\*\* Somatic sensory pathway:  
 periphery spinal nerve dorsal ramus of spinal nerve spinal cord (ascend as ALS or PCML) brain (cerebral cortex)

\*\*we have 31 pairs of spinal nerves and they are the only entry of sensation to spinal cord.

\*\* Our brain learns by experience. Meaning that a stimulus reaching the hand will travel through a peripheral nerve, enter a plexus and reach the spinal cord at the level of C8, it then ascends to reach a specific area in the cerebral cortex which is responsible for –in this case- the hand. With time, our body will adapt to this stimulus and will recognize that if this stimulus is coming from C8 then it must be coming from the hand. Hence, our brain will recognize a sensation coming from the hand whenever a stimulus reaches the dorsal ganglion at the level of C8.

\*\*Each spinal nerve supplying a specific area on the skin is called a ***DERMATOME***.

\*\*What about sensation of visceral organs??

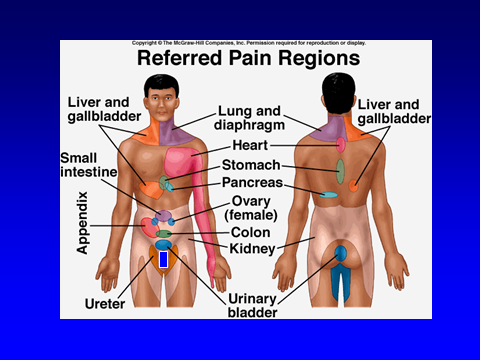
The only way for the sensations of the visceral organs to reach the spinal cord is through the spinal nerves. Hence, visceral organs will participate with dermatomes in spinal nerves.

\*\*For example if there is a pain in visceral organ X , this pain will travel through C8 to reach the spinal cord, but the brain knows from experience that anything coming from C8 is related to hand , so the patient with pain in visceral organ X will sense this pain in his hand . This is called ***Referred pain.***

\*\*visceral pain is always referred pain.

\*\* Referred pain: Pain felt at a site different from the location of the injured or diseased part of the body.

\*\* Memorize the distribution of referred pain of major organs.



\*\*Note: difference between referred pain and radiating pain:

- Referred pain: pain is sensed (on the dermatome) on a different site than its origin (visceral organ). This is because they enter at the same level on the spinal cord.

-radiating pain: pain spread to neighboring skin.

***Special sensation***

-olfaction: the ability to sense odors through the detection of substances which have been aerosolized in to the environment.

-Gustation: the sensation which is produced by the interaction of taste receptors with solubilized chemical stimuli in the oropharyngeal cavity.

\*\*both of them depend on chemical receptors

***Olfactory system***

Olfactory epithelium consists of three types of cells:

1) olfactory neurons: have receptors which convert the chemical signals into neuronal signals.

2) supporting cells: for mechanical support and provide nutrition.

3) basal cells (undifferentiated cells) : act as stem cells for both neurons and supporting cells .

\*\*usually olfactory neurons are replaced every (2-4) weeks

\*\*chemical odors must be dissolved to able to bind with their receptors so we need fluid producing cells and that is the function of ***bowman’s gland***.

\*\*on the roof of nasal cavity there is a highly fenestrated bone called cribriform plate. The bipolar axons of neuronal receptors pass through these fenestrations.

\*\*olfactory receptors (first order neurons)(bipolar neurons) will cross cribriform plate and synapse with second order neurons which have their cell bodies in the olfactory pulp(swelling at the beginning of olfactory nerve 1st cranial nerve)

\*\*Do not memorize the names of the cells in slide#17.

\*\*the junction between the axons of first order neurons (receptors) and second order neurons is called ***Glomerulus***

\*\*the relationship/ratio between first and second order neurons is NOT 1:1. Meaning that not every receptor will synapse with one neuron, instead; every 5 or 6 receptors will synapse with one neuron, and sometimes each receptor synapses with two glomerulus (two neurons) .

\*\*This relationship helps us to distinguish between hundreds of odors by limiting the number of receptors. Not every odor has its own receptor. We are able to identify odors by combining them.   
\*\*The presence of glomerulus and the convergence of odors are the two factors which allow us to smell odors. If the ratio was 1:1 then the number of odors that we would be able to smell are limited to the number of receptors present (this is not favorable).

\*\*when we smell an odor for a long time we will adapt to it. There are two levels of adaptation:

1) at the level of receptors (they will be relatively inhibited )

2) at the level of brain which sends ***centrifugal fibers*** which inhibits the glomerulus from sending information to brain. Hence, the glomerulus is now ready to accept new odors.

***Slide#18***

\*\*Dissolved chemical odors bind with receptors activate second messenger activates CAMP which activate G proteins; hence chemical signals are converted to neuronal signals.

***Slide#21***

\*\*olfactory neurons must go to the cerebral cortex as well as to another areas (associational fiber system) which stimulate emotions and behaviors related to smells.

\*\*one third of neurons go to associational fiber system (for behavioral and emotional stimulation), two third of neurons go to thalamus then to the primary olfactory cortex (to understand and discriminate the smell) which located at inferior and medial surface of temporal lobe,, ***slide#22***

***Disorders of olfactory system***

***Slide #23***

\*Anosmia(loss sensitivity) /Hyposmia(decreased sensitivity to odors) occur because:

1) Access of odorants to olfactory epithelium is blocked (odors can’t bind with their receptor)

-Edema/inflammation of olfactory epithelium

-Ex. Upper respiratory infections, and sinus disease.

2) Head Trauma(mainly occurs in the cribriform plate)

-Ex. Shearing movement of olfactory bulb relative to cribriform plate

-Boxers- transection of olfactory receptor axons in passage.

***Gustatory system***

\*\*gustatory system starts at the tongue

\*\*taste receptors (20-30) accumulate and form taste buds. They are surrounded by basal cells for their regeneration since they only live for about 2 weeks. They are surrounded by supporting epithelia for their support.

\*\*Taste buds usually accumulate on the tongue forming papilla.

\*\* 1 bud contains (40-60) receptor cells

\*\*Microvilli found on apical end of receptor cells and extend into taste pore

\*\*taste receptor cell life span (10-14) days

\*\*we have 5 modalities of taste :

1)bitter

2)sour

3)salty

4)sweet

5)Umami (delicious): senses meaty sensation that exemplifies the taste of monosodium glutamate and is important in the identification of amino acids.

\*\*All taste qualities are detected in all regions of the tongue, and there is no specialization for the detection of different taste qualities, the picture in ***slide #30*** is wrong.

**Slide #31**is not included, you don’t have to memorize the pathways of transduction in taste receptors

**Slide #32**

\*\*there are three cranial nerve carrying the taste sensation (from anterior to posterior) facial nerve,, Glossopharyngeal nerve ,,vagus nerve.

\*\*All carry taste sensation to medulla oblongata (gustatory nucleus) which synapses with the second order neuron, then ascend to the hypothalamus where they synapse with the second order neuron which will eventually reach the cerebral cortex (gustatory cortex) which located at lower part of frontal lobe.

\*\*taste sensation is ipsilateral (for same side) because there is no decussation throughout the pathway.

***Disorders of taste***

-Ageusia: complete loss of taste

-Hypoageusia: decreased taste sensitivity

(no saliva no taste) Saliva is needed to dissolve the chemicals which can then be sensed.

\*\*examples:

-cancer patients undergoing radiation or chemotherapy (salivary glands are destroyed).

-medications

-progressive loss of taste in diabetic patients

\*\*Although anatomically they are two distinct systems, yet the modalities of taste and smell work well together.

\*\****Flavor***: it is not a taste experience, but is the combination between taste and olfaction. Olfaction however is >>>>>>(more potent than) taste

So we smell more than we taste food.

"ماكانفيهمنصوابفمناللهوحدهوماكانفيهمنخطأفمن نفسيومنالشيطان"

