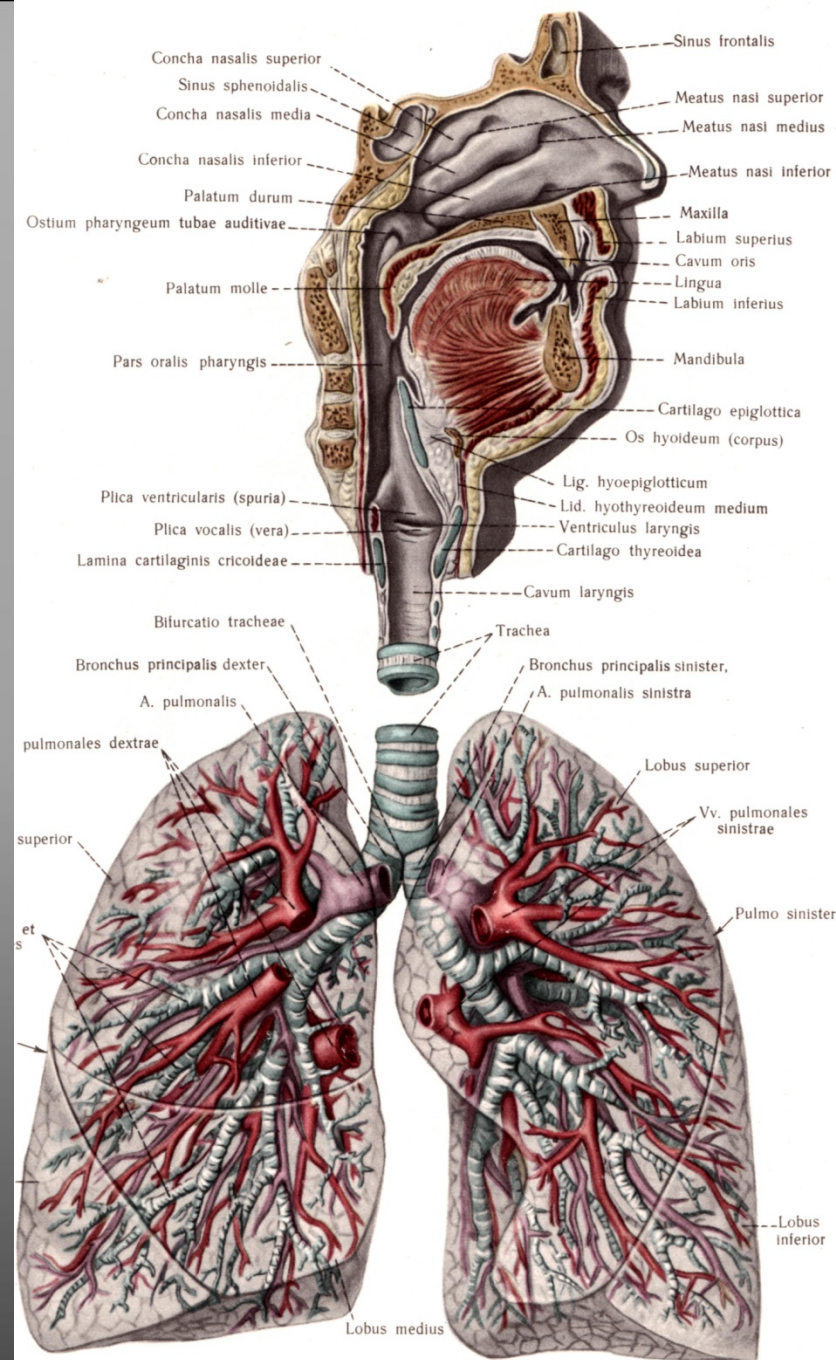




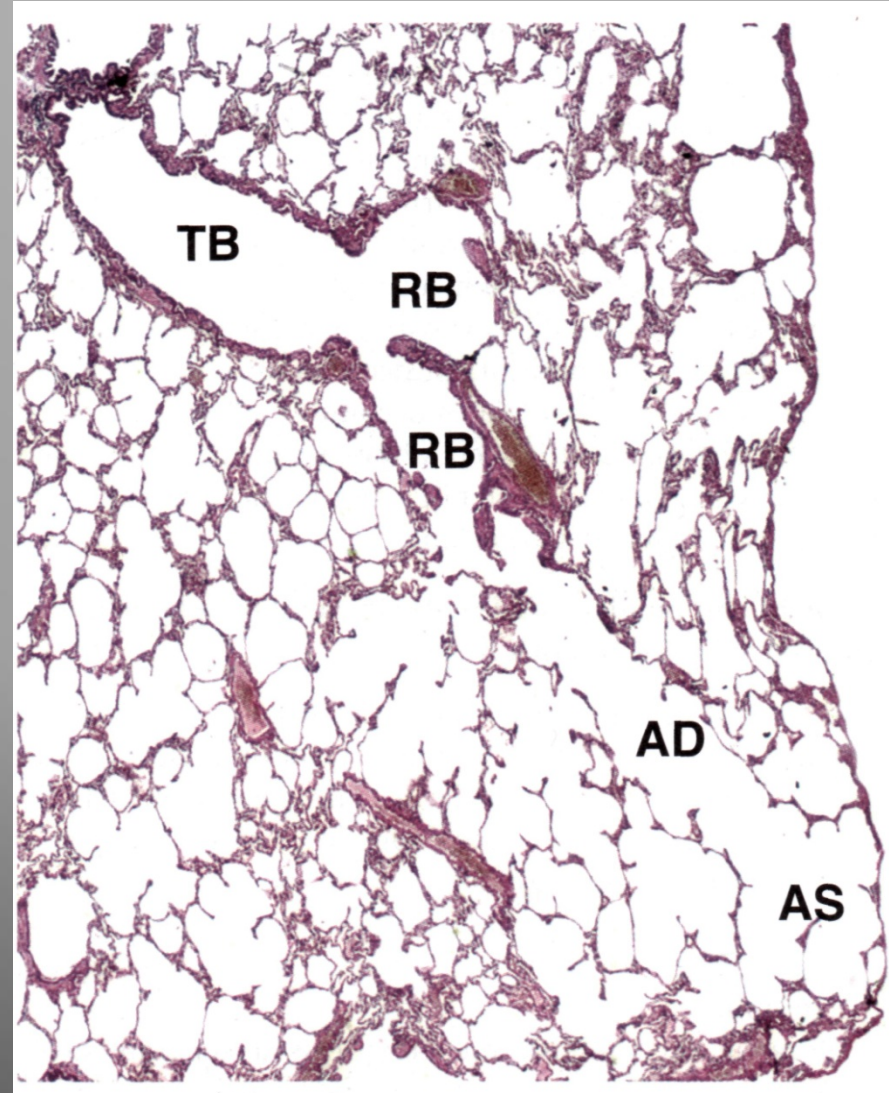
Respiratory system

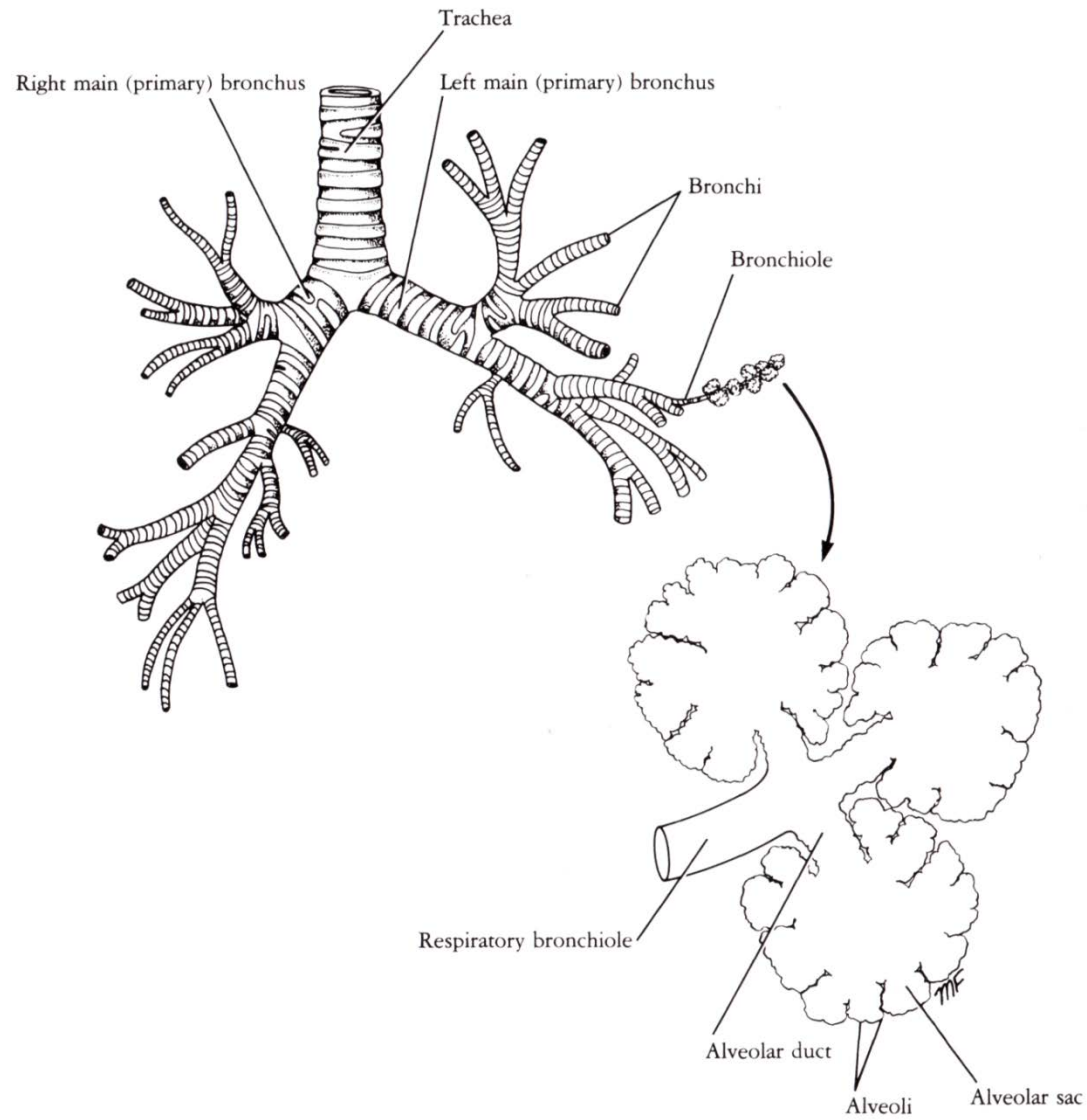
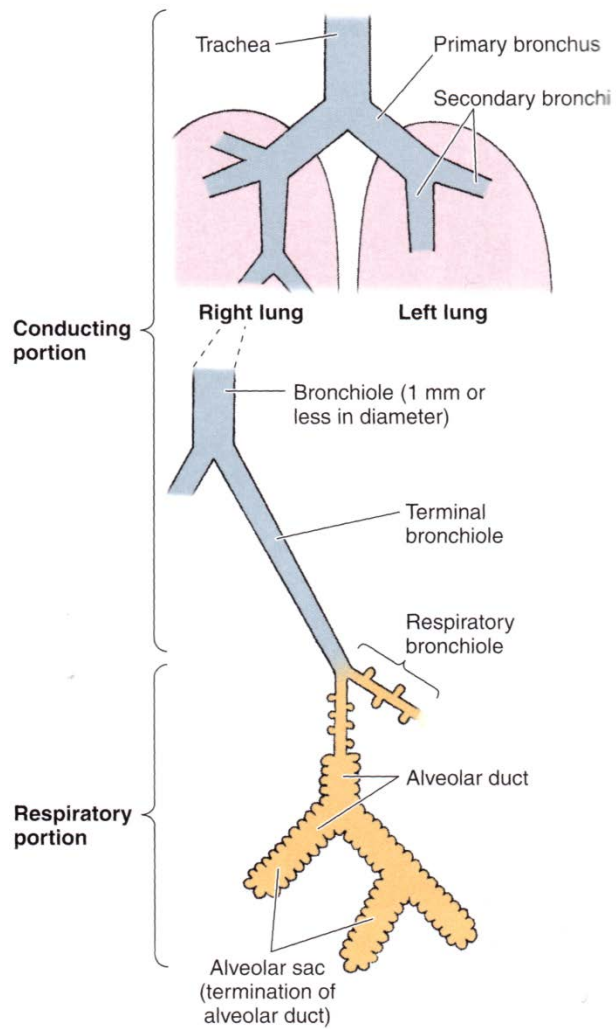
**External nose, Nasal cavity and
Paranasal sinuses**

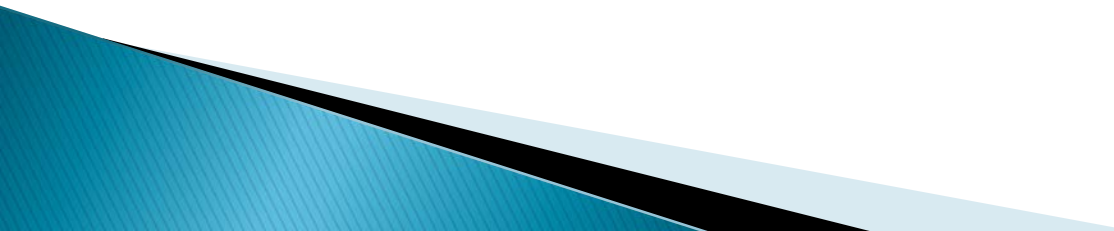
- ▶ The respiratory system can be divided into two principal regions:
- ▶ a **conducting portion**,
- and
- ▶ a **respiratory portion**.

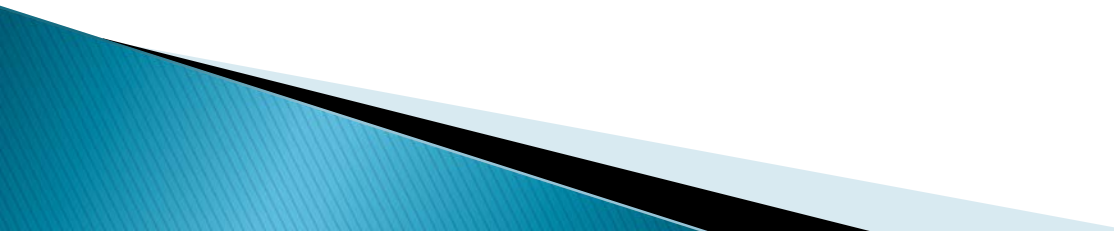


- ▶ **Respiratory portion** (where gas exchange takes place) consists of respiratory bronchioles, alveolar ducts, sacs and alveoli.

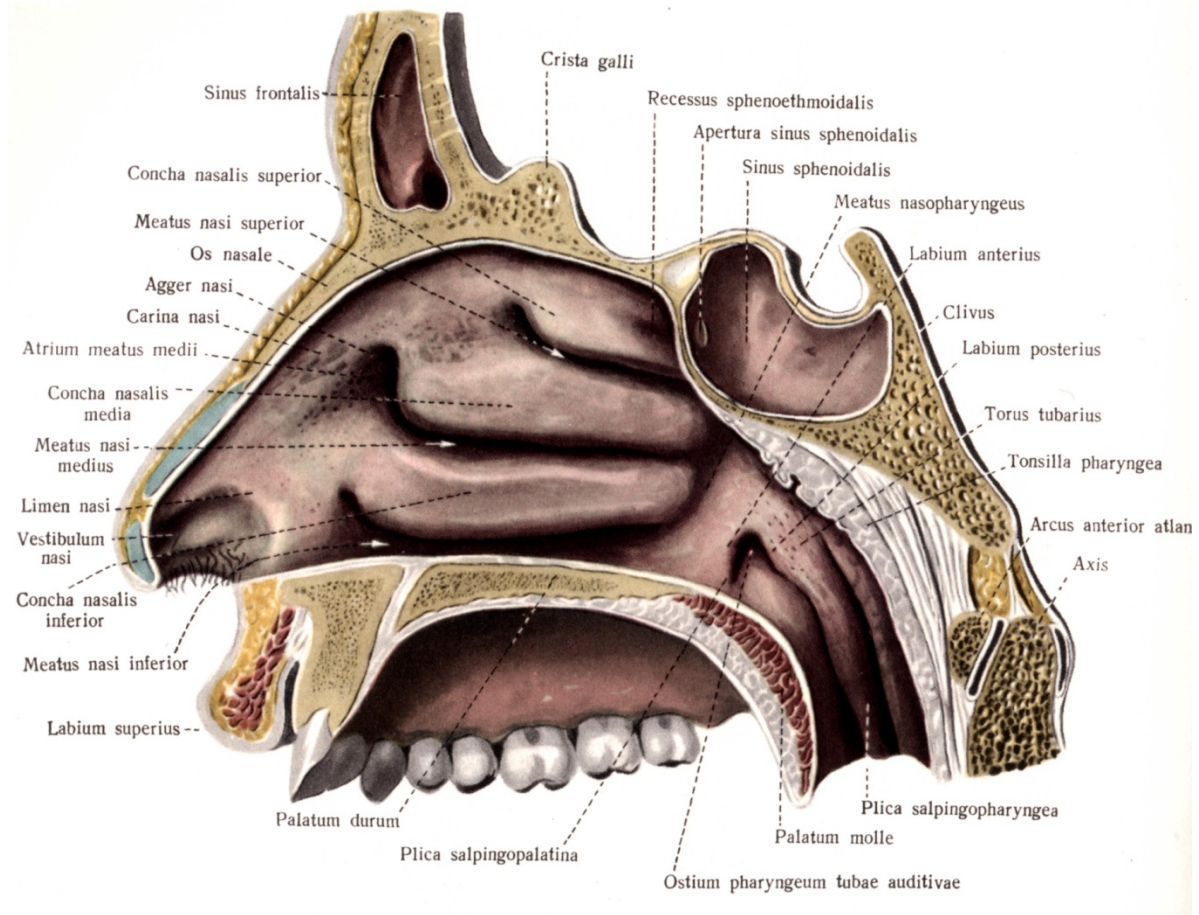


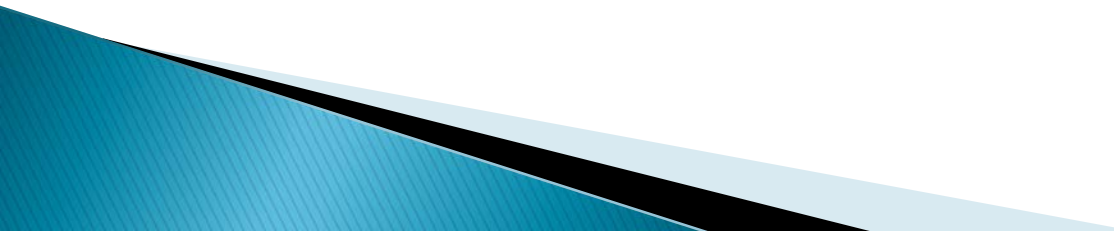


- ▶ **The obligatory conditions** of the conducting organs are:
 - ▶ to provide **uninterrupted air** to and from the lungs,
 - ▶ to **cleanse**,
 - ▶ to **moisten**, and
 - ▶ **to warm the incoming air.**
- 

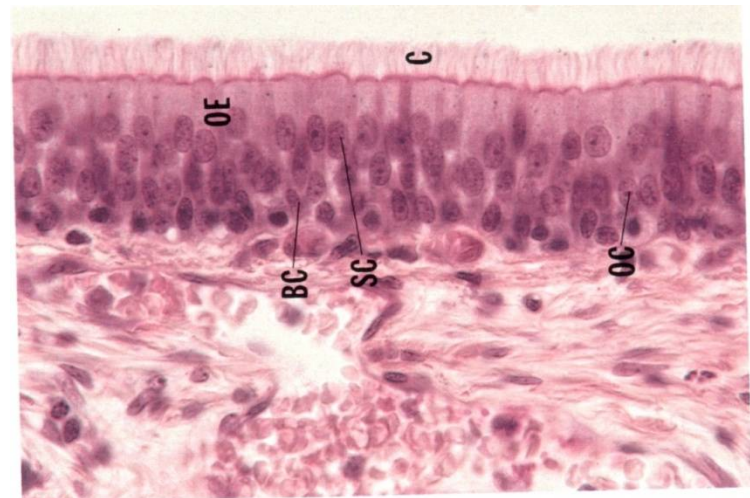
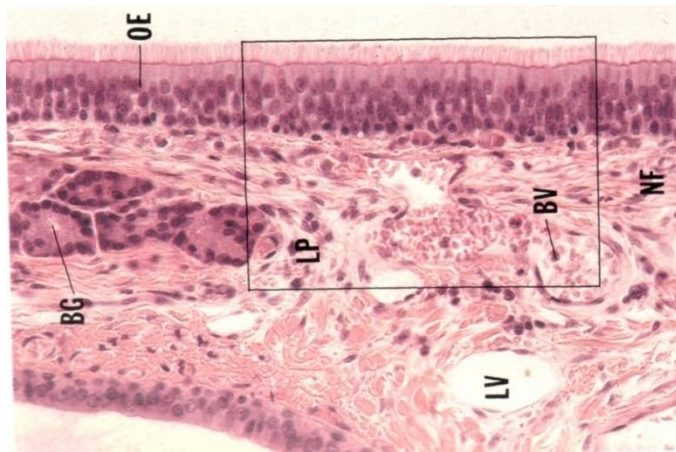
- ▶ **The mucous** is secreted by the goblet cells and the serous glands located in the lamina propria.
 - ▶ The mucous traps the air impurities, serves **to moisten the incoming air, protecting** the mucosa from desiccation.
 - ▶ **The incoming air** is also **warmed** by a rich superficial vascular network.
 - ▶ **Cilia of this epithelium** move the fluid sol phase, toward the oral cavity.
- 


- ▶ As the air enters the nose, large **vibrissae** (specialized hairs) remove coarse particles of dust.

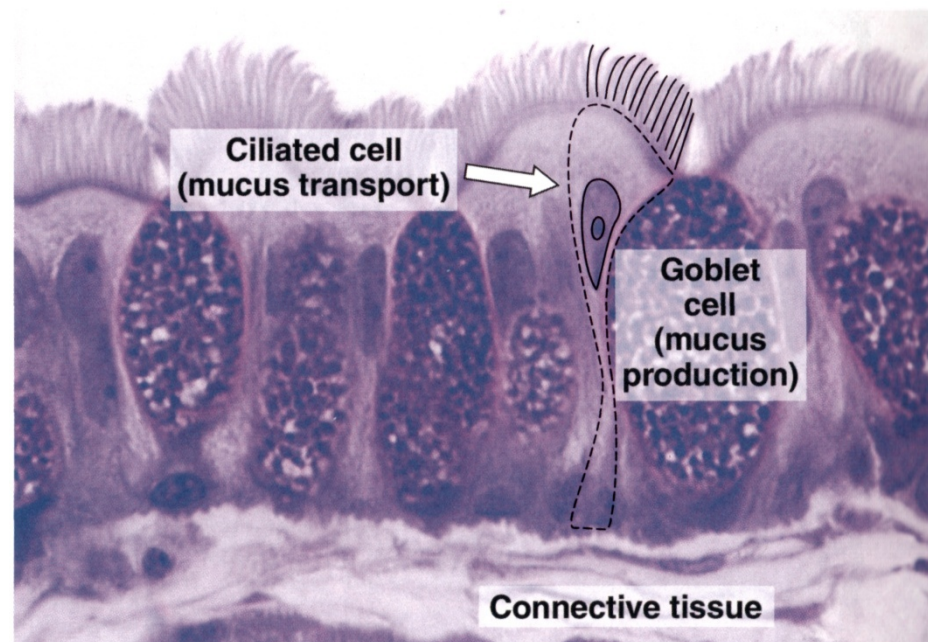
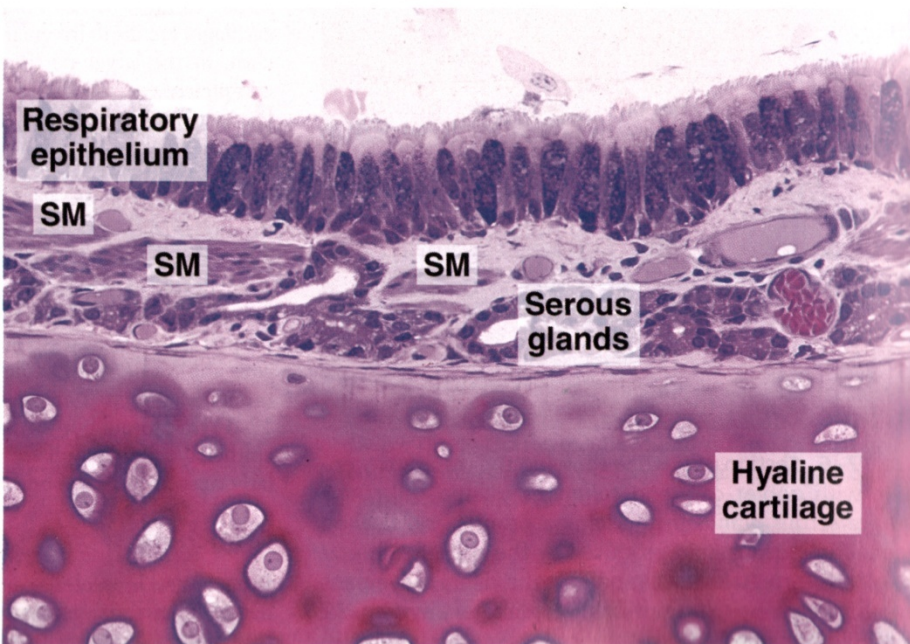


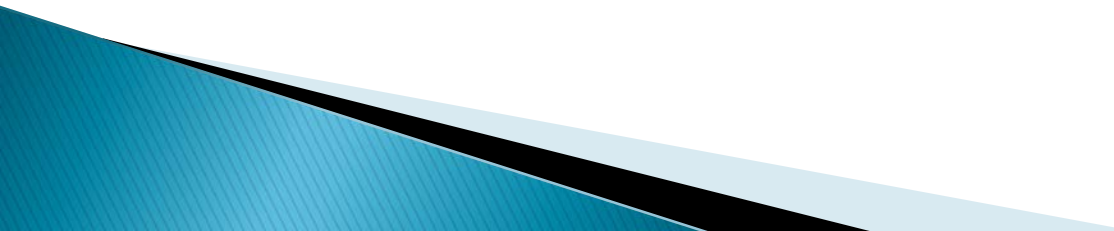
- ▶ **Respiratory Epithelium**
 - ▶ Most of the conducting portion is lined by **pseudostratified columnar ciliated epithelium** that contains a rich population of goblet cells.
 - ▶ As the bronchi subdivided into the bronchioles, the pseudostratified organization gives way to **a simple columnar epithelium**, which is further reduced to **a simple cuboidal layer** in the smallest (terminal) bronchioles.
- 

- ▶ The ciliated, pseudostratified columnar epithelium of the respiratory segment is composed of these **five** cell types:



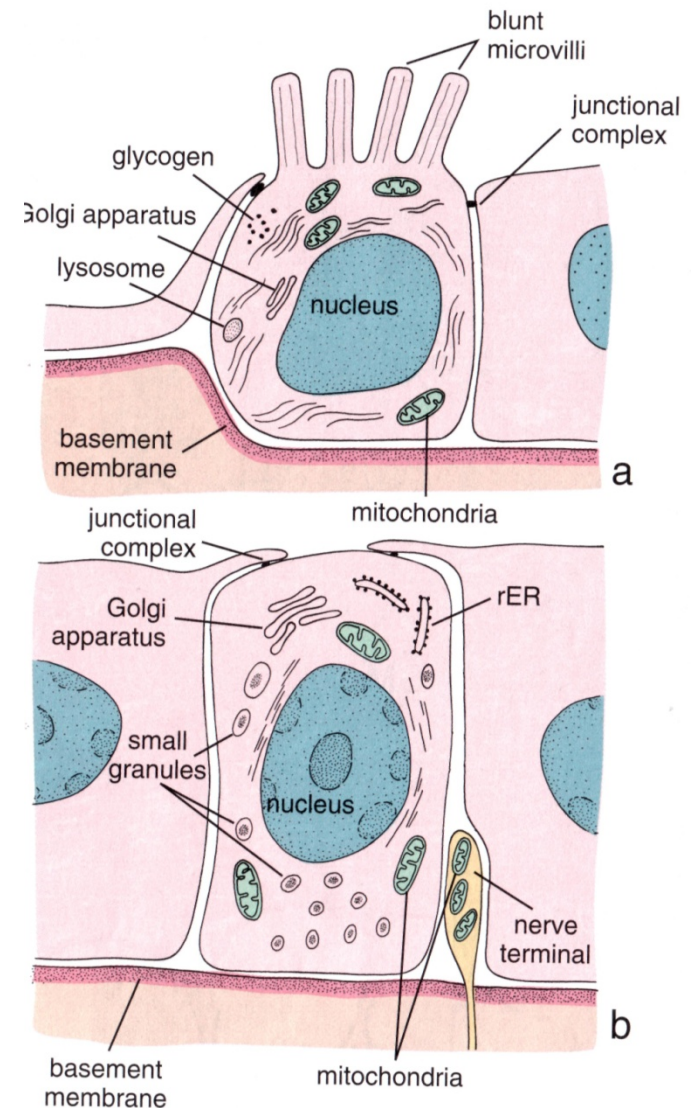
- ▶ **Ciliated cells**, tall columnar cells with cilia that project into the mucus covering the surface of the epithelium.
 - ▶ **Goblet cells** that synthesize and secrete mucus.
 - ▶ **Brush cells**, a general name for those cells in the respiratory tract that bear short, blunt microvilli. They are **sensory receptors**.
 - ▶ **Small granule cells** contain secretory granules are cells of the **neuroendocrine system**.
 - ▶ **Basal cells**, stem cells from which the other cell types arise.
- 



- ▶ **1. Ciliated columnar cells** constitute the most abundant type. Each cell possesses about 300 cilia on its apical surface; beneath the cilia, in addition to basal bodies, are numerous small mitochondria.
 - ▶ **2. The next most abundant cells are the mucous goblet cells.** The apical portion of these cells contains the polysaccharide-rich mucous droplets.
 - ▶ The **goblet cell population** is totally absent from the epithelium in **the terminal bronchioles.**
- 

- ▶ **3.** The remaining columnar cells are known as **brush cells** because of the numerous microvilli present on their apical surface.

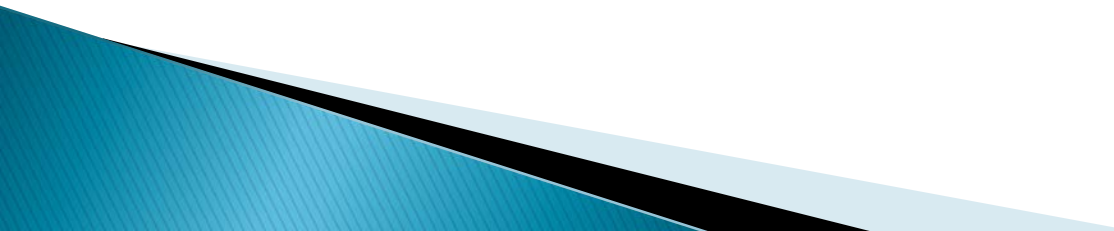
Brush cells have afferent nerve endings on their basal surfaces and are considered to be **sensory receptors**.



- ▶ **4. Basal (short) cells** are small rounded cells that lie on the basal lamina but do not extend to the luminal surface of the epithelium.

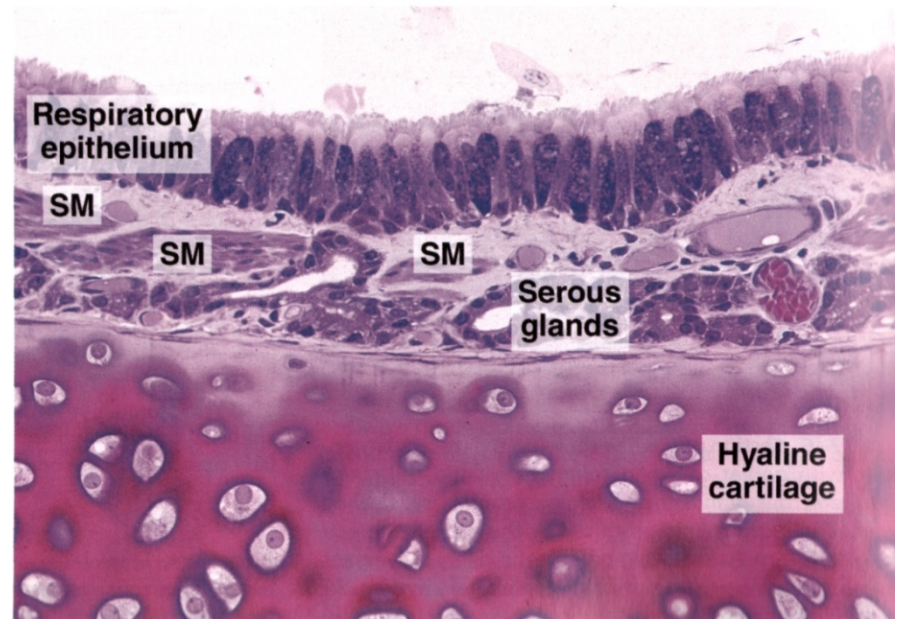
These cells are believed to be **generative cells** that undergo mitosis and subsequently differentiate into the other cell types.



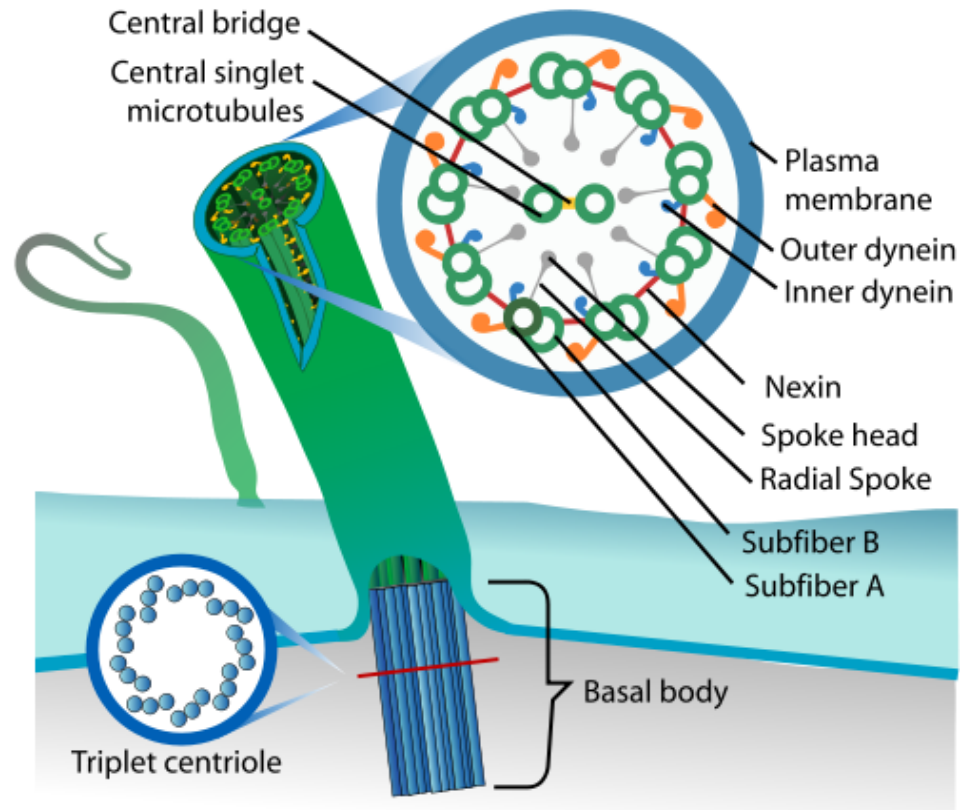
- ▶ **5.**The remaining cell type is the **small granule cell**, possesses numerous granules 100-300 nm in diameter with **dense cores**. These cells constitute a population of cells of the diffuse **neuroendocrine system**.
 - ▶ They **integrate the mucous and serous secretory processes**.
 - ▶ All cells of the ciliated pseudostratified columnar epithelium touch **the basement membrane**.
- 



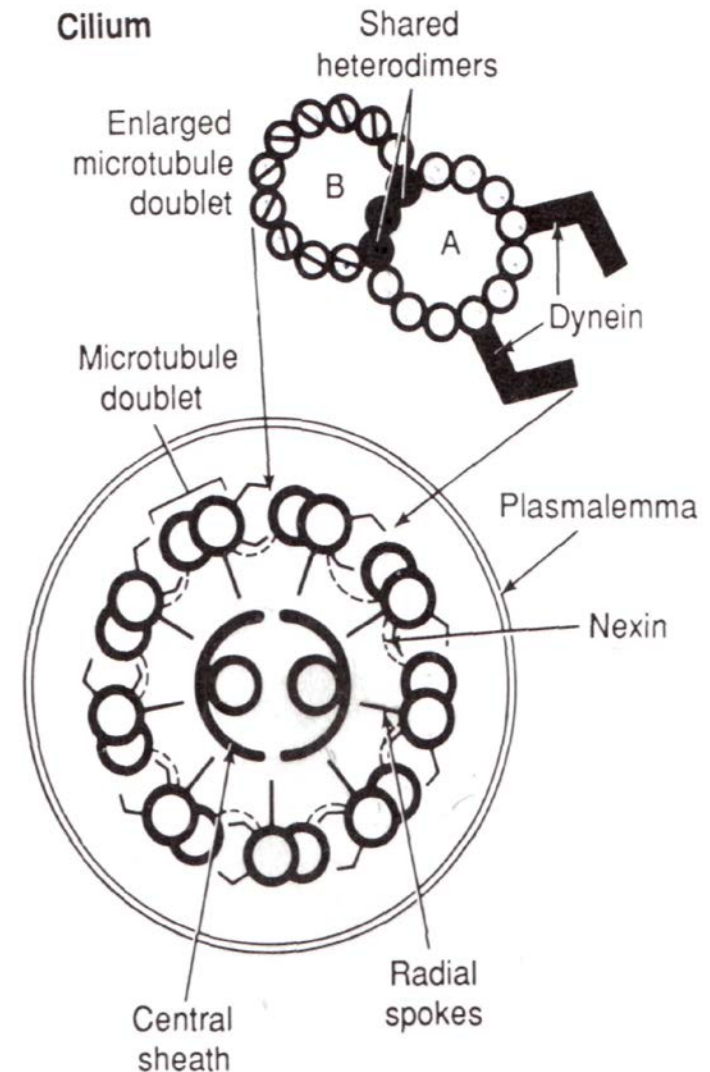
- ▶ Below the epithelium is **the lamina propria**, consists of loose connective tissue, **muscularis mucosae** and **submucosa**, contains glands and blood vessels.
- ▶ **The second layer** is consists of the hyaline cartilage rings.
- ▶ **The third layer** is adventitia.



- ▶ I wish to remind
- ▶ The **axonema** (9 pairs microtubules surround central doublet) arises from microtubules of **the basal body** which lying at the level of apical surface and contains of **(9x3+0)** microtubules.
- ▶ **The root** consists of bunch of actin filaments.



- ▶ The microtubule A consists of 13 subunits, while microtubule B shares 2-3 heterodimers with A.
- ▶ Adjacent doublets are linked to each other via protein bridges called nexins.
- ▶ The dynein arms link adjacent tubules and provide for the sliding of doublets against each other.

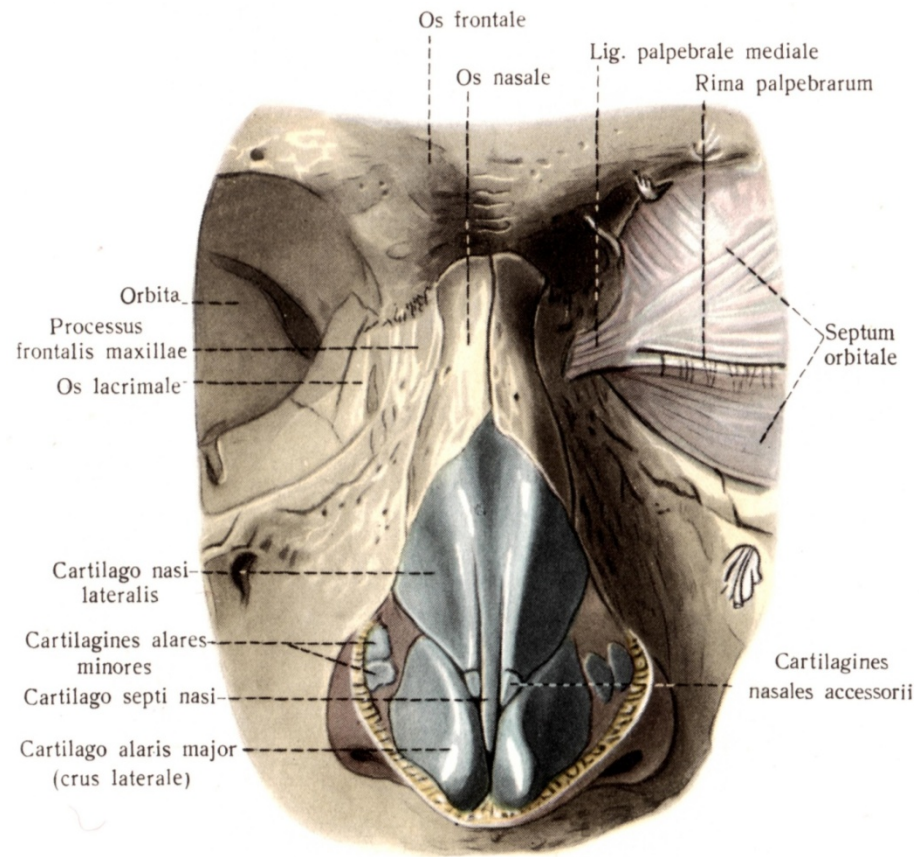
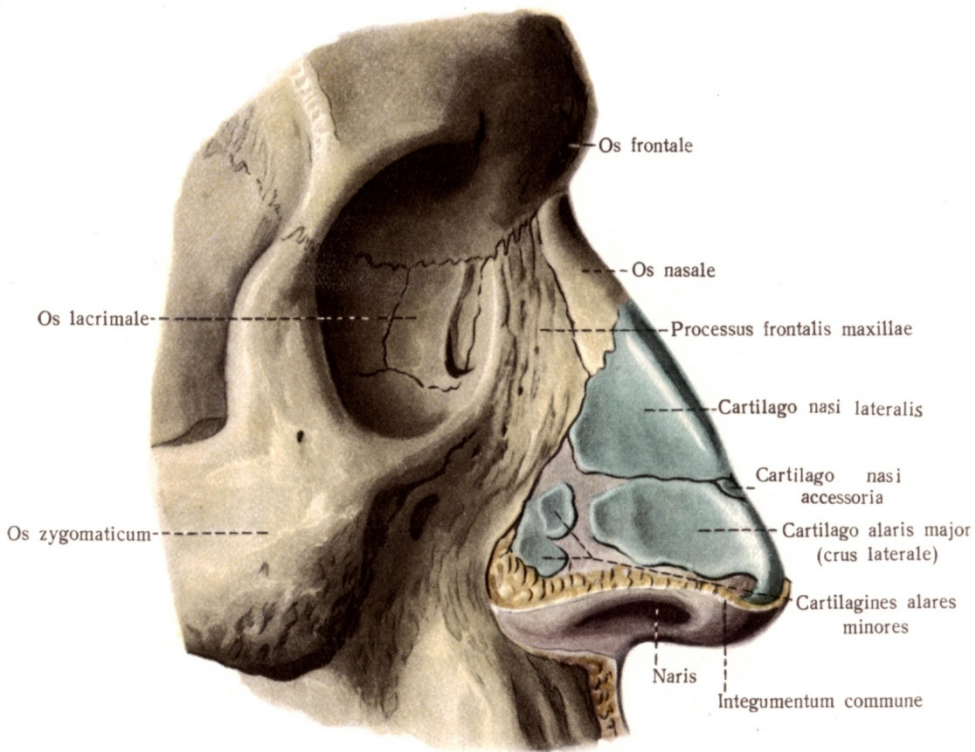


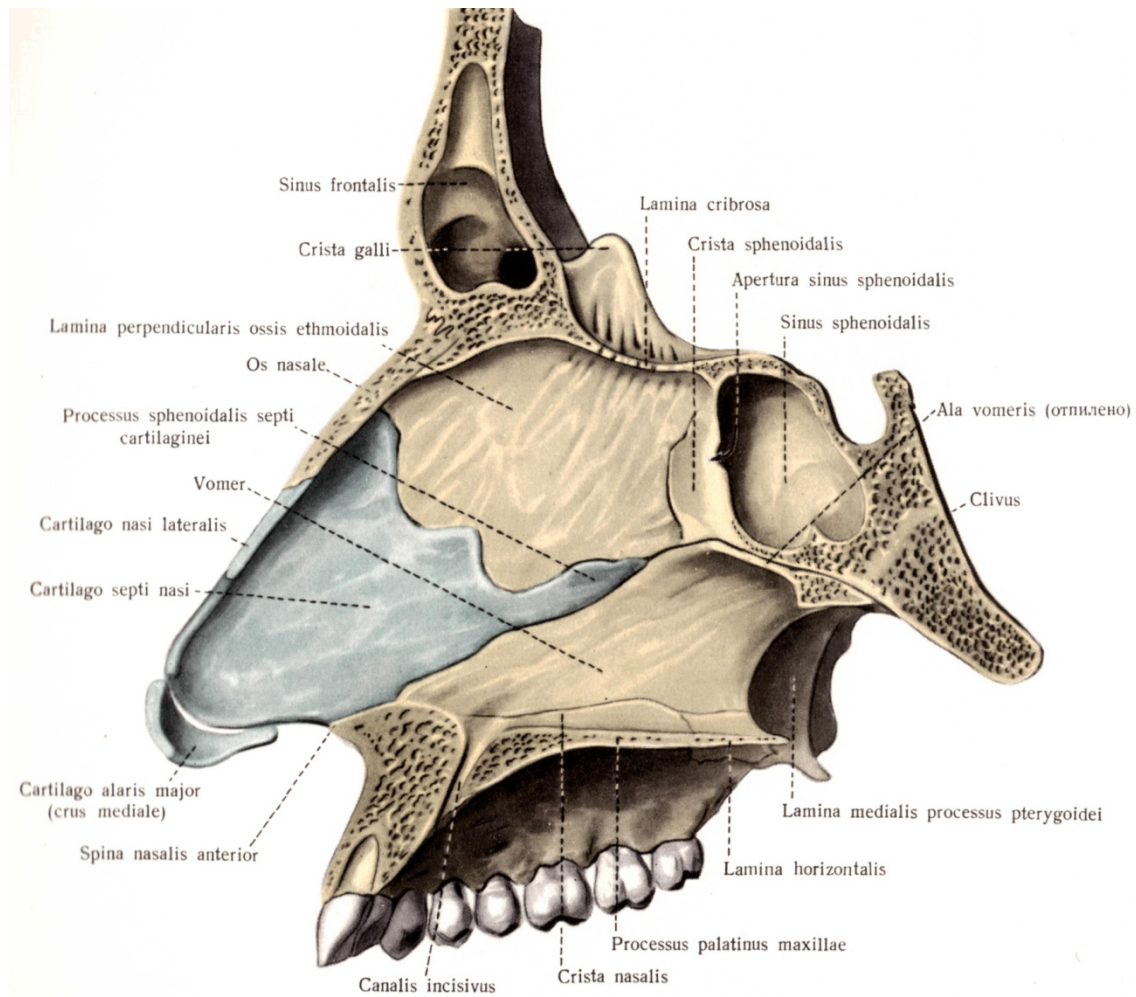
- ▶ **The dynein arms** exhibit **ATP-ase activity** and during the movement breaking down ATP and releases **the energy** for sliding.
- ▶ The dynein arms on microtubule A of one doublet **bind to** and **walk along** the surface of microtubule B of the adjacent doublet and the result is **a whole to bend**.

- ▶ **Immotile cilia syndrome (Kartagener's syndrome)**, a disorder that causes chronic respiratory-tract infections in both sexes and infertility in males by **immobility of cilia and flagella** induced by deficiency of **dynein**, a protein normally present in the cilia.
- ▶ This protein is responsible for the sliding of the microtubules, a process that is necessary for ciliary movement.

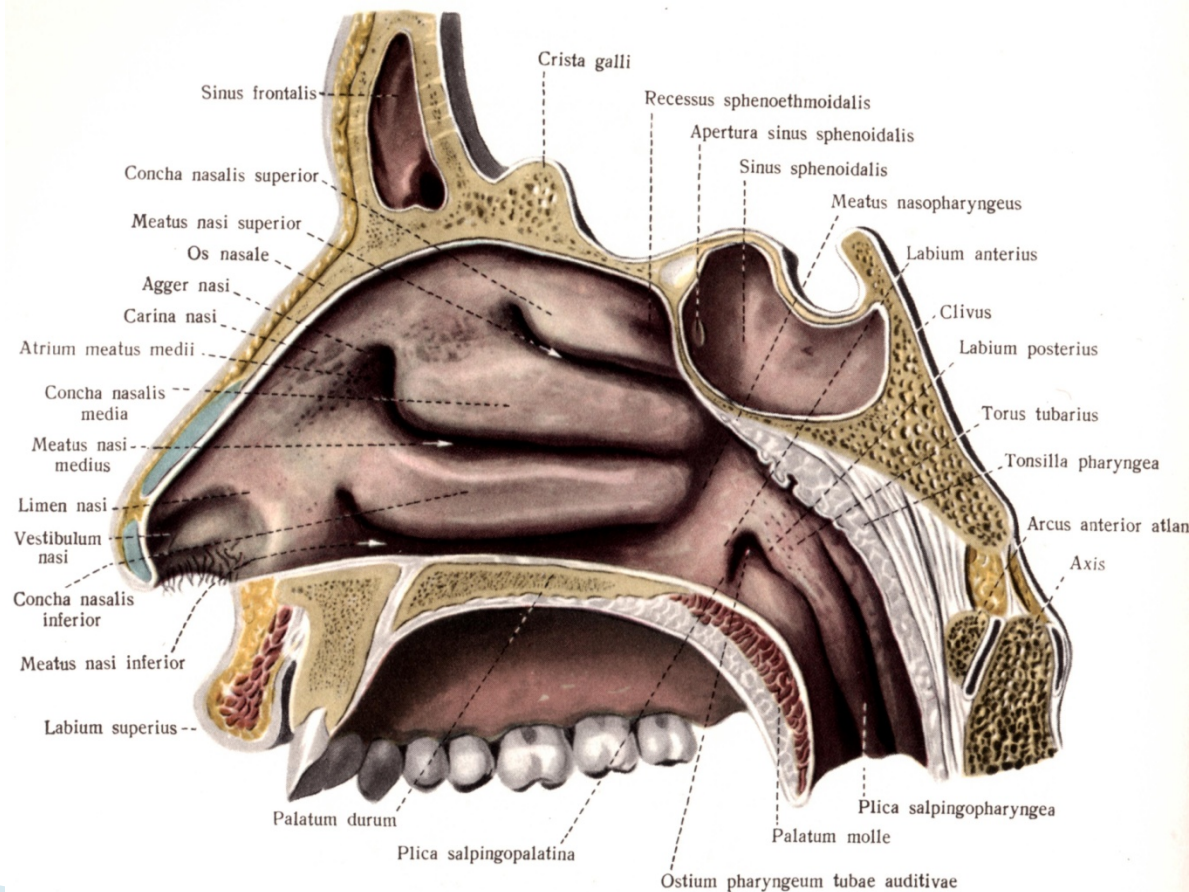


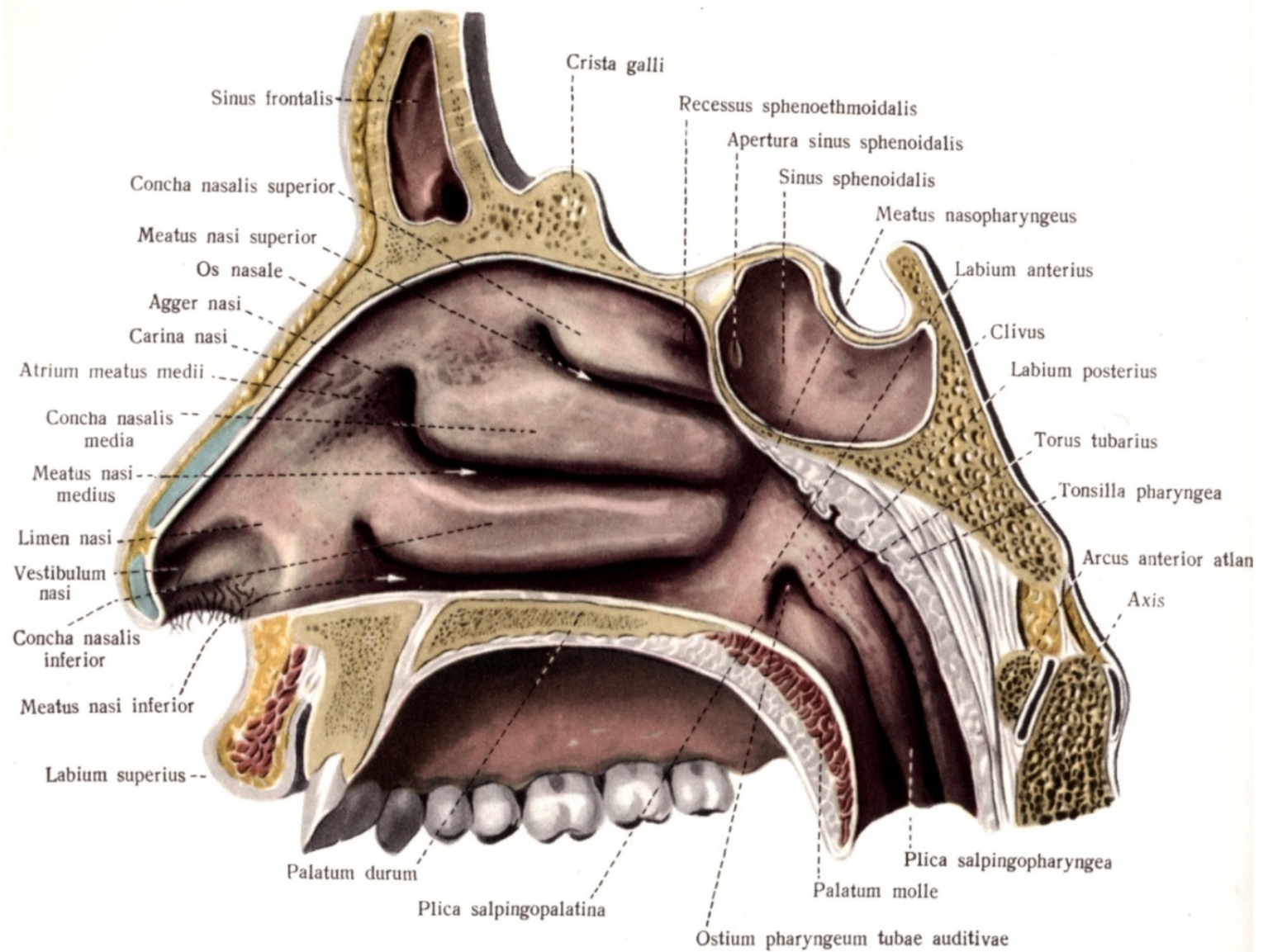
External nose



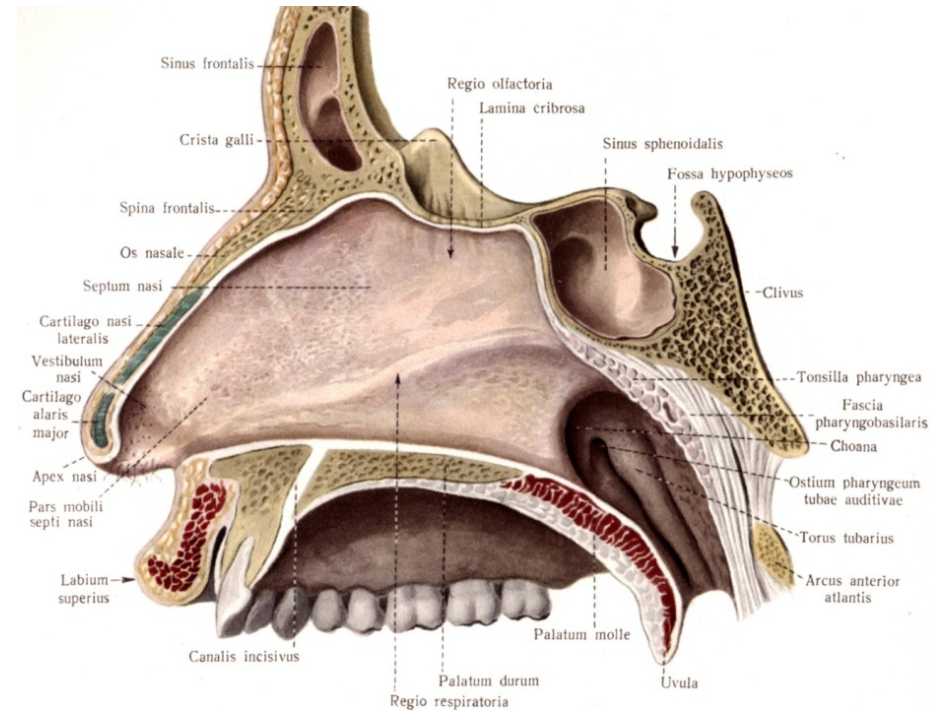
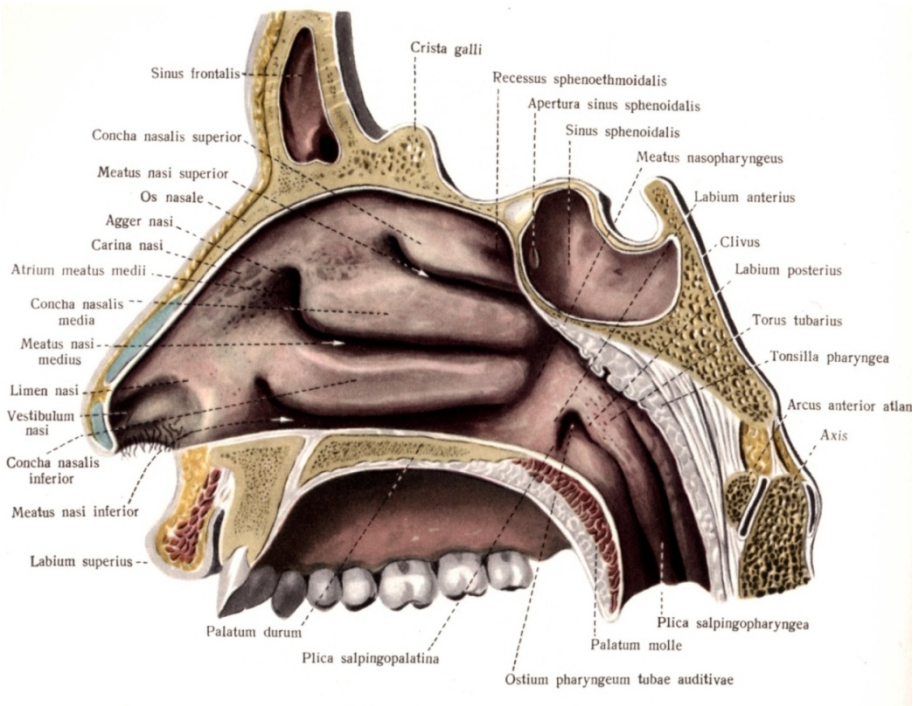



- ▶ The nose consists of two structures: **vestibule** and **nasal fosse**.
- ▶ **Vestibule** is the most anterior and dilated portion of the nose.





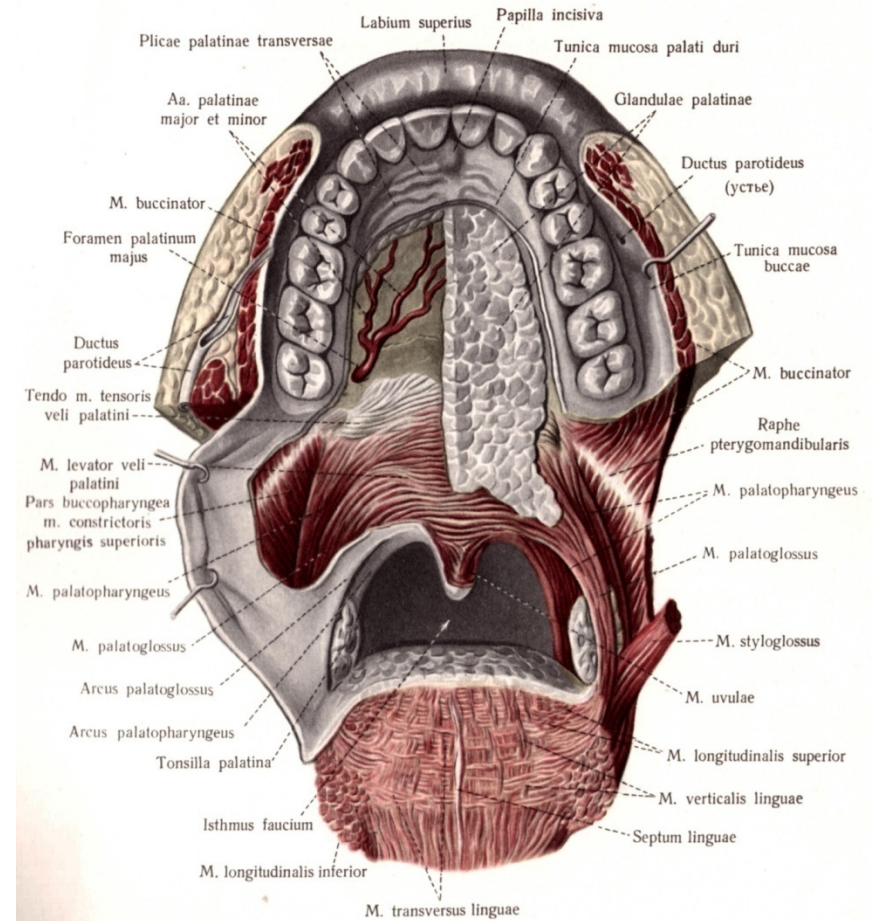
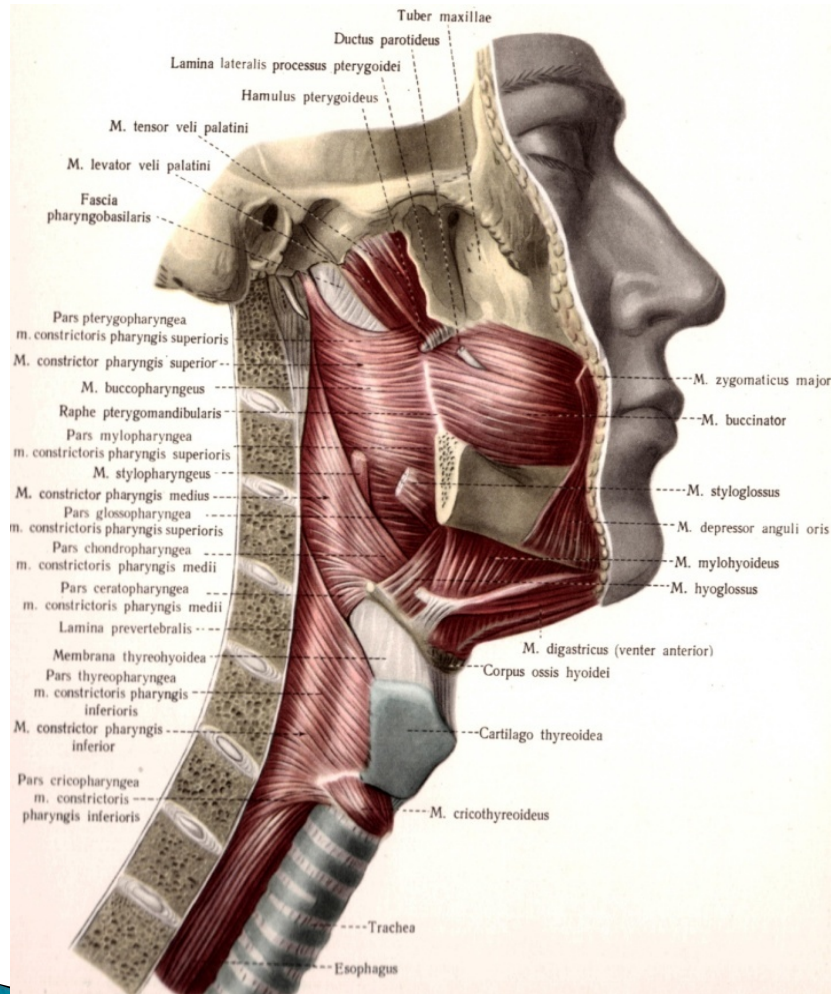
- ▶ **Nasal cavity** has the floor, the roof and two lateral walls.



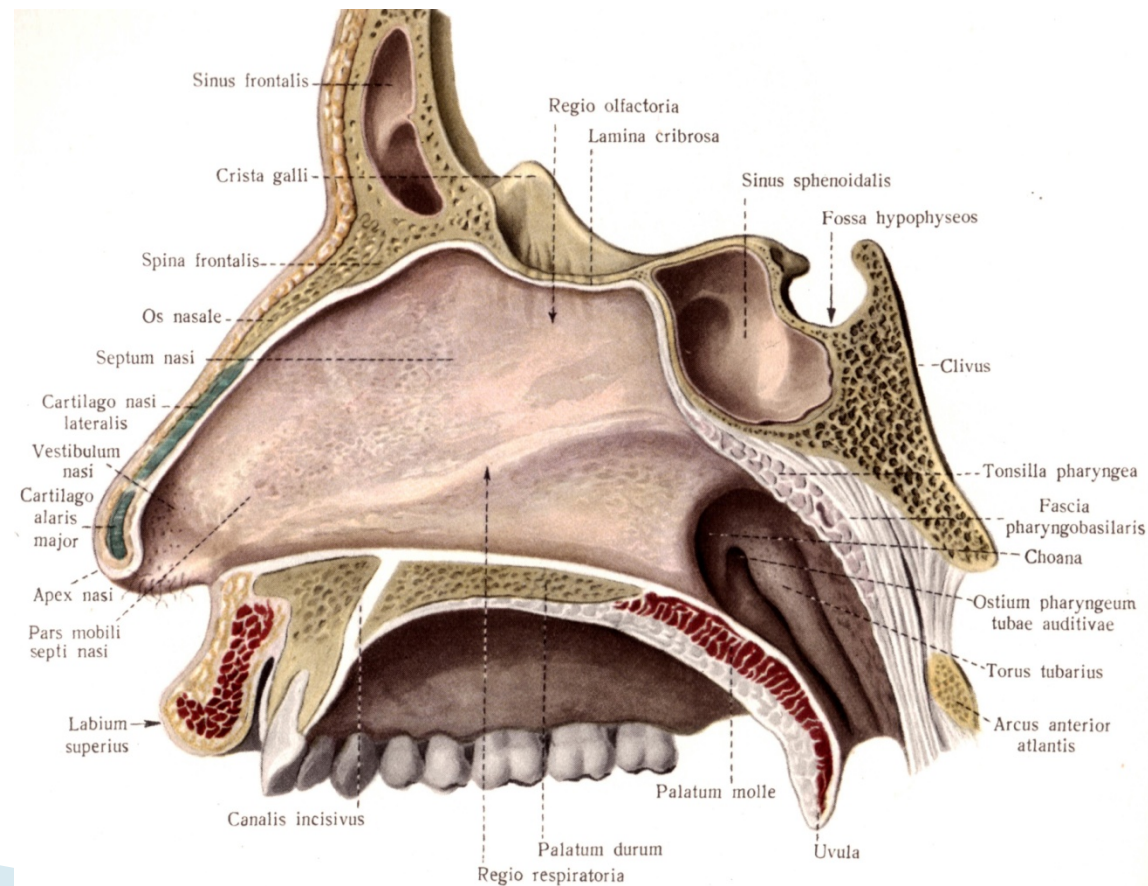
- ▶ **The floor of the nasal cavity** is formed by the hard and soft palatines. They separate the nasal cavity from the oral cavity.
 - ▶ **The hard palate** has the bone basis, covered by a dense mucosa.
 - ▶ **The soft palate** is a mobile, fibromuscular structure attached to the posterior border of the hard palate.
 - ▶ **The palate** on the nasal cavity is covered by pseudostratified columnar ciliated epithelium; on its oral surface lies with stratified nonkeratinized squamous epithelium.
- 

- ▶ The skeletal muscles in the soft palate are four pairs and one unpaired - **uvula**.
- ▶ **The tensor veli palatini muscle** originates from the **scaphoid fossa** at the base of the pterygoid process.
- ▶ **The levator veli palatini muscle** forming the large muscle mass at the medial opening of the auditory tube by stripping away the mucosa at the opening of the auditory tube.
- ▶ **The palatoglossal and palatopharyngeal muscles** are located in the homonymous folds. Between them is the tonsillar bed containing **the palatine tonsils**.

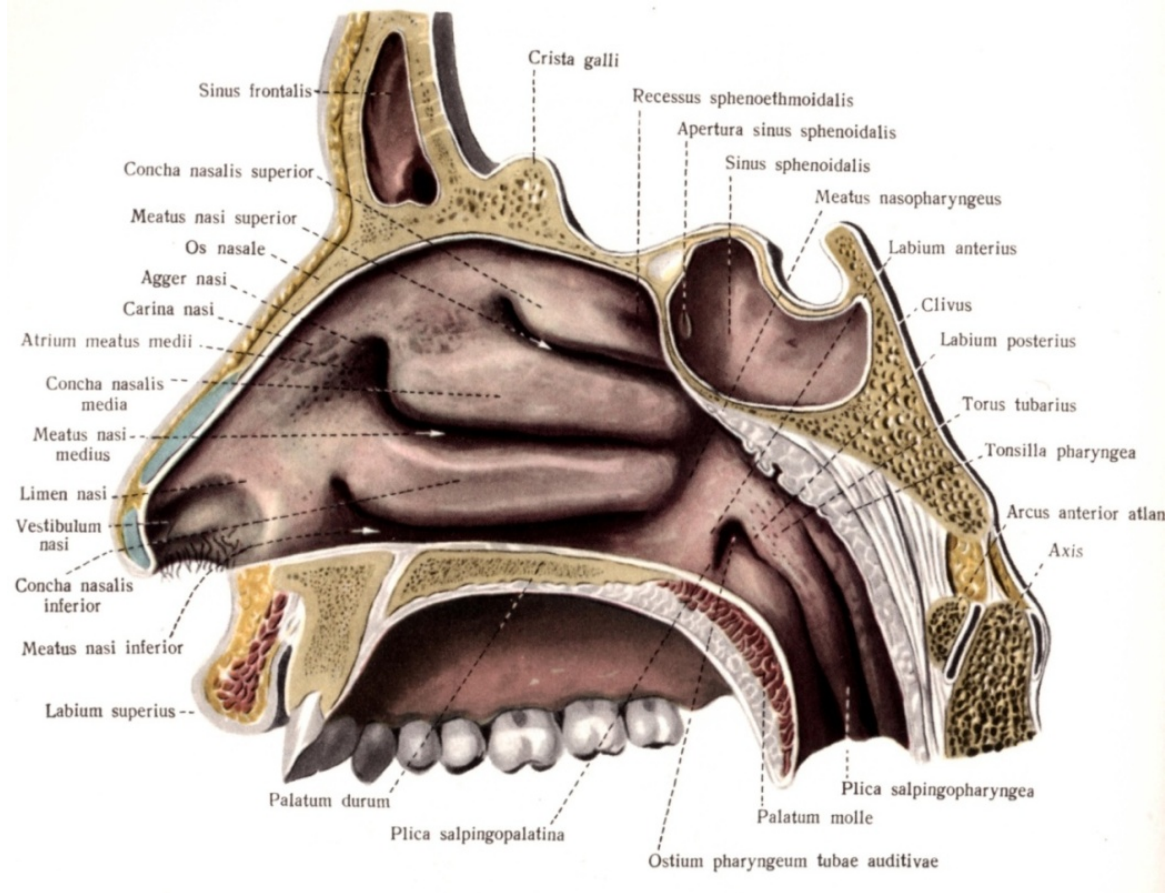
The floor of the nasal cavity

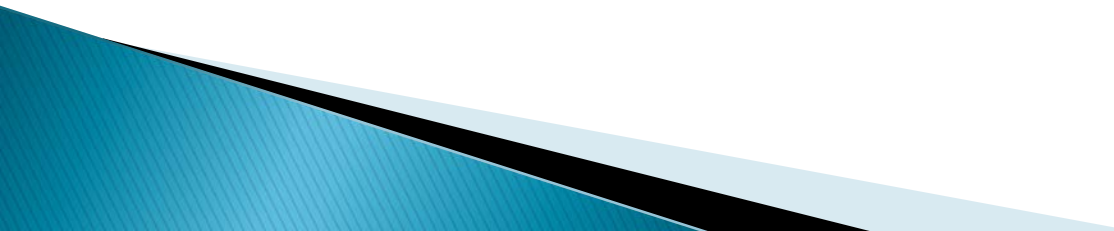


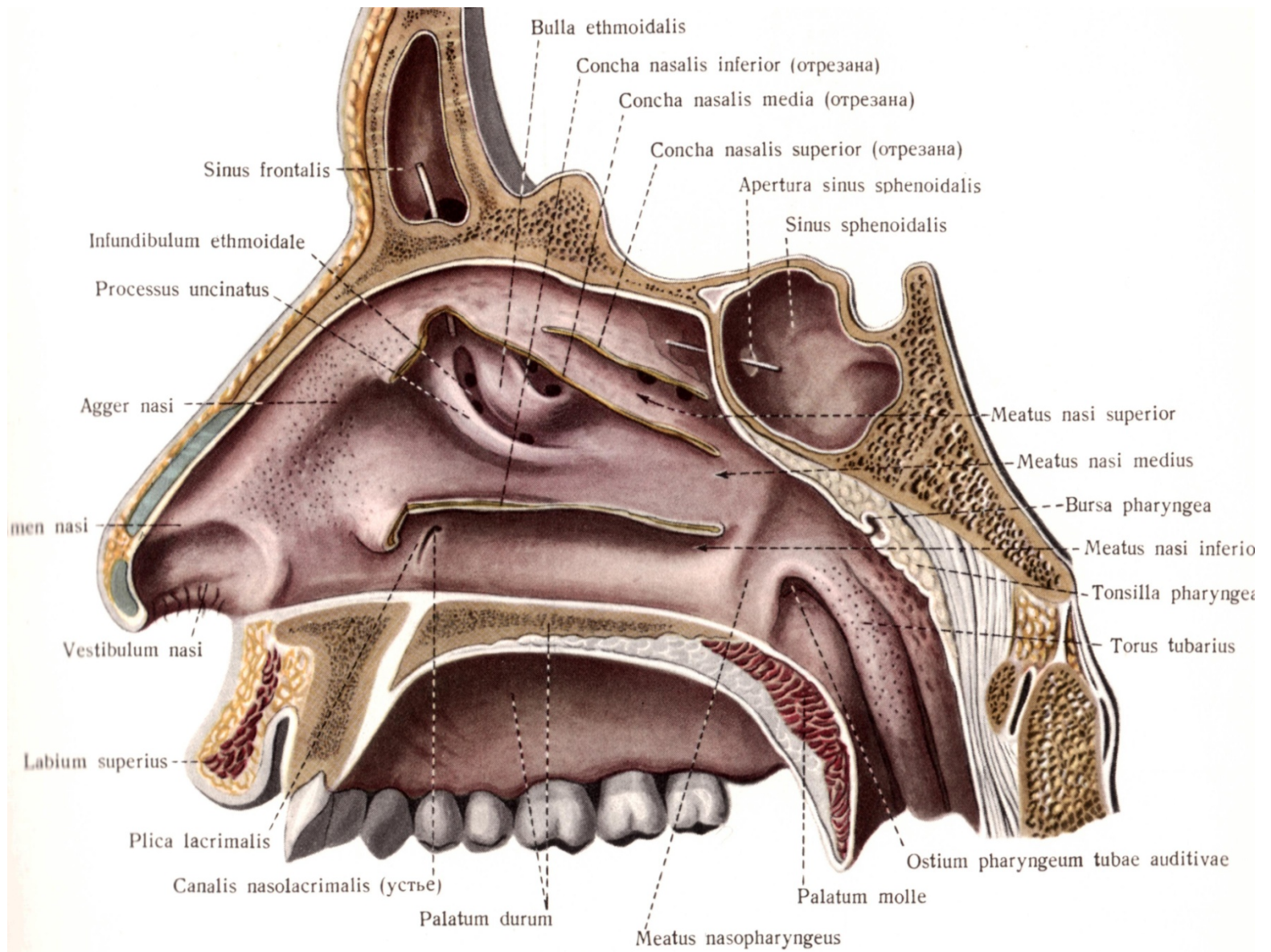
- ▶ **The roof of the nasal cavity** is formed by the three bones: nasal bone, cribriform plate of the ethmoidal bone and the body of sphenoid bone.



The lateral wall of the nasal cavity



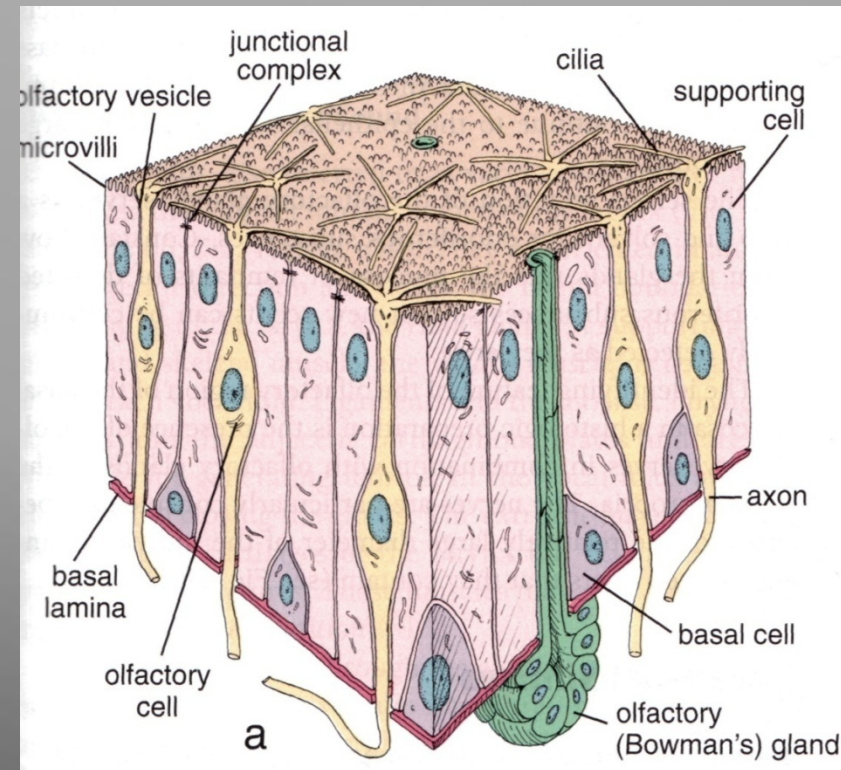
- ▶ On the each **lateral wall** of the nasal cavity there are three bony **shelf-like projections** known as **conchae**.
 - ▶ The superior conchae are covered by a specialized **olfactory epithelium**.
 - ▶ The middle and inferior projections are covered by **respiratory epithelium**.
 - ▶ The conchae play a dual role. They increase surface area as well as cause turbulence in airflow to allow more efficient conditioning of inspired air.
- 




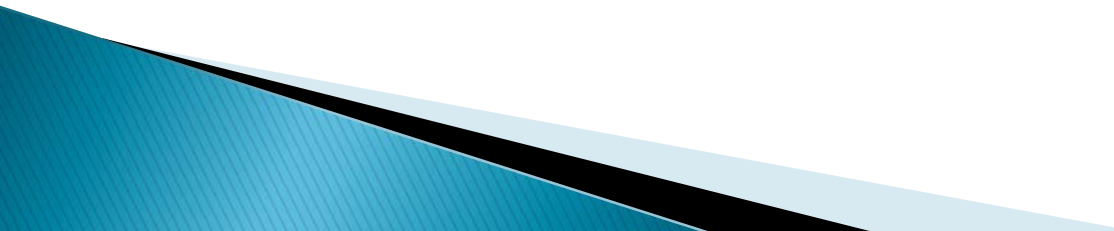
Olfactory epithelium

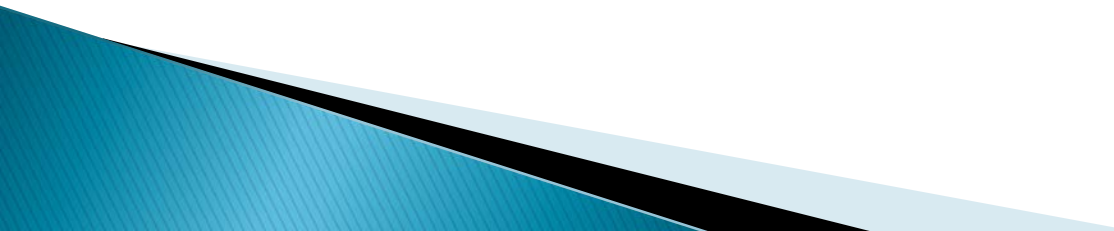
- ▶ The olfactory epithelium consists of olfactory cells, supporting cells, basal cells and brush cells.
- ▶ The incoming odorant molecules are solubilized
- ▶ in the olfactory mucus.

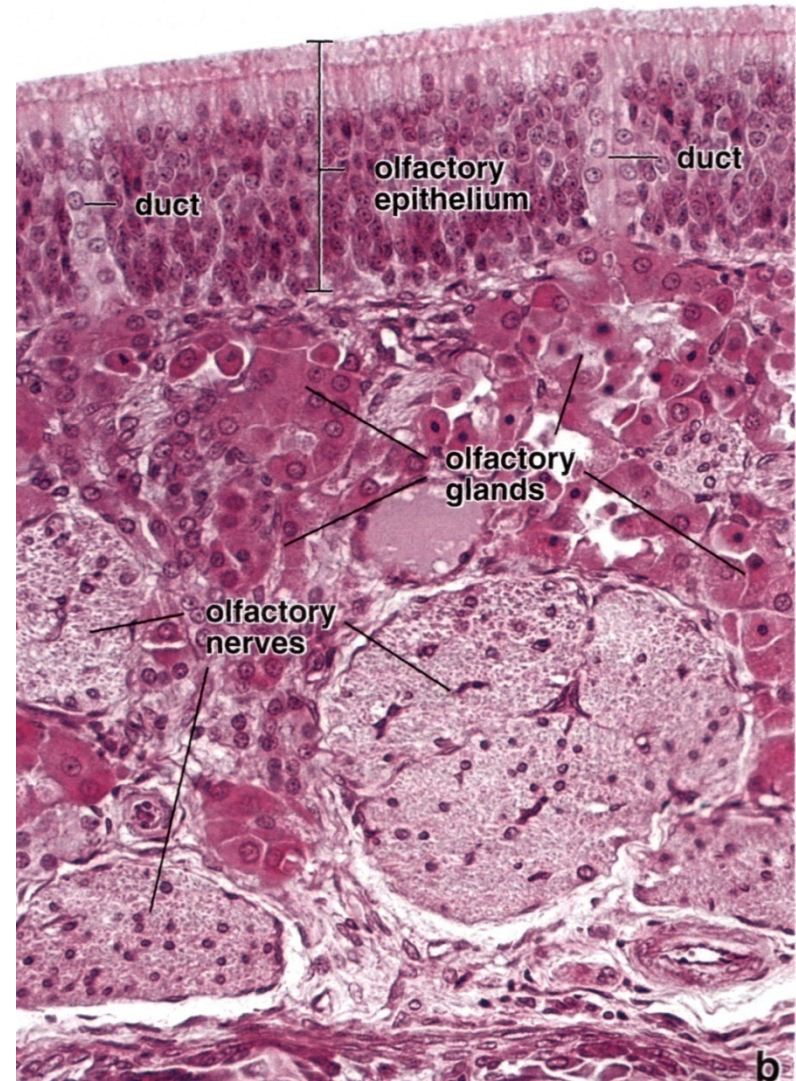
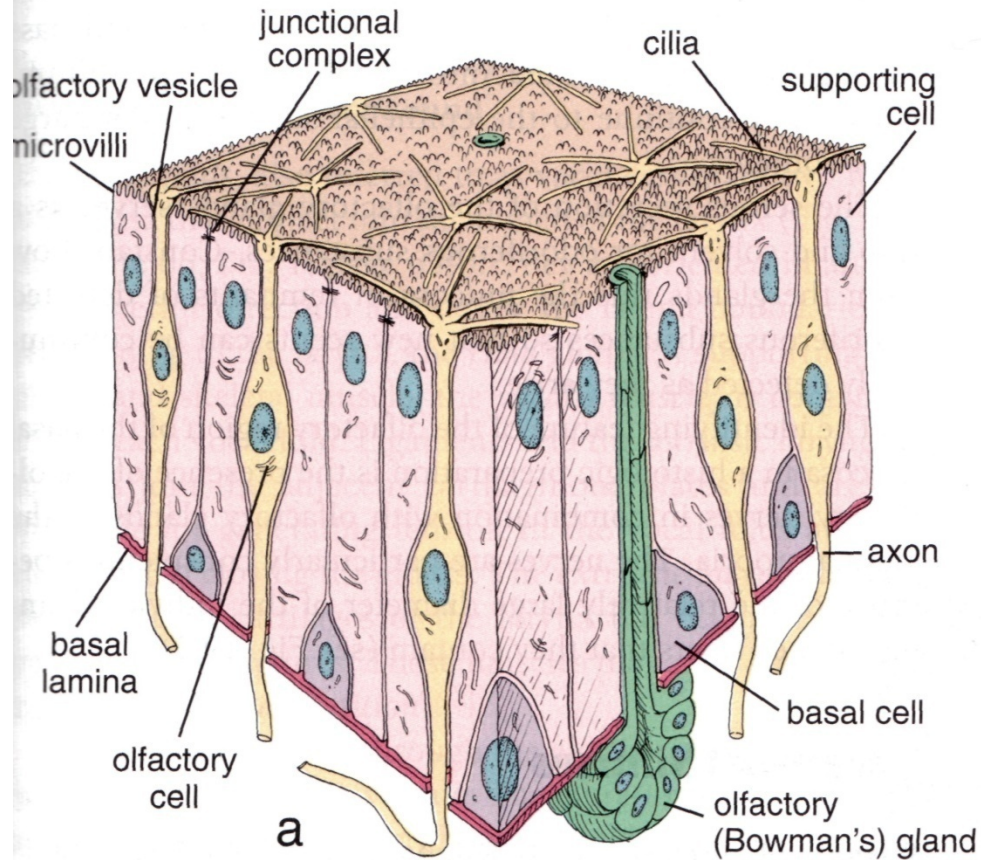
- ▶ **The apical (luminal) pole** of each **olfactory cell** there is a dendritic process projects above the epithelial surface as a knoblike structure called **the olfactory vesicle**.
- ▶ A number of cilia (10 to 23) arise from the olfactory vesicle.
- ▶ From the **basal pole** arises axon which ends to the olfactory bulb.

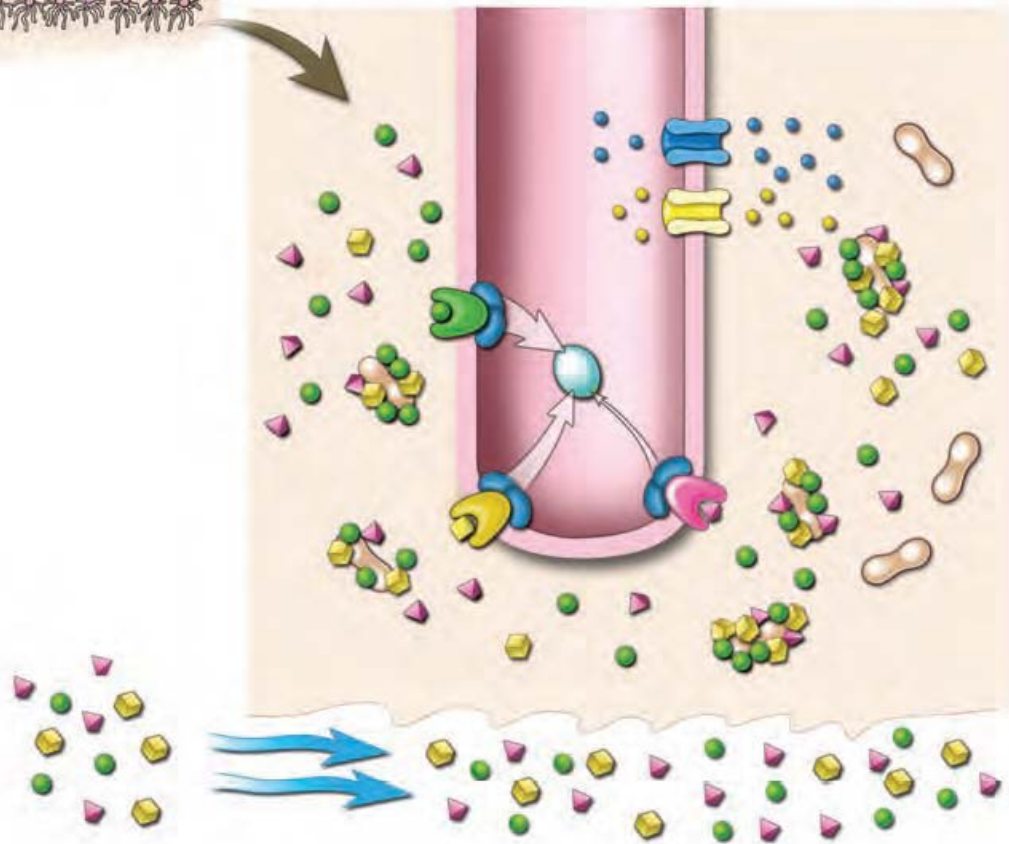
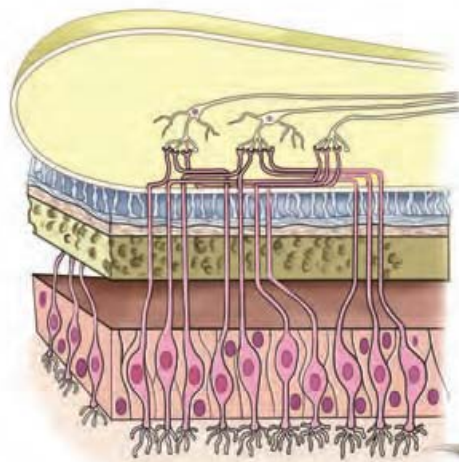


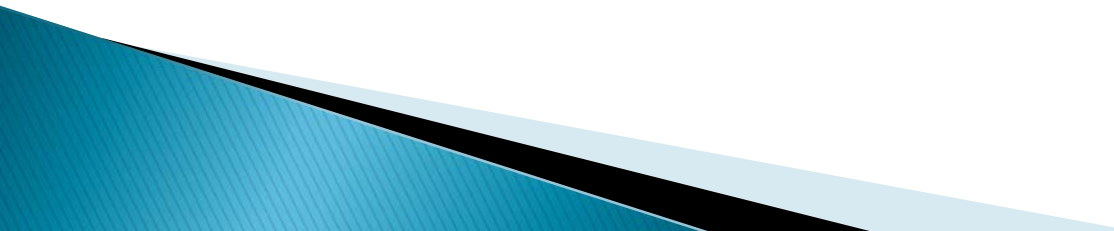
- ▶ The plasma membrane of the cilia contains **odorant-binding proteins** that act as olfactory receptors.
 - ▶ Incoming odorant molecules are solubilized in the olfactory mucus and interact with the olfactory receptors to **generate an action potential**.
 - ▶ The basal pole of the cell gives rise to an axonal process that leaves the epithelial compartment to enter the connective tissue, where it joins with axons from other olfactory cells to form **the olfactory nerve** (I cranial nerve).
- 

- ▶ **Supporting cells** provide mechanical and metabolic support for the olfactory cells.
 - ▶ They are the most numerous cells in the olfactory epithelium. **The nuclei** of these tall columnar or sustentacular cells occupy a more **apical position** in the epithelium than do those of the other cell types, thus aiding in their identification in the light microscope.
 - ▶ They have **numerous microvilli** on their apical surface, and abundant mitochondria. They also possess **lipofuscin granules**.
- 

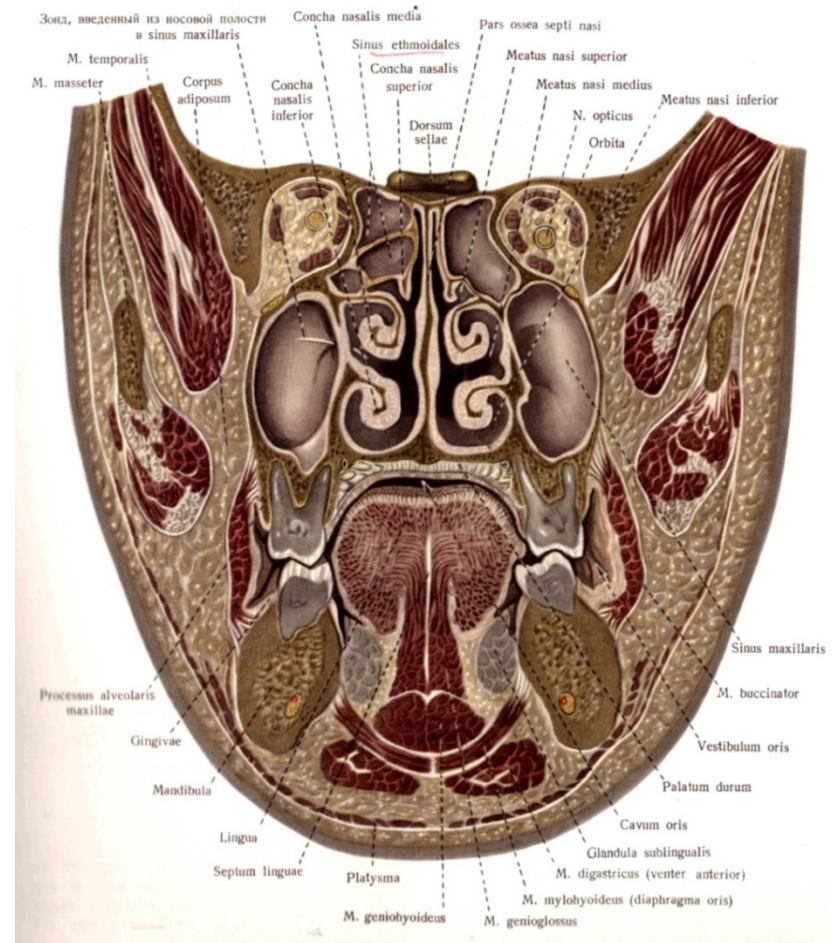
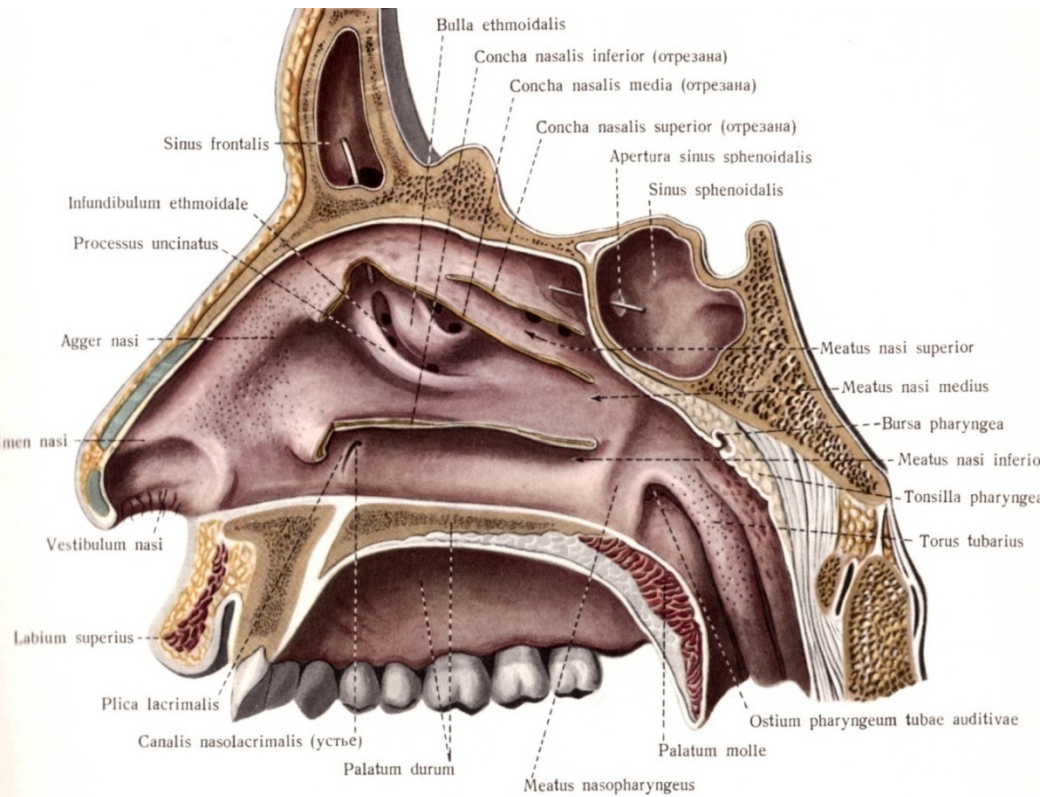
- ▶ **Brush cells** are columnar cells specialized for transduction of general sensation.
 - ▶ They are sensory receptors connected with branches of trigeminal nerve.
 - ▶ They have blunt microvilli at their apical surface, their basal surface is in synaptic contact with nerve fibers that penetrate the basal lamina. The nerve fibers are terminal branches of the **trigeminal nerve** that function in **general sensation** rather than **olfaction**.
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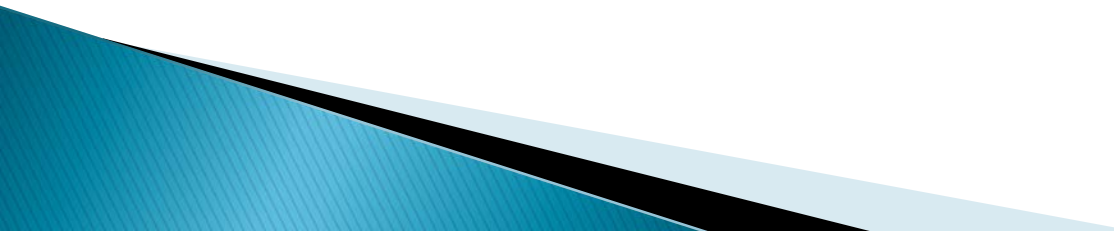




- ▶ **The lamina propria** is directly continuous with the periosteum.
 - ▶ It consists of numerous blood and lymphatic vessels unmyelinated and myelinated nerve and **olfactory (Bowman`s) glands**.
 - ▶ These tubuloalveolar glands produce serous secretion serves as **a trap** and **the solvent** for odorant substances and continuously washes the olfactory surface.
- 

paranasal sinuses



- ▶ **Sinusitis** is an inflammatory process of the sinus that may persist for long periods of time, mainly because of obstruction of drainage orifices.
 - ▶ **Chronic sinusitis** is a component of Kartagener's syndrome, which is characterized by defective ciliary action.
- 



Thank you