
CHAPTER

18

Pharmacology

Animation 18.1: 3D-Animation
Source & Credit: rikkyo.ac

Pharmacology is the study of drug composition, properties and medical applications. The sources of drugs are also studied in pharmacology.

Clinical pharmacology was present in the Middle Ages. Early pharmacologists focused on natural substances, mainly plant extracts. Pharmacology developed in the 19th century as a biomedical science.

Any substance that, when absorbed into the body of a living organism, alters normal body function is known as a **drug**. Drugs are broadly classified into two types.

Pharmacology is not synonymous with pharmacy, which is the name used for a profession, though in common usage the two terms are confused.

A **pharmaceutical drug** or medicinal drug is defined as any chemical substance used in the diagnosis, cure, treatment, or prevention of disease.

Some drugs often make person dependent on them, or addicted. These may be called as **addictive drugs**. By using such drug, the person's body becomes familiar to it and the user cannot function well without it.

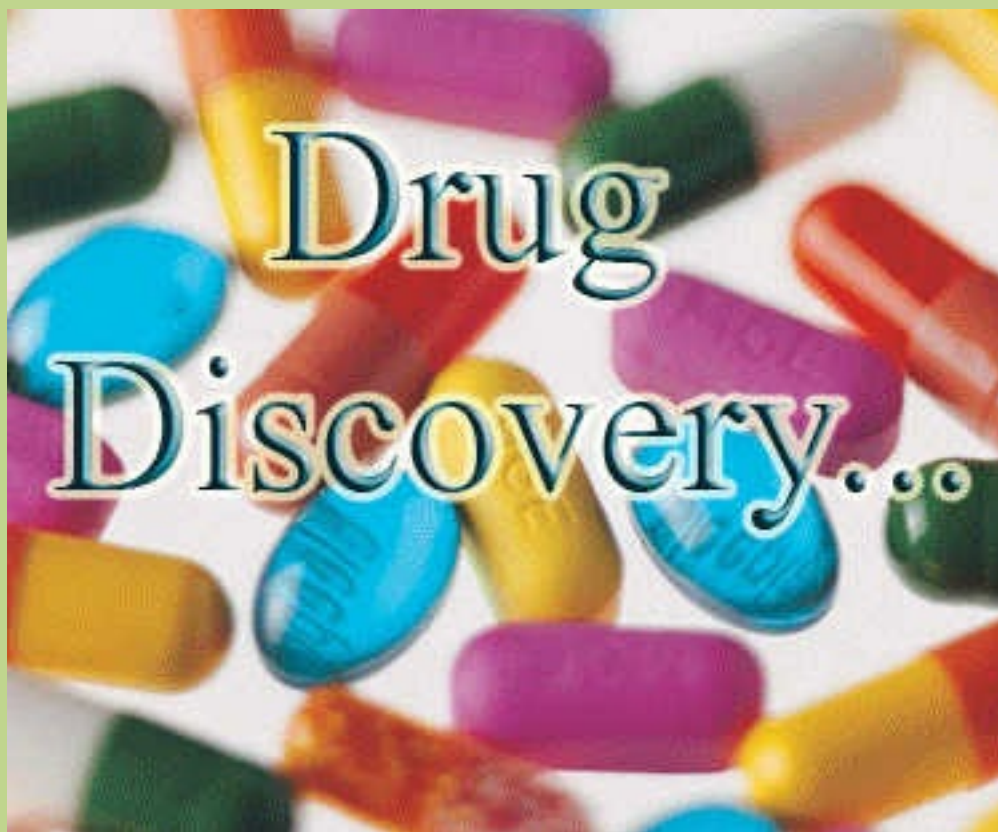
In this chapter, we will learn about the functions of pharmaceutical drugs and the dangers of the addictive drugs.



A page from the book of
Materia Medica

Until 1890, the subject of pharmacology was known as Materia Medica.

Prescription drugs are sold only on physician's prescription. These include barbiturates, tranquilizers, antibiotics etc. Non-prescription drugs are sold over the counter because these are considered safe enough. These include aspirin and some cough medicines.



*Animation 18.2: Insilicon
Source & Credit: Pharmainfo*

18.1 Medicinal Drugs

Various diseases have been made easier to treat in recent years by the production of medicinal drugs. Drugs are obtained from the following sources.

1. Synthetic Drugs

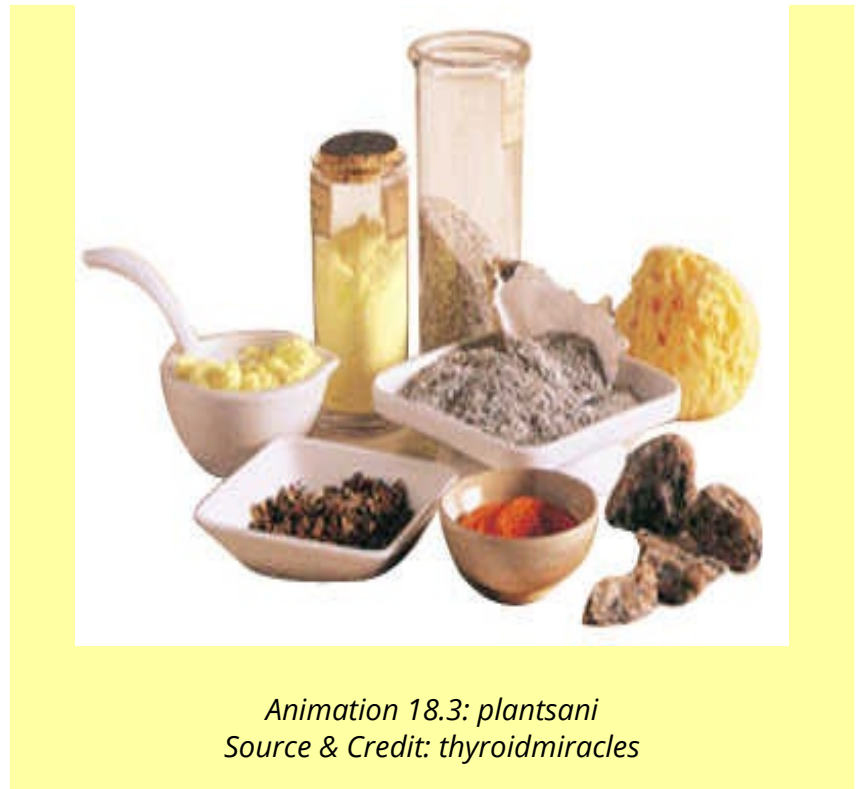
Such drugs do not occur naturally but are synthesized in laboratory. Pharmaceutical companies produce these drugs e.g. aspirin.

2. Drugs from Plants and Fungi

Many important medicines are obtained from plants and fungi. These medicines include antibiotics, cardiotonics and certain analgesics. The antibiotic penicillin comes from a fungus. The cardiotonic, known as digitalis, is used to stimulate the heart. It is made from the leaves of purple flowered plant, foxglove.



Figure 18.1: Digitalis (foxglove)



Many addictive illegal drugs e.g. marijuana are also obtained from plants.

Researchers of a pharmaceutical company spent two years testing soil from all parts of the world to find new antibiotics. The project resulted in the development of one antibiotic, Terramycin, which is used to treat many infections.

The pain reliever morphine is made from opium, which comes from the juice of opium poppy plant.

3. Drugs from Animals

Drugs obtained from animals are usually their glandular products. Fish liver oils, musk, bees' wax, certain hormones and antitoxins are obtained from animal sources.

4. Drugs from Minerals

Several common drugs are produced from minerals. The mineral iodine is used in making tincture of iodine, a liquid that helps prevent infection when applied to cuts and bruises. The powder form of silver nitrate is applied on wounds to stop bleeding and prevent infection.

5. Drugs from Bacteria

Many antibiotics e.g. streptomycin are obtained from bacteria.

18.1.1 Principle Usage Of Important Medicinal Drugs

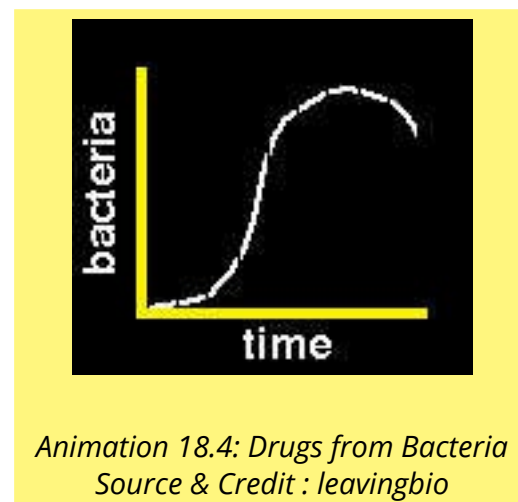
Drugs are classified on the basis of their chemical properties and modes of action.

- **Analgesics** (painkillers) reduce pain e.g. aspirin, paracetamol etc.
- **Antibiotics** inhibit or kill bacteria and treat bacterial infections e.g. tetracycline, cephalosporin etc.
- **Sedatives** induce sedation by reducing irritability or excitement e.g. diazepam.
- **Vaccines** are used to develop immunity against viral and bacterial infections e.g. vaccines against small pox, whooping cough, hepatitis B etc.

Antiseptics reduce the possibility of infections on skin

Antibiotics inhibit or kill bacteria within or on the body

Disinfectants destroy microorganisms found on non-living objects.



Joseph Lister (1827 – 1912) was an English surgeon. He promoted the idea of sterile surgery for the first time. He introduced carbolic acid to sterilise surgical instruments and to clean wounds.

Sir Alexander Flemming (1881 – 1955) was a Scottish biologist. He discovered the antibiotic penicillin from the fungus *Penicillium notatum*, for which he was awarded the Nobel Prize in 1945.

Things to remember !

Medicines can help you feel better. But if medicines are taken incorrectly, they can actually make you feel worse. It is important to:

- Always check the instructions on doctor's prescription slip and make sure you take the doses of medicine strictly as your doctor prescribed.
- Always check the expiry date printed on the medicine pack. The expired medicines may prove poisonous.
- Never take medicines prescribed for someone else, even if you think you have the same medical problem.
- Some medicines – such as antibiotics - must be taken for a specific number of days. Make sure you take the medicine for the stated time. Otherwise the problem may come back again.
- Always check with your doctor before you stop taking a medicine or consider a new treatment.
- Some medicines are not suitable for children, and there are special children's dosages for many medicines.
- Do not take medicine in the dark.
- If your prescription medicines are crucial for your health and life, carry medicines and dosage instructions with you, whenever you are out of home.
- Always keep healthcare products out of the reach of children.
- Do not use the medicine if there are signs of tampering. Inform the pharmacist and the manufacturer of the medicine, about it.

18.2 Addictive Drugs

The following are major categories of addictive drugs:

1. Sedatives

These drugs interact with central nervous system to depress its activities. Sedative drugs induce dizziness, lethargy, slow brain function and depression. Long-term use of sedative induce suicidal thoughts.

2. Narcotics

Narcotics are strong painkillers. These drugs are often prescribed in conjunction with other less potent painkillers (paracetamol or aspirin). These are used to relieve pain for patients with chronic diseases such as cancer. These are also used to relieve acute pain after operations. But some people may abuse narcotics for ecstatic effects.

Morphine and **codeine** are the narcotics, derived from opium (poppy). Morphine acts directly on central nervous system to relieve pain. Morphine has a high potential for addiction. The most commonly abused narcotic i.e. heroin is a semi-synthetic drug from morphine. It affects on central nervous system and causes drowsiness.



Figure 18.2: The fruits of the opium poppy plant



Animation 18.5: Drug addiction
Source & Credit: teensandhealth

In many western countries, heroin is prescribed as a strong analgesic under the name diamorphine. Its use includes treatment for acute pain, such as in severe physical trauma, myocardial infarction, post-surgical pain etc.

3. Hallucinogens

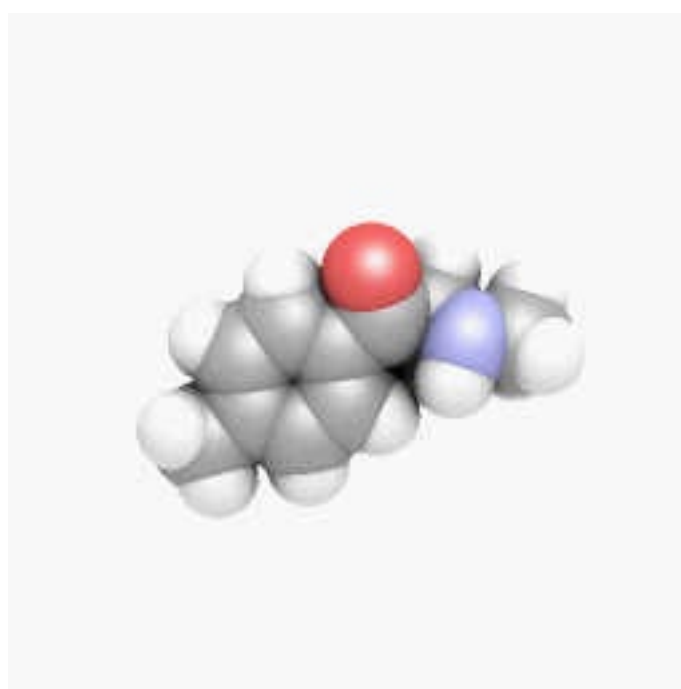
Hallucinogens are the drugs that cause changes in perception, thought, emotion and consciousness. The group includes **mescaline**, which comes from a cactus and **psilocin**, which comes from a mushroom. Physiologically, hallucinogens affect on the sympathetic nervous system, causing dilation of pupils, constriction of some arteries and rise in blood pressure.

Hallucinations are perceptions that have no basis in reality, but that appear entirely realistic.

4. Marijuana (Hashish)

Marijuana is a hallucinogen, which is smoked. It is obtained from the flowers, stems, and leaves of the marijuana plant (*Cannabis sativa* and *C. indica*). Small doses of marijuana result in a feeling of well-being that lasts two to three hours. High doses increase heart rate. It also affects the production of sperms in men and also weakens the short-term memory.

Marijuana is one of the most commonly used drugs in the world, following only caffeine, nicotine, and alcoholic beverages in popularity.



Animation 18.6: 3D Structure of Marijuana
Source & Credit: disinfo

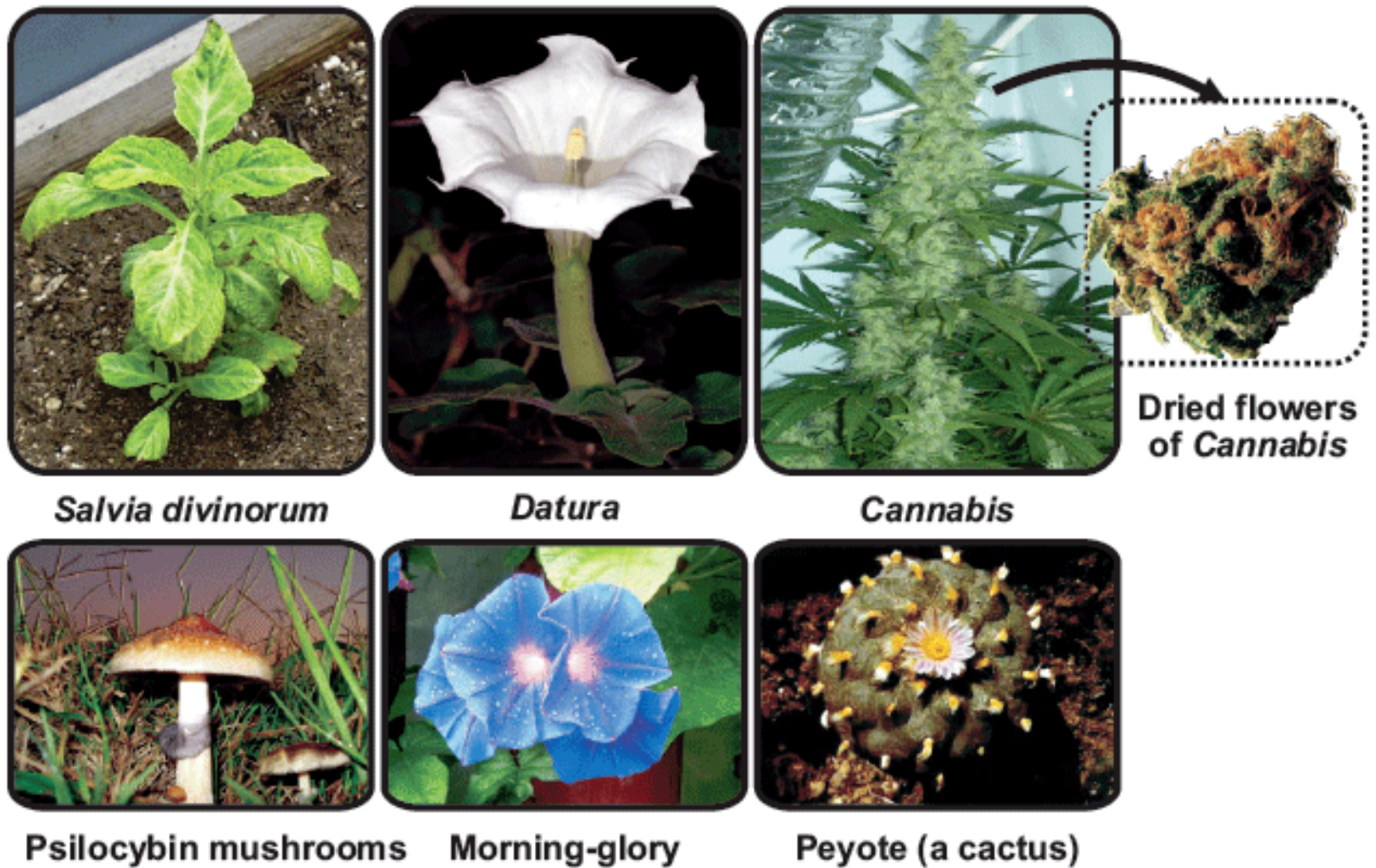


Figure 18.3: Plants from where hallucinogens are obtained

18.2.1 Drug Addiction And Associated Problems

Drug abusers go through withdrawal of social contact or communication. Many studies by the experts of social sciences prove that there exists a close relationship between drug addiction and crime. The compulsion for narcotic drug makes every drug addict a law violator and a criminal. Mere possession of a narcotic drug is a violation of the law. Thus, every drug addict is subject to arrest by the police.

Most narcotic addicts get involved in various types of crime e.g. robbery, shoplifting, burglary, embezzlement etc.



The jails and prisons of our country are full of such people who have committed no other crime than the illegal possession of narcotics.

Drug addicts may commit violent crimes since so many become psychic patients. The addicts are very weak in their social behaviour. They face social stigma i.e. the society dislikes them because of their unpredictable behaviours.

18.3 Antibiotics And Vaccines

Two important medicinal drugs are antibiotics and vaccines.

18.3.1 Antibiotics

An antibiotic is a drug that kills or retards the growth (reproduction) of bacteria. They are the chemicals produced by or derived from microorganisms (bacteria and fungi).

Bactericidal and Bacteriostatic antibiotics

Antibiotics are used to treat many different bacterial infections. Some antibiotics are 'bactericidal', meaning that they kill bacteria. Others are 'bacteriostatic', meaning that they work by stopping bacterial growth.

Three major groups of antibiotics are described below.

Antibiotics are among the most frequently prescribed medications in modern medicine.



Animation 18.8: Narcotics
Source & Credit: whyquit

1. Cephalosporins

Cephalosporins interfere with synthesis of bacterial cell wall and so are bactericidal. Cephalosporins are used to treat pneumonia, sore throat, tonsillitis, bronchitis etc.

Some antibiotics can be used to treat a wide range of infections and are known as 'broad-spectrum' antibiotics. Others are only effective against a few types of bacteria and are called 'narrow-spectrum' antibiotics.

2. Tetracyclines

These are broad-spectrum bacteriostatic antibiotics and inhibit bacterial protein synthesis. Tetracyclines are used in the treatment of infections of respiratory tract, urinary tract, intestine etc. Tetracyclines are not used in children under the age of 8, and specifically during periods of tooth development.

3. Sulpha Drugs - Sulfonamides

Sulpha drugs are synthetic antibiotics that contain sulfonamide group. Sulfonamides are broad spectrum bacteriostatic antibiotics. They inhibit the folic acid synthesis in bacteria. They are used to treat pneumonia and urinary tract infections.

Antibiotic Resistance

Antibiotics are extremely important in medicine, but unfortunately bacteria are capable of developing resistance to them. Such bacteria are not affected by commonly used antibiotics.

Bacteria have number of ways of developing resistance. Sometimes, their internal mechanism stops the working of antibiotic. Bacteria can also transfer the genes responsible for antibiotic resistance between them. So such resistant bacteria make it possible for other bacteria to acquire resistance

Expired drugs can cause damage to kidneys.



Image 18.6: Metabolism
Source & Credit: microgene

The sulfonamide group is also present in other medications that are not antibiotics e.g. thiazide diuretics (medicines for lowering blood pressure).

When bacteria are exposed to the same antibiotics over and over, they can change and are no longer affected by the drug.

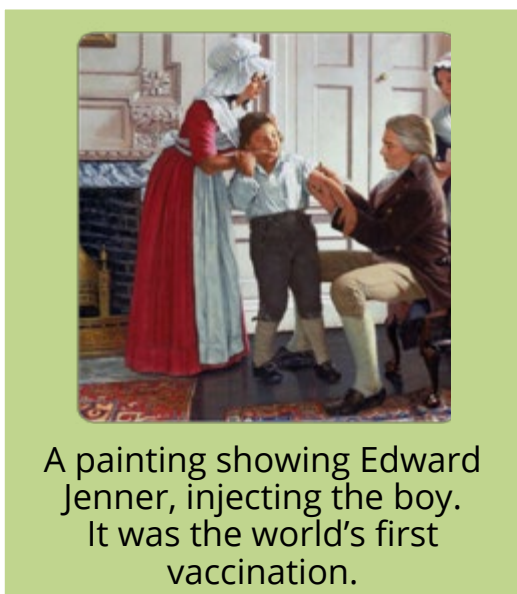
Another reason for increasing antibiotic resistance in bacteria is their use in diseases in which they have no efficacy (e.g. antibiotics are not effective against infections caused by viruses).

Resistance to antibiotics poses a serious and growing problem, because some infectious diseases are becoming more difficult to treat. Some of the resistant bacteria can be treated with more powerful antibiotics, but there are some infections that do not eliminate even with new antibiotics.

18.3.2 Vaccines

A vaccine is a material containing weakened or killed pathogens and is used to produce immunity to a disease by stimulating the production of antibodies.

In 1796, a British physician, Edward Jenner, infected a young boy with cowpox, by injecting pus cells. After the boy had recovered from cowpox, Jenner injected the pus cells from a smallpox patient into him. The boy did not get smallpox.



A painting showing Edward Jenner, injecting the boy. It was the world's first vaccination.

So it became clear that intentional infection with cowpox protected people from smallpox. This method was named “vaccination” and the substance used to vaccinate was called a “vaccine”.

The Mode of Action of Vaccines

Pathogens contain special proteins called “**antigens**”. When pathogens enter the body (blood) of host, these proteins stimulate the immune response in host i.e. synthesis of “**antibodies**”. Antibodies bind to pathogens and destroy them. In addition, “memory cells” are produced, which remain in blood and provide protection against future infections with the same pathogen.

When a vaccine i.e. weakened or dead pathogen is introduced into bloodstream, the white blood cells are stimulated. **B-lymphocytes** recognize the weakened or dead pathogens as enemies and start producing antibodies against them. These antibodies remain in blood and provide protection against pathogens. If real pathogens enter blood, the already present antibodies kill them.

The most common method of administering vaccines is by injection, but some vaccines are given by mouth or nasal spray.

Children are required to be vaccinated before attending school. The vaccination of children has resulted in marked decrease of many once-common diseases including whooping cough, polio, smallpox and others.

Some vaccines do not provide lifetime immunity. For example, tetanus vaccines are only effective for a limited period of time. In such cases, booster shots are necessary to maintain continuous protection.

UNDERSTANDING THE CONCEPT

1. What are the sources of drugs? Give examples.
2. Write a note on sedatives, narcotics and hallucinogens.
3. Describe the main groups of antibiotics.
4. Write a note on resistance against antibiotics.
5. Describe the mode of action of vaccines.

SHORT QUESTIONS

1. Define pharmacology and distinguish it from pharmacy.
2. Differentiate between medicinal drug and addictive drug.
3. Differentiate between analgesic and antibiotic.
4. What is marijuana? To which category of addictive drugs, it belongs?
5. Differentiate between narcotics and hallucinogens.

THE TERMS TO KNOW

[Addictive drug](#)

[Analgesic](#)

[Antibiotic](#)

[Aspirin](#)

[Bactericidal](#)

[Bacteriostatic](#)

[Cardiotonic](#)

[Cephalosporin](#)

[Hallucinogen](#)

[Heroin](#)

[Marijuana](#)

[Medicinal drug](#)

[Morphine](#)

[Narcotics](#)

[Pharmacology](#)

[Sedatives](#)

[Sulfonamide](#)

[Gout](#)

[Vaccine](#)

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SCIENCE, TECHNOLOGY AND SOCIETY

1. Compile a list of various painkillers, antibiotics and sedatives being used in our Pakistan.
2. Summarize the antisocial effects of the usage of hallucinogens and narcotics.
3. Justify the effects of possible over-dosage, under-dosage and drug interactions when using antibiotics without doctor's consultation.

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ON-LINE LEARNING:

1. <http://www.drugabuse.gov/Infofacts/hallucinogens.html>
2. http://en.wikipedia.org/wiki/Psychedelics,_dissociatives_and_deliriant
3. <http://www.well.com/user/woa/fshallu.htm>

GLOSSARY

Abiotic: The non-living components of the environment like water, sunlight, soil, heat etc.

Acid rain: The rain containing sulphuric acid and nitric acid; with pH range of 3 to 6

Acromegaly: Abnormal growth due to excessive production of growth hormone after growing age; the internal organs and body extremities alone grow large and affected persons have large hands, feet and jawbones.

Acrosome: Cap-like head of sperm cell which helps it in penetrating the egg cell.

Addictive drug: The drug which makes a person dependent on it, or addicted

Adrenal cortex: The outer portion of adrenal gland; secretes corticosteroids

Adrenal medulla: The inner portion of adrenal gland; secretes epinephrine or adrenaline

Adrenaline: Epinephrine; a hormone that prepares body to overcome emergency situations; a neurotransmitter produced by some nerve cells

Allele: The alternative form of a gene

Alternation of generations: In plants, the phenomenon in which the sporophyte and gametophyte generations alternate with each other

Alveolar duct: Fine tubules at the end of bronchioles; open into alveoli

Alveolus: A sac-like structure present next to the alveolar duct in lungs

Ammonification: The decomposition of protein of dead plants and animals, and nitrogenous wastes to ammonia by ammonifying bacteria

Analgesic: The medicines that reduce pain

Androecium: The male reproductive whorl of the flower; consists of stamens

Anther: The sac-like structure of a stamen in which pollen grains are produced

Antibiotics: The medicines which inhibit or kill bacteria

Antidiuretic hormone: The hormone of the posterior pituitary; promotes the reabsorption of water in renal tubules

Appendicular Skeleton: The division of the skeleton that includes arms, hands, legs, feet pectoral girdle and pelvic girdle

Aqueous humour: The fluid present in the anterior chamber of the eye i.e. between the cornea and the iris

Arthritis: Terms used for the inflammation in joints

Artificial selection: Selective breeding; intentional breeding between individuals for certain traits, or combination of traits

Aspirin: Acetaminophen; A pain-killer medicine

Asthma: An inflammation of the bronchi that causes swelling and narrowing of the airways

Atmospheric nitrogen fixation: The conversion of atmospheric gaseous nitrogen to nitrates by thunderstorms and lightning

Auditory canal: The part of the external ear; ends at ear drum

Autonomic Nervous System: Part of the peripheral nervous system; consists of motor neurons that send signals to the cardiac muscles, smooth muscle and glands; generally without conscious control

Axial skeleton: The division of the skeleton that includes the skull, vertebral column, ribs and breastbone

Axon: A long, thin fibre that carries nerve impulse away from the cell body of a neuron

Bactericidal: The antibiotics that work by killing bacteria

Bacteriophages: The viruses that attack bacteria

Bacteriostatic: The antibiotics that work by stopping bacteria multiplying

Ball-and-socket joint: The joint that allows movement in all directions e.g. hip and shoulder joints

Batch fermentation process: The discontinuous fermentation process, divided into batches

Biceps: A flexor muscle on the front of the upper arm bone

Binary fission: Division into two; the simplest method of asexual reproduction in prokaryotes and many unicellular eukaryotes

Biogeochemical Cycle: The cyclic pathway through which chemical elements move from environment to organisms and back to the environment

Biological nitrogen fixation: The conversion of gaseous nitrogen into nitrates by living organisms

Biosphere: The last level of ecological organization; all the ecosystems of the world together form the biosphere

Biotechnology: The use of living organisms in systems or processes for the manufacture of useful products or for services for humankind

Biotic: The living components of the environment; include producers, consumers and decomposers

Bone: Hard connective tissue; moves, supports and protects the various organs of the body

Bowman's capsule: Part of nephron: cup-shaped structure enclosing the glomerulus

Breathing: The process through which animals take air in their bodies to get oxygen and then give out the air for getting rid of carbon dioxide

Breeds: The animals which are bred through artificial selection

Bronchioles: Fine tubules formed by the division of the bronchi

Bronchitis: Inflammation in the bronchi or bronchioles

Bronchus: The part of air passageway; formed by the division of the trachea

Budding: A type of asexual reproduction in which a bud develops as a small outgrowth on parent's body and forms the new individual

Bulbs: Underground vertical shoots which have modified leaves

Calyx: The outer whorl of flowers; consists of sepals

Carbon cycle: The biogeochemical cycle in which carbon flows between organisms and the environment

Cardiotonic: Medicines for giving strength to heart muscles

Carnivores: The consumers which eat only animal flesh

Carpel: Part of the gynoecium of the flower; consists of stigma, style and ovary

Cartilage: The connective tissue that makes part of the human skeleton

Cell body: The part of the nerve cell that contains nucleus

Central nervous system: The part of the nervous system consisting of brain and spinal cord

Cephalosporin: A group of antibiotics; interfere with synthesis of the bacterial cell wall

Cerebellum: The part of the hindbrain; controls muscle movements

Cerebral cortex: The outer layer of the cerebral hemispheres

Cerebral hemispheres: The divisions of the cerebrum of the brain

Cerebrospinal fluid: The fluid in the ventricles of the brain and in the central canal of the spinal cord

Cerebrum: The largest part of the forebrain; controls many sensory and motor functions

Cervix: In female reproductive system, the part which separates uterus from the vagina

Chondrocyte: The cells present in the cartilage

Chromatin: The chemical material that make the structure of the chromosome

Cloning: Method of asexual reproduction in which identical offsprings are produced from a vegetative tissue or cell of the parent

Cochlea: The part of the inner ear; consists of three ducts wrapped in the form of a coiled tube; contains sound receptors

Co-dominance: The situation where two allele of a gene pair express their traits independently instead of showing a dominant-recessive relationship

Collecting duct: The tubes into which the renal tubules of nephrons open

Colour blindness: Genetic disorders in which person fails to recognize the basic colours

Commensalism: A type of symbiosis in which one of the partners gets benefit while the other is neither benefited nor harmed

Compact bone: The hard outer layer of bones

Cones: The photosensitive cells in the retina of the eye; sensitive to bright light and so distinguish different colours

Consumer: The part of the biotic components of the ecosystem that consists of animals

Continuous fermentation process: The fermentation in which substrate is added to the fermenter continuously, at a fixed rate

Corm: Short, swollen underground stem; has bud(s) at the top; gives rise to new plants by vegetative propagation

Cornea: The transparent part of sclera that forms in the front of the eye through which light enters

Corolla: The second whorl of flower, consisting of petals

Cotyledon: A modified leaf present in seeds; often gives nourishment to the developing seedling

Cowper's gland: An accessory gland in rabbits male reproductive system; provides lubrication to the ducts

Cranial bones: The bone of the cranium

Cranial nerves: Nerves that arise from or lead to the brain

Cranium: The part of the skull that encloses the brain

Cultivars: The plants which are bred through artificial selection

Cutting: Artificial vegetative propagation in which cuttings are taken from stem or root of parent and are placed in soil

Decomposer: An organism which decomposes the dead bodies and dead matter

Deforestation: Clearing of forests by natural causes or by humans

Dendrites: Short, branched projections of neuron's cell body; transmits nerve impulse towards cell body

Denitrification: The conversion of nitrites and nitrates into nitrogen gas

Diabetes mellitus: More than normal level of glucose in blood; a condition caused by insufficient concentration of insulin in blood

Dialysis: The cleaning of blood (removing nitrogenous wastes and extra water) by artificial ways

Dialyzer: The apparatus used for haemodialysis

Diaphragm: The muscular structure that forms the floor of the chest cavity; present below lungs

Dihybrid cross: A genetic cross in which two pairs of contrasting traits are studied

Distal convoluted tubule: The last part of the nephron

Dominant trait: The trait that appears in the offspring of a cross between two homozygous individuals showing contrasting forms of the trait

Drug: Any substance that, when absorbed into the body of a living organism, alters normal body function

Dwarfism: Less than normal body growth; a condition caused when growth hormone is insufficient during the growing age

Ear drum: Tympanic membrane; A membrane stretched across the inner end of the auditory canal of the ear

Ecological pyramid: A representation of the number of individuals or amount of biomass or energy present in various trophic levels of a food chain

Effectors: The parts of the coordination system that respond when stimulated by nerve impulses or hormones

Emphysema: A disease in which the walls of the alveoli are destroyed

Endocrine gland: A ductless gland; produces and secretes hormones

Endosperm nucleus: In the female gametophyte, the triploid nucleus formed by the fusion of sperm and the fusion nucleus

Endosperm tissue: The tissues that develops from endosperm nucleus; often serves as a food supply for developing embryo

Endospore: The spore formed inside the bacterial cell

Environment: The sum total of physical (abiotic) and biotic conditions which influence the organism

Epicotyl: The embryonic stem above the point of attachment of the cotyledon(s)

Epididymis: A storage area for sperms on the upper part of the testes

Epigeal germination: A type of seed germination in which the hypocotyl elongates and forms a hook, pulling the cotyledons above the ground

Epilepsy: A nervous disorder characterized by recurrent unprovoked seizures (convulsions)

Epinephrine: See Adrenaline

Estrogen: A hormone secreted by the ovaries; promotes development of female secondary sex characteristics and regulates the reproductive cycle

Eustachian tube: The tube between middle ear and the nasal cavity that equalizes the pressure on both sides of the ear drum

Eutrophication: The enrichment of water with inorganic nutrients; the nutrients promote the growth of algae and it leads to increase in the number of the decomposers and depletion of oxygen

Excretion: The process by which the metabolic wastes are removed from the body

Exhalation: The phase of breathing in which air is expelled from the lungs

Exocrine gland: A gland that discharges its secretion into a duct

Extensor: A muscle that extends a joint

Fallopian tube: a part of the female reproductive system; receives egg cell discharged from the ovary

Feedback mechanisms: The mechanisms to control certain functions; one of the products of a pathway are used, usually the end product, to control the activity of the pathway

Fermentation: The process in which there is incomplete oxidation-reduction of the organic substrate (glucose)

Fermenter: A device that provides optimum environment in which organisms can grow to produce biomass and to form the product.

Fertilization: The fusion of male and female gametes to form a zygote

Fibrous cartilage: The cartilage that has large number of fibres in the matrix e.g. the cartilage in intervertebral disc

Flexor: A muscle that bends a joint

Follicle: A structure in the ovary in which the mature egg develops

Food chain: The series of organisms in an ecosystem, in which an organism eats the preceding one and is eaten by the next one

Food web: A network of interconnected food chains; has a number of feeding connections amongst different organisms of a community

Forebrain: The part of the brain; includes cerebrum, thalamus and hypothalamus

Fragmentation: A type of asexual reproduction in which the animal breaks up into many pieces and each piece develops into a mature animal

Fusion nucleus: A part of the female gametophyte in plants; formed by the fusion of two nuclei; gives rise to endosperm nucleus when fertilized by a sperm

Gametogenesis: The process of the formation of gametes

Gametophyte: The haploid generation in plant life cycle; produces gametes

Ganglion: The aggregation of the cell bodies of neurons

Gaseous exchange: Taking in and giving out of gas (oxygen and carbon dioxide) by organism

Gene: Unit of inheritance; consists of the length of DNA that contains specific instructions for the synthesis of a protein molecule

Genetically Modified Organism: The organism in which DNA (gene) from some other organism has been transferred

Genotype: The specific combination of genes in an individual; may be homozygous or heterozygous

Germination: The process by which a seed embryo develops into a seedling

Gigantism: The condition due to excessively production of growth hormone during the growing age; leads to very tall and overweight persons

Global Warming: Increase in the temperature of the Earth; due to the addition of greenhouse gases in atmosphere, which do not allow solar radiations to reflect back into the space

Glomerular filtrate: The material that passes from glomerulus into the Bowman's capsule

Glomerulus: The network of capillaries in the nephron of kidney

Glucagon: The hormone secreted by the islets of Langerhan; increases the blood glucose level

Gout: A type of arthritis; characterised by the accumulation of uric acid crystals in the moveable joints

Grafting: A type of artificial vegetative propagation in which a piece of stem is cut from the plant and is inserted into another plant with established root system

Grey matter: The nervous tissue containing cell bodies and non-myelinated processes of the neurons

Guttation: Appearance of drops of xylem sap on the tips or edges of leaves

Gynoecium: The central whorl in the flower; consists of carpels

Hallucinogen: Drug that causes changes in perception, thought, emotion and consciousness

Haemodialysis: The dialysis in which patient's blood is pumped through the apparatus called dialyzer for cleaning

Heroin: A commonly abused narcotic; derived from morphine; affects the central nervous system and causes drowsiness, disorientation, hypotension etc.

Heterozygous: The genotype that has two different alleles of a trait

Hilum: A scar on the seed coat; the point where the seed is attached to the ovary wall

Hilus: A depression near the centre of the concave area of the kidney; the area through which the ureter, blood and lymphatic vessels and nerves enter/leave the kidney

Hindbrain: The part of the brain consisting of cerebellum, medulla oblongata and pons

Hinge joint: A joint that permits movement of bones in one plane e.g. elbow and knee joints

Histone: The protein present in the structure of chromosome

Homeostasis: The maintenance of a constant internal environment in response to environmental changes

Homologous chromosomes: A pair of chromosomes having the same size and shape and carrying alleles for the same traits

Homozygous: Having two identical alleles of a trait

Hormone: A substance that is secreted by an endocrine gland directly into blood and that produces a specific effect on a particular tissue

Hyaline cartilage: The cartilage that has collagen fibres in its matrix; found covering the ends of the long bones, in the nose, larynx, trachea and bronchial tubes

Hyoid bone: The bone present in neck

Hypermetropia: The condition in which a person is not able to see near objects clearly; happens when the eyeball shortens and image is formed behind the retina

Hyperthyroidism: The over-production of thyroxin; result in increase in energy production, increased heart-beat, frequent sweating and shivering of hands

Hypocotyl: The embryonic stem below the point of attachment of cotyledon

Hypogeal germination: A type of seed germination in which the epicotyl elongates and forms the hook while the cotyledons stay underground

Hypothalamus: The part of the forebrain below the thalamus; controls body temperature, blood pressure and emotion

Hypothyroidism: The under-production of thyroxin; results in low energy production and slowing down of heart-beat

Incomplete dominance: A type of inheritance in which neither of the pair of contrasting alleles is dominant over the other and the heterozygous individual is intermediate in phenotype

Inhalation: The phase of breathing in which air is drawn into the lungs

Inheritance: The transmission of characteristics from parents to offspring

Insertion: The end of the muscle that is attached with a moveable bone

Insulin: The hormone produced by the Islets of Langerhans; lowers the blood glucose level

Interneurons: The neurons present in the brain and spinal cord

Interspecific interactions: Interactions between the members of the different species

Intraspecific interactions: Interactions between the members of the same species

Iodopsin: A pigment present in the cones of the retina

Islets of Langerhans: Groups of endocrine cells present in pancreas; secrete hormones insulin and glucagon

Iris: A muscular ring formed by the bending of the choroid behind the cornea of the eye

Joint: The location at which two or more bones make contact

Kidney failure: A complete or near complete failure of the kidneys to excrete wastes and to regulate water and salts

Kidney stone: The deposits of large chemicals such as calcium oxalate, calcium and ammonium phosphate, uric acid, cystine etc. present in kidneys, ureter or bladder; cannot pass in the urine

Lacuna: The fluid filled space in bone and cartilage, where their cells are present

Larynx: The part of the air passageway between pharynx and the trachea

Lenticels: Pores in the bark of woody stems and mature roots

Ligament: Strong but flexible connective tissue that joins one bone to bone at the joints

Lithotripsy: Treatment for removing kidney stones; non-electrical shock waves are bombarded on the stones to break them

Locus: Plural Loci; The locations or positions of genes on chromosomes

Loop of Henle: The U-shaped portion of the renal tubule of nephron

Macrospore: Haploid cell produced in the ovule; divides mitotically and produces the female gametophyte

Marijuana: A hallucinogen and addictive drug; obtained from the flowers, stems, and leaves of the marijuana plant

Medicinal drug: Any chemical substance intended for use in the medical diagnosis, cure, treatment, or prevention of disease

Medulla oblongata: Part of the hindbrain; on the top of the spinal cord; controls breathing, heart rate, blood of the retina

Narcotics: Strong painkiller drugs; also used as addictive drugs; commonly abused narcotics include heroin, morphine, methadone etc

Nasal cavity: Hollow space in the nose; opens to the outside through nostrils; divided into two portions by a wall

Natural resources: The resources on Earth, which provide everything that humans use or consume

Natural selection: The process in which organisms with favourable variations survive and produce more offspring than less well-adapted organisms

Nephron: The functional unit of kidneys

Nerve: The union of several axons that are enveloped by a covering made of lipid

Neuron: Nerve cell; the unit of the nervous system; able to conduct nerve impulses

Nitrification: The oxidation of ammonia to nitrites and nitrates by the nitrifying bacteria

Nitrogen cycle: The flow of nitrogen between environment and the organisms

Nitrogen fixation: Conversion of nitrogen into nitrates

Nodes of Ranvier: The non-myelinated points between the areas of myelin on the axons of neurons

Non-renewable resource: A resource that is formed over very long periods; the rate of formation is extremely slow so cannot be replaced; e.g. minerals and fossil fuels

Nostril: The openings of the nasal cavity

Nucleosome: The structure formed by the wrapping of DNA around histone proteins

Olfactory bulbs: The anterior parts of the cerebral hemispheres; receive impulses from the olfactory nerves and create the sensation of smell

Oogenesis: The formation of ovum (egg cell)

Oogonium: (Plural Oogonia): The diploid cells in the follicles of the ovary; produce diploid primary oocytes during oogenesis

Optic disc: Blind spot; a point on the retina of the eye where the optic nerve enters the retina; no photosensitive cells exist at this point

Organic evolution: Biological evolution: The modification of characteristics in the species or populations of organisms during their descent, generation by generation

Origin: The end of the muscle that is attached with an immovable bone

Osmoregulation: The regulation of water content in body fluids

Osteoarthritis: Inflammation in joints due to degeneration in the cartilage present at the joints or due to decreased lubricant production at the joints

Osteocyte: The mature bone cells

Osteoporosis: A bone disease in adults, especially in old age; there is a decrease in the density of bones due to loss of calcium and phosphorus

Oval window: The membrane which separates the middle ear from the inner ear

Ovary: The female gonad; produces egg cells and female sex hormones

Overpopulation: Increase in population beyond the carrying capacity of an area or environment

Ozone: The O₃ gas; also present in the upper layer of the atmosphere where it absorbs the ultraviolet rays present in the sun's radiation

Ovule: In seed plants, a structure present in the ovary; contains megaspore that develops into female gametophyte; ovule develops into seed after fertilization

Oxytocin: The hormone secreted by the posterior pituitary; stimulates the contraction of uterus walls in females for child birth; necessary for ejection of milk from the breasts

Papillary ducts: The ducts formed by the joining of many collecting ducts; open into renal pelvis

Paralysis: Complete loss of function by one or more muscle groups due to damage in the nervous system

Parasitism: A type of interspecific interaction in which smaller partner (parasite) derives food and shelter from the body of larger partner (host) and harms the host

Parasympathetic nervous system: Part of the autonomic nervous system; works when there is little or no stress and slows down the overall activity of the body

Parathormone: Hormone of the parathyroid glands; increases the level of calcium ions in the blood

Parathyroid: The endocrine glands located on the posterior sides of the thyroid gland; secrete parathormone

Parthenocarpy: The process in which ovaries develop into fruit without the fertilization in the ovules present in them; results in seedless fruits e.g. bananas

Parthenogenesis: A form of asexual reproduction in which an unfertilized egg develops into new offspring

Peripheral nervous system: A division of the nervous system that consists of nerves and ganglia

Peritoneal dialysis: The dialysis in which the dialysis fluid is pumped into the abdominal peritoneal cavity; the wastes from the blood vessels of the peritoneum diffuse into the dialysis fluid which is then drained out

Pharmaceutical drug: See medicinal drug

Pharmacology: The study of drug composition and properties and medical applications

Phenotype: The expression of the genotype in the form of trait

Phytoplankton: Photosynthetic organisms that float on the surface of water

Pituitary: The endocrine gland attached to the hypothalamus that controls many other endocrine glands in the body

Plumule: The part of the plant embryo that develops into new shoot

Pneumonia: The infection of one or both lungs; caused by specific bacteria, viruses or fungi; the infected part of the lung becomes filled with fluid and pus

Pollen grain: See Microspore

Pollen tube: A tube formed by the tube nucleus of the pollen grain; carries sperms to the ovule

Pollen-sac: The part of the anther where microspore (pollen grains) are produced

Pollination: The transfer of pollen grains from flower's anther to stigma

Pollutant: The substance that causes pollution

Pollution: Undesirable change in the physical, chemical or biological characteristics of air, water and land that may harmfully affect living organisms and other resources

Pons: Part of the hindbrain; present on top of the medulla; assists the medulla in controlling breathing and serves as a connection between the cerebellum and the spinal cord

Predation: An interaction between animals of two species or any plant and an animal, in which the predator attacks, kills and feeds on the smaller animal called prey

Pressure filtration: The first step in urine formation; the process in which most of the water, salts, glucose and urea of the blood is forced out of the glomerulus and passed into Bowman's capsule

Producer: An organism that produces organic compounds from inorganic compounds; an autotroph

Progesterone: A hormone secreted by the ovaries that maintains the uterus during pregnancy

Prostate gland: An accessory gland in the male reproductive system; produces a secretion that neutralizes the acidity

Proximal convoluted tubule: The part of the nephron between Bowman's capsule and the loop of Henle

Pupil: The opening in the centre of the iris of the eye

Pyramid of Biomass: The graphic representation of biomass present per unit area at different trophic levels in an ecosystem

Pyramid of Numbers: The graphic representation of the number of individuals per unit area at various trophic levels in an ecosystem

Radicle: The part of the plant embryo that develops into new root

Receptors: The organs, tissues or cells which detect particular type of stimuli

Recessive trait: The trait which is masked in the offspring of a cross between two homozygous individuals showing contrasting forms of the trait

Recombinant DNA: The vector DNA and the attached gene of interest

Reflex Action: The involuntary and immediate response to a stimulus

Reflex arc: The nerve pathway over which the nerve impulses travel in a reflex action

Renal corpuscle: The collective name for the glomerulus and Bowman's capsule of the nephron

Renal pelvis: The funnel-shaped cavity into which the renal pyramids of kidney project

Renal pyramids: Cone-shaped areas in the renal medulla

Renal tubule: The part of the nephron after the Bowman's capsule; consists of proximal convoluted tubule, loop of Henle and distal convoluted tubule

Renewable resources: The resources which are replenished or reproduced easily e.g. sunlight, air, wind etc.

Reproduction: The process by which organisms produce new organisms of their own kind

Restriction endonucleases: Enzymes used to cut the gene from the total DNA of the organism

Retina: The innermost and the sensitive layer in the eye

Rheumatoid arthritis: Painful inflammation of the membranes at the joints

Rhizomes: Horizontal underground stems; have scale leaves with buds; shoots of the new plant develop and grow from buds (vegetative propagation)

Rhodopsin: A pigment present in the rods of the retina

Rods: The photosensitive cells present in the retina of the eye; sensitive to dim light

Saltatory conduction: Fast nerve impulses; jump over the areas of myelin going from node to node

Schwann cells: The supporting cells around neurons; form the myelin sheath

Sclera: The tough, white outer layer of the eye

Scrotum: A sac of skin outside the body wall in which the testes of the male are located

Sedatives: Types of drugs that interact with the central nervous system to depress its activities; make a person calm or drowsy

Seed coat: Testa: Outer covering of a seed; develops from the integument of the ovule; protects the embryo from mechanical injury and from drying out.

Seed dormancy: A period, during which there is no growth in the seed; seeds in dormancy are ripe seeds but do not germinate; under favourable conditions, the seeds break dormancy and begin to germinate

Selective re-absorption: The second step in urine formation; in it about 99% of the glomerular filtrate is reabsorbed into the blood capillaries surrounding the renal tubule

Semen: The material containing sperms in a fluid

Semicircular canals: The three bony canals present posterior to the vestibule in the inner ear

Seminal vesicle: The associated gland in male reproductive system; produces secretions having nutrients for the sperms

Seminiferous tubule: The coiled tubes present in testes; sperms are formed in these tubules

Sensory nerves: The nerves which contain only the axons of sensory neurons

Single-Cell Protein: The protein content extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria; the micro-organisms are grown in fermenters where they produce a high yield of protein

Skeleton: The framework of hard, articulated structures that provide physical support, attachment for skeletal muscles, and protection for the bodies of animals

Somatic Nervous system: The part of the motor pathway of the peripheral nervous system; gives voluntary control; includes all of the motor neurons that conduct impulses from the CNS to the skeletal muscles

Somatotrophin: Growth hormone: A hormone of the anterior pituitary; promotes the growth of the body

Sperm: The male gamete

Spermatid: The immature non-motile forms of sperms; are converted into sperms after many changes

Spermatogenesis: The formation of sperms

Spermatogonia: The diploid cells in seminiferous tubules of the testes; divide mitotically and produce primary spermatocytes

Spinal nerves: The nerves which arise from the spinal cord

Spongy bone: The soft and porous interior of the bone; contains blood vessels and bone marrow

Sporophyte: The diploid generation in plant life cycle; produces spores

Stamen: The part of the androecium; consists of anther and filament

Sternum: The chest bone

Stigma: The upper part of the carpel

Style: The middle portion of the carpel

Sulfonamides: Sulpha drugs: Synthetic antibiotics that contain the sulfonamide group; bacteriostatic in action

Suspensory ligament: The ring that attaches the lens of the eye to the ciliary muscles

Symbiosis: Long or short term relationship between members of different species; three forms are parasitism, commensalism and mutualism

Sympathetic nervous system: Part of the autonomic nervous system; prepares the body to deal with emergency situations

Synapse: A junction between a neuron and another cell; transmits nerve impulse from one neuron to the next neuron or to effector's cell

Tendon: Tough connective tissue that attaches muscles to bones