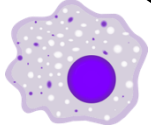


Key Stage 5: Immunity Top Trumps

Macrophage
The big eater...

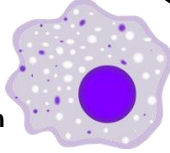


Skill	Score
Size	21µm
Specificity	4
Lifespan	Up to 3 years
Destructiveness	9
Speed of action	7

Immune system associated with:
Innate (although aided by opsonins (e.g. antibodies) released by cells of the adaptive immune system)

Key role
Phagocytose pathogens and present antigens on MHC complex's, whereupon they can act as APCs

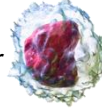
Macrophage
The big eater...



Factual information

Macrophages are large long-lived phagocytes. They mature in the tissue at the site of infection from monocytes as they are too large to fit through the capillary endothelium. Macrophages take longer than neutrophils to perform phagocytosis on account of performing the more complex task of preserving the pathogen antigens and presenting them on MHC complexes for stimulation of the adaptive immune system (T and B Cells). Macrophages are able to recognise

Monocyte
Macrophage precursor

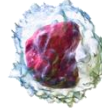


Skill	Score
Size	12µm
Specificity	0
Lifespan	24hrs (if does not mature)
Destructiveness	0
Speed of action	8

Immune system associated with:
Innate

Key role
Travels in the blood stream and is small enough to fit through capillary epithelium whereupon it can mature into a macrophage

Monocyte
Macrophage precursor

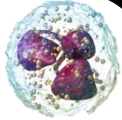


Factual information

Among other roles, monocytes are precursors of macrophages. They are short lived cells that are produced in the bone marrow and circulate in the blood for a few days. Monocytes are small enough that they can leave the blood stream and enter the tissue fluid where they can develop into macrophages. This is important as macrophages are too large to fit through the capillary endothelium.

Neutrophil

The little eater



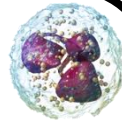
Skill	Score
Size	10µm
Specificity	3
Lifespan	5-135 hrs
Destructiveness	4
Speed of action	9

Immune system associated with:
Innate (although aided by opsonins (e.g. antibodies) released by cells of the adaptive immune system)

Key role
Phagocytose pathogens. Unlike macrophages, they die after and don't form APCs

Neutrophil

The little eater

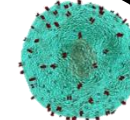


Factual information

Neutrophils are the most abundant WBC in the body accounting for 60-70% of all WBCs. They are attracted towards the site of infection by cytokines and histamines (chemotaxis) released from mast cells within the tissue and by macrophages. Once present the neutrophils destroy pathogens by phagocytosis, however, they are only able to kill a few pathogens before dying themselves. Pus is formed as a consequence of millions of neutrophils dying at the site of infection. Neutrophils further release histamines and cytokines to heighten the immune and inflammatory response.

Helper T-cell

Master controller



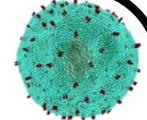
Skill	Score
Size	7-10µm
Specificity	9
Lifespan	NA
Destructiveness	0
Speed of action	6

Immune system associated with:
Adaptive

Key role
Trigger and coordinate the adaptive immune system via the secretion of chemicals such as cytokines following activation by a macrophage (APC) or an infected body cell. Stimulate the production of more T-helper clones, and also T-killer, T-memory and B-cells

Helper T-cell

Master controller

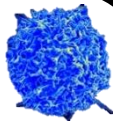


Factual information

T-helper cells are made in the bone marrow and mature in the thymus. Each has a receptor (the T-cell receptor) for a specific non-self antigen that they are able to respond to. T-helper cells are, however, only able to respond to their specific antigen when it is presented on an MHCII protein complex by an APC.

T-helper cells are thus activated by binding to APCs presenting the complementary antigen. Once activated, T-helper cells divide to form clones and T-memory cells. Activated T-helper cells can also stimulate T-killer cell and B-cell activation via cell contact and cytokine release.

Memory T-cell



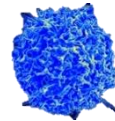
Skill	Score
Size	8 μ m
Specificity	9
Lifespan	6 months
Destructiveness	0
Speed of action	3

Immune system associated with:
Adaptive

Key role

Provide the basis of long-term immunological memory. Ensure a quick response should the pathogen (antigen) be recognised again.

Memory T-cell



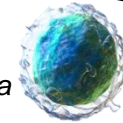
Factual information

T-memory cells are produced as a result of clonal expansion following activation of a T-helper cell.

Once activated T-helper cells divide rapidly to produce active helper clones and memory T-cells. Active helper clones are short lived and help to coordinate the immune response to the present infection while T-memory cells are longer lived and provide the basis for long term immunological memory. If the antigen is detected again, memory cells can divide and respond rapidly.

Naïve B-cell

Precursor to plasma and memory B cell



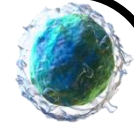
Skill	Score
Size	7-10 μ m
Specificity	9
Lifespan	NA
Destructiveness	7
Speed of action	5

Immune system associated with:
Adaptive

Key role

Once activated B cells divide rapidly to produce B memory cells and plasma cells

Naïve B-cell



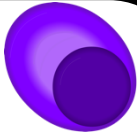
Factual information

Naïve B-cells are those that have not yet been activated by interaction with their corresponding antigen. Activation of B-cells is complex and multistep.

Firstly, B-cells must interact with the antigen and become APCs. Like macrophages, B-cells present antigens on MHC complexes. Secondly, antigen presenting B-cells must interact with previously activated T-helper cells (i.e. T-helper cells that have already interacted with a APC macrophage).

Once activated B cells divide rapidly to produce B memory cells and plasma cells

Plasma cell



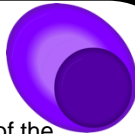
Skill	Score
Size	13 μ m
Specificity	10
Lifespan	7 months
Destructiveness	9
Speed of action	3

Immune system associated with:
Adaptive

Key role

Produce antibodies that bind to specific complementary antigens to act as opsonins (labels for phagocytic cells) and disable and agglutinate pathogens. In so doing, antibodies significantly increased the effectiveness of phagocytic cells

Plasma cell



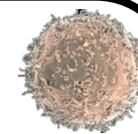
Factual information

Plasma cells are one of the products of B cell division following activation (the other being B-memory cells).

Plasma cells are the antibody producing cells of the immune system. Each plasma cell can only produce antibodies effective against a single pathogen (i.e. antibodies which are complementary to the antigen which interacted with the original B cell from which the plasma cell derived).

Antibodies are effective weapons of the immune system as they help label and immobilise pathogen for faster destruction by macrophages.

Memory B-cell



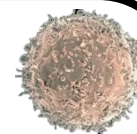
Skill	Score
Size	7-10 μ m
Specificity	9
Lifespan	NA
Destructiveness	7
Speed of action	5

Immune system associated with:
Adaptive

Key role

Provide long term immunological memory in case of reinfection by the same pathogen.

Memory B-cell



Factual information

B-memory cells are produced as one of two types of differentiated B-cell during clonal expansion following B-cell activation by an activated T-helper cell.

B-memory cells are long lived and can differentiate rapidly into plasma cells resulting in the rapid release of antibodies upon reinfection. d

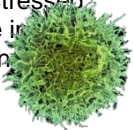
Natural Killer Cell

Skill	Score
Size	7 μ m
Specificity	5
Lifespan	2 weeks
Destructiveness	7
Speed of action	9

Immune system associated with:
Innate (these are general killers not specific to a single antigen target)

Key role

Kill pathogens and distressed cells. Plays a vital role in virally infected and cancerous cells.

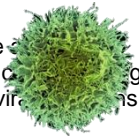


Natural Killer Cell

Factual information

The natural killer cell is a cytotoxic lymphocyte. Unlike most lymphocytes it constitutes part of the innate immune system. Natural killers respond to non-antigen markers and so are able to attack a range of pathogens. While the mechanisms of targeting differ between natural killers and T-killer cells, their modes of action are similar. Both release toxic chemicals in the vicinity of their target. Perforin opens holes in the target membrane through which toxins and digestive enzymes can enter.

Natural killer cells are able to recognise distressed cells, including those suffering from viral infections, and cancerous cells.



Killer T-cell

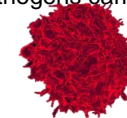
Cytotoxic T-cell

Skill	Score
Size	7-10 μ m
Specificity	9
Lifespan	NA
Destructiveness	7
Speed of action	5

Immune system associated with:
Adaptive

Key role

Present following activation of T-helper cells by APC. Cytotoxic destruction of pathogens carrying specific antigen



T-killer cell

Cytotoxic T-cell

Factual information

T-killer cells are one of the two main categories of T-cell. Like T-helper cells, T-killer cells are produced in the bone marrow and mature in the thymus. Both travel in the blood and are activated by interaction with APC presenting antigens complementary to the receptors they possess.

Once activated, T-killer cells hunt down and attack pathogens or virally infected cells (presenting antigens in the manner of an APC) via a cytotoxic mechanism. They release perforins which punch holes in the target cell membrane in addition to toxic chemicals and digestive enzymes.

T-killer cells can also be stimulated by cytokine release by activated T-helper cells.

