

UNIT-I

EYE (VISION)

Eye

Course No. – VPB 1st Professional year

Credit Hrs. – 4+1=5

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- Vision is that sense that enables animals to see the world around them.
- Animals require vision to survive, find food, protect themselves from predators, seek shelter and so on.
- The main organ of vision is the eye!
- The eye, along with co-ordination with the brain, produces vision.

Parts of the eye (from outside to inside):

- Lens
- Vitreous humor
- Retina
- Optic nerve
- Sclera
- Eyelashes and eyelids
- Cornea
- Aqueous humor
- Iris
- Pupil

🌿 Mechanism of vision –

- Visual function involves a combination of many factors, including:

- the field of view

- depth perception (ability to judge distances)

- acuity (focusing ability)

- perception of motion

- colour differentiation.

LIGHT from Object - Conjunctiva - Cornea - Aqueous humor - Lens - Vitreous humor – RETINA

NERVE IMPULSE - Rods and Cones on retina - Synapse - Bipolar nerve cells - Ganglions - Optic nerves - Occipital lobe of BRAIN.

Classification of Vision –

- Monochromacy- Only one type of cone cells. Eg. Marine mammals, Owl, monkey and Australian sea lion.
- Dichromacy- Two types of cone cells. Eg. Cats, Dogs, Horses and Cattle.
- Trichromacy- Three types of cone cells. Eg. Humans and bees.
- Tetrachromacy- Four types of cone cells. Eg. Birds, fish, amphibians and reptiles.
- Infrared vision- Eg. Snakes.

■ **Monochromacy -**

- Only one type of cone cell.
- Usually black and white vision.
- Seen in Marine mammals, Owl monkey and Australian sea lion.
- In humans, disease of full colour blindness leads to monochromacy.
- Also night vision is humans in monochromatic.

❖ Dichromacy in CATS:

- Field of view- 200°
- Depth perception- Not very good. Objects Max 20 feet away can be focussed on. Objects too close to the eyes can't be focussed on.
- Acuity- Their day time vision is 6 times blurrier than that of humans, but night time vision and peripheral vision is 6-8 times better than that of humans.
- Perception of motion- Very good! Even at night.
- Colour differentiation- 10 times lesser cones than humans in the macula. See mostly blue, yellow and greys.

❖ Dichromacy in DOGS:

- Field of view- 240°
- Depth perception- near sighted. Better depth perception than cats. Central binocular field helps in depth perception.
- Acuity- 20-40 % that of humans. Depends greatly on clarity of cornea, aqueous humor, lens and vitreous humor.
- Perception of motion- 10-20 times more sensitive to motion than humans. Even at dusk!
- Colour differentiation- Two cone cells. Blue and yellow can be differentiated but not red and green



HUMAN VISUAL SPECTRUM

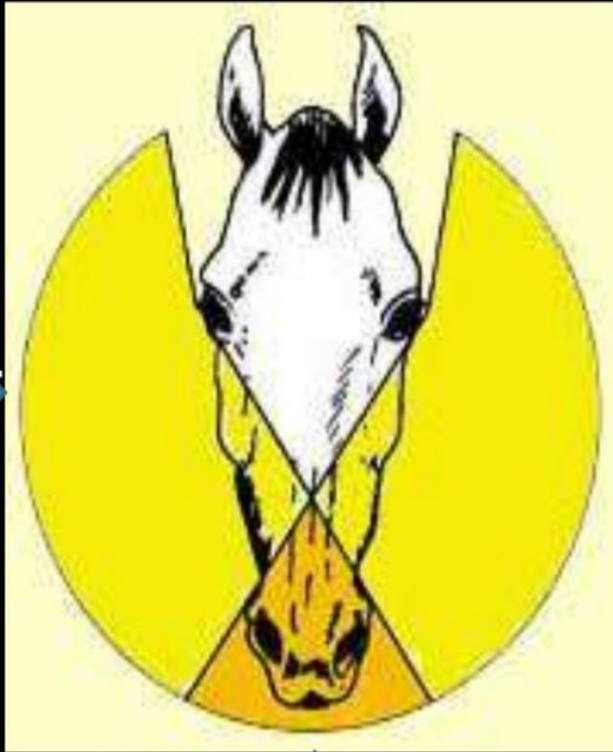


CANINE VISUAL SPECTRUM

➤ Dichromacy in HORSES:

- Field of view- Very wide! 350° , of which 285° is monocular and 65° is binocular. 3 Blind spots- between the eyes, exactly behind the head and under the chin.
- Depth perception- Using binocular field of vision.
- Acuity- Do not adjust very quickly to sudden darkness. Good acuity in binocular field called “visual streak”.

Monocular



Monocular

Binocular

➤ **Dichromacy in Cattle:**

- Field of view- 340° , of which 310° is panoramic and 25° - 30° is binocular. Blind spot is exactly behind the head.
- Depth perception- Very poor, specially in dim light.
- Acuity-They have slit-shaped pupils and weak eye muscles due to which they cannot focus quickly on objects.
- Perception of motion- Average to good.

SUMMARY

- Most of our domestic mammals species come under this class.
- All those mentioned above have a special set of cells on their retina which enable them to see clearly at night. This is called the “TAPETUM LUCIDIUM”.
- It takes in the most minimal amount of light available and reflects in back out to make the animals be able to see the object more clearly.
- The tapetum lucidium is absent in pigs & primates.

Trichromacy - Three types of cone cells.

- HUMANS -

- See red, green and blue.
- Monochromatic vision at night.

- BEES –

- see yellow, blue and Ultraviolet.
- Ultraviolet vision helps bees detect colour patterns on petals that guide them to nectar.
- They have compound eyes, so each lens produces 1 pixel.
- Low resolution- blur vision.

Tetrachromacy in BIRDS:

- More light receptors and more nerve fibres to the brain.
- Birds of prey- more density of photoreceptors in retina, greater visual acuity, placement of eyes to create binocular vision leading to better depth perception. Eg. Eagles.
- Nocturnal birds- more density of rod cells, low number of cone cells, tubular eyes, better night vision. Eg. Owls.
- Seabirds- They have red or yellow oil droplets in the colour receptors to improve distance vision especially in hazy conditions. Eg. Terns, gull and albatrosses.
- Perception of movement- Flickering at a rate $>50\text{Hz}$ can be seen by birds. Movements as slow as the sun goes down.

Tetrachromacy in FISHES:

- The vision in fishes varies between different species. Some have ultraviolet visions, while some have polarized vision.
- They adjust focus by moving the lens closer to or further from the retina.
- They have visual adaptations based on their environment.
- Passage and absorption of light in different waters enables fishes to see longer or shorter wavelengths of colours.
- Most fishes have a fixed pupil size (exc. Sharks and rays).
- Species with spherical lenses have sharper images.

Infrared vision:

- This is seen primarily in SNAKES.
- They have a low resolution colour vision in the day but plenty of rod cells for vision at night.
- Special sensory tools- “Pit Organs”, a pair of holes on either side of the snout between the eye and the nostril. Suspended in each pit is a thin membrane that detects heat.
- A neural receptor: TRPA1 transforms infrared rays to nerve signals.
- The snakes’ brain merges the information from the pit organs with Trigeminal nerves.