Respiratory system.

Respiration – includes.

1) breathing, which is ventilation. This is the actual mechanical movements and movement of the air.

2) Gas exchange - both between air and blood in the lungs and between blood and tissues.

External respiration - refers to the exchange of oxygen and carbon dioxide in the lungs.

Internal respiration – is gas exchange between the blood and the tissues.

To be affective the respiratory system must meet 5 physical requirements.

1) the structures through which gas exchange occurs must be thin, so the diffusion can occur easily.

2) the gas exchange membrane must be kept moist. This allows oxygen and carbon dioxide to dissolve in water to better facilitate diffusion.

3) to ensure enough exchange there must be a rich blood supply present. The human lungs have approximately 760 square feet of surface area in their capillaries. Each lung has approximately 3000 miles of capillaries.

4) The exchange surfaces should be located where incoming air can be warmed, or cooled, moistened, and filtered. This will help prevent damage to the delicate exchange surface.

5) there must be a mechanism for exchange of air, that is, ventilation.

It is important to remember that the respiratory system has functions that are not directly related to gas exchange.

Its functions are:

1) Oxygen and carbon dioxide exchange from bloodstream.

2) vocalization.

3) Abdominal pressure regulation. This compression aides during urination (micturation), the passing of feces (defecation), and childbirth (parturition).

NOTE, some books talk about abdominal muscles becoming more effective when holding a deep breath. This technique may be used when lifting a heavy object (the fixed diaphragm will assist the back muscles). This is a VERY BAD technique which causes an extreme increase in blood pressure. When done on purpose this technique is referred to as a Val Salva Maneuver.

4) Protective mechanism (coughing and sneezing) to keep the passages clear.

Functional divisions of the respiratory system.

1) conducting divisions - includes all of the cavities and structures that transport air to and from the alveoli.

2) respiratory divisions - the alveoli and the gas exchange surfaces.

Structural divisions of the respiratory system.

Nasal cavity - pharynx - larynx - trachea - bronchi - bronchioles - alveoli – Lungs.

Nose – the nose proper and the internal nasal cavity, includes the nasal septum, septal cartilage, paired lateral and alar cartilages forming the nostril, anatomically known as the external nares.

The bones associated with the nasal cavity include the frontal, ethmoid, sphenoid, palatine, maxillary, and inferior nasal conchae.

The nasal cavity has 3 functions,

1) Condition the air. This includes warming, moistening, and cleansing the incoming air. The vibrissae (nose hairs) trap larger particles. The mucous lining traps smaller particles.

2) Detecting aromas (smell). This is accomplished by the olfactory epithelium.

3) Act as a resonating chamber for vocalization.

Pharynx - has 3 divisions.

1) nasopharynx.
2) oropharynx.
3) laryngopharynx.

The nasopharynx - has a respiratory function only. It contains the pharyngeal tonsils (adenoids) and the Uvula.

The oropharynx – lies between the soft palate and the hyoid bone. It contains the palatine and lingual tonsils The oropharynx has a respiratory and digestive function.

laryngopharynx - from the hyoid bone to the larynx, it opens into the esophagus and the larynx.

Larynx (voice box) lies anterior to the 4th to 6th cervical vertebrae.

The larynx has two functions:

1) prevent food from entering the trachea. There is a flap of tissue called the epiglottis which covers the glottis (laryngeal opening) during swallowing.

2) sound production - in the larynx we find many cartilages and the vocal cords.

Vocal cords or vocal folds are strong bands of connective tissue.

1) false vocal folds support the true vocal folds.

2) true vocal folds produce sound. These are covered with stratified squamous epithelium. Note that the rest of the larynx is lined with pseudostratified ciliated columnar epithelium.

There are two types of muscle in the larynx:

1) extrinsic muscles, which raise the larynx during swallowing.

2) intrinsic muscles, which change the length, tension, and position of the vocal folds.

Trachea. The trachea is about 4 inches long. It is a tube of c shaped cartilaginous rings with the open portion of the C facing posteriorly.

this tube divides to form the right and left primary bronchi. At the division there is an internal ridge called the carina. This ridge is highly sensitive and causes a strong cough reflex when irritated.

The right bronchus is more vertical than the left and therefore is more open to foreign objects.

Bronchial tree

The right and left primary bronchi divide into secondary bronchi, which then divide into segmental (tertiary) bronchi. These are called segmental bronchi because they supply a bronchopulmonary segment of the lung. These bronchi in turn divide to form bronchioles. Bronchioles have very little cartilage. Also at this level we change from pseudostratified columnar epithelium to simple cuboidal epithelium. These bronchioles branch to form terminal bronchioles, which connect to respiratory bronchioles, which branch to form many alveolar ducts, which lead into alveolar sacs, made up of individual alveoli.

The division between the conducting portion and the respiratory portion of the respiratory system, is between the terminal and respiratory bronchioles. Can you explain this?

It is at the level of the alveoli where gas exchange occurs. Alveoli are only one cell thick. These cells can be type I alveolar cells (for gas exchange) or type II alveolar cells (for production of pulmonary surfactant)

LUNGS

There are two lungs, right and left.

The Right lung has 3 lobes and 10 bronchopulmonary segments.

1) superior lobe.
2) middle lobe.
3) inferior lobe.

these lobes are separated by two fissures.
1) horizontal fissure.
2) oblique fissure.

The Left lung has two lobes and 10 bronchopulmonary segments (note: some books say 8 bronchopulmonary segments).

1) superior lobe - also has a lingual lobe (lingula).
2) inferior lobe.

These lobes are separated by an oblique fissure.

The lungs have a mediastinal surface, a costal surface, a diaphragmatic surface, and an apex that extends above the level of the clavicle.

The hilum of the lung is the area where the vessels and tubes enter and leave the lung.

6 structures pass through the hilum of the lung.
1) Primary bronchus.
2) Pulmonary artery.
3) Pulmonary Veins.
4) Nerve (both afferents and efferents).
5) lymphatics.
6) Bronchial artery.

There are many surface impressions of the lungs, such as the cardiac notch, cardiac impression, aortic groove, groove for the superior vena cava, and groove for the azygous vein, to name a few.

Pleura.

The pleura are serous membranes which surround the lungs.

The pleurae are comprised of 2 layers.

1) parietal layer, or parietal pleura. This layer lines the body wall.
2) visceral layer, or visceral pleura. This layer lines the surface of the lung.

The potential space between these two layers is referred to as the pleural cavity.

Functions of the pleura include:

1) lubrication.
2) lower pressure. This is necessary for ventilation.
3) compartmentalization. This helps limit infection and damage.

When studying the respiratory system, you should always consider the following:

Understand the mechanisms of ventilation. What is involved in the process of moving air into, and out of, the lungs?

Understand the mechanisms of respiration. What is the difference between external and internal respiration? How are these two different physiologically?