

Classroom

VIDEO

Teacher's Notes

The Eye

Years: 8-12

Duration: 24 mins

Summary

The eye is one of the five sensory organs used to collect information from our surroundings. Each structure within the eye controls an essential function enabling clear and lucid vision. This video, '**The Eye**' takes the audience on an informative journey through this complex structure by means of a biological dissection of a cow's eye. The roles of various structures are clearly explained and are related back to their function. The process of accommodation, whereby the lens changes shape to allow for near and far objects to be viewed clearly, is explained and modelled with the use of light boxes and differing lens thicknesses. The effect of the blind spot (or optic disc) in our eye is also demonstrated. This video is divided into the following parts:

1. From Light Comes Sight
2. The Outer Eye
3. The Inner Eye
4. Forming an Image
5. The Iris
6. The Lens
7. Sending Images to the Brain
8. Accommodation
9. The Blind Spot
10. Seeing in the Dark

Pre-Video Work:

Recommended for Junior Students

1. Ask students to make a list of the five senses that humans generally have. Next to each sense, ask them to write down the structure that is used for each. Finally, to really test the students, ask them to write next to each the information that each sense collects from the environment. Students could then design a table with appropriate column headings into which they can re-write this information

2. Discuss with the students that a "stimulus" is something in the environment that can produce a response in an individual. Tell the students that the last column in the above question were all examples of stimuli.

3. Discuss with your students that sense organs like the eye can detect the stimuli of light and movement, but what else is needed to understand such stimuli?

4. To determine how much the students already know about the eye, ask them to name as many parts of the eye as possible and briefly discuss the function of each part.

5. Read the worksheet questions together to make sure that all students understand the type of information they will need to collect. It would also be beneficial for the students to view the video first and on a second viewing attempt the questions simultaneously.

Recommended for Senior Students

1. Discuss with your students the role that senses have in communication using specific examples (ie. vision - animals demonstrate courtship behaviour to communicate breeding times; olfactory - ants leave chemicals on the ground to act as trail markers etc)

2. Discuss the following terms with the students and ask them to make their own notes following the discussion.

a) **Stimulus** - any aspect of the environment (whether it be internal or external) that provokes a response in an individual by initiating the propagation of an electrical nerve impulse in a nerve fibre.

b) **Receptor** - a specialised cell capable of detecting stimuli. There are different receptors for different stimuli.

3. Ask the students to copy the table into their books and to fill in the missing information from a) to j). The following words can be used:

Mechanoreceptors (x2), Sound, Vision, Heat/Cold, Chemoreceptors, Olfactory (smell), Light, Odour, Taste

Sense	Stimulus	Sensory Receptor
a)	b)	Photoreceptors (rods & cones)
Auditory (hearing)	c)	d)
Touch -	Pressure	e)
-	f)	Thermoreceptors
g)	h)	Chemoreceptors
i)	Sweet, sour, bitter salty substances	j)

4. Discuss with your students the **Stimulus-Response** pathway that takes place for the stimulus of light. Students are to write notes based on this discussion using the following terms: Stimulus - Receptor - Control Centre - Effector - Response.

5. Read the worksheet questions to the students and ask them to spend some time writing answers to the questions for which they already have knowledge. Ask the students to correct or add to their answers as they watch the video.

Research Tasks**Recommended for Junior Students**

1. Use one of the websites listed in the "**Information Sources**" at the end of these notes (or any other eye website) to find out something new that you believe is interesting enough to tell the class about in a 5 minute presentation. Prepare at least one overhead transparency of information/diagrams for use during your presentation.

2. Visit the library or your local optometrist to research the following diseases of the eye. Write a paragraph of notes about each.

- a) short-sightedness
- b) far-sightedness
- c) conjunctivitis
- d) cataracts
- e) sties

3. Use research material to explain:

- a) how we see colours and
- b) colour blindness.

4. Obtain a ray box kit with a variety of convex lenses of differing thicknesses. Experiment using the parallel light rays from the ray box to determine what happens to the path of the light rays as they pass through the different types of convex lenses. **Trace** onto paper the ray box, the light rays, the convex lens and the new path that the light rays take on the other side of the lens. Think back to the video's explanation of accommodation and write a paragraph explaining how your experiment models this process.

Recommended for Senior Students (see

Website Information Sources below for help)

1. Research the limited range of wavelengths detected by the human eye and compare this range with those of other vertebrates and invertebrates (mandatory HSC Biology knowledge).
2. Visit the library to research the following diseases of the eye. Write a paragraph of notes about each (the first two are mandatory HSC Biology knowledge).
 - a) myopia
 - b) hyperopia
 - c) astigmatism
 - d) achromotopsia
 - e) amblyopia
 - f) strabismus
 - g) presbyopia
3. Use information from secondary sources to describe cataracts and the technology that can be used to prevent blindness from cataracts (mandatory HSC Biology task).
4. Using information from secondary sources, compare and describe the nature of photoreceptor cells in:
 - a) mammals
 - b) insects and in
 - c) simple light receptors of one other animal (mandatory HSC Biology task).

Website Information Sources

Recommended for Junior Students

1. http://kidshealth.org/kid/body/eye_noSW.html
(Junior Level approach to understanding the eye)
2. <http://faculty.washington.edu/chudler/amaze.html>
(Animal Senses)
3. <http://faculty.washington.edu/chudler/chvision.html>
(Vision activities)
4. http://www.exploratorium.edu/learning_studio/cow_eye/index.html
(Cow's Eye dissection - step by step pictures)
5. <http://sps.k12.ar.us/massengale/Eye%20dissection.htm>
(Alternative Cow's Eye Dissection with excellent worksheet)
6. <http://faculty.washington.edu/chudler/neurok.html>
(Sense Organ information and activities)

Recommended for Senior Students

1. http://www.exploratorium.edu/learning_studio/cow_eye/index.html
(Cow's Eye dissection - step by step pictures)
2. <http://sps.k12.ar.us/massengale/Eye%20dissection.htm>
(Alternative Cow's Eye Dissection with excellent worksheet)
3. http://boredofstudies.org/courses/science/biology/2003_Biology_N_communication_Ashlee_Betteridge.pdf
(Excellent for HSC Biology Course - covers the eye plus rest of Communication topic. Will help with mandatory tasks as mentioned in the "Research Tasks" of these Notes)
4. <http://soma.npa.uiuc.edu/courses/bio303/Ch11.html>
(electromagnetic spectrum, vertebrate eye, photoreceptors)
5. <http://hyperphysics.phy-astr.gsu.edu/hbase/vision/retina.html#c1>
(Retina, Fovea Centralis, Optic Nerve, Common Vision Defects and their Correction)
6. <http://hyperphysics.phy-astr.gsu.edu/hbase/vision/rodcone.html>
(Rods and Cones)
7. <http://ebiomed.com/gall/eyes/octopus-insect.html>
(Insect and Cephalopod eye)
8. <http://www.stlukeseye.com/Conditions/Default.asp>
(Eye Diseases Index)

The Eye - Video Worksheet for Junior & Senior Students

The Outer Eye

1. What TWO structures protect the eyeball?
2. What does the tear gland do for the eye?
3. Where do excess tears go?
4. What role do the eyelashes have?
5. What does the conjunctiva do?
6. The white part of the eye is called the **i)** _____. It is a tough **ii)** _____ coating of the eye.
7. Where is the optic nerve found and what does it do?
8. How many pairs of muscles are there in the eye to control its movement?
9. What is meant by 'fixation'?
10. What does the sclera become at the front of the eye?
11. Draw a diagram of the iris and pupil to show their arrangement.
12. Is the cornea convex or concave?

The Inner Eye

1. What is behind the cornea?
2. Give TWO roles for this substance?
3. What is behind the lens?
4. What is the function of this substance?
5. What is found at the back of the eye?
6. Name the THREE layers at the back of the eye.
7. Where is the optic disc found and what happens here?

Forming an Image

1. What is released from the eye when the cornea is cut out?
2. What can be seen with the cornea removed?
3. Describe the pupil.

The Iris

1. Describe the iris.
2. What does the iris muscles do in **a)** bright light and **b)** dim light?
3. The effect described in question 2 is called the pupillary light reflex. Why is it called a 'reflex'?
4. Why is this reflex so important?

The Lens

1. What ligament connects the lens to the ciliary body?
2. What is the role of the lens?
3. How do images appear on the retina?
4. What helps us to make sense of this image?
5. What does the retina contain?
6. What are the names of the TWO types of cells in the retina?
7. What do they turn light into?

Accommodation

1. Define 'accommodation'.
2. How is it achieved?
3. What helps the lens to change shape?
4. When the lens is thick the eye can focus on _____ objects.
5. When the lens is thin the eye can focus on _____ objects.
6. Why do people need to wear glasses/contact lenses?
7. What happens to the lens as you get older?
8. What type of lens is used to correct the vision of short-sighted people?
9. Far-sighted people can see clearly into the distance but have trouble seeing objects close to them. A _____ lens helps to bend the light rays in a little before they enter the eye enabling them to be clearly focussed onto the retina.
10. The optic disc is also called the _____ because it does not contain any photoreceptors.
11. Why could the woman in the video demonstration not see the circle at a certain point when one eye was covered?
12. Why doesn't this happen when two eyes are used?
13. What is the tapetum?
14. What layer of the eye is it part of?
15. What is the function of the dark choroid?
16. How does the tapetum differ?
17. Many nocturnal animals have a tapetum. What are the advantages and disadvantages of this structure?
18. Why do eyes appear red in photographs sometimes?
19. How does the red-eye reduction function of cameras help to prevent this?

Activities following the video

Recommended for Junior Students

1. Match the structures in Column A with their functions in Column B by drawing a line

Column A STRUCTURES	Column B FUNCTIONS
Conjunctiva	A ring of muscle that controls the amount of light entering the eye.
Lens	Protects the front of the eyeball from friction and foreign matter.
Sclera	A bundle of nerve fibres which carry electrical signals from the retina to the brain.
Cornea	A tough protective outer layer of the eye.
Optic Nerve	Allows light to pass through onto the lens.
Pupil	Responsible for fine focussing an image onto the retina
Iris	Found at the front of the eye, it bends most of the incoming light.

2. Provide each student with a piece of paper and then give your class the following oral instructions to follow to prove that humans have a blind spot.
- Cut out a rectangle with dimensions 12cm x 8cm on the piece of paper you have been given.
 - Measure in 4cm from the top, bottom and left edges. Draw a 1cm black cross in this position.
 - Measure in 4cm from the top, bottom and right edges. Draw a 1cm black dot in this position.
 - Place your right hand over your closed right eye.
 - Hold the paper in your left hand about 30cm in front of your face.
 - Focus on the black dot and slowly move the paper towards your face.
3. Repeat the cow's eye dissection (or other mammalian eye) as shown in the video. For younger classes it is recommended that each step of the dissection be performed together, as instructed by the teacher, to enable discussion and to maintain class control so that an atmosphere of respect for the biological material can be achieved.
4. Provide an unlabelled diagram of a cross section of the eye and have students label as many structures as they can.

Recommended for Senior Students

1. Repeat the cow's eye dissection (or other mammalian eye) shown in the video to gather first-hand data to relate structures to functions (mandatory HSC Biology task).
 2. Repeat the demonstration shown in the video modelling the process of accommodation (mandatory HSC Biology task).
- a) Write the methodology for modelling the process of accommodation using the following pieces of equipment:
- Light box*
 - Thick convex lens*
 - Thin convex lens*
- b) Perform the modelling activity and record your results by tracing the light path from the source, through the anterior and posterior surface of each convex lens. Show the bending of light that occurs at each medium's boundary. Also, draw a diagram of the eye showing the lens shapes for near and far focussing.
- c) To conclude the report:
- state the definition of accommodation
 - explain how focussing is achieved by the eye (mention the refractive mediums of the eye as well as the action of the ciliary muscles)
 - discuss the similarities and differences that exist between this model of accommodation and the real process.
3. Complete the following table stating the functions of each eye structure.

STRUCTURE	FUNCTION
Retina	
Fovea Centralis (yellow spot)	
Optus Disc (blind spot)	
Optic Nerve	
Retinal Blood Vessels	
Vitreous Humour	
Sclera	
Ciliary Body	
Cornea	
Pupil	
Choroid	
Lens	
Suspensory Ligaments	
Rectus Muscle	
Aqueous Humour	
Iris	
Canal of Schlemm	
Rods	
Cones	