

B5.2 Pathogens and disease

Learning objectives

After this topic, you should know:

- what pathogens are
- how they cause disease
- how pathogens are spread.

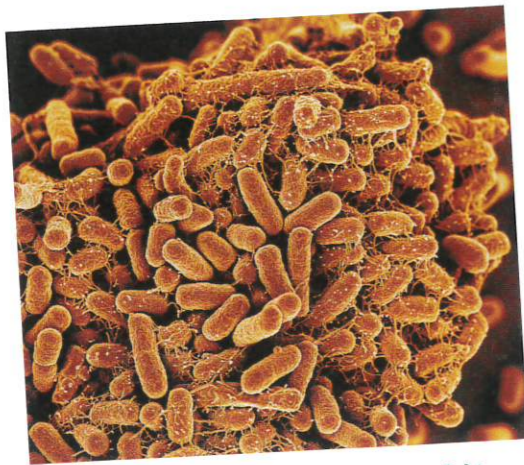


Figure 1 Many bacteria are very useful to humans but some, such as this strain of *E. coli*, are pathogens and cause disease

Synoptic link

Remind yourself about the structure of bacteria by looking back to Topic B1.3.

Communicable diseases, also known as infectious diseases, are found all over the world. Microorganisms that cause disease are called pathogens. Pathogens may be bacteria, viruses, protists, or fungi, and they infect animals and plants, causing a wide range of diseases.

Communicable diseases are caused either directly by a pathogen or by a toxin made by a pathogen. The pathogen can be passed from one infected individual to another individual who does not have the disease. Some communicable diseases are fairly mild, such as the common cold and tonsillitis. Others are known killers, such as tetanus, influenza, and HIV/AIDS.

Sometimes communicable diseases can be passed between different species of organisms. For example, infected animals such as dogs or bats can pass rabies on to people. Tuberculosis can be passed from badgers to cows, and from cows to people.

What are the differences between bacteria and viruses?

Bacteria and viruses cause the majority of communicable diseases in people. In plants, viruses and fungi are the most common pathogens. Bacteria are single-celled living organisms that are much smaller than animal and plant cells. Bacteria are used to make food such as yogurt and cheese, to treat sewage, and to make medicines. Bacteria are important both in the environment, as decomposers, and in your body. Scientists estimate that most people have between 1 and 2 kg of bacteria in their guts, and they are rapidly discovering that these bacteria have a major effect on our health and well-being.

Pathogenic bacteria are the minority – but they are significant because of the major effects they can have on individuals and society.

Viruses are even smaller than bacteria. They usually have regular shapes. Viruses cause diseases in every type of living organism.

How pathogens cause disease

Once bacteria and viruses are inside your body, they may reproduce rapidly.

- Bacteria divide rapidly by splitting in two (called binary fission). They may produce toxins (poisons) that affect your body and make you feel ill. Sometimes they directly damage your cells.
- Viruses take over the cells of your body. They live and reproduce inside the cells, damaging and destroying them.

Common disease symptoms are a high temperature, headaches, and rashes. These are caused by the way your body responds to the cell damage and toxins produced by the pathogens.

How pathogens are spread

The more pathogens that get into your body, the more likely it is that you will develop an infectious disease. There are a number of ways in which pathogens spread from one individual to another.

- **By air (including droplet infection).** Many pathogens including bacteria, viruses, and fungal spores (that cause plant diseases) are carried and spread from one organism to another in the air. In human diseases, droplet infection is common. When you are ill, you expel tiny droplets full of pathogens from your breathing system when you cough, sneeze, or talk (Figure 2). Other people breathe in the droplets, along with the pathogens they contain, so they pick up the infection. Examples include flu (influenza), tuberculosis, and the common cold.
- **Direct contact.** Some diseases are spread by direct contact of an infected organism with a healthy one. This is common in plant diseases, where a tiny piece of infected plant material left in a field can infect an entire new crop. In people, diseases including sexually transmitted infections, such as syphilis and chlamydia, are spread by direct contact of the skin. Pathogens such as HIV/AIDS or hepatitis enter the body through direct sexual contact, cuts, scratches, and needle punctures that give access to the blood. Animals can act as vectors of both plant and animal diseases by carrying a pathogen between infected and uninfected individuals.
- **By water.** Fungal spores carried in splashes of water often spread plant diseases. For humans, eating raw, undercooked, or contaminated food, or drinking water containing sewage can spread diseases such as diarrhoeal diseases, cholera, or salmonellosis. The pathogen enters your body through your digestive system.

Lifestyle factors often affect the spread of disease. For example, when people live in crowded conditions with no sewage system, infectious diseases can spread very rapidly.



Figure 2 Droplets carrying millions of pathogens fly out of your mouth and nose at up to 100 miles an hour when you sneeze

Synoptic link

For more information on bacteria that are resistant to antibiotics, see Topic B15.8.

Key points

- Communicable diseases are caused by microorganisms called pathogens, which include bacteria, viruses, fungi, and protists.
- Bacteria and viruses reproduce rapidly inside your body. Bacteria can produce toxins that make you feel ill.
- Viruses live and reproduce inside your cells, causing cell damage.
- Pathogens can be spread by direct contact, by air, or by water.

- a** What causes infectious diseases? [1 mark]

b How do pathogens make you ill? [2 marks]
- a** Give two ways in which diseases are spread from one person to another. [2 marks]

b Give two ways in which diseases are spread from one plant to another. [2 marks]

c For each method given in part **a** and part **b**, explain how the pathogens are passed from one organism to the other. [4 marks]
- Describe and explain the main differences between bacteria and viruses, and how they cause disease. [6 marks]