cow eye.

Anatomy of the Eye
External Anatomy and Accessory Structures
The adult human eye is a sphere approximately one inch in diameter. Only about one-sixth of the eye’s anterior surface is observable; a cushion of adipose tissue and the walls of the bony orbital protect the remainder.

Anteriorly each eye is protected by the eyelids. The medial and lateral junctions of the upper and lower eyelids are referred to as the medial and lateral canthus. A mucous membrane, the conjunctiva lines the internal surface of the eyelids and continues over the anterior surface of the eyeball to the outer edge of the cornea where it fuses with the corneal epithelium. The conjunctiva secretes mucus, which functions as a lubricant for the eyeball.

The eyelashes project from the edge of each eyelid. Modified sweat glands called ciliary glands lie between the eyelashes and also help in lubrication of the eyeball. The larger meibomian glands, located posterior to the eyelashes secrete an oily substance.

The lacrimal apparatus consists of the lacrimal gland and a series of ducts. The lacrimal glands lie superior and lateral to each eye. They continually release a dilute salt solution (tears) onto the anterior surface of the eyeball through several small ducts. The tears flush across the eyeball into the lacrimal canals medially, then into the lacrimal sac and finally into the nasoacralimal duct, which empties into the nasal cavity.

Six extrinsic eye muscles attached to the exterior surface of each eyeball control eye movement.

<table>
<thead>
<tr>
<th>Name</th>
<th>Controlling Cranial Nerve</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral rectus</td>
<td>VI (abducens)</td>
<td>Moves eye laterally</td>
</tr>
<tr>
<td>Medial rectus</td>
<td>III (oculomotor)</td>
<td>Moves eye medially</td>
</tr>
<tr>
<td>Superior rectus</td>
<td>III (oculomotor)</td>
<td>Elevates eye or rolls it superiorly</td>
</tr>
<tr>
<td>Inferior rectus</td>
<td>III (oculomotor)</td>
<td>Depresses eye or rolls it inferiorly</td>
</tr>
<tr>
<td>Inferior oblique</td>
<td>III (oculomotor)</td>
<td>Elevates eye and turns it laterally</td>
</tr>
<tr>
<td>Superior oblique</td>
<td>IV (trochlear)</td>
<td>Depresses eye and turns it laterally</td>
</tr>
</tbody>
</table>
Activity: Gross Examination of the Eye

Observe the eyes of another student and identify as many structures as possible. Ask the student to look to the left. What extrinsic muscles produce this reaction for the:

Right eye:_____________________________________
Left eye:_____________________________________

Now ask your subject to look superiorly. What two extrinsic muscles of each eye can bring about this motion?

Right eye:_____________________________________
Left eye:_____________________________________
Internal Anatomy of the Eye

The outermost fibrous tunic of the eye is a protective layer composed of dense connective tissue. This can be divided into two identifiable regions: the white sclera, also known as the white of the eye, makes up the majority of the fibrous tunic and the transparent cornea.

The middle tunic is referred to as the uvea or vascular tunic. The posterior region of the tunic, known as the choroid, is rich in blood and contains pigments that prevent the scattering of light within the eye. The choroid is modified to form the ciliary body to which the lens is attached. The iris is pigmented and the pupil is the rounded opening through which light passes.

The innermost sensory tunic of the eye is the retina. It contains the photoreceptors, rods and cones, which starts the electrical chain of events from photoreceptors to bipolar cells and then to ganglion cells. The photoreceptors are located all over the retina, except for where the optical nerve leaves the eyeball. This site is referred to as the optical disc or the blind spot.

The lens divides the eye into two segments. The anterior segment, found anterior to the lens, contains a clear watery fluid called the aqueous humor. The posterior segment behind the lens is filled with a more viscous fluid and is referred to as the vitreous humor.

Lateral to the each blind spot is the macula lutea, an area of high cone density. In its center is the fovea centralis, a minute pit approximately .5mm in diameter, which contains only cones and is the area of highest visual acuity.

Activity: Dissection of the Cow Eye

The cow eye is a typical mammalian eye, but it has specific adaptations characteristic to the grazing animals that have been domesticated. The eyes are located well to the side of the head, providing a total field of vision of approximately 350 degrees with a small binocular field of only 25 degrees. This arrangement allows for maximal alertness for monocular but not binocular vision. In humans, the frontal location of the eyes provides a total visual field of approximately 200 degrees with a binocular overlap of about 110 degrees. The eyes of the human are thus specialized for binocular depth perception of objects relatively close to the eyes.

The cow eye that has been provided for you has been fixed in Carosafe, a non-toxic version of formalin. Fixation of the specimen arrests decomposition and hardens the tissues by the coagulation of the protein material. The fixed eye is easier to handle and retains its form better, the unfixed eye being soft and partially collapsed owing to the loss of intraocular pressure. Fixation however, causes color changes in the tissues and causes loss of transparency of the cornea.

The dissection of the cow eye should be performed by the guidelines in the accompanying handout.
Activity: Visual Tests and Experiments

The Blind Spot

Using the blind spot diagram, hold it approximately eighteen inches from your eyes. Close your left eye and focus your right eye on the plus sign, which should be positioned so that it is directly lined-up with your right eye. Move the diagram very slowly towards your face, always keeping your right eye focused on the plus sign. When the dot focuses on the blind spot, the region without photoreceptors, it will disappear from your view. Have your lab partner record the metric distance at which this occurs. Repeat with the other eye.

Right eye: ____________________________

Left eye: ____________________________

Adaptation of the Retina

If your retinas are exposed to strong light over a period of time, your eyes become sensitive to light. Fix your eyes on the white dot in the center of the peace symbol for at least thirty seconds. Then look at the black dot to the right.

What happens when you stare at the black dot? Explain what is happening.

Visual Acuity

Have your partner stand 20 feet from the posted Snellen eye chart and cover one eye. As your partner reads the lines, check for their accuracy. Record the line with the smallest-sized letters read. If it is 20/20 then the subject vision is normal. If the vision is recorded as any thing with a ratio less than one, 20/40 for example, then the vision acuity is recorded as less than normal. If the visual acuity ration is greater than one, then the subject has better than normal vision. Record your observations.

Right eye: ____________________________

Left eye: ____________________________

Astigmatism
The astigmatism chart tests for defects in the refracting surfaced of the lens and/or cornea. View the chart first with one eye, then the other. Focus on the center of the chart. If all the radiating lines appear equally dark and distinct, your refracting surface surfaces are not distorted. If some of the lines are blurred and appear less dark than others, then some degree of astigmatism is present. Record your observations.

Right eye: ________________________________

Left eye: ________________________________