Chapter 11 - The Circulatory System
The **circulatory system** supplies transportation for the cells of the body. Consists of the heart and all the veins and arteries.
The heart is located between the lungs in the mediastinum and pumps the blood throughout the body.

If you draw a line down the middle of your body about 2/3 of the heart would be left of that line and 1/3 to the right.
**apex** - the blunt point of the heart that lies on the diaphragm and points toward the left

When using a stethoscope, you should listen at the apex
In the case of cardiac arrest (heart stops beating) the heart can be manually compressed and blood will continue to flow around the body.

This combined with breathing into a person is called **cardiopulmonary resuscitation (CPR)**.
The heart has four main cavities:

1.) left atrium
2.) right atrium
3.) left ventricle
4.) right ventricle
**atria** - the two upper chambers of the heart

**ventricles** - the two lower chambers of the heart

The atria receives blood coming back from the body and the ventricles pump the blood throughout the body
The walls of each heart chamber are composed of cardiac muscle called **myocardium**.

The wall that divides the chambers is called the **septum**.
The heart has a covering around it called the **pericardium**

This covering produces a fluid to lubricate the heart so that it doesn't create friction when rubbing against surrounding organs.
The heart pumps by alternately contracting and relaxing

**systole** - the contraction of the heart

**diastole** - the relaxation of the heart
When the heart beats, the atria first contract to force blood into the ventricles and then the ventricles contract to force the blood through the arteries.
There are two valves that separate the atria from the ventricles. These valves are called **AV (atrioventricular) valves**

1.) **bicuspid valve** - located between the left atrium and the left ventricle

2.) **tricuspid valve** - located between the right atrium and the right ventricle

The AV valves prevent backflow into the atria
There are two **semilunar (SL) valves** - which are valves located between the ventricle and the large arteries the ventricles are connected to.

The two SL valves are called the **Pulmonary SL Valve** and the **Aortic SL Valve**
- They prevent backflow of blood into the ventricles
The sound of the heart is defined as **lub dup**. These are two rhythmical, repetitive sounds.

The sound is created by the closing of the AV valves and then the SL valves.
Blood enters the right atrium through two large veins called the **superior vena cava** and the **inferior vena cava**. This is blood returning from the body and is oxygen-poor blood.
The blood is then pumped through the tricuspid valve into the right ventricle. The blood passes through the pulmonary semilunar valve into the **pulmonary artery** which leads to the lungs.
The blood returns from the lungs through four **pulmonary veins** and enters the left atrium. This is oxygen-rich blood.
The blood is then pumped through the bicuspid valve into the left ventricle. The blood passes through the aortic semilunar valve into the **aorta** where it will go to the rest of the body.
The heart itself needs nutrients and oxygen.

Coronary circulation is the delivery of oxygen and removal of waste product from the heart muscle.

- There are two small coronary arteries that flow into the heart muscle.
If this blood supply is cut off by these vessels being plugged a person will suffer a **heart attack**

**Angina pectoris** - Severe chest pain due to lack of oxygen to the heart muscle
This can be fixed by doing **coronary bypass surgery**.

Veins are taken from another part of the body and used to bypass the blocked coronary arteries.
Electrical impulses keep the heart beating properly

When stimulated, all the cells around the atria or ventricles will contract at the same time
Two main structures embedded the heart that control beating by generating strong impulses:

1.) **sinoatrial (SA) node** - called the pacemaker and starts the contraction. Causes the atria to contract

2.) **atrioventricular (AV) node** - Causes the ventricles to contract
Some people experience disturbances in rhythmic beating, such as a **heart block**, which is when impulses are blocked from getting to the ventricles.

An **artificial pacemaker** can be used to help the heart beat properly.
The heart beating generates tiny electrical currents

An **electrocardiogram (ECG)** is an instrument that can be used to record the heart's electrical activity

1.) **P wave** - depolarization of atria

2.) **QRS complex** - depolarization of ventricles

3.) **T wave** - repolarization of ventricles
Blood Vessels

**arteries** - carry blood away from the heart

The largest artery in the body is the aorta

The vessels keep getting smaller and smaller as they branch out until they turn into arterioles
Arterioles - control blood flow into capillaries

Capillaries are microscopic, thin walled vessels where the exchange of nutrients and gases occurs between the blood and the tissue fluid around the cells.

Only one RBC can pass through at a time.

Capillaries occur in areas called capillary beds.
When blood leaves the capillary bed it will enter the venules.

**Venules** increase in size and turn into veins.

**Veins** carry blood toward the heart.
The largest veins are the **superior vena cava** and the **inferior vena cava**
Both veins and arteries are composed of three distinct layers:

1.) **tunica adventitia** (external)
   - outermost layer
   - connective tissue
   - provides strength to prevent bursting under pressure
2.) **tunica media**
- middle layer
- smooth muscle
- contracts to help circulate blood

3.) **tunica intima**
- innermost layer
- made up of epithelial cells called **endothelium**

**Endothelium** lines the inner surface of the entire circulatory system
The capillaries are made up of only endothelium because they need to be thin.

Veins have valves in them that prevent back-flow of blood (arteries do not).

**Varicose veins** are a result of those valves not working properly.
There are four types of circulation:

1.) **systemic circulation** is the blood flow from the left ventricle, through all parts of the body and back to the right atrium.
2.) **pulmonary circulation** is the blood flow from the right ventricle, to the lungs and back to the left atrium.

3.) **hepatic portal circulation** refers to blood flowing through the liver.
   - Blood from the spleen, stomach, pancreas, gallbladder, and intestines flows through the liver.
   - The liver filters harmful things out of the blood.
4.) **fetal circulation** refers to the flow of blood between a fetus and the mother.

This occurs through the **placenta** and the **umbilical cord**.

The umbilical cord contains two **umbilical arteries** and one **umbilical vein**.
A developing fetus has a structure called the **foramen ovale** which is a hole, or shunt, that allows blood to flow from the right atrium directly to the left atrium.
This is important because an unborn baby's lungs are not working yet.

They remain collapsed until birth.

When the baby is born, the foramen ovale is closed and circulation starts to function normally.
Chapter 11

Blood Pressure

Blood pressure is the "push" of blood.

It is highest in the arteries and lowest in the veins.

Low or rapidly falling blood pressure is a serious problem.

High blood pressure can be bad too because it can rupture vessels. A rupture in the brain is called a stroke.
There are many factors that affect blood pressure.

1.) Volume of Blood

- Lots of blood = high blood pressure
- Not enough blood = low blood pressure

A sudden drop in blood volume (e.g., due to severe blood loss) results in low venous return and therefore decreased stroke volume. Sympathetic activity increases heart rate, maintaining cardiac output.
2.) Strength of Heart Contractions

- The stronger the heart beat, the more blood is pumped and the higher the blood pressure.

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3.) Heart Rate

- If heart rate speeds up, blood pressure can go up

- However, if rate is too fast, the ventricles may not be able to fill up before each contraction causing blood pressure to go down

A sudden drop in blood volume (e.g., due to severe blood loss) results in low *venous return* and therefore decreased stroke volume. *Sympathetic* activity increases heart rate, maintaining cardiac output.
4.) Blood Viscosity

- The more viscous (thick) the blood is, the higher the blood pressure

Many people take aspirin daily to help thin their blood
Blood pressure fluctuates often due to such as exercise and stress.

Normal blood pressure is 120/80

120 = systolic pressure (when ventricles contract)

80 = diastolic pressure (when ventricles relax)
Your heart rate (beats per minute) can be checked with your pulse. Pulse is defined as the expanding and recoiling of an artery. Your pulse can be taken at 9 different places, some more easy than others.
The complete cycle (contraction and relaxation) of a heartbeat is called a **cardiac cycle**

This cycle takes about 0.8 seconds for the average heart beating at about 72 beats per minute