

# Cow Eye Dissection

## Introductory Discussion:

Tell the students that we will be learning about what eyes are made of and how they work by dissecting a cow eye. Talk about where the eye comes from, and how we should be respectful and mindful when it comes to using animals for learning.

**Rules** of the dissection:

- Don't touch anything unless the tutor specifically asks you to.
- Don't touch anything without gloves.
- Dissections will be performed on the dissection tray on top of paper towels
- Students may use the scissors, but not the scalpel

Online dissection, for kids abstaining:

<http://www.pbslearningmedia.org/resource/lsp07.sci.life.stru.coweye/cows-eye-dissection/>

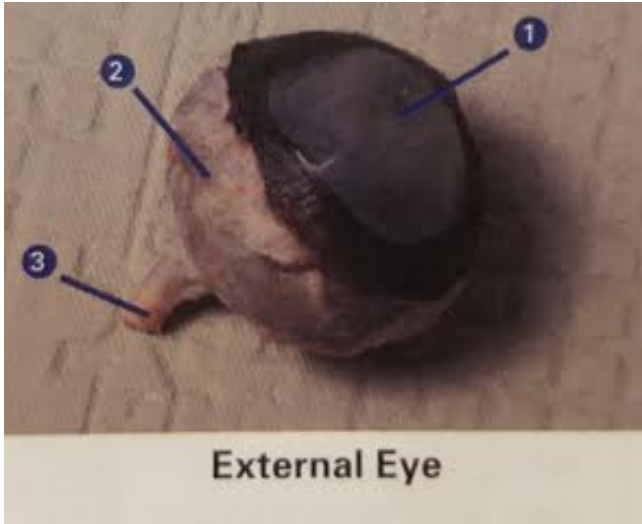
## Dissection:

The human eye is similar in structure to the eye of other mammals, such as a cow's. A cow's eye is larger than a human's, but it has all the same parts. Follow the directions to dissect a mammalian eye and learn how you see. Have students fill out the worksheet about the parts of the eye as you go along.

### 1) Examine the outside of the eye.

See how many parts of the eye you can identify. Look for the whites (or **sclera (2)**), the tough, outer covering of the eyeball (you may not be able to see this until you cut away some fat and muscle). You should be able to identify the **fat** and **muscle** surrounding the eye. You should also be able to find the covering over the front of the eye (the **cornea (1)**). When the cow was alive, the cornea was clear but it becomes cloudy when the eye is preserved. You can look through the cornea and see the **iris**, the colored part of the eye (you may have to gently squeeze the eye to inflate the cornea to be able to see the iris). At the back of the eye, you should be able to see the **optic nerve (3)**.

How it works: When you look at something, your eye sees the light that is being reflected off the object. Light travels through the cornea. The images you see are transferred to your brain through the optic nerve. If your eye sees the light that is being reflected off an object, what do you think you see if there is no light being reflected off an object?



## 2) Cut away the fat and muscle (10-15 mins).

This may be the most time intensive part of the activity. Allow students to cut using the scissors. You may wish to start at the eyelid flap and peel away from there. Once you start to cut away the fat and muscle, you should be able to better see the *sclera*. You may not get to cutting away all the fat and muscle, but as long as you have exposed the outer curvature of the eye so it can be cut in half (as seen below), you should be able to continue with the dissection.

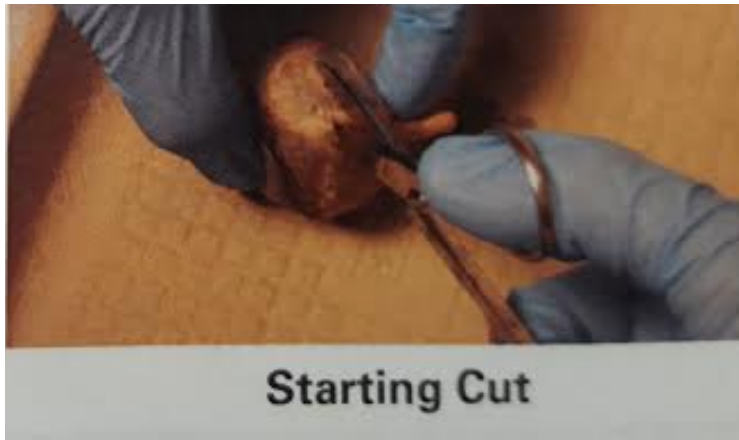


## 3) Tutors -Use the scalpel to make an incision in the cornea.

Cut until the clear liquid under the cornea is released. That clear liquid is the *aqueous humor*. It's mostly made of water and keeps the shape of the cornea. You may allow the students to gently squeeze or tip the liquid out of the eye.

#### 4)Tutors – Use the scalpel to make an incision through the sclera in the middle of the eye.

Do not cut too deeply into the eyeball or squeeze it too tightly, or you may damage the interior. Use the scissors to cut around the middle of the eye, cutting it in half. You may allow the students to do this with the scissors once the incision has been made. You should end up with two halves.



#### 5)Remove the vitreous humor

When the eye is cut in half, you will notice a clear, jelly-like substance called the **vitreous humor**. It may be attached to the front half of the eye. Allow the students to use the wooden probe or the scissors to carefully remove all the vitreous humor. What do you think the function of the vitreous humor is?

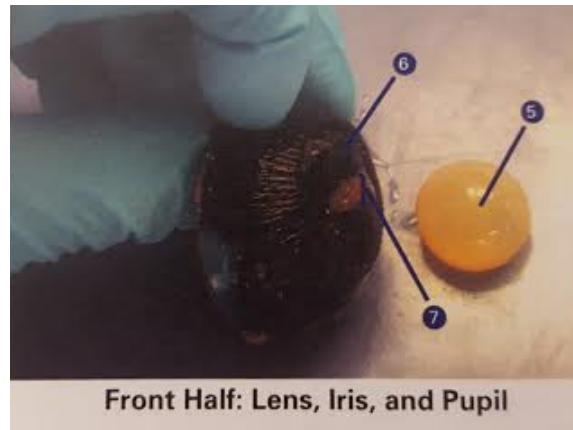
How it works: The vitreous humor is a mixture of protein and water. It's clear so light can pass through it. It also helps the eyeball maintain its shape.



## 6) Take out the lens.

From the front half of the eye, students should be able to remove the **lens (5)** with their fingers (you may have to carefully flip the half of the eyeball inside out to do this). The lens is about the size and shape of a squashed marble. It should feel soft on the outside and hard in the middle. If you look through it, you should be able to see light through it (tutors may have to use the scalpel to peel back the outer layers of the lens to be able to better see light through the lens, as preservation makes the lens cloudy).

*How it works:* The lens, which is protected by the cornea, focuses light that comes into the eye. The lens in your eye is similar to the one in a hand lens.



## 7) Peel off the iris.

Locate the **iris (6)**, a black area that the lens sits on. Students can carefully pull out the iris and lay it flat on the tray. It should come out in one piece. Notice the hole in the middle of the iris. This is called the **pupil (7)**.

*How it works:* The iris opens and closes to allow more or less light into the eye. In our eyes, the iris is the colored part and the pupil is the dark circle in the middle. When it is dark, your iris widens the pupil to allow more light in, making it easier to see. When the environment is bright, your iris contracts to allow less light in. It takes a minute for this change to occur and that is why you cannot immediately see clearly when you walk into a dark area from a bright one (or the other way around).

## 8) (Optional) Allow students to use the scissors to cut the cornea.

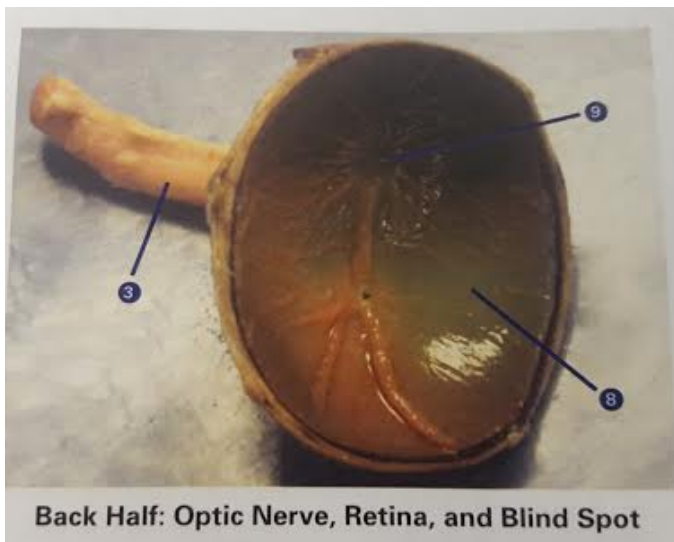
Cutting the cornea with scissors, you may be able to hear a crunching noise. That's the sound of crunching through layers of tissue.

How it works: The cow's cornea has many layers to make it thick and strong. When the cow is grazing, blades of grass may poke the cow's eye, but the cornea protects the inner eye.

## 9) Look at the back half of the eyeball.

On the inside back half of the eyeball, you can see some blood vessels that are part of a thin fleshy film. That film is the **retina (8)**. Before you cut the eye open, the vitreous humor pushed against the retina so that it lay flat on the back of the eye. It may be all pushed together in a wad now. Use your finger to push the retina around and remove all the goopiness.

How it works: The retina is a layer of cells that covers the back of the inside of the eye. Light that comes through the lens is projected onto the retina, similar to how a movie projector creates an image on a screen. The retina is made up of nerve cells called rods and cones. These nerve cells send signals to the brain so you know what you are seeing. Rod cells help you see black and white images and cones are used for seeing color images. Did you know the images that are projected onto your retina are actually upside-down? When the light comes through the lens, the images get flipped and land on the retina upside down. Fortunately, our brain "corrects" the image, so everything appears right-side up.



## 10) Look at the tapetum.

After you have removed the retina, you should see shiny, blue-green stuff underneath. This is the **tapetum**. It reflects light from the back of the eye.

How it works: The tapetum reflects light from the back of the eye. Have you ever seen a cat's eyes shining in the headlights of a car? Cats, like cows, have a tapetum. A cat's eye

seems to glow because the cat's tapetum is reflecting light. If you shine a light at a cow at night, the cow's eyes will shine with a blue-green light because the light reflects from the tapetum.

## 11) Find the blind spot.

Use your fingers to gently lift the tapetum up and see there it is attached to the back of the eye at just one spot. That's the place where the nerves from all the cells in the retina come together. This is called the **blind spot (9)**.

*How it works:* The blind spot is where the nerve cells of the retina converge to form the optic nerve. It is named this because there are no rods or cones in this area (light sensitive cells). Therefore, any images that fall into this area cannot be seen. This means there is always one tiny spot in our field of vision that we do not actually see. Our brain, however, compensates and "fills in" the missing optical input.

## 12) Pinch the optic nerve.

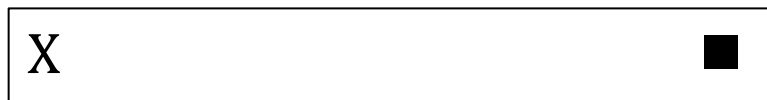
Look at the other side of the back of the eye at the **optic nerve (3)**. To see the separate fibers that make up the optic nerve, pinch the nerve with a pair of scissors or your fingers. If you squeeze the optic nerve, you may get some white goop. That is myelin, the fatty layer that surrounds each fiber of the nerve.

*How it works:* The optic nerve is how the eye sends signals to your brain.

## Fun activity:

### Locate your blind spot

To find the blind spot in your own eye, hold the diagram below in front of you, with your arm straight. Close your left eye and look directly at the "X" with your right eye. You should be able to see both the "X" and the square. While staring directly at the "X", slowly move the page towards your open eye. As soon as the square disappears, stop. What happened to the image of the square?



## Clean up:

Place the tray and any used gloves into the biohazard bag. Students may wipe their hands with the wipes. Keep the hand lens and anything else that might be useful for a future lesson (but wipe them off with ethanol first).