

The Human Body Systems

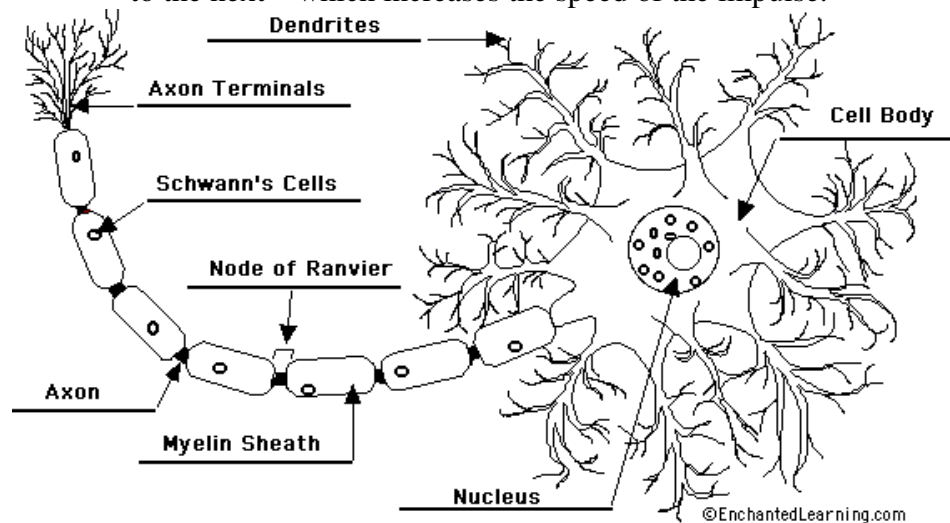
I. Chapter 22 – The Nervous System

A. Functions

1. Receive information about what's happening to the body (both inside & out)
2. Responds to those internal and environmental stimuli
3. Maintains homeostasis

B. The Neuron – the basic unit of structure & function

1. Cells that carry information to, from & through the brain by way of nerve impulses.
2. Structure – cannot grow back if cut or broken
 - a) Large cell body contains the nucleus and multiple thread-like extensions.
 - (1) **Dendrites** – thread-like “fingers” that carry electrical impulses toward the cell body
 - (2) **Axon** - thread-like “fingers” that carry electrical impulses away from the cell body
 - (3) **Myelin Sheath** – made of **Schwann Cells**, surrounds & insulates the Axon leaving many gaps called **Nodes**. The electrical impulse jumps from one node to the next – which increases the speed of the impulse.

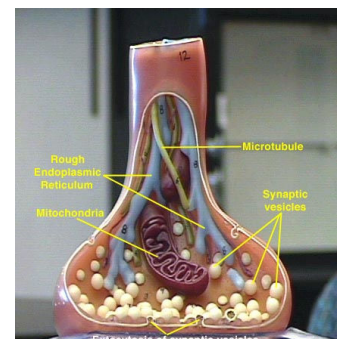


3. Kinds of Neurons – 3 types

- a) **Sensory Neuron** – picks up stimuli from the body & environment and converts them into nerve impulses.
- b) **Interneuron** – the sensory neuron carries the impulse toward the brain until it reaches interneurons. Usually located in the spinal cord or the brain. Some interneurons carry impulses directly back to the motor neurons w/out going to the brain for interpretation (reflex arc)
- c) **Motor Neuron** – Sends impulse from brain/interneuron to the muscle

4. Nerve Impulse travels w/ microelectrical impulses.

- a) An impulse begins when a neuron is stimulated by the environment or by another neuron. It uses **Sodium** and **Potassium Ions** to move the impulse (**action potential**)



- b) Impulse travels from the dendrites to the cell body and then along axons going away from the cell body until it reaches the end of an axon (**Axon Tip**)
- c) The tiny space between the tip of one axon the tip of the next dendrite is the **Synapse**.
- d) When the impulse reaches the tip of the axon, packets of neurotransmitters (**acetylcholine**) are released into the synapse and are received by the **receptors** on the adjacent dendrite which starts a new impulse traveling.

C. Divisions of the Nervous System – Central Nervous System & Peripheral Nervous System

1. **Central Nervous System** – The Brain and Spinal Cord

a) **The Brain**

- (1) Brain contains about **100 Billion Neurons** (all interneurons).
 - (2) Brain wrapped in 3 layers of connective tissue called **meninges**. Space between Meninges and brain filled w/ CSF (**cerebrospinal fluid**) used to protect & cushion the brain. Inflammation of the meninges is disease called **meningitis** and is caused by bacterial or viral infections.
 - (3) Divided into left & right hemispheres, w/ large convolutions.
 - (a) **Gyri** – the ridges or top of the folds
 - (b) **Sulci** – are the “valleys” of the folds
 - (4) **Cerebrum** – Largest of the 3 brain areas – involved in learning, remembering, skeletal muscle movements
 - (5) **Cerebellum** – 2nd largest area, coordination and balance
 - (6) **Medulla Oblongata** (Brain Stem) – Smallest area – controls involuntary actions – breathing, heart rate, basic animal instincts
- b) **Spinal Cord** – runs inside the vertebral column & is the link between the brain and peripheral nervous system.
- (1) Like a major telephone cable w/ thousands of individual nerves. Has the consistency of a ripe banana & is very fragile.
 - (2) 31 pairs of spinal nerves branch out from cord
 - (3) Allows for the **reflex** – a rapid automatic response from a stimulus, without having to be processed by the brain.

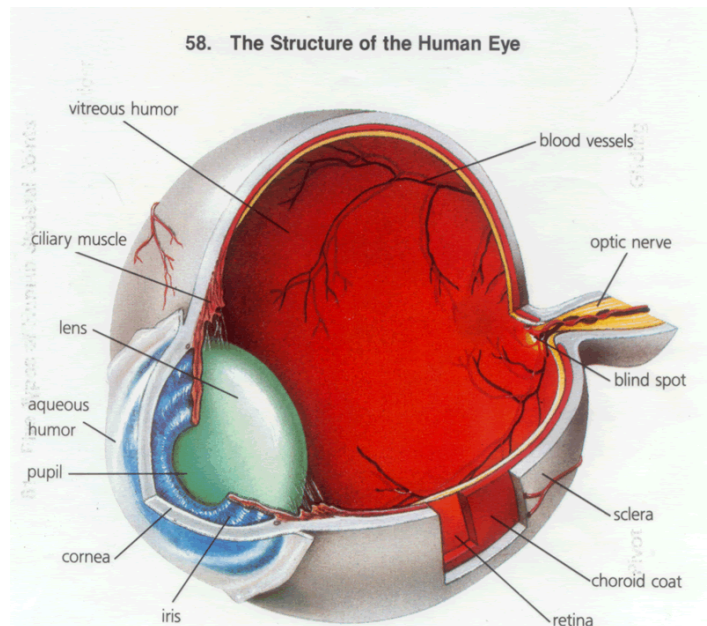
2. **Peripheral Nervous System**

- a) **12 cranial nerve pairs** and **31 spinal pairs** = **43 pairs of nerves** branching off the central nervous system.
- b) **Sensory neurons** bring signals from the body to the spinal cord
- c) **Motor neurons** carry impulses from the brain out to the muscles.
- d) **Somatic nerves** – voluntary actions, walking, picking up fork etc.
- e) **Autonomic nerves** – controls involuntary behaviors, peristalsis, heart beats, blood vessel diameter, etc.

D. Senses

1. Eye Sight

- a) Light passes thru a transparent **cornea** which begins to focus it, next to the fluid filled space called the **aqueous humor**, thru

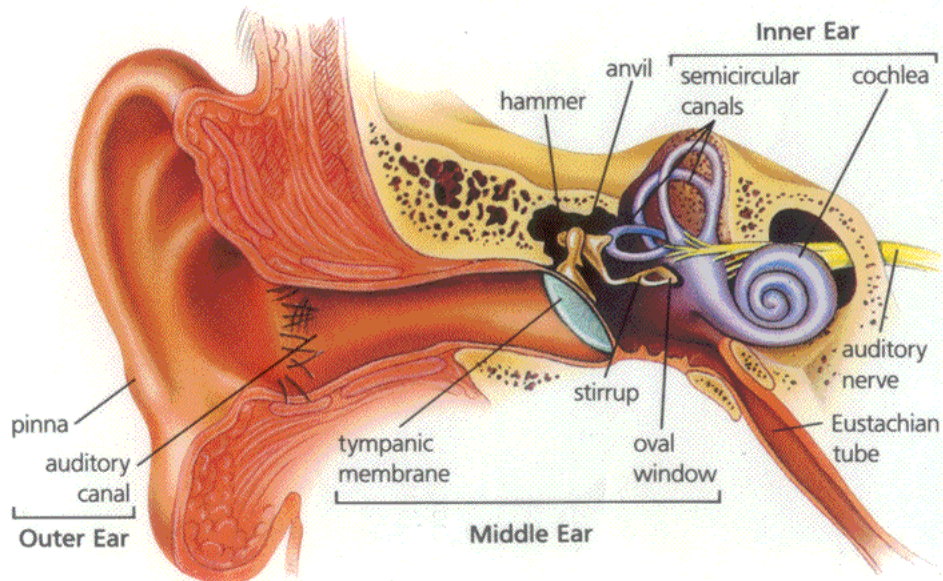


the major focusing structure, the **lens**. The lens is held in place by ligaments attached to **ciliary muscles** (aka. ciliary body). These muscles contract and change the shape of the lens which changes the **focal point**. The **Iris** is the color part of the eye and regulates how much light is allowed into the eye through the pupil. The light then passes thru a fluid (**vitreous humor**) and focuses on the back of the eye, **the retina**. The central region where images focused is the **fovea**. Light sensitive structures detect light/dark and movement are the **rods** (about 1 billion). Color is detected by **cones** (about 3 million). The impulses generated by the rods & cones are transmitted to the brain via the **optic nerve**. The large white ball of the eye is the **Sclera**

2. Human Sound

- a. Converting sound waves (vibrations) into sensory impulses interpreted as sound.
- b. Three parts to your ear: Outer Ear, Middle Ear and Inner Ear
 - i. **Outer Ear**: The funnel shaped **ear flap (pinna)** and the **auditory canal** direct sound to the **eardrum (tympanum)** which separate the outer and middle ear
 - ii. **Middle Ear**: The sound waves vibrate the tympanum which causes the three smallest bones in the body to also vibrate. These bones (in order) are the **Hammer (Malleus)**, **Anvil (Incus)** and **Stirrup (Stapes)**. The end of the stirrup vibrates a thin membrane, the **Oval Window**, covering the inner ear. The **Eustachian tube** connects the middle Ear with the back of the throat (Pharynx) to allow atmospheric pressures to equalize on each side of the **tympanum**.
 - iii. **Inner Ear**: The **Oval Window** separates the middle and inner ears. This membrane touches the fluid filled chamber of the **cochlea** causes the **Cochlea** to vibrate. The inner surface of the cochlea is lined with tiny nerve receptor **Hair Cells**. These receptors stimulate the neurons of the **auditory nerve (Vestibulocochlear Nerve)** which carries impulses to the cerebrum where it is interpreted as sound.

59. The Structure of the Human Ear

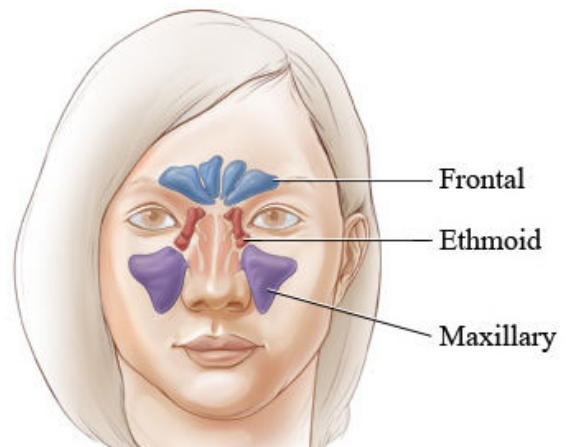


3. Human Sense of Smell – Scientifically called: **Olfaction**

- a) Air contains chemical molecules, **Odors**, floating in the air – they enter the nose when we inhale.
- b) Once air enters the nose it enters our sinuses, high surface areas called **turbinates**, clean, warm & humidify the air.

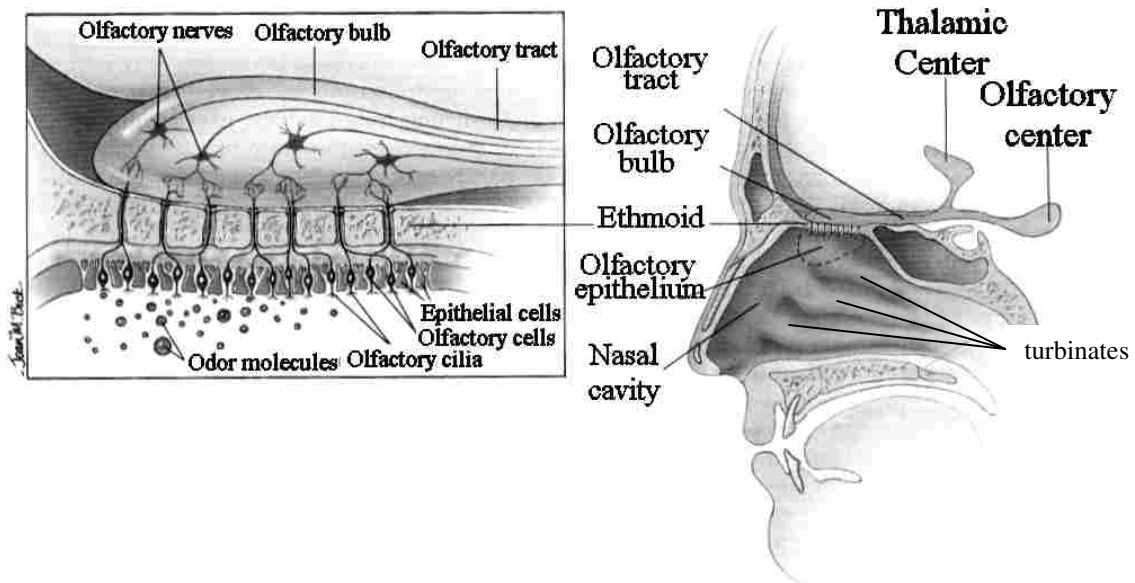
(1) 3 main sinuses cavities:

- (a) **Maxillary Sinus**
- (b) **Ethmoid Sinus**
- (c) **Frontal Sinus**



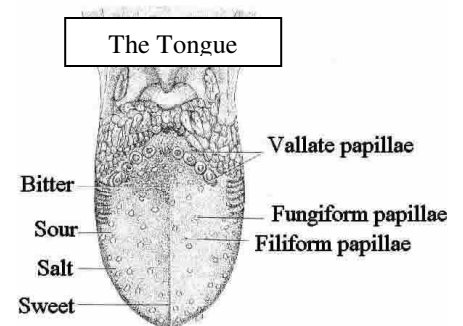
c) The surface, lining, of the sinuses is called the **mucosa**.

- (1) The mucosa on the **superior** (top side) of the sinuses contains millions of olfactory cells located within the **epithelial cells**.
 - (a) **Olfactory cells** bind w/ odors and stimulate attached **olfactory nerves**
- (2) Olfactory nerves conduct the nerve impulse to the **Olfactory Bulb** – collect the signals from the other olfactory cells
 - (a) Two olfactory bulbs (right & left)
- (3) Olfactory bulbs connect directly to the brain



4. Human Sense of Taste

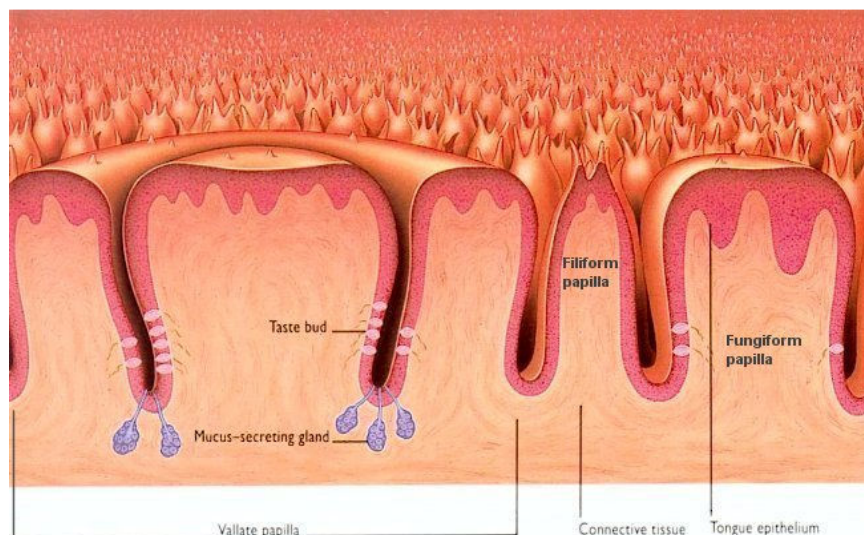
- Molecules of food stimulate taste cells on Taste Buds & send messages to the brain
- Each **taste bud** contains **50-150 receptor cells**. Each receptor responds to one of **4 basic tastes: Sweet, Sour, Salty, Bitter**
- Some 10,000 taste cells are located on **papilla** (plural is papillae) which are the many bumps on the top surface of the tongue. **These bumps are NOT the taste buds!**



(1) 3 types (shapes) of papilla:

- Vallate Papilla**
- Filiform Papilla**
- Fungiform Papilla**

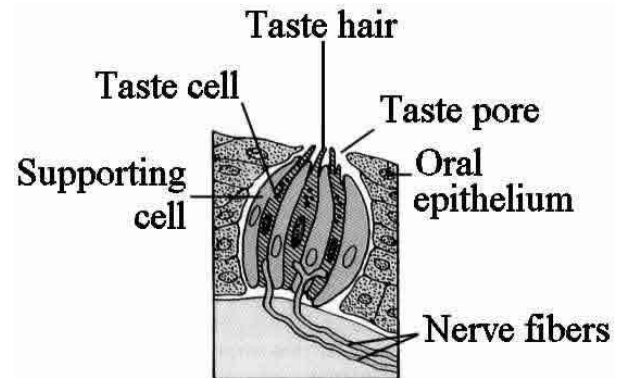
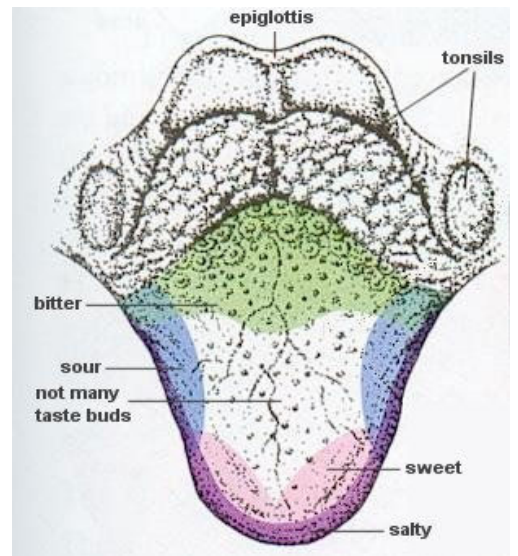
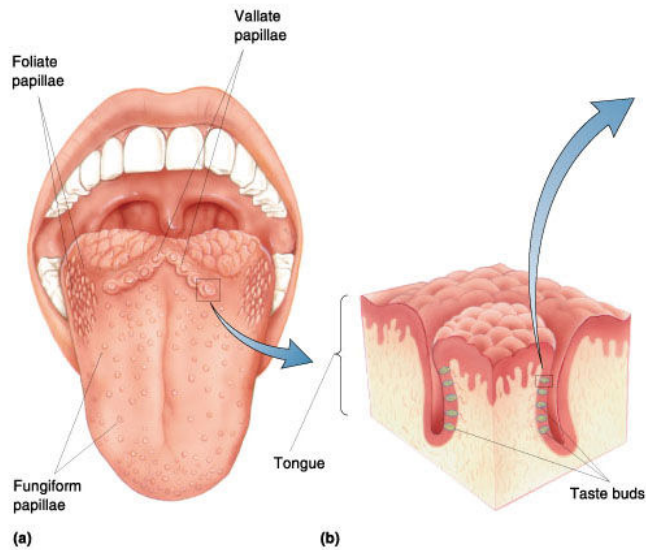
(2) These papillae are also on the **tongue, palate, epiglottis, and pharynx** & help us to determine the flavor of our food.



d) Each **taste cell** is located in the Oral Epithelium & consists of small hairs attached to nerve receptors that lie in the **taste pore**.

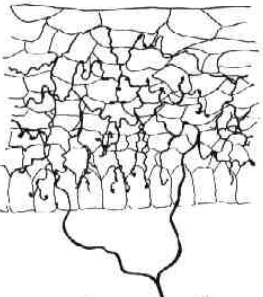
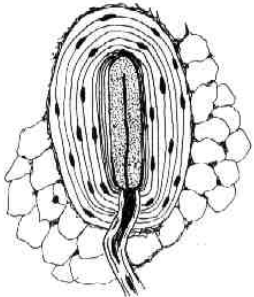

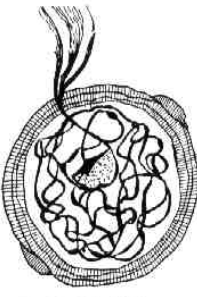
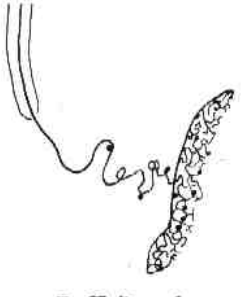
(1) dissolved food or drink **binds** to a **receptor**, like a key in a lock.

(2) If the key fits, then the taste cell sends a **signal** to the **brain**, telling it that this morsel is **sweet, salty, sour, or bitter** (the **four basic types of taste cells**).



5. Human Sense of Touch –

a) Touch receptors are nerve cells that tell your brain about tactile sensations.

				
Free nerve endings (pain)	Pacinian corpuscle (pressure)	Meissner's corpuscle (tactile)	End-bulb of Krause (cold)	Ruffini's end organ (heat)
Pain	Pressure	Tactile	Cold	Heat
Mechanoreceptors			Thermoreceptor	

b) Several types of touch receptors divided into 2 groups

(1) **Mechanoreceptors** – (pain, pressure & tactile)

(a) **Pain - Free nerve endings** informs the brain about pain, and they are located over the entire body.

(b) **Pressure** – detects pressure and limb position

(c) **Tactile** - are located all over the skin but grouped mainly on the skin of the fingertips & lips. Only stimulated when touched. They tell the brain the shape and feel of an object in the hand, or the touch of a pleasant or aggravating touch. They adjust to the environment, which is why the brain eventually ignores clothing that you are wearing.

(2) **Thermoreceptors** – (heat & cold)

(a) **Cold** - can be found in the skin, conjunctiva, lips, and tongue.

(b) **Heat** - are found over the entire body in the skin.