

Vision - 4

Color Vision

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Objectives

- Define color vision
- Identify and describe the mechanism of color vision and the three types of cones, including the range of spectral sensitivity and color blindness
- Identify color vision theory
- Describe the items needed for any color perception
- Compare different types of color blindness

Red Rose



WEBSHOIS

Color Vision

- It is the ability to discriminate between different colors.
- 1- there are 3 primary colors(blue- red- green) sensed by cones in fovea & appreciated within photopic vision.
- 2- sensation of extraspectral colors as white, yellow, orange, purple, can be produced by mixing properties of the blue & red & green in different combinations.
- 3- black means absence of light (not darkness because in dark we do not see black only)

Color (Photopic) Vision

'Young - Helmholtz theory'

'The Trichromatic theory'

Color vision theory :_(Young-Helmholtz theory)

- 1- we have 3 kinds of cones each has a specific photopigment (iodopsin)& is sensitive to one of the 3 primary colors
- a- Blue cone system:- has S pigment (blue sensation pigment) which respond to short wave length (440 nm senses the blue color)
- b- Green cone system:- has M pigment (green sensation pigment) which respond to middle wave length (535 nm senses the green color & less to yellow) & absorb light at the green portion.

- Red cone system:- has L pigment (red sensation pigment) which respond to large wave length at or > 565 nm so senses the red & yellow color & absorb light at the red portion.



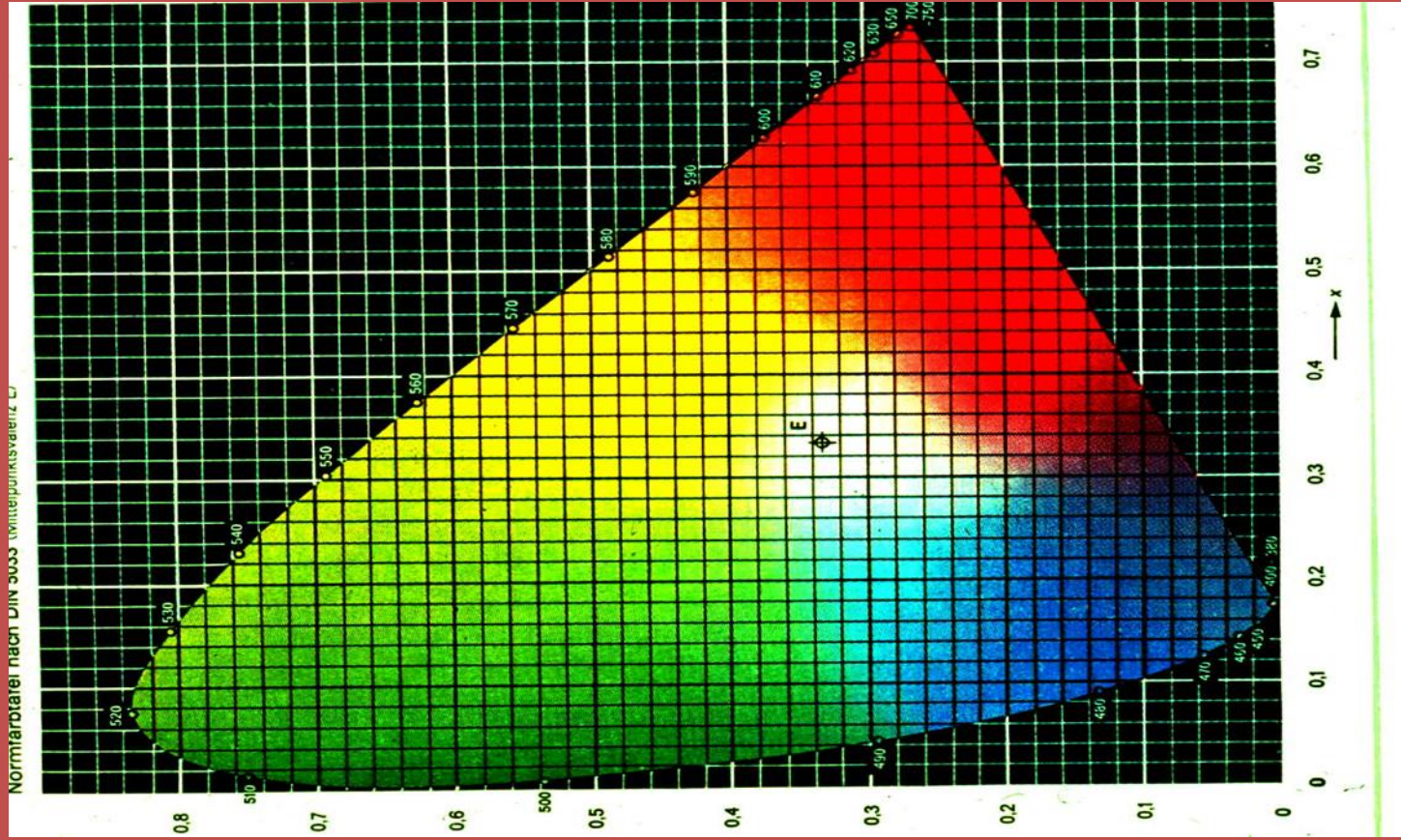


History of color vision

Newton (1704) used a prism to show that sunlight was composed of light with all colors in the rainbow. He defined it as the **spectrum**.



Mixing colors



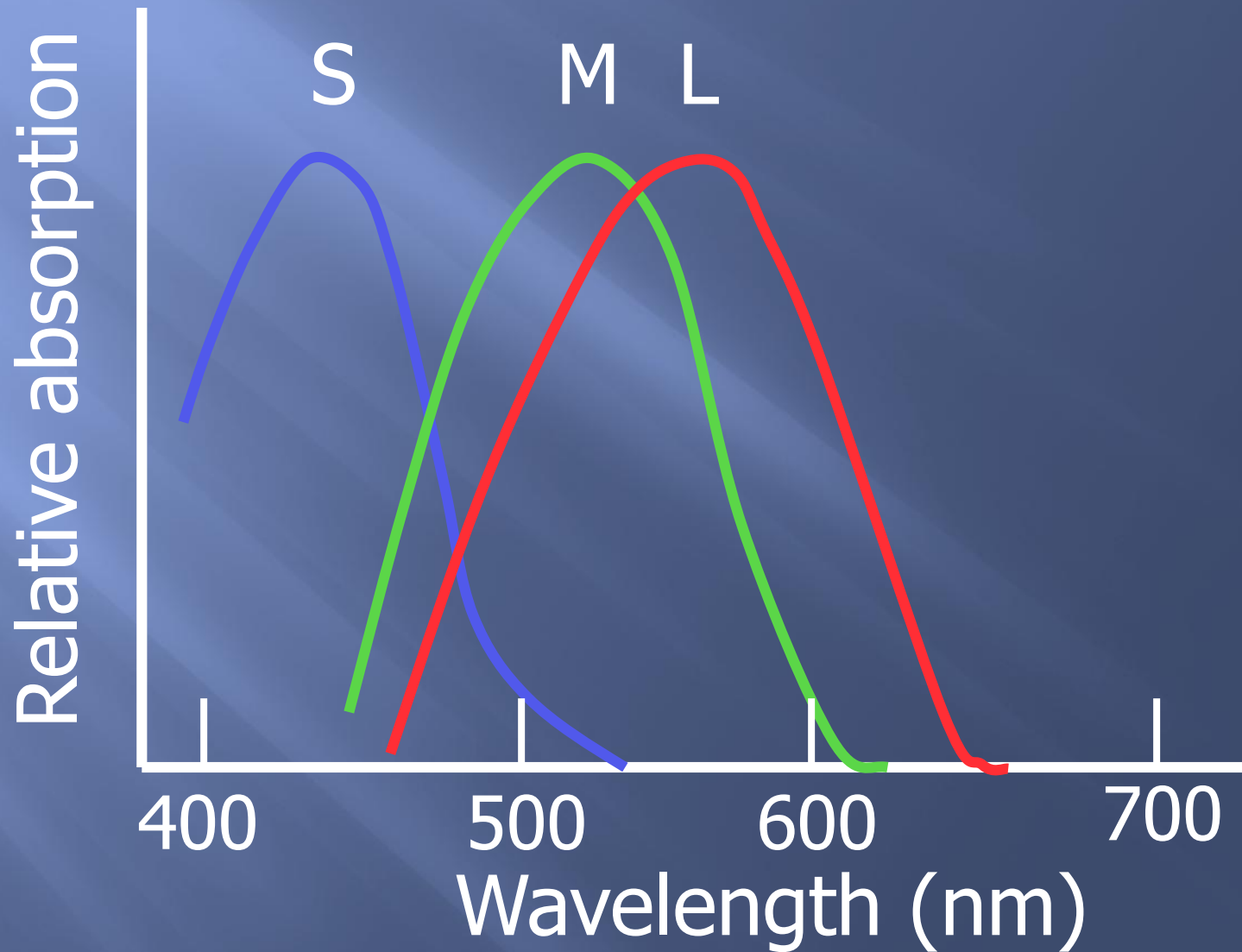
Photopic vision (CONES)

Helmholtz ..1860:

The three primary colors are perceived by three photoreceptor pigments (with broad absorption curves)

White light is produced by mixing three colours

Cone wavelength ranges

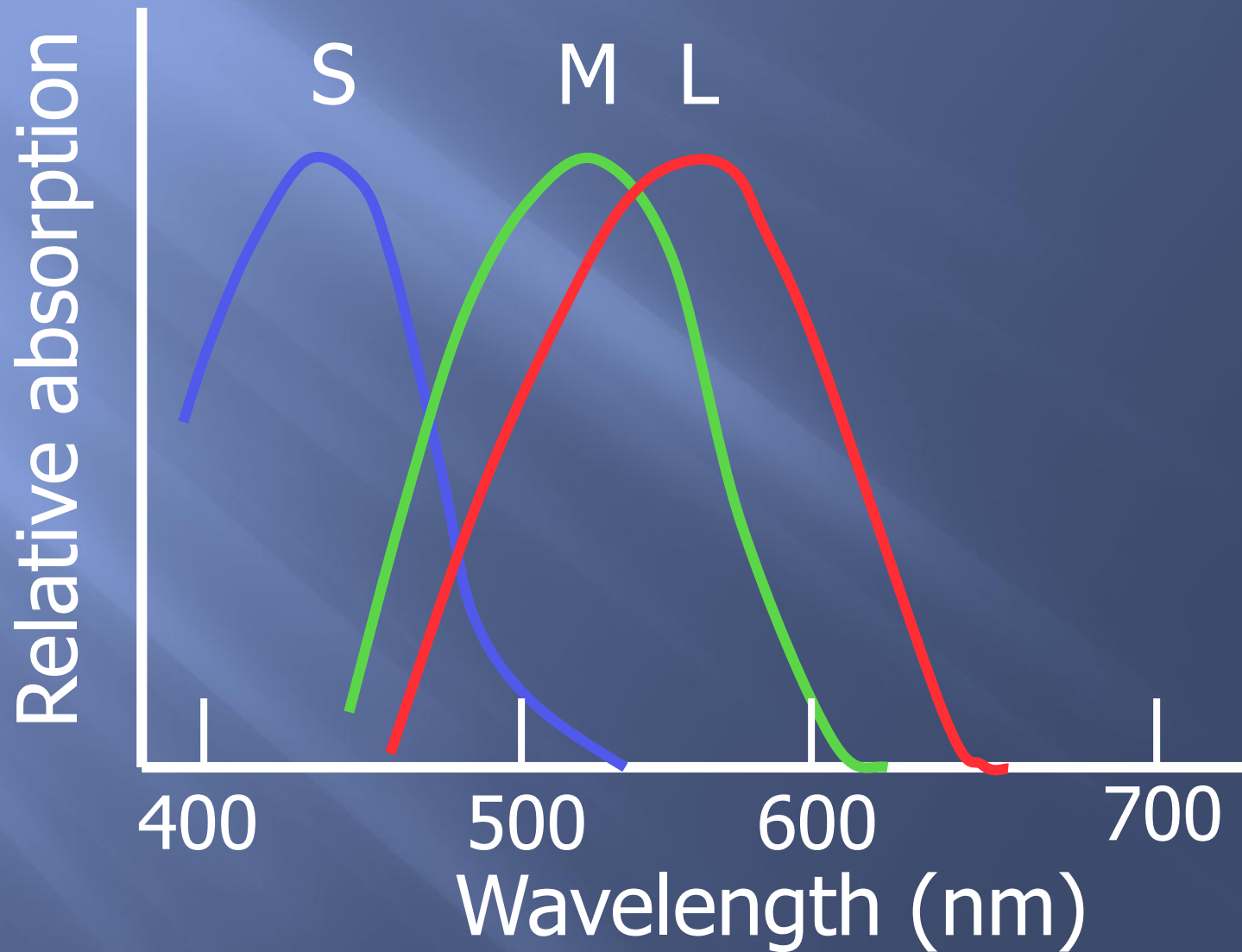


Photopic vision (CONES)

Cone pigments: three kinds



Cone wavelength ranges



Photopic vision

Sensation of any color determined by:

a-Wavelength of light

b-Amount of light absorbed by each type of
cones

c-Frequency of impulses from each cone system
to ganglion cells which is determined by
wave length of light.

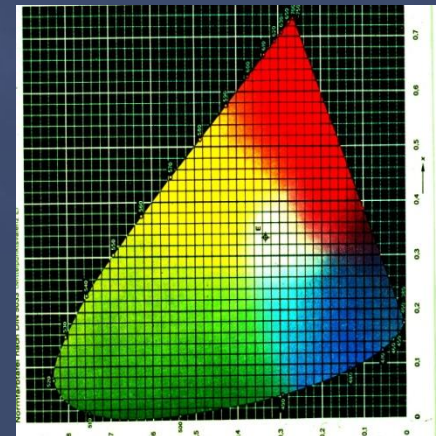
Photopic vision

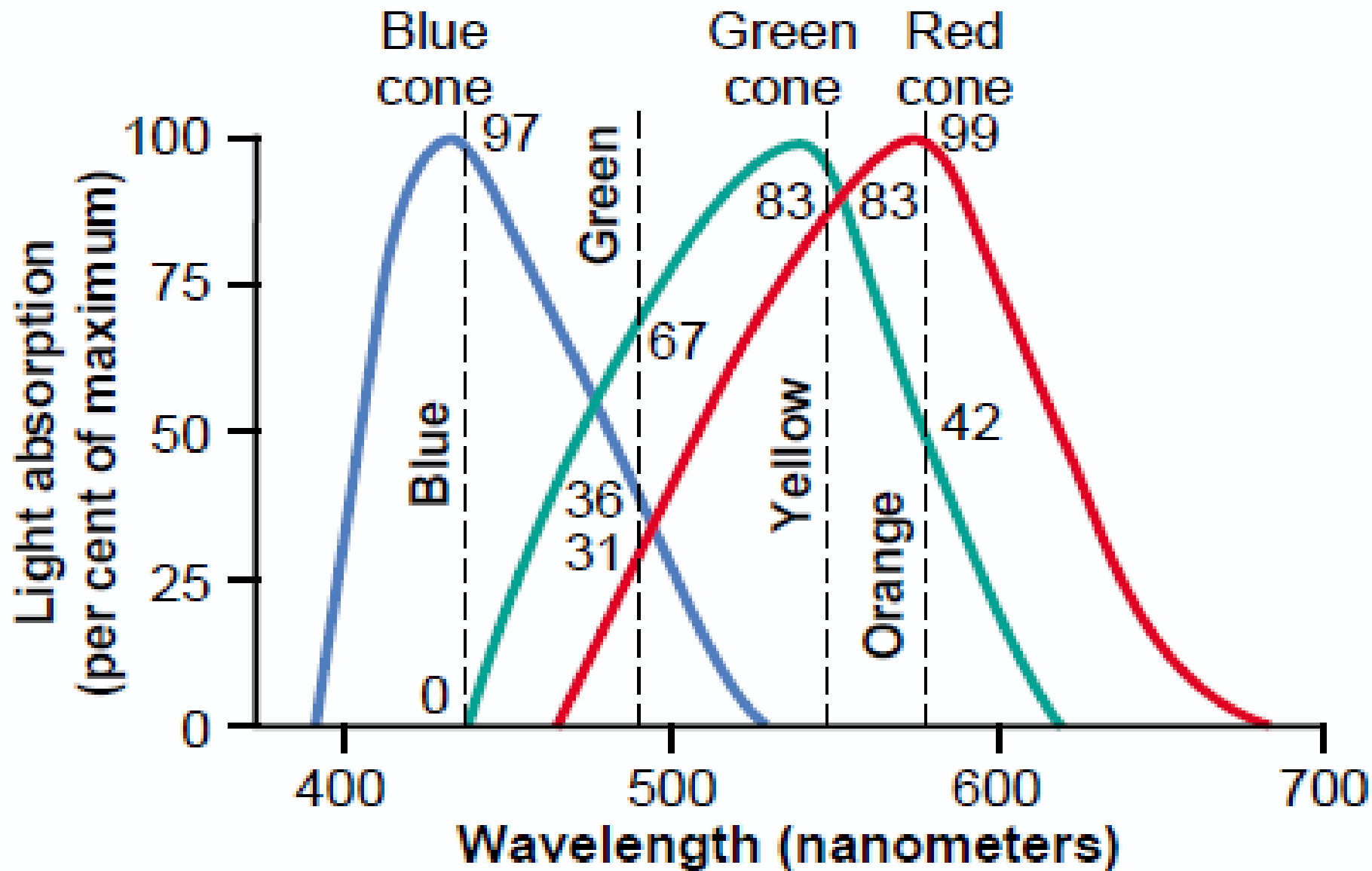


perception of white is due to:
equal stimulation of

blue & red & green cones.

(white is a combination of all wave
lengths)





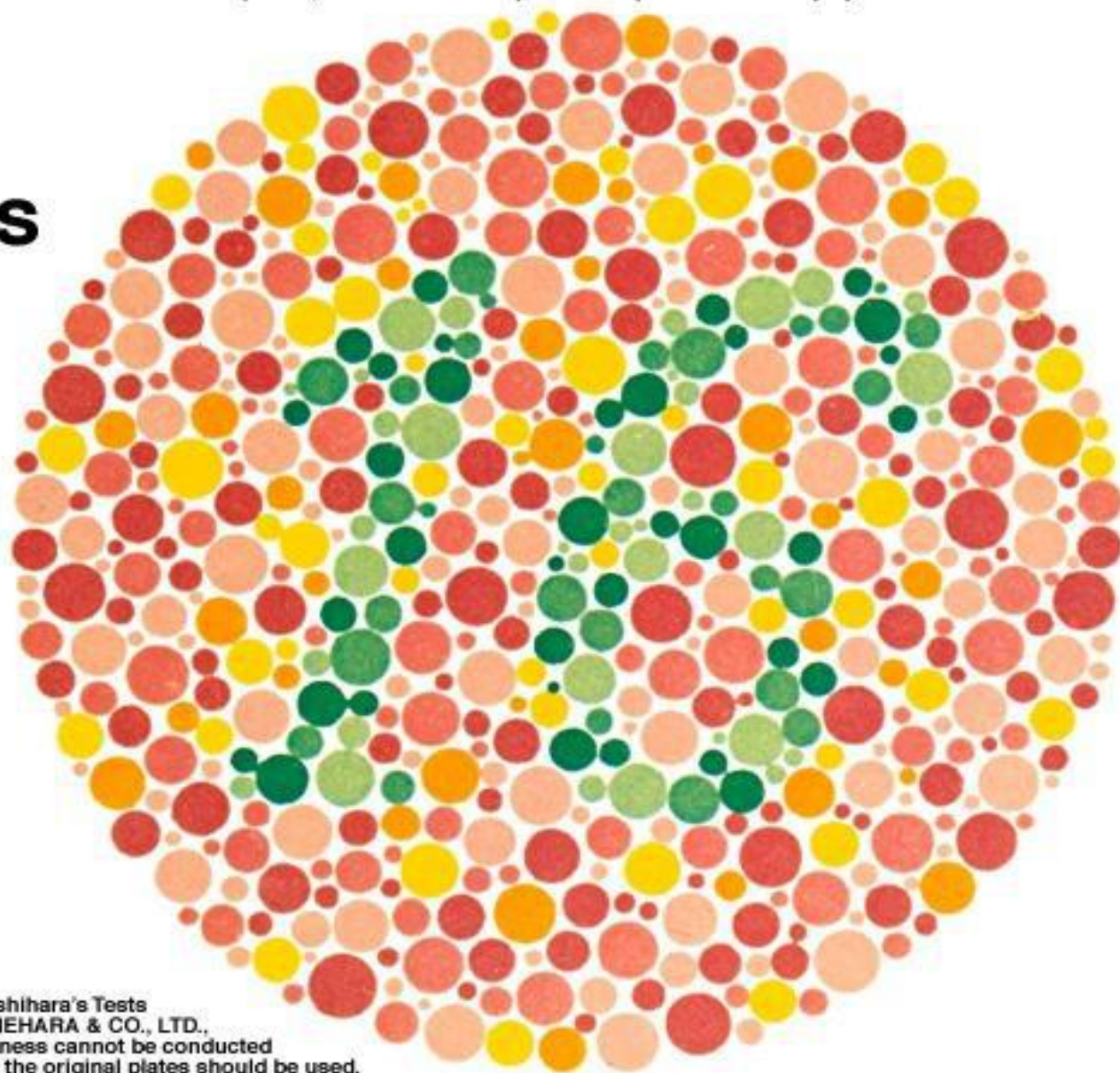
Color vision is coded by :-

- # different responses in ganglion cells that depends upon the wave length of stimulus which determine frequency of impulses in ganglion cells
- # the color perception in the brain depends on the amount of activity in each of the 3 cone systems as mentioned above.

Color Perception

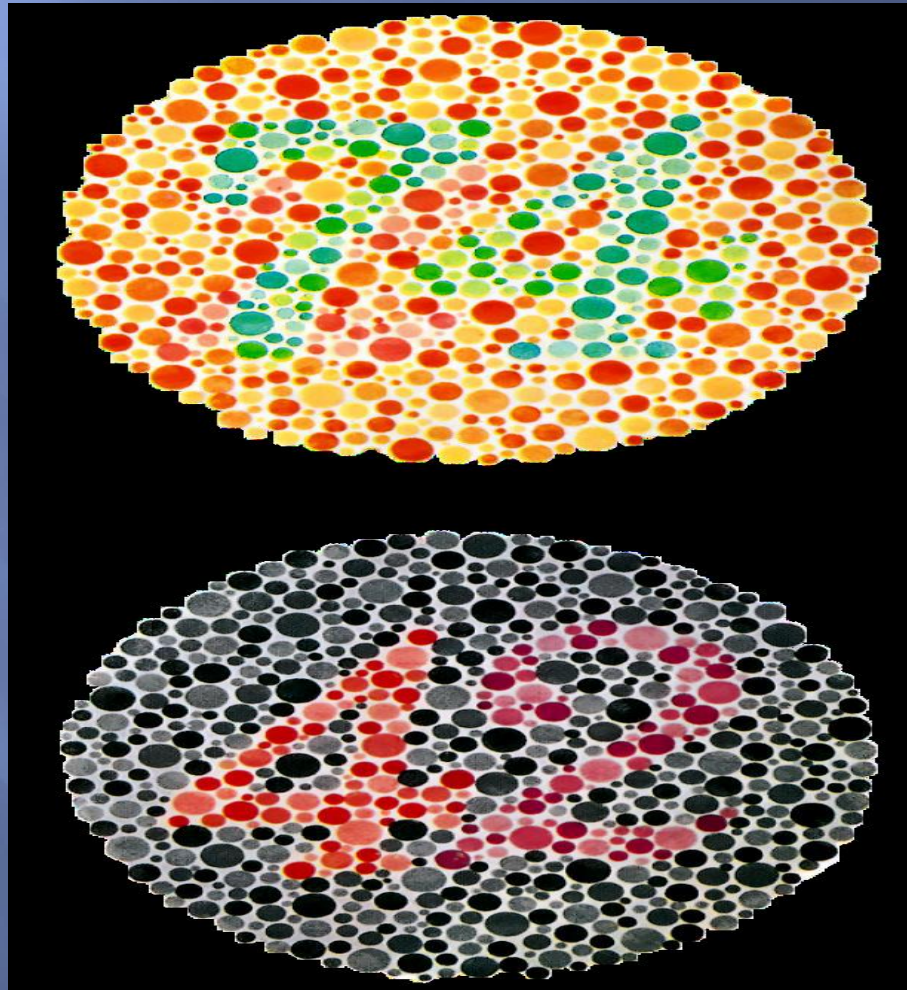
- Perception of orange is due to stimulation of 99% of red cones & 42% of green cones & 0% of blue cones(so ratio is 99:42: 0)
- For perception of yellow the ratio is 83:83: 0.
- Perception of blue is due to stimulation of 0% of red cones & 0% of green cones & 97% of blue cones(so ratio is 0:0: 97)

Test for Color Blindness



The above has been reproduced from Ishihara's Tests for Colour Blindness published by KANEHARA & CO., LTD., Tokyo, Japan, but tests for colour blindness cannot be conducted with this material. For accurate testing, the original plates should be used.

Ishihara Charts



Color Blindness

Weakness or total blindness in detecting a primary color:

Definitions:

1. **Trichromats**: see the 3 1ry colors
2. **Dichromats**: blind to one 1ry color
3. **Monochromats**: have only one color pigment

Color Blindness -cont.

- ▣ Prot Red
 - ▣ Deuter Green
 - ▣ Trit Blue
 - ▣ Anamoly ...weakness
-
- ▣ Protanamoly
 - ▣ Deuteranamoly
 - ▣ Tritanamoly
- Trichromats

Color Blindness -cont.

- ▣ Anamoly ...weakness
 - ▣ Anopia Total loss
 - ▣ Protanopia
 - ▣ Deuteranopia
 - ▣ Tritanopia
- Dichromats
-
- ```
graph LR; A[Protanopia] --- B[Dichromats]; C[Deuteranopia] --- B; D[Tritanopia] --- B;
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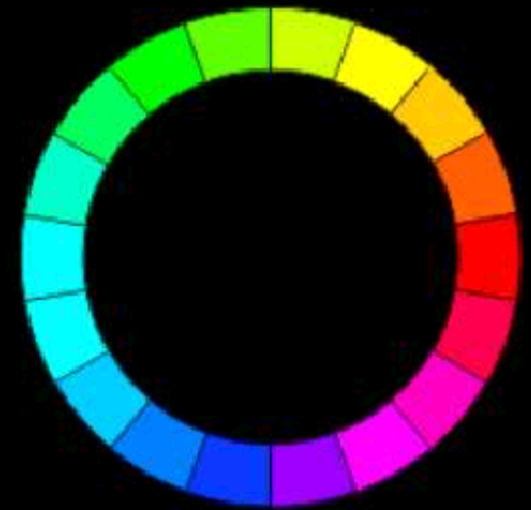
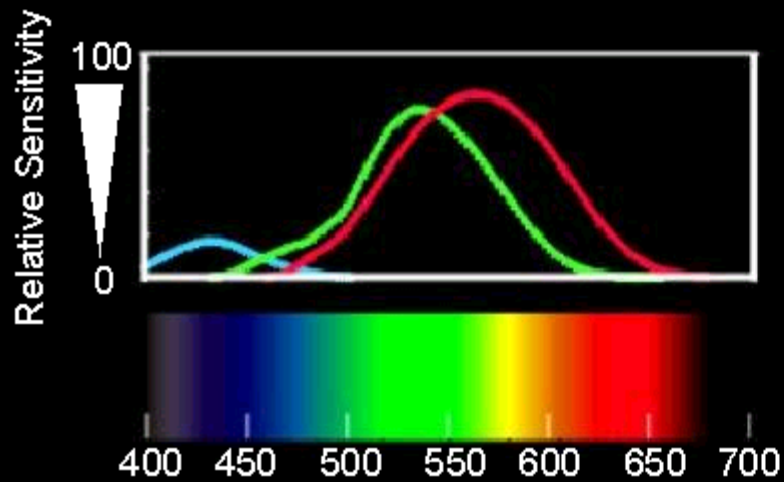
# COLOR BLINDNESS

## Red - Green Blindness:-

- Green & red cones see different colors between wave length 525-675 nm & distinguish them.
- If either of these cones are absent, the person can not distinguish 4 colors ( red - green- yellow- orange)& he can not distinguish red from green (primary colors) so called ( red - green blindness).

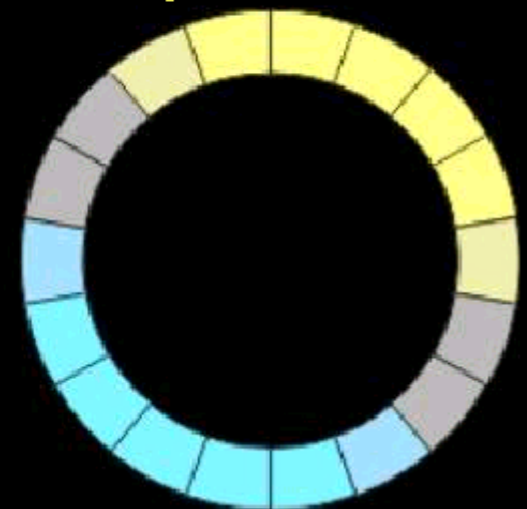
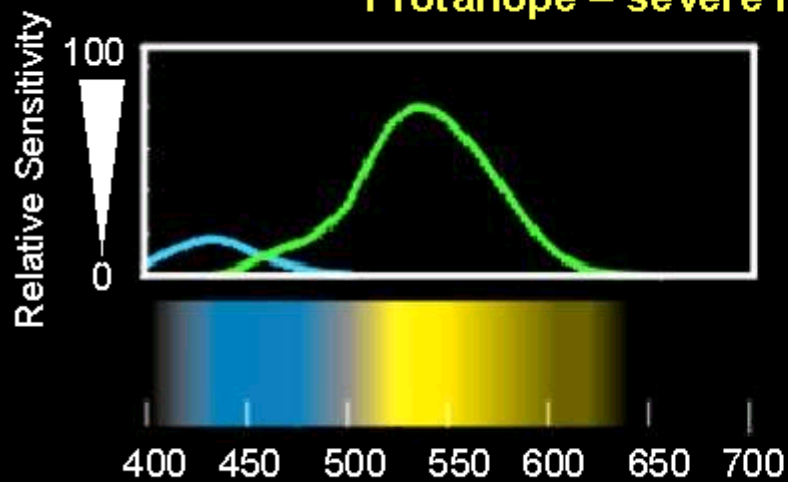


## Trichromatic Vision



## Dichromatic Vision

Protanope – severe red/green color deficiency



# Color Blindness -cont.

- It is x- linked disease transmitted from females to their male sons ( 8% of female are carrier)
- Males have one x & one y chromosome so if this one x chromosome miss the gene for color vision , he will get red-green color blindness(their gene is on x chromosome).
- Females show the disease only if both x chromosomes lack the gene .
- Females from color blind fathers are carriers transmit the disease to  $\frac{1}{2}$  of their sons.

