

Quiz Answers About Immune System

These questions & answers demonstrate a wide array of biology knowledge surrounding the body's immune system.

QUESTION:

People often talk about “strengthening their immune system,” but there are multiple organ systems that have to function properly to defend us against pathogens. Select three organ systems and explain the role they play in defending the body against pathogens.

ANSWER:

I will describe the roles the **integumentary**, **cardiovascular** and **skeletal** organ systems play in terms of defending our body from pathogens.

The **integumentary** system plays the most intuitive role, in that it keeps stuff (debris, pathogen, etc.) from just easily entering our body. While the integumentary system does contain openings (eyes, mouth, etc.) most of these openings come with the ability to secrete fluids to try and "wash away" any invading pathogens (like tears from our eyes). The most sophisticated secretion method is probably the mucus membrane in our trachea which in conjunction with the ciliated cells bring debris back up our windpipe.

However, the integumentary system of course can be breached, either by some lucky pathogens which manage to slip through our openings or from wounds on our skin allowing pathogens in.

Our **cardiovascular** and **skeletal** system function as a fail-safe for when pathogens do enter our body. A variety of white blood cells produced in our bone marrow circulates through our blood vessels hunting down any invading pathogens either through cell or antibody mediated immunity or in the case of an inflammation in response to some injury.

QUESTION:

In your own words or labeled sketch, describe each step of inflammation from wounded cells to clean-up by the white blood cells.

ANSWER:

1. **Damaged Cells Leak Chemical Signals:** Already, so basically, we start off with the immediate aftermath of some type of injury (e.g. paper cut or accidental knife mishap). When our integumentary system gets breached, we have a lot of cells which are injured. Wounded cells will leak out chemical signals like **histamine** or **cytokines** which notify our body about the injury.

2. **Vessels Dilate:** In response to the chemical signals our blood vessels expand resulting in blood flooding the infected area. Flooding the wound serves a two prong function, foremost it carries with it an increased concentration of white blood cells and other useful material like **platelets** which form a blockage to close out the wound and prevent more debris from entering the body, additionally white blood cells are brought into the wounded area.

3. **White Blood Cells go to work:** We have a variety of white blood cells which prefer different functions in this scenario. We have a variant of **lymphocytes** called "**natural cell killers**" which release chemical signals to destroy the plasma membrane of wounded cells. However, this isn't super precise and as such leaves additional debris from left over cellular material and also results in some collateral damage in killing off nearby healthy cells.

To clean up the mess left over by the lymphocytes we have two other types of white blood cells, **neutrophils** which expand out into larger **phagocytes** which eat up smaller debris left over from the injury along with **monocytes** which expand into even larger **macrophages** which eat up larger debris and, if lucky, may stumble upon and consume invading viruses or bacteria.

These **macrophages** additionally play a critical role in identifying **antigens**, unique chemical markers on the surfaces of viruses, whose information they relay to **helper t-cells**, another variant of lymphocytes, which in turn inform other lymphocyte variants (immature B & T cells). This kicks off the secondary process of eliminating any pathogens which sneaked past the **macrophages** during the inflammation response.

4. **Stuff eventually returns to regular functioning:** At some point, assuming it wasn't like a extreme fatal wound cells will undergo mitosis and replace what they can, and the body keeps going along.

QUESTION:

HIV that causes AIDS and the *Yersinia* bacteria that cause the plague attack two critical cells of the immune response. Explain which cell type each pathogen attacks and why these cells are an important part of our defenses.

ANSWER:

Both these pathogens are incredibly deadly due to their ability to fundamentally disrupt our immune system's ability to hunt down entering pathogens by destroying kill cells. The *Yersinia* bacteria was incredibly deadly because it could destroy **macrophages** which serve a fundamental role in not only cleaning debris from wounds, but also in identifying the **antigens**, the unique chemical identifiers of pathogens. Without the **macrophages** collecting data on the **antigens** there's no way for the body's other pathogen killing cells, specifically B & T cell lymphocytes from being able to identify and kill the invading bacteria. As such the *Yersinia* bacteria is able to easily proliferate in the human body.

HIV destroy another type of cell critical in relaying the antigen information, in the form of **Helper T-Cells**. Helper T-Cells are a variant of lymphocytes which mature in the **thymus** and

can collect antigen data from **macrophages** and relay the data to **immature B & T cells** respectively.

These immature cells either become **Memory** or **Cytotoxic T cells** if they were immature T Cells, or they become **Memory** or **Plasma B cells** if they were immature B cells. The Cytotoxic T cells kill off any infected cells whereas the Plasma B cells produce antibodies to trap any rogue pathogens.

Both the memory cells store the information about the antigens and upon the reappearance of a pathogen via reinfection immediately undergo mitosis to produce more Plasma B cells or Cytotoxic T cells respectively.

Without Helper T-Cells or Macrophages our ability to identify and destroy rogue cellular material is incredibly impaired and results in a much-weakened immune system.