

Human defence systems

4.3.1.6 · Infection and response · 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.

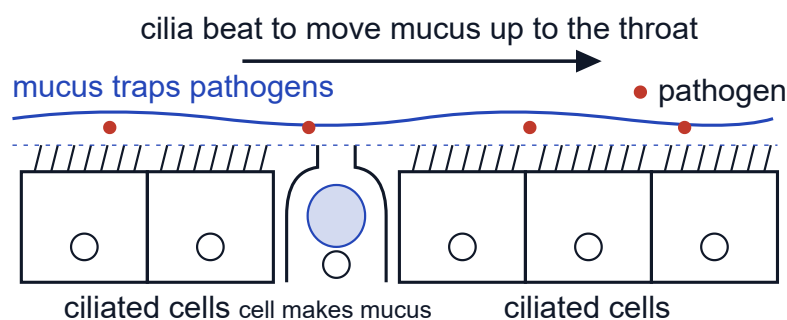
Key facts

- 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.

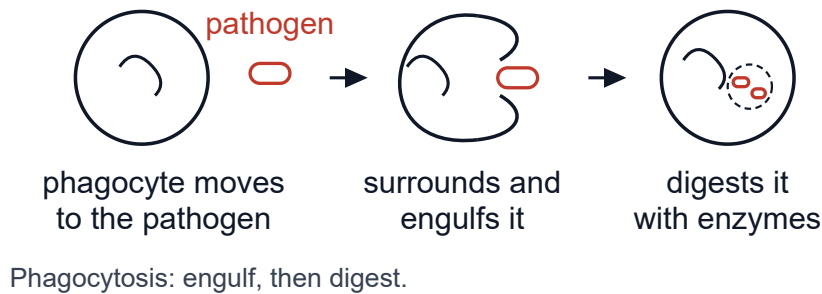


Mucus traps pathogens; cilia sweep it up to the throat.

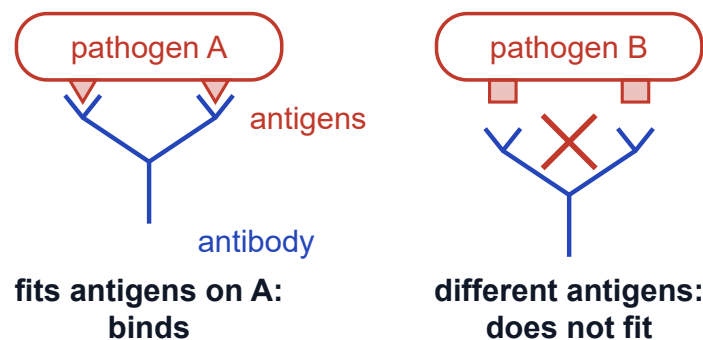
- **Stomach:** produces **hydrochloric acid**, which kills pathogens in food, drink and swallowed mucus.
- These defences are **non-specific**: they work against all pathogens.

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

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

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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