CONCEPT 1

The immune system helps protect us from pathogens and infection.

Activity

Introducing the Immune System

Most microbes are harmless to us and many are helpful. However, some cause disease, and we are constantly exposed to them. Why, then, are we not always sick? How does the body protect us? Share and discuss your ideas.

immune system the body system that defends against pathogens and infection

The **immune system** has several lines of defence that help protect us from pathogens. The first line of defence is the skin and the linings of internal body systems. **Figure 1.18** shows how different body systems work together to fight against pathogens.

Figure 1.18 Other body systems work with the immune system to help protect us from infection.

The Second and Third Lines of Defence

The immune system has ways to attack pathogens that get by the first line of defence. White blood cells can surround and kill them (Figure 1.19). Some white blood cells release chemicals that make it easier for other white blood cells to kill pathogens.

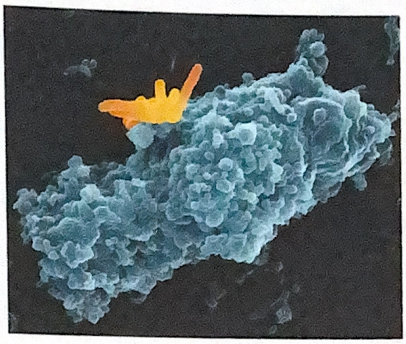

Figure 1.19 A white blood cell (coloured blue) engulfs bacteria (coloured yellow) that have made it past the first line of defence.

If you have an injury or infection, your body responds by getting inflamed. **Inflammation** causes the affected area to become red and swollen like the cut finger in Figure 1.20. White blood cells move to the area, killing pathogens and keeping infection from spreading.

inflammation a process that causes a part of the body to become red and swollen

A third line of defence uses specialized white blood cells to fight a pathogen. In future, if the same pathogen enters the body, these cells can respond quickly so you don't get sick again.

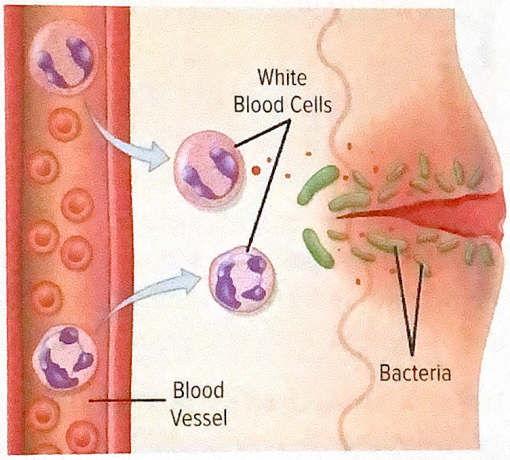

Figure 1.20 When a part of the body is inflamed, it becomes hot and red as blood flow increases. It becomes swollen as fluid floods the tissues. And it becomes painful as nerve endings are stimulated.

Extending the Connections

Exploring the Third Line

Find out about the third line of defence of the immune system. Some keywords to use as a starting point are *antigen*, *antibody*, *B cells*, and *T cells*.

Before you leave this page . . .

1. Trace the path of a pathogen that encounters and gets by the first line of defence but is successfully killed by the second line of defence.
2. How could washing your hands regularly protect you from pathogens?

CONCEPT 2

Outbreaks of disease can have an impact on populations.

Activity

What Do You Do If There's Flu?

The BC Center for Disease Control tracks incidents of influenza and puts out bulletins to communicate its findings. During winter, when flu outbreaks are more common, this information helps inform the public of health threats. If an outbreak were severe, health authorities would share information through the media and your school. Have you experienced changes to your lifestyle or routine due to a flu-related illness? When you hear about an outbreak of flu, what do you think that means? Discuss your ideas with your classmates.

In 2014, the largest and longest outbreak of Ebola virus disease (EVD) to date occurred in West Africa. Symptoms include fever, muscle pain, diarrhea, vomiting, and internal bleeding. EVD is often fatal if left untreated. It is transmitted through direct contact with body fluids of an infected person. Almost 30 000 cases were reported and about 12 000 people died in six countries. Was this considered an outbreak, an epidemic, or a pandemic? **Table 1.4** outlines the differences among these three terms, which are used when a disease becomes a concern to society.

Table 1.4 Terms Used to Describe Disease Occurrence

Epidemic	Outbreak	Pandemic
the occurrence of disease cases above the normal amount expected for a population in a defined area	same definition as an epidemic, but often used to refer to a limited geographic area	an epidemic that has spread over several countries or continents, or around the world

Activity

Demonstrate the Difference

Find an example of each term, *epidemic*, *outbreak*, and *pandemic*, from distant or more recent history. Create a presentation to explain how your examples fit the definitions. Share your presentation and compare your examples to those of your classmates. Ask your classmates any questions you have, and be ready to answer their questions.

The Effects of Epidemics and Pandemics on Human Populations

Epidemics and pandemics can have both social and economic impacts on human populations. **Figure 1.21** shows some examples.

Figure 1.21 Diseases have social and economic consequences. **Classify each of these four cases as a social impact, an economic impact, or both.**

HIV has killed more than 25 million people since it was first identified in 1984. In just the first two decades of the 21st century, more than 1 million people have died due to diseases such as SARS, H1N1, measles, and typhoid.

Some livestock animals can pass on diseases to people. In 2015, an outbreak of bird flu forced poultry producers to kill about 50 million chickens and turkeys. The price of eggs increased, and farmers lost millions of dollars.

Sick days take their toll. Flu alone results in losses of half a billion dollars each year to the Canadian economy.

Taking extra precautions, as well as concern about fear and panic, can lead governments to restrict travel as well as the importation of certain foods.

Connect to Investigation 1-D on pages 56–59

Connect to Investigation 1-E on pages 60–63

Different Populations Have Different Immunities

Deadly diseases have struck human populations throughout history all over the world. Examples are plague, smallpox, measles, HIV/AIDS, and SARS. However, no matter where or when a disease outbreak occurs, there are always some people who have a natural resistance to the pathogen and survive.

For example, starting around 300 CE, there were repeated outbreaks of measles and smallpox over hundreds of years in Europe. Many people died in each outbreak. But over time, people's ability to fight the pathogens increased. Populations of people in Europe had built up immunity to these diseases.

Elsewhere, such as North and South America, people had not been exposed to these same pathogens. When Europeans first came here, First Peoples had never been exposed to these pathogens that cause measles and smallpox. Europeans had hundreds of years to build up immunity to these diseases. But people here had no such immunity, and large numbers died.

Figure 1.22 Vampire bats in the Peruvian rain forest carry rabies. The disease can be passed to humans if they are bitten by an infected bat.

Natural Immunity in Human Populations

Scientists are always searching for populations that have natural immunity. For example, rabies is caused by a virus that affects the nervous system. If left untreated, rabies is fatal. In 2012, scientists learned that people in a remote part of the rain forest in Peru had a natural immunity to rabies (**Figure 1.22**). In the small population, about 10 percent had immunity. In Gabon, in west-central Africa, scientists discovered a population with a natural immunity to Ebola. Cases like these help scientists learn more about diseases, how to treat them, and perhaps how to prevent them.

Extending the Connections

Considering Cultural Practices

Each culture has its own ways of caring for people who are dead or dying during an outbreak of a deadly disease. But during the Ebola epidemic in 2014, cultural practices played a role in spreading the disease. How can a public health agency help reduce the spread of disease and still respect local cultures and customs?

Before you leave this page . . .

1. Give examples of a disease with a social impact and an economic impact.
2. Explain how a population can develop immunity to a disease.