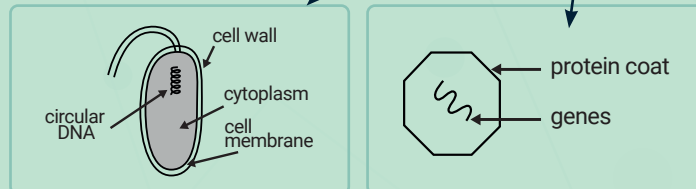


Microorganisms - Most microorganisms are harmless; some are even useful.

Microorganisms that cause diseases are called **pathogens**. **Fungi, protists, bacteria, and viruses** can all cause disease.



Pathogens are communicable, they can be spread by:

- contact
- aerosol
- body fluids
- water
- insects
- contaminated food.

Body defences: Our bodies are adapted to resist infection by microorganisms:

- Skin flora - bacteria that make it difficult for pathogens to become established.
- Intact skin is a barrier and blood clots immediately around wounds.
- Ciliated mucous membranes trap microbes in inhaled air.
- Stomach acid and lysozyme in tears protect where skin is not present.

The immune system - White blood cells

If microbes manage to enter the body, then white blood cells in the body will respond. There are two types of leukocyte:

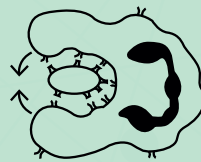
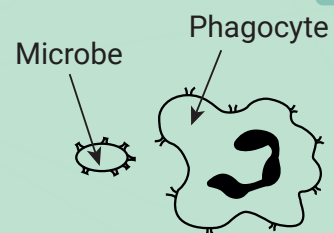
Phagocytes:

Microbes have proteins on their surface called antigens.

The phagocytes recognise the antigens on the microbe as an invader.

The phagocyte engulfs the microorganism.

Enzymes inside the phagocyte digest the microorganism.



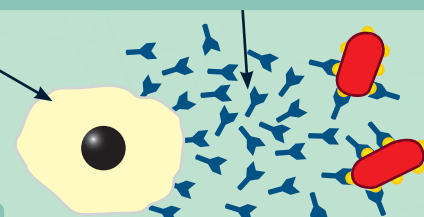
Lymphocytes:

Lymphocytes recognise the specific antigens on invading microorganisms.

Each different strain of microorganism has its own specific antigen.

Antitoxins are also produced by lymphocytes and neutralise any toxins produced by the invading microbes.

Antibodies are produced by the lymphocytes and have complementary shapes to the specific antigen on the microorganism surface.



Antibodies:

- mark the microbe for destruction by the phagocytes
- clump microbes together so many can be destroyed at once
- cause the destruction of the microbe.

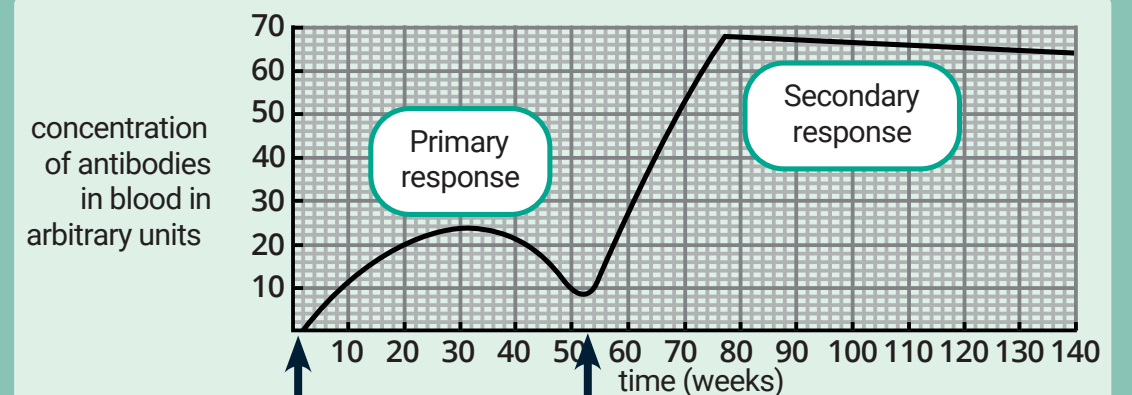
Immune response

Humoral response

- B lymphocytes have receptors for the detection of a specific antigen.
- Activation stimulates production of plasma cells, and memory cells.
- Memory cells remain in the circulation ready to divide if the same antigen is encountered again.
- Antibodies are proteins that are specific to the antigen with which they bind to form an antigen-antibody complex.
- An antigen-antibody complex renders the antigen inactive which increases the rate of engulfment by phagocytes.

Cell-mediated immune response

- Detection of a specific antigen causes the production of T lymphocytes.
- There are many subpopulations of T cells including: effector cells (T killer or cytotoxic T lymphocytes) that cause lysis of the target cells, helper T cells that cooperate with B lymphocytes to initiate an antibody response and memory cells that remain dormant until the host is next exposed to the antigens.
- Cell-mediated defences include the activation of phagocytes, antigen-specific killer and cytotoxic T lymphocytes.
- Activation of B cells involves the release of various chemicals called cytokines in response to an antigen.



The primary response takes longer, and fewer antibodies are produced. If this is caused by catching the disease symptoms will be felt. This response can be initiated by a vaccination.

If the same microbe is encountered again, memory cells recognise them quickly and a large number of antibodies are produced in a short time. No symptoms are felt, and the person is immune to this disease.