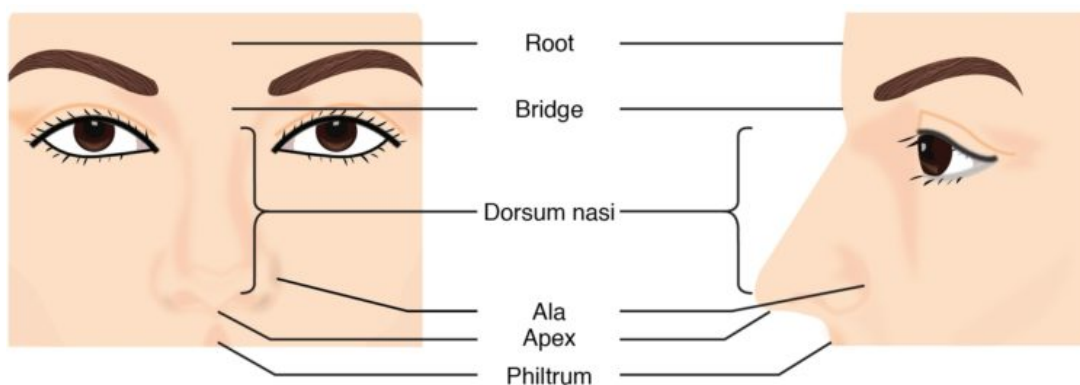


Anatomy, Functions, and Histology of the Human Nose

[See online here](#)

The nose is the human body's primary organ of smell, and it functions as part of the olfactory and respiratory systems. The nose, paranasal sinuses, mouth, larynx (voice box), and pharynx (throat) comprise the upper respiratory tract. While the nose may be best known for inhaling oxygen and exhaling carbon dioxide, it also contributes to other important functions such as tasting and hearing.



Functions of the Nose

The functions of the nose include:

- Regulating respiratory airflow
- Warming the air which is facilitated by the various epithelia lining the passageways of the respiratory system
- Humidifying inspired air by moisturizing it with mucosal secretions
- Providing some defensive functions
- Serving as an organ for the smell senses
- Resonating voice production and facilitating the sneeze reflex

Structure of the Nose

The visible external nose is pyramidal in shape with the root located at the upper region and the base located in the lower region. The variance in shape depends on the shape of the ethmoid bone which is an anterior cranial bone located between the eyes. The internal nose is divided into the left and right nasal cavities by the nasal septum. The internal nose also consists of the skin-lined region known as the vestibule and the

mucosa-lined region known as the nasal cavity proper.

Nose and Nasal Cavities

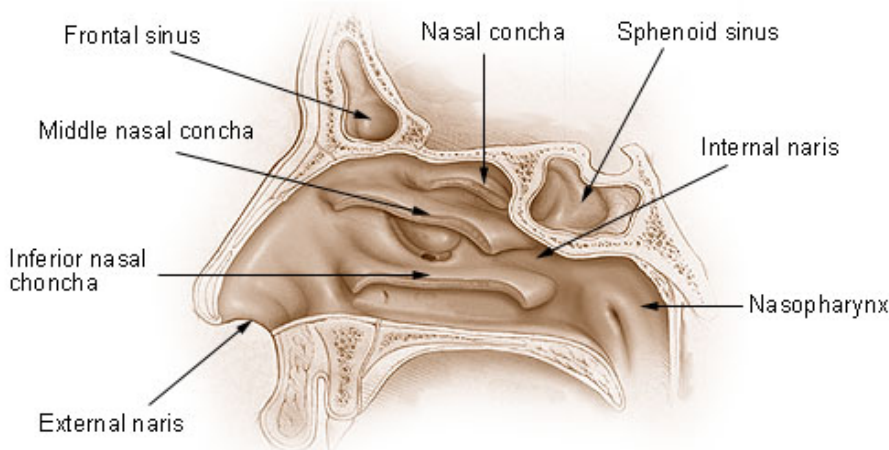


Image: "Illustration of the nasal cavities" by Arcadian. License: Public Domain

The nasal framework

The nasal aperture, or piriform aperture, is situated on the bony skull and represents a bony outline of the nasal cavity, the beginning of the respiratory tract. Located here is the commonly named nasal pyramid with each side consisting of the frontal process of the maxilla (proc. frontalis of the os maxillare) and medial to the nasal bone (os nasale) which is linked to the frontal bone (os frontale) of the forehead.

The nasal cartilage

The front nose section consists of connective tissue with embedded small pieces of cartilage. These include the nasal septum (cartilago septi nasi) and the nasal tip cartilage (lesser alar cartilage and the lateral greater alar cartilage). Whatever impression the nose makes as an aesthetically significant element of the face—be it a high, broad, or even crooked nose—is largely determined by these small cartilages and the cartilage portions of the nasal septum. Very frequently, the bony portion of the nose is affected by mid-facial fractures (e.g., a nasal bone fracture).

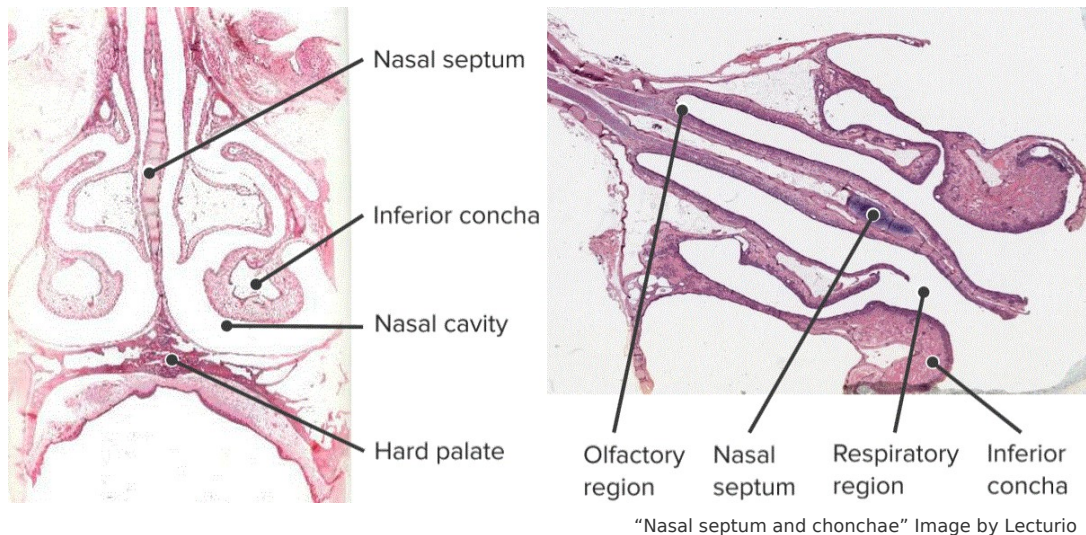
Common causes of nasal fracture can range from blunt impact during sports to varying accidents which result in a deformed nose. Manual alignment through the application of strong thumb pressure with anesthesia followed by repair may be necessary in order to avoid lasting misalignments. Injuries which lead to functional impairments may be corrected through nose surgery or rhinoplasty.

Internal nose

The inner part of the nose is formed by the main nasal cavity that constitutes the nasal concha, nasal passages (nasal meatus), and paranasal sinus. The nasal septum (septum nasi) is the bone and cartilage in the nose that separates the nasal cavity (cavitas nasi) into two fossae, continuations of the nostrils, and jointly forms their medial border. The nasal septum consists of four structures:

- Vomer Bone
- Perpendicular Plate of the Ethmoid Bone
- Septal Nasal Cartilage
- Maxillary Crest

Clinically, septum deviations, or deviations of the nasal septum, are misnomers and actually occur quite frequently. These deviations may be present at birth or may result from an accident. A deviated septum can lead to nasal congestion and breathing difficulties which may require surgical correction.



Nasal cavity

Each nasal cavity has a lateral wall, medial wall, roof, and floor as follows.

The **cribriform plate** of the **ethmoid bone** forms the **roof** of the nasal cavity (**os ethmoidale** - is the part of the **cranial base**, where the **fila olfactoria** of the **N. olfactorius** passes through), which borders above with the nasal bone (**os nasale**) and the body of the sphenoid bone.

The horizontal plate of the palatine bone and the palatine process of the maxilla form the **floor**. The lateral walls are formed by the turbinates or chonchae. The medial walls are formed by the nasal septum on each side.

The main nasal cavity (**cavitas nasi**) extends from the inner nostril (= **nose flap Limen nasi**) all the way to the back till it reaches the **choanae**. The nasal vestibule (**vestibulum nasi**) in casual terms, our outer nostril (**nares**), communicates with the internal nose.

Note: The nasal cavity has a close topographical connection to the medial cranial fossa and the oral cavity.

Nasal passages

The medial wall of the nasal cavity is smooth. The respective lateral wall is hallmarked by three nasal conchae or turbinates (superior, middle, and inferior) that separate the three nasal passages (nasal meatus superior, middle, and inferior) from each other (where the inferior nasal meatus is found below the inferior turbinate, etc.). On one hand, there are

the established openings with a number of important anatomical structures, and on the other hand, the inhaled airstream can be heated and moistened more effectively due to the increased surface area.

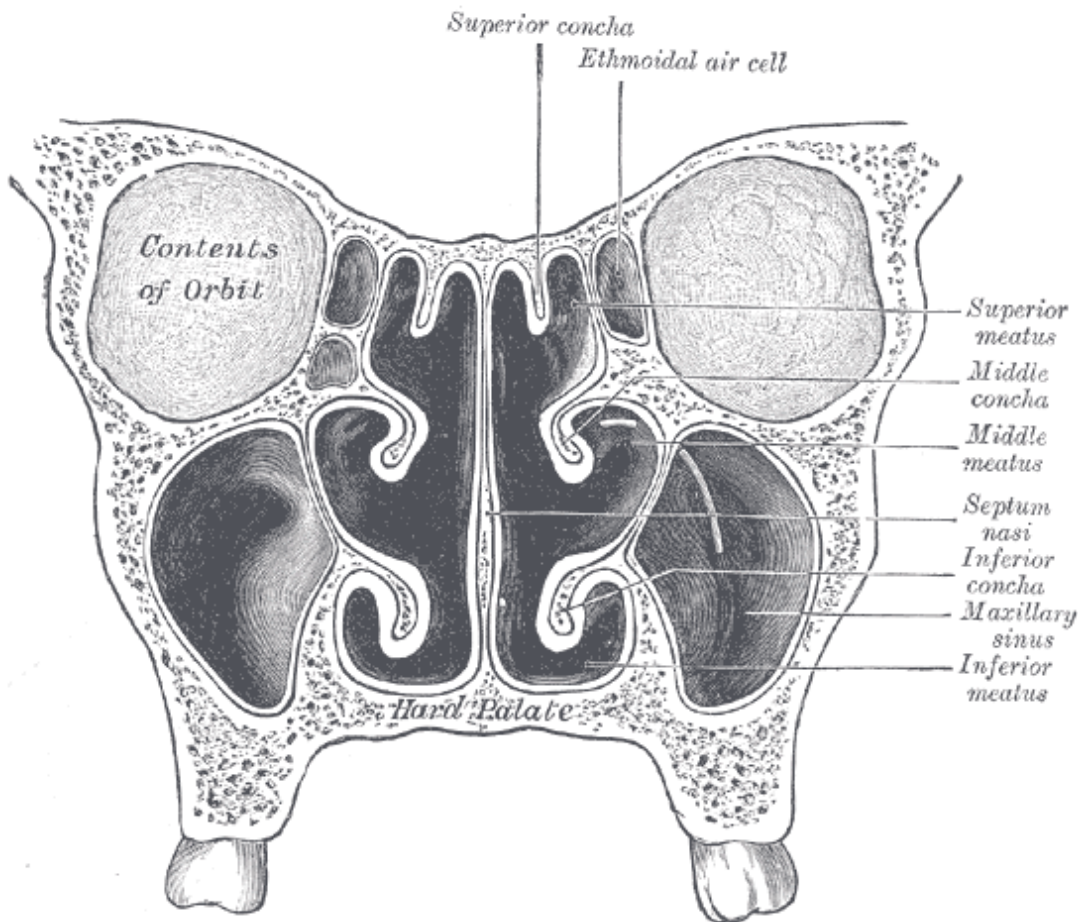


Image: "Coronal section of nasal cavities." by Henry Vandyke Carter - Henry Gray. License: Public Domain

The location of the various openings in the nasal passages is a popular topic among auditors and in the Exam Questions)

Nasal passage	Opening structure
Recessus sphenothmoidal	Sphenoidal sinus (sinus sphenoidalis)
Superior nose passage (Meatus nasi superior)	Posterior ethmoidal cells (cellulae ethmoidales posterior)
Middle nose passage (Meatus nasi medius)	Anterior ethmoidal cells (cellulae ethmoidales anterior), maxillary sinus (Sinus maxillaris), frontal sinus cavity (Sinus frontalis), the excretory duct of the frontal sinus cavity (ductus nasofrontalis) ends in the so-called semilunar hiatus (hiatus semilunaris).
Inferior nose passage (Meatus nasi inferior)	The nasolacrimal duct (ductus nasolacrimalis)

Paranasal Sinus

The four paranasal sinuses (sinus paranasales) include the maxillary sinus (sinus maxillaris), ethmoid sinus (sinus ethmoidalis or cellulae ethmoidales), the sphenoid sinus (sinus sphenoidalis), and the frontal sinus (sinus frontalis).

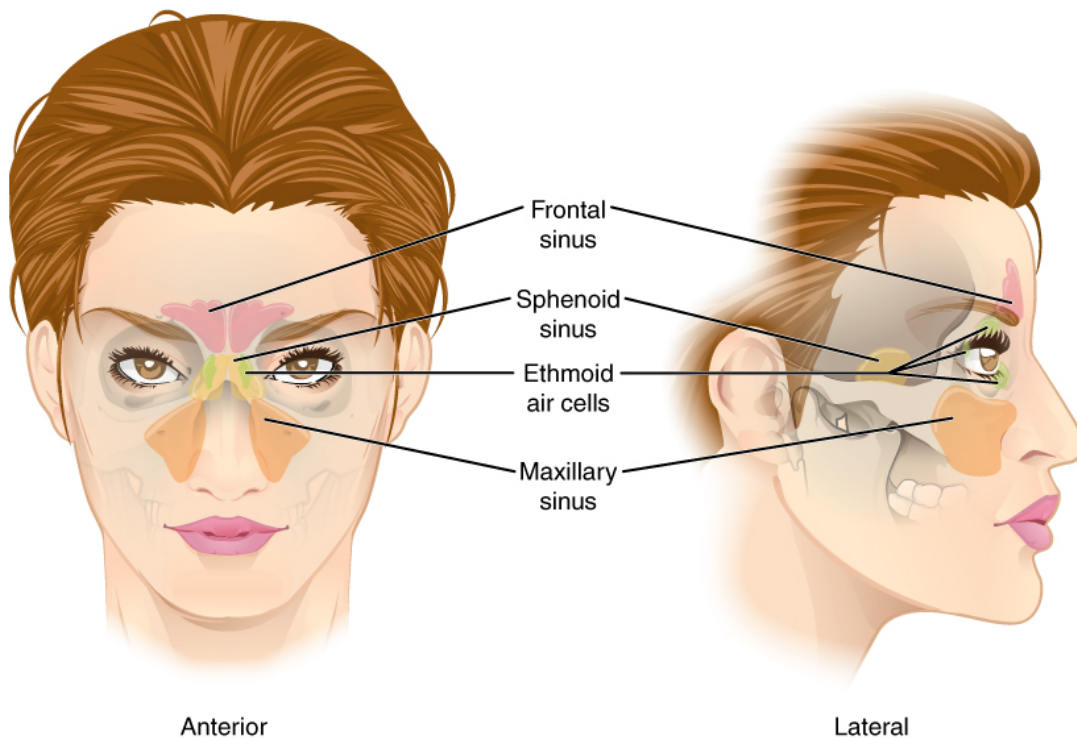


Image: "Anatomy & Physiology, Connexions Web site. <http://cnx.org/content/col11496/1.6/>, Jun 19, 2013." by OpenStax College - Anatomy & Physiology, Connexions Web site. License: [CC BY 3.0](https://creativecommons.org/licenses/by/3.0/)

The air-filled cavities are lined with respiratory epithelium and are all connected to the main nasal cavity. This serves as the ventilation of the sinuses as well as a discharge path for any produced secretion. It is important to know whether inflammation of the sinuses is present. A mucosal swelling or polyp can obstruct the pathways of this system, and sinusitis can become prolonged due to the lack of drainage.

Knowledge of the anatomical relationship between the individual sinuses and the cranial structures is of particular importance in terms of surgical access methods, the danger of injury and infection in pathologies of the otolaryngology (ear-nose-throat medicine), and surgical interventions.

Maxillary sinus (Sinus maxillaris)

The pyramid-shaped maxillary sinus is the largest of the paranasal sinuses, and it drains into the middle meatus of the nose. The medial wall of the maxillary sinus corresponds to the lateral wall of the main nasal cavity. Over the elevated ostium (excretory duct), secretion can drain off by way of the funnel-shaped passage referred to as the infundibulum ethmoidale (groove in the ethmoid bone) and the semilunar hiatus into the middle meatus.

The roof of the maxillary sinus is formed by the floor of the orbit. This is the place where the infra orbitalis nerve passes through (sometimes even without any bony cover) which can get injured due to maxillary sinusitis and surgical interventions. The anterior wall of the maxillary sinus contains the infraorbital foramen through which the nerves pass.

In close anatomic proximity to the roots of the four molars is the floor of the maxillary sinus which contains alveolar recess. If during tooth extraction, the maxillary sinus is accidentally opened or root residue is pushed into the maxillary sinus, an odontogenic sinus inflammation may result. In the case of non-healing, unilateral maxillary sinusitis, possible cause due to dental problems should always be ruled out first. The maxillary

sinus borders its posterior wall on to the pterygopalatine fossa.

Ethmoid sinus (Sinus ethmoidalis)

The ethmoid sinus, or ethmoid air cells of the ethmoid bone, consists of numerous thin-walled cavities that are situated in the ethmoidal labyrinth and completed by the maxilla, frontal, lacrimal, sphenoidal, and palatine bones. The ethmoidal air cells receive sensory fibers from the posterior and anterior ethmoidal nerves and the orbital branches of the pterygopalatine ganglion which carry the postganglionic parasympathetic nerve fibers for mucous secretion from the facial nerve. The ethmoidal cells (sinuses) are not immediately present at birth. By 2 years of age, however, these cells are recognizable through the use of computerized tomography (CT) scanning.

Frontal sinus (Sinus frontalis)

The frontal sinus is found within the frontal bone and is often very large and chambered but can also be entirely non-existent (aplasia). The orbital roof forms the lower boundary. In the case of sinusitis, there is a danger of perforation into the orbital. Since the posterior wall belongs to the base of the skull, there is an additional danger of complications from an intracranial infection. The front wall is formed by the supraorbital forehead.

Sphenoidal sinus (Sinus sphenoidalis)

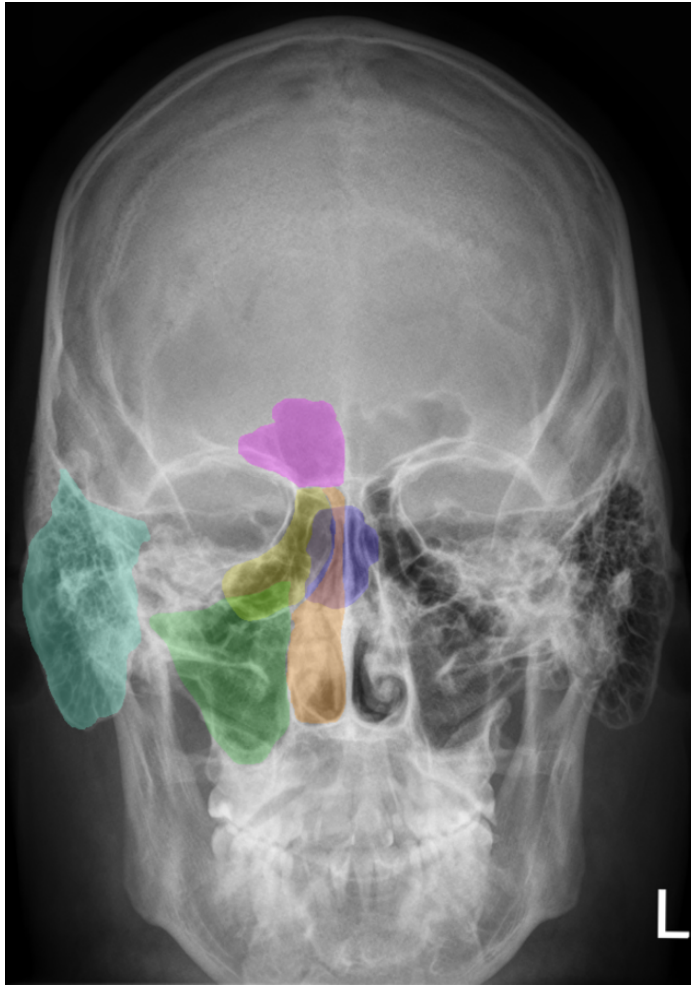


Image: "X-ray of the human skull in frontal view with paranasal sinuses. The paranasal sinuses and main nasal cavity are marked with colours: Main nasal cavity: amber Maxillary sinus: green Ethmoidal cells: yellow Frontal sinus: purple Sphenoidal sinus: blue Mastoid cells: cyan" by Hellerhoff.
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The sphenoidal sinus is found within the sphenoid bone. The floor is formed by the roof of the nasopharynx, and from the front wall, there is a connection to the upper nasal passage (meatus).

The roof of the sphenoid sinus is an anatomically important area since surgical access to the pituitary gland, which is located behind the sphenoid sinus in the fossa hypophysialis, lies in this location. In addition, it borders the sella turcica with the front and middle cranial fossa. The sidewall lies close to the internal carotid artery (a. carotis interna), the optic canal (canalis opticus), and the cavernous sinus.

Possible infection can trigger cavernous sinus thrombosis. In surgery, the anatomical features of the sphenoid sinus must be strictly observed as this can otherwise lead to life-threatening complications.

Image: Nasal cavity and paranasal sinuses in human beings highlighted in an x-ray using different colors on one side. Nasal cavity = orange; maxillary sinus = green; ethmoid sinus = yellow; frontal sinus = purple; sphenoidal sinus = blue; and mastoid process = cyan.

Pathways of the Nose

Nose vessels

The blood supply of the nose is derived from:

- The internal carotid artery that supplies the lateral nasal wall (Aa. ethmoidales from the ophthalmic artery)
- The external carotid artery that supplies the dorsal aspect of the nose (Aa. nasal posterior lateral from the sphenopalatine artery)

The vascular supply of the nasal septum is fundamental. It is fed from both carotids (external and internal) in the front area of the Kiesselbach's plexus. This vessel-rich area is usually the source of bleeding in locally induced nosebleeds (epistaxis).

In very severe nosebleeds—which can neither be stopped with tamponade or compression—it may be necessary to locally obstruct one of the major arterial vessels (the A. maxillary, the external carotid artery, or one of the two Aa. ethmoidales in the orbital).

Nerves of the nose

The sensory innervation of the inner nose is carried out by branches of the trigeminal nerve (the branches of the ophthalmic nerve [V1] in the front upper part; the branches of the maxillary nerve [V2] in the other sections). The sensory perception of smell is carried out by the function of the olfactory nerve.

The nose as a sensory organ

The olfactory nerve, the first cranial nerve (CN1), transmits the sensory perception of smell and originates from the olfactory mucosa (regio olfactoria), an area that is approximately 2 cm² and located on the roof of each nasal cavity. Here, the fila olfactoria passes through the cribriform plate (lamina cribrosa) of the ethmoid bone (os ethmoidale) in the bony skull and merges to form the olfactory bulb.

The fila olfactoria are primary sensory cells. Scent molecules bind to the olfactory receptor cells located in the nasal mucosa and trigger a change in potential. This change is converted into an electrical signal within the cell, and the "coded" information concerning the scent quality is transported through the olfactory tract into the cerebral cortex. During courses of study, this process is discussed extensively in the area of the physiology of senses while the stages of the olfactory tract already belong to the special field of neuroanatomy. In oral tests, the structure of the nose, nonetheless, offers a perfect exam template to question the course of the olfactory pathway:

Olfactory cells with fila olfactoria > olfactory bulb > tractus olfactorius > striae olfactoriae medial and lateral > primary olfactory cortex (area prepiriformis) and amygdala.

Humans can detect about 10,000 different scents. After having suffered a basilar skull fracture, the result could be damaging to the fila olfactoria and as a consequent, loss of sense of smell (anosmia) can. After critical damage, only "strong" smells such as ammonia are perceived, since the trigeminal nerve is responsible for sensory perception.

Histology of the Nose

The **nasal mucous membrane** consists of respiratory epithelium (regio respiratoria) and sensory epithelium with olfactory cells (regio olfactoria). The mucosa is well supplied with blood and has numerous mucus-producing goblet cells—effective heating and humidifying of the air can thereby be ensured. The drainage of the nasal secretions from the nasal cavities aided from the cilia of the ciliated epithelium is an important component of the non-specific immune defense system. The large part of the secretion reaches the nasopharynx and is then swallowed.

Dysfunction of the nose

The pathologies of the nose and paranasal sinuses are important to clinically understand the areas of ear, nose, and throat medication as well as to succeed in medical exams. Relevant facts for the preclinical and preliminary medical examination can be found in the text. A synoptic view of the important nose and paranasal sinus pathologies include:



Image: "Sinusitis maxillaris (Kieferhöhlenentzündung) rechts also links im Röntgenbild. Man erkennt deutlich den Luft-Flüssigkeitsspiegel." by Hellerhoff. License: [CC BY-SA 3.0](#)

- Polyps
- Sinusitis
- Rhinitis
- Epistaxis
- Nasal Septum Deviation
- Tumors of the Nose
- Foreign Substances
- Fractures
- Disturbances of Smell (Neurology)

Important Exam Facts

Important exam topics include but are not limited to the ducts of the paranasal sinuses, the arterial supply of the nose, and important anatomical boundaries and relations of the paranasal sinuses. In neuroanatomy, the components and the course of the olfactory tract will likely be examined.

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