

# 8 Infectious Diseases in Humans

## Study Station >>

### A Diseases

#### Learning Outcomes

- Understand that infectious diseases can be spread from person to person whereas non-infectious diseases cannot.
- Identify examples of infectious and non-infectious diseases.
- Explain that pathogens, such as bacteria and viruses, cause infectious diseases and can be spread through bodily fluids, food and water.

1. A **disease** is a condition that causes the body to function less effectively and produces signs and symptoms.
2. **Signs** can be measured or observed by a person. Examples of signs include rashes, fever, coughing and vomiting.
3. **Symptoms** cannot be measured but can be described, experienced, or felt by the patient. Examples of symptoms include headaches and nausea.
4. Diseases can either be infectious (transmissible) or non-infectious (non-transmissible).
5. Infectious diseases are caused by **pathogens**, such as bacteria and viruses.
6. The table below describes the differences between infectious diseases and non-infectious diseases.

	Infectious Diseases	Non-infectious Diseases
<b>Can Be Spread from One Person to Another?</b>	Yes	No
<b>Caused By</b>	Pathogens	<ul style="list-style-type: none"> <li>• May be inherited</li> <li>• May be caused by factors such as air pollution and lifestyle choices</li> </ul>
<b>Examples</b>	<ul style="list-style-type: none"> <li>• Influenza</li> <li>• Pneumococcal disease</li> <li>• HIV</li> </ul>	<ul style="list-style-type: none"> <li>• Sickle cell anaemia</li> <li>• Type 2 diabetes</li> <li>• Lung cancer and atherosclerosis caused by cigarette smoking</li> <li>• Coronary heart disease (caused by excessive polyunsaturated fats and trans fats in diet)</li> <li>• Liver cirrhosis (caused by excessive alcohol consumption)</li> </ul>

7. Infectious diseases can be spread from person to person through droplets in the air, direct contact and contaminated food and water.
8. When a person coughs or sneezes, numerous tiny **droplets** of moisture, which may contain pathogens, are released through the mouth and/or nose. People within a close range can breathe in these droplets and become infected.
  - In a disease outbreak, wearing masks properly can minimise the spread of diseases and reduce the likelihood and severity of transmission by reducing airborne viral concentrations.
9. Some diseases are spread through **direct person-to-person** contact.
  - Pathogens that cause Sexually Transmitted Infections (STIs), such as the Human Immunodeficiency Virus (HIV), can be transmitted when an infected person exchanges bodily fluids during sexual intercourse with an uninfected person.
  - Hepatitis B and syphilis can be passed on from mother to child through breastfeeding.
  - Infectious diseases are also spread when blood from an infected person comes into contact with the mucous membranes or bloodstream of an uninfected person.
10. When **food and water** that are not properly stored or handled, they can be contaminated with pathogens.
  - Houseflies deposit pathogens onto exposed food that we eat.
  - The spread of water-borne (contaminated water) and food-borne (contaminated food) diseases can be prevented and controlled by practising hygienic food preparation and storage, having good personal hygiene, maintaining a clean water supply and ensuring proper sewage treatment.

### Common Error

- All bacteria are pathogenic.
- Only some bacteria are pathogenic.

### Explanation

Not all bacteria cause diseases. Non-pathogenic bacteria include those used to make yoghurt and cheese. They are also important for a healthy digestive system.

 **Link** → Discover Biology (3rd Edition) Textbook — Section 8.1

**B Prevention and Management of Diseases**

**Learning Outcomes**

- State the signs and symptoms of influenza caused by the influenza virus and pneumococcal disease caused by pneumococcus bacteria.
- Describe the mode of transmission of the influenza virus and the pneumococcus bacteria and methods to reduce their transmissions.

1. **Influenza** and **pneumococcal disease** are two common examples of infectious diseases.
2. Information about the two diseases are given in the table below.

	<b>Influenza</b>	<b>Pneumococcal Disease</b>
<b>Causative Agent</b>	Influenza virus	Pneumococcus bacteria, <i>Streptococcus pneumoniae</i>
<b>Mode of Transmission</b>	<ul style="list-style-type: none"> <li>• Through droplets in the air</li> <li>• When a person touches a contaminated object or surface and then touches his or her own eyes, nose or mouth</li> </ul>	<ul style="list-style-type: none"> <li>• Mainly through respiratory droplets in the air</li> </ul>
<b>Part(s) of Body Affected</b>	<ul style="list-style-type: none"> <li>• Attacks the respiratory system</li> <li>• Can lead to complications such as pneumonia (lung infection)</li> </ul>	<ul style="list-style-type: none"> <li>• Attacks different parts of the body</li> <li>• May lead to serious infections of the lungs, blood, brain and spinal cord</li> </ul>
<b>Signs</b>	<ul style="list-style-type: none"> <li>• High fever</li> <li>• Cough</li> <li>• Sore throat</li> <li>• Stuffy nose</li> </ul>	<ul style="list-style-type: none"> <li>• Fever</li> <li>• Cough</li> <li>• Rapid breathing</li> <li>• Vomiting</li> </ul>
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Headache</li> <li>• Body aches</li> </ul>	<ul style="list-style-type: none"> <li>• Severe headache</li> </ul>

3. To reduce the transmission of the influenza virus or pneumococcal bacteria:
  - Get the respective vaccinations
  - Avoid coming into close contact with people who have the flu and keep a distance from others when infected
  - Cover the mouth and nose with a tissue when coughing or sneezing and dispose of the used tissue properly
  - Wash hands with soap and water or use a disinfectant if you think an object or surface you have touched is contaminated with the virus
  - Avoid touching the eyes, nose and mouth
  - Take the prescribed antiviral drugs to treat influenza and prescribed antibiotics to treat pneumococcal disease

**Link** Discover Biology (3rd Edition) Textbook — Section 8.2

**Checkpoint 8.1**

- Which of the following is an example of a non-infectious disease?
  - Smallpox
  - Diabetes
  - Influenza
  - Chickenpox
- \_\_\_\_\_ is an example of an infectious disease.
  - Diabetes
  - Cancer
  - Smallpox
  - Coronary blockage
- Complete the table to show how each of the diseases is transmitted.

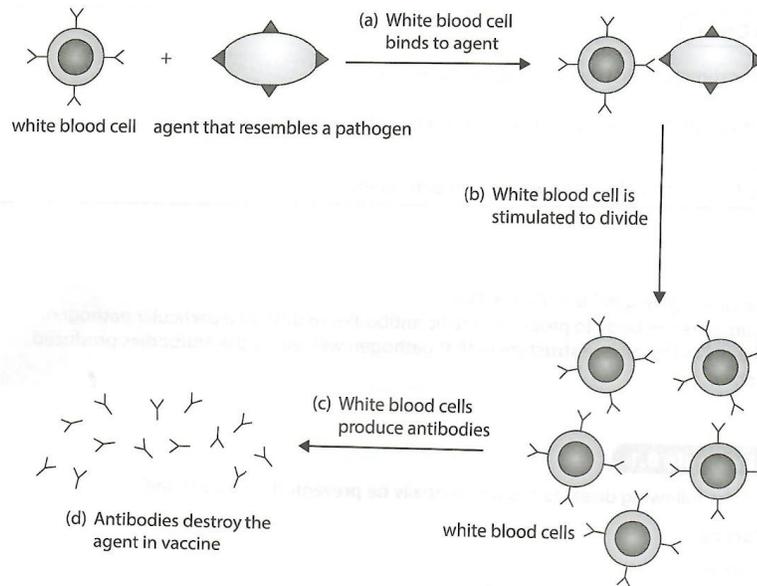
Disease	How It Is Transmitted
Influenza	
Hepatitis B	
HIV infection	
Syphilis	
Pneumococcal	

**C Vaccines and Antibiotics**

**Learning Outcomes**

- Describe vaccines as substances that contain an agent resembling a pathogen and prevent infectious diseases by stimulating white blood cells to produce antibodies against the pathogen.
- State that antibiotics kill bacteria and are ineffective against viruses.
- Explain how the misuse and overuse of antibiotics may accelerate the emergence of antibiotic-resistant bacteria.

- Antigens** are substances that stimulate the production of antibodies. Proteins on the surface of pathogens are examples of antigens.
- Vaccines** contain an agent that resembles a pathogen (antigen).
  - A vaccine prevents infectious diseases by stimulating white blood cells to quickly produce antibodies when the pathogen invades.
  - The antibodies destroy the agent in the vaccine.
  - Some of the white blood cells remain in the bloodstream.
  - When exposed to the live pathogens, the white blood cells recognise the pathogens and quickly produce the antibodies to destroy them before they can infect the body's cells.



3. **Antibiotics** are drugs used to treat bacterial or fungal infections.
4. Antibiotics kill bacteria or deter their growth.
  - Antibiotics weaken bacterial cell walls. When water enters the bacterial cell via osmosis, the weaker cell walls will not be able to prevent the cell from expanding and bursting.
  - They break up bacterial cell membranes.
  - They prevent ribosomes from making proteins and enzymes.
  - Some antibiotics inhibit the enzyme needed for bacterial growth.
5. Antibiotics are ineffective against viruses as viruses do not have cell walls, cell membranes or ribosomes.
6. Resistance to antibiotics can result from their misuse or overuse.
  - When an antibiotic is taken for a bacterial infection, bacterial cells within the bacterial population that are more sensitive to the antibiotic will be killed.
  - Bacterial cells that are less sensitive to the antibiotic may survive.
  - If the antibiotic course is completed, there is a higher chance that all the bacterial cells will be killed. If the course is not completed, the bacterial cells that survive may multiply and increase in number.
  - Over time, subsequent generations of bacterial cells will become increasingly resistant to the antibiotic. Other antibiotics will be needed to treat the same bacterial infection.
7. Antibiotic resistance in pathogens can be reduced by using antibiotics only when necessary to treat bacterial diseases and not viral infections. The full course of antibiotics should be completed as prescribed by the doctor even when symptoms subside to ensure all the bacteria are killed.

 **Link** → Discover Biology (3rd Edition) Textbook — Section 8.2

**Common Error**

- Vaccines protect against diseases caused by viruses only.
- Vaccines can protect against diseases caused by pathogens, either viruses or bacteria.

**Explanation**

Vaccines may be produced from the antigens of pathogens.

**Tip**

- Vaccines are highly specific in their action.
- They stimulate the body to produce specific antibodies to destroy a particular pathogen.
- Any change in the surface structure of that pathogen will render the antibodies produced ineffective.

**Worked Example 8.1**

Which of the following diseases could potentially be prevented with a vaccine?

- 1 Influenza
  - 2 COVID-19
  - 3 Pneumococcal disease
  - 4 Lung cancer
  - 5 Coronary heart disease
  - 6 Syphilis
- A** 1 and 2 only  
**B** 4 and 5 only  
**C** 1, 2, 3 and 6 only  
**D** 1, 2, 3, 4, 5 and 6

**Solution**

Option **C** is the correct answer.

**Explanation**

- Vaccines are produced from antigens of pathogens. They can induce the production of antibodies and memory cells which recognise antigens on the pathogens in the case of an infection.
- Lung cancer and coronary heart disease are not caused by pathogens and thus a vaccine cannot be developed against these diseases.

**Checkpoint 8.2**

1. Vaccines stimulate the production of \_\_\_\_\_.
  - A antibiotics
  - B antibodies
  - C antigens
  - D antibiotics, antibodies and antigens
2. Humans have developed vaccines to protect ourselves from pathogens and antibiotics to treat bacterial diseases.
  - (a) What is a vaccine?
  - (b) What are antibiotics?

 **Test Station >>**

1. Which of the following statements are **correct**?
  - 1 One of the signs of pneumococcal disease is a fever.
  - 2 Some antibiotics can kill viruses.
  - 3 Vaccines can be used to manage diseases caused by bacteria.
  - 4 Antibodies only target viruses.
  - A 1 and 2 only
  - B 1 and 3 only
  - C 2 and 3 only
  - D 3 and 4 only
2. Which of the following **correctly** indicates the common mode of transmission for the disease?

	Disease	Mode of Transmission
1	Influenza	Direct contact
2	Pneumococcal disease	Droplets in the air
3	Hepatitis B	Droplets in the air
4	Syphilis	Direct contact

- A 1 and 4 only
- B 2 and 4 only
- C 2, 3 and 4 only
- D 1, 2, 3 and 4

3. Diseases can be spread through many ways. [1]  
 (a) Define *disease*. [3]  
 (b) Describe, with an example, how diseases are spread via droplets in the air. [3]  
 (c) Describe, with an example, how diseases are spread via direct person-to-person contact. [4]
4. (a) Compare infectious and non-infectious diseases. [5]  
 (b) Complete the table by stating if the disease is infectious or non-infectious. [5]

Disease	Nature of Disease
Influenza	
Coronary heart disease	
Atherosclerosis	
AIDS	
Lung cancer	

5. (a) State **three** ways in which antibiotics act to kill bacteria. [3]  
 (b) Explain how the overuse of antibiotics promotes the development of antibiotic-resistant bacteria. [5]