

Knowledge Organiser: The Immune System

Pathogens

A pathogen is a **microorganism** that causes a disease. There are four main types of pathogen:

Pathogen	Example in animals	Example in plants
Viruses	HIV potentially leading to AIDS	Tobacco mosaic virus
Bacteria	Salmonella	Agrobacterium
Fungi	Athlete's foot	Rose black spot
Protists	Malaria	Downy mildew

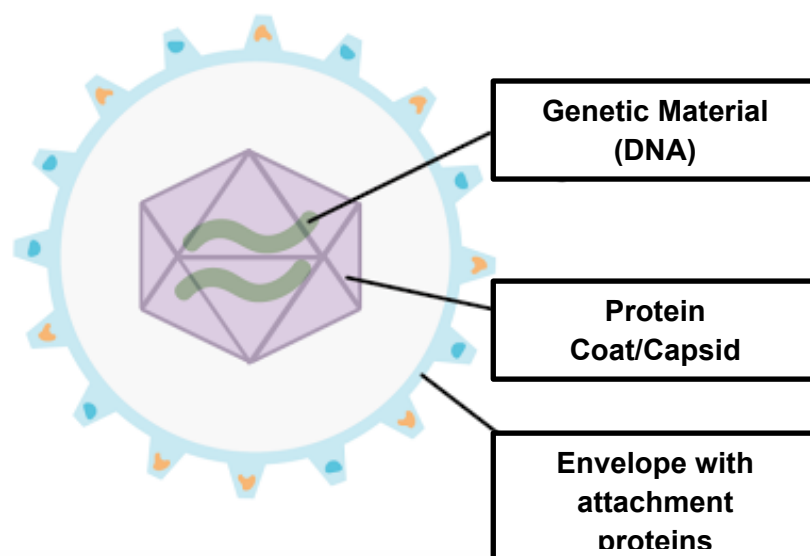
Diseases caused by pathogens are called **communicable diseases**. This means they can be transferred from one person to another.

Viral Diseases

Viruses are **not alive** because they do not complete all of the seven life processes: Movement, Respiration, Sensitivity, Nutrition, Excretion, Reproduction and Growth.

They are made of a relatively **short length of genetic material DNA** which is surrounded by a protein coat (capsid).

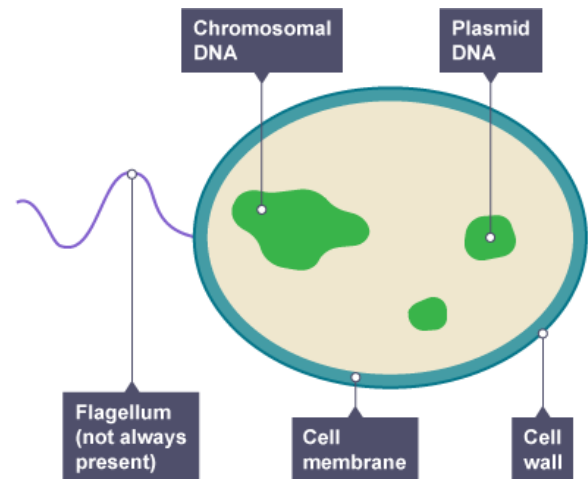
When they have infected a suitable host cell or cells, they **replicate themselves** within the cell thousands of times. They do not divide and reproduce, but **replicate their DNA and protein coats**. These are then assembled into new virus particles. The host cell or cells then **burst** and other nearby cells can be infected with the virus.



Bacterial Diseases

Not all bacteria are pathogens which cause disease. Many bacteria, like those found in the intestines, are useful.

All bacteria are **prokaryotes**, and do not have a nucleus. Unlike viruses, they are cells and so are **larger** but cannot be seen without a microscope.



Bacterial cells divide by a process called **binary fission**.

Structure	Function
Cell Wall	Provides structure and protection.
Cell Membrane	Controls the movement of substances in and out of the cell.
Chromosomal DNA	Found loose in the cytoplasm – formed from a long, coiled up strand.
Plasmid DNA	Circles of DNA. Can move from one bacteria to another.
Flagellum	Rotate/move in a whip like motion to move the bacteria. They can have several.

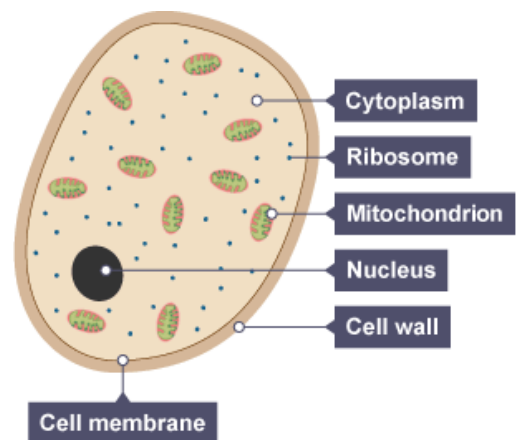
Fungal Diseases

Not all fungi cause disease. **Yeast** is a single-celled fungus that is economically important because we use it to make some **bread and beer**.

Not all fungi are single-celled. Some such as mushrooms are multicellular and so much larger. These are still made of tiny cells like yeast, but have many more of them.

Fungal cells have a **cell wall** made of (unlike plant cells walls which are made of cellulose).

Fungal cells have a nucleus and so are **eukaryotic**.



Protist diseases

Protists are a group of microorganisms that have features that belong to animals, plants and fungi. Some are like animals, others more like plants and some; called moulds are closest to fungi.

They are all **eukaryotic**, which means they have a nucleus.

Preventing Spread

The transmission of pathogens can be **prevented or reduced** in a number of ways:

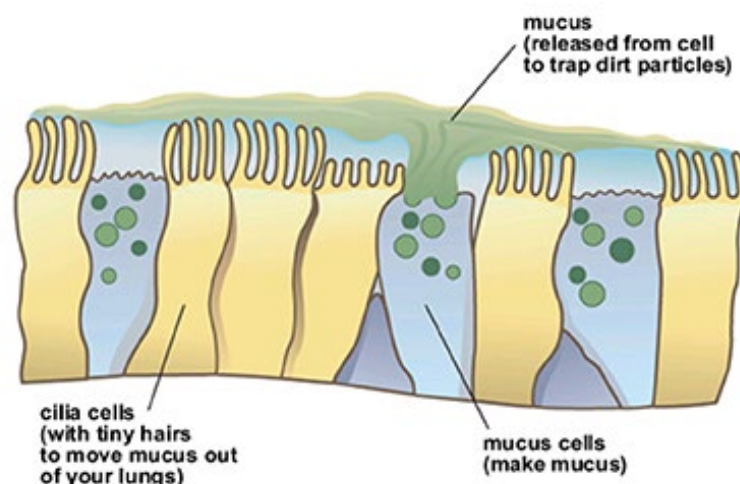
- Sterilising water – chemicals/UV light can kill pathogens in unclean water.
- Good food hygiene – thoroughly cooking foods and preparing them in hygienic conditions.
- Good personal hygiene – cleaning surfaces/washing hands/face masks/gloves.
- Contraception (e.g. condoms) – to prevent the spread of sexually transmitted diseases.
- Vaccinations

Preventing Infection

The body is constantly defending against attacks from pathogens.

The **first line of defence** against infection stops the pathogens from entering your body. They are **not specific** to fight against certain types of pathogen (they are called non-specific, and they can be **physical or chemical** barriers).

- The skin – acts as a physical barrier, if it gets cut it forms a scab, which prevents infection.
- Eyes - produce tears, which contain **enzymes** to break down the pathogen (chemical barrier).
- Nose – cells in the nose produce **mucus**, this traps pathogens before they can enter the lungs. When the nose is blown, mucus is removed and any pathogens are trapped within it.
- Trachea and bronchi – lined with **ciliated** and **goblet cells**, goblet cells create the mucus in order to trap pathogen. Ciliated cells waft their hairs to move mucus and pathogens upwards towards the throat where it is swallowed into your stomach.
- Stomach – **hydrochloric acid** kills pathogens (chemical barrier).



Immune System

If pathogens pass the non-specific first line of defence they will cause an infection. However, the body has a **second line of defence** to stop or minimise this infection. This is called the immune system.

As a part of this there are two types of white blood cell called **phagocytes** and **lymphocytes**.

Phagocytes

Phagocytes surround any pathogens in the blood and engulf them. They release enzymes to destroy the pathogen. This process is called **phagocytosis**.

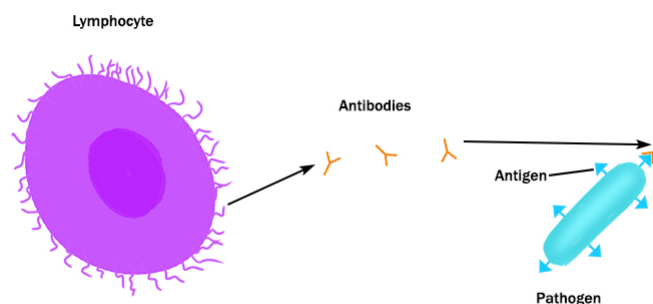
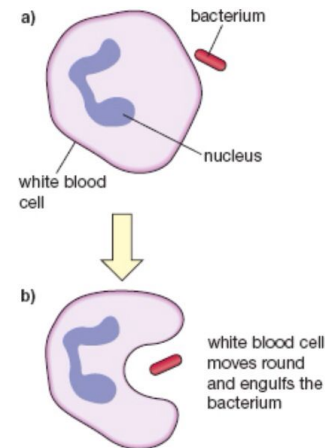
Lymphocytes

They recognise proteins on the surface of pathogens called **antigens** and make **antibodies**.

This can take a few days, during which time you may feel ill. The antibodies cause pathogens to stick together and make it easier for phagocytes to engulf them.

Some pathogens produce **toxins** which make you feel ill. Lymphocytes can also produce **antitoxins** to neutralise these toxins.

The antibodies and antitoxins are highly specific to the antigen on the pathogen, this means different antibodies and antitoxins need to be made each time the body gets infected with a new pathogen.



Immunity

Once you have been infected and your immune system has fought off a pathogen, some of the lymphocytes remain in the bloodstream as **memory cells** which can produce the specific antibody for the antigen.

If the body is infected by the same pathogen again, the memory cells release antibodies to fight off the pathogen and quickly destroy it before there is time for the pathogen to make the person ill. This is called being **immune** to a disease or having **immunity**.

Vaccines

Vaccines contain a **dead/weak** form of a disease.

They cause lymphocytes to make and then release complementary **antibodies** to the specific antigen that was injected.

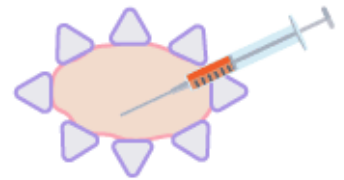
The antibodies attach to and clump the antigens/bacteria together.

Phagocytes engulf the antigens/bacteria to remove them from the body.

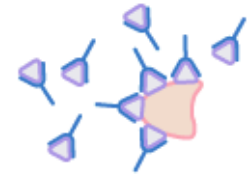
Some of the **lymphocytes** remain in the bloodstream as **memory cells** which can produce the specific antibody for the antigen.

If the body is infected by the real pathogen, the memory cells release antibodies to fight off the pathogen and quickly destroy it.

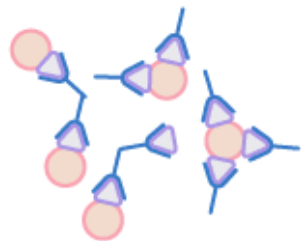
Syringe injects an altered form of the pathogen



White blood cells release complementary antibodies to the specific antigen



They attach and clump pathogens together



White blood cells engulf the pathogens. Phagocytosis occurs



The pathogen is killed off before it can make the person ill. This is called being **immune** to a disease or having **immunity**.

