Which diseases have you had? Tick them in the list below.
Which ones have you had more than once?
Why do you think you can catch some diseases more than once?
Find out what diseases you have been vaccinated against.
Do you know what has happened inside your body as a result of these vaccinations?

<table>
<thead>
<tr>
<th>Disease</th>
<th>I’ve had it once</th>
<th>I’ve had it more than once</th>
<th>I’ve been vaccinated against</th>
</tr>
</thead>
<tbody>
<tr>
<td>chicken-pox</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cholera</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>common cold</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>diphtheria</td>
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<td></td>
<td></td>
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<tr>
<td>flu</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>german measles/rubella</td>
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<td></td>
<td></td>
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<tr>
<td>hepatitis</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>measles</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>mumps</td>
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<td></td>
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<tr>
<td>polio</td>
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<td></td>
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<tr>
<td>rabies</td>
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<td></td>
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<tr>
<td>tetanus</td>
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<td></td>
<td></td>
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<tr>
<td>tuberculosis</td>
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<td></td>
<td></td>
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<tr>
<td>typhus</td>
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<td></td>
<td></td>
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<tr>
<td>whooping cough</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>yellow fever</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Read the passage and find the words matching the definitions.

1. animal or plant on which a parasite lives - __ T
2. substance which catalyzes chemical reactions in living things - __ E
3. substance produced in an animal’s body and carried by the blood to an organ which it stimulates, to assist growth, etc. - __ O __
4. white blood cell - _ _ U _______
5. large white blood cell capable of absorbing bacteria - _______ H ___
6. marked by only slight abnormality and not being such as to give rise to visible symptoms – S ______________
7. medical procedure used to prevent a person from getting a disease - __________ T ___
8. thing that produces a reaction in living things – __________ U __
9. powder formed in flowers, which fertilizes other flowers when carried to them by the wind, insects, etc. - _______ E __
10. long legless crawling reptile - ___ K ___
11. ability of developing and surviving independently – V __________
12. ability to cause the body to produce antibodies - ______________ Y
13. serious contagious disease of the throat causing difficulty in breathing - ___ H _______
14. disease in which the muscles contract and stiffen - ______ U ___
15. poisonous substance produced by bacteria causing disease - __ X __
16. white blood cell capable of absorbing bacteria - ______ Y __
17. by artificial means - __ _____ O

**Immunity**

Immunity is a very important factor in warding off infection. It is usually due to the antagonism between pathogens and specific substances known as antibodies, which are formed by the body in response to stimulation by foreign substances called antigens. Antibodies are usually specific for a given organism. Although they may occur “naturally”, they are customarily manufactured by the host in response to a stimulus provided by a pathogen, or a part of it, in the body.

The animal body has three lines of defense that must be overcome by a pathogen before it can establish an infection. The first line of defense is largely mechanical, but chemical factors are also involved.

Mechanical barriers include the unbroken skin and mucous membranes. Coughing, sneezing, shedding tears, perspiring, and salivating provide mechanical flushing that removes microorganisms. In addition to the mechanical action of mucus, saliva and tears
in removing bacteria, some of these secretions contain substances that inhibit or even destroy microorganisms. An example is lysozyme, an enzyme found in many body fluids and secretions, which has a mild but effective antimicrobial action. Other enzymes and hormones may produce chemical, physiological, or mechanical effects that reduce susceptibility to infection. The acidity or alkalinity of some body fluids has a deleterious effect on many microorganisms, and along with the other factors mentioned, it helps to prevent potential pathogens from entering the deeper tissues of the body.

The second line of defense is cellular (phagocytosis). If microorganisms succeed in passing the barriers imposed by the first line of defense and enter the deeper tissue, they are attacked by specific cells of the body which may ingest and destroy them. These cells are called phagocytes.

Injury to body tissue results in a process known as inflammation, which indicates an attempt on the part of the body to localize and destroy injurious agents and repair damage. In this reaction an exudate is formed as a result of the accumulation of serous fluid and leucocytes in the area. When this happens, there are swelling, heat, tenderness, pain, and red coloring of the site. Phagocytes engulf and destroy invading microorganisms, but in the process many leucocytes and macrophages as well are destroyed. The material that accumulates as a product of inflammation consists largely of serum and leucocytes and is called pus.

Active immunity results when antibodies are produced by the cells or tissues of the host as a result of contact with microorganisms or their products. This type of immunity is of relatively long duration, ranging from a period of a few months to many years, depending on the type of antigen used to stimulate antibody production.

Active immunity may be acquired by natural means while an individual is recovering from an infectious disease or it may be conferred by inapparent or subclinical cases of these disease. Active immunity may also be acquired artificially by injection of an antigen into the body of the host, as in vaccination. Today we are protected against many infectious diseases by inoculations with suitable antigens in the form of vaccines or toxoids.

Passive immunity is conferred when blood serum containing antibodies produced by another person or animal is injected into an individual whose body does not participate in the process of antibody production. Since no antigen is introduced, there is no stimulus for producing antibodies; and as a result, passive immunity is of short duration.

Passive immunity may be acquired naturally by an infant in utero by placental transfer of antibodies from the mother's blood. Thus the infant is protected against infectious diseases. This type of immunity lasts from six months to a year.

**Antigens**

Any substance which, when introduced into the body, gives rise to the production of antibodies is an antigen. Chemically, antigens may be proteins or polysaccharides, complex lipoids, and certain other substances that combine with proteins. Usually they are substances foreign to the body in which they act to produce the antibody response. Many substances may act as antigens: bacteria, viruses, and other microorganisms; foreign proteins such as pollens, egg white, and metabolic products of microorganisms; and cells from a different animal species.

The antigens with which we are primarily concerned are those of microbial origin. The exotoxins produced by Corynebacterium diphtheriae, Clostridium tetani, certain other microorganisms, and venom from snakes and insects are potent antigens that stimulate the production of antibodies capable of protecting against infection and useful in diagnostic tests. Fungi, however, are not strongly antigenic. Heat or chemical treatment destroys the viability of most microorganisms without necessarily decreasing their antigenicity.
Vaccines and toxoids
Vaccines, which are suspensions of killed, living, or attenuated (having weakened virulence) cultures of microorganisms, are used as antigens to produce immunity against infection due to a particular microorganism.
Toxoids are made by destroying the poisonous portions of toxins without altering the antigenic portion. Toxoids are used antigenically for protecting individuals against diphtheria, tetanus, and other diseases caused by toxins or toxin-producing microorganisms.

Antibodies, the third line of defense
In addition to phagocytes, blood contains antibodies for the purpose of defending the body from infection. Antibodies are specific substances formed by the body in response to stimulation by specific foreign and protein-like substances called antigens. Antibodies react against specific microorganisms, their toxic products, and other chemical compounds. They can be used in the treatment of infection caused by the homologous microorganism, and, more importantly, they prevent infection and disease caused by these agents. Antibodies are designated by names that describe their reaction in vitro and sometimes in vivo, when they are allowed to act on certain types of antigens. These names are 1) antitoxins, which neutralize toxins; 2) agglutinins, which cause clumping of the bacterial cells or other soluble antigens; 3) precipitins, which cause precipitation or flocculation of extracts of bacterial cells or other soluble antigens; 4) lysins, which cause dissolution of bacterial or other cells that are specifically sensitive to their action; 5) opsonins, which render microorganisms more susceptible to ingestion by phagocytes. These antibodies are all produced as a result of antigenic stimulus and are present in blood serum. They are called humoral antibodies.

Complement
Complement is a substance in normal blood serum that is detrimental to bacteria. It is not a true antibody; rather, it enhances the activity of antibodies. Complement is present in the blood serum of all normal individuals but varies in amounts in different species and in individuals of the same species. Unlike antibody, it is not specific and does not increase on immunization. Since it is heat labile, it is destroyed by heating to 56°C for a few minutes. It is not specific for a particular antigen.

From: Pelczar - Reid, Microbiology, McGraw - Hill

Questions about the text.
1. What are antibodies?
2. What is the first line of defense of an animal body?
3. What are the mechanical barriers of the first line of defense?
4. Which chemical factors may act as a barrier against microorganisms?
5. What happens in the process of phagocytosis?
6. What happens in the process of inflammation?
7. When does active immunity occur?
8. How is natural active immunity acquired?
9. How is artificial active immunity acquired?
10. How is passive immunity conferred?
11. Why is it of short duration?
12. How can natural passive immunity be acquired?
13. What is an antigen?
14. What substances may act as antigens?
15. Can you give some examples of antigens of microbial origin?
16. What are vaccines?
17. What are they used for?
18. How are toxoids made?
19. What do antibodies react against?
20. What are the different groups of antibodies?
21. What is complement?
22. What is the difference between complement and antibodies?

Use the words in the box to complete the short summary of the reading passage.

active antibodies blood serum capable disease infection injection lymphocytes measles milder no passive pathogen prevented protection ready-made recovered stimulates symptoms time vaccination

If you are immune to a _____________ it means that you are ________________ of rapidly fighting off the disease pathogen. You gain immunity by having ________________ which destroy specific pathogens. Special ________________ produce antibodies the first time a pathogen enters the bloodstream. It will be a ________________ antibody to tackle a particular type of pathogen. For example, the antibody that deals with the measles virus will have ________________ effect on the polio virus. The antibodies stay in your blood after you have ________________ from the infection. If the same type of ________________ attacks you in the future your antibodies are waiting for it. The pathogens are destroyed before they can cause any ________________. You usually only suffer once from diseases such as mumps or ________________ because a second infection is ________________ by the antibodies that remain from the first infection.
You also gain immunity by ____________________. A vaccine contains a weakened or ____________________ form of the pathogen which ____________________ the body to produce antibodies. This is called ____________________ immunity. It takes some ____________________ for active immunity to build up after the injection. If immediate protection is needed ____________________ antibodies can be injected. They can be obtained from the ____________________ of an animal that has made antibodies in response to an ____________________. If soil gets into a deep cut you can get instant ____________________ from tetanus bacteria by going immediately for an ____________________ of antibodies. This is called ____________________ immunity because it does not involve the active response of the body’s immune system.

LANGUAGE

Vocabulary

1. avoid
2. culminate
3. defeat
4. depend on
5. establish

Match verbs and synonyms.

1. avoid
2. culminate
3. defeat
4. depend on
5. establish

6. hold back
7. manage
8. occur
9. range

Match the words in the box into pairs of synonyms.

albumen clumping clustering egg white flushing injection inoculation perspiring poison rinsing sweating utero venom womb

BEFORE READING

CLASSROOM CHALLENGE

Who will be the quickest to match the terms below, all related to immunity, with the definitions?

1. active immunity
2. allergy
3. antibody
4. antigen
5. artificial active immunity
6. artificial passive immunity
7. autoimmunity
8. cell-mediated immunity
9. epitope
10. humoral immunity
11. immune response / reaction
12. immune system
13. immunization
14. natural passive immunity
15. passive immunity
16. phagocyte

☐ immunity involving the production of antibodies to neutralize and destroy the antigen
☐ immunity not involving the production of antibodies in which the antigen is attacked by other cells
☐ immunity in which antibodies are produced by the body as a result of stimulation by antigens
☐ immunity in which antigens composed of living, killed, or attenuated microorganisms, or toxic or detoxified products are injected into the body to stimulate antibody production
☐ immunity in which antibodies produced by an individual are transferred to another
☐ immunity transferred to babies from an immune mother by placental transfer or by colostrum
☐ immunity conferred by injection of blood serum from an immune human or animal
☐ medical procedure that enables a person to develop immunity to specific pathogens
☐ diffused organ which protects the identity of the body
☐ the body’s production of disease-fighting cells and antibodies
☐ foreign substance which penetrates the body causing an immune reaction
☐ protein molecule manufactured by B-lymphocytes to neutralize or destroy antigens
☐ antigenic determinant, small patch of the surface of an antigen at which an antibody molecule binds
☐ cell which devours microorganisms which penetrate through the broken skin
☐ excess immune reaction caused by substances like pollens, foods, drugs, etc., which are not usually considered antigens
☐ condition in which the immune system recognizes and attacks the self’s own tissues

If you haven’t been able to match all the words and definitions, read the passage The Immune System on the next page, it will help you!
The immune system

The life of every organism is constantly threatened by other organisms – this is the nature of the living world. In response, each species has evolved protective mechanisms, varying from camouflage colors, to poisons, to effective running muscles. From their continual battle with microorganisms, vertebrates have evolved an elaborate set of protective measures called, collectively, the immune system. The word “immune” (Latin immunis, meaning “exempt”) implies freedom from a burden: an animal that is immune to a specific infecting agent will remain free of infection by that agent.

The study of the immune system constitutes the discipline of immunology.

The immune system works by a learning process. Our first encounter with a bacterial, fungal, protozoan or viral pathogen leads to an infection, often accompanied by disease symptoms. The immune system aids in recovery from the infection, and after recovery, we usually remain free of that disease forever. Our immune system has learned to recognize this specific pathogen as a foreign infecting agent; should it attack us again, it will be rapidly killed.

A key process carried out by the immune system is recognition. The system must recognize the presence of an invader. It must also be able to discriminate between foreign invaders and the natural constituents of the body: we call this discrimination between nonself and self. The importance of this is underscored by disorders in which such discrimination fails. Such disorders are known as autoimmune diseases, and the most severe ones can be fatal.

The recognition of a foreign invader is only the first step of the immune system’s attack; it must be followed by steps that will kill and eliminate the invader. Thus the immune system carries out two types of activities: recognition processes directed against individual, discrete aspects of a target, and destructive responses that follow from the recognition and allow the system to mount an attack against the invader. Precise recognition is the function of cells called lymphocytes while destruction is carried out both by lymphocytes and by cells called macrophages and neutrophils.

The immune system also has other abilities besides the recognition and killing of invading pathogens. It can kill cancer cells and, in experimental animals at least, it can protect the body against certain tumors. (How active the immune system is against tumors is still a debated question.) The immune system also prevents tissue transplantation between individuals. This is because every vertebrate individual has a unique set of molecules on the surface of its cells. Its immune system recognizes those cells as self, but grafted cells from other individuals, even of the same species, are seen as foreign and are killed, or rejected. Inhibition of this rejection reaction is necessary whenever a surgeon attempts to graft a patch of skin or transplant a kidney from one person to another. Without
special treatment, the only transplants that are accepted without rejection reaction are those from an identical twin.

If we are to understand the immune system, we must answer some key questions. How does the system recognize the individuality of a specific pathogen? How does it discriminate foreign matter from endogenous material, nonself from self? How does it translate the recognition of a foreign invader into a killing reaction? How does it learn, so that the second attack by an invader is repulsed so much faster than the first? The answer to these questions are not fully known. While we understand, for instance, a great deal about how recognition develops, we know less about how the system avoids reacting with self-components.

The immune system works in three fundamentally different ways: by humoral immunity, by cellular immunity, and by secretion of stimulatory proteins, called lymphokines. The term “humor” refers to a fluid, and humoral immunity relies on molecules in solution in the body. These molecules are proteins collectively called immunoglobulin (abbreviated \( \text{Ig} \)). They constitute 20 per cent of the proteins in the blood. A single immunoglobulin molecule is called an antibody, but “antibody” is also used to mean many individually different molecules all directed against the same target molecule. Humoral immunity also involves complement, a set of proteins that are activated to kill bacteria both nonspecifically and in conjunction with antibody.

In cellular immunity, intact cells are responsible for recognition and elimination reactions. The body’s first line of defense is the recognition and killing of microorganisms by phagocytes, cells specialized for the ingestion and digestion of unwanted materials. These cells include neutrophils and macrophages. A key role of antibodies is to help phagocytes recognize foreign materials. There is also an important class of cells that carry antibody-like recognition molecules on their surface and can directly kill cells infected by microorganisms. Another class of cells carrying recognition molecules responds by secretion of limphokines that stimulate the activity of other immune system cells and therefore these cells act indirectly in the clearance of an infection.

The injection of almost any foreign macromolecular substance into an animal elicits the formation of both antibodies and immune cells that specifically bind to that substance. The cells that carry specific recognition molecules are called lymphocytes, while a substance that provokes antibody or lymphocyte formation, or is recognized by an antibody or lymphocyte, is called an antigen.

The invasion of the body by a potential pathogen that has not been previously encountered is potentially devastating for an organism and it cannot wait for an antibody response to develop, which takes days. The body has a number of lines of defense that come into play instantaneously. Phagocytic cells are activated by an encounter with a bacterial cell wall; they engulf the bacterium and kill it. Complement is also activated by the cell walls of pathogens, and it kills many invading pathogens. Cells that are infected with viruses make interferons; these proteins interact with receptors on neighboring cells, triggering a response that makes the cells poor hosts for further infection. These nonspecific reactions are critical: a mouse unable to respond to bacterial cell walls is super-sensitive to bacterial infection; a mouse without interferons receptors on its cells is rapidly killed by many viruses.

The nonspecific initial responses to infection are superseded by specific responses mediated by activated lymphocytes. Lymphocytes are activated either directly by the surface of a pathogen or indirectly by macrophages that digest a pathogen, carry its peptide fragments to their surface, and then present the peptides to the lymphocytes. Lymphocytes also respond to peptide fragments from viruses when these are present on the surface of infected cells. The lymphocytes recognize the foreign nature of these materials and initiate antibody formation.
The major function performed by an antibody is high affinity binding to an antigen. Hydrophobic forces, ionic forces, and van der Waals forces bind antibodies and antigens, but covalent bonds are not formed between them. The site on an antigen at which a given antibody molecule binds is called a determinant or epitope. The surface of a protein molecule provides many epitopes to which antibodies might bind. Some antigens, such as virus particles, have a repeating structure, with the same epitope on them many times. Such an antigen is said to be multivalent.


AFTER READING

CONTENT

Questions about the text.

1. Can you give examples of mechanisms evolved by organisms to protect themselves from other organisms?
2. What mechanism have vertebrate animals evolved to protect themselves against pathogenic organisms?
3. What is meant by being “immune” to an infecting agent?
4. What is immunology?
5. How does the immune system learning process work?
6. What are “nonself” and “self”?
7. What are autoimmune diseases?
8. What happens to foreign invaders when the immune system works properly?
9. What cells carry out recognition processes?
10. What cells carry out destructive responses?
11. Why does tissue transplantation between individuals cause a rejection reaction?
12. Does a rejection reaction take place in all tissue transplants?
13. What proteins does humoral immunity involve?
14. What are antibodies?
15. What is complement?
16. What are phagocytes?
17. What cells do phagocytes include?
18. What are lymphokines?
19. What are lymphocytes?
20. What is an antigen?
21. Is antibody production instantaneous when a pathogen enters the body?
22. What is the task of phagocytic cells?
23. What is the task of complement?
24. What are interferons produced by?
25. How are lymphocytes activated?
26. What is the main function of antibodies?
27. What forces bind antibodies and antigens?
28. What is an epitope?
29. What are multivalent agents?

LANGUAGE

Vocabulary

a  Match the nouns in the box into pairs of synonyms.

- camouflage disguise encounter great deal healing lot meeting objective recovery target

b

discrete distinct endangered fatal grafted harsh lethal severe threatened transplanted underlined underscored

c

- aid bind bring out carry out derive digest discriminate distinguish elicit engulf follow from forbid help perform prevent set substitute supersede tie trigger

d

- burden cancer destruction disease disorder fatal freedom infected invader poison poor protective threatened unwanted
Match the adjectives in the box into pairs of synonyms.
Match the verbs in the box into pairs of synonyms.
Which of the words in the box have a positive connotation, which ones have a negative connotation, which ones may have both depending on the context?

Grammar

Read again this sentence from the reading passage: “should it attack us again, it will be rapidly killed”. Conditions may be expressed by inversion of verb and subject. In the above sentence inversion of should and it has replaced the if-clause: “if it should attack ...”. Such replacement can be done whenever an if-clause contains one of the auxiliary verbs were, had or should. Replace the if-clauses in these sentences using inversion.

1. If you had asked me, I would have helped you.
2. If you were here now, you could explain the whole matter.
3. If anything should go wrong, call me immediately.
4. If it should be necessary, I will go.
5. If they had been vaccinated they wouldn’t have caught the disease.