Horse Vision

Most grazing and prey animals, like horses, have eyes on the sides of their heads. This adaptation allows them to see predators from nearly anywhere. Horses use two forms of vision: monocular and binocular. Monocular vision allows the horse to see on both sides of his head, meaning the left eye and the right eye work independently and see different views. Binocular vision allows the horse to use both eyes together to see directly ahead. The visual adaptations in horses are remarkable because they allows horses to have a "panoramic" view, with small blind spots directly in front of and behind their bodies.

Objectives

- Students will understand the difference between monocular and binocular vision as it relates to depth perception.
- Students will experience how parallax contributes to depth perception.
- Students will construct an argument based on experimentation that binocular vision allows for greater depth perception.
- Students will be able to identify that vision is based on information received through photoreceptors and translated in the brain.

Supplies/Resources

- Small-sized balls (ping-pong, softballs, foam balls) - one for each group
- Material that can cover one eye - bandannas, eye patch
- Yardstick or measuring tape
- Removable tape (like painter's tape)
- Student information and lab worksheets for each group

Teacher Suggestions

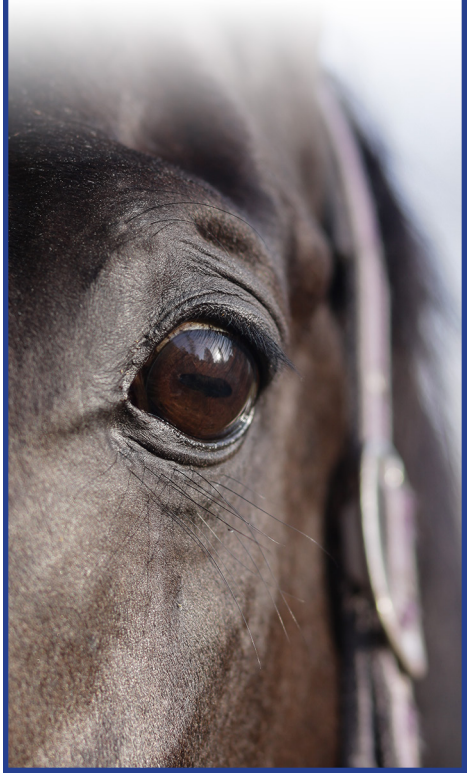
- The words marked with an * may be difficult for some students to understand. Encouraging the use context clues is appropriate in these instances.
  ***panoramic, variation, myth**
- You will also find a horse vision simulation video at https://www.teachkyag.org/lessons/horse-vision.

Kentucky Academic Science Standards

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function and support survival, growth, behavior, and reproduction.

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

4-PS4–2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.



How do horses see?

Structures in a horse's large eyes give them amazing vision. While they may not see detail as well as we do, horses have a larger field of vision and better night vision than humans. They are also good at seeing movement at a distance.

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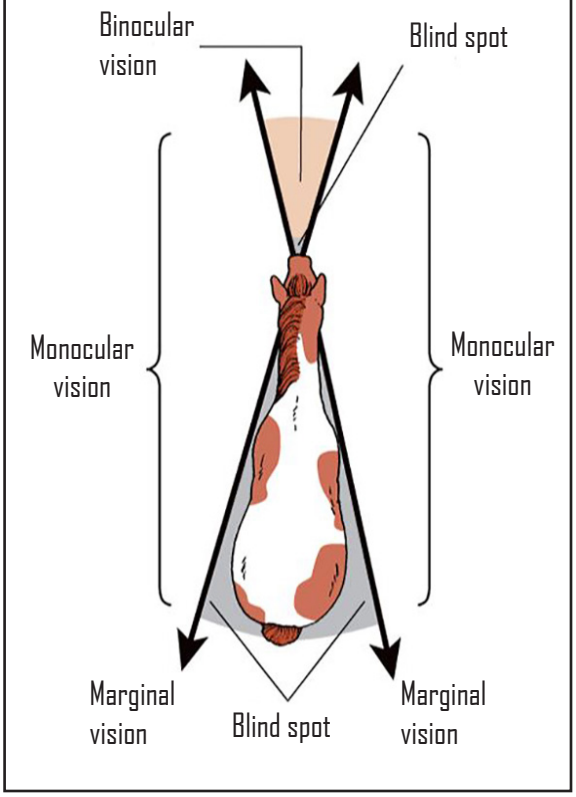
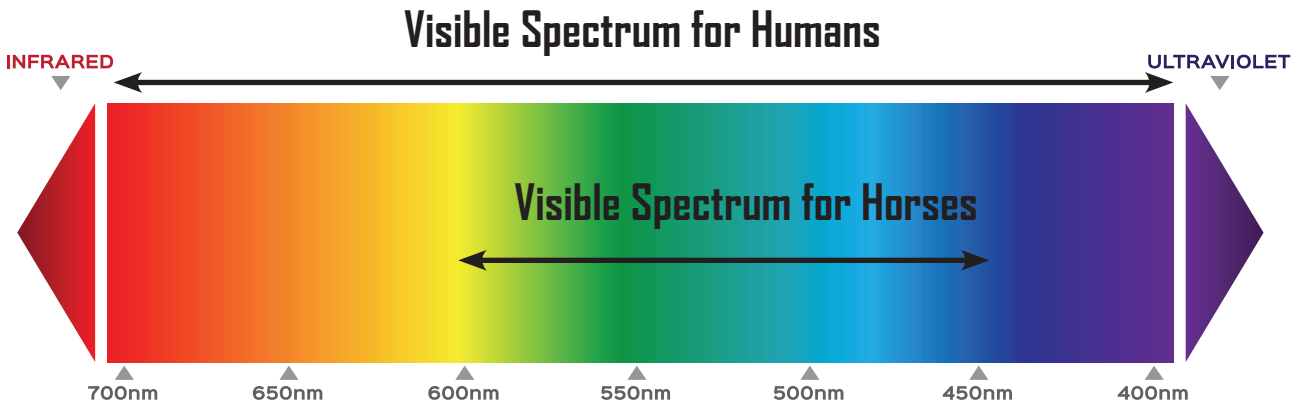
Horse Vision



Merck Veterinary Manual

Do horses see color?

It is a myth that horses are color blind. Recent studies have proven that horses do see color, but not as brightly or colorful as we do. Horses can see only two of the visible wavelengths in the light spectrum because they have only two types of cone cells: blue-sensitive cone cells and yellow-sensitive cone cells. Cone cells sense color, so horses can see blue, green, and variations of the two colors, though they don't see them as brightly as humans. Horses cannot see red or shades of red.



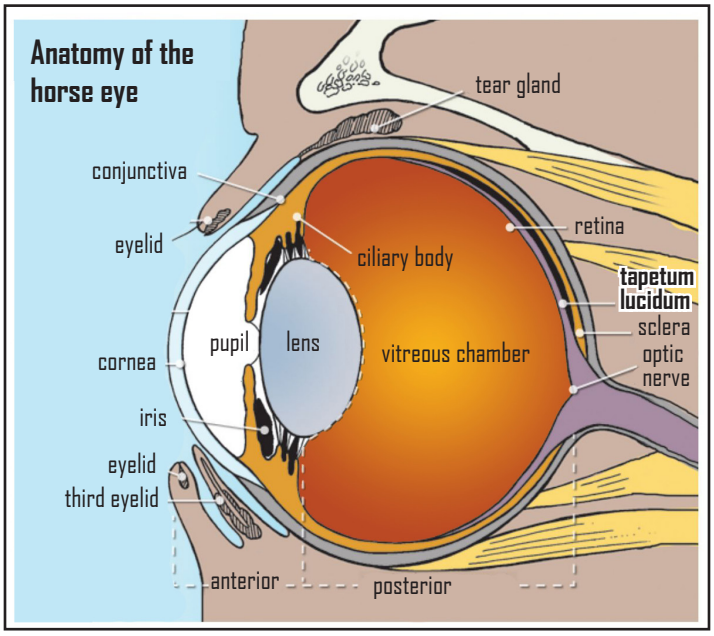


Image courtesy of Lynne Sandmeyer, DVM

Can horses see at night?

Horses have visual adaptations that allow them to see in very little light. They have more rod photoreceptors (cells that help you see at night) and larger pupils (the black part at the center of the eye that lets light in) than humans.

Horses also have a very special visual adaption called the tapetum lucidum. Those are not words you hear often! The tapetum lucidum acts like an internal light reflector (like the reflector on your bicycle or on a road sign at night). This is why horse eyes seem to glow in the dark when a light is shown in their eyes. The tapetum lucidum gives them superior night vision. However, equine eyes cannot transition between bright and dim locations as well as human eyes.

Try this with a partner: Look at your partner's eye. Really notice and focus on the size of the pupil. Next, close your eyes and count to 30. Open your eyes together and look at the size of your partner's pupil. How did the size of the pupil change?

Here's why: Your pupil wants to let in as much light as possible so that messages can be sent to the brain. When you close your eyes, your pupils can't detect light. Your brain tells your pupils to get bigger to try to find light so the brain can receive messages. Your eyes and your brain are always in communication, and it's light that allows the communication to happen.

Binocular Vision vs. Monocular Vision Exploration Lab

Humans have binocular vision, which means our eyes work together to focus on one view and to have greater depth perception. Depth perception is what allows us to know exactly how far to extend our hand to pick up a pencil or glass of water so we don't knock it over.

Although our eyes are positioned in the front of our head, each eye still gives us a slightly different view. To prove this, try the following activity:

Hold your pencil at arm's length. Look at your pencil with your left eye open and right eye closed. Do not move your arm or pencil. Switch eyes. It appears that your pencil has moved, but it hasn't. This effect is called parallax. It occurs because each eye is viewing the pencil from a slightly different perspective or view. Even though the view is just slightly different from each eye, our brain combines the images into one view. The variation in the two images gives us depth perception. As you can see from this short activity, one eye can see all the colors and details of the pencil. So, what is the advantage of having two eyes?

Horses have the advantage of having two sight adaptations: binocular and monocular vision. Monocular vision allows the horse to see a different view with each eye. Horses can easily change from monocular to binocular vision.

Materials Needed

A partner
A small ball
Piece of cloth that can be used to cover one eye
Yardstick or measuring tape
Removable tape
BV vs. MV Data Table Sheet
Pencil

Explore how binocular vision aids in depth perception with the following activity.

Procedures

1. Use your measuring tape to measure a distance of 12 feet and use a piece of tape to mark the beginning and end.
2. Mark increments of 2 feet with a tape "placeholder."

Start **Finish**
0 — 2 — 4 — 6 — 8 — 10 — 12

3. Have Partner A stand on the start line and Partner B stand on the 2-foot mark. Partner B will gently toss the ball to Partner A with both eyes open, 10 times. Record the number of catches.
4. Repeat these steps again with Partner A standing on the start line and Partner B tossing 10 times from the 4, 6, 8, 10, 12-foot marks with eyes open. Record the number of catches.
5. Use your material to cover your right eye and repeat steps 3-4. Record your catches.
6. Cover your left eye and repeat steps 3-4. Record your catches.
7. Switch. Partner A tosses and Partner B catches. Record the number of catches.
8. Add the totals for each column and answer the questions.

Binocular Vision vs. Monocular Vision Exploration Lab Record Sheet

Partner A: _____ **Partner B:** _____

Distance	Tosses Caught Both Eyes Open Student A	Tosses Caught Both Eyes Open Student B	Tosses Caught Left Eye Only Student A	Tosses Caught Left Eye Only Student B	Tosses Caught Right Eye Only Student A	Tosses Caught Right Eye Only Student B
2 Feet						
4 Feet						
6 Feet						
8 Feet						
10 Feet						
12 Feet						
Total Tosses Caught						

Lab Exploration Questions:

1. Was it easier to catch the ball with two eyes open or one?

2. Did you change how you watched the ball with one eye covered? In what ways?

3. Did you catch the ball differently with one eye covered? In what ways?

4. Did it get harder to catch the ball as the distance increased? In what ways?

5. What would be the advantage of having both binocular and monocular vision, like a horse?