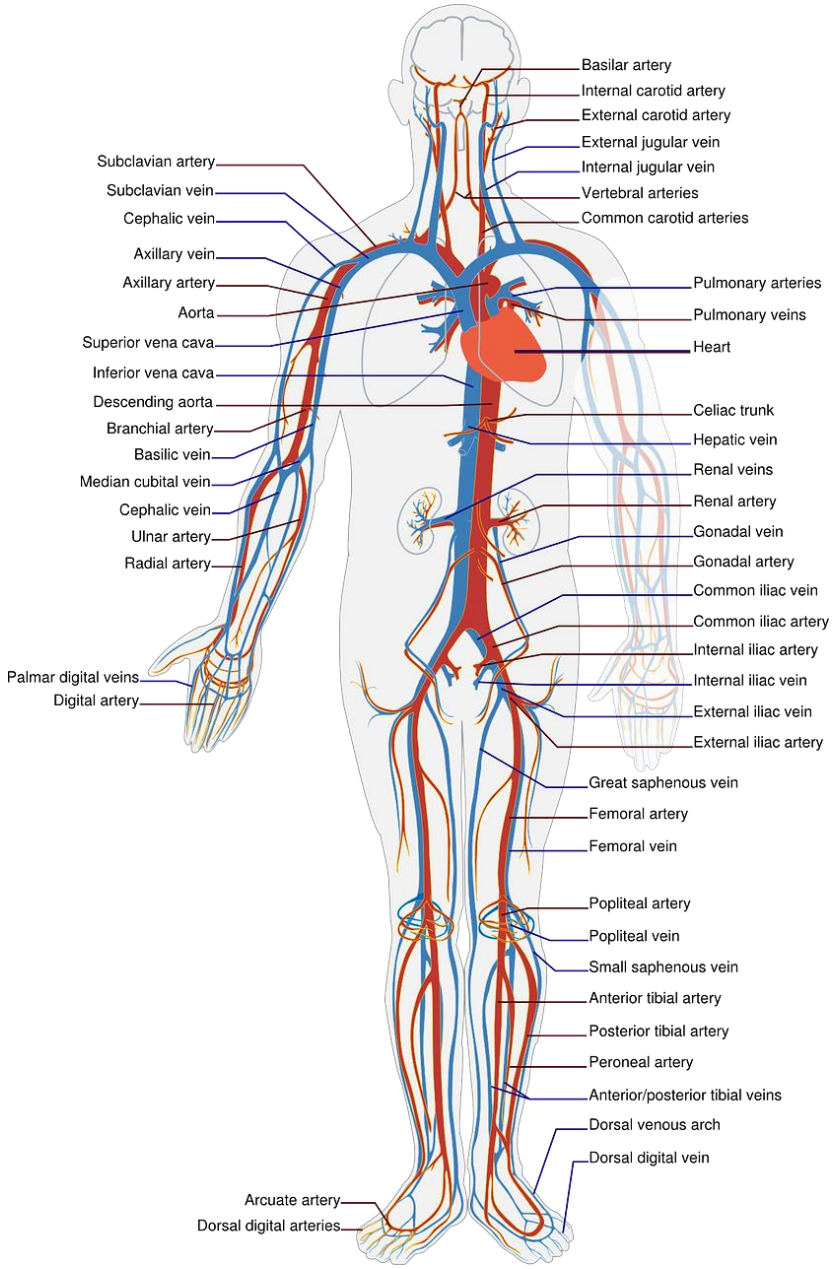
Body Fluids and Circulation

Circulatory System



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Circulatory system

- Heart
  - Left Atrium
  - Right Atrium
  - Left Ventricle
  - Right Ventricle
- Blood Vessels
  - Arteries
  - Veins
  - Capillaries
- Blood
  - Plasma
  - RBC
  - WBC
  - Platelets

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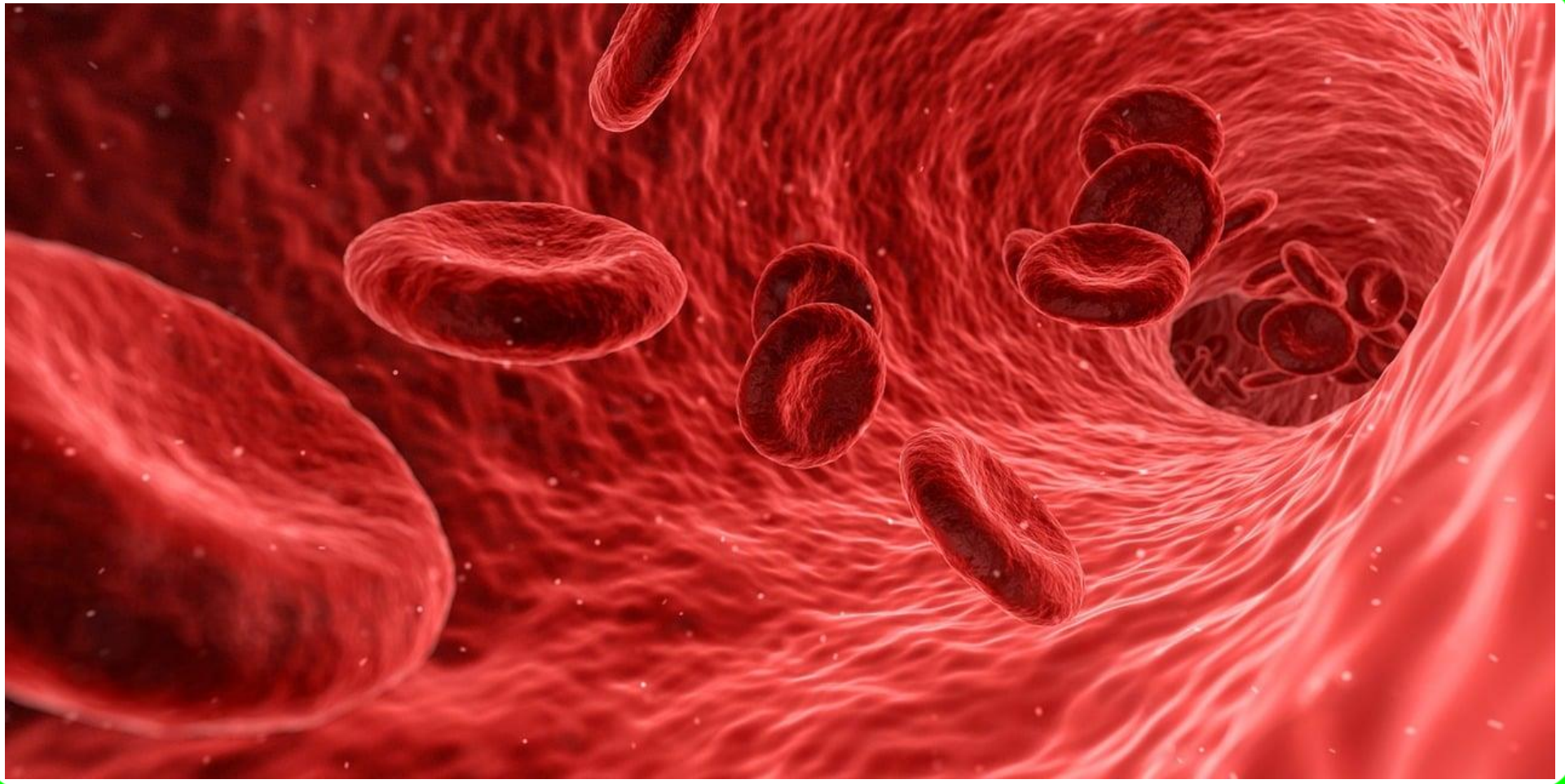
Body Fluids



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Body Fluids

Blood is the most commonly used body fluid by most of the higher organisms including humans for this purpose.

Lymph is another fluid helps in the transport of certain substances.

Blood

Blood is a special connective tissue consisting of a fluid matrix, plasma, and formed elements.

B. John Ebenezer

Plasma

Plasma is a straw coloured, viscous fluid constituting nearly 55 per cent of the blood. It consists of;

90-92 per cent water

6-8 per cent protein.

Fibrinogen, globulins and albumins are the major proteins.

B. John Ebenezer

Plasma

Globulins are involved in defense mechanisms of the body.

Albumins help in osmotic balance.

Fibrinogens are needed for clotting or coagulation of blood.

Blood clotting factors are also present in the plasma in an inactive form.

Plasma without the clotting factors is called serum.

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Plasma

Plasma also contains small amounts of minerals like Na^{+}, Ca^{++}, Mg^{++}, HCO_3^{-}, Cl^{-}, etc.

Glucose, lipids and amino acids are also present in the plasma.

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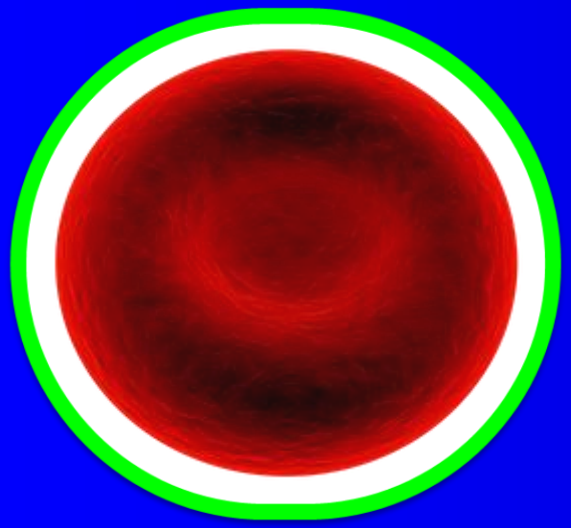
Erythrocytes



Erythrocytes, leucocytes and platelets are collectively called formed elements and they constitute nearly 45 per cent of the blood.

Erythrocytes or red blood cells (RBC) are the most abundant of all the cells in blood.

A healthy adult man has, on an average, 5 millions to 5.5 millions of RBCs mm^{-3} of blood.

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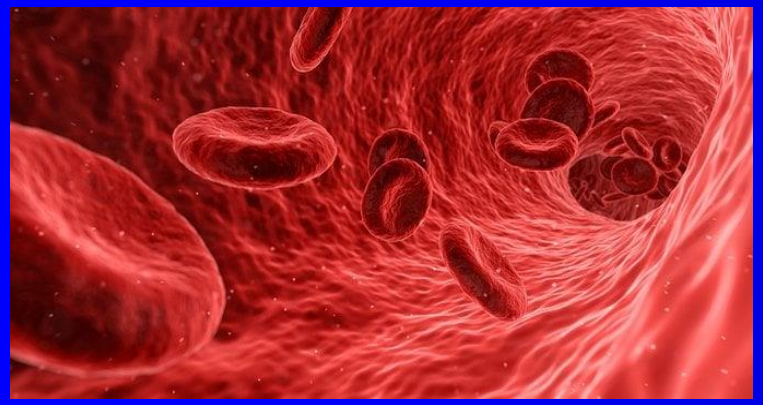
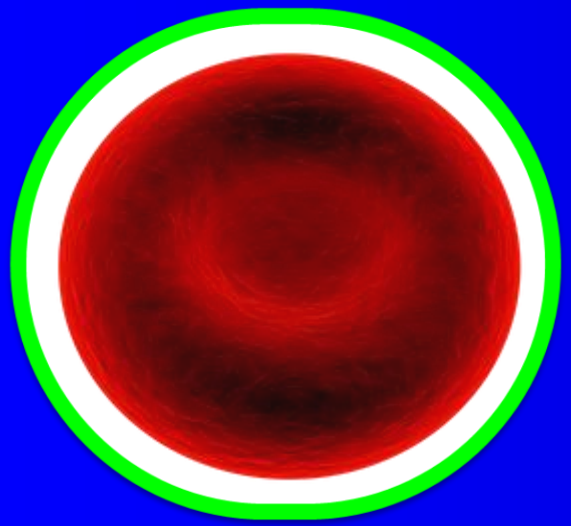
Erythrocytes





RBCs are formed in the red bone marrow in the adults.

RBCs are devoid of nucleus in most of the mammals and are biconcave in shape.

They have a red coloured, iron containing complex protein called haemoglobin.

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Erythrocytes

A healthy individual has **12-16 gms of haemoglobin per100 ml of blood**.

They transport of respiratory gases.

RBCs have an average life span of **120 days** after which they are destroyed in the spleen (graveyard of RBCs).

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Leucocytes

Leucocytes are also known as white blood cells (WBC) as they are colourless due to the lack of haemoglobin.

They are nucleated and are relatively lesser in number which averages **6000-8000 mm^{-3} of blood.**

Leucocytes are short lived.

B. John Ebenezer

Leucocytes

Granulocytes

- Neutrophils
- Eosinophils
- Basophils

Agranulocytes

- Lymphocytes
- Monocytes

Leucocytes are classified into granulocytes and agranulocytes.

Neutrophils, eosinophils and basophils are granulocytes,

Lymphocytes and monocytes are the agranulocytes.

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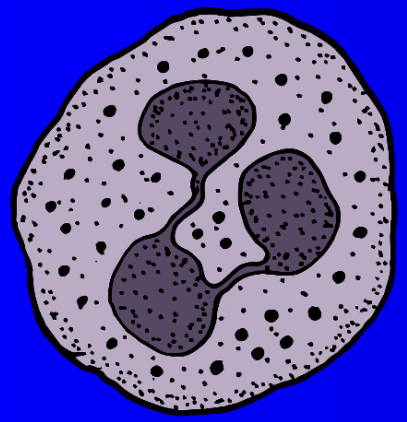
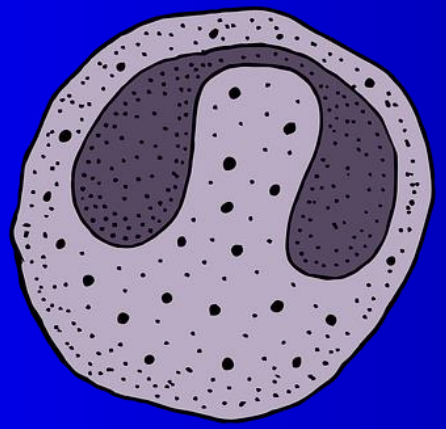
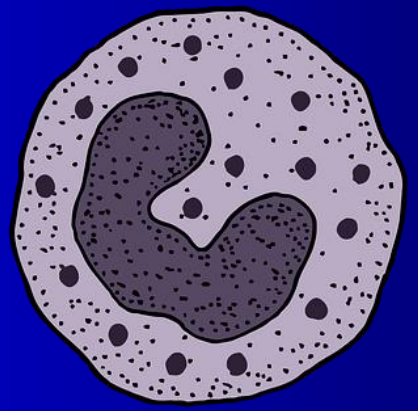
Leucocytes



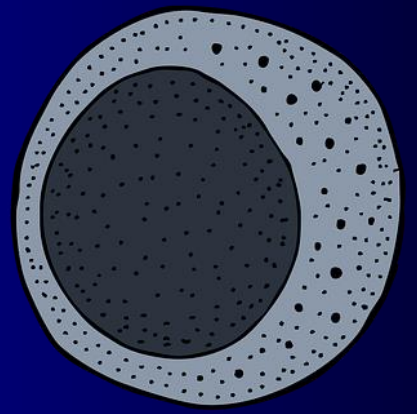
Neutrophil



Eosinophil



Basophil



Lymphocyte

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Leucocytes

Neutrophils are the most abundant cells (60-65 per cent) of the total WBCs.

Neutrophils and monocytes (6-8 per cent) are phagocytic cells which destroy foreign organisms entering the body.

Basophils are the least (0.5-1 per cent) among them.

Basophils secrete histamine, serotonin, heparin, etc., and are involved in inflammatory reactions.

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Eosinophils (2-3 per cent) resist infections and also causes allergic reactions.

Lymphocytes (20-25 per cent) are of two major types – ‘B’ and ‘T’ forms.

Both B and T lymphocytes are responsible for immune responses of the body.

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Platelets

Platelets also called **thrombocytes**, are cell fragments produced from megakaryocytes (special cells in the bone marrow).

Blood normally contains **1,50,000-3,50,000 platelets mm^{-3}**.

Platelets can release a variety of substances most of which are involved in the coagulation or clotting of blood.

A reduction in their number can lead to clotting disorders which will lead to excessive loss of blood from the body.

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Lymph

As the blood passes through the capillaries in tissues, some water along with many small water soluble substances move out into the spaces between the cells of tissues leaving the larger proteins and most of the formed elements in the blood vessels.

This fluid released out is called the interstitial fluid or tissue fluid.

It has the same mineral distribution as that of plasma.

Exchange of nutrients, gases, etc., between the blood and the cells always occur through this fluid.

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Lymph

An elaborate network of vessels called the lymphatic system collects this fluid and drains it back to the major veins.

The fluid present in the lymphatic system is called the lymph.

- Lymph is a colourless fluid containing specialised lymphocytes which are responsible for the immune responses of the body.
- Lymph is also an important carrier for nutrients, hormones, etc.
- Fats are absorbed through lymph in the lacteals present in the intestinal villi.

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Mechanism of Blood Clotting

Injury or Trauma → Stimulates → Platelets → Release → Blood ClottingFactors

Injured Tissues → Release → Blood ClottingFactors

Calcium ions play an important role in clotting.

B. John Ebenezer

Mechanism of Blood Clotting

Prothrombin (Inactive) —Thrombokinase→ Thrombin (Active)

Fibrinogen (Inactive) —Thrombin→ Fibrin (Active)

Fibrin and Blood Cells —Causes→ Clot or Coagulum

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Mechanism of Blood Clotting

An injury or a trauma stimulates the platelets in the blood to release certain factors which activate the mechanism of coagulation.

Certain factors released by the tissues at the site of injury also can initiate coagulation.

Calcium ions play a very important role in clotting.

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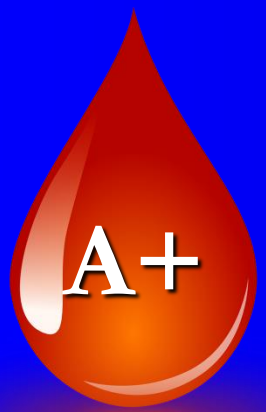
Blood Groups in Human

Blood Groups



Dr. Karl Landsteiner, born at Vienna in Austria discovered the ABO blood groups.

He was awarded with Nobel Prize for Medicine in the year 1930.

Dr. Reuben Ottenberg carried out the first clinical blood transfusion based on Landsteiner's research in 1907 at Mt. Sinai Hospital in New York.

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The Eight Major Blood Groups

A+

B+

AB+

O+

A-

B-

AB-

O-

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Blood Group : A

Antigen in RBC	A
Antibody in Plasma	Y B

‘A’ group is determined by the presence of ‘A’ antigen on the surface of the red blood cells and ‘B’ antibody in the plasma.

Antibody ‘B’ would attack blood that contain ‘B’ antigen.

People with ‘A’ group can donate their blood to ‘A’ and ‘AB’ groups. They can receive blood from ‘A’ and ‘O’ groups.

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Blood Group : B

Antigen in RBC	B
Antibody in Plasma	Y A

‘B’ group is determined by the presence of ‘B’ antigen on the surface of the red blood cells and ‘A’ antibody in plasma.

Antibody ‘A’ would attack blood that contains ‘A’ antigen.

People with ‘B’ group can donate their blood to ‘B’ and ‘AB’ groups. They can receive blood from ‘B’ and ‘O’ groups.

B. John Ebenezer

Blood Group : AB

Antigen in RBC	AB
Antibody in Plasma	Y No Antibody

‘AB’ group is determined by the **presence of both A and B antigens** on the surface of red blood cells but **absence of both A and B Antibodies** in the plasma.

People with ‘AB’ blood group are called universal recipients.

They can receive blood from all the people (A, B, AB & O groups), because this group does not have any antibody in the plasma.

But they can donate their blood only to people with ‘AB’ group, because this group has both A and B antigens in the RBC.

B. John Ebenezer

Blood Group : O

Antigen in RBC	O
Antibody in Plasma	Y AB

‘O’ group is determined by the **absence of both A and B Antigens** on the surface of the red blood cells but the presence of both **A and B Antibodies** in the plasma.

People with ‘O’ blood group are called universal donors.

They can donate their blood to all the people. (A, B, AB & O groups), because this group does not have any antigen in the RBC.

But they can receive only ‘O’ group blood, because this group has both A and B antibodies in their plasma.

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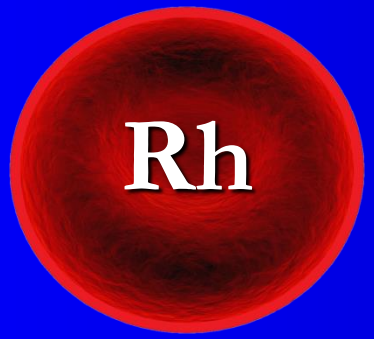
Rhesus Factor or Rh Factor

Antigen in RBC	
Blood Type	Positive (+)

Rh factor is an antigen (Protein) present on the surface of red blood cells.

Rh-Positive blood is determined by the presence of Rh antigen on the surface of RBC.

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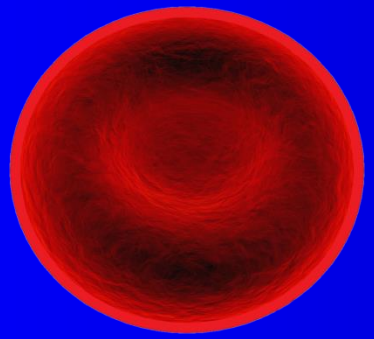
Rhesus Factor or Rh Factor

Antigen in RBC	
Blood Type	Negative (-)

Rh-Negative blood is determined by the absence of Rh antigen on the surface of RBC.

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Blood Grouping

Antigen in RBC	A	B	AB	O
Antibody in Plasma	Y B	Y A	Y No Antibody	Y AB

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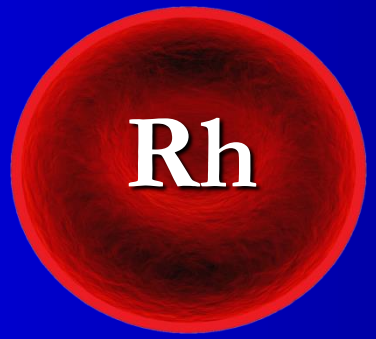
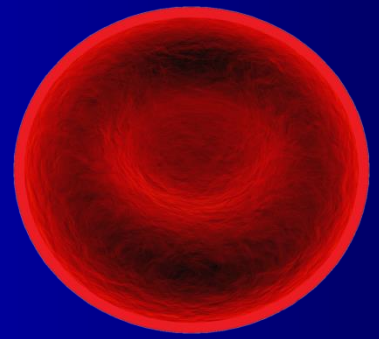
Rh Factor

Rhesus Factor		
Blood Type	Positive (+)	Negative (-)

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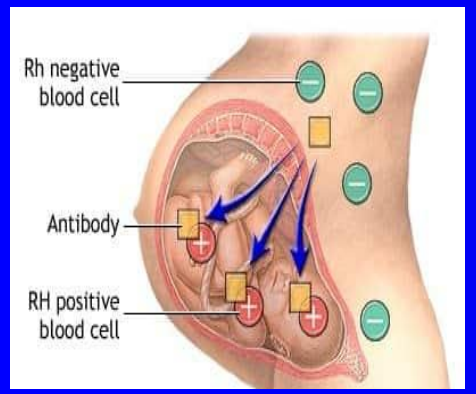
Rh Incompatibility

Rh Incompatibility

Rh incompatibility is a condition that develops when a pregnant woman has Rh-negative blood and the baby in her uterus has Rh-positive blood.



Causes

During pregnancy, red blood cells from the foetus enter the mother's blood through the placenta.

If the mother is Rh-negative, her immune system treats Rh-positive foetus as a foreign body.

The mother's body makes antibodies against the fetal blood cells.

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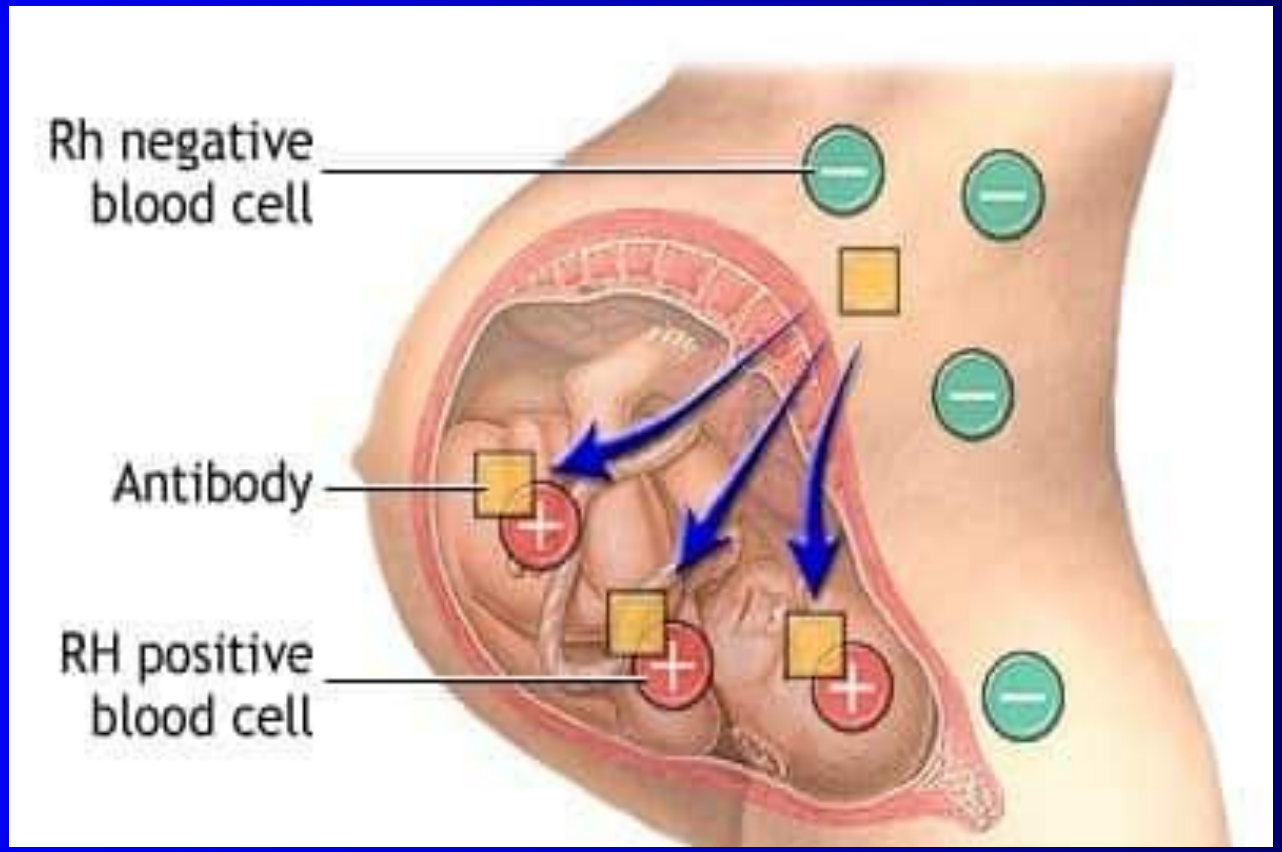
Rh Incompatibility



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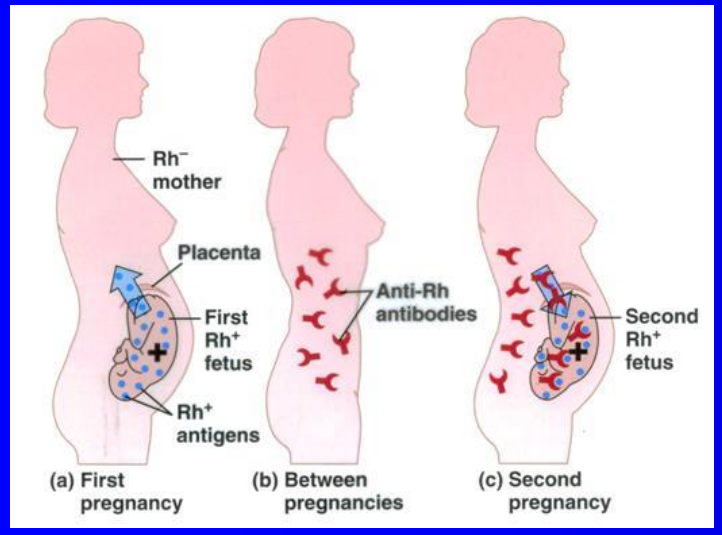
Rh Incompatibility



These antibodies may enter the developing baby through the placenta.

They destroy the baby's circulating red blood cells.

Firstborn infants are not affected unless the mother had past miscarriages or abortions.

This would sensitize her immune system. This is because it takes time for the mother to develop antibodies.

All the Rh-positive foetus will be affected.

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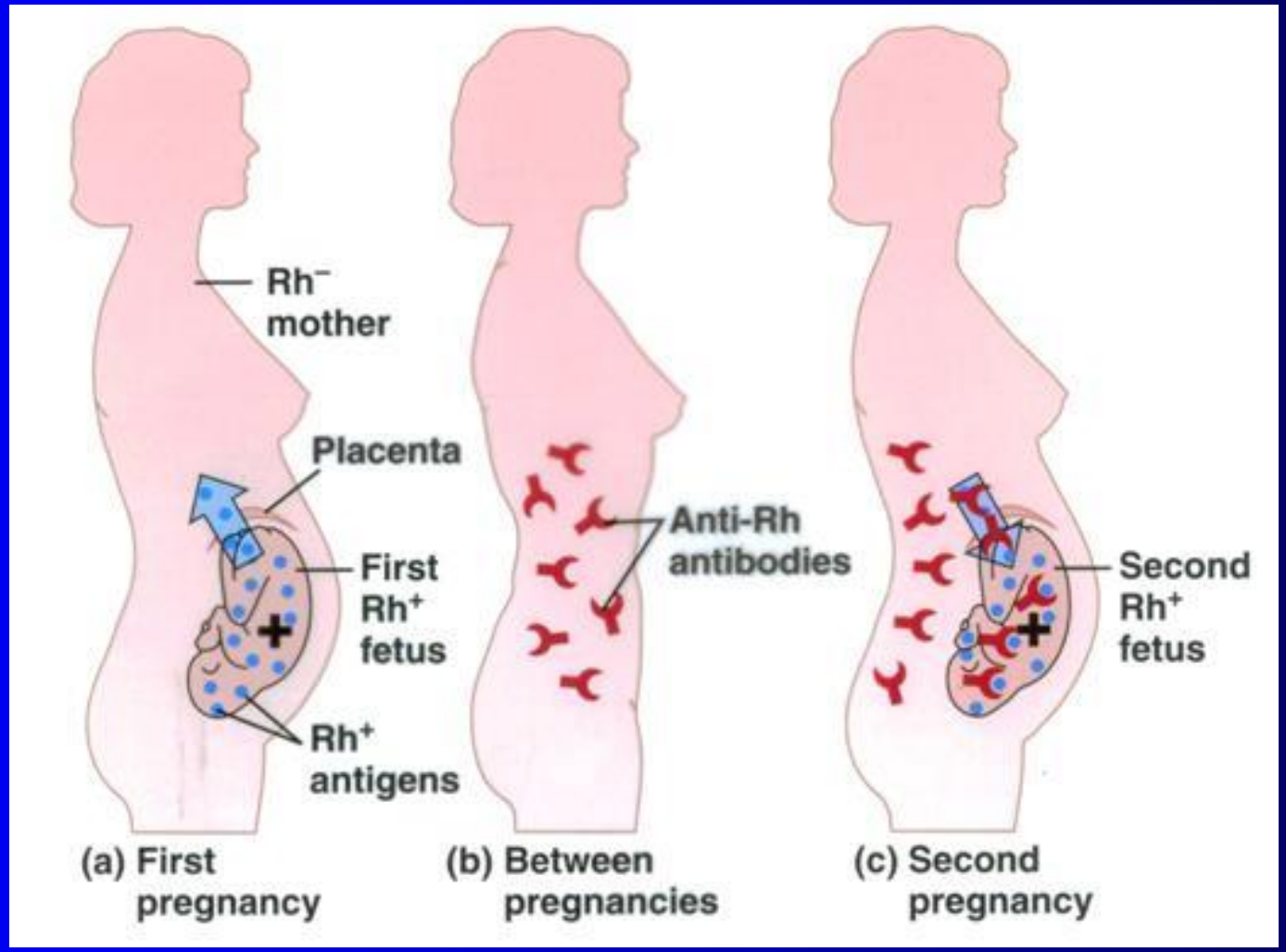
Erythroblastosis foetalis



B. John Ebenezer

Rh Incompatibility

Rho(D) Immunoglobulin

RhoGam

Ultrafiltered
Prefilled
Anti-D Injection

Rh incompatibility develops **only when the mother is Rh-negative and the infant is Rh-positive.**

This could be fatal to the foetus or could cause severe **anaemia** and **jaundice** to the baby.

This condition is called ***erythroblastosis foetalis***.

This can be avoided by administering **anti-Rh antibodies** called **RhoGAM** to the mother immediately after the first delivery.

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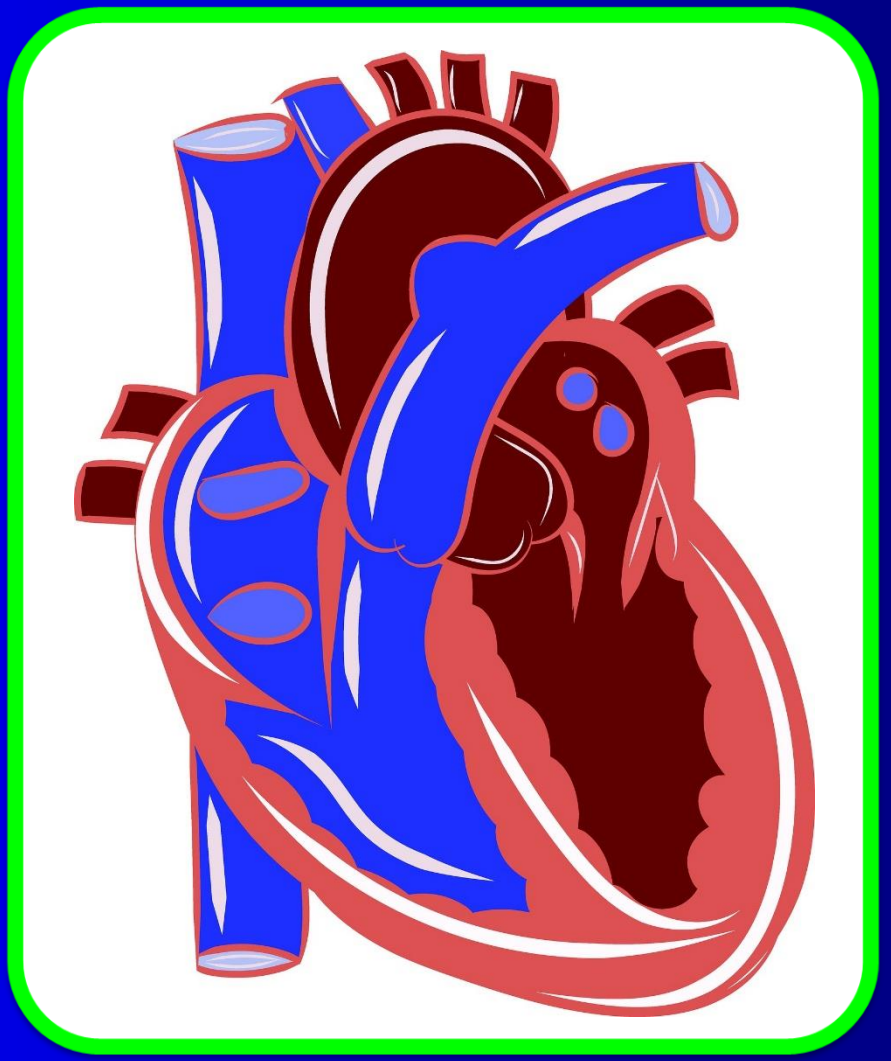
Circulation

Circulatory System



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Patterns of Circulatory System

The circulatory patterns are of two types – open or closed.

Open circulatory system is present in **Arthropods and Molluscs** in which the blood pumped by the heart passes through large vessels into open spaces or body cavities called sinuses.

Closed circulatory system is present in **Annelids and Chordates** in which the blood pumped by the heart is always circulated through a closed network of blood vessels.

This pattern is considered to be more advantageous as the flow of fluid can be more precisely regulated.

B. John Ebenezer

Patterns of Circulatory System

Circulatory System

Open Circulatory system

The blood passes through large vessels into open spaces or body cavities called sinuses

- Arthropods
- Molluscs

Closed Circulatory System

The blood is always circulated through a closed network of blood vessels

- Annelids
- Molluscs

B. John Ebenezer

Chambers of Heart

Fishes have a 2-chambered heart with an atrium and a ventricle.

Amphibians and the reptiles (except crocodiles) have a 3-chambered heart with two atria and a single ventricle.

Crocodiles, birds and mammals have a 4-chambered heart with two atria and two ventricles.

In fishes the heart pumps out deoxygenated blood which is oxygenated by the gills and supplied to the body parts from where deoxygenated blood is returned to the heart (single circulation).

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Chambers of Heart

In amphibians and reptiles, the left atrium receives oxygenated blood from the gills/lungs/skin and the right atrium gets the deoxygenated blood from other body parts.

They get mixed up in the single ventricle which pumps out mixed blood (incomplete double circulation).

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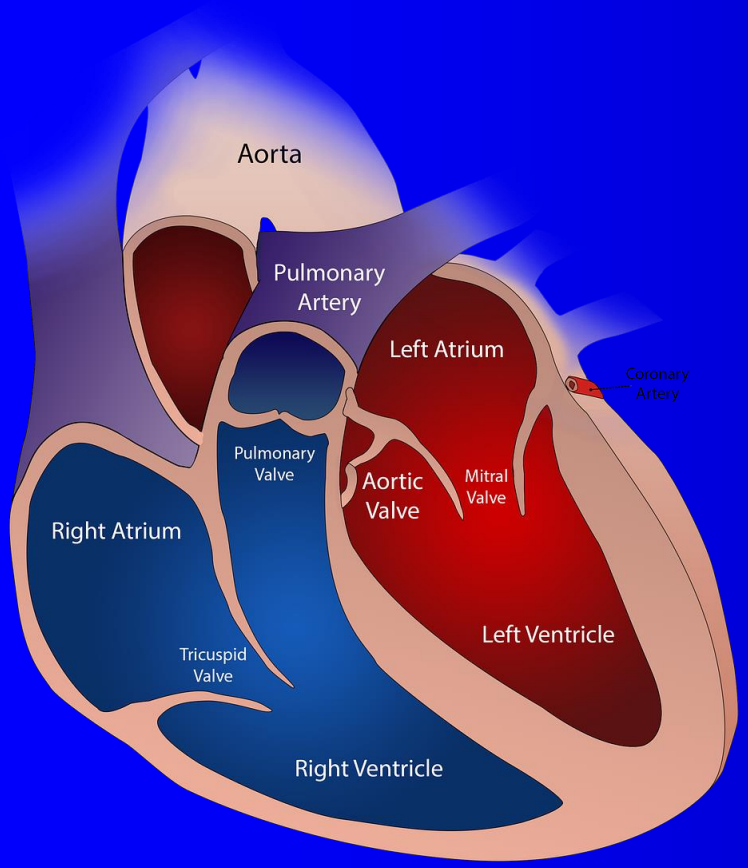
Chambers of Heart



In birds and mammals, oxygenated and deoxygenated blood received by the left and right atria respectively passes on to the ventricles of the same sides.

The ventricles pump it out without any mixing up, i.e., two separate circulatory pathways are present in these organisms, hence, these animals have double circulation.

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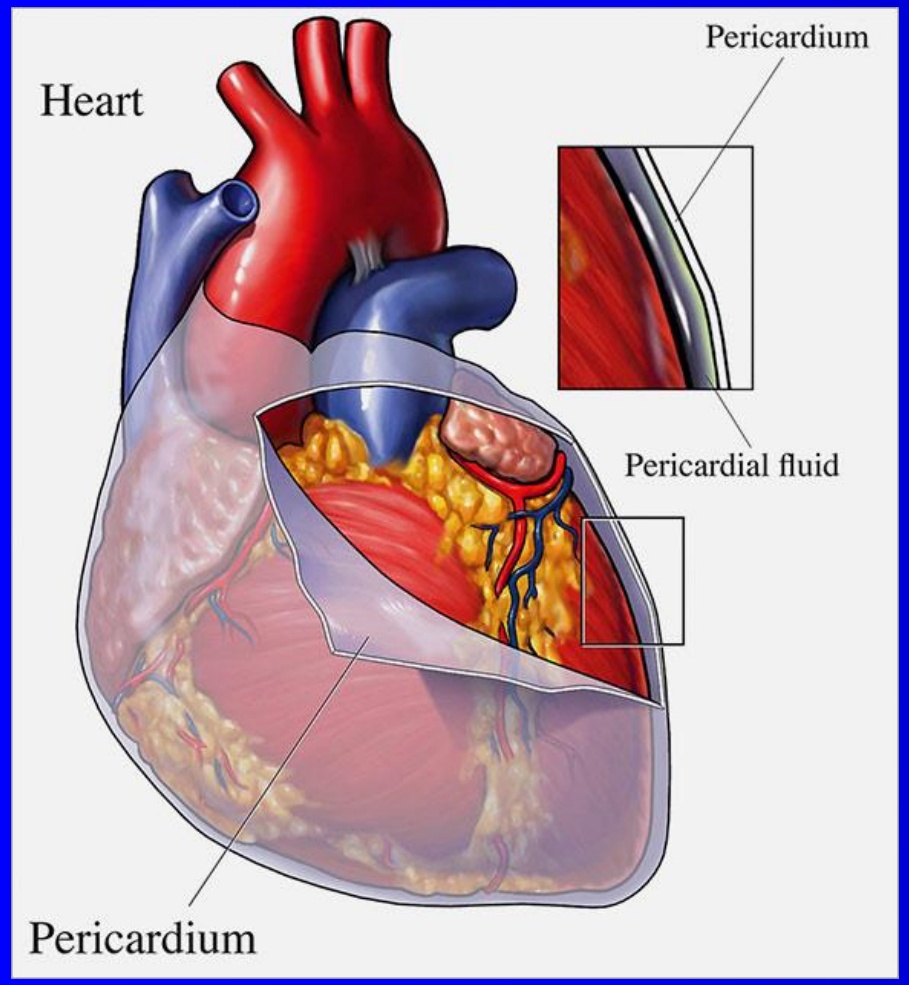
Structure of Heart



Heart, the mesodermally derived organ, is situated in the thoracic cavity, in between the two lungs, slightly tilted to the left.

It has the size of a clenched fist.

It is protected by a double layered membranous bag, **pericardium,** enclosing the pericardial fluid.

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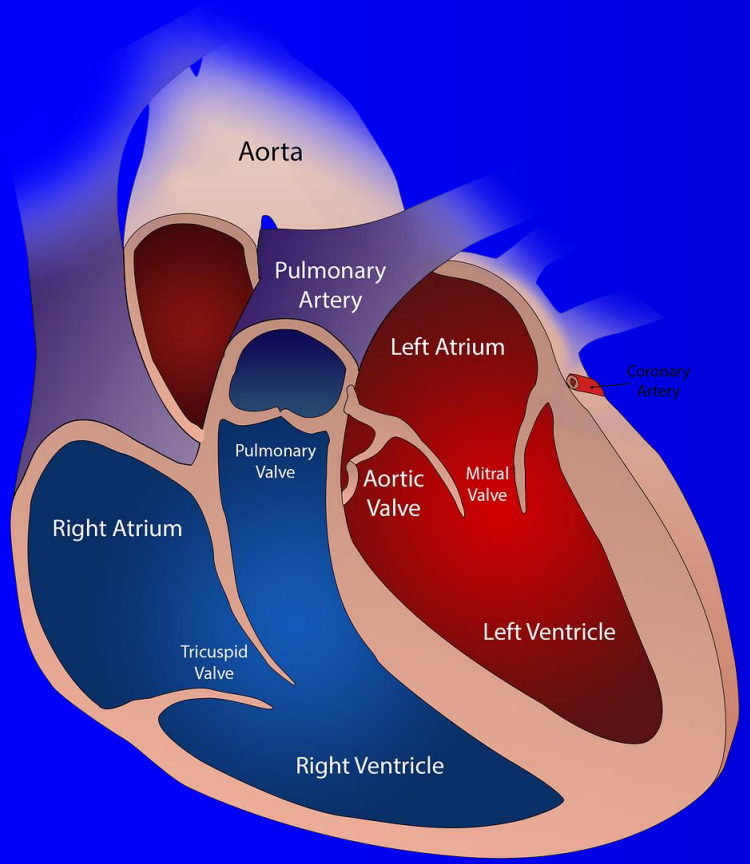
Structure of Heart



Our heart has four chambers.

The two small upper chambers are called **atria**

The two larger lower chambers are called **ventricles**.

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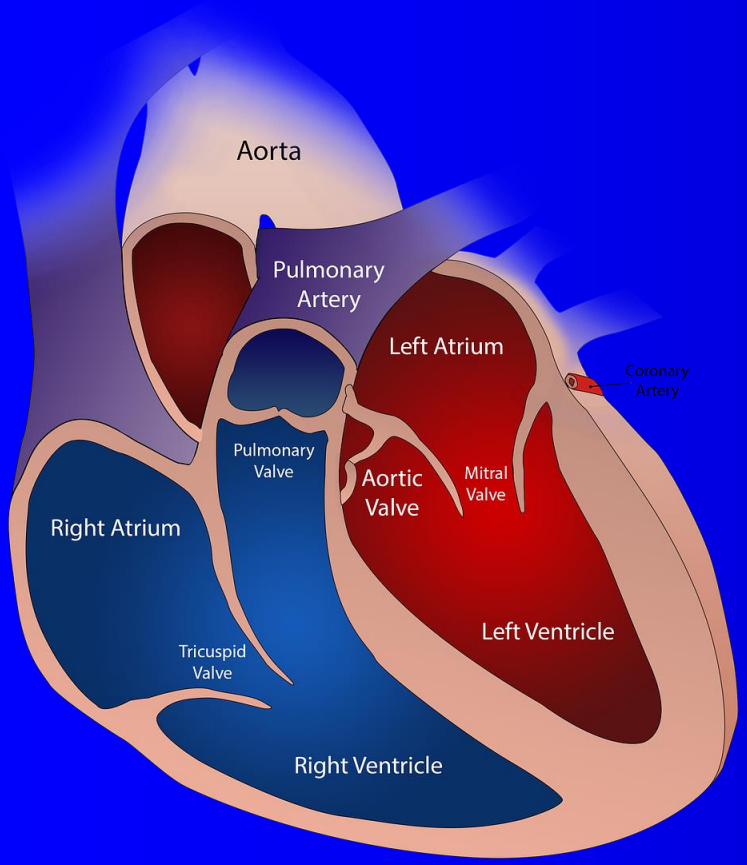
Structure of Heart



A thin walled **Inter-Atrial Septum** separates the right and the left atria.

A thick walled **Inter-Ventricular Septum** separates the left and the right ventricles

The atrium and the ventricle of the same side are also separated by a thick fibrous tissue called the atrio-ventricular septum.

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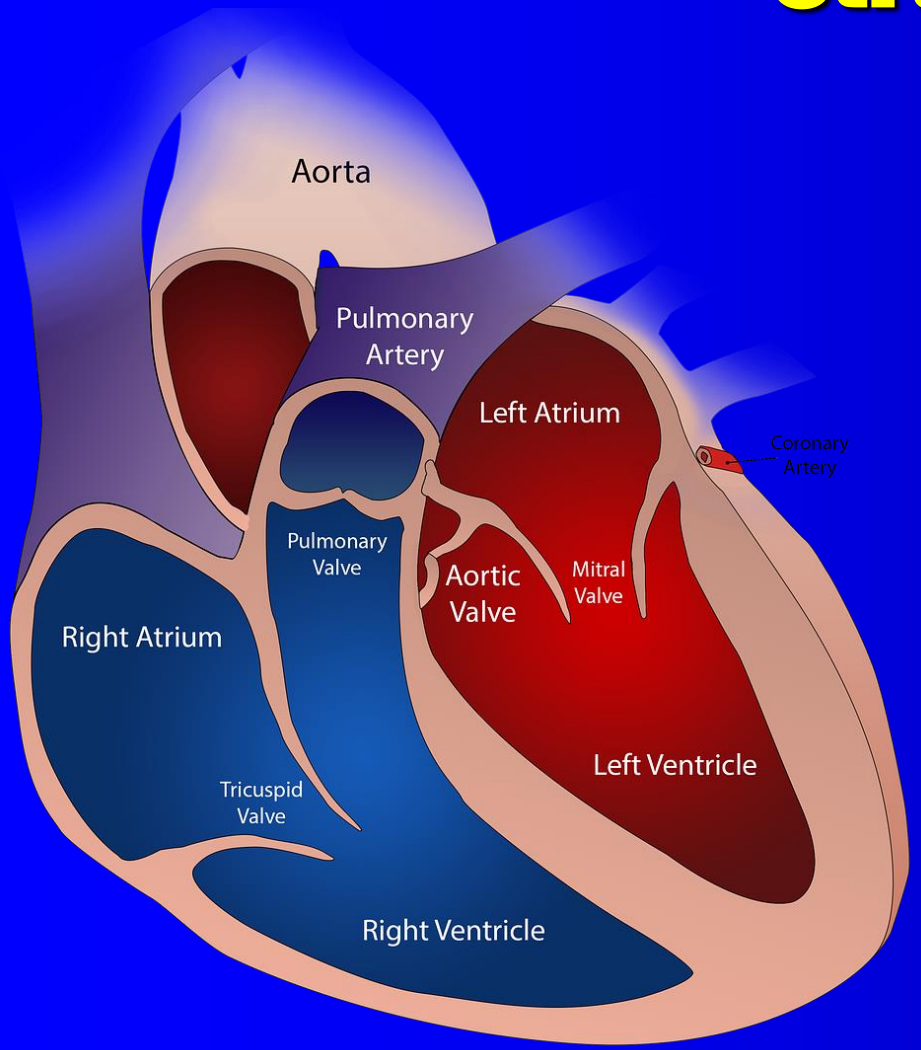
Structure of Heart



The opening between the right atrium and the right ventricle is guarded by a valve formed of three muscular flaps or cusps, the tricuspid valve.

The opening between the left atrium and the left ventricle is guarded by a valve formed of two muscular flaps or cusps, the bicuspid or mitral valve.

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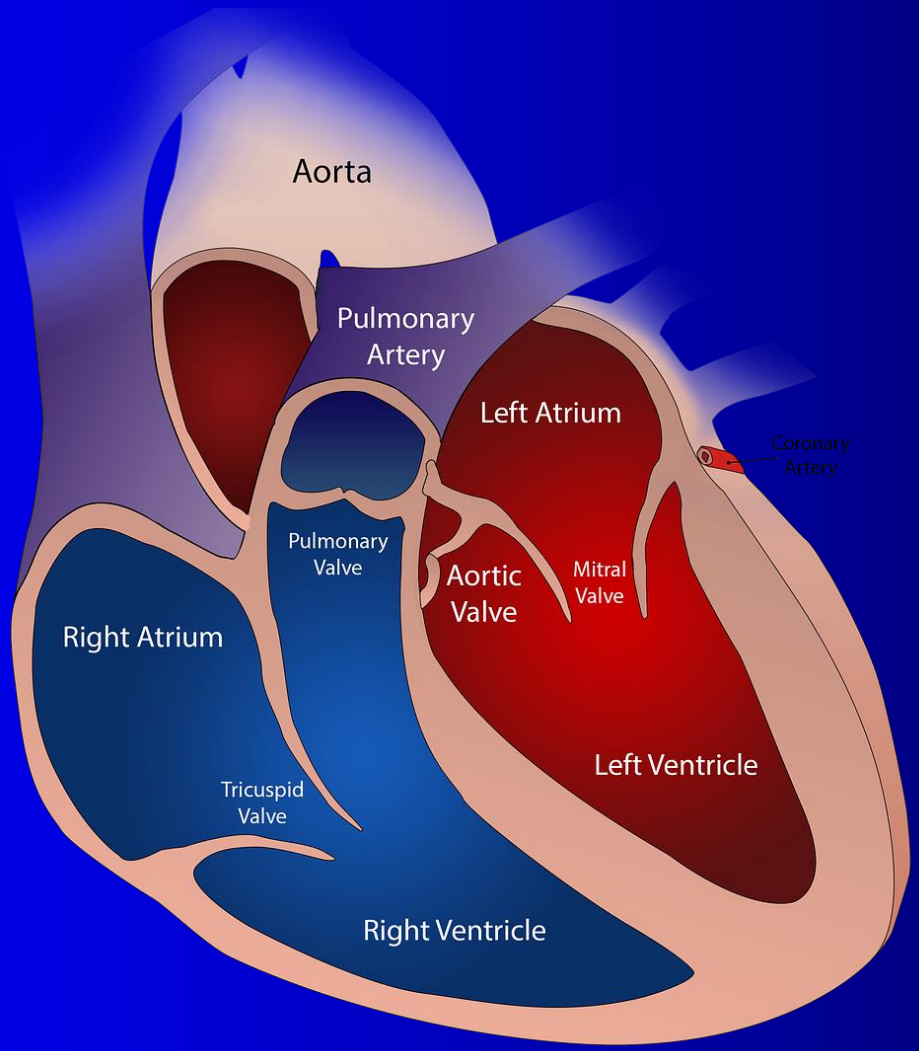
Valves of Heart



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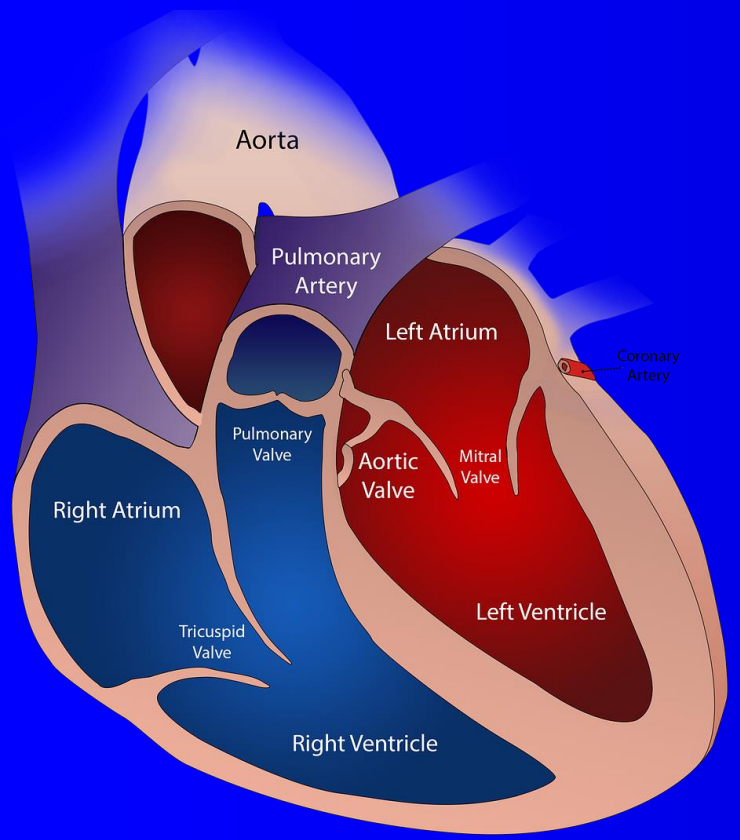
Structure of Heart



The openings of the right ventricle into the pulmonary artery and the left ventricle into the aorta are provided with the semilunar valves.

The valves in the heart allows the flow of blood only in one direction.

These valves prevent backflow of blood.

The entire heart is made of cardiac muscles. The walls of ventricles are much thicker than that of the atria.

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The walls of the ventricles are much thicker than the walls of atria as the ventricles have to pump blood into various organs of the body.

Valves prevent the back flow of blood when the atria or ventricles contract.

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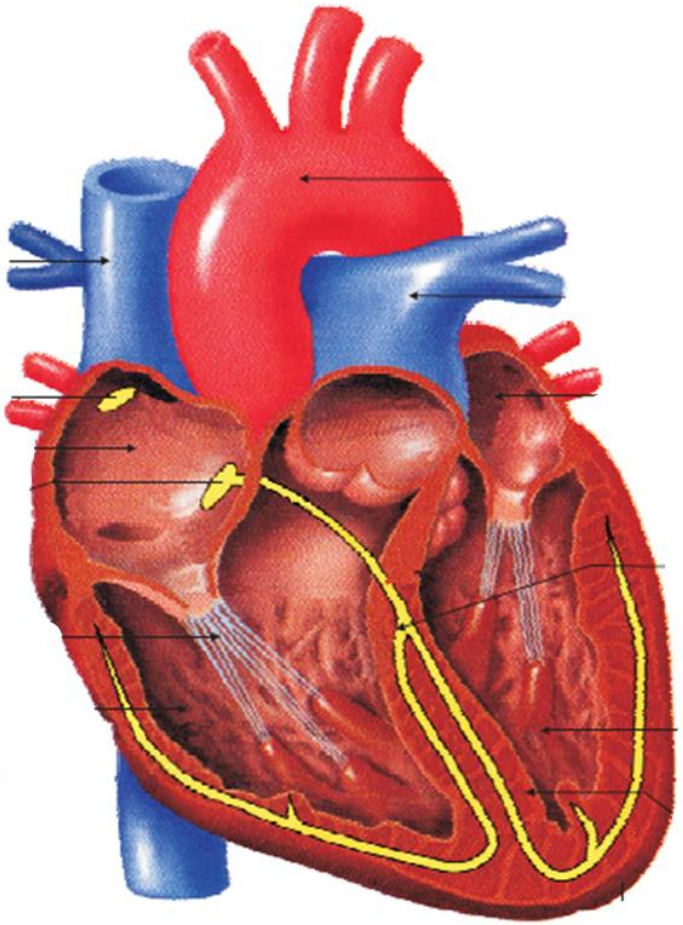
Electrical System of Heart

Nodal Tissue



A specialised cardiac musculature called the nodal tissue is distributed in the heart.

A patch of this tissue is present in the right upper corner of the right atrium called the **Sino-Atrial Node (SAN).**

Another mass of this tissue is seen in the lower left corner of the right atrium close to the atrio-ventricular septum called the **Atrio Ventricular Node (AVN).**

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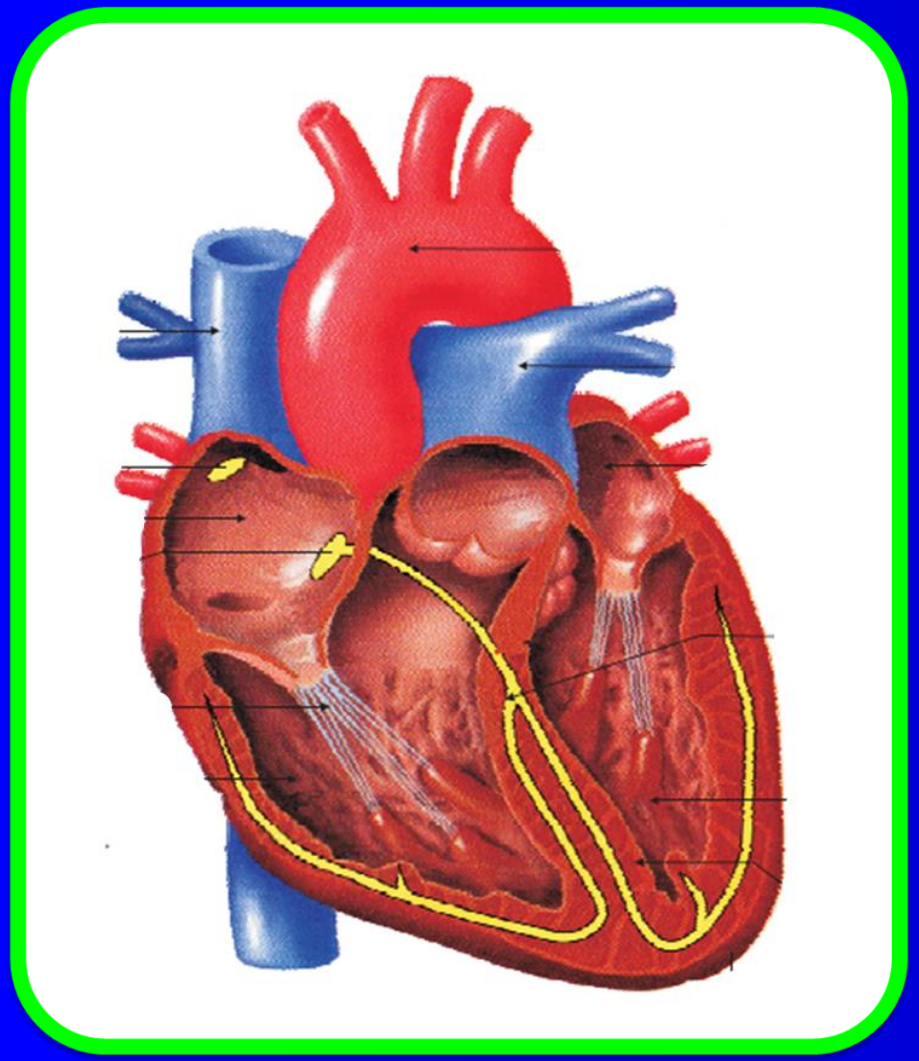
Sino Atrial Node



Sino-Atrial Node (SAN) is located in the upper right corner of the right atrium.

The SAN can generate the maximum number of action potentials, i.e., 70-75 min^{-1}, and is responsible for initiating and maintaining the rhythmic contraction of the heart.

Therefore, it is called the pacemaker.

Our heart normally beats 70-75 times in a minute (average 72 beats min^{-1}).

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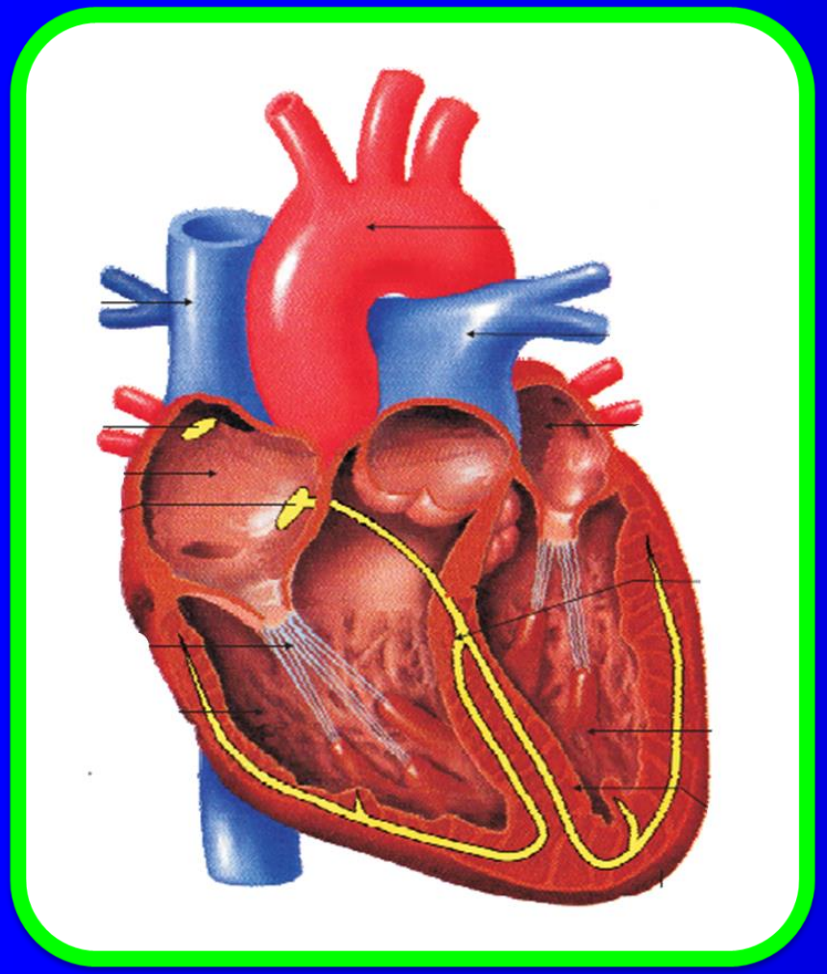
Atrio Ventricular Node



Atrio Ventricular Node (AVN) is located in the lower left corner of the right atrium close to the atrio-ventricular septum.

The AV node continues as Atrioventricular bundle (AV bundle) or bundle of HIS which passes through the atrio-ventricular septum and interventricular septum.

The AV bundle immediately divides into a right and left bundles.

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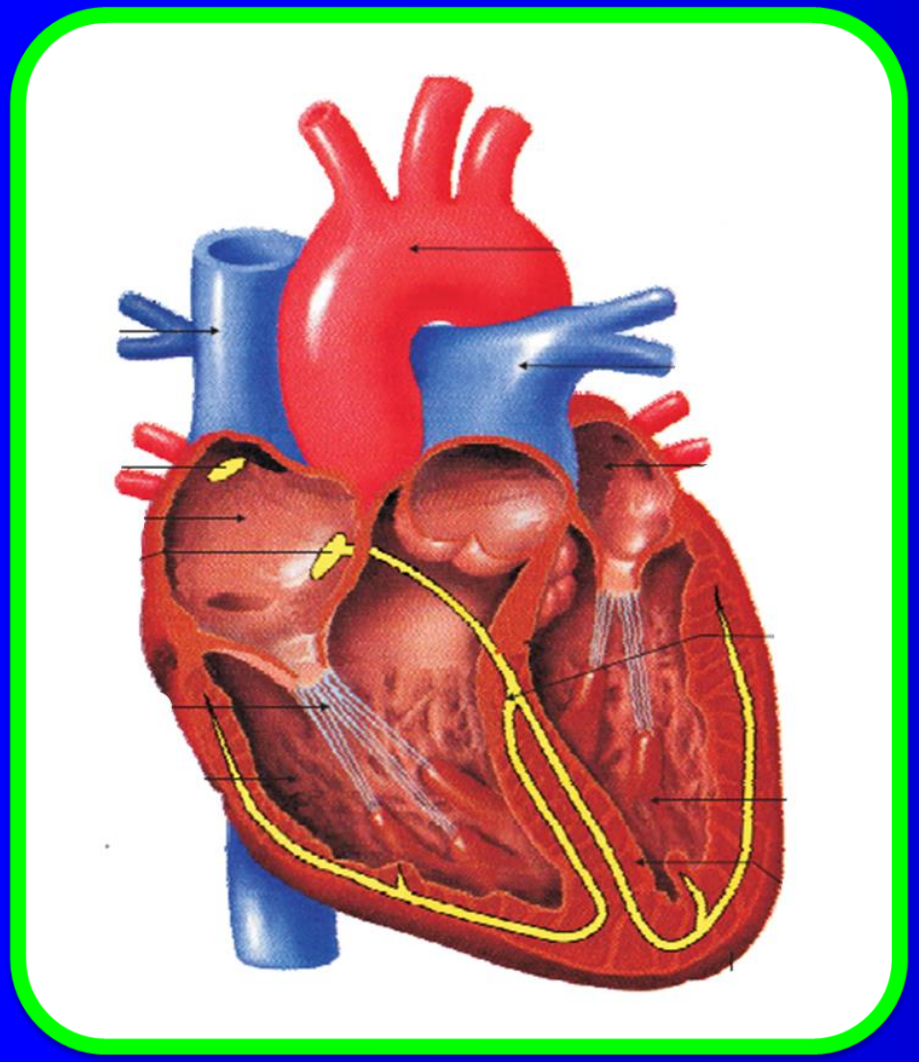
Atrio Ventricular Node



The right and left branches give rise to minute fibres throughout the ventricular muscles of the respective sides and are called purkinje fibres.

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Polarisation, Depolarisation and Repolarisation

Polarization is the existence of opposite electrical charges on either side of a cell membrane.

Depolarization is the state in which the cell membrane changes from positive to negative charge outside the cell membrane and from negative to positive charge inside the cell membrane.

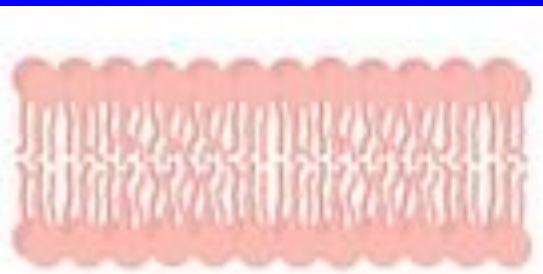
Repolarization is the state in which the cell membrane change back to its resting stage i.e from negative to positive charge outside the cell and from positive to negative charge inside the cell.

B. John Ebenezer

Polarisation, Depolarisation and Repolarisation

Polarisation

+ OUT

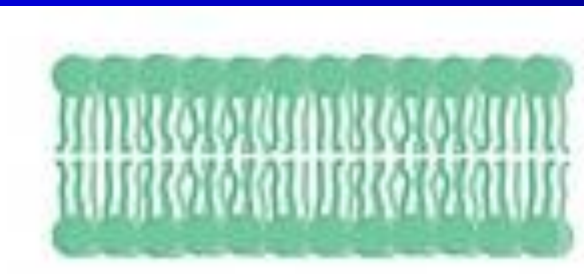


- IN

Polarization is the existence of opposite electrical charges on either side of a cell membrane

Depolarisation

- IN



+ OUT

Cell membrane changes from positive to negative charge outside and from negative to positive charge inside the cell membrane.

Repolarisation

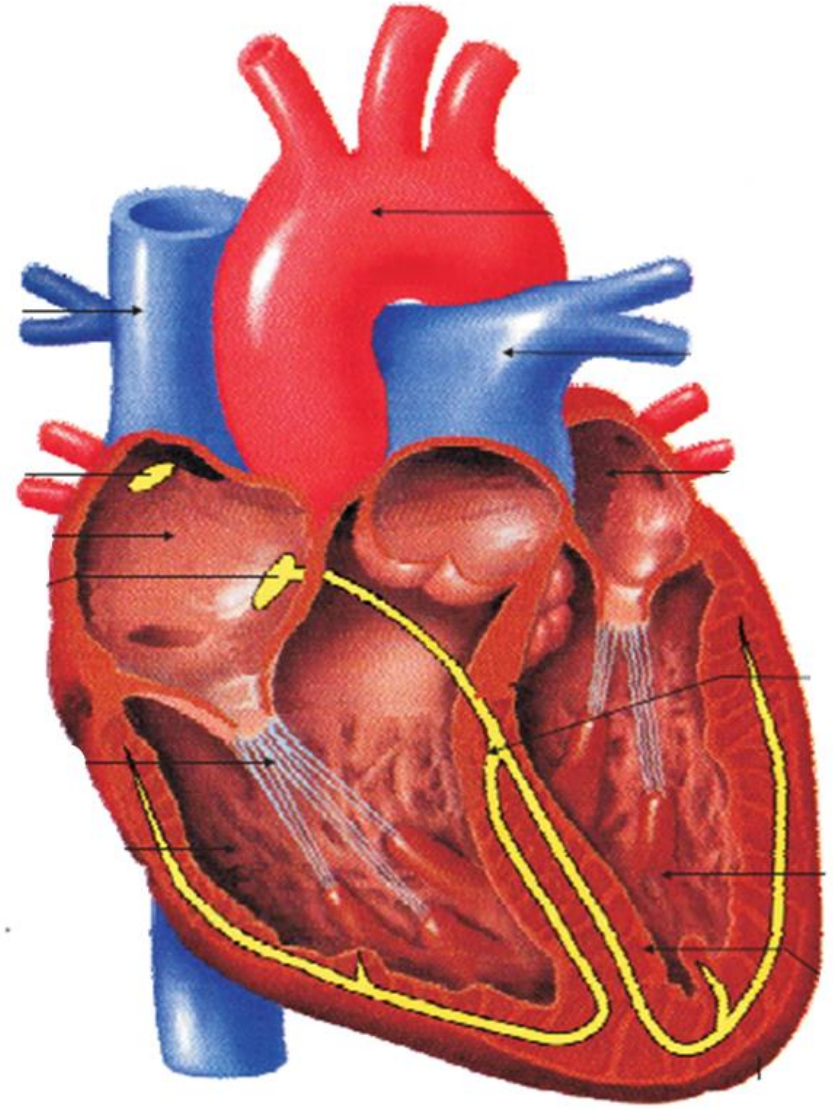
+ OUT

- IN

cell membrane changes from negative to positive charge outside and from positive to negative charge inside the cell membrane

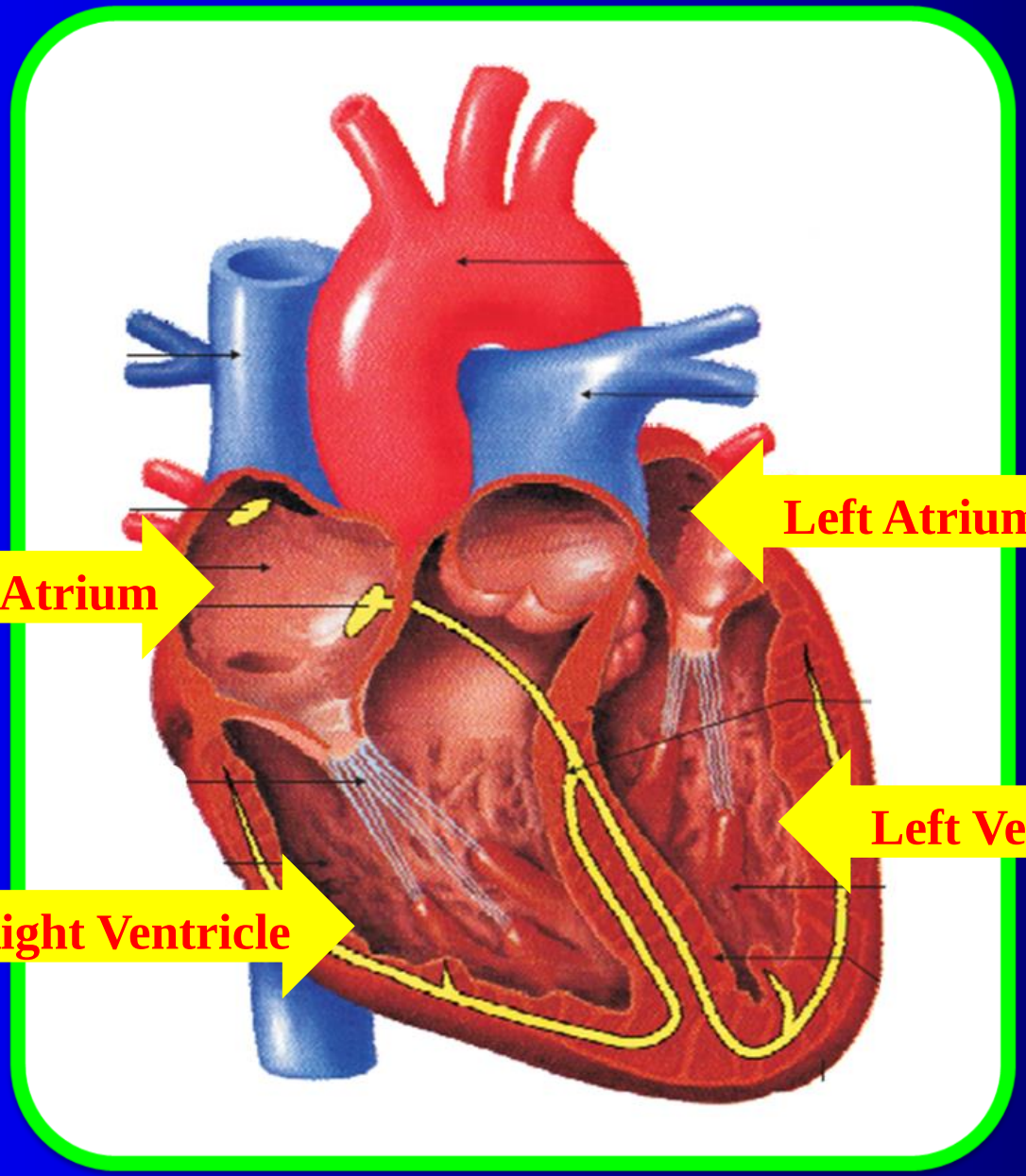
B. John Ebenezer

Heart



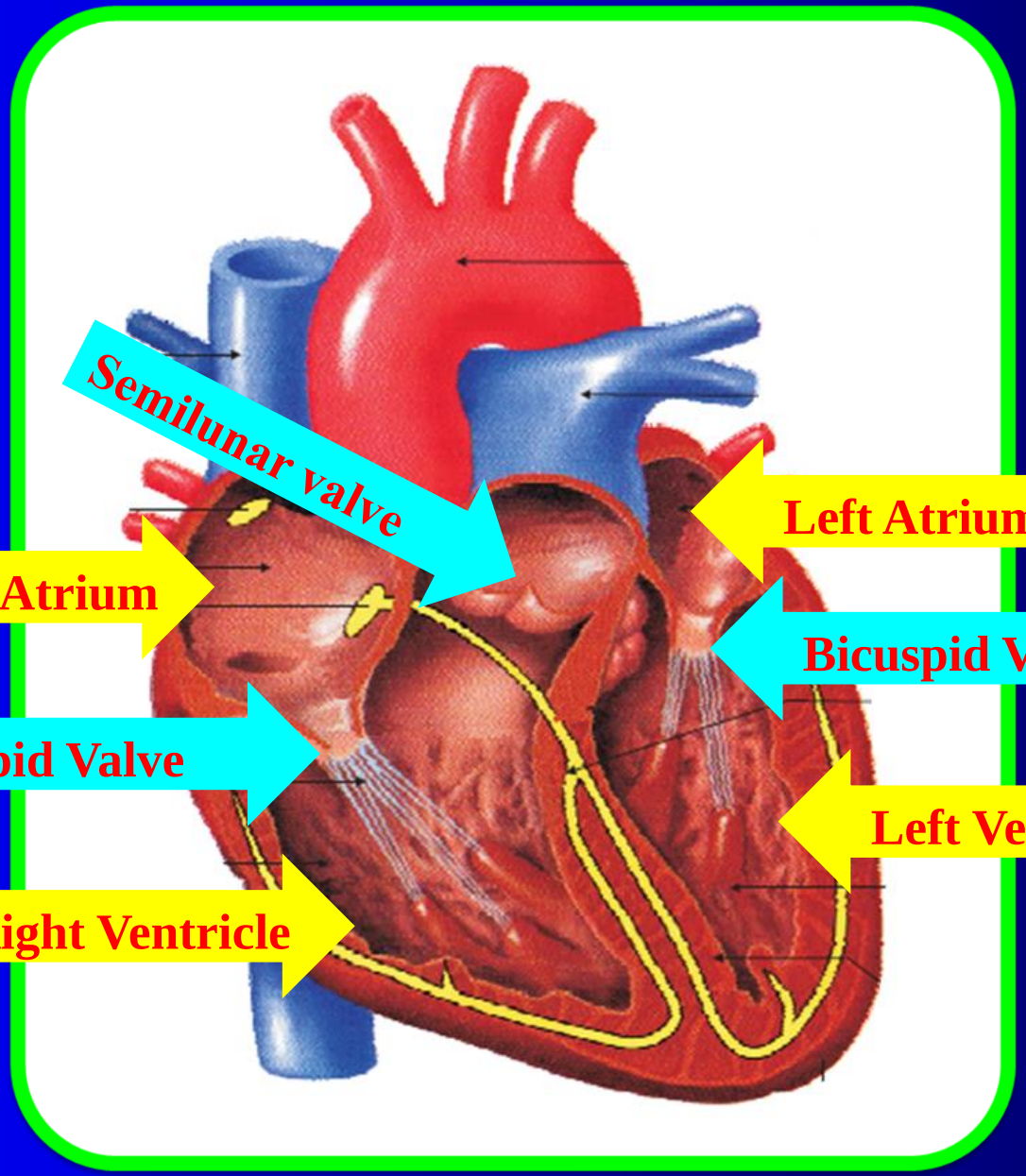
B. John Ebenezer

Heart



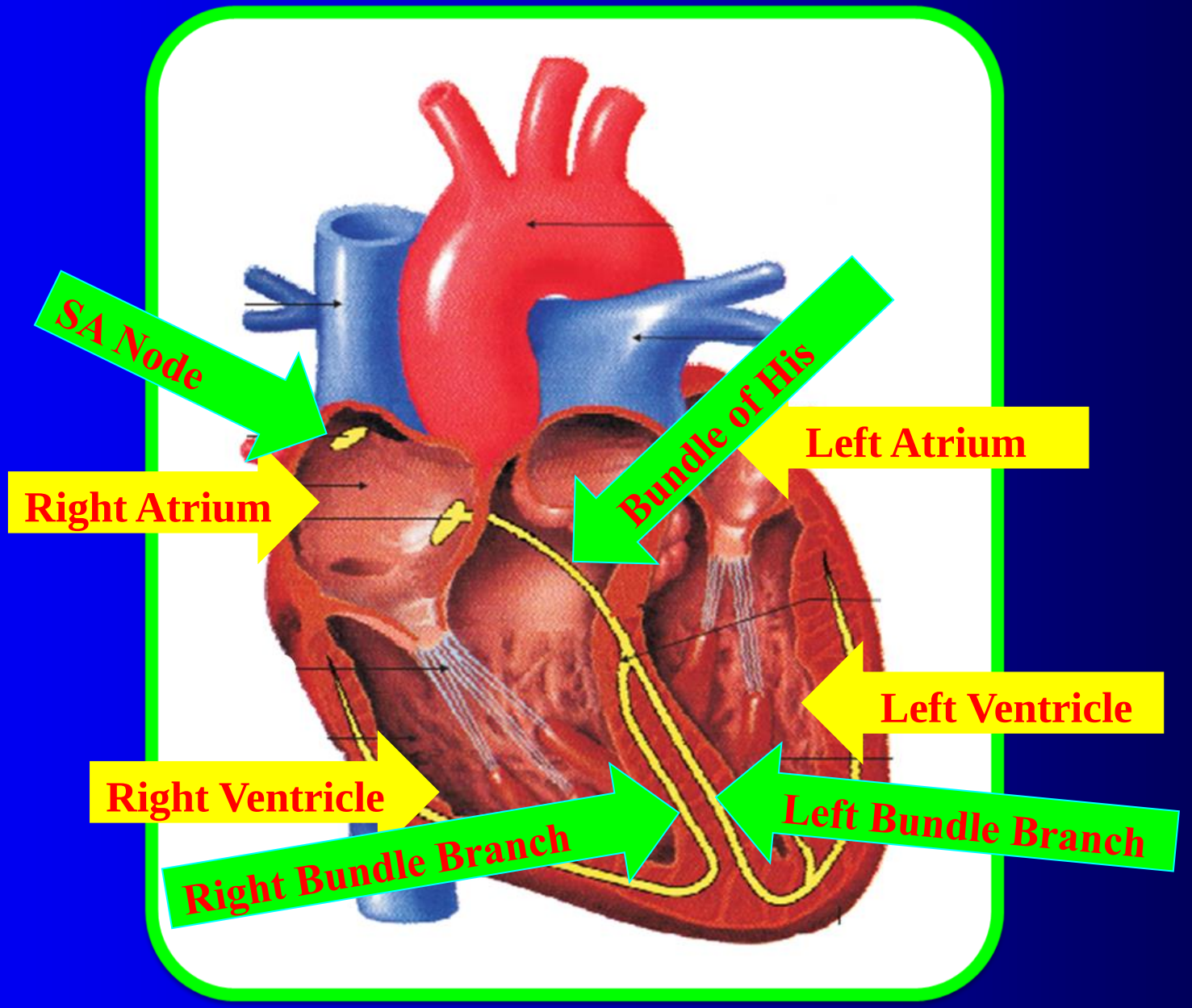
B. John Ebenezer

Heart



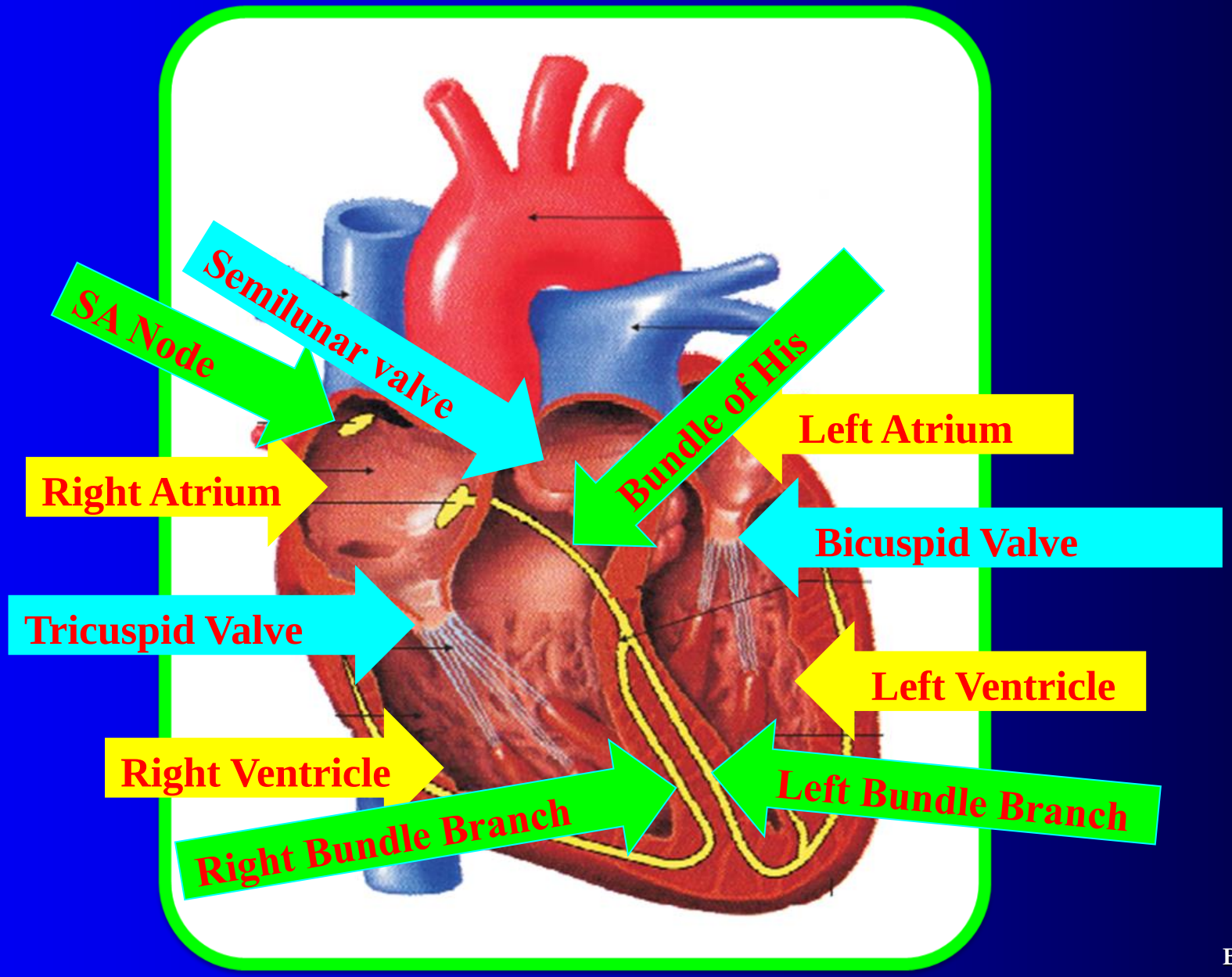
B. John Ebenezer

Heart



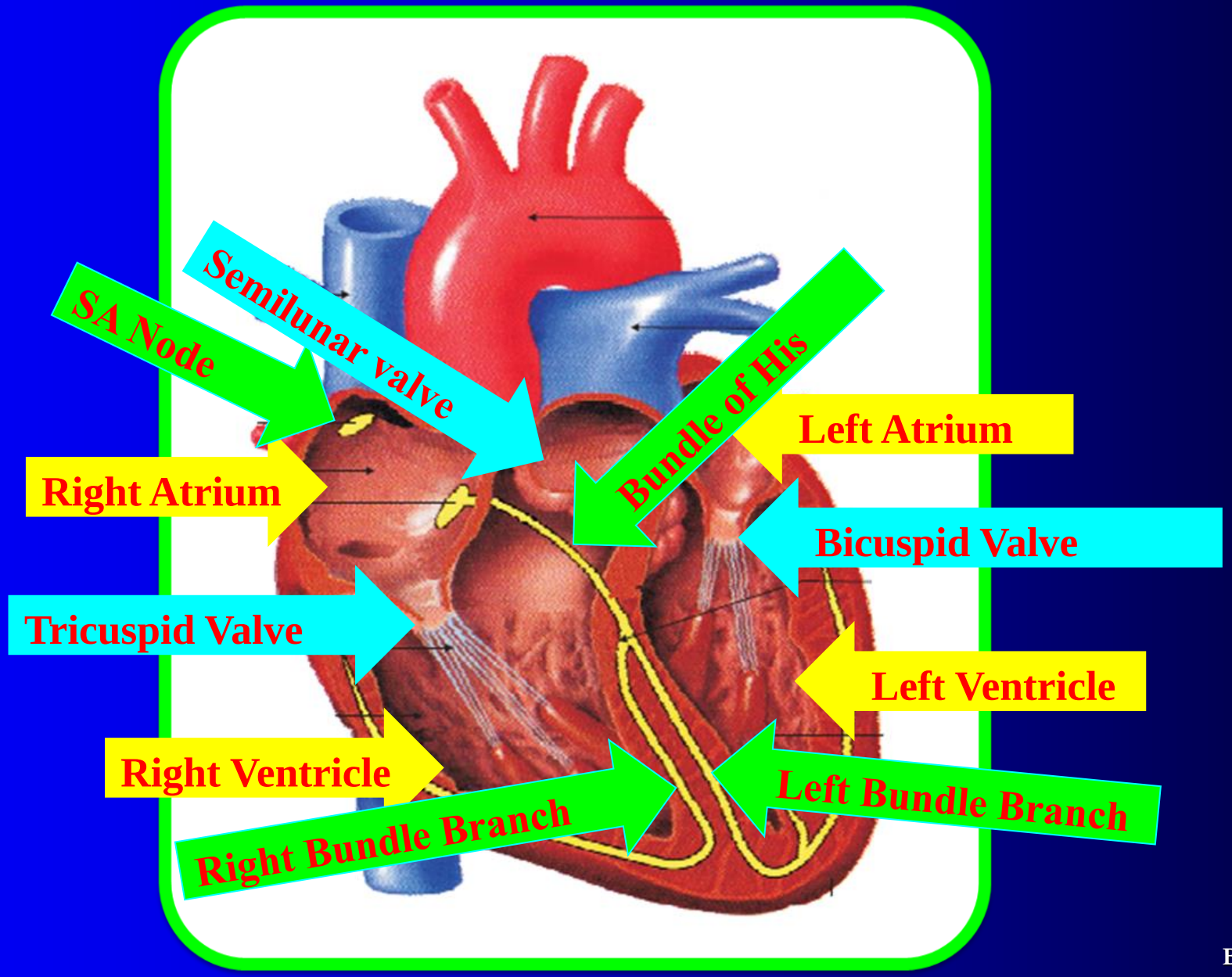
B. John Ebenezer

Heart



B. John Ebenezer

Heart



B. John Ebenezer

Cardiac Cycle

Cardiac Cycle

As the tricuspid and bicuspid valves are open, blood from the pulmonary veins and vena cava flows into the left and the right ventricle respectively through the left and right atria.

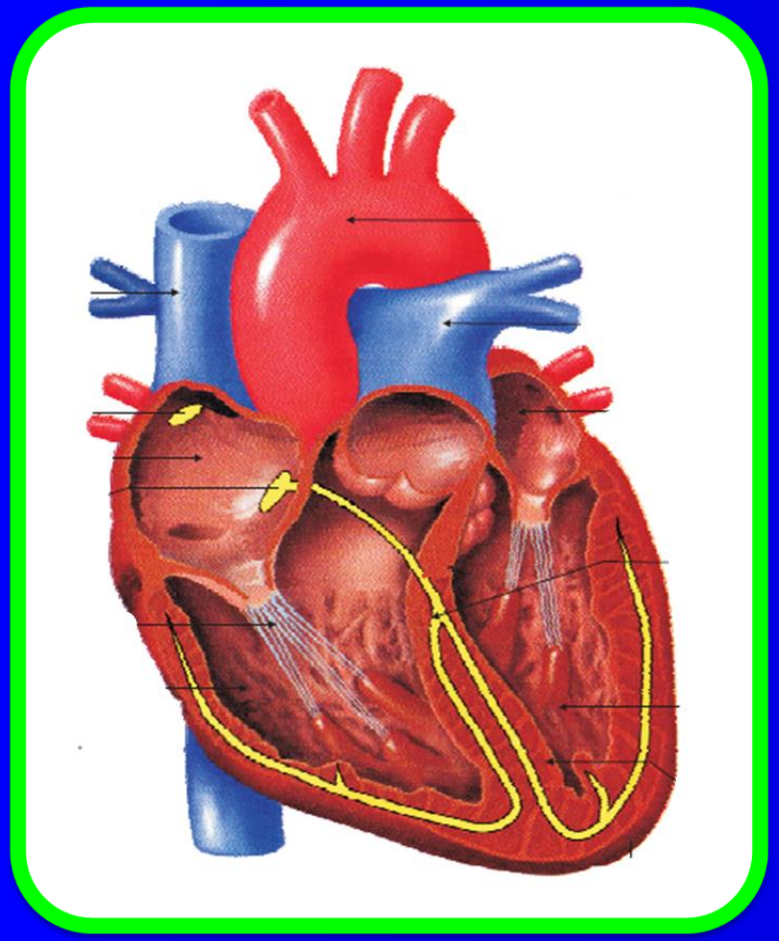
The semilunar valves are closed at this stage.

The SAN now generates electrical impulse which stimulates both the atria to undergo a simultaneous contraction – the atrial systole.

This increases the flow of blood into the ventricles by about 30 per cent.

B. John Ebenezer

Cardiac Cycle



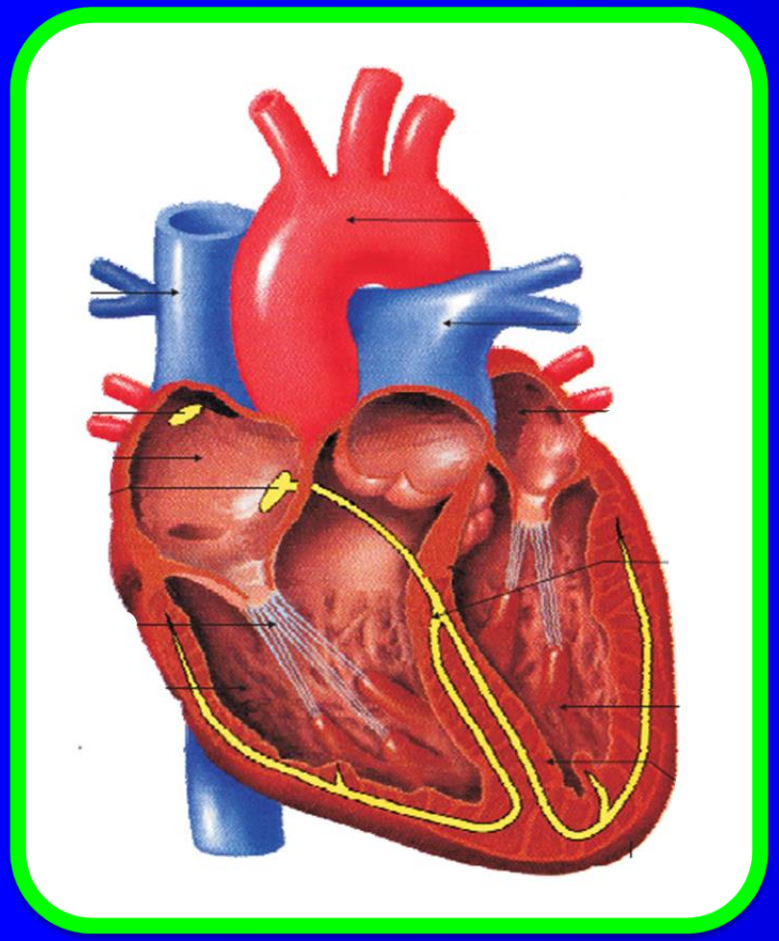
Atrio Ventricular Node (AVN) is located in the lower left corner of the right atrium close to the atrio-ventricular septum.

The AV node continues as Atrioventricular bundle (AV bundle) or bundle of HIS which passes through the atrio-ventricular septum and interventricular septum.

The AV bundle immediately divides into right and left bundles.

B. John Ebenezer

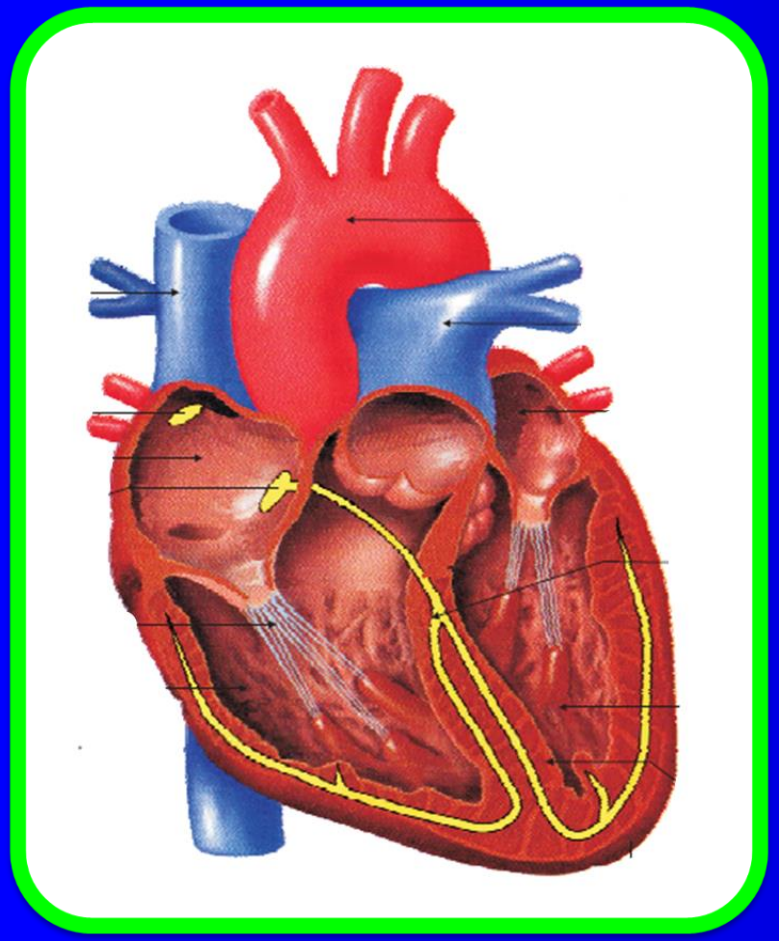
Cardiac Cycle



Electrical impulse is conducted to the ventricular side by the AVN and AV bundle from where the bundle of HIS transmits it through the entire ventricular musculature.

B. John Ebenezer

Cardiac Cycle

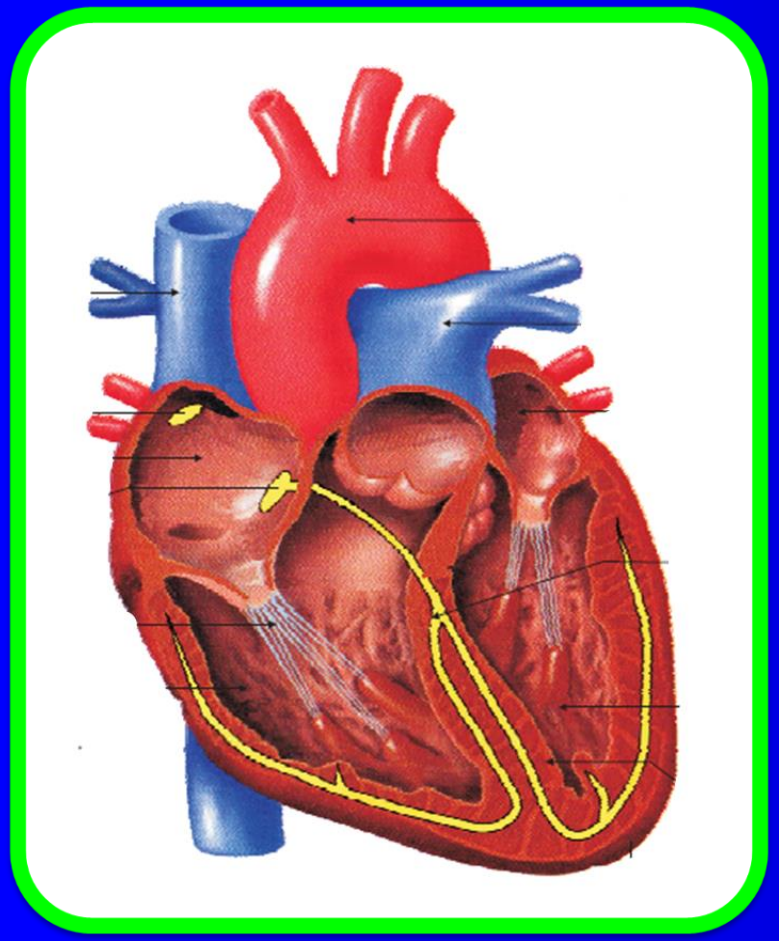


This causes the ventricular muscles to contract, (ventricular systole), the atria undergoes relaxation (diastole), coinciding with the ventricular systole.

Ventricular systole increases the ventricular pressure causing the closure of tricuspid and bicuspid valves due to attempted backflow of blood into the atria.

B. John Ebenezer

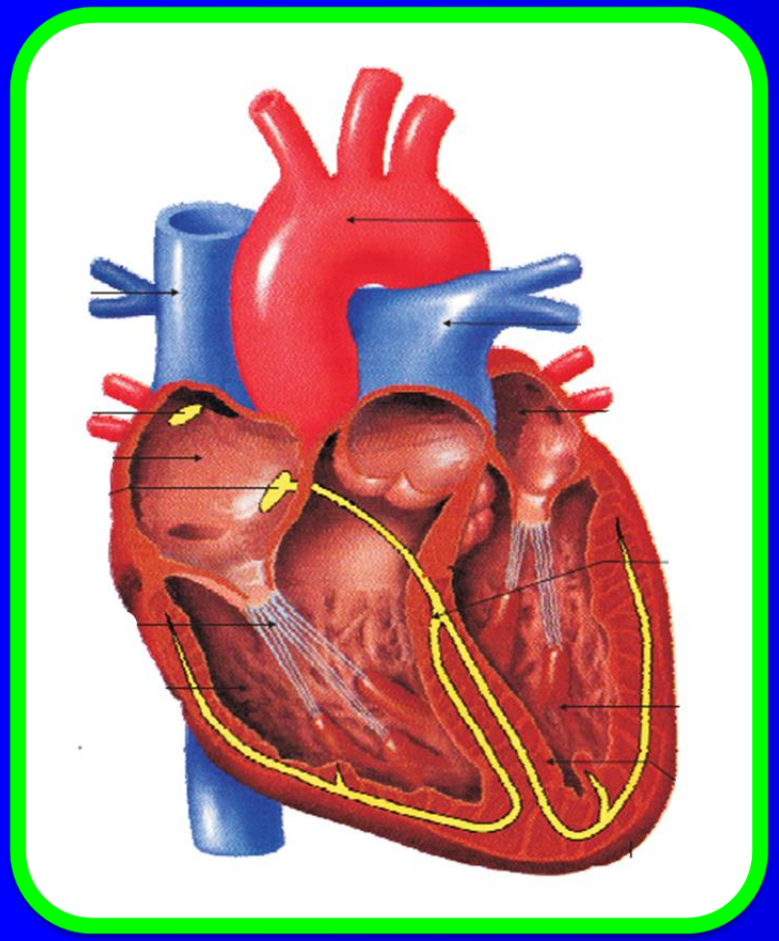
Cardiac Cycle



As the ventricular pressure increases further, the semilunar valves guarding the pulmonary artery (right side) and the aorta (left side) are forced open, allowing the blood in the ventricles to flow through these vessels into the circulatory pathways.

B. John Ebenezer

Cardiac Cycle



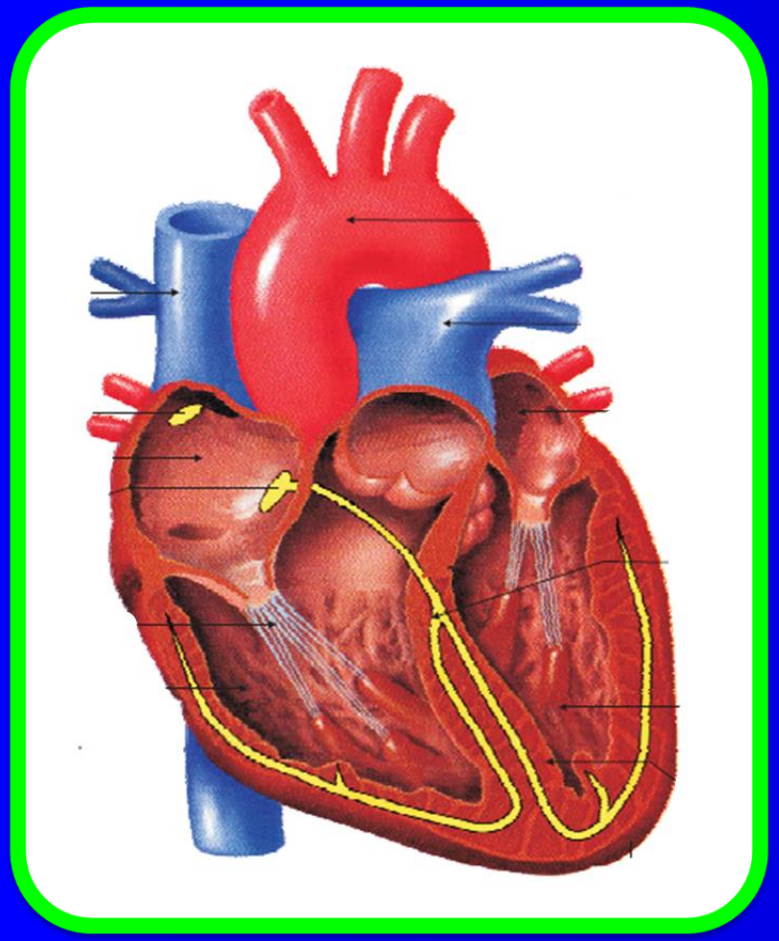
The ventricles now relax (ventricular diastole) and the ventricular pressure falls causing the closure of semilunar valves which prevents the backflow of blood into the ventricles.

As the ventricular pressure declines further, the tricuspid and bicuspid valves are pushed open by the pressure in the atria exerted by the blood which was being emptied into them by the veins.

The blood now once again moves freely to the ventricles.

B. John Ebenezer

Cardiac Cycle

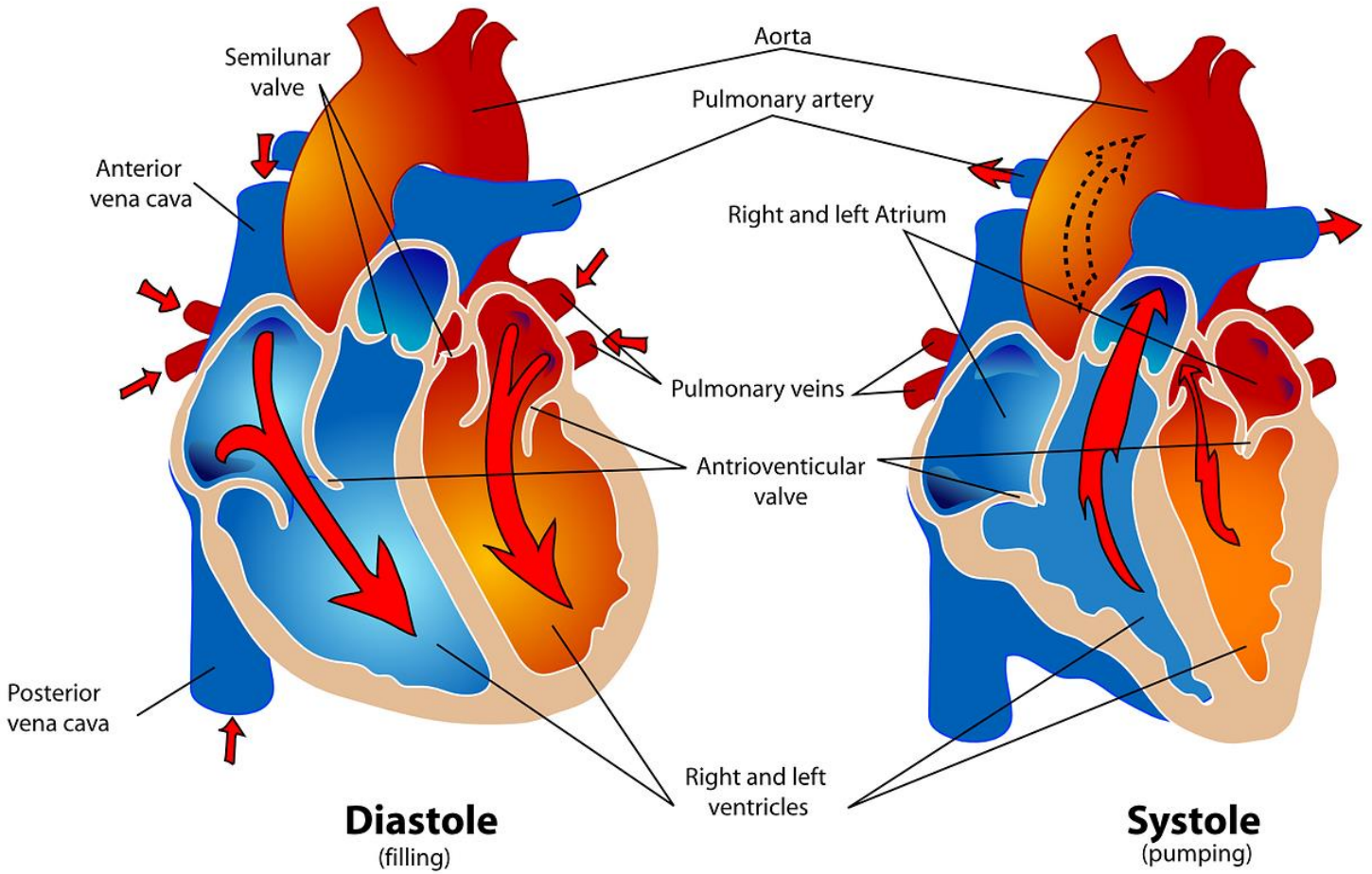


The ventricles and atria are now again in a relaxed (joint diastole) state, as earlier.

Soon the SAN generates a new action potential and the events described above are repeated in that sequence and the process continues.

B. John Ebenezer

Diastole and Systole



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Cardiac Cycle

Joint Diastole
All the four Chambers are relaxed

Deoxygenated blood enters Right Atrium through Vena Cavae

SA Node produces Electric Impulse

Atrial Systole
Both the Atria contracts Simultaneously

Blood enters Ventricles

Electrical Impulse reaches the Ventricles through AV Node

Ventricular Systole
Ventricles contract

Blood enters Lungs through Pulmonary Artery

Blood enters the Body through Aorta

Blood enters Left Atrium through Pulmonary Vein

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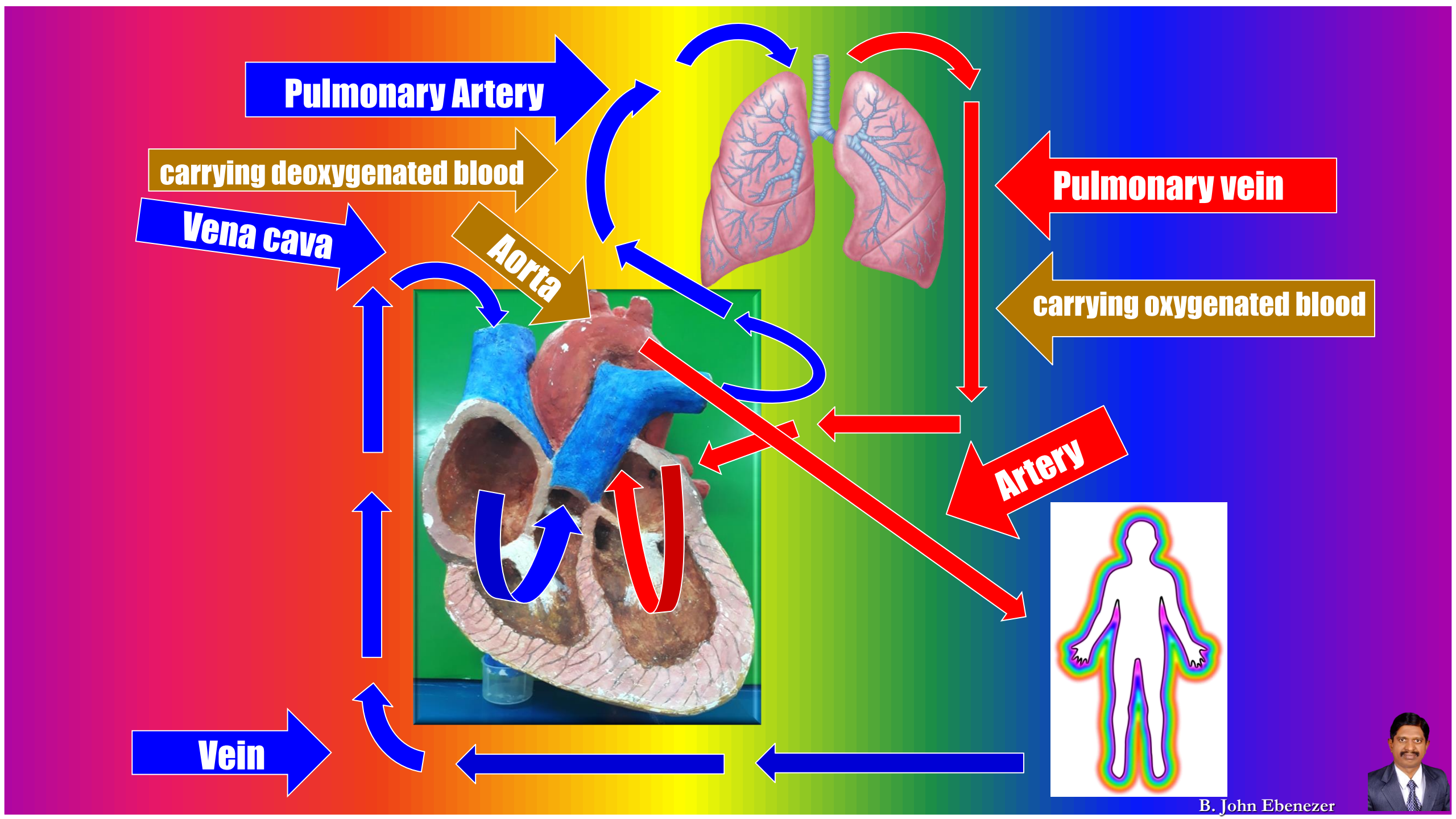
Pulmonary Artery
carrying deoxygenated blood
Vena cava
Aorta
Pulmonary vein
carrying oxygenated blood
Artery
Vein
B. John Ebenezer

Cardiac Cycle

This sequential event in the heart which is cyclically repeated is called the cardiac cycle and it consists of systole and diastole of both the atria and ventricles.

The heart beats 72 times per minute.

The duration of a cardiac cycle is **0.8 seconds**.

During a cardiac cycle, each ventricle pumps out approximately **70 mL** of blood which is called the stroke volume.

B. John Ebenezer

Cardiac Cycle

The stroke volume multiplied by the heart rate (no. of beats per min.) gives the cardiac output.

Therefore, the **cardiac output** can be defined as the **volume of blood pumped out** by each ventricle **per minute.**

This averages **5000 mL or 5 litres** in a healthy individual.

The body has the ability to alter the **stroke volume** as well as the **heart rate** and thereby the **cardiac output**.

The cardiac output of an athlete is much higher than that of an ordinary man.

B. John Ebenezer

Cardiac Cycle

During each cardiac cycle two prominent sounds are produced which can be easily heard through a stethoscope.

The first heart sound (lub) is caused by the closure of the bicuspid and tricuspid valves.

The second heart sound (dub) is caused by the closure of the semilunar valves.

These sounds have clinically diagnostic significance. These sounds provide information about the condition and working of the heart.

B. John Ebenezer

Electrocardiogram

ECG

In 1901, Willem Einthoven, a Dutch physician, invented the first practical electrocardiograph and received the Nobel Prize in Medicine in 1924 for his electrocardiography work.

ECG is a graphical representation of the electrical activity of the heart during a cardiac cycle.

To obtain a standard ECG the a patient is connected to the machine with three electrical leads (to each wrist and to the left ankle) that continuously monitor the heart activity.

B. John Ebenezer

ECG

Multiple leads are attached to the chest region for a detailed evaluation of the heart's function.

Each peak in the ECG is identified with a letter from **P to T** that corresponds to a specific electrical activity of the heart.

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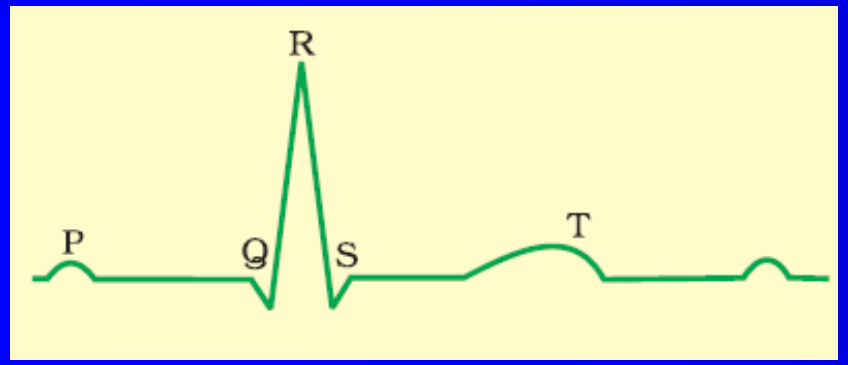
PQRST Waves



A typical human electrocardiogram has five waves – P, Q, R, S, and T.

The P, R, and T-waves are above the base line and are known as **positive waves**.

The Q and S-waves are below the base line and are known as **negative waves**.

The P-wave is of atrial origin, while the Q, R, S, and T-waves are of ventricular origin.

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PQRST Waves

The P-wave represents the electrical **excitation or depolarization of the atria**, which leads to the **contraction of both the atria**.

The QRS complex represents the electrical **excitation or depolarization of the ventricles**, which leads to the **ventricular contraction**.

The contraction starts shortly after Q and marks the beginning of the systole.

The T-wave represents the **return of the ventricles** from excited to normal state (**repolarization or ventricular relaxation**).

The end of the T-wave marks the end of systole.

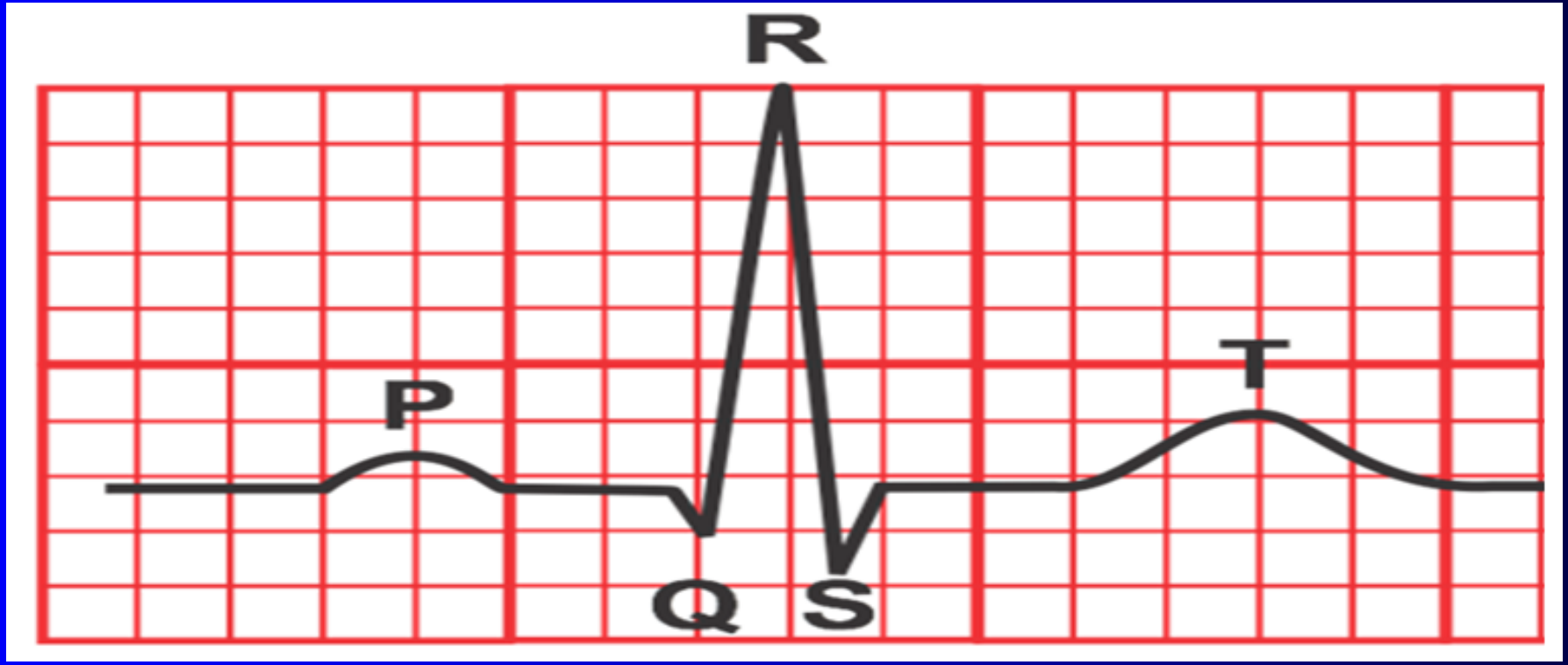
B. John Ebenezer

Electrocardiogram

Atrial Depolarization — Atrial Contraction

Ventricular Depolarization — Ventricular Contraction

Ventricular Repolarization — Ventricular Relaxation



Ventricular Systole

Ventricular Diastole

B. John Ebenezer

ECG

We can determine the heart beat rate of an individual by **counting the number of QRS complexes** that occur in a given time period.

The ECGs obtained from different individuals have roughly the same shape for a given lead configuration.

So, any deviation from this shape indicates a possible abnormality or disease.

Hence, it is of a great clinical significance.

B. John Ebenezer

Double Circulation

Pulmonary and Systemic Circulations

The deoxygenated blood from right ventricle enters the lungs through pulmonary artery. The oxygenated blood from the lungs enters the left atrium through pulmonary vein. This pathway of blood is known as pulmonary circulation.

The oxygenated blood from left ventricle enters the tissues through aorta, arteries, arterioles and capillaries. The deoxygenated blood from the tissues enters the right atrium through venules, veins and vena cava. This pathway of blood is known as systemic circulation

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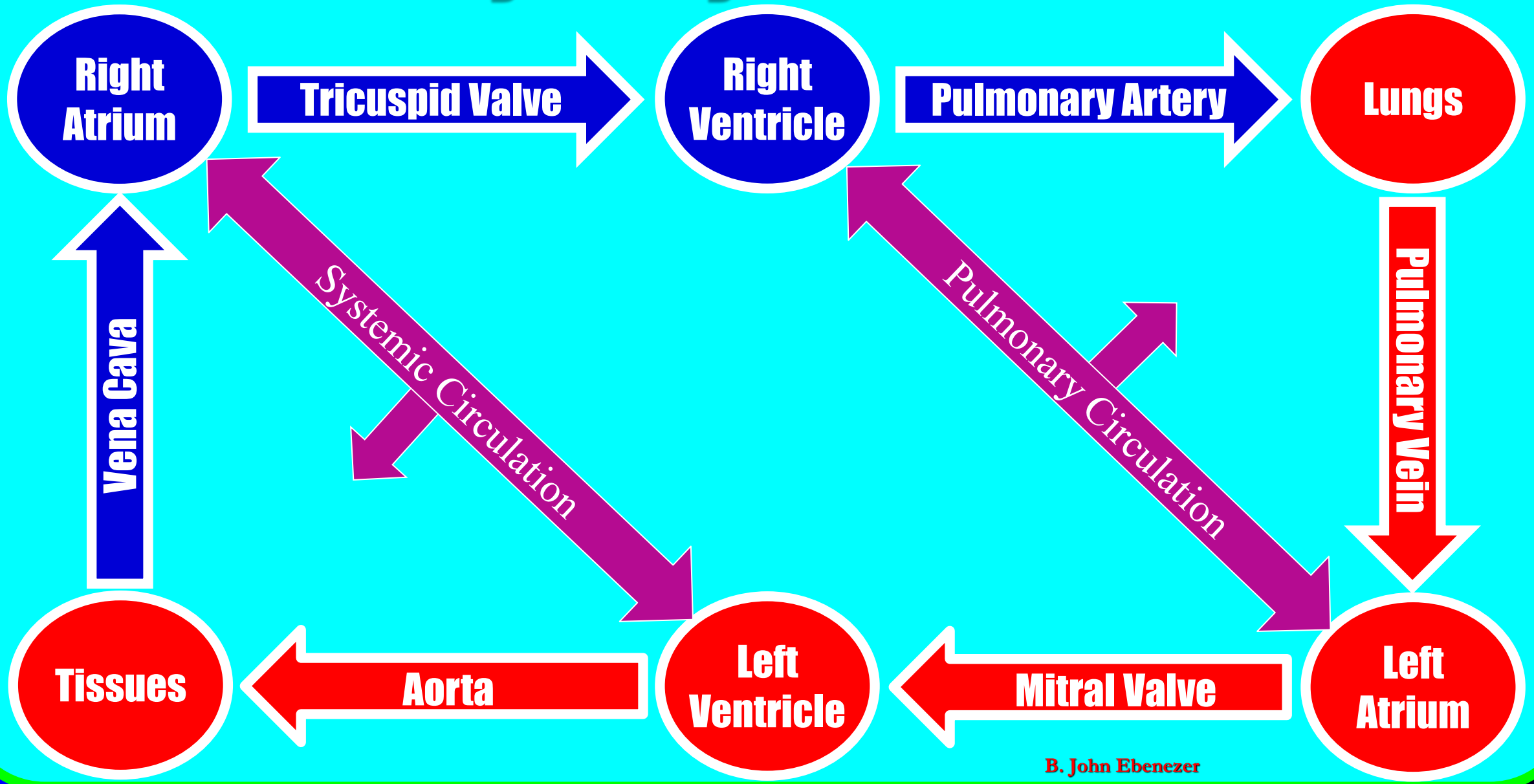
Pulmonary and Systemic Circulations



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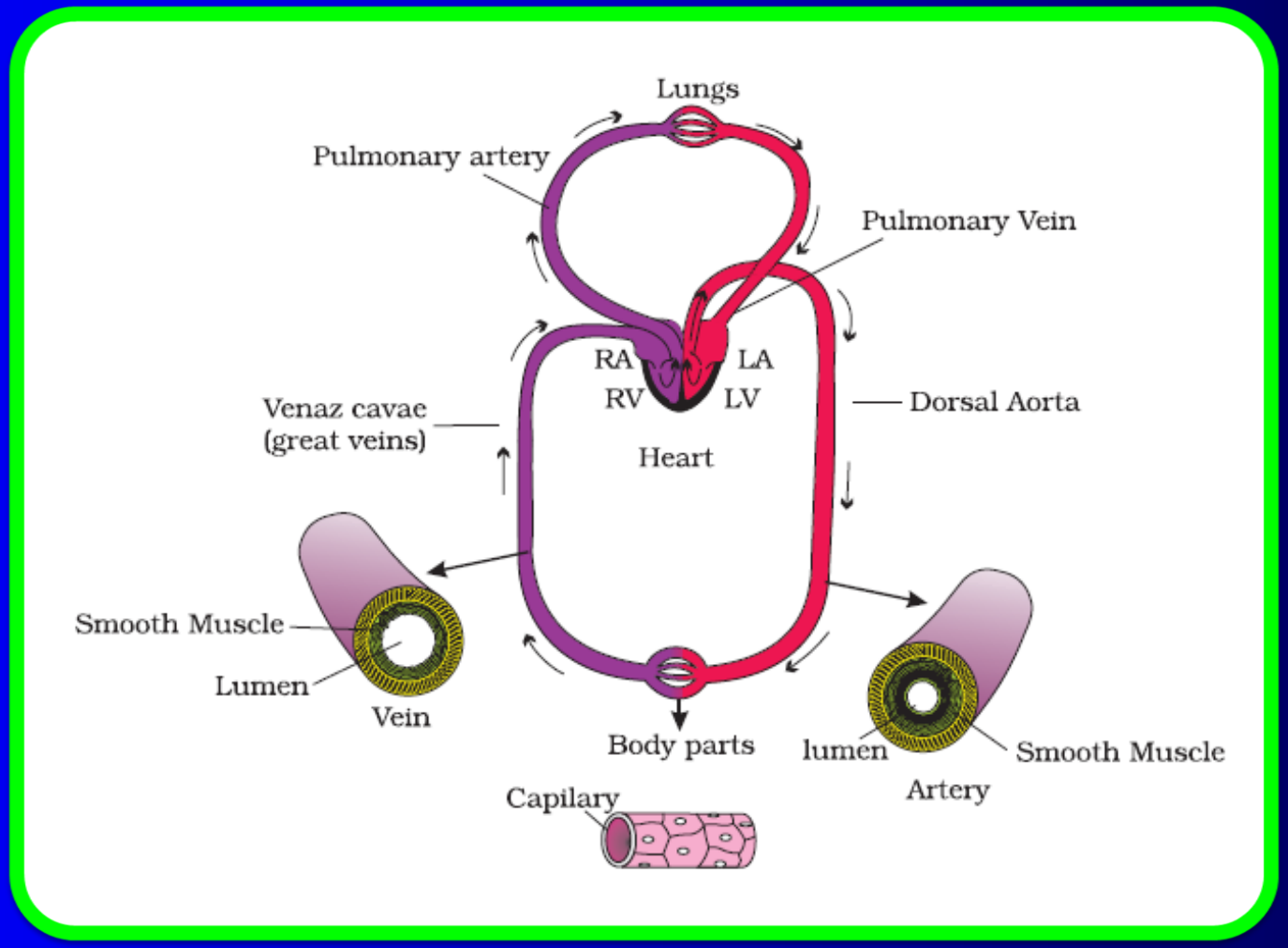
Cardiac Cycle



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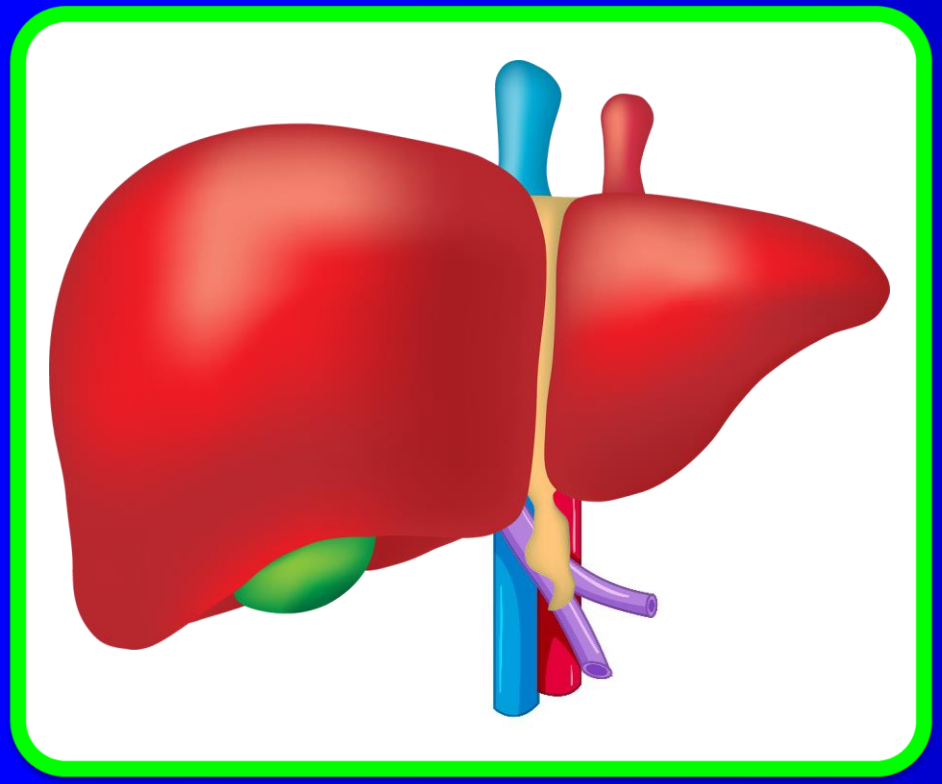
Hepatic Portal Vein



The unique vascular connection between the **digestive tract and liver** is called hepatic portal system.

The hepatic portal vein carries blood from **intestine to the liver** before it is delivered to the systemic circulation.

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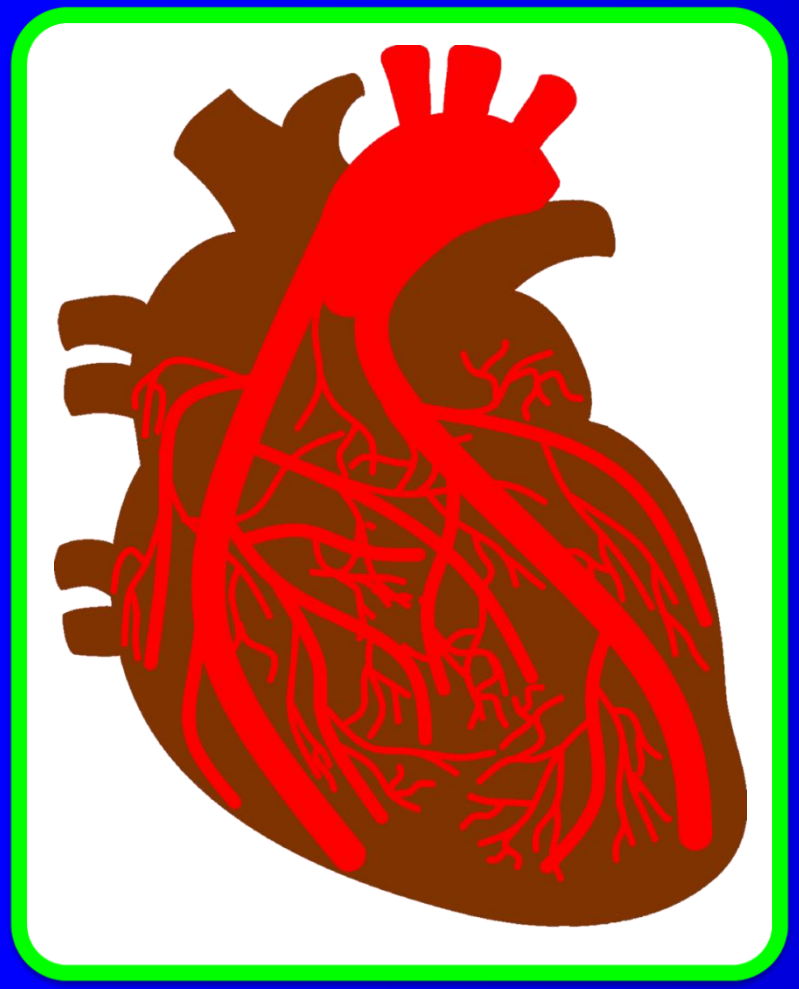
Coronary System



A special **Coronary System of blood vessels** is present in our body for the circulation of blood **to and from the cardiac musculature.**

B. John Ebenezer

Regulation of Cardiac Activity

Regulation of Cardiac Activity

Normal activities of the heart are regulated intrinsically, i.e., auto regulated by specialised muscles (nodal tissue), hence the **heart is called myogenic**.

A special neural centre in the medulla oblangata can moderate the cardiac function through autonomic nervous system (ANS).

Neural signals through the sympathetic nerves (part of ANS) can increase the rate of heart beat, the strength of ventricular contraction and thereby the cardiac output.

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The parasympathetic neural signals decrease the rate of heart beat, speed of the conduction of action potential and thereby the cardiac output.

Adrenal medullary hormones can also increase the cardiac output.

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Autonomic Nervous System

Sympathetic Nervous System

- Increases
  - Heart beat rate
  - Ventricular Contraction
  - Cardiac Output

Parasympathetic Nervous System

- Decreases
  - Heart beat rate
  - Speed of Conduction of Action Potential
  - Cardiac Output

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Disorders of Circulatory System

High Blood Pressure - Hypertension

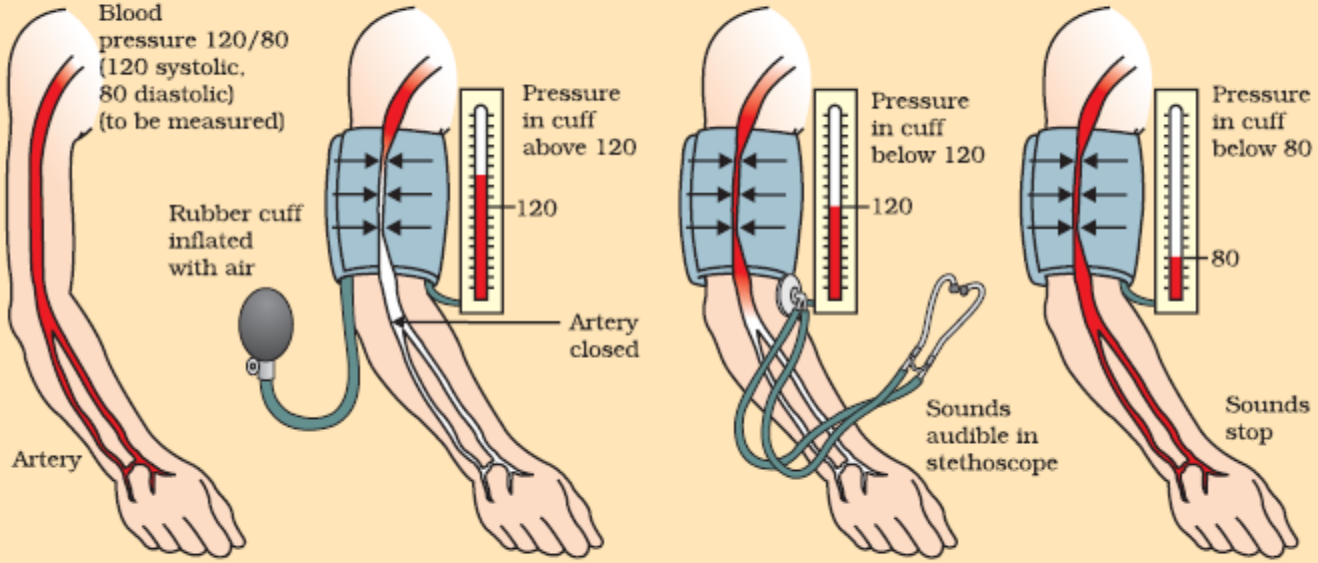
The first clinically applicable sphygmomanometer was invented in 1881 by Austrian physician **Karl Samuel Ritter von Basch**

B. John Ebenezer

Blood Pressure

Blood pressure

The force that blood exerts against the wall of a vessel is called blood pressure. This pressure is much greater in arteries than in veins. The pressure of blood inside the artery during ventricular systole (contraction) is called systolic pressure and pressure in artery during ventricular diastole (relaxation) is called diastolic pressure. The normal systolic pressure is about 120 mm of Hg and diastolic pressure is 80 mm of Hg.



Blood pressure is measured with an instrument called sphygmomanometer. High blood pressure is also called hypertension and is caused by the constriction of arterioles, which results in increased resistance to blood flow. It can lead to the rupture of an artery and internal bleeding.

B. John Ebenezer

High Blood Pressure - Hypertension

The normal blood pressure is 120/80 mm Hg.

120 mm Hg is the systolic, or pumping pressure and 80 mm Hg is the diastolic, or resting pressure.

The blood pressure which is higher than the normal pressure is called Hypertension.

If the blood pressure of an individual is 140/90 or higher, it is hypertension.

High blood pressure leads to heart diseases and also affects vital organs like brain and kidney.

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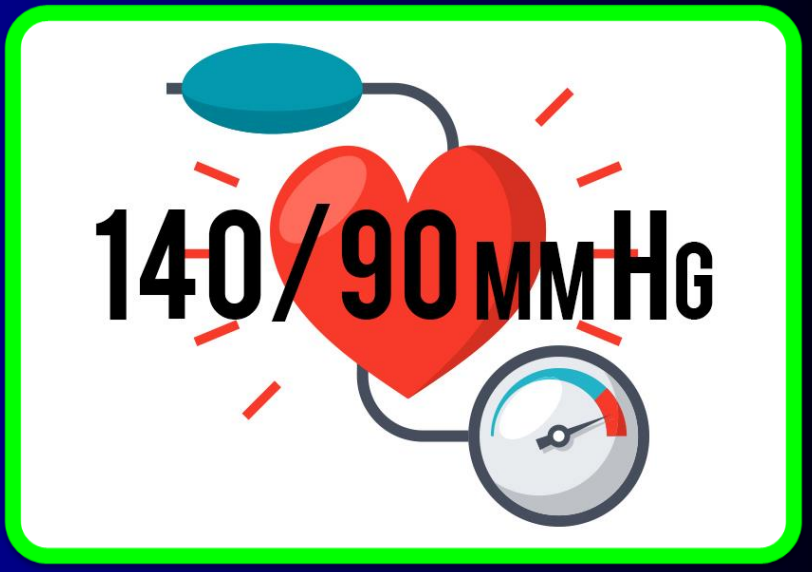
Normal and High Blood Pressure

Normal Blood Pressure

High Blood Pressure



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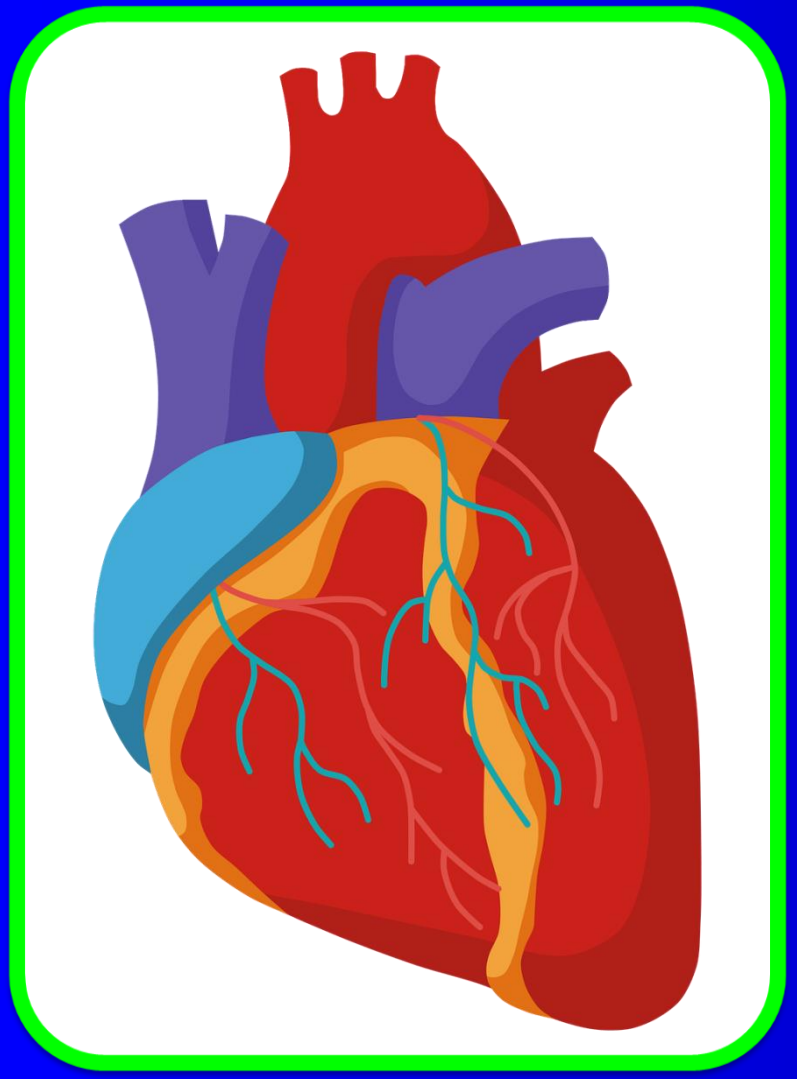
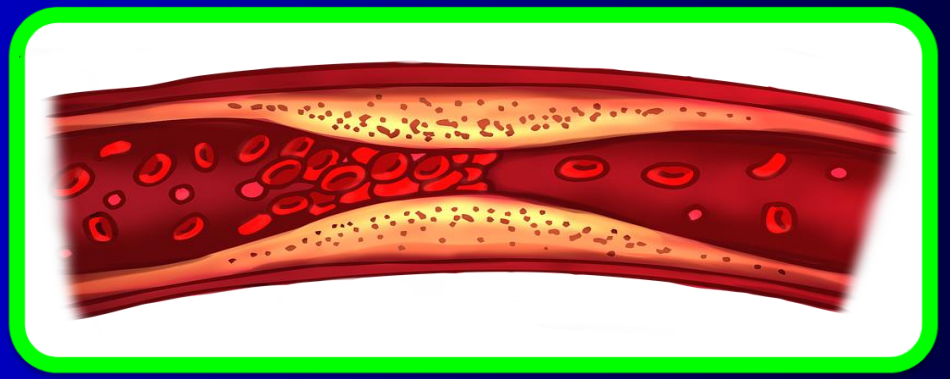
Coronary Artery Disease - CAD





The narrowing of Coronary Arteries due to the deposition of **fat, cholesterol, calcium and fibrous tissues (Plaque)** and block the supply blood to the heart muscles is called Coronary Artery Disease.

B. John Ebenezer

Angina

The **acute chest pain** caused due to reduced blood flow to heart is called anigina.

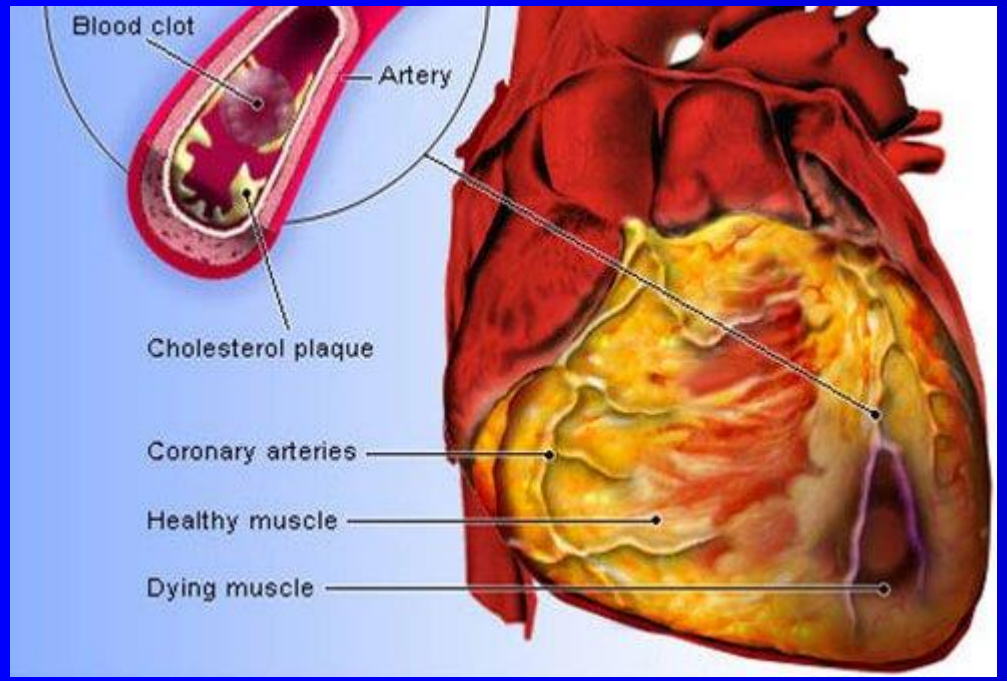
It is also called ‘angina pectoris’.

A symptom of **acute chest pain** appears when enough oxygen is not reaching the heart muscle due to **lack of blood flow** to heart.

Angina can occur in men and women of any age but it is more common among the **middle-aged and elderly people.**

B. John Ebenezer

Heart Failure

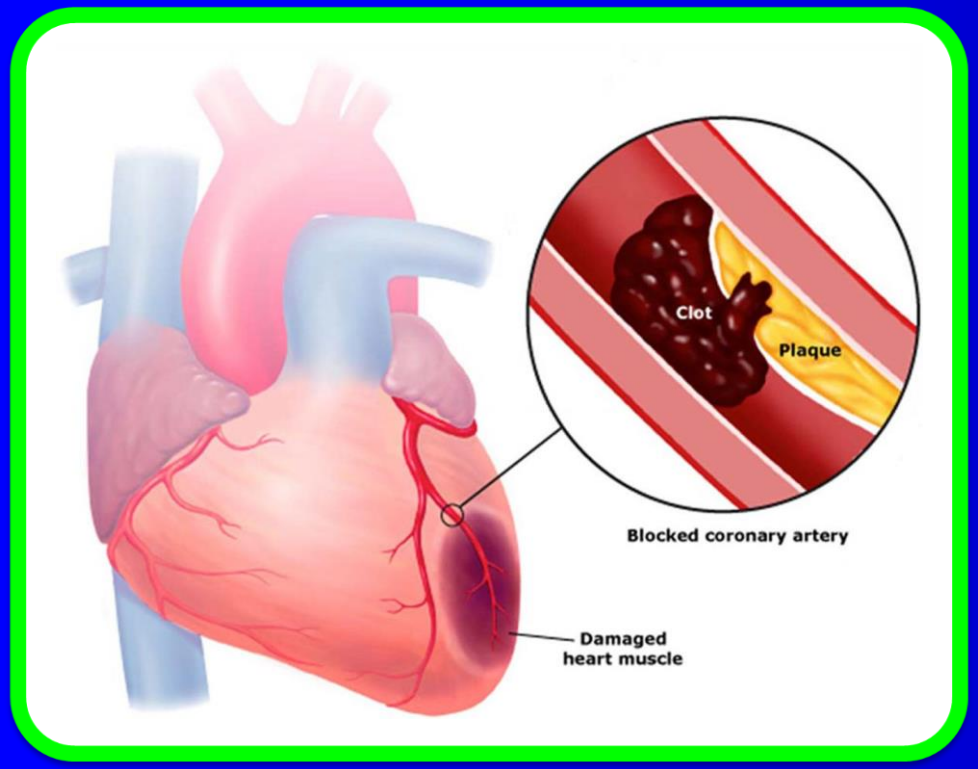


The **inability of heart to pump required amount of blood** to other parts of the body is known as heart failure.

Hence, it is a **pumping problem** of heart.

B. John Ebenezer

Heart Attack



The sudden **blockage of coronary artery** which prevents the flow of oxygen rich blood to the heart is called heart attack.

If the blocked artery is not reopened quickly, the part of the heart normally nourished by that artery begins to die.

It is a **plumbing problem** of the heart.

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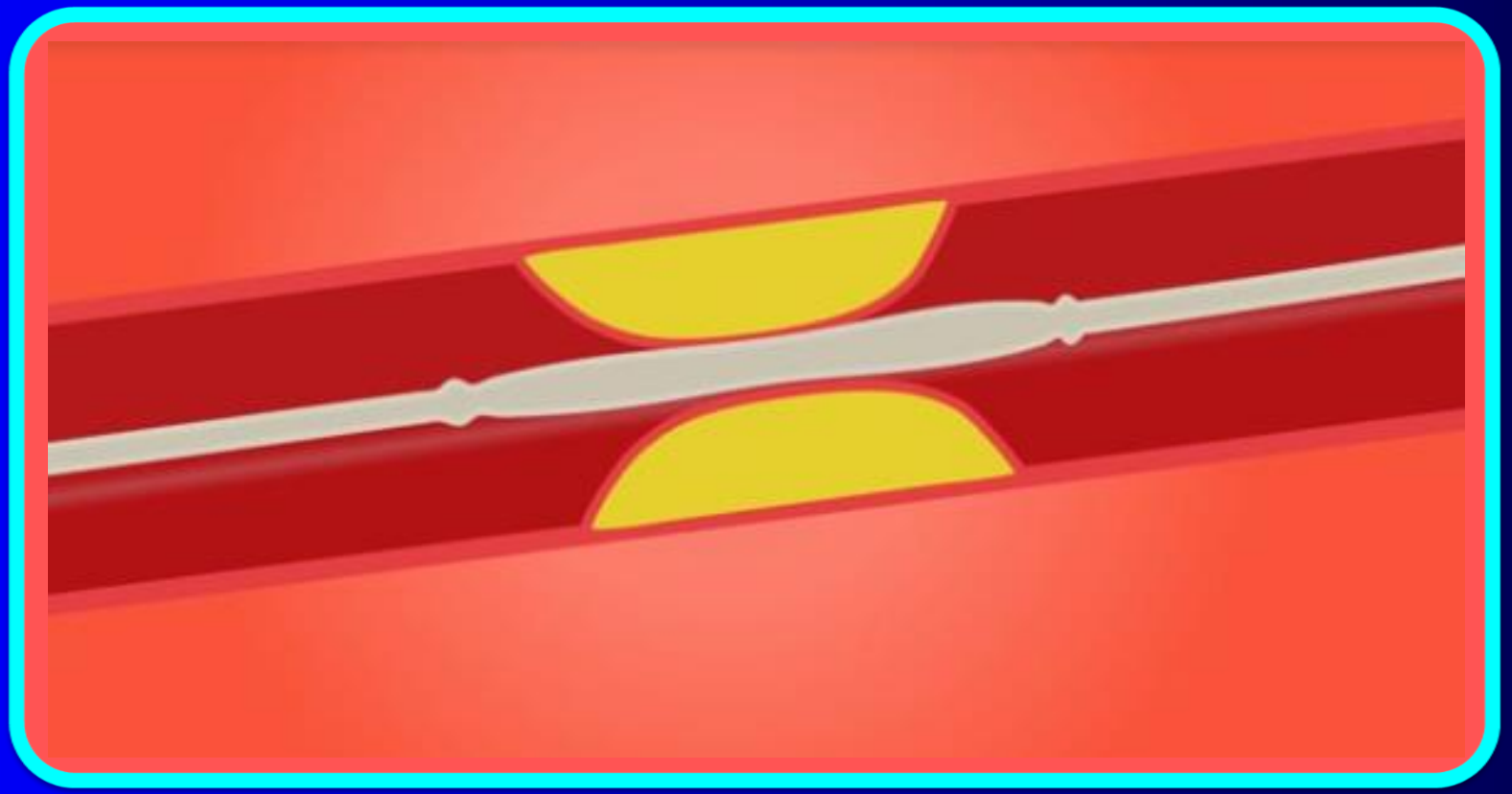
Angioplasty



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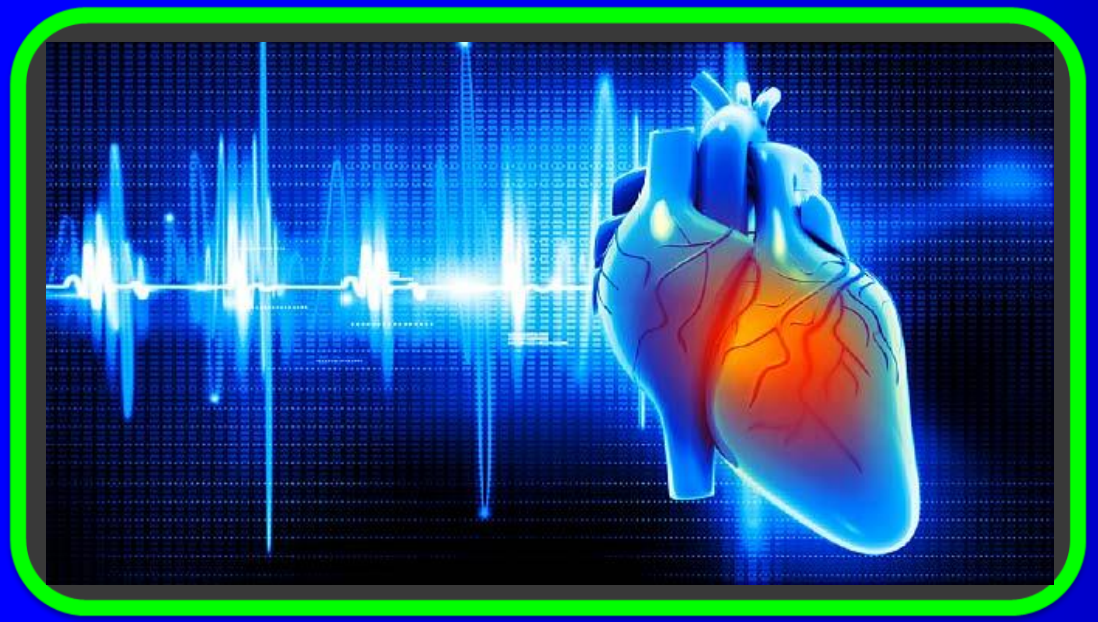
Pacemaker

Cardiac Arrest



The sudden **stopping of heart beat** due to **electrical problem** of the heart is called cardiac arrest.

The heart needs to be restarted.

If not treated on time, cardiac arrest can lead to death within a few minutes.

Hence, cardiac arrest is an **electrical problem.**

B. John Ebenezer

Heart Failure is a pumping problem
Heart Attack is a Plumbing problem
Cardiac Arrest is an electrical problem

B. John Ebenezer


God Bless You!