

3.9 Pathogens cause disease



Our understanding of how infectious pathogens disrupt the normal functioning of our body and cause disease has developed over many centuries. Scientists use Koch's postulates to provide evidence that a pathogen causes a disease. There are many different types of pathogens including bacteria, fungi, protozoans and non-living viruses. Penicillin and other antibiotics can be used to kill bacteria, but not viruses or other pathogens.

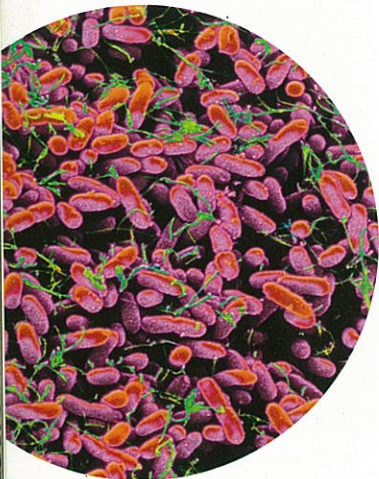


Figure 3.40 Some bacteria keep us healthy. Other bacteria are pathogens and interfere with the natural functioning of our bodies.

One of the first people in Western medicine to question the accepted idea of supernatural causes of diseases was Hippocrates (460–377 BCE). He concluded that something in the air, soil, water and food causes diseases in humans and animals. His work was followed up by Claudius Galen (131–201 CE), who was a doctor to the gladiators, and used animal dissections to explore anatomy.

Girolamo Francastor (1478–1553) was an Italian astronomer and doctor who was one of the first to suggest that disease could be transmitted from person to person via small invisible particles. He theorised that these particles could travel through the air, via contaminated clothing or by direct contact with the sick person. It took 200 years and the discovery of the microscope to confirm his theories and to develop the 'germ theory' used today.

Germ theory states that many diseases are caused by the presence and actions of specific microorganisms. These microorganisms are called **pathogens**. Germ theory was confirmed by Louis Pasteur and Robert Koch.

Robert Koch went on to develop Koch's postulates.

- 1 The microorganism or other pathogen must be present in all cases of the disease.
- 2 The pathogen can be isolated from the diseased host and grown in the laboratory.
- 3 The pathogen from a pure culture must cause the disease when inoculated into a healthy susceptible laboratory animal.
- 4 The pathogen must be re-isolated from the new host and shown to be the same as the originally inoculated pathogen.

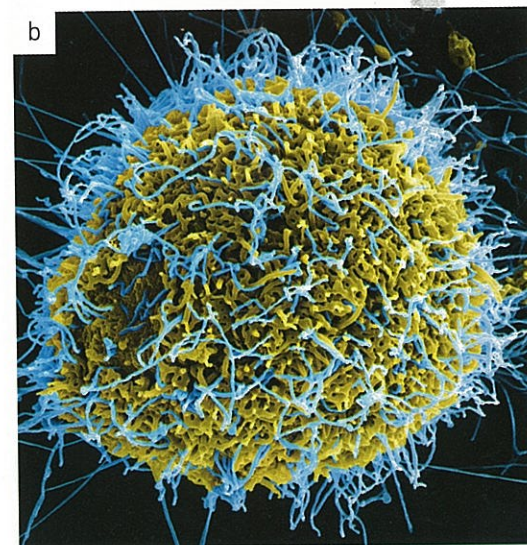
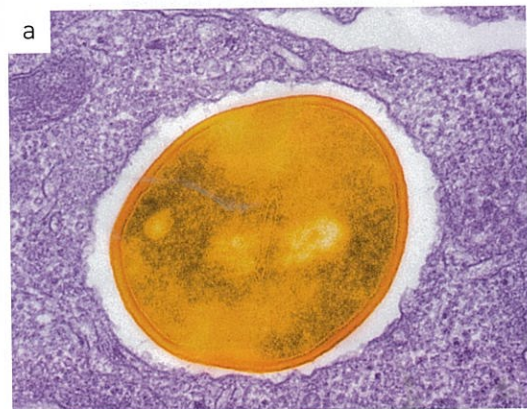


Figure 3.41 Most infections are caused by microscopic pathogens such as bacteria or viruses. (a) Bacteria are very small cells that are able to reproduce by themselves. They can release toxins that affect the normal functioning of our body. (b) Viruses are unable to reproduce by themselves. Instead they invade our cells and use the organelles to make new copies of themselves. This stops our cells from functioning properly.

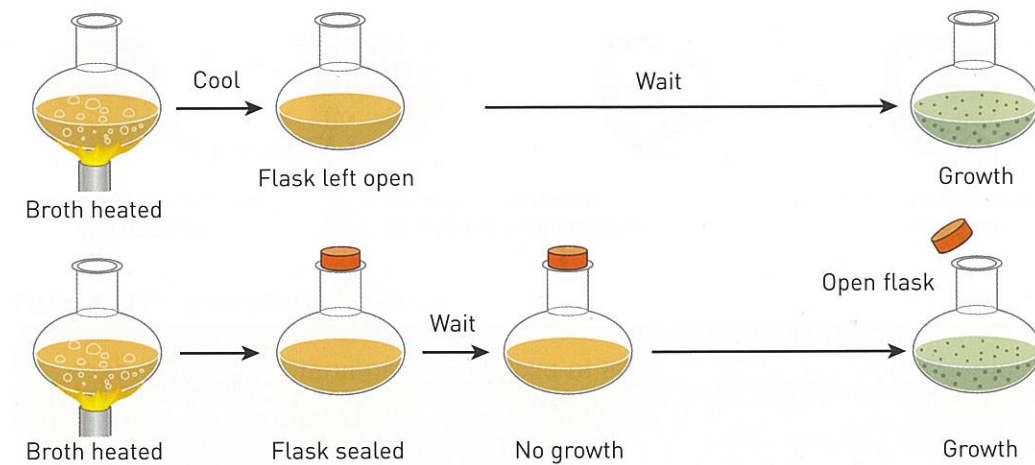


Figure 3.42 Louis Pasteur's experiments found that microorganisms in milk were killed by heat. This process is called pasteurisation and is still in use today.

Australian scientists Barry Marshall and Robin Warren followed these postulates when they researched stomach ulcers in 1984. Together they discovered that a bacterium (*Helicobacter pylori*) was found in all patients with stomach ulcers. Most doctors at the time thought that no bacteria could survive in the acidic environment of the stomach. Marshall and Warren isolated the bacteria and injected it to cause the disease in mice. Unfortunately, many doctors still did not believe the research, so Barry Marshall swallowed a culture of the bacteria to cause the disease in himself. Treatment with antibiotics killed the bacteria and cured his stomach ulcer. Barry Marshall and Robin Warren were awarded the Nobel Prize in Physiology or Medicine in 2005.

Antibiotics

Before antibiotics were discovered, a single scratch from the thorn on a rose bush could become infected and kill you.

In 1928, Alexander Fleming was trying to grow bacteria in his laboratory. When he returned from holidays he discovered some

Petri dishes he had left open on the bench were growing a mould similar to that found growing on bread. There were no bacteria growing near the mould. Being a good scientist, Fleming recognised that further investigation was necessary. He performed some experiments and discovered that the *Penicillium* mould was releasing a chemical that killed bacteria. Australian scientist Howard Florey was then instrumental in developing penicillin into a form that could be mass-produced. Both men were awarded the Nobel Prize in Physiology or Medicine for their work.

Penicillin works by breaking down the cell walls of bacteria. As human cells do not have a cell wall, they are unaffected. This means that penicillin will kill the bacteria in your body but not kill your own body cells. Viruses do not have cell walls. Instead they have a protein coat that surrounds and protects them. This means penicillin does not affect viruses such as influenza or the common cold.

Most viruses cannot be treated by any readily available medicines.



Figure 3.43 Robin Warren (left) and Barry Marshall (right)

Check your learning 3.9

Remember and understand

- 1 What is the difference between a virus and bacteria?
- 2 What is germ theory?
- 3 What are Koch's postulates?
- 4 Identify how Warren and Marshall used each of Koch's postulates to find the cause of stomach ulcers.
- 5 Name an infection that you or someone you know had that was cured with antibiotics.
- 6 How is Louis Pasteur's discovery still in use today?