

Diseases & Immunity

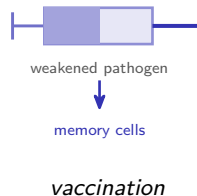
IGCSE Biology ■ Topic 10

IGCSE Biology



What we will cover

- 1 Pathogens & transmission
- 2 The body's defences
- 3 Antigens & antibodies
- 4 Vaccination
- 5 Active vs passive immunity
- 6 Cholera



1

Disease and defence

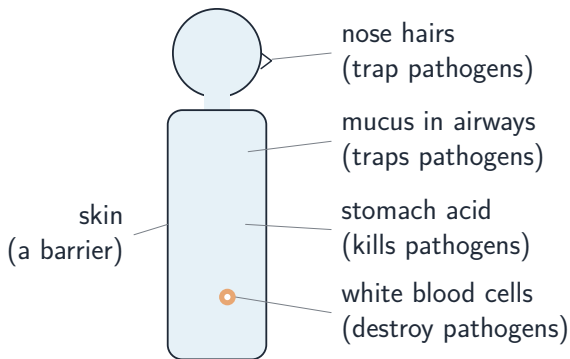
Pathogens and transmission



indirect: through food, water or air

- by **direct contact** 直接接触 – for example through blood and other **body fluids** 体液.
- indirectly – for example from **contaminated** 污染 surfaces, food, animals, or the air.

The body's defences

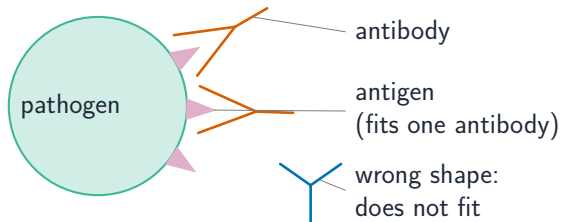


- **skin** – a barrier that covers and protects the body.
- **hairs in the nose** – trap dust and pathogens in the air you breathe in.
- **mucus** 黏液 – sticky liquid in the airways that traps pathogens.
- **stomach acid** 胃酸 – kills most pathogens in your food.

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Immunity

Antigens and antibodies



Each pathogen carries
antigens 抗原.

Lymphocytes 淋巴细胞 make
antibodies 抗体 (proteins).

An antibody's shape is **complementary** 互补 to one antigen – it fits only that pathogen.

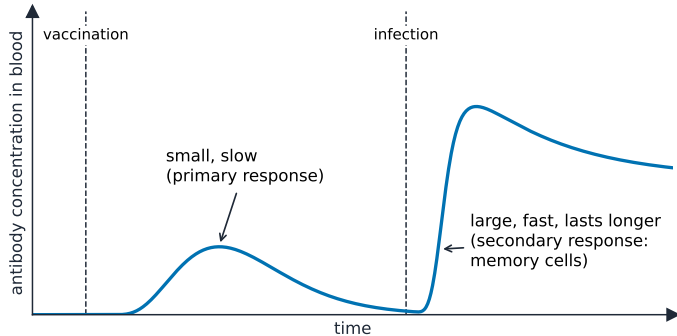
Vaccination

Vaccination 疫苗接种 putting **weakened pathogens** or their **antigens** into the body.



The pathogen is destroyed **before** it can make you ill.

Vaccination, in detail



vaccine: primary + memory · reinfection: rapid secondary

After vaccination, memory cells give a fast, large response if the real pathogen arrives

Active vs passive immunity

active immunity 主动免疫

your own antibodies (infection/vaccine); **memory cells** → long-term

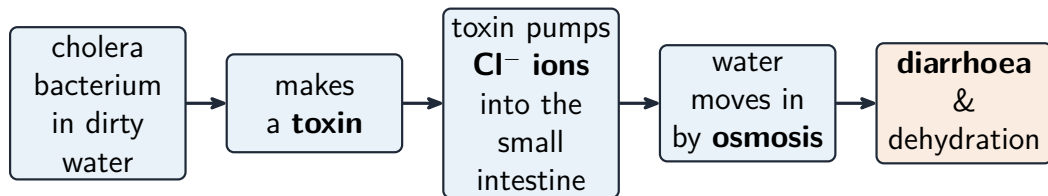
passive immunity 被动免疫

antibodies from another (placenta, breast milk); **no** memory → short-term

Cholera

Cholera 霍乱 spreads in dirty water. Its **toxin** 毒素:

- pumps chloride ions into the gut
- water follows by **osmosis** 渗透
- → **diarrhoea** 腹泻 & **dehydration** 脱水



How pathogens spread



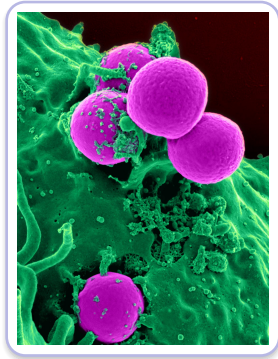
A mosquito can spread pathogens from person to person when it bites.

How a pathogen is transmitted, and how to stop it

direct contact	blood or other body fluids passing from one person to another
indirect contact	contaminated food or water, an object, an animal vector, or droplets in the air
a transmissible disease 传染病	one in which a pathogen 病原体 can be passed from one host to another
clean water	a safe supply, so drinking water is not contaminated
hygienic 卫生 preparation	of food, and good personal hygiene – washing your hands
waste and sewage treatment 污水处理	proper disposal, so waste never reaches water or food

Cholera is the standard example: a **bacterium 细菌** spread by contaminated water, and stopped by **sewage treatment and a clean supply** rather than by medicine.

A white blood cell engulfs bacteria



A white blood cell (green) engulfing round bacteria (purple), a key body defence

The body's own defences, and how public health helps

skin	a physical barrier, and it produces oil and sweat that inhibit bacteria
mucus and cilia	trap and sweep out pathogens in the airways
stomach acid	kills most pathogens swallowed with food, before they reach the small intestine 小肠
phagocytes 吞噬细胞	white blood cells that engulf and digest pathogens
lymphocytes	make antibodies specific to one antigen
breast-feeding 母乳喂养	passes antibodies to infants 婴儿 – natural passive immunity, before their own system is ready

Public health works upstream: clean water, hygienic food, safe waste disposal and vaccination stop the pathogen **reaching** anyone.

Exam tips

- Pathogen = organism that causes disease. Transmissible = can pass between hosts, by direct contact or indirectly.
- Learn the five body defences: skin, nose hairs, mucus, stomach acid, white blood cells.
- An antibody's shape is **complementary** to one antigen (like an enzyme and its substrate).
- Active immunity (from infection or vaccination) makes **memory cells** → long-term. Passive immunity (placenta, breast milk) makes **no** memory cells → short-term.
- Cholera: toxin → chloride ions into the gut → water in by osmosis → diarrhoea and dehydration.

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Recap

Worked example – active or passive immunity?

A traveller is given an injection of ready-made antibodies. Is this active or passive immunity, and how long does it last?

- The antibodies were **not made by the traveller** – they were given.
- So it is **passive immunity** 被动免疫: protection starts **immediately**.
- But no **memory cells** are made.
- When the antibodies break down the protection is gone $\Rightarrow$ **short-lived**.

Active: you make your own antibodies (vaccine or infection) – slow to start, **long-lasting** (memory cells). **Passive:** given to you – instant, **short**.

Worked example – why a second dose works better

After a first vaccine dose antibody levels rise slowly and stay low; after a second dose they rise faster and much higher. Explain.

- First dose: **no memory cells** for that **antigen** 抗原 yet.
- Time is lost finding the matching **lymphocyte** 淋巴细胞 $\Rightarrow$ slow, small.
- Second dose: the **memory cells** recognise it at once.
- So antibodies come **sooner and in far greater numbers**.

The marks are for **memory cells**. “The body is used to it” earns nothing – name the cells, and say they are already there.

Topic 10 – key takeaways

1

Defences

skin, mucus, stomach acid, white cells

2

Antibodies

complementary shape to one antigen

3

Immunity

active makes memory cells;
passive does not

4

Cholera

toxin → osmosis → diarrhoea

Check yourself

- 1 Name two of the body's defences.
- 2 What cell makes antibodies?
- 3 Which immunity makes memory cells?
- 4 Why does cholera cause water loss?



Answers 1. e.g. skin & stomach acid 2. a lymphocyte 3. active immunity 4. water moves into the gut by osmosis