ANATOMY OF THE RESPIRATORY SYSTEM

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Abstract

By the end of this section, you will know ● The organs of the respiratory system ● And their structure.

7.0 INTRODUCTION

Respiration involves ventilation of the lungs (breathing), gaseous exchange between the lungs and blood, transport of gases (oxygen and carbon dioxide) in the blood, exchange of gases between the blood and tissue fluid, and the use of oxygen in cellular metabolism.

The respiratory system however, is the organ system that rhythmically takes in air and expels it from the body, thereby supplying the body with oxygen and removing the carbon dioxide it generates.

The principal organs of the respiratory system (figure 1) are the nose, pharynx, larynx, trachea, bronchi and lungs. The upper respiratory tract refers to respiratory organs in the head and neck i.e. the nose, nasal cavity, pharynx, larynx and associated structures. The lower respiratory tract refers to the respiratory organs in the thorax i.e. the trachea, bronchi and lungs.

Though air can pass through the mouth (oral cavity), it is considered as a part of the digestive system.

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7.1 NOSE

The nose is the externally visible part of the respiratory system. It is formed by bone, hyaline cartilage, dense connective tissue and skin. The nostrils or anterior nares or external nares are the external openings of the nose. They open into the nasal cavity. The nasal cavity extends from the nostrils to the choanae or posterior nares or internal nares which are the openings to the pharynx.

The nasal cavity is divided into the right and left nasal fossae by the nasal septum. It is composed of bone and hyaline cartilage. The hard palate forms the floor of the nasal cavity, separating it from the oral cavity. Guard hair found just inside the external nares in the nasal cavity trap some of the large particle of dust suspended in air.

Three folds of tissue project from the lateral walls of the nasal cavity towards the septum. These are the superior, middle and inferior nasal conchae. They cause turbulence in the inhaled air and ensure that most air touches the inner walls of the nasal cavity. As it does so, most dust in the air stick to mucus on the inner walls of the nasal cavity. The air also picks up moisture and heat from the nasal cavity.
Sensory receptors for the sense of smell are found in the olfactory mucosa. The olfactory mucosa is a small patch of epithelium that covers the roof of the nasal fossae and parts of the septum and superior conchae. The rest of the nasal cavity is lined with pseudostratified columnar epithelial cells containing cilia and goblet cells. The goblet cells produce mucus that traps debris in the air while the cilia sweep the mucus posteriorly to the pharynx where it is swallowed and digested.

The nose warms, cleanses and humidifies inhaled air. Aside the respiratory function, the nose detects odour in the airstream and serves as a resonating chamber that amplifies the voice.

7.2 PHARYNX

The pharynx is a common passageway for the respiratory and digestive systems. It is a muscular funnel extending from the choanae to the larynx. It receives air from the nasal cavity and air, food and water from the oral cavity. Inferiorly it opens into the larynx and the oesophagus.

The pharynx has three regions (figure 2): nasopharynx, oropharynx and laryngopharynx. The nasopharynx is the superior part of the pharynx that connects to the nasal cavity. It extends from the external nares to the level of the uvula. The uvula is a soft process extending from the posterior end of the soft palate. The soft palate forms the floor of the nasopharynx. The soft palate and uvula are elevated during swallowing to prevent food from passing through the nasopharynx into the nasal cavity.

The oropharynx is the middle part of the pharynx that connects to the oral cavity. It extends from the uvula to the epiglottis. The epiglottis is a flap of tissue guarding the superior opening of the larynx. During swallowing, extrinsic muscles of the larynx pull the larynx upwards towards the epiglottis and the tongue pushes the epiglottis downwards to meet it. The airway is thus closed and, food and drinks are directed into the oesophagus.

The laryngopharynx is the inferior part that connects to the larynx and the oesophagus. It extends from the tip of the epiglottis to the oesophagus.
The larynx or voicebox is a cartilaginous chamber which serves to keep food and drinks out of the airway. It extends from the root of the tongue and the hyoid bone to the trachea. It also produces sound (phonation).

7.4 TRACHEA
The trachea or windpipe is a rigid membranous tube consisting of connective tissue and smooth muscle, reinforced with 16 to 20 C-shaped cartilages. The C-shaped cartilages form the anterior and lateral side of the trachea. They protect the trachea and keep it always open for passage of air. The posterior wall of the trachea consists of smooth muscle which can alter the diameter of the trachea by contracting or relaxing.

The trachea begins immediately inferior to the larynx, runs anterior to the oesophagus in the neck and ends by dividing into the right and left primary bronchi in the mediastinum. It is lined with pseudostratified columnar epithelium, which contains goblet cells that produce mucus that trap inhaled particles, and numerous cilia that push mucus and foreign particles towards the larynx. From the larynx, they enter the oesophagus and are swallowed.

7.5 PRIMARY BRONCHI
The trachea divides into the left and right primary bronchi at the level of the angle of the sternum. The left primary bronchus is more horizontal than the right primary bronchus due to the position of the heart.
The primary bronchi extend from the trachea to the lungs. They are also lined with pseudostratified ciliated columnar epithelium and supported by the C-shaped pieces of cartilage, like the trachea.

7.6 LUNGS

The lungs are the principal organs of respiration. They are located in the thoracic cavity. Each lung is a cone-shaped organ, with its base resting on the diaphragm while its apex extends superiorly to a point slightly above the clavicle.

The surface of the lung is covered by two membranes called pleurae that are continuous with each other. The inner membrane is the visceral pleura while the outer membrane is the parietal pleura. The space between the parietal and visceral pleurae is called the pleural cavity. The pleural cavity contains a slippery fluid secreted by the pleurae called the pleural fluid. This fluid lubricates the surfaces of the pleurae, so that expansion and contraction of the lung can occur with minimal friction.

The right lung is shorter than the left lung because of the high position of the liver in the abdominal cavity below. The left lung is narrower than the right lung because the heart in the mediastinum tilts more towards left.

The right lung has two fissures on its surface which divide it into the superior, middle and inferior lobes, while the left lung has a single fissure which divides it into the superior and inferior lobes.

Each lobe is divided into bronchopulmonary segments by connective tissue septa. These septa are not visible as the surface fissures. In all, the left lung has 9 bronchopulmonary segments while the right lung has 10.

The point of entry of the primary bronchi, blood vessels and nerves into each lung is called the hilum. It is on the mediastinal (medial) surface of the lung. The structures that enter the lung at the hilum are together called the root of the lung.

7.7 BRONCHIAL TREE

After entering the lung, each primary bronchus branches many times to form the bronchial tree. The bronchial tree is a highly branched system of air tubes extending from the primary bronchus to the alveoli.
Figure 3: Bronchial tree.

The secondary bronchi divide into tertiary bronchi (also called segmental bronchi) which extend to the bronchopulmonary segments. The tertiary bronchi divide numerous times to give rise to bronchioles. The walls of the bronchioles have a layer of smooth muscle, do not have cartilages and are lined by ciliated simple columnar epithelium.

The bronchioles divide numerous times to give rise to terminal bronchioles whose walls consist of smooth muscle without cartilage and are lined with ciliated simple cuboidal epithelium.

The terminal bronchioles divide into respiratory bronchioles whose walls consist of thin, simple squamous epithelium. The respiratory bronchioles have alveoli budding from their walls. The respiratory bron-
Bronchioles divide to form **alveolar ducts**. The alveolar ducts lead into clusters of **alveoli** (small air sacs) called **alveolar sacs**.

The thin simple squamous epithelium lining the walls of the respiratory bronchioles, alveolar ducts and alveoli allow for gaseous exchange to occur. However gaseous exchange occurs mainly across the wall of the alveoli. Each alveolus is surrounded by a network of blood capillaries supplied by the pulmonary artery.

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Figure 4: Alveoli.
REFERENCES


Openstax College (2013) Organs and structures of the respiratory system. Retrieved from the Connexions Web site: http://cnx.org/content/m46548/1.8/4


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