

Chapter 6: Preventing and treating disease

Knowledge organiser

Non-specific defences

Non-specific defences of the human body against all pathogens include:

Skin

- physical barrier to infection
- produces antimicrobial secretions
- microorganisms that normally live on the skin prevent pathogens growing

Nose

- Cilia and **mucus** trap particles in the air, preventing them from entering the lungs.
- Trachea and bronchi produce mucus, which is moved away from the lungs to the back of the throat by cilia, where it is expelled.

Stomach

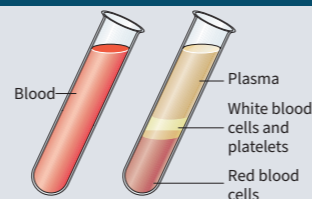
- Produces strong acid (pH 2) that destroys pathogens in mucus, food, and drinks.

White blood cells

If a pathogen enters the body, the immune system tries to destroy the pathogen.

The function of **white blood cells** is to fight pathogens.

There are two main types of white blood cell – lymphocytes and phagocytes.



Lymphocytes

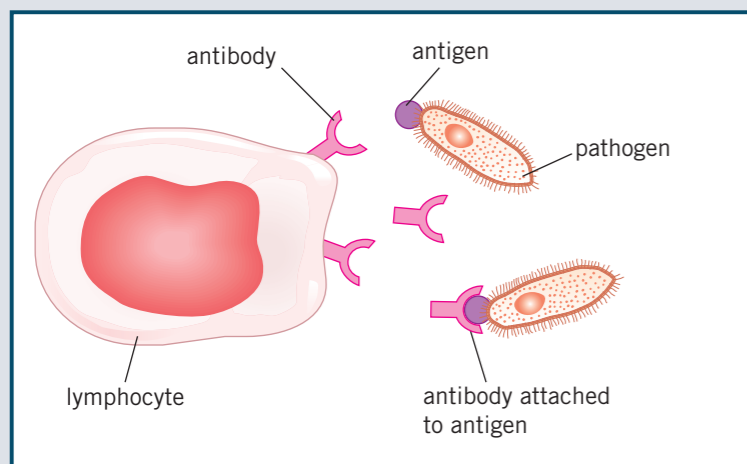
Lymphocytes fight pathogens in two ways:

Antitoxins

Lymphocytes produce **antitoxins** that bind to the toxins produced by some pathogens (usually bacteria). This *neutralises* the toxins.

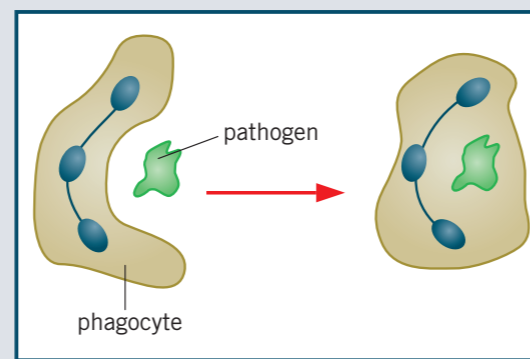
Antibodies

Lymphocytes produce **antibodies** that target and help to destroy specific pathogens by binding to **antigens** (proteins) on the pathogens' surfaces.



Phagocytes

- 1 Phagocytes are attracted to areas of infection.
- 2 The phagocyte surrounds the pathogen and engulfs it.
- 3 Enzymes that digest and destroy the pathogen are released.



Treating diseases

Antibiotics

- **Antibiotics** are medicines that can kill *bacteria* in the body.
- Specific bacteria need to be treated by specific antibiotics.
- Antibiotics have greatly reduced deaths from infectious bacterial diseases, but antibiotic-resistant strains of bacteria are emerging.

Treating viral diseases

- Antibiotics *do not* affect viruses.
- Drugs that kill viruses often damage the body's tissues.
- Painkillers treat the symptoms of viral diseases but do not kill pathogens.

Discovering and developing new drugs

Drugs were traditionally extracted from plants and microorganisms, for example

- the heart drug digitalis comes from foxglove plants
- the painkiller aspirin originates from willow trees
- penicillin was discovered by Alexander Fleming from *Penicillium* mould.

Most modern drugs are now synthesised by chemists in laboratories.

New drugs are extensively tested and trialled for

- **toxicity** – is it harmful?
- **efficacy** – does it work?
- **dose** – what amount is safe and effective to give?

Stages of clinical trials

Pre-clinical trials

Drug is tested in cells, tissues, and live animals.

Clinical trials

- 1 Healthy volunteers receive very low doses to test whether the drug is safe and effective.
- 2 If safe, larger numbers of healthy volunteers and patients receive the drug to find the optimum dose.

Peer review

Before being published, the results of clinical trials will be tested and checked by independent researchers. This is called **peer review**.

Double-blind trials

Some clinical trials give some of their patients a **placebo** drug – one that is known to have no effect.

Double-blind trials are when neither the patients nor the doctors know who has been given the real drug and who has been given the placebo. This reduces biases in the trial.

Vaccinations

Vaccinations involve injecting small quantities of dead or inactive forms of a pathogen into the body. This stimulates lymphocytes to produce the correct antibodies for that pathogen. If the same pathogen re-enters the body, the correct antibodies can be produced quickly to prevent infection. If a large proportion of the population is vaccinated against a disease, it is less likely to spread. This is called **herd immunity**.

Key terms

Make sure you can write a definition for these key terms.

antibiotic antibody antigen antitoxin dose double-blind trial efficacy Herd immunity
 mucus peer review placebo toxicity vaccination white blood cell

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Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

B6 questions

Answers

1	What non-specific systems does the body use to prevent pathogens getting into it?	Put paper here	<ul style="list-style-type: none">• skin• cilia and mucus in the nose, trachea, and bronchi• stomach acid
2	What three functions do white blood cells have?	Put paper here	phagocytosis, producing antibodies, producing antitoxins
3	What happens during phagocytosis?	Put paper here	phagocyte is attracted to the area of infection, engulfs a pathogen, and releases enzymes to digest the pathogen
4	What are antigens?	Put paper here	proteins on the surface of a pathogen
5	Why are antibodies a specific defence?	Put paper here	antibodies have to be the right shape for a pathogen's unique antigens, so they target a specific pathogen
6	What is the function of an antitoxin?	Put paper here	neutralise toxins produced by pathogens by binding to them
7	What does a vaccine contain?	Put paper here	small quantities of a dead or inactive form of a pathogen
8	How does vaccination protect against a specific pathogen?	Put paper here	vaccination stimulates the body to produce antibodies against a specific pathogen – if the same pathogen reenters the body, white blood cells rapidly produce the correct antibodies
9	What is herd immunity?	Put paper here	when most of a population is vaccinated against a disease, meaning it is less likely to spread
10	What is an antibiotic?	Put paper here	a drug that kills bacteria but not viruses
11	What do painkillers do?	Put paper here	treat some symptoms of diseases and relieve pain
12	What properties of new drugs are clinical trials designed to test?	Put paper here	toxicity, efficacy, and optimum dose
13	What happens in the pre-clinical stage of a drug trial?	Put paper here	drug is tested on cells, tissues, and live animals
14	What is a placebo?	Put paper here	medicine with no effect that is given to patients instead of the real drug in a trial
15	What is a double-blind trial?	Put paper here	a trial where neither patients nor doctors know who receives the real drug and who receives the placebo