BIOLOGY FOR ENGINEERS 21BE45

SCHEME & SOLUTION IAT#2

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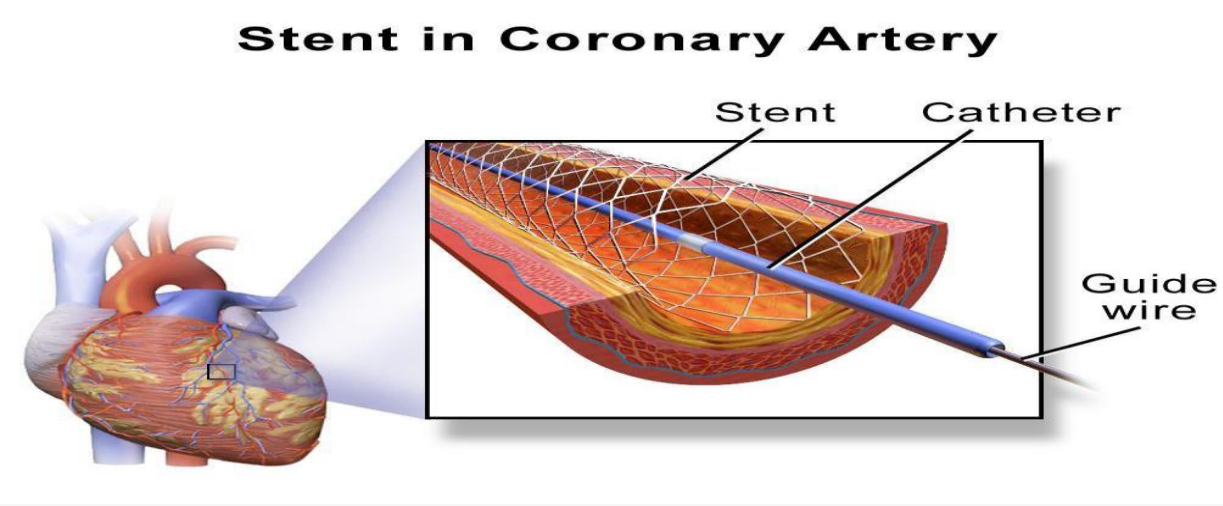
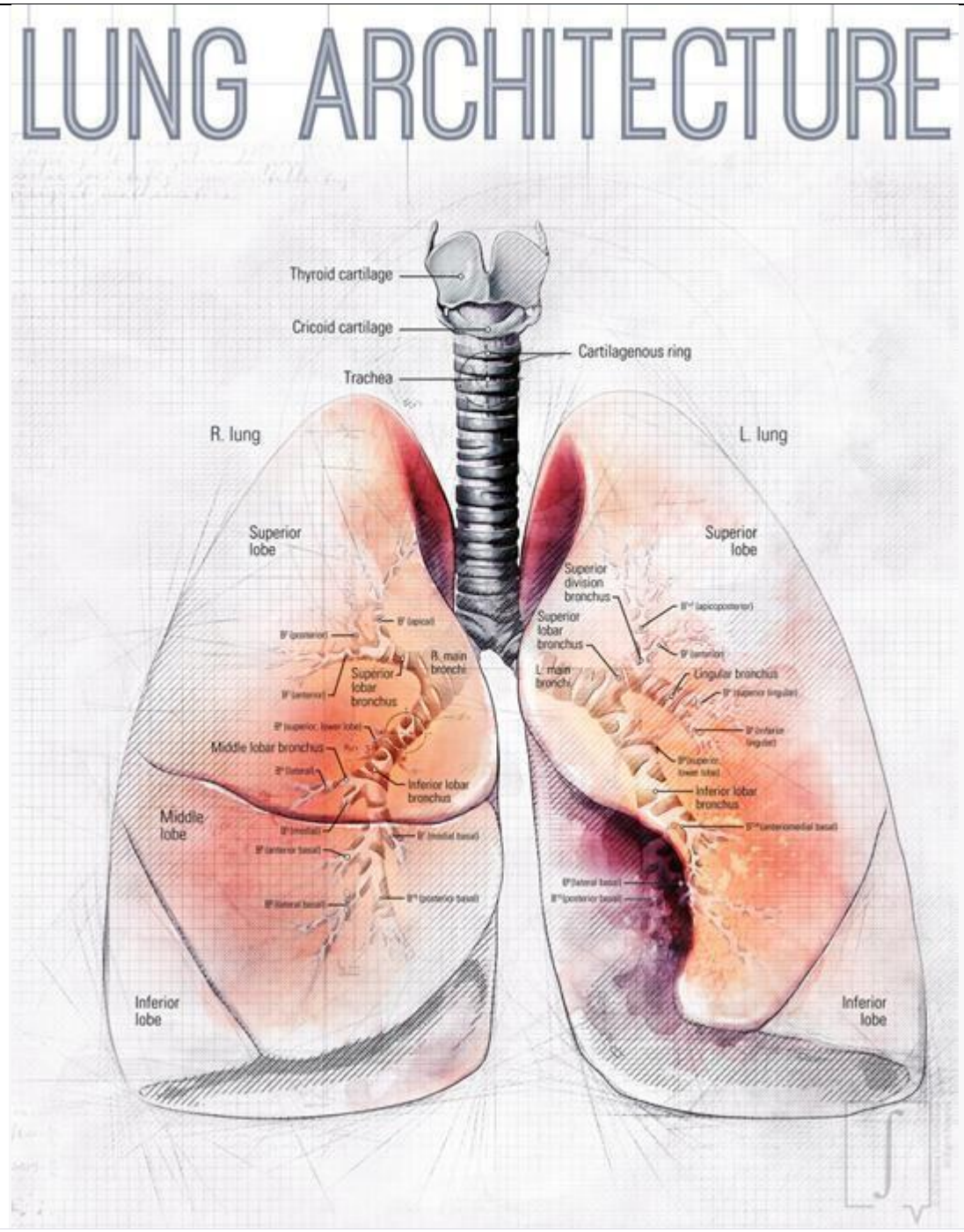
1.	*ELECTRO ENCEPHALO GRAM [EEG]:* An electroencephalogram (EEG) is a test that measures electrical activity in the brain using small, metal discs (electrodes) attached to the scalp. Brain cells communicate via electrical impulses and are active all the time, even during asleep. This activity shows up as wavy lines on an EEG recording. An EEG is one of the main diagnostic tests for epilepsy. An EEG can also play a role in diagnosing other brain disorders. An EEG can find changes in brain activity that might be useful in diagnosing brain disorders, especially epilepsy or another seizure disorder. An EEG might also be helpful for diagnosing or treating: □ Brain tumors □ Brain damage from head injury □ Brain dysfunction that can have a variety of causes (encephalopathy) □ Sleep disorders □ Inflammation of the brain (herpes encephalitis) □ Stroke □ Sleep disorders An EEG might also be used to confirm brain death in someone in a persistent coma. A continuous EEG is used to help find the right level of anesthesia for someone in a medically induced coma. Voltage fluctuations measured by the EEG bioamplifier and electrodes allow the evaluation of normal brain activity including the posterior dominant rhythm (PDR), first described by Hans Berger. EEG can detect abnormal electrical discharges such as sharp waves, spikes or spike-and- wave complexes that are seen in people with epilepsy, thus it is often used to inform the medical diagnosis. EEG can detect the onset and spatio-temporal evolution of seizures and the presence of status epilepticus. It is also used to help diagnose sleep disorders, depth of anesthesia, coma, encephalopathies, cerebral hypoxia after cardiac arrest, and brain death. EEG used to be a first- line method of diagnosis for tumors, stroke and other focal brain disorders, but this use has decreased with the advent of high-resolution anatomical imaging techniques such as magnetic resonance imaging (MRI) and computed tomography (CT). Despite limited spatial resolution, EEG continues to be a valuable tool for research and diagnosis. It is one of the few mobile techniques available and offers millisecond-range temporal resolution which is not possible with CT, PET or MRI. Derivatives of the EEG technique include evoked potentials (EP), which involves averaging the EEG activity time-locked to the presentation of a stimulus of some sort (visual, somatosensory, or auditory). Event-related potentials (ERPs) refer to averaged EEG responses that are time-locked to more complex processing of stimuli; this technique is used in cognitive science, cognitive psychology, and psychophysiological research. A stent is a tiny tube that helps keep your arteries -- the blood vessels that carry blood from your heart to other parts of your body, including the 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	

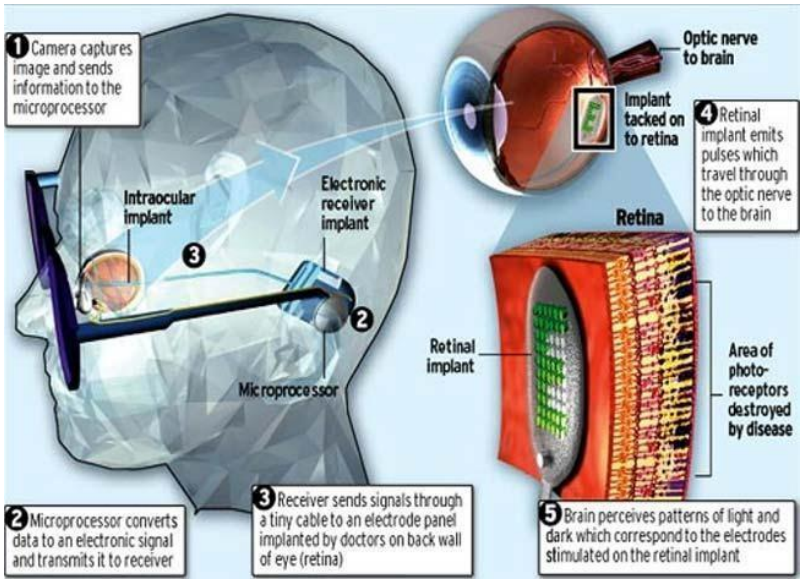
2	body absorbs over time. They're coated in medicine that slowly releases into your artery to prevent it from being blocked again. If a fatty substance called plaque builds up inside an artery, it can reduce blood flow to your heart. This is called coronary heart disease and it can cause chest pain. The plaque can also cause a blood clot that blocks blood flowing to your heart, which may lead to a heart attack. By keeping an artery open, stents lower your risk of chest pain. They can also treat a heart attack that's in progress. Most of these stents are constructed from a nickel titanium alloy. Structure: Stents are generally tubular structures that can be either self-expandable or balloon-expandable. Stents may have a thin coating to serve different purposes. Drug-eluting stents (DES) are coated with medications that help prevent reblockage or restenosis of the treated vessel segment. Biocompatibility: Stents are designed to be biocompatible to minimize adverse reactions and promote tissue healing. 
3.	The lungs are primarily responsible for exchange of gases, allowing oxygen to enter the bloodstream and carbon dioxide to be removed from the body. **Primary Function:** Filtration: When you inhale, the air passes through the nose, which contains tiny hairs called cilia. The cilia help filter out larger particles such as dust, pollen, and other contaminants, preventing them from reaching the lungs. Defence mechanisms: The lungs have a specialized defence mechanism to protect against pathogens and harmful substances. The respiratory tract is lined with cells that produce mucus, which acts as a sticky trap, capturing bacteria, viruses, and other harmful particles. Immune system response: The lungs have a complex immune system that helps to neutralize and eliminate foreign invaders. Exposure to certain substances like tobacco smoke, air pollution, or occupational hazards can lead to respiratory problems and long-term damage. Lobes: The lungs are divided into lobes. The right lung has three lobes: the upper lobe, middle lobe, and lower lobe. The left lung has two lobes: the upper lobe and lower lobe .Bronchi: The bronchi are the main airways that enter the lungs. The trachea bifurcates into two primary bronchi, one leading to each lung creating a bronchial tree-like structure.

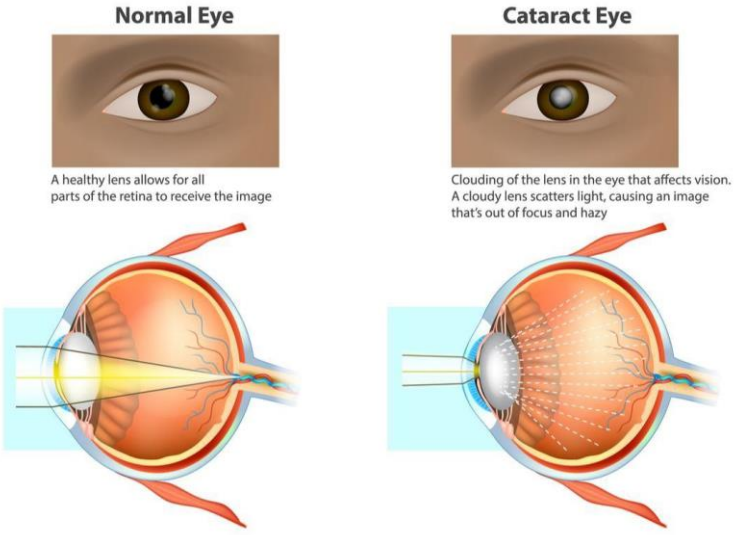


4. **Cataract:** Cataract is a common eye condition characterized by the clouding of the lens, which leads to a gradual loss of vision .With cataracts, the lens becomes progressively opaque, causingblurry vision and eventually leading to vision impairment if left untreated. Cataracts can develop for various reasons, including aging, prolonged exposure to ultraviolet radiation. Symptoms of cataracts may include blurred vision, difficulty seeing in dim light or at night, sensitivity to glare, seeing halos around lights, and a need for frequent changes in eyeglass prescription.The treatment for cataracts typically involves surgical intervention. Cataract surgery is a common and generally safe procedure in which the cloudy lens is removed and replaced with an artificial

intraocular lens (IOL).

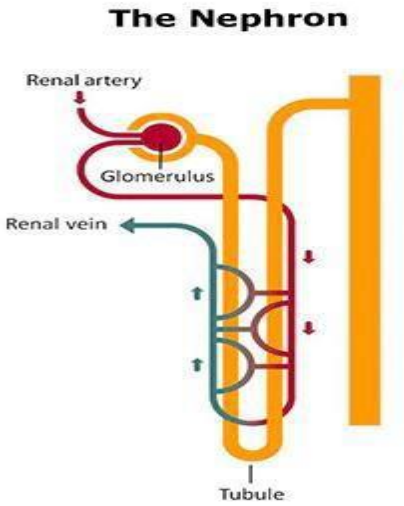
Bionic Eye: A bionic eye, also known as a retinal implant designed to restore vision in individuals with severe vision loss or blindness. The basic concept of a bionic eye involves bypassing the damaged or non-functioning photoreceptor cells and directly stimulating the remaining functional cells or the optic nerve to transmit visual signals to the brain. External Components: The external components of a bionic eye system include a small video camera mounted on a pair of glasses worn by the user. The camera captures visual information from the environment. Processing Unit: The captured visual information is processed by a small unit worn or carried by the user. This unit converts the visual signals into electrical signals that can be used to stimulate the remaining visual cells or the optic nerve.





5. The kidneys filter blood, remove waste products, and regulate the body's fluid and electrolyte levels. 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.

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 A carcinogen refers to any substance or agent that has the potential to cause cancer. Although WHO and USEPA have set an arsenic maximum contaminant level (MCL) for public drinking water at 10ppb, in most of the arsenic-affected Asian countries, including India; the permissible limit of arsenic in drinking water is 50 ppb. The World Health Organizations (WHO) current provisional guideline for arsenic in drinking water is 10 ppb



6. **Muscular dystrophy**: Muscular dystrophy(MD) refers to a group of genetic disorders characterized by progressive muscle weakness and degeneration.It is caused by mutations in genes that are involved in the structure and function of muscle fibers. These mutations lead to the inability of the body to produce specific proteins essential for muscle integrity, resulting in the gradual breakdown of muscle tissue over time.Duchenne Muscular Dystrophy (DMD): DMD is the most prevalent and severe form of muscular dystrophy, predominantly affecting males.
It is caused by mutations in the DMD gene, which leads to the absence of the dystrophin protein.

Osteoporosis: :
Osteoporosis is a skeletal disorder characterized by low bone mass and deterioration of bone tissue, leading to increased bone fragility and a higher risk of fractures. The condition is often referred to as a "silent disease" because it progresses without noticeable symptoms until a fracture occurs. Bone Density Loss: Osteoporosis involves a decrease in bone mineral density (BMD), making bones more porous and susceptible to fractures, especially in areas like the spine, hips, and wrists.

Bioengineering approaches for Muscular Dystrophy:
Gene Therapy: Gene therapy involves introducing functional genes into cells to correct or replace faulty

	genes responsible for muscular dystrophy. **Cell-Based Therapies:** Stem cell-based therapies hold promise for muscular dystrophy treatment. **Tissue Engineering:** Tissue engineering approaches involve creating functional muscle tissue constructs in the lab and implanting them into affected areas.	
7.	• **Bioengineering approaches for Osteoporosis:** • **Biomechanical Stimulation:** Mechanical loading techniques, such as low-intensity vibration or whole-body vibration, to stimulate bone remodelling and improve bone density in individuals with osteoporosis. • **Implantable Sensors:** Implantable sensors to monitor bone health and provide real-time feedback on bone density and quality • **Artificial Bone Substitutes:** Bioengineers are creating synthetic bone substitutes, such as calcium phosphate-based materials, that can be implanted to replace damaged or weakened bone areas. These substitutes serve as a scaffold for new bone growth. • Echolocation is a technique used by bats, dolphins and other animals to determine the location of objects using reflected sound. This allows the animals to move around in pitch darkness, so they can navigate, hunt, identify friends and enemies, and avoid obstacles. • The oilbird is active at night, and some insect-eating swiftlets roost in dark caves, so it makes sense for them to have evolved the ability to echolocate. Both use sharp, audible clicks to navigate through the darkness. Some nocturnal shrews use ultrasonic squeaks to explore their dark surroundings, and the shrew-like tenrecs of Madagascar echolocate at night using tongue clicks, possibly to find food. Hedgehogs use ultrasonic whistles, they've got excellent hearing and they live in similar habitats to tenrecs and shrews, but we haven't yet been able to confirm that they echolocate for certain. Another intriguing possibility is humans – many blind people can find their way around simply by listening to echoes bouncing off surrounding objects, and some expert human echolocators make short high clicks similar to those found in nature. House mice use Ultrasonic sounds to attract mates. Rats and other rodents also use it to communicate. • The Huia Cavitympanum is the only known frog species that can communicate using purely ultrasonic calls. This unusual frog lives in the Philippines. These frogs can hear sounds up to 38 kilohertz, the highest frequency any amphibian species has been known to hear. Many animals use Echolocation to help them move about in low light and to locate food. They also use Ultrasonic sounds to communicate. From watching animals and through scientific	

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