CAIE Biology A-level

Topic 11: Immunity

Notes

Immune response

Physical barriers to infection include:

- **Skin** is a **tough physical barrier** consisting of **keratin**
- **Stomach Acid** (hydrochloric acid) which **kills bacteria**
- **Gut and skin flora –** natural bacterial flora **competes with pathogens** for food and space

Non-specific responses of the body to infection include:

- **Inflammation –** histamines released by damaged white vessels cause vasodilation which increases the flow of blood to the infected area and increases permeability of blood vessels. As a result of that antibodies, white blood cells and plasma leak out into the infected tissue and destroy the pathogen
- **Lysozyme action –** lysozyme is an enzyme found in secretions such as tears and mucus which kills bacterial cells by damaging their cell wall
- **Interferon –** interferons prevent viruses spreading to uninfected cells by stopping protein synthesis in viruses
- **Phagocytosis** is a process in which **specialised white blood cells** engulf pathogens thus destroying them by fusing a pathogen such as bacteria enclosed in a phagocytic vacuole with a lysosome. The phagosome and lysosome combine and the enzymes from the lysosomes destroy the pathogen. The main phagocytes are macrophages and neutrophils.

After the pathogen is engulfed and destroyed, its chemical markers called **antigens** are then **presented on the surface of the phagocyte**. The phagocyte then becomes an **antigen presenting cell** which activates other types of immune system, immune response will be stimulated if the antigen is recognised as foreign. Antigens can be **self** or **non-self**. Self antigens are antigens that are already a part of the body's immune system. Non-self antigens are foreign antigens (not the body's own) which can **initiate an immune response**.

The specific immune response is antigen specific and produces responses specific to one type of pathogen only. This type of immune response relies on **lymphocytes produced in the bone marrow**:

- **B cells** mature in the bone marrow and are involved in the **humoral response**
- **T cells** move from the bone marrow to the thymus gland where they mature, they are involved in **cell mediated response**

Primary immune response

When the body encounters a pathogen for the first time, the immune system initiates antibody production which then destroys the pathogen.

T and B memory cell production is also initiated so that if the body were to encounter the same antigen again it would immediately destroy it. (secondary immune response.)

Specific immune response glossary

T lymphocytes

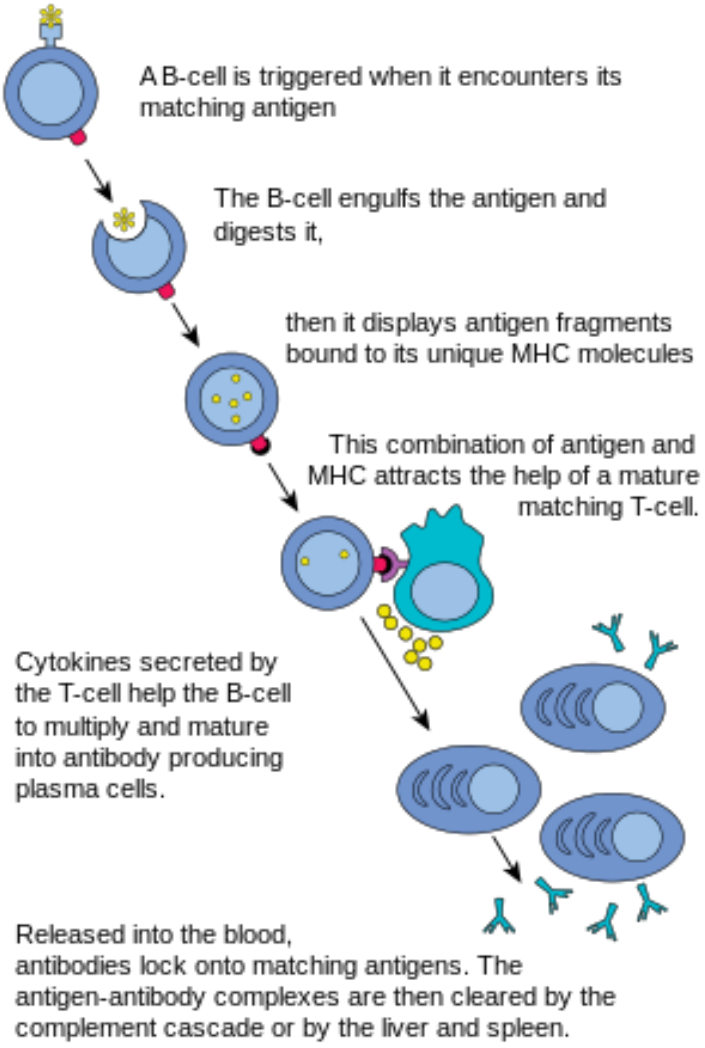
- **T helper** cells **stimulate B cells and T killer cells to divide**
- **T killer** cells **destroy pathogen infected cells**

B lymphocytes

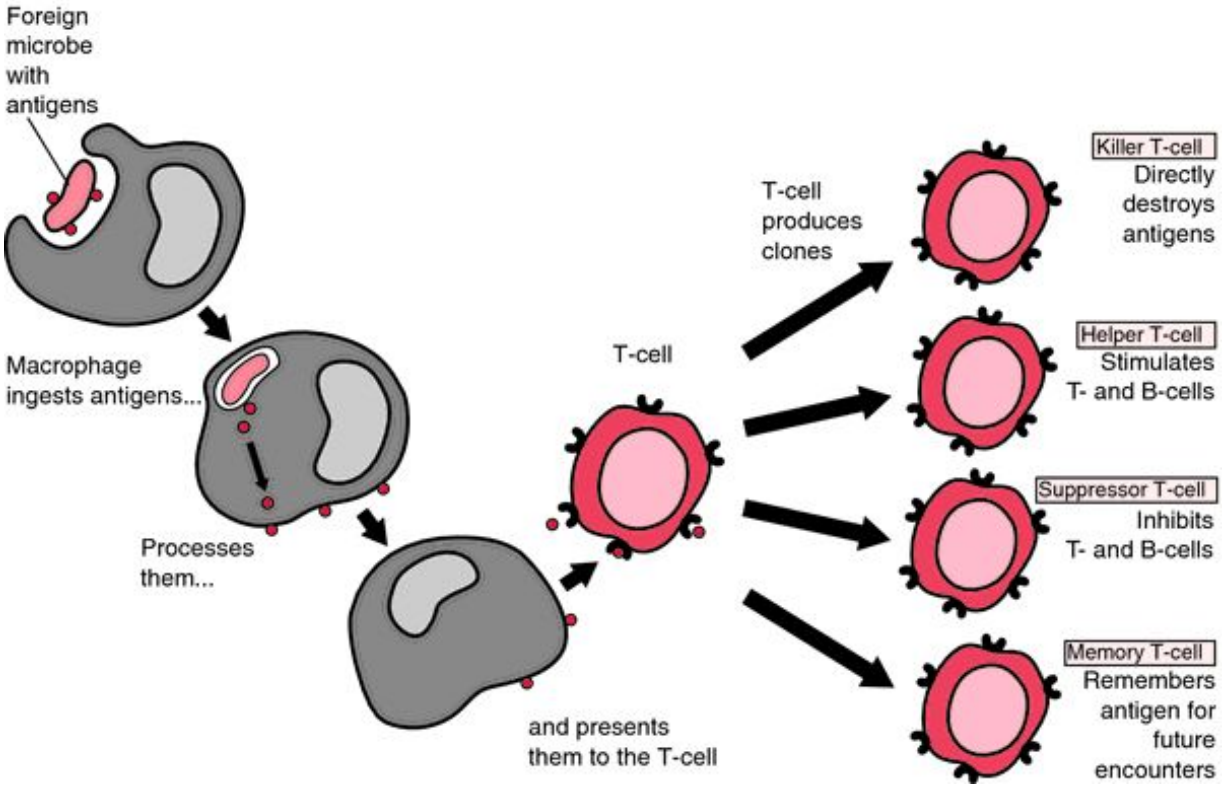
- **B effector** cells - form **clones** of plasma cells
- **Plasma cells** - produce a **large amount antibodies** specific to an foreign antigen

Memory cells are cells which replicate themselves when exposed to an invading pathogen and remain in the lymph nodes searching for the same antigen thus resulting in a much **faster immune response.** This allows long term immunity.

Humoral response



Cell-mediated response



Antibodies

Structure

- **Y-shaped glycoproteins**
- Bind to specific antigens to trigger an immune response
- **2 long identical polypeptide chains** and **2 shorter identical chains**
- The chains are held in place by **disulfide bridges** which also helps them maintain their shape
- Antibodies bind to the antigen via a 'lock and key' mechanism similar to enzymes
- **2 antigen binding sites** allowing antibody to bind to 2 antigens

Monoclonal antibody production via the hybridoma method

- Inject mouse with antigen. This initiates the immune response and the mouse produces antibodies specific to the antigen
- The spleen cells which produce lymphocytes which produce antibodies are removed
- Spleen cells bind with myeloma cells to produce hybridoma cells
- The hybridoma cells can divide continuously to produce many antibodies. These are all specific to the original antigen.

Monoclonal antibodies can be **used in the treatment of diseases such as cancer.** Cancer cells have markers present on their surface which can be clumped together into a mass with

monoclonal antibodies. This allows cancerous cells to be easily identified and treated. Monoclonal antibodies can carry the drug to cancerous tumours or they can trigger immune responses to destroy the tumour.

Immunity

Immunity can either be **active or passive**; active **immunity results from the production of antibodies by the immune system** in response to the presence of an antigen whereas passive immunity results from the **introduction of antibodies from another person or animal.** There are also two subtypes of immunity; natural or artificial:

- **Natural active immunity** arises from being exposed to an antigen/getting the disease whereas **natural passive immunity** is the result of crossing of mother's antibodies through the placenta and their presence in breast milk.
- **Active artificial immunity** is acquired through vaccinations which stimulate the immune system and lead to production of antibodies whereas **passive artificial immunity** is where antibodies are injected into the body.

Vaccinations help provide **long-term immunity** and also helps prevent **epidemics** by preventing the spread of the disease to the greater population. When a significant amount of the population is vaccinated, it also provides immunity to the population who hasn't been vaccinated (**herd immunity**).