Vision

Teacher's Guide

SASKATOON ZOO SOCIETY

saskatoonzoosociety.ca

VISION

SUBJECT:
Science

GRADE:
8

CURRICULUM CONNECTIONS:

Grade 8:
Physical Science:
Optics and Vision

OVERVIEW:

This program will explore the mechanics of the human eye and compare human vision with diverse visual systems found in other animals. Students will look at specialized animal vision features like infrared sensing and UV detection, contrasting them with the human-engineered technologies (e.g., night-vision cameras and UV glasses) that accomplish similar tasks. The goal is to deepen students' understanding of sensory biology.

OBJECTIVES:

1. Students will be introduced to the fundamentals of human vision
2. Students will be able to connect animal adaptations to human optical technologies
3. Students will compare human vision to animal vision by looking at specific animals at the Zoo.
4. Students will learn the purpose of rods and cones and the differences each make to the way in which animals see.
5. Students will compare eye position between predator and prey species
6. Students will be introduced to concepts such as infrared & ultraviolet light perception.

KEY VOCABULARY:

Infrared vision: Ability to detect reflected heat signatures to "see" in the dark
Ultraviolet vision: Ability to see in the ultraviolet spectrum- humans can't as the lens filters UV light to protect the retina
Dichromatic/Trichromatic/Tetrachromatic: two types of cones/three types of cones/four types of cones
Diurnal/Nocturnal: daytime (species)/night time (species)
Binocular Vision: vision using two eyes with overlapping fields of view, allowing good depth perception
Tapetum lucidum: reflective layer of tissue behind the retina in many animals that enhances vision in low light by reflecting light back through the retina. (think "green eye shine" in cats)

BACKGROUND INFORMATION

Vision isn't solely about the eyes; it's the brain's interpretation of light signals, demonstrated by the fact that the human optic nerve creates a blind spot that the brain fills in. While humans process three primary colors (trichromacy), most insects, birds, and fish possess tetrachromatic vision, perceiving a world rich with UV light, which we only detect using specialized camera sensors. Conversely, pit vipers use a specialized organ, the pit, to sense infrared radiation (heat), a feature paralleled by thermal imaging technology used in surveillance and rescue.

PRE-VISIT ACTIVITIES

Activity One: The Blind Spot

Objective: To demonstrate that the human eye has a blind spot where the optic nerve connects and to show how the brain fills in the missing information.

Materials: Small cards (or paper) with a distinct mark (like an 'X') on the left side and a different, simple shape (like an 'O' or a dot) on the right side, spaced about 6-8 cm apart.

Procedure:

1. Have students hold the card at arm's length, close their left eye, and focus their right eye on the 'X'.
2. They should slowly move the card toward their face while maintaining focus on the 'X'.
3. At a certain distance (usually 20-25 cm), the 'O' will vanish because its image falls directly onto the blind spot.
4. Have them repeat, closing the right eye and focusing on the 'O' to make the 'X' disappear.

Discussion: Ask students: "Why didn't you notice the blind spot before this activity?"

Answer: The brain uses information from the other eye or the surrounding visual field to “fill in” the missing area.

Activity Two: Colour Afterimages

Human visual system processes colour in 3 antagonistic pairs: red/green; blue/yellow; black/white

Activity: Have students stare intensely at a brightly coloured image for 30 seconds, then immediately look at a blank white wall or sheet of paper.

If they stare at a red image - the afterimage will be green

If they stare at a yellow image - the afterimage will be blue

Explanation: the cone cells and subsequent retinal ganglion cells responsible for perceiving a certain colour (e.g., red) become fatigued or temporarily inhibited. When the student looks away at a neutral background, the opposing process (e.g., green) is relatively uninhibited and fires strongly, causing the illusion of the complementary colour. Colour perception is an **active** neural process, not passive.

POST-VISIT ACTIVITIES

Activity One: Designing an enhanced vision sensor

Objective: Students will select a specialized animal vision feature discussed in the Zoo presentation (e.g., UV detection in birds, thermal sensing in snakes, depth perception in owls) and design a device that incorporates at least two of these features

Project: Students work in groups to choose at least two vision adaptations. They then sketch a design for a new human product that integrates both (or more) of these features. Example: a new camera, a new drone, etc

Written Assignment: Students write a paragraph explaining:

- The key animal features they picked
- Why these features might be important for humans (does it solve any human problem)
- How does their new device work

Presentation: Students present to their classmates. Classmates have a chance to ask questions about the device.

Activity Two: Career Insights

Objective: To allow students the opportunity to observe and hopefully participate in activities led by an optometrist.

Idea: If possible, see if you can arrange an optometrist to come into the classroom. Perhaps they could lead some stations related to visual acuity, eye alignment, colour vision screening.

Expand: Discuss the technology in the Optometrist’s clinic that are useful for vision testing. Discuss the impact of screen time on eye health, what education is necessary to become an optometrist?