**Topic 9. Transport in Animals**

**9.1 Transport in Animals**

**Describe the circulatory system as a system of blood vessels with a pump and valves to ensure one-way flow of blood**

* The main transport system of all mammals is the blood system, also known as the circulatory system;
* It is a network of tubes , called blood vessels;
* A pump, the heart, keeps blood flowing through the vessels;
* Valves in the heart and veins prevent backflow of blood.

**Describe the single circulation of a fish**

**Describe the double circulation of a mammal**



* Blood passes through the heart twice for each complete circulation of the body;
* The right side of the heart collects deoxygenated blood from the body and pumps it to the lungs;
* Thus there is a low pressure circulation in the lungs;
* The left side collects oxygenated blood from the lungs and pumps it to the body;
* Thus there is a high pressure circulation to the body tissues.
* The double circulatory system helps to maintain blood pressure, making circulation efficient.

**Explain the advantages of a double circulation**

**9.2 Heart**

**Name and identify the structures of the mammalian heart, limited to the muscular wall, the septum, the left and right ventricles and atria, one-way valves, coronary arteries and the atrio-ventricular and semilunar valves**



* The heart is a pump, made of muscle, which moves blood around the body;
* The muscle is constantly active and is supplied by coronary arteries to provide it with oxygen and glucose;
* The heart has two sides- the right side receives deoxygenated blood from the body and pumps it to the lungs for oxygenation; while the left side receives oxygenated blood from the lungs and pumps it to the body;
* The left and right side of the heart is completely separated from each other by a septum;
* There are four chambers- two atria and two ventricles;
* The right atrium receives blood from vena cava and the left atrium from pulmonary vein.
* Both the atria then squeeze the blood into the ventricles;
* The right and left ventricles receive blood from the atria and squeeze it into arteries;
* Right ventricle pumps blood into the pulmonary artery & the left ventricle pumps to the aorta;
* The tricuspid valve allow blood to flow from right atrium to right ventricle and the bicuspid valve allow blood to flow from left atrium to left ventricle preventing backflow;
* The semilunar valves allow blood to move to the arteries when the ventricles contact and prevent backflow
* The wall of the left ventricle is much thicker than the right ventricle because it needs to build up enough pressure to move the blood to all the main organs.
* Thus the blood flowing to the lungs in the pulmonary artery has a much lower pressure than the blood in the aorta.

**State that blood is pumped away from the heart into arteries and returns to the heart in veins**

**Explain the relative thickness:**

 **– of the muscle wall of the left and right ventricles**

 **– of the muscle wall of the atria compared to that of the ventricles**

**Explain the importance of the septum in separating oxygenated and deoxygenated blood**

**Describe the functioning of the heart in terms of the contraction of muscles of the atria and ventricles and the action of the valves**

* Heart beats as the cardiac muscles in its walls contract and relax;
* When they contract, heart becomes smaller, squeezing blood out. This is called systole;
* When they relax, the heart becomes larger, allowing blood to flow into the atria and ventricles. This is called diastole;
* The rate at which heart beats is controlled by a patch of muscle in the right atrium called pacemaker;
* The pacemaker sends electrical signals through the walls of the heart at regular intervals , which make the muscle contract;
* There is a valve between atrium and ventricle called atrioventricular valves.
* These are of two kinds- Bicuspid and tricuspid valves;
* The function of these valves is to stop blood flowing from the ventricles back to the atria;
* This is important, so that when the ventricles contract the blood is pushed into arteries and not into the atria;
* As the ventricles contract, the pressure of the blood pushes the semilunar valves upwards;
* The tendons attached to them stop them from going up too far.

**State that the activity of the heart may be monitored by ECG, pulse rate and listening to sounds of valves closing**

**Investigate and state the effect of physical activity on the pulse rate**

**Explain the effect of physical activity on the heart rate**

IGCSE Biology by Mary Jones and Geoff Jones – pg. 88-Activity 8.1-To find the effect of exercise on the rate of heartbeat.

* Heart beats about 70 times a minute, more if you are younger;
* The rate becomes lower the fitter you are;
* During exercise the heart rate increases to supply the muscles with more oxygen and glucose;
* These are needed to allow the muscles to respire aerobically, so they have sufficient energy to contract;
* Regular exercise is needed to keep the heart muscle in good tone;
* This results in the heart being more efficient in maintaining blood pressure and reduces the risk of coronary heart disease.

**Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible risk factors as diet, stress, smoking, genetic predisposition, age and gender**

**Discuss the roles of diet and exercise in the prevention of coronary heart disease**

* Coronary arteries supply blood (nutrients and oxygen) to the heart muscles.
* If a coronary artery gets blocked for e.g. by a blood clot , the cardiac muscle run short of oxygen;
* Blockage of the coronary arteries is called coronary artery disease;
* Thus the cardiac muscles cannot respire, so they cannot obtain energy to allow them to contract;
* The heart therefore stops beating; this is called heart attack or cardiac arrest.

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| *Cause* | *Explanation* | *Preventive measures*  |
| Poor diet with too much saturated fat | Leads to cholesterol building up in the arteries, eventually blocking the blood vessel | Cholesterol-free diet |
| Smoking | Nicotine damages the heart and blood vessels | Stop smoking |
| Stress | Tends to increase blood pressure , which can result in fatty materials collecting in the arteries | Find ways of relaxing, and identify the causes of stress and avoid them |

**Describe ways in which coronary heart disease may be treated, limited to drug treatment with aspirin and surgery (stents, angioplasty and by-pass)**

**9.3 Blood & lymphatic vessels**

**Name the main blood vessels to and from the:**

* **heart, limited to vena cava, aorta, pulmonary artery and pulmonary vein**
* **lungs, limited to the pulmonary artery and pulmonary vein**
* **kidney, limited to the renal artery and renal vein**

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| Blood vessels | To  | From |
| 1. Heart | Vena cava and pulmonary vein | Pulmonary artery and aorta |
| 2. Lungs | Pulmonary artery | Pulmonary vein |
| 3. Liver | Hepatic portal vein and hepatic artery | Hepatic vein |
| 4. Kidney | Renal artery | Renal vein |

**Describe the structure and functions of arteries, veins and capillaries**

**Explain how the structures of arteries, veins and capillaries are adapted for their functions**



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| **Blood vessel** | **Structure** | **How structure is related to function** |
| Artery | 1. Thick, tough wall with muscles and elastic tissue,
2. Narrow lumen
3. Valves absent
 | 1. Thick walls to withstand and maintain blood pressure (prevents bursting).
2. Narrow lumen maintains high blood pressure.
3. High pressure prevents backflow of blood.
 |
| Vein | 1. Thin wall with less muscles and elastic tissue
2. Large lumen
3. Valves present
 | 1. Thin walls allow muscles to exert pressure on the veins.
2. Wide lumen allows great volume of blood to pass or reduces resistance to blood flow.
3. Valves prevent backflow of blood.
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| Capillary | 1. Permeable wall, one cell thick, with no muscle and elastic tissue
2. Lumen approximately one red blood cell wide,
3. Valves absent
 | 1a. One cell thick wall allows diffusion of materials between capillary and surrounding tissues. 1b. Pores in the wall allow white blood cells  to exit.1. Narrow lumen allows blood cells to pass through slowly and increases oxygen diffusion from red blood cell.
2. Valves absent as blood pressure is lower than in arteries.
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**State the function of arterioles, venules and shunt vessels**

**Outline the lymphatic system in terms of lymphatic vessels and lymph nodes**

**Describe the function of the lymphatic system in the circulation of body fluids and the protection of the body from infection**

**9.4 Blood**

**List the components of blood as red blood cells, white blood cells, platelets and plasma**

**Identify red and white blood cells, as seen under the light microscope, on prepared slides and in diagrams and photomicrographs**

Plasma



Blood platelets

Red blood cell

White blood cell

**Identify lymphocyte and phagocyte white blood cells, as seen under the light microscope, on prepared slides and in diagrams and photomicrographs**

**State the functions of the following components of blood:**

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| *Components of blood* | *Function* |
| 1. Red blood cells | Red in color due to hemoglobin pigment, which carries oxygen and transports it to the tissues. |
| 2. White blood cells | Fights infection by phagocytosis and antibody production. |
| 3. Platelets | Causes blood clotting |
| 4. Plasma | Transport of blood cells, ions, soluble nutrients, hormones and carbon dioxide. |

**State the functions of:**

**lymphocytes – antibody production**

**phagocytes – phagocytosis**

* The immune system is the body’s defence against disease and foreign bodies. This defence takes the following forms.
* *A Antibody production:*
* Antibodies are produced by lymphocytes (WBC) in response to the presence of pathogens such as bacteria;
* This is because alien cells have chemicals called antigens on their surface;
* A different antibody is produced for each antigen;
* Antibodies make bacteria clump together in preparation for action by phagocytes or neutralize the toxins produced by the bacteria;
* *B. Phagocytosis:*
* Phagocytes have the ability to move out of capillaries to the site of infection;
* They then engulf (ingest) the infecting pathogen and kill them by digesting them. A process called phagocytosis.

**Describe the process of clotting as the conversion of fibrinogen to fibrin to form a mesh**

**State the roles of blood clotting as preventing blood loss and preventing the entry of pathogens**

**Describe the transfer of materials between capillaries and tissue fluid (details of the roles of water potential and hydrostatic pressure are not required)**