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
WEBSHOTS

Color Vision

- It 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 (rhodopsin)& 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.

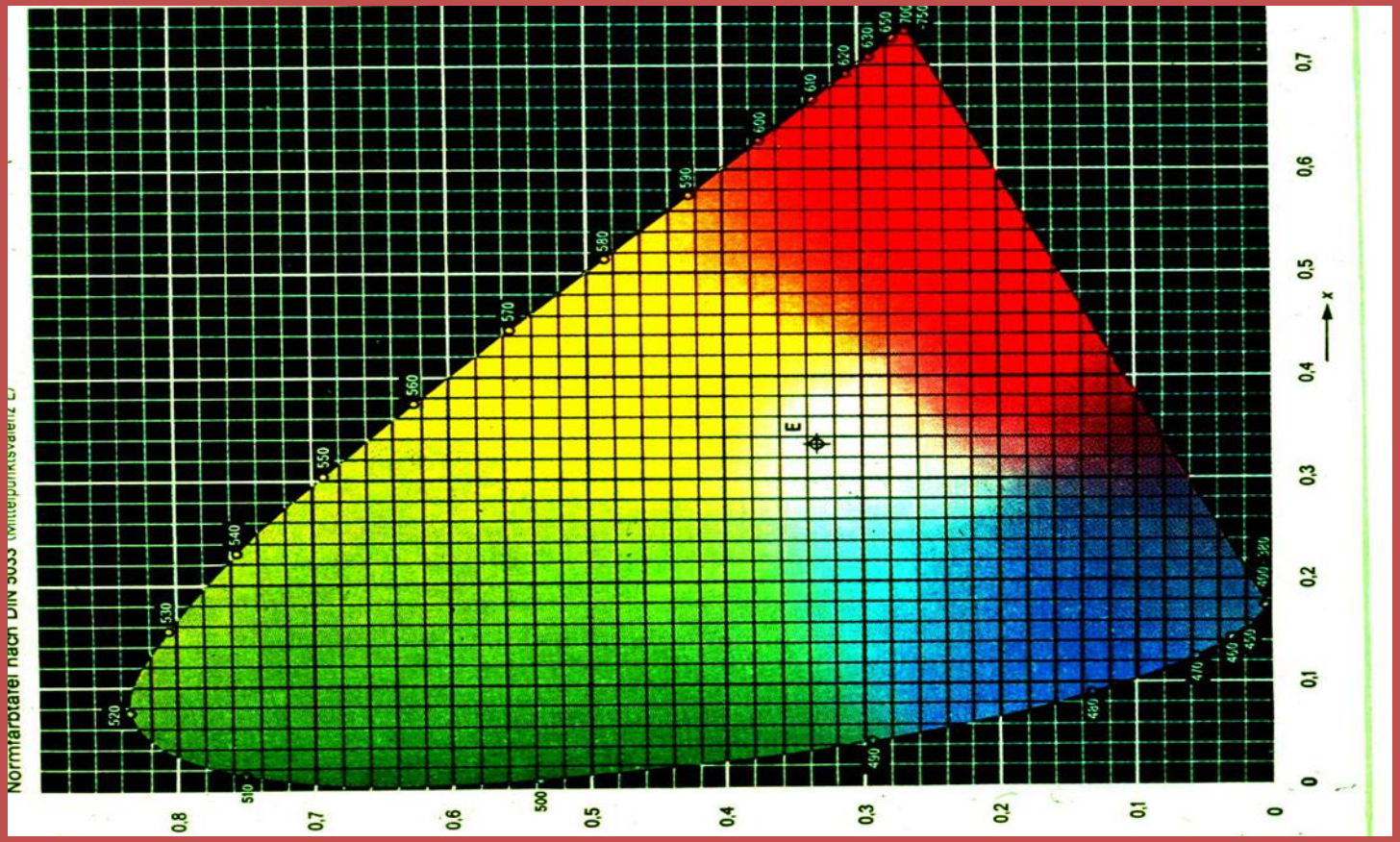
- Red cone system:- has L pigment (red sensation pigment) which respond to large wave length at or > 535 nm so senses the red & yellow color & absorb light at the red portion.


LB

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



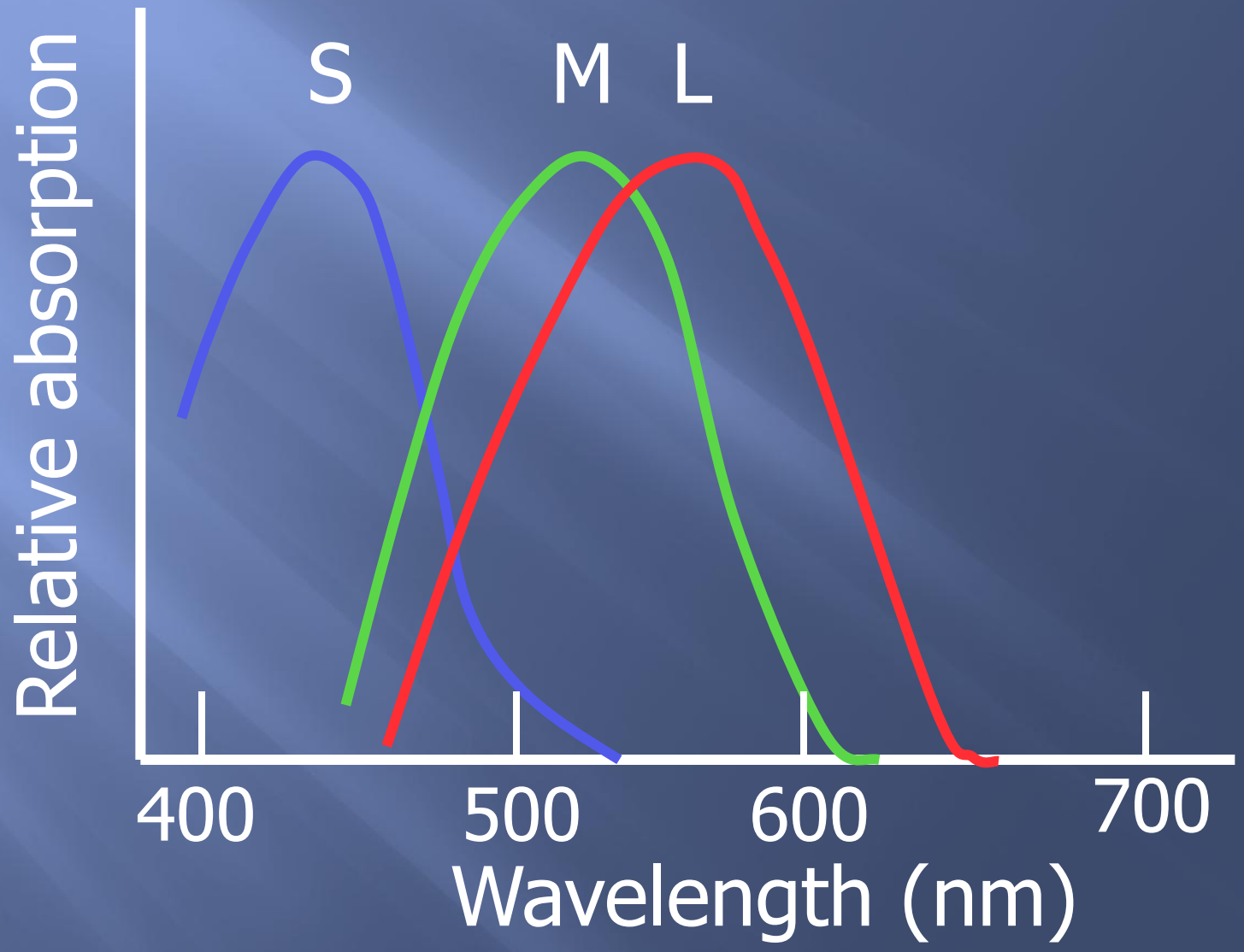
Photopic vision (CONES)

Helmholtz ..1860:

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

White light is produced by mixing three colours

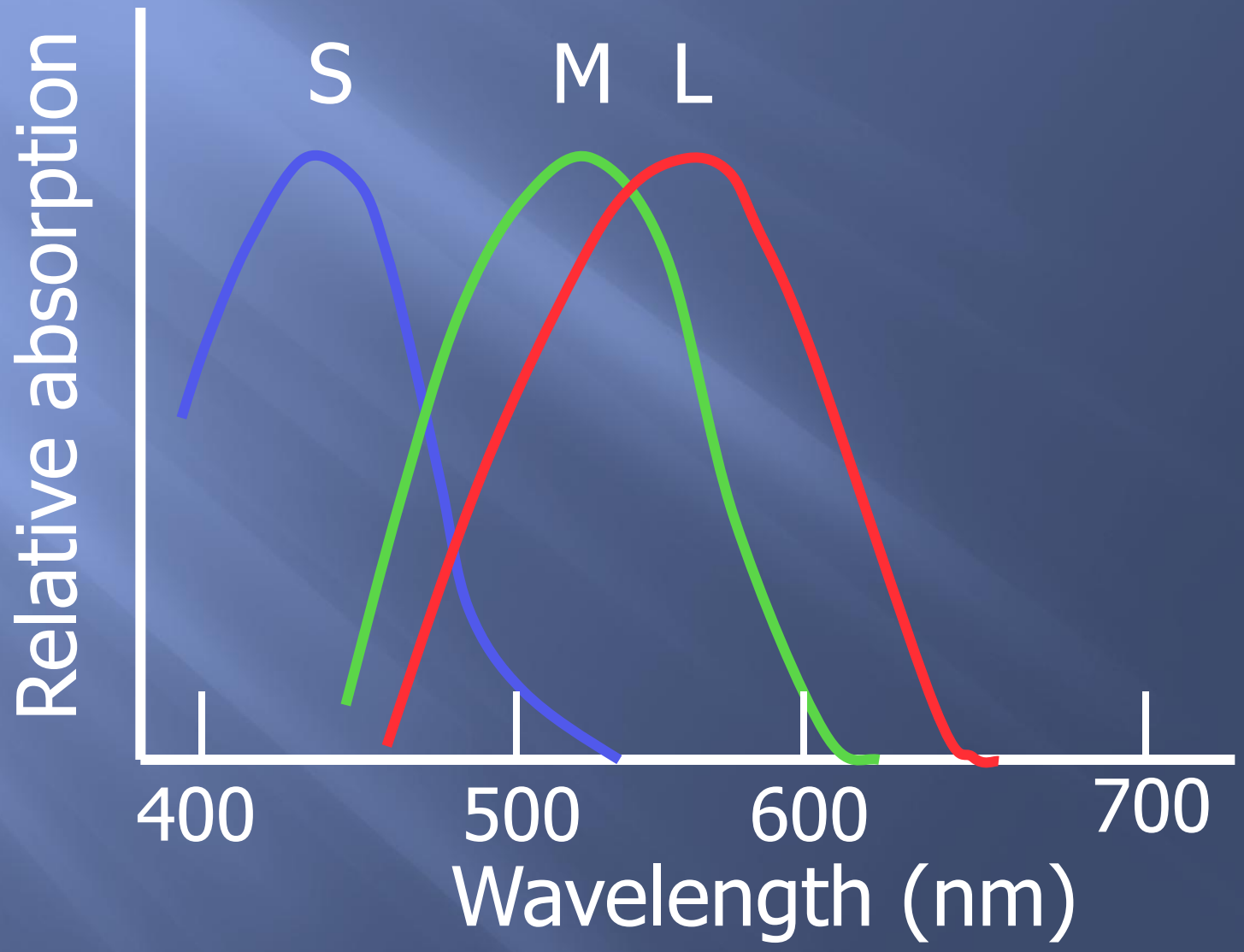
Cone wavelength ranges



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.

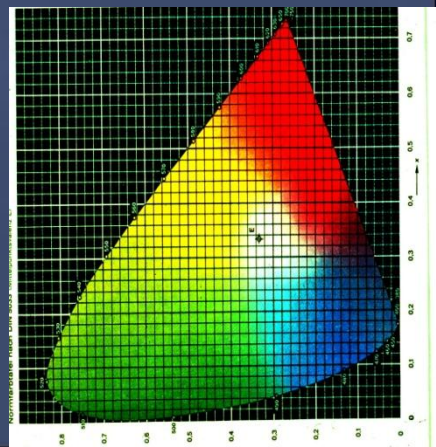
Photopic vision

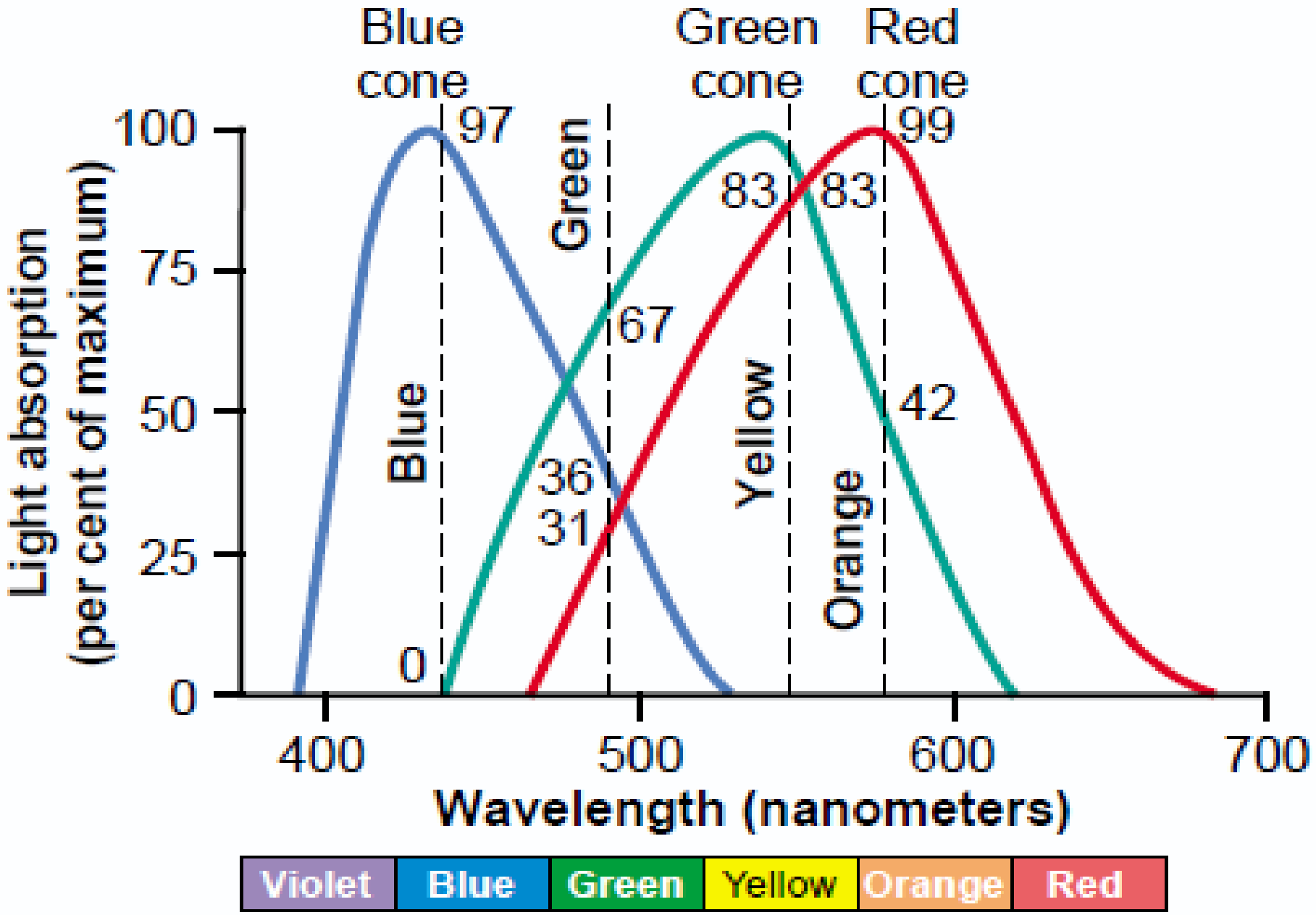
perception of white is due to:

equal stimulation of

blue & red & green cones.

(white is a combination of all wave lengths)




Blue cone
Green cone
Red cone
100
75
50
25
0
Light absorption (per cent of maximum)
97
99
83
83
67
42
36
31
0
Blue
Green
Yellow
Orange
400
500
600
700
Wavelength (nanometers)
Violet
Blue
Green
Yellow
Orange
Red

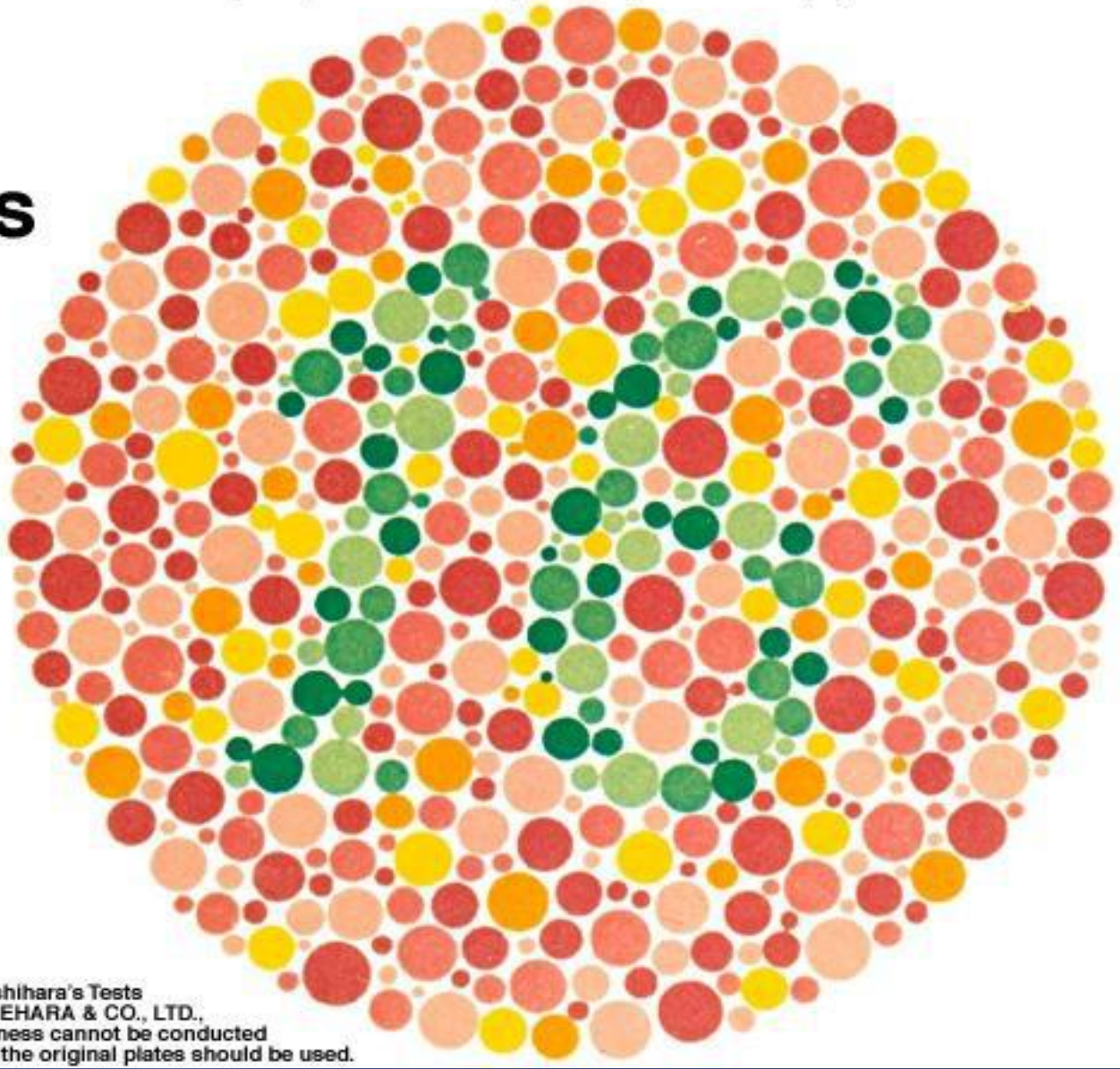
Color vision is coded by :-

- 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

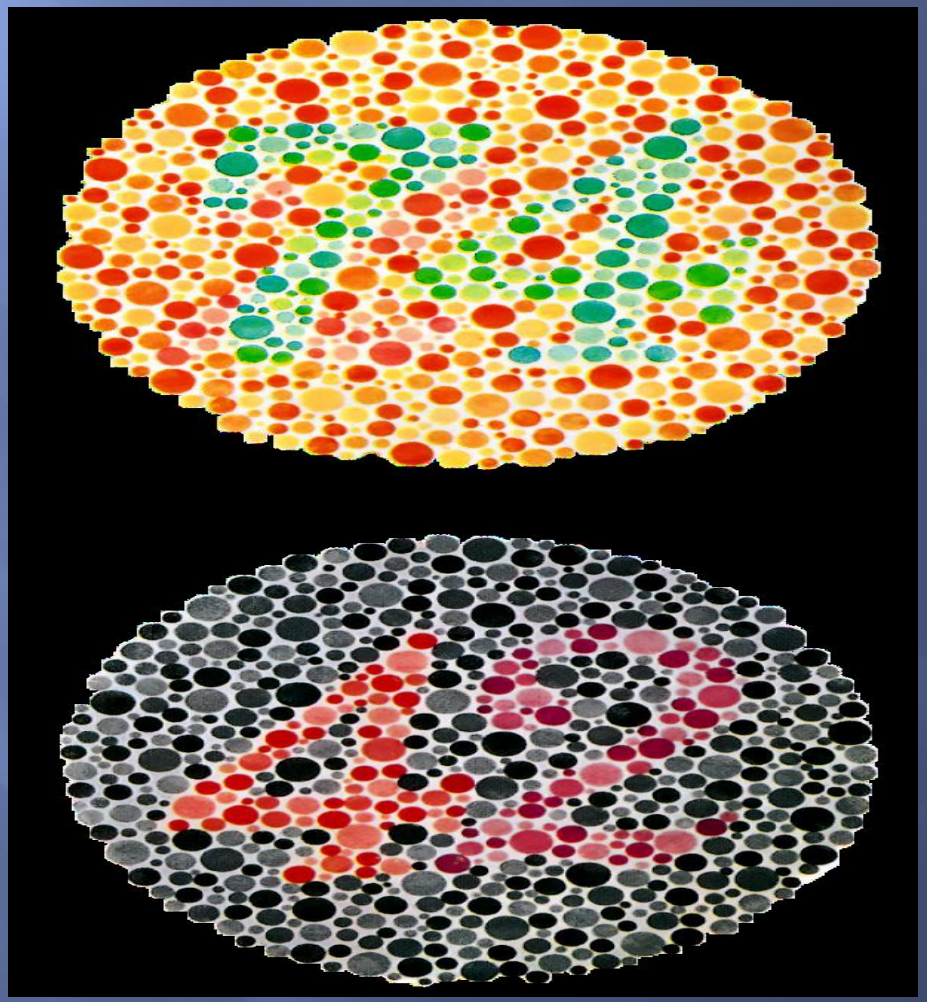
- Perception of orange is due to stimulation of 99% of red cones & 42% of green cones & 0% of blue cones(so ratio is 99:42: 0)
- For perception of yellow the ratio is 83:83: 0.
- Perception of blue is due to stimulation of 0% of red cones & 0% of green cones & 97% of blue cones(so ratio is 0:0: 97)

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

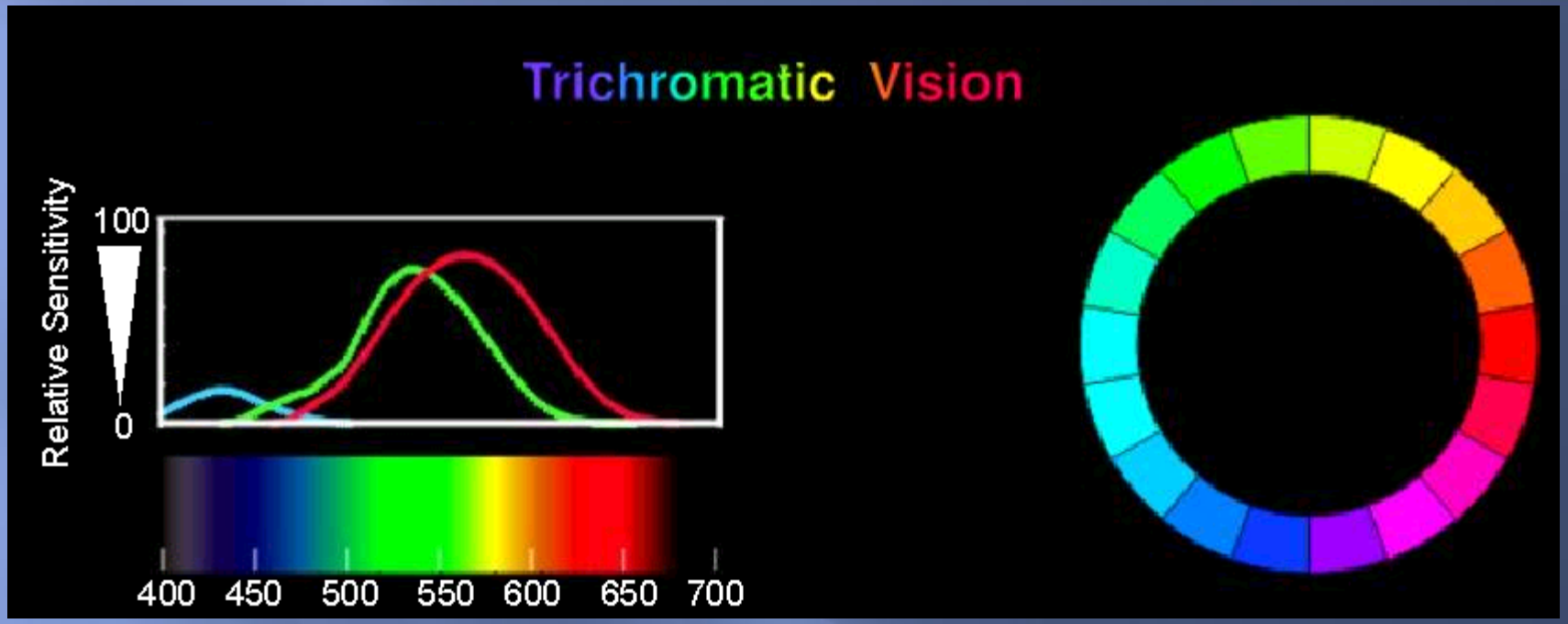
- Protanopia
- Deuteranopia
- Tritanopia

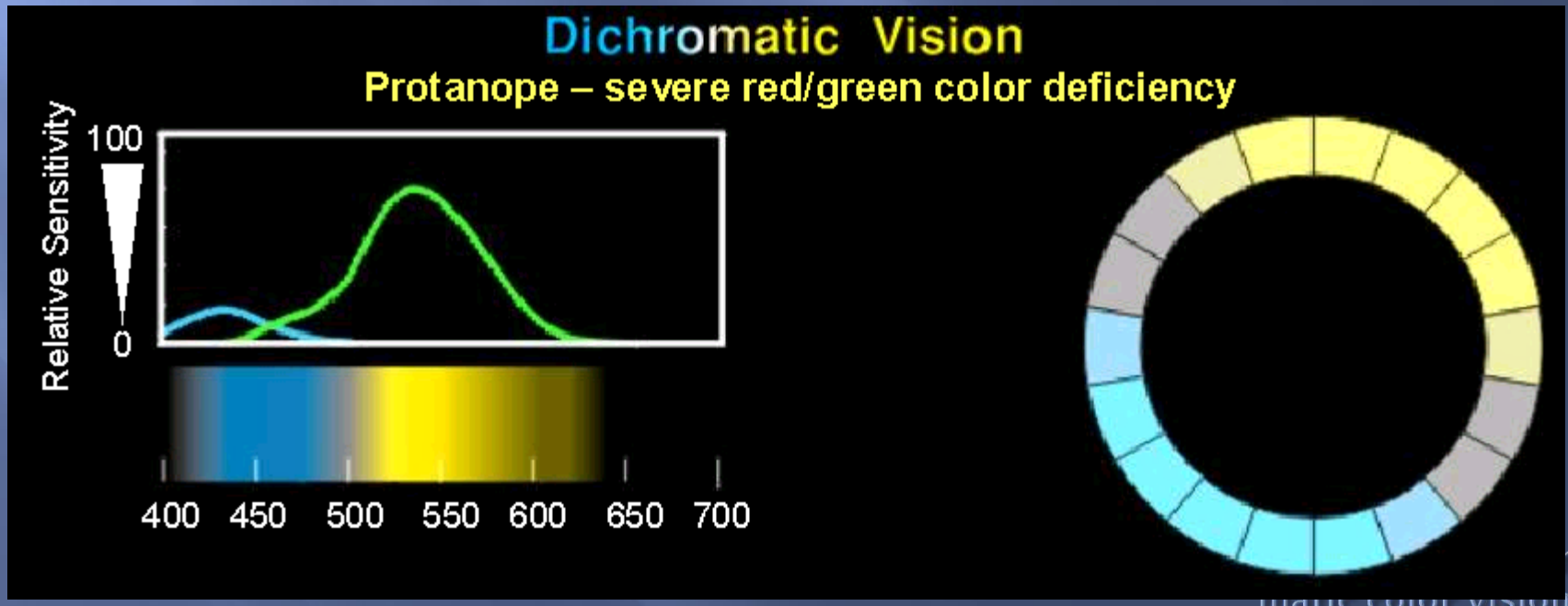
Dichromats

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
Relative Sensitivity
100
0
400 450 500 550 600 650 700


Dichromatic Vision
Protanope – severe red/green color deficiency
Relative Sensitivity
100
0
400 450 500 550 600 650 700

Color Blindness -cont.

- It is x- linked disease transmitted from females to their male sons, never occure in females as they have 2 x chromosomes –
- 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.