CHAPTER 8
HUMAN HEALTH AND DISEASES

DEFINITION

Health can be defined as state of body and mind which allows a person to function well physically, mentally and socially.

Factors Affecting Our Health

1. ***Our dietary habits:*** A person eating a well balanced diet containing adequate amounts of nutrients required by our body on daily basis is healthier than a person taking nutritionally deficient diet.

2**.** ***Lifestyle***: A person having a sedentary lifestyle is less healthy than a person doing moderate amount of physical activity.

3. ***Our social environment***: A person living under stressful social environment with lot of antisocial activities are always under stressful mental conditions and more prone to stress related disorders as compared to a person living in relaxed environment.

4. ***The kind the work that we do to earn our living***: People working in the factories or environment with air or noise pollution will get respiratory and hearing problems respectively.

5. ***State of the mind:*** Affects the neural system and endocrine system which in turn affects our immune system. State of the immune system has a vital role to play in keeping us in a healthy state.

6. ***Genetic information***: Genetic information inherited from parents can be cause of many physical abnormalities and some genetic diseases can be passed on from parents to the offspring.

7. ***Our physical environment***: People living in clean areas with a proper garbage and sewage disposal system in place and lot of greenery are healthier than people living under unhygienic conditions and areas lacking greenery.

8. ***Economic conditions of individual:*** affects the health by affecting the buying capacity and also amount of the money spend by the individuals on health.

Disease

Definition – A state when the functioning of one or more organs of the body is affected resulting in altered physiological state with signs and symptoms telling us that there is something wrong with our health, it is called as disease.

Diseases can be classified as **Infectious** and **Non infectious** Diseases

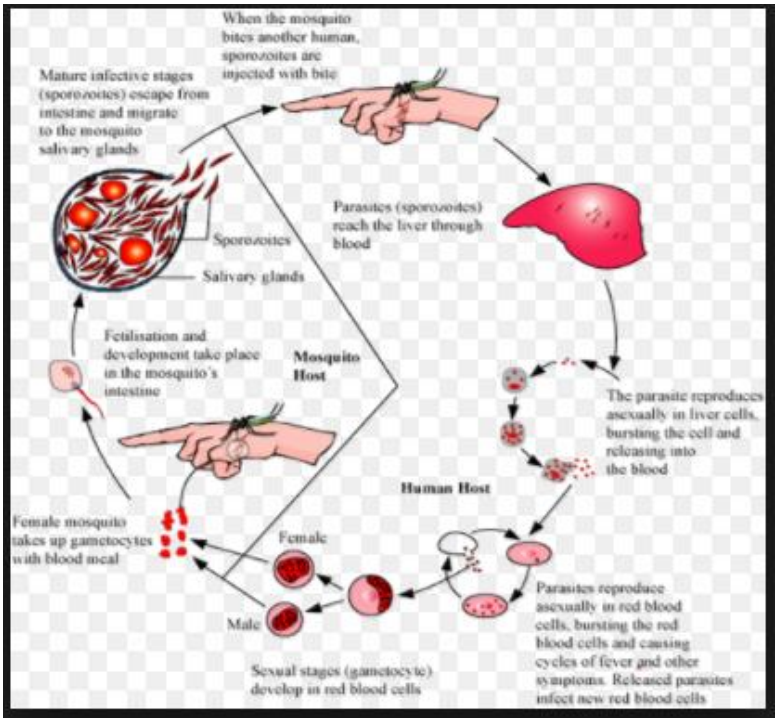
Infectious Diseases –Diseases which are easily transmitted from one person to another are called infectious diseases. They are caused by pathogens. Examples include Common cold, malaria, AIDS

Non infectious Diseases –Disease which cannot be transmitted from one person to another are called non –infectious diseases. Examples – Cancer and Diabetes.

Pathogens: Organisms that cause diseases in a host are called pathogens. They are usually microorganisms like bacteria, fungi, viruses, etc.

Widal test: It is a serological test that can be used for detecting typhoid.

Disease caused by Bacteria			
Disease	**Name of Bacteria**	**Mode of transmission**	**Symptoms**
Typhoid fever	*Salmonella typhi*	Contaminated food and water	Sustained high fever Stomach pain Weakness Constipation Loss of appetite (in severe cases – Intestinal perforations and death)
Pneumonia	*Streptococcus pneumoniae/ Haemophilus influenzae*	Sharing of glasses and utensils , inhaling droplet nuclei	Alveoli of lungs get infected leading to respiratory problems ,fever , chills ,cough and headache (lips and nails become grey in severe cases)
Disease caused by Viruses			
Disease	**Name of Viruses**	**Mode of transmission**	**Symptoms**
Common Cold	Rhino Virus	Air – through droplet nuclei, and through contaminated objects.	Infection of nose and respiratory tract. Nasal congestion and discharge, hoarseness, cough headache tiredness
Disease caused by protozoa			
Disease	**Name of Protozoa**	**Mode of transmission**	**Symptoms**
Malaria	*Plasmodium (P.falciparum ,P.vivax, P. malaria*)	By vector (Female Anopheles mosquito)	High fever and chills at fixed time interval due to release of haemozoin after rupture of infected RBC's.
Amoebiasis (amoebic dysentery)	*Entamoeba histolytica*	Houseflies act as mechanical carriers) serve to transmit the parasite from faeces of infected person to food (faeco-oral transmission	constipation, abdominal pain and cramps, stools with excess mucous and blood clots



Stages in the life cycle of *Plasmodium*

Life Cycle of Plasmodium:

1. Sporozoites: The infectious form of *Plasmodium* which enters the human body through the bite of a female *Anopheles* mosquito.
2. Multiplication of parasites inside the liver cells.
3. Attack of the RBCs by the parasites causing the rupture of the RBCs.
4. Release of a toxic substance called haemozoin by the ruptured RBCs that causes chills and recurring fevers every three to four days.
5. Transfer of the parasites into the body of the female *Anopheles* mosquito when the infected person is bitten by the mosquito.
6. Multiplication of the parasites within the mosquito to form sporozoites. These sporozoites are stored in the salivary glands of the mosquito.
7. The infected mosquito bites an uninfected person and the cycle repeats.

- It is important to note that the malarial parasite *Plasmodium* requires two hosts to complete its life cycle- the human host and the female *Anopheles* mosquito.

Diseases caused by worms:

Disease	**Pathogen**	**Mode of Transmission**	**Symptoms**
Ascariasis	*Ascaris*	Faeco-oral transmission	Fever, anaemia, muscular pain, internal bleeding and blockage of intestinal passage.
Elephantiasis/Filariasis	*Wuchereria bancrofti, W.malayi*	Bite of female mosquito vectors	Chronic inflammation of lymphatic vessels of lower limbs and genital organs causing gross deformities.
Diseases caused by Fungi			
Ringworm	*Microsporum, Trichophyton, Epidermophyton*	Direct contact through soil, contaminated clothes, combs, etc.	Dry, scaly lesions on skin, nails and scalp accompanied by intense itching. Symptoms

			worsen with increased heat and moisture

Prevention and Control:

1. Maintenance of personal and public hygiene
2. Isolation and Quarantine
3. Elimination of vectors and their breeding places
4. Protection against vectors
5. Vaccination
6. Antibiotics

8.2: IMMUNITY

The ability of the host to fight and protect against disease-causing organisms conferred by the immune system is called immunity.

Immunity is of two types:

(i) Innate immunity
(ii) Acquired immunity.

8.2.1 Innate Immunity

Innate immunity is a non-specific type of immunity in an individual that is present at the time of birth. It works by preventing the entry of pathogens through various barriers. There are various types of barriers by which the body prevents the entry of the foreign agents into our body.

Innate immunity consist of four types of barriers.

These are —

(i) **Physical barriers**
Examples - Skin, Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts
(ii) **Physiological barriers**: Acid in the stomach, saliva in the mouth, tears from eyes
(iii) **Cellular barriers**: Certain types of leukocytes (WBC) of our body can phagocytose and destroy microbes. For example, the polymorpho-nuclear leukocytes (PMNL-neutrophils), monocytes, natural killer (type of lymphocytes) in the blood, as well as macrophages in tissues.
(iv) **Cytokine barriers**: Cells infected with a virus secrete certain special proteins called as interferons which protect other non-infected cells from further viral infection.

8.2.2: Acquired Immunity

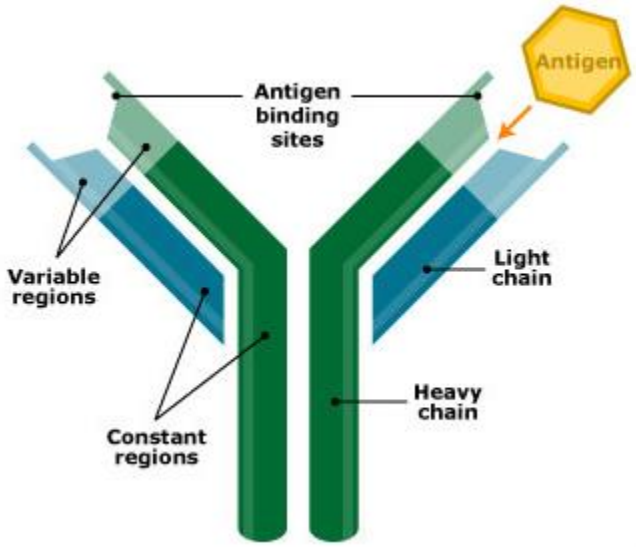
This type of immunity is pathogen specific and is characterized by a memory .When the pathogen is encountered for the first time a low intensity primary response is produced. Subsequent encounters with the same pathogen produces a high intensity response with the help of memory cells. This is called secondary or anamnestic response. Primary and secondary response are carried out with the help of 2 special types of lymphocytes B- lymphocytes and T lymphocytes. B-Lymphocytes produce special proteins called antibodies whereas the T lymphocytes help B-lymphocytes to produce antibodies.

<u>Antibody Structure</u>

Each antibody has 2 light chains and 2 heavy chains.

It is represented as H_2L_2.

Antibodies in our bodies are of different types such as IgA, IgG, IgE, and IgM.



Humoral Immune response

It is the kind of immune response that involve production of antibodies as these antibodies are present in the blood (body humor)

Cell-mediated immunity

It is an immune response that does not involve antibodies, but rather involves the activation of phagocytes, antigen-specific cytotoxic T-lymphocytes, and the release of various cytokines in response to an antigen.

The body is able to differentiate 'self' and 'non-self' and the cell-mediated immune response is responsible for the graft rejection.

8.2.3: Active immunity v/s Passive immunity

Active immunity.	**Passive immunity**
When a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body. This type of immunity is called active immunity.	When ready-made antibodies are directly given to protect the body against foreign agents, it is called passive immunity.
Effective after a lag period	This type of immunity is immediately effective after antibodies are given
Memory cells are produced which can produce stronger response the next time body encounters same antigen.	Memory cells are not produced and there is no long term protection provided to the body.
Examples – Vaccines like BCG, MMR	Examples – Anti-Tetanus injection ,Injections for snake bite, colostrum(yellowish fluid produced by the mother in the initial days of lactation) contains abundant IgA antibodies to protect the infant against infections

8.2.4: Vaccination and Immunization:

Vaccination: It is the introduction of antigenic proteins of pathogens or part or whole of inactivated or weakened pathogens into the host body so as to trigger the host immune system to produce antibodies against the antigens.

Vaccination works on the principle of memory. The antibodies produced in response to the vaccine will then help the body fight against the actual infection. During the actual infection these antibodies will be produced in large amounts by the activation of memory B and T cells of the immune system which will recognize the antigen and form the suitable antibodies faster.

In some cases, if a person has been severely infected or needs antibodies in his body faster to fight the infection readymade antibodies may be introduced into his body. This is called as **passive immunization**. This method is employed when time is insufficient to activate the host immune system so as to produce the required antibodies.

Newer techniques like recombinant DNA technology allows the production of antigenic polypeptides in bacteria and yeast. This allows for large scale manufacture of vaccines against specific antigenic polypeptides of various pathogens. As the cellular material of the pathogen is not present in the vaccine, the side effects to the vaccine may also be lesser in these cases.

8.2.5: Allergies

Definition: The aggravated response of the immune system to certain antigens present in the environment is called **allergy.**

The substances to which such an immune response is produced are called **allergens**. The antibodies produced to these are of IgE type.

Common examples of allergens are mites in dust, pollens, animal dander, etc. Symptoms of allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing.

Allergy is due to the release of chemicals like histamine and serotonin from the mast cells. Drugs like anti-histamines, adrenalin and steroids act quickly to reduce the symptoms of allergy.

Modern-day lifestyle has led to lowered immunity and increased susceptibility to allergies.

8.2.6: Auto immunity

The human immune system can differentiate antigen which are foreign to the body from the antigen which are part of the body. This is called auto immunity.

In some cases the body attacks its own cells due to genetic and other unknown reasons. This causes damage to the body and is called auto-immune disease. Example -Rheumatoid arthritis.

8.2.7: Immune System in the Body:

It consists of:

- Lymphoid organs
- Tissues
- Cells
- Antibodies

The immune system functions as follows:

- It differentiates between self and non-self
- It protects the body against non-self or foreign antigens

- It acts on the basis of memory and protects the body against antigens to which it has been previously exposed
- It is involved in allergic reactions
- It is important in auto-immune diseases
- It is important in organ transplant and graft rejection.

Lymphoid organs

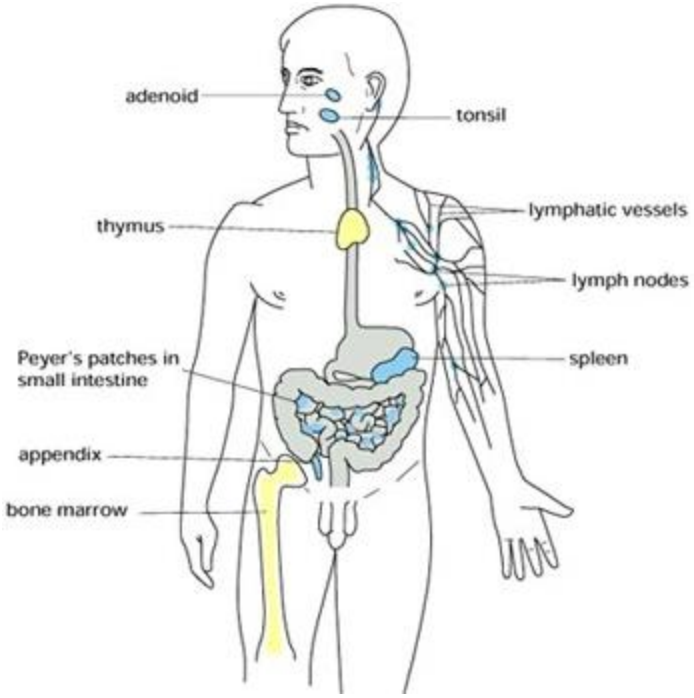
-These are the organs where origin and/or maturation and proliferation of lymphocytes occur
-Lymphoid organs defend the body against foreign antigens or spread of tumors.
- These organs exist as primary, secondary and tertiary. This is based on the stage of lymphocyte development and maturation the organ is involved in.
- Lymphoid organs contain connective tissues with different types of leukocytes or white blood cells. Of these, lymphocytes are usually present in the highest percentage regardless of the type of lymphoid organ

The primary lymphoid organs	bone marrow, thymus	immature lymphocytes differentiate into antigen-sensitive lymphocytes
Secondary lymphoid organs	Spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix	provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells

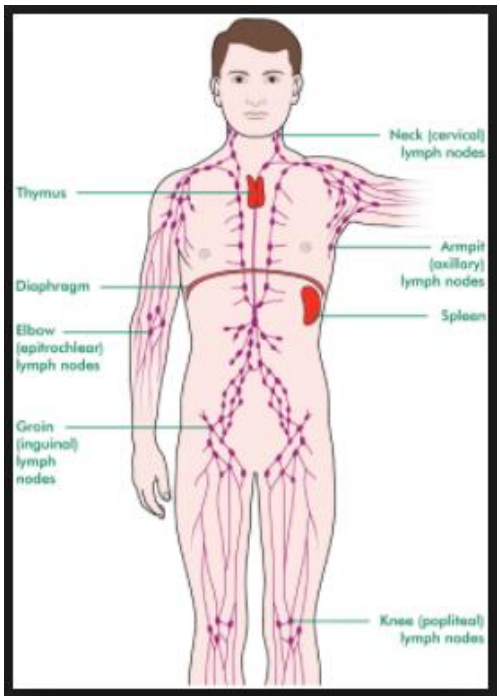
- **The bone marrow is the main lymphoid organ** where all blood cells including lymphocytes are produced.
- **The thymus** is a lobed organ. It is located beneath the breastbone and near the heart. The thymus is quite large at the time of birth but its size keeps decreasing with increase in age and by the time puberty is attained it reduces to a very small size.

Both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

- **The spleen** is a large bean shaped organ. It mainly contains lymphocytes and phagocytes. It acts as a filter of the blood by trapping blood-borne microorganisms. Spleen also has a large reservoir of erythrocytes.
- **The lymph nodes** are small solid structures located at different points along the lymphatic system. Lymph nodes trap the micro-organisms or other antigens that get into the lymph and tissue fluid. Antigens that get trapped in the lymph nodes are responsible for the activation of lymphocytes present within the lymph nodes. This causes the immune response. Lymphoid tissue is also located within the lining of the major tracts (respiratory, digestive and urogenital tracts). It is called as **mucosal associated lymphoid tissue (MALT**). It forms approximately 50 per cent of the lymphoid tissue in human body



Lymphoid Organs in Human Body



Lymph Nodes in Human Body

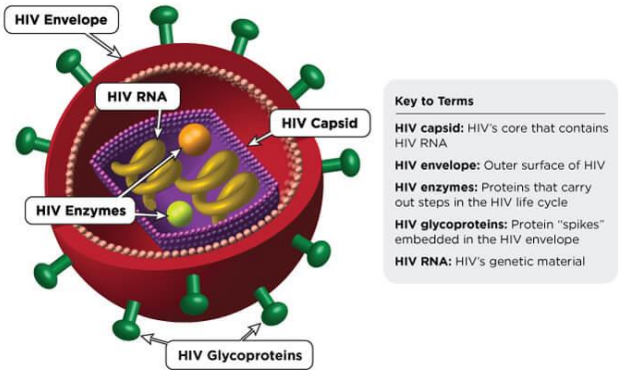
8.3: AIDS (Acquired Immuno Deficiency Syndrome).

This refers to an acquired condition of deficiency of immune system. It is a condition acquired during the lifetime of an individual referring to the fact that it is not a congenital disease. 'Syndrome' means a group of symptoms.

-AIDS was first reported in 1981 and in approximately the last twenty-five years, it has spread all over the world killing more than 25 million persons.

Causative Agent -The Human Immuno deficiency Virus (HIV)

It is a member of a group of viruses called **retrovirus.** They have an envelope enclosing the RNA genome. They also contain the reverse transcriptase gene.



Transmission of HIV-infection

(a) Sexual contact with infected person,

(b) By transfusion of contaminated blood and blood products,

(c) By sharing infected needles as in the case of intravenous drug abusers and

(d) From infected mother to her child through placenta.

People who are at high risk of getting this infection

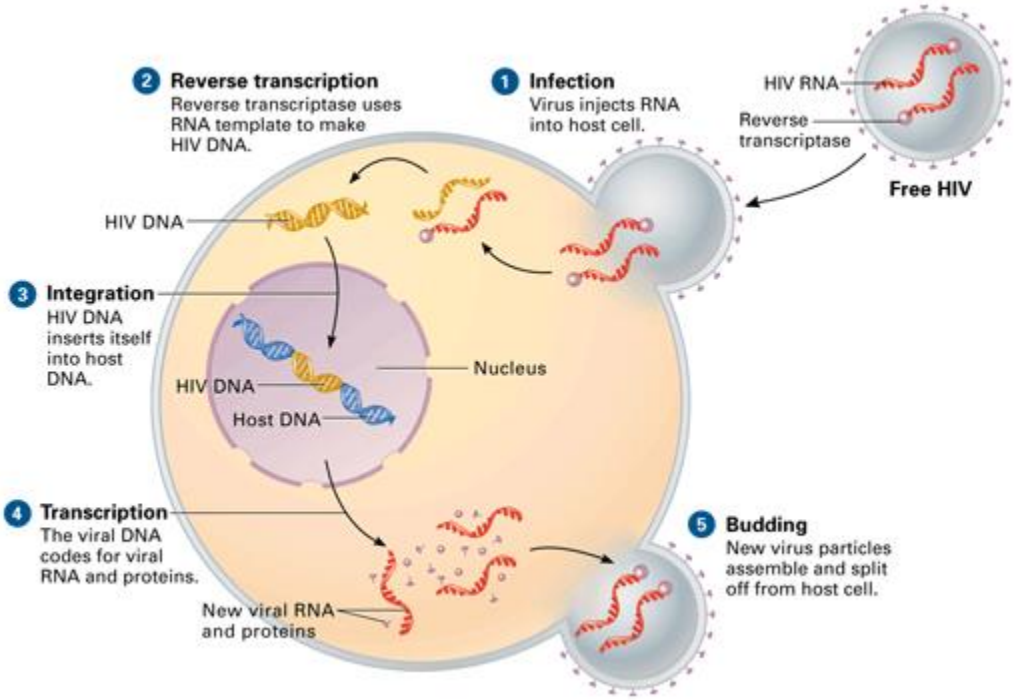
-individuals who have multiple sexual partners
-drug addicts who take drugs intravenously,
-Individuals who require repeated blood transfusions (certain cancers, anemia, and thalassemia)
-children born to an HIV infected mother.

HIV/AIDS does not spread through mere touch or physical contact.

It spreads only through contact with body fluids. It is important for the physical and psychological well-being of the infected person that the HIV/AIDS infected persons not be isolated from family and society. There always exists a sufficient time interval between the infection and appearance of symptoms. This incubation period may vary from a few months to many years (usually 5-10 years).

How HIV affects the body?

- The virus enters the body of the person and infects the macrophages.
- The RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase.
- This viral DNA is thus incorporated into host cell's DNA and then directs the infected cells to produce more virus particles.
- The macrophages continue to produce virus.
- At the same time HIV enters into helper T-lymphocytes (TH) to replicate and produce progeny viruses.
- The progeny viruses released in the blood attack other helper T-lymphocytes. This entire cycle is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person.
- During this period, the person suffers from bouts of fever, diarrhea and weight loss.
- Due to decrease in the number of helper T lymphocytes, the person starts suffering from infections that could have been otherwise dealt with by the immune system. This includes diseases such as those caused by bacteria especially *Mycobacterium*, viruses, fungi and even parasites like *Toxoplasma.* The patient becomes immuno-deficient and is unable to protect themselves against these infections.



Detection:

Enzyme linked immuno-sorbent assay (ELISA): It is a biochemical technique used in immunology to detect the presence of an antibody or an antigen in a sample. A western Blot test is also done to confirm results of ELISA test.

Treatment: Use anti-retroviral drugs. By this the life span of patient can be prolonged but it cannot prevent death.

Prevention of AIDS: As AIDS has no cure, prevention is the best option.

- Spread can be limited by conscious effort and behavior patterns.
-More effective monitoring can prevent infection through blood transfusion, transmission from mother to new-born.

Role of government and non government organization in limiting spread of this disease.

-National AIDS Control Organisation (NACO) and other non-governmental organisation (NGOs) are making efforts to educate people about AIDS.
-WHO conducts a number of programmes to prevent the spreading of HIV infection.
Prevention and Control Methods:

- Making blood transfusions safe from HIV
- Ensuring the use of only disposable needles and syringes in public and private hospitals and clinics.
- Free distribution of condoms
- Controlling drug abuse
- Advocating safe sex
- Promoting regular check-ups for HIV in susceptible populations.

Role of Society in preventing spread of this disease

- Sympathy for HIV/AIDS patients.
- Disclosure about the HIV status to prevent further spread to more people.
- Co-operation and co-ordination between society and medical fraternity to prevent the spread of the disease.

8.4: Cancer

- In our body, cell growth and differentiation is highly controlled and regulated.
- In cancer cells, there is breakdown of these regulatory mechanisms.
- Normal cells exhibit **contact inhibition.** Due to this contact of a cell with other cells inhibits its uncontrolled growth.
- Cancer cells lose contact inhibition. As a result of this, cancerous cells continue to divide giving rise to masses of cells called **tumors**.

Tumors are of two types:

1. **Benign tumors** normally remain limited to their original location and do not spread to other parts of the body. They cause less damage.
2. The **malignant tumors** are a mass of proliferating cells called neoplastic or tumor cells. These cells grow very rapidly. They thus invade and damage the surrounding normal tissues. As these cells are actively dividing and growing it leads to the starvation of the normal cells by competing for vital nutrients. Cells may be sloughed from such tumors and reach distant sites through blood. Wherever they get lodged in the body they cause the emergence of a new tumor. This property called **metastasis.**

Causes of cancer:

-Transformation of normal cells into cancerous neoplastic cells may be induced by physical, chemical or biological agents. These agents are called carcinogens.
Common carcinogens:
-Ionising radiations: X-rays and gamma rays
-Non-ionizing radiations: UV
Both ionizing and non-ionising radiations cause DNA damage that causes neoplastic transformation.
-The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer.

Oncogenic viruses are cancer causing viruses. They have genes called viral oncogenes.
Several genes called cellular oncogenes(c-onc) or proto oncogenes have been identified in normal cells which can be activated under certain conditions and therefore lead to oncogenic transformation of the cells.

Cancer Detection and Diagnosis:

Early detection of cancers is essential as it allows the disease to be treated successfully in many cases. Cancer detection is based on:

- **Biopsy:** a piece of the suspected tissue cut into thin sections is stained
- Histopathological studies of the tissue (thin sections are examined under the microscope)
- **Blood and bone marrow tests:** for increased cell counts in the case of leukemias.
- **Radiography**: (use of X-rays),
- **CT (computed tomography)**: This technique uses X-rays to generate a three-dimensional image of the internals of an object.
- **MRI (magnetic resonance imaging)**: MRI involves use of strong magnetic fields and non-ionizing radiations to accurately detect pathological and physiological changes in the living tissue.
- **Antibodies against cancer-specific antigens**: Used for detection of certain cancers.
- **Techniques of molecular biology**: To detect genes in individuals with inherited susceptibility to certain cancers. Identification of such genes may be helpful in prevention of cancers. Such individuals may be advised to avoid exposure to particular carcinogens to which they are susceptible (e.g., tobacco smoke in case of lung cancer).

Treatment of cancer:

- Treatment of cancer can be done by one or combinations of different approaches. The common approaches for treatment of cancer are surgery, radiation therapy, chemotherapy and immunotherapy.
- In radiotherapy, tumor cells are irradiated lethally, taking proper care of the normal tissues surrounding the tumor mass.
- Several chemotherapeutic drugs are used to kill cancerous cells. These drugs may be specific for particular tumors. Most drugs have side effects like hair loss, anemia, etc.
- Majority of the cancers are treated by a combination of all the above methods.
- Tumor cells avoid detection and destruction by immune system. Therefore, they are treated with substances called **biological response modifiers**. They are substances such as α-interferon which activate their immune system and help in destroying the tumor.

8.5: Drug Abuse

Drugs are chemical substances which when taken inside the body for a purpose other than the medicinal use or in amounts and frequency that impairs ones physical, psychological functions, it constitutes a drug abuse.

Commonly abused drugs

-opioid
-cannabinoids
-coca alkaloids

Drug /Chemical nature	Obtained from	Taken by	Action
Opioids / Diacetylmorphine	Latex of Poppy plant (*Papaver somniferum*)	snorting or injection	-bind specifically to the opioid receptors present in the CNS and GI tract. -Depressant and slows down body functions
Cannabinoids	Inflorescences of plant *Cannabis sativa*	Oral ingestion Inhalation	Has effect on cardiovascular systems of the body.

Coca alkaloids or Cocaine	Coca Plant *Erythroxylum coca*	Snorted	It interferes with the transport of the neurotransmitter Dopamine and has potent stimulating effect on the CNS producing a sense of Euphoria and increased energy .Excessive dosage leads to hallucination.

Smoking

-Tobacco is smoked, chewed or used as a snuff.
- Contains large amounts of chemical substance including nicotine which is an alkaloid.
- It stimulates the adrenal gland to release adrenaline and non adrenaline into blood circulation, both of which raise blood pressure and increase heart rate.
-Smoking increases the incidence of lung cancer. It also affects urinary bladder and throat causing bronchitis, emphysema, coronary heart diseases and gastric ulcers.
-Tobacco chewing increases the risk of cancer of oral cavity.
- Smoking increases CO content in the blood and therefore reduces the content of haem -bound oxygen. This causes oxygen deficiency in the body leading to anemia.
-An addict usually requires counseling and medical help to get rid of habit.

8.5.2: Adolescence and Drug/Alcohol abuse:
Adolescence is a period during which an individual reaches reproductive maturity. It is a link between childhood and adulthood. It is a period where there is emotional and behavioral growth of the individual. It is therefore characterized by several physiological and psychological changes. Therefore, during this period an individual is highly vulnerable.

Youngsters are motivated towards drugs and alcohol use due to:

- Curiosity
- Need for adventure
- Experimentation
- Perceived benefits of alcohol and drug use
- Stress and academic pressure
- Need to appear cool/peer pressure
- Influence of popular media
- Unstable family structure

8.5.2: Addiction and Dependence:

Addiction: Addiction is a psychological attachment to certain effects such as euphoria and a temporary feeling of well-being usually associated with drugs and alcohol. With repeated use of drugs, the tolerance level of the receptors present in our body increases. As a result the receptors respond only to higher doses of drugs or alcohol. This leads to greater intake and more addiction

Dependence: Dependence is the tendency of the body to manifest a characteristic and unpleasant **withdrawal syndrome** if regular dose of drugs/alcohol is abruptly discontinued. This is typically manifested as nausea, anxiety shakiness and sweating. These may be relieved when use is resumed again.
In some cases, withdrawal symptoms can be severe and even life threatening and the person may need medical supervision.
Dependence causes the patient to ignore all social norms just so as to get sufficient funds to satiate his/her needs. These result in many social problems.

8.5.3: Effects of Drug/Alcohol Abuse

- reckless behavior
- Vandalism and violence.
- Excessive doses of drugs may lead to coma and death due to respiratory failure, heart failure or cerebral hemorrhage.
- Intravenous intake of drugs could lead to increases susceptibility to diseases like AIDS, Hepatitis, etc.
- Damage to nervous system and Liver cirrhosis
- Adverse effect on foetus due to consumption during pregnancy
- Side effects of performance enhancing drugs for sports:
- In females: masculinization, increased aggressiveness, mood swings, depression, abnormal menstrual cycle, excessive facial and body hair, enlargement of clitoris and deepening of voice
- In males: acne, aggressiveness, mood swings, depression, reduction in testicles, decreased sperm production, kidney and liver dysfunction, breast enlargement, premature baldness, enlargement of the prostate

Common warning signs of drug and alcohol abuse

- Drop in academic performance
-unexplained absence from school/college
-lack of interest in personal hygiene
-withdrawal, isolation, depression, fatigue, aggressive and rebellious behavior
- deteriorating relationships with family and friends
-loss of interest in hobbies
- Change in sleeping and eating habits
- Fluctuations in weight, appetite, etc.
- Stealing to get money to buy drugs/alcohol.

8.5.4: Prevention and Control

1. ***Avoid undue peer pressure***
2. ***Education and counselling***
3. ***Seeking help from parents and peers***
4. ***Looking for danger signs***
5. ***Seeking professional and medical help***