

SCOP Respiration

Overview

The respiratory system is responsible for **gas exchange**, specifically the intake of **oxygen** and the expulsion of **carbon dioxide**. It should be noted that over the history of the Earth, a majority of species (bacteria) regarded oxygen as a poison. Oxygen is extremely reactive, corrosive, and toxic to most life forms. In humans, oxygen is used in the process of respiration to manage electron distribution in the cascade of chemical reactions needed for proper physiology. The waste product of cellular respiration is carbon dioxide, which must be expelled from the body.

The very name “respiratory system” is incorrect. Respiration only truly occurs inside the cell; the “respiratory system” really should be called a “ventilation system”.

Ventilation is a mechanical process based on creating pressure differences relative to the external atmosphere inside the thoracic cavity. Air enters the body through the **nares** (nostrils), though it may also enter through the **mouth**. The nostrils are separated by a piece of cartilage, the **septum**. Air then travels through the **sinuses**, small cavities throughout the facial bones which also make the skull lighter. Air passing through the nostrils and sinuses is warmed and moistened, and is also filtered of foreign matter by small **hairs**, **cilia**, and **mucus**.

Air then enters the **pharynx**, an area at the far back of the mouth. This is the area shared by both the respiratory and digestive systems. Air next travels into the **larynx**, or **voice box**. The opening to the larynx is called the **glottis**, which is covered by a movable flap called the **epiglottis**. The epiglottis closes off access to the larynx during the act of swallowing to avoid food and fluid from entering the larynx. The larynx contains the vocal flaps (or vocal cords, which is a misnomer), which vibrate to produce the sounds of speech. One of the ligaments that supports the larynx on the top connects to the **hyoid bone**, the only bone in the body not connected to any other bone. Beyond the larynx is the **trachea**, or **windpipe**. The trachea branches into the **bronchi** (singular: bronchus), which lead into each **lung**. The bronchi subdivide into smaller tubes, called **bronchioles**. Eventually, the bronchioles subdivide into very small bronchioles that end in sacs called **alveoli** (singular: alveolus). It is at the alveoli that gas exchange occurs by osmosis with capillaries of the circulatory system. The **thoracic cavity** is lined by a special membrane called the **pleura**, which is slippery and prevents irritation to the lungs when breathing occurs.

The mechanical process of breathing is a simple one, though often misunderstood. Breathing is controlled by a thin, flat muscle that separates the thoracic and abdominal cavity, called the **diaphragm**. During **inhalation**, the diaphragm contracts, increasing the volume of the thoracic cavity and decreasing the pressure around the lungs. This causes the lungs to expand, reducing the pressure inside the alveoli and forcing air to push itself in to the lungs. During **exhalation**, the diaphragm relaxes, reducing the size of the thoracic cavity, increasing the pressure around and inside the lungs and forcing air out.

Disorders

Probably the most common disorders of the respiratory system are infections such as **rhinovirus (cold)** and **influenza**. The body reacts to these infections not only by raising the body’s temperature (a fever), but also by increasing mucus content in the nasal sinuses. Additionally, sneezing and coughing are triggered as a way of forcibly expelling mucus which has picked up foreign bodies.

Asthma is also a common disorder related to the immune response and allergies. People who suffer from asthma have their bronchi swell, reducing the ability of air to reach the alveoli. In addition, smooth muscle around the bronchioles begins to spasm, further making breathing difficult. During these attacks, which can be brought on by exposure to a variety of environmental factors (pollen, pollution, etc.) or stress, breathing can be severely restricted, to the point that without treatment, asthmatics can pass out and even die.

Hiccups are spasms of the diaphragm. Air is forced very quickly up the trachea, and through the epiglottis, causing the characteristic sound.

Tuberculosis (consumption) is one of the great scourges of past centuries, though in industrial nations it is finally under control. It is a highly contagious bacterial infection that if caught early enough can be treated by antibiotics. If not treated, the bacterial toxins destroy the alveoli. In the past, sufferers would have their lungs calcified to prevent further destruction of the lungs. Special sanitariums were constructed for the infected, and many spent at least part of the time in **iron lungs**. These chambers completely surround the body below the neck, and create artificial pressure differences around the body to allow air to be forced into the body. Today, exposure to the bacteria can be checked by a skin test (the **Mantoux test**), though in the past it could only be tested for by chest X-ray.

Anatomy: Respiration

Version 1.2

Pneumonia is an inflammation of the lungs that can also result in fluid buildup in the lungs, which makes breathing difficult. Bacterial pneumonia is generally not serious, and is treatable with antibiotics. The viral variety is extremely serious.

Emphysema is a chronic debilitating disease caused by exposure to chemicals, generally found in industrial pollutants, tobacco smoke, and coal dust, among others. The alveoli break down, severely reducing the capability of the body to exchange gasses. This process is irreparable, and almost always contributes to a shorter life.

Pleurisy is the inflammation of the lining of the chest cavity (pleura). This inflammation makes breathing quite painful, and can eventually damage the lungs.

If the chest wall is breached, allowing for external air to reach the area around the lungs, it becomes physically impossible for the diaphragm to create pressure differences between the thoracic cavity and the external atmosphere, meaning a person could suffocate despite having full control of their breathing. This is called a **pneumothorax**, and in some cases creates what is called a “sucking chest wound”, with the “sucking” coming from the diaphragm’s mostly unsuccessful attempts to control air pressure around the lungs. To make matters worse, air that has entered the body applies pressure to the lungs from the outside, making it difficult or impossible for the lungs to expand. Typically, the wound must be sealed, and then a needle is inserted into the chest cavity to bleed off the air that has accumulated. In some cases, the build up of pressure around the lung is so great, that the lung deflates, creating a condition called a **collapsed lung**. Since each lung is individually contained, a collapse of one lung is not immediately life-threatening.