Hello, I'm Dr Alex Lathbridge and this is Bitesize Biology.

This is episode two in a six-part series on Infection and Response.
In this episode we're going to talk about the defence systems that humans have to protect against infection.

In the last episode we looked at the different types of pathogens that can invade our bodies and cells. Thankfully, our bodies have different defence systems to protect us from pathogens.

There are some defence systems that fight against all pathogens

Non-specific defence systems help protect against everything. These non-specific defence systems are either physical barriers or chemical barriers. We're going to look at the skin, the nose, the eyes, trachea, bronchi, and the stomach. So grab a pen and let's get into it.

First up, one you probably know, the skin.

The skin is your body's biggest organ. It covers nearly all of you to help protect against invading pathogens.

Imagine it like a huge blanket covering your organs and skeleton and muscles.

If your skin is cut, it can heal itself by forming a scab, so even when there is a hole in the blanket, it can repair itself and acts as a physical barrier from any infections getting in.

Your nose has hairs and mucus which act as a physical barrier to stop invading pathogens. (Yes the hairs and bogies up your nose actually have a purpose!) The hairs and mucus trap pathogens before they can get to the lungs, and so they can be blown out of the nose.

The eyes secrete tears, and those tears have enzymes in them, that destroy pathogens and other substances. This is an example of a chemical barrier.

Next is the trachea. That's the windpipe that runs from your nose towards the lungs. It is lined with cells that have tiny hairs called cilia. The cells waft the tiny cilia hairs, like a Mexican wave, which moves mucus and pathogens upwards towards the throat, where they can be swallowed and moved down to your stomach. This reduces the amount of pathogens entering your lungs.

There are also things known as goblet cells. They're in your trachea and bronchi and produce mucus which acts as a physical barrier to trap pathogens.

Finally, the stomach. Now this is the big one. It has hydrochloric acid in it, which is strong enough to kill nearly any invading pathogen, in food that's sent down to the stomach, or ones found in water.

This is a type of chemical barrier against infection.

So the physical barriers are the skin, nose, trachea and bronchi.

The chemical barriers are found in the eyes and the stomach.

But what if the pathogens are able to enter your cells? What happens then?

Fortunately, there's an immune system that has multiple ways to destroy pathogens or limit their effects.

I'm going to take you back over the basics and give you some easy tricks to remember the more difficult bits.

Here's what you need to know, so grab a pen:

The cells in your body are covered with little molecules known as antigens. These are unique to each of us (unless you're a twin.) Basically, antigens are ID cards that allow your body to tell your own cells from potentially harmful things that can trigger an immune response.

Cells in your immune system fight anything that they identify as being foreign. That means it's unknown because it has a foreign antigen. Be it nasty things like pathogens or potentially good things like transplanted organs, the immune system mounts a response to things that it sees as foreign.

This is where white blood cells come in.

There are two types of white blood cell that you need to know, phagocytes and lymphocytes.

Phagocytes literally engulf pathogens in a process called phagocytosis, which looks a little bit like a blob eating everything, and then breaking them down using enzymes. They're like the jack-of-all-trades and can basically deal with anything by engulfing and digesting them.

So if they detect a foreign antigen, that marker, that cell gets broken down, this is known as phagocytosis. Plus, they also signal other phagocytes to come over and help destroy the foreign body.

Phagocytes do this to all foreign bodies, so they are called non-specific.

The second white blood cell type that we're looking at are called lymphocytes.

Unlike phagocytes that engulf and digest non-specifically, lymphocytes are part of specific immune responses (I'll explain what this means).

There are two main categories of lymphocytes: B cells and T cells.

B cells produce proteins known as antibodies to fight pathogens. These are good, trust me. It sounds weird that they're called antibodies because it makes it sound like they're bad for your body but

they're not. I like to think that antibody is just short for "anti-foreign body."

The key thing to remember is that antibodies are specific to antigens. And remember, each pathogen has its own unique antigen on its surface, that ID card, so each antibody is unique.

These antibodies are complementary in shape to the antigen, like a lock and a key. So that's how they bind to them.

This allows them destroy pathogens in three ways:

By binding to the antigens on a pathogen, it can stop them from moving by clumping them together.

Then can also call over phagocytes which can destroy them by phagocytosis: engulfing and digesting.

Or the antibodies make the pathogens destroy themselves

But what about your body cells that have already been infected by the pathogen? What happens to them?

Alright but what about your body cells that have already been infected by the pathogen? What happens to them?

Thankfully, some of the lymphocytes stick around in the immune system, as things known as memory lymphocytes.

What this means, is that if you get infected by the same pathogen again, the lymphocytes are able to recognise those antigens and produce high quantities of the correct antibodies very quickly.

So this time the immune response will be a lot quicker and will be able to destroy the pathogen before symptoms arise. This is how vaccination works, but more on that in the next episode.

Two quick things to put this stuff into the real world for you, but you don't need this for your exams. First, allergies. If you're allergic to something, like dust, pollen, or nuts, etc, it means that your immune system is responding to a type of antigen that we call an allergen. Basically, it means your immune system is taking its job way too seriously and fighting off something harmless.

The second thing is that, if someone gets an organ transplant, it can be unsuccessful if the immune system sees the foreign cells as dangerous and starts attacking them. And this is known as organ rejection.

I'm Dr Alex Lathbridge and this is Bitesize Biology. Catch up on BBC sounds.