Biyani Girls College, Jaipur

First Internal Examination 2019-20

B. Sc. I Year (BT)

Paper: Immunology

Time: 1:30 Hours **SET-A** **MM: 30**

All questions are compulsory.

Q1. Answer the following questions in very short: **1×7=7**

a). The ability of an organism to resist infections by pathogens is called……………..?

Ans: Immunity

b). Name the compound found in the saliva?

Ans: Amylase

c). Which antibody gives a primary immune response?

Ans: IgM

d). Inflammatory response in allergy is due to release by mast cell of ………………..?

Ans: Histamine

e). Write the antigen and antibody associated with blood group 'O'?

Ans: No antigen and antibody

f). Name the animal by which the Rh factor named?

Ans: Rhesus monkey

g). Segment of antigen that is recognized by the antibody is called…………………………?

Ans: Epitope

Q2. Explain the following terms with examples: **4×2=8**

a). Granulocytic Cells

Ans: Granulocytes are white blood cells that help the immune system fight off infection. They have a characteristic morphology; having large cytoplasmic granules, that can be stained by basic dyes, and a bi-lobed nucleus. Typically granulocytes have a role both in innate and adaptive immune responses in the fight against viral and parasitic infections. As part of the immune response, granulocytes migrate to the site of infection and release a number of different effector molecules, including histamine, cytokines, chemokines, enzymes and growth factors. As a result granulocytes are an integral part of inflammation and have a significant role in the eitology of allergies.

There are four types of granulocyte; basophils, eosinophils, neutrophils and mast cells.

1. Basophils: Basophils are the least common type of granulocyte, making only 0.5% of the circulating blood leukocytes. They are involved in a number of functions such as antigen presentation, stimulation and differentiation of $CD4^{+}$ T cells.

2. Eosinophils: Eosinophils make up approximately 1% of circulating leukocytes. Eosinophils play an important and varied role in the immune responses and in the pathogenesis of allergic or autoimmune disease.

3. Neutrophils: Neutrophils are the most abundant leukocyte found in human blood and form the vanguard of the body's cellular immune response.

4. Mast Cells: Mast cells are a type of granulocyte whose granules are rich in heparin and histamine. Mast cells are important in many immune related activities from allergy to response to pathogens and immune tolerance.

b). Spleen

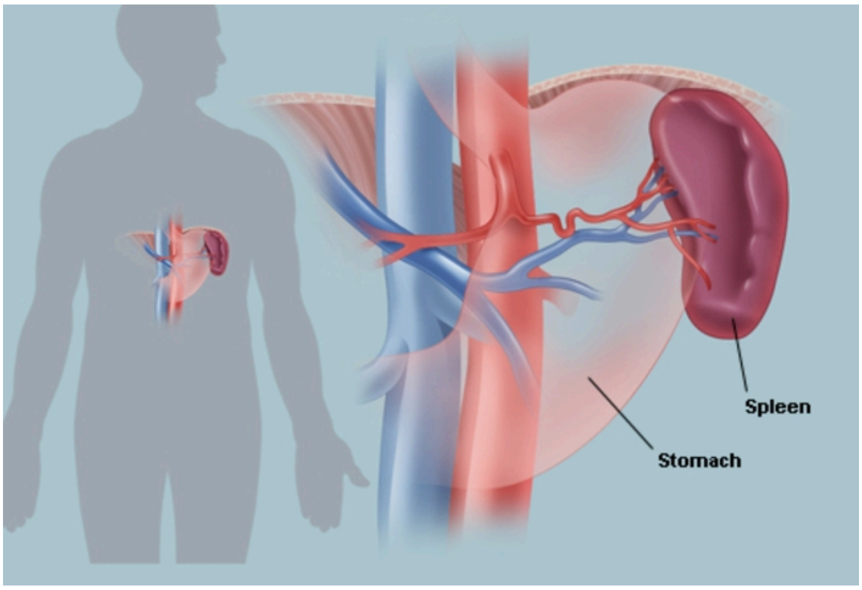
Ans: The spleen is an organ in the upper far left part of the abdomen, to the left of the stomach. The spleen varies in size and shape between people, but it's commonly fist-shaped, purple, and about 4 inches long.

The spleen plays multiple supporting roles in the body. It acts as a filter for blood as part of the immune system. Old red blood cells are recycled in the spleen, and platelets and white blood cells are stored there. The spleen also helps fight certain kinds of bacteria that cause pneumonia and meningitis.

Spleen Conditions

- Enlarged Spleen (Splenomegaly): An enlarged spleen, usually caused by viral mononucleosis ("mono"), liver disease, blood cancers (lymphoma and leukemia), or other conditions.
- Ruptured spleen: The spleen is vulnerable to injury, and a ruptured spleen can cause serious life-threatening internal bleeding and is a life-threatening emergency. An injured spleen may rupture immediately after an injury, or in some cases, days or weeks after an injury.
- Sickle cell disease: In this inherited form of anemia, abnormal red blood cells block the flow of blood through vessels and can lead to organ damage, including damage to the spleen. People with sickle cell disease need immunizations to prevent illnesses their spleen helped fight.

- Thrombocytopenia (low platelet count): An enlarged spleen sometimes stores excessive numbers of the body's platelets. Splenomegaly can result in abnormally few platelets circulating in the bloodstream where they belong.
- Accessory spleen: About 10% of people have a small extra spleen. This causes no problems and is considered normal.



Q3. Define Immunity? Describe the different barrier associated with Innate Immunity? **7**

Ans: The immune system comprises both innate and adaptive immune responses. Innate immunity occurs naturally because of genetic factors or physiology; it is not induced by infection or vaccination but works to reduce the workload for the adaptive immune response. Both the innate and adaptive levels of the immune response involve secreted proteins, receptor-mediated signaling, and intricate cell-to-cell communication. The innate immune system developed early in animal evolution, roughly a billion years ago, as an essential response to infection. Innate immunity has a limited number of specific targets: any pathogenic threat triggers a consistent sequence of events that can identify the type of pathogen and either clear the infection independently or mobilize a highly specialized adaptive immune response. For example, tears and mucus secretions contain microbicidal factors.

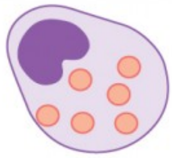
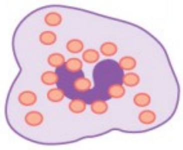
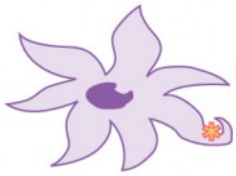
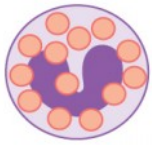
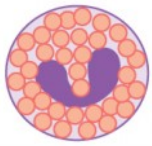
Physical and Chemical Barriers

Before any immune factors are triggered, the skin functions as a continuous, impassable barrier to potentially infectious pathogens. Pathogens are killed or inactivated on the skin by desiccation (drying out) and by the skin's acidity. In addition, beneficial microorganisms that coexist on the skin compete with invading pathogens, preventing infection. Regions of the body that are not protected by skin (such as the eyes and mucus membranes) have alternative methods of defense, such as tears and mucus secretions that trap and rinse away pathogens, and cilia in the nasal passages and respiratory tract that push the mucus with the pathogens out of the body. Throughout the body are other defenses, such as the low pH of the stomach (which inhibits the growth of pathogens), blood proteins that bind and disrupt bacterial cell membranes, and the process of urination (which flushes pathogens from the urinary tract).

Despite these barriers, pathogens may enter the body through skin abrasions or punctures, or by collecting on mucosal surfaces in large numbers that overcome the mucus or cilia. Some pathogens have evolved specific mechanisms that allow them to overcome physical and chemical barriers. When pathogens do enter the body, the innate immune system responds with inflammation, pathogen engulfment, and secretion of immune factors and proteins.

Pathogen Recognition

An infection may be intracellular or extracellular, depending on the pathogen. All viruses infect cells and replicate within those cells (intracellularly), whereas bacteria and other parasites may replicate intracellularly or extracellularly, depending on the species. The innate immune system must respond accordingly: by identifying the extracellular pathogen and/or by identifying host cells that have already been infected. When a pathogen enters the body, cells in the blood and lymph detect the specific pathogen-associated molecular patterns (PAMPs) on the pathogen's surface. PAMPs are carbohydrate, polypeptide, and nucleic acid "signatures" that are expressed by viruses, bacteria, and parasites but which differ from molecules on host cells. The immune system has specific cells, described in Figure, with receptors that recognize these PAMPs. A macrophage is a large phagocytic cell that engulfs foreign particles and pathogens. Macrophages recognize PAMPs via complementary pattern recognition receptors (PRRs). PRRs are molecules on macrophages and dendritic cells which are in contact with the external environment. A monocyte is a type of white blood cell that circulates in the blood and lymph and differentiates into macrophages after it moves into infected tissue. Dendritic cells bind molecular signatures of pathogens and promote pathogen engulfment and destruction. Toll-like receptors (TLRs) are a type of PRR that recognizes molecules that are shared by pathogens but distinguishable from host molecules). TLRs are present in invertebrates as well as vertebrates, and appear to be one of the most ancient components of the immune system. TLRs have also been identified in the mammalian nervous system.

Cell type	Characteristics	Location	Image
Mast cell	Dilates blood vessels and induces inflammation through release of histamines and heparin. Recruits macrophages and neutrophils. Involved in wound healing and defense against pathogens but can also be responsible for allergic reactions.	Connective tissues, mucous membranes	
Macrophage	Phagocytic cell that consumes foreign pathogens and cancer cells. Stimulates response of other immune cells.	Migrates from blood vessels into tissues.	
Natural killer cell	Kills tumor cells and virus-infected cells.	Circulates in blood and migrates into tissues.	
Dendritic cell	Presents antigens on its surface, thereby triggering adaptive immunity.	Present in epithelial tissue, including skin, lung and tissues of the digestive tract. Migrates to lymph nodes upon activation.	
Monocyte	Differentiates into macrophages and dendritic cells in response to inflammation.	Stored in spleen, moves through blood vessels to infected tissues.	
Neutrophil	First responders at the site of infection or trauma, this abundant phagocytic cell represents 50-60 percent of all leukocytes. Releases toxins that kill or inhibit bacteria and fungi and recruits other immune cells to the site of infection.	Migrates from blood vessels into tissues.	
Basophil	Responsible for defense against parasites. Releases histamines that cause inflammation and may be responsible for allergic reactions.	Circulates in blood and migrates to tissues.	
Eosinophil	Releases toxins that kill bacteria and parasites but also causes tissue damage.	Circulates in blood and migrates to tissues.	

Cytokine Release Affect

The binding of PRRs with PAMPs triggers the release of cytokines, which signal that a pathogen is present and needs to be destroyed along with any infected cells. A cytokine is a chemical messenger that regulates cell differentiation (form and function), proliferation (production), and gene expression to affect immune responses. At least 40 types of cytokines exist in humans that differ in terms of the cell type that produces them, the cell type that responds to them, and the changes they produce.

One subclass of cytokines is the interleukin (IL), so named because they mediate interactions between leukocytes (white blood cells). Interleukins are involved in bridging the innate and adaptive immune responses. In addition to being released from cells after PAMP recognition, cytokines are released by the infected cells which bind to nearby uninfected cells and induce those cells to release cytokines, which results in a cytokine burst.

A second class of early-acting cytokines is interferons, which are released by infected cells as a warning to nearby uninfected cells. One of the functions of an interferon is to inhibit viral replication. They also have other important functions, such as tumor surveillance. Interferons work by signaling neighboring uninfected cells to destroy RNA and reduce protein synthesis, signaling neighboring infected cells to undergo apoptosis (programmed cell death), and activating immune cells.

In response to interferons, uninfected cells alter their gene expression, which increases the cells' resistance to infection. One effect of interferon-induced gene expression is a sharply reduced cellular protein synthesis. Virally infected cells produce more viruses by synthesizing large quantities of viral proteins. Thus, by reducing protein synthesis, a cell becomes resistant to viral infection.

Phagocytosis and Inflammation

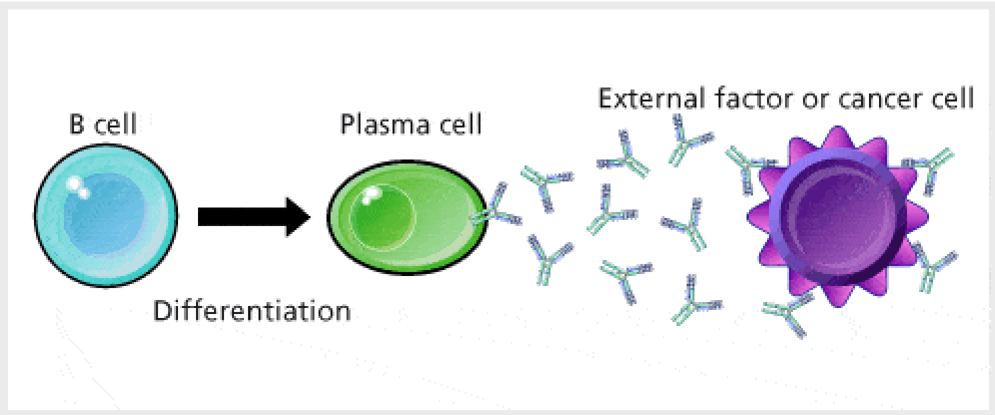
The first cytokines to be produced are pro-inflammatory; that is, they encourage inflammation, the localized redness, swelling, heat, and pain that result from the movement of leukocytes and fluid through increasingly permeable capillaries to a site of infection. The population of leukocytes that arrives at an infection site depends on the nature of the infecting pathogen. Both macrophages and dendritic cells engulf pathogens and cellular debris through phagocytosis. A neutrophil is also a phagocytic leukocyte that engulfs and digests pathogens. Neutrophils are the most abundant leukocytes of the immune system. Neutrophils have a nucleus with two to five lobes, and they contain organelles, called lysosomes, that digest engulfed pathogens. An eosinophil is a leukocyte that works with other eosinophils to surround a parasite; it is involved in the allergic response and in protection against helminthes (parasitic worms).

Neutrophils and eosinophils are particularly important leukocytes that engulf large pathogens, such as bacteria and fungi. A mast cell is a leukocyte that produces inflammatory molecules, such as histamine, in response to large pathogens. A basophil is a leukocyte that, like a neutrophil, releases chemicals to stimulate the inflammatory response. Basophils are also involved in allergy and hypersensitivity responses and induce specific types of inflammatory responses. Eosinophils and basophils produce additional inflammatory mediators to recruit more leukocytes. A hypersensitive immune response to harmless antigens, such as in pollen, often involves the release of histamine by basophils and mast cells.

Cytokines also send feedback to cells of the nervous system to bring about the overall symptoms of feeling sick, which include lethargy, muscle pain, and nausea. These effects may have evolved because the symptoms encourage the individual to rest and prevent them from spreading the infection to others. Cytokines also increase the core body temperature, causing a fever, which causes the liver to withhold iron from the blood. Without iron, certain pathogens, such as some bacteria, are unable to replicate; this is called nutritional immunity.

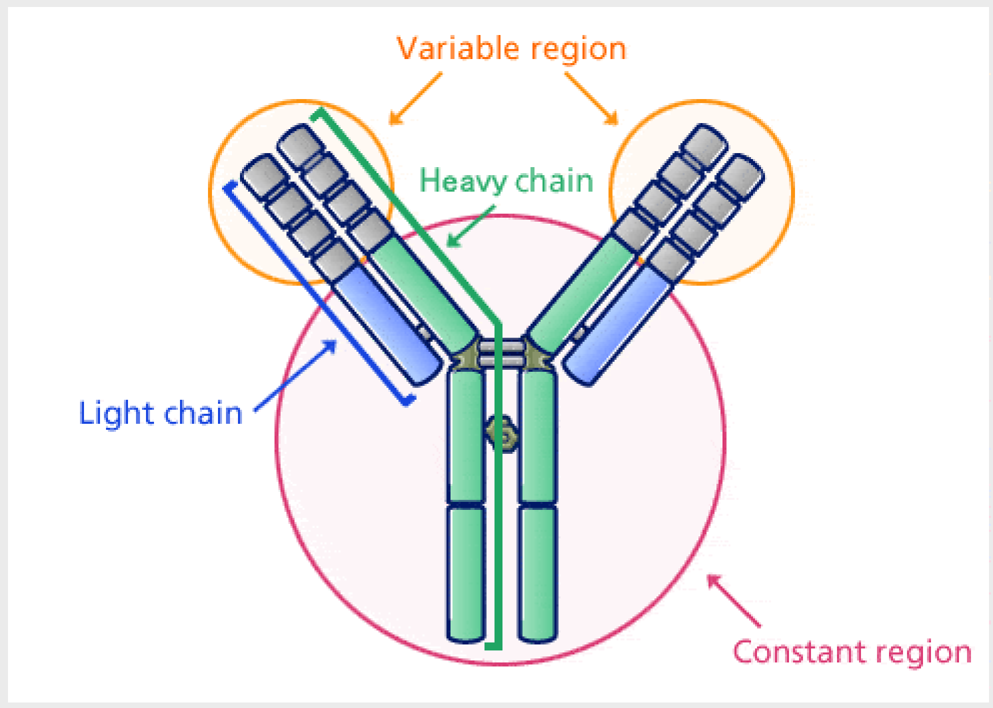
Q4. Define Antibody? Explain its Classes and their biological Activities? **8**

Ans: Antibody (Ab) also know as Immunoglobulin (Ig) is the large Y shaped protein produced by the body's immune system when it detects harmful substances, called antigens like bacteria and viruses. The production of antibodies is a major function of the immune system and is carried out by a type of white blood cell called a B cell (B lymphocyte), differentiated B cells called plasma cells. The produced antibodies bind to specific antigens express in external factors and cancer cells.



Structure of Antibody

Antibodies are heavy (~150 kDa) globular plasma proteins. The basic structure of all antibodies are same.

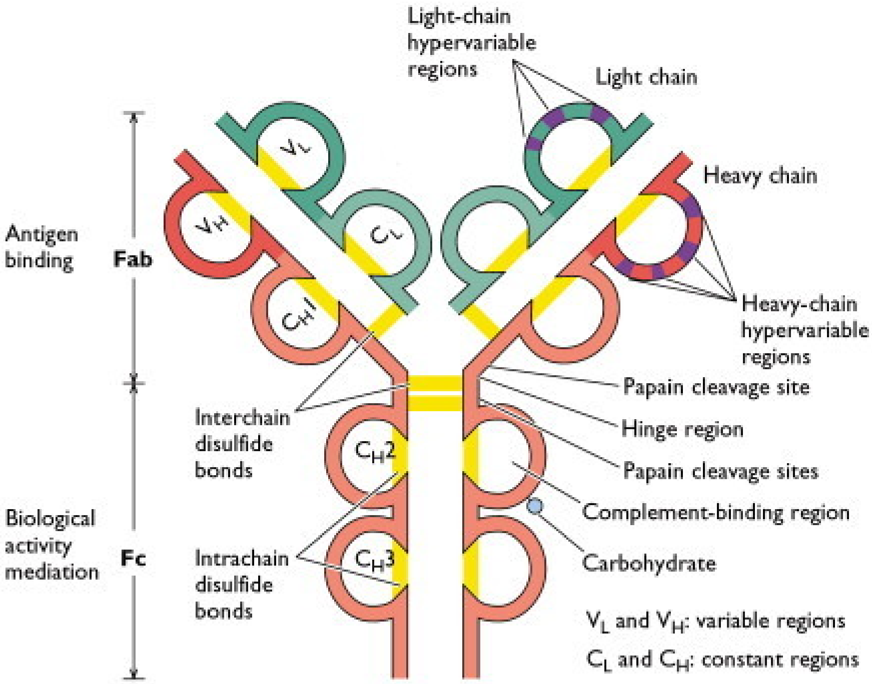


Structure of Antibody.

Source: Kyowa Hakko Kirin Co., Ltd

There are four polypeptide chains: two identical heavy chains and two identical light chains connected by disulfide bonds. Light Chain (L) consists polypeptides of about 22,000 Da and Heavy Chain (H) consists larger polypeptides of around 50,000 Da or more. There are five types of Ig heavy chain (in mammal) denoted by the Greek letters: α, δ, ε, γ, and μ. There are two types of Ig light chain (in mammal), which are called lambda (λ) and kappa (κ).

An antibody is made up of a variable region and a constant region, and the region that changes to various structures depending on differences in antigens is called the variable region, and the region that has a constant structure is called the constant region.



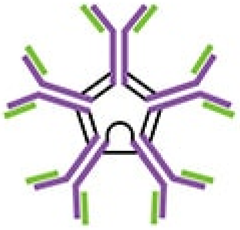
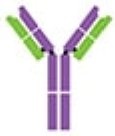
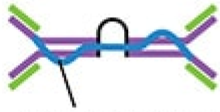
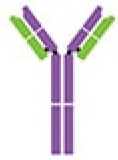
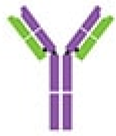
Structure of Antibody

Source: Sino Biological Inc.

Each heavy and light chain in an immunoglobulin molecule contains an amino-terminal variable (V) region that consists of 100 to 110 amino acids and differ from one antibody to another. The remainder of each chain in the molecule – the constant (C) region exhibits limited variation that defines the two light chain subtypes and the five heavy chains subclasses. Some heavy chains (α, δ, γ) also contain a proline-rich hinge region. The amino terminal portions, corresponding to the V regions, bind to antigen; effector functions are mediated by the carboxy-terminal domains. The ε and μ heavy chains, which lack a hinge region, contain an additional domain in the middle of the molecule. CHO denotes a carbohydrate group linked to the heavy chain.

Classes/Types of Antibody

Serum containing antigen-specific antibodies is called antiserum. The 5 types – IgG, IgM, IgA, IgD, IgE – (isotypes) are classified according to the type of heavy chain constant region, and are distributed and function differently in the body.

The Five Immunoglobulin (Ig) Classes					
	IgM pentamer	IgG monomer	Secretory IgA dimer	IgE monomer	IgD monomer
					
Heavy chains	μ	γ	α	ε	δ
Number of antigen binding sites	10	2	4	2	2
Molecular weight (Daltons)	900,000	150,000	385,000	200,000	180,000
Percentage of total antibody in serum	6%	80%	13%	0.002%	1%
Crosses placenta	no	yes	no	no	no
Fixes complement	yes	yes	no	no	no
Fc binds to		phagocytes		mast cells and basophils	
Function	Main antibody of primary responses, best at fixing complement; the monomer form of IgM serves as the B cell receptor	Main blood antibody of secondary responses, neutralizes toxins, opsonization	Secreted into mucus, tears, saliva, colostrum	Antibody of allergy and antiparasitic activity	B cell receptor

Functions of Antibody

1. IgG provides long term protection because it persists for months and years after the prescence of the antigen that has triggered their production.

2. IgG protect against bacteris, viruses, neutralise bacterial toxins, trigger compliment protein systems and bind antigens to enhance the effectiveness of phagocytosis.

3. Main function of IgA is to bind antigens on microbes before they invade tissues. It aggregates the antigens and keeps them in the secretions so when the secretion is expelled, so is the antigen.

4. IgA are also first defense for mucosal surfaces such as the intestines, nose, and lungs.

5. IgM is involved in the ABO blood group antigens on the surface of RBCs.

6. IgM enhance ingestions of cells by phagocytosis.

7. IgE bind to mast cells and basophils wich participate in the immune response.

8. Some scientists think that IgE's purpose is to stop parasites.

9. IgD is present on the surface of B cells and plays a role in the induction of antibody production.

Biyani Girls College, Jaipur

First Internal Examination 2019-20

B. Sc. I Year (BT)

Paper: Immunology

Time: 1:30 Hours **SET-B** **MM: 30**

All questions are compulsory.

Q1. Answer the following questions in very short: **1×7=7**

a). The ability of an organism to resist infections by pathogens is called……………..?

Ans: Immunity

b). Name the compound found in the stomach Juice?

Ans: Dil HCL

c). Which antibody is found in mother milk?

Ans: IgA

d). Name the antibody responsible for allergetic reaction?

Ans: IgE

e). Write the antigen and antibody associated with blood group 'AB'?

Ans: Both antigen A and B and their corresponding antibody a and b.

f). Who is the founder of ABO blood group System?

Ans: Karl Landsteiner

g). Segment of antibody that is recognized by the antigen is called…………………………?

Ans: Paratope

Q2. Explain the following terms with examples: **4×2=8**

a). Thymus

Ans: The thymus gland will not function throughout a full lifetime, but it has a big responsibility when it's active—helping the body protect itself against autoimmunity, which occurs when the immune system turns against itself. Therefore, the thymus plays a vital role in the lymphatic system (your body's defense network) *and* endocrine system.

Before birth and throughout childhood, the thymus is instrumental in the production and maturation of T-lymphocytes or T cells, a specific type of white blood cell that protects the body from certain threats, including viruses and infections. The thymus produces and secretes thymosin, a hormone necessary for T cell development and production.

The thymus is special in that, unlike most organs, it is at its largest in children. Once you reach puberty, the thymus starts to slowly shrink and become replaced by fat. By age 75, the thymus is little more than fatty tissue. Fortunately, the thymus produces all of your T cells by the time you reach puberty.

Anatomy of the Thymus

The thymus is located in the upper anterior (front) part of your chest directly behind your sternum and between your lungs. The pinkish-gray organ has two thymic lobes.

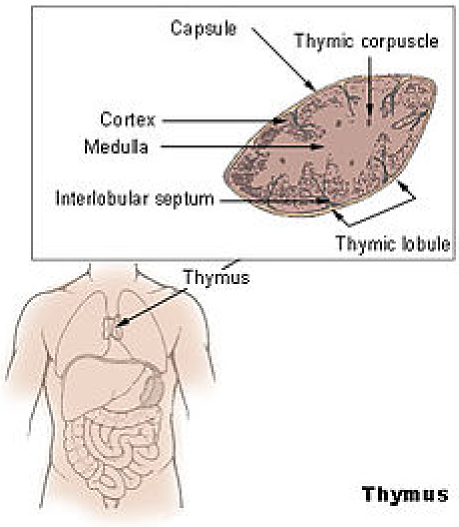
The thymus reaches its maximum weight (about 1 ounce) during puberty.

Thymosin: The Hormone of the Thymus

Thymosin stimulates the development of T cells. Throughout your childhood years, white blood cells called lymphocytes pass through the thymus, where they are transformed into T cells.

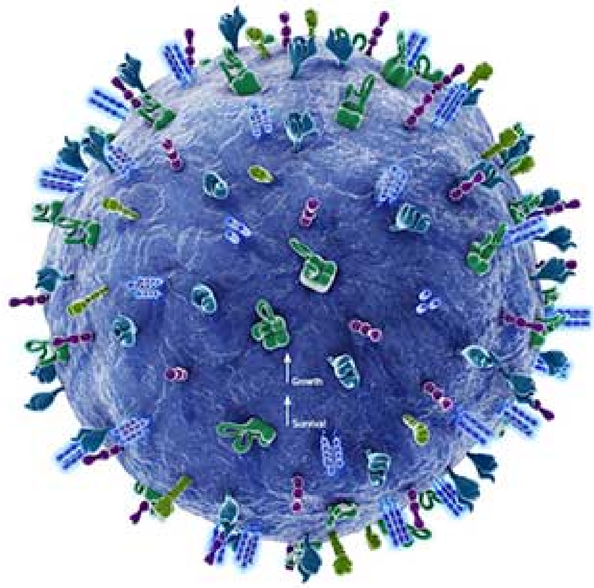
Once T cells have fully matured in the thymus, they migrate to the lymph nodes (groups of immune system cells) throughout the body, where they aid the immune system in fighting disease. However, some lymphocytes, regardless if they reside in the lymph nodes or thymus, can develop into cancers (known as Hodgkin disease and non-Hodgkin lymphomas).

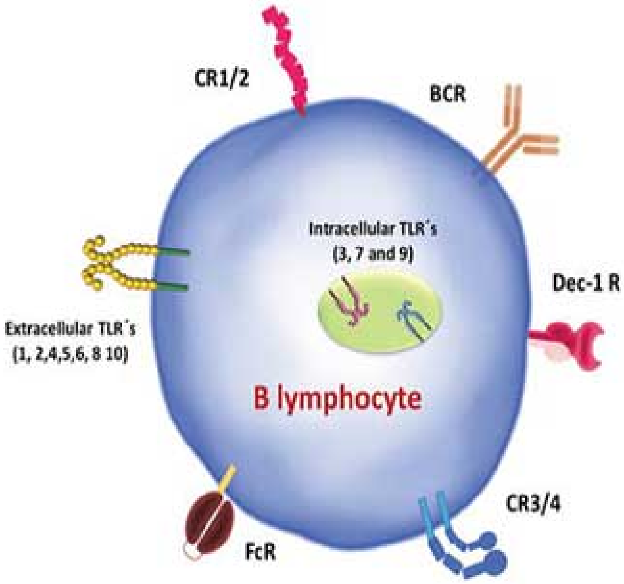
Though the thymus gland is only active until puberty, its double-duty function as an endocrine and lymphatic gland plays a significant role in your long-term health.



b). B lymphocytes

Ans: B lymphocytes, the cells that produce antibodies, were so called because in birds they were found to mature in an organ called the **Bursa of Fabricius**. In mammals, no anatomic equivalent of the bursa exists, and the early stages of B cell maturation occur in the bone marrow. Thus, B lymphocytes now refer to bone marrow–derived lymphocytes.





B cells are found in the germinal centers of the lymph nodes, in the white pulp of the spleen, and in the MALT. B cells perform two important functions:

1. They differentiate into plasma cells and produce antibodies.
2. They can present antigen to helper T cells (Act as Antigen Presenting Cells).

The major subsets of B cells are follicular B cells, marginal zone B cells, and B-1 cells, each of which is found in distinct anatomic locations within lymphoid tissues. Follicular B cells express highly diverse, clonally distributed sets of antibodies that serve as cell surface antigen receptors and as the key secreted effector molecules of adaptive humoral immunity. In contrast, B-1 and marginal-zone B cells produce antibodies with very limited diversity.

Origin of B cells

B-cell development begins in the bone marrow with the asymmetric division of an HSC and continues through a series of progressively more differentiated progenitor stages to the production of common lymphoid progenitors (CLPs), which can give rise to either B cells or T cells. Progenitor cells that remain in the bone marrow become B cells. B cell precursors, during embryogenesis, first proliferate and develop in the fetal liver. From there, they migrate to the bone marrow, the main site of B-cell maturation in the adults. The Pre-B cells have only μ heavy chains in the cytoplasm but do not have surface immunoglobulin and light chains. Pre-B cells are found in the bone marrow, while mature B cells are found in the circulation.

According to clonal selection theory, each immunologically competent B cell possesses receptor for either IgM or IgD that can combine with one antigen or closely related antigens. After binding of the antigen, the B cell is activated to proliferate and form a clone of cells. Selected B cells are transformed to plasma cells that secrete antibodies specific for the antigen. Plasma cells synthesize the immunoglobulin with the same antigenic specificity as those carried by activated B cells.

Q3. Write short notes on: **2×4=8**

a). Physical Barrier

Ans: Before any immune factors are triggered, the skin functions as a continuous, impassable barrier to potentially infectious pathogens. Pathogens are killed or inactivated on the skin by desiccation (drying out) and by the skin's acidity. In addition, beneficial microorganisms that coexist on the skin compete with invading pathogens, preventing infection. Regions of the body that are not protected by skin (such as the eyes and mucus membranes) have alternative methods of defense, such as tears and mucus secretions that trap and rinse away pathogens, and cilia in the nasal passages and respiratory tract that push the mucus with the pathogens out of the body. Throughout the body are other defenses, such as the low pH of the stomach (which inhibits the growth of pathogens), blood proteins that bind and disrupt bacterial cell membranes, and the process of urination (which flushes pathogens from the urinary tract).

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b). Lymphatic System

Ans: The lymphatic system is part of the immune system. It also maintains fluid balance and plays a role in absorbing fats and fat-soluble nutrients.

The lymphatic or lymph system involves an extensive network of vessels that passes through almost all our tissues to allow for the movement of a fluid called lymph. Lymph circulates through the body in a similar way to blood.

There are about 600 lymph nodes in the body. These nodes swell in response to infection, due to a build-up of lymph fluid, bacteria, or other organisms and immune system cells.

A person with a throat infection, for example, may feel that their "glands" are swollen. Swollen glands can be felt especially under the jaw, in the armpits, or in the groin area. These are, in fact, not glands but lymph nodes.

They should see a doctor if swelling does not go away, if nodes are hard or rubbery and difficult to move, if there is a fever, unexplained weight-loss, or difficulty breathing or swallowing.

The lymphatic system has three main functions:

- It maintains the balance of fluid between the blood and tissues, known as fluid homeostasis.
- It forms part of the body's immune system and helps defend against bacteria and other intruders.
- It facilitates absorption of fats and fat-soluble nutrients in the digestive system.

The system has special small vessels called lacteals. These enable it to absorb fats and fat-soluble nutrients from the gut.

They work with the blood capillaries in the folded surface membrane of the small intestine. The blood capillaries absorb other nutrients directly into the bloodstream.

Anatomy

The lymphatic system consists of lymph vessels, ducts, nodes, and other tissues.

Around 2 liters of fluid leak from the cardiovascular system into body tissues every day. The lymphatic system is a network of vessels that collect these fluids, or lymph. Lymph is a clear fluid that is derived from blood plasma.

The lymph vessels form a network of branches that reach most of the body's tissues. They work in a similar way to the blood vessels. The lymph vessels work with the veins to return fluid from the tissues.

Unlike blood, the lymphatic fluid is not pumped but squeezed through the vessels when we use our muscles. The properties of the lymph vessel walls and the valves help control the movement of lymph. However, like veins, lymphatic vessels have valves inside them to stop fluid from flowing back in the wrong direction.

Lymph is drained progressively towards larger vessels until it reaches the two main channels, the lymphatic ducts in our trunk. From there, the filtered lymph fluid returns to the blood in the veins.

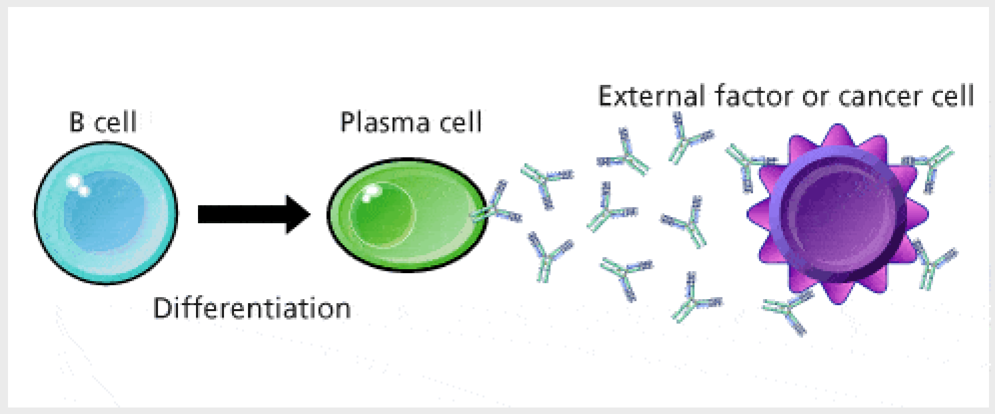
The vessels branch through junctions called lymph nodes. These are often referred to as glands, but they are not true glands as they do not form part of the endocrine system.

In the lymph nodes, immune cells assess for foreign material, such as bacteria, viruses, or fungus.

Lymph nodes are not the only lymphatic tissues in the body. The tonsils, spleen, and thymus gland are also lymphatic tissues.

Q4. Define Antibody? Explain its Classes and their biological Activities? 8

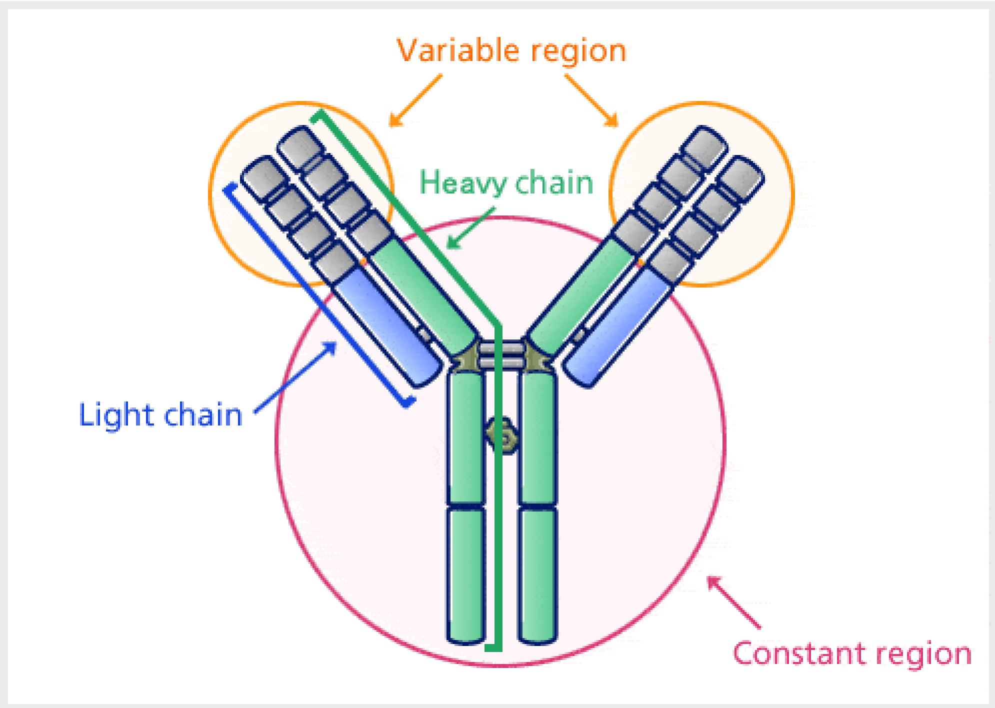
Ans: Antibody (Ab) also know as Immunoglobulin (Ig) is the large Y shaped protein produced by the body’s immune system when it detects harmful substances, called antigens like bacteria and viruses. The production of antibodies is a major function of the immune system and is carried out by a type of white blood cell called a B cell (B lymphocyte), differentiated B cells called plasma cells. The produced antibodies bind to specific antigens express in external factors and cancer cells.



Source: Kyowa Hakko Kirin Co., Ltd

Structure of Antibody

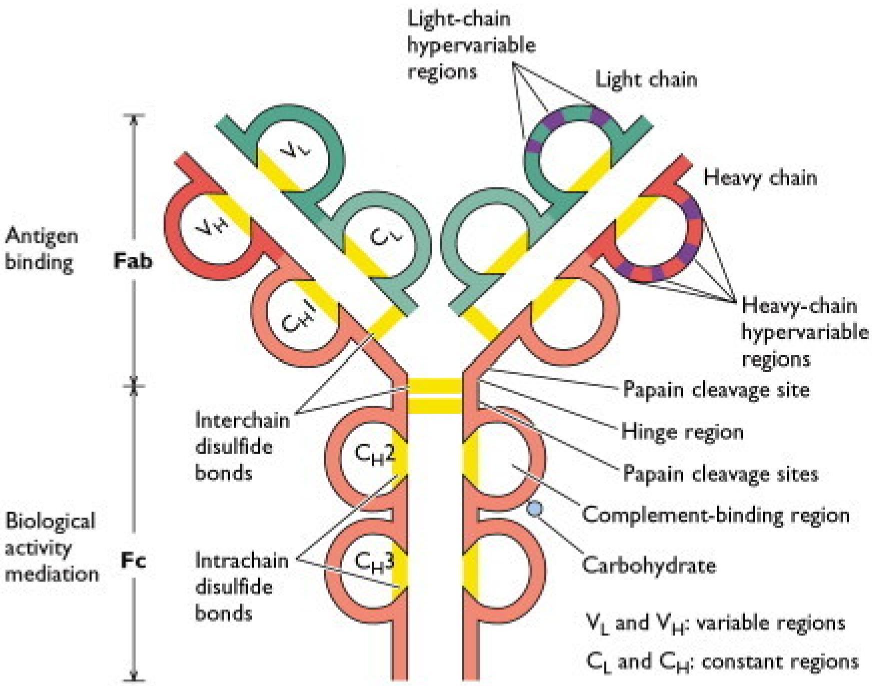
Antibodies are heavy (~150 kDa) globular plasma proteins. The basic structure of all antibodies are same.



Structure of Antibody.
Source: Kyowa Hakko Kirin Co., Ltd

There are four polypeptide chains: two identical heavy chains and two identical light chains connected by disulfide bonds. Light Chain (L) consists polypeptides of about 22,000 Da and Heavy Chain (H) consists larger polypeptides of around 50,000 Da or more. There are five types of Ig heavy chain (in mammal) denoted by the Greek letters: α, δ, ε, γ, and μ. There are two types of Ig light chain (in mammal), which are called lambda (λ) and kappa (κ).

An antibody is made up of a variable region and a constant region, and the region that changes to various structures depending on differences in antigens is called the variable region, and the region that has a constant structure is called the constant region.



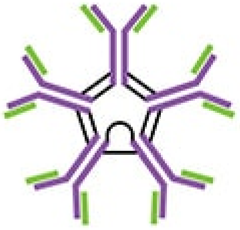
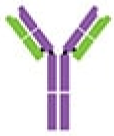
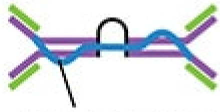
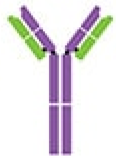
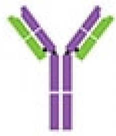
Structure of Antibody

Source: Sino Biological Inc.

Each heavy and light chain in an immunoglobulin molecule contains an amino-terminal variable (V) region that consists of 100 to 110 amino acids and differ from one antibody to another. The remainder of each chain in the molecule – the constant (C) region exhibits limited variation that defines the two light chain subtypes and the five heavy chains subclasses. Some heavy chains (α, δ, γ) also contain a proline-rich hinge region. The amino terminal portions, corresponding to the V regions, bind to antigen; effector functions are mediated by the carboxy-terminal domains. The ε and μ heavy chains, which lack a hinge region, contain an additional domain in the middle of the molecule. CHO denotes a carbohydrate group linked to the heavy chain.

Classes/Types of Antibody

Serum containing antigen-specific antibodies is called antiserum. The 5 types – IgG, IgM, IgA, IgD, IgE – (isotypes) are classified according to the type of heavy chain constant region, and are distributed and function differently in the body.

The Five Immunoglobulin (Ig) Classes					
	IgM pentamer	IgG monomer	Secretory IgA dimer	IgE monomer	IgD monomer
					
Heavy chains	μ	γ	α	ε	δ
Number of antigen binding sites	10	2	4	2	2
Molecular weight (Daltons)	900,000	150,000	385,000	200,000	180,000
Percentage of total antibody in serum	6%	80%	13%	0.002%	1%
Crosses placenta	no	yes	no	no	no
Fixes complement	yes	yes	no	no	no
Fc binds to		phagocytes		mast cells and basophils	
Function	Main antibody of primary responses, best at fixing complement; the monomer form of IgM serves as the B cell receptor	Main blood antibody of secondary responses, neutralizes toxins, opsonization	Secreted into mucus, tears, saliva, colostrum	Antibody of allergy and antiparasitic activity	B cell receptor

Functions of Antibody

10. IgG provides long term protection because it persists for months and years after the prescence of the antigen that has triggered their production.

11. IgG protect against bacteris, viruses, neutralise bacterial toxins, trigger compliment protein systems and bind antigens to enhance the effectiveness of phagocytosis.

12. Main function of IgA is to bind antigens on microbes before they invade tissues. It aggregates the antigens and keeps them in the secretions so when the secretion is expelled, so is the antigen.

13. IgA are also first defense for mucosal surfaces such as the intestines, nose, and lungs.

14. IgM is involved in the ABO blood group antigens on the surface of RBCs.

15. IgM enhance ingestions of cells by phagocytosis.

16. IgE bind to mast cells and basophils wich participate in the immune response.
17. Some scientists think that IgE’s purpose is to stop parasites.
18. IgD is present on the surface of B cells and plays a role in the induction of antibody production.