**Discovering the Immune System KS2**

Links to Babraham Institute research themes:

<https://www.babraham.ac.uk/our-research/healthy-ageing>

<https://www.babraham.ac.uk/our-research/lymphocyte>

Links to Babraham Institute scientific services

<https://www.babraham.ac.uk/science-services/flow-cytometry>

**What are microorganisms**

* What are Microorganisms – introduce the basic facts – why not look up some of your own!
* They are tiny, small living creatures; we use microscopes to see them.
* They can be bacteria, viruses, fungi etc.
* They were on Earth long before dinosaurs, produce a lot of the oxygen we breathe
* They can be found everywhere!

**What do microorganisms do**

* Most of them are NOT harmful, here’s some examples of ‘good’ and ‘bad’:
	+ Harmful things: infections, tooth decay (bacteria), making our food rot, causing diseases in plants
	+ Helpful things: making antibiotics to fight infections, food/drink production (yoghurt = lactobacillus, bread and beer = yeast), decomposing dead plants, animals etc to their constituent chemicals

**How can infections spread?**

* Sneeze particles (aerosol droplets) can remain in a room for 3 days after a sneeze
* Use of tissues
* Hand washing
* Contact with other people and other things like door handles
* Food hygiene.

**What is the immune system?**

The immune system is what keeps us from being sick, despite there being microorganisms everywhere, some of which could make us sick.

We have developed barriers against microorganisms:

* Our skin
* Saliva
* Tears
* Stomach acid

We have an immune system army, with many ‘cells’ that have different jobs to protect us such as cells that fight against bad microorganisms, each with different jobs:

* Dendritic cell – collect parts of micro-organisms and show them to T cells and B cells.
* T cells – co-ordinate the attack on the microorganisms
* B-cells to make signposts called antibodies to direct macrophages to ‘eat’ them, so eliminating the ‘bad’ micro-organisms from the body.
* For more detailed information on immune cell types, refer to ‘Weapons of Microscopic Destruction Immune Cell Guide.pdf’

**Innate vs Adaptive Immune System**

Your immune system has two strategies for destroying pathogens, innate and adaptive immunity. The cells of the innate immune system respond quickly within hours of infection and are a great line of first defence. Adaptive immunity is much slower (it can take up to a week to reach full force) but is far more specific.

The key players in innate immunity are always on guard and ready for action, they include macrophages, neutrophils and dendritic cells as well as the epithelial barriers – cells on our skin, in our gut and respiratory tract which act as physical barriers for pathogens.

B cells, antibodies, helper T and Killer T cells make up the adaptive immune response. They can mount a specific immune response to a particular invader. After an attack some T cells and B cells become memory cells and act as scouts looking for the same pathogen in the future. This process is called immunological memory and allows you to mount a quicker and more effective immune response the next time you are infected with the same pathogen. Vaccination makes use of this amazing memory response. By infecting the body with a small amount, or attenuated (killed) version, of a pathogen a vaccine causes your immune system to initiate an attack without you getting sick. If, in the future, you are infected by the same pathogen the immune system is primed and ready to attack.

<http://immunearmy.babraham.ac.uk/immune-army>

**Antibodies and antigens**

Our own cells, as well as pathogens, have unique identifiers which are recognised by immune cells and antibodies – these identifiers are called antigens. A single pathogen can have hundreds of antigens and this allows many immune cells or antibodies to identify and start a counter-attack on it.

**Latex agglutination**

Latex agglutination is observed when a sample containing the specific antigen (or antibody) is mixed with an antibody (or antigen) which is coated on the surface of latex particles.

Latex agglutination tests have been applied in clinical laboratories for the detection of infectious diseases and in 1956 Singer and Plotz first described Rheumatoid Factor Test, a test based on latex agglutination. In rheumatoid arthritis (RA), IgG antibodies produced by lymphocytes in the synovial joint react with the IgM antibodies (RF, rheumatoid factor) to generate immune complexes that activate the complement and cause the tissue destruction. The RA is of diagnostic significance.

Since then, tests to detect microbial and viral infections, autoimmune diseases, hormones, drugs and serum proteins have been developed and marketed by many companies worldwide. The principle is used for the diagnosing many infections such as Hepatitis B, H.influenzae, N. meningitidis, etc.. All methods of detecting or quantitating antigen or antibody take advantage of the fact that they react to form a complex. At the optimum antigen-antibody concentration, this complex precipitates out. However, if the antigen is particulate in nature, agglutination of antigen-antibody complex is observed.

**Agglutination Reactions**

The reaction between a particulate antigen and an antibody results in visible clumping called agglutination. Antibodies that produce such reactions are known as agglutinins. The principle of Agglutination reactions are similar to precipitation reactions; they depend on the cross linking of polyvalent antigens. When the antigen is an erythrocyte it is called hemagglutination.Theoretically all antibodies can agglutinate particulate antigens but IgM, due to its high specificity is a particularly good agglutinin.

There is no agglutination can be observed when the concentration of antibody is high, (lower dilutions), and then the sample is diluted, agglutination occurs. Prozone effect is defined as the invisibility of agglutination at high concentrations of antibodies. It is due to the reason that excess antibody forms very minute complexes that do not clump to form visible agglutination.

**Qualitative agglutination test**

Agglutination tests can be used in a qualitative manner to assay for the presence of an antigen or an antibody. The antibody is mixed with the particulate antigen and a positive test is indicated by the agglutination of the particulate antigen.

For example, to determine patient’s blood type the red blood cells of the person can be mixed with antibody to a blood group antigen. Another example is that to assay the presence of antibodies in a patient sample, the serum of the patient is mixed with the red blood cell (RBC) of a known blood type.

**Quantitative agglutination test**

To measure the level of antibodies to particulate antigens, agglutination test can be widely used. For this test, serial dilutions of the sample can be made and it is tested for antibody. Then a fixed amount of particulate antigen or bacteria or red blood cells can be added to it. Determine the maximum dilution which forms agglutination and this maximum dilution which gives observable agglutination is known as the titer. The results is shown as the reciprocal of the maximum dilution that forms visible agglutination.

<http://vlab.amrita.edu/?sub=3&brch=69&sim=195&cnt=1>