The Cardiovascular System

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The Cardiovascular System

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- The Cardiovascular System -

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The Cardiovascular System

– the structure and functions of the heart and blood vessels

Introduction

- The Cardiovascular system's main role is to transport essential gases and nutrients around the body.
- In particular, the CV system is responsible for transporting nutrients to all body tissues, deliver oxygen to required sites and remove wastes created by metabolic processes of the body.
- This is possible with the heart and blood vessels working together, with the heart pumping blood around the body, through a network of blood vessels.

Functions of the Cardiovascular System

The human body relies on the CV system to function efficiently both at rest, and while exercising.

It's main functions include –

- to circulate blood around all parts of the body – organs, tissues, cells etc.
- to transport water, oxygen and nutrients to the cells
- to transport wastes, such as carbon dioxide and other metabolic wastes away from the cells
- to assist in body's homeostasis and the maintenance of correct body temperature
- to fight disease through the white blood cells and antibodies contained in the blood.

Components of the Cardiovascular System

The Cardiovascular system is made up of –

Pulmonary circulation - where blood is transported from the heart, to the lungs and back to the heart

- at the lungs removes wastes eg. $C0_2$, and picks up oxygen, O_2

Systemic circulation **-** where blood is transported from the heart, around the body, to the body's extremities, and back to the heart

The essential components of the cardiovascular system are –

- the heart,
- the blood – red and white blood cells, platelets and plasma
- the blood vessels – arteries, veins and capillaries

Did you know…..an average adult contains roughly 4.7 to 5.7 litres of blood, accounting for approximately 7% of their total body weight.

Image of the network of blood vessels, from a body scan……

Red vessels depicted here represent arteries carrying oxygenated blood - 0_2

Blue vessels here represent veins – returning wastes including carbon dioxide - $C0_2$

Note – the placement of the heart – it is predominantly on the athlete's left side of the body, due to the left ventricle being larger

Structure & function of the HEART

The heart is…..

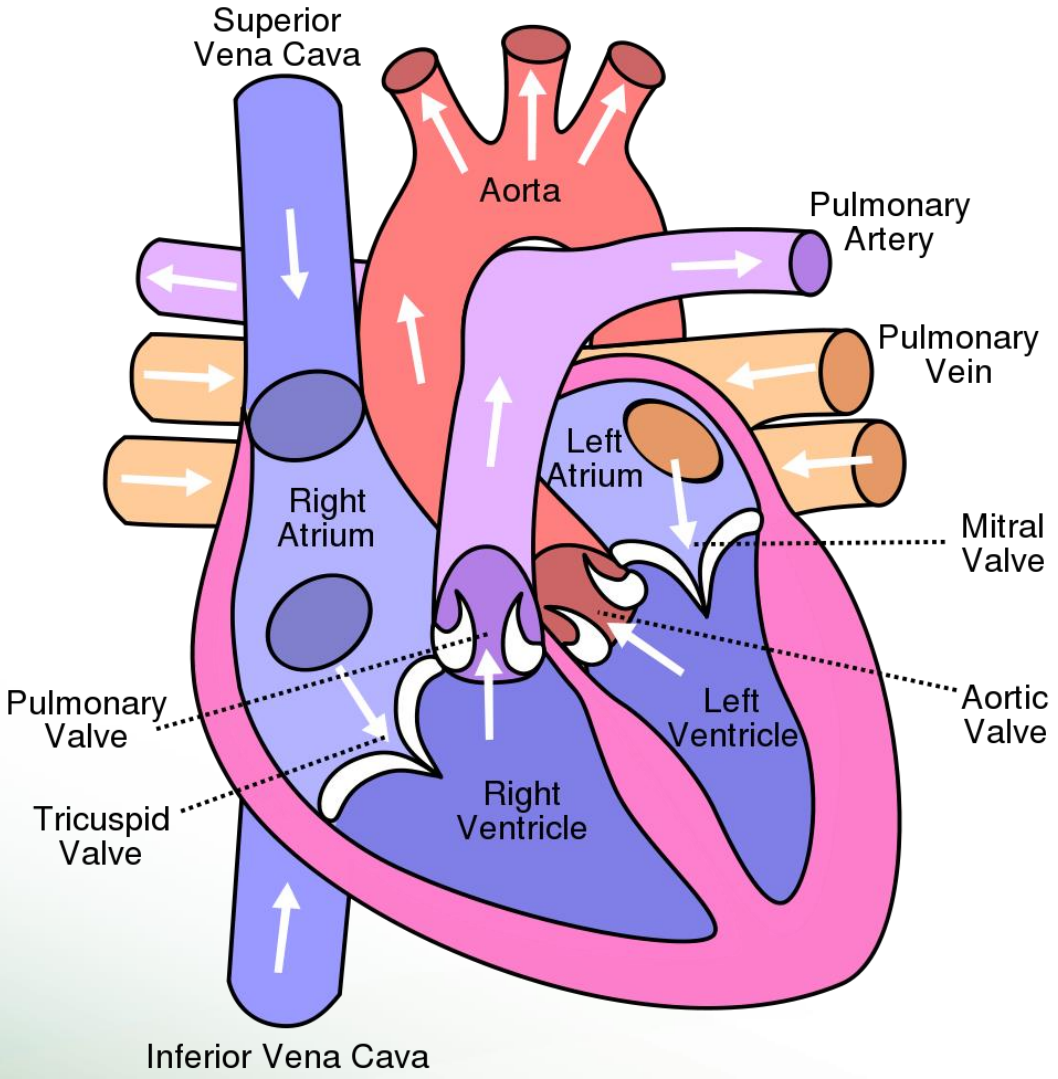
- designed to pump blood around the body
- an involuntary muscle
- made of cardiac muscle tissue
- made up of two pumps, left and right, divided by the septum
- made up of four chambers - two atria (singular. atrium) and two ventricles

The septum

- divides the heart into two pumps
- prevents the blood from the left side from mixing with the blood on the right
- the left side of the heart – pumps oxygenated blood, returned from the lungs, around the body
- the right side of the heart – pumps deoxygenated blood, returned from the body, to the lungs

Refer to the diagram following

The Heart


Superior Vena Cava
Aorta
Pulmonary Artery
Pulmonary Vein
Left Atrium
Right Atrium
Mitral Valve
Pulmonary Valve
Aortic Valve
Left Ventricle
Tricuspid Valve
Right Ventricle
Inferior Vena Cava

Structure & function of the HEART

The atria *(singular: atrium)*

- are the upper chambers and receive blood into the heart

The ventricles

- are the lower chambers and pump blood out of the heart

Valves in the heart

- are located between the atrium and ventricles, and entrance to arteries
- their roles is to ensure the one way flow of blood
- the tricuspid valve is located between the right atrium & right ventricle
- the mitral valve – located between left atrium & left ventricle

Did you know…

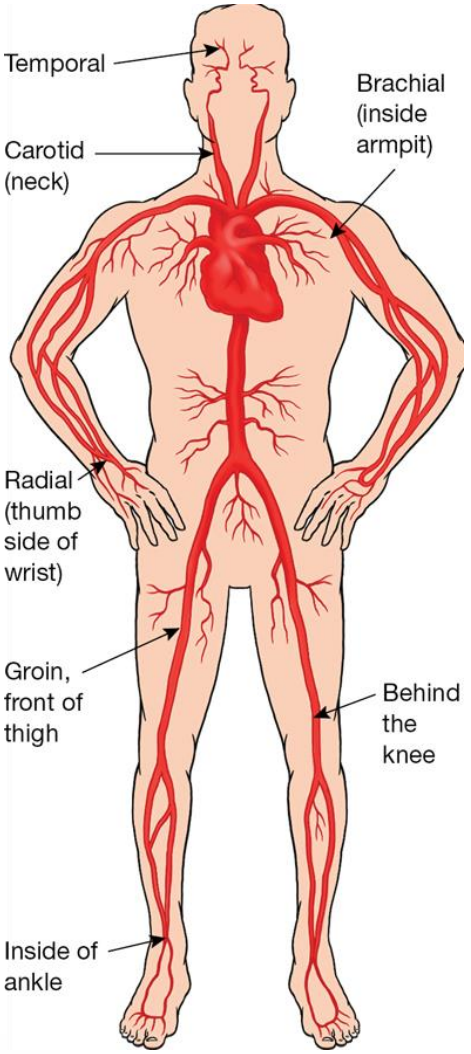
- an adult heart is about the size of a fist
- the heart is well protect by the ribcage
- is predominantly positioned on the left of the sternum

Factors that affect Heart Rate……

- exercise & movement
- gender
- temperature
- eating
- laughing
- smoking
- body position

Major pulse sites of the body

The carotid, and the radial pulse on the wrist, are the most common places to take your pulse.



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The components of BLOOD

Red Blood Cells

- make up 99% of blood cells
- transports oxygen (O_2) and carbon dioxide (CO_2) around the body, particularly to the muscles to assist in energy production
- contains hemoglobin, to which the O_2 attaches
- are produced in the bone marrow
- have a life span of approx. 3 months

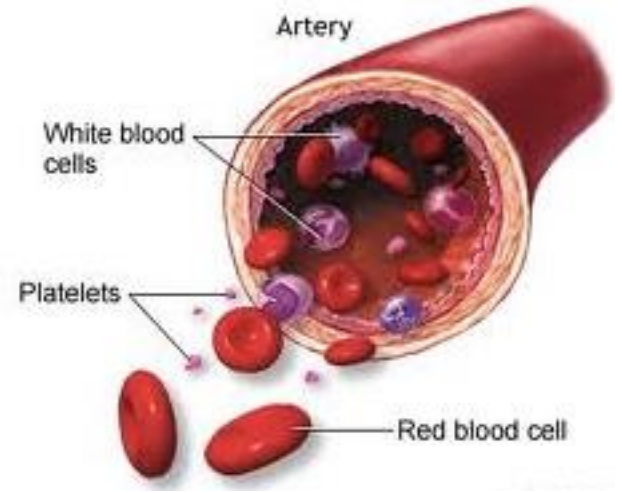
White Blood Cells

- are able to pass through capillary walls
- assist in the fight against disease
- have a life span of only a few days

The components of BLOOD

Platelets

- cells that allow blood to clot when a blood vessel is damaged
- smaller than red blood cells



Plasma

- clear, yellowish fluid that the blood cells are suspended in
- continually passes through capillary walls to provide with nutrients and remove wastes

The flow of blood throughout the body

The Vascular System ……

- is a network of blood vessels which carry blood to all parts of the body
- includes three types of blood vessels, which control the **flow** and **volume** of blood around the body
- is comprised of -
  - ✓ arteries
  - ✓ veins
  - ✓ capillaries

Arteries

Characteristics of Arteries…..

- arteries carries oxygen rich blood AWAY from the heart
- there is **ONE EXCEPTION - the pulmonary artery carries <u>deoxygenated</u> blood AWAY from the heart to the lungs**
- the muscular walls enables the artery to expand to accommodate the greater blood volume experienced with each heart beat.
- arteries have elastic, muscular walls to assist with the flow of the blood around the body
- the elasticity helps to maintain the blood pressure throughout the body
- as the blood is pumped out of the heart it is under pressure
- as arteries become smaller, and progress into the depths of the body, they are called **ARTERIOLES**.

Arteries - The Aorta

The AORTA

- is the most important and largest artery in the body
- has very thick walls and is highly elastic
- is the main artery coming out of the left ventricle of the heart
- coming out of the left ventricle, the aorta arches and divides into branches, as it assists with the blood supply to both upper and lower parts of the body
- as the left ventricle contracts, it recoils and pushes the blood out and through the arteries, it is responsible for pulsating blood pressure
- receives at rest, approximately five litres of blood from the heart

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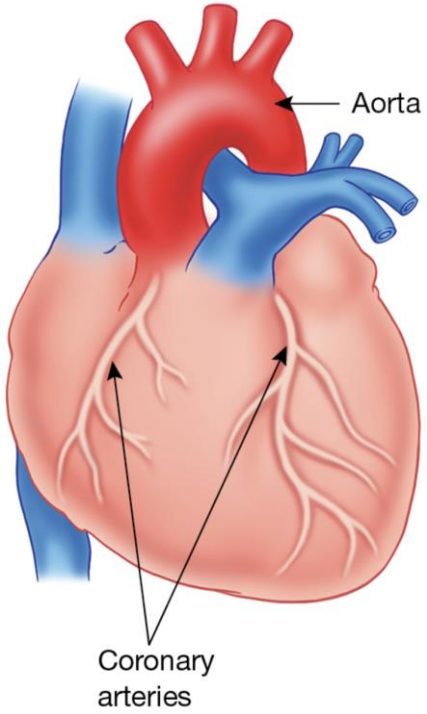
Coronary Arteries

The heart also needs a blood supply to be able to work effectively.



CORONARY ARTERIES

- supply the heart muscle with oxygen and other nutrients

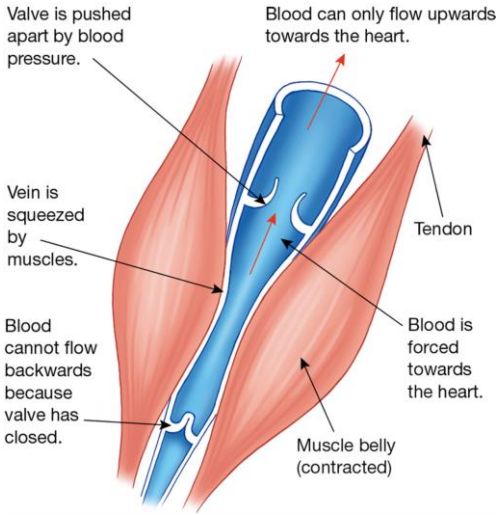
Heart attacks

- often occurs when one or both of these arteries are blocked by fatty deposits
- chest pain is caused by reduced blood flow and the dying of heart muscle

Veins

Characteristics of Veins…..

- veins carries deoxygenated blood TOWARDS the heart
- there is **ONE EXCEPTION - the pulmonary vein carries <u>oxygenated</u> blood TO the the heart from the lungs**
- generally carry a lower oxygen content and a higher carbon dioxide CO_2,
- the walls of veins are thin and are NOT elastic
- as veins become progressively smaller, towards the body's extremities, they are called **VENULES**
- have **ONE WAY VALVES** to assist in moving the blood towards the heart
- The contraction of skeletal muscles also assist in the return of the blood to the heart from extremities, often referred to as *"a muscle pump"*



The assistance of muscles to assist in venous return

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Venous Pooling

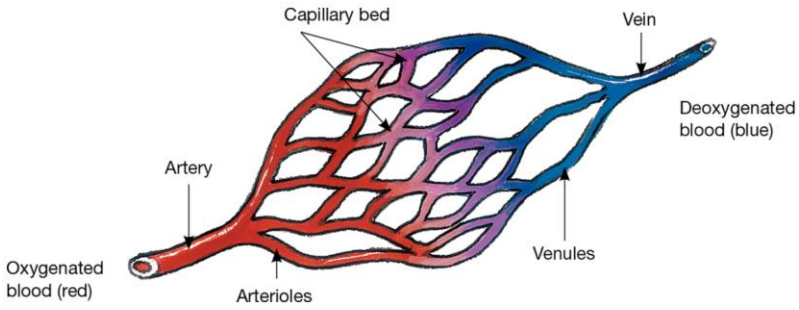
During exercise the blood flow around the body increases dramatically eg. from 5 litres/min to possibly 30 litres/min

- a gradual cool down period is beneficial to allow the body, and the increased blood flow, to return to it's resting state
- lightly exercising, with the muscles still contracting assists as in gradually diminishing excess blood flow around the body, until it has reached resting level.
- without cooling down, the combination of high blood flow and gravity creates an increase or 'pooling' of blood in the legs.

Capillaries

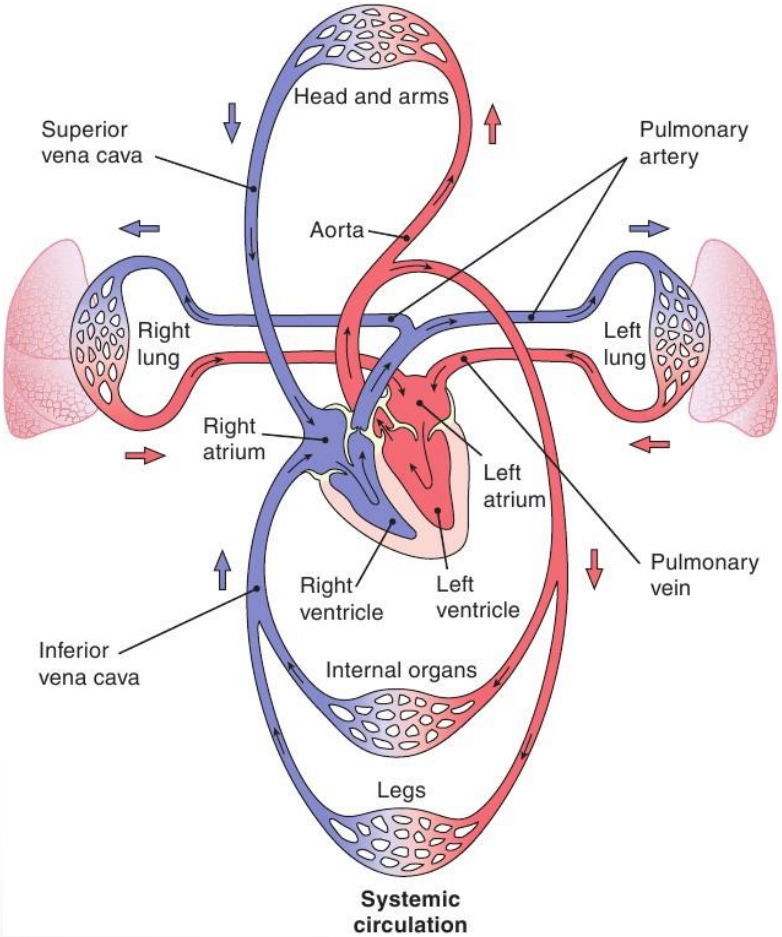
Characteristics of Capillaries…..

- smallest blood vessels
- as arterioles become smaller they become capillaries
- have very thin walls
- are only one cell thick
- at the capillary level the thin walls enable the exchange of nutrients & waste to take place, to and from the blood, from the cell



- capillaries dilate (increase in diameter) to allow the increased blood flow required during exercise.

The Cardiovascular System



The flow of blood through the heart & around the body

Blood is able to flow through the heart due to the continual contraction and relaxation of the atria and ventricles.

Deoxygenated blood returns to the heart from the rest of the body, via the superior and inferior vena cava and enters the right atrium.

The blood then passes, via the tricuspid valve, into the right ventricle where it is pumped to the lungs, via the PULMONARY ARTERY for oxygenation.

Leaving the lungs, the blood is now rich in oxygen, (depicted in red in diagrams) returns to the heart via the PULMONARY VEIN and enters and collects in the left atrium. It then passes through the mitral valve into the muscular left ventricle.

The blood is then pumped out of the left ventricle via the aorta, into arteries, then smaller arterioles as they branches out through the body.

The flow of blood through the heart & around the body

The arterioles join the capillaries, where nutrients & wastes are exchanged, through gaseous exchange (eg. O_2 in to cells & CO_2 out of cells) enabled through the very thin capillary walls.

The deoxygenated blood returns to the heart via venules and veins.

The veins, with their one way valves, prevent the back flow of the blood as it works against gravity to return to the heart, and enters the right atrium to begin the process again.

The return of the blood in the veins is also assisted by contraction of the surrounding working skeletal muscles.

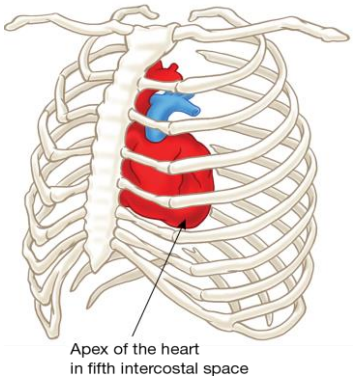
Some other terminology

SYSTOLE - when the heart contracts, it forces blood out of the heart via the ventricles and into the arteries.

DIASTOLE - when the heart relaxes, it fills with blood from the veins.

Some Facts
……about the heart and CV System

- ✓ An adults heart is approximately the size of a fist
- ✓ at rest, average adult heart rate is approx. 70 beats per minute (bpm)
- ✓ maximum heart rate (MHR) is approx. 220 – your age
- ✓ at maximum work – the heart may circulate up to 35 litres of blood in a minute
- ✓ the heart is located towards the left of the sternum



Heart and Circulation video clip

Please **turn up your volume** then view the short video on the next slide.

When the video is completed please return and go to the next slide in the presentation.

Heart and Circulation video clip

Please **turn up your volume** then click on the URL link below
to view a short video clip The Heart and Circulatory system.

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