**06. The Cardiovascular System**

The Cardiovascular System is composed of the blood, the heart and the arteries and veins. It refers to two main systems - the pulmonary circulatory system and the systemic circulatory system.

Blood is pumped from the heart around the body through a transport system of arteries and veins. It distributes oxygen and essential nutrients to the whole body as well as removing potentially damaging waste products and carbon dioxide.

**TOPIC 1: WHAT IS BLOOD?**

A fluid connective tissue made up of plasma and cells. Adult bodies contain approximately 4-5 litres whereas a new-born baby has only 300millitres. It is alkaline (pH7.4).

**WHAT DOES BLOOD DO?**

* Transports oxygen, nutrients, hormones and enzymes around the body.
* Transports carbon dioxide and waste materials from the body to the organs of excretion.
* Helps fight infection (with leucocytes and antibodies - see opposite for more detail).
* Prevents the loss of body fluids after accidents by clotting.
* Regulates body temperature.

**WHAT IS BLOOD MADE OF?**

**A: Plasma**

Plasma makes up 55% of blood volume. It is a slightly thick, straw-coloured fluid. It is mostly water (90-92%) and the rest is plasma proteins (albumin, globulin, fibrinogen and prothrombin).

**The structure of blood**

Plasma helps to transport the following essential substances around the body:

* **Mineral salts -** sodium chloride, commonly known as table salt, sodium carbonate and the salts of potassium, magnesium, phosphorus, calcium, iron, copper, iodine - which help nerve conduction and ensure that tissue cells keep the right acid balance.
* **Nutrients -** amino acids, fatty acids, glucose, glycerol, vitamins. Most of these come from digested food and are absorbed (by the plasma proteins in blood) from the intestines to be used by cell tissues for energy, repair and cell reproduction.
* **Waste -** waste products, for example urea, are transported to the liver for breakdown, and then to the Kidneys to be excreted as urine
* **Hormones -** chemical messengers produced by the endocrine glands. Plasma transports them to various organs and their job is then to change or influence that organ's activity or behaviour.
* **Enzymes -** the chemical catalysts in the body. They produce or speed up chemical changes in other substances but remain unchanged themselves.
* **Gases -** oxygen (O2) and carbon dioxide (CO2) are dissolved in plasma.
* **Antibodies -** the body's protectors. These complex proteins are produced by lymphocytes in response to the presence of antigens, such as viruses and bacteria, in the body.

**B: Cells**

There are three types of blood cells:

* **Erythrocytes** (also known as Red Blood Cells/ Red Corpuscles)

**Structure:** small biconcave cells with no nucleus or other organelles.

**Function:** transport oxygen bound to haemoglobin (oxyhaemoglobin) - for which iron and vitamin B12 are required.

**General characteristics:**

* Approximately 5,000,000 per millilitre of blood
* Produced in red bone marrow
* Life span of about 120 days
* Broken down in the spleen and then the liver (where any spare iron is retrieved and recycled)
* Oxyhaemoglobin gives blood its characteristic red colour
* **Leucocytes** (also known as White Blood Cells/ White Corpuscles)

**Structure:** large irregularly shaped cells which contain a nucleus

**Function:** to protect the body from infection

**General characteristics:**

* Approximately 8000 per millilitre of blood in a healthy body
* Number can increase rapidly when infection is present
* Produced in bone marrow
* Life span varies from hours to years depending on type and usage
* Can pass through capillary walls into tissues
* **Thrombocytes** (also known as Platelets)

**Structure:** small, fragile cell fragments, contain mitochondria but no nucleus

**Function:** contain various elements that are responsible for blood clotting

**General characteristics:**

* Approximately 250,000 per millilitre of blood
* Produced in bone marrow from parts that break off large cells
* Life span approximately 10 days

**TOPIC 2: THE HEART & SYSTEMS OF CIRCULATION**

**HOW DOES BLOOD CIRCULATE?**

Blood is pumped from the heart (a muscular organ) around the body through a transport system of arteries, veins and capillaries.

The blood circulation is two closed systems.

* Pulmonary circulation is the transport of blood from the heart to the lungs and back again
* Systemic circulation is the transport of blood from the heart to the rest of the body and back.

**WHAT IS THE HEART?**

The heart is the centre of the circulatory system (hence the use of the word heart to mean centre in English). If blood is the body's fuel, the heart is its engine.

**WHAT DOES THE HEART LOOK LIKE?**

It is a hollow red organ, approximately the size of its owner's fist, positioned in the centre of the thorax and divided into four chambers. These are the right and left atria (or auricles) in the upper part, and the right and left ventricles in the lower part. Atria and ventricles are connected by the atrioventricular opening. The septum, a muscular wall, separates the right and left sides of the heart. This prevents the blood from the veins know as deoxygenated blood on the right coming into contact with blood going to the arteries know as oxygenated blood on the left.

The heart has a muscular wall with membranes covering and lining it. The wall is divided into three layers:

* **Endocardium:** the inner layer, is the thin serous membrane, composed of endothelial tissue, that lines the interior of the heart.
* **Myocardium:** the middle layer. This is the thickest layer and it is made of cardiac muscle
* **Pericardium:** the outer layer, is a double-walled sac that contains the heart and the roots of the great vessels. The inner layer is serous pericardium, while the outer layer is fibrous pericardium, a structure which helps to keep the heart in the right position in the chest.

**WHAT DOES THE HEART DO?**

The heart is the pump that drives the whole circulatory system. It receives and propels blood, rhythmically contracting, forcing the blood through a system of vessels. The heart's action is controlled by the autonomic nervous system.

**WHAT IS A HEARTBEAT?**

The heartbeat, or cardiac cycle, is the pattern of muscular contraction of the heart wall:

* Both the atria contract, forcing their contents into the ventricles
* The atria relax but the ventricles contract, emptying their contents into the arteries
* The ventricles relax and the heart is at rest.

While resting the heart dilates and fills with blood. The period of rest (diastole) equals the period of contraction (systole).

The heartbeat (or cycle) starts at a point in the right atrium called the pacemaker (sino-atrial node). This consists of specialised neuromuscular tissue which is supplied by the autonomic nervous system. From here, the contraction of the heart muscle spreads through the atria and then down the septum to the walls of the ventricles.

**WHAT IS A PULSE?**

The number of times the heart beats in one minute is known as the heart rate. When you feel your pulse this is what you are feeling - the rate at which your heart is pumping blood through your circulatory system. Technically, it is a wave of artery wall distension. When blood is pumped from the left ventricle into the aorta, the aorta distends, i.e. swells. The elastic wall of the aorta then recoils thus forcing the blood to move on. This sets up a wave of swelling and contracting which continues along all the elastic arteries. What we think of as a pulse is in fact this wave, which can be felt wherever an artery passes close to the surface of the skin and over a bone. Since the pulse varies with the heart rate, the pulse is taken to check if a heart is beating normally.

**IS THE HEARTRATE ALWAYS THE SAME?**

The heart rate changes in both healthy and unhealthy bodies, for a variety of reasons. The following all affect it:

* **Exercise:** increases the rate of the heartbeat (and rest slows it down again)
* **Age:** heart rate is faster in infants and slows gradually as age increases
* **Size of the heart:** a smaller heart may have a faster heart rate and a larger heart a slower heart rate
* **Emotions and excitement:** increase the heart rate, first through nervous stimuli and then through an increase in the level of adrenaline
* **Temperament:** a placid, slow heart rate is not easily varied whereas an excitable person will have a quicker heart rate which changes easily
* **Disease:** the heart rate is quickened by fever, haemorrhage, hyper-thyroidism and slowed by jaundice, heart blockages and pressure on the brain.

**DID YOU KNOW?**

Most adults heartrate is 72-80 beats per minute whereas most babies have a rate of 130 times a minute.

In one lifetime, a heart will beat approximately 2,700,000,000 times.

**An artificial pacemaker**

Artificial pacemakers are implanted to help the heart maintain a regular heartbeat. these provide an electrical or battery powered impulse to provoke a contraction

**WHAT IS PULMONARY CIRCULATION?**

The circulation of blood from the heart to the lungs and back. Deoxygenated blood travels from the heart to the lungs in the pulmonary artery. The blood gets rid of its carbon dioxide (CO2) and replaces it with oxygen (02). It then returns to the heart via the pulmonary veins (from lungs to heart) ready to be pumped around the body.

**HOW DOES THIS HAPPEN?**

The right atrium receives deoxygenated blood from the superior vena cava (the vein from the upper body) and the inferior vena cava (the vein from the lower body). The blood then flows into the right ventricle from where it is pumped into the pulmonary artery which divides into the right and left pulmonary arteries (which go to the right and left lungs). Blood reaches the lungs via tiny vessels called capillaries which are porous to gases (see The Respiratory System p.158). The lungs remove the carbon dioxide (CO2) from the blood in the capillaries, replace it with oxygen and return the oxygenated blood to the left atrium of the heart through the four pulmonary veins. The blood is pushed by the contraction of the left atrium through the bicuspid valve into the left ventricle. The left ventricle then contracts and pumps the blood through the aorta, which branches to form the ascending and descending aorta, for distribution around the body.

**HOW IS THE DIRECTION OF THE BLOOD CORRECTLY MAINTAINED?**

The direction of blood is maintained by valves. The atrioventricular openings each have a valve: the tricuspid valve on the right and the bicuspid valve on the left. Both these valves allow blood to flow

from the atria into the ventricles, but block the atria when the ventricles contract, ensuring that blood continues to circulate in the correct direction. The semi-lunar valves (three pocket-shaped flaps at the vessel's entrance) in the aorta and the pulmonary artery, ensure that there is no back flow from the aorta to the left ventricle or from the pulmonary artery into the right ventricle.

**WHAT IS CORONARY CIRCULATION?**

The heart is, of course, a muscle which needs the benefits of circulation like every other muscle and organ in the body. It has its own circulatory system called coronary circulation. Right and left coronary arteries leave the beginning of the aorta and branch within the heart wall to form a network of capillaries to feed the tissue cells. The blood is then collected back into the coronary veins which empty into the right atrium of the heart.

**DID YOU KNOW?**

If you take a heart out of a human body it will continue to beat, even if it is cut into pieces...!

**WHAT IS SYSTEMIC CIRCULATION?**

Systemic circulation is the circulation of blood from the heart to the body. Blood leaves the heart by the aorta, the largest artery in the body, travels throughout the body and returns to the heart through the inferior and superior venae cavae (two of the largest veins). An extensive network of arteries, veins and capillaries transports blood to every cell in the body.

**WHAT IS PORTAL CIRCULATION?**

The veins from the stomach, spleen, pancreas and intestines join to form the hepatic-portal vein which carries blood into the liver.

**WHAT DO ARTERIES AND VEINS DO?**

Arteries carry oxygenated blood from the heart and veins carry deoxygenated blood to the heart, except in the pulmonary system.

**ARTERIES**

**Structure:** arteries are thick-walled, hollow tubes. They all have the same basic construction:

* A fibrous outer covering
* A middle layer of muscle and elastic tissue
* An endothelial layer made of squamous epithelial tissue.

The quantity of muscle and elastic tissue in the middle layer depends on the size of the artery and its distance from the heart because arteries need to expand in order to propel blood along. Small arteries further from the heart have more muscle - to maintain blood pressure and keep the blood moving around the body, and less elastic tissue - because blood has been distributed to organs and so the flow has decreased and there is less stretching force placed on the vessels. The movement of the blood maintains potency (the openness of the vessel). Large arteries branch into small arteries which branch into arterioles which branch into capillaries.

**Function:** systemic arteries carry oxygenated blood from the heart to the body. The pulmonary artery carries deoxygenated blood to the lungs.

**ARTERIOLES**

**Structure:** arterioles are a smaller version of arteries. They have a similar structure, though the middle layer of the walls is mainly muscle tissue with less elastic tissue than arteries. Under normal conditions all the arterioles are slightly contracted which helps to maintain blood pressure.

**Functions:** when more oxygen and nutrients are required by an active organ, the arterioles relax and dilate to increase blood supply to it (example : muscles during exercise, the stomach and intestines after eating and the skin when the body temperature rises). They contract when an organ is at rest.

**General characteristics:**

* The hormones adrenaline, noradrenaline and vasopressin (antidiuretic hormone) may cause the arterioles to contract
* In cases of shock, all the arterioles relax and blood pressure is very low. This is a dangerous condition.

**CAPILLARIES**

**Structure:** capillaries are the smallest blood vessels. Their walls are one cell thick (i.e. microscopic) and porous, thus allowing the passage of gases (like oxygen and carbon dioxide) and nutrients. A large amount of water, plus the solutions dissolved in it, filters out through the capillary walls and bathes the body tissues. This liquid is called interstitial fluid. It carries food, vitamins, mineral salts and hormones out to the tissues and collects waste products, especially carbon dioxide and urea, from them. Most of the fluid then returns to the capillaries before they join up to become venules.

**Function:** to distribute essential oxygen and nutrients to most parts of the body. Capillaries supply every part of the body except the deep brain, the hyaline cartilage and the epidermis.

**VENULES**

**Structure:** venules are small veins.

These have a thin wall with a large lumen (the passage in the centre in which the blood travels). They are easily collapsed under pressure.

**Function:** they carry deoxygenated blood from the capillaries to the larger veins.

**DID YOU KNOW?**

During a 24-hour period an adult human heart pumps 36,000 litres of blood through 20,000 km of blood vessels.

A bruise is caused by dead blood cells. When capillaries burst, the blood cells leak out into surrounding tissue and die off. The various colours in a bruise show the different stages of the cells' breakdown and finally the body gets rid of them and normal skin colour returns.

**VEINS**

**Structure:** veins have three-layered walls and though the basic structure is similar to that of arteries, their walls are much thinner and the lumen is much larger. They vary in size, the largest being the venae cavae (from the body into the heart) and the pulmonary vein (from the lungs to the heart). The action of skeletal muscles pushes blood through the vessels. Valves in the endothelial layer of the veins prevent a back flow of blood. Blood pressure in veins is very low so these valves are essential.

**Function:** systemic veins carry deoxygenated blood back to the heart. Pulmonary veins carry oxygenated blood to the heart.

**Different characteristics of arteries and veins**

**Characteristics of arteries** - Transport blood from heart

**Characteristics of veins** - Transport blood to the heart

**Characteristics of arteries** - Oxygenated blood (not pulmonary)

**Characteristics of veins** - Deoxygenated blood (not pulmonary)

**Characteristics of arteries** - Lumen (passage) is small

**Characteristics of veins** - Lumen (passage) is large

**Characteristics of arteries** - Pumped by heart and muscle tissue in artery wall

**Characteristics of veins** - Pumped by skeletal muscle pump and the presence of

 valves

**Characteristics of arteries** - Thick, muscular and elastic walls

**Characteristics of veins** - Thin walls, not muscular or elastic

**Characteristics of arteries** - Oxygenated blood contains a high concentration of

 nutrients

**Characteristics of veins** - Deoxygenated blood contains a high concentration of

 waste products

**MAIN VEINS AND ARTERIES**

The circulations begin at the heart. The inferior and superior venae cavae bring deoxygenated blood into the right atrium, the pulmonary veins bring oxygenated blood into the left atrium. The pulmonary arteries take blood to the lungs. The aorta, the main artery in the body, carries oxygenated blood to the body. It branches upwards to form the ascending aorta, which takes blood to the upper body (arms and head) and downwards, to form the descending aorta, taking blood to the rest of the body. Usually the names of veins correspond to the names of the arteries and they generally follow the same course, albeit in a different direction. When the blood reaches the various branches it is distributed through a network of arteries, arterioles al capillaries. The capillaries, the last vessels to distribute oxygenated blood, join the first vessels to collect deoxygenated blood, also called capillaries, which link up to form venules which feed into a network of veins taking the blood back to the heart where it travels to the lungs for reoxygenation.

**TOPIC 3: MAIN ARTERIES AND VEINS OF THE BODY**

**Head and neck -** main arteries

**Head and neck -** main veins

**Trunk -** main arteries and veins

**Arm -** main arteries

**Arm -** main veins

**Leg -** main arteries

**Leg -** main veins

**TOPIC 4: BLOOD PRESSURE**

**WHAT IS BLOOD PRESSURE?**

The force that the blood exerts on the walls of the blood vessels as it is transmitted from the heart. Without pressure blood would not move at all. Blood is always under pressure but the amount of pressure varies in different types of blood vessels: high blood pressure in the arteries gradually becomes lower in the capillaries and veins. In the large veins approaching the heart there is negative pressure. The heartbeat also affects blood pressure: when the ventricle is contracting it is high, when the ventricle is dilating it is low.

**WHAT FACTORS PRODUCE AND MAINTAIN PRESSURE?**

* **Cardiac output:** determined by the volume of blood pumped out of the heart and the heart rate. If cardiac output increases, blood pressure increases.
* **Resistance offered by the arterioles:** vasoconstriction is controlled by the vasomotor nerves and by adrenaline and noradrenatine. The greater the vasoconstriction the higher the blood pressure.
* **Total blood volume:** if the amount of circulating blood is reduced, blood pressure is lowered; if there is too much retention of fluid (oedema), blood pressure is raised.
* **Viscosity of blood:** this depends partly on the plasma, especially the amount of plasma proteins and also on the number of erythrocytes. The lower the viscosity, the lower the blood pressure.
* **Elasticity of artery walls:** if the arteries harden there is a loss of elasticity and pressure is raised. If the arteries soften, there is lower pressure.

**Blood pressure is given as two readings:**

* **Systolic:** when the heart is contracting pressure reaches its peak level
* **Diastolic:** when the heart is relaxing (dilating) pressure reaches its lowest level.

A blood pressure reading of 100/70 means that systolic pressure is 100mmHg and diastolic pressure is 70mmHg.

**HOW ARE THEY MEASURED?**

Blood pressure is measured with a sphygmomanometer. The patient's upper arm is encircled by an inflatable rubber bag contained in a cuff connected to a pressure pump and manometer. By pumping up the bag, the pressure can be raised to approximately 140+mm of mercury pressure (Hg) which is sufficient to constrict the brachial artery so no blood can pass through and the radial pulse disappears. The pressure is then lowered to a point where the pulse can be felt. At this point the pressure shown on the column of mercury is considered to be the systolic pressure. The diastolic pressure reading is taken when the sound of the pulse fades.

**CAUSES AND EFFECTS OF HIGH AND LOW BLOOD PRESSURE**

**Hypertension (high blood pressure)**

**Causes:** stress, medication, kidney disease, narrowing or hardening of the arteries, smoking, alcohol, diet and hereditary factors.

**Effects:** angina, heart attack, strokes, kidney complaints.

**Hypotension (low blood pressure)**

**Causes:** underactive adrenal glands, hereditary factors; shock may cause short term hypotension.

**Effects:** dizziness; fainting.

**TOPIC 5: BLOOD CLOTTING**

**HOW DOES BLOOD CLOT?**

If a blood vessel (a capillary, vein or artery) is damaged (internally or externally) bleeding occurs until a clot forms. This clot stops excessive loss of blood from the system. If no blood clot forms it is called a haemorrhage. The following shows the four stages of clot formation.

**1.** Thrombocytes (platelets) are easily damaged and if a blood vessel wall is broken they disintegrate and release an enzyme called thromboplastin.

**2.** Thromboplastin then converts a plasma protein called prothrombin into an active enzyme called thrombin. Calcium is needed for this process to work. (Thus thromboplastin + calcium + prothrombin = thrombin).

**3.** Thrombin then changes another plasma protein, fibrinogen into fibrin. Fibrin is insoluble and forms a net-like covering across the damaged vessel. (Thus thrombin + fibrinogen = fibrin).

**4.** As blood tries to flow through the net, the red and white cells and platelets are trapped and form a clot. The additional fluid that remains is known as serum. (Thus fibrin + blood cells = clot).

**The following are necessary for a clot to form:**

* Prothrombin
* Calcium
* Thromboplastin (produced by damaged platelets)
* Fibrin
* Vitamin K (necessary for formation of prothrombin)

**Blood clotting can be affected by:**

* A deficiency of platelets as in severe bone marrow diseases
* Lack of one of the necessary components listed opposite (causing diseases such as haemophilia)
* An absence of fibrinogen
* Lack of Vitamin K which is necessary for the production of prothrombin
* Lack of calcium
* An excess of fibrinogen in the blood can cause thrombosis (internal and potentially dangerous blood clots).

Finally, blood types. All human blood is the same in terms of composition and function. But four different types exist, the discovery of which made blood transfusions much more successful.

**WHAT ARE BLOOD TYPES?**

In 1902 an Austrian physician named Karl Landsteiner began studying why some patients died as a result of blood transfusions. He discovered the existence of different human blood types and subsequently classified them as four groups: A, B, AB and O.

Type O is known as the universal donor because type O blood can be given to patients with any blood group whereas type AB is known as the universal recipient: patients with type AB blood can receive blood from any blood group. The table shows which group is compatible with which.

**Type : O**

**Can give to :** Any blood group

**Can receive from :** O

**Type : AB**

**Can give to :** AB

**Can receive from :** Any blood group

**Type : A**

**Can give to :** A and AB

**Can receive from :** A and O

**Type : B**

**Can give to :** B and AB

**Can receive from :** B and O

**WHAT IS THE RHESUS FACTOR?**

The Rhesus factor (abbreviated as Rh) is an antigen found in the red blood cells of most people and animals. Blood that is described as rhesus positive contains this antigen, whereas rhesus negative blood does not.

**The cultural and historical significance of blood**

The use of the word 'blood' in the English language shows that, historically, the circulation has had a moral and social importance beyond its biological necessity, signifying family, connection and emotion. 'Blood is thicker than water' means that family duties and connections are stronger than any others. 'Blood money' refers to the compensation paid to the relatives of a murder victim in an attempt to stop them seeking revenge. If you have 'bad blood' you are likely to feel unwell and friends or relatives with 'bad blood' between them do not like each other. The term 'blue blood' comes from the Spanish sangre azul, which was used to describe aristocrats of 'purer' ancestry than those with 'mixed' blood. It is still used today to refer to the nobility and aristocracy.

Since blood has such a strong link to family and emotions it is no surprise that 'cold-blooded' means lacking feeling and 'making one's blood boil' means causing anger.

**TOPIC 6: DISEASES AND DISORDERS (PATHOLOGIES)**

**VARICOSE VEINS**

Deoxygenated blood in the lower body has to move uphill in order to return to the heart. Valves prevent the blood flowing backwards but sometimes these valves, especially those in the superficial veins of the legs, no longer work effectively.

Consequently the veins become dilated and blood collects in the veins instead of returning to the heart. The veins become distended and knobbly, showing through the skin.

**Varicose veins are often caused by:**

* Heredity
* Excessive periods of sitting and standing
* Pregnancy
* Obesity.

**ANAEMIA**

Anaemia is a reduction in the blood's ability to carry oxygen, caused either by a decrease in red blood cells, or the haemoglobin they carry, or both. It may be caused by extensive loss of blood, lack of iron in the diet, the failure of bone marrow to produce the normal level of cells or it may be inherited.

**LEUKAEMIA**

Leukaemia is a cancer of the blood, caused by over-production of white blood cells.

**SEPTICAEMIA**

Also known as blood poisoning, this is a generalised disease associated with the circulation and multiplication of toxic bacteria in the blood.

**HAEMOPHILIA**

The blood's inability to clot. This is an inherited disease which affects mainly men but which can be carried by women.

**ARTERIOSCLEROSIS**

A degenerative disease of the arteries, in which the walls of the vessels harden and lose elasticity. The loss of elasticity causes an increase in blood pressure. This condition mainly affects the elderly.

**ATHEROSCLEROSIS/ATHEROMA**

A build-up of fats, including cholesterol, inside the arteries which causes a narrowing of the artery passage, hardening of the vessel walls and a loss of elasticity.

**HAEMORRHOIDS**

Also known as piles, these are enlarged veins in the rectum or anus which may collapse or contain blood clots.

**PHLEBITIS**

Inflammation of a vein. Thrombo-phlebitis is the inflammation of a vein where a blood clot has formed.

**THROMBUS**

A blood clot in the heart or in the blood vessels.

**HIV/AIDS**

Acquired Immune Deficiency Syndrome (AIDS) is a complex disease that follows infection with the Human Immuno-deficiency Virus (HIV). The virus attacks T-lymphocytes, making the immune system incapable of fighting disease. It is transmitted through blood and other body fluids.

**HIGH BLOOD PRESSURE**

Also known as hypertension, this is blood pressure which consistently remains above the normal level.

**LOW BLOOD PRESSURE**

Also known as hypotension, this is blood pressure which consistently remains below the normal level.

**HIGH CHOLESTEROL**

High cholesterol is an excessive build-up of a fatty substance called cholesterol, which can cause a reduction in arterial capacity (atherosclerosis - see previous page) and thus high blood pressure.

**HEPATITIS A B C**

Inflammations of the liver, caused by viruses, toxic substances or immunological abnormalities. Type A is spread by fecally contaminated food. Types B and C are transmitted by infected body fluids including blood. Contagious.

**CORONARY THROMBOSIS**

A blood clot in the coronary artery.

**STRESS**

Stress can be defined as any factor which affects mental or physical health. When a person is stressed, the heart beats faster, thus pumping blood more quickly. Excessive and unresolved stress can lead to high blood pressure, coronary thrombosis and heart attacks.

**ANGINA**

A heart condition characterized by chest pain due to reduced oxygen to the heart.

**ANEURYSM**

A cardiovascular disease characterized by a saclike widening of an artery resulting from weakening of the artery wall.

**HAEMATOMA**

A localized swelling filled with blood.

**DVT (deep vein thrombosis)**

Is the formation of a blood clot ("thrombus") in a deep vein.

**CARDIAC ARRHYTHMIA**

Is a term for any of a large group of conditions in which there is abnormal electrical activity in the heart. The heart beat may be too fast or too slow, and may be regular or irregular.

**TACHYCARDIA**

An abnormally rapid heartbeat (over 100 beats per minute).

**BRADYCARDIA**

An abnormally slow heartbeat.

**CARDIAC FAILURE**

Is a condition in which a problem with the structure or function of the heart impairs its ability to supply sufficient blood flow to meet the body's needs.

**EPISTAXIS (NOSE BLEEDS)**

Is the relatively common occurrence of hemorrhage from the nose, usually noticed when the blood drains out through the nostrils.

**GANGRENE**

Is a complication of cell death characterized by the decay of body tissues, which become black (and/or green) and malodorous.

**HOLE IN THE HEART (SEPTAL DEFECTS)**

Are small holes in the septa between the atria and ventricles.

**INTERMITTENT CLAUDICATION**

Is lameness due to pain in leg muscles because the blood supply is inadequate; pain subsides with rest.

**MYOCARDIAL INFARCTION**

The destruction of heart tissue resulting from obstruction of the blood supply to the heart muscle.

**PALPITATIONS**

Is an abnormal awareness of the beating of the heart, whether it is too slow, too fast, irregular, or at its normal frequency.

**PULMONARY EMBOLISM**

Is a blockage of the pulmonary artery by foreign matter or by a blood clot.

**RAYNAUD'S SYNDROME**

Is a vascular disorder that affects blood flow to the extremities (the fingers, toes, nose and ears) when exposed to cold temperatures or in response to psychological stress.

**SICKLE CELL ANAEMIA**

A congenital form of anaemia occurring mostly in people with black skin; characterized by abnormal blood cells having a crescent shape.

**THALASSEMIA**

An hereditary anaemia resulting from reduced production of either alpha or beta haemoglobin. Depending on the type, the condition can be fatal before or just after birth, or can result in varying levels of anaemia and development difficulties.

**VARICOSE ULCERS**

A chronic ulceration above the ankles due to varicose veins which interfere with the normal blood circulation in the affected areas.

**INTERRELATIONSHIPS**

Circulatory system links to:

**Respiratory:** carries oxygen to every cell and system of the body (internal respiration); removes waste gas from the body through diffusion between capillary/alveoli (external respiration).

**Lymphatic:** linked to the lymphatic system at tissue level - the circulatory system transports some waste products away from the tissues (mainly carbon dioxide) and any additional waste products are carried away by the lymphatic system. The circulatory and lymphatic systems also work together to protect the body (immunity). The lymphatic system empties back into the blood system.

**Endocrine:** hormones carried in blood to various target organs

**Digestive:** nutrients broken down in the digestive process are transported by blood from the small intestines to the liver then around the body

**Muscular:** blood transports glucose for energy conversion to the muscles.

**Urinary:** blood passes through the kidneys for purification of toxins

**Skeletal:** erythrocytes and leucocytes are manufactured in the bone marrow of long bones

**Skin:** circulation transports oxygen and nutrition to skin, hair and nails.

**Summary**

The cardiovascular system:

* Blood is the body's fuel, delivered by the circulatory system: it carries nutrients and oxygen to the body and collects waste and carbon dioxide from it
* The heart is the circulatory system's engine: it pumps blood around the body
* Arteries and veins are the circulatory system's pipes: they transport oxygenated blood from the heart (except the pulmonary artery) and deoxygenated blood to the heart (except the pulmonary vein).