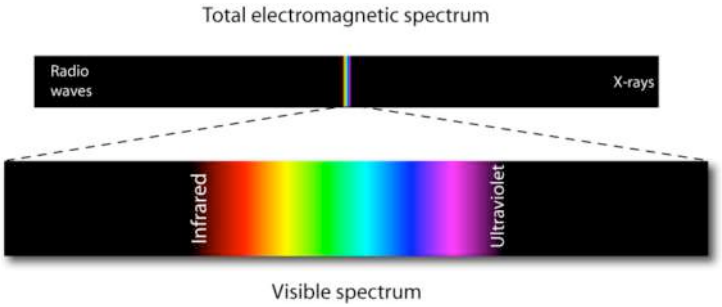
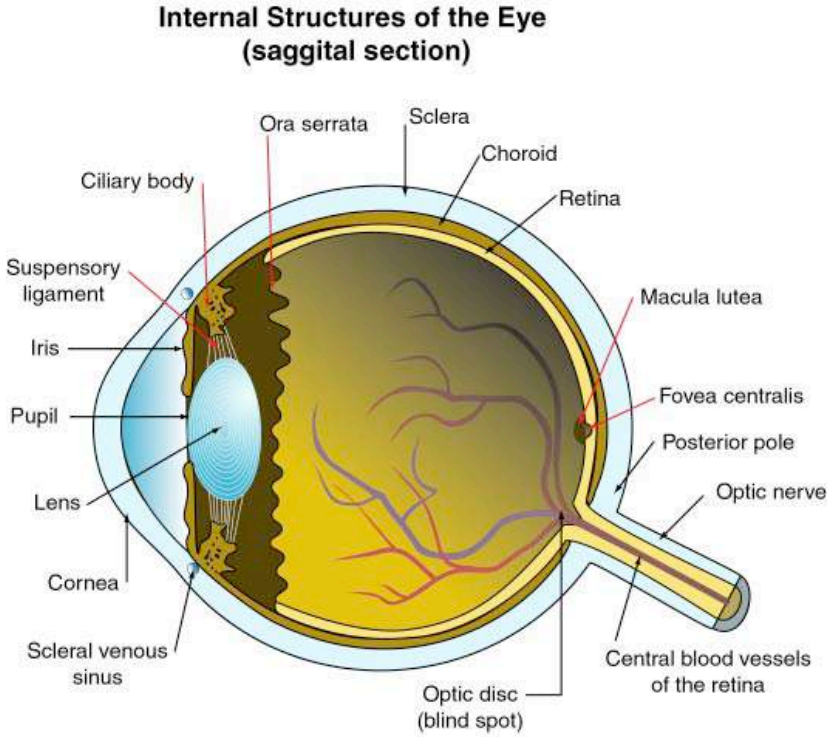
Senses- Vision

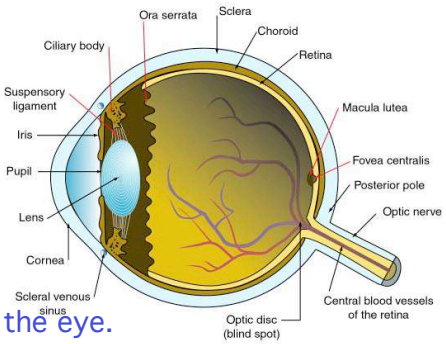


Light is a small part (1/70th) of the total electromagnetic (EM) spectrum.
The EM band extends from radio waves at one extreme to x-rays at the other.
The eye detects light and converts it into nerve signals.

The signals are sent to the visual cortex, located in the occipital lobe of the brain.
Here the nerve impulses are interpreted as sight; various parts of the visual cortex are involved in analyzing shapes, color, contrast, movement, etc, which combine to give us a moving image.



Eye



Sclera ...is the white part of the eye.

Made of a tough layer of CT fibers and covers about 80% of the surface of the eyeball.

Cornea

...is the clear, transparent part at the front of the eye.

It allows light to enter the eye and it also refracts (focuses) the light onto the retina.

Transplant

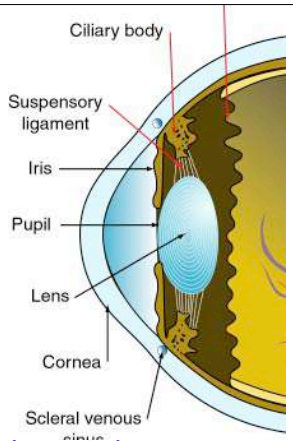
The cornea has a poor blood supply, so the immune response is rather limited. As a result corneal transplants are easy to do and very successful.

Lasix

This is a popular surgery these days. As the cornea is the major focusing element of the eye, reshaping the cornea can enhance visual acuity.

This is usually done for individuals who are very nearsighted. It does not help those individual with decline of near vision due to age.

Ciliary body



Just inside the sclera, near the edge of the cornea, is a circular projection called the ciliary body. It produces a fluid called aqueous humor. More later.

Iris

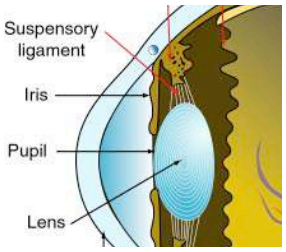
The iris is a circular extension off the ciliary body. This is the colored part of the eye. The different eye colors are due to different levels of a dark pigment called melanin. People with blue eyes have small amounts of melanin; dark eyes, large amounts. This pigment helps to reduce light scattering within the eye and allows you to see better in bright sunlight.

pupil

...is a hole in the middle of the iris. It's size regulated by muscles within the iris.

In bright light the the circular muscle of the iris contracts and the pupil constricts; in the dark the radial muscle contracts and the pupil dilates, this lets more light into the eye.

Lens

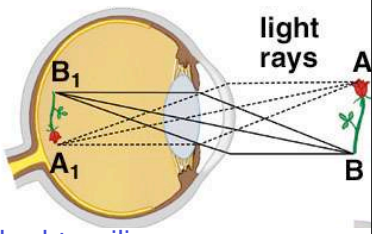


Just inside the iris is the lens. Its function is fine focusing; it is not the major focusing element, which is the cornea.

focusing

The lens is able is fine focus because it can change shape.

For you to see an image clearly, the image needs to be focused onto the retina.

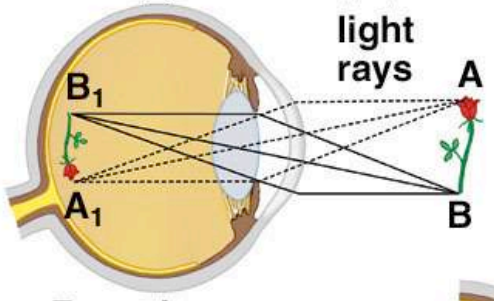


The image of a close, unfocused object, falls behind the retina; so you need to bring the image forward.

Ligaments around the periphery of the lens are attached to ciliary muscles in the ciliary body. When these muscles contract the ligaments loosen and the lens get thicker. The light rays are more sharply bent, the image is brought forward and the close object comes into focus.

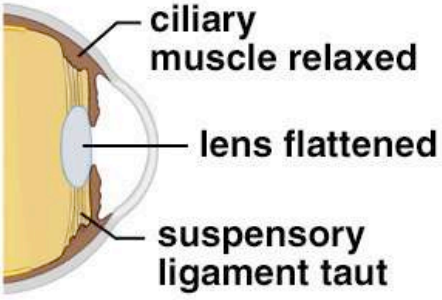
The opposite is true for far objects.

As you get older the lens stiffens and it becomes harder for you to focus on close objects; this is called presbiopia.

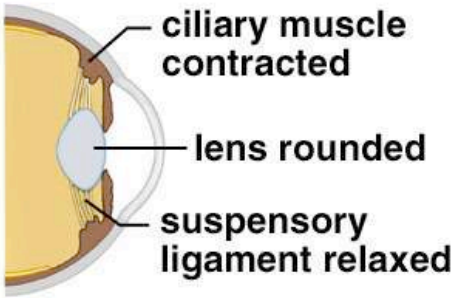


Focusing

a. Focusing



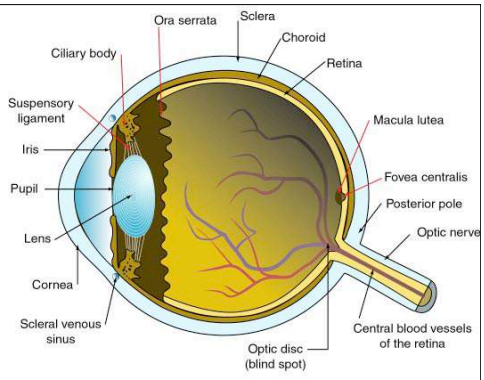
b. Focusing on distant object



c. Focusing on near object

Aqueous humor

The ciliary body continually makes a fluid (similar to blood plasma without proteins) called aqueous humor. This fluid is drained by tiny channels, near the edge of the cornea, called the scleral venous sinus
The humor carries nutrients and removes wastes from the region just in front of the lens and behind the cornea.



glaucoma

... is a condition in where too much fluid is made or it is not drained properly. The pressure (intraocular pressure, IOP) builds up and eventually damages the retina, leadin to blindness.

vitreous humor (or body)

...is located behind the lens and in front of the retina. It is a clear, jelly-like material tha helps to keep the retina in place.

cataracts

As you age and the lens' proteins accumulates damage (usually from UV light), the lens becomes opaque and cloudy. Treatment requires surgery to remove the lens and replace it with a prosthesis. Fairly common procedure.

Lacrimal glands

These are small almond shaped glands located above and lateral to the eye.

They produce tears; a fluid that cleans and moistens the surface of the eyeball.

Tears pass through the lacrimal ducts on to the eye surface and are drained by the nasolacrimal ducts into the nasal cavity.

Retina

.. Is found at the back of and inside the eye..

It is made of several layers of cells,some of which absorb light and convert it into nerve impulse; others process the signals and pass them to the optic nerve

optic nerve

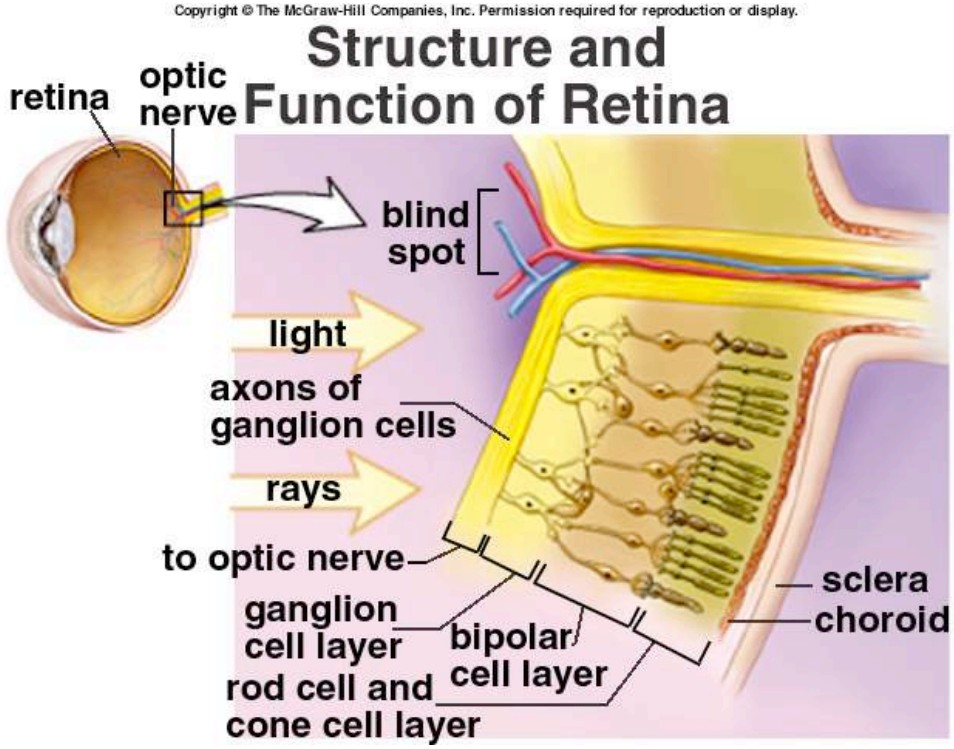
...is a bundle of nerve fibers that carry signals from the retina to the visual cortex of the brain, where the signals are perceived as sight.

Blind spot

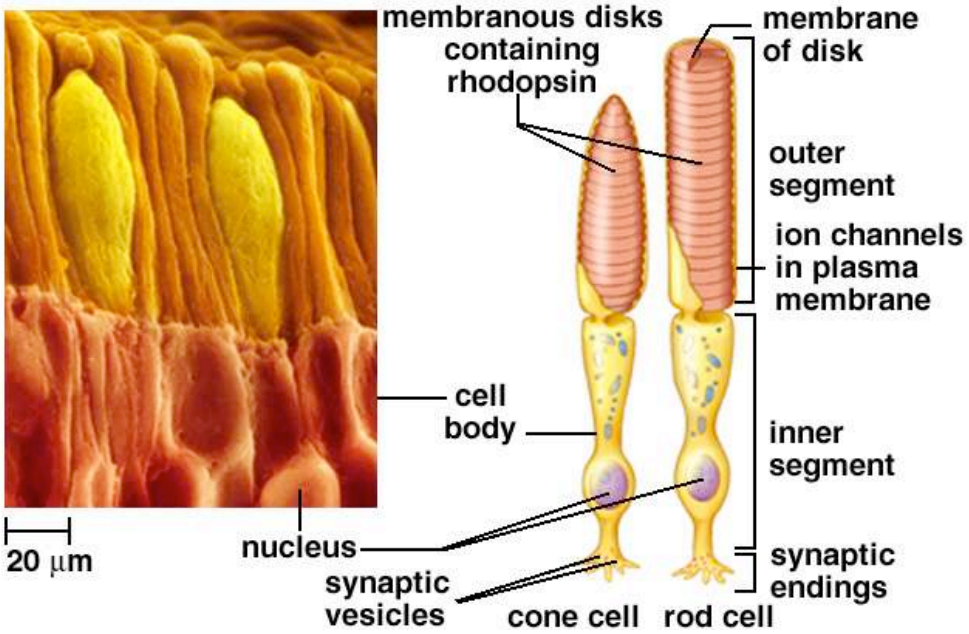
The place where the optic nerve leaves the retina. Because of the way the light sensitive cells (photoreceptors) of the retina are arranged, the nerve fibers have to pass through the layer of photoreceptors; this spot has no photoreceptors, hence a blind spot.

Fovea

The fovea is the place on the retina where most of the photoreceptors are found, along the visual axis on the retina; the highest density of these cells. So the fovea has the highest visual acuity (sharpness.)

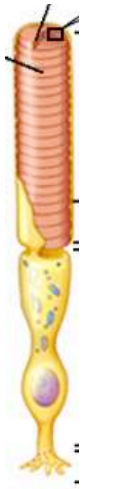


Photoreceptors in Eye



rods

Are photoreceptors of the retina that are very sensitive to low light levels and are active at night. The rods give you information about levels of light, so they are responsible for black and white vision. There are about 125 million rod cells/eye, mostly found in the periphery of the retina.


rod cell

rhodopsin

Is a chemical in the rod cells that absorbs light and through a series of reactions causes the cell to send nerve impulses down the optic nerve.

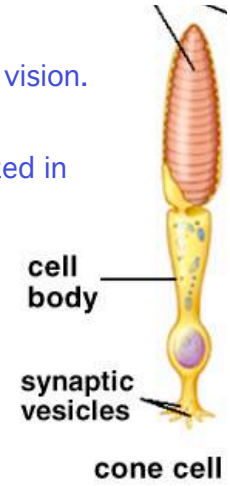
In bright light, such as daylight, rhodopsin is almost completely broken down, and the rod cells are non-functional.

cones

Are photoreceptors of the retina that are responsible for color vision.

They require bright light to function.

There are about 7 million of these and they are almost all located in the fovea.



cone cell

color vision

... is produced by three types of cones working together; red, green and blue.

By stimulating these cells independently to varying degrees you can see all of the colors in the spectrum

color blindness

...occurs when one (usually the red or green) cone type is not working properly.

near and far sight

To be able to see with good visual acuity the image needs to be projected on to the retina with sharp focus.

If a person is near sighted, that is they can see close up but not far, they are myopic.

If a person is far sighted or hypermetropic, that is they can see far but not close up.

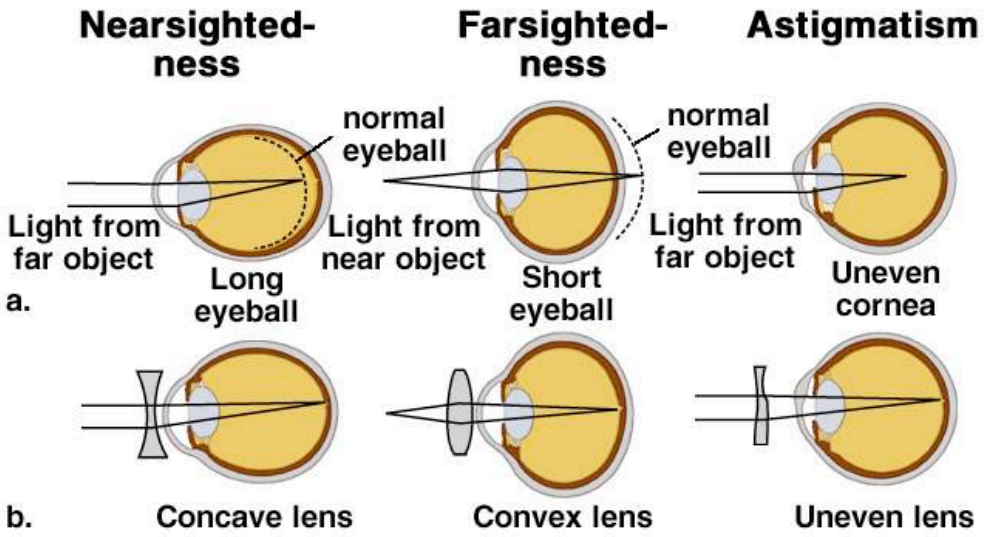
20/20

This number gives a measure of how sharp the image is.

Def. You see at 20 feet what the average person sees at 20 feet.

If you are 20/800 (very myopic, or near sighted) you see at 20 ft what the average person sees at 800ft.

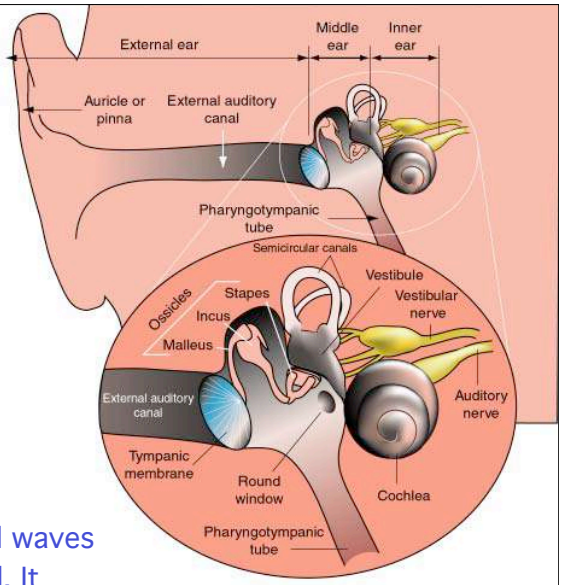
Eye Abnormalities with Possible Corrective Lenses



Ear

The ear detects sound vibrations and converts those vibrations into nerve impulses.

Human hearing frequency ranges from 20 Hz-20 KHz; that is from 20 to 20,000 cycles per second.
Males: 18-18,000 Hz
Females: 22-22,000 Hz



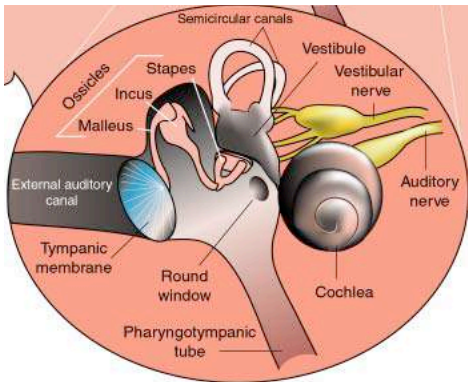
Outer- pinna

The outer cup-shaped pin collects sound waves and funnels them into the auditory canal. It helps localize (where it is located in space) sound as well.

Auditory canal

Carries the sound into the middle ear, located within the temporal bone of the skull.

Ear



Middle

an air-filled space Located within the temporal bone of the skull; contains the tiny "ear bones"

Eardrum or tympanic membrane

A taut skin-like sheet which covers the end of the auditory canal; transmits sound to the ear bones called...

ossicles-

Function: 1) amplify sound 2) transmits sound into the inner ear.

The ossicles move in response to sound waves. They each vibrate in turn starting with the malleus, which rests on the tympanic membrane and lastly, the stapes, next to the inner ear.

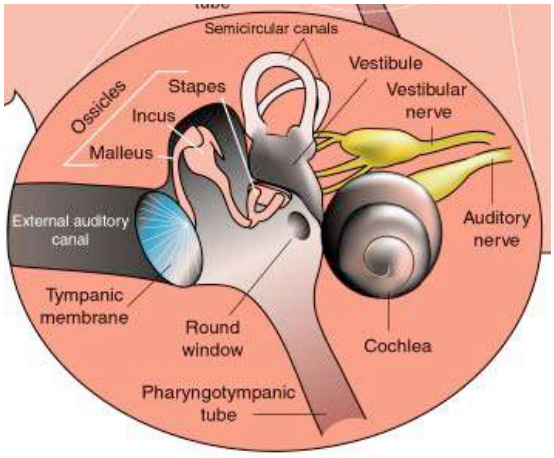
i) hammer- malleus

ii) anvil- incus

iii) stirrup- stapes

oval and round windows

Ear



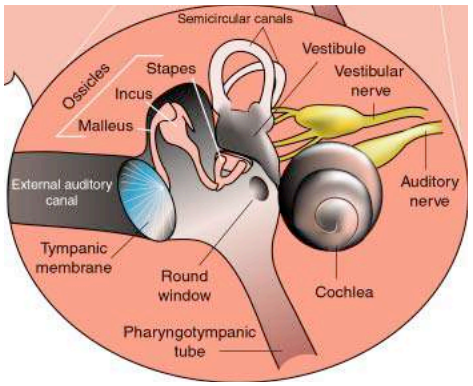
oval and round windows

Sitting under the stapes is the oval window. This opening is covered with a membrane. As the stapes moves, it causes the membrane of the oval window to move. Sound vibrations are transferred to a fluid, in the inner ear, behind the window.

The round window is similar to the oval window. Its function is to carry sound energy out of the inner ear back into the middle ear.

This energy is then dissipated down the Eustachion or pharyngotympanic tube.

Ear -middle



Eustachion tubes

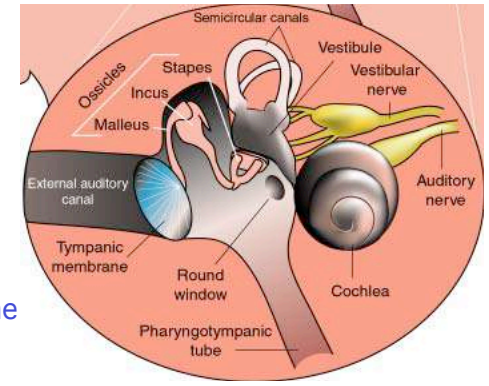
Leads from the middle ear to the throat.

Function: to equalize pressure between the outer ear and the middle ear.

If the pressure is not equalized the tympanic membrane may bulge in or out, depending on the difference in pressure.

If the pressure difference is too great, the membrane may burst; a ruptured ear drum.

Ear-Inner



The inner ear has three parts: 1) vestibule, 2) semicircular canals, 3) cochlea.

Vestibule

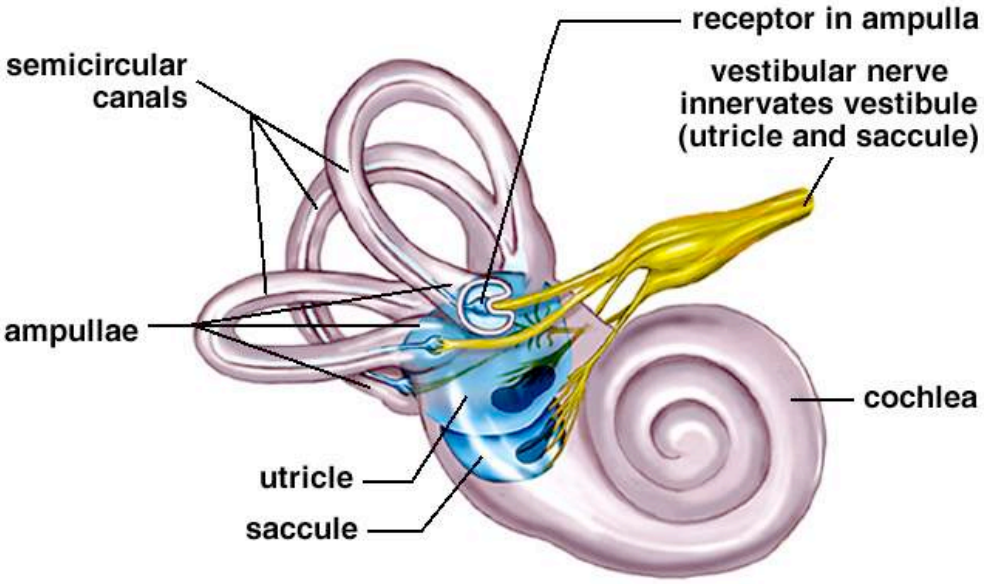
This region contains two structures, called the utricle and saccule, that determine the position of the head with respect to gravity. They also provide information about whether the body is accelerating and in which direction.

semicircular canals

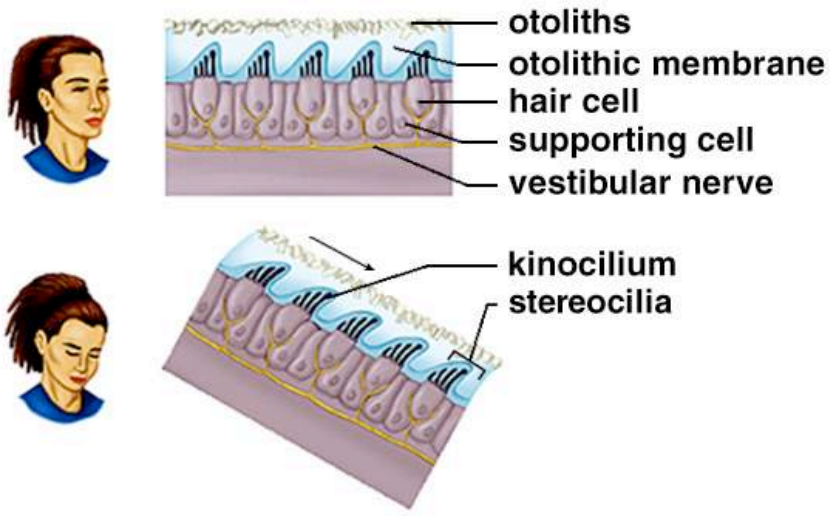
...are three tubes which determine if the body is rotating along any or all of the three axes of space.

In combination the vestibule and the semicircular canals tell the brain if and how the body is moving.

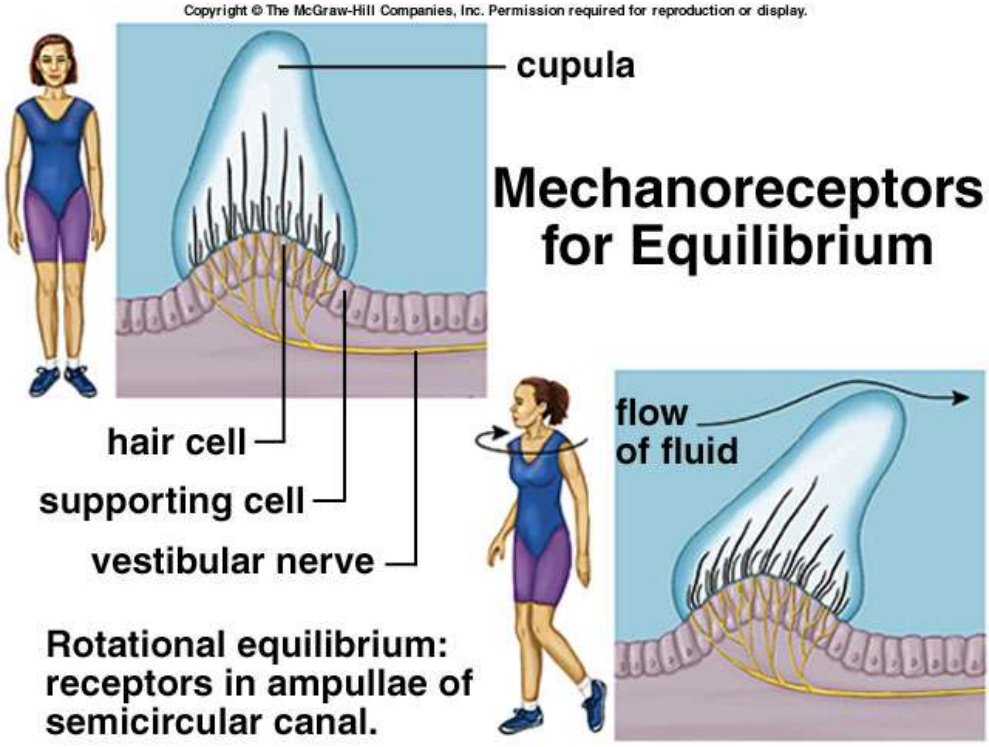
Mechanoreceptors for Equilibrium



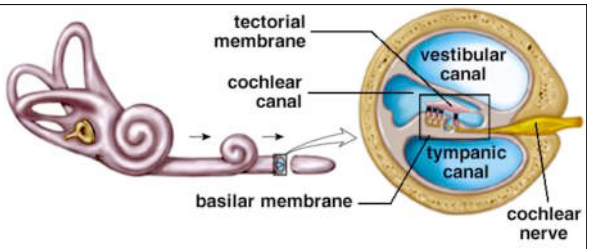
Mechanoreceptors for Equilibrium



Gravitational equilibrium: receptors in utricle and saccule of vestibule.



Ear-Inner



The Cochlea

Receives vibrations from the middle ear, through the oval window. The sound energy is carried into the fluid which fills the coiled interior of the cochlea. This energy causes several membranes to vibrate. One of them is called the ....

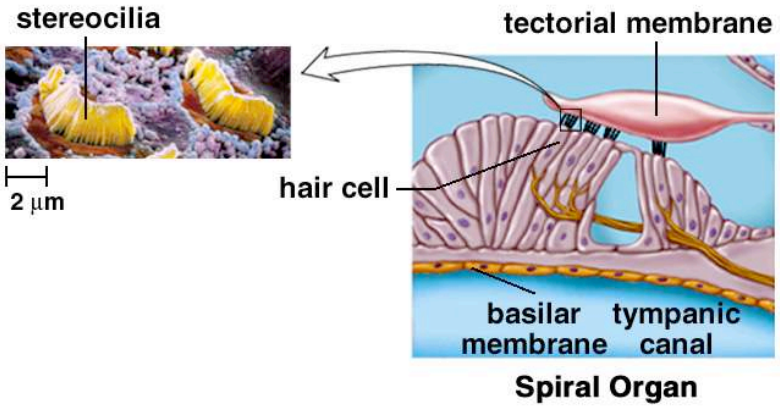
tectorial membrane

As this membrane moves, it pushes down on “hair” cells called stereocillia. As the hairs bend they generate nerve impulse which pass out of the inner ear via the vestibulocochlear nerve.

Ear-Inner

tectorial membrane

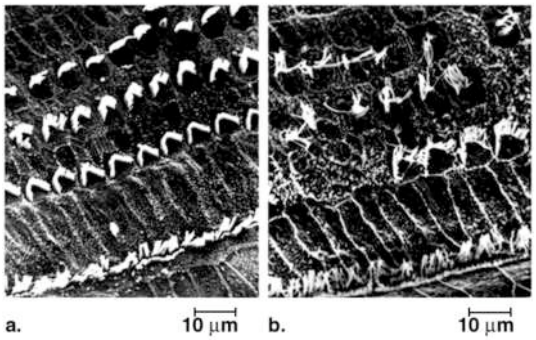
There are many different groups of stereocillia, each group sensitive to different frequencies of sound.



Deafness ...can be grouped into two major categories

1)Conduction

In this type of deafness the,sound conduction pathway, ear drum, ossicles, are damaged and won't carry the sound properly into the inner ear.



This can be treated with conventional hearing aids, which amplify the overall volume of sound or may enhance certain frequencies.

2)nerve

In this condition, the cochlea or the vestibulochoclear nerve has been damaged.

The hair cells of the cochlea can be damaged by loud sounds.. This can be selective; that is if certain frequencies are loud enough they will damage those stereocillia and leave the others alone..

This can be treated with a cochlear implant, which substitutes for the cochlea and generates electrical signals which are sent down the vestibulocochlear nerve to the brain.