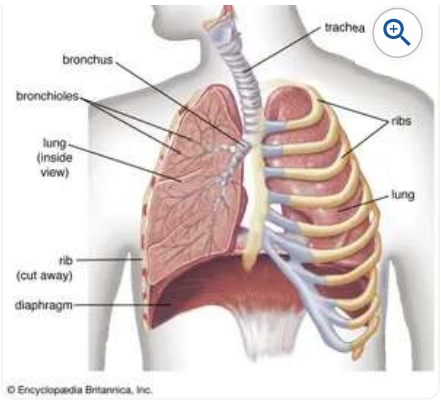
human respiratory system

physiology

Quick Summary Ask the Chatbot

Arthur A. Siebens • All Britannica Editors Jan. 12, 2026 • History



human lungs The lungs serve as the gas-exchanging organ for the process of respiration.

The design of the respiratory system

The human gas-exchanging organ, the lung, is located in the thorax, where its delicate tissues are protected by the bony and muscular thoracic cage. The lung provides the tissues of the human body with a continuous flow of oxygen and clears the blood of the gaseous waste product, carbon dioxide. Atmospheric air is pumped in and out regularly through a system of pipes, called conducting airways, which join the gas-exchange region with the outside of the body. The airways can be divided into upper and lower airway systems. The transition between the two systems is located where the pathways of the respiratory and digestive systems cross, just at the top of the larynx.

Passage of air through the respiratory tract explained The respiratory tract conveys air from the mouth and nc...(more)

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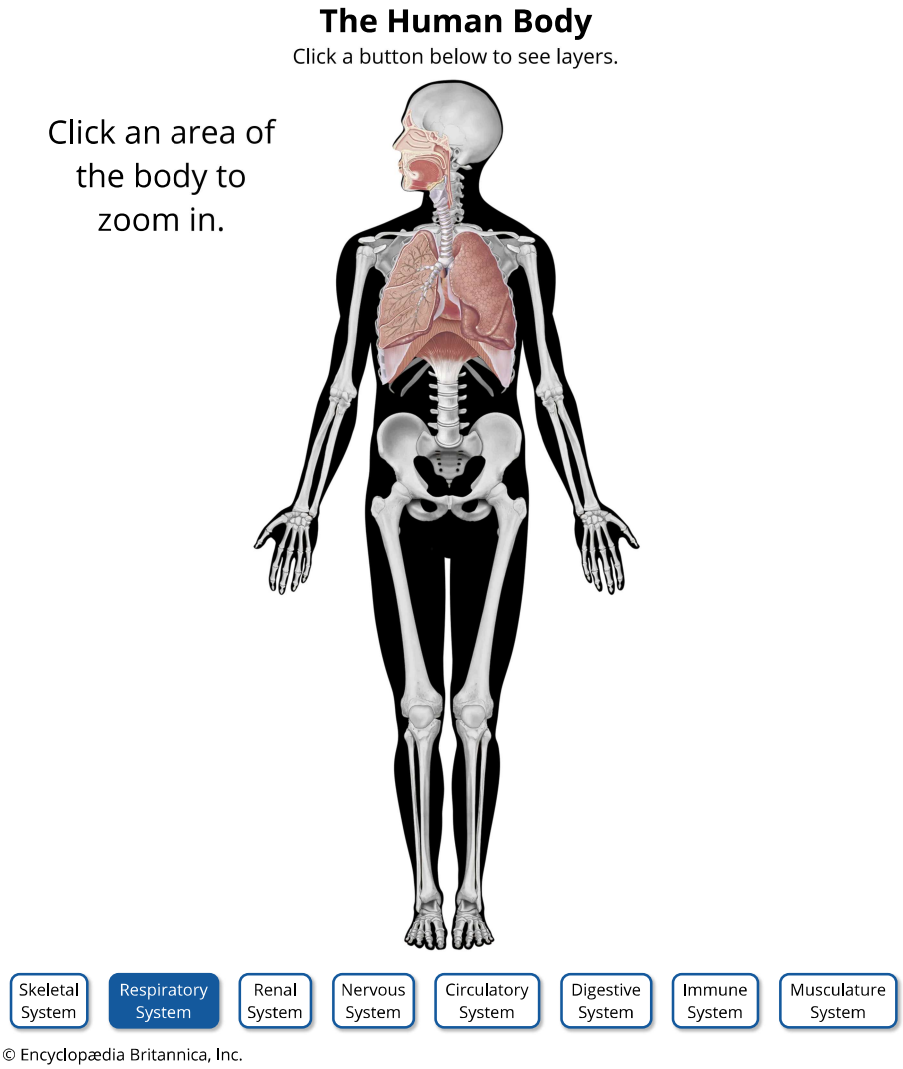
The upper airway system comprises the nose and the paranasal cavities (or sinuses), the pharynx (or throat), and partly also the oral cavity, since it may be used for breathing. The lower airway system consists of the larynx, the trachea, the stem bronchi, and all the airways ramifying intensively within the lungs, such as the intrapulmonary bronchi, the bronchioles, and the alveolar ducts. For respiration, the collaboration of other organ systems is clearly essential. The diaphragm, as the main respiratory muscle, and the intercostal muscles of the chest wall play an essential role by generating, under the control of the central nervous system, the

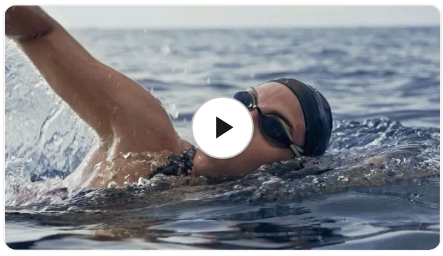
pumping action on the lung. The muscles expand and contract the internal space of the thorax, the bony framework of which is formed by the ribs and the thoracic vertebrae. The contribution of the lung and chest wall (ribs and muscles) to respiration is described below in The mechanics of breathing. The blood, as a carrier for the gases, and the circulatory system (i.e., the heart and the blood vessels) are mandatory elements of a working respiratory system (*see* blood; cardiovascular system).



Morphology of the upper airways

The nose

The nose is the external protuberance of an internal space, the nasal cavity. It is subdivided into a left and right canal by a thin medial cartilaginous and bony wall, the nasal septum. Each canal opens to the face by a nostril and into the pharynx by the choana. The floor of the nasal cavity is formed by the palate, which also forms the roof of the oral cavity. The complex shape of the nasal cavity is due to projections of bony ridges, the superior, middle, and inferior turbinate bones (or conchae), from the lateral wall. The passageways thus formed below each ridge are called the superior, middle, and inferior nasal meatuses.



How much air do you breathe in a lifetime? Every minute, multiple liters of air are cycled through your lungs.

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On each side, the intranasal space communicates with a series of neighbouring air-filled cavities within the skull (the paranasal sinuses) and also, via the nasolacrimal duct, with the lacrimal apparatus in the corner of the eye. The duct drains the lacrimal fluid into the nasal cavity. This fact explains why nasal respiration can be rapidly impaired or even impeded during weeping: the lacrimal fluid is not only overflowing into tears, it is also flooding the nasal cavity.

The paranasal sinuses are sets of paired single or multiple cavities of variable size. Most of their development takes place after birth, and they reach their final size toward age 20. The sinuses are located in four different skull bones—the maxilla, the frontal, the ethmoid, and the sphenoid bones. Correspondingly, they are called the maxillary sinus, which is the largest cavity; the frontal sinus; the ethmoid sinuses; and the sphenoid sinus, which is located in the upper posterior wall of the nasal cavity. The sinuses have two principal functions: because they are filled with air, they help keep the weight of the skull within reasonable limits, and they serve as resonance chambers for the human voice.

The nasal cavity with its adjacent spaces is lined by a respiratory mucosa. Typically, the mucosa of the nose contains mucus-secreting glands and venous plexuses; its top cell layer, the epithelium, consists principally of two cell types, ciliated and secreting cells. This structural design reflects the particular ancillary functions of the nose and of the upper airways in general with respect to respiration. They clean, moisten, and warm the inspired air, preparing it for intimate contact with the delicate tissues of the gas-exchange area. During expiration through the nose, the air is dried and cooled, a process that saves water and energy.

Two regions of the nasal cavity have a different lining. The vestibule, at the entrance of the nose, is lined by skin that bears short thick hairs called vibrissae. In the roof of the nose, the olfactory bulb with its

Related Topics: lung • trachea • larynx • pharynx • gas exchange

sensory epithelium checks the quality of the inspired air. About two dozen olfactory nerves convey the sensation of smell from the olfactory cells through the bony roof of the nasal cavity to the central nervous system.

On the Web: Biology LibreTexts - Structure and Function of the Respiratory System (Jan. 12, 2026)

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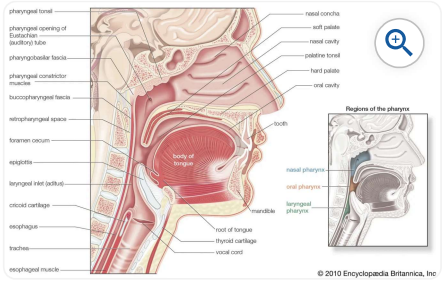
The pharynx

For the anatomical description, the pharynx can be divided into three floors. The upper floor, the nasopharynx, is primarily a passageway for air and secretions from the nose to the oral pharynx. It is also connected to the tympanic cavity of the middle ear through the auditory tubes that open on both lateral walls. The act of swallowing opens briefly the normally collapsed auditory tubes and allows the middle ears to be aerated and pressure differences to be equalized. In the posterior wall of the nasopharynx is located a lymphatic organ, the pharyngeal tonsil. When it is enlarged (as in tonsil hypertrophy or adenoid vegetation), it may interfere with nasal respiration and alter the resonance pattern of the voice.



human pharynx Sagittal section of the pharynx.

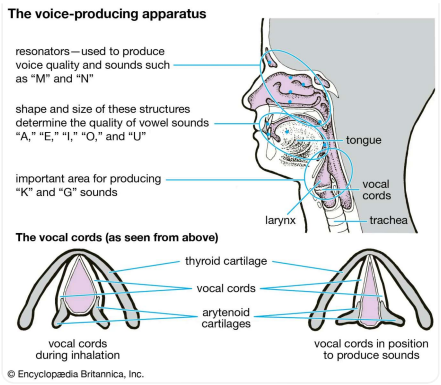
The middle floor of the pharynx connects anteriorly to the mouth and is therefore called the oral pharynx or oropharynx. It is delimited from the nasopharynx by the soft palate, which roofs the posterior part of the oral cavity.

The lower floor of the pharynx is called the hypopharynx. Its anterior wall is formed by the posterior part of the tongue. Lying directly above the larynx, it represents the site where the pathways of air and food cross each other: Air from the nasal cavity flows into the larynx, and food from the oral cavity is routed to the esophagus directly behind the larynx. The epiglottis, a cartilaginous, leaf-shaped flap, functions as a lid to the larynx and, during the act of swallowing, controls the traffic of air and food.

Morphology of the lower airways

The larynx

The larynx is an organ of complex structure that serves a dual function: as an air canal to the lungs and a controller of its access, and as the organ of phonation. Sound is produced by forcing air through a sagittal slit formed by the vocal cords, the glottis. This causes not only the vocal cords but also the column of air above them to vibrate. As evidenced by trained singers, this function can be closely controlled and finely tuned. Control is achieved by a number of muscles innervated by the laryngeal nerves. For the precise function of the muscular apparatus, the muscles must be anchored to a stabilizing framework. The laryngeal skeleton consists of almost a dozen pieces of cartilage, most of them very small, interconnected by ligaments and membranes. The largest cartilage of the larynx, the thyroid cartilage, is made of two plates fused anteriorly in the midline. At the upper end of the fusion line is an incision, the thyroid notch; below it is a forward projection, the laryngeal prominence. Both of these structures are easily felt through the skin. The angle between the two cartilage plates is sharper and the prominence more marked in men than in women, which has given this structure the common name of Adam's apple.



voice-producing apparatus The parts of human anatomy that produce vocal sound.

Behind the shieldlike thyroid cartilage, the vocal cords span the laryngeal lumen. They correspond to elastic ligaments attached anteriorly in the angle of the thyroid shield and posteriorly to a pair of small pyramidal pieces of cartilage, the arytenoid cartilages. The vocal ligaments are part of a tube, resembling an organ pipe, made of elastic tissue. Just above the vocal cords, the epiglottis is also attached to the back of the thyroid plate by its stalk. The cricoid, another large cartilaginous piece of the laryngeal skeleton, has a signet-ring shape. The broad plate of the ring lies in the posterior wall of the larynx and the narrow arch in the anterior wall. The cricoid is located below the thyroid cartilage, to which it is joined in an articulation reinforced by ligaments. The transverse axis of the joint allows a hingelike rotation between the two cartilages. This movement tilts the cricoid plate with respect to the shield of the thyroid cartilage and hence alters the distance between them. Because the arytenoid cartilages rest upright on the cricoid plate, they follow its tilting movement. This mechanism plays an important role in altering length and tension of the vocal cords. The arytenoid cartilages articulate with the cricoid plate and hence are able to rotate and slide to close and open the glottis.

Viewed frontally, the lumen of the laryngeal tube has an hourglass shape, with its narrowest width at the glottis. Just above the vocal cords there is an additional pair of mucosal folds called the false vocal cords or the vestibular folds. Like the true vocal cords, they are also formed by the free end of a fibroelastic membrane. Between the vestibular folds and the vocal cords, the laryngeal space enlarges and forms lateral pockets extending upward. This space is called the ventricle of the larynx. Because the gap between the vestibular folds is always larger than the gap between the vocal cords, the latter can easily be seen from above with the laryngoscope, an instrument designed for visual inspection of the interior of the larynx.

The muscular apparatus of the larynx comprises two functionally distinct groups. The intrinsic muscles act directly or indirectly on the shape, length, and tension of the vocal cords. The extrinsic muscles act on the larynx as a whole, moving it upward (e.g., during high-pitched phonation or swallowing) or downward. The intrinsic muscles attach to the skeletal components of the larynx itself; the extrinsic muscles join the laryngeal skeleton cranially to the hyoid bone or to the pharynx and caudally to the sternum (breastbone).

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