5.4 DEFENCE AGAINST INFECTIOUS DISEASE

5.4.1 Explain how skin and mucous membranes act as barriers against pathogens.

A diagram of the skin is not required.

The best way to prevent disease is to prevent the pathogens from entering the body. The skin plays a major role in this. When unbroken, it is almost impossible for any microorganism to penetrate. Weak points are those where we are not protected by skin. Most of these areas have defenses of their own. Mucus is an often used barrier. It traps microorganisms and prevents further entry.

Lungs: mucus and cilia which transport the mucus to the throat.
Stomach: very acid environment.
Eyes: tears contain lysozymes (enzymes which destroy bacterial cell walls).
Vagina: mucous and acidic environment.

5.4.2 Outline how phagocytic leucocytes ingest pathogens in the blood and in body tissues.

Details of the sub-divisions and classifications of phagocytes are not required.

Despite all of the above measures to keep pathogens out of the body, many of them do manage to get in. This is called infection (a successful invasion of the body by pathogens) but does not always lead to disease. Leucocytes (white blood cells) are the body's defense against pathogens after they have entered. They can be found in the blood but also in the body's tissues, e.g. lungs. Several different kinds of leucocytes exist, some of which are phagocytic, i.e. they simply will 'eat' (**phagocytosis**) any cell which is not recognised as 'body own' (determined by the 'code' on the outside of the cell surface membrane)

5.4.3 State the difference between antigens and antibodies.

5.4.4 Explain antibody production.

Antigen: a molecule recognised as foreign by the immune system.
Antibody: (also known as 'immunoglobulin') a globular protein that recognises an antigen.

Antibodies have several ways of dealing with antigens. One common method is to gather several antigens and lump them together. This interferes with the microorganism's usual life cycle by making them a better target for the phagocytic leucocytes.

Antibodies are produced by the **B-lymphocytes** or **B-cells**. These are one kind of leucocytes (white blood cells). All blood cells are produced in the bone marrow. B-lymphocytes also differentiate in the bone marrow before moving to the lymph nodes.

When an antigen has entered the body, a phagocytic leucocyte will ingest the invader and travel to a B-cell in the lymph nodes. Here the phagocytic leucocyte will present the antigen to the B-cell. The presence of another leucocyte (a T helper cell) will then cause the B-cell to clone itself many times. A few of these cloned cells will remain as memory cells but the majority differentiate into plasma cells. Plasma cells secrete large amounts of (only one kind of) antibodies which are released into the lymph, which drains into the blood.

Memory cells are kept so that the antibody production will be faster at the next invasion of the same antigen.

A B-cell, and its subsequent clones, will be able to produce only one kind of antigen.

T-cells also originate from the bone marrow but travel to the thymus in an immature state and mature there. Two different kinds of T-cells develop: T helper cells and cytotoxic T cells. The T helper cells play a role in the production of antibodies by B-cells. T helper cells interact with the phagocytes and the B-cells to come to the production of the correct antibodies. Cytotoxic T cells directly kill pathogens in what is known as the **cell-mediated response.**

5.4.5 Outline the effects of HIV on the immune system.

The effects of HIV should be limited to a reduction in the number of active lymphocytes and a loss of the ability to produce antibodies.

Acquired Immune Deficiency Syndrome (**AIDS**) is caused by the Human Immunodeficiency Virus (**HIV**). People can become infected with the HIV virus in several ways:

- sexual contact.
- blood contact: contaminated hypodermic syringes.
  transfusion of blood/blood products.
  mother to foetus via placenta.
- mother to child via breast milk.

When the HIV virus infects a person, the virus will specifically infect and destroy the T-helper cells (lymphocytes). This interferes with the specific defence (the ability to produce antibodies, see section 5.4.4) and often leads to a number of 'opportunistic diseases' like rare forms of pneumonia and skin cancer.