Human Health and Diseases

Health

Health does not simply mean ‘absence of disease’.
It could be defined as a state of complete physical, mental and social well-being.

Advantages of good health:

When people are healthy, they are more efficient at work. This increases productivity and brings economic prosperity.
Health also increases longevity of people and reduces infant and maternal mortality.

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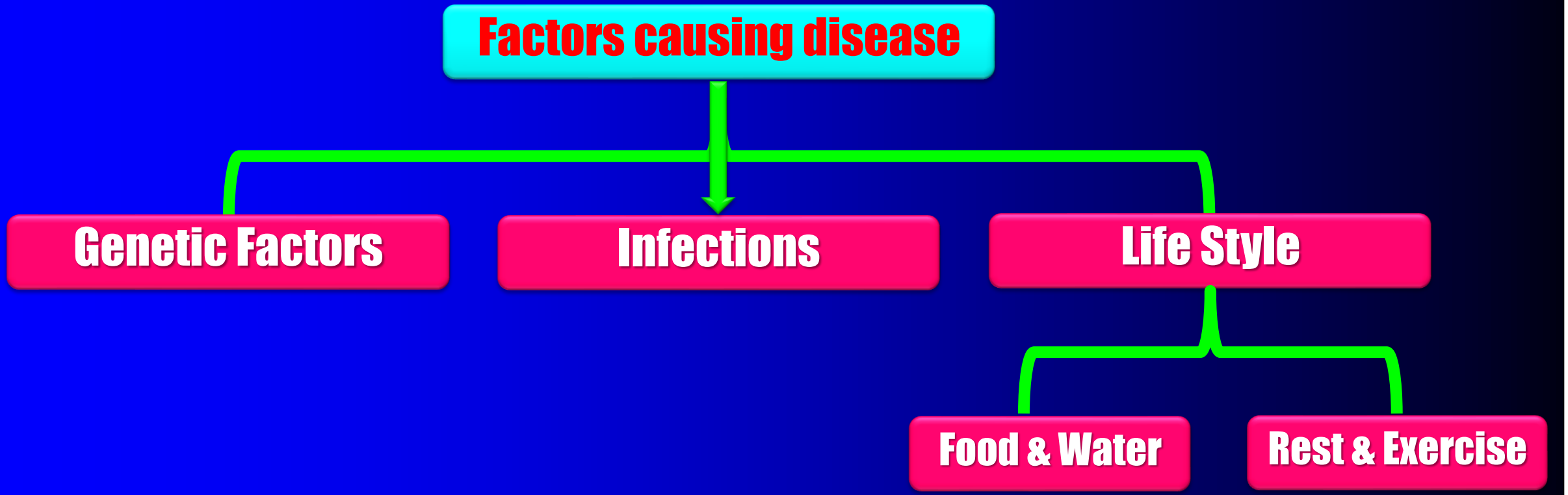

Factors causing diseases are

(i) genetic disorders

(ii) infections

(iii) life style including food and water we take, rest and exercise.

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Factors that Maintain Good Health

- Balanced diet, personal hygiene and regular exercise.
- Awareness about diseases and their effect on different bodily functions.
- Vaccination (immunisation)
- Control of vectors
- Proper disposal of wastes
- Maintenance of hygienic food and water.

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Definition of Health

When the functioning of one or more organs or systems of the body is adversely affected, characterised by various signs and symptoms, we say that we are not healthy, i.e., we have a **disease**.

Communicable Diseases
Non-Communicable Diseases

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Typhoid

Typhoid

Salmonella typhi is a pathogenic bacterium which causes **typhoid**

These pathogens enter the small intestine through contaminated food and water then migrate to other organs through blood.

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Typhoid

Symptoms

Sustained high fever (39° to 40°C)
Weakness
Stomach pain
Constipation,
Headache
Loss of appetite.
Intestinal perforation and death may occur in severe cases.
Typhoid is conformed by Widal Test

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Pneumonia

Pneumonia

Streptococcus pneumoniae and *Haemophilus influenzae*

They infect the alveoli (air filled sacs) of the lungs. As a result, the alveoli get filled with fluid leading to severe problems in respiration.

Mode of Infection:

by inhaling the droplets/aerosols of an infected person

by sharing utensils with an infected person.

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Symptoms of Pneumonia

Fever, chills, cough and headache.

In severe cases, the lips and finger nails may turn grey to blue in colour.

Nasal Block and discharge

Sore throat

Hoarseness

Cough

Headache

Tiredness

It lasts for 3-7 days.

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Common Cold

Common Cold

Rhino viruses

They infect the nose and respiratory passage but not the lungs.

Mode of Infection:

Inhaling droplets of an infected person.

Touching contaminated objects such as pens, books, cups, doorknobs, computer keyboard or mouse, etc.,

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Symptoms of Common Cold

Nasal congestion and discharge

Sore throat,

Hoarseness,

Cough,

Headache

Tiredness usually last for 3-7 days.

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Malaria

Malaria

Plasmodium, a tiny protozoan is responsible for this disease.

Different species of *Plasmodium* (*P. vivax*, *P. malaria* and *P. falciparum*)

Of these, malignant malaria caused by *Plasmodium falciparum* is the most serious one and can even be fatal.

Malarial parasite requires two hosts – human and mosquitoes to complete its life cycle

The toxin **haemozoin** causes recurring fever, chill and shivering.

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Malaria

Plasmodium enters the human body as sporozoites (infectious form) through the bite of infected female *Anopheles* mosquito.

The parasites initially multiply within the liver cells and then attack the red blood cells

(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 three to four days.

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Malaria

When a female *Anopheles* mosquito bites an infected person, these parasites enter the mosquito's body and undergo further development.

The parasites multiply within them to form sporozoites that are stored in their salivary glands.

When these mosquitoes bite a human, the sporozoites are introduced into his/ her body, thereby initiating the events mentioned above.

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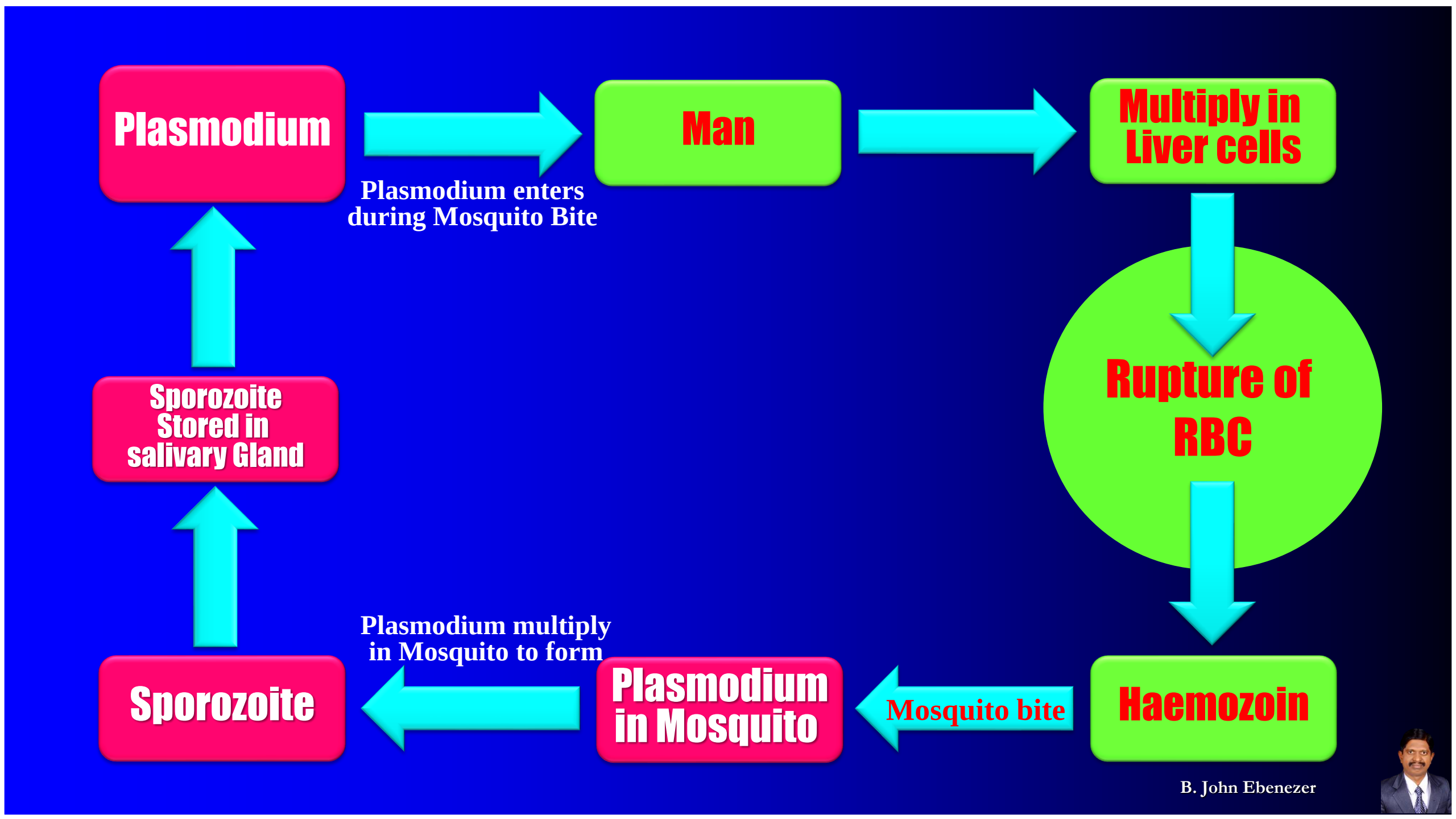
Plasmodium
Plasmodium enters during Mosquito Bite
Man
Multiply in Liver cells
Rupture of RBC
Haemozoin
Mosquito bite
Plasmodium in Mosquito
Plasmodium multiply in Mosquito to form
Sporozoite
Sporozoite Stored in salivary Gland
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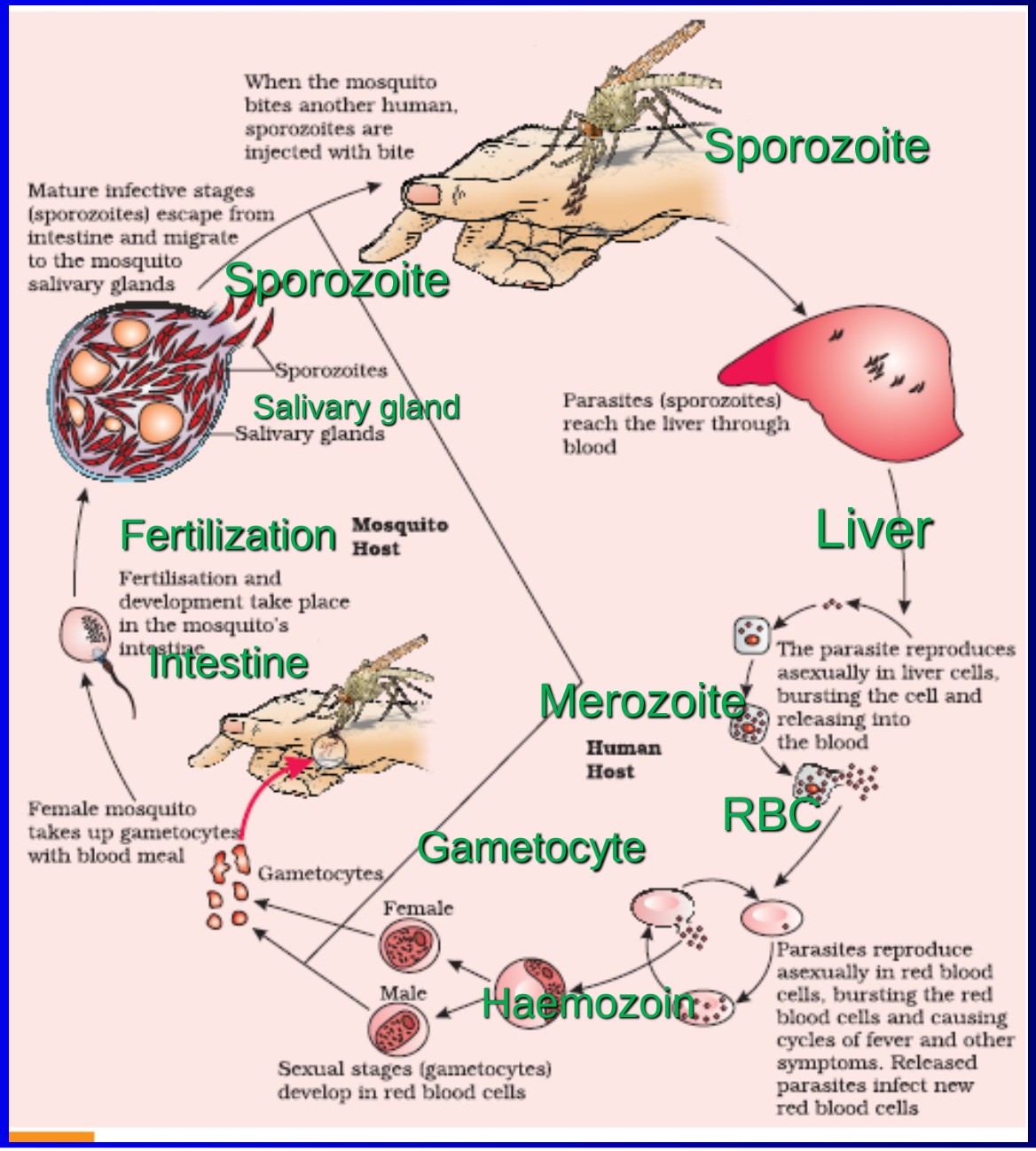
Life Cycle of Mosquito



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Amoebic Dysentery

Amoebic Dysentery

Entamoeba histolytica is a protozoan parasite in the large intestine of human, causes **amoebiasis**.

Mode of Infection:

Houseflies act as carriers and transmit the parasite from faeces of infected person to food

Symptoms:

Constipation
Abdominal pain and cramps
Stools with mucous and blood clots

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Ascariasis

Ascariasis

Ascaris, the common round worm and *Wuchereria*, the filarial worm, are some of the helminths which are known to be pathogenic to man.

Ascaris, an intestinal parasite causes **ascariasis**.

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Ascariasis

Mode of Infection:

A healthy person acquires this infection through contaminated water, fruits, vegetables etc.,

Symptoms:

Internal bleeding

Muscular pain

Fever

Anemia

Blockage of the intestinal passage

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Filariasis

Filariasis

Causal Organism:

The filarial worms *Wuchereria (W. bancrofti* and *W. malayi)*

Mode of Infection:

The pathogens are transmitted to a healthy person through the bite of Female **Culex mosquito.**

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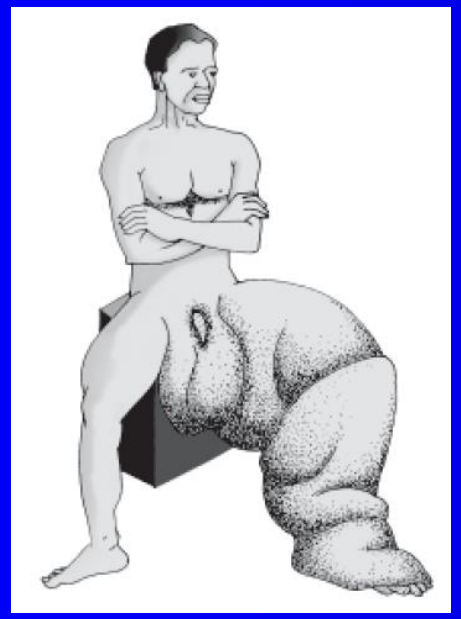
Filariasis



Symptoms:

Inflammation of the organs in which the worms live for many years.

They affect the **lymphatic vessels of the lower limbs** and causing them to swell like an elephant.

So the disease is called **elephantiasis** or **filariasis.**

The genital organs are also often affected, resulting in gross deformities.

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Filariasis

Aedes aegypti transmits dengue virus, yellow fever virus, chikungunya virus, and Zika virus

Culex,mosquitoes referred to as common house mosquitoes trans mit West Nile virus and Japanese encephalitis virus.

Female Anopheles mosquitoes transmit Plasmodium

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Ring worm

Ring worm

Causal Organisms:

Many fungi belonging to the genus *Microsporum*, *Trichophyton* and *Epidermophyton*.

Mode of Infection:

Ringworms are acquired from soil or by using towels, clothes or even the comb of infected individuals.

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Ring worm

Symptoms:

- Appearance of dry, scaly lesions on various parts of the body such as skin, nails and scalp
- These lesions are accompanied by intense itching.
- Heat and moisture help these fungi to grow, which make them thrive in skin folds such as in the groin or between the toes.

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Prevention

Prevention

Maintenance of personal hygiene (keeping the body clean; consumption of clean drinking water, food, vegetables, fruits, etc.)

Maintenance of public hygiene (Public hygiene includes proper disposal of waste.

Periodic cleaning and disinfection of water reservoirs, pools, and tanks and observing standard practices of hygiene in public catering.

Eradication of the vectors and their breeding places.

Vaccination for diseases like polio, diphtheria, tetanus etc.

Use of Antibiotics and drugs.

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Prevention

Maintenance of personal and public hygiene is very important for prevention and control of many infectious diseases.

Personal hygiene includes keeping the body clean; consumption of clean drinking water, food, vegetables, fruits, etc.

Public hygiene includes proper disposal of waste and excreta; periodic cleaning and disinfection of water reservoirs, pools, cesspools and tanks and observing standard practices of hygiene in public catering.

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Prevention

Food and water borne diseases:

Typhoid, Amoebiasis and Ascariasis.

Have hygienic food and water.

Air-borne diseases:

Pneumonia and Common Cold,

Avoid close contact with the infected persons or their belongings.

Vector borne diseases:

Malaria and Filariasis

Control or eliminate the vectors and their breeding places.

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Control of Vectors

Vector control can be achieved by avoiding stagnation of water in and around residential areas.

Regular cleaning of household coolers.

Use of mosquito nets.

Introducing fish like *Gambusia* in ponds which feed on mosquito larvae.

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Control of Vectors

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.

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Prevention

The advancements made in biological science have helped us to effectively deal with many infectious diseases.

The use of vaccines and immunisation programmes have enabled us to eradicate deadly disease like smallpox completely.

Infectious diseases like polio, diphtheria, pneumonia and tetanus have been controlled by the use of vaccines.

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Prevention

Biotechnology is making newer and safer vaccines.

Discovery of antibiotics and various other drugs has enabled us to treat infectious diseases effectively.

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Immunity

Immunity

The ability of immune system to fight against the disease causing organisms is called **immunity**.

Immunity is of two types: (i) Innate immunity and (ii) Acquired immunity.

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Immunity

Innate Immunity

Consists of

- Physical Barrier
- Physiological Barrier
- Cellular Barrier
- Cytokine Barrier

Acquired Immunity

Classified into

- Active Immunity
  - Humoral/ Antibody Mediated Immunity
  - Cell Mediated Immunity
- Passive Immunity

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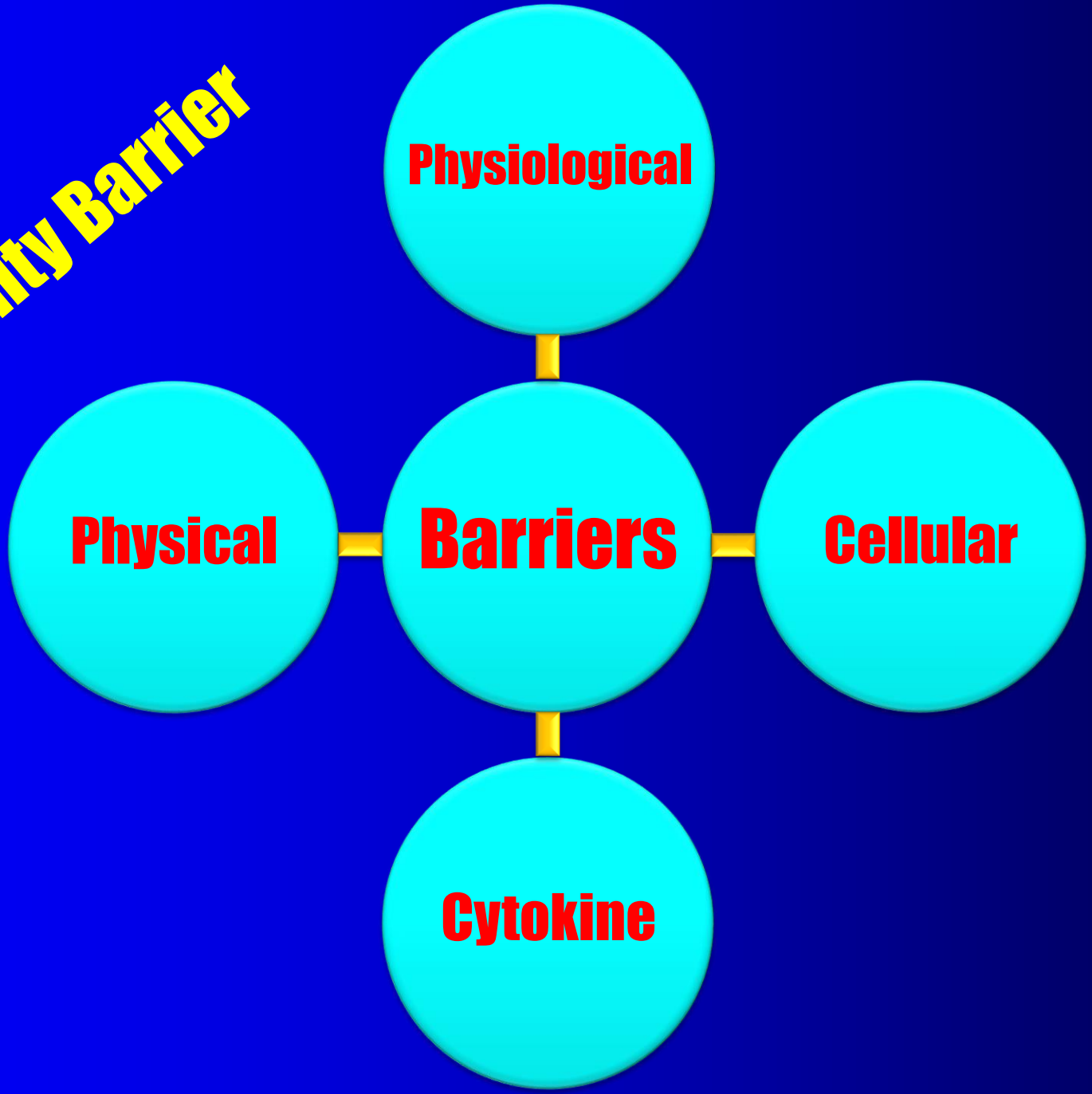
Innate Immunity

Innate Immunity Barrier



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Physical Barriers

The following are the physical barriers which prevent the entry of microbes.

Skin is the main barrier which prevents entry of the micro-organisms.

Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.

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Physiological Barriers

The following are the physiological barriers which prevent microbial growth.

Hydrochloric Acid in the stomach

Saliva in Mouth (Lysozyme)

Tear from eyes (Lysozyme)

The enzyme lysozyme breaks down bacterial cell walls, which are made of a compound called peptidoglycan. Lysozyme is found in both tears and saliva.

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Cellular Barriers

The following types of leukocytes (WBC) of our body can phagocytose and destroy microbes.

Neutrophils (**Polymorpho Nuclear Leukocytes** -PMNL-neutrophils)

Monocytes

Natural killer Lymphocytes

Macrophages in tissues

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Cytokine Barriers

Virus-infected cells secrete proteins called **interferons** which protect non-infected cells from further viral infection.

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Acquired Immunity

Acquired Immunity

Classified into

Active Immunity

- Humoral/ Antibody Mediated Immunity
- Cell Mediated Immunity

Passive Immunity

- Colostrum
- Tetanus Ig
- Rabies Ig
- Hepatitis-B Ig

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Acquired Immunity

The immunity acquired by a person after birth either by an infection or vaccination is called acquired immunity.

It is pathogen specific

It is present only in vertebrates

Specificity:

It is the ability to distinguish different foreign molecules.

Memory:

It is the capacity to distinguish self and non-self molecules/ cells.

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Acquired Immunity

When our body encounters a pathogen for the first time, it produces a response called **primary response** which is of low intensity.

Subsequent encounter with the same pathogen elicits a highly intensified **secondary or anamnestic response**.

This is because of the fact that our body has memory of the first encounter.

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Acquired Immunity

The primary and secondary immune responses are carried out with the help of two special types of lymphocytes present in our blood, i.e., **B-lymphocytes and T-lymphocytes.**

The B-lymphocytes produce antibodies.

The T-cells themselves do not secrete antibodies but help B cells produce them.

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Structure of Antibody

An antibody molecule has four polypeptide chains.

It is held together in the form of ‘Y’.

The tips of upper two arms bind to antigen and **form antigen-antibody complex.**

Two chains are **long (heavy or H)** and **two chains are short Light or L)** chains.

So the antibody is referred to as H_2L_2.

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Structure of Antibody

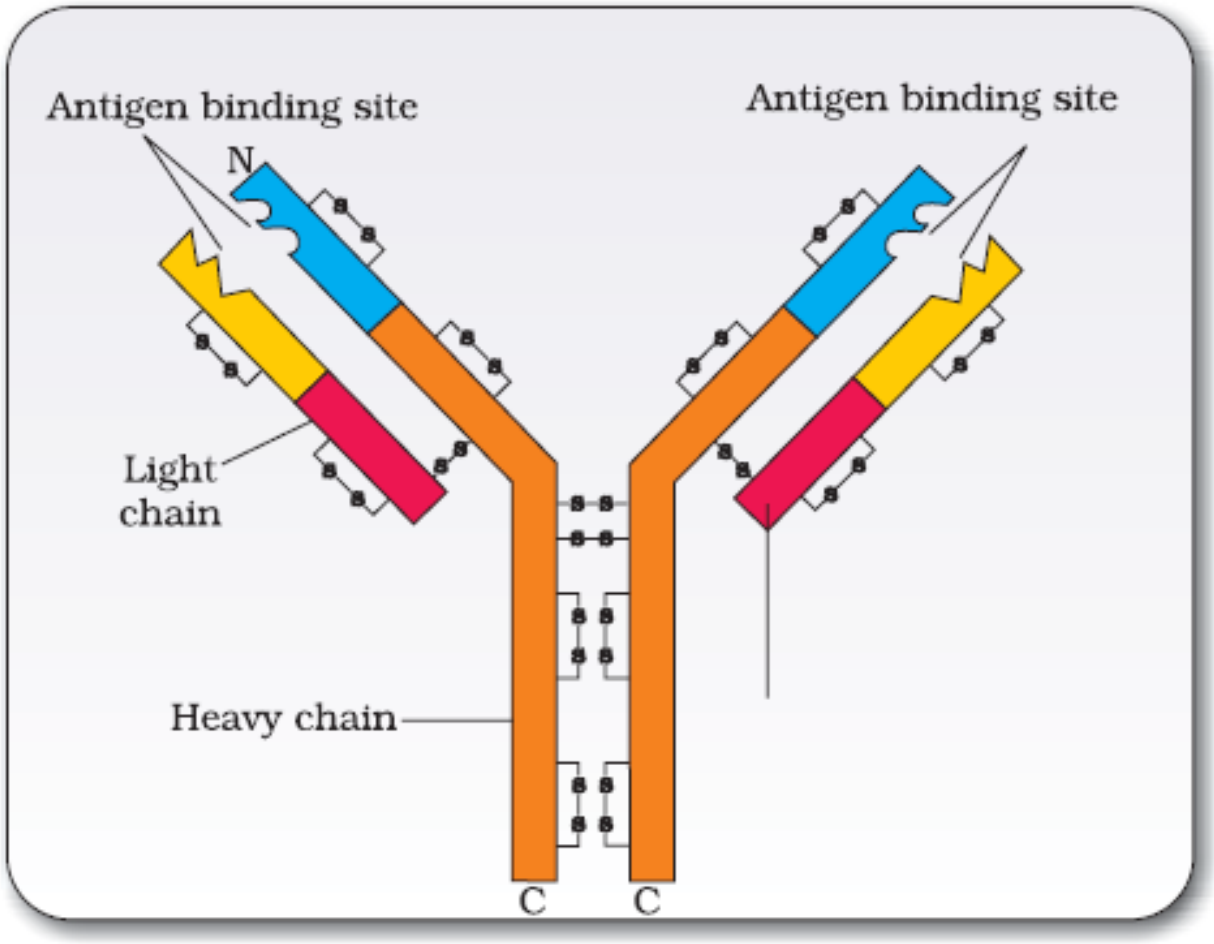

Figure 8.4 Structure of an antibody molecule

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Humoral Immunity

Humoral Immunity

It consists of **antibodies in the body fluids**.

They are produced by B- lymphocytes in response to antigen.

The antibodies are collectively called **immunoglobulins.**

The different types of immunoglobulins are

Ig A, Ig D, Ig E, Ig M, Ig G.

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Cell Mediated Immunity

Cell Mediated Immunity

When some human organs like heart, eye, liver, kidney fail to function, transplatation is the only remedy to enable the patient to live a normal life.

Grafts from any source such as an animal, another primate, or human beings cannot be made since the grafts would be rejected sooner or later.

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Cell Mediated Immunity

Tissue matching, blood group matching are essential for any graft/transplant.

The patient has to take **immunosuppressants** throughout the life.

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

Cyclosporine is an immunosuppressant obtained from a fungus Trichoderma polysporum

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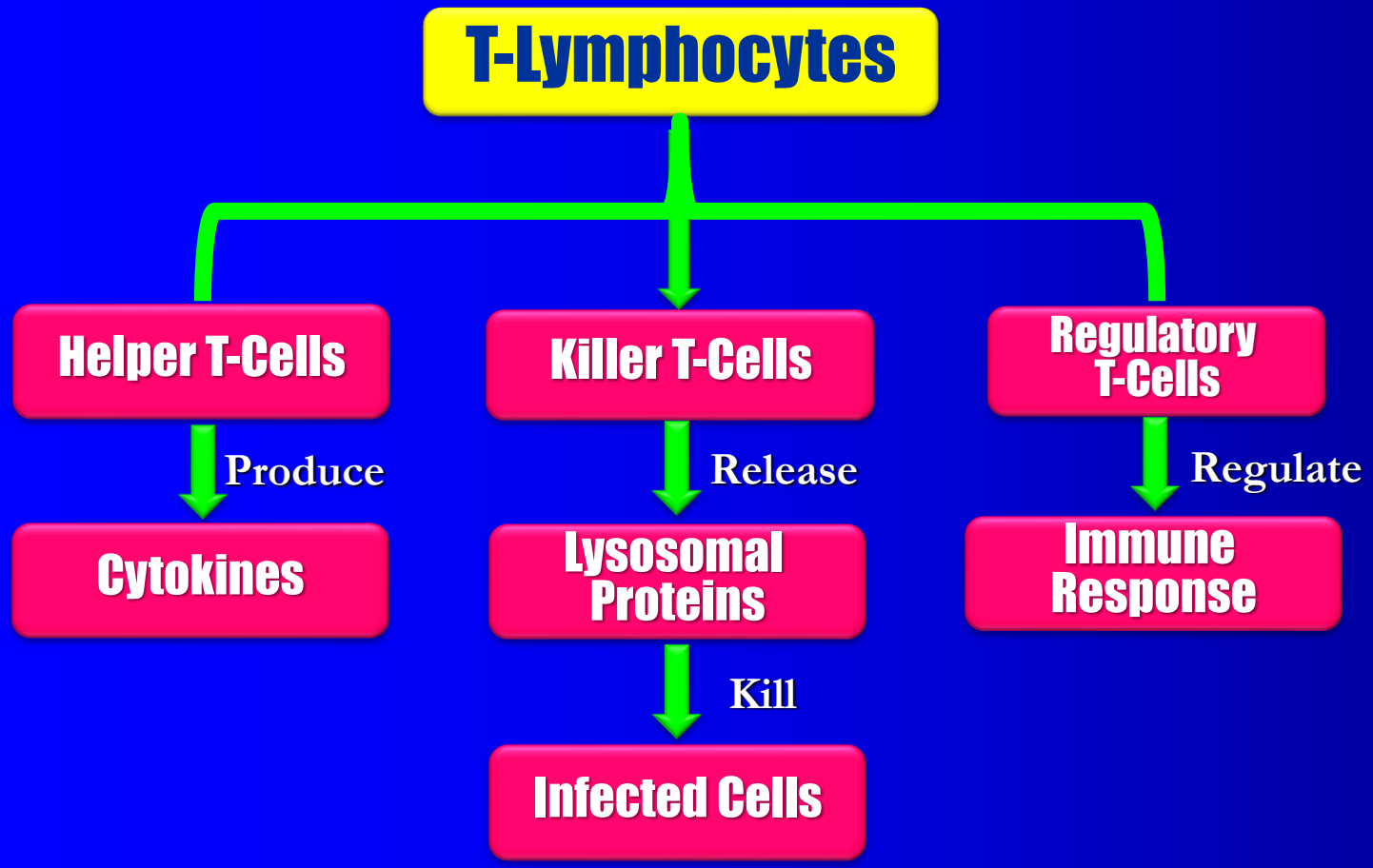

Cell mediated immunity is performed by T lymphocytes.

Two groups of lymphocytes- **Helper T cells and Killer T cells.**

Cell Mediated Immunity

Helper T- cells **activate specific B cells to produce antibodies**.

Killer T cells **kill specific target cell** by various mechanisms.

T-lymphocytes are responsible for graft rejection.

Helper T- cells **activate specific B cells to produce antibodies**.

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Cell Mediated Immunity

Killer T cells **kill specific target cell** by various mechanisms.

T-lymphocytes are responsible for graft or organ rejection.

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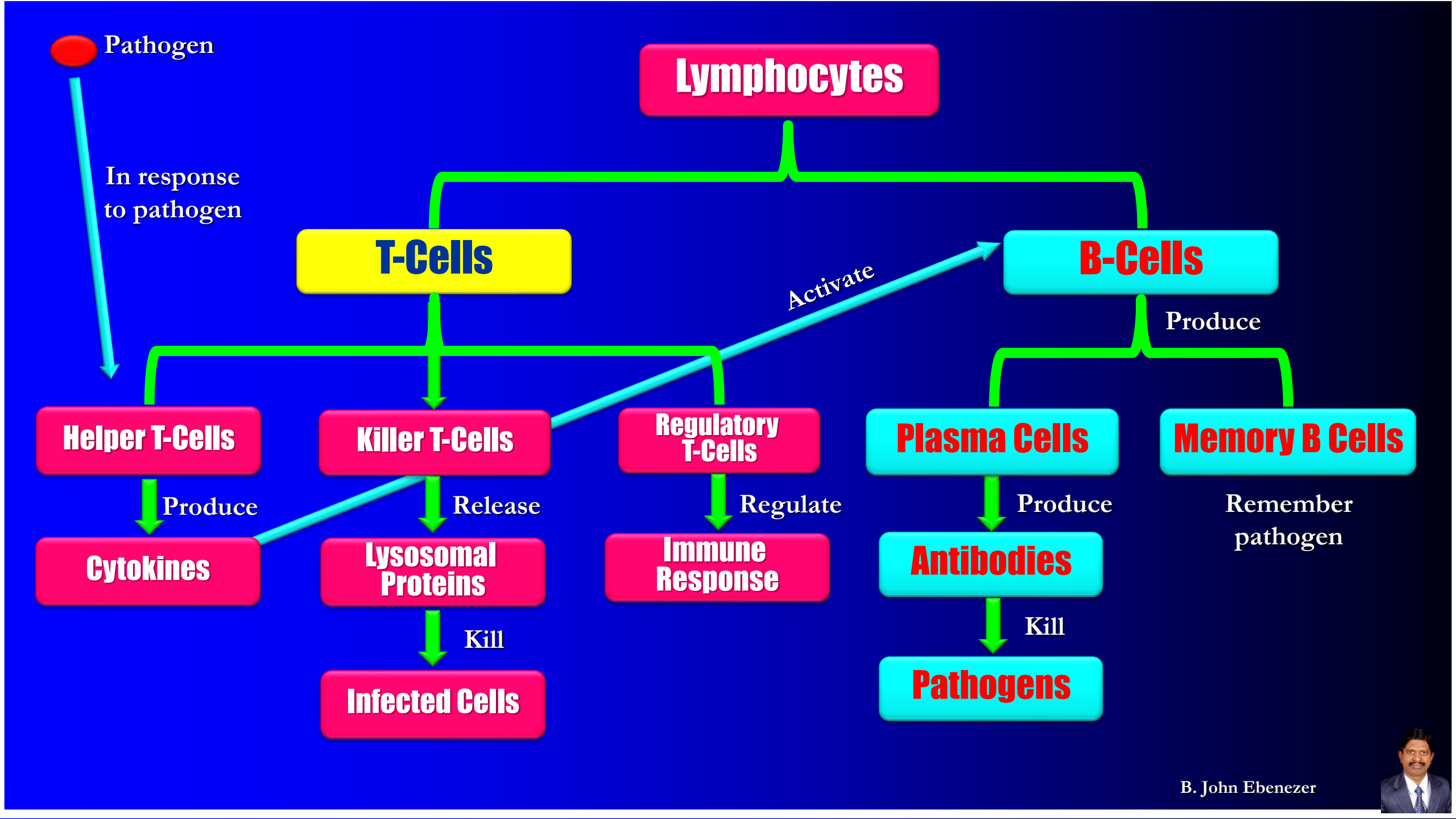
Pathogen
In response to pathogen
Lymphocytes
T-Cells
B-Cells
Activate
Produce
Helper T-Cells
Killer T-Cells
Regulatory T-Cells
Plasma Cells
Memory B Cells
Produce
Release
Regulate
Produce
Remember pathogen
Cytokines
Lysosomal Proteins
Immune Response
Antibodies
Kill
Kill
Infected Cells
Pathogens
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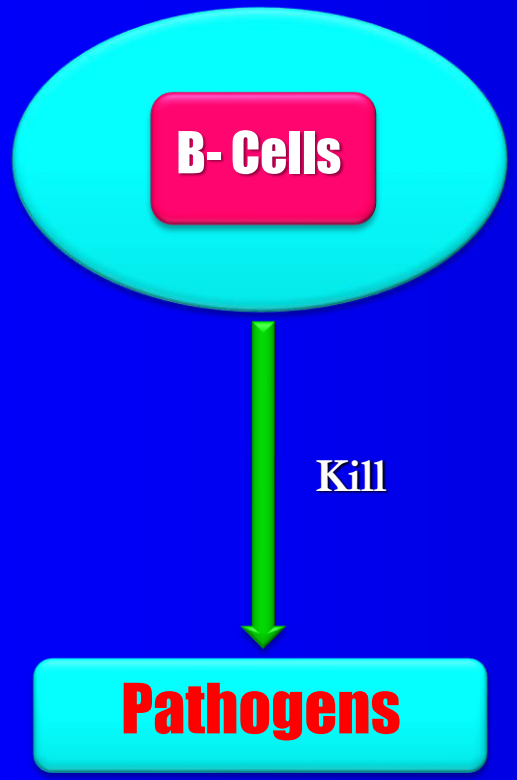
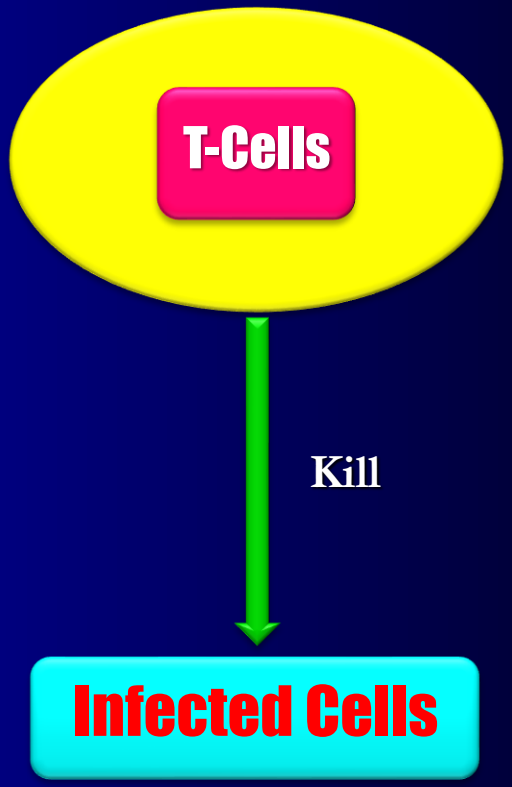


I kill outer cells



I kill inner cells

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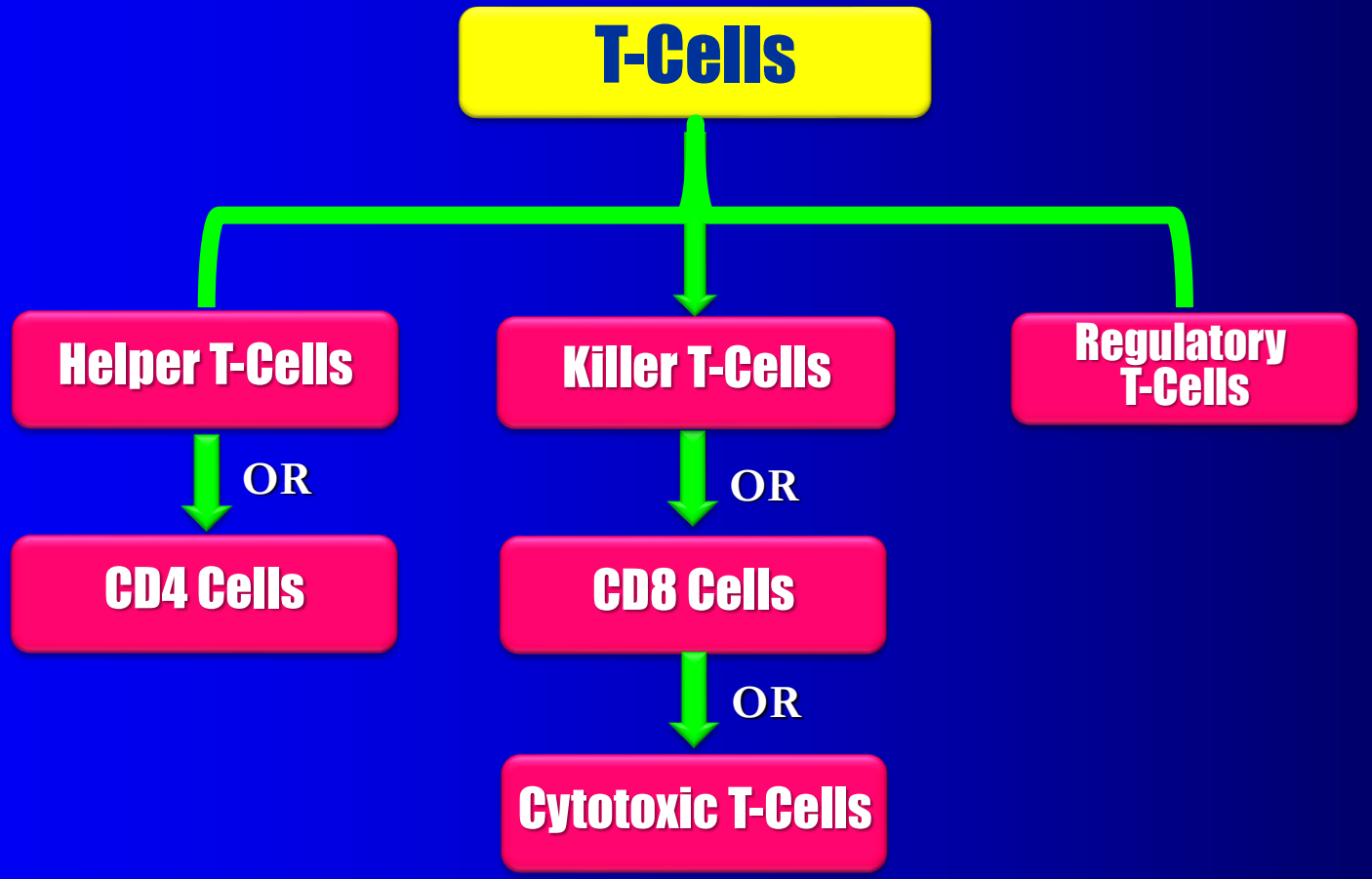

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Active and Passive Immunity

Active and Passive Immunity

The immunity developed by the production of antibodies by the immune system in response to the antigens (living or dead microbes or other proteins) is called **active immunity.**

The immunity developed by the introduction of ready-made antibodies is called **passive immunity**.

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Passive Immunity

The yellowish fluid **colostrum** secreted by mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant.

The foetus also receives some antibodies from the mother, through the placenta during pregnancy.

These are some examples of passive immunity.

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Active and Passive Immunity

ACTIVE	PASSIVE
The immunity developed in our body by the antibodies produced in our own body in response to the entry of pathogens is active immunity.	The immunity developed in our body by the introduction of antibodies produced in the body of other organisms is passive immunity
Antibodies develop in our own cells.	Antibodies develop in other vertebrates and injected into our body.
It takes time to develop immunity.	Immune response is faster.
It stays for a longer period.	It stays for a shorter period.
E.g. Immunity developed due to infection (natural exposure) to antigen or by vaccination.	E.g. Immunity provided to infants in the form of colostrum, tetanus antitoxin

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Vaccination

Vaccination and Immunisation

The introduction of attenuated or weakened pathogens or toxoids into the body to confer resistance against those antigens is called vaccination.

The antibodies produced by the immune system in response to the pathogen kill the pathogen and prevent the infection.

The immune system also produces Memory B and T cells that recognise the pathogen quickly on subsequent exposure and attack them vigorously with a massive production of antibodies.

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Vaccination and Immunisation

Antigen:

The antigenic proteins of pathogen or inactivated/weakened pathogens introduced into the body are called antigens.

Antibodies:

The protein substances produced by immune system in response to the antigens are called antibodies. Antibodies neutralise the pathogens during actual infection.

Memory:

The vaccines also produce Memory B and T cells that recognise the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies.

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Vaccination and Immunisation

If a person is infected with some deadly microbes, quick immune response is required as in tetanus.

We have to directly inject the **preformed antibodies**, or **antitoxin** (a preparation containing antibodies to the toxin).

In case of snake bite, the injection given to the patients contain **preformed antibodies** against the snake venom.

This type of immunisation is called **passive immunisation**.

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Vaccination and Immunisation

Antigenic polypeptides of pathogen in bacteria or yeast are produced by Recombinant DNA technology.

Large scale production of vaccines are done by this technology and has increased the availability of vaccines.

e.g., Hepatitis B vaccine is produced from yeast.

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Summary of Vaccination and Immunisation

The principle of immunisation or vaccination is based on memory of the immune system.

It produces antibodies that neutralise toxin or pathogen.

It also produces memory cells.

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Immune Response

Primary immune response:

- Immunity developed in the body due to first encounter with an antigen.
- Takes longer time to develop
- It is feeble and declines rapidly.

Secondary immune response:

- Produced by memory cells, formed during primary response.
- Heightened immune response in a shorter time.
- Stays for longer time.

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Allergy

Allergy

The exaggerated or hypersensitive response of the immune system to certain antigens present in the environment is called **allergy**.

Allergens:

The substances that cause allergy are called allergens.

Common allergens are mites in dust, pollens, animal dander, etc.

The antibodies produced to these are of IgE type.

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Allergy

Cause of Allergy:

Allergy is due to the release of chemicals like **histamine and serotonin** from the mast cells.

For determining the cause of allergy, the patient is exposed to or injected with very small doses of possible allergens, and the reactions studied.

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Allergy

Symptoms of Allergy:

Symptoms of allergic reactions include **sneezing, watery eyes, running nose and difficulty in breathing.**

Remedy:

The use of drugs like **anti-histamine, adrenalin and steroids** quickly reduce the symptoms of allergy.

The use of drugs like **anti-histamine, adrenalin and steroids** quickly reduce the symptoms of allergy.

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Allergy

Modern life style has resulted in lowering of **immunity** and **more sensitivity to allergens**.

More and more children in metro cities of India suffer from **allergies and asthma** due to sensitivity to the environment.

This is because of the protected environment provided early in life.

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Autoimmunity

Autoimmunity

The autoimmunity is a failure of the immune system to recognize its own cells and tissues as “self” and attacking its own cells mistakenly.

This results in damage to the body and is called **autoimmune** disease.

Sometimes due to **genetic and other unknown reasons**, the body attacks self-cells.

But the real cause of autoimmunity is unknown.

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Autoimmunity

Autoimmune Disease

A condition in which our immune system mistakes our own healthy tissues as foreign and attacks them is called an autoimmune disease.

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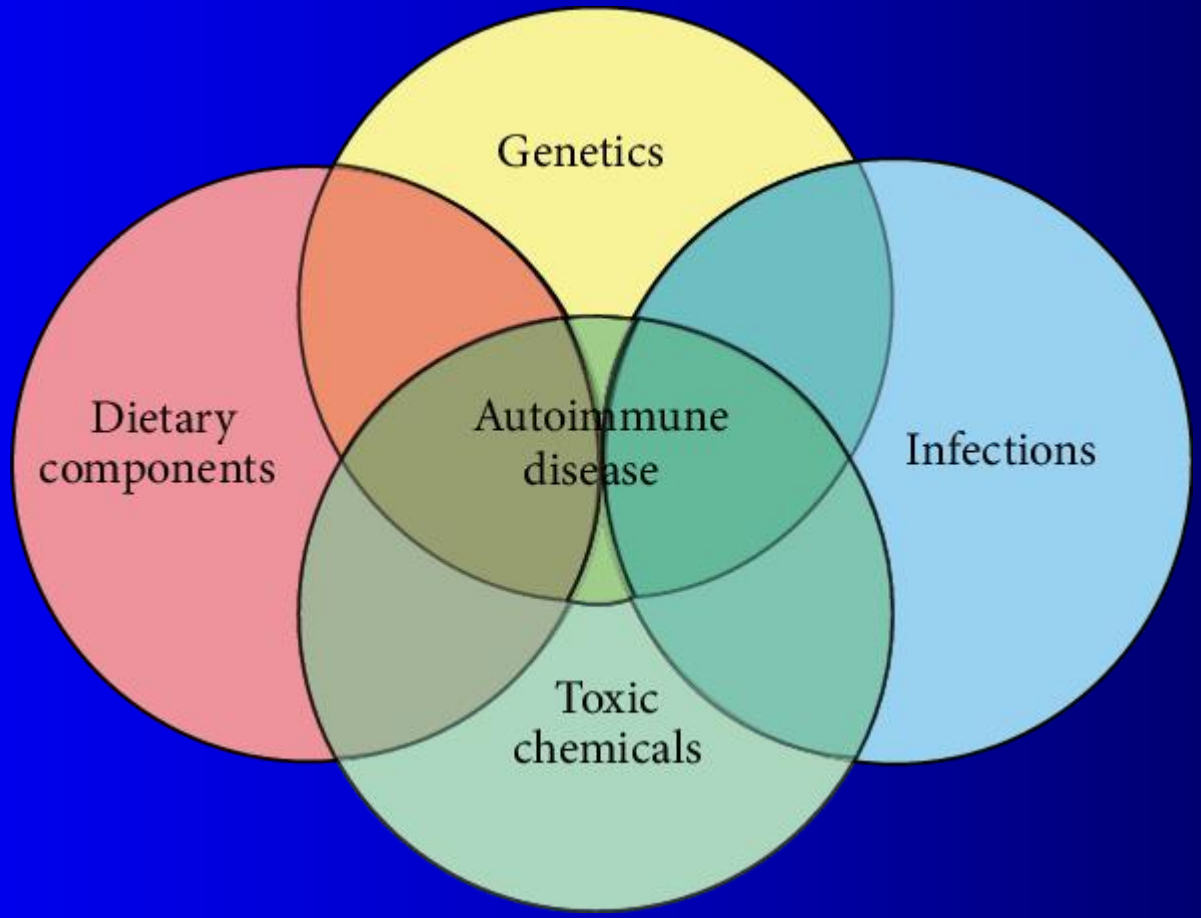
Causes of Autoimmune Diseases



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Autoimmunity

Rheumatoid arthritis which affects many people in our society is an auto-immune disease.

Rheumatoid arthritis:

The immune system attacks the joints causing inflammation, swelling, and pain.

Type 1 Diabetes mellitus:

The antibodies attack and destroy insulin producing cells of the pancreas.

People with type 1 diabetes require insulin to survive.

Psoriasis:

The immune system stimulates skin cells to reproduce rapidly, producing scaly plaques on the skin.

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Immune System in the Body

Lymphoid Organs

Lymphoid Organs

Primary Lymphoid Organs

- Bone Marrow
- Thymus

Secondary Lymphoid Organs

- Tonsil
- Spleen
- Lymph Nodes
- Peyer's Patches
- MALT

Mucosal Associated Lymphoid Tissue (MALT)

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Lymphoid Organs

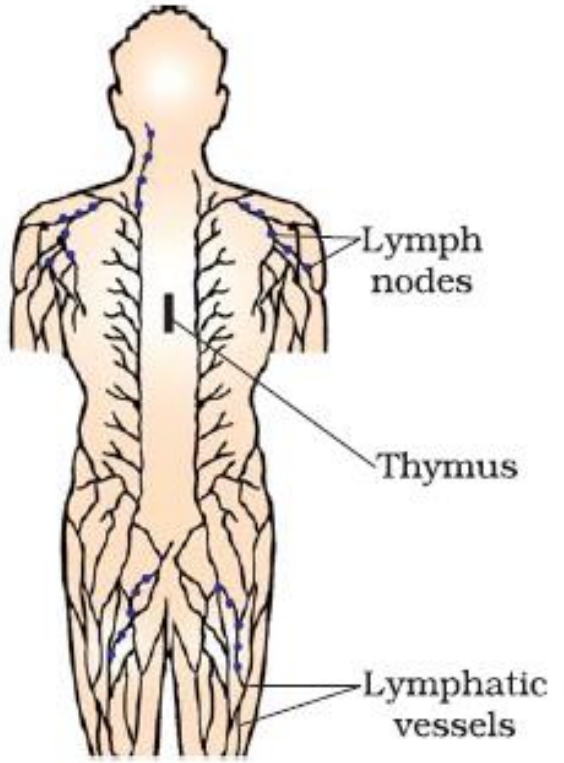

Figure 8.5 Diagrammatic representation of Lymph nodes

The origin and maturation of lymphocytes occur in Lymphoid organs.

The primary lymphoid organs are **bone marrow** and **thymus** where immature lymphocytes differentiate into antigen-sensitive lymphocytes.

After maturation the lymphocytes migrate to secondary lymphoid organs.

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Primary Lymphoid Organs

Bone Marrow

The bone marrow is the main lymphoid organ where all **blood cells and lymphocytes** are produced.

It provides micro-environment for the development and maturation of B- Lymphocytes.

After maturation the B-Lymphocytes differentiate into antigen-sensitive lymphocytes.

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Thymus

The thymus is a lobed organ located near the heart and beneath the breastbone.

The thymus is quite large at the time of birth but keeps reducing in size with age.

It reduces to a very small size by the time puberty is attained

It provides microenvironment for the maturation of T- Lymphocytes.

After maturation the T-Lymphocytes differentiate into antigen-sensitive lymphocytes.

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Primary Lymphoid Organs

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

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Primary Lymphoid Organs

Both B-cells and T-cells are formed in the bone marrow.

B-cells get matured in the bone marrow.

T-cells which are formed in the B-cells migrate to thymus and get matured in Thymus.

B-cells produce antibodies.

T-cells help in killing the pathogen and helping other immune cell to fight infection.

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Primary Lymphoid Organs

Bone Marrow

Produces

- B- Lypmhocytes (B-Cells)
- T- Lymphocytes (T-Cells)

B-cells and T-cells are formed in bone marrow. Only B-cells get matured in bone marrow.

Maturation in Bone Marrow

B- Cells

Thymus

T-cells are formed in bone marrow. But matured in Thymus

Maturation in Thymus

T-Cells

Lymphocytes

T-Cells

- Helper T-Cells
  - Produce
  - Cytokines
- Killer T-Cells
  - Release
  - Lysosomal Proteins
  - Kill
  - Infected Cells
- Regulatory T-Cells
  - Regulate
  - Immune Response

B-Cells

Produce

- Plasma Cells
  - Produce
  - Antibodies
  - Kill
  - Pathogens
- Memory B Cells
  - Remember pathogen

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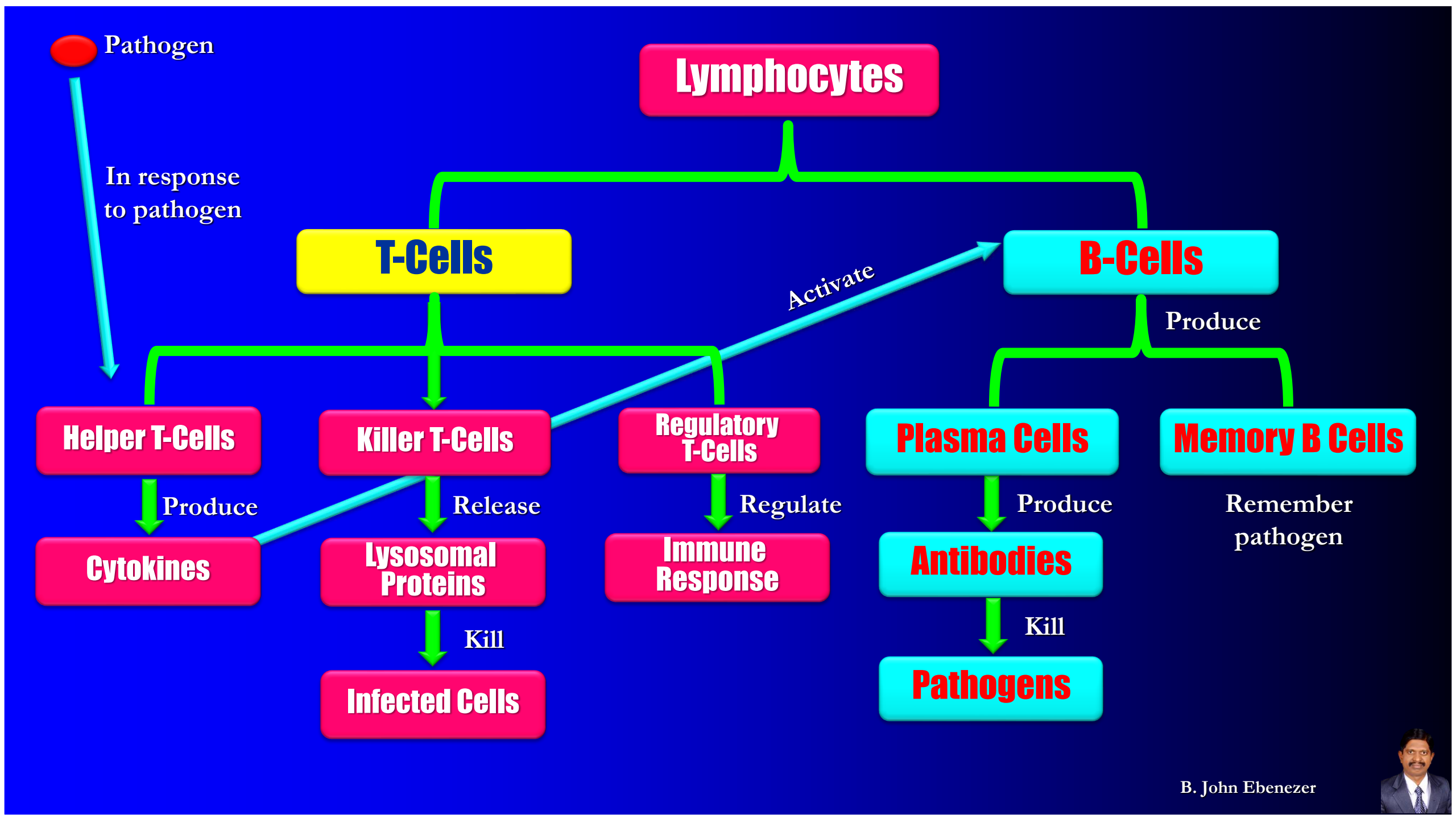
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In response to pathogen
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Activate
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Regulatory T-Cells
Plasma Cells
Memory B Cells
Produce
Release
Regulate
Produce
Remember pathogen
Cytokines
Lysosomal Proteins
Immune Response
Antibodies
Kill
Kill
Infected Cells
Pathogens
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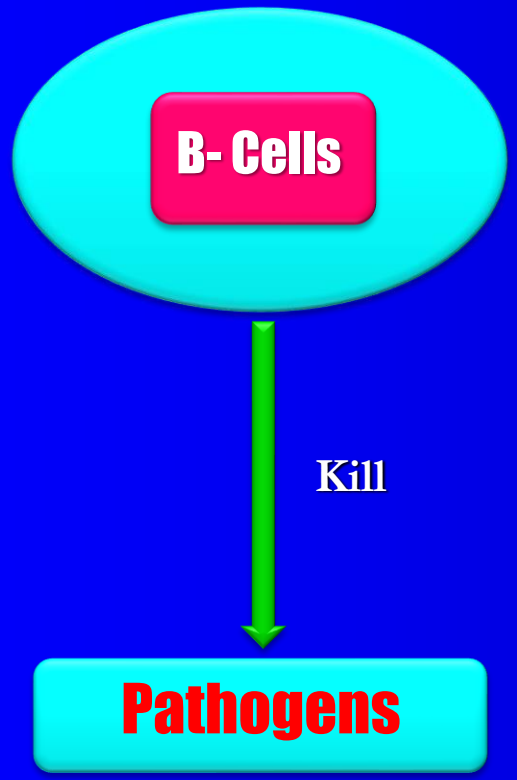
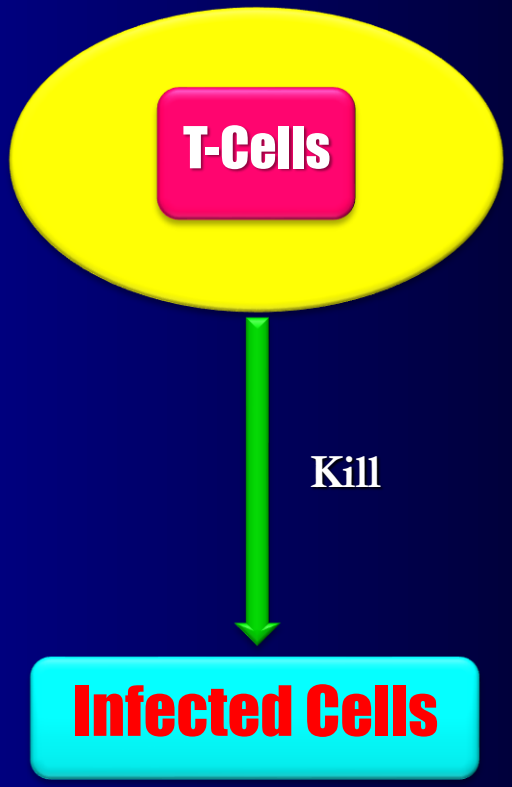
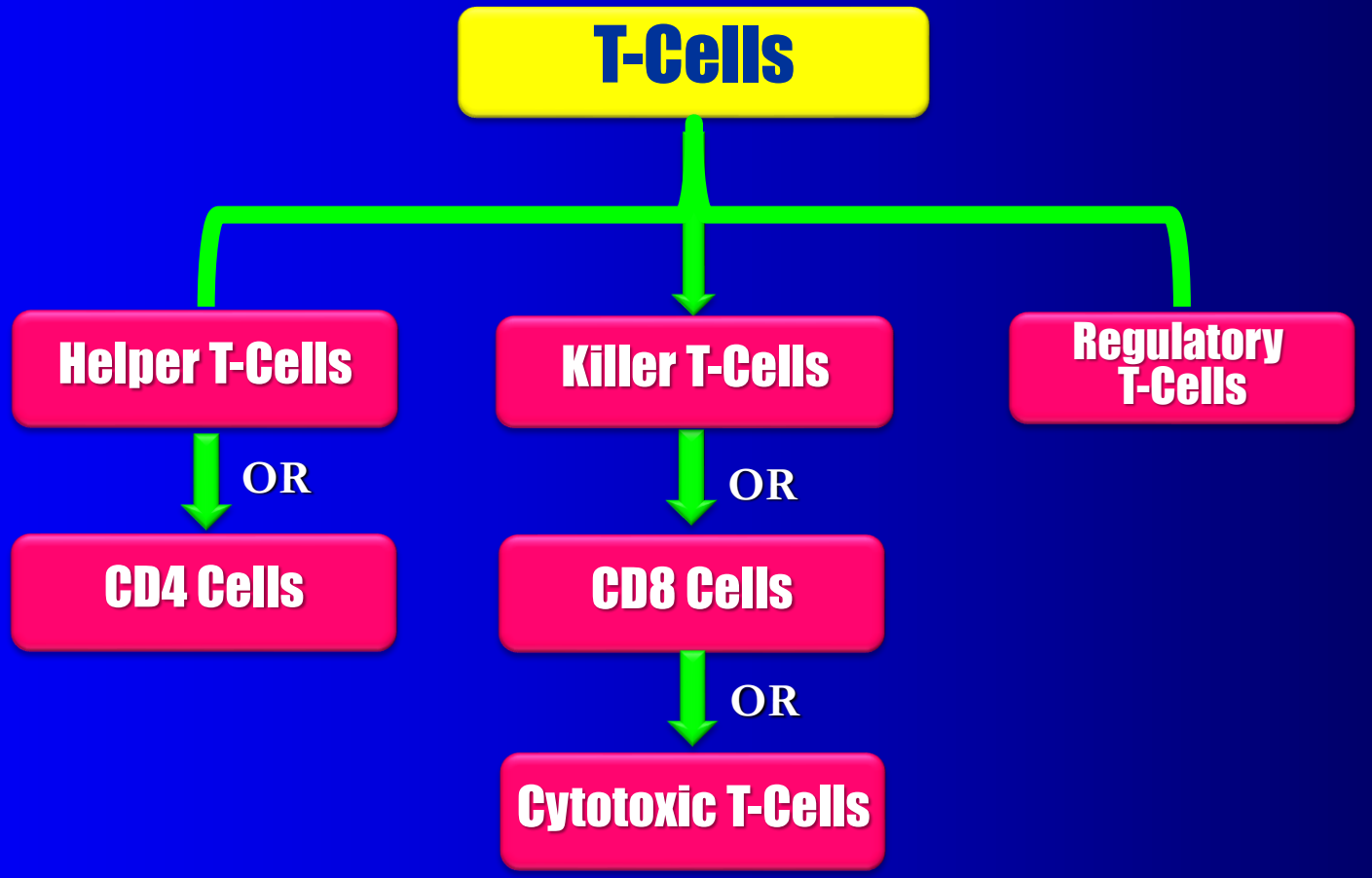


I kill outer cells



I kill inner cells

B. John Ebenezer



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Secondary Lymphoid Organs

Secondary Lymphoid Organs

Secondary lymphoid organs are spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix.

The secondary lymphoid organs provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.

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Spleen

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.

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Lymph Nodes

The lymph nodes are small solid structures located at different points along the lymphatic system.

Lymph nodes trap the microorganisms or antigens, which enter the lymph and tissue fluid.

Antigens trapped in the lymph nodes are responsible for the activation of lymphocytes present there and cause the immune response.

Lymph nodes filter lymph and help the immune system in making an immune response.

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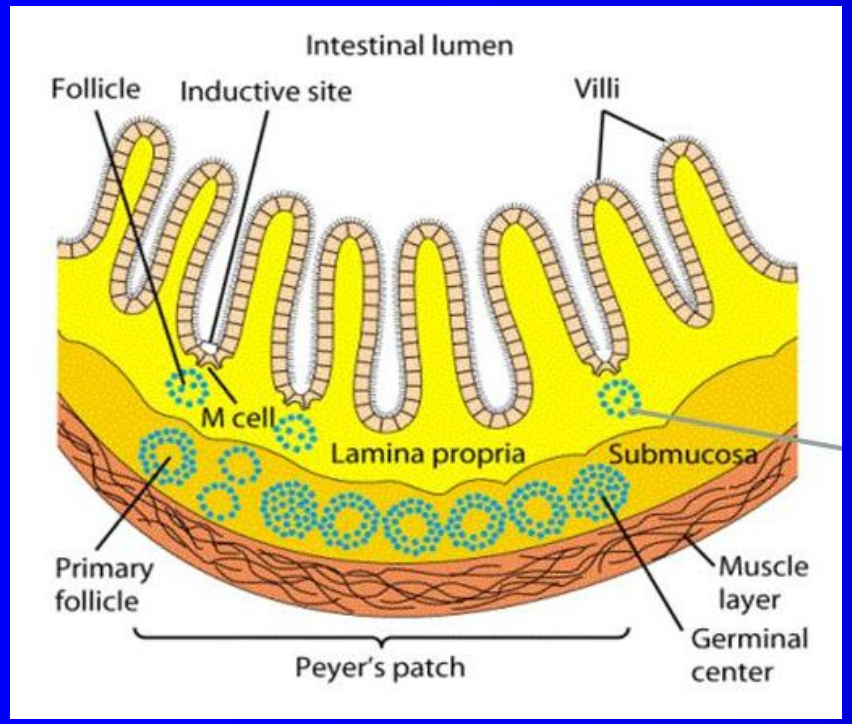
Mucosal Associated Lymphoid Tissue (MALT)



Lymphoid tissue is also located within the lining of the major tracts (respiratory, digestive and urogenital tracts) called **mucosal associated lymphoid tissue** (MALT).

It constitutes about 50 per cent of the lymphoid tissue in human body.

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Acquired Immuno Deficiency Syndrome

The word AIDS stands for **Acquired Immuno Deficiency Syndrome**.

This means deficiency of immune system, acquired during the lifetime of an individual indicating that it is not a congenital disease.

'Syndrome' means a group of symptoms.

AIDS was first reported in 1981.

It has spread all over the world killing more than 25 million people.

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AIDS

Causal Organism:

Human Immuno deficiency Virus (HIV), a member of **retrovirus**, which have an envelope enclosing the RNA genome.

Modes of Transmission of HIV:

- Sexual contact with infected person.
- Transfusion of contaminated blood and blood products.
- Sharing infected needles as in the case of intravenous drug abusers.
- From infected mother to child through placenta.

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High Risk People

People who are at high risk of getting this infection are:

Those who have multiple sexual partners.

Drug addicts who take drugs intravenously

Individuals who require repeated blood transfusions.

Children born to HIV infected mothers.

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AIDS

It is important to note that AIDS does not spread by touch or physical contact.

It spreads only through body fluids.

Hence, AIDS patients should not be isolated from family and society.

There is a time-lag between the infection and appearance of AIDS symptoms.

This period may vary from a few months to many years (usually 5-10 years).

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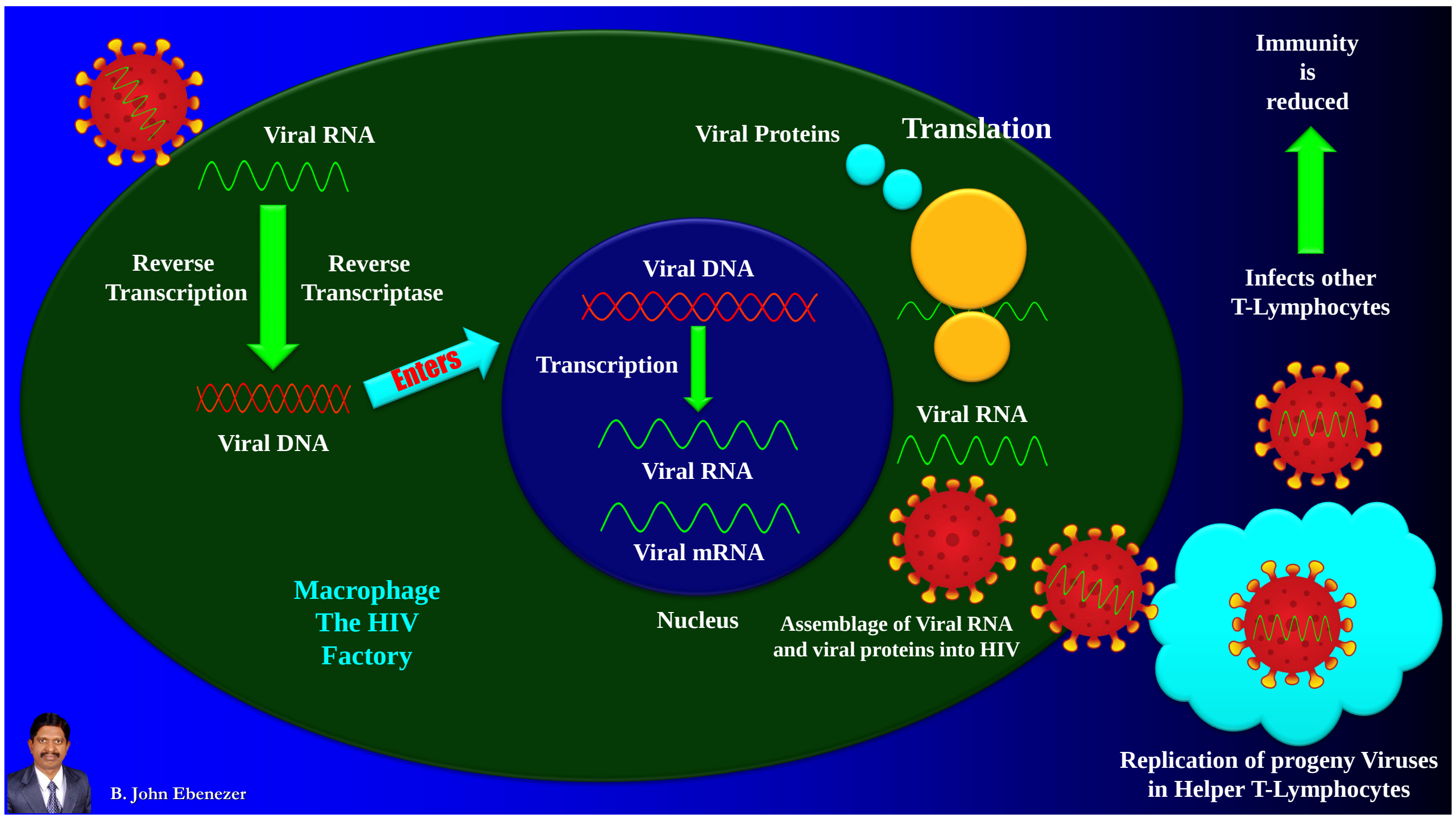
Viral RNA
Reverse Transcription
Reverse Transcriptase
Viral DNA
Enters
Viral DNA
Transcription
Viral RNA
Viral mRNA
Nucleus
Macrophage
The HIV
Factory
Viral Proteins
Translation
Viral RNA
Assemblage of Viral RNA and viral proteins into HIV
Immunity is reduced
Infects other T-Lymphocytes
Replication of progeny Viruses in Helper T-Lymphocytes
B. John Ebenezer

Acquired Immuno Deficiency Syndrome

Virus

Enters

Introduces RNA

Cytoplasm

RNA

Reverse Transcription

DNA

Enters Nucleus

Nucleus

Incorporates into Host Genome

New Viral RNA is produced

Enters

Helper T Lymphocytes

Replicates and produce

Progeny Viruses

Enters

Blood

Infects T - Lymphocytes

Immunity is reduced

Acquired Immuno Deficiency Syndrome

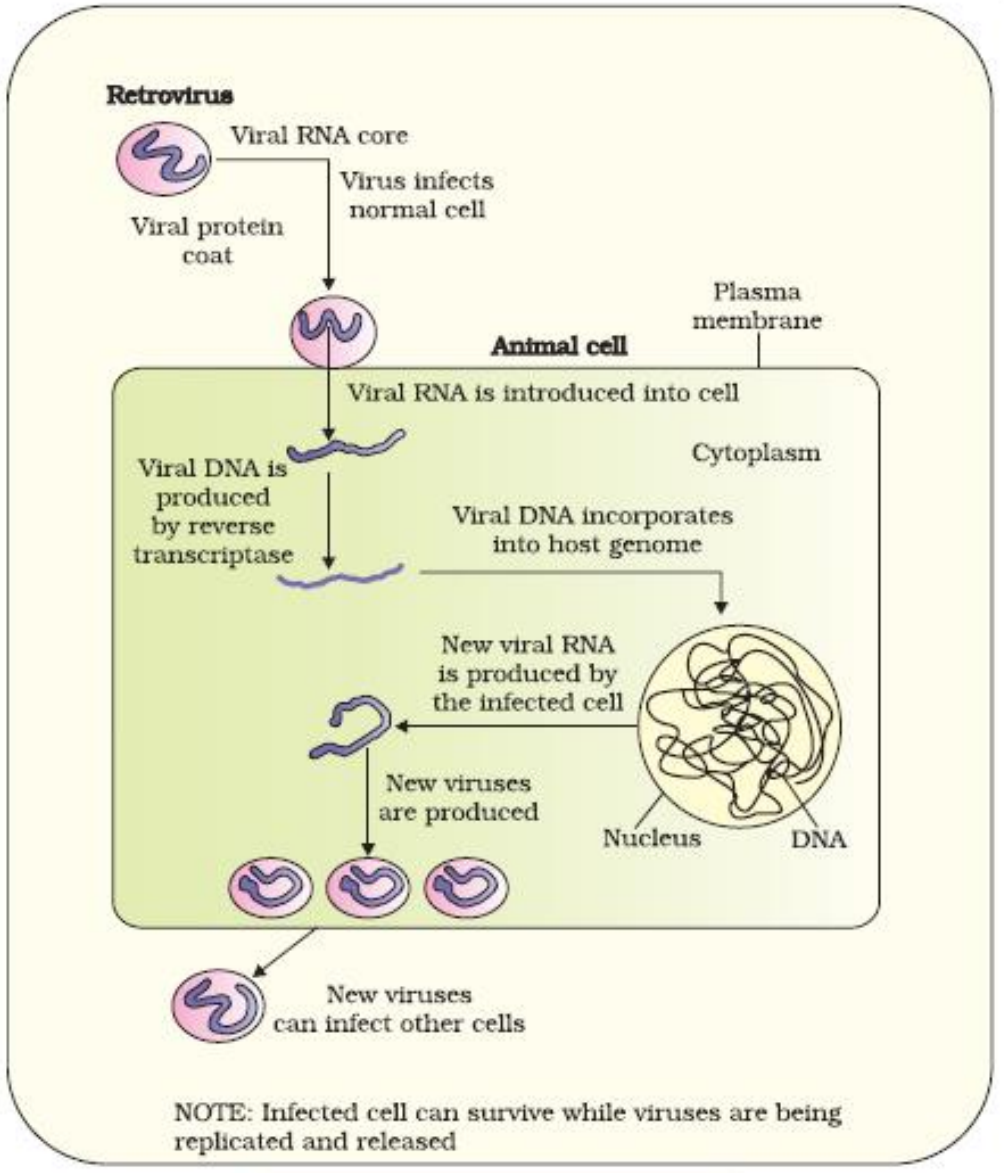

Figure 8.6 Replication of retrovirus

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Life Cycle of HIV

After getting into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme **reverse transcriptase**.

This viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce virus particles.

The macrophages continue to produce virus and acts like a HIV factory.

Simultaneously, HIV enters into helper T-lymphocytes (TH), replicates and produce progeny viruses.

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Life Cycle of HIV

The progeny viruses released in the blood attack other helper T-lymphocytes.

This 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 **fever, diarrhoea and weight loss.**

Due to decrease in the number of helper T lymphocytes, the person starts suffering from infections such as *Mycobacterium*, viruses, fungi and even parasites like *Toxoplasma*.

B. John Ebenezer

AIDS

The patient becomes immuno-deficient and is unable to protect against these infections.

Diagnosis:

A widely used diagnostic test for AIDS is **Enzyme Linked Immuno-Sorbent Assay** (ELISA).

Treatment:

Treatment of AIDS with **anti-retroviral drugs** is only partially effective.

They can only prolong the life of the patient but cannot prevent death, which is inevitable.

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Prevention of AIDS

National AIDS Control Organisation (NACO) and other

Non-governmental organisation (NGOs) are doing a lot to educate people about AIDS.

- Using safe blood for transfusion.
- Use of disposable needles and syringes in hospitals and clinics.
- Free distribution of condoms.
- Controlling drug abuse.
- Advocating safe sex.
- Promoting regular check-ups for HIV in susceptible populations.

B. John Ebenezer

AIDS

Infection with HIV should not be hidden.

AIDS patients need **help** and **sympathy**.

The society should recognise it as a problem to be dealt with in a collective manner in order to reduce the chances of wider spread of the disease.

It is a malady (serious problem) that can only be tackled, by the **society** and **medical fraternity** acting together to prevent the spread of the disease.

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Cancer

Cancer

Cancer is one of the most dreaded diseases of human beings and is a major cause of death all over the globe.

More than a million Indians suffer from cancer and a large number of them die annually.

The mechanisms that underlie development of cancer or oncogenic transformation of cells, its treatment and control have been some of the most intense areas of research in biology and medicine.

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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 show a property called **contact inhibition** by which contact with other cells inhibits their uncontrolled growth.

Cancer cells have lost this property.

As a result of this, cancerous cells just continue to divide giving rise to masses of cells called **tumors**.

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Cancer

The uncontrolled and rapid cell division caused due to mutation, gives rise to masses of cells called **tumors** is known as cancer.

Cancer cells have lost the property of **contact inhibition,** leading to uncontrolled growth.

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Cancer

Normal Cell	Cancer cell
In normal cell, the cell growth and differentiation is highly controlled and regulated.	In cancer cells, there is breakdown of the regulatory mechanisms.
They show a property called contact inhibition by which contact with other cells inhibits their uncontrolled growth.	They have lost the property of contact inhibition, which causes uncontrolled growth.
They divide and growth normally and do not starve any cell and do not compete for vital nutrients.	They actively divide and grow and also starve the normal cells by competing for vital nutrients.
They do not show the property called metastasis.	They show the property called metastasis and reach distant sites through blood.
They do not cause tumour.	They cause tumour wherever they get lodged in the body.

Cancer

Tumors are of two types: benign and malignant.

Benign tumors remain confined to their original location and do not spread to other parts of the body and cause little damage.

Malignant tumors are a mass of proliferating cells called neoplastic or tumor cells.

These cells grow very rapidly, invading and damaging the surrounding normal tissues.

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Cancer

As these cells actively divide and grow they also starve the normal cells by competing for vital nutrients.

Tumor cells reach distant sites through blood, and wherever they get lodged in the body, start a new tumor there.

This property called **metastasis** is the most feared property of malignant tumors.

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Types of Tumour

Benign Tumour	Malignant Tumour
Benign tumour is non-cancerous.	Malignant tumour is cancerous.
The cells grow slowly.	The cells grow very rapidly.
It remains confined to its original location.	It does not remain confined to its original location.
The cells do not invade.	The cells show metastasis and invade.
It causes a little damage to the surrounding normal tissues.	It causes severe damage to the surrounding normal tissues.
It is harmless.	It is very harmful.

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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**.

Ionising radiations like X-rays and gamma rays and non-ionizing radiations like UV rays cause DNA damage leading to neoplastic transformation.

The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer.

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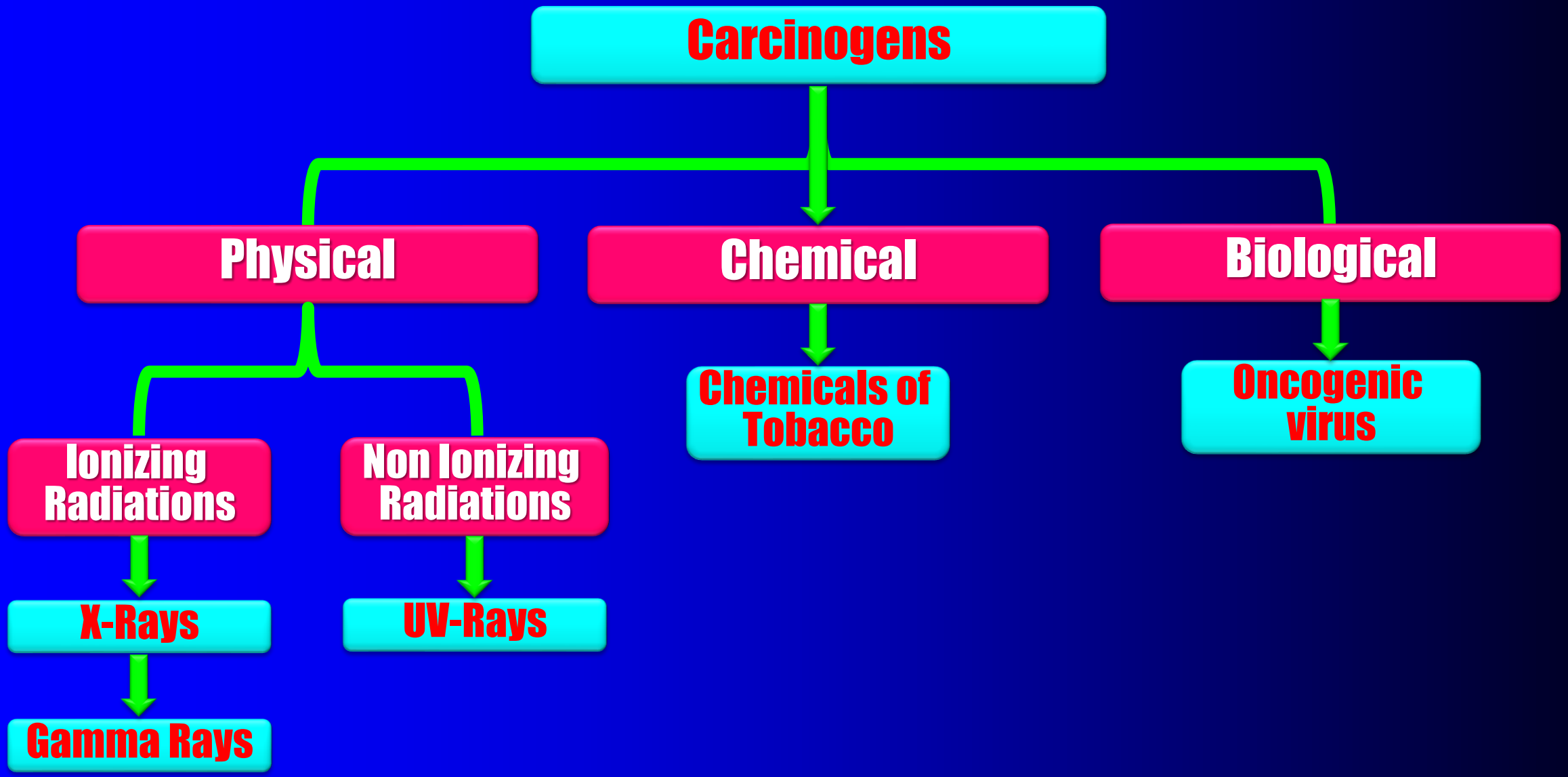

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Causes of Cancer

Cancer causing viruses called **oncogenic viruses** have genes called **viral oncogenes**.

Several genes called **cellular oncogenes** (*c-onc*) or **proto oncogenes** have been identified in normal cells

When these genes are activated under certain conditions, could lead to oncogenic transformation of the cells.

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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 and histopathological studies of the tissue, blood and bone marrow tests for increased cell counts in the case of leukemias.

In biopsy, a piece of the suspected tissue cut into thin sections is stained and examined under microscope (histopathological studies) by a pathologist.

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Cancer Detection and Diagnosis

Techniques like radiography (use of X-rays), CT (computed tomography) and MRI (magnetic resonance imaging) are very useful to detect cancers of the internal organs.

Computed tomography uses X-rays to generate a three-dimensional image of the internals of an object.

MRI uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.

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Cancer Detection and Diagnosis

Antibodies against cancer-specific antigens are also used for detection of certain cancers.

Techniques of molecular biology can be applied to detect genes in individuals with inherited susceptibility to certain cancers.

Identification of such genes, which predispose an individual to certain cancers, may be very 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).

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Treatment of Cancer

The common treatment of cancer are surgery, radiation therapy 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. Some of these are specific for particular tumors.

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Treatment of Cancer

- Radiotherapy
- Chemotherapy
- Immunotherapy
- Surgery

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Side Effects of Treatment

Majority of drugs have side effects like hair loss, anemia, etc. Most cancers are treated by combination of surgery, radiotherapy and chemotherapy.

Tumor cells destroyed by immune system.

Therefore, the patients are given substances called biological response modifiers such as ã-**interferon** which activate their immune system and help in destroying the tumor.

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DIAGNOSIS OF CANCER

- Biopsy and histopathological studies of tissue
- Blood and bone marrow test (for leukemia)
- MRI, CT scan or radiography
- Use of antibodies against cancer specific antigen

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Drugs or Narcotics

Drugs

Narcotics are substances that affect mood or behaviour

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Drugs

- Opioids
- Cannabinoids
- Coca-alkanoids
- Barbiturates
- Amphetamines
- Benzodiazepines
- LSD **(Lysergic acid Diethyl amides)**

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Opioids

Opioids (Morphine & Heroin)
Papaver somniferum

- **Opioids** are the drugs, which bind to specific **opioid receptors** present in our central nervous system and gastrointestinal tract.
- They act as depressant and analgesic (painkillers)
- They are commonly called ***smack*** and chemically **diacetylmorphine**.
- It is a white, odourless, bitter crystalline compound obtained by acetylation of morphine.
- Morphine is extracted from the **latex of poppy plant** *Papaver somniferum* and taken by snorting and injection.
- Heroin is a depressant and slows down body functions.

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Opioids (Morphine & Heroin)

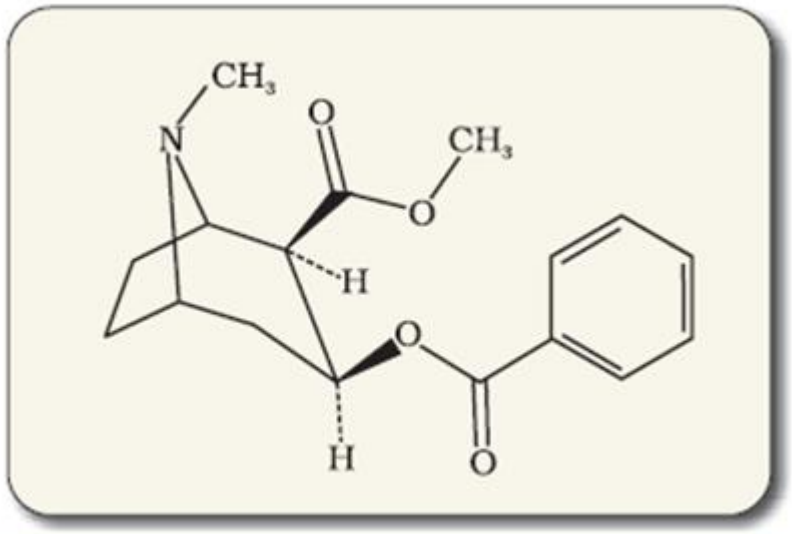

Figure 8.7 Chemical structure of Morphine

Figure 8.8 Opium poppy

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Cannabinoids

Cannabinoids (*Cannabis sativa*)

- **Cannabinoids** are a group of chemicals which interact with **cannabinoid receptors** present in the brain.
- Natural cannabinoids are obtained from the **inflorescences** of the plant *Cannabis sativa*.
- The **flower tops, leaves and the resin of cannabis** plant are used to produce **marijuana, hashish, charas and ganja**.
- It is taken by **inhalation and oral ingestion**, these are known for their effects on cardiovascular system of the body.

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Cannabinoids (*Cannabis sativa*)

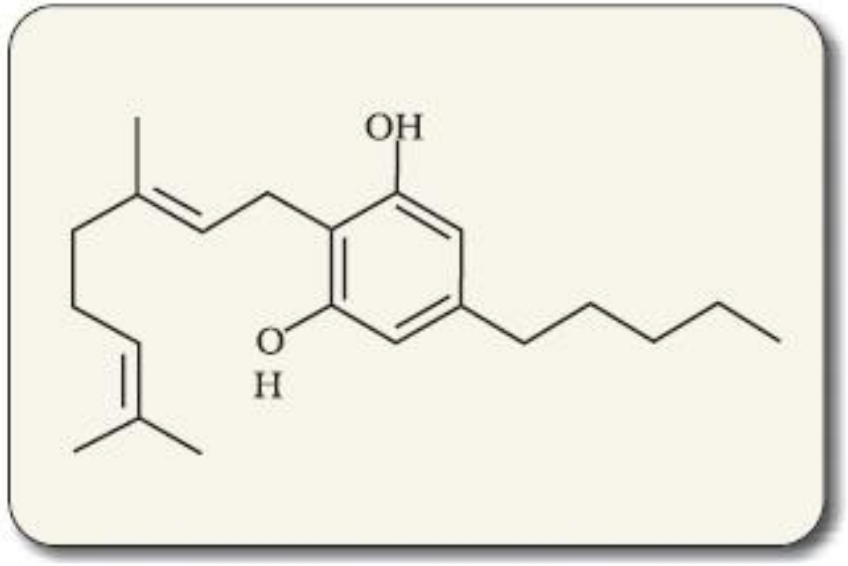

Figure 8.9 Skeletal structure of cannabinoid molecule

Figure 8.10 Leaves of *Cannabis sativa*

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Cocaine

Coca alkaloid or Cocaine

Coca alkaloid or **cocaine** is obtained from coca plant *Erythroxylum coca*, native to South America.

- It interferes with the transport of neurotransmitter **dopamine**.
- Cocaine is commonly called **coke** or **crack** is usually snorted.
- It produces a sense of **euphoria** (extreme happiness) and increased energy.
- Excessive dosage of cocaine causes **hallucinations**.

- Other well-known plants with **hallucinogenic** properties are *Atropa belladona* and *Datura*.

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Datura metal

Figure 8.11 Flowering branch of *Datura*

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Belladona is obtained from roots & dried leaves of Atropa belladonna is **diuretic and antispasmodic**.

Atropine is obtained from the leaves of Atropa belladonna, used to dilate pupil of eye during eye test.

Narcotic is an illegal drug, affecting mood or behavior.

Diuretic causes increased passing of urine.

Antispasmodic is used to relieve spasm (muscle tightening) of muscle.

Sedative or Tranquilizer is a drug used to calm a person or to sleep.

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- Drugs like **barbiturates, amphetamines, benzodiazepines, lysergic acid diethyl amides (LSD)** are normally used as medicines to treat depression and insomnia, are abused.

- Morphine is a very effective **sedative and painkiller** which is very useful in patients who have undergone surgery.

- When these are taken for a purpose other than medicinal use it impairs **one's physical, physiological or psychological functions**.

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Tobacco

Tobacco

- Tobacco has been used by human beings for more than 400 years.
- It is smoked, chewed or used as a snuff. Tobacco contains a large number of chemical substances including **nicotine**, an alkaloid.
- Nicotine stimulates adrenal gland to release **adrenaline and nor-adrenaline** into blood circulation, both of which **raise blood pressure and increase heart rate.**
- Smoking causes **cancers of lung, urinary bladder and throat, bronchitis, emphysema, coronary heart disease, gastric ulcer** etc.
- Tobacco chewing causes increased risk of cancer of the oral cavity.
- Smoking increases carbon monoxide (CO) content in blood and reduces the concentration of haem-bound oxygen. This causes oxygen deficiency in the body.

B. John Ebenezer

Effects of Narcotics

- The use of alcohol during adolescence may have long-term effects. It could lead to heavy drinking in adulthood.
- The chronic use of drugs and alcohol damages **nervous system and liver (cirrhosis).**
- The use of drugs and alcohol during pregnancy affects the foetus.
- The use of narcotic analgesics, anabolic steroids, diuretics and certain hormones in sports to increase **muscle strength and promotes aggressiveness** as a result increased athletic performance.

B. John Ebenezer

Medicinal Use of Drugs

Drugs	Medicinal Use
Atropine	Dilating pupil of eye during eye test
Belladona	Diuretic and Antispasmodic
Morphine	Sedative and painkiller used during surgery
Barbiturates, amphetamines, benzodiazepines, lysergic acid diethyl amides (LSD)	Treating depression and insomnia

B. John Ebenezer

The side-effects of the use of anabolic steroids in females

- The side-effects of the use of anabolic steroids in females include:
- masculinization (features like males),
- increased aggressiveness
- mood swings
- depression
- abnormal menstrual cycles
- excessive hair growth on the face and body
- enlargement of clitoris
- deepening of voice

B. John Ebenezer

The side-effects of the use of anabolic steroids in males

- In males it includes
- acne
- increased aggressiveness
- mood swings
- depression
- reduction in the size of the testicles, decreased sperm production
- kidney and liver dysfunction
- breast enlargement
- premature baldness
- enlargement of the prostate gland

B. John Ebenezer

Prevention

Prevention and control of alcohol and drug abuse among adolescents

- Avoid undue peer pressure.
- Educating and counseling to face problems, stress, to accept failure etc.
- Help from parents and peers.
- Professional and medical help.

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Prevention and control of alcohol and drugs abuse among adolescents

(i) **Avoid undue peer pressure :**

Every child has his/her **own choice and personality**, which should be respected and nurtured.

A child should not be **compelled unduly to perform beyond his/her threshold limits**; be it studies, sports or other activities.

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(ii) **Education and Counselling:**

Educating and counselling the individual to face **problems and stresses,** and to accept **disappointments and failures** as a part of life.

It is worth to channelize the child's energy into healthy pursuits like sports, reading, music, yoga and other extracurricular activities.

(iii) **Seeking help from parents and peers:**

Seeking help from parents and peers should be done immediately so that they can guide appropriately.

Help may even be sought from close and trusted friends.

Besides getting **proper advise to sort out their problems**, this would help young to **vent their feelings of anxiety and guilt**.

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(iv) **Looking for danger signs:**

Parents and teachers need to look for and **identify the danger signs** discussed above.

Even friends, if they find someone using drugs or alcohol, should not hesitate to bring this to the notice of parents or teacher in the best interests of the person concerned.

Appropriate measures would be required to diagnose the malady (Malady=disease) and the underlying causes.

This would help in initiating proper remedial steps or treatment.

(v) Seeking professional and medical help:

A lot of help is available from highly qualified psychologists, psychiatrists, and de-addiction and rehabilitation programmes to help individuals who have unfortunately got in the quagmire of drug/alcohol abuse.

With such help, the affected individual with sufficient efforts and will power, can get rid of the problem completely and lead a perfectly normal and healthy life.

Quagmire-Soft wetland where a person can sink into the soil

Drug Abuse

Use of Narcotics affects your mind and behavior.
It is a sin
Never try it

Smoking is injurious to health
It is a sin
Never try it

B. John Ebenezer

Drinking alcohol like wine, beer, whisky is dangerous to health.
It is a sin
Never try it

Be a Teetotaller

B. John Ebenezer

God Bless You!