

McGraw-Hill Ryerson

**BC Science
CONNECTIONS**

A large, light purple number '8' is positioned on the right side of the page, partially overlapping the word 'CONNECTIONS'.

BC Science Connections 8

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?

- 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?

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

- **Immune system:**
 - The body system that defends against pathogens and infection
 - Has three lines of defence to protect us from pathogens



Figure 1.18: The three lines of defence of the immune system.

1st Line of Defense



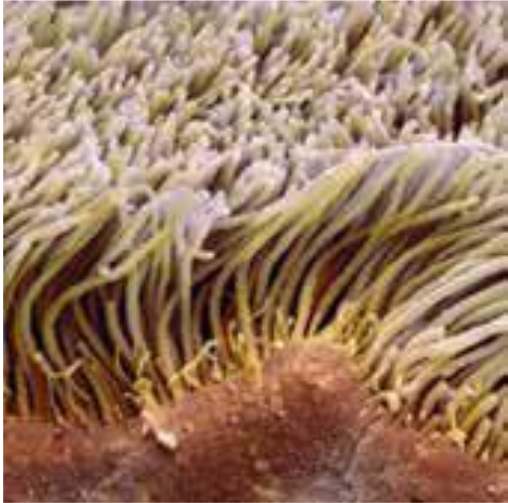
LOCK DOWN
Emergency Inside Building - Intruder/Imminent Threat

2nd Line of Defense



3rd Line of Defense





The First Line of Defence

[Skin and linings of internal body systems](#)

The First Line of Defence

Skin

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



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

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

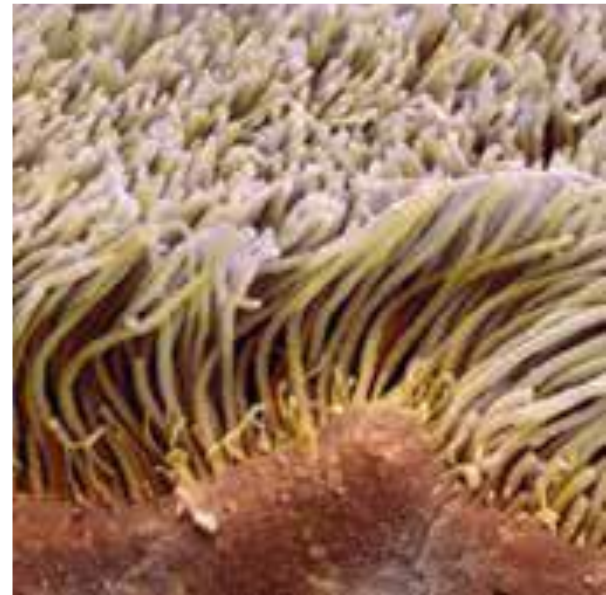


Figure 1.18: Hairs and hair-like structures of the respiratory system

The First Line of Defence

Contents and linings of the digestive system

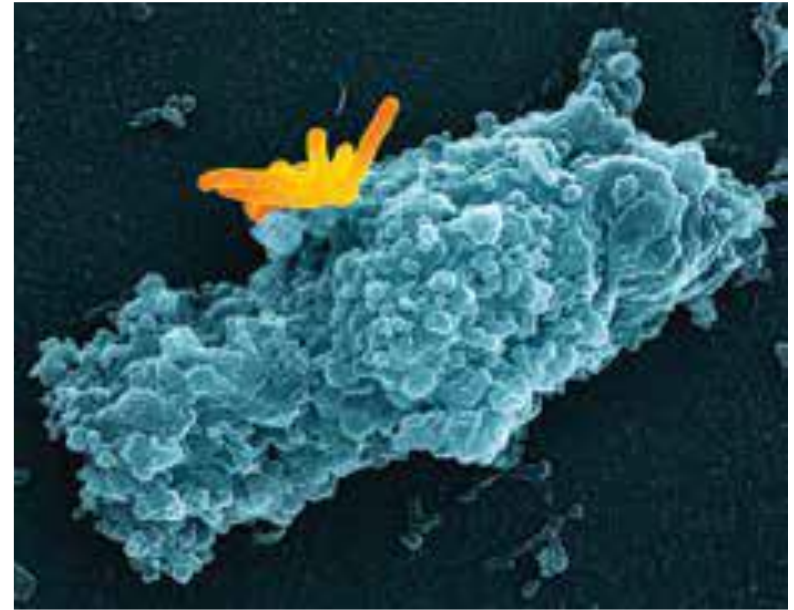
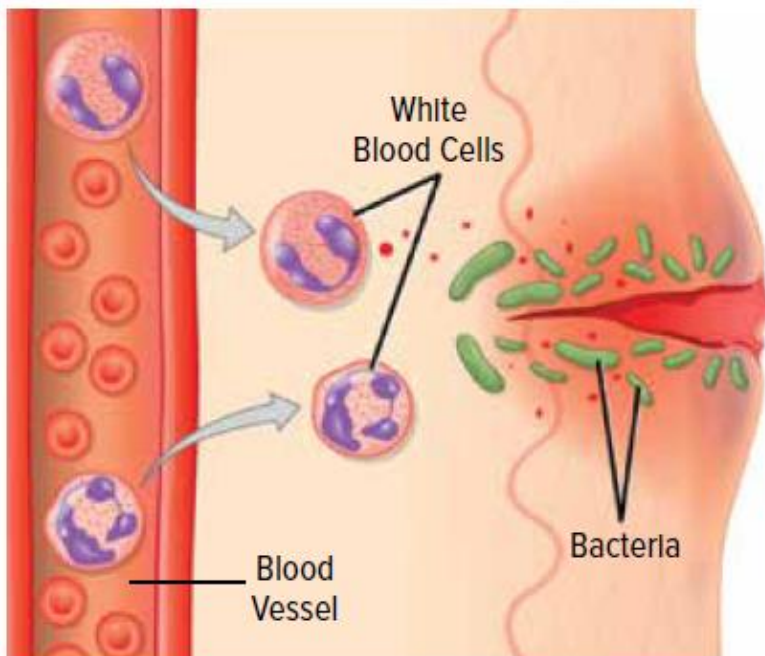
- Strong acids in your stomach: kill many types of pathogens
- Mucus: traps pathogens that are then removed by vomiting



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

The Second Line of Defence

White blood cells and inflammation



The Second Line of Defence

White blood cells (WBCs):

- Surround and kill pathogens that get through the first line of defence
- Some WBCs release chemicals that make it easier for other WBCs to kill pathogens

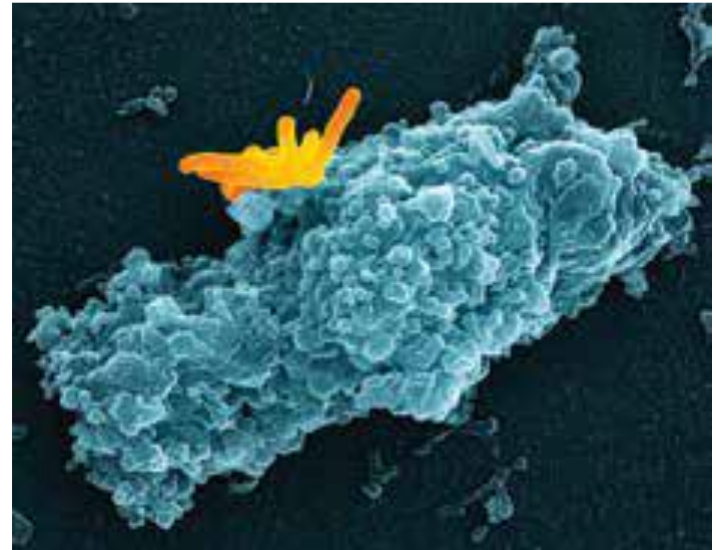


Figure 1.19: A white blood cell (blue) engulfs a bacteria (yellow)

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
- Increased blood flow
→ white blood cells move into the affected area and kill pathogens

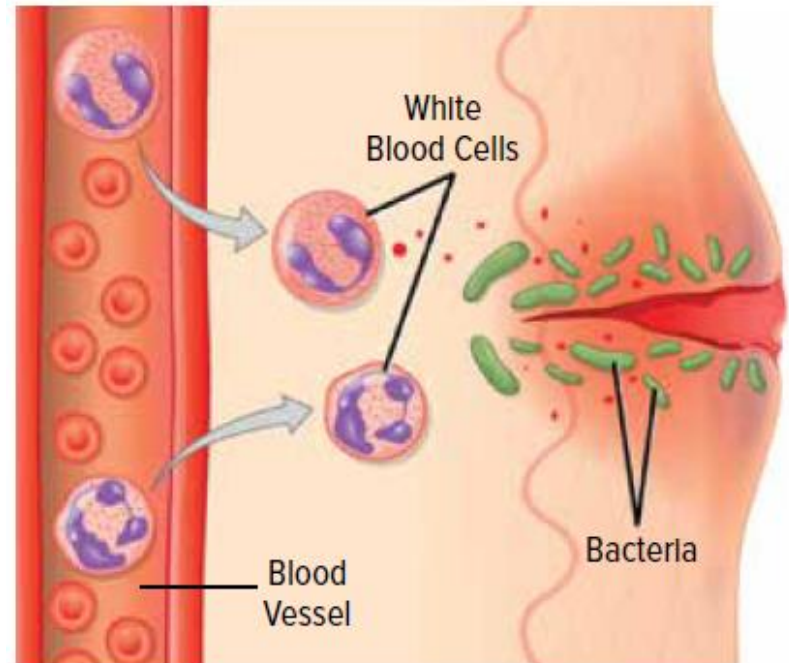


Figure 1.20: Inflammation

The Second Line of Defence

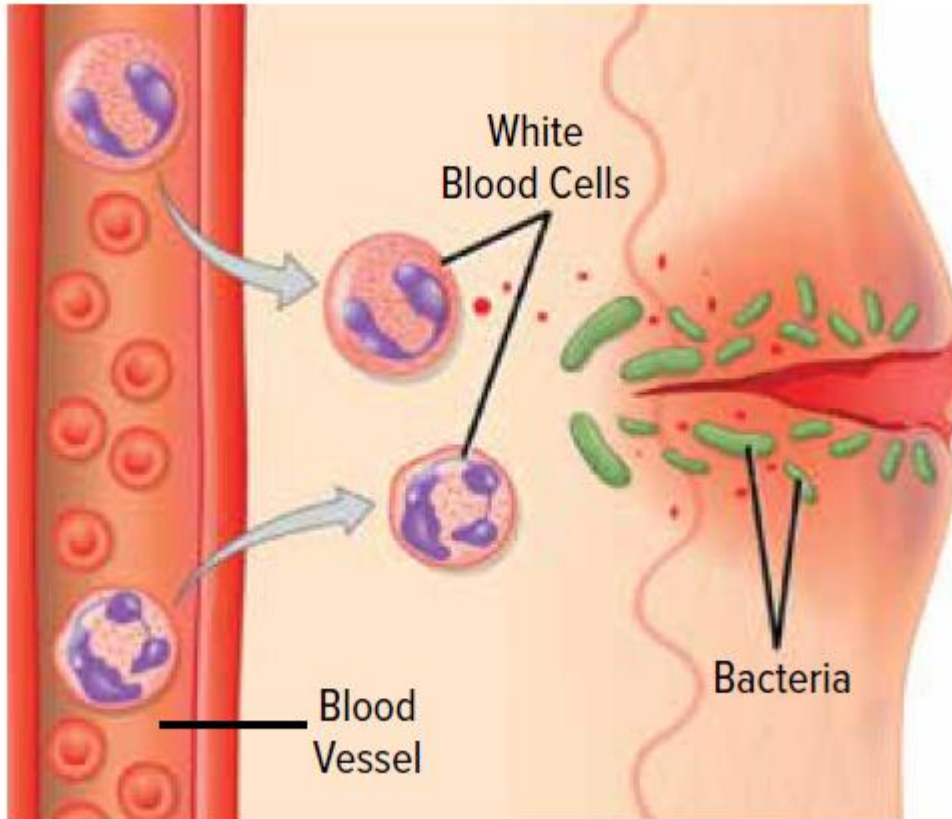


Figure 1.20:

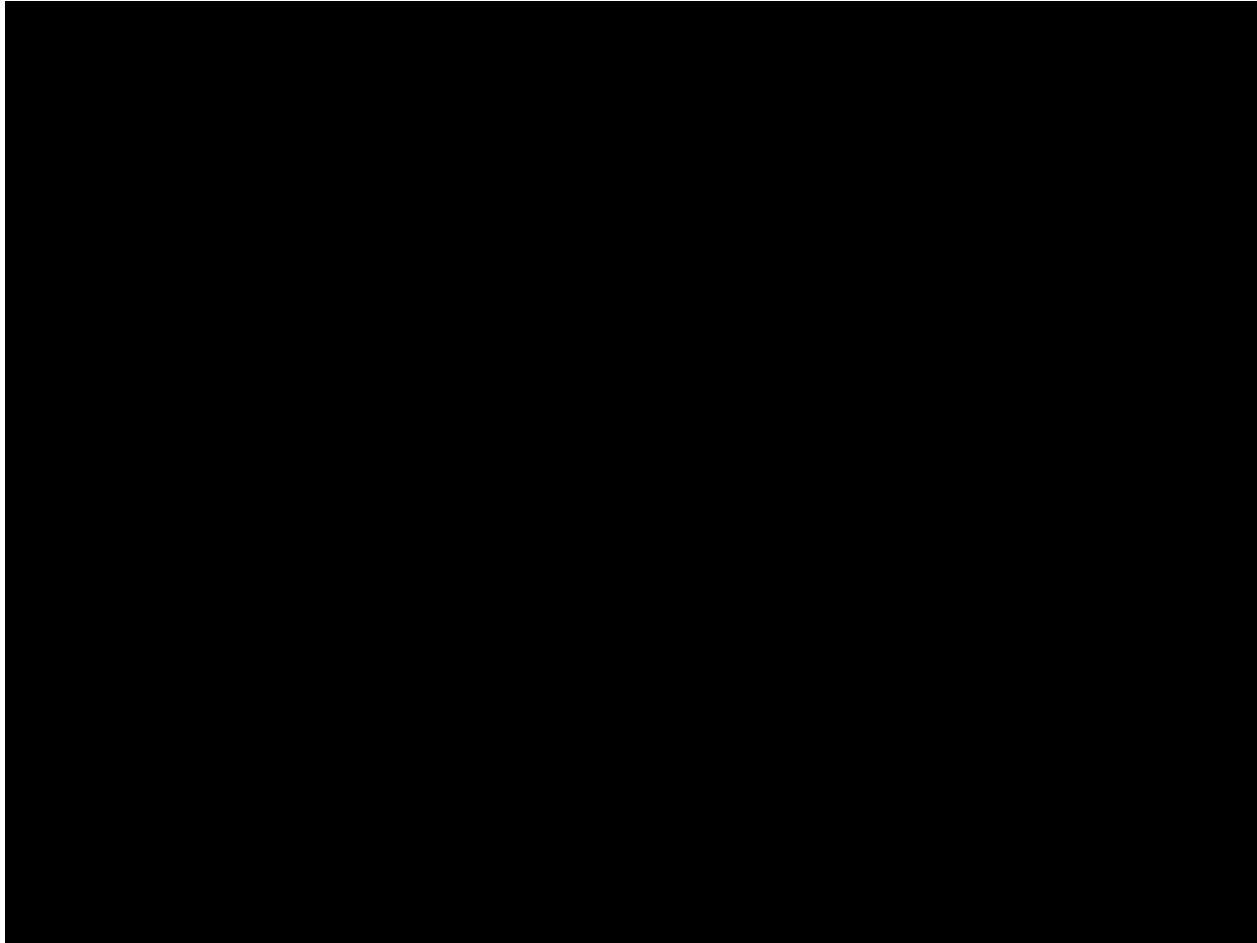
When a part of the body is inflamed, it becomes hot and red as blood flow increases.

It becomes swollen as fluid floods the tissues.

And it becomes painful as nerve endings are stimulated.

The Second Line of Defence

[White blood cells video](#)



The Third Line of Defence

Specialized white blood cells that 'remember' pathogens and can fight re-infections more effectively; antibodies

CD8 T Cell



B Cell



Regulatory
T Cell



CD4 T Cell



The Third Line of Defence

Specialized white blood cells (T cells, B cells)

- Recognize pathogens that they have previously fought
- If the same pathogen enters the body in the future, they respond quickly so you don't get sick again



The Third Line of Defence

T cells: directly kill infected cells



B cells: produce antibodies

(**Antibodies:** particles in the bloodstream that detect proteins produced by pathogens and infected cells; attach to and neutralize pathogens and infected cells)

*Disclaimer: This slide presents a very simplified version only.

Classify each of the following statements as the first, second, or third lines of defence.

1. Mucus can trap pathogens.
2. Specialized white blood cells, called T cells and B cells, allow your body to develop an immune response that prevents further infection.
3. The skin and the linings of internal body systems stop many pathogens.
4. Inflammation causes a part of the body to become red and swollen as blood cells move into the area.
5. Acids given off by the body can kill some pathogens.
6. White blood cells can surround and kill pathogens keeping infection from spreading.
7. The immune system defends against pathogens and infection.

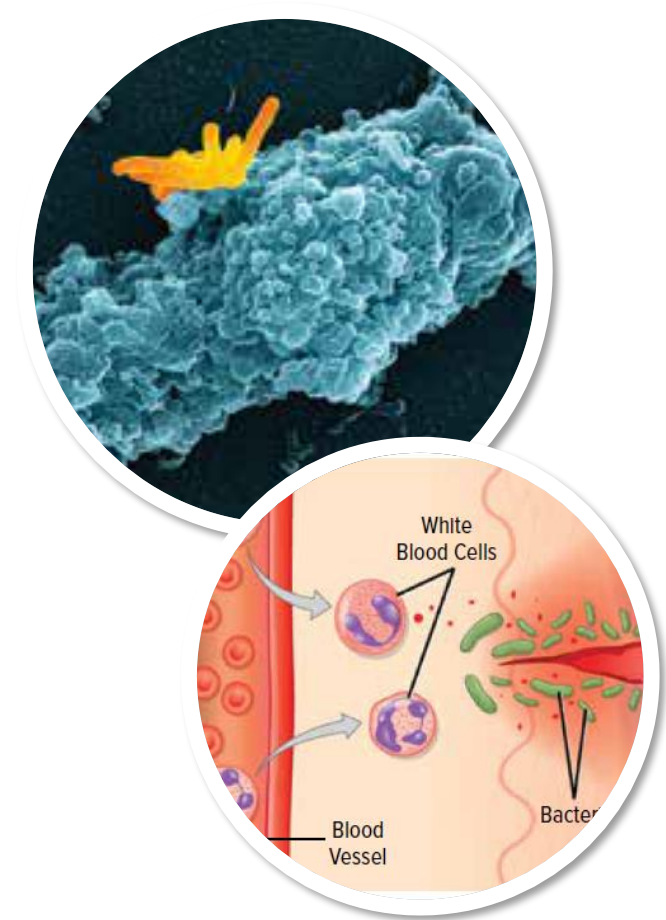
Classify each of the following statements as the first, second, or third lines of defence.

1. Mucus can trap pathogens. (1)
2. Specialized white blood cells, called T cells and B cells, allow your body to develop an immune response that prevents further infection. (3)
3. The skin and the linings of internal body systems stop many pathogens. (1)
4. Inflammation causes a part of the body to become red and swollen as blood cells move into the area. (2)
5. Acids given off by the body can kill some pathogens. (1)
6. White blood cells can surround and kill pathogens keeping infection from spreading. (2)
7. The immune system defends against pathogens and infection. (1, 2, 3)

Workbook break (pg. 38-39)

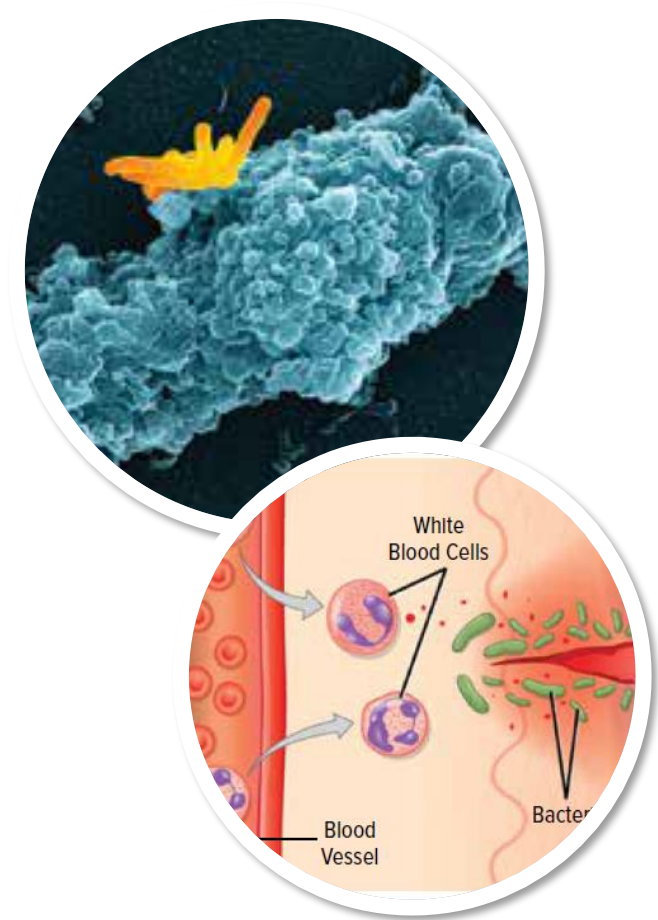
Discussion Questions

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



Activity

- Devise (and draw) an analogy for the immune system lines of defence.
- Extension: Draw a comic strip to 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.



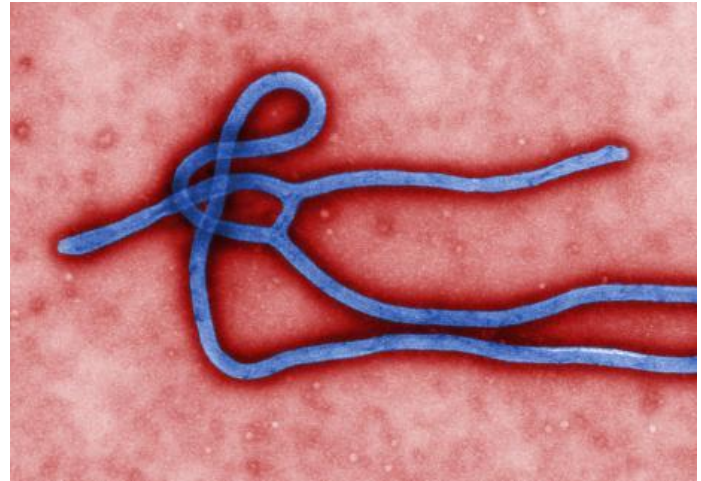
Immune system: very complex!

Video: FYI only (not testable)

- <https://www.youtube.com/watch?v=zQGOcOUBi6s>
“The Immune System Explained I – Bacteria Infection”

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

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 epidemicoften used to refer to a limited geographic areaFewer cases, smaller area than epidemic	<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?

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?

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?

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?

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?

Preventing Disease Transmission

Think-pair-share:

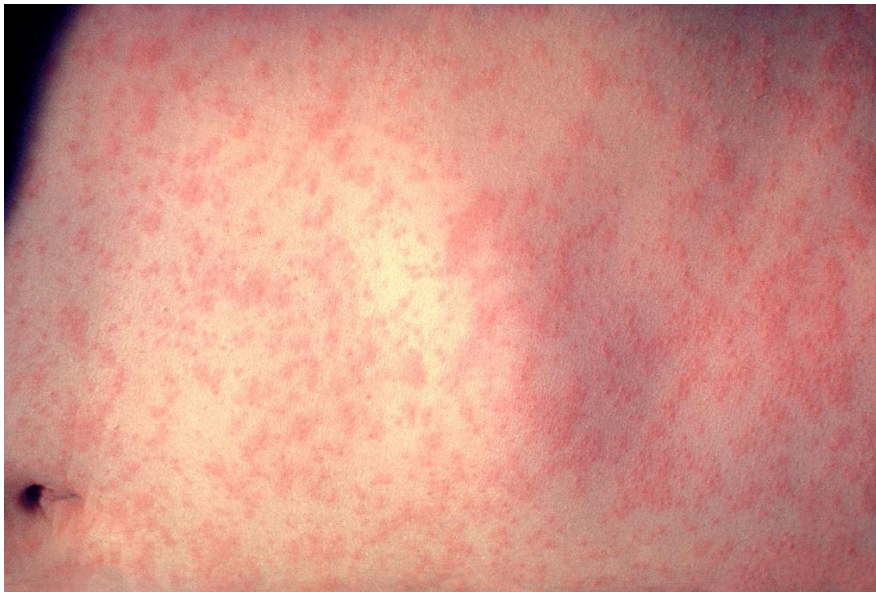
What are some ways we can prevent disease transmission?

Video

[Ted-ed](#) “How Pandemics Spread”

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)

Different Populations Have Different Immunities

- **Immunity:** the ability of a living thing to resist a particular infection or toxin by the action of white blood cells
 - What line(s) of defense are involved in immunity?
 - 2nd: same response every time
 - 3rd: response can be developed/trained



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)

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.

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.



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.

