**Vision**

The following concepts and terms related to vision must be memorized and understood:

**Transduction:**refers to any sensory energy (eg. light energy) being converted (transformed) into neural energy/impulses.

Light is composed of electromagnetic waves with **Wavelengths**(the distance from one peak to another peak on a wave) and **Amplitudes**(the height of the wave)

**Wavelength**determines **hue**(color, i.e. Red, Blue, Green) and *pitch* or *frequency*when it to comes to sound.

**Amplitude**determines **intensity**(brightness, i.e. bright red, dark red) and *loudness*with regards to sound.

***The Eye***

External light enters the eye and travels through the following structures:

1. **Cornea**(protective layer).
2. **Pupil**(an adjustable opening) controlled by the **Iris**(muscle around the pupil).
3. **Lens**(an oval transparency) that changes shape to focus light by a process called**Accommodation**; light is then focused onto a structure at the back of the eye called the*retina*(multi-neuron surface).
4. **Retina:**this is the light sensitive inner surface of the eye containing the *receptor* *cells*called **rods** and **cones** (see below).
   1. **Rods:**these detect brightness of light and allow us to see in **black and** **white**. They are more light sensitive than cones and enable us to see in darker areas. There are approximately 120 million rods and they are situated along the periphery of the retina
   2. **Cones:**thesedetect **color**and detail and function best in well-lit areas. Many have their *own* bipolar cell that allows them to relay individual information to the cortex thereby allowing cones to detect fine detail. There are approximately 6 million cones and they are clustered at the center of the retina around the *fovea (the area of central focus)*.

The Retina has 2 types of receptor cells:

Once light energy strikes the rods and cones, chemical changes produce neural signals that activate *bipolar cells* in turn activating *ganglion cells*. The axons of these form the **Optic Nerve**that will then carry information to the brain.

Everyone has a **Blind Spot**, a small region in the visual field where nothing could be seen. This is because there are no receptor cells where the optic nerve leaves the eye in the retina. Normally, we dont witness this effect because we have two eyes that compensate for each others blind spot, and the fact that our eyes are constantly moving.

There are 3 basic types of **Acuity**or how sharp or clear vision is: normal vision,**nearsightedness**(only see *near*things clearly), and **farsightedness**(only see *far*things clearly).

Nobel prize winners Hubel and Wiesel discovered **Feature Detectors**in the brains cortex that are sensitive to specific *features*in what we see (i.e. shape, color, depth, movement, form, and even postures, arm angle, gaze). Our brains processlots of information **simultaneously**. For example, looking at a kiwi fruit, the brain processes the greenish brown color, the oval shape, and the furry texture all at the same time.

People can still remarkably locate objects but are not consciously aware of how they did it. Such a phenomenon is called *Blind Sight.*

***Color Vision***

Color processing is described in 2 stages:

1. 1. **Young-Helmholtz trichromatic (three-color) theory:** Light is detected by three types of cones each specifically sensitive to Red, Blue, or Green. Combinations of these colors produce intermediate colors (yellow, purple, etc.).
   2. **Opponent-Process theory**Color is then processed by their opponent colors (red-green, blue-yellow, black-white). That is, some cells are excited by blue and inhibited by yellow, vice versa. Thus, you cannot see a bluish-yellow.

**Color constancy**refers to the importance of the surrounding background effects on perceived color. Color constancy states that colors do not look different even in different illumination (i.e. sunlight versus a dark room). *Green grass will still be green whether on a clear or cloudy day.*