HUMAN HEALTH AND DISEASES

- **Health** is a state of complete *physical, mental & social well-being.* It is affected by genetic disorders, infections, change in life style (food, water, rest, exercise, habits etc).
- Mind influences immune system (through neural and endocrine systems) and thereby health.
- When the functioning of organs or systems of the body is adversely affected, it is called a **disease**.
- Diseases may be **infectious** (transmits from one person to another) or **non-infectious** (do not transmit. E.g. cancer).

- Disease causing organisms are called **Pathogens.** Parasites are pathogens as they harm the host.

Good humour hypothesis (by **Hippocrates** & **Indian Ayurveda system):** It states that health is a state of body & mind where there is a balance of certain humours. Persons with 'black bile' belong to hot personality and would have fevers.

William Harvey disproved this hypothesis. He discovered blood circulation and demonstrated normal body temperature in persons with black bile using thermometer.

COMMON INFECTIOUS DISEASES IN MAN

1. BACTERIAL DISEASES

a. **Typhoid:** Pathogen is ***Salmonella typhi.***

- **Mode of transmission:** It enters small intestine through food & water and migrates to other organs via blood.
- **Symptoms:** Sustained high fever (39°-40° C), headache, weakness, stomach pain, constipation & loss of appetite. Intestinal perforation and death may occur.

Widal test is used for confirmation of the disease.

Mary Mallon **(Typhoid Mary)** was a professional cook. She was a typhoid carrier who spread typhoid for several years through the food she prepared.

b. Pneumonia: Pathogen is ***Streptococcus pneumoniae* & *Haemophilus influenzae.***

It infects lung alveoli. The alveoli get filled with fluid leading to respiratory problems.

- **Mode of transmission:** Inhaling the droplets/aerosols released by an infected person. Sharing glasses and utensils with an infected person.
- **Symptoms:** Respiratory problems, fever, chills, cough, headache. In severe cases, lips and finger nails turn grey to bluish colour.

Other bacterial diseases: Dysentery, plague, diphtheria, etc.

2. VIRAL DISEASES

a. **Common cold:** Pathogen is ***Rhinoviruses.***

It infects nose & respiratory passage but not lungs.

- **Mode of transmission:** Inhaling droplets resulting from cough or sneezes. Through contaminated objects (pens, books, cups, doorknobs, computer accessories) etc.
- **Symptoms:** Nasal congestion & discharge, fever, headache, sore throat, cough, hoarseness, tiredness etc. Common cold lasts for 3-7 days.

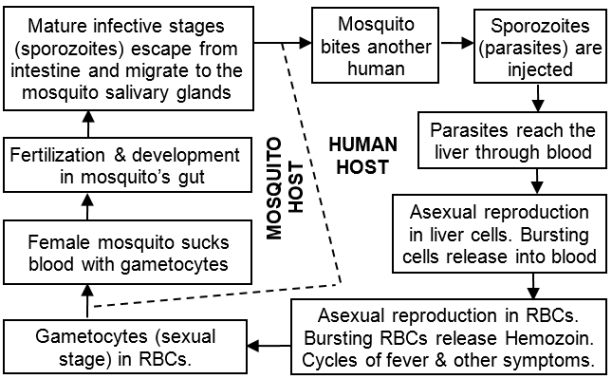
3. PROTOZOAN DISEASES

a. **Malaria:** Pathogen is ***Plasmodium sp.*** *(P. vivax, P. malariae* & *P. falciparum).*

Most serious (malignant) malaria is caused by *P. falciparum.*

- **Mode of transmission:** By female *Anopheles* mosquito.
- **Symptoms:** Haemozoin (toxin released by *Plasmodium)* causes chill and high fever recurring every 3-4 days.

Life cycle of Plasmodium



b. Amoebiasis (Amoebic dysentery): Pathogen is ***Entamoeba histolytica.***

- **Mode of transmission:** Houseflies (mechanical carriers) transmit parasites from faeces to food & water.
- **Symptoms:** Constipation, abdominal pain and cramps, stools with excess mucus and blood clots.

4. HELMINTH DISEASES

a. **Ascariasis:** Pathogen is ***Ascaris*** (Intestinal parasite).

- **Mode of transmission:** Soil, water, vegetables, fruits etc. contaminated with faeces containing eggs of parasites.
- **Symptoms:** Internal bleeding, muscular pain, fever, anaemia and blockage of intestinal passage.

b. **Filariasis (Elephantiasis):** Pathogen is **Filarial worms or *Wuchereria*** *(W. bancrofti & W. malayi).*

- **Mode of transmission:** Bite of female *Culex* mosquito.
- **Symptoms:** Filarial worms live in lymphatic vessels (usually of lower limbs). It causes chronic inflammation of the organs in which they live for many years. Limbs and genital organs may be deformed.

5. FUNGAL DISEASES

a. **Ring worms:** Pathogens are ***Microsporum, Trichophyton* & *Epidermophyton.*** They are seen in groin, b/w toes etc.

- **Mode of transmission:** From soil or by using towels, cloths, comb etc. Heat and moisture help fungi to grow.
- **Symptoms:** Dry, scaly lesions on skin, nails, scalp etc. Intense itching.

PREVENTION AND CONTROL OF DISEASES

Personal hygiene

Keep the body clean. Use clean drinking water, food etc.

Public hygiene

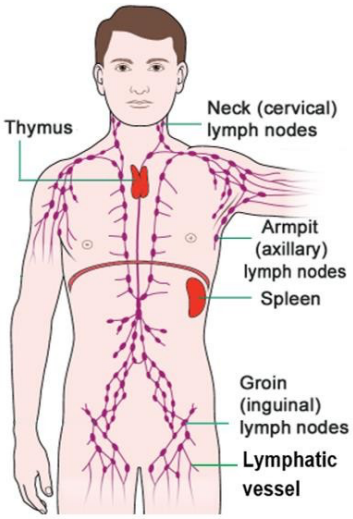
a. Proper disposal of wastes and excreta.
b. Periodic cleaning and disinfection of water reservoirs, pools, cesspools and tanks.
c. Avoid contact with infected persons or their belongings (to control air-borne diseases).
d. Standard practices of hygiene in public catering.
e. Control and eliminate the vectors (e.g. mosquitoes).
   - Avoid stagnation of water.
   - Regular cleaning of household coolers.
   - Use of mosquito nets.
   - Introduce larvivorous fishes like *Gambusia* in ponds.
   - Spraying insecticides in ditches, drainage and swamps.
   - Provide doors and windows with wire mesh.

These precautions can avoid vector-borne diseases like Malaria, Filariasis, Dengue & *Chikun gunya.*

Vaccines & **immunisation** helped to control diseases like smallpox, polio, diphtheria, pneumonia & tetanus. Drugs like **antibiotics** also helped to treat infectious diseases.

HUMAN IMMUNE SYSTEM

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



LYMPHOID ORGANS

These are the organs where origin/maturation & proliferation of lymphocytes occur. 2 types: Primary & Secondary.

a. Primary lymphoid organs

The organs where lymphocytes are matured & differentiated to antigen-sensitive lymphocytes. It is 2 types:

1. **Bone marrow:** The site of formation of all blood cells including B & T-lymphocytes.
2. **Thymus:** A bilobed organ seen near the heart and beneath the breastbone. It is large during birth but gradually reduces in size and becomes very small size in puberty. Immature T-lymphocytes from bone marrow is migrated to thymus and matured.

b. Secondary lymphoid organs

- The organs, to which matured lymphocytes migrate from primary lymphoid organs, interact with antigens and then proliferate to become **effector cells.**
  E.g. Spleen, lymph nodes, tonsils, Peyer's patches, Mucosa-associated lymphoid tissue (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.
- **MALT:** Located within the lining of respiratory, digestive & urinogenital tracts. It constitutes 50% of lymphoid tissue.

IMMUNITY

It is the ability of the immune system to fight the pathogens. It is 2 types: Innate and Acquired.

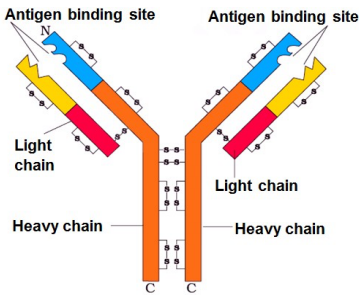
1. Innate (inborn) immunity

- It is the *non-specific* immunity present at the time of birth.
- It includes 4 types of **Barriers:**

a. **Physical barriers:** Prevents entry of microbes. E.g. ***Skin***, ***Mucus coating*** of the respiratory, gastro-intestinal and urino-genital tracts. Mucus traps microbes.
b. **Physiological barriers:** They prevent microbial growth. E.g. gastric HCl, saliva, tear etc.
c. **Cellular barriers: Phagocytes** like *WBC* [*Polymorpho-nuclear leukocytes (PMNL)* or *neutrophils, monocytes* and natural killer *lymphocytes], macrophages* etc.
d. **Cytokine barriers:** Virus infected cells secrete a cytokine protein called ***interferon.*** It protects non-infected cells from further viral infection.

2. Acquired (adaptive) immunity

- It is *pathogen specific* immunity developed during lifetime.
- It is characterized by *memory*, i.e. during first encounter of a pathogen, body produces *primary response* in low intensity. Second encounter of the same pathogen causes a *secondary (anamnestic) response* in high intensity.
- Primary and secondary immune responses are carried out with *B-lymphocytes (B-cells)* and *T-lymphocytes (T-cells)*.
  a. **B-lymphocytes:** Produce *antibodies*. These are the proteins to fight the pathogens.
  b. **T-lymphocytes:** Help B-cells to produce antibodies.



Structure of an antibody molecule

An antibody has **4 polypeptide chains:** 2 **light chains** and 2 **heavy chains (H_2L_2).**

Types of antibodies:

IgG, IgA, IgM, IgE & IgD.

Types of Acquired immune response

1. **Humoral immune response/ Antibody mediated immunity (AMI):** It is the immune response mediated by ***antibodies.*** Antibodies are found in blood plasma. So called as Humoral immune response.

2. **Cell-mediated response / cell-mediated immunity (CMI):** It is the immune response mediated by ***T-lymphocytes (T-cells).*** The body can differentiate 'self' and 'non-self' and the CMI causes Graft rejection.

   Tissue matching & blood group matching are essential before undertaking any graft/ transplant. After this, the patient should take immuno-suppressants all his life.

Types of Acquired immunity

Acquired immunity is 2 types: Active and passive.

1. **Active immunity:** It is the immunity in which antibodies are produced in a host body when the host is exposed to *antigens* (e.g. living or dead microbes or other proteins). It is a slow process. It is produced by 2 ways:
   a. **Natural Active Immunity:** It is developed during natural infection by microbes.
   b. **Artificial Active Immunity:** It is developed by injecting the microbes deliberately during immunization.
2. **Passive immunity:** Here, readymade antibodies are directly given to the body. It is 2 types:
   a. **Natural Passive Immunity:** E.g.
      - Antibodies (IgG) from mother → Placenta → Foetus
      - Antibodies (IgA) in colostrum → infants
   b. **Artificial Passive Immunity:** E.g.
      - Anti-tetanus serum (ATS)

Immunization

This is based on 'memory' of the immune system. 2 types:

1. Active Immunization (Vaccination)

- In this, a preparation of **vaccine** (antigenic proteins of pathogen or inactivated pathogen) is introduced into the body. It results in the development of antibodies.
- During actual infection, the antibodies neutralize antigens.
- The vaccines also generate memory B and T-cells. They recognize the pathogen quickly.
- E.g. Polio vaccine, Hepatitis B vaccine, DPT vaccine etc.
- Vaccines are produced using DNA recombinant technology (E.g. Hepatitis B vaccine produced from Yeast).

2. Passive Immunization

- It is the direct injection of **pre-formed antibodies or antitoxin.** It is required for quick immune response.
- E.g. Immunization against Tetanus, 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.
- Antibodies produced against the **allergens** are **IgE type.**
- IgE binds on **mast cells** to release chemicals like ***histamine*** and ***serotonin*** from them. It results in allergic reactions.
- **Symptoms:** Sneezing, watery eyes, running nose, difficulty in breathing, wheezing, skin rashes 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.
- **Asthma** is a respiratory disease due to allergy.
- Modern-day life style and protected environment provided early in life result in low immunity and more sensitivity to allergens. So, many children in metro cities suffer from allergies and asthma.

Autoimmunity

- In higher vertebrates, memory-based acquired immunity evolved based on the ability to differentiate foreign organisms from self-cells.
- Sometimes, due to genetic and other unknown reasons, the body attacks self-cells resulting in damage to the body. It is called **auto-immune disease.** E.g. *Rheumatoid arthritis.*

AIDS (Acquired Immuno Deficiency Syndrome)

- It is the deficiency of immune system.
- Syndrome means a group of symptoms.
- It is caused by **HIV (Human Immunodeficiency Virus),** a **retrovirus** having RNA genome.
- AIDS was first reported in America (1981).
- In the last 25 years, it killed over 25 million persons.

Transmission:

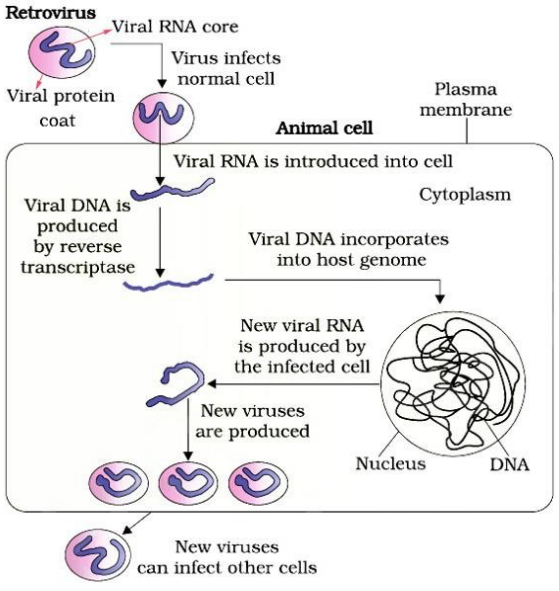
- Sexual contact with infected person.
- Transfusion of contaminated blood & blood products.
- Sharing of infected needles.
- From infected mother to her child through placenta.

High risk people 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.

HIV does not spread by touch or physical contact. It spreads only through body fluids.
There is a time-lag (from few months to 5-10 years) between the infection and appearance of symptoms.

Replication of retrovirus:



Life cycle of HIV:

HIV enters body → To macrophages (acts as HIV factory) → RNA genome replicates in presence of *Reverse transcriptase* to form viral DNA → Viral DNA incorporates into host DNA→ Infected cells produce virus particles → HIV enters into helper T-cells (T_H lymphocytes) → Replicates & produce progeny viruses → Attack other T_H cells → T_H cells decrease → Weaken immunity.

- During this period, the person suffers from fever, diarrhoea and weight loss.
- Due to deficiency of T_H cells, he may be infected with *Mycobacterium*, viruses, fungi & parasites like *Toxoplasma.*
- **Diagnosis: ELISAtest** (Enzyme-linked immuno-sorbent Assay).
- **Treatment:** Anti-retroviral drugs are partially effective. They can only prolong the life of the patient.

Prevention of AIDS:

- Educate people about AIDS through organisations like **National AIDS Control Organisation (NACO), non-governmental organisations (NGOs), WHO** etc.
- Make blood (from blood banks) safe from HIV.
- Use disposable needles and syringes.
- Advocate safe sex and free distribution of condoms.
- Control drug abuse.
- Regular check-ups for HIV in susceptible population.

CANCER

- Cancer is an abnormal and uncontrolled multiplication of cells resulting in the formation of tumour (masses of cells).
- Normal cells show a **contact inhibition** (contact with the other cells inhibits their uncontrolled growth). Cancer cells do not have this property.

Types of Tumours

- **Benign tumours:** Confined to the place of its origin. They do not spread to other parts. Cause little damage.
- **Malignant tumours:** Mass of proliferating cells **(neoplastic or tumour cells)** that grow rapidly, invade and damage the surrounding normal tissues. Due to active division and growth, they starve normal cells by competing for nutrients. Cells sloughed from tumours reach other sites via blood where they form a new tumour. This is called **metastasis**.

Causes of cancer (Carcinogens)

- **Physical agents:** E.g. 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:** E.g. **oncogenic viruses, c-onc (cellular oncogenes or proto oncogenes)** etc. When C-onc in normal cells is activated, the cells become oncogenic.

Cancer detection and diagnosis

- **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.
- **Imaging techniques:**
  - **Radiography:** Use of X-rays.
  - **CT (Computerized tomography) scan:** Uses X-rays to generate a 3D image of the internals of an object.
  - **MRI (Magnetic Resonance Imaging):** Uses magnetic fields and non-ionising radiations to detect pathological and physiological changes in the living tissue.
- Use of **Antibodies** against cancer-specific antigens.
- **Molecular biology technique:** To detect cancer related genes. Such individuals should avoid carcinogens (e.g. tobacco smoke).

Treatment of cancer

- **Radiotherapy:** 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.**

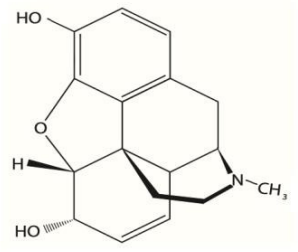
Most cancers are treated by combination of surgery, radiotherapy and chemotherapy.

DRUGS, SMOKING AND ALCOHOL ABUSE

DRUGS

1. Opioids:

- They bind to specific **opioid receptors** in CNS and gastrointestinal tract. E.g. morphine, heroin, brown sugar.



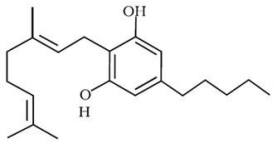
Chemical structure of Morphine


Opium poppy

- **Morphine** is extracted from latex of ***Papaver somniferum*** **(poppy plant).** It is a sedative & painkiller. Used in surgery.
- **Heroin** (*smack* or diacetylmorphine) is a white, odourless, bitter crystalline compound. It is obtained by acetylation of morphine. It is taken by snorting and injection. Heroin is a depressant and slows down body functions.

2. Cannabinoids:

- They interact with **cannabinoid receptors** in the brain.
- Generally taken by inhalation and oral ingestion.
- Natural cannabinoids are obtained from inflorescences of ***Cannabis sativa*** **(Hemp plant).** Its flower tops, leaves & resin are used to make *marijuana, hashish, charas & ganja.*
- They affect cardiovascular system.
- Cannabinoids are abused by some sportspersons.



Skeletal structure of cannabinoid molecule

Leaves of *Cannabis sativa*

Flowering branch of *Datura*

3. Coca alkaloid or cocaine (coke or crack):

- It is obtained from coca plant ***Erythroxylum coca*.**
- It interferes with transport of neurotransmitter dopamine.
- Cocaine is usually snorted.
- It stimulates CNS producing euphoria & increased energy.
- Excessive dosage of cocaine causes hallucinations.
- *Atropa belladona* & *Datura* are also hallucinogenic plants.

Drugs like barbiturates, amphetamines, benzodiazepines, etc. are used as medicines to treat mental illnesses like depression & insomnia. But their abuse causes impairment of physical, physiological or psychological functions.

SMOKING

- Tobacco has been used by human beings for over 400 years.
- It is smoked, chewed or used as a snuff.
- It contains many chemical substances like **nicotine** (an alkaloid). It stimulates adrenal gland to release adrenaline and nor-adrenaline, causing high BP and heart rate.
- Smoking 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 & DRUG/ALCOHOL ABUSE

- **Adolescence** is 'a period' and 'a process' during which a child becomes mature in terms of his/her attitudes and beliefs for effective participation in society.
- Adolescence is a bridge linking childhood and adulthood (period of 12-18 years of age). It is very vulnerable phase of mental and psychological development.

Causes of drug/alcohol use in Adolescence

- Curiosity and Experimentation.
- Need for adventure and excitement.
- To escape facing problems.
- Stress from pressure to excel in academics or examination.
- Television, movies, newspapers, internet etc.
- Unstable or unsupportive family structures & peer pressure.

Addiction and Dependence

- **Addiction:** It is a psychological attachment (euphoria and a temporary feeling of wellbeing) 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 abruptly discontinued. This results in anxiety, shakiness, nausea and sweating. Dependence leads to social adjustment problems.

Effects of Drug/alcohol abuse

- Reckless behaviour, vandalism and violence.
- Coma and death due to respiratory failure, heart failure or cerebral haemorrhage.
- Drugs mixed with alcohol may cause death.
- Damage of nervous system and liver cirrhosis.
- Mental and social distress to family and friends.
- Social problems like stealing and spread of infectious diseases (e.g. AIDS, hepatitis B).
- Use of drugs and alcohol by pregnant woman affect the foetus (Foetal alcohol syndrome or FAS).
- Loss of sexual drive and necrospermia.
- Misuse of drugs by athletes (e.g. narcotic analgesics, anabolic steroids, diuretics & certain hormones to increase muscle strength and bulk and to promote aggressiveness).

Warning signs of drug/alcohol abuse in Adolescence period

- Drop in academic performance and absence from school.
- Lack of interest in personal hygiene.
- Withdrawal and isolation.
- Depression, fatigue, aggressive and rebellious behaviour.
- Change in sleeping and eating habits.
- Fluctuations in weight, appetite etc.
- Loss of interest in hobbies.
- Deteriorating relationships with family and friends.

Side effects of anabolic steroid abuse

In males:

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

In females:

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

In adolescent male & female: Severe facial and body acne, premature closure of the growth centres of the long bones resulting in stunted growth.

Prevention and control

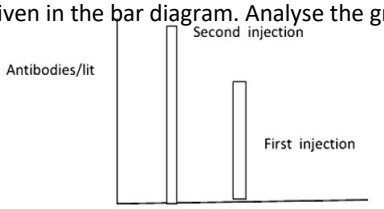
1. Avoid undue peer pressure.
2. Education and counselling.
3. Seeking help from parents and peers.
4. Looking for danger signs.
5. Seeking professional and medical help.
   a. Psychologists and psychiatrists.
   b. De-addiction and rehabilitation programs.

MODEL QUESTIONS

1. Match the following

A	B	C
Malaria	*Haemophilus influenza*	Worms
Pneumonia	*Plasmodium vivax*	Bacteria
Filariasis	*Microsporum*	Protozoan
Ringworm	*Wuchereria bancrofti*	Fungus

2. Analyze the relationship between first two words and fill the fourth place.
   a. Ascariasis: *Ascaris* Cold: ……. b. AIDS: ELISA Typhoid: …….
3. Odd man out. Justify your answer.
   a. Spleen, lymph nodes, thymus, Peyer's patches b. Gastric HCl, PMNL, saliva, tear
   c. Cocaine, Morphine, Brown sugar, Heroine
4. Expand the following abbreviations.
   a. MALT b. CMI c. AIDS d. HIV e. NACO
5. Gopal was playing with his pet dog in the courtyard. Suddenly he developed sneezing, running nose and skin rashes.
   a. With which conditions are the above symptoms related?
   b. Explain the mechanism of reaction.
6. "The soldiers of a country kill their own king". In your body, similar situation take place. Find out that process.
7. Changes occurring in the number of antibodies in an individual injected with same antigen on two separate occasions are given in the bar diagram. Analyse the graph and answer the following questions.



   a. In which injection, the number of antibodies is increased?
   b. Why the injections in two separate occasions with the same antigen cause different results?

8. Select the false statement:
   a. Peer pressure is a cause of alcoholism.
   b. Discontinuing of drug abuse causes withdrawal syndrome.
   c. Adolescence is the physical change of an individual.
   d. AIDS, Hepatitis B etc. may be spread due to drugs & alcoholism.
9. As a part of adolescence health education Programme, prepare a pamphlet showing common problems of adolescence with special regard to mental problems.
10. Prepare a table showing the adverse effects of alcoholism, drug addiction and smoking. Give suitable titles.