COLOR VISION
ACQUITY OF VISION

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ALL FIGURES HAVE BEEN TAKEN FROM ‘COMPREHENSIVE TEXTBOOK OF PHYSIOLOGY’ BY DR. G K PAL WITH PERMISSION)

- VISUAL ACQUITY
- ADAPTATION
- COLOR VISION
- COLOR BLINDNESS

DARK ADAPTATION

- WHEN PERSON REMAINS IN BRIGHT LIGHT AND THEN MOVES INTO A DIMLY LIGHTED ROOM, HE EXPERIENCES A TEMPORARY BLINDNESS THAT IMPROVES AFTER A FEW MINUTES.

- THE EYE ADJUSTS TO LOW LEVELS OF ILLUMINATION. THIS IS CALLED AS DARK ADAPTATION.

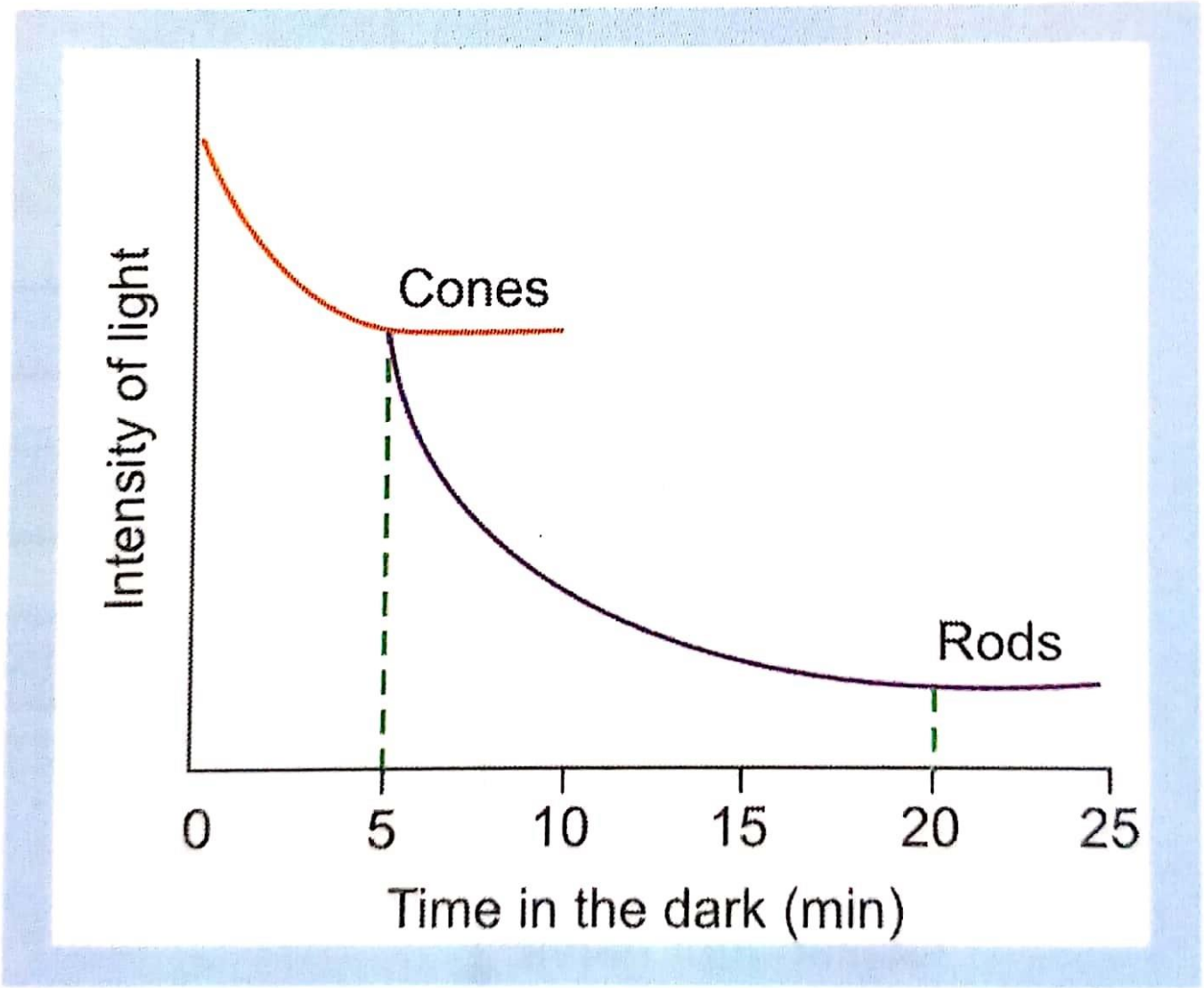

Fig. 146.3: Dark adaptation. Maximum fall in cone sensitivity occurs in 5 minutes; Maximum fall in rod sensitivity occurs in 20 minutes.

PURKINJE SHIFT

- IN BRIGHT LIGHT, CONES ARE OPTIMALLY FUNCTIONING; THEREFORE THE PEAK SPECTRAL SENSITIVITY OF RETINA IS AT 560 NM.
- IN SCOTOPIC VISION ONLY RODS ARE FUNCTIONAL; THEREFORE PEAK SPECTRAL SENSITIVITY OF RETINA IS AT 500 NM.
- THIS SHIFT OF PEAK SPECTRAL SENSITIVITY WHEN A PERSON GOES FROM BRIGHT TO DIM LIGHT IS KNOWN AS PURKINJE SHIFT.

CRITICAL FUSION FREQUENCY

- IMAGE OF ANY OBJECT REMAINS ON THE RETINA FOR SOME TIME SO THAT IF PICTURES ARE SHOWN ONE AFTER THE OTHER, THEY GIVE AN APPEARANCE OF BEING CONTINUOUS.

- THE CRITICAL FREQUENCY AT WHICH FUSION OCCURS IS KNOWN AS FLICKER FUSION FREQUENCY.

ACUITY OF VISION

- SHORTEST DISTANCE BY WHICH TWO LINES OR POINTS CAN BE SEPARATED AND STILL BE PERCEIVED AS TWO LINES.
- IT IS THE DEGREE TO WHICH DETAILS AND CONTOURS OF OBJECT ARE PERCEIVED.
- VISUAL ACUITY AND COLOR VISION ARE FUNCTIONS OF CONES.

FACTORS AFFECTING

A) OPTICAL FACTORS:

- - CURVATURE OF THE CORNEA
- - CURVATURE OF LENS
- - PLASTICITY OF LENS
- - CONDITION OF CILIARY MUSCLE

B) RETINAL FACTORS:

- - VISUAL ACUITY IS HIGHEST AT THE FOVEA AND DECREASES TOWARDS THE PERIPHERY.
- - IN REFRACTORY ERRORS, CATARACT, VASCULARIZATION OF CORNEA- VISUAL ACUITY IS DECREASED

C) STIMULUS FACTORS:

- - ILLUMINATION OF SURFACE.
- - SIZE OF THE OBJEST
- - DISTANCE OF THE OBJECT FORM THE EYE
- - COLOR OF THE OBJECT
- - SHAPE OF ITS BORDERS
- - DURATION FOR WHICH OBJECT REMAINS IN VIEW.
- - COLOR CONTRAST.
- - TYPE OF STIMULUS.

EXAMINATION OF VISUAL AQUITY

- DISTANT VISION: SNELLEN'S CHART
- NEAR VISION: JAEGER'S CHART

DEPTH PERCEPTION

- THE DETERMINATION OF DISTANCE OF THE OBJECT IS CALLED AS DEPTH PERCEPTION.

MECHANISM:

- COMPARATIVE SIZE
- STEREOPSIS OR BINOCULAR DEPTH PERCEPTION

- FAILS AT INFINITE DISTANCE

COLOR VISION

- Color vision: Is the capacity to distinguish objects based on the wavelengths or frequencies of the light they reflect.

- Color blindness or deficiency:

A condition in which certain colors cant be distinguished due to absence or deficiency in color receptor cones.

- Human eyes perceive about 100 colours with different
- i) Hue (wavelength 400 nm to 700 nm)
- ii) Intensity (luminosity)
- iii) saturation

- Spectral colours- VIBGYOR (wave length 400 to 700)
- Extra spectral colours- colours not in the spectrum (e.g. Pink)

- Primary colours- blue, green & red

COLOR PERCEPTION

- Hue Is the identification of color.
- Brightness Is the intensity of color.
- Saturation Is the purity of a color.

Color vision is the function of

3 types of cones.

Tritan blue at 414-424nm.

Deutran green522-539nm.

Protan red 549-570nm.

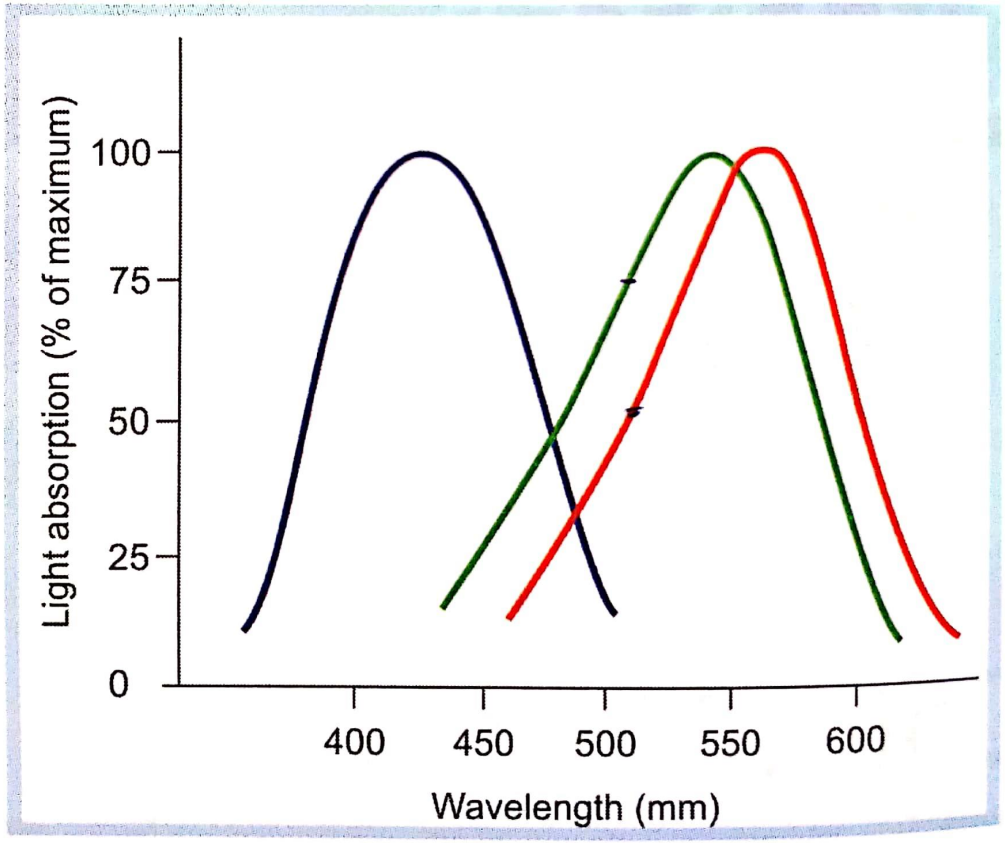

Fig. 147.1: Mean absorption spectra of the three cone pigmer in the human retina.

THEORIES OF COLOR VISION

- i) Young Helmholtz trichromatic theory or pigment theory
- ii) Granits modulator & denominator theory
- iii) Hartridge’s polychromatic theory
- iv) Herings theory of opposite colours

- There are three groups of cones in retina which are sensitive to three types of primary colours.

- The sensation of many colours is produced by combined stimulation of three types of receptors.

- Orange= 0:42:99
- Blue= 97:0:0,
- Yellow= 0:83:83,
- Black= 0:0:0,
- White= all equally

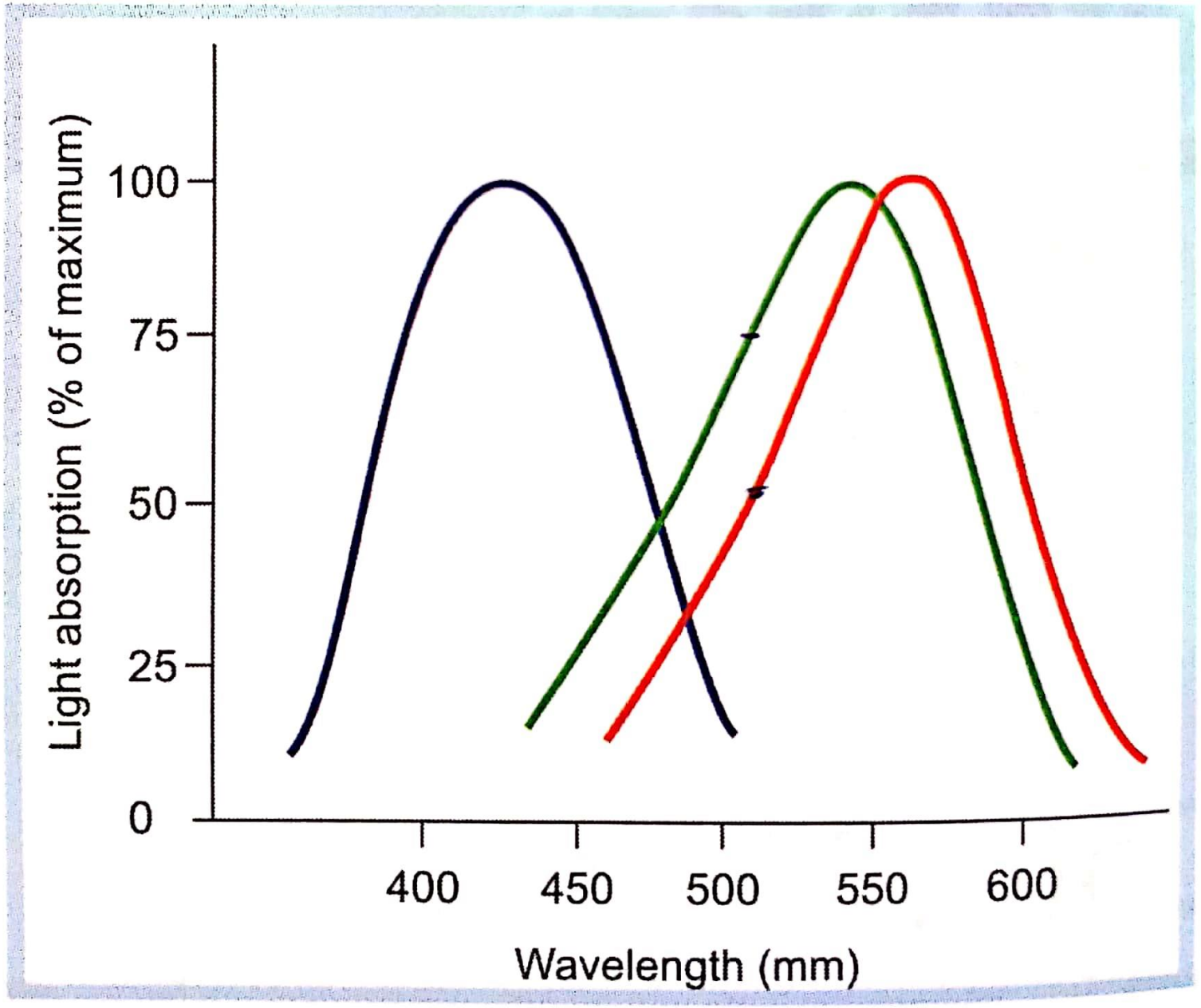

Fig. 147.1: Mean absorption spectra of the three cone pigmer
in the human retina.

PATHWAY OF COLOR VISION

Cones

↓

Bipolar Cells

↓

“X” Ganglion Cell

↓

Lateral geniculate body (III, IV, V, VI layers)- Parvocellular layers

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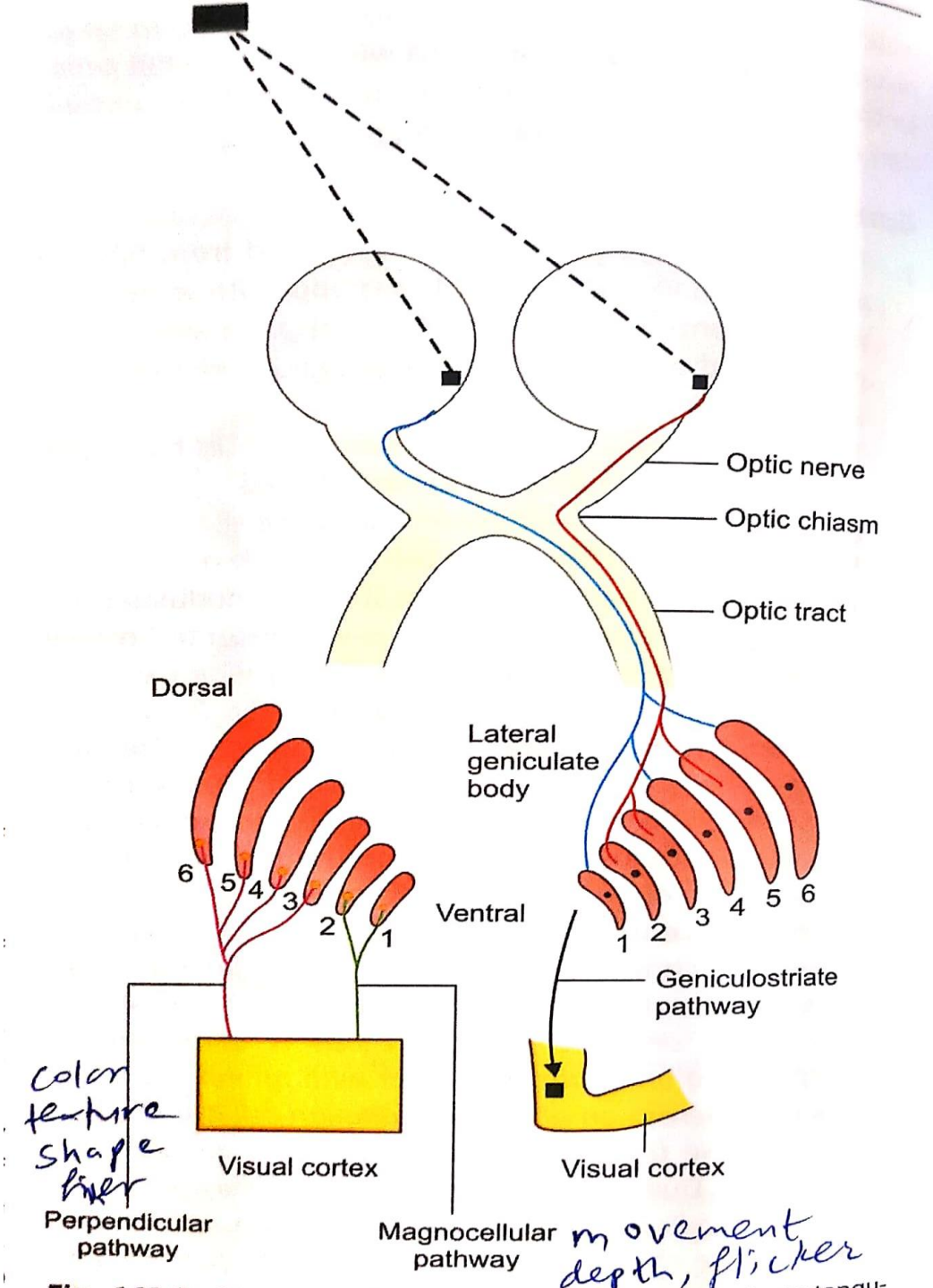
Visual cortex

↓

Other layers of visual cortex and color blobs


Optic nerve
Optic chiasm
Optic tract
Dorsal
Lateral geniculate body
6 5 4 3 2 1
Ventral
1 2 3 4 5 6
Geniculostriate pathway
color
texture
shape
Visual cortex
Visual cortex
Perpendicular pathway
Magnocellular pathway
movement
depth, flicker

Colour blindness

- Total loss of colour vision is called achromatopsia.

- partial loss is called colour blindness in which there is inability to distinguish certain colours.

- It effects 8%males & 0.4%females: X linked recessive disorder.

COLOR BLINDNESS

Trichromate: Normal colour vision

Dichromates: Normal 2 of 3 cone pigments.

Monochromates: One normal cone pigment.

- prot- red
- Deuter- green
- Trit- blue

- Loss of cone: ---anopia (e.g. loss of red cone = protanopia)

Monochromatism Not able to differentiate colors of equal brightness.

- Dichromatism absence of one cone
  - Tritanopia blue is missing
- Deutranopia green is missing
- Protanopia red is missing

THANK YOU