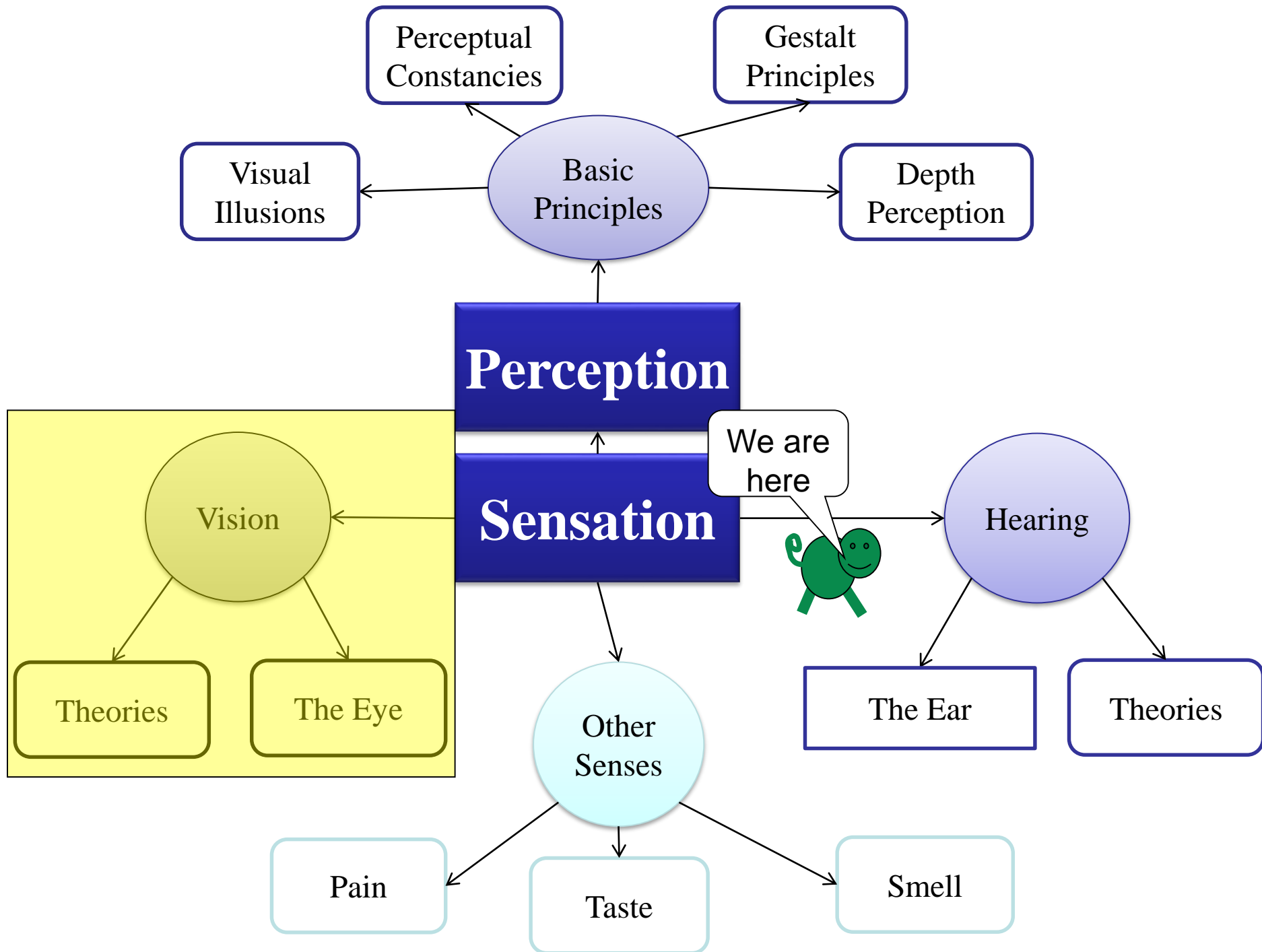
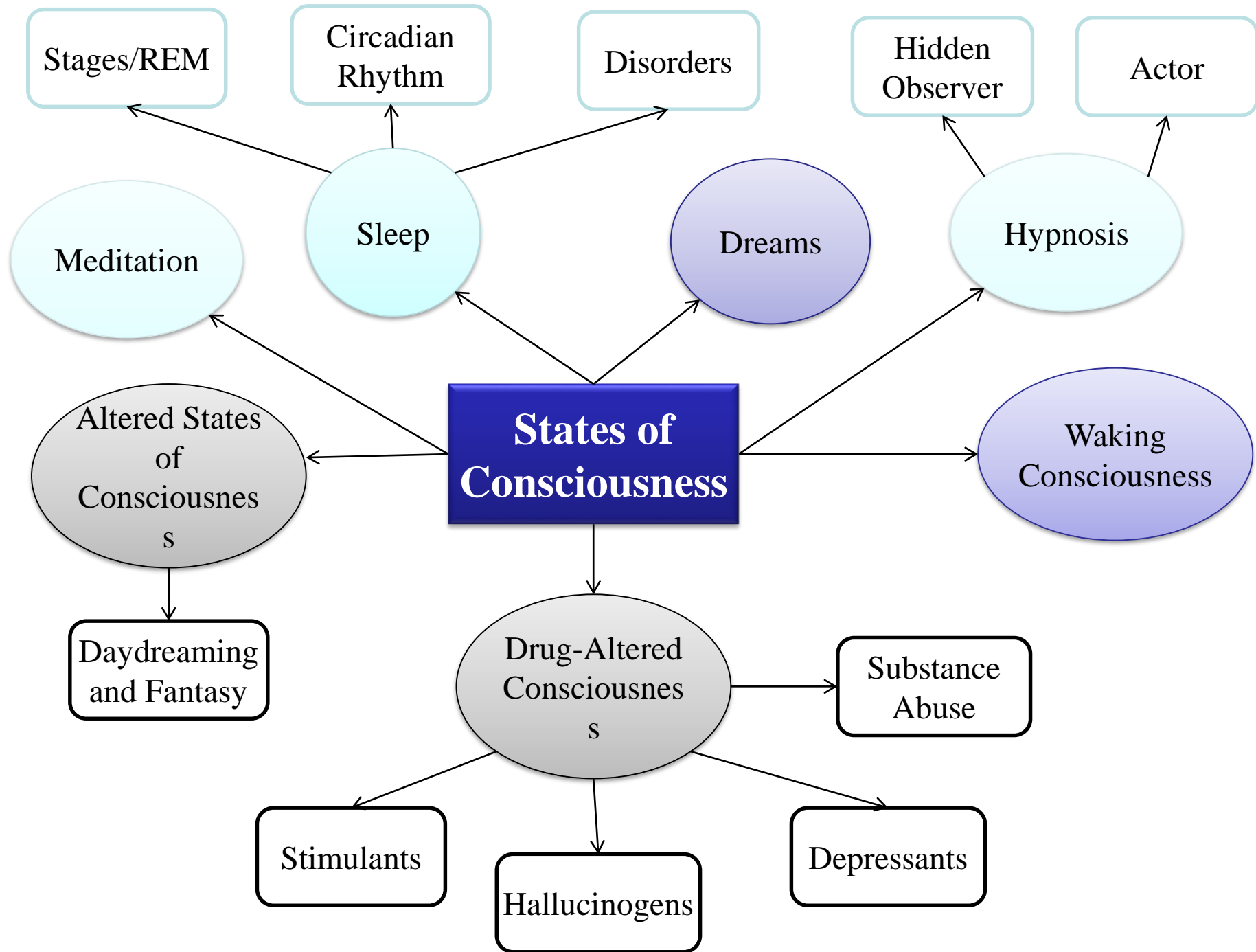


Unit 4: Sensation, Perception and States of Consciousness

Essential Task 4-2: Describe the sensory process of vision including the specific nature of energy *transduction* (*rods and cones and the trichromatic theory of color vision*), relevant anatomical structures (*cornea, pupil, iris, lens, retina, optic nerve, blind spot and fovea*) and specialized pathways in the brain (*opponent process theory of color vision and the occipital lobe*).





Essential Task 4-2:

Outline

- Vision - relevant anatomical structures
 - Path light travels (*cornea, pupil, iris, lens, and retina*)
 - optic nerve, blind spot and fovea
 - Transduction (rods and cones)
- *Color Vision*
 - The trichromatic theory of color vision
 - Color Blindness
 - Opponent process theory of color vision
 - After-Image Effect

“We do not know the sun or the earth. We can only know the sun that we see and the earth that we feel.”

Explain this quote. Do you agree with this quote? Explain why or why not.

What is vision?

Do we really see each others?



Vision

- Vision begins with lightwave
- gathering light; light is reflected off of objects and gathered by the eye
- Eyes receive light energy and transduce it into neural messages that our brain processes into what we consciously see.

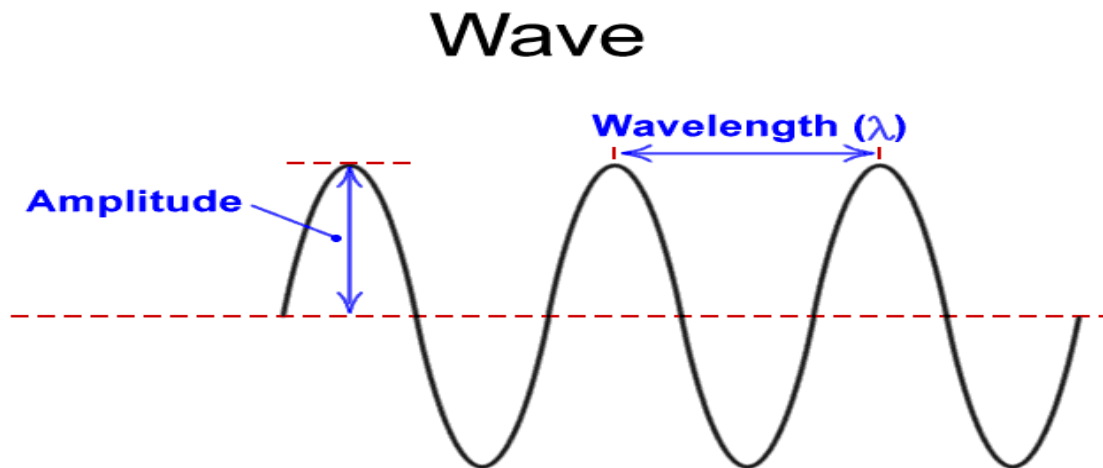
Vision: Light wave

Wave length – Distance from one wave peak to the next

- Short wavelength = bluish color
- Long wavelength = reddish color

Intensity – the amount of energy in the waves by amplitude or height

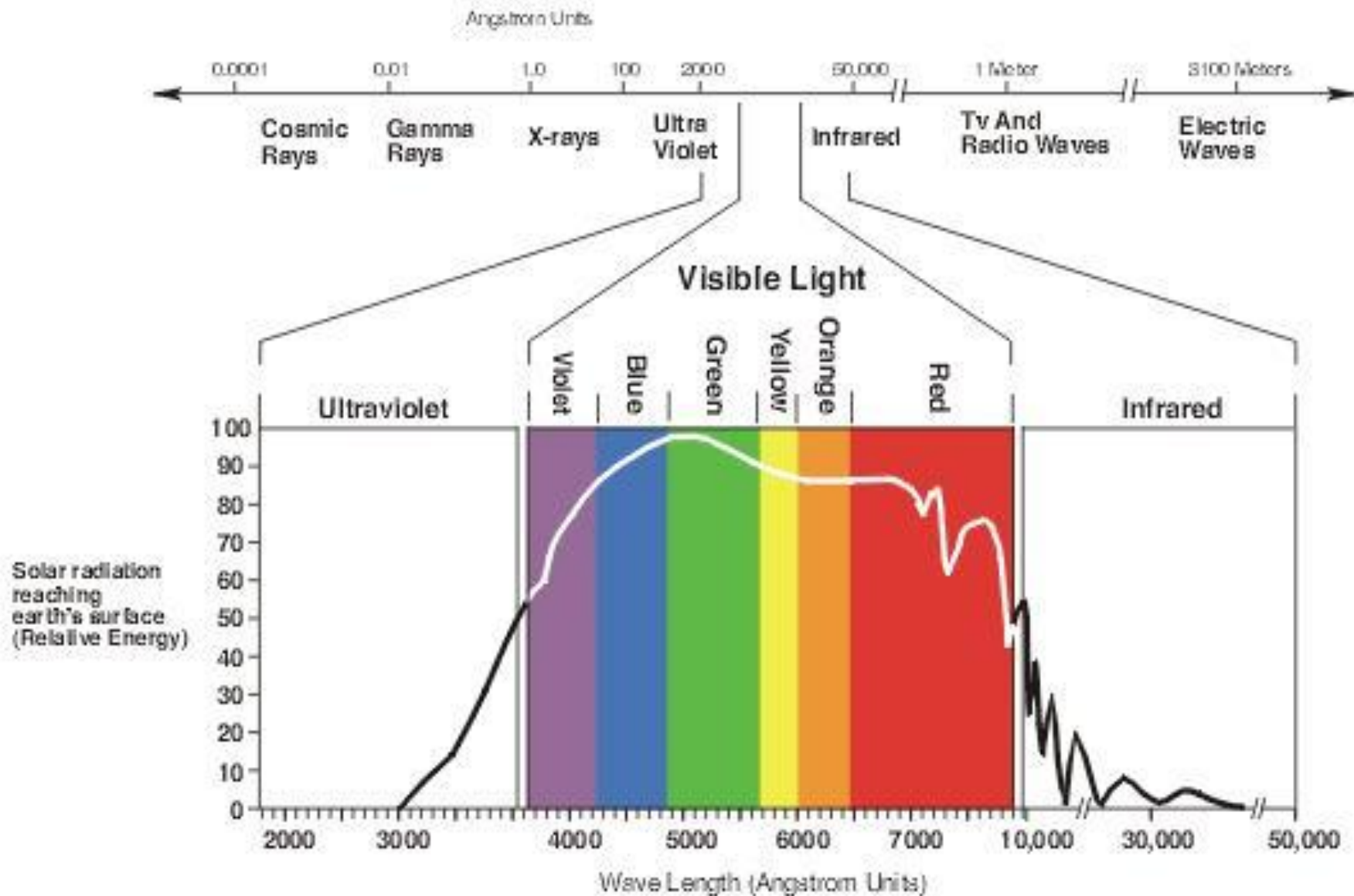
- Higher the amplitude the brighter the color
- Lower amplitude dull colors





Hue — the color we experience (blue, red, green)

Electromagnetic Spectrum



Eye Parts

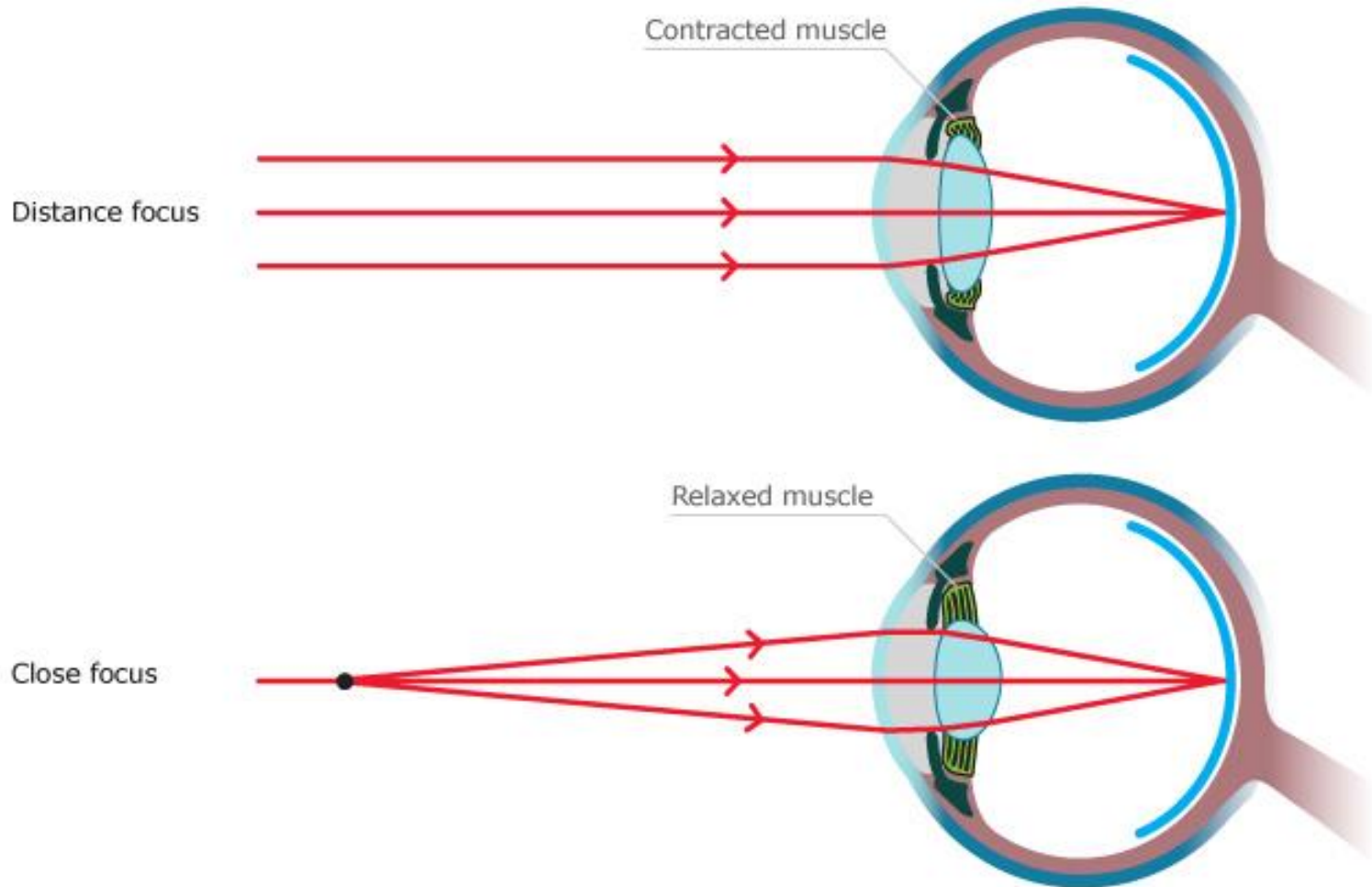
- **Cornea** – Transparent membrane covering the front of the eye; bends light rays
- **Pupil** – small adjustable opening which light enters
- **Iris** – colored muscle that helps open up or close the pupil (control the amount of light)
- **Lens** – transparent structure behind the pupil; takes it to retina
- **Retina** – light sensitive inner layer of cells in the back of the eye; easily damaged from excessive exposure to light
- **Fovea** – central focal point in the retina, around which the eye's cones cluster.
- **Cones** – retinal receptors cells that are concentrated near the center of the retina that functions in day light; color
- **Rods** – retinal receptors that detect black, white and grey
- **Optic nerve** – the nerve that carries neural impulses from the eye to the brain

Accommodation

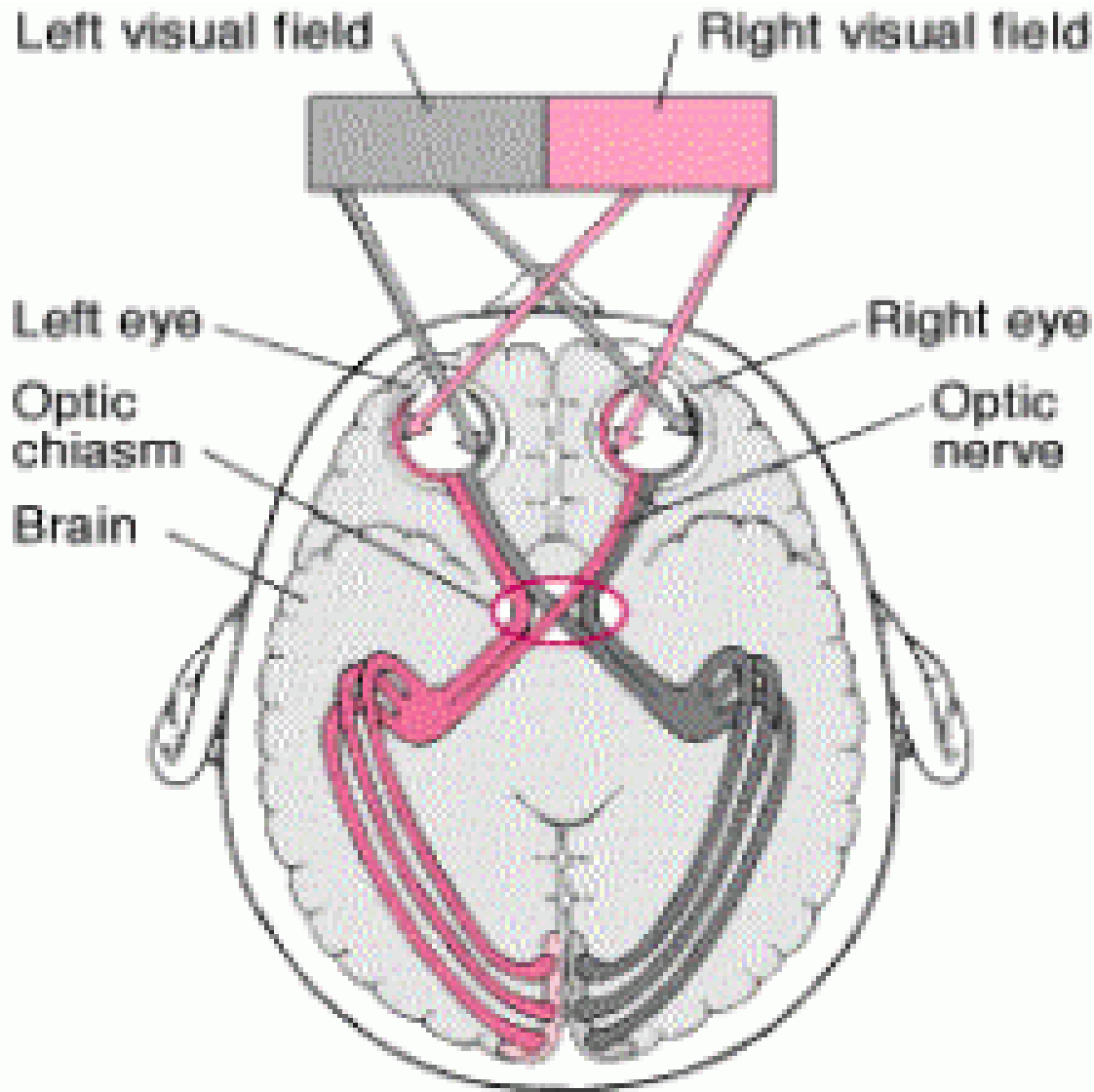
- Accommodation is the process by which the eye's lens changes shape to focus near or far objects on the retina.
- https://www.youtube.com/watch?v=p_xLO7yxgOk

Accommodation

How the eye focuses light



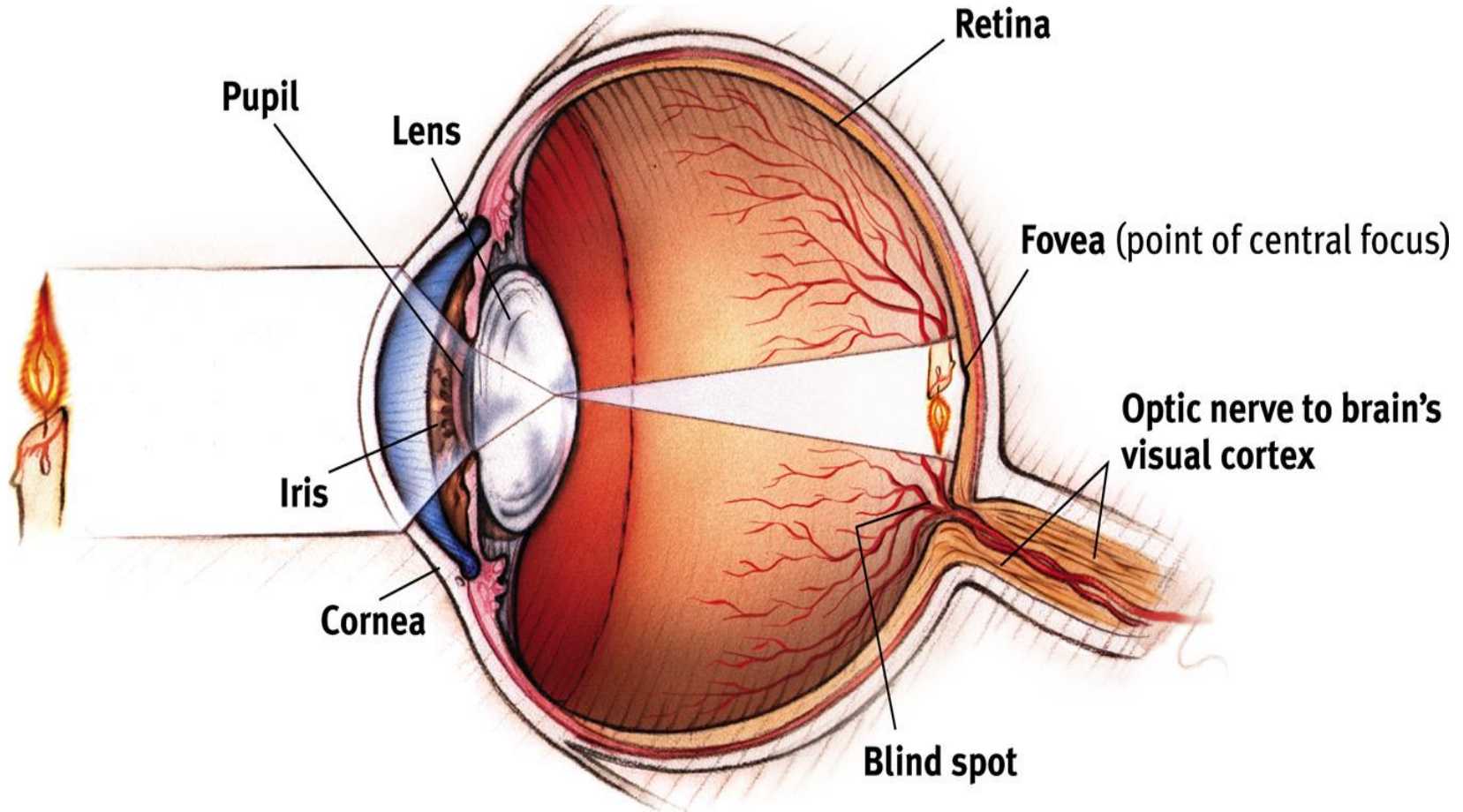
Retinal Visual Field



- Right visual field is processed by the left optic nerves
- Left visual field is processed by the right optic nerves

Path light travels through the eye.

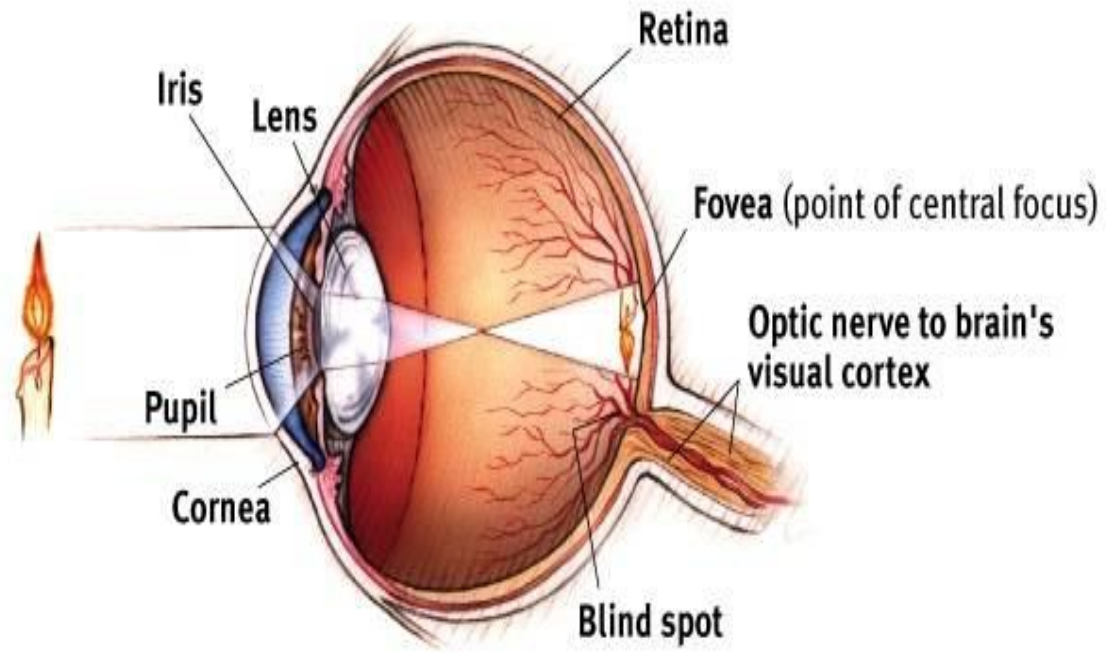
[Outline](#)



[Outline](#)

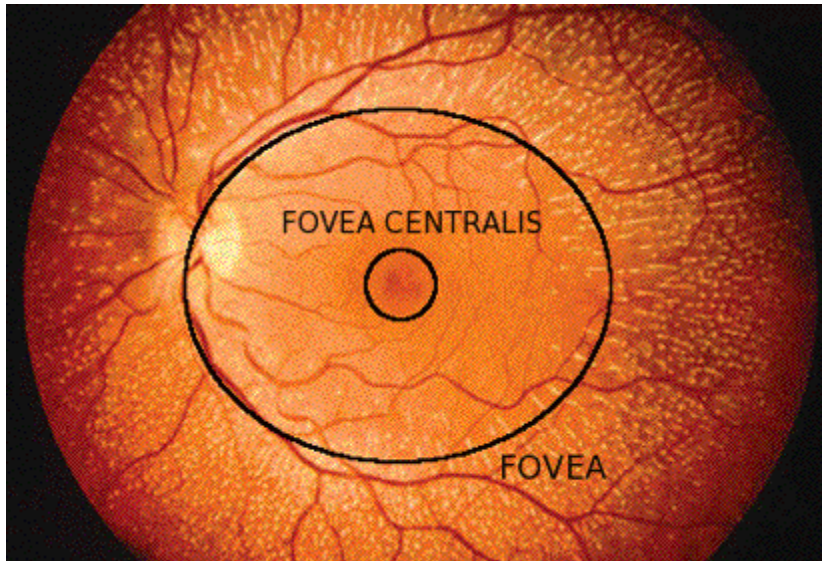
Path light travels through the eyes.

1. Cornea
2. Pupil
3. Lens
4. Retina (rods and cones)
5. Bipolar cells
6. Ganglion cells
7. Optic nerve



Fovea

Outline

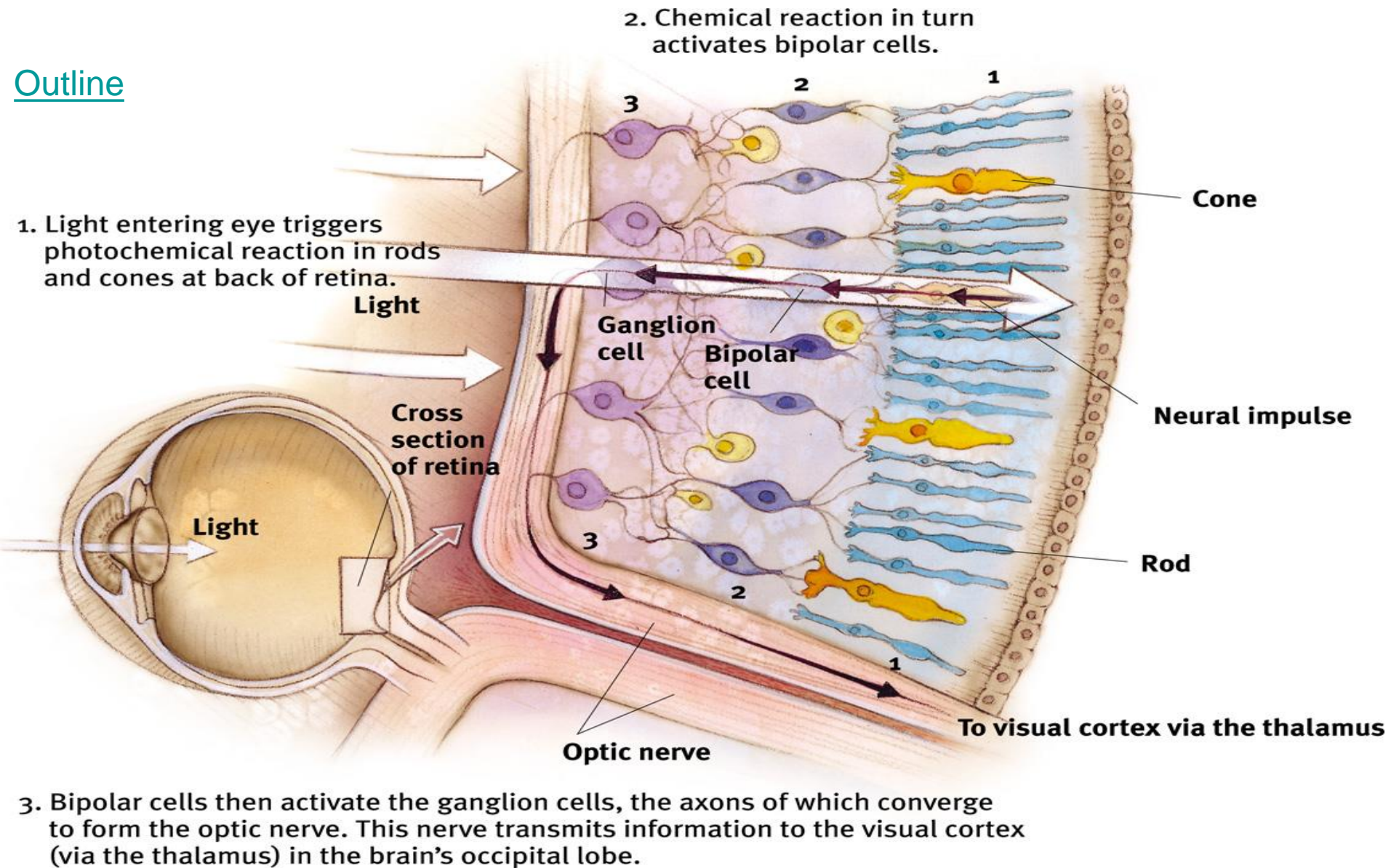


*Central fovea (Fovea Centralis) is responsible for visual acuity and color sensitivity.
High resolution!*

The green and red cones are concentrated in the fovea centralis. The 'Blue' cones are mostly found outside the fovea centralis.

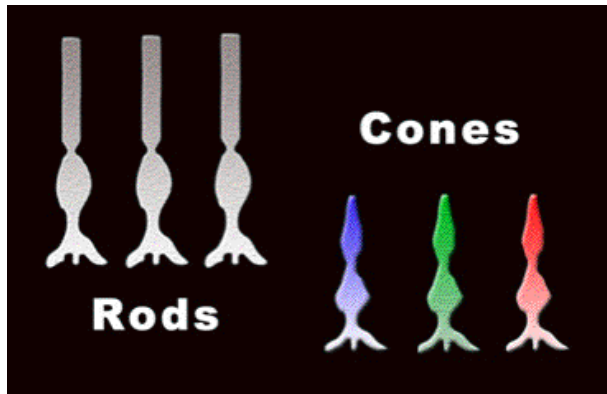
Transduction occurs in the Retina

Outline

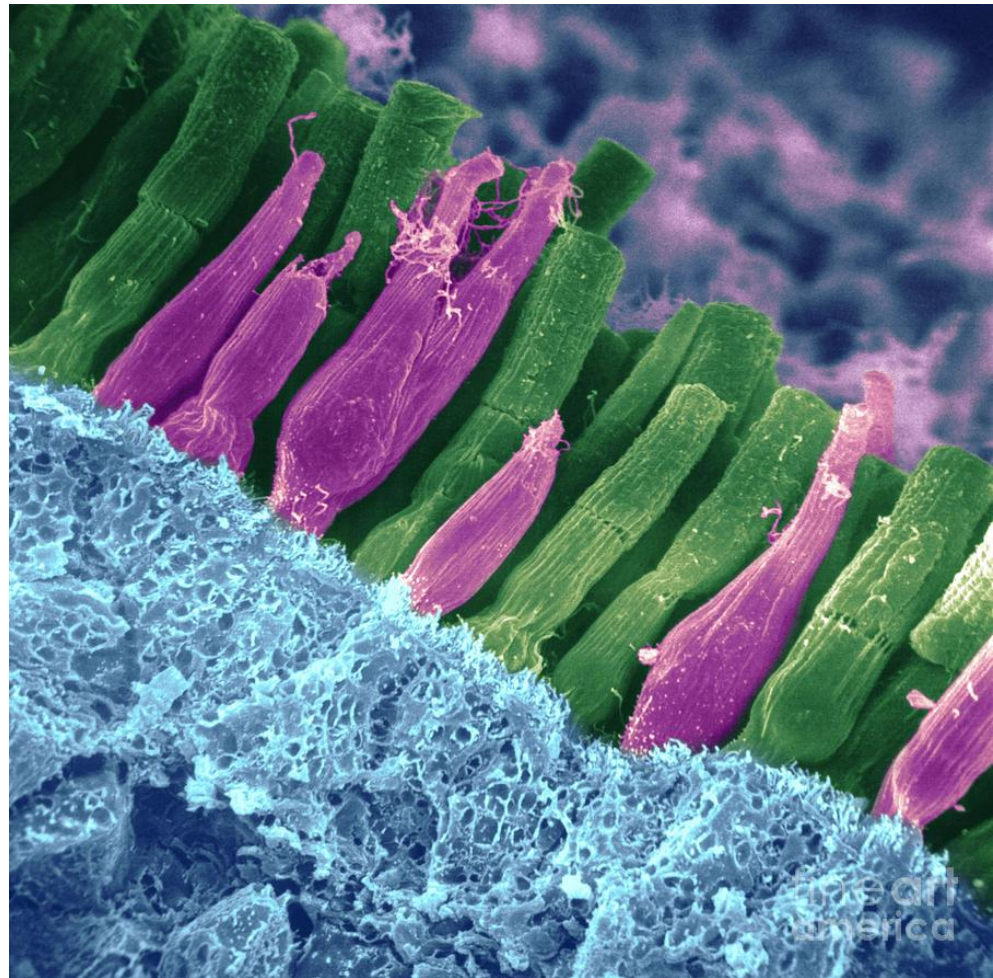


Rods and Cones

Outline



Rods and cones transduce information into electrical signal.



Light Control

- Visual acuity – sharpness of visual perception
- Fovea – Area at the center of the retina only containing cones (color)
- Peripheral vision – Vision at edges of visual fields; side vision
- Tunnel vision – Loss of peripheral vision

Tunnel Vision



Visual information processing

- Feature detectors – nerve cells in the brain that respond to specific features of the stimulus
 - Such as shapes, angle, or movement
 - Different locations in the brain have specialized functions
 - Color, form, motion, depth
- Saccade – reflexive movement of eyes from side to side so that neurons will continue to firing and so fill in the information due to blind spot

Blindspot test

1. Hold the card at eye level about an arm's length away. Make sure that the cross is on the right.
2. Close your right eye and look directly at the cross with your left eye. Notice that you can also see the dot.
3. Focus on the cross, but be aware of the dot as you slowly bring the card toward your face. The dot will disappear, and then reappear, as you bring the card toward your face. Try moving the card closer and farther to pinpoint exactly where this happens.

Trichromatic Color Theory

Young-Helmholtz Theory

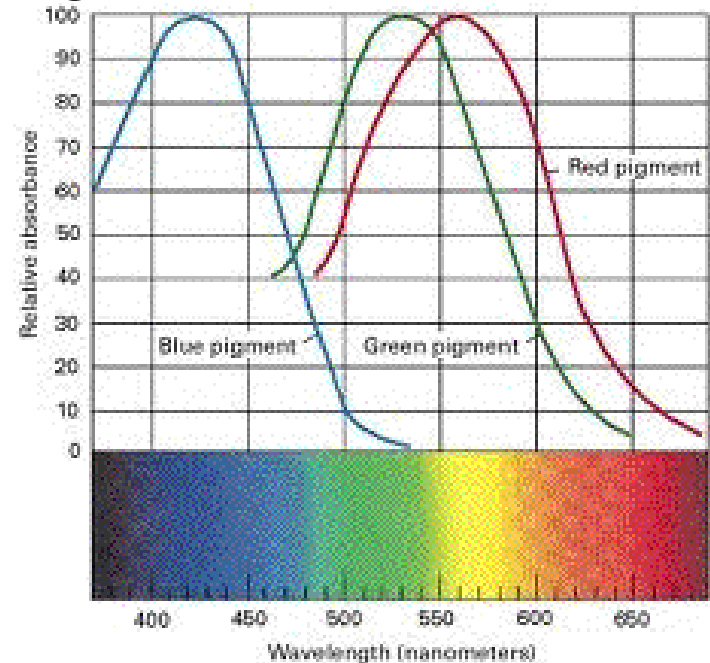
Outline

- We see color due to the

RED

GREEN

BLUE



Three Cone types in the retina

Colored Blindness

- Inability to perceive colors; lacks cones or has malfunctioning cones
 - Total color blindness is rare
 - Genetic
- Color weakness: Inability to distinguish some colors
 - Red green is most common (more common with men)
 - Recessive gene linked with X chromosome

Color Blindness

Outline



Trichromatic view
(blues, greens, and reds)



Dichromatic problems
with reds and greens



Monochromatic view
(no blues, greens, or reds)



Dichromatic
Problems with
reds and greens

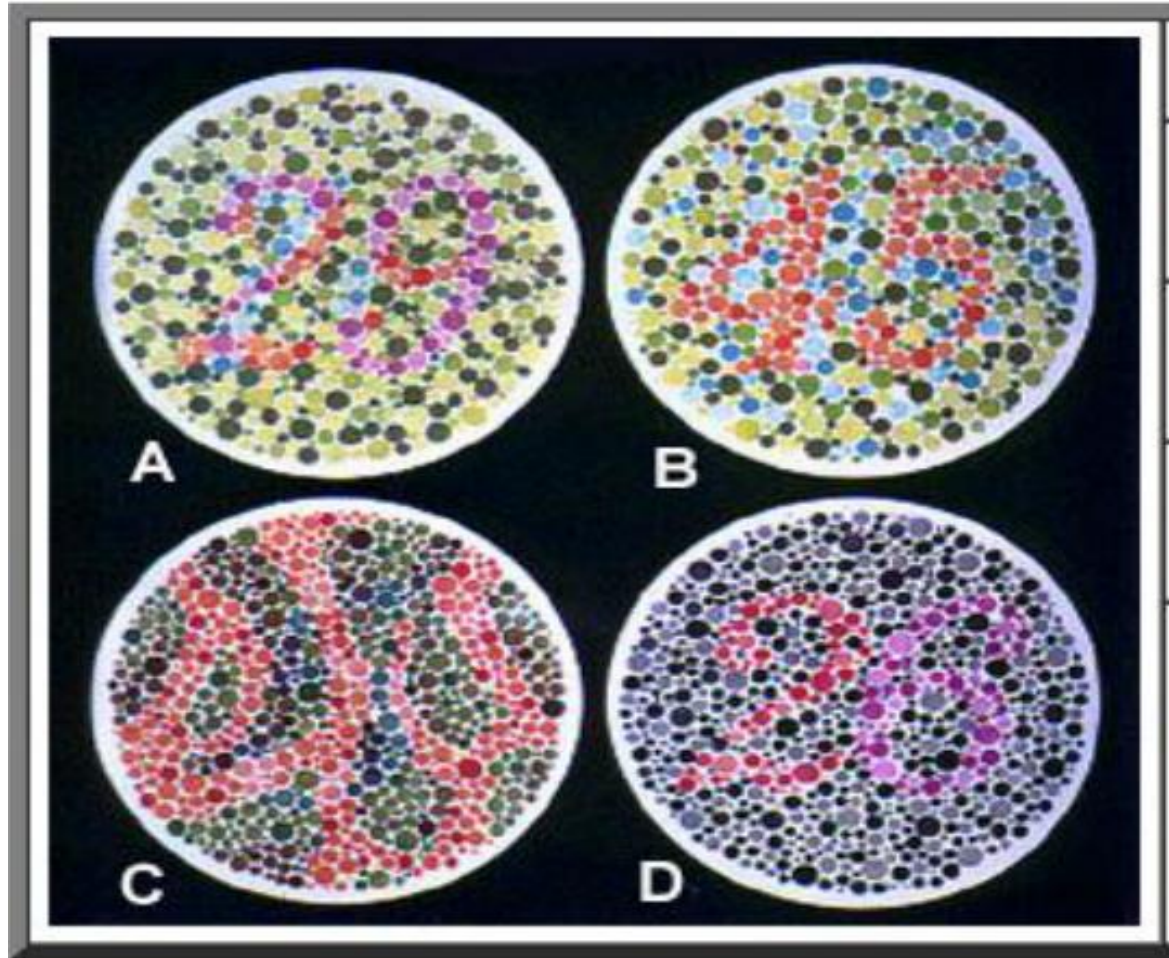


Dichromatic
Problems with
Blues and
Greens

Color Blindness Tests

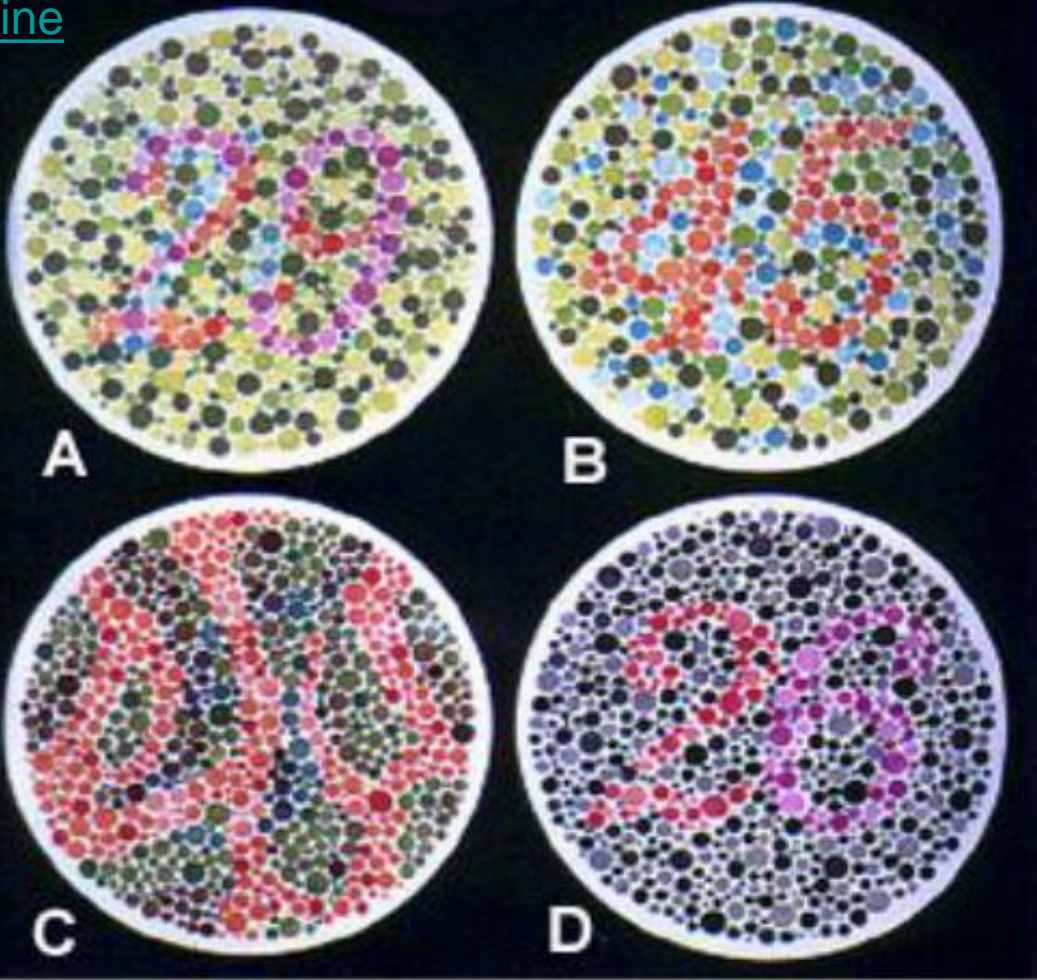
Outline

Write down
what numbers
you see



Color Blindness Tests

Outline



4 Sex-Linked Traits:

1. Normal Color Vision:

A: 29, B: 45, C: --, D: 26

2. Red-Green Color-Blind:

A: 70, B: --, C: 5, D: --

3. Red Color-blind:

A: 70, B: --, C: 5, D: 6

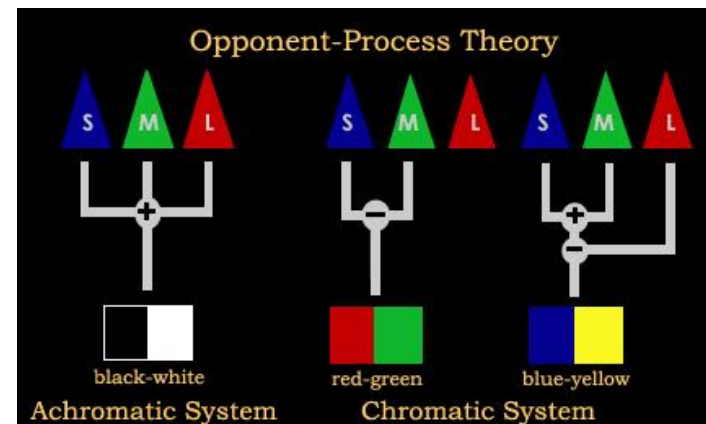
4. Green Color-Blind:

A: 70, B: --, C: 5, D: 2

Opponent Process Theory

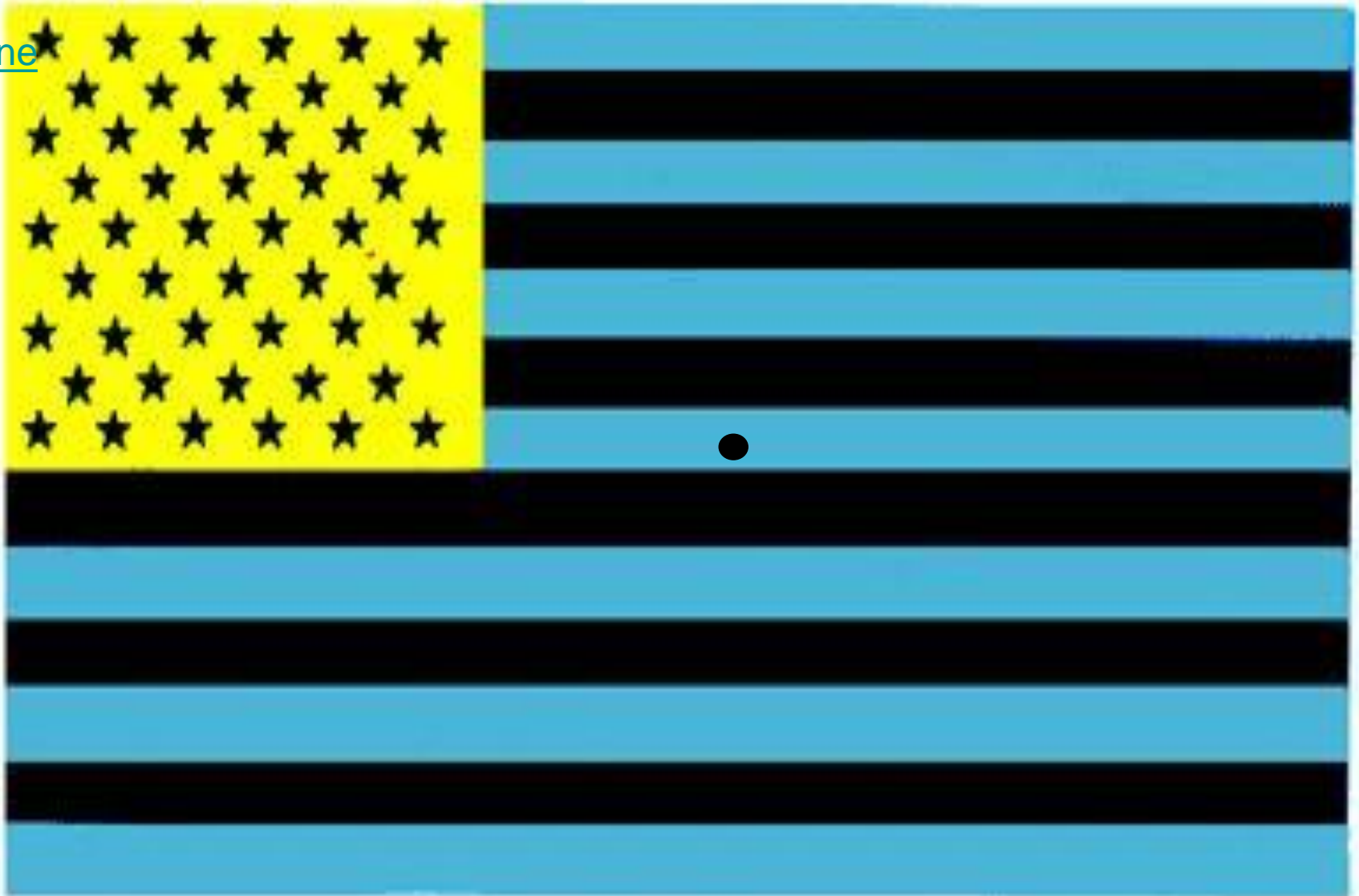
Outline

- Further up in the optic nerve, neurons work in pairs to help process color vision signals.
- Red-Green = Xmas
- Blue-Yellow = Beach
- Black-White = Oreo
- Explains after image effect



Opponent Process theory helps us explain the after-image effect

Outline



Neuroscience of ghosts!

[Outline](#)



Alas poor Yorick it was an after-image!

[Outline](#)

Dark Adaptation

- Increased retinal sensitivity to light after entering the dark; similar to going from daylight into a dark movie theater
- Rhodopsin: light-sensitive pigment in the rods; involved with night vision
 - We do not see color in the dark
- Night Blindness: Blindness under low-light conditions; hazardous for driving at night