A disease is any condition that is harmful to or interferes with the well-being of an organism. Many years ago, tens of thousands of people died during epidemics of diseases, yet no one knew what caused the diseases. Imagine how frightening it was to face invisible killers!

The Invaders

Today we know that many diseases are caused by agents that invade the body and interfere with the normal activities of cells. The invasion is called infection. Some of the invaders are living things, such as bacteria, fungi, or parasitic worms. These invaders either rob cells of their nutrients or produce waste products that poison cells. In either case, the invaders can kill the cells.

Bacteria

While there are many helpful bacteria, there are numerous diseases and harmful effects caused by bacteria that invade the human body. Tetanus, strep throat, and pneumonia (Figure 1), are a few of the more common conditions. Bacteria are also responsible for food spoilage and contamination of drinking water.

Fungi

Several human diseases are caused by fungi. Athlete’s foot is one common problem (Figure 2). Most of these diseases are just annoying, but some can be deadly.
Protists
Malaria is caused by an animal-like protist called *Plasmodium*, which is transmitted by mosquitoes. The protists are transmitted when infected female mosquitoes bite humans. Despite efforts to control mosquito populations, malaria continues to be a widespread disease in tropical countries. A disease commonly known as beaver fever is caused by a protist called *Giardia lamblia*. A common source of this infection is drinking untreated stream or pond water. Beaver fever usually causes an upset stomach and diarrhea, but it can also have more serious effects on some people.

Viruses
Viruses are often grouped with living invaders; however, viruses are not living things because they are not true cells. A virus contains no nucleus, cytoplasm, organelles, or cell membrane. A virus is a small strand of genetic information covered by a protein coat.

Viruses are only active once they invade a living cell. They take over the cell and turn it into a factory for making more viruses (Figure 3). Viruses are responsible for many diseases, including colds, cold sores, influenza, and HIV/AIDS.

![Figure 3](image)

A virus infects a cell and uses it reproduce more viruses.
The Defenders

Your immune system defends you by destroying invaders. One defence is to attack the invaders directly with white blood cells (Figure 4). Once the invaders are engulfed by the cells, the white blood cells’ lysosomes release special chemicals that destroy the invaders, but also destroy the white blood cell. Pus is made of the strands of protein and cell fragments that remain after invaders have been attacked by white blood cells. As well as attacking and killing bacteria, white blood cells kill body cells that have been damaged by bacteria, viruses, or poisonous chemicals. Only healthy cells remain.

Antibodies

Another way that your immune system defends you is by using antibodies. Antibodies are made by a special type of white blood cell. Antibodies are large molecules that lock onto invading organisms.

Invading cells all have distinctive molecules, called markers, on their cell membranes or protein coats. These markers have a specific shape, and the antibodies are designed to fit that shape and lock onto them (Figure 5). Each type of antibody works on only one type of invader. You will learn more about antibodies in Section 3.6.

Figure 4
White blood cells engulf and digest invading bacteria.

Figure 5
Each antibody can combine with only one marker.

2.5 CHECK YOUR UNDERSTANDING

1. What types of invaders cause infection in humans? Given an example of each type.
2. Why are viruses not considered to be living things?
3. In your own words, explain what disease is.
4. Identify two ways in which white blood cells protect the body from diseases.