

Chapter 38 - Human Defence System

Learning objectives

- To describe the general defence system in humans, including the skin, mucous membranes and phagocytic white blood cells
- To describe the specific defence system (immune system) in humans and define the term 'induced immunity'
- To describe vaccination and immunisation
- To describe the role of lymphocytes in the immune system, including B cells in antibody production and the four types of T cell.

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Chapter 38 - Human Defence System

A **pathogen** is an organism that causes disease.

The general defence system:

- acts against all pathogens
- is not specific to any one pathogen

The specific defence system:

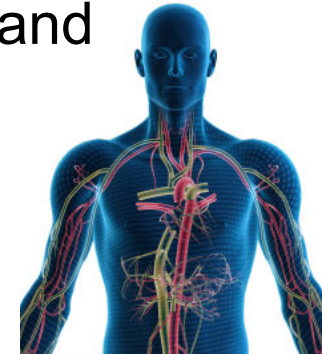
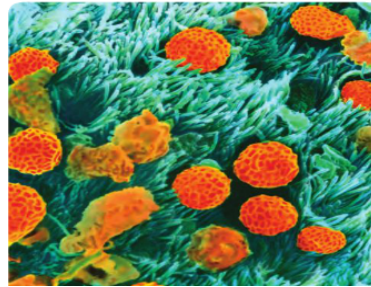
- acts against only one particular type of pathogen
- is called the immune system acts by forming antibodies and by killing infected cells



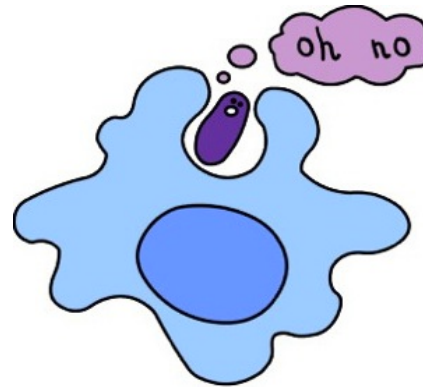
General Defence System

There are 2 main parts to the general defence system,

1. Skin, blood clotting, lysozyme(in tears), chemicals in sebum, mucous membranes, cilia, stomach acid and lactic acid in the vagina.



2. White blood cells that act by phagocytosis, defensive proteins (interferons and complement) and inflammation.





The **specific defence system** attacks particular (or specific) pathogens.

Specific Defence System

Lymphocytes and monocytes:

Both are **white blood cells**

Found in lymphatic tissue

Both react to antigens

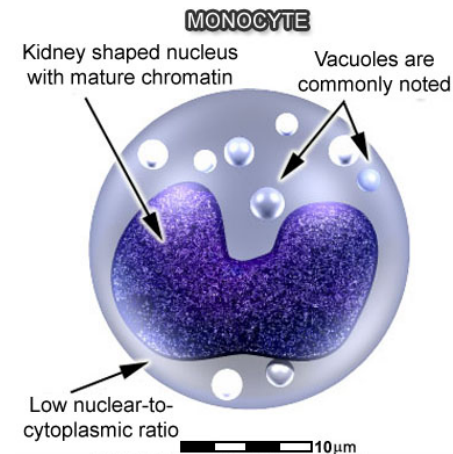
Monocytes (which develop into macrophages)

Destroy pathogens and display antigens on their membranes

Lymphocytes

Attack body cells displaying antigens

Produce antibodies

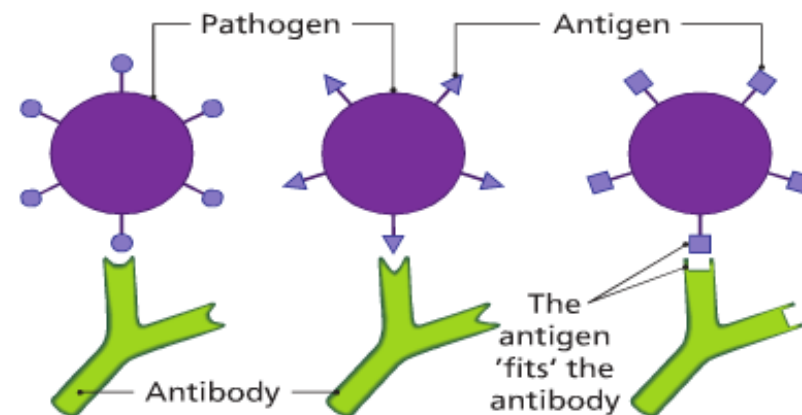


Antigens and Antibodies

An **Antigen** is a foreign molecule that stimulates the production of antibodies.

It is a chemical on the coat of a bacteria, virus or fungus.

An **Antibody** is a protein produced by lymphocytes in response to an antigen.



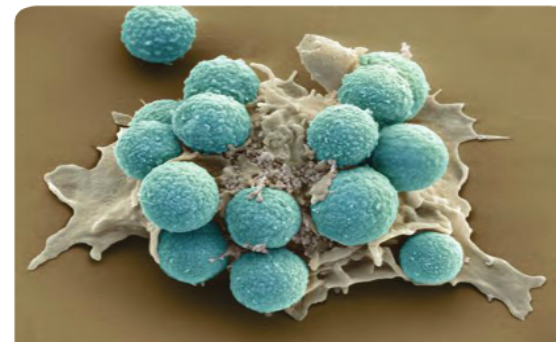
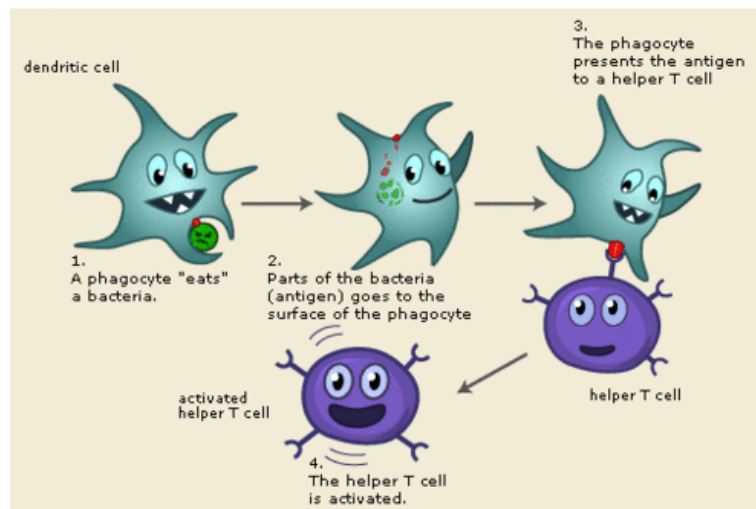
As in enzymes, each type of antibody is highly specific to a single antigen. The antibodies surround the pathogen invaders and cause them to burst by the **complement system**.

Duration of Immunity



On first contact with an antigen (or pathogen), the body takes about 14 days to produce the maximum number of antibodies. On subsequent contact with the same antigen, antibodies are produced in large numbers in about 5 days. This prevents the re-infection from producing symptoms.

Some lymphocytes survive for many years as **memory cells**, allowing long-term immunity.




Induced Immunity

Induced immunity is the ability to resist disease (by producing antibodies) caused by specific antigens.

There are two types of Immunity - **Active** and **Passive**

Active immunity means that a person makes his/her own antibodies. This provides long-term immunity in two ways:

- when pathogens naturally enter the body - cold or **flu**
- when antigens are artificially placed in the body due to **vaccination**

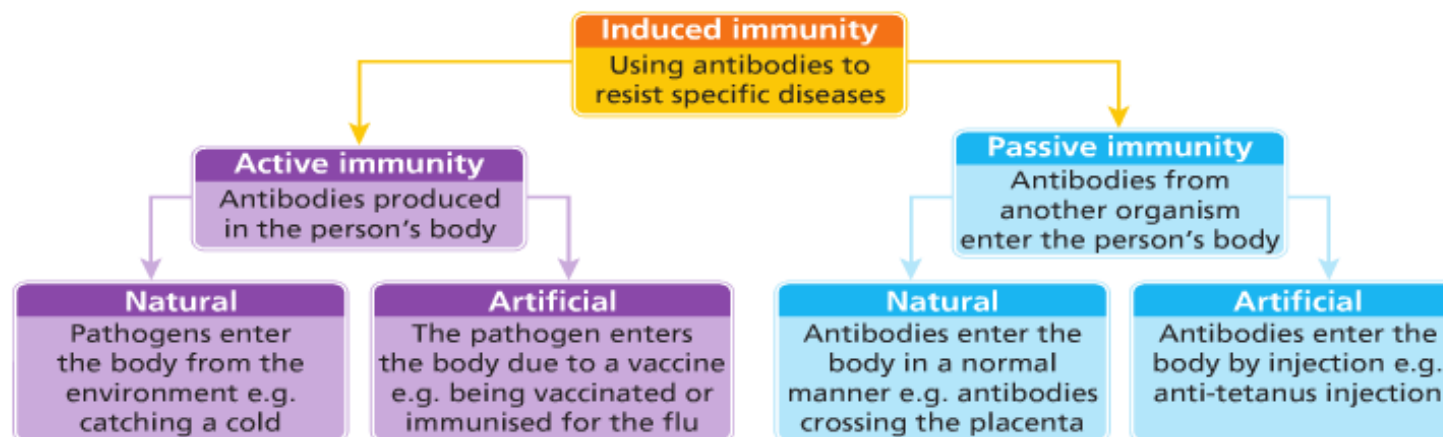
 **Artificial active immunity** occurs when a pathogen is medically introduced into the body.

A **vaccine** is a non disease-causing dose of a pathogen (or its toxin), which triggers the production of antibodies.



Passive immunity occurs when foreign antibodies are introduced into the body. This provides short-term immunity in two ways:

- a child getting antibodies in a natural manner from the placenta or **mother's milk**
- getting an **injection** of foreign antibodies



Higher Level - Types of Lymphocytes

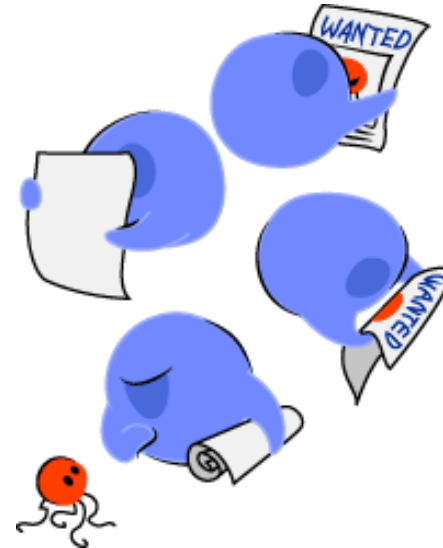
B-cells (or B-lymphocytes) mature in the **bone** marrow.

T-cells (or T-lymphocytes) mature in the **thymus** gland.

B-cells:

- recognise an antigen
- produce antibodies

control mostly bacterial infections (and some viral infections)



T-Cells

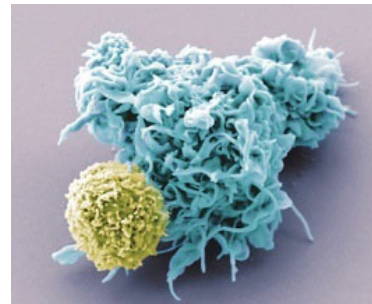
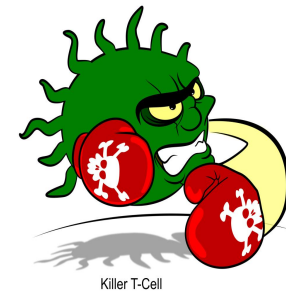
The **four types of T-cells** all recognise specific antigens:

Helper T-cells - stimulate B-cells (to produce antibodies).

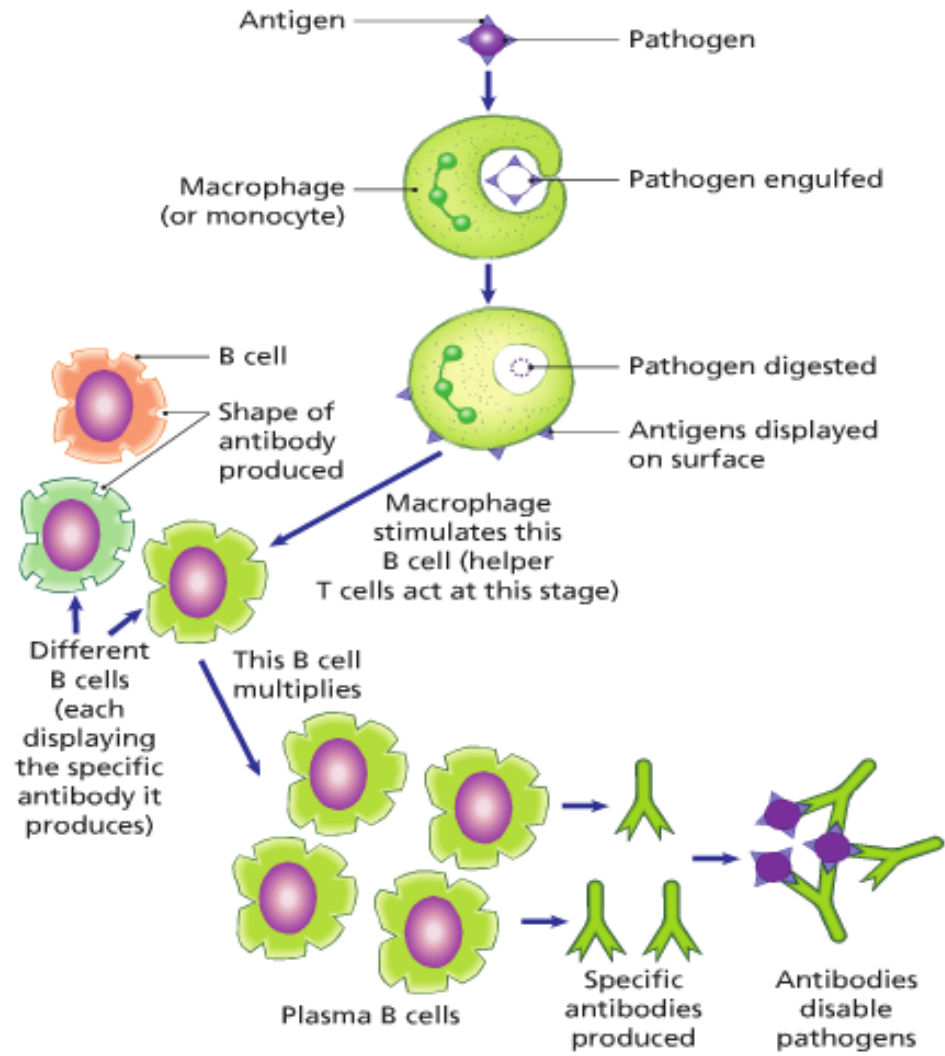
Killer T-cells - (cytotoxic cells) produce perforin, which causes abnormal body cells to burst.

Suppressor T-cells - turn off immune responses.

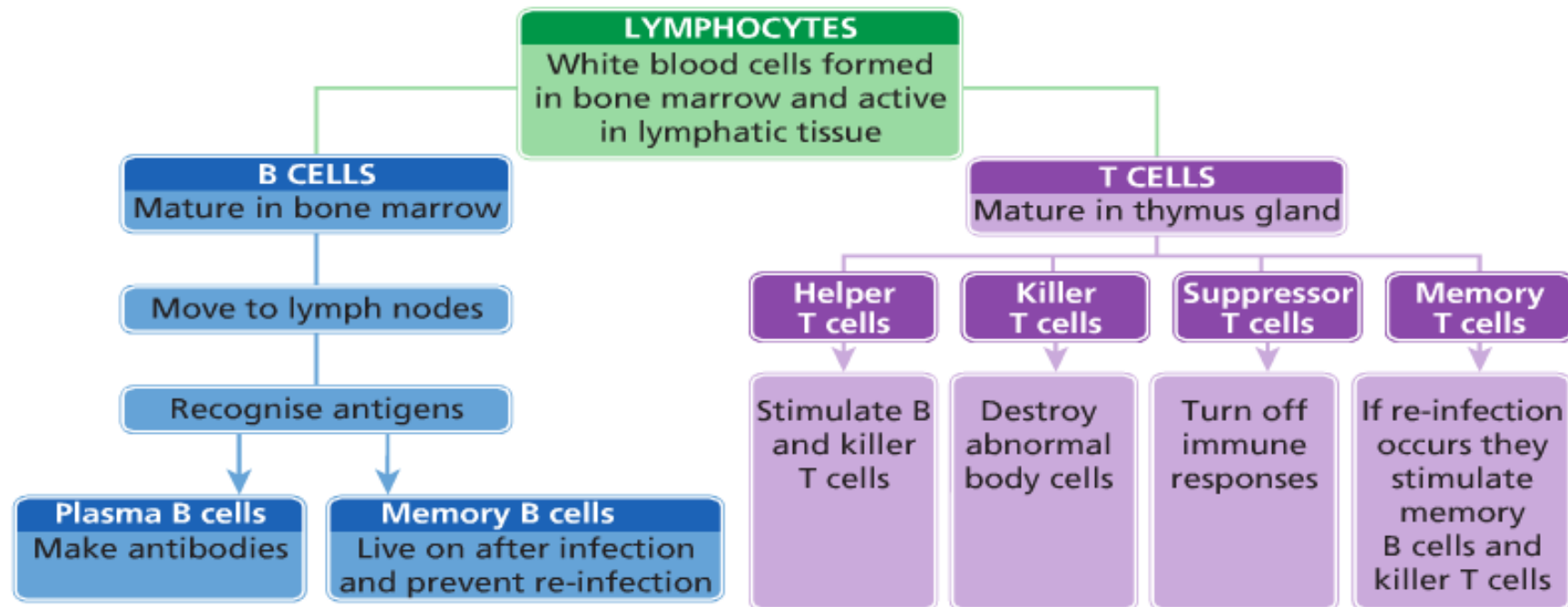
Memory T-cells - survive a long time to trigger immunity to the same antigen in later years



How B-Cells work



Summary of Lymphocytes



Summary of the Defence System

Summary of the human defence system		
General defence system (non-specific)		Specific (immune) system
First line of defence	Second line of defence	Third line of defence
Skin	Phagocytes	Monocytes destroy antigens
Mucous membranes	Defence proteins	Antibodies
Secretions from skin and mucous membranes	Inflammation	

