I. Functions of the Respiratory System
   a. The primary function of the respiratory system is gas exchange – the addition of oxygen to and the removal of carbon dioxide from the blood.
   b. Ventilation is the process of inhaling and exhaling air into and out of the lungs. When the diaphragm contracts the size of the chest cavity increases, the lungs expand, air rushes into the lungs, and intrathoracic pressure decreases.
   c. Respiration is the actual gas exchange between the alveoli and the capillary system in the lungs. As soon as the lungs fill with air through the alveoli into the blood and carbon dioxide in the blood diffuses into the air.

II. Components of the Respiratory System
   a. Nose – the nose serves to warm, moisturize, and filter the particulate matter contained in the air. The nose also provides the body with the sense of smell.
   b. Pharynx (throat) – a tubular structure about 5 inches long which serves as a passage way for both air and food.
   c. Larynx (voice box) – a short passageway that connects the pharynx with the trachea. The larynx also serves as the organ of voice by vibration of the vocal cords.
      i. It is composed of thyroid cartilage (Adam’s Apple which is cartilage rings and plates that give it a rigid form), muscles that act on the cartilages to vary the larynx opening, and a mucosal-covered membrane that is its lining.
      ii. The Epiglottis is situated in the larynx and covers the trachea and esophagus (depending upon whether the individual is breathing or swallowing) to keep foreign matter out of the lungs or stomach.
      iii. The Glottis is made of vocal cords and this is where sound originates.
   d. Trachea (wind pipe) – a tubular passageway for air about 4 inches in length and 1 inch in diameter. The trachea sits anterior to the esophagus.
   e. Bronchi – tubes that branch off of the trachea (at about the 5th thoracic vertebrae) and extend into the lungs.
   f. Lungs – the lungs are paired cone shaped organs that occupy most of the thoracic cavity. The right lung has three lobes and the left lung has two lobes.
      i. Bronchioles – smaller and smaller tubes that branch into the lung tissue. They are passageways for air from bronchi to the alveoli.
ii. Alveoli – air sacs (pouches of lung tissue) that are surrounded by tiny capillaries, where gas exchange takes place between the air and the blood.
   1. The lungs contain 30 million alveoli providing a surface area of about 750 square feet for the exchange of gasses (about the size of a tennis court).
   2. Through a process known as diffusion, oxygen moves from the alveoli into the blood, and carbon dioxide moves from the blood into the alveoli.

III. Respiratory Diseases
   a. Asthma – one of the most common respiratory diseases, asthma can be caused by a number of stressors such as a respiratory tract infection, emotional upset, changes in barometric pressure or temperature, exercise, inhalation of a noxious odor, or exposure to an allergen.
      i. Asthma is a reversible disease characterized by spasms of the smooth muscles in the bronchi and bronchioles, and edema and inflammation of the mucous lining. This causes narrowing of the airway and production of copious amounts of mucous.
      ii. Asthma attacks may begin with coughing, wheezing, shortness of breath, and a sense of fatigue.
      iii. Asthma can be treated by medication, relaxation, controlled breathing, and removal of the allergen. If these procedures do not help, immediate medical attention may be necessary.
   b. Bronchitis – an inflammation of the bronchial tubes. It occurs in both acute and chronic forms.
      i. A viral respiratory infection is the most common cause. Non-infectious irritations, including genetic factors, air pollution, cigarette smoking, and carbon monoxide exposure may also cause this disease.
      ii. The initial symptoms of bronchitis start with nasal inflammation, slight fever, sore throat, and back and muscle pains. A cough signals the beginning of bronchitis. The cough can last 2-3 weeks or longer.
      iii. Management of bronchitis involves rest until the fever subsides, drinking lots of water, and medications for fever and cough suppressing.
   c. Emphysema – anatomic alteration of the lung characterized by an abnormal enlargement of the air spaces and accompanied by destructive changes in the alveolar walls. Emphysema is irreversible and permanent.
      i. Emphysema is associated with cigarette smoking, or prolonged exposure to pollution or industrial dust particles.
      ii. There is also an inherited form of emphysema that can occur in non-smokers.
d. Pneumonia – an infection or inflammation of the alveoli.
   i. The alveolar sacs fill up with fluid and dead white blood cells reducing the amount of air space in the lungs.
   ii. Coughing, fever, and fatigue are symptoms of pneumonia.
   iii. A chest x-ray is necessary to diagnose pneumonia and will show increased density in the lung fields.
   iv. The acute phase of pneumonia will last 7 to 10 days.

e. Pneumothorax – refers to the presence of air within the chest cavity but outside the lung. In this condition, the lung separates from the chest wall and is said to be collapsed. The volume of the lung is diminished and so the amount of air that can be inhaled to exchange oxygen and carbon dioxide with the blood is reduced.
   i. Respiratory distress becomes evident.
   ii. Symptoms include difficulty inhaling, sudden sharp chest pain, hypoxia (lack of oxygen), and cyanosis.
   iii. Pneumothorax can occur if air enters the chest directly through a wound open to the outside. In an intact chest, it can also occur if air leaks out from a lung that has been lacerated by a fractured rib.
   iv. Some people have congenitally weak areas on the surface of their lungs. Occasionally, this weak area will rupture, allowing air to leak. Such an event is called a spontaneous pneumothorax.
   v. Immediate medical attention is necessary. Respiratory support may be necessary while transporting the patient.

IV. Exercise and Breathing
   a. A normal resting respiration rate for adults is 12-18 breaths per minute. This can be measured by simply counting the number of times a person breathes in and out. Often, however, a person subconsciously alters their respiration rate if they know they are being watched.
   b. When exercise increases oxygen demands, the frequency with which a given red blood cell travels from the lung to the heart must increase. Thus, the physiologic requirements of exercise demand the coupling of increased circulatory and respiratory activities to meet the gas exchange requirements.
   c. In heavy exercise, expiration requires energy instead of being primarily passive.

V. Exercise and Altitude
   a. Altitude sickness (a maladjustment of an individual to the lack of oxygen at a high altitude) is becoming more common as more people are hiking, skiing, and participating in recreational activities at higher altitudes than ever before.
b. At high altitudes, the number of molecules/volume of oxygen is smaller than at sea level. Your body does not get the amount of oxygen it is used to. The athlete’s body compensates for this decrease in oxygen uptake with corresponding tachycardia. When the body is suddenly without its usual oxygen supply, hyperventilation can occur.

c. It is important for athletes to acclimatize to high altitudes in order to perform at their best. Studies show that athletes should begin acclimatizing between 3 – 14 days prior to their events.

d. Symptoms may appear at 7,500 – 8,000 feet above sea level, and death has occurred at altitudes of 8,000 – 12,000 feet.

e. In addition to the lack of oxygen, people at higher altitudes face temperature changes, and increased exposure to ultraviolet rays.

f. The severity of symptoms and rapidity of onset vary from person to person. Some people are inherently more susceptible than others, especially young people who have made a rapid ascent.

g. The symptoms are directly proportional to the rapidity of the ascent, the duration and degree of exertion; they are inversely proportional to acclimatization and physical conditioning.

h. There is a time lag of 6 to 96 hours between arrival and the onset of symptoms, which include headache, difficulty sleeping, early morning arousal, difficulty breathing on exertion, loss of appetite, light-headedness, fatigue, confusion, weakness, alteration of heart rate, and edema.

i. Altitude sickness can last from 2 to 5 days.

j. In extreme cases, local swelling of the brain can cause impaired judgment and coordination, as well as blurred vision and hallucinations. The condition may progress to coma and death. This condition is a medical emergency.