

Chapter

8.1

Health and Diseases

“Disease” is a very wide term. Any change from the normal state that causes discomfort or disability or impairs the health may be called a disease. The Oxford English Dictionary defines disease as “a condition of the body or some part or organ of the body in which its functions are disturbed or deranged”. The World Health Organization (WHO) gave the following definition of health in 1948 –

“Health” is a state of complete physical, mental and social well-being, and not merely an absence of disease or infirmity”. The WHO definition of health recognizes three dimensions of health : physical, mental and social. The physical health can be determined by various tests, but it is difficult to assess the mental health and social well-being.

Disease Agents

The disease agent is a factor (substance or force) which causes a disease by its excess or deficiency or absence. These agents are of five main types :

(1) **Biological Agents** : These include viruses, rickettsias, bacteria, fungi, protozoans, helminthes and arthropods. The biological agents are called **pathogens** (Gr. *Pathos* = disease; *genes* = producing).

(2) **Nutrient Agents** : These comprise food components such as carbohydrates, fats, proteins, minerals, vitamins and water.

(3) **Chemical Agents** : These are further of two types

(i) **Endogenous Chemical Agents** : These are formed in the body itself and include hormones, enzymes, urea and uric acid.

(ii) **Exogenous Chemical Agents** : These enter the body from outside by inhalation, ingestion or inoculation. Pollutants (fumes, gases, dusts, metals) and allergens (spores, pollen) are examples.

(4) **Physical Agents** : These include heat, cold, humidity, pressure radiation, electricity and sound.

(5) **Mechanical Agents** : These comprise chronic friction or other mechanical forces which results in injury, sprain, dislocation fracture.

(6) **Deficiency and Excess of substances** : e.g. Hormones, enzymes.

Some diseases are caused by genetic disorders and lack or underdevelopment of organs. The agents for certain diseases such as peptic ulcers, coronary heart diseases and hypertension, are not fully known.

Types of Diseases

The diseases may be broadly classified into two types : Congenital and acquired.

(1) **Congenital Diseases** : These are anatomical or physiological abnormalities present from birth. They may be caused by (a) a single gene mutation (alkaptonuria, phenylketonuria, albinism, sickle-cell anaemia, haemophilia, colour blindness); (b) chromosomal aberrations (Down’s syndrome, Klinefelter’s syndrome, Turner’s syndrome); or (c) environmental factors (cleft palate, harelip). Unlike the gene-and chromosome-induced congenital defects, environmentally caused abnormalities are not transmitted to the children.

(2) **Acquired Diseases** : These diseases develop after birth. They are further of two types : communicable and non-communicable.

(i) **Communicable (Infectious) Diseases** : These diseases are caused by viruses, rickettsias, bacteria, fungi, protozoans and worms.

(ii) **Noncommunicable (Noninfectious) Diseases** : These diseases remain confined to the person who develops them and do not spread to others. The non-communicable diseases are of four kinds :

(a) **Organic or Degenerative Diseases** : These diseases are due to malfunctioning of some of the important organs, e.g., heart diseases, epilepsy. Heart diseases result from the abnormal working of some part of this vital organ. Epilepsy may result from abnormal pressure on regions of the brain.

(b) **Deficiency Diseases** : These diseases are produced by deficiency of nutrients, minerals, vitamins, and hormones, e.g., kwashiorkar, beri-beri, goitre, diabetes are just a few from a long list.

(c) **Allergies** : These diseases are caused when the body, which has become hypersensitive to certain foreign substance, comes in contact with that substance. Hay fever is an allergic disease.

(d) **Cancer** : This is caused by an uncontrolled growth of certain tissues in the body.

Communicable Diseases

Reservoir of Infection for Pathogens : Every pathogen has some reservoir where it normally lives when it is outside the host susceptible to the disease. The reservoir varies for different pathogens. It may be soil, water, animals or other persons called **carriers**. The animals which act as reservoirs do not contract the diseases and are known as reservoir hosts.

Transmission of Diseases (Pathogens) : The diseases (pathogens) are transmitted from the reservoirs of infection to the healthy persons in the following ways :

(1) **Direct Transmission** : The pathogens of some diseases reach the human body directly without intermediate agents. This can occur as under :

(i) **Contact with Infected Persons** : Certain diseases produce sores or lesions on the skin. Contact with materials discharged from these sores or lesions brings about infection. Ringworm, athlete's foot, barber's itch, chickenpox, smallpox, syphilis and gonorrhoea are spread by direct contact. Kissing also spreads infection. The diseases that are transmitted by direct contact are called **contagious diseases**.

(ii) **Droplet Infection** : Some diseases are caught by merely being in a confined place (room, theatre, bus) with an infected person. The latter throws out tiny droplets of mucus by coughing, sneezing, spitting or even talking. These droplets may contain pathogens (viruses, bacteria) dislodged from nasal membrane, throat, and lungs. Many of these droplets are inhaled. Diphtheria, scarlet fever, influenza, common cold, measles, mumps, tuberculosis, pneumonia, and whooping cough are spread by droplets.

(iii) **Contact with Soil** : The bacteria responsible for tetanus and blood poisoning enter the human body from the soil through injuries. Hence, skin injuries should not be neglected.

(iv) **Animal Bites** : Virus of rabies, or hydrophobia, is introduced through the wound caused by the bites of rabid animals, most commonly dogs.

(v) **Through Placenta** : In the later part of pregnancy, due to age or injury, the placenta becomes permeable to certain pathogens such as virus of german measles and bacteria of syphilis. The pathogens then pass from the maternal blood into the foetal blood.

(2) **Indirect Transmission** : The pathogens of certain diseases reach the human body through some intermediate agents as explained below :

(i) **Arthropod Vectors** : Insects transmit diseases in two different ways.

Housefly carries the causative organisms of cholera, typhoid, dysentery and tuberculosis on the legs and mouth parts from faeces and sputum to food and drinks. The latter, if taken, cause infection. It also carries the microbes responsible for ophthalmia and conjunctivitis from eye to eye. Ants, cockroaches and house crickets also carry disease germs to articles of food.

Certain blood-sucking insects carry disease-causing organisms in their body and transmit them with bites. Human body-louse spreads typhus, rat flea transmits bubonic plague, tsetse fly spreads African sleeping sickness, sandfly transmits kala-azar and oriental sore, *Aedes* mosquito spreads yellow fever, *Culex* mosquito transmits filariasis, and *Anopheles* mosquito spreads malaria, ticks spread rocky mountain spotted fever.

(ii) **Vehicle-borne Method** : The causative organisms of dysentery, cholera and typhoid enter the human digestive tract with food, water and ice. Most of the helminthes which produce diseases in man also get into the body in a similar way. Some diseases are transmitted through blood, e.g., AIDS.

(iii) **Air-borne Method** : The pathogens may reach the humans with air and dust. The epidemic typhus spreads by inhalation of dried faeces of infected lice.

(iv) **Fomite-borne Method** : Many diseases are transmitted through the use of contaminated articles such as handkerchiefs, towels, clothes, utensils, toys, door handles, taps, soaps, syringes and surgical instruments.

(v) **Unclean Hands** : The unclean hands may carry disease germs to food or mouth. Therefore, hands should be washed before taking meals.

(vi) **Human Carriers** : Certain diseases, notably diphtheria and typhoid, spreads by human carriers. The latter are themselves healthy and immune, but have pathogenic organisms in their body. These pathogens are transmitted in the ways already mentioned.

How Pathogens Cause Diseases : Pathogens produce diseases in two ways : tissue damage and toxin secretion.

(1) **Tissue Damage** : The bacteria responsible for tuberculosis damage cells and cause lesions in the lungs. Blood oozes from the lesions into the air sacs, leading to haemorrhages. The bacteria that cause meningitis attack the protective membranes covering the brain. The virus of rabies destroys brain tissue. The polio virus damages motor nerve cells in the spinal cord.

(2) **Toxin Secretion** : Many microbes produce powerful poisons, called **toxins**, which cause diseases. Toxins are of 2 types :

(i) **Exotoxins** : These are released as soon as produced. The diseases brought about by exotoxins include tetanus, scarlet fever, diphtheria, and botulism (food poisoning)

(ii) **Endotoxins** : These are retained in the bacterial cells and released when bacteria die and disintegrate. The diseases caused by endotoxins include typhoid fever, cholera, bubonic plague and dysentery.

Defence mechanism

Immune response : Nature has provided certain ways in the body to defend ourselves from the invasion of pathogens and therefore, from the disease. The ability of a host's body to prevent or overcome the effects caused due to the invasion by pathogenic organisms and its toxins is known as **resistance** and **immunity**. Resistance is considered as an inherent factor and those acquired during life to overcome the disease, while the **immunity** is accepted to be due to the acquired factors that help in resistance. The host body has two lines of defence that must be overcome by a pathogen before establishing an infection.

External defence mechanism : This defence mechanism involves mechanical and chemical factors e.g. skin, mucus membrane, mucus secretion, peristalsis, coughing, sneezing, shedding tears, etc. Chemicals are lysozymes present in the body.

Internal defence mechanism : This mechanism of defence has two lines of defence against pathogen :

(1) **Non-specific Defence Mechanism** : It is further of two types : external defence or first line of defence and internal defence or second line of defence.

(i) **External Defence** : It includes physical and chemical barriers.

(a) Physical Barriers

☐ **Skin** : The skin is physical barrier of body. Its outer tough layer, the stratum corneum prevents the entry of bacteria and viruses.

☐ **Mucus Membrane** : Mucus secreted by mucus membrane traps the microorganisms and immobilises them. Microorganisms and dust particles can enter the respiratory tract with air during breathing which are trapped in the mucus. The cilia sweep the mucus loaded with microorganisms and dust particles into the pharynx (throat). From the pharynx it is thrown out or swallowed for elimination with the faeces.

(b) **Chemical barriers** : Oil secreted by the oil glands and sweat secreted by sweat glands make the surface of the skin acidic (pH 3-5). This does not allow the microorganisms to establish on the skin. Some friendly bacteria also occur on the skin which releases acids and other metabolic wastes that check the growth of pathogens. The sweat also contains an enzyme named **lysozyme** that destroys the cell walls of many bacteria.

The mesh of fine hair in our nostrils filters out particles which may carry pathogens. Nasal secretions also destroy the harmful foreign germs with their lysozyme.

Certain bacteria normally live in vagina. These bacteria produce lactic acid. Lactic acid kills the foreign bacteria.

Thus physical and chemical barriers form the first line of defence.

(ii) **Internal Defence** : The internal defence is carried on by white blood corpuscles, macrophages, inflammatory reaction, fever and interferons.

(a) **White blood corpuscles (Leucocytes)** : The leucocytes in general and lymphocytes in particular are capable of squeezing out through the wall of the blood capillaries into the extra-vascular regions. This phenomenon is called **diapedesis**. The leucocytes protect in different ways.

☐ **Lymphocytes** : Lymphocytes can produce plasma cells which secrete antibodies to provide immunity.

☐ **Monocytes** : They are phagocytic in action.

☐ **Eosinophils** : Eosinophils can attach themselves to parasitic forms and cause their destruction by liberating lysosomal enzymes on their surface.

☐ **Neutrophils** : They eat harmful germs and are, therefore phagocytic in nature.

(b) **Macrophages** : The macrophages are formed by enlargement of monocytes. They are large cells which are phagocytic in nature.

(c) **Inflammatory Response** : When the microorganisms like bacteria, viruses, etc. enter the body tissue through some injury, these produce some toxic substances which kill more cells. These broken cells also release some material which attract the mast cells. The mast cells release histamine. Histamine causes dilation of capillaries and small blood vessels surrounding the injury and increases the permeability of the capillary walls. The more blood flows to area making it red and warm. The fluid (plasma) leaks out into the tissue spaces, causing its swelling. This reaction of the body is known as inflammatory response. The plasma that accumulates at the injured site dilutes the toxins secreted by bacteria and decreases their effect.

(d) **Fever** : The inflammatory response may be in the region of the wound (localized), or it may spread all over the body (systemic). In systemic inflammatory response, the number of WBC increases generally, the fever is caused by the toxins released by the pathogens or by compounds called pyrogens (fever producing substances; Gr. *Pre* = fire). These compounds are released by W.B.C. in order to regulate temperature of the body. Moderate fever stimulates the phagocytes and inhibits growth of microorganisms. However, a very high fever is dangerous.

(e) **Interferons** : These are the proteins released by the cells in response to a viral infection which they help to combat. These interferons do not inactivate the virus, but they make the unattacked cells less susceptible so they are prevented from the attack of virus. They also prevent the viruses from taking over the cellular machinery. *Interferon proteins* have proved to be effective in, treating influenza and hepatitis, but their role in cancer treatment is doubtful. Thus the leucocytes, macrophages, inflammatory response, fever and interferons forms second line of defence.

Table : 8.1-1 Differences between Antibodies and Interferons

Antibodies	Interferons
These act inside the cells.	These act outside the cells.
They are slow acting.	They are quick acting.
They act against bacteria and viruses.	They act only against viruses.
Their action is long lasting	Their action is temporary.

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6	b	7	c	8	a	9	d	10	a
11	c	12	c	13	b	14	a	15	d
16	d	17	c	18	b	19	d	20	b
21	d	22	b	23	d	24	b	25	b
26	c	27	a	28	a	29	a	30	c
31	a	32	a	33	b	34	d	35	c
36	b	37	c	38	d	39	d	40	a
41	c	42	b	43	d	44	a	45	a
46	d	47	c	48	b	49	c	50	c
51	d	52	a	53	c				

21	a	22	c	23	b	24	d	25	c
26	b	27	b	28	c	29	c	30	a
31	d	32	c	33	a	34	c	35	d
36	d	37	c	38	d				

Assertion and Reason

1	c	2	a	3	a	4	a	5	c
6	d	7	b	8	e	9	d	10	e
11	a	12	b	13	d	14	a	15	b
16	b	17	b	18	a	19	d	20	b
21	b	22	b	23	c	24	b	25	d
26	b								

Evolution of Man

1	c	2	a	3	b	4	a	5	b
6	d	7	b	8	b	9	b	10	b
11	c	12	a	13	d	14	b	15	d
16	d	17	c	18	a	19	b	20	a
21	d	22	c	23	a	24	c	25	b
26	b	27	c	28	a	29	d	30	a
31	b	32	d	33	d	34	c	35	b
36	a	37	b	38	a	39	a	40	c
41	a	42	b	43	b	44	b	45	b
46	d	47	d	48	b	49	d	50	b
51	d	52	a	53	a	54	b	55	a
56	d	57	a	58	d	59	c	60	b
61	a	62	a	63	c	64	d	65	c
66	c								

NCERT Exemplar Questions

1	b	2	c	3	b	4	c	5	b
6	d	7	a	8	c	9	d	10	c
11	a	12	a	13	b	14	c	15	d
16	b	17	d	18	a				

Critical Thinking Questions

1	c	2	c	3	d	4	c	5	a
6	c	7	c	8	d	9	b	10	c
11	b	12	a	13	d	14	d	15	a
16	b	17	a	18	a	19	d	20	b

AS Answers and Solutions

Origin of Life

12. (b) Charles Darwin (1809-1882) was an English naturalist. In 1831, Darwin got an opportunity to travel on *H.M.S. Beagle* (a ship in which Charles Darwin sailed around the world) for a voyage of world exploration. Alfred Russel Wallace (1823-1913), another English naturalist, also travelled widely and studied the fauna and flora of South America and South East Asia. Evolutionary ideas similar to those of Darwin developed in Wallace's mind. The thinking of both Darwin and Wallace in respect of organic evolution was similar. In 1859, Wallace's paper and a summary of Darwin theory together appeared in the *Journal of the proceeding of Linnean Society*. Finally in 1859, Darwin published his observations and conclusions under the name "Origin of species by Natural Selection".
15. (a) Earth came into existence about 4.6 billion years ago from a large spinning cloud of gas and dust.
30. (a) Protobionts are prebiotic chemical aggregates having one or more properties of living systems. Process of aggregation of organic molecules is called coacervation. It produced three types of protobionts – coacervates, microspheres and vesicles. Coacervates are reversible emulsoid aggregates consisting of protein and polysaccharide with some water.
41. (d) Abiogenesis or spontaneous creation or Autobiogenesis was proposed by von Helmont (1577-1644) and state that life originated abiogenetically from non living materials by spontaneous generation about 3.5 billion years ago.
42. (d) Father Suarez was a strong believer (supporter) of the theory of special creation. He believed that whole life on earth was formed in 6 days.

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43. (b) The spark discharge glass apparatus was designed by Miller and Urey to show that simple organic compounds could be formed in nature from the inorganic molecules.
44. (c) Coacervates are the colloidal aggregates of large complex organic molecules capable of growth and division.
45. (c) George Cuvier and orbigne were the chief supporter of theory of catastrophism. It states that there had been several creations, each preceded by a catastrophs due to some geological disturbances like volcanic eruptions, upheaveling of earth; unprecended increase in sea level etc.
47. (d) Oparin and Sydney Fox held that large organic molecules synthesized abiotically on primitive earth later came together spontaneously and due to intermolecular attraction, formed large colloidal aggregates called coacervates.
49. (b) Big bang theory was proposed by Lemaitre in 1931.

Organic Evolution and Speciation

2. (d) Hardy Weinberg equilibrium is applicable for randomly mating populations only.
5. (a) Process of evolution of different species in a given area starting from a point and radiating to other area of geography (habitats) is called adaptive radiations
Example : Darwian's finches
Australian marsupials.
7. (b) Seas form the barriers to free intercontinental movement and separates the continents, causing evolution and endemism. Endemic species are those species which are in a restricted area.
17. (b) Microevolution is the development of minute changes due to gene mutations and recombinations. These changes occur below the level of species.
18. (b) Darwin gave Natural selection theory, Hugo de Vries proposed mutation theory of evolution, Lamarck proposed theory of inheritance of acquired characters and Huxley said that the birds are glorified reptiles.
21. (c) Environmental variations are those variations which are merely due to environment. These variations are temporary and have nothing to do with the next generation. Hereditary variations are those variations which transfer to next generation. Discontinuous variations are sudden changes in organism which are also heritable.
30. (d) Inclusive fitness theory is proposed by Hamilton. Lamarck proposed theory of inheritance of acquired characters and theory of use and disuse of organs. Darwin proposed theory of natural selection. Weismann proposed theory of continuity of germplasm.
33. (a) The earliest known bird in fossil record is *Archaeopteryx lithographica*, meaning ancient wing. It dates back to late jurassic period about 140 million years ago. It was discovered in a slate quarry at Langenthalheim, Bavaria (Germany) in 1861 by Andreas Wagner. A second skeleton was discovered in 1877 and third in 1956 from the same locality.
39. (b) According to Lotsy (1918) a species is a group of genetically identical individuals.
43. (d) Modern concept of evolution depends mainly upon genetic variations involving mutation and gene recombination, natural selection, speciation and reproductive isolation.
46. (b) Biological species concept states that the members of the same species are reproductively compatible but are reproductively isolated from other species.
59. (b) Miller and Urey performed an experiment to demonstrate that simple organic compounds could be formed in nature from inorganic molecules.
63. (d) These are the isolating mechanisms involved in the pre mating reproductive isolation.

Evidences of Evolution

4. (a) Homologous structures are similar because they have been inherited from a common ancestor. For example, forelimbs of dog and camel, have both evolved from a common ancestral mammal.
9. (a) Divergent evolution : Bones of forelimbs of vertebrates
Convergent evolution : Eyes of octopus and mammals.
12. (b) Mesozoic era is also known as the 'age of reptiles'. It is believed that mass extinction at the end of mesozoic era was probably due to the collision of earth with meteorites.
15. (d) Radioactive carbon C^{14} has a shorter half life period. This carbon is present in all the fossils.
16. (c) Wings of bat are skin folds stretched mainly between elongated finger but the wings of birds are a feather covering all along the arm. They look similar because they have a common use for flying, but their origin are not common. This makes them analogous characteristics rather than homologous characteristics.
25. (d) Homologous organs are those organs which have the same origin and similar basic structure but may differ in external appearance and function. Wings of birds and pectoral fins of fishes are an example of the homologous organs.
26. (d) Man-like apes gave rise to primitive man-like forms, the hominids in the Pliocene epoch.
28. (a) Connecting link is the intermediate form of organism between two groups of organisms.
Example : *Neopilina* is a connecting link between Annelida and Mollusca.
29. (a) All are modified forelimbs, with the same types of bones, they have become different due to adaptation to habitat.
30. (c) Cretaceous period of Mesozoic era occurred on earth about 65-146 million years ago. During this period, the flowering plants appeared and became dominant, mass extinctions of marine life and some terrestrial life, including dinosaurs occurred and modern continents became well separated.
31. (b) Analogous organs have different embryonic origin but perform similar functions. These organs are developed in organisms, widely different phylogenetically due to similar habitats and modes of life.
Example : Wings of insects, birds and bats.

34. (b) *Limulus* is a living arthropod.
42. (c) Genetic drift or Sewall Wright effect is an important mechanism in evolutionary change in small populations. In a small population not all the alleles which are representative of that species may be present. Therefore, chance events may result in the elimination of that allele from population.
44. (b) Coenozoic era – Age of mammals.
Mesozoic era – Age of reptiles.
Palaeozoic – Age of ancient life
Azoic era – Complete absence of living organism.
46. (c) Atavism or reversion is the sudden reappearance of some ancestral features.
47. (d) The forelimbs of aquatic mammals like whales & seals are modified into flippers for swimming.
49. (c) Parallel evolution is the independent development of similar characteristics in two related groups of organisms in response to similar requirements or environmental influences.
59. (c) Sedimentary rocks are formed by the settling of the sediments of the rain water and has a fair chance of trapping the organisms in it for fossilization.
65. (a) Himalayan mountain ranges separate *Palaeartic* and *Oriental* zoogeographical regions.
66. (d) *Peripatus* is a connecting link between annelida and arthropoda.
67. (d) Homologous organs are found in forms showing adaptive radiation from a common ancestor, so these give evidence of divergent evolution.
71. (c) Pectoral fins of rohu and fore limbs of horse have similar origin and basic structure, hence these are homologous organs.
72. (d) *Archaeopteryx* is the connecting link between birds and reptiles. It shows that birds have been evolved from reptilian ancestors. As per Huxley "Birds are the glorified reptiles".
74. (c) 'Wisdom teeth' are third molars of our dentition. Being useless, these are poorly developed and vestigial.
81. (c) The wings of an insect are analagous to wings of bird and bat. It is due to the fact that the basic structure of wings of the insect is different from the wings of bird and bat. However their function is similar.
85. (d) The study of fossils is known as palaeontology. Fossils are the remains or impressions of the hard parts of the past individuals in the strata of the earth. Fossils are studied for tracing evolutionary history of organisms and studying extinct organisms.
86. (a) Homologous organs are similar in structure and origin but not necessarily in function. Hence, organs from different species having a similar basic form, microscopic structures, body position and embryonic development are said to be homologous.
87. (d) Wings of pigeon, mosquito and bat perform same function (flying) but have evolved from separate ancestral populations. This similarity developed in distantly related groups as an adaptation for same function is called convergent evolution.

88. (d) It acts as connecting link between Annelids and Arthropods. Like annelids, it has continuous muscle layers in the body wall, unjointed leg like parapodia, nephridia for excretion and simple gut. Main arthropod characters are claws on the legs, haemocoel, tracheae for respiration, dorsal hearts with ostia etc.
90. (b) Vestigial organs are those which occur in reduced form and are useless. But nails are the derivatives of epidermis, involving keratin and are protective in function.
93. (a) The dominant animals during the Jurassic period were dinosaurs.
94. (a) *Archaeopteryx*, intermediate between reptiles and birds, originated towards the close of Jurassic period.

Lamarckism

6. (a) Jean Baptiste de Lamarck proposed "theory of inheritance of acquired characters" or popularly known as "use and disuse" theory.
8. (a) Jean Baptiste Lamarck (1744–1829), a French biologist put forth his views on the evolution of life as a theory of 'inheritance of acquired characters' in his book '*Philosophic Zoologique*' (1809).

Darwinism

2. (b) Alfred Russel Wallace (1823–1913) was contemporary to Darwin. He independently proposed theory of natural selection and origin of species.
4. (b) In 1831, Darwin got an opportunity to travel by *H.M.S. Beagle* for a voyage of world exploration, planned by British Admiralty. The voyage lasted for five years.
5. (a) Carrion are dead bodies. No finches feed on carrion.
30. (c) Directional selection is the natural selection that favours the establishment of one particular advantageous mutation within a population, resulting in a change in phenotype in that direction.
33. (b) Darwinism could not explain the origin of adaptive characters. Neo-Darwinism could explain the sources of variability.
37. (c) According to both the views, 'something' is passed from parent to offspring, which causes development of specific characters, i.e., all that has been acquired by the organism during its lifetime is preserved by generation and transmitted to offsprings in form of pangenes or gemmules.
42. (b) Patagia or wings are used for flying. So, the animals possessing patagia exhibit volant or flight adaptations.
45. (a) Darwin supported his 'Natural selection Theory' on the basis of continuous variation inspite of discontinuous variation.

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46. (d) Industrial melanism is an adaptation where the moths living in the industrial areas develop melanin pigments to match their body to the soot covered surroundings.
49. (c) Prototherians the most primitive mammals which provide an evidence of organic evolution from geographical distribution are found in Australia.
50. (c) There are thirteen types of finches described by Darwin. They are geographically isolated and found in Galapagos Islands of south pacific.
51. (d) Development of different functional structures from a common ancestral form is called adaptive radiation.
These are –
1. Darwin's finches of the Galapagos Islands.
2. Australian Marsupials.
3. Limbs of mammals.
53. (c) Neo-Darwinism has emerged out as the 'modern synthetic theory of evolution. It designated by Huxley (1942).
Dobzhansky's (1937) book "Genetics and the origin of species" provided the initial basis of this theory and Muller (1949), Fisher (1958), Wright (1968), Mayr (1963, 70) Stebbins (1966-76) etc. helped significantly in its formulation.

Evolution of Man

1. (c) Brain capacity of *Homo habilis* was 650-800 CC while *Homo erectus* showed 900 CC; *Homo neanderthalensis* showed 1400 CC; *Homo sapiens* showed 1450 CC cranial capacity.
3. (b) Actual name of this fossil was *Pithecanthropus erectus*. This was classified under *Homo erectus*.
5. (b) 'Peking man' is also known as *Homo erectus pekinensis* or *Sinanthropus pekinensis*.
19. (b) It had a cranial capacity of about 940c.c.
20. (a) Anthropometry refers measurement of human traits like length of limbs, stature, body weight, etc. in human population and human ancestors. It is of great use in the study of human evolution.
26. (b) Pliocene is the epoch of tertiary period of coenozoic era. Man was originated in this era.
27. (c) Neanderthals were the first human beings who believed in the immortality of soul, and practised ceremonial burial.
29. (d) The modern man differs from the apes in arms shorter than legs, in apes the arms are used in locomotion, called brachiation this is a type of suspension and swinging of the body.
32. (d) The cranial capacity of Java man (*Homo erectus erectus*) is 900 c.c. The cranial capacity of Peking man (*Homo erectus pekinensis*) is 1075 c.c. The cranial capacity of Handy man (*Homo habilis*) is 700 c.c. and the cranial capacity of modern man (*Homo sapiens sapiens*) is 1400 – 1450 c.c.
33. (d) The chromosomes of man and chimpanzees are quite similar. The number of chromosomes in chimpanzee is 48 and in man is 46, which become reduced due to fusion of 2 chromosomes.
34. (c) *Australopithecus* fossils were discovered in 1920 by Prof. Raymond from Taung in South Africa.
38. (a) The closest relative of modern man is considered to be Chimpanzee on the basis of :
(i) Similar banding pattern in 3rd and 6th chromosome.
(ii) Similar blood groups (ABO)
(iii) Similar blood proteins.
40. (c) Cro-Magnon man (*Homo sapiens fossilis*) is the direct ancestor of modern man. Its fossil remains were found in 1864 from rock shelters caves in France. More fossils were later found from caves of North-West Italy, Poland, Czechoslovakia and France.
42. (b) Their brain capacity ranged from 450-600 c.c or slightly above.
48. (b) *Ramapithecus* belongs to Pliocene epoch, so it is the most primitive ancestor of man.
49. (d) Biological name of Java man is *Homo erectus erectus* or *Pithecanthropus erectus*.
59. (c) *Australopithecus ramidus* is the most ape-like hominid ancestor and is considered to be missing link between hominids and apes.
60. (b) The cranial capacity of chimpanzee is 400 cc.
63. (c) Its fossils (some teeth, skull cap and femur bone) were found in 1891 by a Dutch anatomist, Eugene Dubois on the bank of Solo river in Eastern Java.

Critical Thinking Questions

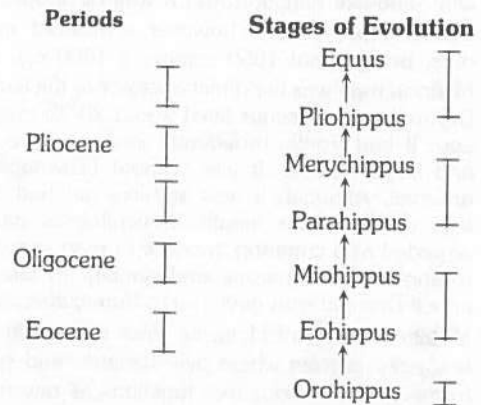
2. (c) The first living organisms developed in reducing atmosphere were chemo-heterotrophs as they required ready-made organic materials as food and anaerobes as they were capable of respiration in the absence of oxygen.
5. (a) According to Darwin, evolution took place due to small variations and survival of the fittest. Wings of butterfly and birds are analogous or convergent. Vermiform appendix is vestigial organ.
6. (c) Species having more than one subspecies are called Polytypic species, while the species having no subspecies are called monotypic species.

- 7. (c) According to Allen's Law : The extremities such as tail and pinnae become smaller in animals living in cold climate.
- 9. (b) Trilobites and brachiopods were the most abundant animals evolved during the cambrian period. They become extinct in permian period.
- 19. (d) Human races are sub-divisions of a single species, therefore they are capable of interbreeding.
- 23. (b) Possession of pharyngeal gill slits and gill pouches is one of the three diagnostic characters of chordates. So, these structures do appear in the embryonic stages of all vertebrates.
- 28. (c) Species are the groups of individuals that sexually interbreed or are potentially interbreeding form.
- 36. (d) A molecule which is unstable structurally and chemically cannot act as a genetic material

- 7. (b) Oparin reported that if a mixture of a large protein and a polysaccharides is shaken, coacervates are formed. The core of these coacervates was mainly formed of protein, polysaccharides and some water and was partially isolated from the surrounding aqueous solution having lower amount of proteins and polysaccharides. Coacervates could grow by absorbing materials from outside and could increase in number by budding.
- 8. (e) *Equus* is the modern horse which arose from *Pliohippus* in pleistocene epoch. *Pliohippus*, the pliocene horse, evolved from *Merychippus* in pliocene epoch about one crore years ago.

Assertion and Reason

- 1. (c) During the profound changes that have been taking place since the remote past we have lost the direct evidences of origin of life. Due to these changes, the scientists, though skilled were not able to protect the evidence.
- 2. (a) *Ginkgo biloba* is a living fossil because its ancestors are unchanged for the last many hundred years while its relative disappeared.
- 3. (a) Mimicry is the resemblance of one organism to another or to any natural object for the purpose of concealment, protection or for some other advantages. It is found in *Iguana*, *Chameleon* (girgit), leaf butterfly and stick insect.
- 4. (a) The Darwin Wallace theory of Natural Selection can be generalised as the change in species by the survival of an organismal type exhibiting a natural variation that gives it an adaptive advantage in an environment. Thus leading to a new environmental equilibrium. The idea of the survival of the fittest explain the above evolution by natural selection. According to survival of fittest, some of the variations exhibited by living things make it easier for them to survive and reproduce thus more adaptive forms increase. Those which are not fit (or less adaptive) become eliminated.
- 5. (c) Oparin and Sydney Fox held that large organic molecules synthesised abiotically on primitive earth and formed large colloidal aggregates due to intermolecular attraction. These colloidal particles were called coacervates. In coacervates, lipid molecules are joined end to end forming a layer around each aggregate. This represents a single lipid membrane. Coacervates divide by budding like bacteria.
- 6. (d) As the humans would require more gestation period (should have been 21 months as compared to 9 months and will increase). Similarly the head size is increasing (especially the frontal brain) hence growth rate needs to increase but surprisingly most of the brain growth occurs after birth till 2 years (when the anterior fontanellae close at 18 months) and some more till 30 years when finally the cranial sutures close. Thus an increase in brain/skull size would require increase in gestation period.



- 9. (d) Homologous organs are those which have the same essential structure, which they inherit from common ancestors though they may be very differently modified in adaptation to different functions. Analogous organs are structurally different organs which get modified to perform similar functions.
- 10. (e) The new world monkey's possess a flat nose with widely separated and outwardly directed nostrils. Their tail is long, sensitive and prehensile for grasping the branches of trees, but their limbs cannot be used for grasping the branches of trees, because of non-opposable thumbs and mostly clawed digits. The Old world monkeys possess a narrow nose with closely placed and downwardly directed nostrils. Their tail is generally short and not prehensile, but their limbs having opposable thumbs and nailed digits, are well adapted for grasping. They are closer to man as they have better developed brain, smaller ear pinnae, sensitive finger tips, presence of both rods and cones in the retina of eyes etc.
- 11. (a) A species composed of only a few organisms has limited genetic variation and mating possibilities. Should conditions for survival change and should some of these organisms die due to their lack of characteristics that could accommodate that change the species would become smaller over time and could eventually die out.
- 12. (b) All primates have a common ancestry (monophyetic origin). Primate evolution began 80-100 million years ago. The evolutionary history of eutherian mammals dates back to early cretaceous period. The earliest eutherians were shrew-like terrestrial insectivores. They were small, ground dwelling mammals.

1346 Evolution

13. (d) An evolutionary tree depicts the pattern of relationships among major groups of organisms. Most evolutionary trees place information about the pattern of relationships among organisms on the horizontal axis and information about time on the vertical axis.
14. (a) Banding pattern of chromosome is the direct evidence that chimpanzee is human's closest relative.
15. (b) Cro-Magnon man emerged about 34000 years ago. Thus it is regarded as most recent ancestor of today's man. It has, therefore, been called as *Homo sapiens fossilis*. The Cro-Magnon man was like us, about 1.8 meters tall, well-built body. Its face was perfectly orthognathous with a narrow elevated nose, broad and arched forehead, moderate brow-ridges, strong jaws with man-like dentition and a well developed chin. Its cranial capacity was, however somewhat more than ours, being about 1650 cc(ours is 1400 cc). The Cro-Magnon man was the direct ancestor of the living man.
16. (b) *Dryopithecus africanus* lived about 20-25 million years ago. It had frontly broadened jaws, semierect posture and large canines. It was without browridges. It was arboreal. Although it was ape-like but had arms and legs of the same length. *Dryopithecus africanus* is regarded as a common ancestor of man and great apes (orangutan, chimpanzee and gorilla). In late Miocene epoch *Dryopithecus* gave rise to *Ramapithecus*.
17. (b) Mutation theory of Huger de Vries states that evolution is a jerky process where new varieties and species are formed by mutations that functions as raw material of evolution. A number of mutations have appeared in the past. Mutations are also induced. Ancon sheep is a short legged variety which appeared suddenly in Massachusetts in 1971. Hornless cattle developed as mutation from the horned cattle in 1889.
18. (a) Darwin finches are an excellent example of the way in which the species gene pools have adapted in order for long term survival via their offspring. Finches were formed due to divergent evolution (Adaptive radiation) to avoid interspecific competition.
The common birds of Galapagos islands, the finches were markedly different from the finches of main land. The closely related species of finches had beak of different shapes and sizes, and adapted for feeding on completely different diets. Darwin also found that fossils of Galapagos islands are most similar to living species of South America. The food supply increases in arithmetic ratio but the population increases in geometric ratio. With the study of this theory it struck to Darwin that there is struggle for existence among plants and animals.
19. (d) In allopatric speciation (species formation), a part of the population becomes geographically isolated from the main population. The population becomes entirely separated and finally constitutes a new species. In sympatric speciation, a small segment of the original population becomes isolated reproductively. As the isolating mechanism comes into force, a new subspecies emerges. In due course of time a new species is formed.
20. (b) *Homo habilis* was the first tool maker and used tools of chipped stones extensively. It is also called handy man because heaps of tools found with these fossils included sharpened stones which indicates that *Homo habilis* was capable of "making tools". He also led community life in caves and greatly cared for the young ones.
21. (b) The phenomenon of development of a new species from pre-existing one is called speciation. A species is a collection of demes. The deme is a groups of populations with a common gene pool.
22. (b) Convincing evidence of common ancestry comes from the similarities in the biochemical composition, reactions and physiological activities of living beings, like metabolic process, enzymes, cytochrome C, insulin, haemoglobin, blood and lymph etc. Genetic code is the sequence of DNA nucleotides that determines the amino acid sequence of the translated protein. The genetic code is read in triplets of bases called codons.
Genetic code is applicable universally i.e. a codon specifies the same amino acid from a virus to a tree or human beings. The mRNA from chick oviduct introduced in *E. coli* produces an ovalbumen in the bacterium exactly similar to one formed in chick.
23. (c) Atavism is the appearance of certain ancestral characters which had either disappeared or were reduced. There are present some examples of atavism in human being, viz., the power of moving pinna in some persons, greatly developed canine teeth, exceptionally long dense hairs, short tail in some babies and presence of additional mammae in some individuals. Third molars and hair on the body are examples of vestigeal organs.
24. (b) Progressive evolution is the formation of more complex specialized organisms from simple and less elaborate forms. Examples : evolution of amphibians from fish like ancestors and evolution of birds and mammals from reptile-like ancestors. Retrogressive evolution is the formation of simple and less elaborate forms from more complex and specialized ones. Example : evolution of many parasitic organisms like tape worm which does not have digestive system. It absorbs food through body surface.
25. (d) If humans share ancestry with other primates, then we should expect to see remnants of that common ancestry in our genes. For example, tails. This characteristic is still exhibited occasionally in atavism. According to current evolutionary theory, the ancestors of humans lost their tails about 25 million years ago, when apes (tail-less primates) diverged from monkeys (tailed primates). Theory of the continuity of the germplasm was given by Weismann.
26. (b) Replacement of organic parts by mineral deposits is called petrification. Fossils formed through petrification are termed petrified fossils. These fossils consists of only the hard parts of extinct organisms. Moulds of hardened and fossilized mud that surrounded an extinct individuals have been found. In most cases, the buried individuals have been completely destroyed, but the moulds have retained true copies of their shapes. Sometimes, a mould is found with petrified fossil of the individual also. Such fossils are termed as casts.

Evolution

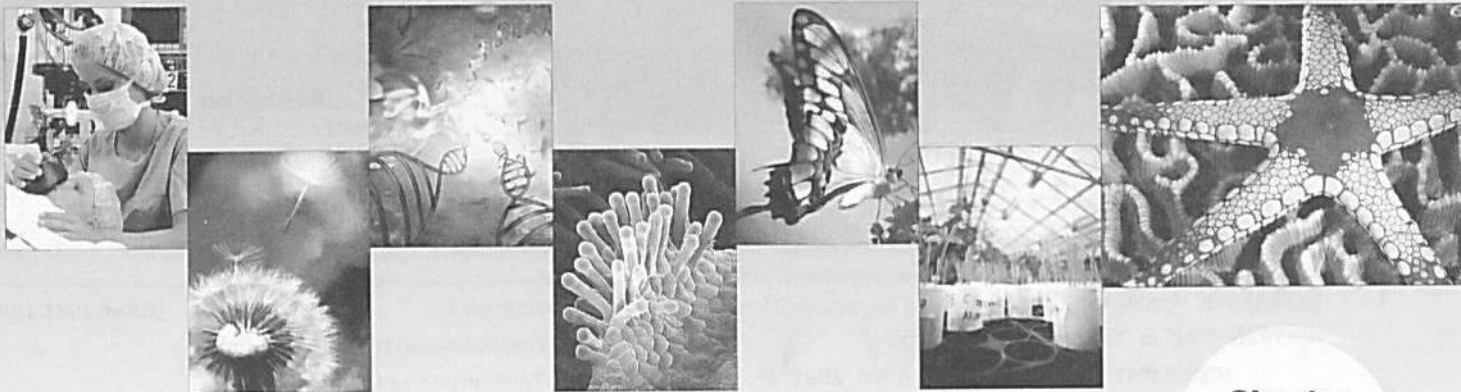
SET Self Evaluation Test

1. Geologically one of the following eras is known as "Golden age of Reptiles" or "Golden age of Dinosaurs"
[CBSE PMT 1994, 2002; CPMT 1996, 2003, 05, 10; Pb. PMT 2000; BVP 2000, 02, 04; Kerala CET 2003; Haryana PMT 2005; J & K CET 2005, 08; MP PMT 2007; VITEEE 2008]
- (a) Mesozoic (b) Cenozoic
(c) Palaeozoic (d) None of the above
2. How many years are considered in one minute in Geological clock [GUJCET 2015]
- (a) 52,000 years (b) 1, 87,500,000 years
(c) 3, 25,000 years (d) 1, 90,000 years
3. Species diversity generally increases as one proceeds from [CBSE PMT 1994; AMU (Med.) 2006]
- (a) Low altitude to high altitude, and from low latitudes to high latitudes
(b) High altitude to low altitude, and from low latitudes to high latitudes
(c) High altitude to low altitude, and from high latitudes to low latitudes
(d) Low altitude to high altitude, and from high latitudes to low latitudes
4. What is correct [AIIMS 2009, 11]
- (a) Natural selection is responsible for extinction of dinosaurs
(b) Lion and Leopard have convergent evolution
(c) *Homo habilis* and *Homo erectus* are closely related
(d) *Biston betularia* shows cryptic camouflage
5. To be evolution of successful, a mutation must occur in
- (a) Germplasm DNA (b) Somatoplasm DNA
(c) RNA (d) Cytoplasm
6. Hardy and weinberg principle explains [DPMT 2006; AIIMS 2010]
- (a) Genetic equilibrium (b) Non random mating
(c) Evolutionary force (d) All of the above
7. In case of evolution which of the following statement is not correct [Odisha PMT 2002]
- (a) Fossilized animals provide important information to trace evolution
(b) Wing of birds and forelimbs of cows are homologous
(c) In higher animals early development stages are similar
(d) Variation among individuals are not important in natural selection
8. Homeostasis is [CBSE PMT 1991]
- (a) Disturbance in regulatory control
(b) Tendency to resist internal changes
(c) Plant and animal extracts used in homeopathy
(d) A tendency to change with change in environment
9. What does the term 'reproductive isolation' refers to [AIIMS 2010]
- (a) An individual is unable to fertilise itself
(b) Genes are not exchanged between two populations
(c) Individuals from two population never mate
(d) Individuals from two populations never produce offsprings
10. When two related populations occupy geographically or spatially separate areas, they are called [Kerala PMT 2007; J & K CET 2010]
- Or
- The organisms separated by geographical barriers are termed [NCERT]
- (a) Allopatric population (b) Quantum population
(c) Saltational population (d) Parapatric population
(e) Sympatric population
11. Major radiation of mammals birds and pollinating insects took place in which epoch [Kerala PMT 2006]
- (a) Oligocene (b) Eocene
(c) Pliocene (d) Paleocene
(e) Miocene

AS Answers and Solutions

1	a	2	d	3	c	4	d	5	a
6	a	7	d	8	b	9	b	10	a
11	d								

3. (c) The environmental conditions in these region are favourable and hence species have become diversified.
5. (a) The mutations which occur in germplasm DNA are heritable and natural selection becomes active over such mutations.
7. (d) Since variations, which help the organisms in adaptations, are selected by nature and form the basis of evolution.



Chapter

8.1

Health and Diseases

“Disease” is a very wide term. Any change from the normal state that causes discomfort or disability or impairs the health may be called a disease. The Oxford English Dictionary defines disease as “a condition of the body or some part or organ of the body in which its functions are disturbed or deranged”. The World Health Organization (WHO) gave the following definition of health in 1948 –

“Health” is a state of complete physical, mental and social well-being, and not merely an absence of disease or infirmity”. The WHO definition of health recognizes three dimensions of health : physical, mental and social. The physical health can be determined by various tests, but it is difficult to assess the mental health and social well-being.

Disease Agents

The disease agent is a factor (substance or force) which causes a disease by its excess or deficiency or absence. These agents are of five main types :

(1) **Biological Agents** : These include viruses, rickettsias, bacteria, fungi, protozoans, helminthes and arthropods. The biological agents are called **pathogens** (Gr. *Pathos* = disease; *genes* = producing).

(2) **Nutrient Agents** : These comprise food components such as carbohydrates, fats, proteins, minerals, vitamins and water.

(3) **Chemical Agents** : These are further of two types

(i) **Endogenous Chemical Agents** : These are formed in the body itself and include hormones, enzymes, urea and uric acid.

(ii) **Exogenous Chemical Agents** : These enter the body from outside by inhalation, ingestion or inoculation. Pollutants (fumes, gases, dusts, metals) and allergens (spores, pollen) are examples.

(4) **Physical Agents** : These include heat, cold, humidity, pressure radiation, electricity and sound.

(5) **Mechanical Agents** : These comprise chronic friction or other mechanical forces which results in injury, sprain, dislocation fracture.

(6) **Deficiency and Excess of substances** : e.g. Hormones, enzymes.

Some diseases are caused by genetic disorders and lack or underdevelopment of organs. The agents for certain diseases such as peptic ulcers, coronary heart diseases and hypertension, are not fully known.

Types of Diseases

The diseases may be broadly classified into two types : Congenital and acquired.

(1) **Congenital Diseases** : These are anatomical or physiological abnormalities present from birth. They may be caused by (a) a single gene mutation (alkaptonuria, phenylketonuria, albinism, sickle-cell anaemia, haemophilia, colour blindness); (b) chromosomal aberrations (Down’s syndrome, Klinefelter’s syndrome, Turner’s syndrome); or (c) environmental factors (cleft palate, harelip). Unlike the gene-and chromosome-induced congenital defects, environmentally caused abnormalities are not transmitted to the children.

(2) **Acquired Diseases** : These diseases develop after birth. They are further of two types : communicable and non-communicable.

(i) **Communicable (Infectious) Diseases** : These diseases are caused by viruses, rickettsias, bacteria, fungi, protozoans and worms.

(ii) **Noncommunicable (Noninfectious) Diseases** : These diseases remain confined to the person who develops them and do not spread to others. The non-communicable diseases are of four kinds :

(a) **Organic or Degenerative Diseases** : These diseases are due to malfunctioning of some of the important organs, e.g., heart diseases, epilepsy. Heart diseases result from the abnormal working of some part of this vital organ. Epilepsy may result from abnormal pressure on regions of the brain.

(b) **Deficiency Diseases** : These diseases are produced by deficiency of nutrients, minerals, vitamins, and hormones, e.g., kwashiorkar, beri-beri, goitre, diabetes are just a few from a long list.

(c) **Allergies** : These diseases are caused when the body, which has become hypersensitive to certain foreign substance, comes in contact with that substance. Hay fever is an allergic disease.

(d) **Cancer** : This is caused by an uncontrolled growth of certain tissues in the body.

Communicable Diseases

Reservoir of Infection for Pathogens : Every pathogen has some reservoir where it normally lives when it is outside the host susceptible to the disease. The reservoir varies for different pathogens. It may be soil, water, animals or other persons called **carriers**. The animals which act as reservoirs do not contract the diseases and are known as reservoir hosts.

Transmission of Diseases (Pathogens) : The diseases (pathogens) are transmitted from the reservoirs of infection to the healthy persons in the following ways :

(1) **Direct Transmission** : The pathogens of some diseases reach the human body directly without intermediate agents. This can occur as under :

(i) **Contact with Infected Persons** : Certain diseases produce sores or lesions on the skin. Contact with materials discharged from these sores or lesions brings about infection. Ringworm, athlete's foot, barber's itch, chickenpox, smallpox, syphilis and gonorrhoea are spread by direct contact. Kissing also spreads infection. The diseases that are transmitted by direct contact are called **contagious diseases**.

(ii) **Droplet Infection** : Some diseases are caught by merely being in a confined place (room, theatre, bus) with an infected person. The latter throws out tiny droplets of mucus by coughing, sneezing, spitting or even talking. These droplets may contain pathogens (viruses, bacteria) dislodged from nasal membrane, throat, and lungs. Many of these droplets are inhaled. Diphtheria, scarlet fever, influenza, common cold, measles, mumps, tuberculosis, pneumonia, and whooping cough are spread by droplets.

(iii) **Contact with Soil** : The bacteria responsible for tetanus and blood poisoning enter the human body from the soil through injuries. Hence, skin injuries should not be neglected.

(iv) **Animal Bites** : Virus of rabies, or hydrophobia, is introduced through the wound caused by the bites of rabid animals, most commonly dogs.

(v) **Through Placenta** : In the later part of pregnancy, due to age or injury, the placenta becomes permeable to certain pathogens such as virus of german measles and bacteria of syphilis. The pathogens then pass from the maternal blood into the foetal blood.

(2) **Indirect Transmission** : The pathogens of certain diseases reach the human body through some intermediate agents as explained below :

(i) **Arthropod Vectors** : Insects transmit diseases in two different ways.

Housefly carries the causative organisms of cholera, typhoid, dysentery and tuberculosis on the legs and mouth parts from faeces and sputum to food and drinks. The latter, if taken, cause infection. It also carries the microbes responsible for ophthalmia and conjunctivitis from eye to eye. Ants, cockroaches and house crickets also carry disease germs to articles of food.

Certain blood-sucking insects carry disease-causing organisms in their body and transmit them with bites. Human body-louse spreads typhus, rat flea transmits bubonic plague, tsetse fly spreads African sleeping sickness, sandfly transmits kala-azar and oriental sore, *Aedes* mosquito spreads yellow fever, *Culex* mosquito transmits filariasis, and *Anopheles* mosquito spreads malaria, ticks spread rocky mountain spotted fever.

(ii) **Vehicle-borne Method** : The causative organisms of dysentery, cholera and typhoid enter the human digestive tract with food, water and ice. Most of the helminthes which produce diseases in man also get into the body in a similar way. Some diseases are transmitted through blood, e.g., AIDS.

(iii) **Air-borne Method** : The pathogens may reach the humans with air and dust. The epidemic typhus spreads by inhalation of dried faeces of infected lice.

(iv) **Fomite-borne Method** : Many diseases are transmitted through the use of contaminated articles such as handkerchiefs, towels, clothes, utensils, toys, door handles, taps, soaps, syringes and surgical instruments.

(v) **Unclean Hands** : The unclean hands may carry disease germs to food or mouth. Therefore, hands should be washed before taking meals.

(vi) **Human Carriers** : Certain diseases, notably diphtheria and typhoid, spreads by human carriers. The latter are themselves healthy and immune, but have pathogenic organisms in their body. These pathogens are transmitted in the ways already mentioned.

How Pathogens Cause Diseases : Pathogens produce diseases in two ways : tissue damage and toxin secretion.

(1) **Tissue Damage** : The bacteria responsible for tuberculosis damage cells and cause lesions in the lungs. Blood oozes from the lesions into the air sacs, leading to haemorrhages. The bacteria that cause meningitis attack the protective membranes covering the brain. The virus of rabies destroys brain tissue. The polio virus damages motor nerve cells in the spinal cord.

(2) **Toxin Secretion** : Many microbes produce powerful poisons, called **toxins**, which cause diseases. Toxins are of 2 types :

(i) **Exotoxins** : These are released as soon as produced. The diseases brought about by exotoxins include tetanus, scarlet fever, diphtheria, and botulism (food poisoning)

(ii) **Endotoxins** : These are retained in the bacterial cells and released when bacteria die and disintegrate. The diseases caused by endotoxins include typhoid fever, cholera, bubonic plague and dysentery.

Defence mechanism

Immune response : Nature has provided certain ways in the body to defend ourselves from the invasion of pathogens and therefore, from the disease. The ability of a host's body to prevent or overcome the effects caused due to the invasion by pathogenic organisms and its toxins is known as **resistance** and **immunity**. Resistance is considered as an inherent factor and those acquired during life to overcome the disease, while the **immunity** is accepted to be due to the acquired factors that help in resistance. The host body has two lines of defence that must be overcome by a pathogen before establishing an infection.

External defence mechanism : This defence mechanism involves mechanical and chemical factors e.g. skin, mucus membrane, mucus secretion, peristalsis, coughing, sneezing, shedding tears, etc. Chemicals are lysozymes present in the body.

Internal defence mechanism : This mechanism of defence has two lines of defence against pathogen :

(1) **Non-specific Defence Mechanism** : It is further of two types : external defence or first line of defence and internal defence or second line of defence.

(i) **External Defence** : It includes physical and chemical barriers.

(a) **Physical Barriers**

☐ **Skin** : The skin is physical barrier of body. Its outer tough layer, the stratum corneum prevents the entry of bacteria and viruses.

☐ **Mucus Membrane** : Mucus secreted by mucus membrane traps the microorganisms and immobilises them. Microorganisms and dust particles can enter the respiratory tract with air during breathing which are trapped in the mucus. The cilia sweep the mucus loaded with microorganisms and dust particles into the pharynx (throat). From the pharynx it is thrown out or swallowed for elimination with the faeces.

(b) **Chemical barriers** : Oil secreted by the oil glands and sweat secreted by sweat glands make the surface of the skin acidic (pH 3-5). This does not allow the microorganisms to establish on the skin. Some friendly bacteria also occur on the skin which releases acids and other metabolic wastes that check the growth of pathogens. The sweat also contains an enzyme named **lysozyme** that destroys the cell walls of many bacteria.

The mesh of fine hair in our nostrils filters out particles which may carry pathogens. Nasal secretions also destroy the harmful foreign germs with their lysozyme.

Certain bacteria normally live in vagina. These bacteria produce lactic acid. Lactic acid kills the foreign bacteria.

Thus physical and chemical barriers form the first line of defence.

(ii) **Internal Defence** : The internal defence is carried on by white blood corpuscles, macrophages, inflammatory reaction, fever and interferons.

(a) **White blood corpuscles (Leucocytes)** : The leucocytes in general and lymphocytes in particular are capable of squeezing out through the wall of the blood capillaries into the extra-vascular regions. This phenomenon is called **diapedesis**. The leucocytes protect in different ways.

☐ **Lymphocytes** : Lymphocytes can produce plasma cells which secrete antibodies to provide immunity.

☐ **Monocytes** : They are phagocytic in action.

☐ **Eosinophils** : Eosinophils can attach themselves to parasitic forms and cause their destruction by liberating lysosomal enzymes on their surface.

☐ **Neutrophils** : They eat harmful germs and are, therefore phagocytic in nature.

(b) **Macrophages** : The macrophages are formed by enlargement of monocytes. They are large cells which are phagocytic in nature.

(c) **Inflammatory Response** : When the microorganisms like bacteria, viruses, etc. enter the body tissue through some injury, these produce some toxic substances which kill more cells. These broken cells also release some material which attract the mast cells. The mast cells release histamine. Histamine causes dilation of capillaries and small blood vessels surrounding the injury and increases the permeability of the capillary walls. The more blood flows to area making it red and warm. The fluid (plasma) leaks out into the tissue spaces, causing its swelling. This reaction of the body is known as inflammatory response. The plasma that accumulates at the injured site dilutes the toxins secreted by bacteria and decreases their effect.

(d) **Fever** : The inflammatory response may be in the region of the wound (localized), or it may spread all over the body (systemic). In systemic inflammatory response, the number of WBC increases generally, the fever is caused by the toxins released by the pathogens or by compounds called pyrogens (fever producing substances; Gr. *Pre* = fire). These compounds are released by W.B.C. in order to regulate temperature of the body. Moderate fever stimulates the phagocytes and inhibits growth of microorganisms. However, a very high fever is dangerous.

(e) **Interferons** : These are the proteins released by the cells in response to a viral infection which they help to combat. These interferons do not inactivate the virus, but they make the unattacked cells less susceptible so they are prevented from the attack of virus. They also prevent the viruses from taking over the cellular machinery. *Interferon proteins* have proved to be effective in, treating influenza and hepatitis, but their role in cancer treatment is doubtful. Thus the leucocytes, macrophages, inflammatory response, fever and interferons forms second line of defence.

Table : 8.1-1 Differences between Antibodies and Interferons

Antibodies	Interferons
These act inside the cells.	These act outside the cells.
They are slow acting.	They are quick acting.
They act against bacteria and viruses.	They act only against viruses.
Their action is long lasting	Their action is temporary.

(2) **Specific Defence Mechanism (The Immune System):** Immune system forms third line of defence. There are two components of immune system in the body : Humoral immune system and cell-mediated immune system. One of the most important characteristics of the immune system is that it can recognize body's own cells and macromolecules (**self**) from those which are foreign invaders (**nonself**).

(i) **Humoral Immune System or Antibody-mediated Immune system (AMIS) (Humoral :** Pertaining to body fluids): Humoral immune system results in production of antibodies. These antibodies circulate as soluble proteins in the plasma of blood and lymph which were earlier called **humors**. The humoral system protects the body against bacteria and viruses that enter the blood and lymph of the body. Antibodies are of many kinds.

(ii) **Cell-mediated Immune System (CMIS) :** In this system, highly specialized cells carry out defensive activities. These circulate in the blood and tissue. It protects the body against pathogens including the protists and fungi which have entered the host's cells. This system also reacts against tissue transplants and perhaps also against the body's own cells if they become cancerous. Two kinds of cells (*T* and *B* cells) are responsible for these responses.

The antigens are foreign 'molecules' that invade the body of an organism. The word 'antigen' is a shortened form of 'antibody generating' because they stimulate the production of antibodies in response to infection. Antigens are generally large molecules. The majority of them are made of proteins or polysaccharides found on the cell walls of bacteria and other cells or on the coats of viruses. All antigens are not the parts of microorganisms. Other structures like pollen grains, white of an egg, shell fish, certain fruits and vegetables, chicken, feathers of birds, blood cells from other persons or animals, drugs, chemicals, etc. can also induce the immune system to produce antibodies.

Table : 8.1-2 Types of Antibodies

S.No.	Classes	Description
1.	IgG	Main antibody type in circulation; attacks microorganisms and their toxins.
2.	IgA	Main antibody type in secretions, such as saliva and milk; attacks microorganisms and their toxins.
3.	IgE	Antibody responsible for allergic reactions.
4.	IgM	Antibody type found in circulation; largest antibody, with 5 subunits,
5.	IgD	Antibody type found primarily as a membrane bound immunoglobulin.

Cells of the Immune System : Lymphocytes (a type of WBCs) are the main cells of immune system of the body. Lymphocytes, meant for immune system, are of two types : *T*-cells and *B*-cells. Both types of cells develop from the stem cells found in the liver of the foetus and in the bone marrow cells of the adult. Those lymphocytes that migrate to the thymus and differentiate under its influence are called '**T-cells**', while those cells that continue to be in the bone marrow for differentiation are known as '**B-cells**'. The final maturation of young lymphocytes occur in lymphoid tissues like lymph nodes, spleen and tonsils. *T*-cells are responsible for cellular immunity, however, *B*-cells produce the antibodies—about 20 trillions per day that take part in the humoral immunity. Both *T*-cells and *B*-cells require antigens to trigger them into action but they respond differently.

B-lymphocytes are independent of the thymus and in man probably complete their early maturation within the bone marrow. They are called *B*-cells because they mature within the **Bursa of Fabricius** in birds

Table : 8.1-3 Cells of Immune System

S.No.	Cell Type	Function
1.	Helper T Cell	Assists the immune process by helping other cells in the immune system to achieve an efficient immune response.
2.	Cytotoxic T Cell	Defects and kills infected body cells recruited by helper T cells.
3.	Suppressor T Cell	Guards against the overproduction of antibodies and overactivity of cytotoxic T cells.
4.	Memory cell	"Remembers" the original stimulation by the immune system and remains in the lymphoid tissue.
5.	Natural killer cell (NK)	The lymphocyte without receptor site and help to attack and neutralize virus-infected and tumor cells.
6.	B Cell	Precursor of plasma cell, specialized to recognize a specific foreign antigen.
7.	Plasma cell	Biochemical factory devoted to the production of antibodies directed against a specific antigen.
8.	Mast cell	Initiator of the inflammatory response which aids the arrival of leucocytes at a site of infection, secretes histamine and is important in allergic response.
9.	Monocyte	Precursor of macrophage.
10.	Macrophage	The body's first cellular line of defence; also serves as antigen presenting cell to <i>B</i> and <i>T</i> cells and engulfs antibody covered cells.

(1) **Mode of Action of B-Cells to Antigens :** When antigens enter a tissue fluid, *B*-cells are stimulated to produce antibodies. The body has thousands of antigen-specific *B*-cells. The membrane of each *B*-cell type would have been sensitized by the previous contact with the antigen. If this does not happen, the *B*-cells are destroyed. However, the new *B*-cells will keep on producing. Once an antigen-specific *B*-cell is activated by the

antigen it multiplies very fast to form a clone of **plasma cells**. These plasma cells produce antibodies at a rate of about 2,000 molecules per second. This 'capacity' of the *B*-cells to produce specific antibodies is acquired during its process of development and maturation even before it was exposed to an antigen. However, an antigen is necessary to stimulate the production of antibodies.

(2) **Mode of Action of T-cells to Antigens** : Like B-cells, T-cells also respond to antigens by producing a clone (a group) of T-cells. T-cells live for 4-5 years or even longer. There are separate T-cells for each type of antigen that invades the body. T-cells of a clone that are produced in response to an antigen are similar morphologically but they perform different functions. According to their functions, they are of three types.

(i) **Killer T-cells** : These cells attack directly and destroy antigens. In the process, these cells move to the site of invasion and produce chemicals that attract phagocytes and stimulate them so that they can feed more vigorously on antigens. They also produce substances that attract other T-cells.

(ii) **Helper T-cells** : These cells stimulate B-cells to produce more of antibodies.

(iii) **Suppressor T-cells** : These cells suppress the entire immune system keeping it away from attacking the own body cells. Some of these cells also become memory cells.

Table : 8.1-4 Distribution of B- and T-Cells in Man

S.No.	Tissue	B-Cells %	T-Cells %
1.	Blood	15-25%	75-85%
2.	Spleen	55-75%	5-45%
3.	Bone marrow	Abundant	Few
4.	Thoracic duct	10-20%	80-90%
5.	Lymph nodes	20-30%	60-70%
6.	Thymus gland	Few	Abundant

Table : 8.1-5 Differences between B-Lymphocytes (B-Cells) and T-Lymphocytes (T-Cells)

S.No.	Feature	B-Lymphocytes (B-cells)	T-Lymphocytes (T-cells)
1.	Origin and site of differentiation	Bone marrow, Bursa of Fabricius (in fowl), gut-associated lymphoid tissue (Peyer's patches)	Bone marrow Thymus
2.	Immune System	B-cells form humoral or antibody-mediated immune system (AMIS).	T-cells form cell-mediated immune system (CMIS).
3.	Action	They defend against viruses and bacteria that enter the blood and lymph.	They defend against pathogens including protists and fungi that enter the cells.
4.	Division	They are formed by the division of plasma cells.	They are formed by the division of lymphoblasts of three types : killer, helper and suppressor cells.
5.	Movement	Plasma cells do not move to the site of infection.	Lymphoblasts move to the site of infection.
6.	Reaction against Transplants and cancer cells	Plasma cells do not react against transplants and cancer cells.	Killer cells react against transplants and cancer cells.
7.	Effect on Immune System	Plasma cells have no inhibitory effect on immune system.	Suppressor cells inhibit immune system.

Immunity

Definition : The resistance of the body to occurrence of any disease is known as immunity. Study of the ability of an organism to resist a disease is called **immunology**.

Development of Immunity : A person may develop immunity in three ways.

(1) **Vaccination** : It is a technique to develop immunity without infection. Weakened or dead pathogens (**attenuated**) or parts of pathogens are injected into a person who is required to be made immune. The pathogens given in a vaccine are unable to cause the disease but are sufficient to stimulate the formation of antibodies by the host's immune system. Often 2 or 3 additional doses are needed to generate adequate immunity. These doses are called **booster doses**.

(2) **Antitoxins** : Antibodies that neutralize toxins produced in the body or introduced from outside are, called **antitoxins**. Bacterial toxins are produced in the body, however antitoxins produced from outside are prepared from snake venom and is used as a remedy for snake bites.

(3) **Immunity through Diseases** : Some diseases such as mumps, measles, small pox produce a life long immunity. Hence these diseases do not appear again.

Types of Immunity : There are two main types of immunity : Inborn or innate and acquired or adaptive.

(1) **Inborn or Innate Immunity** : This type of immunity is inherited by the organisms from their parents and protects it from birth throughout life. Examples : Human beings have inborn immunity against **distemper** (a fatal disease of dogs).

(2) **Acquired or Adaptive Immunity** : This immunity is acquired in life time. The acquired immunity is of two types : Active or natural and passive or artificial.

(i) **Active Immunity** : When an organism's own cells produce antibodies it is called active immunity. It develops when a person suffers from a disease or gets vaccination for a disease.

(ii) **Passive Immunity** : In passive immunity, the antibodies are produced in some other organisms (e.g. vertebrates) in response to the given antigen. These antibodies are then injected into the human body at the time of need. This is known as **inoculation**. For example persons infected by rabies, tetanus, *Salmonella* (causes food poisoning) and snake venom are given the sufficient amount of antibodies so that they can survive.

Passive immunity provides immediate relief, however, active immunity requires some time for the formation of antibodies. There is another form of passive immunity. Nursing mothers transfer antibodies prepared in their body to the infants in their milk. Bottle-fed infants do not get this benefit. After a few weeks, infant's own immunity system starts working.

Table : 8.1-6 Difference between Active Immunity and Passive Immunity

S.No.	Active Immunity	Passive Immunity
1.	It is developed when the person's own cells produce antibodies in response to infection or vaccine.	It develops when antibodies produced in other organisms are injected into a person to counter act antigen such as snake venom,
2.	It provides relief only after long period.	It provides immediate relief.
3.	It has no side effects.	It may cause reaction.
4.	It is long lasting.	It is not long lasting.

Disorders of Immune System

Allergies : Allergy is the hypersensitiveness of a person to some foreign substance coming in contact with or entering the body. The substances that cause **allergic** reaction are called **allergens**. The common allergens are dust, pollen mould, spores, fabrics, lipsticks, nail paints, feathers, fur, plants, bacteria, foods, heat, cold, sunlight.

Symptoms : The symptoms that result from an allergy may be of different kinds but mostly it affects the skin and mucous membrane. Hay fever affects the mucous membranes of the nose, eyes and upper respiratory tracts. In asthma, the lower portions of the respiratory system are severely affected. In eczema the skin becomes red, followed by the appearance of minute blisters. Eczema may affect any part of the body and is one of the most severest of all allergic symptoms.

Cause : During allergic reaction there is increased release of histamine from mast cells. It causes marked dilation of all the peripheral blood vessels and the capillaries become highly permeable so that large amounts of fluid leak out from the blood into the tissues.

(1) **Hay fever :** In this allergic form, there is swollen, reddened, running eyes and nose. The drugs called **antihistamines** are of major importance in the treatment of this allergic disorder.

(2) **Asthma :** The tissue surrounding the respiratory tubes in the lungs swell up and compress the tubes. Hence there is difficulty in breathing. Antihistamine drugs are also given in this disease.

(3) **Anaphylactic shock :** It is an allergic reaction involving all the tissues of the body and occurs in a few minutes after the injection of an antigen such as **penicillin**. Such a reaction is very serious. Histamine released from ruptured mast cells causes marked dilation of all the arteries so that a large amount of fluid is passed from the blood to the tissues and there is a drastic fall in blood pressure. The affected person may become unconscious and the individual may die within a short time.

Autoimmunity : Sometimes it may also happen that the immune system of the body goes off the track and starts behaving against the 'own body' or 'self'. This leads to a variety of diseases known as autoimmune diseases. This type of diseases depends on which type of 'self-antigen' is involved. When the cells acting as antigens in the same body, they are called autoantigens. The nature of autoimmune diseases depends on the autoantigens involved. For example, if the autoantigens are RBC then the body

destroys its own RBC, resulting in chronic anaemia; if the autoantigens are muscle cells then it results in the destruction of its own muscles resulting in severe weakness (*myasthenia gravis*); if the autoantigens are liver cells, then it results in chronic hepatitis, etc. Other autoimmune diseases are insulin-dependent diabetes, Addison's disease, ulcerative colitis and rheumatoid arthritis.

Immuno deficiencies

(1) **Severe Combined Immuno deficiency (SCID) :** Sometimes new born children are without T-cells and B-cells. These children are highly susceptible to various infections. The most serious disorder of this type is a congenital disease known as severe combined immuno deficiency (SCID) in which both B-cells and T-cells are not present in the body. Such children are highly susceptible even to minor infections. In developed countries like U.S.A. such children are kept alive by keeping them in germ-free environments called isolation suits.

Table : 8.1-7 Autoimmune Disorders

S.No.	Disorder	Symptoms	Antibodies Against
1.	Glomerulo nephritis	Lower back pain	Kidney cell antigens that resemble Strep bacteria antigens
2.	Grave disease	Restlessness, Weight loss, irritability, Increased heart rate and Blood pressure	Thyroid gland antigens near thyroid stimulating hormone receptor, causing overactivity
3.	Juvenile diabetes	Thirst, hunger, weakness, emaciation	Pancreatic beta cells
4.	Hemolytic anemia	Fatigue and weakness	Red blood cells
5.	Myasthenia a gravis	Muscle weakness	Receptors for nerve messages on skeletal muscle
6.	Pernicious anemia	Fatigue and weakness	Binding site for vitamin B on cells lining stomach
7.	Rheumatic fever	Weakness, shortness of breath	Heart cell antigens that resemble Strep bacteria antigens
8.	Rheumatoid arthritis	Joint pain and deformity	Cells lining joints
9.	Scleroderma	Thick, hard, pigmented skin patches	Connective tissue cells
10.	Systemaic lupus erythmatos is	Red rash on face, prolonged fever, weakness, kidney damage	DNA, neurons, blood cells
11.	Ulcerative colitis	Lower abdominal pain	Colon cells

(2) **Acquired Immune Deficiency Syndrome (AIDS) :** It is a disorder of cell mediated immune system of the body. There is a reduction in the number of helper T-cells which stimulate antibody production by B-cells. This results in the loss of natural defence against viral infection.

Discovery : AIDS was first noticed in USA homosexuals in 1981 by Gottlies. Virus of AIDS was isolated and identified by **Prof. Luc Montagnier** in France in 1983 and almost the same time by **Prof. Robert Gallo** in USA. AIDS infections were detected in India for the first time in prostitutes of Chennai in 1986.

In India, four AIDS reference centres have been established.

- (i) A.I.I.M.S., New Delhi.
- (ii) National Institute of communicable Diseases, New Delhi,
- (iii) National Institute of Virology, Pune.
- (iv) Centre for Advanced Research on Virology, CMC, Vellore.

Symptoms of AIDS : An HIV infection can be divided into 3 stages.

(1) **Asymptomatic Carrier :** Only 1%-2% of those newly infected have mononucleosis-like symptoms that may include fever, chills, aches, swollen lymph glands, and an itchy rash. These symptoms disappear, and there are no other symptoms for 9 months or longer. Although the individual exhibits no symptoms during this stage. He or she is highly infectious. The standard HIV blood test for the presence of antibody becomes positive during this stage.

(2) **AIDS Related Complex (ARC) :** The most common symptom of ARC is swollen lymph glands in the neck, armpits, or groin that persist for 3 months or more. There is severe fatigue unrelated to exercise or drug use; unexplained persistent or recurrent fevers, often with night sweats; persistent cough not associated with smoking, a cold, or the flu; and persistent diarrhoea. Also possible are signs of nervous system impairment, including loss of memory, inability to think clearly, loss of judgement, and/or depression.

When the individual develops non-life threatening and recurrent infections such as thrush or herpes simplex, it is a signal that full-blown AIDS will occur shortly.

(3) **Full-Blown AIDS :** In this final stage, there is severe weight loss and weakness due to persistent diarrhoea and usually one of several opportunistic infections is present. These infections are called opportunistic because the body can usually prevent them – only an impaired immune system gives them the opportunity to get started. These infections include the following –

(i) **Pneumocystis carinii pneumonia :** There is not a single documented case of this type of pneumonia in persons with normal immunity.

(ii) **Toxoplasmic encephalitis :** In AIDS patients, this infection leads to loss of brain cells, seizures, and weakness.

(iii) **Mycobacterium avium :** This is an infection of the bone marrow that leads to a decrease in red blood cells, white blood cells, and platelets.

(iv) **Kaposi's Sarcoma :** A cancer of the blood vessels that causes reddish purple, coin-size spots and lesions on the skin.

Treatment of AIDS : The drug **zidovudine** (also called azidothymidine, or AZT) and dideoxyinosine (DDI) prevent HIV reproduction in cells. Proteases are enzymes HIV needs to bud from the host cell; researchers are hopeful that a protease inhibitor drug will soon be available.

A number of different types of vaccines are in, or are expected to be in, human trials. Several of these are sub unit vaccines that

utilize genetically engineered proteins that resemble those found in HIV. For example, HIV-1, the cause of most AIDS cases has an outer envelop molecule called GP 120. When GP 120 combines with a CD4 molecule that projects from a helper T lymphocyte, the virus enters the cell. There are sub unit vaccines that make use of GP 120. An entirely different approach is being taken by **Jonas Salk**, who developed the polio vaccine. His vaccine utilizes whole HIV-1 killed by treatment with chemicals and radiation. So far, this vaccine has been found to be effective against experimental HIV-1 infection in chimpanzees, and clinical trials will occur soon.

AIDS Prevention : Shaking hands, hugging, social kissing, coughing or sneezing and swimming in the same pool do not transmit the AIDS virus. You cannot get AIDS from inanimate objects such as toilets, doorknobs, telephones, office machines, or household furniture.

HIV has been isolated from semen cervical secretions, lymphocytes, plasma, cerebrospinal fluid, tears, saliva, urine and breast milk. The secretions known to be especially infectious are semen, cervical secretions, blood and blood products. Infection spreads :

- (1) By sexual intercourse, vaginal and anal
- (2) By infected blood, blood products, donated semen and organs
- (3) By contaminated needles used :
 - (i) During the treatment of patients
 - (ii) When drug abusers share needles
- (4) From an infected mother to her child :
 - (i) Across the placenta before birth
 - (ii) While the baby is passing through the birth canal
 - (iii) Possibly by breast milk

The following behaviour will help prevent the spread of AIDS

(1) Do not use alcohol or drugs in a way that prevents you from being in control of your behaviour. Especially, do not inject drugs into veins, but if you are an intravenous drug user and cannot stop your behaviour, always use a sterile needle for injection or one cleansed by bleach.

(2) Refrain from multiple sex partners, especially with homosexual or bisexual men or intravenous drug users of either sex. Either abstain from sexual intercourse or develop a long-term monogamous (always the same partner) sexual relationship with a partner who is free of HIV and is not an intravenous drug user.

(3) If you uncertain about your partner, always use a latex condom. Follow the directions, and also use a spermicide containing nonoxynol-9, which kills viruses and virus-infected lymphocytes. The risk of contracting AIDS is greater in persons who already have a sexually transmitted disease.

Diagnosis : Once the host is infected by HIV. HIV is detected by the ELISA Test. (Enzyme-linked immunosorbent assay). A positive ELISA should be confirmed using another test called the western blot test.

Hepatitis : It is a liver inflammation caused by virus, use of many drugs, chemicals and alcohol. Hepatitis may be of following types :

Hepatitis A : It is caused by *Hepatitis A virus (HAV)*. It is transmitted through infected food, water, clothes and faeces. It may occur in epidemic form especially in areas where hygiene is poor. This virus does not damage liver cells.

Hepatitis B : It is caused by *Hepatitis B virus (HBV)*. It is transmitted by infected food and blood products; such as plasma or by medical instruments contaminated with infected blood. It results in the swelling of liver cells.

Hepatitis is also caused by poisonous chemicals, alcohol, as a side effect of certain drugs and from severe amoebiasis.

Vaccines

History of Vaccines and Vaccination : In vaccination weakened or dead pathogens, or portions of pathogens, are injected into a person who is required to be made immune. The pathogens given in a vaccine are unable to cause the disease, but are sufficient to stimulate the formation of antibodies by host's cells. The process of vaccination was initiated by Edward Jenner in 1790. He observed that milkmaids did not contract smallpox apparently because they were exposed to a similar but milder form of disease called cowpox. Edward Jenner infected first James Phipps, a healthy boy of about 8 years with cowpox and two months later he infected the boy with smallpox. The boy did not suffer from small pox. Jenner proposed that an induced mild form of a disease would protect a person from a virulent form (which has ability to damage the host). He used the term vaccine (in Latin *Vacca* means 'cow') and the term vaccination for protective inoculation. Edward Jenner was the first to discover a safe and effective means of producing artificial immunity against small pox. Thus once vaccination is done the individual is protected from the disease. Vaccination develops acquired immunity. Pasteur confirmed Jenner's findings and produced vaccines for other diseases like anthrax, rabies and chicken cholera.

For protection need : Antibody provoking agents are called vaccines. These are used against viral and bacterial diseases.

Calmette & Guerin developed BCG vaccine for T.B. and Salk made Polio vaccine. Sabin also prepared Polio vaccine. Enders developed vaccine against measles. WHO was formed in 1948 at Geneva to take health problems at global level. In May, 1974, Global Immunisation Programme was launched by WHO for six disease (Diphtheria, Pertussis, Tetanus, Measles, TB & Polio).

Vaccination : It is the possible way to induce active acquired immunity against the germs of various diseases such as polio, diphtheria, whooping cough, tetanus and small pox. The immune system is thus induced to produce antibodies against these antigens. The artificial introduction of disease factors in the body is known as vaccination. Usually 2-3 injections are given to achieve full immunity against a specific pathogen and the further dose is called as booster doses.

Other Vaccines : Vaccines are also available for diphtheria, tetanus, whooping cough, tuberculosis, measles, polio, mumps, plague.

Types of Vaccines

(1) **Killed vaccine** : These vaccines are prepared by killing the pathogenic organisms by heat uv-rays/alcohol formalin/phenol, e.g., Typhoid Vaccine, Cholera Vaccine.

(2) **Toxoid** : These are prepared by destroying the toxic property of the toxins produced by organisms but retaining its antigenic property, e.g., Tetanus toxoid, Antidiphtheria toxoid.

(3) **Attenuated living vaccines** : The pathogen is made weakened to make it nonvirulent, e.g., Oral Polio Vaccine (OPV), BCG (Bacille Calmette Guerin). MMR (Mumps, Measles, Rubella) Provide active life long immunity.

(4) **Antibodies as vaccines** : Serum is used after a person/animal has been exposed to infection. This serum contains antibodies against that pathogen. It provides passive artificial immunity for some period only, e.g., ATS (*Anti tetanus serum*), *Antirabies serum*.

(5) Antigens like polysaccharides of *Pneumococci*, Interferon (glycoproteins) are also used as vaccines.

Table : 8.1-8 Some Important Vaccines

S.No.	Name of Vaccine	Category of Vaccine	Used for treatment of
1.	B.C.G.	Live vaccine (actual weakened germs)	Tuberculosis
2.	Cholera Vaccine	Killed vaccines (micro-organisms are killed)	Cholera
3.	Mumps Vaccine (MMR)	Live vaccine (actual weakened germs)	Mumps Measles & Rubella
4.	Oral Polio Vaccine (OPV)	Live vaccine	Polio, 1st dose given when child is 3 months old. Booster dose is given after 1 year
5.	Rubella Vaccine	Live vaccine	German measles and small pox
6.	Rubeolla Vaccine	Live vaccine	Measles
7.	Tetanustoxoid (TT)	Toxoid (bacterial toxin loses toxicity but retains antigenicity)	Tetanus
8.	Toxoid Serum	Toxoid (bacterial toxin loses toxicity but retains antigenicity)	Diphtheria
9.	Typhoid Vaccine (TAB)	Killed vaccine (micro organisms are killed)	Typhoid (Typhoid & Paratyphoid)
10.	Triple Antigen (DPT) (Diphtheria, Pertussis Tetanus)	Toxoid	Diphtheria, tetanus and whooping cough, 1 st dose given when child is 3 months old. Booster dose at 2 years.

T Tips & Tricks

- ✍ Ancylostoma duodenale larvae penetrate through exposed parts of hands and feet. It is common amongst agricultural workers.
- ✍ Cruetzfeldt Jakob Disease (CJD) is human disease equivalent to BSE. (Bovine spongiform encephalopathy). Upto 1984, about 26 cases of (CJD) were reported in India.
- ✍ He La cells : Cancer cells capable to propagate outside a living system. These are named after their donor, Heriatta Lacks, who died of cervical in 1951.
- ✍ Ames Test : It is a routine screening test developed by Bruce Ames to know the mutagenicity and carcinogenic nature of a substance.
- ✍ Plague vaccine provides immunity for six month. It was developed by Dr. Hoffkine, a Russian scientist.
- ✍ Small pox has been completely eradicated through compulsory immunization and the last case of small pox in human being was reported in 1978.
- ✍ Ali Maow Maalin was the last recorded victim of small pox.
- ✍ In mumps, if sex organ are involved then it may cause sterility in males.
- ✍ MMR vaccine : Triple antigen for Measles, Mumps and German measles (Rubeolla).
- ✍ August 29 is called Mosquito day.
- ✍ The wood of Tectona grandis is termite resistance.
- ✍ In September, 1997, India launched a Rs. 791 crore "Enhanced Malaria Control Project" aided by World bank loan. The 5 year project will stress for a decentralized strategy and people participation.
- ✍ Robert Koch (1876) was first to establish connection between disease and pathogen (anthrax disease of sheep due to *Bacillus anthracis*).
- ✍ Pasteur (1879). Development of vaccines through attenuation of pathogens.
- ✍ AIDS Day. December 1.
- ✍ Epitope. Region of antigen at which antibody combines.
- ✍ Paratope. Region of antibody that combines with antigen.
- ✍ Lentivirus. Slow acting virus, e.g., HIV.
- ✍ MALT. Mucosa Associated Lymphoid Tissue.

Q Ordinary Thinking

Objective Questions

General

1. Which one of the following provide non specific pathogen defense for the body [NCERT; Odisha JEE 2008]

(a) T-cells	(b) B-cells
(c) Phagocytes	(d) Stem cells
2. To which category multiple sclerosis belong [VITEEE 2008]

(a) Immunodeficiency diseases	(b) Autoimmune diseases
(c) Hyper sensitivity	(d) All the above
3. Which one of the following statement is correct [CBSE PMT 2009]

(a) Patients who have undergone surgery are given cannabinoids to relieve pain
(b) Benign tumours show the property of metastasis
(c) Heroin accelerates body functions
(d) Malignant tumours may exhibit metastasis
4. Note the following:

(A) Skin	(B) Phagocytes
(C) B-cells	(D) Inflammation
(E) Antibodies	(F) T-cells
(G) Fever	(H) Antimicrobial proteins
(I) NK-cells	(J) Secretions

 Identify the factors involved in 2nd line of defence [EAMCET 2009]

(a) (B), (D), (G) and (I)	(b) (B), (C), (E) and (I)
(c) (D), (F), (H) and (J)	(d) (C), (E), (G) and (H)
5. Choose the wrong statement regarding AIDS [Kerala PMT 2009]

(a) AIDS is an immunodeficiency disease
(b) It is caused by a retrovirus, HIV
(c) HIV selectively infects and kill B-lymphocytes
(d) Retroviruses have RNA genomes that replicate via DNA intermediate
(e) Viral RNA genome is converted into DNA copy by reverse transcriptase
6. Only one of the following four ways through which AIDS can spread [WB JEE 2008]

(a) Infected needles and syringes
(b) Through mosquito bites
(c) Looking after AIDS patient
(d) Shaking hands, coughing, sneezing, hugging
7. Active immunity development is related to [WB JEE 2008]

(a) Natural killer cells	(b) Memory cells
(c) Helper T cells	(d) Suppressor T cells
8. When an organ is transplanted and is rejected by the body, the lymphocytes are produced by [AMU (Med.) 2009]

(a) Cytotoxic T cells	(b) NK cells
(c) Suppressor T cells	(d) B cells

9. Which one of the following statements is correct with respect to immunity [NCERT; CBSE PMT (Mains) 2012]
- Preformed antibodies need to be injected to treat the bite by a viper snake
 - The antibodies against small pox pathogen are produced by T-lymphocytes
 - Antibodies are protein molecules, each of which has four light chains
 - Rejection of a kidney graft is the function of B-lymphocytes
10. The most commonly used marker enzyme in clinical diagnosis of prostate cancer is [AMU (Med.) 2009]
- Amylase
 - Alkaline phosphatase
 - γ -GTPase
 - Acid phosphatase
11. Cells obtained from cancerous tumors are known as [MP PMT 2009]
- Hybridomas
 - Myelomas
 - Lymphocytes
 - Monoclonal cells
12. Which Ig is produced in primary immune response [WB JEE 2009]
- Or
- Which antibody is first to be released into blood following an infection [WB JEE 2016]
- IgA
 - IgE
 - IgG
 - IgM
13. Immunodeficiency makes a person highly susceptible to infection. It is caused by [AFMC 2006]
- Lack of B cells
 - Lack of T cells
 - Lack of both B and T cells
 - None of the above
14. Expand ELISA [DPMT 2007]
- Enzyme linked immunosorbent assay
 - Enzyme linked ion sorbent assay
 - Enzyme linked inductive assay
 - None of the above
15. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to [NEET (Phase-I) 2016]
- Allergic response
 - Graft rejection
 - Auto-immune disease
 - Active immunity
16. Characters of acquired immunity are [DPMT 2007]
- Specificity of antigen
 - Difference between self and non-self
 - Retains memory
 - All of these
17. DPT vaccine is given for [Pb. PMT 2004]
- Tetanus, polio, plague
 - Diphtheria, whooping cough and leprosy
 - Diphtheria, pneumonia, tetanus
 - Diphtheria, whooping cough, tetanus
18. Plasma cells are derived from [MHCET 2015]
- Cytotoxic T – cells
 - Helper T – cells
 - Memory B – cells
 - Memory T – cells
19. Rishikesh is famous for the production of [AIIMS 2004]
- Antibiotics
 - Heavy electricals
 - Fertilizers
 - Transistorized radios
20. B.C.G. vaccine is used against [NCERT; AFMC 2002, 05, 09]
- T.B.
 - Leprosy
 - Food poisoning
 - None of these
21. The immune system which works against self is [MP PMT 2003]
- Self immune system
 - Autoimmunity
 - Specific immunity
 - None of the above
22. How many polypeptide chains are present in gamma immunoglobulin [Odisha JEE 2010]
- Or
- How many variable segments are present in the basic structure of antibody molecule [WB JEE 2010]
- 5
 - 4
 - 6
 - 2
23. AIDS is caused by [MP PMT 1996]
- Blood cancer
 - HTLV-III
 - Bacterium
 - TMV
24. Bursa of Fabricius is an important organ of birds. This organ is associated with [VITEEE 2006; WB JEE 2012]
- Generation of basophils
 - Production of uric acid
 - Metabolism of fatty acid
 - Generation of B-cell
25. Passive immunity can be obtained by injecting [WB JEE 2008]
- Or
- After vaccination the body builds up
- Antigens
 - Antibodies
 - Antibiotics
 - Vaccination having weakened germs
26. As per the guidelines of the Indian Red Cross Society, which of the following persons is recommended for blood donation [KCET 2011]
- People not in good health, under the influence of alcohol or drugs
 - Ladies during menstruation, pregnancy and breast feeding
 - Healthy women but unwed and below the age of 35
 - Persons who are immunized with live vaccines
27. First triple antigen vaccination is given to the child at the age of
- One month
 - Three month
 - Four month
 - One year
28. Edward Jenner discovered [KCET 2001; MH CET 2015; WB JEE 2016]
- Vaccination against polio
 - Immunization against polio
 - Vaccination against small pox
 - Immunization against small pox
29. Immediate hypersensitivity which result in the release of histamine and other inflammatory substances is mediated by [AMU (Med.) 2010]
- IgA
 - IgD
 - IgE
 - IgG

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30. Immunoglobulins are proteins that show.....Structure
[AMU (Med.) 2010]
(a) Primary (b) Secondary
(c) Tertiary (d) Quaternary
31. Which one of the following acts as a physiological barrier to the entry of microorganisms in human body
[NCERT; CBSE PMT (Pre.) 2011]
(a) Skin
(b) Epithelium of Urogenital tract
(c) Tears
(d) Monocytes
32. In ELISA TEST substance used is [Bihar CECE 2006]
(a) Peroxidase (b) Polymerase
(c) Ligase (d) Endonuclease
33. Vaccine against rabies was first developed by [J & K CET 2010]
(a) Edward Jenner (b) George Snell
(c) Louis Pasteur (d) Peter Goror
34. After infection of germs immunity acquired is [NCERT]
Or
The immunity obtained after the body has recovered from a disease is [MP PMT 1996]
(a) Active immunity (b) Passive immunity
(c) Natural immunity (d) Both (a) and (b)
35. Antibody formation and immunity production is done by a protein called globulin present in the [AIIMS 1993]
(a) Stroma of RBC (b) Haemoglobin of RBC
(c) Plasma (d) Blood platelets
36. Study of interaction of antigens and antibodies in the blood is [CMC Vellore 1993; JIPMER 1993, 98]
(a) Cryobiology (b) Serology
(c) Haematology (d) Angiology
37. AIDS is caused by HIV that principally infects [MP PMT 1994; CBSE PMT 2005]
(a) All lymphocytes (b) Activator B cells
(c) T-4 lymphocytes (d) Cytotoxic T cells
38. Which part of the body is known as 'Police guard'
(a) Tonsils (b) Liver
(c) Skin (d) Leucocytes
39. Which one of the following is not an autoimmune disease [J & K CET 2010]
(a) Grave's disease (b) Pernicious anemia
(c) Rheumatoid arthritis (d) Insomnia
40. Read the following four statements (A-D)
(a) Colostrum is recommended for the new born because it is rich in antigens
(b) Chikengunya is caused by a Gram negative bacterium
(c) Tissue culture has proved useful in obtaining virus-free plants
(d) Beer is manufactured by distillation of fermented grape juice
How many of the above statements are wrong [NCERT; CBSE PMT (Mains) 2012]
(a) Two (b) Three
(c) Four (d) One
41. Antibodies are produced by [AIEEE Pharmacy 2004; DPMT 2007; MP PMT 2007; Odisha JEE 2009]
(a) Erythrocytes (b) Thrombocytes
(c) Monocytes (d) Lymphocytes
42. What is the process, in which antibody comes in contact with antigen and convert them in harmless insoluble matter, called [GUJCET 2007; Odisha JEE 2009]
(a) Activation (b) Agglutination
(c) Neutralization (d) Opsonization
43. People administered with preformed antibodies get [Kerala PMT 2012]
Or
Short-lived immunity acquired from mother to foetus across placenta or through mother's milk to the infant is categorized as [NCERT; AFMC 2012]
(a) Active immunity (b) Innate immunity
(c) Auto immunity (d) Natural immunity
(e) Passive immunity
44. Which cell of immune system cause pore formation at the surface of the plasma membrane [NCERT; Odisha JEE 2004]
(a) Helper T-cell (b) Killer T-cell
(c) Suppressor T-cell (d) B-cell
45. Humoral immunity is due to [Pb. PMT 2000; Odisha PMT 2002, 04; WB JEE 2011, 12]
(a) B-lymphocytes (b) T-lymphocytes
(c) L-Lymphocytes (d) P-Lymphocytes
46. At which stage of HIV infection does one usually show symptoms of AIDS [NCERT; CBSE PMT (Pre.) 2010, 11; AIPMT 2015; AIPMT (Cancelled) 2015]
(a) Within 15 days of sexual contact with an infected person
(b) When the infecting retrovirus enters host cells
(c) When viral DNA is produced by reverse transcriptase
(d) When HIV replicates rapidly in helper T-lymphocytes and damages large number of these
47. Which one of the following pairs of disease can spread through blood transfusion [NCERT; AIEEE Pharmacy 2004]
(a) Cholera and hepatitis
(b) Hepatitis and AIDS
(c) Diabetes mellitus and malaria
(d) Hay fever and AIDS
48. Which of the glands is often referred in relation with AIDS [BHU 1995]
Or
T-cells are lymphocytes which produce the cellular immunity. These are developed from [MP PMT 2003]
(a) Thyroid (b) Thymus
(c) Adrenal (d) Pancreas
49. How does AIDS virus enter into man [MP PMT 1995]
(a) Through food (b) Through kissing
(c) Through water (d) Through blood

50. Sensitivity to any allergen is related to [CBSE PMT 1996]
 (a) Deviation from the process of immunity
 (b) Age of the person
 (c) Eating habit
 (d) Rise in environmental temperature

51. Passive immunity was discovered by [CBSE PMT 1996]
 (a) Robert Koch (b) L. Pasteur
 (c) Edward Jenner (d) Eemil Von Behring

52. A certain patient is suspected to be suffering from Acquired Immuno Deficiency Syndrome. Which diagnostic technique will you recommend for its detection [NCERT; DPMT 2003; BVP 2004; Pb PMT 2004; MH CET 2004; AMU (Med.) 2006; CBSE PMT (Pre.) 2011]
 (a) ELISA (b) Australian antigen
 (c) HIV test (d) None of these

53. The cell-mediated immunity inside the human body is carried out by [NEET 2013]

- (a) Erythrocytes (b) T-lymphocytes
 (c) B-lymphocytes (d) Thrombocytes

54. HIV causes reduction in [NCERT; MP PMT 1997, 2010; BHU 2000, 08; AFMC 2004; CBSE PMT 2006; WB JEE 2009]

Or

HIV virus affects in AIDS patient

[Odisha JEE 2004, 09; MP PMT 2012]

- (a) T-helper cells only (b) All T-cells
 (c) B-cells only (d) Both B and T-cells

55. A molecule that elicits an immune response is called [MP PMT 1997]

- (a) Antibody (b) Antigen
 (c) Mutagen (d) Carcinogen

56. Vaccines are prepared from immune [MP PMT 1998]

- (a) Vitamins (b) Blood
 (c) Serum (d) Plasma

57. AIDS can be transmitted by [MP PMT 1998]

- (a) Blood circulation (b) Hand shake
 (c) Courtship (d) All of the above

58. The antibodies are [MP PMT 1998]

- (a) Gamma-globulins (b) Albumins
 (c) Vitamins (d) Sugar

59. The factor responsible for cirrhosis of liver is [NCERT; MP PMT 1998]

- (a) Sugar (b) Vitamins
 (c) Fats and oils (d) Alcoholism

60. Full form of AIDS is [MP PMT 1999; CPMT 2009]

- (a) Anti immune deficiency syndrome
 (b) Auto immune deficiency syndrome
 (c) Acquired immuno deficiency syndrome
 (d) Acquired immune disease symptom

61. The antibodies are [CBSE PMT 1996, 99; BHU 2000; MP PMT 2012]

- (a) Lipids (b) Germs
 (c) Proteins (d) Carbohydrates

62. The term 'active immunity' means [NCERT; CBSE PMT 1999; BHU 1999]

- (a) Resistance developed after disease
 (b) Resistance developed before disease
 (c) Resistance rate of heart beat
 (d) Increasing quantity of blood

63. The immunoglobulin abundant in colostrum is [NCERT; Kerala PMT 2010; AIPMT 2015]

Or

The yellowish fluid colostrum has abundant antibodies to protect the infant [MP PMT 2011]

- (a) Ig G (b) Ig M
 (c) Ig D (d) Ig E
 (e) Ig A

64. In the immune system, interferons are a part of [Kerala PMT 2010]

- (a) Physiological barriers (b) Cellular barriers
 (c) Physical barriers (d) Cytokine barriers
 (e) Macrophages

65. Match the type of immunity listed in column I with the examples listed in column II. Choose the answer that gives the correct combination of alphabets of the two columns

Column I		Column II	
Types of immunity		Example	
A.	Natural active	p.	Immunity developed by heredity
B.	Artificial passive	q.	From mother to foetus through placenta
C.	Artificial active	r.	Injection of antiserum to travellers
D.	Natural passive	s.	Fighting infections naturally
		t.	Induced by vaccination

[KCET 2010]

- (a) A→s, B→t, C→q, D→r (b) A→t, B→s, C→r, D→p
 (c) A→p, B→q, C→r, D→t (d) A→s, B→r, C→t, D→q

66. Consider the following four statements (A–D) regarding kidney transplant and select the two correct ones out of these

- (A) Even if a kidney transplant is proper the recipient may need to take immuno-suppressants for a long time
 (B) The cell-mediated immune response is responsible for the graft rejection
 (C) The B-lymphocytes are responsible for rejection of the graft
 (D) The acceptance or rejection of a kidney transplant depends on specific interferons

The two correct statements are

[CBSE PMT (Pre.) 2010; AIPMT 2015]

- (a) (A) and (B) (b) (B) and (C)
 (c) (C) and (D) (d) (A) and (D)

67. Which of the following is an autoimmune disease [NCERT; Odisha JEE 2004; MP PMT 2010]

- (a) Rheumatoid arthritis (b) Grave's disease
 (c) Hashimoto's disease (d) All of the above

68. Antibodies are of which class of proteins [MP PMT 2010]
 (a) Structural (b) Enzymatic
 (c) Transport (d) Immunoglobulin
69. Which one of the following can **not** be used for preparation of vaccines against plague [CBSE PMT (Mains) 2010]
 (a) Formalin-inactivated suspensions of virulent bacteria
 (b) Avirulent live bacteria
 (c) Synthetic capsular polysaccharide material
 (d) Heat-killed suspensions of virulent bacteria
70. Select the correct statement with respect to diseases and immunisation [NCERT; CBSE PMT (Mains) 2011]
 (a) Certain protozoans have been used to mass produce hepatitis B vaccine
 (b) Injection of snake antivenom against snake bite is an example of active immunisation
 (c) If due to some reason *B* and *T*-lymphocytes are damaged, the body will not produce antibodies against a pathogen
 (d) Injection of dead / inactivated pathogens causes passive immunity
71. An immunoglobulin G molecule is composed of [WB JEE 2016]
 (a) Two identical heavy chains and two identical light chains
 (b) Two identical heavy chains and two different light chains
 (c) Two different heavy chains and two identical light chains
 (d) Two
72. MALT constitutes about _____ percent of the lymphoid tissue in human body [NEET 2017]
 (a) 50% (b) 20%
 (c) 70% (d) 10%
4. The substance produced by a cell in viral infection that can protect other cells from further infection is [NCERT]
 (a) Serotonin (b) Colostrums
 (c) Interferon (d) Histamine
5. Transplantation of tissues/organs to save certain patients often fails due to rejection of such tissues/organs by the patient. Which type of immune response is responsible for such rejections [NCERT; NEET 2017]
 (a) Auto-immune response
 (b) Humoral immune response
 (c) Physiological immune response
 (d) Cell-mediated immune response
6. Antivenom against snake poison contains [NCERT]
 (a) Antigens
 (b) Antigen-antibody complexes
 (c) Antibodies
 (d) Enzymes
7. Which of the following is not a lymphoid tissue [NCERT]
 (a) Spleen (b) Tonsils
 (c) Pancreas (d) Thymus
8. Which of the following glands is large sized at birth but reduces in size with ageing [NCERT]
 (a) Pineal (b) Pituitary
 (c) Thymus (d) Thyroid

GT Critical Thinking

Objective Questions

1. Certain compounds are released by the WBC which raise the body temperature. These compounds are known as [RPMT 2001]
 (a) Pyrogens (b) Histamines
 (c) Toxigens (d) Pathogens
2. Hypochromic microcytic anaemia and leucopenia are caused by the deficiency of respectively [EAMCET 2009]
 (a) Pyridoxine and riboflavin (b) Pyridoxine and folacin
 (c) Biotin and folacin (d) Biotin and cyanocobalamin
3. A person likely to develop tetanus is immunized by administering [CBSE PMT 2009]

Or

- When a quick immune response is required due to infection of a deadly microbes, the patient is injected with [NCERT]
 (a) Dead germs (b) Preformed antibodies
 (c) Wide spectrum antibiotics (d) weakened germs
4. If you suspect major deficiency of antibodies in a person, to which of the following would you look for confirmatory evidence [CBSE PMT 2007; AIPMT 2015]
 (a) Serum albumins (b) Serum globulins
 (c) Fibrinogen in the plasma (d) Haemocytes
5. Active immunity is obtained by
 (a) Antibodies (b) Weakened germs infection
 (c) Natural resistance (d) None of these

NQ NCERT

Exemplar Questions

1. The organisms which cause diseases in plants and animals are called [NCERT]
 (a) Pathogens (b) Vectors
 (c) Insects (d) Worms
2. When an apparently healthy person is diagnosed as unhealthy by a psychiatrist, the reason could be that [NCERT]
 (a) The patient was not efficient at his work
 (b) The patient was not economically prosperous
 (c) The patient shows behavioural and social maladjustment
 (d) He does not take interest in sports
3. AIDS is caused by HIV. Among the following, which one is not a mode of transmission of HIV [NCERT]
 (a) Transfusion of contaminated blood
 (b) Sharing the infected needles
 (c) Shaking hands with infected persons
 (d) Sexual contact with infected persons

6. Each immunoglobulin has two heavy chains & two light chains, the antigen binding site is present in
[NCERT; DPMT 2007; AIIMS 2008]
- (a) Variable region of heavy chain
 - (b) Variable region of both heavy and light chain
 - (c) Variable region of light chain
 - (d) Constant region of both light and heavy chain

7. SCID is caused by defective gene coding for the enzyme called
[Kerala PMT 2006]
- (a) Adenosine transaminase
 - (b) Guanosine transaminase
 - (c) Adenosine deaminase
 - (d) Guanosine deaminase
 - (e) Adenosine transferase

8. Which of the following vaccines are injected to babies at the age of 1½, 2½ and 3½ months
[Kerala PMT 2006]
- (a) DPT-Hip.B and Polio
 - (b) Polio and BCG
 - (c) BCG and DPT-Hib
 - (d) BCG and Hepatitis B
 - (e) Polio and DPT-Hip.B

9. In which one of the following options the two examples are correctly matched with their particular type of immunity

[NCERT; CBSE PMT (Pre.) 2012]

	Examples	Type of immunity
(a)	Polymorphonuclear leukocytes and monocytes	Cellular barriers
(b)	Anti-tetanus and anti-snake bite injections	Active immunity
(c)	Saliva in mouth and Tears in eyes	Physical barriers
(d)	Mucus coating of epithelium lining the urinogenital tract and the HCl in stomach	Physiological barriers

10. Match each disease with its correct type of vaccine

(A)	Tuberculosis	(I)	Harmless virus
(B)	Whooping cough	(II)	Inactivated toxin
(C)	Diphtheria	(III)	Killed bacteria
(D)	Polio	(IV)	Harmless bacteria

[AIPMT (Cancelled) 2015]

	(A)	(B)	(C)	(D)
(a)	(III)	(II)	(IV)	(I)
(b)	(IV)	(III)	(II)	(I)
(c)	(I)	(II)	(IV)	(III)
(d)	(II)	(I)	(III)	(IV)

11. AIDS related complex (ARC) is a disease which leads to fever, swollen lymph nodes, night sweats, loss in weight etc. represents
[MP PMT 1994]

- (a) Severe form of AIDS
- (b) Initial form of AIDS
- (c) No link with AIDS
- (d) None of the above

12. Which of the following disease is due to an allergic reaction
[NCERT; CBSE PMT 1995; AIIMS 1998; AFMC 2002]

- (a) Goitre
- (b) Enteric fever
- (c) Skin cancer
- (d) Hay fever

13. The protein $\alpha-1$ antitrypsin is used to treat the disease
[Kerala PMT 2011]

- (a) Cancer
- (b) Rheumatoid arthritis
- (c) Alzheimer's disease
- (d) Emphysema
- (e) ADA deficiency disease in children

14. Severe Acute Respiratory Syndrome (SARS)
[CBSE PMT 2004; AIIMS 2004, 08]

- (a) Is caused by a variant of *Pneumococcus*
- (b) Is caused by a variant of the common cold virus (corona virus)
- (c) Is an acute form of asthma
- (d) Affects non-vegetarians much faster than the vegetarians

15. Which immunoglobulin is the largest in size [Odisha JEE 2004]

- (a) IgA
- (b) IgD
- (c) IgE
- (d) IgM

16. If interferon is being produced in the body of a sick person, the person is most likely to be suffering from [CPMT 2004]

- (a) Typhoid
- (b) Malaria
- (c) Measles
- (d) Tetanus

17. A person is injected with globulin against hepatitis. This is
[BVP 2004]

- (a) Artificially acquired passive immunity
- (b) Artificially acquired active immunity
- (c) Naturally acquired active immunity
- (d) Naturally acquired passive immunity

18. How does vaccination work [J & K CET 2012]

- (a) The immune system produces antibodies which stay in the blood
- (b) Memory lymphocytes are produced. They remain in the body to fight off any future infection with the live pathogen
- (c) The dead pathogen stays in the body and constantly stimulates the immune system
- (d) All of the above

19. ELISA is used to detect viruses, where [CPMT 2004]

- (a) Alkaline phosphatase is the key reagent
- (b) Catalase is the key reagent
- (c) DNA-probes are required
- (d) Southern blotting is done

1362 Health and Diseases

20. Allergy involves [BCECE (Bihar) 2005; Kerala PMT 2006, 07; AMU (Med.) 2012; J & K CET 2012]

Or

The antibodies produced during allergy are [NCERT]

- (a) IgE (b) IgG
(c) IgA (d) IgM
21. Which of the following is correct regarding AIDS causative agent HIV [NEET (Phase-II) 2016]
- (a) HIV does not escape but attacks the acquired immune response
(b) HIV is enveloped virus containing one molecule of single-stranded RNA and one molecule of reverse transcriptase
(c) HIV is enveloped virus that contains two identical molecules of single-stranded RNA and two molecules of reverse transcriptase
(d) HIV is unenveloped retrovirus

Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :

- (a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion
(c) If the assertion is true but the reason is false
(d) If both the assertion and reason are false
(e) If the assertion is false but reason is true

1. Assertion : Myaesthesia gravis is an autoimmune disease.
Reason : Immune system rejects the transplant muscles.
2. Assertion : SCID is a primary immunodeficiency.
Reason : It is a serious congenital immunodeficiency.
3. Assertion : STDs are also called silent diseases.
Reason : These remain asymptomatic during early stages.
4. Assertion : Genital herpes cannot be cured.
Reason : Genital herpes can be inhibited by Acyclovir.
5. Assertion : AIDS spreads more rapidly than the hepatitis.
Reason : HIV has shorter incubation period than that of HBV.
6. Assertion : Anti - AIDS vaccines are being developed in USA.
Reason : These vaccines may be used to control HIV infection in India.
7. Assertion : Chlamydiosis is most common bacterial sexually transmitted disease.
Reason : It can be easily differentiated from gonococcal urethritis.

Answers

General

1	c	2	b	3	d	4	a	5	c
6	a	7	b	8	a	9	a	10	d
11	b	12	d	13	c	14	a	15	c
16	d	17	d	18	c	19	a	20	a
21	b	22	b	23	b	24	d	25	b
26	d	27	b	28	c	29	c	30	d
31	c	32	a	33	c	34	a	35	c
36	b	37	c	38	a	39	d	40	a
41	d	42	b	43	e	44	b	45	a
46	d	47	b	48	b	49	d	50	a
51	d	52	a	53	b	54	a	55	b
56	c	57	c	58	a	59	d	60	c
61	c	62	a	63	e	64	d	65	d
66	a	67	d	68	d	69	c	70	c
71	a	72	a						

NCERT Exemplar Questions

1	a	2	c	3	c	4	c	5	d
6	c	7	c	8	c				

Critical Thinking Questions

1	a	2	b	3	b	4	b	5	b
6	b	7	c	8	a	9	a	10	b
11	b	12	d	13	d	14	b	15	d
16	c	17	a	18	b	19	a	20	a
21	a								

Assertion and Reason

1	c	2	a	3	a	4	b	5	d
6	c	7	c						

AS Answers and Solutions

General

9. (a) Preformed antibodies need to be injected to treat the bite by a viper snake. It is also a type of immunisation which is called as passive immunization.
13. (c) The B cells and T cells are produced in bone marrow. The T cells (T-helper cells) stimulated B cells to produce antibodies. Antibodies are the main component of immune system.
16. (d) Acquired immunity is obtained during the life of an individual to a particular micro-organism due to previous infection, vaccination or inoculation of antiserum. It has four unique characteristics :
- Specificity : It is specific for each & every type of pathogen.
 - Diversity : It operates against the whole diversity of pathogenic organisms, their toxins & pollutants.
 - Difference between self & non-self : It can differentiate molecules & cells of foreign origin from those of self.
 - Memory : The immunity against a pathogen developed during an initial infection is retained by the individual so that second encounter with the pathogen invites a heightened immune response.
24. (d) Bursa of fabricus is a blind sac on the cloaca in the birds. It has lymphoid tissue involved in antibodies production and in fighting against invading bacteria. It is therefore called cloacal thymus.
28. (c) Edward Jenner of Britain in 1796 showed that vaccination with cowpox protects individuals from small pox.
31. (c) Physiological barriers to the entry of micro-organisms in human body are tears in eyes, saliva in mouth and HCl in stomach.
40. (a) Colostrum is recommended for the new born because it is rich in antibodies (B) Chikengunya is caused by a virus.
42. (b) Three main events occur in the process of formation of antigen-antibody complex. These are – agglutination, opsonization and neutralization.
- Agglutination : When an antibody comes in contact with the antigen, foreign bodies like virus, bacteria etc. it become associated with them and are converted into a mass of harmless, insoluble matter.
 - Opsonization : Specific immunoglobulin molecules, surround the antigen over its surface. The phagocytes identify such complexes, engulf them and destroy them.
 - Neutralization : Antibodies make the toxins produced by viruses and bacteria ineffective and destroy them.
46. (d) Symptoms of AIDS appear when there is depletion of helper T-cells.
48. (b) Thymus is an important gland in the early part of human life and forms T-lymphocytes. It is referred in relation to AIDS because AIDS virus destroys T-lymphocytes.
69. (c) Synthetic capsular polysaccharide vaccines are available for treatment of pneumonia caused by *Streptococcus pneumoniae*, *Hemophilus influenza* and for meningitis caused by *Neisseria meningitidis*. They are not available for plague

Critical Thinking Questions

6. (b) Each antibody consists of 4 polypeptides – two heavy chains & two light chains joined to form a 'Y' shaped molecule. The amino acid sequence in the tips of the 'Y' varies greatly among different antibodies. This variable region, composed of 110–130 aminoacids, give the antibody its specificity for binding antigen. The variable region includes the ends of the light & heavy chains.
9. (a) Neutrophils and monocytes are example of cellular barrier providing innate immunity.
21. (a) HIV attacks helper T cells and not try to hide from them.

Assertion and Reason

1. (c) Autoimmunity is a type of disorder when the immune system of an individual starts rejecting its own body cells or self. This leads to a variety of disease called autoimmune diseases. If the self antigens are muscle cells, then immune system destroys own muscles cells and causes myaesthesia gravis characterized by severe weakness.
2. (a) Severe combined Immuno Deficiency (SCID) is the most serious congenital immuno-deficiency of children so called primary immunodeficiency.
3. (a)
4. (b)
5. (d)
6. (c)
7. (c)

Health and Diseases

SET Self Evaluation Test

1. Allergens are [DPMT 2006]
 (a) Infectious and increased secretion of IgE
 (b) Non-infectious and increased secretions of IgE
 (c) Infectious and increased secretion of IgG
 (d) Non-infectious and increased secretion of IgM
2. The treatment of snake-bite by antivenine is an example of [AIIMS 2004]
 (a) Artificially acquired active immunity
 (b) Artificially acquired passive immunity
 (c) Naturally acquired passive immunity
 (d) Specific natural immunity
3. Column I lists the components of body defense and column II lists the corresponding descriptions. Match the two columns. Choose the correct option from those given
- | Column I | Column II |
|-----------------------------|---|
| A. Active natural immunity | p. Injection of gamma globulins |
| B. First line of defense | q. Complement proteins and interferons |
| C. Passive natural immunity | r. Direct contact with the pathogens that have entered inside |
| D. Second line of defense | s. Surface barriers |
| | t. Antibodies transferred through the placenta |
- [KCET 2006]
 (a) A = s, B = r, C = t, D = q (b) A = r, B = s, C = q, D = t
 (c) A = r, B = s, C = t, D = q (d) A = t, B = r, C = q, D = p
4. Which of the following organs is not involved in the elicitation of immune response [NCERT; CPMT 2004]
 (a) Brain (b) Lymph nodes
 (c) Spleen (d) Thymus
5. Passive immunity is defined as immunity [AIIMS 1998]
 (a) Inherited from the parents
 (b) Achieved through vaccination
 (c) Acquired through first exposure to the disease
 (d) Achieved through the sera of other animals enriched in antibodies
6. Inflammatory response in allergy is caused by the release of one of the following by mast cells [MP PMT 1997; AIIMS 1999]
 (a) Histamines (b) Antibodies
 (c) Antigen (d) None of them
7. Vaccination against small pox means the introduction into our body, of [MP PMT 1996]
 (a) Leucocytes obtained from animal
 (b) Antibodies produced in other animals
 (c) Antibodies
 (d) Actual weakened germs or attenuated small pox virus
8. Suspension of killed or attenuated pathogenic micro-organisms on inoculation if stimulate the formation of antibodies, it is known as [MP PMT 1994]
 (a) Vaccine (b) Antibiotic
 (c) Sera (d) Antitoxins
9. What is introduced in polio vaccination [MP PMT 1995]
 (a) Antibodies (b) Antigen
 (c) Antibiotics (d) Bacteriostatic agent
10. An insect bite may result in inflammation of that spot. This is triggered by the alarm chemicals such as [AIIMS 2008]
 (a) Histamine and dopamine (b) Histamine and kinins
 (c) Interferons and opsonin (d) Interferons and histones
11. This class of antibodies is made up of five immunoglobulin unit [AMU (Med.) 2009; WB JEE 2011]
 (a) IgG (b) IgM
 (c) IgA (d) IgD
12. Antibodies resemble which of the following shape [J & K CET 2012]
 (a) X (b) Y
 (c) Z (d) O
13. People, who are at the high risk of getting HIV infection [MP PMT 2011]
 (a) Individuals who have multiple sexual partners
 (b) Drug addicts who take drugs intravenously
 (c) Individuals who require repeated blood transfusions
 (d) All of the above
14. Interferons are [MP PMT 2011]
 (a) Protein products of macrophases, which destroy microbes
 (b) Protein secreted by Virus infected cells which protect non infected cells from further viral infection
 (c) Allergens
 (d) Antibody molecules

AS Answers and Solutions

1	b	2	b	3	c	4	a	5	d
6	a	7	d	8	a	9	b	10	b
11	b	12	b	13	d	14	b		

1. (b) Allergens are non-infectious foreign substances that cause allergic reaction. Allergy is the hyper-sensitiveness of a person to some foreign substance coming in contact with or entering the body. The common allergens are dust, pollen, mould spores, fabrics, lipsticks, nailpaints, fur, heat bacteria etc.
 Allergy involves mainly the secretion of IgE antibodies and histamine. The allergy causes marked dilation of all the peripheral blood vessels.
5. (d) Passive immunity is conferred by transfer of immune products, like antibodies etc. from another individual into a non-immune individual.
8. (a) Vaccine generates the primary immune response and the memory T or B cells.