

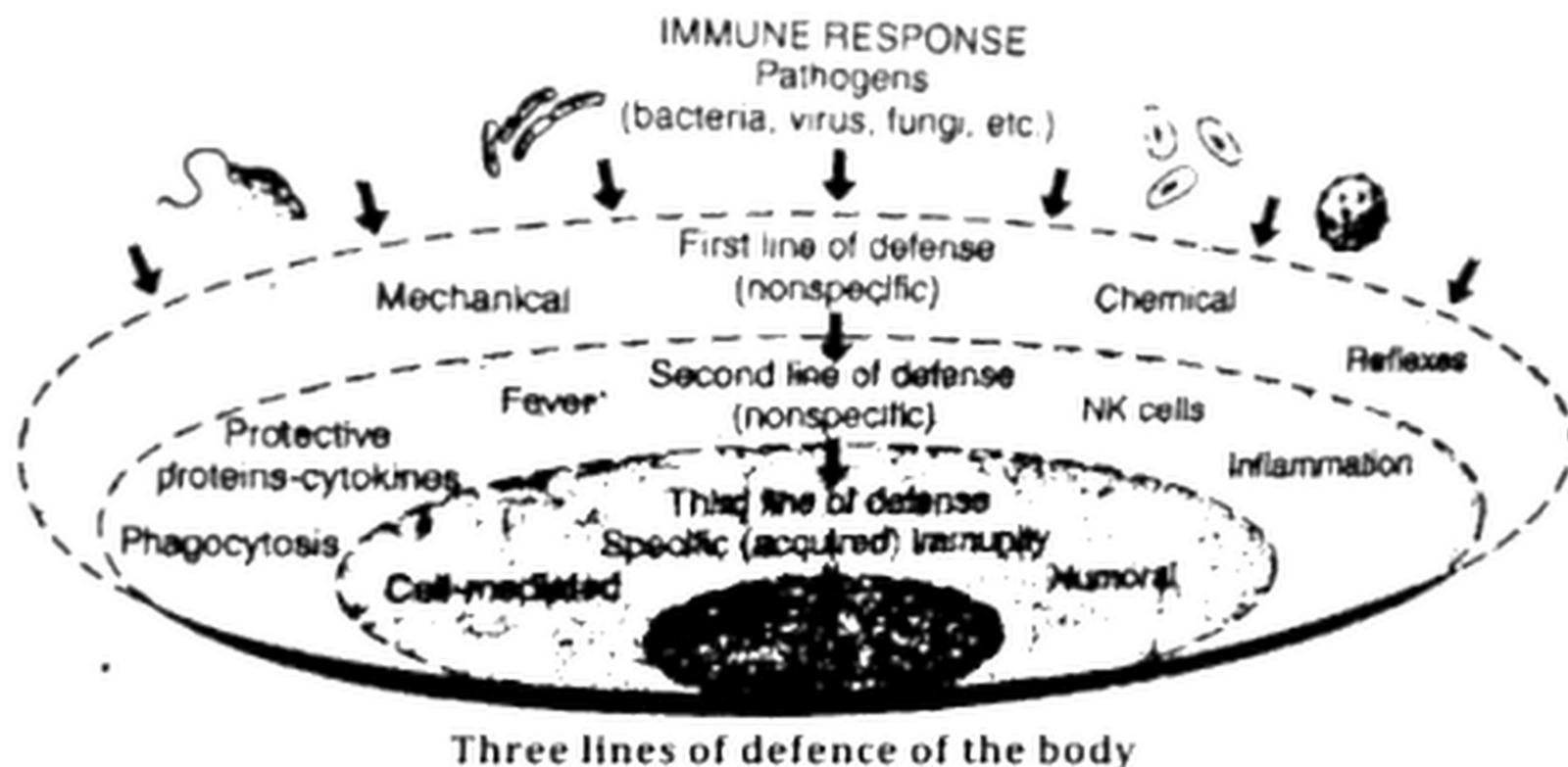
CHAPTER-13

IMMUNITY

Q1. Discuss body's three lines of defense.

Ans: First Line of Defence:

The first and obviously best, defence is to keep microbes out in the first place. The human body has two surfaces exposed to the environment: the skin and the mucous membranes of the digestive and respiratory tracts. These surfaces are external barriers to microbial invasion. Since these barriers inhibit generally all kind of microbial invasion thus, first line of defence is supposed to be a non-specific defence.



Second Line of Defence – Nonspecific Defence:

If microbes become successful to penetrate the skin or mucous membranes then a second line of defence takes action against these foreign invaders. The second line of defence comprises three nonspecific internal defence. First, the body has a standing army of phagocytic cells and **natural killer cells**. Second, invasion of microbes provokes an **inflammatory response**. Third, the body often produces **fever** or gives rise temperature response. In addition, some protective proteins are also the part of second line of defence.

These defences are non-specific because they attack a wide variety of microbes, rather than targeting specific invaders as the immune response does.

Third line of Defence – The Specific Defenses:

If a pathogen is able to get past the body's non-specific defence, the third line of defence interferes with a series of defence responses, often called immune responses that attack the particular pathogens having specific antigens. These antigens serve as the stimulus to produce an immune response. The term "antigen" comes from ANTI-body Generating substances. Viruses, bacteria and other pathogens have specific antigens on their surface.

Since, the third line of defence responds against particular infection and acts as the most powerful means of resisting infections therefore, it is also called **specific defence**. Its response can be of two types **Humoral immune response** and **cell-mediated immune response**. These immune responses are particularly carried out by two components B-lymphocytes or B cells and T-lymphocytes or T cells. However, third line of defence also involves the role of monocytes (macrophages) that participate in the activation of these lymphocytes.

Q2. Recognize the role of the acids and enzymes of the digestive tract in killing the bacteria present in food.

Ans: Epithelium of digestive tract: an impenetrable barrier against microbial

invasion: The gastrointestinal tract as GIT, it is covered by a mucous membrane which protects the GIT against microbial invasion by means of its various kinds of secretions. Such as **hydrochloric acid** in the stomach is secreted by oxyntic or parietal cells that kill the bacteria present in food. In addition, various **digestive enzymes** present in gastric juice, intestinal juice and pancreatic juice also digest the bacteria present in food.

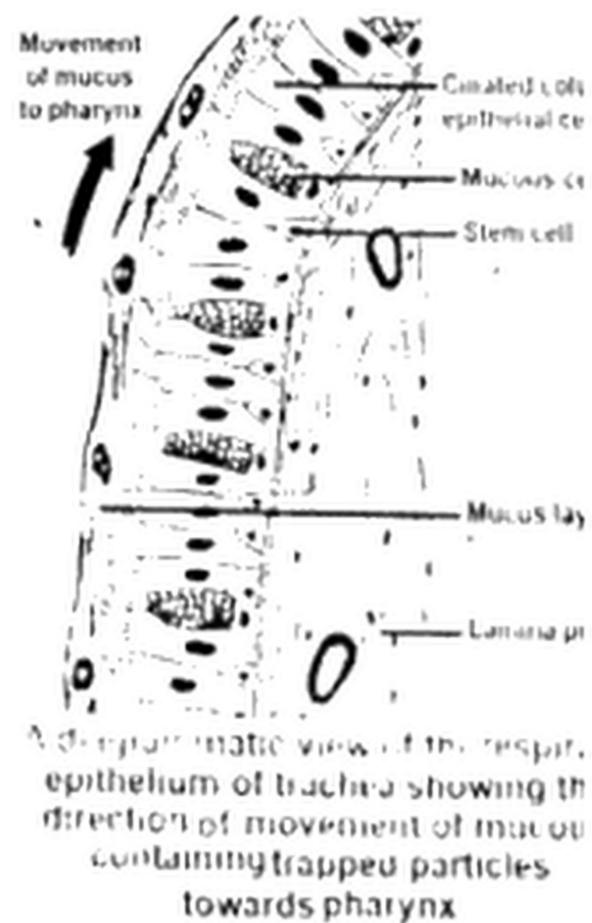
Q3. State the role of ciliated epithelium of nasal cavity of the mucous of the bronchi and bronchioles in trapping air borne microorganisms.

Ans: Epithelium of respiratory tract:

an impenetrable barrier against

microbial invasion: The anterior part of nasal cavities that contain hairs is called **vestibule**. These vestibular hairs filter the large dust particles of the inhaled air. The inner surface of nasal cavities is also lined by **ciliated**

mucous epithelium. The **mucous** secreted by this epithelium is also involved in trapping of fine dust particles and microbes. The **cilia** of the epithelium sweep the trapped, fine dust particles and microbes' posterior to the pharynx, where they are swallowed and are eliminated by the digestive system. The trachea and the air passageways within the lungs are also lined by ciliated mucous epithelium that is also involved in trapping of the dust particles and microbes. The cilia in this region propel mucus and foreign particles towards the larynx, where they enter the pharynx and are swallowed.



Teacher's Point

Teachers would guide the students to write a brief research paper on the history of discovery of immunity.

Skills: Initiating and Planning

- ◆ **Justify the inflammatory response in arthritis as an example of a misdirected immune response.**

In this disease autoantibodies are formed against IgG (antibody or immunoglobulin of class G). These autoantibodies are called rheumatoid factors. The agent that induce these autoantibodies is unknown. Within the inflamed joints, the synovial membrane is infiltrated with T cells plasma cells and macrophages and the synovial fluid contains high levels of macrophage-produced inflammatory cytokines.

Science Titbits

Several experiments have suggested that interleukin-1 causes fever by first inducing the formation of one of the prostaglandins. When drugs block prostaglandin formation the fever is either completely abrogated or at least reduced. In fact this may be the explanation for the manner in which aspirin reduces the degree of fever because aspirin impedes the formation of prostaglandins from arachidonic acid. It also would explain why aspirin does not lower the body temperature in a normal person because a normal person does not have any interleukin-1. Drugs such as aspirin that reduce the level of fever are called antipyretic.

Skills: Initiating and Planning

- ◆ **Justify why physician prescribe antihistamine therapy to the patients of runny nose or skin rashes.**

Runny nose or skin rashes are a type of hypersensitivity reaction in which histamine is released from the mast cells and basophils. Its release causes vasodilation, increased capillary permeability and smooth muscle contraction. Antihistamine drugs block histamine receptor sites so histamine action cannot take place. So, in this way they are effective on allergic rhinitis are runny nose and skin rashes.

Science, Technology and Society Connections

- ◆ **Justify why physician prescribe antipyretic drugs, when fever is a nonspecific defence against microbial infections.**

Antipyretic drugs create their effects by inhibiting prostaglandin production in the hypothalamus, which has the effect of block in set point elevation, and maintaining the set point at nearer normal levels.

Science Titbits

Early investigators of the immune system found that, when plasma from an immune animal was injected into the blood of a non-immune animal, the non-immune animal become immune. Because the process involved body fluids (humors), it was called Humoral immune response. As in the response antibodies are responsible, hence, it is also called antibody mediated immune response. It was also discovered that blood cells transferred from an immune animal could be responsible for immunity and this process was called cell-mediated immunity.

Teacher's Point

Teacher would guide the students to make a model of antibody.

Teacher's Point

Teacher would guide the students to make a list of diseases for which vaccines are available.

Science Titbits

In 1717 May, Montagu the wife of an English ambassador to the Ottoman Empire, observed local women inoculating their children against smallpox **Edward Jenner** observed and studied Miss Sarah a milkmaid who had previously caught cowpox and was found to be immune to smallpox.

Skills: Initiating and Planning

- ◆ **Justify why physician prescribe antihistamine therapy to the patients of runny nose or skin rashes.**

Runny nose or skin rashes are a type of hypersensitivity reaction in which histamine is released from the mast cells and basophils. Its release causes vasodilation, increased capillary permeability and smooth muscle contraction. Antihistamine drugs block histamine receptor sites so histamine action cannot take place. So in this way they are effective on allergic rhinitis are runny nose and skin rashes.

- ◆ **Explain why a transplant recipient is given immune suppressant drugs and determine what implication does this has on his life.**

Organ transplantation has become a routine procedure due to improvement of surgical techniques, better tissue typing and the availability of drugs that more selectively inhibit rejection of transplanted tissues and prevent the patient from becoming immunologically compromised. Transplant rejection occurs as a delayed hypersensitivity rejection as a function of lymphocytes and not due to antibodies immunosuppressive drugs has side effects like pain diarrhea leucopenia sepsis s, thrombocytopenia, skin rashes, anaphylactic reaction, hypertension, hyperkalemia and neurotoxicity (tremors, seizures, hallucination). Hence, each system is affected, so the person starts of feel weakness and gets fatigue easily.

Science, Technology and Society Connections

Describe malignant melanoma as due to the inability of tumour-infiltrating lymphocyte (TIL) to control the tumour of skin cancer and correlate it with the scientific" c advancements of inserting a gene of tumour necrosis factor in the lymphocyte.

Cancer starts when cells in the body begin to grow out of control. Melanoma is a Cancer that usually starts in the melanocytes a type of skin cell. Melanomas can develop anywhere on the skin, but they are more likely to start on the trunk (chest and back) in men and on the legs in women. The neck and face are other common sites. The cancerous growths develop when unrepaired DNA damage o skin cells (most often caused by ultraviolet radiation from sunshine or tanning beds) triggers mutations (genetic defects) that lead the skin cell to multiply rapidly and form malignant tumours. These tumours originate in the pigment-producing melanocytes in the basal layer of the epidermis. Tumour-infiltrating lymphocytes are believed to represent the immune reaction/response to melanoma cells. Tumour (tumor)-infiltrating lymphocytes (TIL), are white blood

cells that have left the bloodstream and migrated into a tumour. They are mononuclear immune cells, a mix of different type's cells (i.e. T cells, B cells, NK cells, macrophages) in variable proportions, T cells being the most abundant cells. They can often be found in the stroma and within the tumour itself.

TILs are not strong enough to control certain types of tumors e.g. malignant melanoma. For the gene therapy of malignant melanoma first the TIL cell are removed from the patient and reinserted a gene that codes for the protein tumour necrosis factor (TNF). The protein kills tumour cells by preventing them from establishing a blood supply. The engineered TIL cells were then returned to the patient blood stream to seek out and invade the malignant melanoma tumours.

Science, Technology and Society Connections

- ◆ **Describe the discovery of monoclonal antibodies and justify how this accomplishment revolution many aspects of biological research.**

In 1970 Cesar Milstein and Georges Kohler working in Cambridge solve the problem of developing a technique for producing monoclonal antibodies, for which they were awarded Nobel Prize in 1984. Monoclonal means belonging to one clone. Each type of antibody is made by one type of B cells which cloned itself, in other words multiplies make many identical copies of itself in response to a particular antigen. Milstein and Kohlar fused B cells with cancer cells, which are immortal to form hybridoma cells. The hybridoma cells continue to multiply and can be cloned so that large quantities of antibodies can be produced. Monoclonal antibodies are harvested from cell cultures rather than animals. The ability to make monoclonal antibodies has been spawned a new industry. A

common area of application is medical diagnosis. Monoclonal antibodies are used for determining pregnancy and for diagnosing diseases such as hepatitis, rabies cancer, streptococcal throat infections, herpes viruses, leukemias (cancers of white blood cells) and lymphomas etc. A monoclonal antibody has been developed which is very effective at preventing rejection of transplanted kidneys. Monoclonal antibodies can be used to find out the types of antigens present in the donor and increase the accuracy of matching.

Science Titbits

A group of antimicrobial proteins called **defensins** is secreted by activated macrophages. These small proteins damage broad groups of pathogens by various mechanisms without harming the body cells.

Activity

1. Recognizing phagocytes and lymphocytes while observing prepared slides.

