



Human Senses

All senses work the same way:



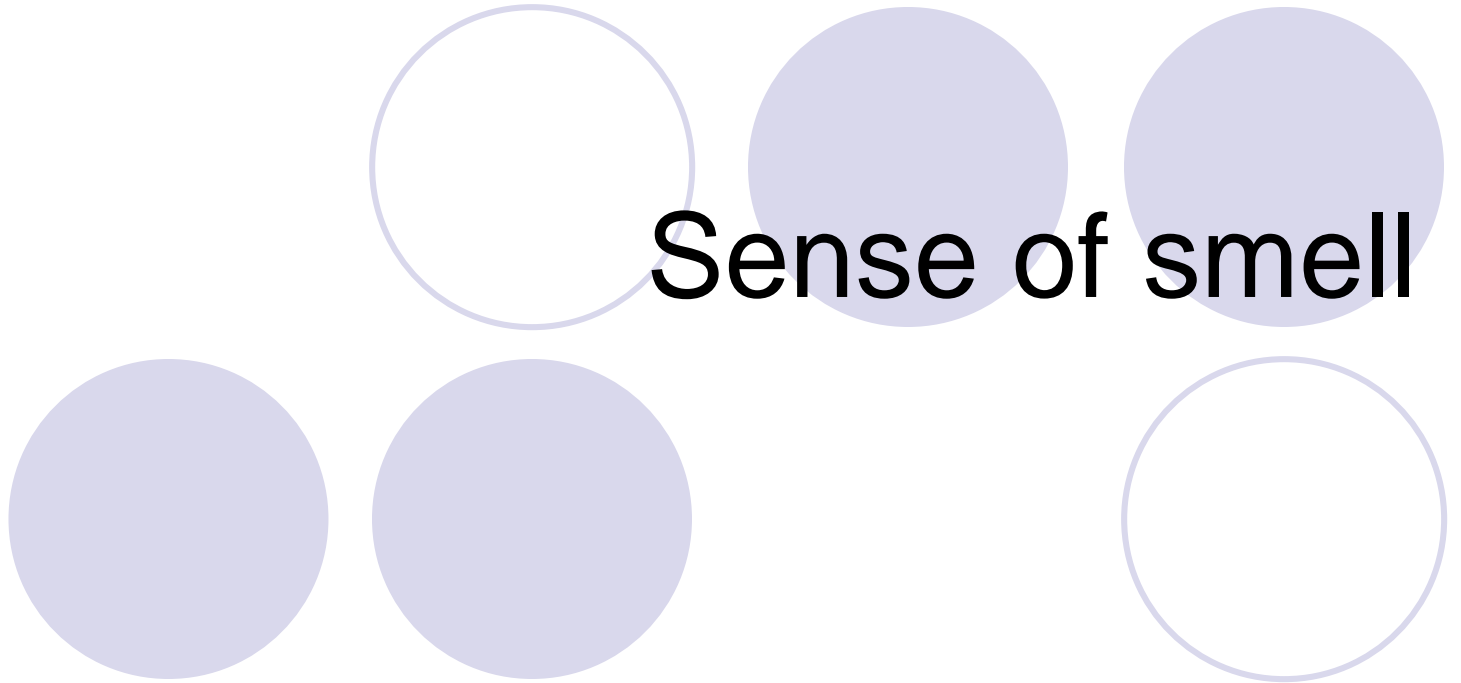
- Receptors collect information
 - stimulate neurons
 - information is sent to the brain
 - integrates with other senses
 - forms a perception

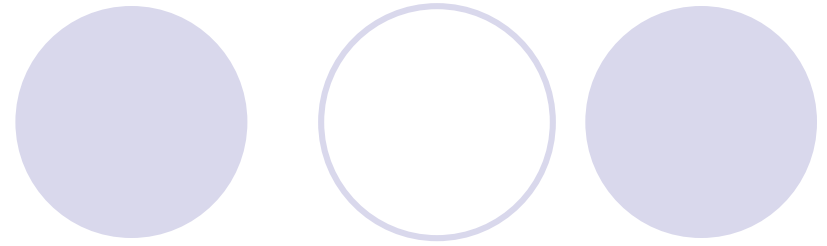
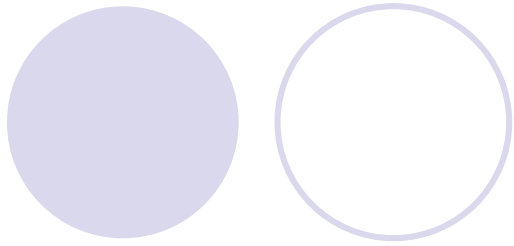
Receptor types:



- **Pain receptors** or **nociceptors** – respond to tissue damage due to mechanical, electrical, thermal or chemical energy
- **Thermoreceptors** – respond to temperature change
- **Mechanoreceptors** – respond to mechanical forces, such as pressure or fluid movement; changes usually deform the receptor
- **Proprioceptors** – sense changes in muscles and tendons
- **Baroreceptors** – in blood vessels – detect changes in pressure
- **Stretch receptors** – in lungs – sense degree of inflation
- **Photoreceptors** -respond to light – as little as one photon
- **Chemoreceptors** – sensitive to chemical concentration of various substances

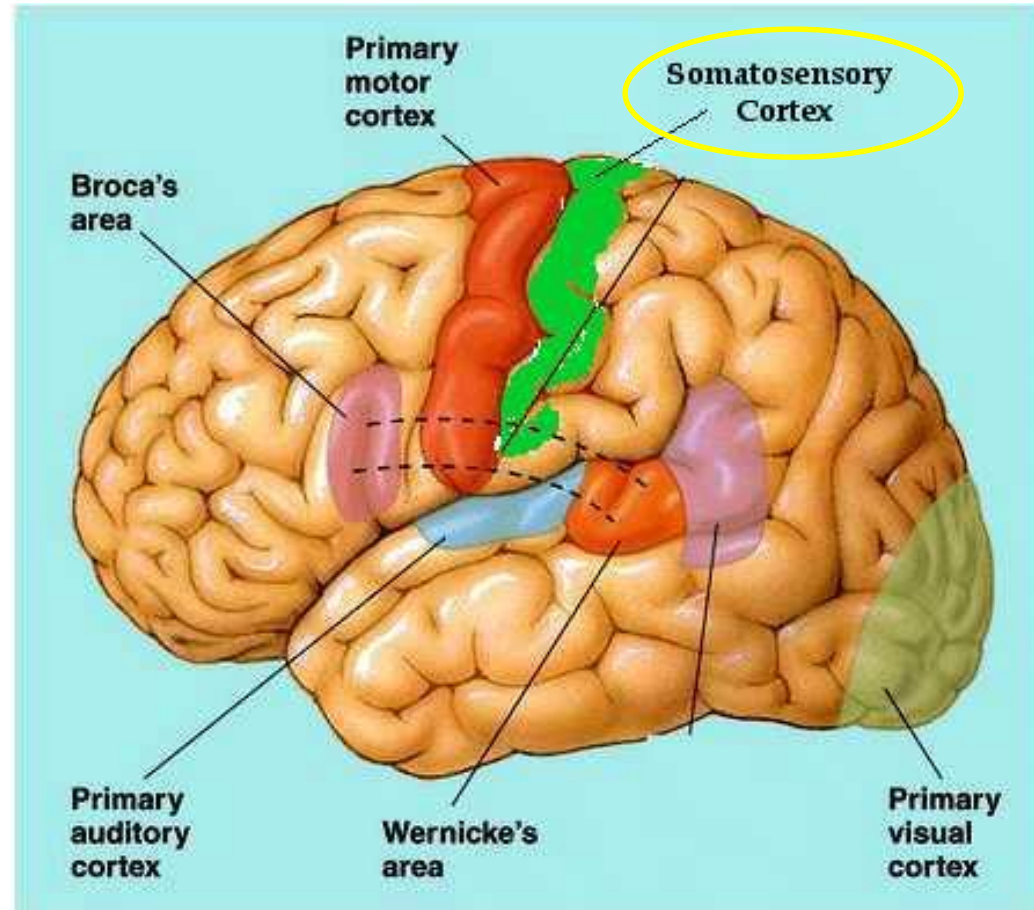
Sense of smell





Both smell and taste use chemoreceptors.

Of all the senses, only smell and taste have fibers that run to cortical areas.



Importance of Smell



- Enjoyment and selection of food
- Flavors are combinations of taste (~20%) and smell (~80%)
- Gives warning of harmful substances

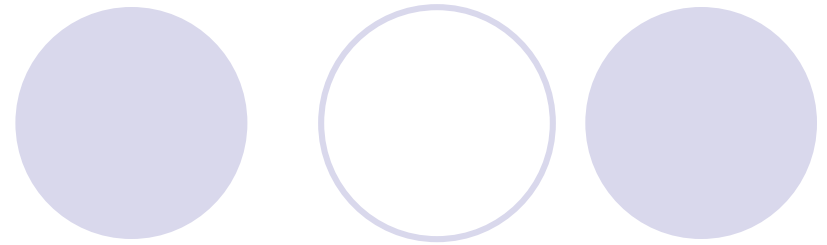
Odor Profiling



- **Fragrant** (e.g. florals and perfumes)
- **Fruity** (all non-citrus fruits)
- **Citrus** (e.g. lemon, lime, orange)
- **Woody and resinous** (e.g. pine or fresh cut grass)
- **Chemical** (e.g. ammonia, bleach)
- **Sweet** (e.g. chocolate, vanilla, caramel)
- **Minty and peppermint** (e.g. eucalyptus and camphor)
- **Toasted and nutty** (e.g. popcorn, peanut butter, almonds)
- **Pungent** (e.g. blue cheese, cigar smoke)
- **Decayed** (e.g. rotting meat, sour milk)

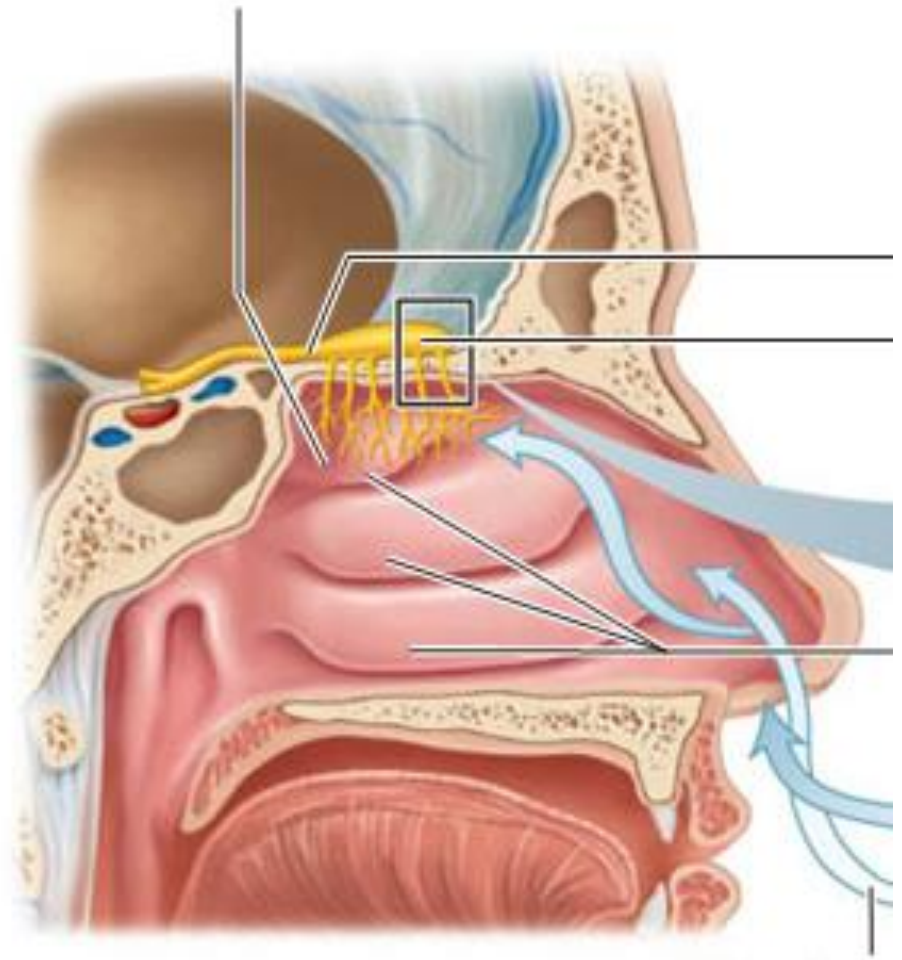
Other aromas, like coffee, are amalgams of two or more.

Olfactory System



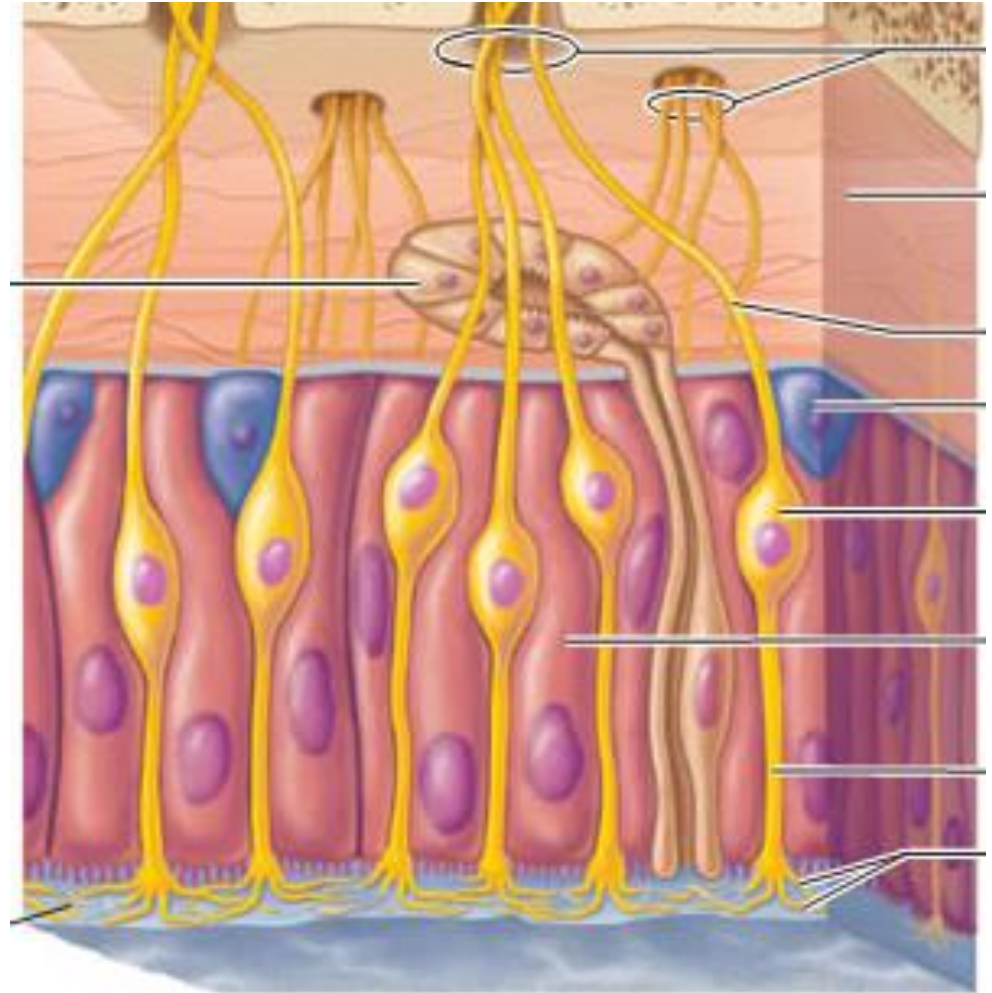
Olfactory Epithelium

The nose contains
10-100 million
olfactory receptors
in just 2.4cm of the
superior part of
each nostril



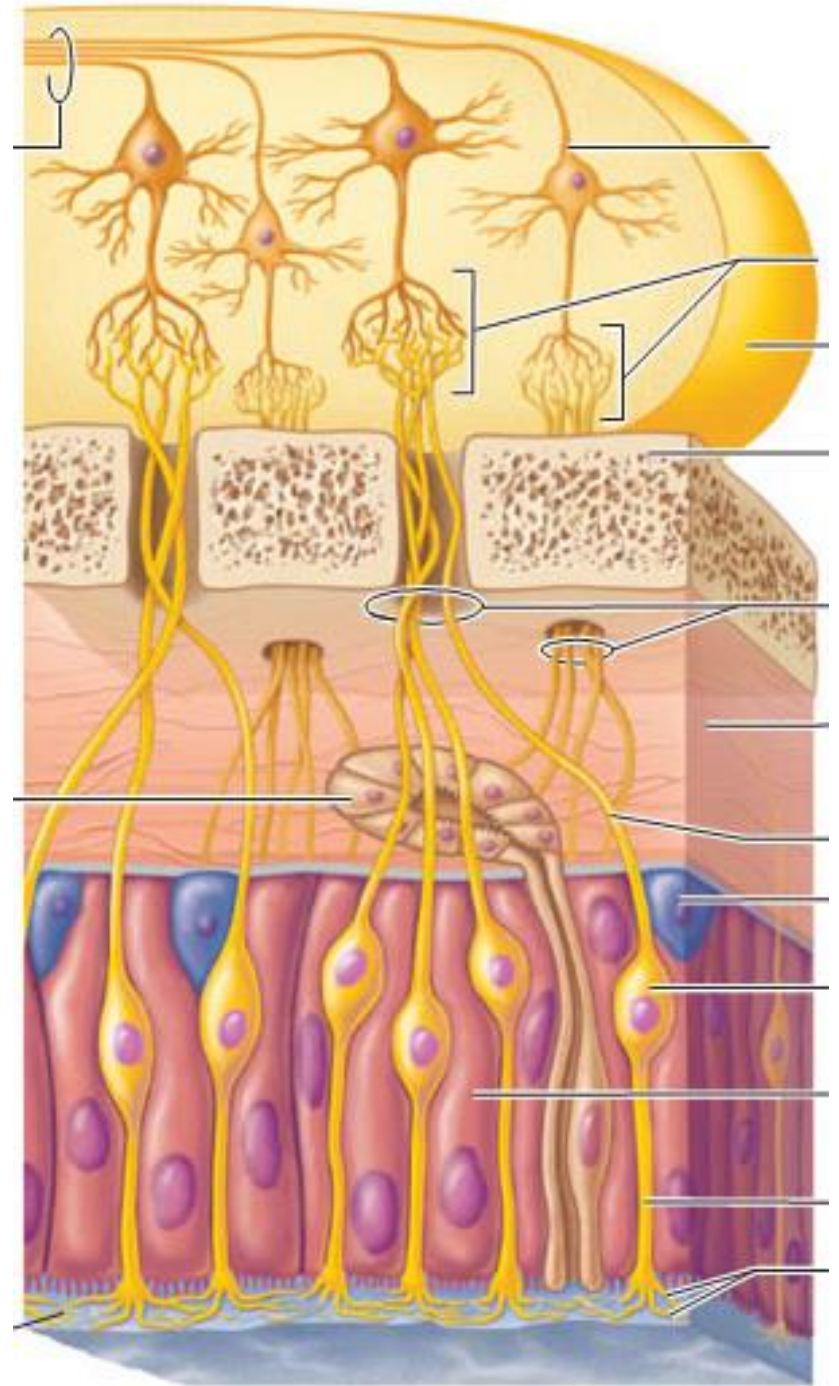
Olfactory Receptors

- The end of the cell forms a knob with cilia
- The cilia is covered in mucus



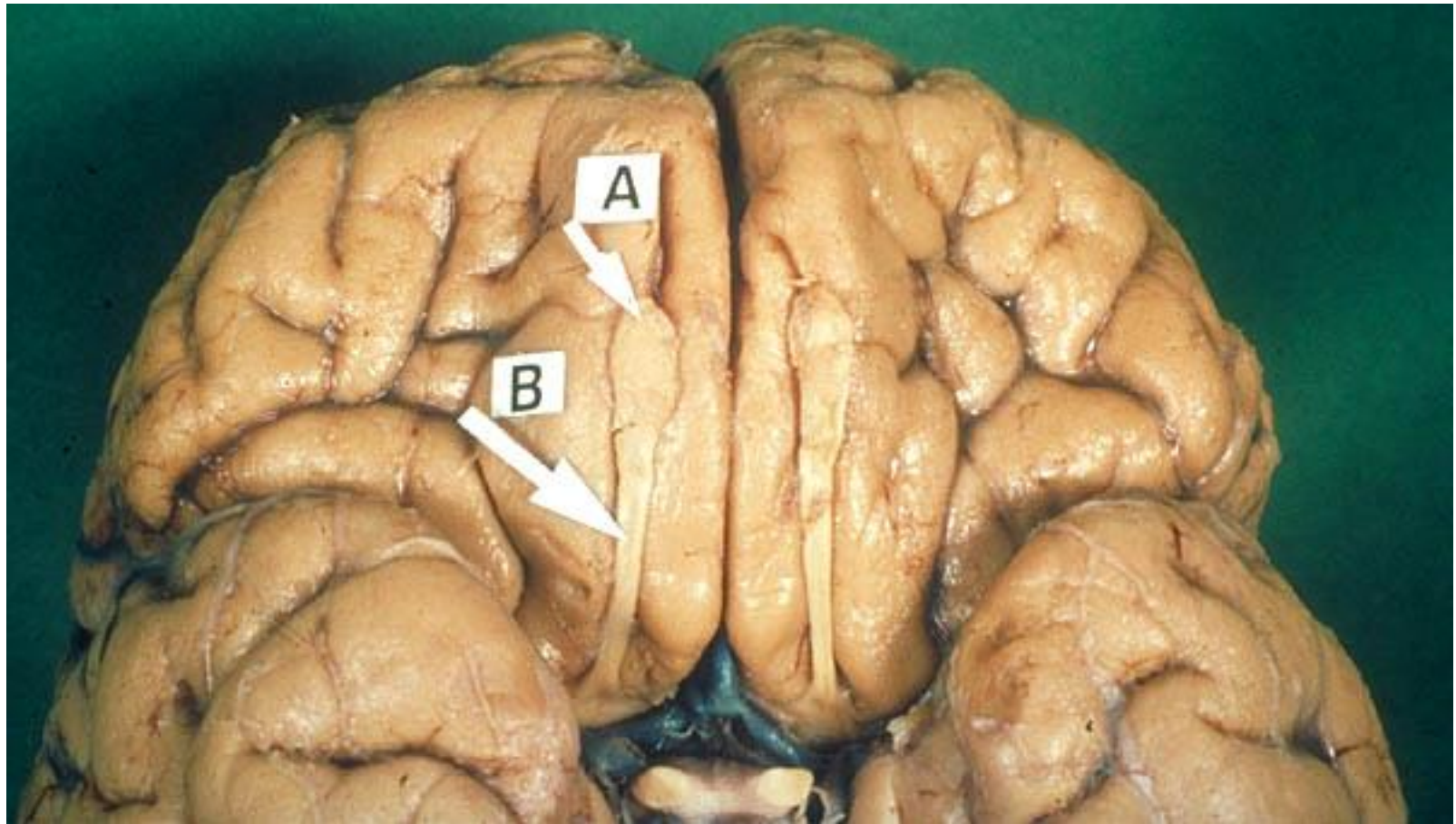
Olfactory Bulb

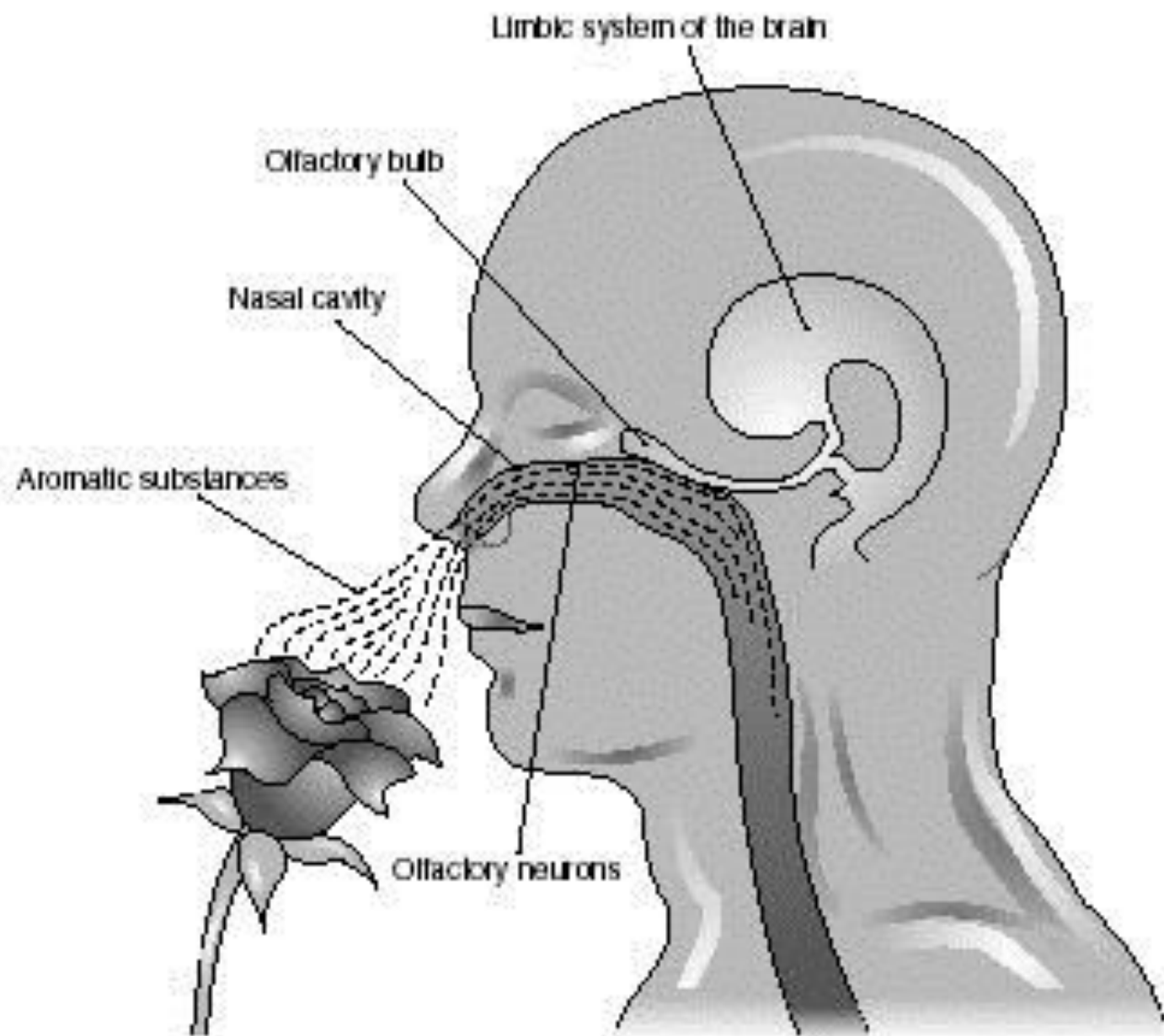
- The odor diffuses into the mucus covering the cilia
- Signal passed through from cell to neuron in olfactory bulb



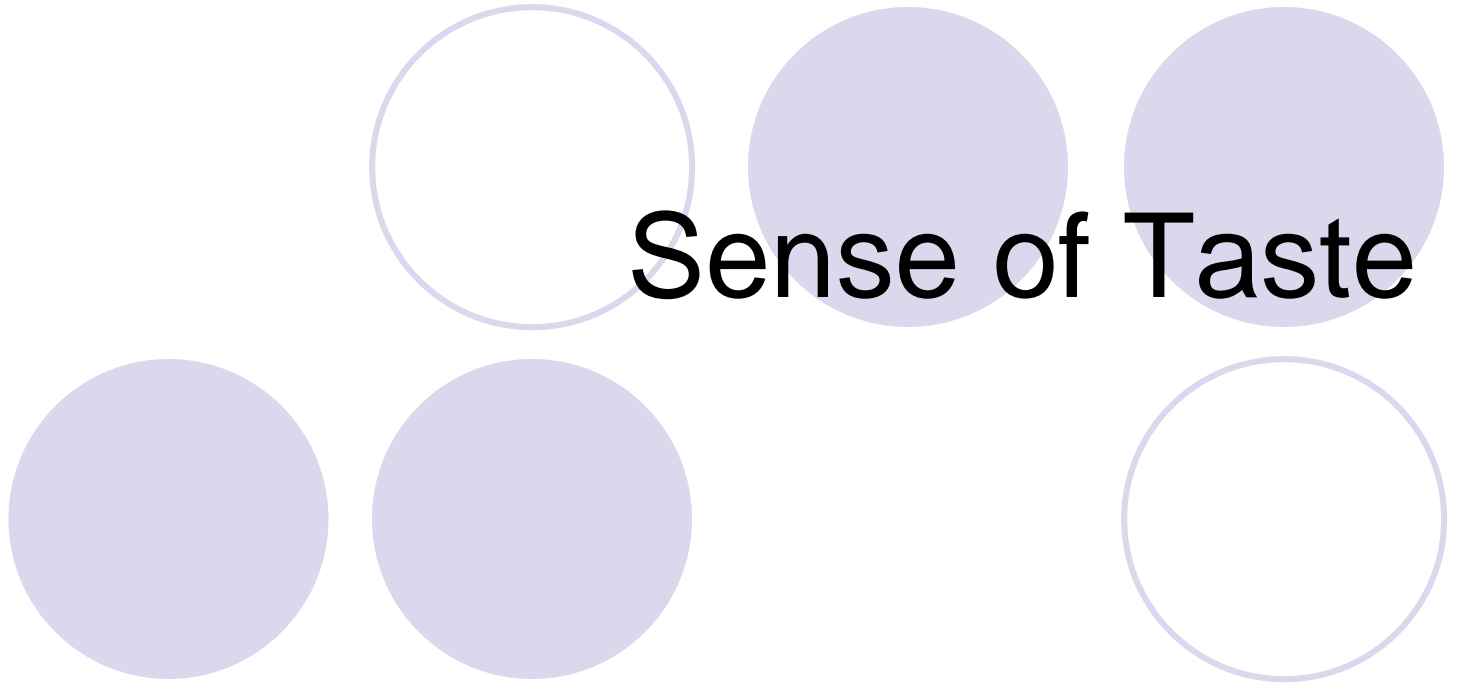
Olfactory Tract

Signal is brought from the olfactory bulb to cerebellum via tract





Sense of Taste





Gustatory sensations : Taste

Substance must be dissolved before can be detected

Detects 4 basic sensations:

salty, sour, sweet and bitter

Also may have receptors for alkaline, metallic,

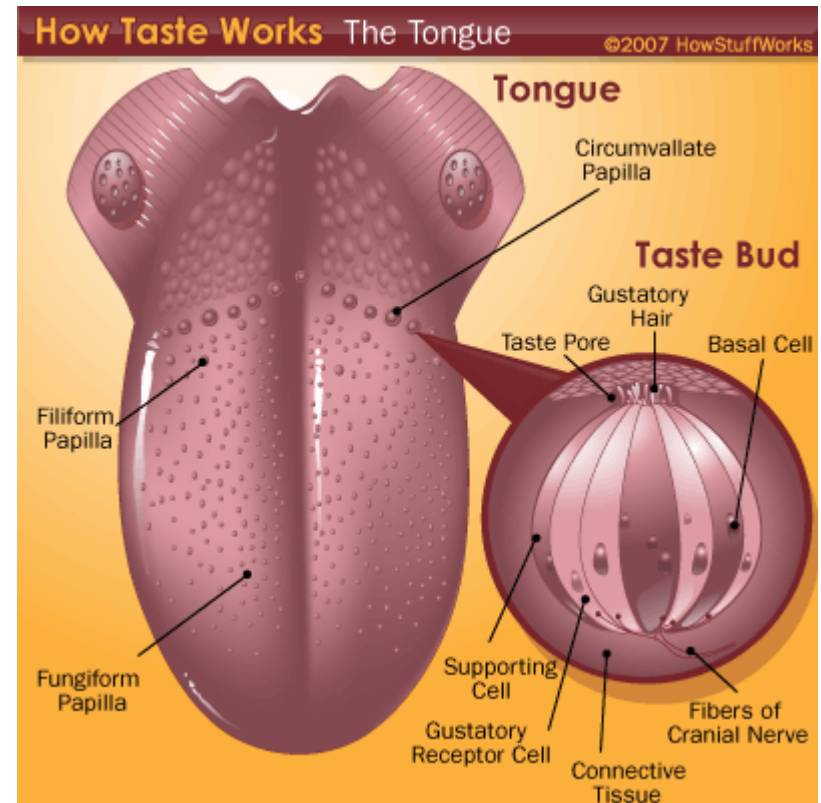
umami (Savoriness found in [fermented](#) and aged foods)
and water!

Gustatory sensations : Taste

The tongue has millions of visible papillae.

Each papillae contains hundreds of taste buds.

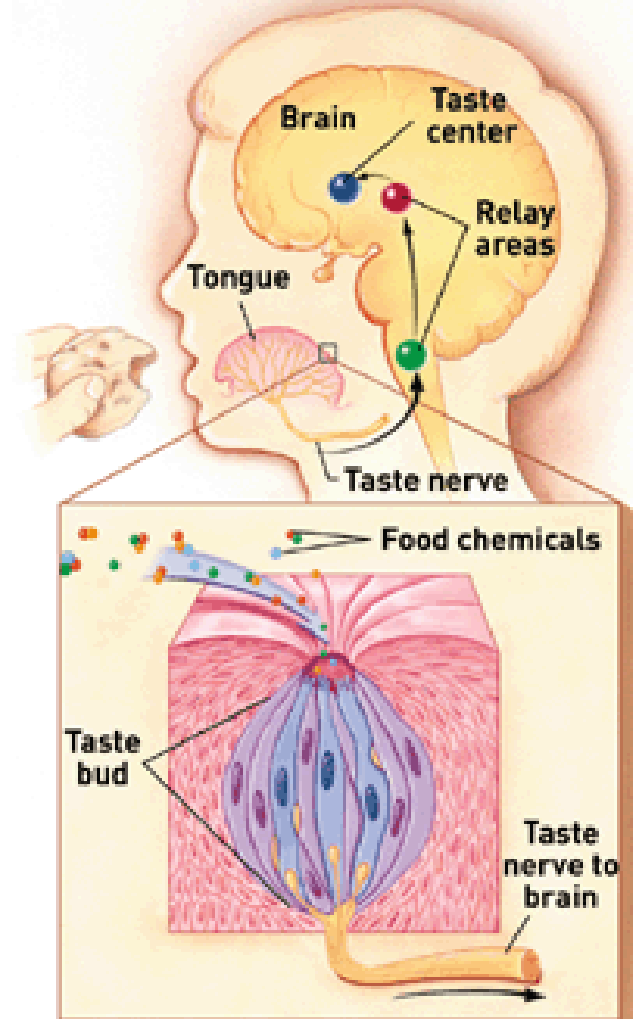
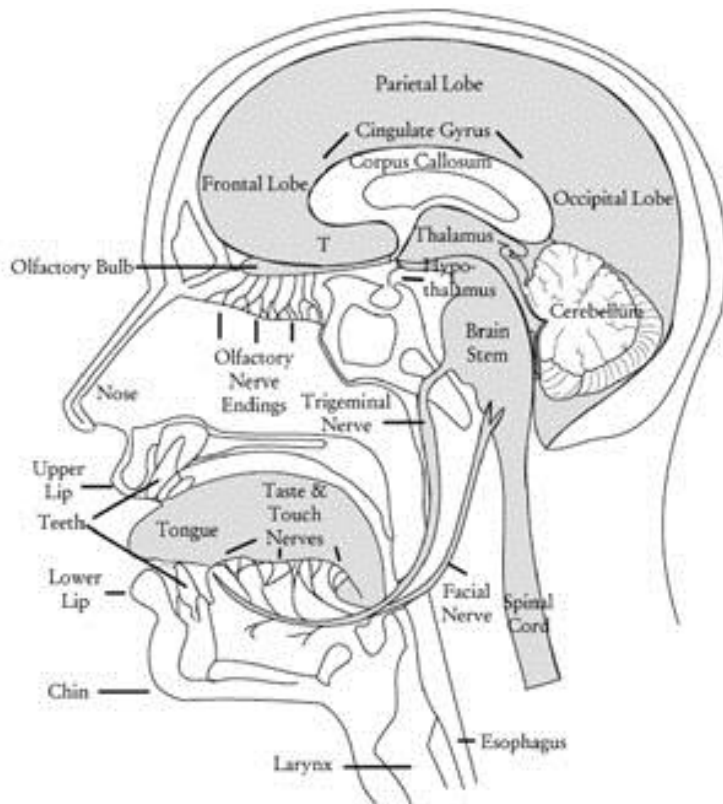
Each taste bud contains 50-100 receptor cells.



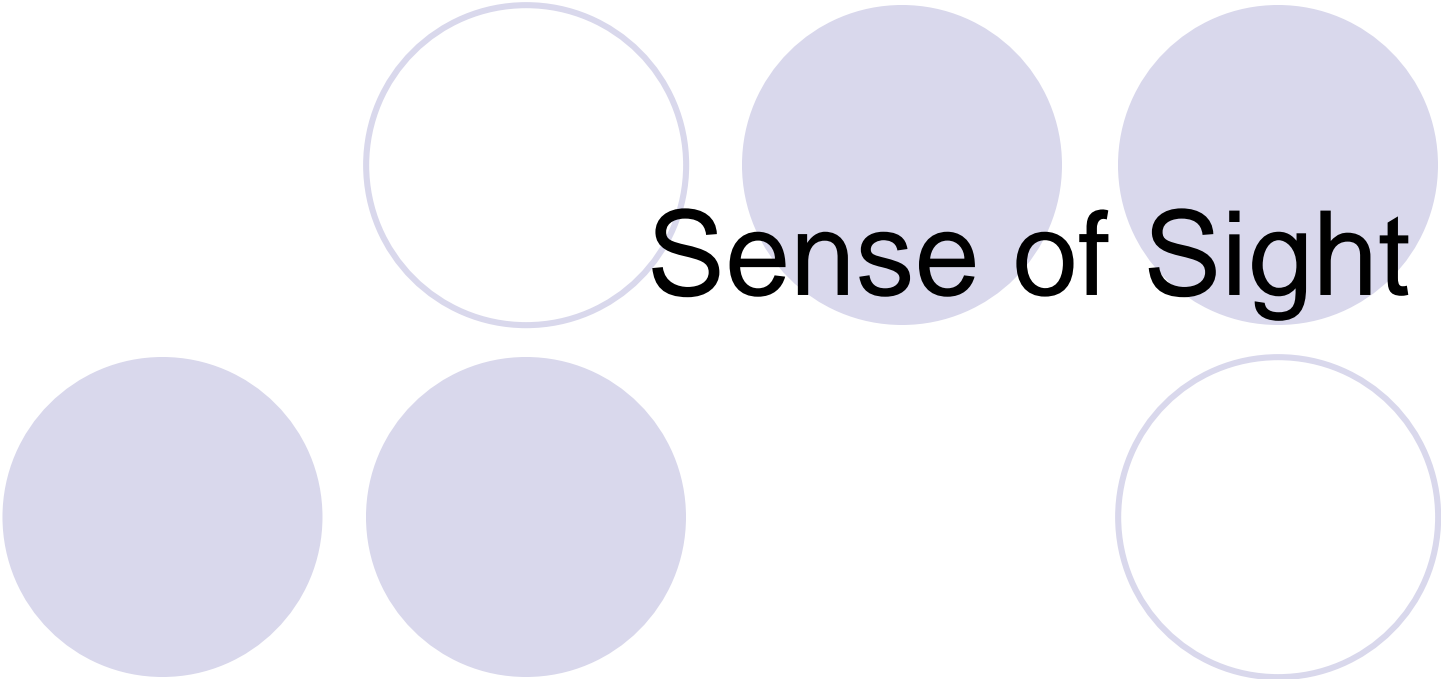
Fun Fact: On average, people lose half their taste receptors by 20 years old.

Gustatory sensations : Taste

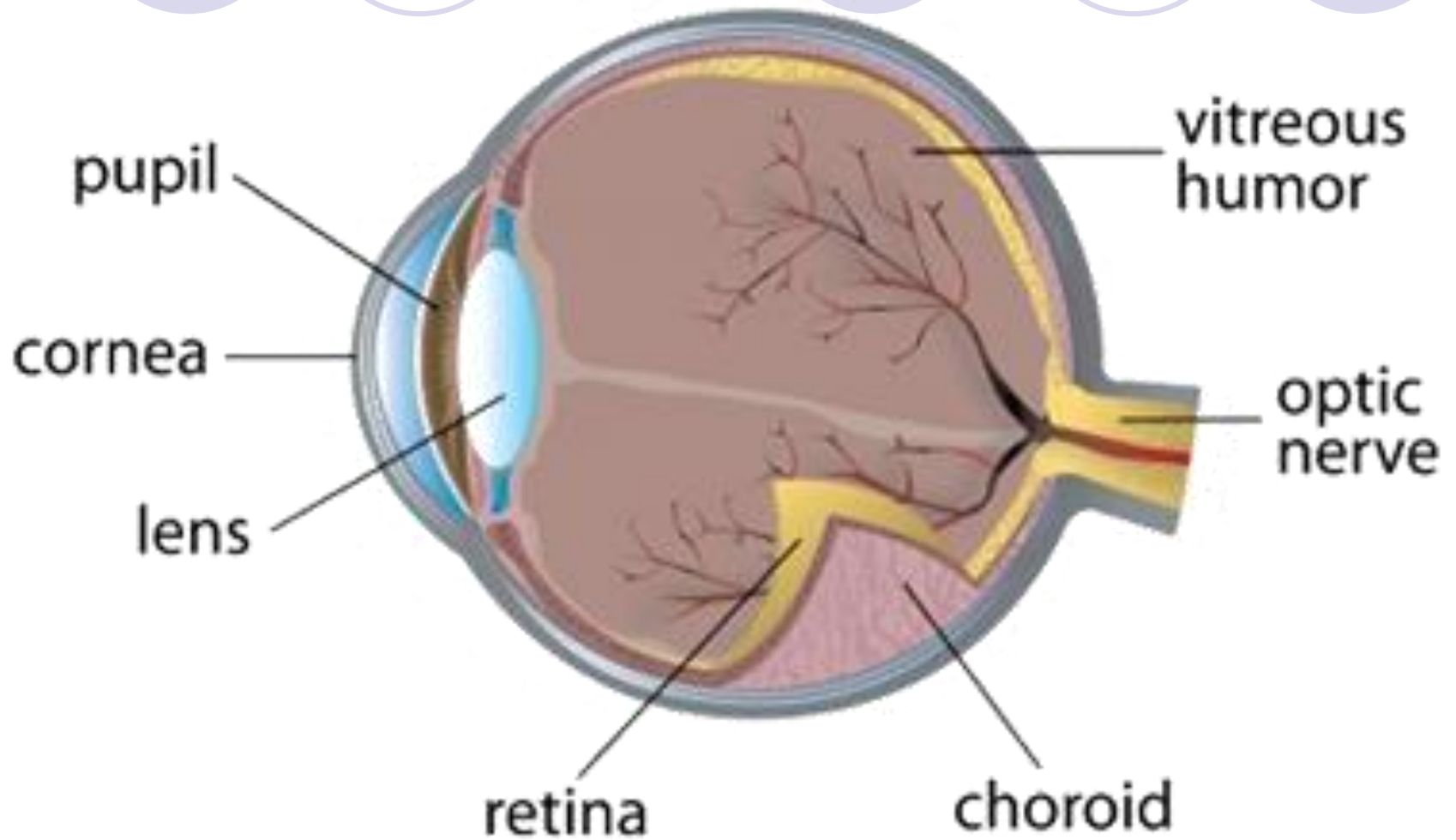
When taste hits the taste bud, the signal is passed through the receptor cell to the neuron.



Sense of Sight

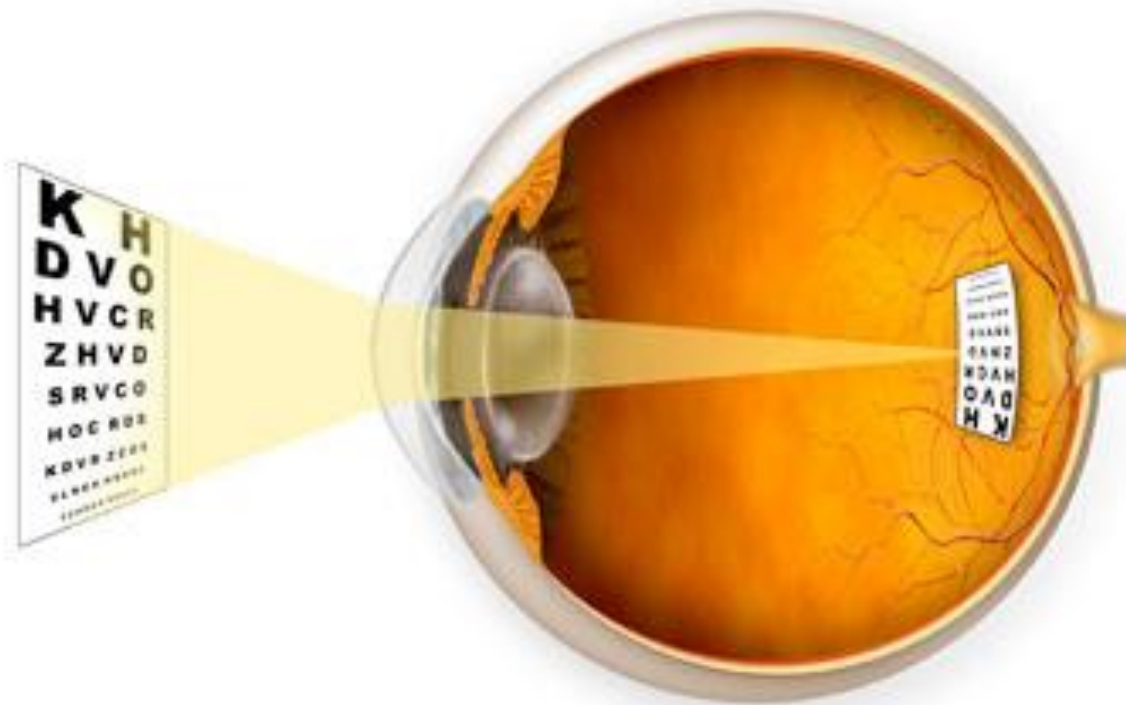


Parts of the Human Eye



Processing Light

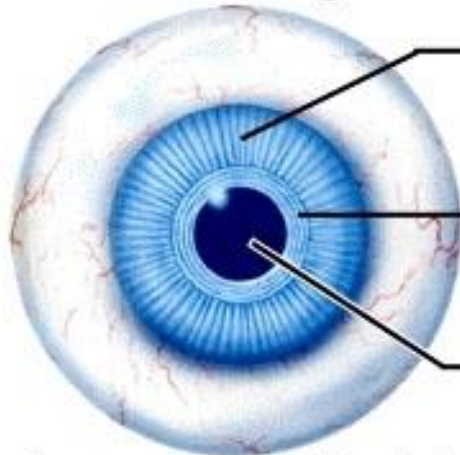
- Light enters through cornea than pupil
- Iris enlarges and shrinks allowing different amounts of light





**Sympathetic motor
nerve fiber**

In dim light



**Radially arranged smooth
muscle fibers of the iris**

**Circularly arranged smooth
muscle fibers of the iris**

Pupil

In normal light

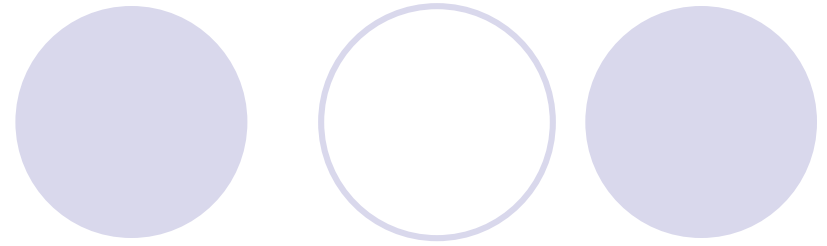


**Parasympathetic
ganglion**

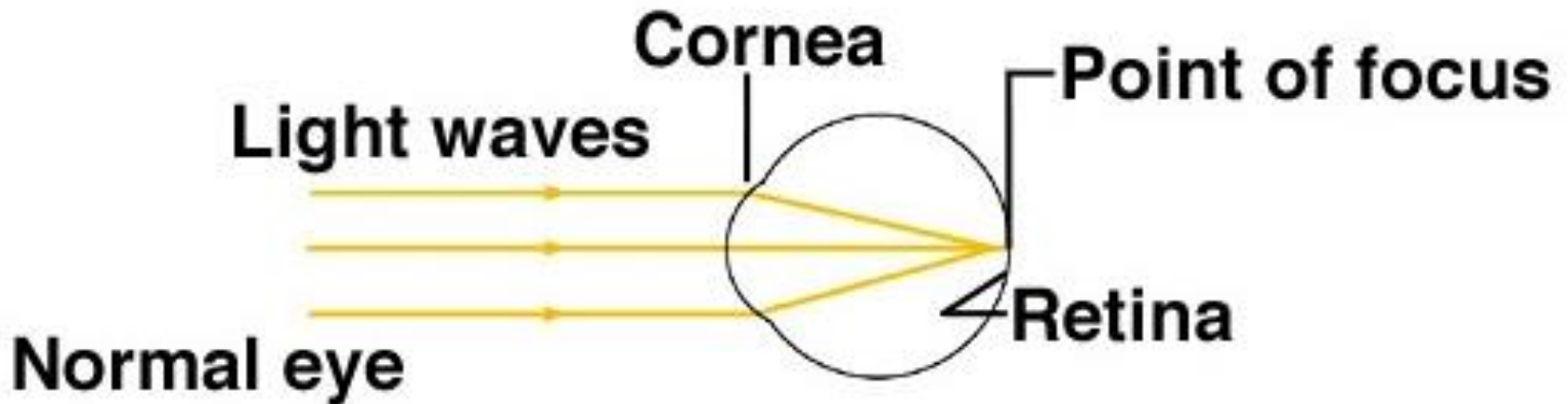
In bright light

**Pupil Dilation
and Constriction**

Processing Light

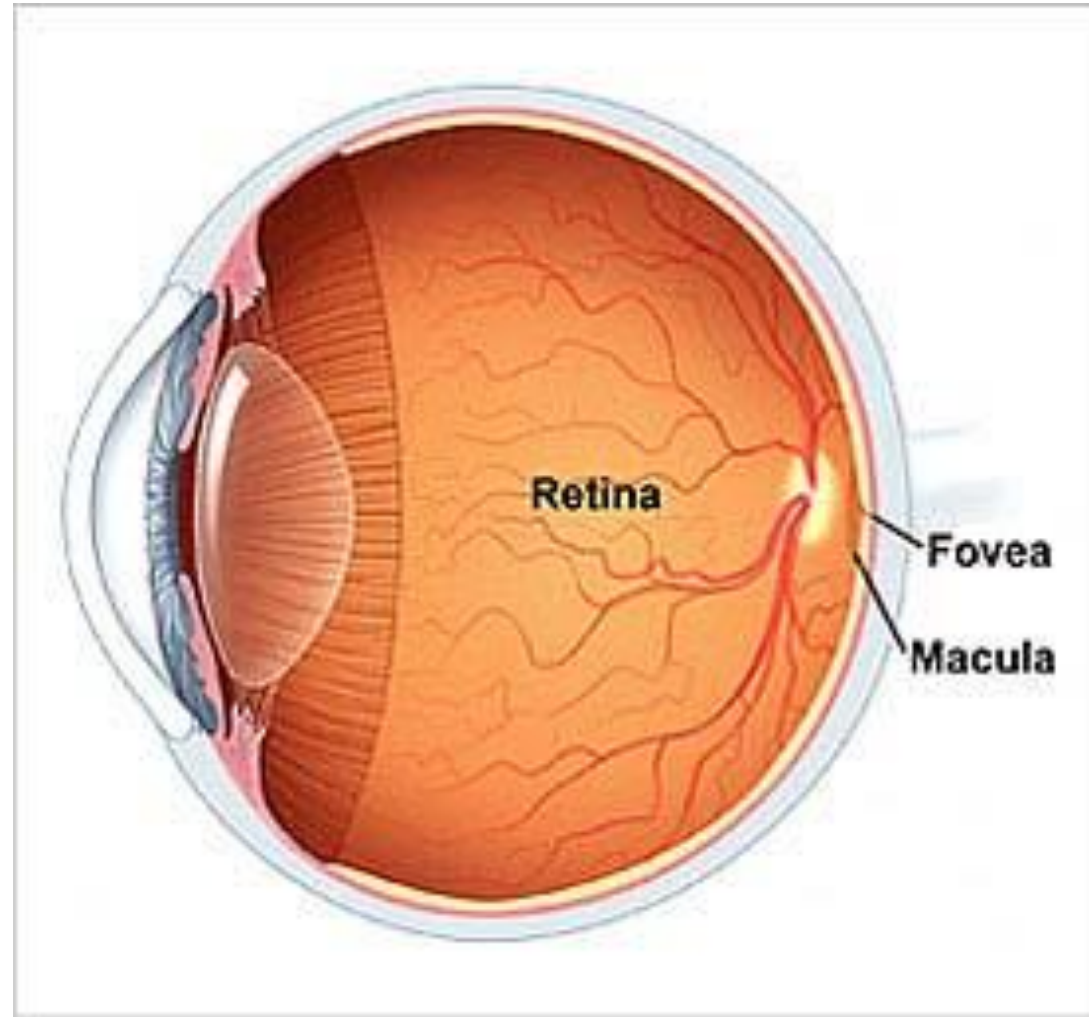


- Than passes through the lens, which focuses the light into the vitreous of eye

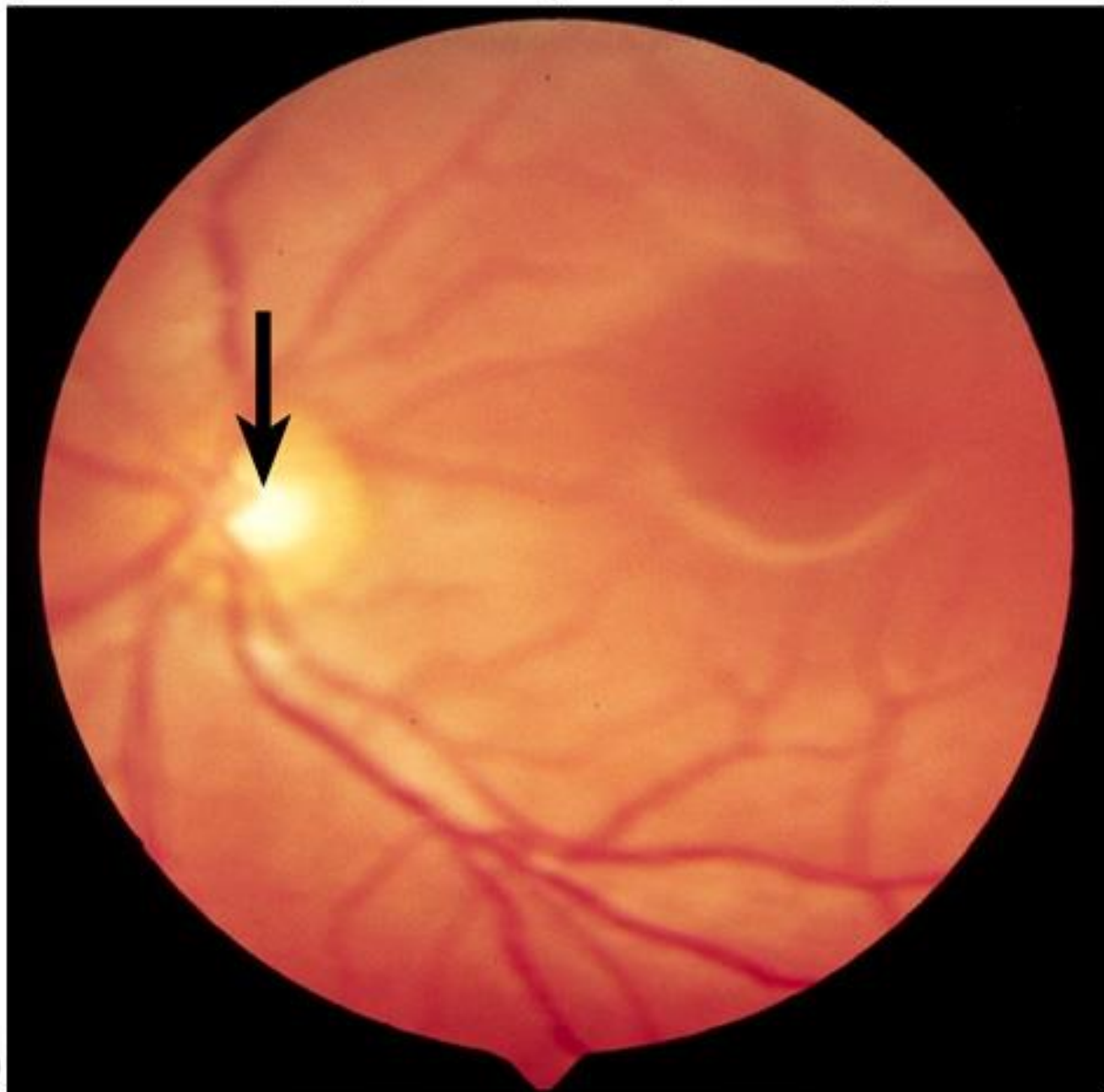


Processing Light

- Hits the retina which turns light into electrical impulse and sends it through the optic nerve

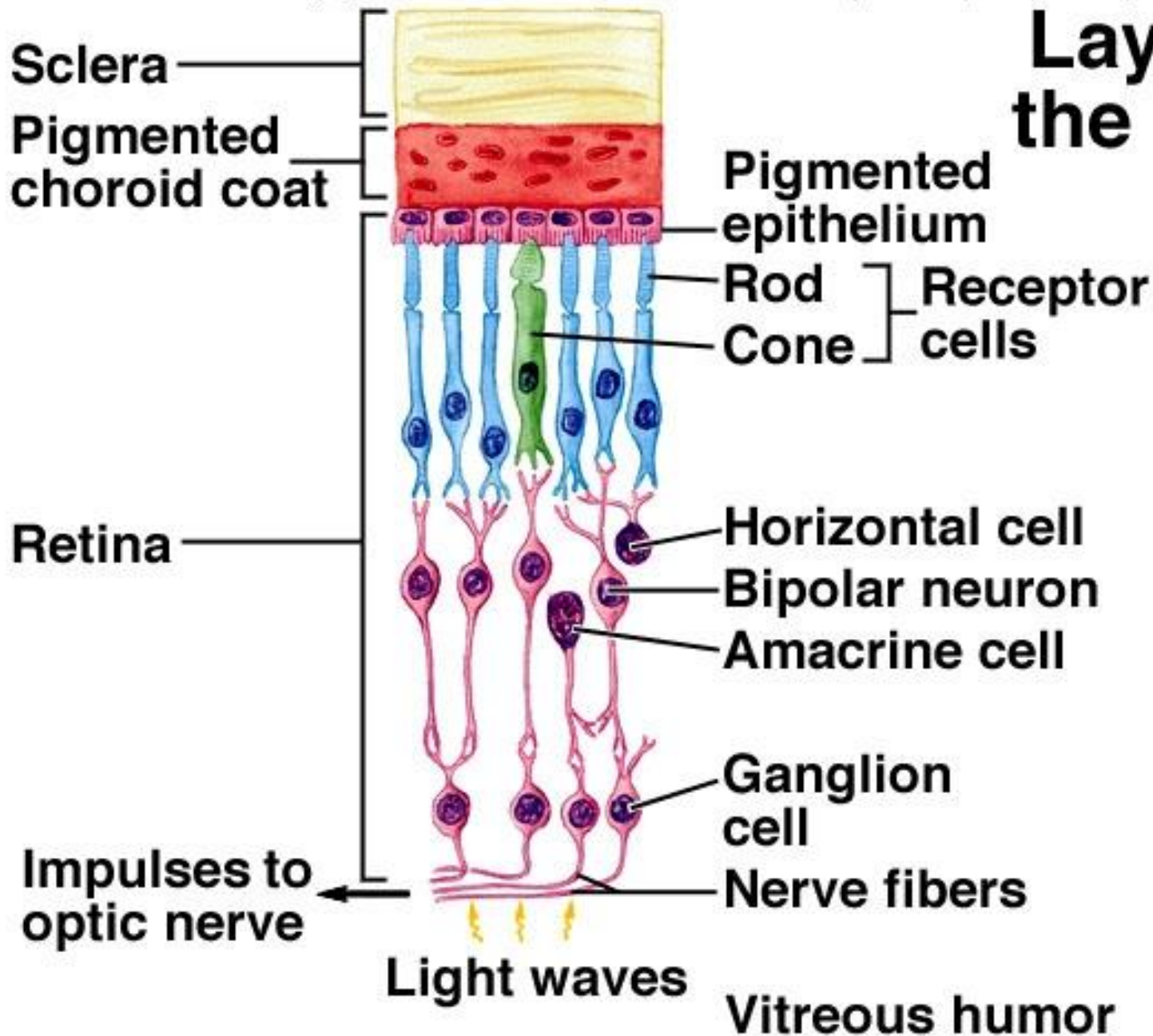


Optic Disk



(a)

Layers of the Retina



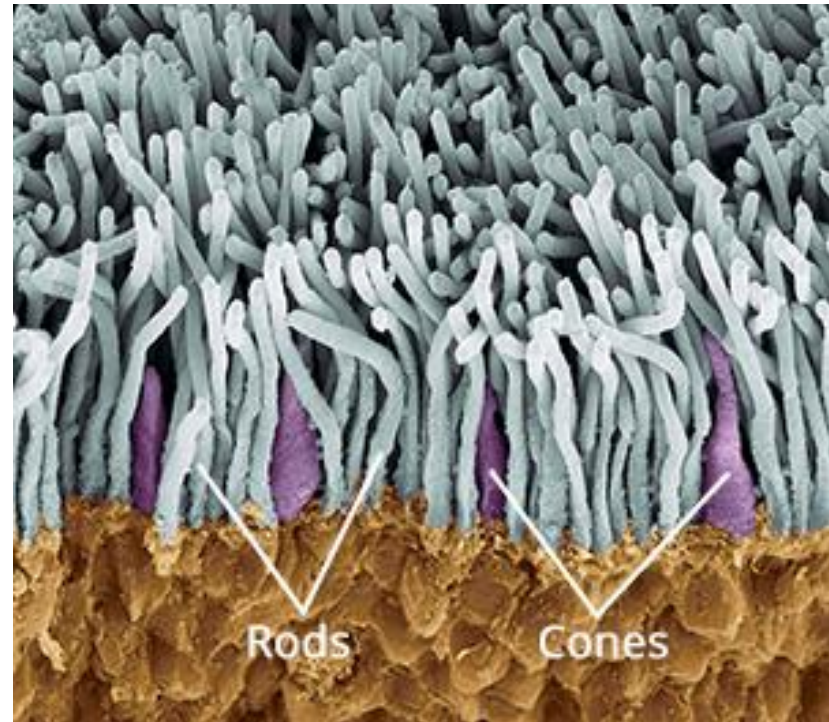
Processing Light

- Rods

- Numerous (120 million)
- Sensitive
- Vision in low light levels:
Gray-scale

- Cones

- Less (6-7 million)
- Vision in high light levels:
3 types based on
wavelength, aka color





Example with red dot

Afterimage



- Overstimulation of receptors makes them lose sensitivity
 - Eventually exhaust their supply of photopigment, resulting in a decrease in signal to the brain.
 - An attempt to keep vision constant



Color vision

Uses three different photopigments in the eye:
blue, green and red

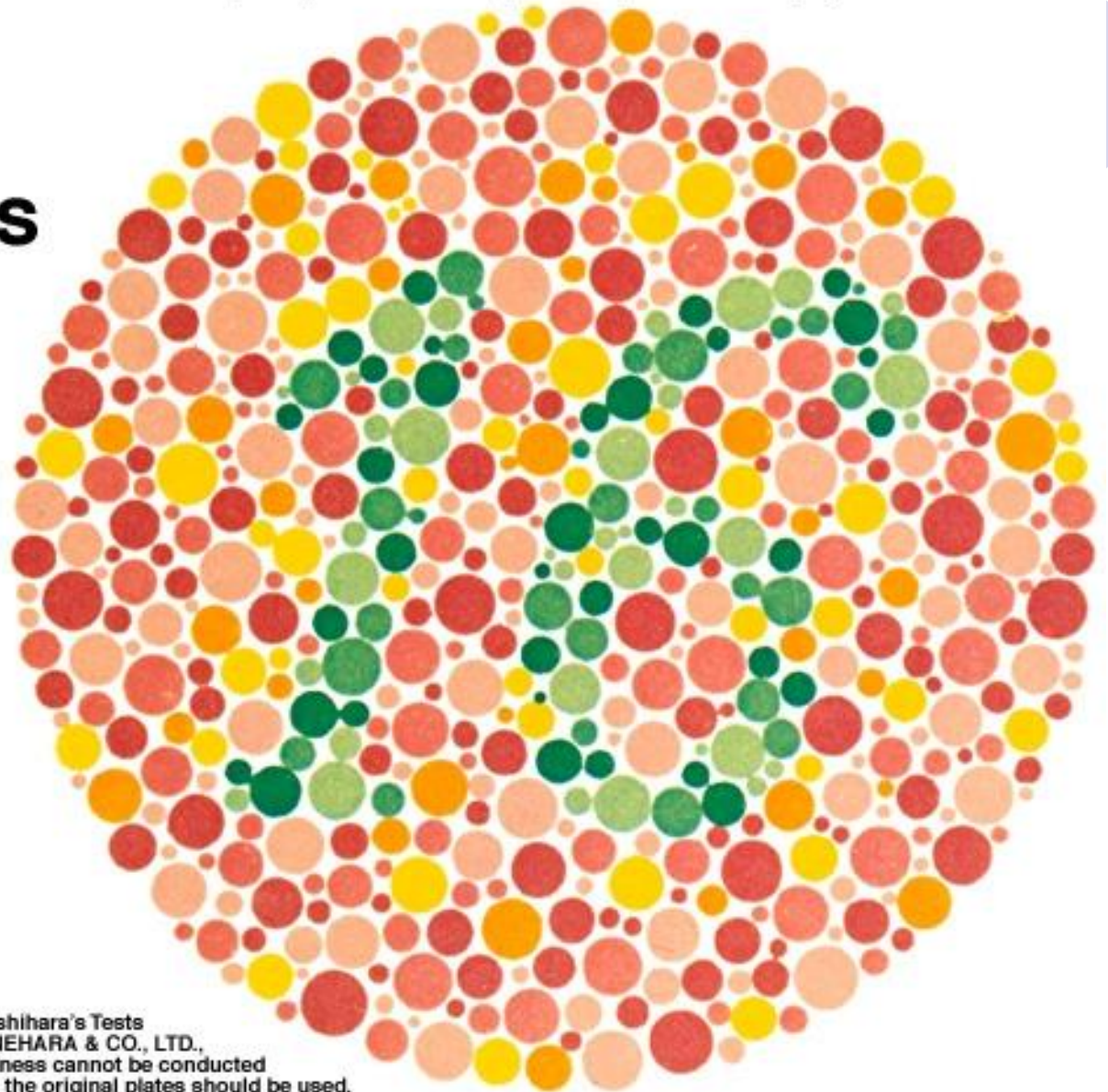
The pigment used to detect a color might be missing or reduced spectrum, causing color blindness

Red – green color blindness most common

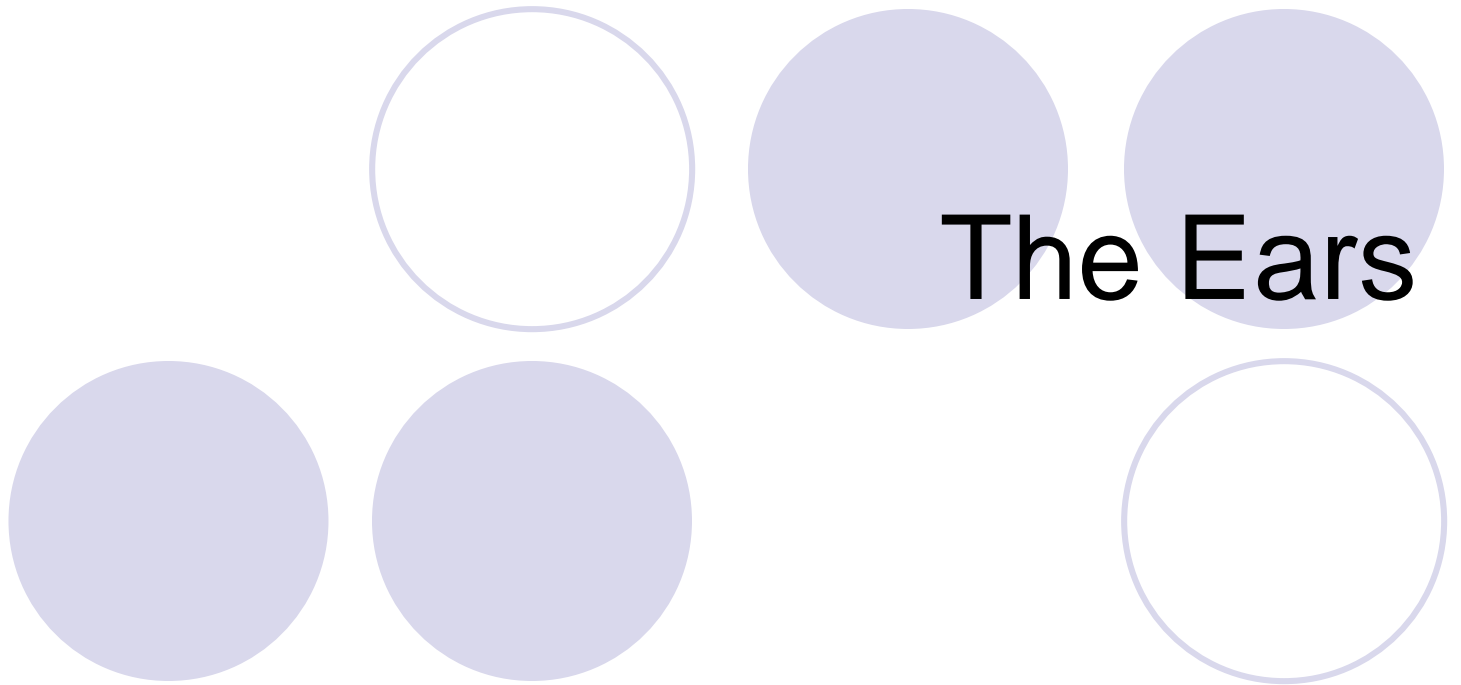
Sex-linked trait carried on X chromosome

(Males only have **one** gene for color vision)

Test for Color Blindness



The above has been reproduced from Ishihara's Tests for Colour Blindness published by KANEHARA & CO., LTD., Tokyo, Japan, but tests for colour blindness cannot be conducted with this material. For accurate testing, the original plates should be used.



The Ears

