

# Human defence systems

4.3.1.6 · Biology · revision notes

How your body stops pathogens getting in (the non-specific defences of the skin, nose, trachea and bronchi, and stomach) and how white blood cells destroy pathogens that do get in. A favourite for 'describe' and 'explain' questions, often in unfamiliar contexts such as smoking.

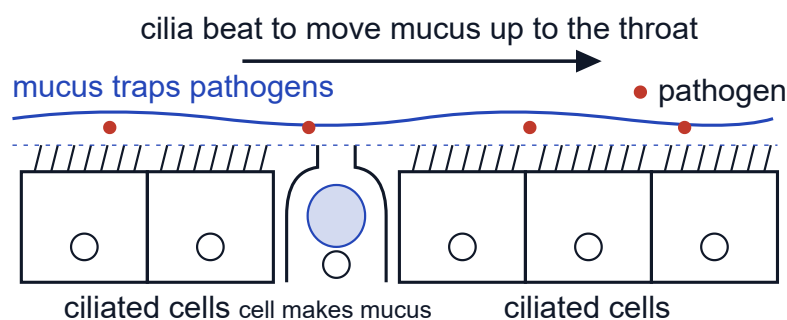
## Key facts

- Skin: physical barrier + antimicrobial secretions; scabs seal cuts
- Trachea and bronchi: mucus traps pathogens; cilia move the mucus to the throat
- White blood cells: phagocytosis, antibodies, antitoxins
- Antigen = molecule (e.g. a protein) on the surface of a pathogen
- Antitoxin: neutralises a toxin made by bacteria
- Nose: hairs and mucus trap particles
- Stomach: hydrochloric acid kills pathogens
- Phagocytosis = engulfing and digesting a pathogen
- Antibody: binds to a specific antigen on a pathogen

## Notes

### Non-specific defences: keeping pathogens out

- **Skin:** a physical barrier that pathogens cannot get through while it is unbroken. It also produces antimicrobial secretions that kill pathogens. If the skin is cut, the blood clots and a scab seals the wound.
- **Nose:** hairs and sticky mucus trap particles, which may contain pathogens, from the air you breathe in.
- **Trachea and bronchi:** cells lining them make **mucus**, which traps pathogens. Other cells have **cilia** (tiny hairs) that beat to move the mucus up to the throat, where it is swallowed.

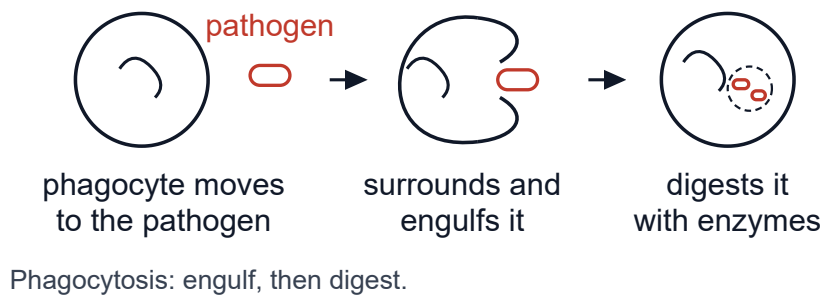


Mucus traps pathogens; cilia sweep it up to the throat.

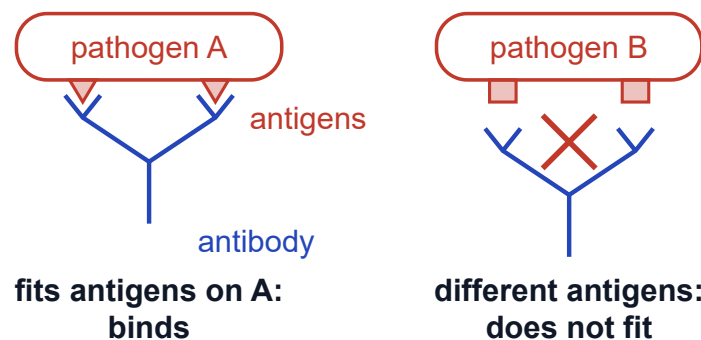
- **Stomach:** produces **hydrochloric acid**, which kills pathogens in food, drink and swallowed mucus.
- These defences are **non-specific**: they work against all pathogens.

## The immune system: white blood cells

- If a pathogen gets into the body, the **immune system** tries to destroy it. White blood cells do this in three ways.
- **Phagocytosis**: white blood cells called phagocytes engulf (surround) pathogens and digest them.



- **Antibody production**: white blood cells called lymphocytes make **antibodies**. Antibodies bind to **antigens** (molecules such as proteins) on the surface of a pathogen. This helps to destroy the pathogens, e.g. by sticking them together so phagocytes can engulf them.
- Antibodies are **specific**: each one fits the antigen of only one type of pathogen, so a different antibody is needed for each pathogen.



Antibodies are specific: the shape must fit the antigen.

- **Antitoxin production**: white blood cells make **antitoxins**, which bind to the toxins made by bacteria and neutralise them.

## Why you can still get ill

- The first time a pathogen gets in, it takes time for white blood cells to make the right antibodies.
- Meanwhile the pathogen reproduces, so you may feel ill before it is destroyed.

## How to answer each type of question

### Describe how a part of the body stops pathogens

2 marks

Grade 4

1. Name what does the job (mucus, cilia, acid, skin).
2. Say what it does to the pathogens (traps, moves away, kills, keeps out).

**Example.** Describe how the trachea and bronchi protect the body against pathogens.

**Model answer.** Mucus traps pathogens (1). Cilia beat to move the mucus up to the throat, where it is swallowed (1).

### Describe how white blood cells defend the body

3 marks

Grade 5

1. Give three separate ways: phagocytosis, antibodies, antitoxins.
2. Add what each one does, not just its name.

**Example.** Describe **three** ways that white blood cells help to defend the body against pathogens.

**Model answer.** They engulf and digest pathogens (phagocytosis) (1). They produce antibodies, which bind to antigens on the pathogens (1). They produce antitoxins, which neutralise the toxins made by bacteria (1).

## Don't lose marks

- ✗ Mixing up antigen, antibody and antibiotic. Antigen = on the pathogen; antibody = made by white blood cells; antibiotic = a medicine that kills bacteria.
- ✗ Saying white blood cells 'eat' pathogens without saying that they engulf and digest them.
- ✗ Saying cilia trap pathogens. Mucus traps them; cilia move the mucus.
- ✗ Saying antibodies neutralise toxins. Antitoxins do that; antibodies bind to antigens on pathogens.
- ✗ Saying stomach acid digests pathogens. It kills them.

## More tips

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### Memory tricks

- From outside in: skin, nose, trachea and bronchi, stomach = barrier, trap, sweep, acid.
- Three jobs of white blood cells: eat them (phagocytosis), tag them (antibodies), neutralise their poisons (antitoxins).
- Antibody vs antitoxin: an antibody targets the pathogen itself; an antitoxin targets the toxin.
- Lock and key: an antibody fits one antigen, like a key fits one lock.

### Exam technique

- Use the key words: barrier, mucus, cilia, hydrochloric acid, engulf, digest, antibodies, antigens, antitoxins.
- For 'describe three ways white blood cells defend', give three different ways, each with what it does.
- In unfamiliar contexts, work out which defence is affected and follow the consequences one step at a time.

## What each grade needs

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What you need to be able to do, from the first marks up to the top grade.

### Grade 3

#### Name the body's non-specific defences

The skin, the nose, the trachea and bronchi, and the stomach.

### Grade 4

#### Describe how each defence stops pathogens

Skin is a barrier; mucus traps pathogens; cilia move the mucus away; stomach acid kills pathogens.

### Grade 4

#### Name three ways white blood cells defend

Phagocytosis, producing antibodies and producing antitoxins.

### Grade 5

#### Describe phagocytosis

A white blood cell engulfs a pathogen and digests it.

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