CIE Biology A-level

Topic 11: Immunity

Notes

Immune response

Physical barriers to infection include:

- **Skin,** which 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 Immune Response:

Non-specific responses of the body to infection include:

- **Inflammation –** histamines released by white blood cells cause vasodilation which increases the flow of blood to the infected area and increases permeability of blood vessels. As a result, antibodies, white blood cells and plasma leak out of capillaries 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 phagocytes engulf pathogens thus destroying them by fusing a pathogen such as bacteria enclosed in a phagocytic vacuole with a lysosome. There are two types of phagocyte: **neutrophils and macrophages**. These are both made in **bone marrow**.

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.

White blood cell count increases with infectious diseases as more are produced to help fight the infection.

Specific 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**

Specific immune response glossary:

- **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.** They allow **long term immunity.**
- **B effector** cells are **antibody producing** cells. When the correct antibody is produced to fit the antigen on the pathogen, the antibody divides by mitosis in order to multiply so that the infection can be prevented. This is called **clonal selection** as the antibody clones itself.
- **T helper** cells **stimulate B cells and T killer cells to divide**
- **T killer** cells **destroy pathogen infected cells**

Monoclonal antibodies:

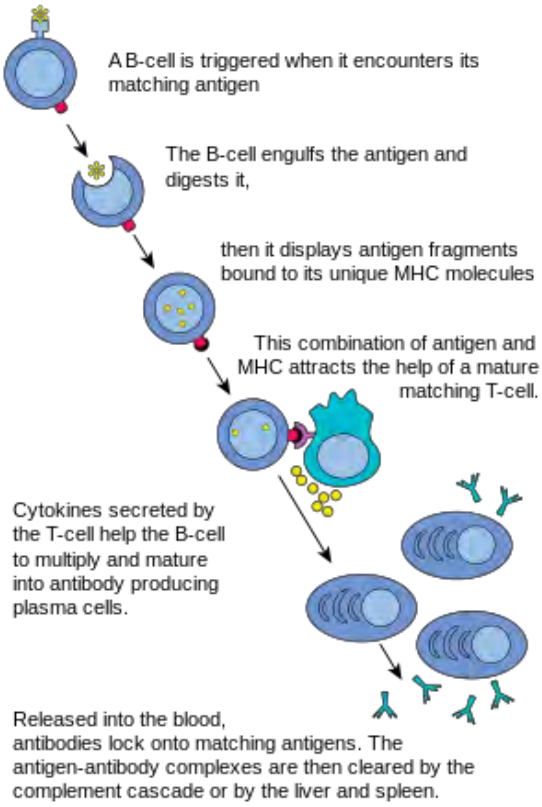
Monoclonal antibodies are produced via the **hybridoma method**:

1. Antigens injected into mouse to provoke an immune response.
2. B cells are removed from mouse and fused with tumour cells that are grown in a culture. These are called **hybridomas**.
3. Antibody-producing hybridomas are grown in a culture to produce many identical antibodies. These can be used to diagnose and treat diseases.

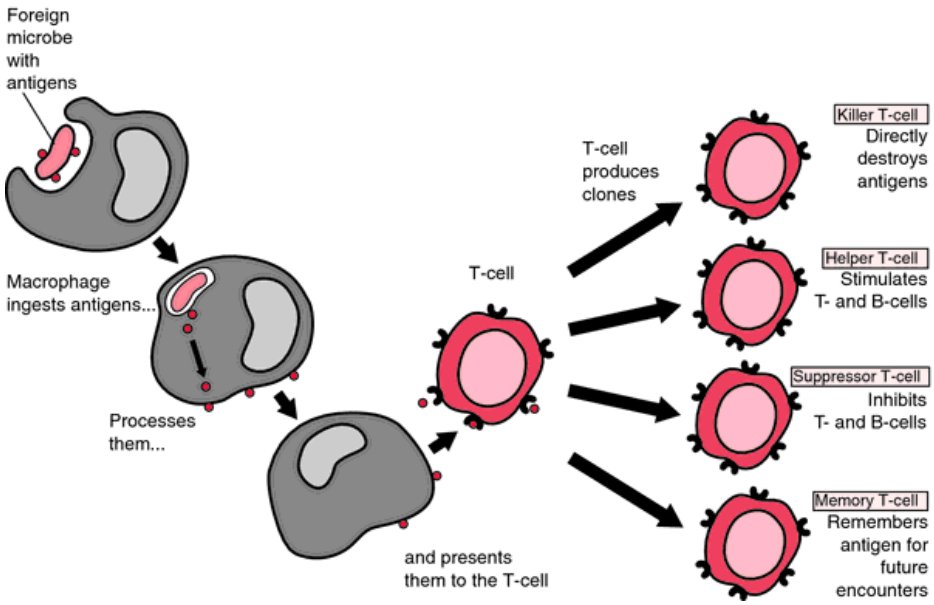
Diagnosing diseases (ELISA test):

1. Mobile monoclonal antibodies are attached to a coloured dye and placed near the bottom of a vertical strip of plastic. Non-mobile antibodies are placed near the top.
2. Bottom of strip is placed in urine sample (not covering antibodies). Urine sample will contain the pathogen.
3. As urine moves up strip, the antigens on the pathogen will bind to the coloured antibodies and continue to move up the strip.
4. When the mobile antibodies/pathogen reach the non-mobile antibodies, they will bind together. This will create a coloured strip, indicating that the patient has the disease.

Humoral response



Cell mediated response



Autoimmune diseases:
Each type of cell has specific molecules on its surface that allows white blood cells identify it. This is how they determine which cells are 'self' and which are 'non-self', i.e. foreign pathogens. **Autoimmune diseases**, such as myasthenia gravis, occur when the white blood cells fail to distinguish between self and non-self, leading to an immune response on healthy cells.

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. Not all diseases have vaccines; some are too complex. In some countries, people are unable to receive vaccines as the vaccine cannot be stored or there are no healthcare systems in place.