

# Exercise walk-through

Diseases and immunity ■ 10.1

eXercise

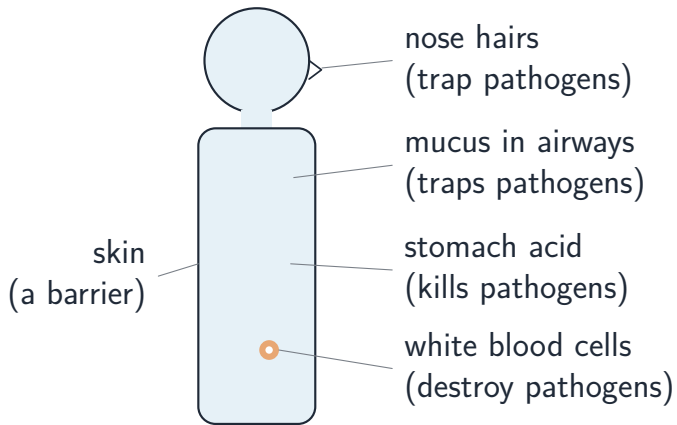
## You must be able to

- define pathogen and transmissible disease; list the body's defences
- explain antigens/antibodies and how vaccination works
- compare active and passive immunity

## Method — Defences and vaccination

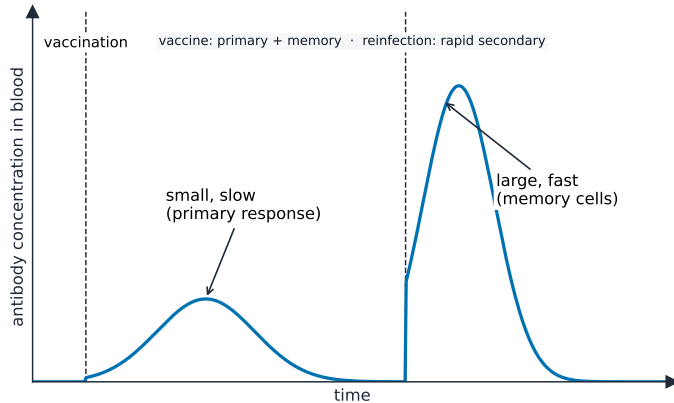
- **passive immunity** (placenta, breast milk): short-term, no memory cells.

## Method — Defences and vaccination



*The body's defences: skin, nose hairs, mucus, stomach acid, white cells*

# Method — Defences and vaccination



*Antibody response: small after vaccination, large and fast on re-infection*

## Method — The defences, in the order the marks are given

**Pathogen** 病原体: an organism that causes disease. A **transmissible disease** passes from one host to another, directly (touch, body fluids) or indirectly (contaminated food or water, air, an insect vector).

**The body's defences, in two layers.**

- **Mechanical and chemical barriers, which act against every pathogen:** the skin as a physical barrier; hairs in the nose; **mucus** trapping pathogens in the airways, with cilia sweeping it up; stomach acid killing what is swallowed; tears containing enzymes.
- **The white blood cells, which act against a specific pathogen:** **phagocytes** 吞噬细胞 engulf and digest pathogens; **lymphocytes** 淋巴细胞 make **antibodies** 抗体 whose shape is complementary to the pathogen's **antigen** 抗原, so they bind to it and mark it for destruction or make the pathogens clump together.

## Method — The defences, in the order the marks are given

**Active and passive immunity.** **Active** immunity comes from the body making its own antibodies, after an infection or a vaccination; it is slow to start but long-lasting, because memory cells remain. **Passive** immunity comes from receiving antibodies made elsewhere, such as through the placenta or breast milk; it is immediate but short-lived, because no memory cells are made.

**Worked example (how a vaccine works).** Describe how a vaccine gives long-term protection.

- 1 The vaccine puts a weakened, dead or partial pathogen, carrying its antigens, into the body.
- 2 Lymphocytes recognise the antigens and make specific antibodies against them.
- 3 **Memory cells** remain in the blood afterwards.

## Method — The defences, in the order the marks are given

- 4 If the real pathogen enters later, the memory cells make antibodies faster and in larger amounts, so the person does not become ill.

**Controlling the spread of a disease:** clean water supplies, hygienic food preparation, waste disposal and sewage treatment, personal hygiene such as hand washing, and vaccination programmes. When enough people are vaccinated, **herd immunity** protects those who cannot be, because the pathogen cannot find enough hosts to spread through.

## Practice 2.1 ■ 1 mark

Define a pathogen.

## Solution 2.1

### Worked steps

an organism that causes disease **B1**.

## Practice 2.2 ■ 2 marks

State two of the body's defences against pathogens.

## Solution 2.2

Method: The defences, in the order the marks are given

### Worked steps

any two of: skin; nose hairs; mucus; stomach acid; white blood cells **B1** **B1**.

## Practice 2.3 ■ 2 marks

State two mechanical barriers that stop pathogens entering the body.

## Solution 2.3

Method: The defences, in the order the marks are given

### Worked steps

Any two of: the skin as a physical barrier; hairs in the nose; mucus in the airways trapping pathogens; cilia sweeping mucus away **B2**.

## Practice 2.4 ■ 2 marks

Explain why an antibody against measles does not protect against influenza.

## Solution 2.4

Method: The defences, in the order the marks are given

### Worked steps

An antibody has a shape complementary to one particular antigen **B1**; the measles and influenza viruses carry different antigens, so the measles antibody cannot bind to the influenza virus **B1**.

## Practice 2.5 ■ 2 marks

Give two methods of controlling the spread of a disease carried in water.

## Solution 2.5

Method: The defences, in the order the marks are given

### Worked steps

Any two of: treating and chlorinating the water supply; treating sewage so it does not reach drinking water; boiling water before drinking; hand washing **B2**.

## Exam-style 3.1 ■ 1 mark

An antibody is able to bind to one pathogen because its shape is:

- A** the same as the antibody
- B** complementary to the pathogen's antigen
- C** larger than the pathogen
- D** always changing

## Solution 3.1

Method: The defences, in the order the marks are given

- A the same as the antibody
- B complementary to the pathogen's antigen 
- C larger than the pathogen
- D always changing

### Worked steps

B. An antibody's shape is complementary to the pathogen's antigen.

## Exam-style 3.2 ■ 3 marks

A child is vaccinated against measles.

- (a) Describe how the vaccine gives long-term protection.
- (b) State the difference between active and passive immunity.

## Solution 3.2

Method: The defences, in the order the marks are given

### Worked steps

(a) the vaccine's antigens make lymphocytes produce antibodies **M1**; and memory cells form **M1**; if the real pathogen arrives, the memory cells make antibodies fast, so you don't become ill **A1**.

(b) active immunity is made by your own body (long-term, memory cells); passive immunity comes from another body's antibodies (short-term, no memory cells) **M1 A1**.

## Exam-style 3.3 ■ 4 marks

A country runs a vaccination programme against a viral disease.

- (a) Describe how the vaccine produces long-term protection.
- (b) Explain why the protection is described as active immunity.
- (c) A newborn baby receives antibodies in its mother's breast milk. Name this type of immunity and explain why it lasts only a few months.
- (d) Describe how a phagocyte destroys a pathogen that has entered the blood.
- (e) When most of the population is vaccinated, unvaccinated people also become less likely to catch the disease. Explain why.

## Solution 3.3

Method: The defences, in the order the marks are given

### Worked steps

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- (a) The vaccine introduces a weakened, dead or partial pathogen carrying its antigens **B1**; lymphocytes recognise the antigens **B1** and make specific antibodies against them **B1**; memory cells remain, so if the real pathogen enters later, antibodies are made faster and in larger quantities and the person does not become ill **B1**.
- (b) The person's own lymphocytes make the antibodies **B1**, and memory cells remain afterwards, so the protection is long lasting **B1**.
- (c) Passive immunity **B1**; the antibodies were made by the mother, not the baby **B1**; the baby makes no memory cells, and the antibodies are gradually broken down,

## Solution 3.3

so the protection fades **B1**.

(d) The phagocyte engulfs the pathogen, taking it inside the cell **B1**; enzymes then digest and destroy it **B1**.

(e) There are too few people left who can catch and pass on the pathogen **B1**, so it cannot spread easily and the unvaccinated are unlikely to meet an infected person, which is herd immunity **B1**.