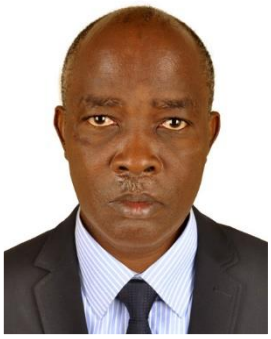

Dr. Bbosa Science

Defense against Diseases

Every animal is equipped with a complex system of defense mechanism which are designed it to withstand attacks by pathogens (bacteria, fungi and viruses) and to remove foreign materials form its system.

Prevention of entry

(a) The hard, keratinized outer layer of skin protect the body from entry of bacteria.
(b) the trachea and gaseous exchange surfaces are protected by mucus and the beating of cilia towards the throat to remove foreign particles
(c) the stomach is protected by the acid that kills bacteria which come with food.
(d) the eyes are protected by tears that contain enzymes lysozyme which split bacterial cell wall.
(e) the vagina is protected by mutualistic bacteria that secrete lactic acid making the vaginal fluids acid which provide unfavorable condition for many pathogens.
(f) entry through wounds is prevented by blood clotting.

Antisepsis and asepsis

These artificial devises and technics aimed at elimination or prevention of entry of pathogens into the body.

(i) Sterilization by heat.
(ii) Use of solutions called antiseptics that kill microorganism.
(iii) Aseptic techniques which ae aimed at eliminating germs from the environment altogether such as wearing sterilized clothes in the hospital theatre, keeping the theatre clean and leaning with disinfectants and detergents.

The immune system

This deals with microorganism that gain entry into the body. Immunity has been defined as by Sir MacFarlane Burnet as “the capacity of the body to recognize the intrusion of material foreign to the body and to mobilize cells and cell products to help remove that particular sort of foreign material with greater speed and efficiency.

The simplest component of the immune systems are the cell which engulf and digest foreign materials in blood and tissues in the same way as amoeba engulfs and digests its food by phagocytosis.

Phagocytosis
It is carried out by white blood cells called phagocytes; **Neutrophil** and **microphages**. Neutrophil (60% of white blood cells) are made in the bone marrow. They move about in contact with the endothelium of blood vessels where they ingest and digest bacteria.

The neutrophils can squeeze between the cells lining the capillaries and migrate into the tissue. They wander through tissues to the site of infection attached by chemicals released by microorganisms and the local tissue cells (chemotaxis)

Macrophages develop from another type of white blood cells in blood called monocytes which make up 6%of blood. Monocytes are made in the bone marrow and after circulating in the blood for one or two days, they squeeze through the cell lining the capillaries and migrate into tissues where they become macrophages. Proteins assist the macrophages to recognize the pathogen and are called complement.

Large invaders such as tape worm, flukes and nematodes are dealt with by special types of white blood cells called eosinophils which are capable of producing large and powerful enzymes capable of breaking down the body walls of flukes and other such parasites. At the same time basophils (another type of white blood cells) and mast cells produce chemical substance which stimulate the immune system to mount an attack against these invaders at the site of infection.

Natural immunity
This immunity is nonspecific; the cells responsible for it (phagocytes, eosinophil, mast cell) cannot distinguish between one type of microorganism and another. Phagocytes, for example, will engulf any foreign cell that they encounter provided it is “labelled| for them and non-adaptive [response is the same no matter how many tomes a person is infected with the same type of microorganism. Natural immunity does not improve if the same microorganism gets into the body a second time or more.

Adaptive immunity/acquired immunity

This is different from natural immunity in the following ways.

a. It is **specific**, that is, different types of cells responsible for it can distinguish between different types of microorganism.
b. It has a **memory**, which enables its cells to produce an enhanced response to repeated infection by the same type of microorganism.
c. It is brought about by lymphocytes because they are abundant in the **lymphatic response**, particularly **lymph nodes**.

There are two types of lymphocytes in blood and lymph: B lymphocytes and T-lymphocytes also called B-cell and T cells respectively for short)

B lymphocytes
The b lymphocytes originate in the bone marrow. Any substance that initiate an adaptive immune response is called antigen. It may be a pathogen or its toxic product, or various non harmful molecules and cells such as pollen and ampicillin. When a B lymphocyte encounters an antigen it produces **antibody** a specific protein molecule called **immunoglobulin**. The antibody combines with antigen and helps to eliminate it from the body. What makes B lymphocytes so remarkable is that they can produce highly specific antibodies against a vast number of different types of antigen.

T lymphocytes
These look exactly like B lymphocytes but they do not produce antibodies. The T lymphocytes also originate in the bone marrow but they have to pass through the thymus gland during their maturation. They are responsible for what is called **cell-mediated immunity**. T lymphocytes are more varied in their action than B lymphocytes, they have to make contact with their matching antigen before they can start work. They have special receptors on their surface which enable them to recognize the correct antigen.

a. T helper cell help other cells in the immune system. For example, they stimulate B lymphocyte to divide into antibody producing cells. If these helper cells are not present, the B lymphocytes cannot go into action. They also enhance the action of phagocytes. It is the T helper cells which are invaded by HIV.

b. T suppressor cells suppress other cells in immune system. They have opposite effect of T-helper cells on B lymphocytes and phagocytes. They act as brakes in immune system, dampening it down and preventing from over reacting.

c. T killer cell destroy cells infected with viruses before the viruses have time to proliferate. They also attack cells from other individuals if they get into the body, and in doing so they cause the rejection problems associated with skin grafts and transplant surgery. T killer cells are regulated in the same way as B cells by the T helper and T suppressor. Together, the T helper and T suppressor cells regulate and control the production of antibodies by the B cells and enhance or suppress the action of phagocytes. T cells also secrete short-lived messenger proteins called **lymphokines** which activate or suppress every aspect of the immune response. One of their functions is to stimulate macrophages to engulf other cells much more readily. This enables the macrophages to attack bacteria which invade the immune system and fight fungal infection and tumors.

   One group of lymphokines are called interferons. These are effective against a wide range of viruses and they work by inhibiting the protein-making machinery of the infected cells so that viruses cannot proliferate. They also stimulate changes in infected cells which makes them resistant to the viruses.

Immunity and immunization

Immunity is the ability of the body to resist infections. The type of immunity by antibodies is called active immunity because they body makes its own antibodies in response to arrival of antigen.

During the development of a mammal, a certain number of antibodies pass from the mother to the fetus via the placenta or after birth via the milk. This confers **passive immunity** on the younger animals at any rate for a short time after birth. The human infant, for example, may be protected from diseases such as measles and poliomyelitis as a result of passive of passive immunity; and this one is an advantage of breast feeding.

Active artificial immunity
This can be established by introducing a small quantity of antigen, the **vaccine**, into the body (immunization). This activates the appropriate antibody producing cells that multiply and fight that particular organism in case it enters the body. For example, poliomyelitis.

Vaccine used today, however, usually involve the use of weakened (attenuated) form of the virus or bacteria. Attenuated microorganism will not cause disease but it stimulates the immune system to produce antibodies against it. The BCG vaccine, which gives protection against TB is an example.

Passive artificial immunity
In passive **artificial immunity**, a person receives antibodies against a certain disease form the outside source and is not induced to make them. The antibodies are usually prepared by injecting antigens responsible for the disease into a suitable animal or by extracting the antibodies from the blood stream of a person who is already making them. The drawback with this procedure is that the protection, though immediate, is relatively short lived.

Chemotherapy and antibiotics
Chemotherapy is the use of chemical substances, natural or synthetic, that kill or prevent the production of microorganisms in the body. The term is now extended to include the inhibition of dividing malignant cell in cancer. The chemical substances are called chemotherapeutic agents. Some of these substances such as penicillin are secreted by microorganism and are selectively toxic to other microorganism in which case they are called antibiotics.

Problems arising from immune system
1. Allergy: this is a group of unpleasant symptoms which result from an excessive immune responsible or hypersensitivity. These symptoms include bouts of sneezing, running nose, itchy eyes, fever and so on. Allergies can be induced by a variety of agents such as grass pollen, cut fur, fungal spore, certain drugs and food, or as a result of an insect bite
2. Rejection of transplanted tissue.

Blood groups, the ABO system
The entire human population can be divided into four groups on the on the basis of the reaction between the blood group of different individuals when mixed together. These groups are called A, B, AB and O and are known as collectively as the ABO system. The capital letter stands for different types of glycoprotein present on the surface of person's red blood cells. These glycoproteins are antigen, similar to those found on the surface of bacteria. We all make antibodies against foreign antigens, but not of course against those on our own red blood cell.

The antibodies are called anti-A and anti-B. if an individual has a particular antigen on the red cells, the corresponding antibody is not present in plasma. Thus a person belonging to blood group A has red cells with antigens A on them; the plasma does not contain anti-A antibody; but it does contain Anti B antibodies. A person belonging to blood group B, has B antigens on the red cells and plasma contains anti-A antibody only. In blood of blood group AB, the red cells carry both antigen A and B and neither antibodies are present in plasma. Group O blood has neither antigen but both antibodies. When blood of different kind, say, A and B mixed. They agglutinate or form chimps which may block the recipients blood vessel. For instance, if blood of group A is given to a patient of blood group B, the anti-A antibodies in the patient's blood will cause agglutination of the donors' red cells because they carry the A-antigen. It does not matter that the donor's antibodies (anti B) are incompatible with the recipient's antigen B because the recipient receives relatively little blood and the dilution effect minimizes agglutination. The table below summarizes what happens when blood of different groups are mixed.

	Oab	Ab	Ba	AB
Oab	-	-	-	-
Ab	+	-	+	-
Ba	+	+	-	-
AB	+	+	+	-

+ agglutination
- No agglutination
Capital letter- antige
Small letter - antibody

A universal donor (group O) can give blood to a recipient of any blood group without causing agglutination.

A universal recipient (group AB) receives blood from any donor of any group without agglutination. In practice blood transfusion are normally carried out using blood from the same group as the of the recipient. The group to which sample of blood belong is determined by a compatibility test.

The Rhesus system

In addition to the ABO system, there are many other antigens on human red blood cells. One of these is the Rhesus antigen, so called because it was first identified by injecting rabbits with read blood calls obtained from the rhesus monkey. The majority of people possess red blood cells with the Rhesus positive antigen present, and they are known as Rhesus positive (Rh^+). The remainder lack the rhesus antigen and are called rhesus negative (Rh^-).

1.	2010/1/39	Which one of the following couple is likely to produce a fetus suffering from fatal crythroblastosis? A. Rh^+ mother and Rh^- father B. Rh^- mother and Rh^- father C. Rh^+ mother and Rh^+ father D. Rh^- mother and Rh^+ father
2.	2007/1/10	When a fetus receives antibodies from the mother through the placenta, it

		acquires A. Active immunity B. Long-term immunity C. Passive immunity D. Artificial immunity
3.	1999/1/36	Which one of the following is not the method by which antibodies attack antigen? A. Engulfing B. Agglutination C. Lysis D. Absorption on surface
4.	1998/1/9	Which one of the following are target cells for the HIV (AIDS virus)? A. Erythrocytes B. Thrombocytes C. Lymphocytes D. Phagocytes
5.	1996/1/37	Which of the following statement about immunity is incorrect? A. Heat killed bacteria become antibodies when injected into an animal. B. Antibodies are special proteins C. Antibodies are produced against specific antigen D. Antigens can be molecules on foreign microbe

a. The biochemical property of blood essential for its protective function of the body is the

A. ability to clot.

B. possession of antibodies.

C. presence of hemoglobin.

D. possession of white blood cells.

The answer is B

Antibodies are important biochemical constituents of blood that are necessary for protecting the body against invasion by foreign microbes that may cause disease.

29. The biochemical property of blood essential for its protective function of the body is the

A. ability to clot.

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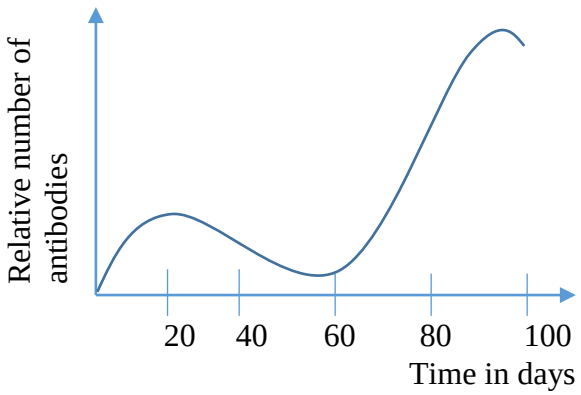
D. possession of white blood cells.

Structured Questions		
1	2008/1/46	The figure below shows the immune response of a person's blood after vaccinations are given on day one and 60days later.  (a) What is the effect of giving immunization to an individual? (1Mark) …… …… (b) From the graph, state the type of immunity acquired by the individual, giving a reason. (2marks) …… …… …… …… (c) Explain the shape of the graph (04marks) …… ……

		…… …… …… …… (d) Describe three ways in which antibodies combat antigens (3marks) …… …… …… ……