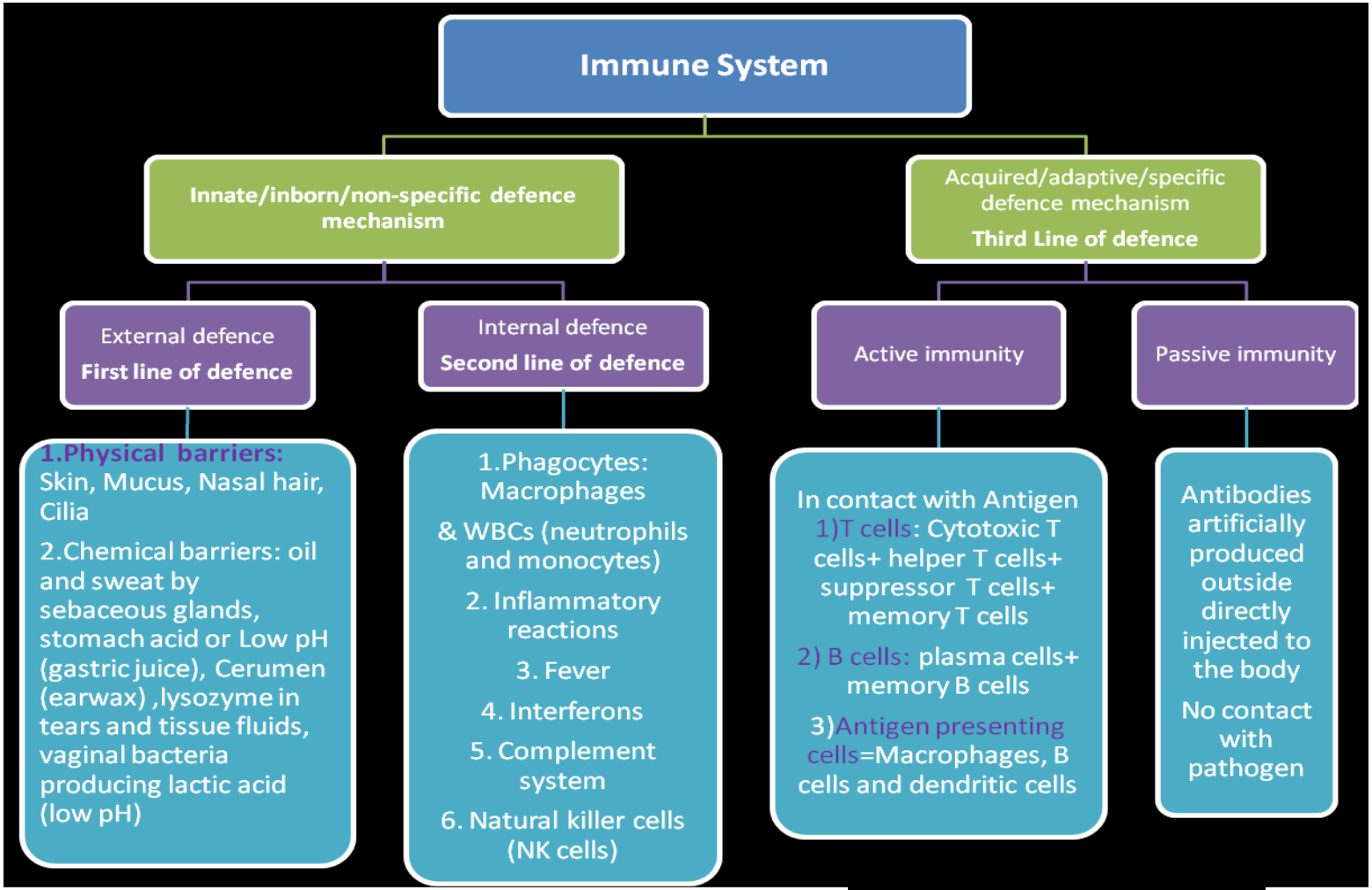
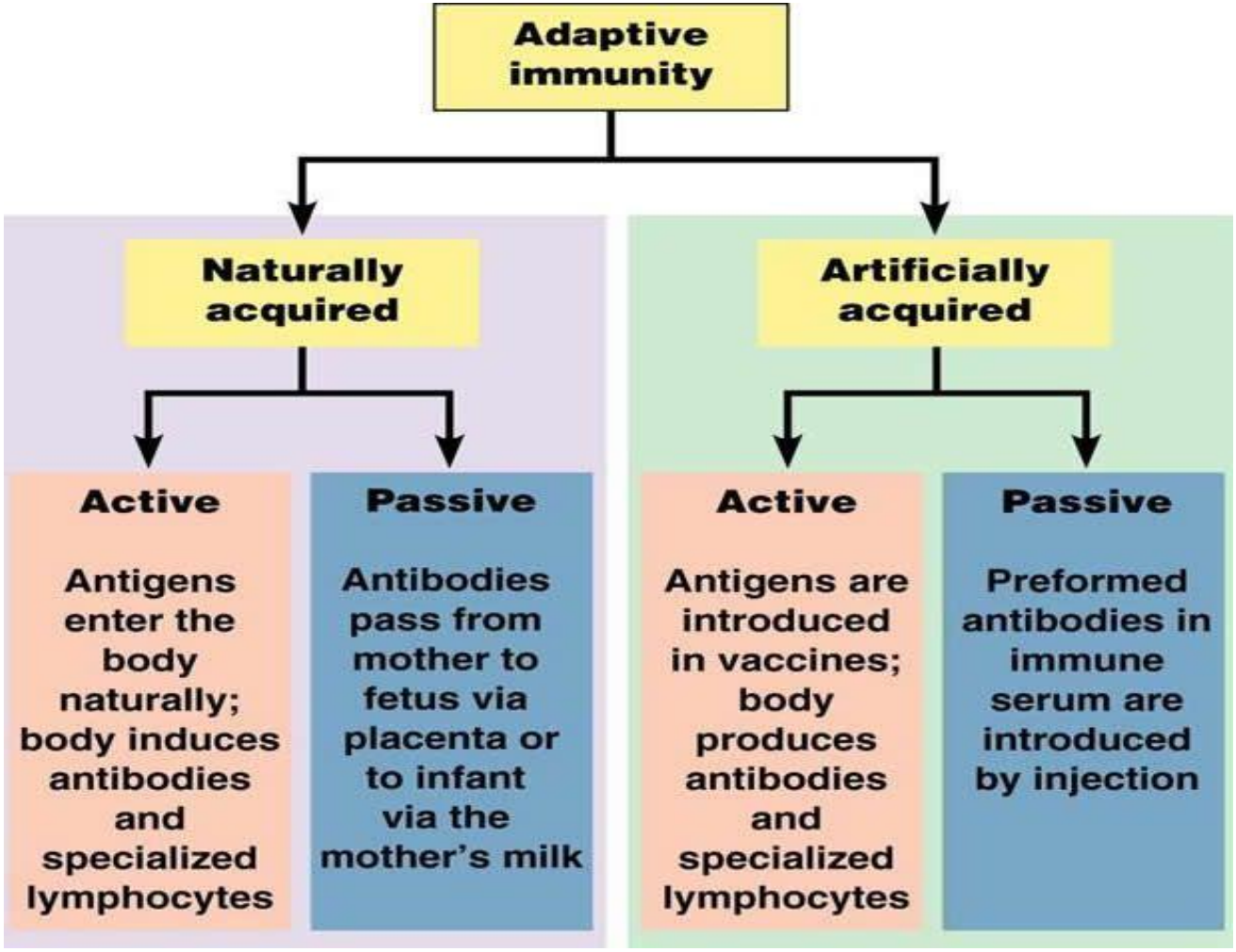
BASICS OF IMMUNOLOGY


Immune System
Innate/inborn/non-specific defence mechanism
Acquired/adaptive/specific defence mechanism
Third Line of defence
External defence
First line of defence
Internal defence
Second line of defence
Active immunity
Passive immunity
1.Physical barriers:
Skin, Mucus, Nasal hair, Cilia
2.Chemical barriers: oil and sweat by sebaceous glands, stomach acid or Low pH (gastric juice), Cerumen (earwax) ,lysozyme in tears and tissue fluids, vaginal bacteria producing lactic acid (low pH)
1.Phagocytes: Macrophages
& WBCs (neutrophils and monocytes)
2. Inflammatory reactions
3. Fever
4. Interferons
5. Complement system
6. Natural killer cells (NK cells)
In contact with Antigen
1)T cells: Cytotoxic T cells+ helper T cells+ suppressor T cells+ memory T cells
2) B cells: plasma cells+ memory B cells
3)Antigen presenting cells=Macrophages, B cells and dendritic cells
Antibodies artificially produced outside directly injected to the body
No contact with pathogen


Adaptive immunity
Naturally acquired
Artificially acquired
Active
Antigens enter the body naturally; body induces antibodies and specialized lymphocytes
Passive
Antibodies pass from mother to fetus via placenta or to infant via the mother's milk
Active
Antigens are introduced in vaccines; body produces antibodies and specialized lymphocytes
Passive
Preformed antibodies in immune serum are introduced by injection

IMMUNE SYSTEM

The immune system refers to a collection of cells and proteins that function to protect the skin, respiratory passages, intestinal tract and other areas from foreign antigens, such as microbes (organisms such as bacteria fungi, and parasites), viruses, cancer cells, and toxins

The immune system has two “lines of defense”:

INNATE IMMUNITY and **ADAPTIVE IMMUNITY.**

Innate immunity represents the first line of defense to an intruding pathogen. It is an antigen-independent (non-specific) defense mechanism that is used by the host immediately or within hours of encountering an antigen. The innate immune response has no immunologic memory and, therefore, it is unable to recognize or “memorize” the same pathogen should the body be exposed to it in the future.

Adaptive immunity, on the other hand, is antigen-dependent and antigen-specific and, therefore, involves a lag time between exposure to the antigen and maximal response. The hallmark of adaptive immunity is the capacity for memory which enables the host to mount a more rapid and efficient immune response upon subsequent exposure to the antigen.

The primary function of innate immunity is the recruitment of immune cells to sites of infection and inflammation through the production of cytokines (small proteins involved in cell-cell communication).

Cytokine production leads to the release of antibodies and other proteins and glycoproteins which activate the complement system, a biochemical cascade that functions to identify and opsonize (coat) foreign antigens, rendering them susceptible to phagocytosis (process by which cells engulf microbes and remove cell debris).

The innate immune response also promotes clearance of dead cells or antibody complexes and removes foreign substances present in organs, tissues, blood and lymph. It can also activate the adaptive immune response through a process known as antigen presentation

Cells involved in the innate immune response

Phagocytes (macrophages and neutrophils), dendritic cells, mast cells, basophils, eosinophils, natural killer (NK) cells and lymphocytes (T cells).

Phagocytes are sub-divided into two main cell types: neutrophils and macrophages. Both of these cells share a similar function: to engulf (phagocytose) microbes. In addition to their phagocytic properties, neutrophils contain granules that, when released, assist in the elimination of pathogenic microbes.

Unlike neutrophils (which are short-lived cells), macrophages are long-lived cells that not only play a role in phagocytosis, but are also involved in antigen presentation to T cells.

Macrophages are named according to the tissue in which they reside. For example, macrophages present in the liver are called Kupffer cells while those present in the connective tissue are termed histiocytes

Dendritic cells also phagocytose and function as antigen-presenting cells (APCs) and act as important messengers between innate and adaptive immunity.

Mast cells and basophils share many salient features with each other and both are instrumental in the initiation of acute inflammatory responses, such as those seen in allergy and asthma.

Unlike mast cells, which generally reside in the connective tissue surrounding blood vessels, basophils reside in the circulation.

Eosinophils are granulocytes that possess phagocytic properties and play an important role in the destruction of parasites that are too large to be phagocytosed. Along with mast cells and basophils, they also control mechanisms associated with allergy and asthma.

NK cells (also known as large granular lymphocytes [LGLs]) play a major role in the rejection of tumours and the destruction of cells infected by viruses. Destruction of infected cells is achieved through the release of perforins and granzymes from NK-cell granules which induce apoptosis (programmed cell death)

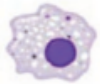
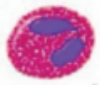
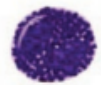
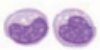
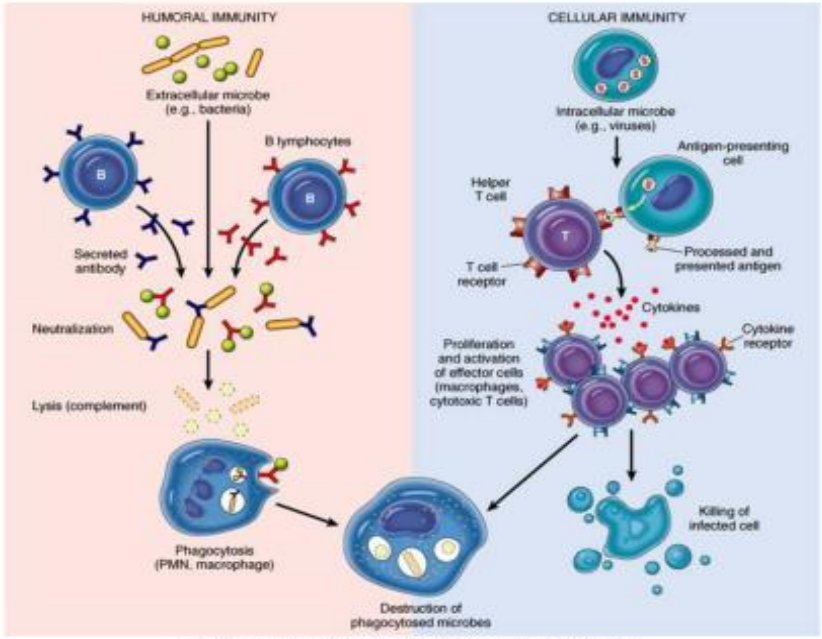
Cell	Image	% in adults	Nucleus	Functions	Lifetime	Main targets
Macrophage*		Varies	Varies	• Phagocytosis • Antigen presentation to T cells	Months – years	• Various
Neutrophil		40-75%	Multi-lobed	• Phagocytosis • Degranulation (discharge of contents of a cell)	6 hours – few days	• Bacteria • Fungi
Eosinophil		1-6%	Bi-lobed	• Degranulation • Release of enzymes, growth factors, cytokines	8-12 days (circulate for 4-5 hours)	• Parasites • Various allergic tissues
Basophil		< 1%	Bi- or tri-lobed	• Degranulation • Release of histamine, enzymes, cytokines	Lifetime uncertain; likely a few hours – few days	• Various allergic tissues
Lymphocytes (T cells)		20-40%	Deeply staining, eccentric	T helper (Th) cells (CD4+): immune response mediators Cytotoxic T cells (CD8+): cell destruction	Weeks to years	• Th cells: intracellular bacteria • Cytotoxic T cells: virus infected and tumour cells • Natural killer cells: virus-infected and tumour cells
Monocyte		2-6%	Kidney shaped	Differentiate into macrophages and dendritic cells to elicit an immune response	Hours – days	• Various

Figure 1 Characteristics and function of cells involved in innate immunity [1,3,4]. *Dust cells (within pulmonary alveolus), hist
(connective tissue), Kupffer cells (liver), microglial cells (neural tissue), epithelioid cells (granulomas), osteoclasts (bone), mesangial cells (kid

Humoral and Cell-mediated Immunity



Humoral Immunity

Involves B-cell production of antibodies that bind antigens resulting in either:

1. Neutralization
2. lysis (by the complement system), or
3. phagocytosis and destruction

Cell-mediated Immunity

Involves T-cell recognition of abnormal antigens on the surface of host cells (indicating viral infection or tumorigenic change) and the killing of infected cells.