

ST. MARYS HIGH SCHOOL , MOUNT ABU

PHYSICAL EDUCATION

CLASS : IX

CHAPTER : 4 (Circulatory System )

Read the topics carefully

**Structure of the Heart**

**1. Heart**

- Human heart is made up of cardiac muscles.
- Heart is a hollow cone shaped muscular organ.
- It is a **sort** of pump.
- The pumping action of the heart is fundamental to adequate nutrition of cells and maintenance of internal environment.
- The heart is located in the thorax between the lungs and above central depression of the diaphragm.
- Its weight is approximately 300 gm.
- Heart is divided by a septum into two sides left and right .
- Each side of the heart is further subdivided into two chambers.
- The upper chambers are called Atrium or Auricles and the lower chambers are called ventricle.
- There are four chambers in the heart – left auricle, right auricle , left ventricle and right ventricle. These chambers are described below :
  - a) Right atrium or auricle : The right atrium receives blood from the veins and pumps it to the right ventricle.
  - b) Right Ventricle : The right ventricle receives blood from the right atrium and pumps it to the lungs, Where it is loaded with oxygen.
  - c) Left Atrium or Auricle : The left atrium receives blood from the lungs and pumps it to the left ventricle.
  - d) Left Ventricle : The left ventricle ( the strongest chamber ) pumps oxygen rich blood to the rest of the body. The left ventricles vigorous contractions create our blood pressure.

**2. Arteries**

- Arteries contain blood under very high pressure and are, therefore, elastic, muscular and thick walled.
- The structure and relative thickness vary with the size of artery.
- The great extensibility of the arteries enables them to receive additional amount of blood forced into them to each contraction of the heart.

**Classification of arteries** : Arteries may be divided into three classes:

- Elastic Arteries** : These arteries include those large arteries leading directly from the heart . These arteries are called conducting arteries because they conduct blood from the heart to muscular arteries. These arteries are large and may be up to 3 cms in diameter .These arteries have more elasticity to bear the shock of contraction of heart.
- Muscular Arteries** : These arteries are of medium size .These are also called distributing arteries because they distribute the blood to the various organs.
- Arterioles** : These are also muscular arteries but they are much smaller in size. They maintain the blood pressure of the body in general.

### 3. Veins

The veins return the blood to the heart . The structure of the of the veins is similar to that of arteries. These veins tend to collapse when not filled with blood. The total diameter of the veins returning blood from any organ is as least twice the diameter of the arteries carrying blood to the organ.

### 4. Capillaries

The capillaries are really minute vessels. They connect the arterioles with the venules.

Types of capillaries : there are three types of capillaries :

- Continuous Capillaries** : These capillaries are found in all types of muscles, in connective tissue and in the central nervous system.
- Fenestrated Capillaries** : These are found in renal organ, endocrine glands and in intestines.
- Sinusoidal capillaries** : These are enlarged capillaries found in the liver,spleenand bone-marrow.

#### Functions of capillaries

In the capillaries , exchange of materials takes place. It has been estimated that there are about 7000sq. meters of blood capillaries in an adults body. This is indeed ,a large area for exchange of substances between the blood

and tissue fluid. In the glandular organs, the capillaries supply the substances requisite for secretion, in the alimentary canal, they take up some time of the digested food; in the lungs, they get oxygen and give up CO<sub>2</sub> in the kidneys, they discharged the waste products collected from the other parts.

## HEART RATE, STROKE VOLUME, CARDIAC OUTPUT

**Heart Rate** : Heart rate is defined as the number of times your heart beats in one minute. It is measured by using a stethoscope or by feeling your pulse. Usually, heart rates vary between 40 beats and 80 beats per minute at rest. The average resting heart rate is 70 beats per minute.

### Stroke Volume

**Stroke Volume** is defined as the amount of blood pumped by the left ventricle of the heart in one contraction. The stroke volume is not all the blood contained in the left ventricle, normally only about two-thirds of the blood in the ventricle is expelled with each beat.

### Cardiac Output

Cardiac output is the total volume of blood pumped by the heart per minute. It is the product of blood pumped by each heart stroke volume and the number of beats (Heart rate).

Cardiac output = stroke volume x heart rate

## Mechanism of Blood Circulation

The circulation of blood through out the body mainly depends upon the heart. The course of the blood from the left ventricle through arteries, arteriols and capillaries, returning it to the right auricle by veins is called systematic circulation. The course of blood from the right ventricle through the lungs to the left auricle is called pulmonary circulation. Systematic circulation has greater force and pulmonary circulation has lesser force.

- a) **Systematic Circulation** : In systematic circulation, blood comes out from left ventricle of the heart by aorta. Then blood passes through small arteries which carry the blood to the various parts of the body. These arteries are further divided and sub-divided until the arterioles are reached. These have narrow passage and resist the flow of blood.
- b) **Pulmonary Circulation** : From right auricle the blood passes into the right ventricle. When right ventricle contracts, the blood goes into pulmonary artery. This is divided to carry the blood to right and left lungs. The blood is resisted very little in lungs. In lungs each artery breaks up in smaller arteries, then into arterioles and lastly into pulmonary capillaries. Blood there gets O<sub>2</sub> and leaves Co<sub>2</sub>. Then, pulmonary capillaries unite until veins are formed. Then blood comes back to the heart by four pulmonary veins which emit the purified blood into left auricle. In this way, the blood circulation takes place throughout the body.

## ► BLOOD

Blood is such a medium of transportation through which nutritional substances as well as oxygen is carried to all the parts of body. Its density is more than water . Its colour in arteries is bright red , whereas, in veins its colour is slightly dark.

### Composition of blood ( Red Blood Cells, White Blood Cells, Platelets, Plasma)

Blood is composed of following constituents :

1. **Red Blood Cells or Erythrocytes**
2. **White Blood Cells or Leucocytes**
3. **Platelets or Thrombocytes**
4. **Plasma**

1. **Red Blood Cells or Erythrocytes** : Red blood cells constitute about 45% of whole blood . These cells are very soft and flexible. These blood cells pass through very narrow passages whose diameter is less than the diameter of these cells. These cells are red in colour due to the presence of haemoglobin . The average life of a red blood cell is about 120 days. The red cell originate in bone marrow, especially in that of the short, flat, irregular bones and in the cancellous tissue *at the ends of the long bones*. Vitamin B12 ,protein ,copper,cobalt,iron and folic acid play a very significant role in the formation of these cells. These cells are usually stored in spleen ,liver and stomach.
2. **White Blood Cell or Leucocytes** : White blood cells are transparent and colourless. These cells are larger and fewer in comparison to red blood cells. These cells are formed in red bone marrow and lymphatic tissues. White blood cells are the part of the immune system . They destroy and remove old cells and cellular debris. They fight against infection and protect us from diseases . According to their structure they can be classified into following parts :
  - a) **Granulocytes**
  - b) **Agranulocytes**
3. **Platelets** : **These** are tiny cells. Their size is approximately  $\frac{1}{3}$  in comparison to red blood cells. Their number is approximately 400000 in each cubic millimeter of blood . They help in blood clotting . They are circular in shape . They originate in bone marrow and spleen . They are also called thrombocytes. They change

fibrinogen into fibrin which ultimately helps in blood clotting or coagulation . Due to the lack of these cells organs of the body swell up.

4. **Plasma** : Plasma forms about 54.3 % of the whole blood . It is bloods liquid medium . It is straw yellow in colour . In an average human being its volume is about 2.7 to 3.00 litres.

## **BENEFITS OF EXERCISE ON THE CIRCULATORY SYSTEM**

There are following benefits of exercise on circulatory **system** :

1. **Increase in the Size of Heart** : When we perform exercises , our heart beats at a faster rate . In fact, the muscles of our heart are exercised ,therefore, heart gets larger in size. Exercise helps to build stronger heart walls and promoting the larger volumes .The blood is pumped greatly and oxygen is also delivered to the muscles of the body sufficiently .
2. **Decrease in Resting Heart Rate or Pulse Rate** : Regular exercise decreases the resting heart or pulse rate. In fact after regular exercise for a longer period your heart is able to do more work with less effort, so your resting heart rate or pulse rate goes down . Your heart becomes more efficient.
3. **Reduction in Heart Related Problem** : Regular exercises gradually reduce stress related hormones from circulating in the blood stream. In fact, exercises increase the level of endorphins that reduces stress and keeps one happy. Regular exercises increase the blood vessel path which in turn lowers the risk of developing plaque that can lead to coronary heart diseases .
4. **Improvement in Cardio- vascular System** : **Regular** exercise improves our cardio-vascular system efficiently .Exercises strengthen cardiac muscles that surrounding our heart. The wall of the heart become thicker and stronger . Heart also starts pumping a greater volume of blood with each stroke. Consequently resting heart rate decreases . The walls of arteries also improve in elasticity . Hence ,it can be averred that exercises improve the efficiency of cardio –vascular system.
5. **Increase in Haemoglobin** : Haemoglobin is an iron rich protein present in red blood cells and is responsible for carrying throughout the body. In fact , regular exercises such as walking, jogging, **running, biking** ,swimming etc., boost red blood cell production which ultimately increases the level of haemoglobin .
6. **Faster Recovery to Normal Pulse after Physical Activity** : Your faster recovery to normal heart beats or pulse after physical activity can be a key indicator to your health . An experienced athletes heart rate or pulse becomes normal earlier in comparison to an unexperienced athlete . In fact , due to the improvement in the efficiency of heart after regular exercise the recovery of heart rate or pulse becomes faster.

7. **Delay in Fatigue** : Regular exercise delay fatigue in an individual . Fatigue is felt due to formation of lactic acid and other waste products in the muscles. These waste products are easily and quickly removed from muscles ,if exercises are performed regularly .So, regular exercise can delay the process of fatigue.

### EXERCISES

1. What do you mean by circulatory system?
2. What is the main function of heart ?
3. What do you mean by muscular arteries?
4. What do you mean by ventricles in brief?
5. What are platelets?
6. What is meant by haemoglobin ?
7. Briefly discuss the benefits of exercise on the circulatory system.
8. Discuss the functions of capillaries in brief.
9. Differentiate between heart rate, stroke volume and cardiac output.
10. Discuss the mechanism of blood circulation in brief.
11. Enlist the constituents of blood . Brief explain any one of them .

**Note : Write the questions and answers in your physical education note book.**