Memory cells and long term immunity

Both B-lymphocytes and T-lymphocytes can form memory cells after encountering a pathogen in the body. The function of these is to allow the body to ‘remember’ the pathogens that it has already encountered and so produce a much faster immune response to them a second time around. The role of memory cells is best understood in relation to B-lymphocytes.

When a familiar antigen is encountered, B-lymphocyte memory cells (produced during a previous immune response to the same pathogen) will divide and form new antibody-producing plasma cells. Some memory cells will be left, however, so that the body can respond to any number of future infections with the same pathogen.

Three main differences exist between the first (or primary) response to a pathogen by B-lymphocytes and the next (secondary or subsequent) response:

1. Antibodies are produced **more rapidly**
2. **Larger amounts** of antibodies are produced in the secondary response
3. The effect is **longer lasting**.

The presence of memory cells means that with some diseases such as mumps or chicken pox, one infection can make a person immune or resistant to that infection for the rest of their life. The pathogens causing these diseases will almost certainly get into their body again during that time, but the immune response is so rapid that they will not become ill.

With other infections, such as malaria and influenza, the immunological memory is not so good and so people can suffer many illnesses from the same pathogen. This is because some pathogens have a very high mutation rate in the genes coding for antigen proteins. The structure of the antigen changes slightly and the memory cells fail to recognise it.
Natural acquired immunity

If someone catches a disease, their body produces antibodies to defend itself from the disease. The lymphocytes, which produce these antibodies, remain in circulation for some time – just in case the body is infected again. Sometimes, babies inherit the antibody from their mother’s milk. This is called innate immunity.

Naturally acquired immunity builds up in recovery from a disease. The immunity remains in the body forever.

Innate immunity

This is when a person is born with a specific immunity. This can either be acquired from the mother’s milk (a clear advantage of breast feeding) or via the placenta (during pregnancy). The immunity is acquired from the mother for infections, which the mother has recently combated. Antibodies are only present in the milk for the first four days.

Artificial acquired immunity

When someone is vaccinated against a disease, a harmless form of the bacteria (or virus) is introduced into the body so that the body produces the antibodies to deal with it.

Artificial immunity produced by a vaccine has different forms:

1. May have harmless form of the disease. This stimulates unspecialised antibodies to produce clone cells capable of producing antibodies against the disease.

2. May be the killed form of the disease

3. May have ready-made antibodies

4. May have toxoid – to neutralise poison from disease

However, the problem with these is that they need to be repeated as they only last a short period of time.

Think about it!

With this in mind, what do you think the government should be doing for the fight against the flu every year?
Malaria, TB and HIV

Malaria
Malaria is a disease caused by protozoan parasites, which are of the genus *Plasmodium*. This organism has a complex life cycle, which we are not going to look into.

The main way in which the parasites travel from one host to another is via a female mosquito of the *Anopheles* genus.

The life cycle of Plasmodium
Parasites enter the blood in the saliva of a female *anopheles* mosquito vector. The saliva is injected by the mosquito to prevent the blood from clotting whilst the mosquito is feeding.

For about an hour after the infection, parasites can be found in the blood. After this time, they have all penetrated liver cells. This is because it is the ideal site: nutrients are present.

Within each infected liver cell, the parasite divides to form approximately 1000 more parasites. This process takes 8-10 days.

The liver cells then burst – releasing the new parasites into the blood. Most of the new parasites enter red blood cells where they divide to form 20-30 more parasites over the following 48 hours. The remaining parasites re-infect liver cells.

The infected blood cells burst open releasing the parasites within. These re-infect other red blood cells. Along with the parasites, toxic excretory granules (from the parasites) are released into the blood and it is these, which cause the characteristic malarial fever.

If a female mosquito feeds on the blood of an infected person, parasites enter its gut. They bore through the gut wall and make their way into the mosquito’s salivary glands. When the mosquito next feeds, the parasite passes into the bloodstream of the person who is bitten.
TB
- This is the abbreviation for “Tuberculosis”.
- It is an infectious disease caused by bacteria called *mycobacteria*
- The main bacteria is called *mycobacterium tuberculosis*

It usually attacks the lungs, but can actually affect any organ. The classic symptoms of someone with tuberculosis include:
- chronic cough
- night sweats
- loss of weight
- blood-tinged sputum (what you cough out)
- fever

*(you do not actually need to know the symptoms for your exam, but this is just there for extra information)*

TB is actually very easy to transmit – if it is pulmonary TB. During active pulmonary tuberculosis, transmission can occur via air droplets.

- Every time someone sneezes or coughs, they release up to 40 000 droplets of air
- Each one of these droplets may carry the disease
- Just one bacterium is enough to possibly cause further problems

It is most commonly transmitted in those who are in regular contact with an infected person.

HIV / AIDS
- HIV stands for human immunodeficiency virus
- As it says in its title, HIV is a virus
- Infection with the virus can lead to a disease called AIDS
- AIDS is a condition in which results in the immune system beginning to fail
- Because of this, a person with AIDS is more susceptible to diseases (the body can’t fight them off)

Transmission:
- transfer of blood, semen, vaginal fluid, pre-ejaculate and breast milk can lead to transfer of the virus
- the virus is in all these liquids in either the free state or within infected immune cells

- 4 main ways of transferring the virus
  - Unprotected sexual intercourse
  - Contaminated needles
  - Breast milk
  - Transferral of virus from mother to baby during birth

HIV has killed more than 25 million people since it was recognised in 1981.
0.6% of the entire global population people are infected with HIV