Circulatory System

What are closed and open circulatory systems?

Open circulatory systems occur when there are no small blood vessels or capillaries interfacing with cells to provide nutrients. E.g. arthropods. Closed circulatory systems occur in all vertebrates and involve circulating fluid (containing lymph and blood) confined to vessels, diffusion occurring across vessel walls to cells to supply nutrients.

What is single circulation and where does it occur?

Single circulation occurs when the animal does not have lungs, it has gills instead. As a result, blood obtains oxygen through direct diffusion with the environment and there is one circuit for blood flow. Animals with this system have a two-chambered heart with an atrium and a ventricle, blood flows into the atrium where it pools and is pumped out the ventricle, which controls blood pressure. Deoxygenated blood enters the gill capillary beds where it obtains oxygen via diffusion as water is pumped across the gill surface. Oxygenated blood then flows through the systemic circuit, where it supplies somatic cells with nutrients. Deoxygenated blood then enters the atrium to begin circulation again. E.g. sharks, rays and bony fish

What is double circulation and where does it occur?

Involves two circuits; pulmonary circuit and systemic circuit. Pulmonary circuit carries deoxygenated blood to the lungs and returns oxygenated blood to the heart. Systemic circuit carries oxygen rich blood and delivers oxygen to capillary beds and hence somatic cells. As there are two circuits there are two pumps (deoxygenated blood pumped by right side, oxygenated blood pumped by left side). Double circulation maintains higher blood pressure than single circulation.

Which circulatory system in double circulation has higher pressure, why? Lower, why?

Systemic- Higher; blood has much further to travel to reach capillary beds and then return to heart.
Pulmonary – Lower; blood has relatively short distance to travel to and from the lungs.

Describe mammalian circulation.

The right ventricle pumps deoxygenated blood to the lungs via the pulmonary arteries. In the lungs diffusion occurs, blood cells absorb oxygen and expel C0 2 as waste. Oxygen rich blood from the lungs travels along pulmonary veins and enters the left atrium where it pools before entering the left ventricle. The left ventricle pumps oxygenated blood at high pressure into the aorta where it disperses through the systemic circuit to capillary beds and in turn body cells. Oxygen and other nutrients is diffused across vessel and cell walls. Deoxygenated blood then enters veins and returns to the heart via the superior vena cava (from head, neck and forelimbs) and inferior vena cava (trunk and hind limbs). The superior and inferior vena cava flow into the right atrium.

Describe the anatomy of the mammalian heart.

The mammalian heart has four chambers, two atria and two ventricles. Atria are relatively thin walled, receiving blood from the body or the lungs. Ventricles are much thicker walled as they pump blood around the circuits. As the left ventricle pumps blood around the whole body it is much thicker walled (approx. 3x) than the right ventricle.

Describe the cardiac cycle.

The heart contracts and relaxes in a rhythmic cycle known as the cardiac cycle. Contraction (pumping) = systole and is caused by electric pulses into nodes (sinuatrial and atrioventricular). Relaxation (filling) = diastole.

What membranous, tough sack is the heart held within? What is its purpose?

Pericardium. Protects heart and is coated with a lubricant (serous fluid) which allows the heart to pump and move within the thoracic cavity freely.

How is the heart muscle supplied with blood?

As the heart is constantly beating it requires a large amount of oxygen relative to other organs (exception is the brain). Coronary vessels supply the heart muscles with blood; coronary arteries branch off from the aorta and run along grooves in the heart muscle between chambers, branching off to capillary beds. Deoxygenated blood is then carried back to the heart via coronary veins where it joins with vena cava and flows into the right atrium.

What are the two valves inside the heart? What is their role and how do they create a heartbeat?

Atrioventricular valve and semilunar valve. One each in left and right side; atrioventricular valves are between atria and ventricles; semilunar valves control blood flow to the pulmonary artery and aorta. Prevent backflow of blood in heart (defect of such = heart murmur). Recoil of blood against valves causes heart beat (first – AV, second – Semilunar)

Define the circulatory system providing a description of its functions and components.

The circulatory (or cardiovascular) system is a transport system within the body, carrying oxygen, nutrients and waste products between organs. The medium of transportation of these products is blood, composed of cells in a matrix of plasma. The circulatory system consists of the heart, a muscular pump and two closed circuits, the pulmonary circuit to the lungs, and the systemic circuit which carries blood to the body.

What are heart rate, stroke volume and cardiac output?

The heart rate, also called the pulse, is the number of beats per minute The stroke volume is the amount of blood pumped in a single contraction The cardiac output is the volume of blood pumped into the systemic circulation per minute and depends on both the heart rate and stroke volume

What is the basic structure of blood vessels?

Inside to outside: endothelium (epithelial layer that lines blood vessels), smooth muscle and connective tissue. Valves in veins returning via the inferior vena cava for blood to flow against the gradient.

What are the major types of blood vessels and how do they differ?

Capillaries: Capillaries have thin walls, the endothelium plus its basement membrane, to facilitate the exchange of materials. Blood flows slow through capillaries to allow efficient and sufficient transfer of nutrients. Arteries and veins have an endothelium, smooth muscle, and connective tissue. Arteries have thicker walls than veins to accommodate the high pressure of blood pumped from the heart, while veins have a much larger lumen