

# Anatomy and Physiology

## 6. The Respiratory System



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# The Respiratory System

## Tour of the System

Life itself depends on the ability of the blood to deliver oxygen to and remove carbon dioxide from every cell, tissue and organ of the body. This is the responsibility of the respiratory system. This system also works very closely with other body systems, including the circulatory system.

The medulla in the brain regulates the **breathing rate**, based on the carbon dioxide content of the blood. Breathing is automatic, although under 'normal' conditions, there is the ability to alter the breathing rate consciously. The respiratory system consists of two main processes, **inhalation** and **exhalation**, which occurs in the **thoracic cavity**.

There is around 21% oxygen inhaled from the air and around 16% oxygen exhaled; this is why resuscitation can be effective in saving lives.

### Inhalation

The diaphragm (located at the base of the rib cage) contracts, ribs move outwards and upwards, creating more space in the pleural cavity (space between the lining and covering of the lung). This changes the air pressure via a vacuum mechanism, forcing air into the lungs.

The air enters the nose through the *nostrils* (nares).

In the nasal cavity, air passes through *nasal conchae*.

The nasal conchae are mucosal tissues in the nose. As well as directing the movement of air, they heat, moisten and filter the air.

The air then passes through the *pharynx*, *larynx* and into the *trachea*.

The trachea is *ciliated* and secretes *mucus*.

Mucus is required to keep the airways lubricated and trap foreign particles, such as bacteria.

The cilia move mucus steadily upwards, until it can be swallowed and pass through the digestive system.

As the trachea moves towards the lungs, it divides into two main branches, the *primary bronchi*.

The bronchi enter the lung with blood vessels, lymphatics and nerves at a point known as the *root of the lung*.

The bronchi branch repeatedly, until the branches are very small.

These small branches are *bronchioles*.

Bronchioles eventually end at the very thin walled *alveoli* of the lungs.

### **Gas exchange**

Red blood cells (erythrocytes) enter the lungs to rid themselves of carbon dioxide and pick up oxygen. The blood vessels keep getting smaller until they are very small capillaries in the walls of the alveoli. As the blood passes through these capillaries, the exchange of gases takes place in a split second.

Because the alveoli are very thin and cover a surface area of around 75 meters squared they provide the maximum surface area for the exchange of oxygen and carbon dioxide. This exchange or diffusion takes place through changes in pressure.

### **Exhalation**

This is the reverse of inhalation. Air is pushed out of the lungs as the rib cage is lowered and pulled in. The diaphragm also relaxes. Exhaled air is rich in carbon dioxide, which is the main waste product from cellular respiration (energy production) in the body.

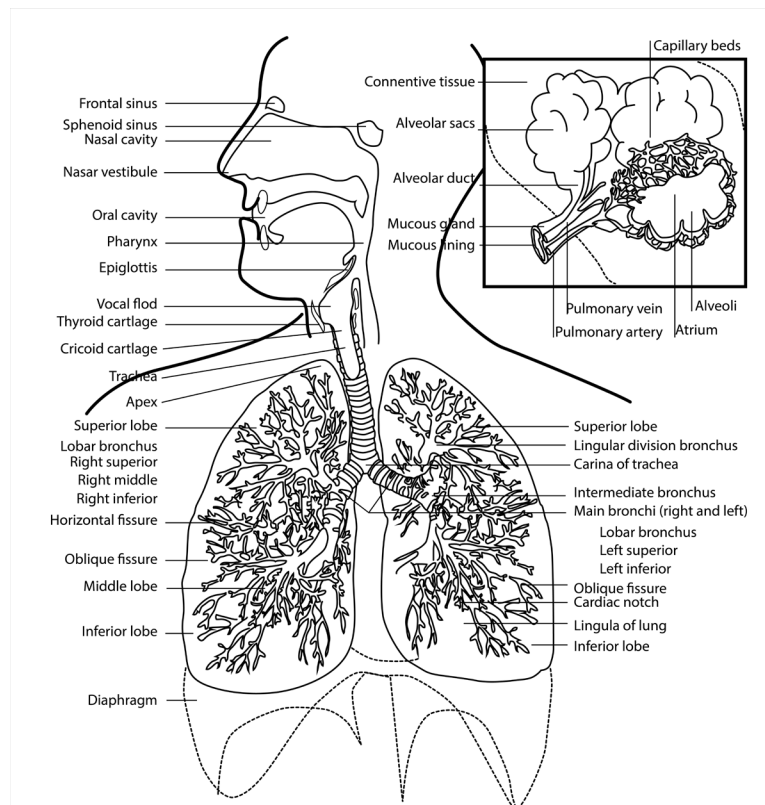
### **Functions**

The respiratory system brings oxygen into the body, performs gas exchange in the lungs and removes waste carbon dioxide from the body.

### **Components**

#### **Pharynx**

This is the part of the throat located behind the mouth and nasal cavity and is important in the digestive system.



## Epiglottitis

This is a cartilage flap at the entrance to the voice box (larynx). When this is closed, food cannot enter the trachea (windpipe), or 'go down the wrong way'.

## Larynx

The larynx or voice box allows the generation of sound with the help of varying pressure in the lungs.

## Trachea

The trachea or windpipe connects the larynx to the lungs, allowing air to move between the two. It also contains goblet cells which produce mucus.

## Bronchi

These passages (singular is broncus) connect the trachea to the bronchioles.

## Bronchiole

Bronchioles end at the alveoli. They are typically less than 1 mm in diameter and they are able to change diameter to decrease or increase airflow.

## **Lungs**

These are the main respiratory organs. They transport oxygen into the blood stream and release carbon dioxide. They contain many alveoli. The right lung has three lobes (sections) and the left lung is slightly smaller with two lobes, to leave room for the heart. They are composed of a variety of different tissues, including smooth muscle. The lungs of an average male can hold 6 liters of air and a woman's lungs can hold around 4 liters of air.

## **Rib cage**

The 12 sets of ribs that make up the rib cage protect the lungs and help in the process of respiration. Between the ribs are *intercostal muscles* that move the rib cage during the respiratory cycle.

## **Diaphragm**

This is a sheet of skeletal muscle found at the bottom of the rib cage. It separates the thoracic cavity (lungs, ribs and heart) from the abdominal cavity. The diaphragm is also essential in altering pressure in the thoracic cavity during respiration.

## **Alveoli**

The alveoli (singular is alveolus) are the site of gas exchange in the lungs.

## **Common Diseases and Disorders**

**Asthma:** The airways constrict in this chronic disease and symptoms include shortness of breath, wheezing and coughing.

**Bronchitis:** Infection of the bronchial tubes.

**Cold/Common Cold:** A cold is characterized by a sore throat, cough and runny nose. A virus from the Rhinovirus family often causes colds.

**Emphysema:** With exposure to heavy air pollution, often through smoking, the walls of the alveoli break down. When this occurs, the alveoli double in size and fill with fluid. Because this puts further pressure on the walls of the alveoli, they continue to break and allow fluid to accumulate. This repeats itself and destroys the lungs, impairing body function.

**Flu or influenza:** A virus from the influenza (Orthomyxoviridae) group of viruses causes flu. Not only is it highly infectious, flu can also cause severe illness.

**Laryngitis:** When people "lose their voice"; this is through infection or inflammation of the larynx. Sounds are created when air pushes by the vocal chords in the larynx. If these vocal chords are inflamed, they are unable to vibrate properly.

**Pneumonia:** This is infection of the lungs. Pneumonia caused by bacteria is easier to

treat than infection caused by a virus. Viral pneumonia can be very serious in medically compromised people or the elderly.

**Pleurisy:** If the pleural cavity around the lungs becomes infected, fluid starts to accumulate. Not only does this hamper breathing, it is also very painful.

## Medical Terminology

**Bronchodilation:** The process by which the bronchioles dilate, allowing more air to the alveoli.

**Bronchoconstriction:** A decrease in the diameter of bronchioles, reducing air flow.

**Cilia:** These are hair-like projections found on many lining cells in the body. They play an important role in moving substances along.

**Coughing:** This is essential to keep the lungs clear from debris such as mucus and dust.

**Diffusion:** The movement of molecules from an area of high concentration to an area of low concentration through a membrane. Diffusion allows gas exchange at the alveoli.

**Mucus:** Produced by certain cells, mucus often lines surfaces in the body. There are different types of mucus, but their main role is protection.

**Pulmo:** Any word beginning with *pulmo* relates to the lung.

**Pulmonology:** The branch of internal medicine that studies respiratory disorders.

**Vital capacity:** This is the maximum quantity of air exhaled after a maximum inspiration. This measurement is taken with a spirometer and is a frequent measure of respiratory health.

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