

# Vision

The stimulus for vision is light. Light is measured in frequency and amplitude.

**Frequency** - distance between wavelengths (how many waves per second...how close together)

- This determines the **Hue** or **color** the light will appear.
  - Reds = longer wavelengths (38,000 to an inch)
  - Blues = shorter wavelengths (70,000 to an inch)

Things are not actually colored, the color is created in our brain...based on how the light is reflected by the object

A tomato is seen as red, because it reflects the long wavelengths of red

**Amplitude** - the height of the wavelengths (intensity of waves)

- Physical intensity of the light
- This determines how **bright** the light will seem

Parts of the eye:

- **Cornea** –
  - light enters the eye,
  - protects the eye,
  - bend light to provide focus
- **Pupil** –
  - adjustable opening in the center of the eye,
  - light enters through
- **Iris** –
  - colored part of the eye,
  - surrounds the pupil, muscle,
  - controls size of pupil opening, which adjusts light intake
- **Lens** –
  - behind the pupil,
  - transparent structure,
  - changes shape to help focus images on the retina
- **Retina** –
  - light sensitive inner surface of the eye,
  - contains the receptor rods and cones,
  - and a layer of neurons that begin the visual processing

The visual receptors are the rods and cones in the retina.

**Cones** = 3 types

- One sensitive to red, one to green, one to blue
- Located more in the center of the retina
- 5-7 million in each eye

**Rods** = only “see” the world in blacks, whites, grays

- Located on the edges of the retina
- Need less light to work, but give less detail
- 100 million in each eye

\*\*\*Because of the rod/cone placement in the retina anything you see in the periphery will appear lacking in color\*\*\*

**Bipolar cells** –neurons that transfer info from the cones and rods

**Ganglion cells** – axons bundled together to form the optic nerve

**Feature detectors** – nerve cells in the visual cortex that respond to specific features of visual stimuli (i.e. lines, angles, edges, movement)

- **2 Special parts of the**
- **Fovea**
  - tiny pit right at the center of the retina which contains only cones, and where your vision is the sharpest, clearest
- **Blind spot**
  - Spot where the **optic nerve** leaves the eye, so there are no receptors, so we do not see anything in this area. The brain fills in what it believes should be in that spot, based on the surroundings.

### Afterimages

Receptors get tired of working - so stare at something and then look away--only the rested images persist after the removal of a stimulus

#### Black and white:

Part of the retina that was exposed to the dark will become more sensitive (dark adapted) the part exposed to white will become less sensitive (light adapted) so when you look at a white sheet it will see gray rather than white

#### Color: After images always appear in complementary colors

- Yellow = blue
- Green = red

### Optical Defects

**Nearsightedness:** see close objects clearly, but not distant objects

- the lens focuses the visual image a little in front of the retina, rather than clearly on it

**Farsightedness:** see distant objects clearly, but not close objects

- the lens tends to focus the visual image behind the retina, rather than directly on it

**Night-blindness:** caused by disability in the rods. Too little Vitamin A depletes the rods supply of rhodopsin.

**Colorblindness:** caused by a defect in the cones

- May be red or green deficient (so they see the world in blue, yellow, black, white)(colors at the blue-green end of the spectrum appear blue, while colors at the red-yellow end appear yellow)
- Blue or yellow is very rare
- affects mostly men, very few women (8% of men, .5% of women)
- very few people are totally colorblind
- 1 in 40,000 are colorblind

## Theories of Vision

- **Parallel Processing:**
  - Doing many things at once
  - The brain divides the visual scene into color, movement, form, depth, and works with them at the same time.
  - We then put all of this work together to form our perceptions
  - For example facial recognition = integrates information from the retina with stored information about people you know to recognize the person...to do this your brain is using about 30% of the cortex
    - If researchers use a magnetic pulse to disrupt the part of the brain where this info is stored, you will not be able to recognize the face
    - One stroke victim has lost the ability to perceive movement, for her people just appear her or there, but she can not “see” them move from place to place...if she tries to pour tea, it appear frozen, she can not see it rising in the cup
- **Young-Helmholtz Trichromatic theory:**
  - Thomas Young and Hermann von Helmholtz, 1800s based on the idea that colors can be created by mixing the primary colors, concluded that vision probably works in a similar way
  - There are three types of cones, red, blue and green
    - We see yellow when both the red and green cones are stimulated
- **Opponent-Process Theory**
  - Ewald Hering
  - Was curious about how yellow works, because in the real world red and green do not make yellow
  - Opposing RETINAL processes are responsible. Some colors turn on the cones and other turn off the cones
  - This message is then interpreted by the brain and we experience color based on that interpretation