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Bio 141

The respiratory system is divided into the upper respiratory system and the lower respiratory system. The upper respiratory system consists of the nostrils, nasal cavity, and pharynx. The lower respiratory system consists of the lungs, bronchi, larynx, and trachea. The primary organ of the respiratory system is the lung; it is part of the lower respiratory system. In the lungs, oxygen from the air is exchanged with blood through the wall of the lungs. There are two lungs, the left lung and right lung, and each lung is composed of three lobes called the superior, middle, and the inferior lobe. Each of the lobes consists of numerous alveoli and alveolar sacs, and the alveolar sacs consist of two or more alveoli. Alveoli are small pouches made of simple squamous epithelium supported by a thin elastic basement membrane that is covered with in a fluid called surfactant. Two layers of serous membranes encase the lungs, these are the parietal pleura membrane that line the wall of the thoracic cavity, and the visceral pleura which covers the lungs themselves. The space between the visceral and parietal pleura is the called the pleural cavity, and it contains fluid to help lubricate and limit the friction from the movement of the membranes. The lungs are connected to tubes, called bronchi. Bronchi are tubes that branch off of the trachea. The trachea branches off into the bronchi that go to each of the lobes of the left and right lungs. Bronchiole branch of the bronchi and which finally branch off into terminal bronchiole. Terminal bronchioles allow air to circulate deep into the lungs during the inhalation and exhalation of air.

An inhalation causes a breath to occur. A breath occurs when the diaphragm, a flat muscle at the lower end of the chest cavity, contracts. When it contracts, it flattens and moves downward, thereby enlarging the chest cavity and pulling air in. This is an
inhale. When the diaphragm relaxes, it moves upward, decreasing the size of the chest cavity, causing air to be pushed out. This is an exhalation.

Following a breath through the respiratory system is the best way to understand the accessory organs that are part or contribute to the proper functioning of the respiratory system. Air enters the respiratory system through the nostrils. It then enters the nasal cavity where hair and cilia filter the air and remove bacteria, dust and other particles from it. Also, incoming air is warmed, moistened, and sampled for odor. The air is then drawn through a passageway at the back of the throat where food and air paths cross called the pharynx. It is always open for breathing, except when swallowing. A flap-like structure, the epiglottis, which covers the entrance to the trachea at the larynx, prevents food from entering the air passageway during swallowing. The air then travels through the glottis, the opening of the air passageway, through the space between the vocal cords. And into the larynx, the upper portion of the trachea, which is specialized as the “voice box”. Thickened cords of tissue known as the vocal cords vibrate when air is forced through the trachea. Air passes through this tube to the lungs. The tube is ringed with cartilage to keep it from collapsing and open for free movement of air. From the trachea the air passes to the bronchus, one of two tubes which branch from the trachea one into each lung. Each is lined with cilia and mucus secreting cells, which moves bacteria and debris upward and out of the lungs. The air then continues on into the bronchioles, which are continuations of the bronchi. The bronchioles branch off into the terminal bronchiole that delivers to the alveolar. The epithelial membrane of the alveoli is where the exchange of oxygen and carbon dioxide takes place. It is in the alveolar that the primary physiologic function of the lungs takes place.
The primary function of the lungs is the exchange of gases with the environment. In this exchange of gases, air with a high content of O₂ is inhaled, and air with a high content of CO₂ is exhaled. The alveoli are dead end pockets where the bronchioles terminate. Capillaries surround the alveoli, and this is where the exchange of O₂ and CO₂ between the air and body tissue occurs. Thus, the epithelial cells of the alveoli are actually the respiratory exchange membrane. The tissue is moist which allows the O₂ from the external air to diffuse into the moist tissue and through to the capillaries below it. The blood plasma in the capillaries has a low amount of O₂, which facilitates its diffusion into the blood. Only a very limited amount of O₂ can diffuse into the blood plasma. So, once the O₂ has diffused into the plasma the hemoglobin in the red blood cells must be present to attract the O₂ and bind O₂ molecules to the red blood cells. The majority of the oxygen carried in the blood is bonded to the hemoglobin of red blood cells. Thus, allowing more oxygen to diffuse across the membrane and into the blood plasma. Without the hemoglobin in the red blood cells the blood would not be able to carry sufficient oxygen to sustain the cells in the body. Likewise, the CO₂ diffuses from the blood plasma in the capillaries, which is carried in the blood plasma as CO₃⁻ (carbonic acid), HCO₃⁻ (bicarbonate ion) and attached to hemoglobin. Most of the carbon dioxide is present in the blood as a bicarbonate ion (HCO₃⁻). The pressure differences near the surface of the alveoli cause CO₂ to convert from CO₃⁻, HCO₃⁻, and become unattached from the hemoglobin in the blood and be released through the membrane and into the air pockets of the alveoli. But in order for the gas exchange to occur, ventilation must also be occurring, otherwise, the air in the lungs would soon become saturated with carbon
dioxide, and depleted of oxygen. For this gas exchange to work the human body must ventilate air from the environment into the lungs.

Ventilation refers to the bulk flow of air into and out from the lungs. Ventilation is controlled by the autonomic and somatic nervous systems. This allows humans to hold their breath but within limits. Breathing centers in the brain respond to this by stimulating movement of the muscles, which cause you to exhale. The breathing control centers in the brain respond directly to CO₂ levels, but usually do not respond directly to oxygen levels. Thus, it is an increased amount of CO₂ in the blood that causes us to breathe. As the CO₂ level of the blood rises, the blood pH decreases. Since an increased amount of CO₂ means we have used more oxygen, obviously breathing will replenish the oxygen levels. Some the large arteries have oxygen sensors and when the oxygen levels in the blood are severely depressed, these sensors signal that the rate and depth of breathing should increase. Ventilation is two-phase procedure inhalation and exhalation. For inhalation, the diaphragm and rib muscles relax and recoil to their resting position. The decreased volume of the chest cavity pushes air out of the lungs. There are disorders that can impair the flow of air through the lungs or the absorption of oxygen and release of carbon dioxide by the lungs.

Disorders of the respiratory system can be classified into different categories by the causation of the disorder. First type of causation of respiratory systems disorders is smoking and other pollutes, they are the most common causes of disorders of the respiratory system. They commonly cause: asthma, which is a reaction to low concentrations of agents that normally don’t cause reactions in other people; chronic obstructive pulmonary, which is a disease includes both emphysema, a breakdown of the
walls of the alveoli and chronic bronchitis, which is an excessive secretions of bronchial mucus that causes excessive coughing, and lung cancer which is usually a cancer of the bronchial tubes. The second category are disorders that are caused by microorganisms such as bacteria and viruses, these include Pneumonia, Tuberculosis, Coryza, and Influenza. Pneumonia and Tuberculosis are caused by bacterium. Pneumonia is usually caused an infection of the pneumococcal bacterium Streptococcus pneumoniae, the infection normally occurs in the alveoli, and tuberculosis is caused by the bacterium Mycobacterium tuberculosis. Viruses cause Coryza, called the common cold, and Influenza, although they unpleasant they generally do not cause lasting damage in a healthy adult. Third, are respiratory disorders caused by genetic defects, Cystic Fibrosis is the most common. Cystic fibrosis is a genetic disease that causes excessive secretions that buildup, and causes destruction of the lung tissue. Finally, are disorders such as pulmonary edema, which can have many different causations, it is characterized by an “accumulation of fluid in the interstitial spaces and alveoli of the lungs.” (Tortora and Grabowski 2003)
Bibliography