

Elephanatics.Org
ARE ELEPHANTS COLORBLIND?

Grades: 3-6th

Issue or Problem: Kids ask the best questions and are a testament to a curious mind! During a presentation one child asked if elephants were colorblind. So let's explore the question and take a closer look at how elephants see the world.

Objectives: By the end of this lesson students will-

- Be able to recognize similar characteristics between humans and elephants
- Be able to answer the question of whether or not elephants are colorblind
- Be able to name at least one difference between how elephants and humans see
- Learn about ways they can help elephants

Materials:

- ✓ Link to an example of a person who is red/green color deficient
<http://www.webexhibits.org/causesofcolor/2.html>
- ✓ Simple diagram of an eye. A good diagram and kid friendly description of the parts of the eye can be found here- <https://kidshealth.org/en/kids/eyes.html>
- ✓ Computers to do research

Background Information for Teachers: Research has shown that elephants are colorblind compared to humans. In daylight, elephants are dichromatic; meaning they have two kinds of color-sensors in their retina: one type of cone for red and another for green. Humans have three kinds of cones: Red, Blue, and Green, referred to as trichromatic. However, that does not mean elephants cannot make sense of their visual world because they are missing a third cone. It just means they see things differently. Interestingly, color-blind humans share identical sets of visual pigments with elephants. This means they can see the colors blue and yellow but reds and greens are not distinguishable. In the general human population, about 8% of all males are color blind and about 0.5% of all females are color blind.

An elephant also exhibits arrhythmic vision, which means their vision changes with the time of day. At night their eyes are most sensitive to blue and violet light meaning they can see pretty well under the smallest amount of daylight letting them see well into the night compared to humans. Unfortunately, their range of vision is clear only up to about 10 meters and they can only see for short distances of up to 25 meters. They also have limited peripheral vision.

The elephant's other senses have adapted to make up for the difference of poor eyesight. The eyesight of an elephant is not as far reaching as a human's eyesight but its sense of smell is unparalleled. The elephant's acute sense of smell is also used in communication along with its other senses of touch, hearing and its amazing ability to detect vibrations.

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Activities:

Activity 1- Introduction

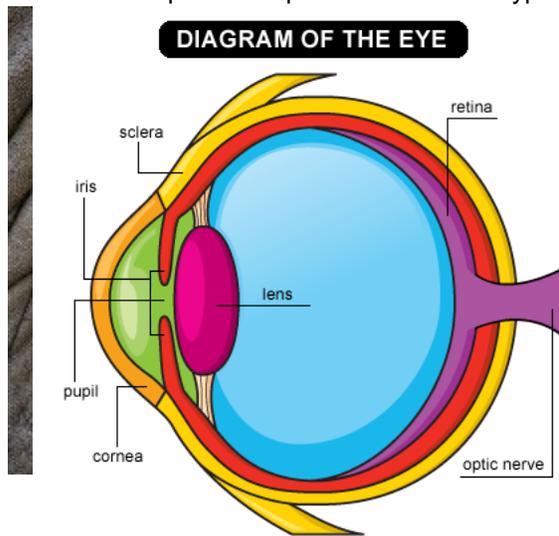
1. Communicate to your students that today they will be learning about how elephants see.
2. Ask your students to spend a minute silently thinking about their eyes and the way they see. Ask them the following questions:
 - a. Where are your eyes located? How does that help them?
 - b. What time of day do your eyes work the best?
 - c. Do we all see colors the same?
 - d. Do you think humans and elephants see the same?
3. Explain to your students that what they see in front of them is called central vision. Peripheral vision picks up on movement coming from their sides. Have them look straight ahead then hold up a hand directly in front of them so they are looking at their palm. To see their palm and the lines in their palm they are using binocular vision (vision using two eyes with overlapping fields of view, allowing good perception of depth). Now without moving their heads and while still looking straight ahead, they should slowly move their hand in an arc towards their ear. Have them wiggle their fingers. While still looking straight ahead, can they see their fingers wiggle? This is their peripheral vision. Is their peripheral vision the same as the person next to them?
4. Ask your students to name some animals that have their eyes in the front like humans do. Examples: lions, eagles, owls, wolves, fox etc. Have them name some animals that have eyes on the side of their heads. Examples: deer, mice, rabbits, goats, turtles etc. Ask them why some animals have forward facing eyes while some are on the side? *Generally, animals with eyes that are located on the side of its head would suggest a prey animal. Side eye placement allows for greater peripheral vision. This enables the animal to see predators approaching from the side as well as from behind. Animals with forward facing eyes are generally hunters or predators. Forward facing eyes allows an animal to see and judge depth which is important if you need to hunt and catch your food.*
5. Ask them where an elephant's eyes are located? What is the benefit to the elephant having eyes on the side of its head as opposed to the front?

Activity 2- Rods, Cones and Colorblind

1. Show your students a simple diagram of a human eye. Depending on the age of your students you may decide to give a brief description of the parts of an eye. (Visit <https://kidshealth.org/en/kids/eyes.html> for the image on the right and kid friendly explanations of the different parts of the eye.) The part we want to focus

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on is the retina that contains the cones and rods. Explain that the retina is the back part of the eye that contains the cells that respond to light. These specialized cells are called photoreceptors. There are 2 types of photoreceptors in the retina: rods and cones.



Elephant eye from www.kotofoundation.org

2. Rod cells are most sensitive to changes in light, shape and movement. Rods help us see in dim light. Cone cells help us see color and function best in bright light. Not everyone can tell colors apart in the same way. Some people are what we call “colorblind”. This means they may be missing a type of cone in their retina or a cone may be weak making it harder for them to see certain colors. Elephants, just like humans have cones and rods in their eyes. Humans have three kinds of cones: Red, Blue, and Green, we call this trichromic. Elephants are dichromic; meaning they have two kinds of cones in their retina: red and green. Interestingly, colorblind humans share identical sets of visual pigments with elephants. This means they can see the colors blue and yellow but reds and greens are not distinguishable. Colorblind humans and elephants see the world very similarly
3. Spend some time at the below link that gives examples of what you see when you are red/green color deficient (deuteranopia- M cone reduced or absent). Elephants are dichromic in daylight and would see the world similarly: <http://www.webexhibits.org/causesofcolor/2.html> Ask your students, what color would trees and shrubs look like for an elephant? Can they think of some benefits of being colorblind for the elephant?
4. Humans are diurnal (mostly active during the day). If we are up and active at night, we generally use lights that help us see. Elephants are both diurnal and nocturnal (active at night). “Elephants are an Arrhythmic species, which are animals that have the ability to see as well in dim light as they can in the light of day. They can do this because the retina in their eye changes nearly as quickly as the light does. Inside an elephant’s retina are “rod free areas” that allow them to see different wavelengths of light at night, in short, they become extremely sensitive to blue and violet light, or the colors of a night sky. Basically, this allows them to “see in the dark.” Most nights the African desert is lit by the moon. For an elephant this is as bright as day. But on those rare nights when the

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clouds move in blocking any light from the moon, an elephant is virtually blind. They are not able to see when there is no light whatsoever” (<https://www.kotafoundation.org/a-sight-to-behold>).

Activity 3- Researching Elephant Senses

1. Elephants eyes have long eyelashes to help keep their eyes free from blowing dirt, sand and other particles. They also have three eyelids: upper, lower and a “third eyelid” called a nictating membrane. This “eyelid” moves vertically across the eye and helps protect the eye when feeding, bathing and from debris. The nictating membrane is clean and helps keep the eye moist. Have your students research what other animals have nictating membranes.
2. Considering all we have learned about an elephant’s vision, it isn’t their strongest sense. Unfortunately, their range of vision is clear only up to about 10 meters and they can only see for short distances of up to 25 meters. If eyesight isn’t their strongest sense what other senses do elephants rely on? Have your students research elephant senses and answer the following questions.
 - a. Since elephants don’t rely on their sight to guide them long distances, how do the determine where to find the next food or water source?
 - b. What sense is the strongest in elephants?
 - c. How do elephants tell each other apart?

Webpages that can help answer these questions:

- <https://www.elephantnaturepark.org/about/elephant-anatomy/>
- www.elephantvoices.org/about-elephantvoices.html
- <https://seaworld.org/animals/all-about/elephants/senses/>

Resources:

For more information on color blindness and a listing of sites to explore what being colorblind looks like visit <http://www.colourblindawareness.org/colour-blindness/>

The following organizations are helping to protect elephants for future generations. You can learn about the issues facing elephants and how you can help by visiting their websites.

- The Nature Conservancy: nature.org/elephants
- The David Sheldrick Wildlife Trust: sheldrickwildlifetrust.org/
- The Northern Rangeland Trust: nrt-kenya.org/
- Tsavo Trust: tsavotrust.org/
- World Wildlife Federation: <https://gifts.worldwildlife.org/>
- Save the Elephants: <http://www.savetheelephants.org/>
- International Elephant Foundation: <https://elephantconservation.org/>
- Amboseli Trust for Elephants: <https://www.elephanttrust.org/>
- International Fund for Animal Welfare: ifaw.org/united-states

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