



Immune Defence

BIOLOGY • CELLS AND DNA • IMMUNE DEFENCE

Section 1: Pathogens

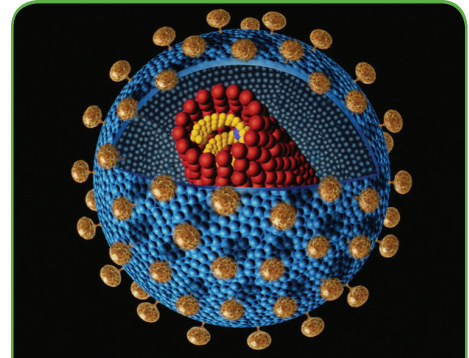
• What are pathogens?

Pathogens are disease causing organisms. Bacteria and viruses are the most common pathogens of humans, but fungi and worms can also cause disease.

Bacterial diseases in humans include cholera, tetanus and salmonella. Common viral diseases include influenza, the common cold, chickenpox and measles.

• Suggested Films

- Pandemic Viruses
- FactPack: Bacteria
- FactPack: Viruses



A model of the virus that causes AIDS

Extension Question

Q1. What fungal diseases can humans contract?

The two most common infections caused by fungi are ringworm and athlete's foot.

• How do pathogens cause disease?

Pathogens cause disease in a variety of ways. Bacteria, for example, cause many of their effects by secreting toxins into the body, which can cause a range of symptoms including diarrhoea, fever, muscle spasms and blood poisoning. Viruses reproduce by invading cells of the body. This can interfere with the activity of the cell and even kill the cell when the viruses burst out.

Some diseases are usually not too serious, such as chickenpox and the common cold, but others can be fatal, such as tetanus and HIV.

• Suggested Films

- Terrible TB: Part 1
- Terrible TB: Part 2

Extension Question

Q2. What are the causes and symptoms of tetanus?

Tetanus is caused by a bacterium called *Clostridium tetani*. The bacterium usually enters the body through a cut, which has become contaminated. The bacteria produce a toxin, which causes muscles in the body to contract. It can sometimes lead to death.

• How are pathogens spread between people?

Pathogens can be spread in various ways. Some, like influenza and the common cold viruses, are carried in airborne water droplets, which can be breathed in. Others, like the bacteria which cause cholera and salmonella, are carried into the body in contaminated water and food respectively. Some pathogenic agents are introduced into the body when the skin is broken. For example, insect bites can carry pathogens into the body as can the use of dirty needles by drug addicts.

• Suggested Films

- Pandemic Viruses: SARS
- Bee Stings

Extension Question

Q3. What is a pandemic?

A pandemic refers to a sudden and rapid increase in the incidence of a disease across many countries of the world. There were several flu pandemics in the last century, and many believe it is only a matter of time before another one strikes.



The bacterium that causes the highly contagious disease cholera

Section 2: Our Defence Against Disease

• How do we defend ourselves against disease?

We have several lines of defence which are designed to minimise the chances of infection. The first of these consists of various physical barriers, including the skin, mucus, hairs and stomach acids.

Next comes a series of cellular responses which can be activated almost immediately. One involves the activity of platelets to clot the blood and seal wounds, while the other involves white blood cells called phagocytes. Phagocytes can recognise foreign pathogens and destroy them by engulfing them in a process called phagocytosis.

The final line of defence involves another type of white blood cell called lymphocytes. These cells take longer to become activated, but they are able to recognise pathogenic agents and respond by producing active proteins called antibodies. Antibodies are extremely effective and act in a variety of ways. Some neutralise viruses and bacterial toxins, and others clump pathogens together and label them for phagocytes to ingest more efficiently.

• Suggested Films

- Immune Defence: Part 1
- Bee Stings

Extension Question

Q4. What is phagocytosis?

Phagocytosis is the process by which white blood cells, called phagocytes, can ingest foreign particles and thereby destroy them. It is basically a form of 'cell eating' in which the phagocyte can surround a particle with its cytoplasm before engulfing and digesting it with enzymes.

DIAGRAM 01:



Physical Barriers

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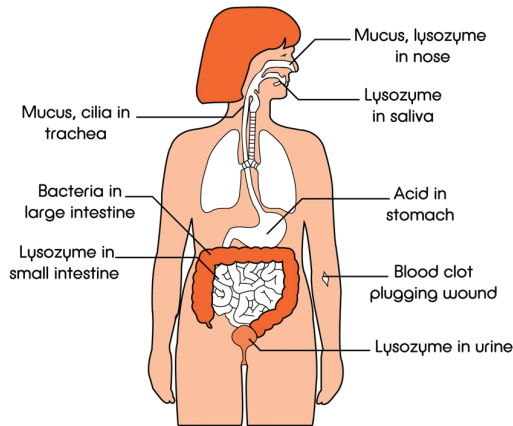


DIAGRAM 02:

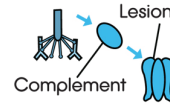


Antigens and Antibodies

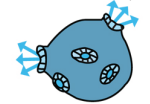
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Binding of antibodies to antigens inactivates antigens by

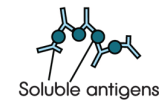
Complement fixation: activation of complement



Leads to cell lysis



Precipitation of soluble antigens



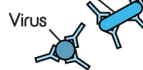
Enhances phagocytosis



Agglutination of antigen-bearing particles, such as microbes



Neutralisation, blocks viral binding sites: coats bacteria and/or opsonization



• How do we become immune to diseases?

Although the immune response by lymphocytes is delayed, it is highly specific and typically leads to immunity. Once lymphocytes have responded to and destroyed a specific pathogen, some of them are left in the body for many years. These are called memory cells. They are capable of responding very quickly and powerfully if the body becomes infected again with the same pathogen. This is the basis of long-term immunity and is also the reason it is possible to vaccinate people against certain diseases.

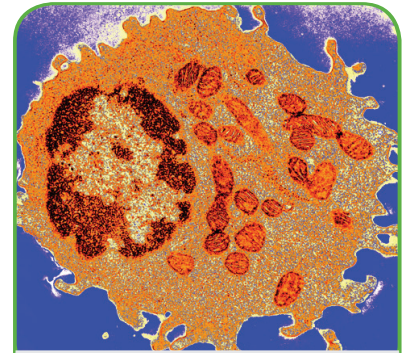
• Suggested Film

– Immune Defence: Part 2

Extension Question

Q5. How long do memory cells live for?

This varies according to the disease they respond to. For example, memory cells against certain diseases, such as polio and smallpox, are lifelong, whereas others often only live for 10 to 20 years.



White blood cells defend our bodies against disease

• How does HIV cause AIDS?

The Human Immunodeficiency Virus (HIV) infects cells of the immune system called T helper cells. These are a type of lymphocyte which are crucial to the effective functioning of the entire immune system. Once infected by HIV they stop functioning properly and their numbers gradually decline. Over time a patient's immune system gradually weakens and they develop AIDS (Acquired Immune Deficiency Syndrome).

• Suggested Film

– HIV/AIDS: Immune Evader

Section 3: Vaccines and Antibiotics

• How do vaccinations work?

By injecting someone with a weakened form of a bacteria or virus, it is possible to stimulate the immune system to respond and produce specific memory cells to that pathogen. Provided the pathogen has been suitably weakened it will not cause the disease, but it will trigger an immune response that will lead to immunity. People today receive vaccinations for many different diseases including polio, tetanus, measles and whooping cough.

• Suggested Film

– Smallpox: The First Vaccine

Extension Question

Q6. What is a booster?

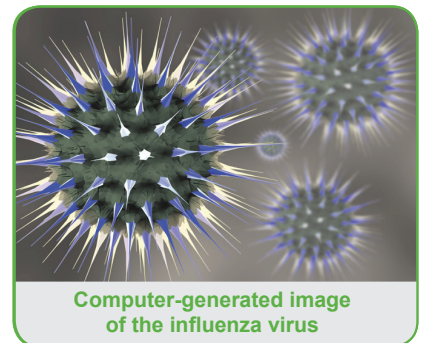
A booster is an additional injection of a vaccine, which is given to boost the immune response and thereby improve protection against disease. People are usually given booster vaccinations for tetanus, for example.

• Why do you need a flu vaccination every year?

Some pathogens, and especially some viruses like influenza, have a tendency to mutate. This means that when they reproduce the genetic material inside them, some of the characteristics of the pathogen change. For example, it might cause proteins on the outside of a virus (called antigens) to change so that memory cells no longer recognise it. If this is the case, then a new vaccine needs to be developed in order to protect people from the new viral strain.

• Suggested Film

– Pandemic Viruses



Computer-generated image of the influenza virus

Extension Question

Q7. What is an antigen?

An antigen is a protein on the surface of a pathogen which can be recognised by the immune system. This leads to an immune response in which lymphocytes produce antibodies that specifically recognise and bind to those antigens.

• What are antibiotics?

Antibiotics are chemicals which can kill bacteria. They are not to be confused with antibodies, which are proteins produced by the body's own immune system. Examples of antibiotics include penicillin and tetracycline, drugs which are prescribed by doctors to help treat bacterial infections.

• Suggested Film

– Pandemic Viruses

Extension Question

Q8. How do bacteria become resistant to antibiotics?

Antibiotics kill bacteria which are susceptible to them. Bacteria that are not susceptible to the antibiotic, reproduce, meaning there are more bacteria that are resistant to antibiotics. This means that the overuse of antibiotics invariably leads to the evolution of antibiotic resistant strains.



Antibiotics are used to treat many bacterial infections

Quizzes

Immune Defence: Part 1

Basic

• Which of the following acts as a physical barrier against infection?

- A – blood
- B – white blood cells
- C – muscles
- D – skin

• What helps to form a scab?

- A – phagocytes
- B – hormones
- C – platelets
- D – antibodies

• What kind of cells are phagocytes and lymphocytes?

- A – red blood cells
- B – white blood cells
- C – platelets
- D – skin cells

Advanced

• Which of the following are examples of pathogens?

- A – bacteria
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- C – lymphocytes
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• Which of the following are white blood cells?

- A – platelets
- B – antibodies
- C – lymphocytes
- D – fibrin

• What is the name of the blood protein involved in blood clotting?

- A – insulin
- B – adrenaline
- C – fibrin
- D – actin

Immune Defence: Part 2

Basic

• Which of the following diseases is caused by a virus?

- A – tetanus
- B – cholera
- C – athlete's foot
- D – common cold

• What proteins do lymphocytes produce?

- A – antibodies
- B – antibiotics
- C – antiseptics
- D – antigens

• What do we call lymphocytes that remain in the body after an infection?

- A – helper cells
- B – memory cells
- C – antibodies
- D – antigens

Advanced

• What is the general name for proteins on the surface of pathogens which lymphocytes can recognise?

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- B – antibiotics
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• With what do memory cells provide the body?

- A – immunity to all diseases
- B – immunity to a specific disease
- C – antibiotic resistance
- D – antibody resistance

• Answers

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