# Vision Part 4

# Physiology of Color Vision


Color index

- Important
- Further Explanation

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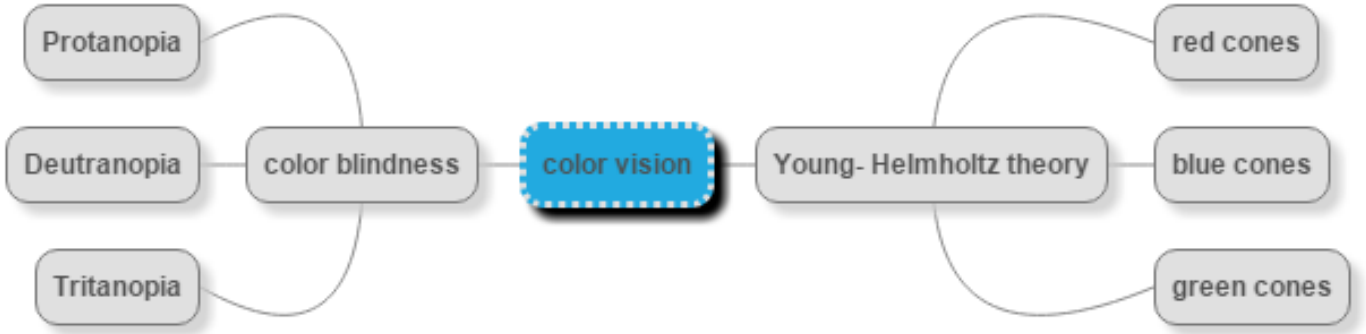
# Contents



**Recommended Video!**

**Please check out this link before viewing the file to know if there are any additions/changes or corrections. The same link will be used for all of our work Physiology Edit**


Protanopia
Deutranopia
Tritanopia
color blindness
color vision
Young- Helmholtz theory
red cones
blue cones
green cones

Mind Map

# COLOR VISION

Its the ability to discriminate between different colors

- there are 3 primary colors( blue- red- green) sensed by cones in fovea & appreciated within photopic vision (Cones).

- sensation of extra spectral colors as white, yellow, orange, purple, can be produced by mixing properties of the blue &red & green in different combinations.

perception of white is due to equal stimulation of blue & red & green cones. There is **no wave length** corresponds to white, white is a combination of all wave lengths in the spectrum.

What about **Black** ?

black means absence of light ( not darkness because in dark we do not see black only)

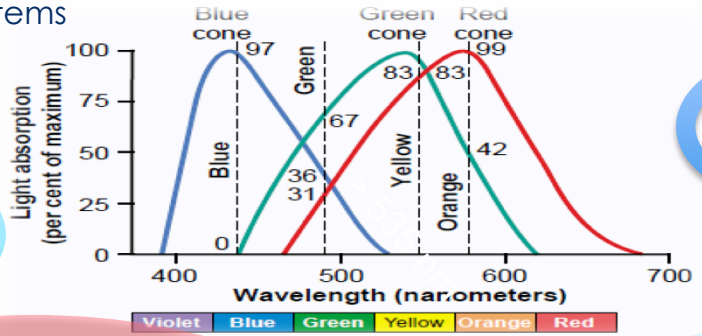
blind eye does not see **black** rather, it sees nothing

## Characteristics of color

Colors have three attributes hue, intensity, and saturation (degree of freedom from dilution with white). For any color there is a complementary color that, when properly mixed with it, produces a sensation of white.

# Color vision theory ( Young- Helmholtz theory ) :

The color perception in the brain depends on the amount of activity in each of the 3 cones systems




**sensation of any color determined by**

1-wave length of light

2-amount of light absorbed by each type of cones

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

**Blue cone system**:- has S pigment ( blue sensation pigment) which respond to short wave length ( 440 nm senses the blue color)

we have 3 kinds of cones each has a specific photo-pigment (rhodopsin)& is sensitive to one of the 3 primary colors

**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.

**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.

Each cone system respond to its color at a lower threshold than needed to sense other colors ( red cones respond to red or yellow color at a lower threshold than to green color)

# Color vision is coded by?

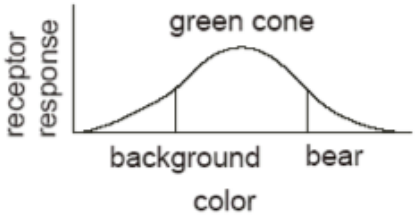
different responses in ganglion cells that depends upon the wave length of stimulus which determine frequency of impulses in ganglion cells

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)

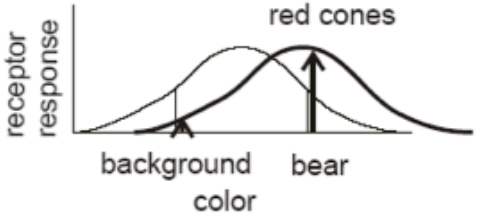
perception of blue is due to stimulation of 0% of red cones & 0% of green cones & 97% of blue cones
( so ratio is 0:0: 97 )

perception of yellow is due to stimulation of 50% of red cones & 50% of green cones & 0% of blue cones
( so ratio is 50:50: 0)

Spectral sensitivity of a cone.




green cones see




red cones see

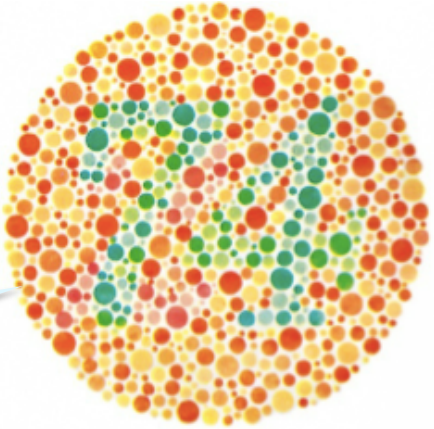
## What is the advantages of color vision?

Color is important for distinguishing an object from its background

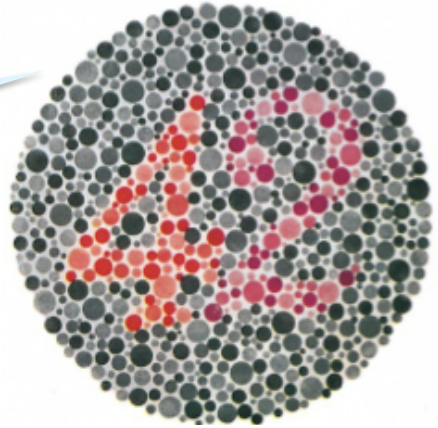
# Ishihara charts

Which are plates containing figures made up of colored spots on a background of similarly shaped coloed spots.

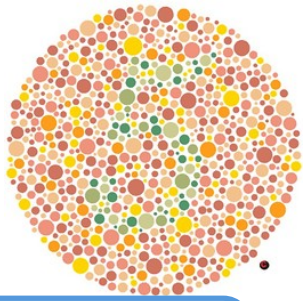
They are intentionally made up of colors that are liable to look the same as the background to an individual who is color blind



Some color blind individuals are unable to distinguish certain colors, whereas others have only a color weakness



# Color Blindness



- There is Gene for rhodopsin → on chromosome (**3**) .
- And Gene for blue sensitive s cone pigment → on chromosome (**7**) .
- Gene for red & green sensitive cone pigment → on **x** chromosome .

when a single group of color receptive cones is absent **( due to absence of there gene)** the person can not see or distinguish some colors from others

## **Red-green** blindness (most common)

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).

it is **X-linked** disease.

Transmitted from females to their male sons, never occure in females as they have 2 x chromosomes

EXCEPT if both x chromosomes lack the gene so Females will show the disease

- 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 from color blind fathers are carriers transmit the disease to ½ of their sons.

## Trichromats

have 3 cone pigments( normal or have slight weakness in detecting red or green or blue color

## Dichromats

have 2 cone pigments systems only so he is completely blind to red or green or blue ( so they may have protanopia, deuteranopia,or tritanopia)

## Monochromats

have only one cone system or loss of all so see only black or grey or have no color perception.

they get color by mixing only 2 of the primary colors

Protanopia (rad-blindness)

Deuteranopia (green-blindness)

Tritanopia (blue-blindness)

no red cones system so person has shortened spectrum wave length, ( if only weakness in red color vision is called protanomaly.)

no green cones system
-so person see only long & short wave length)
- if only weakness in green color vision is called deutranomaly.

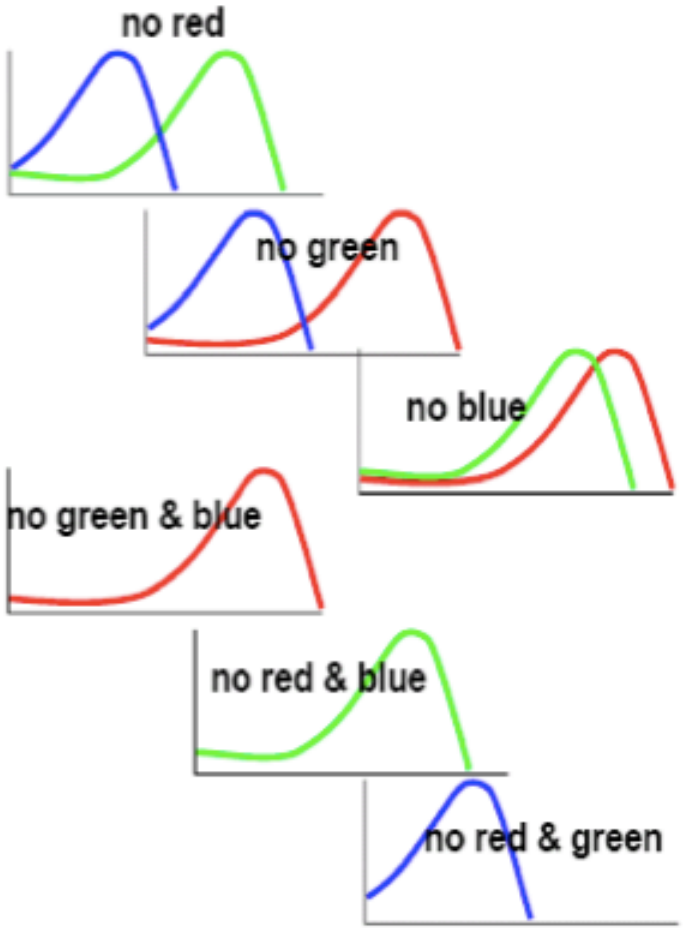
No blue cones system , if only weakness in blue color vision is called tritanomaly.

**NOTE :** Nopia in the end of the word means blindness, nomaly means = weakness
Prot = RED , Deuter= GREEN , Trit=BLUE

# Colour blindness.

Each cone type contains a different light sensitive photo pigment. Colour blindness occurs when there is a defect in the genes that produce these photo pigments. Various combinations of defects can occur.

1) Missing one cone type
2) Missing two cone types
3) Missing all three cone types (vision is limited to the rods)
4) A cone type is made with a photo pigment different from normal.



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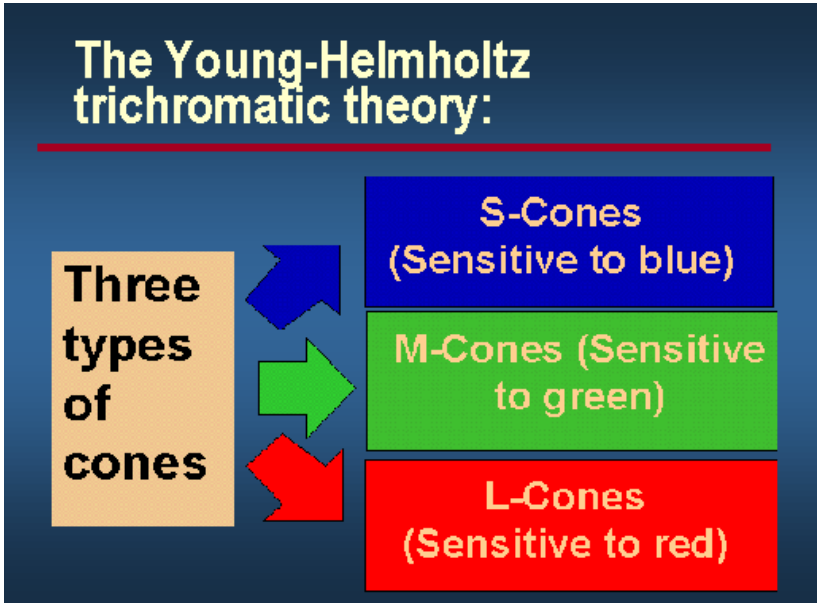
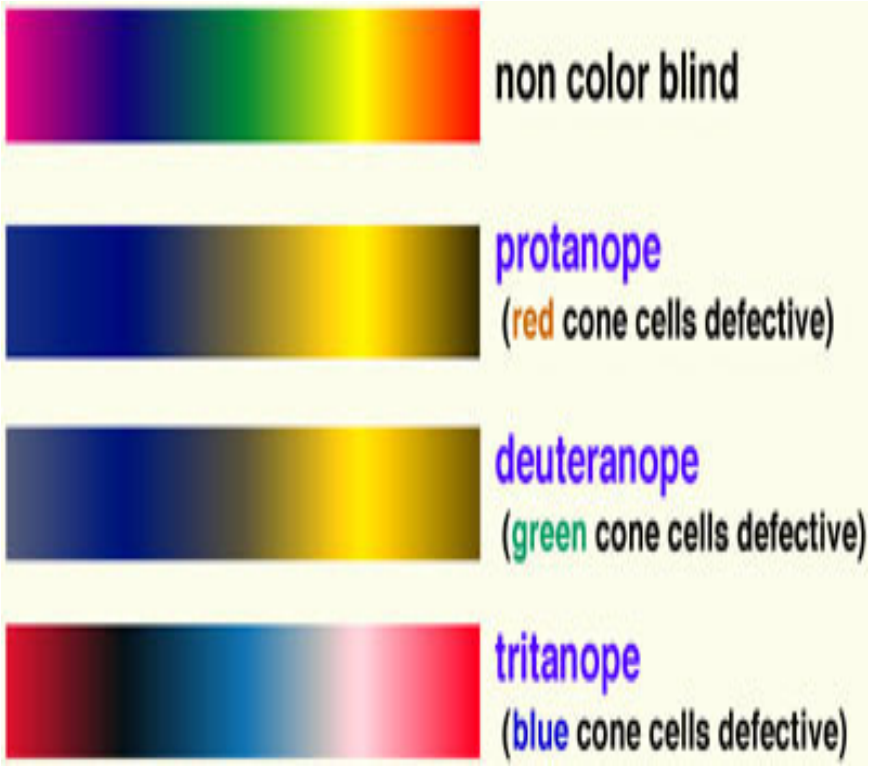

The Young-Helmholtz trichromatic theory:
Three types of cones
S-Cones (Sensitive to blue)
M-Cones (Sensitive to green)
L-Cones (Sensitive to red)


non color blind
protanope
(red cone cells defective)
deuteranope
(green cone cells defective)
tritanope
(blue cone cells defective)

Summary

**1- there are 3 primary colors are sensed by:**
A. Rods in fovea
B. Cons in the peripheral
C. Cons in fovea
D. Rods in the peripheral

**2-Blue cone system respond to short wave length:**
A. 440 nm
B. 442nm
C. 441nm
D. 445nm

**3-Which one of the following has only one cone system or loss of all ( see only black or grey or have no color perception )**
A. Dichromats
B. Monochromats
C. Trichromats
D. none

**4- Deuteranomaly is a condition of ?**
A. Trichromats
B. Dichromats
C. Monochromats
D. None

**5- there is a carrier women for red-green blindness but her husband is normal, they have 4 sons & 2 daughters. There will be ?**
A. . All sons are affected
B. 2 sons & one daughter are affected
C. One daughter is carrier & 2 sons are normal
D. All daughters are carriers

1.c
2. a
3.B
4.A
5. C

MCQs

**1-what are the Colours attributes ?**

. hue, intensity, and saturation

**2-what is Colour vision?**

. It the ability to discriminate between different colors.

**3- what are the three cons system?**

.blue, red and green cons system

**4-how does the white light form?**

.by the combination of all the wavelengths of the spectrum.

**5- pathway of color vision start with?**

. Cones

**6- where are cones found ?**

. In the fovea centralis .

SAQs

THANK YOU FOR CHECKING OUR WORK!

# BEST OF LUCK

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