Diseases and immunity

IGCSE Biology

Pathogens and disease

A **pathogen** 病原体 is an organism that causes **disease** 疾病. A **transmissible disease** 传染病 is one in which the pathogen can pass from one **host** 宿主 to another.

How pathogens spread

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

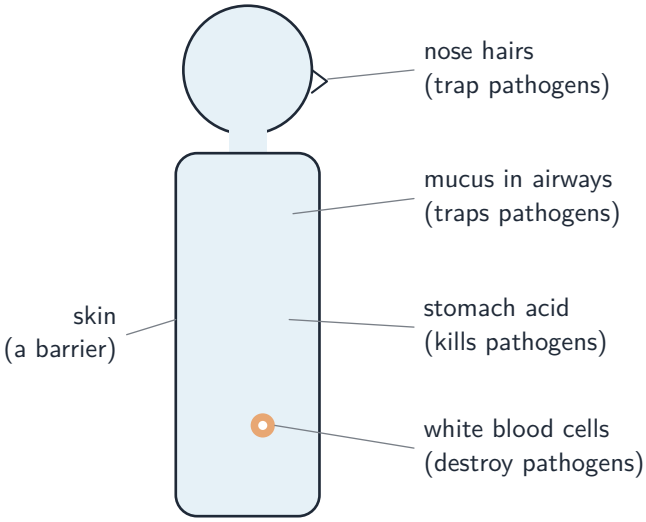
A pathogen is **transmitted** 传播 in two main ways:

- 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.

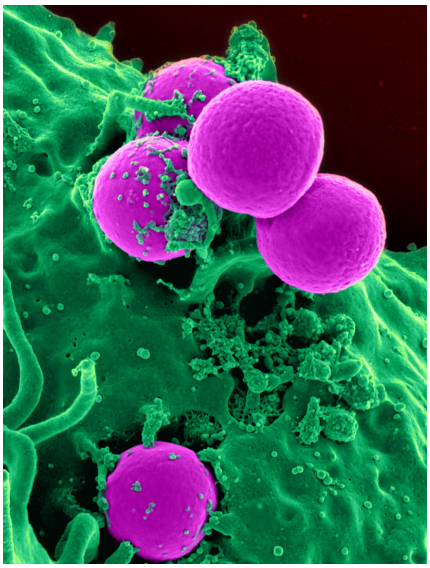
The body's defences

Your body has several **defences** 防御 that keep pathogens out or destroy them:

- **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.
- **white blood cells** 白细胞—find and destroy any pathogens that get inside.



The body keeps most pathogens out; white blood cells deal with any that get in



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

Image: National Institutes of Health (NIH), Public domain (commons.wikimedia.org)

Controlling the spread of disease

Good public health stops disease spreading:

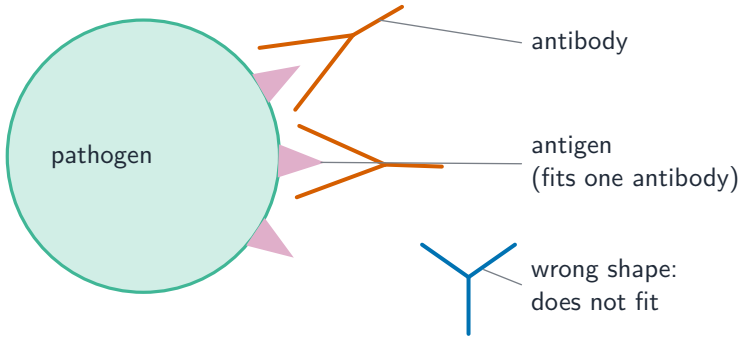
- a clean water supply, so drinking water carries no pathogens.
- **hygienic** 卫生 food preparation and good personal hygiene, such as washing your hands.
- proper waste disposal and **sewage treatment** 污水处理, so waste does not contaminate water or food.

Immunity (Supplement)

Antigens and antibodies

Every pathogen carries **antigens** 抗原 on its surface, and each kind of antigen has its own special shape.

Antibodies 抗体 are **proteins** 蛋白质 made by **lymphocytes** 淋巴细胞 (a kind of white blood cell). An antibody has a shape that is **complementary** 互补 to one antigen, so it fits only that antigen. When antibodies bind to a pathogen's antigens, they either destroy the pathogen directly or mark it so that **phagocytes** 吞噬细胞 destroy it.



An antibody's shape is complementary to one antigen, so it fits only that pathogen

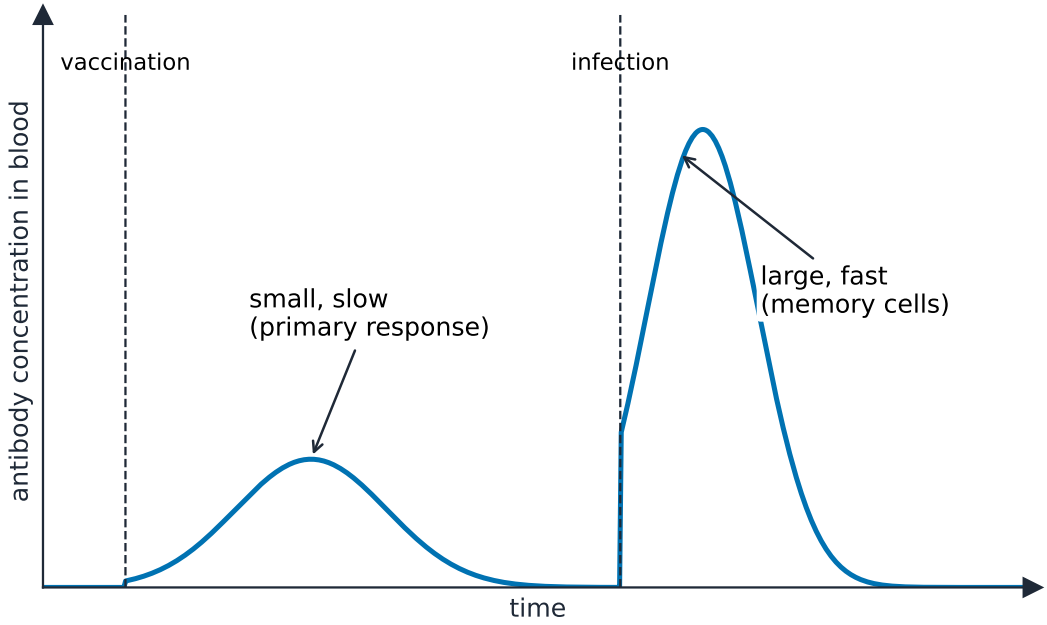
Active immunity and vaccination

Active immunity 主动免疫 is protection made by your **own** body producing antibodies. You gain it after an infection, or after **vaccination** 疫苗接种.

Vaccination works like this:

1. weakened pathogens, or just their antigens, are put into the body; they cannot make you ill.
2. the antigens make your lymphocytes produce antibodies.
3. the body also makes **memory cells** 记忆细胞 that stay for years.

If the real pathogen enters later, the memory cells make antibodies very fast, so you do not become ill. This gives long-term protection. If most people in a group are vaccinated, the disease cannot spread easily.



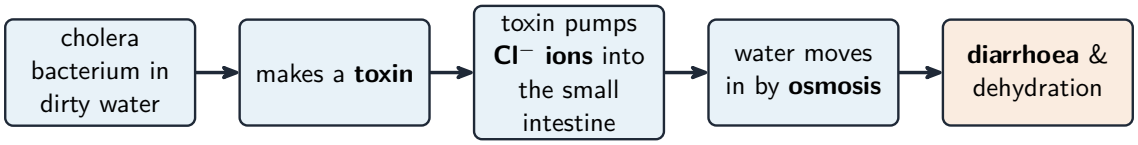
After vaccination, memory cells give a fast, large response if the real pathogen arrives

Passive immunity

Passive immunity 被动免疫 is protection from antibodies made by **another** body, not your own. For example, a baby receives antibodies from its mother across the **placenta** 胎盘 and in **breast milk** 母乳. This is why **breast-feeding** 母乳喂养 helps protect **infants** 婴儿. Passive immunity is only short-term, because **no** memory cells are made.

Cholera (Supplement)

Cholera 霍乱 is a disease caused by a **bacterium** 细菌 that spreads in contaminated water. The cholera bacterium makes a **toxin** 毒素. This toxin causes **chloride ions** 氯离子 to be pumped into the **small intestine** 小肠. Water then moves into the intestine by **osmosis** 渗透. The result is **diarrhoea** 腹泻, **dehydration** 脱水 (loss of water) and a loss of **ions** 离子 from the blood.



Cholera toxin pulls water into the gut by osmosis, causing diarrhoea and dehydration

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.