



Physiology Team



Lecture : 16

Color Vision

Done By: Najoud Al-Otaibi
Reviewed By: Othman Al-Mutairi.

OBJECTIVES

At the end of this lecture, student should be able to describe:

- 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.
- Compare different types of color blindness.

MIND MAP

important

Color Vision

Sensation of colors

Sensation of the **3 primary** colors

Sensation of the **ExtraSpectral** colors

Young Helmholtz theory

Orange

yellow

Blue

R	G	B
99	42	00

R	G	B
50	50	00

R	G	B
00	00	97

Colors Defects ☹️

rhodopsin gene defect
In **Chrom. (3)**

red-green blindness : Defect in **Chrom. (X)** sex linked (males)

Red Cone

L=Long wave length ($L > 535$ nm)
sense More yellow

Green Cone

M=Medium wave length
(535 nm) sense Less yellow

Blue Cone

S=Short wave length (440 nm)

Anopia= blindness
Anomaly= Weakness
Protanomaly

(Protanopia) red-blindness

(Deutanopia) green-blindness

(Tritanopia) Blue blindness
Defect in **Chrom.(7)**

Slides

Important

Doctor's Notes

Explanation

Boy's Slides

Sensation of any color determined by:

- a- Wave length of light
- b- Amount of light absorbed by each type of cones
- c- Frequency = (No. of impulses) from each cone system to ganglion cells which is determined by wave length of light.

Important notes:

- Each cone system respond to its color at a **Lower Threshold**.
(red cones respond to red or yellow color at a **Lower Threshold** THAN to green color)
- Perception of white is due to **equal stimulation of (blue + red + green)** cones, White has **NO wave length**. (white = combination of all wave lengths).
- A single wavelength can be perceived as = 200 level of hues*20 level of saturation*500 brightness level=2,000,000 possible gradation of color with only three type of cones.!!!
- Conic rational stimulation in color perception:
Orange=(99:42:0), Yellow=(50:50:0).

Color Defects:

1) red –green blindness:-

- **CAN'T** see different colors between wave length 525-675 nm & distinguish them.
- **CAN'T** distinguish 4 colors (**red** – **green** – **yellow** - **orange**)
- He **CAN'T** distinguish **red** from **green** (primary colors)

- x-linked disease transmitted from females to their male sons, never occur in females as they have 2 x chromosomes (**unless Both affected**)
- **Mostly in males.**
- (Females from red-green blinded fathers are just **carriers**) and give the disease to $\frac{1}{2}$ **of their sons.**

2) Trichromats:-

Normal 3 cone pigments or have slight weakness in just one of them

Cont. Colors Defects:

3) Dichromats:-

- Have only 2 NORMAL cone pigments so he is **COMPLETELY BLIND** to red or green or blue
- So they may have:
 - **Protanopia**= has short spectrum wave length (weakness = **protanomaly**)
 - **Deutanopia** = see only long & short wave length (weakness = **deutanomaly**)
 - **Tritanopia** = see long & medium wave length (weakness = **tritanomaly**)

4) Monochromats:-

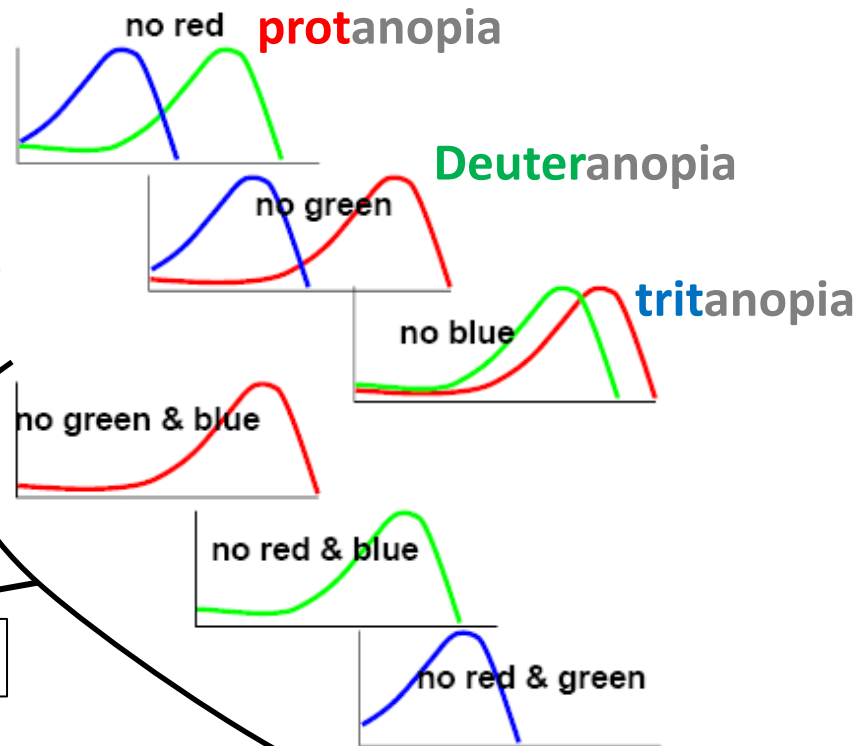
- Have only 1 NORMAL cone pigment or **loss of all 3 pigments**
- See only (black or grey) or have **NO COLOR perception**

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.

Monochromats



SUMMARY

- **Young Helmholtz theory** of the **3** primary colors (**Red** – **Green** – **Blue**).

- **Sensation of any color is determinate by :**

- 1) **Wave length** of light.

- 2) **Amount of light** absorbed by each cone.

- 3) **Frequency** of impulses from each cone system to ganglion cells.

Determined by **Wave Length of light**.

- **Colors defects are either:**

- **TRI**chromats (ALL cones normal or just one is slightly weak)

- **DI**chromats. e.g= (**prot**anopia, **Deu**teranopia & **trita**nopia)

- **MONO**chromats. e.g=(red-green blindness)

HELPFUL LINK 😊

How do we see colors?



http://www.youtube.com/watch?v=l8_fZPHasdo

■ Slides

■ Important

■ Doctor's Notes

■ Explanation

■ Boy's Slides

QUESTIONS

Q1: Orange has a color ratio of :

- A) 99:42:00 B) 70:50:00 C) 00:00:97 D) 50:50:00

Q2: Red cone responds equally to which of these :

- A) Red & Blue B) Red & Green C) Red & Yellow

Q3: Which of these colors has no wave length :

- A) Red B) White C) Blue D) Green

Q4: Which of these diseases is x-Linked disease:

- A) protanopia B) Deutanopia C) tritanopia D) red –green
blindness

Q5: Patient can only see Long & Short waves, what does he have :

- A) deutranomaly B) tritanopia C) deutanopia D) protanopia

Q6: Which of these cones have a wave length of 590 nm :

- A) Red cone B) Yellow cone C) Blue cone D) Green cone

**Key
Answers**

1	2	3	4	5	6
A	C	B	D	C	A

THE END

**If there are any Problems or Suggestions,
Feel free to contact:**

Physiology Team Leaders
Mohammed Jameel & Shaimaa Al-Refaie

432100187@student.ksu.edu.sa
432200643@student.ksu.edu.sa

THANK YOU