MEDICINE
KING SAUD UNIVERSITY

تمت المراجعة
شوق الأحمري & عبدالعزيز العنقري

Physiology Team 436

CNS PHYSIOLOGY

- Text
- Important
- Formulas
- Numbers
- Doctor notes
- Notes and explanation

Lecture No.12

" Don't Stop When You're Tired, Stop When you're DONE "

Color vision, light and accommodation reflex

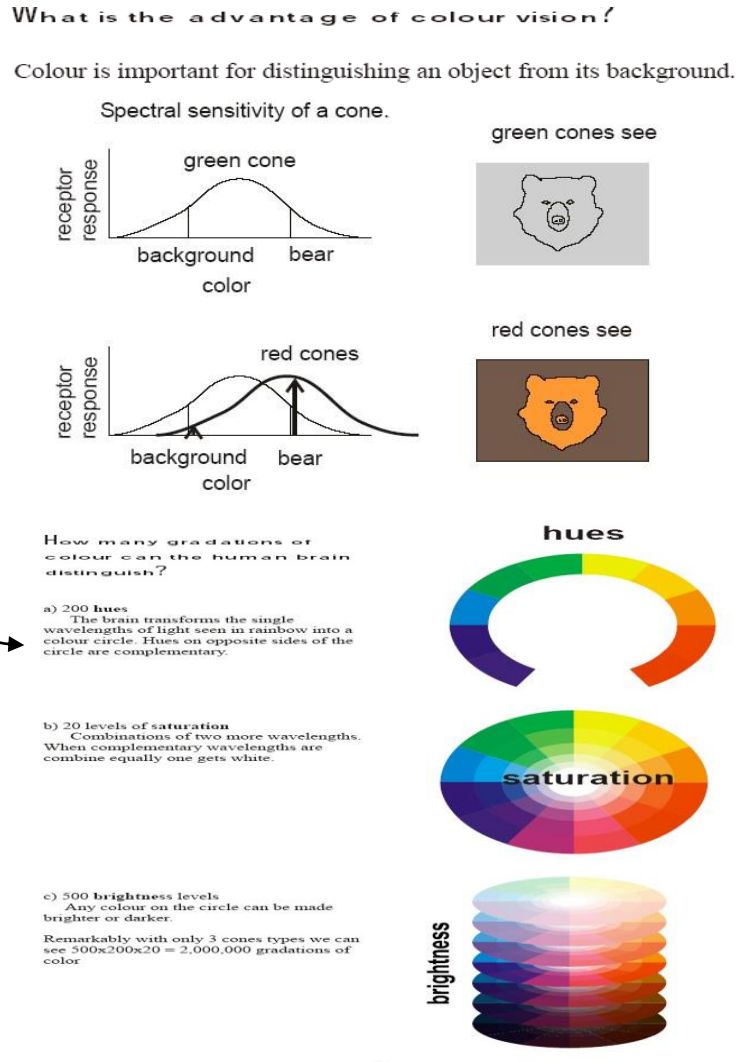
Objectives:

1. Perform the test for visual acuity using a Snellen's chart, list the common refractive errors and describe how they can be corrected.
2. Perform the test for near vision using a Jaeger's chart.
3. Perform the test for Astigmatism using Astigmatism chart and describe how it can be corrected.
4. Determine one's near point.
5. Demonstrate one's blind spot.
6. Explain the mechanisms of accommodation with the help of Purkinje-Sanson images.
7. Identify one’s color-vision defects using the Ishihara's colored charts.

Color vision

- It the ability to discriminate between different colors.

- there are 3 primary colors (blue red green) sensed by cones in fovea & appreciated within photopic vision.
- sensation of extraspectral colors as white yellow orange purple can be produced by mixing properties of the blue &red & green in different combinations.
- Black means absence of light (not darkness because in dark we do not see black only)
- 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.
- Black is the sensation produced by the absence of light, but it is probably a positive sensation because the blind eye does not "see black;" rather, it "sees nothing.



ONLY IN MALES' SLIDES

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.

Color vision theory

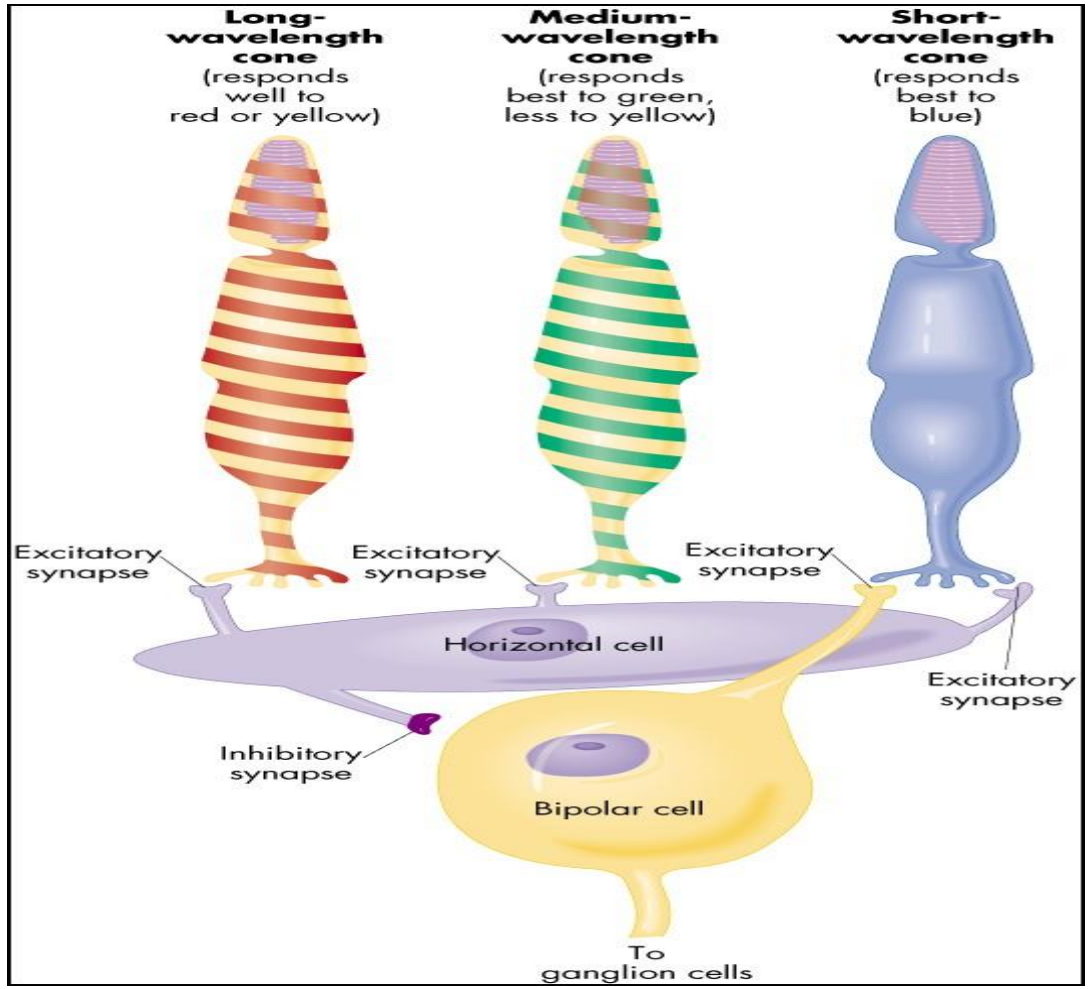
Young - Helmholtz theory (The Trichromatic theory) :
we have 3 kinds of cones each has a specific photopigment (rhodopsin) & is sensitive to one of the 3 primary colors

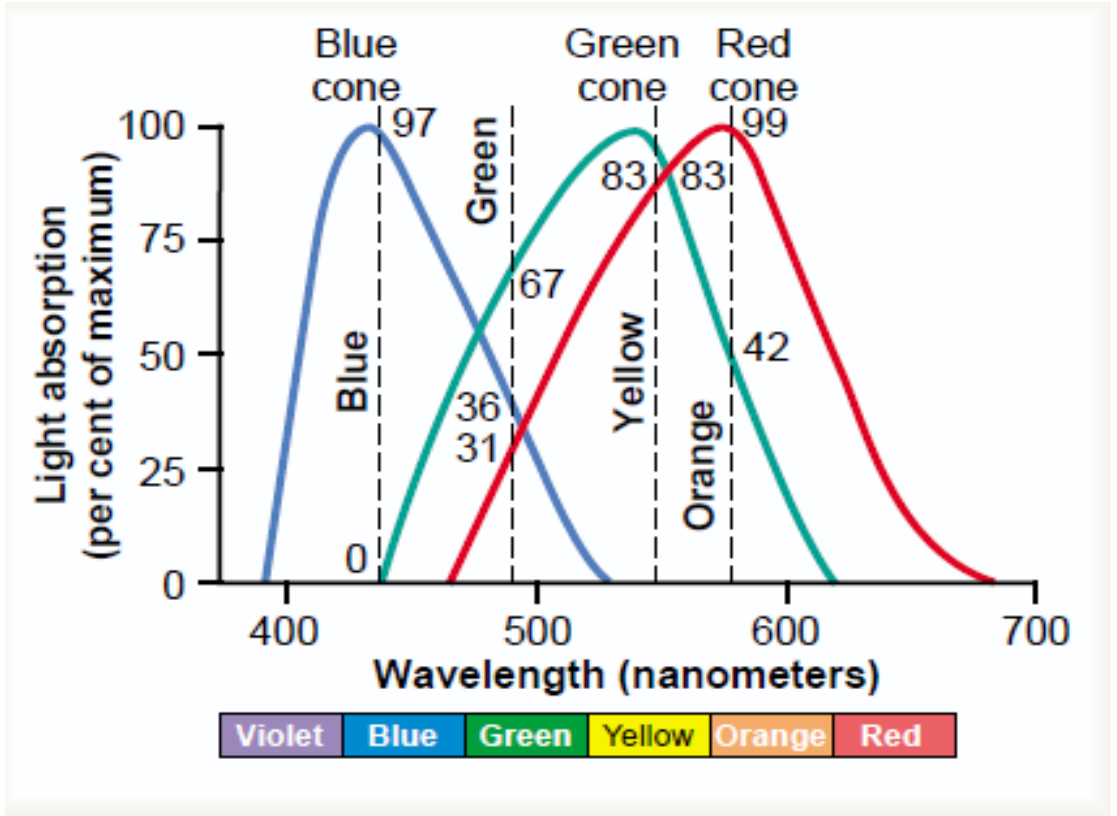
	Blue cone system	Green cone system	Red cone system
The pigment	S pigment (blue sensation pigment)	M pigment (green sensation pigment)	L pigment (red sensation pigment)
Wave length	short wave length (440 nm)	middle wave length (535 nm senses the green color & less to yellow)	large wave length at or > 535 nm so senses the red & yellow color
Absorbing light at	-	The light absorbed at the green portion	The light absorbed at the red portion

- The three primary colors are perceived by three photoreceptor pigments (with broad absorption curves).
- White light is produced by mixing three colors.
- 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).

Cone wavelength ranges

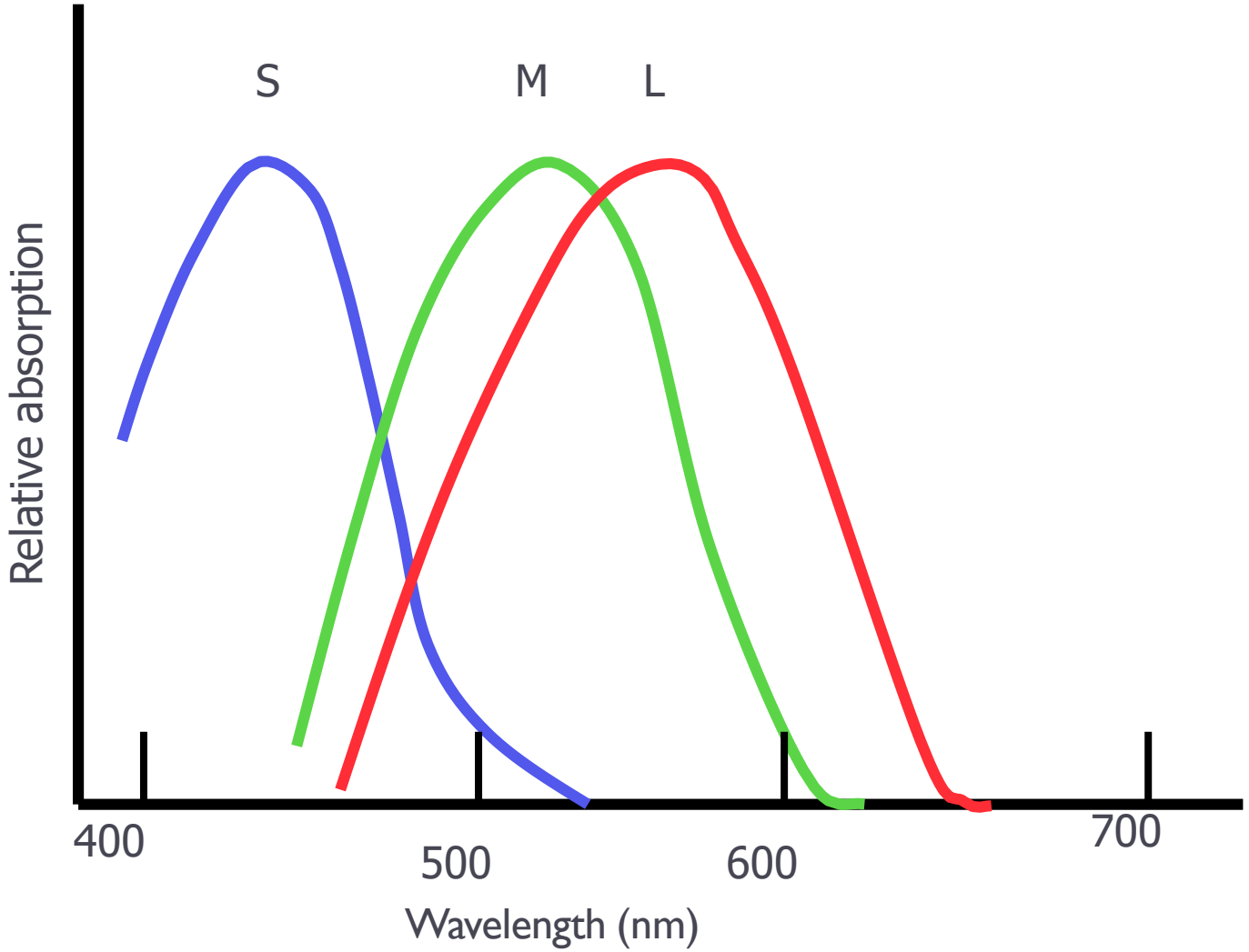
ONLY IN FEMALES' SLIDES



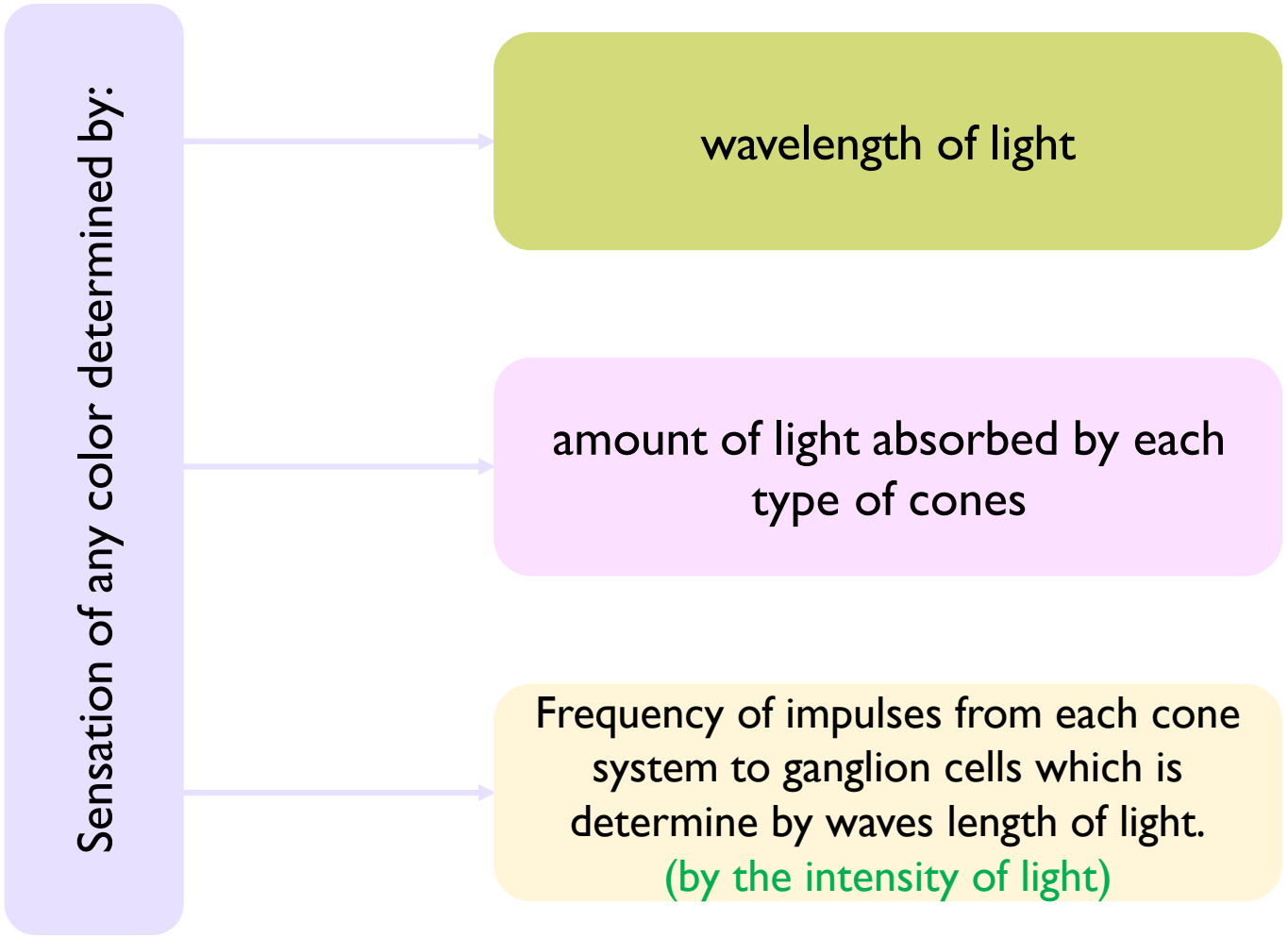


Light absorption by the pigments of three color-receptive cones of human retina.

Cone wavelength ranges

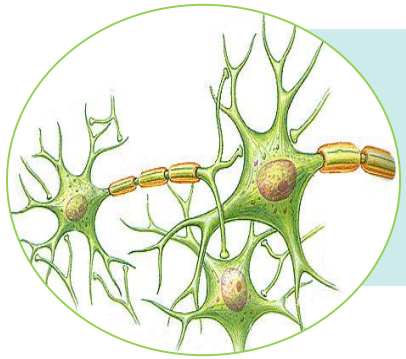


Sensation of colors



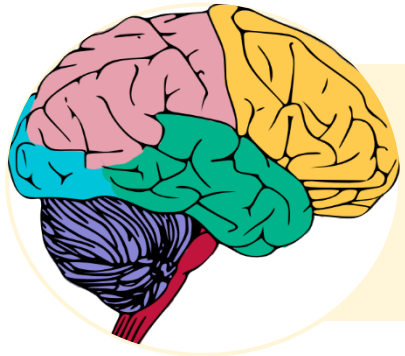
Color coding

Color vision is coded by:



In ganglion cells:

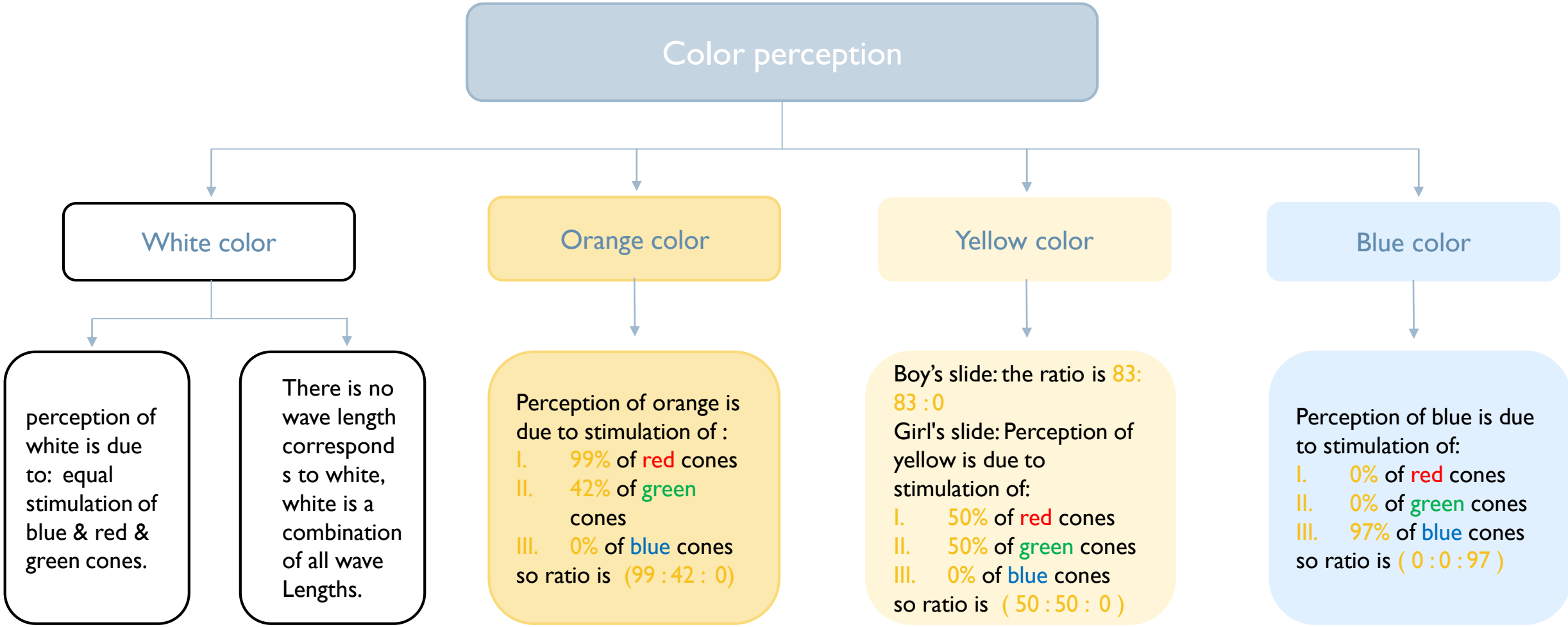
different responses in ganglion cells that depends upon the wave length of stimulus which determine frequency of impulses in ganglion cells.



In brain:

the color perception in the brain depends on the amount of activity in each of the 3 cone systems as mentioned above.

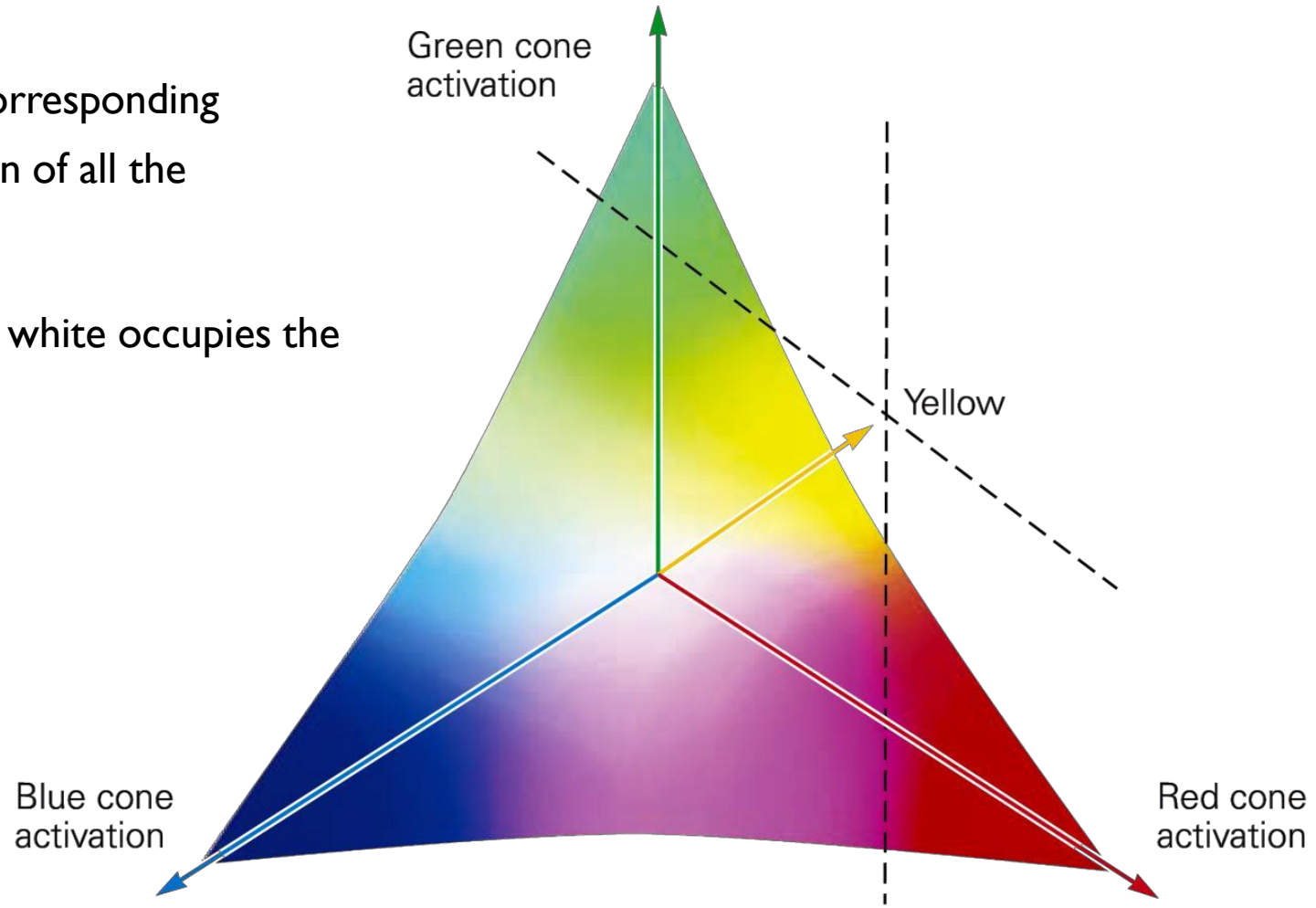
Color perception



تدرجات الألوان تحدد بناء على اختلاف نسب الألوان الثلاث الأساسية فمثلاً الأزرق ينتج عندما تتحفز ال(Blue cones) بنسبة 97% ولو كان اللون أزرقاً فاتحاً فستكون نسبة التحفيز أقل .

Color perception

- Perception of white light
- there is no single wavelength of light corresponding to white; instead, white is a combination of all the wavelengths of the spectrum.
- as can be seen in this vector diagram – white occupies the middle of the vector



Color blindness

Definition

Weakness or total blindness in detecting a primary color

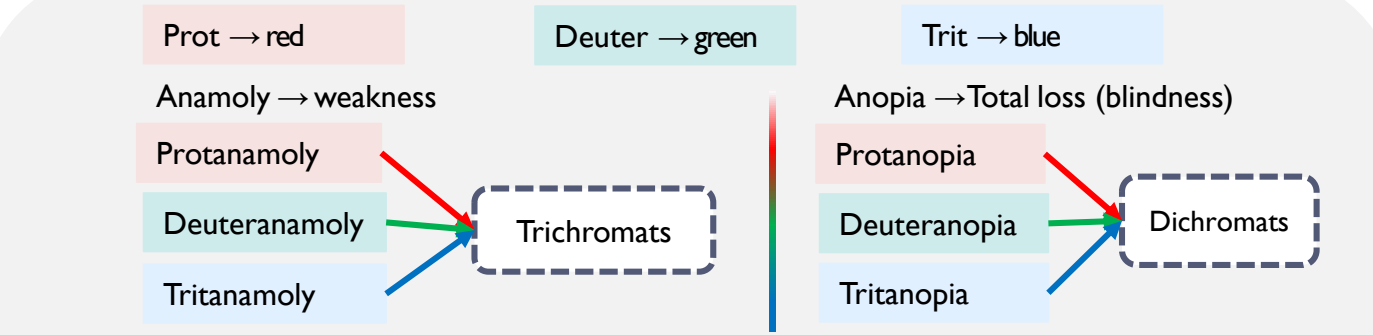
Related definitions

- Trichromats: see the 3 1ry colors (normal or have slight weakness in detecting red or green or blue color).
- Dichromats: boy's slide: (blind to one 1ry color) girl's slide: "have only 2 cone pigments systems only so he is completely blind to red or green or blue (so they may have protanopia , deuteranopia, or tritanopia) they get color by mixing only 2 of the primary colors".
- Monochromats: have only one color pigment (system) or loss of all so see only black or grey or have no color perception.

Anamoly and Anopia

Red - green blindness

Color blindness is a genetic condition



ONLY IN FEMALES' SLIDES

Protanopia (red blindness): no red cones system so person has shortened spectrum wave length
If only weakness in red color vision is called Protanamoly

Deuteranopia (green blindness): no green cones system so person see only long & short wave length
If only weakness in green color vision is called Deuteranamoly

Tritanopia (blue blindness): no bluecones system
If only weakness in blue color vision is called Tritanamoly

Cont.

Definition | Related definitions | Anamoly and Anopia | Red - green blindness | Color blindness is a genetic condition

- 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 occur 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 ½ of their sons.

ONLY IN FEMALES' SLIDES

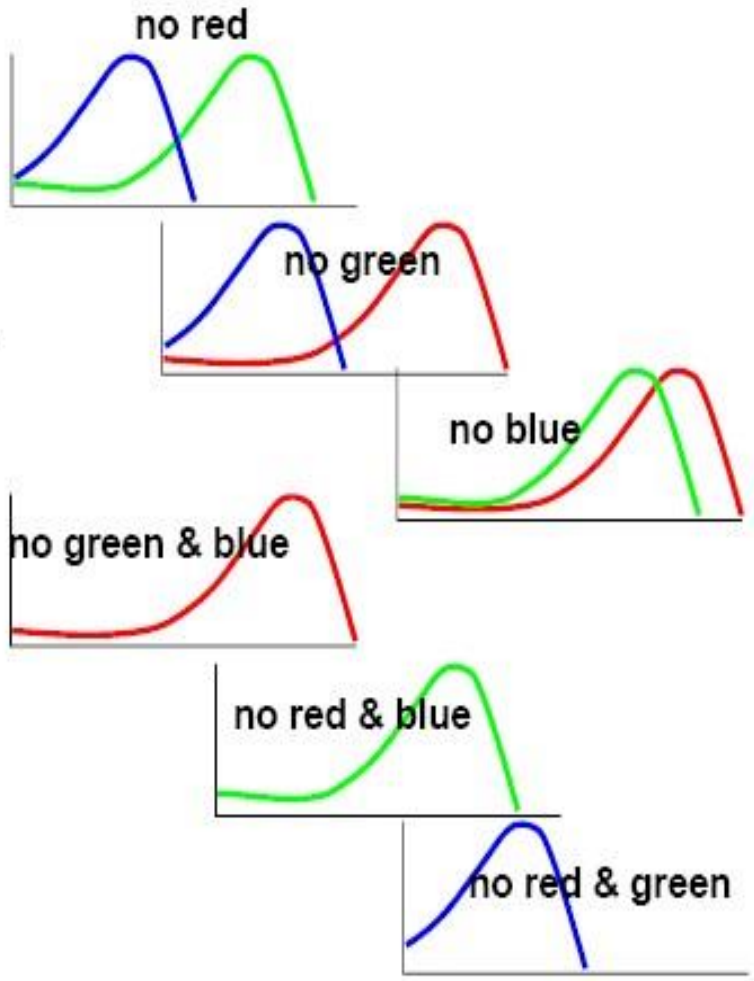
- There is gene for rhodopsin on chromosome (3).
- There is gene for blue sensitive S cone pigment on chromosome (7).
- There is gene for red & green sensitive cone pigment on x chromosome.
- when a single group of color receptive cones is absent (due to absence of their gene) the person can not see or distinguish some colors from others.

Color blindness

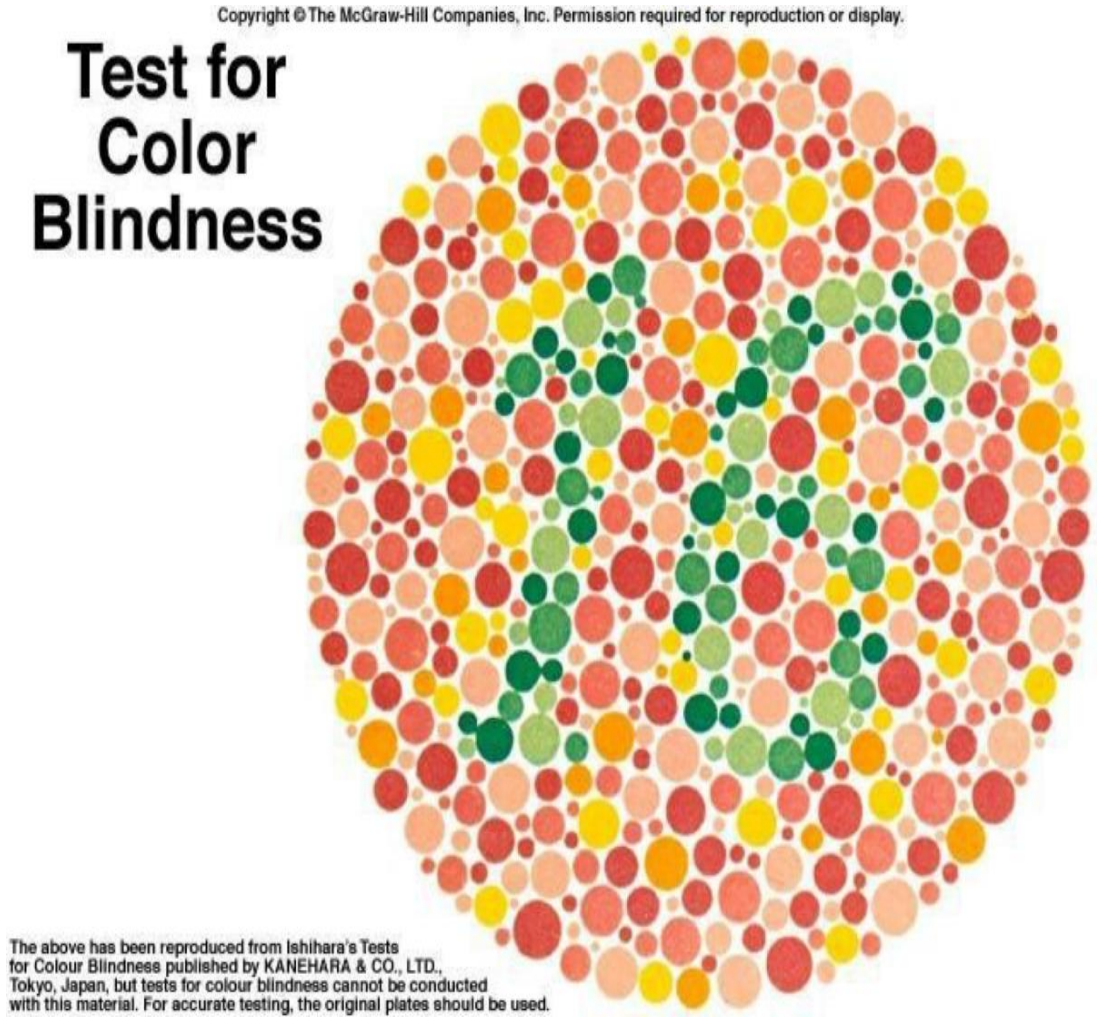
Colour blindness.

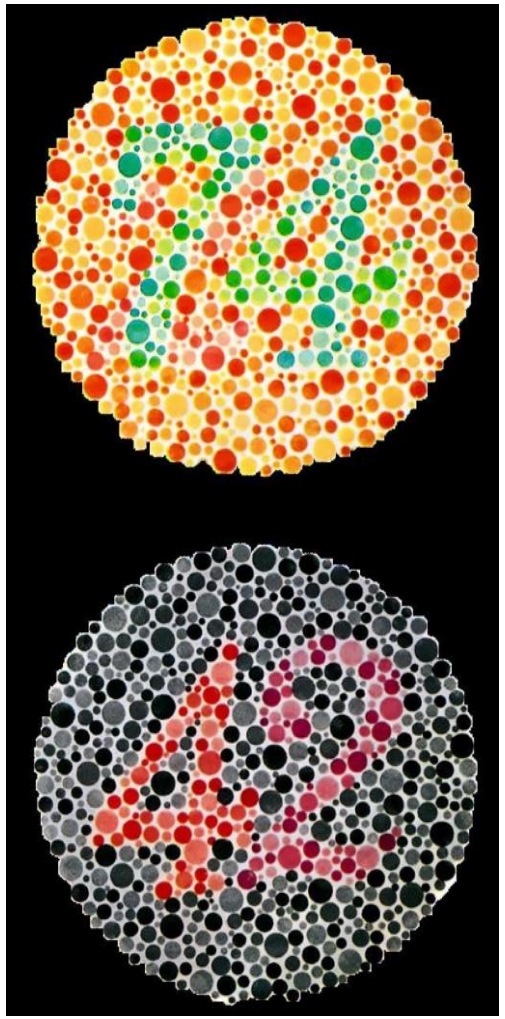
Each cone type contains a different light sensitive photo pigment. Colour blindness occurs when there is a defect in the genes that produce these photo pigments. Various combinations of defects can occur.

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.



Test for color blindness





- Ishihara chart, which are plates contain figures made up of colored spots on background of similarly shaped colored spots.
- The figures are intentionally made up of colors that are liable to look the same as the background to an individual who is color blindness.
- Some color-blind individuals are unable to distinguish certain colors, whereas other have only a color weakness.

Thank you!

اعمل لترسم بسمة، اعمل لتمسح دمعة، اعمل و أنت تعلم أن الله لا يضيع أجر من أحسن عملا.

The Physiology 436 Team:

Females Members:

Allulu Alsulayhim

Shatha Alghaihb

Amal Alshaibi

Ghada Alhadlaq

Males Members:

Team Leaders:

Lulwah Alshiha

Laila Mathkour

Mohammad Alayed

Contact us:




QUIZ

اقتراحات وشكاوي

References:

- Females and Males slides.
- Guyton and Hall Textbook of Medical Physiology (Thirteenth Edition.)