ZLGY-MM: XII

8. HUMAN HEALTH & DISEASE

❖ **Health** is a state of complete physical, mental & social well-being.

- To maintain good health, **personal** and **public hygiene** is very important.

Personal hygiene
- Have balanced diet
- Use clean drinking water, food etc.
- Keep the body clean
- Take regular exercise-***Yoga*** to achieve physical and mental health
- Aware about diseases and their effect on different bodily functions
- Take vaccination (immunisation) against infectious diseases timely

Public hygiene
- Have proper disposal of wastes
- Control disease vectors

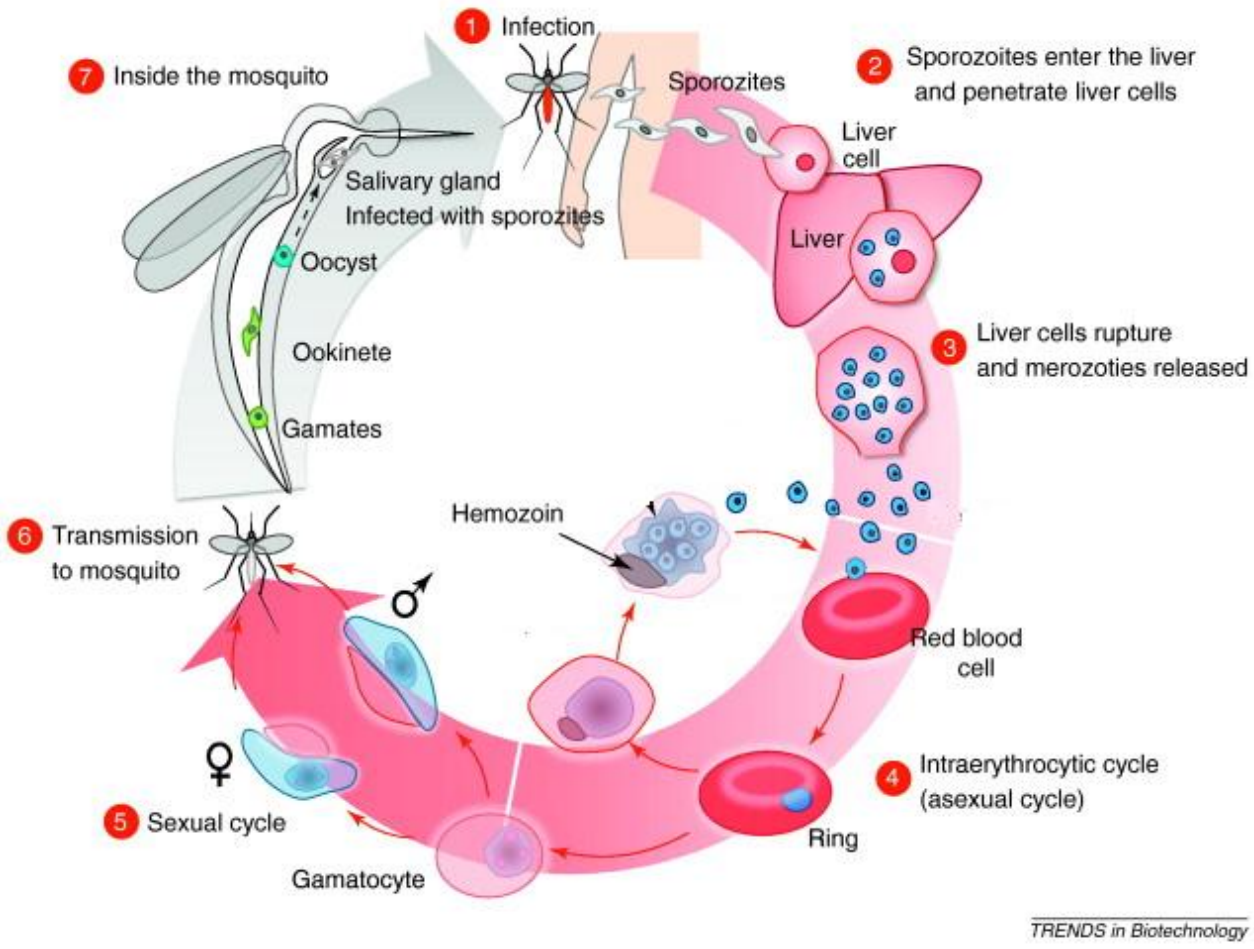
❖ **Disease** is the malfunctioning of body or parts characterised by various symptoms.

Diseases may be-

- ***Infectious*** -transmitted from one person to another.
  These diseases are caused by organisms called **pathogens**. They enter the body by various means, multiply and interfere with normal vital activities, resulting in morphological and functional damage.
  E.g.: AIDS.
- ***Non-infectious***-which are not transmitted from one person to another.
  They occur due to genetic disorder, change in life style (food, water, rest, exercise, habits etc).
  E.g.: Cancer

COMMON INFECTIOUS DISEASES IN MAN

Disease	Pathogen	Mode of transmission	Infecting part	Symptoms
I-BACTERIAL DISEASES				
a) **Typhoid** Confirmation:- **Widal test**	*Salmonella typhi*	Through contaminated food & water	Enter the small intestine and migrate to other organs through blood.	Sustained high fever (39°- 40°C), weakness, stomach pain, constipation, headache and loss of appetite. - Intestinal perforation and death may occur in severe cases.
b) **Pneumonia**	*Streptococcus pneumoniae* & *Haemophilus influenzae*	i. Inhaling the droplets/ aerosols released by an infected person. ii. Through contaminated objects.	Lung alveoli. -The alveoli get filled with fluid leading to severe respiratory problems.	Fever, chills, cough and headache. - In severe cases, the lips and finger nails may turn gray to bluish in colour.
Other bacterial diseases -**Dysentery, plague, diphtheria**				
II-VIRAL DISEASES				
c) **Common cold**	Rhino viruses	,,	Nose and respiratory passage (but not the lungs)	Nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness, etc., which usually last for 3-7 days
III-PROTOZOAN DISEASE				
d) **Malaria**	*Plasmodium sp.* (*P. vivax*, *P. malaria* & *P. falciparum*- malignant)	Through the bite of infected female ***Anopheles*** mosquito	Initially multiply within the liver cells and then attack the RBCs resulting in their rupture	The rupture of RBCs is associated with release of a toxic substance, **haemozoin**, which is responsible for the chill and high fever recurring every 3-4 days.
e) **Amoebiasis (dysentery)**	*Entamoeba histolytica*	**Houseflies** transmit the parasite from faeces of infected person to food & water.	In large intestine	Constipation, abdominal pain and cramps, stools with excess mucous and blood clots.
IV-HELMINTHIC DISEASE				
f) **Ascariasis**.	*Ascaris*	Through contaminated soil water, vegetables, fruits, etc. with the eggs of the parasite excreted along with the faeces of infected persons.	Intestine	Internal bleeding, muscular pain, fever, anaemia and blockage of the intestinal passage.
g) **Filariasis (Elephantiasis)**	Filarial worms/ ***Wuchereria sp.*** *(W. bancrofti* & *W. malayi)*	Through the bite of female ***Culex*** mosquito.	The lymphatic vessels of the lower limbs and the genital organs	Due to blockage of lymph vessels, **inflammation** occurs in the organs in which worms live.
V-FUNGAL DISEASES				
h) **Ringworms**	*Microsporum*, *Trichophyton* & *Epidermophyton*	From soil or contaminated articles of infected persons.	In skin folds such as those in the groin or between the toes.	Dry, scaly lesions on skin, nails and scalp with intense itching.



Stages in the life cycle of *Plasmodium*

Prevention & Control of infectious diseases

a) For water-borne diseases like **typhoid**, **amoebiasis, ascariasis** etc.
- ✓ Proper disposal of waste and excreta
- ✓ Periodic cleaning and disinfection of water reservoirs, pools, cesspools and tanks
- ✓ Keeping standard practices of hygiene in public catering.

b) For air-borne diseases like **pneumonia, common cold** etc.(in addition to the above measures)
- ✓ Avoid close contact with the infected persons or their belongings.

c) For vector-borne disesases like **malaria**, **filariasis**, **dengue, chikungunya** etc.
- ✓ Control or eliminate the vectors and their breeding places.
- ✓ Avoiding stagnation of water in and around residential areas.
- ✓ Use of mosquito nets.
- ✓ Introducing fishes like *Gambusia* in ponds that feed on mosquito larvae.
- ✓ Spraying of insecticides in ditches, drainage areas and swamps, etc.
- ✓ Doors and windows should be provided with wire mesh to prevent the entry of mosquitoes.

IMMUNE SYSTEM

- It is the system that gives immunity to the body by recognizing, responding and remembering foreign antigens.
- Play role in allergic reaction, auto-immune disease and organ transplantation.
- Includes **lymphoid organs, tissues, cells** and soluble molecules like **antibodies.**

Lymphoid organs

These are the organs where origin, maturation & proliferation of lymphocytes occur. 2 types-

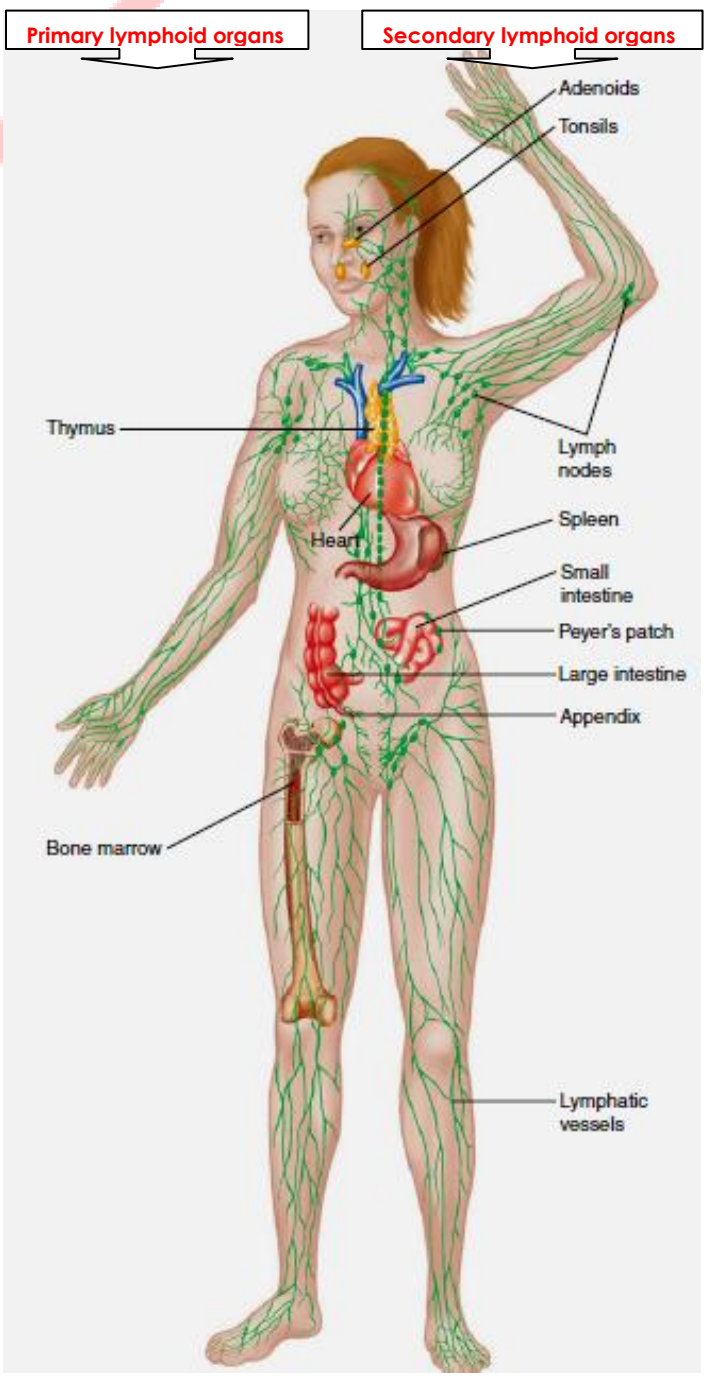
a. Primary lymphoid organs

➔ Here, immature lymphocytes differentiate into antigen-sensitive lymphocytes. These include bone marrow and thymus.
- **Bone marrow** is the site of formation of blood cells.
- **Thymus** is large during birth but gradually reduces in size.

b. Secondary lymphoid organs

➔ The organs, to which matured lymphocytes migrate, interact with antigens and then proliferate to become **effector cells.**

E.g. Spleen, lymph nodes, tonsils, Peyer's patches, MALT & appendix.
- **Spleen:** Bean-shaped organ. Contains lymphocytes and phagocytes.
  - It removes worn-out RBCs & microorganisms from blood.
  - It is a reservoir of erythrocytes in foetus.
- **Lymph nodes:** Found in lymphatic system.
  - They trap microorganisms or other antigens.
  - Trapped antigens activate lymphocytes and cause immune response.
- **Tonsils-** Mass of lymphoid tissues present on either side of pharynx.
- **Peyer's patches-** Mass of lymphoid tissues present on walls of small intestine as patches.
- **Mucosal associated lymphoid tissue (MALT):** Located within the lining of respiratory, digestive & urinogenital tracts.



IMMUNITY

- It is the ability of the immune system to fight the disease-causing organisms.
- **Edward Jenner**- *Father of immunology* (study of immunity)
- Immunity is of 2 types: Innate and Acquired.

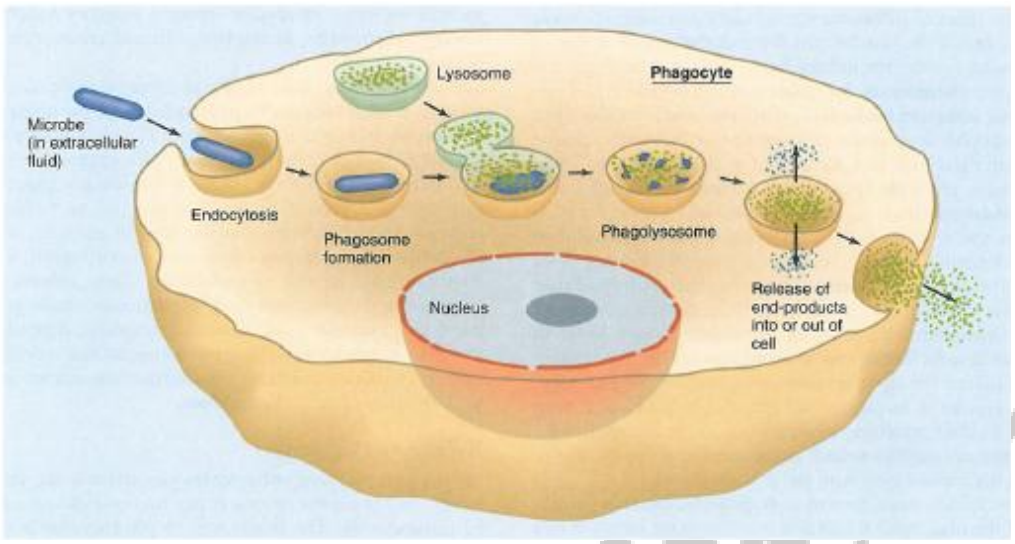
1-Innate Immunity

- It is the *non-specific* type of immunity present at the time of birth.
- It provides barriers to the entry of the foreign agents into the body. Barriers are 4 types —

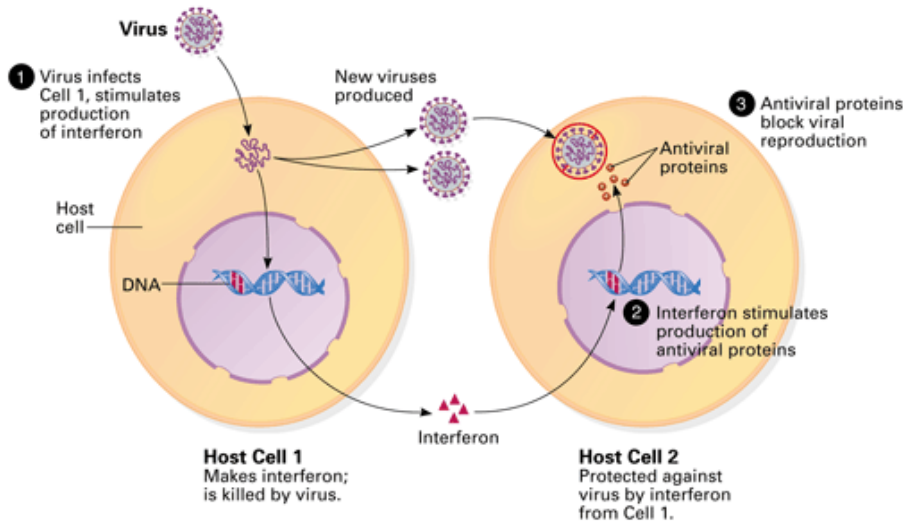
(i) ***Physical barriers*****:** E.g. ***Skin*** (Prevent entry of the micro-organisms)
Mucus coating (Trap microbes in respiratory, gastrointestinal and uro-genital tracts)

(ii) ***Physiological barriers*****:** E.g. ***Acid*** in the stomach
Saliva in the mouth } Prevent microbial growth
Tears from eyes

(iii) ***Cellular barriers*****:** WBC (E.g. Neutrophils, Monocytes)
Natural killers (E.g. Lymphocytes& macrophages) } Phagocytose and destroy microbes



Phagocytosis

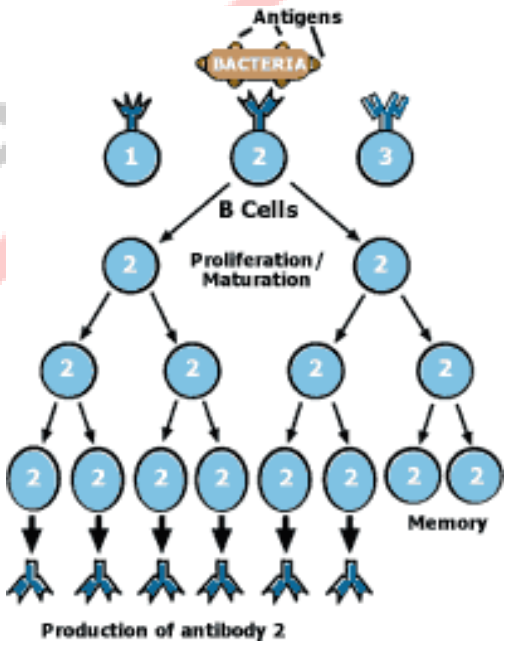


Interferon action

(iv) ***Cytokine barriers*****:** Virus infected cells secrete proteins called ***interferon*** which protect non-infected cells from further viral infection.

2-Acquired Immunity

- It is **pathogen *specific*** immunity that an individual acquires during his life.
- <u>It is characterised by memory.</u>
  i.e. during first encounters a pathogen, the body produces a ***primary response*** which is of low intensity to eliminate it and produce numerous **memory cells**. Immune system retains these cells for a long period. When a second encounter with the same pathogen occurs, memory cells *quickly* produce large number of ***effector cells*** to evoke **secondary response** of high intensity.
- The primary and secondary immune responses are carried out with *B-lymphocytes* and *T-lymphocytes*.
  a. B-lymphocytes (B-cells): Produce *antibodies*.
  b. T-lymphocytes: Help B-cells to produce antibodies.

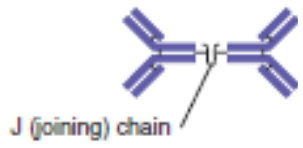
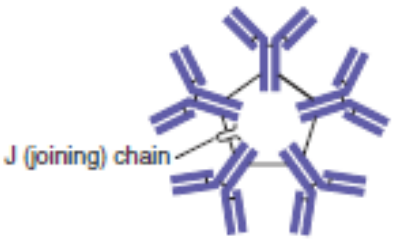


Production of antibody 2

Antibody

- It is the molecules which are produced in response to antigen (foreign agent or pathogen). It inactivates antigen.
- A particular antibody binds only with a particular antigen (i.e., it is specific).
- Each antibody has 4 polypeptide chains- 2 small light chains and 2 larger heavy chains (H_2L_2).

5 major classes of antibodies-

Class of antibody	Structure	Features	Roles in antigen disposal
IgG		- The most common class of antibody produced in the 2^0 response. - Crosses the placenta, so it is important in foetal and **new born** immunity.	- **Neutralize** the toxins released by antigen - **Agglutinates** (binding) - **Opsonise** (form a coat on antigen to facilitates ***phagocytosis***)
IgE	,,	- Involved in **allergies**	- **Neutralize** antigen. - Binds to mast cells and basophils, causing them to *release histamine.*
IgD	,,	- Antigen receptors on B cells	- **Neutralize**
IgA		- Cross epithelial cells, so is present on mucosal surfaces and in **breast milk**; - Important in immunity in new borns.	- **Neutralize** - **Agglutinates**
IgM		- The most common class of antibody produced in the 1^0response	- **Neutralize** - **Agglutinates**

Acquired immune response: 2 types-

1. Humoral or **Antibody Mediated Immunity (AMI):**

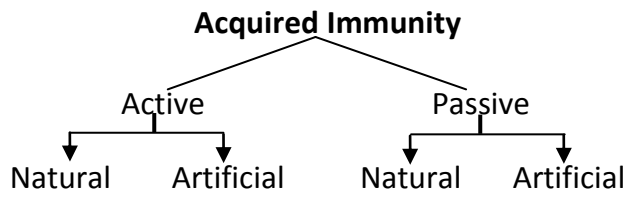
- Immunity mediated by antibodies produced in the body fluids (humours) such as plasma or lymph.

2. Cell-mediated immunity (CMI):

T-lymphocytes mediated immunity.

- *T-lymphocyte recognizes non self and directly attack pathogen.*
- *This system is responsible for the graft (transplanted organ) rejection*. Patient has to take ***immunosuppressant*** to suppress this action.

Types of Acquired immunity



1. Active immunity: The immunity in which antibodies are produced in a host body when the host is exposed to *antigens.*
It is a slow process. It is produced by 2 ways:

a. Natural Active Immunity: Immunity gained through natural infection by microbes.

b. Artificial Active Immunity (Vaccination): Immunity gained through injecting the **vaccine** (antigenic proteins of pathogen or inactivated pathogen).

Step 1. Prepared **vaccine** is introduced into body.

Step 2. The antibodies produced in the body against the vaccines. The vaccines also generate memory B and T-cells that recognize the pathogen quickly.

Step 3. The antibodies produced in the body against the antigens neutralize the pathogenic agents during actual infection.

E.g. Vaccines against Polio, Hepatitis-B (using rDNA technology from yeast), DPT etc.

2. Passive immunity: The immunity gained by the body through direct transfer of readymade antibodies. It is 2 types:

a. Natural Passive Immunity: Immunity gained by mother's antibody.

E.g.
- Antibodies (IgG) from mother → Placenta → Foetus
- Antibodies (IgA) in **colostrum** → infants

b. Artificial Passive Immunity: Immunity gained by the injection of pre-formed antibodies or antitoxin extracted from hyper-immune sera of animals. It is done for quick immune response.

E.g.
- Immunization against tetanus (Anti-tetanus serum -ATS), snake venom etc.

ALLERGIES

- It is the exaggerated response of the immune system to certain antigens present in the environment.
- **Allergens:** Substances causing allergy.
  E.g. mites in dust, pollens, animal dander, fur etc.
- **IgE type** antibodies produced against the **allergens.** They release chemicals like ***histamine*** and ***serotonin*** from the ***mast cells.***
- **Symptoms:** Sneezing, watery eyes, running nose, difficulty in breathing etc.
- **Determination of cause of allergy:** The patient is exposed to or injected with very small doses of possible allergens, and the reactions studied.
- **Treatment:** Drugs like *anti-histamine*, *adrenaline* and *steroids* quickly reduce the symptoms of allergy.
- Modern-day life style & protected environment results in lowering of immunity and more sensitive to allergens by children in urban area.

Autoimmunity:

It is an abnormal immune response. Due to genetic and other unknown reasons, body attacks self cells.
E.g. *Rheumatoid arthritis.*

AIDS (Acquired Immunodeficiency Syndrome)

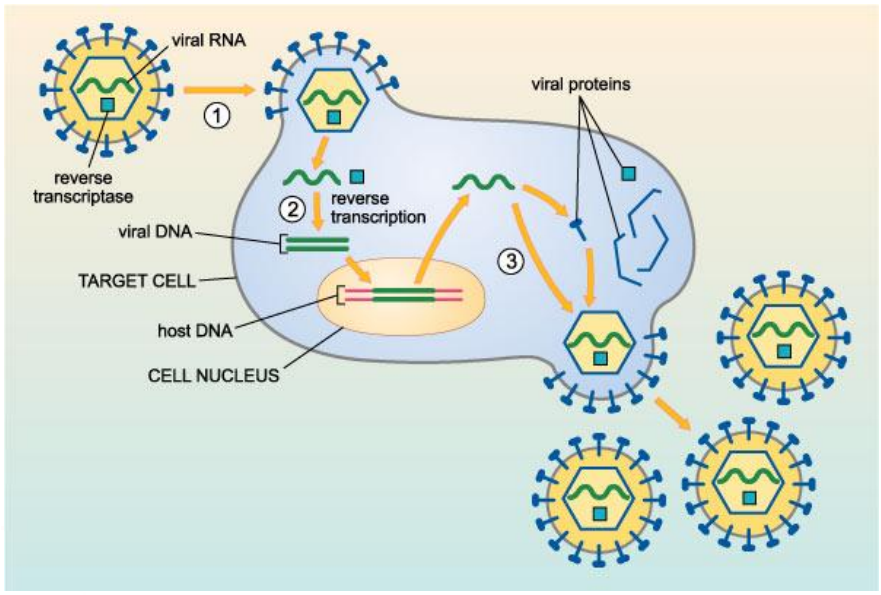
Acquired → Infection is due to conscious behaviour.
Immunodeficiency → Body's immune system is not working properly
Syndrome → A group of symptoms.

- Pathogen: **HIV (Human Immunodeficiency Virus),** a **retrovirus** having RNA genome.
- **Transmission:** HIV spreads only through body fluids. It does not spread by touch or physical contact.
  - Sexual contact with infected person.
  - Transfusion of contaminated blood & blood products.
  - Sharing of infected needles.
  - From infected mother to her child through placenta.

- **Individuals having high risk of getting HIV:**
  - Individuals with multiple sexual partners
  - Drug addicts who take drugs intravenously
  - Individuals who require repeated blood transfusion
  - Children born to an HIV infected mother

- **Replication & action of HIV:**

HIV gets into a body →
Its viral RNA is introduced into **macrophages** (host cell) →
RNA, in presence of ***Reverse transcriptase,*** is converted to viral DNA →
Viral DNA incorporates into host DNA→
Directs the infected cells to synthesis viral components →
Assembly of viral components to form virus →
Budding of HIV from the host cell →
HIV enters into helper T-cells in blood →
Replicates & produce progeny virus →
They attack other **helper T-cells,** decrease in number →
Immunity weakens →
Shows **symptoms** like fever, diarrhoea & weight loss →
Person may be infected with *Mycobacterium*, viruses, fungi and parasites like *Toxoplasma*→
Death



There is a **time-lag** (from few months to 5-10 years) between the infection and appearance of symptoms.

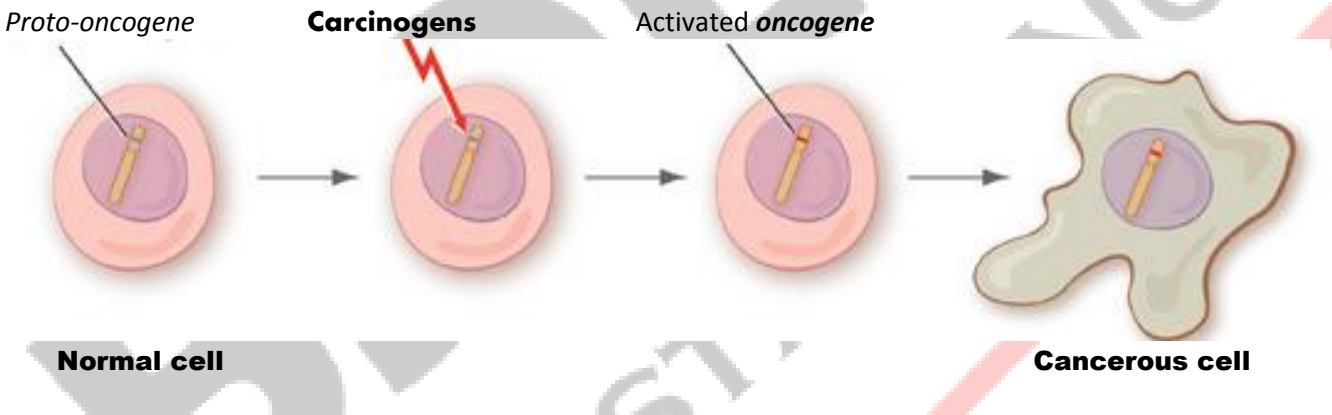
- **Diagnosis: ELISA test** (Enzyme-linked immune-sorbent Assay).
- **Treatment:** Anti-viral drugs partially effective. They can only prolong the life of the patient.
- **Prevention of AIDS:**
  - Educate peoples about AIDS.
  - Making blood (from blood banks) safe from HIV.
  - Use of disposable needles and syringes.
  - Advocating safe sex and free distribution of condoms.
  - Controlling drug abuse.
  - Regular check-ups for HIV in susceptible population.

CANCER

- **Cancer** (cancrum[G]= crab) is an uncontrolled proliferation of cells resulting in the formation of **tumour** (masses of cells).
- Normal cells show a **contact inhibition** (contacting with neighbouring cells inhibits their division). Cancer cells loss this property.
  ➔ **Cause- Oncogenes** stimulates cell proliferation. All cells have a counterpart of these genes called **proto-oncogenes (c-onc)** which are involved in normal cell function. Mutation of proto-oncogenes leads to cancer causing **oncogenes.**

Carcinogens- Agents which cause cancer (i.e., by stimulating **oncogenes**).

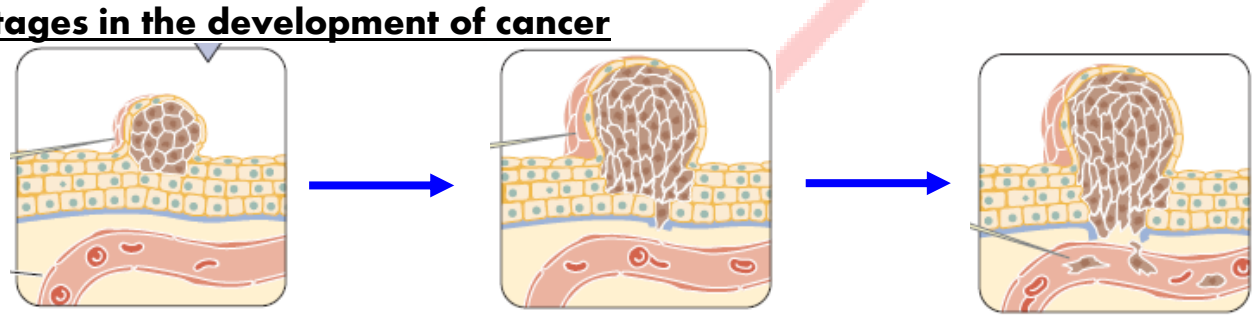
- **Physical agents:** Ionizing radiations like X-rays and gamma rays and non-ionizing radiations like UV.
- **Chemical agents:** Tobacco smoke (major cause of lung cancer), vinyl chloride, caffeine, nicotine, mustard gas etc.
- **Biological agents:** Viruses**.**



- Tumours are 2 types:
  I. **Benign:** Confined to the place of its origin. Harmless.
  II. **Malignant:** Spread and invade nearby tissues by blood. Harmful.

Metastasis: The spread of cancer cells from one part of the body to another.

Stages in the development of cancer



A **benign**, precancerous tumour grows

A **malignant** tumour develops

The cancer ***metastasizes*** (spread to other tissue through the blood stream)

- **Cancer detection**
  - **Biopsy:** A thin piece of the suspected tissue is stained and examined under microscope (histopathological studies).
  - **In case of leukemia:** Biopsy & histopathological studies. Blood & bone marrow tests for increased cell counts.
  - **Radiography** (use of X-rays), **CT (Computed tomography) scan** & **MRI (Magnetic Resonance Imaging).**
  - Use of **Antibodies** against cancer-specific antigens.
  - Techniques of **molecular biology** to detect genes related to cancer. Such individuals may be advised to avoid exposure to particular carcinogens (e.g. tobacco smoke).

- **Treatment of cancer**
  - **Radiation therapy:** Tumour cells are irradiated lethally, without damaging surrounding normal tissues.
  - **Chemotherapy:** Use of chemotherapeutic drugs. Many drugs have side effects like hair loss, anaemia etc.
  - **Immunotherapy:** The patients are given **biological response modifiers** (e.g. α- interferon) which activates their immune system and helps in destroying the tumour.
  - Surgery.
    - ➔ Most cancers are treated by combination of surgery, radiotherapy and chemotherapy.

DRUGS & ALCOHOL ABUSE

A. DRUGS:

- **Drug** is a chemical which is usually taken for the treatment of some mental disorders like depression, insomnia etc. on the advice of some physician, and is withdrawn as soon as the desired effect is achieved.
- When drugs are taken for purposes other than medicinal or taken in amounts / frequencies that impair physical, physiological or psychological functions, it is called **drug abuse**.

Class	Derivatives	Effect
Opioids- Extracted from **poppy plant** (*Papaver somniferum*)	1. ***Morphine*:** Dried milky latex obtained from the fruits. Strong sedative and pain killer. Useful during surgery. 2. ***Heroin (Diacetyl morphine/smack):*** Bitter crystalline compound produced by acetylation of morphine. 3. **Brown sugar**	• Taken by snorting (inhaled) and injection • Drugs which bind to opioid receptors in CNS and gastrointestinal tract. • These are **depressants** (depress the brain activity) and slows down body functions.
Cannabinoids- Obtained from **Hemp plant** (*Cannabis sativa*).	1. ***Marijuana*** – Varying mixture of plant's leaves, seeds, stem and flower tops. 2. ***Charas (hashish)***- Sticky yellow exudation from leaves and female inflorescence 3. ***Ganja***- Dried female inflorescence	▪ Smoked or oral ingestion ▪ Drugs that interact with cannabinoid **receptors in brain**. ▪ **Affects cardiovascular** system. ▪ Cause **hallucination** (illusion of seeing or hearing something which is not actually present)
Coca alkaloids- Obtained from **coca plant** *(Erythroxylum coca)*	1. **Cocaine/ Coke/ Crack**	• Usually snorted or smoked • Interferes the transport of **dopamine**. • Stimulate CNS producing **euphoria** (sense of excitement). • Excessive dosage causes hallucination.
Others	1. ***Atropa belladonna*** 2. ***Datura*** } Hallucinogens 3. ***Lysergic Acid Diethyl amides (LSD)*** 4. ***Barbiturates*** } Depressants 5. ***Benzodiazepines*** 6. ***Amphetamines*** ⟶ Stimulant	

✓ Misuse of drugs by athletes (e.g. narcotic analgesics, anabolic steroids, diuretics & certain hormones to increase muscle strength and bulk and to promote aggressiveness).

B. SMOKING

- Tobacco is smoked, chewed or used as a snuff.
- Tobacco contains **nicotine** which stimulates adrenal gland to release adrenaline and nor-adrenaline, causing high BP and heart rate.
- Effects:-
  - Causes cancers of lung, urinary bladder and throat, bronchitis, emphysema, coronary heart disease, gastric ulcer etc.
  - Tobacco chewing causes oral cancer.
  - Smoking increases CO content in blood and reduces oxyhaemoglobin. This causes O_2 deficiency in the body.

ADOLESCENCE & DRUGS

✓ **Adolescence** is a period of 12-18 years of age
✓ It is very vulnerable phase of mental and psychological development.

- **Causes of drug/alcohol use in Adolescence period:**
  - Experimental curiosity.
  - Need for adventure, excitement & peer pressure.
  - Unstable or unsupportive family structures.
  - Stress from pressure to excel in academics or examination.
  - TV, movies, news papers, internet etc.

Addiction & Dependence

- **Addiction:** It is a psychological attachment (**euphoria** and a temporary feeling of well being) with drugs and alcohol.
  With repeated use of drugs, the tolerance level of the receptors increases. Thus the receptors respond only to higher doses leading to greater intake and addiction.
- **Dependence:** It is the tendency of the body to manifest a characteristic and unpleasant ***withdrawal syndrome*** if regular dose of drugs/alcohol is discontinued.
  This results in anxiety, shakiness, nausea and sweating.
  Dependence leads to social adjustment problems.

Effects of Drug/alcohol abuse

Immediate effects:-

- ✓ Reckless (disregarding danger) behaviour, vandalism (wilfully destroy property) and violence.

Effects due to over dose:-

- ✓ Coma
- ✓ Death due to respiratory failure, heart failure or cerebral haemorrhage.

Far reaching effects:-

- ✓ Drop in academic performance and absence from school.
- ✓ Lack of interest in personal hygiene.
- ✓ **Withdrawal** and isolation from family and friends.
- ✓ Depression & fatigue.
- ✓ **Aggressive** & **rebellious** behaviour
- ✓ Loss of interest in hobbies.
- ✓ Fluctuations in sleeping, eating habits, weight, appetite etc.
- ✓ Social problems like **stealing** and spread of **infectious diseases** (e.g. AIDS, hepatitis B).
- ✓ Damage of **nervous system** and liver (**cirrhosis**).
- ✓ Use of drugs and alcohol by pregnant woman adversely **affect the foetus**.

Side effects of anabolic steroid abuse

In females:

- Masculanisation
- Mood swings & depression
- Increased aggressiveness
- Excessive hair growth
- Abnormal menstrual cycle
- Deepening of voice
- Enlargement of clitoris

In males:

- Acne
- Mood swings & depression.
- Increased aggressiveness
- Reduced testicles
- Decreased sperm
- Kidney & liver dysfunction
- Breast enlargement
- Premature baldness
- Enlargement of prostate gland

Prevention & 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.
   a. Psychologists and psychiatrists.
   b. De-addiction and rehabilitation programs.