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WEAPONS OF MICROSCOPIC DESTRUCTION

HOW YOUR IMMUNE SYSTEM KEEPS YOU SAFE FROM ATTACK

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Haematopoietic Stem Cells

Truly flexible, the stem cell is what all our immune cells start off life as. These 'jack of all trades' are found in the bone marrow. Here they renew themselves throughout our lives and occasionally decide to become any one of our many immune cells.

This is a very flexible path, and the cells do not decide which immune cell to become until they reach specific checkpoints. The decision at each of these 'checkpoints' is influenced by many things; location in the body, infection, and what cells need to be replaced at the time.

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Neutrophils

The most abundant white blood cell in your body and the first cells on the scene when you graze your knee or cut your finger. They are the body's rapid response force, being highly mobile and able to quickly congregate at the site of an infection or cut.

Neutrophils are also known as **granulocytes** because of the 'granules' which can be seen inside the cells. These granules contain highly toxic and reactive oxygen to kill engulfed pathogens.

To be recognised and engulfed, the pathogen must be coated in antibodies by a process called **opsonisation.** Neutrophils can also 'degranulate' to release their reactive oxygen-filled granules at a site of inflammation to aid the killing of pathogens. They are the most abundant cells in pus, giving it its yellow/white appearance.

This image shows a neutrophil – check out our video of it moving!

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Dendritic Cells

The intelligence officers of the immune system, found in every part of the body, including our skin, gut and immune organs (thymus and bone marrow, where our immune cells develop).

Dendritic cells 'collect' parts of pathogens from around the body and take them to the lymph nodes, where many immune system cells can be found.

The dendritic cells show T cells and B cells the pathogen parts and stimulate them to multiply and attack the pathogen. Dendritic cells are also essential in the development of T and B cells.

This image shows dendritic cells (red) with blood vessels (green) in the lymph node.

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T Cells

T cells come in different forms:

Helper T cells produce chemical messages called cytokines which boost antibody production by B cells and activate macrophages. Special Helper T cells in the spleen and lymph nodes help control the responses of B cells. Here they test and help those B cells trying to make their antibodies more efficient.

Killer T cells patrol the body checking our own cells for invaders such as viruses. Viruses are hidden within our cells and so cannot be directly detected by our immune system. Killer T cells look for indicators on the surface of our cells which show whe they are infected by viruses and can then directly kill those cells.

Regulatory T cells suppress other T cells. By doing this they control the immune system and help make sure that it does not respond to self-antigens. Regulatory T cells are an important self-check which prevent excessive immune reactions and reduce autoimmune disease.

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B Cells

B cells are the ninjas of the immune system, as one of their main jobs is to make **antibody weapons**. Antibodies are 'Y' shaped proteins; each one is slightly different so that many germs – or **pathogens** - can be identified.

Antibodies can also be made in various forms depending on where in the body they need to be, for example in our blood or on our skin. When B cells first develop they produce simple antibodies which respond initially to invading pathogens, but later these antibodies can be improved.

When a virus or bacteria attacks your body, the simple stock of antibodies produced by B cells respond. Then special command units are formed called **germinal centres**, where defence attack is planned and co-ordinated. From here improved invader-specific antibodies and immune cells are sent out to join the battle.

Using a powerful microscope we can see B cells (blue) in the lymph node.

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Macrophages

Macrophages are the immune system's clean-up crew. They 'eat' anything foreign, such as bacteria. Additionally, these cells dispose of pollen and bits of our own cells.

At sites of infection and inflammation (where you see weeping and pus) these cells 'mop up' the debris left over from battles fought between immune cells and pathogens.

Macrophages are also supported by the antibodies produced by B cells. Antibodies cover a pathogen, like tomato ketchup, making it irresistible to a macrophage.

Here we are able to see macrophages (red/green) moving around under the microscope.

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