The immune response

Non-specific (innate) immune system
Includes chemical and physical barriers (the first line of defence) and responses such as inflammation (the second line of defence). Its effects are rapid, short-lived and non-specific. Found in all multicellular organisms.

PHYSICAL AND CHEMICAL BARRIERS
- Physical barriers include the skin and the mucous membranes of the airways, guts, and urinary and reproductive systems.
- Chemical barriers include hydrochloric acid secreted by the stomach lining.

LEUKOCYTES
Made in the bone marrow, leukocytes, or white blood cells, are an important part of the immune system. There are two main types: granulocytes, which have granular cytoplasm and a lobed nucleus, and agranulocytes, which have smooth cytoplasm and a non-lobed nucleus. Leukocytes include mast cells, basophils, macrophages, dendritic cells, neutrophils, eosinophils, B cells and T cells.

INFLAMMATION
Invading microbes trigger inflammation. This involves an increase in blood flow to the affected part of the body, which leads to swelling, pain and an increase in temperature. Mast cells and basophils are involved in inflammation.

COMPLEMENT
A set of around 30 proteins in the blood plasma that can be activated by the presence of microbes or antibody–antigen complexes. Complement can destroy pathogens and activate phagocytic cells.

PHAGOCYTOSIS
White blood cells including dendritic cells, macrophages and granulocytes such as eosinophils and neutrophils engulf (or phagocytose) microbes or cells that are infected, damaged or dying. They enclose the particle or cell with a phagosome and then break down the contents with hydrolytic enzymes. Some cells then become antigen-presenting cells (APCs), which present the digested remains to other immune cells.

CLONAL SELECTION
The process by which a B cell and T cell specific to the antigen are selected for clonal expansion by an APC.

ANTIGEN PRESENTATION
Antigen-presenting cells (APCs) break up invading or non-self particles and cells and display parts of them – antigens – for other immune cells to inspect. They include macrophages and dendritic cells.

LYMPHOCYTES
Agranulocyte white blood cells. Types include B cells and T cells.

CLONAL EXPANSION
After clonal selection, the selected B cells and T cells divide by mitosis to produce many identical progeny, or clones.

Antibodies
- Produced in response to the presence of specific antigen on the surface of APCs.
- Help to neutralize viruses or bacteria.

Memory B cell
- Long-lived B cells that remember specific antigens and respond rapidly to future encounters.

Plasma B cell
- B cells that produce large amounts of a particular antibody. Each cell will make only one type of antibody.

Helper T cell (CD4+)
- T cells that present antigens on their surface to activate B cells.

Cytotoxic T cell (CD8+)
- T cells that destroy infected or cancerous cells.

B cell
- Long-lived B cells that remember specific antigens and respond rapidly to future encounters.

Helper T cell (CD4+)
- T cells that present antigens on their surface to activate B cells.

Cytotoxic T cell (CD8+)
- T cells that destroy infected or cancerous cells.

Mast cell
- Cells involved in allergic reactions, releasing histamine and other inflammatory molecules. Mast cells are also found on mucous membranes.

Basophil
- Cells involved in allergic reactions, releasing histamine and other inflammatory molecules. Basophils are also found on mucous membranes.

Neutrophil
- Fast-acting phagocytes that flush to the site of inflammation.

Macrophage
- APCs that destroy foreign substances by phagocytosis and releasing enzymes to break down substances.

Dendritic cell
- APCs that present antigens to T cells and activate them.

Mast cell
- Cells involved in allergic responses, releasing histamine and other inflammatory molecules. Mast cells sit within skin and mucosal tissues.

Macrophage
- Phagocytes that also produce hydrolytic enzymes. Some cells then become antigen-presenting cells (APCs), which present the digested remains to other immune cells.

NATURAL KILLER (NK) CELLS
NK cells kill pathogen-infected cells and cancer cells. They also release chemicals called cytokines, which alert and attract other immune cells.

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