

Diseases and immunity revision notes

Diseases and immunity explains what causes infectious disease, how pathogens pass from one person to another and how the body and public health measures stop them. For Extended candidates it goes on to antibodies, vaccination, passive immunity and how the cholera bacterium makes people ill.

For Cambridge IGCSE Biology 0610 (and 0970, which has the same content). **Supplement** is Extended content, only examined on Papers 2 and 4.

1 Pathogens and transmission Spec 10.1.1–10.1.5, 10.1.16–10.1.17

Pathogens and how they are transmitted Spec 10.1.1, 10.1.2, 10.1.3

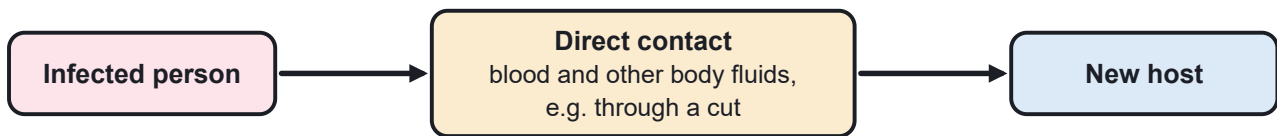
A **pathogen** is a disease-causing organism. Bacteria, viruses, fungi and protists can all be pathogens.

A **transmissible disease** is a disease in which the pathogen can be passed from one host to another. The host is the organism the pathogen lives in or on.

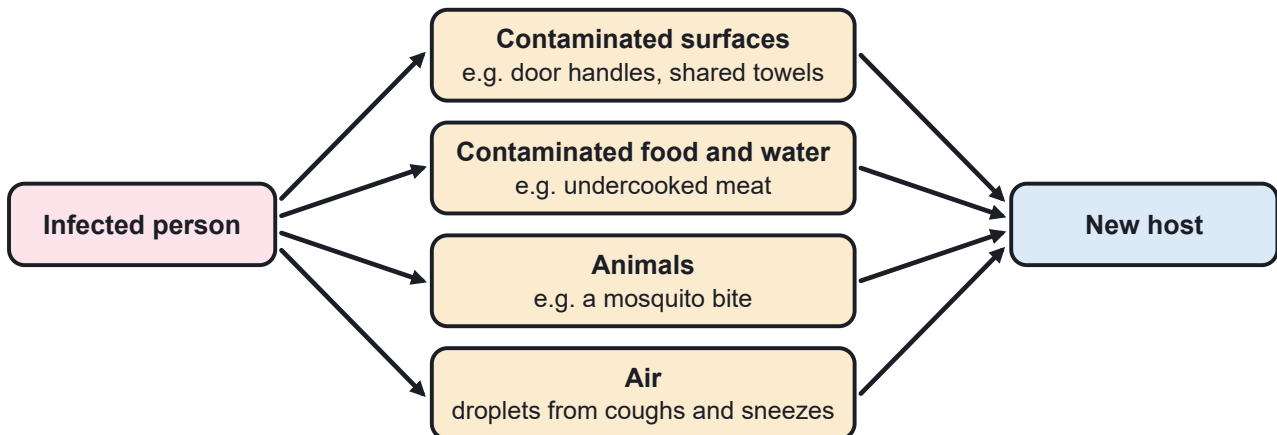
How pathogens are transmitted

Direct and indirect transmission		
Route	What happens	Examples
Direct contact	The pathogen passes straight from an infected person to another person.	Blood and other body fluids, for example through a cut or by sexual contact
Indirect: contaminated surfaces	The pathogen is left on an object or surface and picked up later.	Door handles, shared towels
Indirect: food and water	The pathogen is swallowed in food or drink that is contaminated.	Undercooked meat, unclean drinking water
Indirect: animals	An animal carries the pathogen from one host to another.	A mosquito that bites an infected person and then a healthy person
Indirect: air	Pathogens are carried in tiny droplets from coughs and sneezes and breathed in.	Droplets from an infected person

Direct transmission



Indirect transmission



Pathogens reach a new host by **direct contact** or **indirectly** through surfaces, food and water, animals or air.

Exam tip: Say 'transmissible' and 'passed from one host to another'. Do not just write 'catching'.

Body defences Spec 10.1.4

The body has defences that stop pathogens getting in, and others that destroy the ones that do get in.

Body defences	
Defence	How it protects the body
Skin	Forms a tough barrier that stops pathogens entering the body.
Hairs in the nose	Trap dust and pathogens in the air that is breathed in.
Mucus	Sticky liquid in the nose and airways that traps pathogens so they can be removed.
Stomach acid	Kills most pathogens that are swallowed in food and drink.
White blood cells	Destroy pathogens that get inside the body, for example by ingesting them (phagocytes) or by making antibodies (lymphocytes).

Common mistake: Hairs and mucus do not kill pathogens. They trap them. Stomach acid and white blood cells are the defences that kill or destroy pathogens.

Controlling the spread of disease Spec 10.1.5

Good public health stops pathogens reaching people in the first place. Each measure breaks a **transmission** route, so fewer people take in the pathogen.

Controlling the spread of disease

Measure	Why it is important
A clean water supply	Drinking water is treated so it does not contain pathogens. This stops water-borne diseases, such as cholera, spreading.
Hygienic food preparation	Washing hands and surfaces, cooking food thoroughly and storing it correctly stops pathogens getting into food or growing in it.
Good personal hygiene	Washing hands, especially after using the toilet and before eating, removes pathogens and stops them being passed on.
Waste disposal	Rubbish is removed and dealt with so that pathogens in it cannot contaminate food, water or surfaces, and animals that carry pathogens are not attracted.
Sewage treatment	Sewage contains pathogens from human faeces. Treating it means it does not contaminate drinking water or food crops. The stages of sewage treatment are not required.

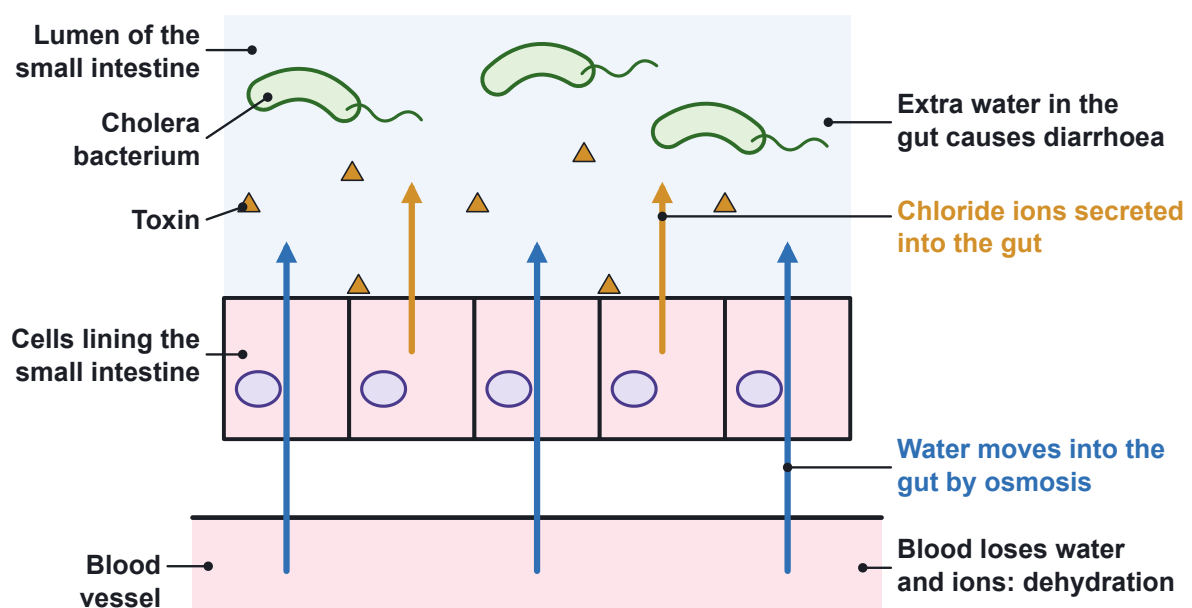
Exam tip: Link every measure to a route: the pathogen is kept out of water, food or off hands. 'It keeps things clean' earns no mark.

Cholera Spec 10.1.16, 10.1.17 Supplement

Cholera is a disease caused by a bacterium. It is transmitted in contaminated water, so it spreads where drinking water is not clean or sewage is not treated.

The cholera bacterium lives in the small intestine and produces a **toxin**. The toxin has these effects:

1. The toxin causes cells lining the small intestine to secrete chloride ions into the small intestine.
2. The chloride ions lower the water potential in the gut, so water moves into the gut from the blood by **osmosis**.
3. The extra water causes **diarrhoea**.
4. Large amounts of water and ions are lost from the body, so the person becomes **dehydrated** and loses ions from the blood.



The cholera toxin makes lining cells secrete **chloride ions** into the gut, so water follows by **osmosis**, causing diarrhoea and dehydration.

Exam tip: Put the sequence in order: toxin, chloride ions secreted, water moves in by osmosis, diarrhoea. Name osmosis.

Quick check

1. What is a pathogen?
2. What is a transmissible disease?
3. Name the body defences in the syllabus.
4. **Supplement** Which route of transmission is cholera associated with?

2 Immunity

Spec 10.1.6–10.1.15

Supplement

Antigens, antibodies and active immunity Spec 10.1.6, 10.1.7, 10.1.8, 10.1.9, 10.1.10

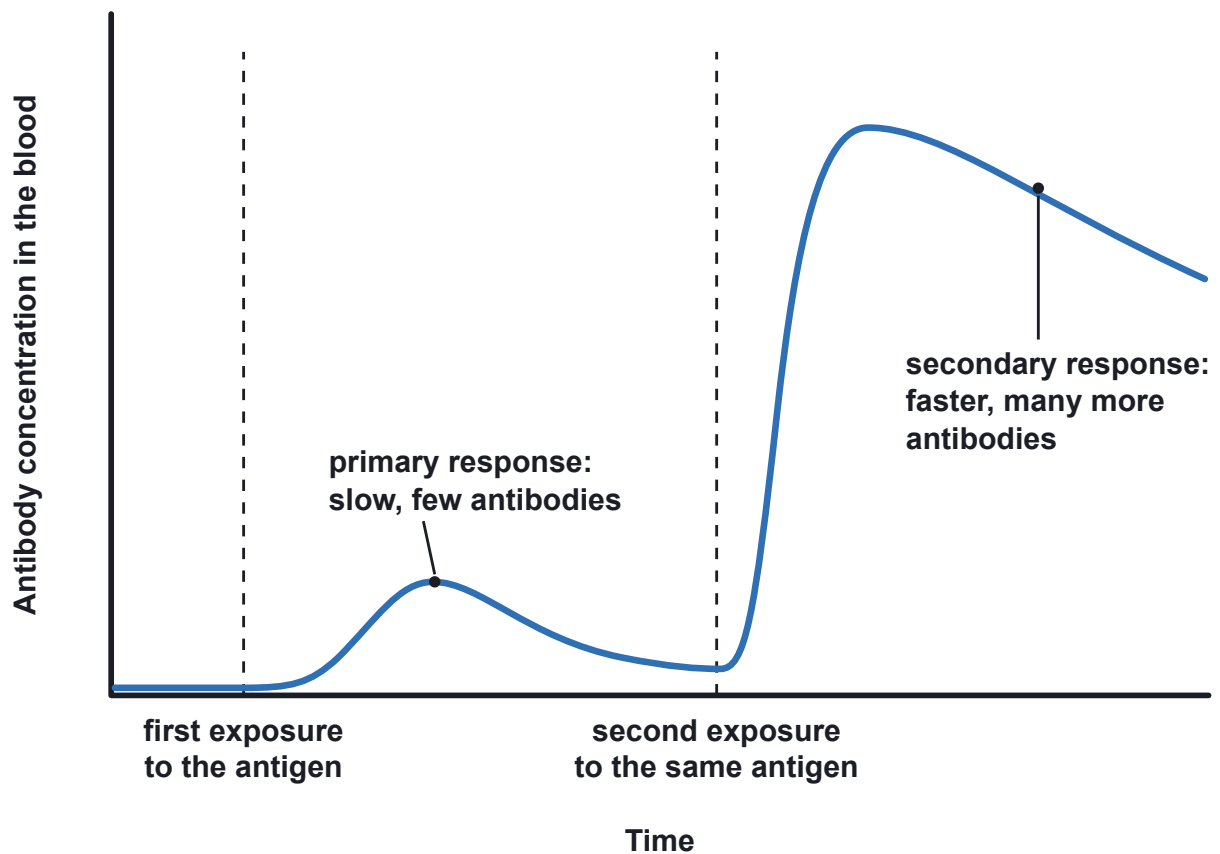
Each pathogen has its own **antigens**. Antigens are molecules on the surface of the pathogen, and they have specific shapes.

Antibodies are proteins made by white blood cells (lymphocytes). An antibody has a shape that is **complementary** to one specific antigen, so it fits that antigen and no others. This means that a different antibody is needed for each pathogen.

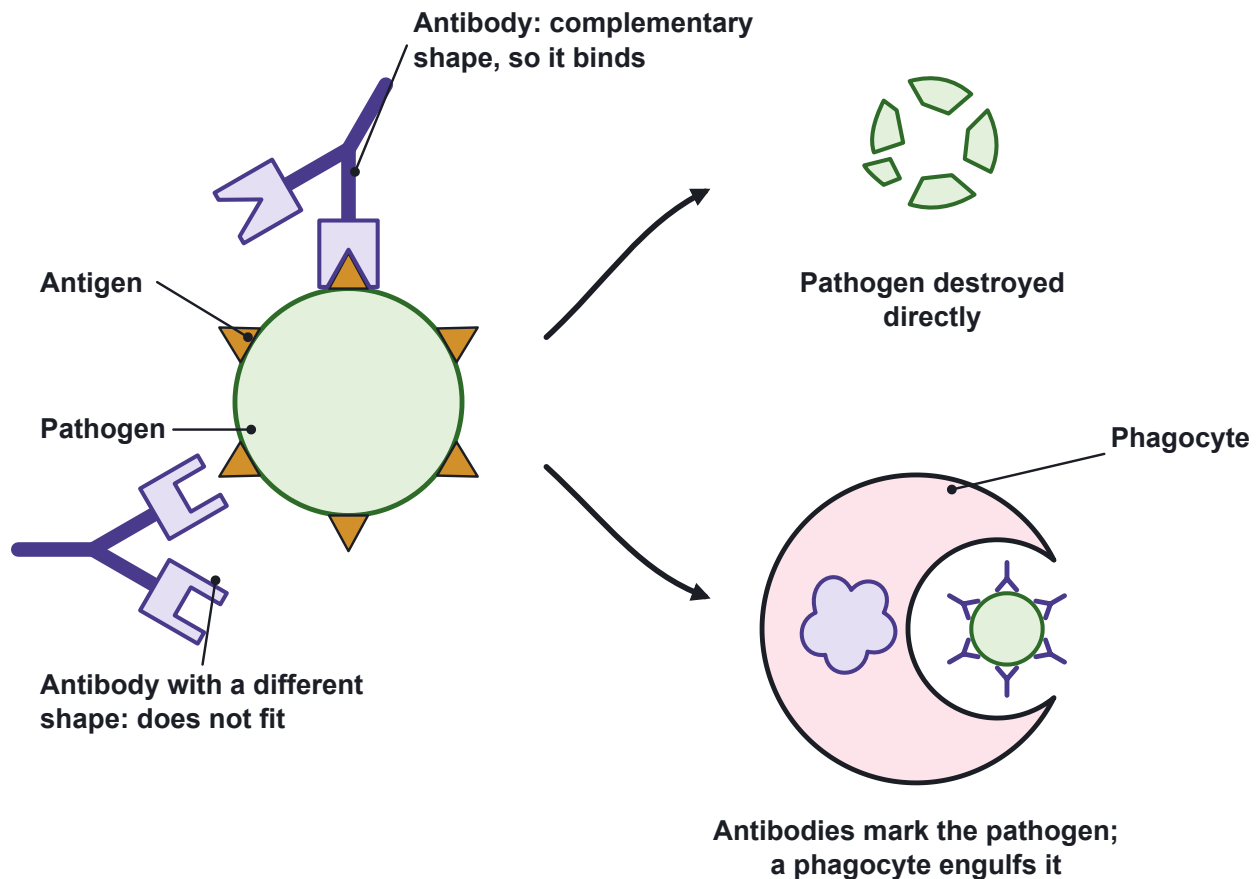
Antibodies bind to antigens. This leads to either direct destruction of the pathogens or marking of the pathogens so that phagocytes destroy them.

Active immunity is defence against a pathogen by antibody production in the body. It is gained in two ways:

- after an infection by a pathogen (the body makes antibodies and recovers)
- by vaccination



Memory cells made after the first exposure make the **secondary response** faster and bigger than the primary response.



Each antibody is **complementary** to one antigen. Binding leads to direct destruction of the pathogen or marks it for destruction by **phagocytes**.

Exam tip: Use the word 'complementary' for the shape of antibody and antigen. An antibody is specific to one antigen.

Vaccination Spec 10.1.11, 10.1.12

Vaccination gives **active immunity** without the person having to suffer the disease.

1. Weakened pathogens or their antigens are put into the body.
2. The antigens stimulate an immune response by lymphocytes, which produce antibodies.
3. Memory cells are produced that give long-term immunity. If the real pathogen enters later, memory cells respond quickly and make large amounts of antibody.

When a large proportion of the population is vaccinated, the pathogen has **fewer susceptible hosts** to infect. It is passed on less often, so the disease spreads less, and people who cannot be vaccinated are protected too.

Common mistake: Vaccines contain weakened pathogens or antigens, not antibodies. The person makes the antibodies.

Passive immunity Spec 10.1.13, 10.1.14, 10.1.15

Passive immunity is a short-term defence against a pathogen by antibodies acquired from another individual. The person's own lymphocytes do not make the antibodies.

Antibodies pass from mother to baby across the placenta before birth, and in breast milk after birth.

Breast-feeding is important for passive immunity in infants. The baby's immune system is not yet fully developed, and antibodies in the milk protect the baby against pathogens, for example in the gut.

Memory cells are not produced in passive immunity. The antibodies are broken down, so the protection is short-term and the baby is not protected if the pathogen returns later.

Active and passive immunity		
	Active immunity	Passive immunity
Antibodies made by	The person's own lymphocytes	Another individual (passed on)
Source	Infection or vaccination	Placenta or breast milk
Memory cells	Produced	Not produced
Length of protection	Long-term	Short-term

Exam tip: The key contrast is memory cells. No memory cells means short-term protection.

Quick check

1. What is an antibody?
2. What gives long-term immunity after vaccination?
3. Name two ways a baby gets antibodies from its mother.
4. Why is passive immunity short-term?

Quick check answers

Pathogens and transmission

1. A disease-causing organism.
2. A disease in which the pathogen can be passed from one host to another.
3. Skin, hairs in the nose, mucus, stomach acid and white blood cells.
4. Contaminated water.

Immunity

1. A protein that binds to a specific antigen.
2. Memory cells.
3. Across the placenta and in breast milk.
4. No memory cells are produced.