

CAIE Biology IGCSE

10: Diseases and Immunity

Notes

(Content in **bold** is for Extended students only)

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Diseases and Immunity

A **pathogen** is an **organism that causes disease**. Pathogens include **bacteria and viruses**. Organisms which harbour these pathogens are referred to as **hosts**. Pathogens can be passed from host to host and thus are called **transmissible diseases**.

Pathogens can be transmitted in two ways:

- **Direct contact**- the pathogen can be transmitted from host to host via transfer of blood and other body fluids
- **Indirectly**-from contaminated surfaces, foods, animals and air

It is therefore important to make sure that food is prepared **hygienically**, waste and sewage are treated and disposed of, clean water supply and good personal hygiene is maintained to **prevent the spread of disease**.

Defences against infection:

The body's first line of defense attempts to prevent pathogens from entering the body, and includes:

- **Mechanical barriers** - this includes hairs in the nose and skin.
- **Chemical barriers** - includes mucus, stomach acid and tears.

Once the pathogen has infected the body, an **immune response** occurs to kill it. This involves **phagocytosis and antibody production** by white blood cells.

Antibodies and antigens:

Pathogens can be detected by **white blood cells** and are destroyed in an immune response. Each pathogen has a **specific** antigen protein with specific shapes on their cell membrane. In the immune response, **lymphocytes** produce specific **antibodies**, which bind to the antigens to produce an **antibody-antigen complex**. As each type of pathogen has different antigens, a specific antibody which is **complementary** to this antigen must be made for each disease. This is because antibodies have **complementary shapes** which only fit specific antigens. Once the antibody binds to the antigens, the pathogens clump together making them harmless. They can then either be **killed directly** or **marked for destruction by phagocytes**.



Active immunity:

Active immunity is a defense against a pathogen by antibody production in the body. It can be gained after an infection by a pathogen, or through vaccination.

Infection:

After the pathogen has been killed, some of the lymphocytes remain as **memory cells**. This means that if the same pathogen ever enters the body again, the lymphocyte would **recognize the antigens** and be able to **produce new antibodies more quickly** than the first time. Memory cells stay in the body for years, thus giving **long-term immunity**.

Vaccination:

1. A **dead or attenuated** version of a pathogen or their antigens is given to the patient
2. The antigens evoke an **immune response** by lymphocytes, in which **antibodies** are produced
3. **Memory cells** are produced which stay in the body, giving **long-term immunity**

Vaccination can be used to **control the spread of disease** by providing **herd immunity**. This is where a large amount of the population is vaccinated and are thus immune to the pathogen, so the **disease cannot spread** as there are only a few people left who can still become infected. The few that cannot be vaccinated, for example due to medical reasons, are therefore protected against the disease.

Passive immunity:

Passive immunity is a **short-term defense** against a pathogen and can be gained through **acquiring antibodies from another individual**. One example of passive immunity is antibodies being passed to a baby through the mother's milk, thus it is important for babies to be breastfed to reduce the risk of diseases. It can also be gained through **injections of antibodies** from a donor or from a pregnant mother to her baby in the womb through the **placenta**.

Passive immunity is short-term as **memory cells are not produced**.



Cholera:

Cholera is a disease caused by an infection with **Vibrio cholerae** bacteria. This bacteria is transmitted in contaminated water. It is then ingested via contaminated food or water.

1. When the bacteria enters the small intestine, it binds to the **small intestine** wall and then produces a toxin.
2. This toxin causes cells lining the small intestine to secrete **chloride ions** into the lumen of the small intestine.
3. The concentration of **chloride ions** in the lumen increases. This decreases the water potential in the lumen.
4. Water moves from the cells (higher water potential) into the lumen (lower water potential) by **osmosis**.
5. This causes a lot of water to be lost from the body via faeces. This is known as **diarrhoea**.
6. This also leads to a very low concentration of chloride ions in the blood.
7. Since a lot of water has been lost from the body, this leads to **dehydration**.

