CHAPTER 2

2.1 Structure and functions of Heart

The heart made up of three layers of tissue in the heart wall. The outer layer of the heart wall is the epicardium, the middle layer is the myocardium, and the inner layer is the endocardium. Two-thirds of the Heart mass is located to the left side of midline. The heart is enclosed in a pericardial sac that is lined with the parietal layers of a serous membrane. There are four chambers in the heart Right atrium, Right ventricle, Left atrium and Left ventricle. The two atria are thin-walled chambers that receive blood from the veins. The two ventricles are thick-walled chambers that forcefully pump blood out of the heart. Differences in thickness of the heart chamber walls are due to variations in the amount of myocardium present. Pumps need a set of valves to keep the fluid flowing in one direction. The right atrioventricular valve is the tricuspid valve. The left atrioventricular valve is the bicuspid, or mitral, valve. The valve between the right ventricle and pulmonary trunk is the pulmonary semilunar valve. The valve between the left ventricle and the aorta is the aortic semilunar valve. When the ventricles contract, atrioventricular valves close to prevent blood from flowing back into the atria. When the ventricles relax, semilunar valves close to prevent blood from flowing back into the ventricles. The heart works as two pumps, one on the right and one on the left, working simultaneously. Blood flows from the right atrium to the right ventricle, and then is pumped to the lungs to receive oxygen. From the lungs, the blood flows to the left atrium, then to the left ventricle. From there it is pumped to the systemic circulation. The systole is a short period that occurs when the tricuspid and mitral valves close;

the diastole is a relatively longer period when the aortic and pulmonary valves close. The systole-diastole relationship is the reference in measuring blood pressure. The normal function of a heart is 72 bpm.

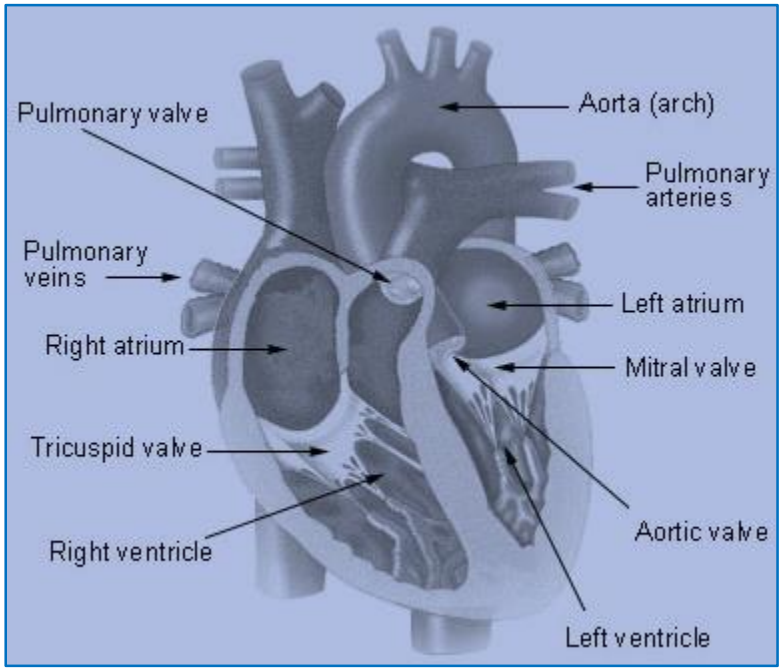

Figure 2

Effects and functions of cardiac muscle

Cardiac output is the product of the heart rate (HR), or the number of heart beats per minute (bpm), and the stroke volume (SV), which is the volume of blood pumped from the ventricle per beat; thus, CO = HR × SV. Values for cardiac output are usually denoted as L/min. A normal adult has a cardiac output of 4.7 litters

Heart rate, also known as pulse, is the number of times a person's heart beats per minute. Normal heart rate varies from person to person, but for a normal adult is 72bpm.

Cardiac Pressure: The amount of pressure in arteries during the

contraction of heart muscle. This is called systolic pressure. The bottom number refers to your blood pressure when your heart muscle is between beats. This is called diastolic pressure. A normal adult has a pressure of 120/80 mm Hg

Blood cholesterol: Total cholesterol levels less than 200 milligrams per decilitre (mg/dL) are considered desirable for adults (LDL cholesterol levels should be less than 100 mg/dL).

Blood Glucose: A fasting blood sugar level less than 100 mg/dL (5.6 mmol/L) is normal. A person needs to keep blood sugar levels within a safe range to reduce the risk of diabetes and heart disease. Blood glucose monitoring measures the amount of sugar that the blood is transporting during a single instant.

Hemoglobin (Hb or Hgb): is a protein in red blood cells that carries oxygen throughout the body. The normal range for hemoglobin is: For men, 13.5 to 17.5 grams per decilitre. For women, 12.0 to 15.5 grams per decilitre.

2.2 Structure and Functions of Lungs

The lungs are a pair of organs located in the either side of the thorax. The lungs are covered by a thin tissue layer called the pleura. A thin layer of fluid acts as a lubricant allowing the lungs to slip smoothly as they expand and contract with each breath. Primarily responsible for the exchange of oxygen and carbon dioxide between the air we breathe and the blood. The lungs are separated into sections called lobes, two on the left and three on the right. The air passages continue to divide into ever smaller tubes, which finally connect with tiny air sacs called alveoli. Pulmonary artery splits in two for the left and right lungs and then continues to branch much

like the tracheobronchial tree. These vessels branch into a fine network of very tiny tubes called capillaries.

The act of breathing (involuntary action)

1. Inhalation – the intake of air into the lungs through expansion of chest volume. Air passes from the high pressure outside the lungs to the low pressure inside the lungs. Contraction of the diaphragm muscle, Contraction of the rib muscles & chest cavity expands
2. Exhalation – the expulsion of air from the lungs through contraction of chest volume. Air passes from the high pressure in the lungs to the low pressure in the upper respiratory tract. Diaphragm muscles are no longer contracting, curves and rises to the position

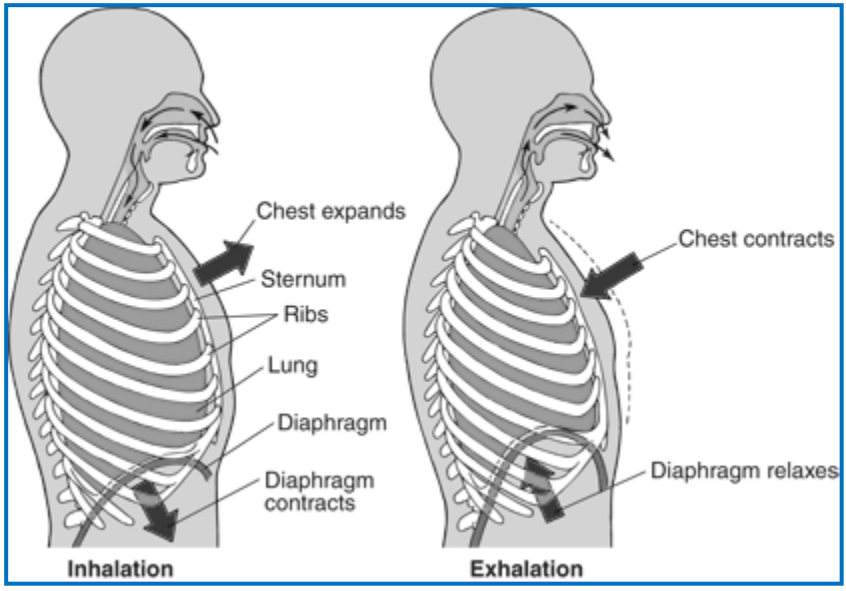

Figure 3

Lung Volume

Sum of all **volume** compartments or **volume** of air in **lungs** after

maximum inspiration. The **normal** value is about 6,000mL (4-6 L). And it can be sub divided into four volumes:

a. Tidal Volume- is the amount of air that can be inhaled and exhaled during one normal (quiet) breathing cycle (about 500 ml for men & women).

b. Inspiratory reserve volume (IRV) is the amount of air that can be forcibly inhaled beyond a tidal inhalation (about 3,000 ml for men & 2,000 ml for women).

c. Expiratory reserve volume (ERV) is the amount of air that can be forcibly exhaled beyond a tidal exhalation (about 1200 ml for men & 700 ml for women).

d. **Residual Volume** (RV) is the amount of air remaining in the lungs after an ERV (= about 1,200 ml in men & women).

e. **So that** Functional reserve capacity = ERV + RV & Total lung capacity = RV + VC.

f. Vital Capacity is maximum amount of air that can be moved in or out of the lungs in a single respiratory cycle, ie. Vital capacity = TV + IRV + ERV (about 4.8ml for men & women)

2.3 Structure and Functions of Skeletal Muscle

Skeletal muscle is comprised of a series of muscle fibers made of muscle cells. These muscle cells are long and multinucleated. At the ends of each skeletal muscle a tendon connects the muscle to bone. This tendon connects directly to the epimysium, or collagenous outer covering of skeletal muscle. Underneath the epimysium, muscle fibers are grouped into bundles called fascicles. The perimysium, as it is called, allows nerve and blood vessels to

make their way through the muscle. Each fascicle is formed from tens to hundreds of bundled muscle fibers. Each muscle fiber is formed from a chain of multinucleated muscle cells. These fibers are then protected by another layer called the endomysium as they are bundled into fascicles. Sarcomeres are formed from *actin* and myosin, as well as a number of proteins (The two most important are troponin and tropomyosin. Tropomyosin surrounds the actin filament and stops the heads of myosin from attaching. Troponin locks tropomyosin in place until receiving the signal to contract)

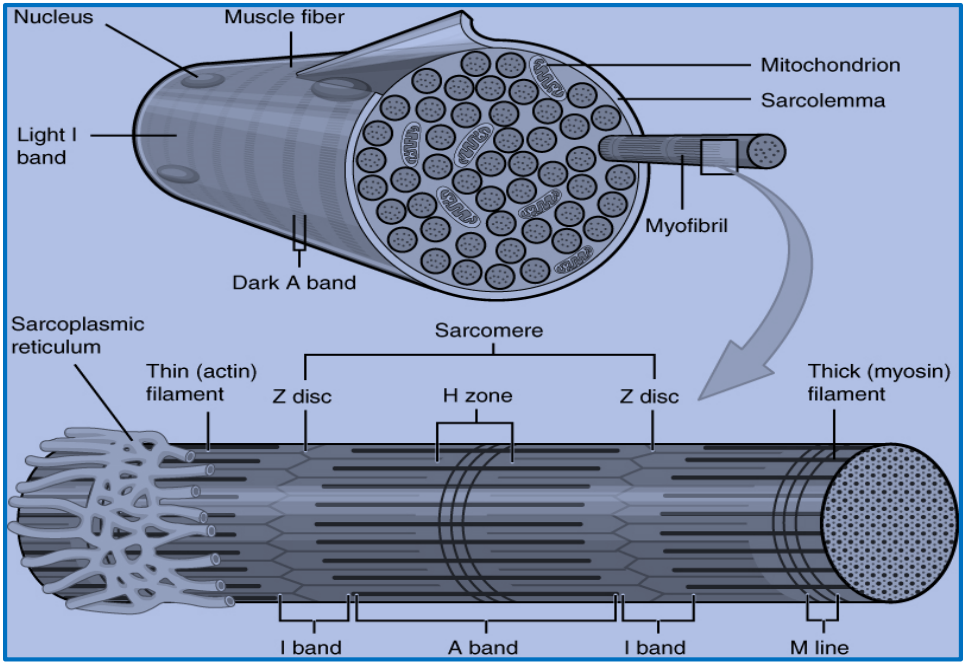

Figure 4

- The filaments seen between the dark bands are actin and myosin filaments. The **thick** filaments made up of myosin and **thin** filaments made up of actin compose structures called sarcomeres.
- **Z-line** can refer to: the borders that separate and link sarcomeres within a skeletal muscle. A sarcomere is defined as the segment

between two neighbouring Z-lines

- **H zone** The region of a striated muscle fibre that contains only thick (myosin) filaments. The **H zone** appears as a lighter band in the middle of the dark A band at the centre of a sarcomere.
- In striated muscle sarcomere, the **M line** is the attachment site for the thick filaments. The **M line** is in the center of the A band and sarcomere.
- The **I band** is the region of a striated muscle sarcomere that contains thin filaments.
- Thick filaments will happen only in **A band**

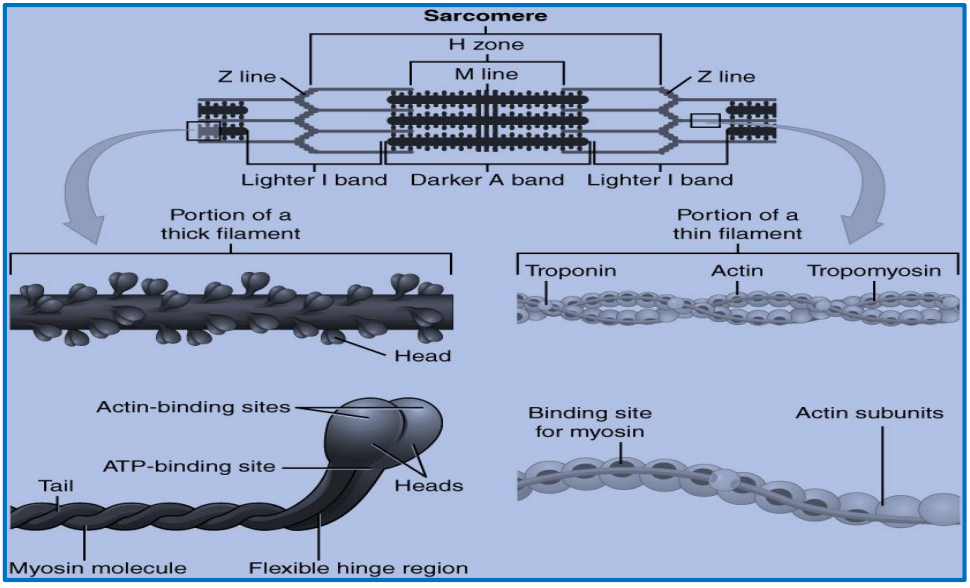

Figure 5

Effects of Skeletal Muscle

a. **Muscle Tone**- Degree of muscle tension or resistance during rest or in response to stretching. Physical exercises that are

used with the aim of developing a physique with a large emphasis on musculature. In this context, the term toned implies leanness in the body.

b. Muscle **hypertrophy** involves an increase in size of skeletal muscle through a growth in size of its component cells. Two factors contribute to hypertrophy: *sarcoplasmic hypertrophy*, it focuses more on increased muscle glycogen storage; and *myofibrillar hypertrophy*, it focuses more on increased myofibril size.