CMR INSTITUTE OFTECHNOLOGY

SCHEMEOF EVALUATION

InternalAssessmentTest1–JUNE2024

Sub:	**BIOLOGY FOR ENGINEERS**		**Code:**
Date:	10/7/2024 Duration: 90mins MaxMarks: 50	**Sem:** **4**	**BBOC407**
			Branch:*AIML*

Note:Answeranyfivefullquestions. ***(5X10= 50)***

Question No.		**Description**	**MarksSplitup**		**Total Marks**
1.	a	✓ Biomolecules defination ✓ 4 Types of biomolecules with property and functions	2 2*4	10M	10M
2.	a)	✓ applications of enzymes in biosensors ✓ applications of enzymes in Bio- bleaching	5M 5M	10M	10M
3.	a)	✓ Structure of a cell with diagram. ✓ functions of a cell	7M 3M	10M	10M
4.		PHA in bioplastics production. PLA in bioplastics production.	5 5	10M	10M
5.	a)	properties of cellulose justify cellulose as an effective water filter.	***5M*** ***5M***	10M	10M
6.		✓ DNA Vaccines	10M		10M

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Internal Assessment Test 2 – July 2024

Sub:	BIOLOGY FOR ENGINEERS	Sub Code:	BBOC407	Branch:	AIML /CSE(AIML)

Date:	10/07/24	Duration:	90 minutes	Max Marks:	50	Sem/Sec:	IV	OBE

		Answer any FIVE FULL Questions	MARKS	CO	RBT
1	a	Explain Brain as a central processing unit.	[10]	2	L1
2	a	Give an account on the structure and functioning of kidneys.	[10]	2	L2
3	a	With a diagram explain heart as pump system.	[10]	2	L3
4	a	Compare the process of photosynthesis to the functioning of photovoltaic cells.	[10]	3	L2
5	a	Define GPS system existing in birds.	[10]	3	L3
6	a	Explain the lotus leaf effect.	[10]	3	L1

1. Explain Brain as a central processing unit.

Ans. **BRAIN AS A CPU SYSTEM**:

Both CPU and brain use electrical signals to send messages. The brain uses chemicals to transmit information; the computer uses electricity. Even though electrical signals travel at high speeds in the nervous system, they travel even faster through the wires in a computer. Both transmit information.

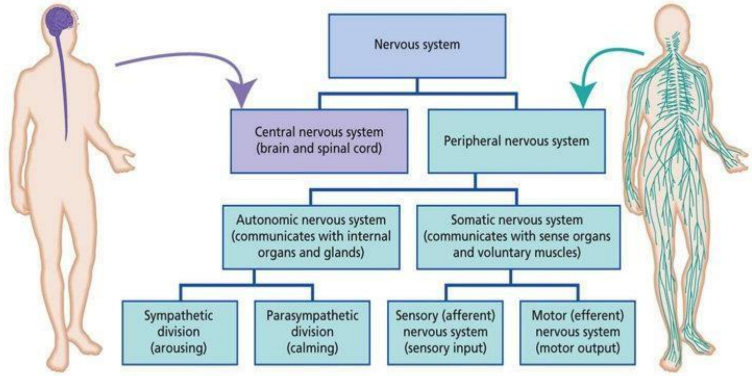
A BCI system is a computer-based system that takes brain signals, analyses them and translates them into commands that are relayed to a device to trigger a desired action. A BCI system does not use peripheral nerves and head muscles. The CNS (Central Nervous System), for example, is used to measure signals produced by the central nervous system. Thus, for example, a sensor that is activated by the voice or the movement of a muscle is not a BCI system. Also an EEG is not BCI itself, because it only records brain signals but it does not produce an output that acts on the user's environment. It is also wrong to think that BCI is a mind-reader. They do not export information from unsuspecting users or users unwillingly using the system. They allow users to act in their environment when they want it by reading their brain signals rather than muscles. The user and the BCI work together. The user, after a training session, produces brain signals encoded by the BCI system. The BCI then translates these commands and transmits them into an output device. Brain computer interfaces have contributed to various areas of research. Applications that are about medicine, neuro-technology and smart environment, neuro-marketing and advertising, education and self-regulation, games and entertainment, as well as security and identification.

The nervous system has two main parts: The central nervous system is made up of the brain and spinal cord. The peripheral nervous system is made up of nerves that branch off from the spinal cord and extend to all parts of the body.

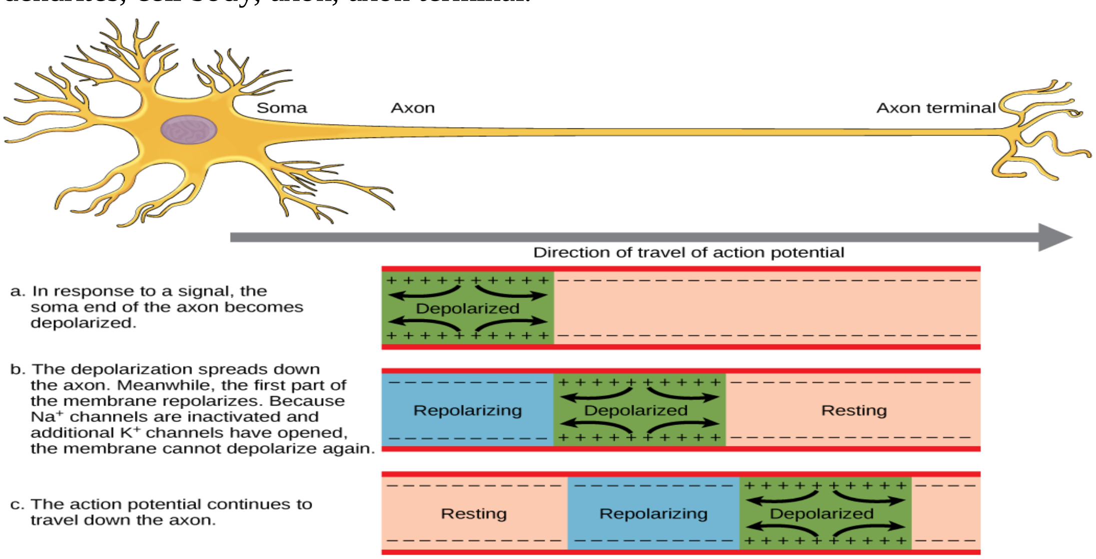
1) CNS:

CNS includes the brain and spinal cord. The brain is the body's “control center.” The CNS has various centers located within it that carry out the sensory, motor and integration of data. These centers can be subdivided to Lower Centers (including the spinal cord and brain stem) and higher

centers communicating with the brain via effectors.
2) PNS:
PNS is a vast network of spinal and cranial nerves that are linked to the brain and the spinal cord. It contains sensory receptors which help in processing changes in the internal and external environment. This information is sent to the CNS via afferent sensory nerves. The PNS is then subdivided into the autonomic nervous system and the somatic nervous system. The autonomic has involuntary control of internal organs, blood vessels, smooth and cardiac muscles. The somatic has voluntary control of skin, bones, joints, and skeletal muscle. The two systems function together, by way of nerves from the PNS entering and becoming part of the CNS, and vice versa.



SIGNAL TRANSMISSION:
A neuron sending a signal (i.e., a presynaptic neuron) releases a chemical called a neurotransmitter, which binds to a receptor on the surface of the receiving (i.e., postsynaptic) neuron. Neurotransmitters are released from presynaptic terminals, which may branch to communicate with several postsynaptic neurons.
Axon terminals are where neurotransmission begins. Hence, it is at axon terminals where the neuron sends its OUTPUT to other neurons. At electrical synapses, the OUTPUT will be the electrical signal itself. At chemical synapses, the OUTPUT will be neurotransmitter.
The correct outline for the sequence of transmission of an electrical impulse through a neuron is dendrites, cell body, axon, axon terminal.



2. Give an account on the structure and functioning of kidneys.

Ans. ***KIDNEY AS FILTRATION SYSTEM:***

Introduction:

Kidneys remove wastes and extra fluid from the body. Kidneys also remove acid that is produced by the cells of the body and maintain a healthy balance of water, salts, and minerals—such as sodium, calcium, phosphorus, and potassium—in the blood. Without this balance, nerves, muscles,and other tissues in the body may not work normally.

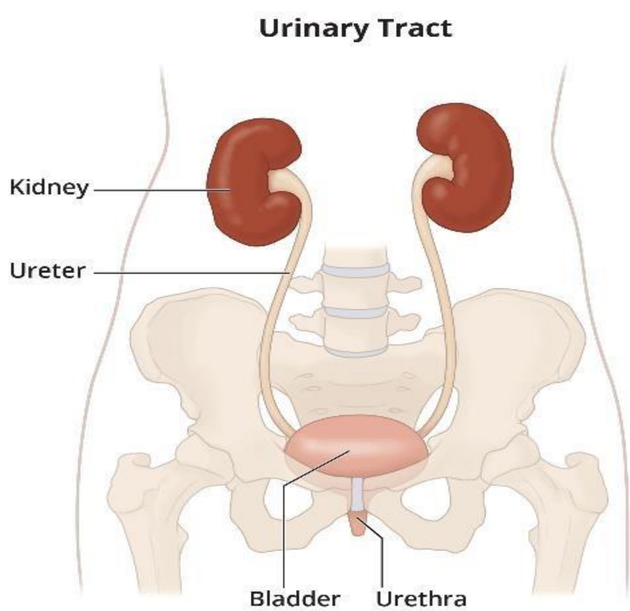
Kidneys also make hormones that help

- Control blood pressure.
- Make red blood cells NIH external link.
- Keeps bones strong and healthy.

Architecture:

The kidneys are two bean-shaped organs, each about the size of a fist. They are located just below

the rib cage, one on each side of the spine. Healthy kidneys filter about a half cup of blood every minute, removing wastes and extra water to make urine. The urine flows from the kidneys to the bladder through two thin tubes of muscle called ureters, one on each side of the bladder. Your bladder stores urine. Kidneys, ureters, and bladder are part of your urinary tract.

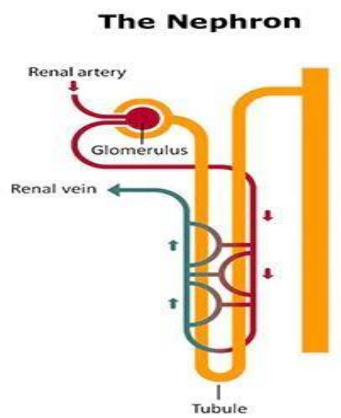


MECHANISM OF FILTRATION:

Each kidney is made up of about a million filtering units called nephrons. Each nephron includes a filter, called the glomerulus, and a tubule. The nephrons work through a two-step process: the glomerulus filters blood, and the tubule returns needed substances to your blood and removes wastes.

Each nephron has a glomerulus to filter your blood and a tubule that returns needed substances to your blood and pulls out additional wastes. Wastes and extra water become urine.

The glomerulus filters your blood. As blood flows into each nephron, it enters a cluster of tiny blood vessels—the glomerulus. The thin walls of the glomerulus allow smaller molecules, wastes, and fluid—mostly water—to pass into the tubule. Larger molecules, such as proteins and blood cells, stay in the blood vessel. The tubule returns needed substances to your blood and removes wastes.



A blood vessel runs alongside the tubule. As the filtered fluid moves along the tubule, the blood vessel reabsorbs almost all of the water, along with minerals and nutrients your body needs. The tubule helps remove excess acid from the blood. The remaining fluid and wastes in the tubule become urine.

How does blood flow through my kidneys?

Blood flows into the kidney through the renal artery. This large blood vessel branches into smaller and smaller blood vessels until the blood reaches the nephrons. In the nephron, blood is filtered by the tiny blood vessels of the glomeruli and then flows out of the kidney through the renal vein.

Blood circulates through your kidneys many times a day. In a single day, kidneys filter about 150 quarts of blood. Most of the water and other substances that filter through your glomeruli are returned to the blood by the tubules. Only 1 to 2 quarts become urine.

When the kidney doesn't function properly, chronic kidney disease occurs when a disease or condition impairs kidney function, causing kidney damage to worsen over several months or years.

CKD:

Chronic kidney disease includes conditions that damage your kidneys and decrease their ability to keep you healthy by filtering wastes from your blood. If kidney disease worsens, wastes can build to high levels in your blood and make you feel sick. You may develop complications like

- high blood pressure
- anemia (low blood count)
- weak bones
- poor nutritional health
- nerve damage

Symptoms:

People with CKD may not feel ill or notice any symptoms. The only way to find out for sure if you have CKD is through specific blood and urine tests. These tests include the measurement of both the creatinine level in the blood and the protein in the urine.

Treatment:

Depending on the cause, some types of kidney disease can be treated. Often, though, chronic kidney disease has no cure. Treatment usually consists of measures to help control signs and symptoms, reduce complications, and slow the progression of the disease. If your kidneys become severely damaged, you might need treatment for end-stage kidney disease.

DIALYSIS:

Dialysis is a procedure to remove waste products and excess fluid from the blood when the kidneys stop working properly. It often involves diverting blood to a machine to be cleaned.

There are 2 main types of dialysis:

- Haemodialysis involves diverting blood into an external machine, where it's filtered before being returned to the body
- Peritoneal dialysis involves pumping dialysis fluid into the space inside your abdomen (tummy) to draw out waste products from the blood passing through vessels lining the inside of the abdomen

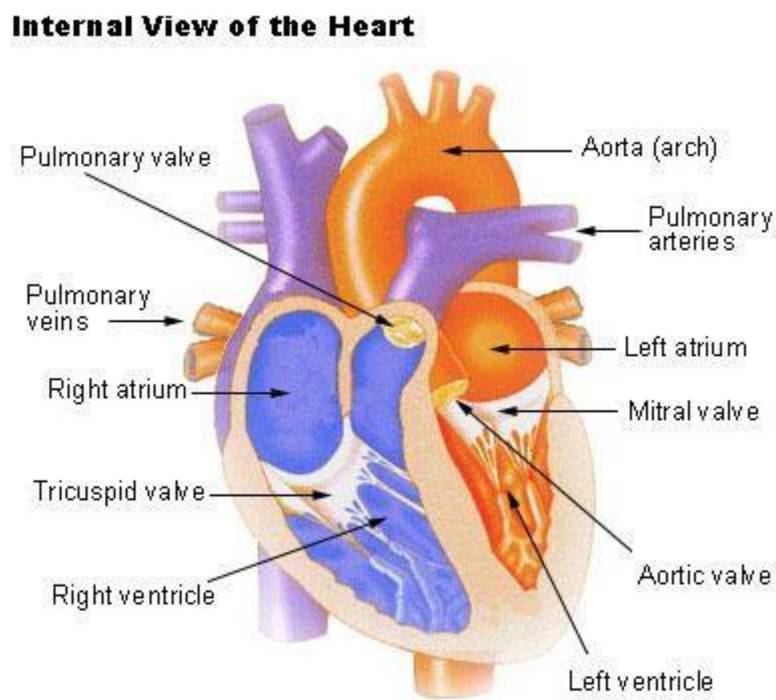
3. With a diagram explain heart as pump system.

Ans. ***HEART AS A PUMP SYSTEM:***

Heart is sort of like a pump, or two pumps in one. The right side of your heart receives blood from the body and pumps it to the lungs. The left side of the heart does the exact opposite: It receives blood from the lungs and pumps it out to the body. While an LVAD consists of thick tubes and a pump connected externally to the heart muscle and aorta, percutaneous heart pumps place a much smaller tube inside the heart's chambers. These tiny heart pumps are placed in the heart via a thin tube called a catheter that is threaded through a puncture site in the skin. The human heart is very strong and is capable of pumping blood up to 30 feet distance. An average heart beats maximum of 70-80 beats per minute and is considered healthy. The efficiency of the heart can be maintained and improved by performing physical activity. The heart is called a double pump because each side pumps blood to a different circulation. Deoxygenated blood from the body drains to the right side of the heart. This is the first pump that sends blood to the lungs, called the pulmonary circulation, where it becomes oxygenated and releases carbon dioxide.

Here is what happens as blood flows through the heart and lungs:

The blood first enters the right atrium. The blood then flows through the tricuspid valve into the right ventricle. When the heart beats, the ventricle pushes blood through the pulmonic valve into the pulmonary artery. The pulmonary artery carries blood to the lungs where it “picks up” oxygen.It then leaves the lungs to return to the heart through the pulmonary vein. The blood enters the leftatrium. It drops through the mitral valve into the left ventricle. The left ventricle then pumps bloodthrough the aortic valve and into the aorta. The aorta is the artery that feeds the rest of the body through a system of blood vessels. Blood returns to the heart from the body via two large blood vessels called the superior vena cava and the inferior vena cava. This blood carries little oxygen, as it is returning from the body where oxygen was used. The vena cava pump blood into the right atrium and the cycle begins all over again.



The human heart is a four-chambered ~~muscular organ, shaped and sized~~ roughly like a man's closed fist with two-thirds of the mass to the left of midline. The heart is enclosed in a pericardial sac that is lined with the parietal layers of a serous membrane. The visceral layer of the serous membraneforms the epicardium.
The myocardium of the heart wall is a working muscle that needs a continuous supply of oxygen and nutrients to function efficiently. For this reason, cardiac muscle has an extensive network of blood vessels to bring oxygen to the contracting cells and to remove waste products.

ELECTRICAL SIGNALING:

The sinus node generates an electrical stimulus regularly, 60 to 100 times per minute under normal conditions. The atria are then activated. The electrical stimulus travels down through the conduction pathways and causes the heart's ventricles to contract and pump out blood.

ECG MONITORING:

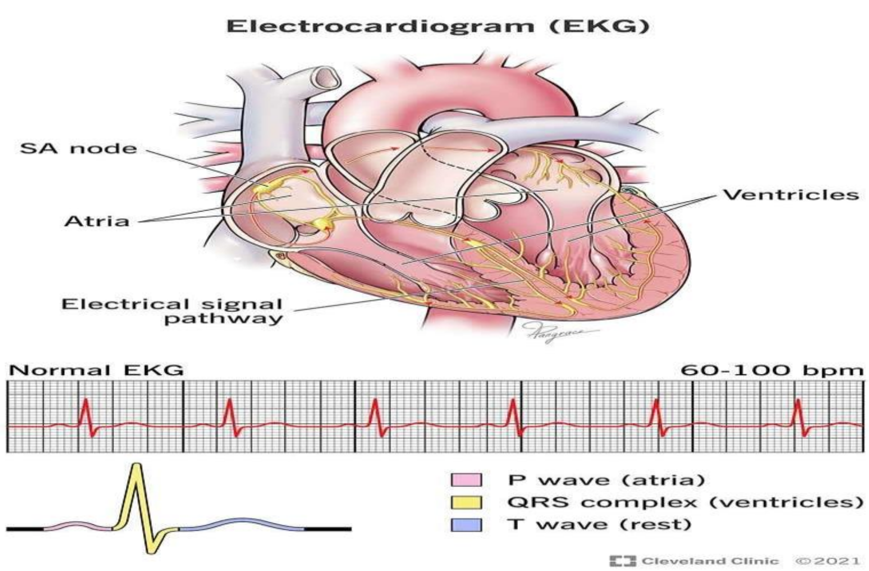
ECG monitoring systems have been developed and widely used in the healthcare sector for the past few decades and have significantly evolved over time due to the emergence of smart enablingtechnologies.
Nowadays, ECG monitoring systems are used in hospitals, homes, outpatient ambulatory settings, and in remote contexts. They also employ a wide range of technologies such as IoT, edge computing, and mobile computing. In addition, they implement various computational settings in terms of processing frequencies, as well as monitoring schemes. They have also evolved to serve

purposes and targets other than disease diagnosis and control, including daily activities, sports, and even mode-related purposes.

This massive diversity in ECG monitoring systems' contexts, technologies, computational schemes, and purposes makes it hard for researchers and professionals to design, classify, and analyze ECG monitoring systems. Some efforts attempted to provide a common understanding of ECG monitoring systems' processes, guiding the design of efficient monitoring systems. However,these studies lack comprehensiveness and completeness.
They work for specific contexts, serve specific targets, or are suitable for specific technologies. This makes the available ECG monitoring system processes and architectures hard to generalize and reuse. On the other hand, some studies attempted to analyze ECG monitoring systems' attributes and provide classification taxonomies, supporting better analysis and understanding of the ECG systems reported in the literature. However, exiting reviews related to ECG monitoring in the literature can be intuitive and incomprehensive.

They do not consider the latest technological trends, and they target very narrow research niches, such as wearable sensors, mobile sensors, disease diagnosis, heartbeat detection, emotion recognition, or ECG compression methods. Hence, there is a need to provide a comprehensive, expert-verified taxonomy of ECG monitoring systems, a common architecture, and a complete setof processes to guide the classification, analysis, and design of these systems.

The existing ECG classification algorithms usually include signal preprocessing, such as wavelet transform and manual feature extraction, but the amount of computation will increase the delay of the real-time classification system. In recent years, deep learning algorithm with their advantages of automatic learning features is increasingly used in the field of health care, such as medical imagerecognition and segmentation, time series data monitoring, and analysis. At present, the outstanding algorithm can establish an end-to-end DNN network to learn the characteristics of ECG records by using the extensive digital characteristics of ECG data, which saves a lot of signal preprocessing steps. Because the performance of DNN increases with the amount of training data,this method can make good use of the extensive digitization of ECG data.
Arrhythmias are any abnormal activation sequence of the myoscardium. Some of these include myocardial infarction, which is caused by the sudden loss of blood supply to the heart. One of the most difficult and essential health problems in the real world is the prediction of heart disease. This condition affects the function of blood vessels and can weaken the body of the patient. According to the WHO, around 18 million people die yearly due to heart disease globally.
Due to the increasing prevalence of cardiac diseases, people are prone to prevent devastating event from happening. They are used to diagnose a patient's cardiac condition.



diseases including **heart failure (HF**). Artificial intelligence (AI) can be used for semi-automated ECG analysis. The aim of this evaluation was to provide an overview of AI use in HF detection from ECG signals and to perform a meta-analysis of available studies.

Evaluation of symptoms suggestive of HF currently demands physicians to valuate various parameters including imaging and laboratory data and the electrocardiogram (ECG). Besides a standard examination that includes an ECG, imaging information, such as echocardiography or magnetic resonance imaging, is seen as gold standard in diagnosis of HF. Nevertheless, an adequate use of such imaging data is associated with relevant technical infrastructure and medical expertise. The ECG is a well-established, quick, and easily accessible method for diagnosis and screening of various cardiovascular diseases. It provides specific features that indicate presence of HF or prognosis in HF patients especially to rule out HF in case of a normal ECG. However, use of an ECG as primary diagnostic instrument often only yields insufficient diagnostic specificity. Further, general practitioner–based ECG reporting has varying results, introducing further diagnostic uncertainty.

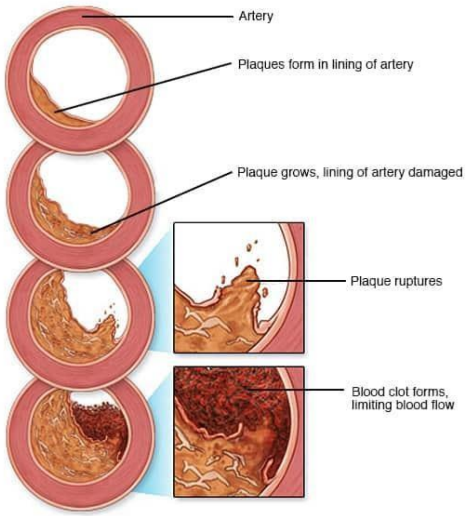
Electrocardiography (ECG) is a quick and easily accessible method for diagnosis and screening of**cardiovascular**

Devices providing medically relevant information generated directly by individuals outside the healthcare system such as smartphones with health applications or wearables including smartwatches are an emerging trend. This development promises that a growing number of, e.g., ECG data generated at home will be available for a diagnostic screening. Such data have already shown potential in computer-aided decision support systems to warn patients of rhythmic abnormalities. Management of this quantity of data, however, might be a challenge for the individual healthcare professional, as well as for the healthcare system itself. The potentially beneficial use of artificial intelligence (AI) in cardiology in general has been discussed already, e.g., as a tool for clinicians that could facilitate precision in daily practice and even might improve patient outcomes. AI might also be able to help in interpretation of ECG signals and could therefore be used to analyze ECG data in specific cases and on a large scale for early identification of cardiovascular diseases such as HF.

REASONS FOR BLOCKAGES OF BLOOD VESSELS:

Coronary artery disease is a common heart condition. The major blood vessels that supply the heart (coronary arteries) struggle to send enough blood, oxygen and nutrients to the heart muscle. Cholesterol deposits (plaques) in the heart arteries and inflammation are usually the cause of coronary artery disease.

Signs and symptoms of coronary artery disease occur when the heart doesn't get enough oxygen- rich blood. If you have coronary artery disease, reduced blood flow to the heart can cause chest pain (angina) and shortness of breath. A complete blockage of blood flow can cause a heart attack.Coronary artery disease starts when fats, cholesterols and other substances collect on the inner walls of the heart arteries. This condition is called atherosclerosis. The buildup is called plaque. Plaque can cause the arteries to narrow, blocking blood flow. The plaque can also burst, leading to a blood clot.



Besides high cholesterol, damage to the coronary arteries may be caused by:
Diabetes or insulin resistance, High blood pressure, Not getting enough exercise (sedentarylifestyle), Smoking or tobacco use.

DESIGN OF STENTS:

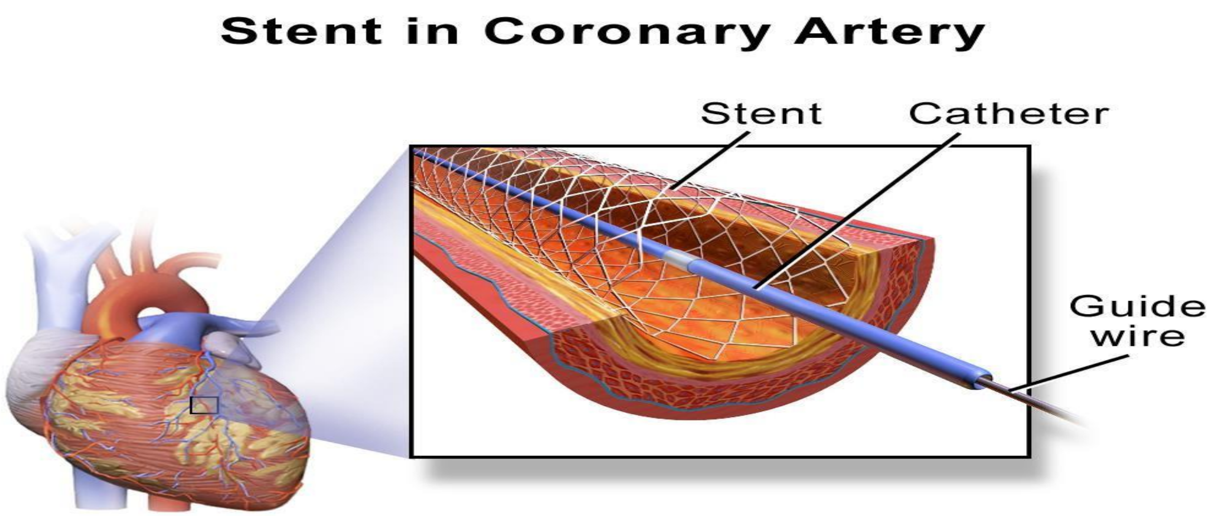
A stent is a tiny tube that can play a big role in treating your heart disease. It helps keep your arteries -- the blood vessels that carry blood from your heart to other parts of your body, includingthe heart muscle itself -- open.
Most stents are made out of wire mesh and are permanent. Some are made out of fabric. These are called stent grafts and are often used for larger arteries.
Others are made of a material that dissolves and that your body absorbs over time. They're coated in medicine that slowly releases into your artery to prevent it from being blocked again.

Why Would You Need a Stent?

If a fatty substance called plaque builds up inside an artery, it can reduce blood flow to your heart.This is called coronary heart disease and it can cause chest pain.
The plaque can also cause a blood clot that blocks blood flowing to your heart, which may lead toa heart attack.
By keeping an artery open, stents lower your risk of chest pain. They can also treat a heart attackthat's in progress.

Doctor usually inserts a stent using a minimally invasive procedure. They will make a small incision and use a catheter to guide specialized tools through your blood vessels to reach the area that needs a stent. This incision is usually in the groin or arm. One of those tools may have a camera on the end to help your doctor guide the stent. During the procedure, doctor may also use an imaging technique called an angiogram to help guide the stent through the vessel.

Using the necessary tools, doctor will locate the broken or blocked vessel and install the stent. Then they will remove the instruments from your body and close the incision.



DESIGN:

Most of these stents are constructed from a nickel titanium alloy. Balloon expandable stents are susceptible to permanent deformation when they are compressed extrinsically, which is not an issue in the coronary tree. Self-expanding stents do not have this limitation. Furthermore, self- expanding stents have less axial stiffness and are thus more flexible and will conform to the shape of the vessel rather than the vessel conforming to the shape of the stent. Balloon expandable stents, by virtue of their design, resist expansion by the balloon, but they have less acute recoil when they are placed in a poorly compliant lesion. However, after the initial deployment, the stent is at its maximal diameter and cannot get larger, whereas a self-expanding stent that is appropriately oversized for the vessel will exhibit a chronic outward force on the lesion and may lead to a larger lumen over time. For the reasons above, there are some coronary lesions where balloon expandable stents are not ideal, such as aneurysmal, ectatic vessels, thrombus laden vessels, and vessels that are tapering with a large size mismatch between distal reference and proximal reference vessels.

PACE MAKERS:

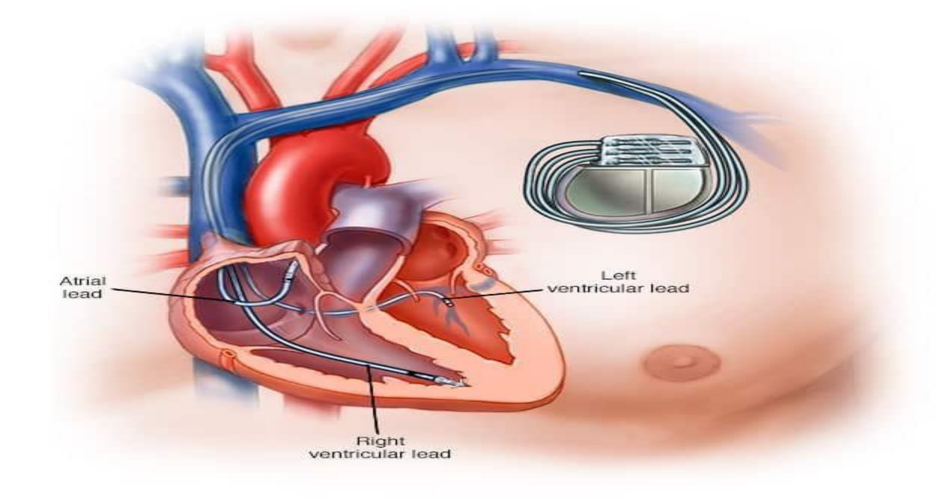
A pacemaker is a small device that's placed (implanted) in the chest to help control the heartbeat. It's used to prevent the heart from beating too slowly. Implanting a pacemaker in the chest requiresa surgical procedure.

A pacemaker is also called a cardiac pacing device.

Types:

Single chamber pacemaker. This type usually carries electrical impulses to the right ventricle ofyour heart.
Dual chamber pacemaker. This type carries electrical impulses to the right ventricle and the rightatrium of your heart to help control the timing of contractions between the two chambers.
Biventricular pacemaker. Biventricular pacing, also called cardiac resynchronization therapy, is for people who have heart failure and heartbeat problems. This type of pacemaker stimulates both of the lower heart chambers (the right and left ventricles) to make the heart beat more efficiently. A **pacemaker** is implanted to help control your heartbeat. Your doctor may recommend a temporary pacemaker when you have a slow heartbeat (bradycardia) after a heart attack, surgery or medication overdose but your heartbeat is otherwise expected to recover. A pacemaker may be implanted permanently to correct a chronic slow or irregular heartbeat or to help treat heart failure. Pacemakers work only when needed. If your heartbeat is too slow (bradycardia), the pacemaker sends electrical signals to your heart to correct the beat.

Some newer pacemakers also have sensors that detect body motion or breathing rate and signal the devices to increase heart rate during exercise, as needed.

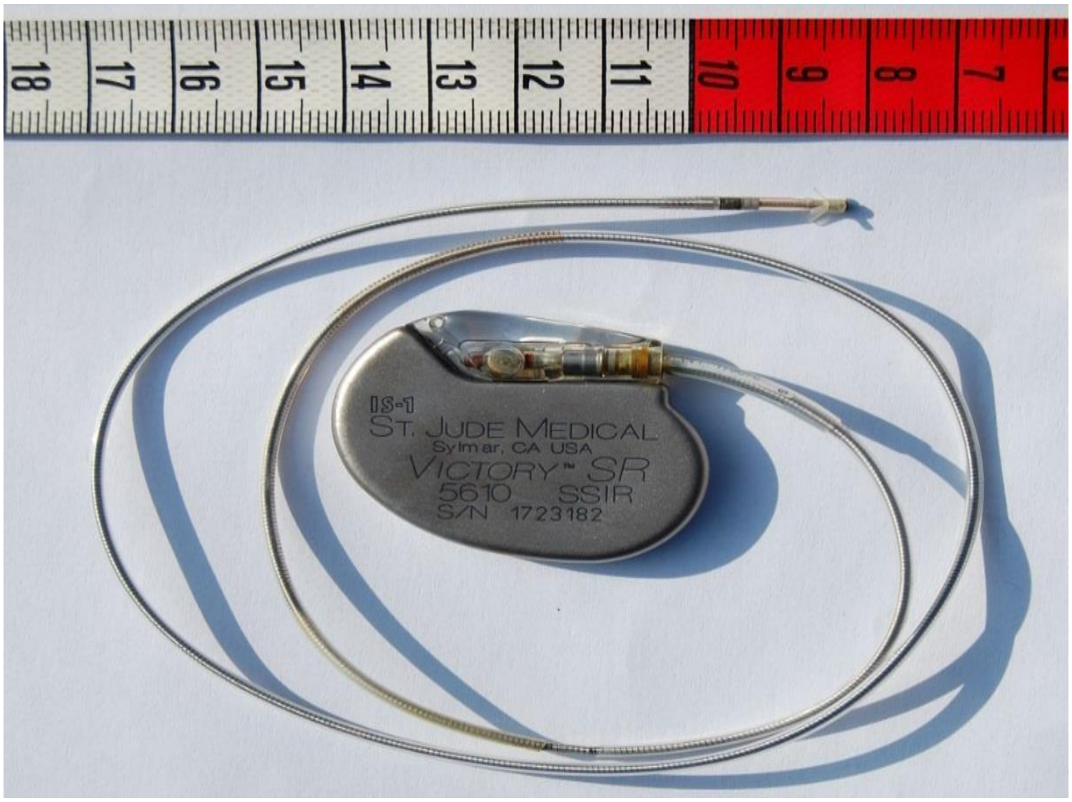


COURTESY: *WIKIMEDIA COMMONS*

A pacemaker has two parts:

1) Pulse generator. This small metal container houses a battery and the electrical circuitry that controls the rate of electrical pulses sent to the heart.

2) Leads (electrodes). One to three flexible, insulated wires are each placed in one or more chambers of the heart and deliver the electrical pulses to adjust the heart rate. However, some newer pacemakers don't require leads. These devices, called leadless pacemakers, are implanted directly into the heart muscle.



DEFIBRILLATORS:

Defibrillators are devices that send an electric pulse or shock to the heart to restore a normal heartbeat. They are used to prevent or correct an arrhythmia, an uneven heartbeat that is too slow or too fast. If the heart suddenly stops, defibrillators can also help it beat again. Different types of defibrillators work in different ways. Automated external defibrillators (AEDs), which are now found in many public spaces, are used to save the lives of people experiencing cardiac arrest. Evenuntrained bystanders can use these devices in an emergency.

Other defibrillators can prevent sudden death among people who have a high risk of a life- threatening arrhythmia. They include implantable cardioverter defibrillators (ICDs), which are surgically placed inside your body, and wearable cardioverter defibrillators (WCDs), which rest on the body. It can take time and effort to get used to living with a defibrillator, and it is importantto be aware of possible complications.

There are three types of defibrillators: AEDs, ICDs, and WCDs.

An AED is a lightweight, battery-operated, portable device that checks the heart's rhythm and sends a shock to the heart to restore normal rhythm. The device is used to help people having cardiac arrest.

Sticky pads with sensors, called electrodes, are attached to the chest of someone who is having cardiac arrest. The electrodes send information about the person's heart rhythm to a computer in the AED. The computer analyzes the heart rhythm to find out whether an electric shock is needed.If it is needed, the electrodes deliver the shock.

ICDs are placed through surgery in the chest or stomach area, where the device can check for arrhythmias. Arrhythmias can interrupt the flow of blood from your heart to the rest of your body or cause your heart to stop. The ICD sends a shock to restore a normal heart rhythm.
An ICD can give off a low-energy shock that speeds up or slows down an abnormal heart rate, or a high-energy shock to correct a fast or irregular heartbeat. If low-energy shocks do not restore your normal heart rhythm, the device may switch to high-energy shocks for defibrillation.
ICDs are similar to pacemakers, but pacemakers deliver only low-energy electrical shocks. ICDs have a generator connected to wires that detect your heart's beats and deliver a shock when needed. Some ICDs have wires that rest inside one or two chambers of the heart. Others do not have wires going into the heart chambers but instead rest on the heart to monitor its rhythm.
The ICD can also record the heart's electrical activity and heart rhythms. The recordings can help your healthcare provider fine-tune the programming of the device so it works better to correct irregular heartbeats. The device is programmed to respond to the type of arrhythmia you are mostlikely to have.

WCDs have sensors that attach to the skin. They are connected by wires to a unit that checks your heart's rhythm and delivers shocks when needed. Like an ICD, the WCD can deliver low- and high-energy shocks. The device has a belt attached to a vest that is worn under your clothes. Your provider fits the device to your size. It is programmed to detect a specific heart rhythm.

4. Compare the process of photosynthesis to the functioning of photovoltaic cells.
5. Define GPS system existing in birds.
6. Explain the lotus leaf effect.