

UNIT 1

Life processes are performed at the cellular level

TOPIC 1.5

How does the body protect us from pathogens?



TOPIC 1.5 How does the body protect us from pathogens?

Topic 1.5: How does the body protect us from pathogens?

- The H1N1 influenza virus first appeared in people in 2009
 - Originally only infected birds or pigs, but changed into a new virus that infected humans
 - Canada: 45 000 cases and 505 deaths



Why do you think most of these people are wearing masks?

TOPIC 1.5 How does the body protect us from pathogens?

Concept 1: The immune system helps protect us from pathogens and infection.

• **Immune system:**

- The body system that defends against pathogens and infection
- Has several lines of defence to protect us from pathogens
 - First line of defence: skin and linings of internal body systems



Figure 1.18: The first line of defence of the immune system.

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The First Line of Defence

• **Skin**

- Skin: physical barrier to keep pathogens from entering body
- Sweat and natural body acids: kill pathogens on surface of skin



Figure 1.18: Skin is waterproof, so you can easily wash pathogens from it.

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The First Line of Defence

- **Linings of the respiratory system**

- Hairs in your nose and throat: trap pathogens and move them back out of your body
- Mucus: pathogens get caught in sticky mucus, and are removed from your body when you cough, sneeze, and swallow



Figure 1.18: Hairs and hair-like structures of the respiratory system

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The First Line of Defence

- **Contents and linings of the digestive system**

- Strong acids in your stomach: kill many types of pathogens
- Mucus: traps pathogens that are removed by vomiting



Figure 1.18: Your digestive system can help stop you from getting sick.

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The Second Line of Defence

- **White blood cells (WBCs):**
 - Surround and kill pathogens that get by the first line of defence
 - Some WBCs release chemicals that make it easier for other WBCs to kill pathogens

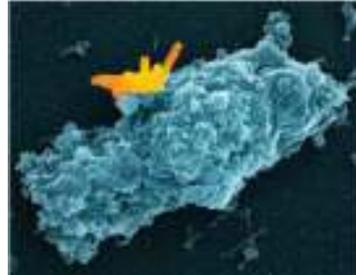


Figure 1.19: A white blood cell (blue) engulfs a bacteria (yellow)

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The Second Line of Defence

- **Inflammation:**
 - A process that causes a part of the body to become red and swollen
 - Occurs if you have an injury or infection
 - White blood cells move into the affected area and kill pathogens

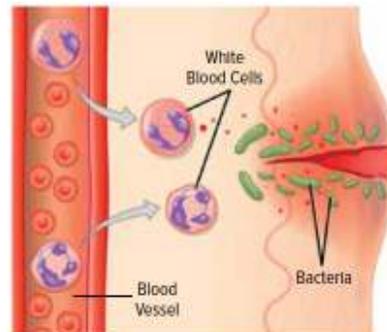


Figure 1.20: Inflammation

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The Second Line of Defence

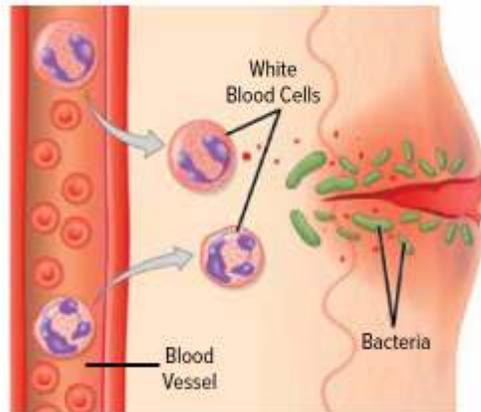


Figure 1.20:

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.

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The Third Line of Defence

- **Specialized white blood cells (WBCs)**
 - These WBCs can recognize pathogens that they have previously fought
 - If the same pathogen enters the body in the future, the WBCs respond quickly so you don't get sick again

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

Discussion Questions

- 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.
- How could washing your hands regularly protect you from pathogens?

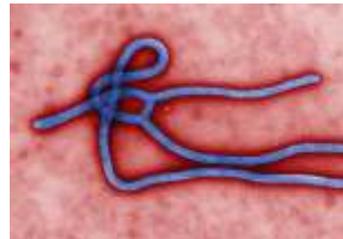


BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

Concept 2: Outbreaks of disease can have an impact on populations.

- **Ebola virus disease (EVD)**
 - Largest and longest outbreak occurred in 2014 in West Africa
 - Symptoms: Fever, muscle pain, diarrhea, vomiting, internal bleeding
 - Transmission: Direct contact with an infected person
 - 30 000 cases were reported; 12 000 people died in six countries



Ebola virus

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

Table 1.4: Terms Used to Describe Disease Occurrence

Epidemic	Outbreak	Pandemic
<ul style="list-style-type: none"> the occurrence of disease cases above the normal amount expected for a population in a defined area 	<ul style="list-style-type: none"> same definition as an epidemic often used to refer to a limited geographic area 	<ul style="list-style-type: none"> an epidemic that has spread over several countries or continents, or around the world

Was Ebola virus disease (EVD) an outbreak, epidemic, or pandemic?

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The Effects of Epidemics and Pandemics on Human Populations

- **HIV:**
 - Killed more than 25 million people since 1984
- **SARS, H1N1, measles, typhoid:**
 - More than 1 million people have died in the first two decades of the 21st century



Figure 1.21: HIV: social impact, economic impact, or both?

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The Effects of Epidemics and Pandemics on Human Populations

- **Bird flu:**
 - 50 million chicken and turkeys had to be killed in 2015
 - Price of eggs increased
 - Farmers lost millions of dollars



Figure 1.21: Bird flu: social impact, economic impact, or both?

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The Effects of Epidemics and Pandemics on Human Populations

- **Flu:**
 - Causes people to take sick days
 - Results in losses of half a billion dollars a year to the Canadian economy



Figure 1.21: Flu: social impact, economic impact, or both?

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

The Effects of Epidemics and Pandemics on Human Populations

- **Extra precautions due to disease outbreaks:**
 - Can lead to fear and panic
 - Causes government to restrict travel and importation of certain foods



Figure 1.21: Extra precautions due to disease outbreaks: social impact, economic impact, or both?

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

Different Populations Have Different Immunities

- Measles and smallpox: many outbreaks in Europe over hundreds of years
 - Over time, populations of people in Europe built up immunity to these diseases



Skin of a patient with measles (Centers for Disease Control and Prevention)

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

Different Populations Have Different Immunities

- Europeans brought pathogens that caused measles and smallpox to North and South America
 - People in the Americas had never been exposed to these pathogens
 - Large numbers of First Peoples died when exposed to these pathogens



Smallpox virus (Centers for Disease Control and Prevention)

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

Natural Immunity in Human Populations

- **Remote community in the Peruvian rain forest**
 - About 10% of people have natural immunity to rabies, which is fatal if untreated
- **Gabon (west-central Africa)**
 - Small population with natural immunity to Ebola



Figure 1.22: Vampire bats in the Peruvian rain forest carry rabies.

BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

Discussion Questions

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



BC Science Connections 8, Copyright © McGraw-Hill Education

TOPIC 1.5 How does the body protect us from pathogens?

Summary: How does the body protect us from pathogens?

- The immune system helps protect us from pathogens and infection.
- Outbreaks of disease can have an impact on populations.
- Different populations have different immunities.



BC Science Connections 8, Copyright © McGraw-Hill Education