

Exercise walk-through

Antibodies and vaccination ■ 11.2

eXercise

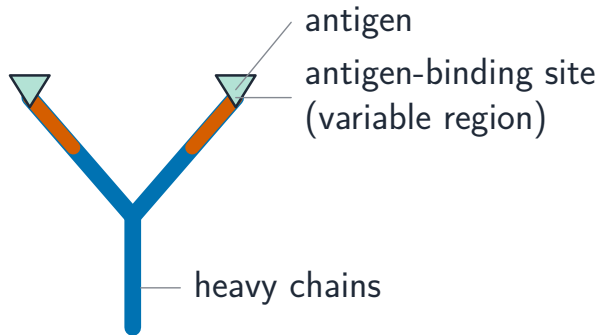
You must be able to

- relate antibody structure to function and outline the hybridoma method
- distinguish active/passive and natural/artificial immunity
- explain how vaccines and vaccination programmes give long-term immunity

Method — Antibody structure and function

An antibody is a Y-shaped protein; its two **variable regions** 可变区 bind one antigen only. Antibodies clump pathogens together, mark them for phagocytes, and block toxins.

Method — Antibody structure and function



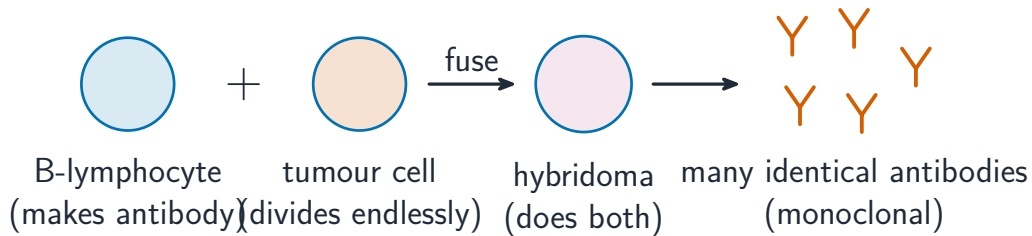
each tip fits one antigen only

A Y-shaped antibody with an antigen fitting into each tip (the variable regions)

Method — Monoclonal antibodies

A **hybridoma** 杂交瘤 = a B-lymphocyte (makes the wanted antibody) fused with a tumour cell (divides endlessly). Uses: **diagnosis** (e.g. pregnancy test) and treatment (carry drugs to target cells).

Method — Monoclonal antibodies



Method — Types of immunity

	natural	artificial
passive	after an infection (your body responds)	vaccination (safe dose of antigen)
	antibodies passed from mother to baby	injection of ready-made antibodies

active = your body makes its own antibodies (slow, long-lasting);

passive = ready-made antibodies given (fast, short-lived)

Method — Vaccination and herd immunity

A **vaccine** contains antigens that trigger a primary response and make memory cells — long-term immunity without illness. If enough people are vaccinated, **herd immunity** 群体免疫 protects the rest.

Method — Vaccination and herd immunity

the disease cannot pass through vaccinated people



Practice 2.1 ■ 2 marks

State the part of an antibody that binds the antigen, and explain why it binds only one antigen.

Solution 2.1

Method: Antibody structure and function

Worked steps

the variable region / antigen-binding site **B1**; its shape is complementary to one antigen only **B1**.

Practice 2.2 ■ 1 mark

State one difference between active and passive immunity.

Solution 2.2

Method: Types of immunity

Worked steps

active immunity is made by your own body and is long-lasting; passive immunity uses ready-made antibodies and is short-lived **B1**.

Exam-style 3.1 ■ 1 mark

Which is an example of **passive natural** immunity?

- A recovering from chickenpox
- B being given a vaccine
- C antibodies passing from a mother to her baby in breast milk
- D being injected with ready-made antibodies

Solution 3.1

Method: Types of immunity

- A recovering from chickenpox
- B being given a vaccine
- C antibodies passing from a mother to her baby in breast milk 
- D being injected with ready-made antibodies

Worked steps

C. Antibodies passing from mother to baby = passive (ready-made) and natural.

Exam-style 3.2 ■ 1 mark

Why does passive immunity not last long?

- A** the antibodies are the wrong shape
- B** no memory cells are produced
- C** the antigens are destroyed
- D** phagocytes remove the antibodies

Solution 3.2

A the antibodies are the wrong shape

B no memory cells are produced



C the antigens are destroyed

D phagocytes remove the antibodies

Worked steps

B. No memory cells are made, so the immunity is short-lived.

Exam-style 3.3 ■ 3 marks

- (a) Outline how monoclonal antibodies are produced by the hybridoma method.
- (b) State **one** use of monoclonal antibodies in medicine and explain how their specificity is important.

Solution 3.3

Method: Monoclonal antibodies

Worked steps

(a) an animal is given the antigen so it makes B-lymphocytes producing the wanted antibody **B1**; these are fused with tumour cells to form hybridomas **B1**; the hybridomas both make the antibody and divide endlessly, giving many identical antibodies **B1**.

(b) e.g. diagnosis (pregnancy test) or carrying drugs to cancer cells **B1**; the antibody binds only the target molecule/cell, so it is specific and does not affect others **B1**.

Exam-style 3.4 ■ 3 marks

Explain how a vaccination programme can protect even people who have not been vaccinated.

Solution 3.4

Method: Vaccination and herd immunity

Worked steps

vaccinating enough people means the pathogen cannot pass easily between them **M1**; so it cannot reach the unvaccinated people **M1** — this is herd immunity **A1**.