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| **Activity 2.4.1: Exploring the Anatomy of the Eye**  |

Introduction

Our senses allow us to communicate with the outside world. What we smell, hear, taste, touch and see direct our actions. But it is vision that dominates our impressions of the outside world. We use this sense every moment when we are awake and we even dream in visual images while we sleep. We blink. We stare. We cry. Our eyes not only interpret what we see, but they allow us to communicate our feelings and emotions. Each of us sees the world differently. Through the miracle of the eye, we take in the world around us and make it our own.

Your eye has the amazing ability to convert light into a stream of nervous impulses. Light is directed through the eye and an image of what we see is projected on the retina, at the back of the eye. Neurons then take information about this image to the brain for processing and interpretation. Each structure in the eye plays a unique role in assuring that the image you see is the image before you.

One way to figure out how something works is to look inside it. In this activity, you will use your power of sight to learn about the power of sight. To investigate how the eye works, you will dissect a cow’s eye and observe its unique structure. As you complete the dissection, see if you can figure out the specific function of each part of your eye. Observe how all the parts of an eye work together to allow you to take in a brilliant sunset, an exciting sporting event, or a scary movie.

Equipment

* Computer with Internet access
* Dissection tray and tools
* Scissors
* Flashlight or penlight
* Cow eye (fresh or preserved)
* Safety goggles
* Lab apron
* Gloves
* Paper towels
* Laboratory journal

Procedure

1. View the drawing of the eye found at the Exploratorium site <http://www.exploratorium.edu/learning_studio/cow_eye/eye_diagram.html> and copy this labeled drawing into your notes. Use a whole page and leave room under each label for a description of function.
2. Look at all of the parts that are labeled. With your partner, describe the function of any of the parts. Do not do additional research at this point. See what you can come up with based on changes you notice in your own eye and your prior knowledge of items such as a lens. Be prepared to share your ideas with the class.
3. Explore the function of each of these parts in more detail as you complete a dissection of a cow’s eye. With your class, view the eye dissection video found at the Exploratorium site <http://www.exploratorium.edu/learning_studio/cow_eye/step01.html>
4. Use the step-by-step screenshots as visual references as you complete your dissection. You should also reference these steps to learn about the function of each part you dissect. See how the actual description of function compares to what you have discussed with your partner. As you complete your dissection, add a box under each label on your diagram that describes the basic function of the part. Key structures will be listed below in **bold** text.
5. Put on safety goggles and a lab apron. If instructed to do so by your teacher, put on gloves. Obtain a cow’s eye, a dissecting tray and a set of dissecting instruments. Place the cow eye in the tray.
6. First, look at the external anatomy of the eye. See how many parts you can identify just by looking at your drawing.
7. Observe the fat attached to the outside of the eye. Remember the fat pads you built behind the eye of your Maniken®. What purpose do you think this fat serves?
8. Find muscle attached to the side of the eye. Why do you think the human eye is surrounded by six different muscles? What roles do these muscles play?
9. If you have a relatively fresh eye, pull on the muscles and watch the eye move.
10. If the eyelid is still present, note its structure and the presence of eyelashes. What is the function of the eyelid and eyelashes?
11. Find the **sclera**, the tough outer covering of the eye also called the “whites” of the eye. Feel the sclera. Do you think this structure is designed for strength or clarity? Why?
12. Using your scissors, trim the fat and the muscle tissue from the eye.
13. Find the **cornea**, the covering over the front of the eye. When the cow was alive, the cornea was clear. Describe the membrane now.
14. Note that the cornea does not have any blood vessels. Given the function of the cornea, why do you think it is important that the cornea is clear and free of blood vessels?
15. Look through the cornea and see the **iris**, the colored part of the eye. Note the **pupil**, the dark oval in the middle of the eye. What shape is the pupil in a human eye?
16. Orient the eye in the tray so the cornea is to the side. Fluid is going to flow out of the eye once you make a cut. You do not want to spray yourself or your partner. Use a scalpel to make an incision in the middle of the cornea. Cut until the liquid under the cornea is released. This watery fluid is called the **aqueous humor**.
17. Prepare to cut through the sclera, divide the eye in half, and remove the cornea. Use the scalpel to make an incision through the sclera on the side of the eye- about 2-3cm posterior to the cornea. Put the point of your scissors in the incision and carefully cut around the sclera to remove the front of the eye. Return to the video or the screen shots if you have trouble visualizing this step.
18. Note the thickness of the cornea. Place the cornea on your tray and cut into it with a scalpel. Listen to the crunch. The many layers of the cornea help protect your eye.
19. Gently pull the iris out from the eye. Since you have removed the cornea, this colored part should be visible and should come out in one piece. Note the hole in the middle. Remember, this is the pupil.
20. With a flashlight or penlight, carefully shine a stream of light into your partner’s eye. Watch what happens to the pupil. Take the light away and observe this reaction. Switch positions and allow your partner to observe these changes. Describe your observations below.
21. Given what you observed, state the function of the pupil.
22. Find the lens of the eye suspended in a jelly-like fluid called the **vitreous humor**. With your fingers or the scalpel, carefully remove the lens. It is a clear lump inside the vitreous humor.
23. Now see what the lens can do. Hold the lens up in the direction of your partner and look through it. What do you notice about the image you see? NOTE: If the eye is not fresh, you may have trouble seeing through the lens.
24. Put the lens down on your paper and look through it to words on the page. If you are using a preserved eye, you may need to shine a light on the lens to see the words. What do you notice?
25. Examine the posterior half of the eyeball. If the vitreous humor is still in the eyeball, carefully remove this fluid and observe the thin lining that detaches easily from the inner surface of the eyeball. This is the **retina**. Depending on the freshness of the eye, you may see blood vessels running through this layer.
26. If the retina is not already hanging from the back of the eye, use forceps to gently pull the retina away from the back wall.
27. Note that the retina is the sensory layer of the eyeball which contains receptors for sight, called rods and cones. The eye uses light coming in to make an image, a picture which lands on the retina. Seeing the state of the retina after removing the fluid, what do you think would happen to the retina if this fluid was not present? How would this affect vision?
28. Notice how the retina is attached at one point called the *optic disk*. The optic disk is the point at which all the nerves from the retina converge and exit the eye via the **optic nerve**. Light can not stimulate this point on the retina; this point is referred to as the blind spot.
29. Locate the optic nerve. You may find this spot by locating a patch of white goop. This goop is the myelin around the neurons of the optic nerve. What is the function of this myelin?
30. Note that the optic nerve takes messages back to the brain and interprets the signal projected on the retina. Which area(s) of the brain is (are) responsible for processing these signals? NOTE: You can refer back to your brain map.
31. Observe the iridescent layer of the inner eyeball behind the retina. This is the tapetum. Humans do not have this layer in their eyes. Based on the function of this structure, why don’t we see a tapetum in the human eye?
32. Take a look at each of the parts you have removed from the eye and make sure you can identify each structure.
33. Discard the tissue as directed by your teacher and clean your tray and instruments.
34. Make sure you have described the function of each structure in your laboratory notebook. Use the websites found below (or view the video again) if you are unclear about the function of a specific part.
* Exploratorium: The Eye <http://www.exploratorium.edu/learning_studio/cow_eye/eye_diagram.html>
* Neuroscience for Kids: The Eye <http://faculty.washington.edu/chudler/bigeye.html>

Conclusion

1. Trace the path of light from the time it enters the eye to the time it leaves the eye to travel to the brain. You should refer to your labeled eye diagram.
2. Is the response of your pupil a reflex or a voluntary action? Describe how this response is controlled by the nervous system.
3. Describe two ways in which the cow eye and the human eye differ? How are these differences linked to function?
4. Describe how what you see can impact other human body systems. Provide at least five specific examples of how your communication with the outside world through your eyes initiates a response in another body system. For example, when you see a ball whizzing towards you, your muscular and skeletal systems are activated to move your limbs and catch the ball.
5. Describe at least three specific ways that we communicate with the outside world and at least three ways (other than sight) in which the world communicates to us.