

Diseases and immunity

IGCSE Biology

Pathogens and disease

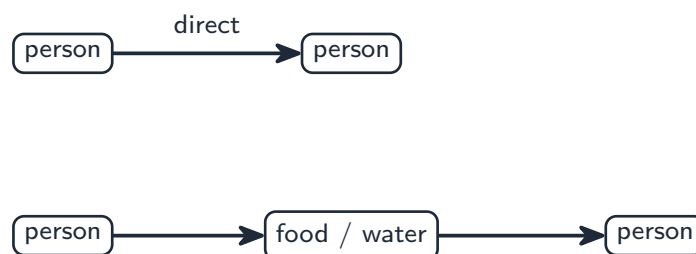
A **pathogen** 病原体 is an organism that causes **disease** 疾病. A **transmissible disease** 传染病 is one in which the pathogen can pass from one **host** 宿主 to another.

How pathogens spread



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

Image: Dunpharlain, CC BY-SA 4.0 (commons.wikimedia.org)



indirect: through food, water or air

Pathogens spread by direct contact or indirectly

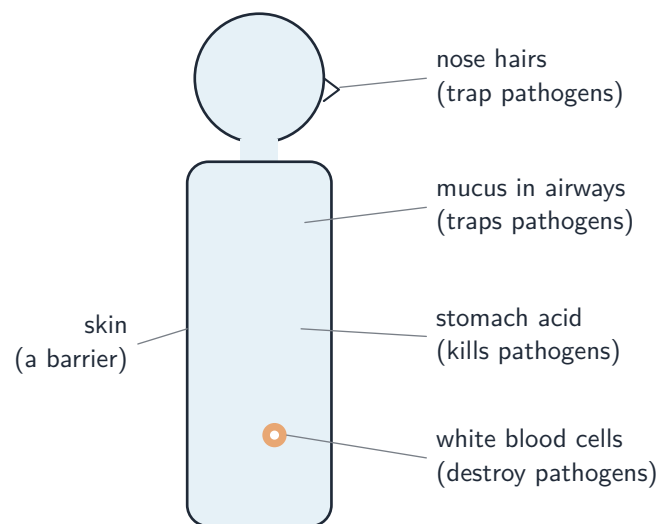
A pathogen is **transmitted** 传播 in two main ways:

- 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.

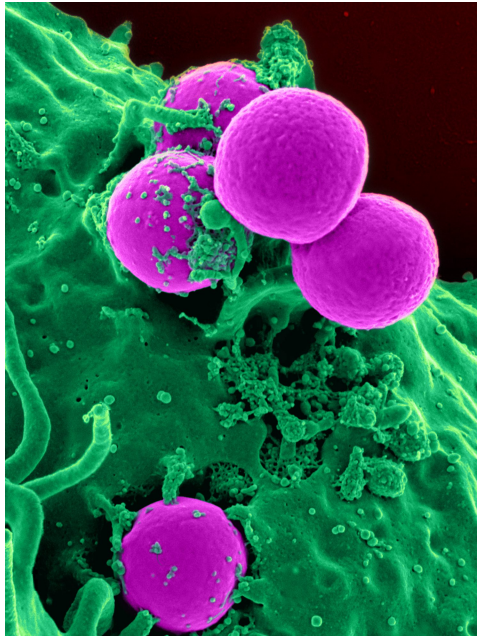
The body's defences

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:

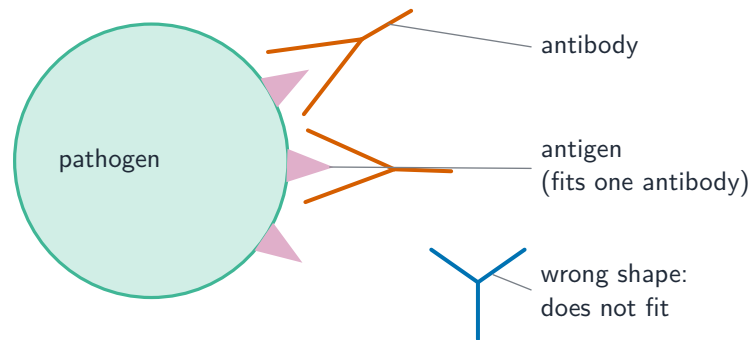
- a clean water supply, so drinking water carries no pathogens.
- **hygienic** 卫生 food preparation and good personal hygiene, such as washing your hands.
- proper waste disposal and **sewage treatment** 污水处理, so waste does not contaminate water or food.

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

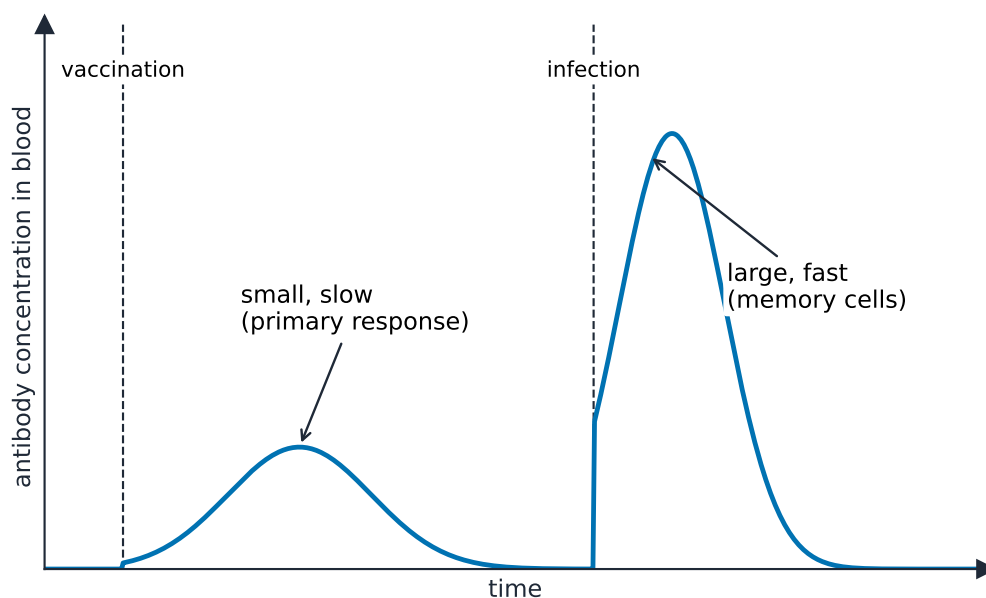
Active immunity and vaccination

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

Worked example. After a first dose of a vaccine, antibody levels rise slowly and stay low. After a second dose of the same vaccine, they rise faster and reach a much higher

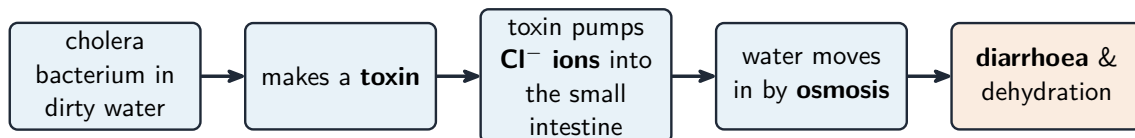
level. Explain. At the first dose the body has no memory cells for that antigen, so time is lost while the right lymphocyte is found and multiplies - the response is slow and small. The second dose meets the memory cells left over from the first, which recognise the antigen at once, so antibodies are made sooner and in far greater numbers. The marks are for **memory cells**: "the body is used to it" earns nothing.

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.