

## The Basics of Immunity

Everything is made of *molecules*. The types, locations and quantities of something's molecules determine whether it is a desk, a tree, or a chimpanzee, for example. Some molecules are unique to certain life forms, and these unique molecules are called *antigens*. Antigens are like fingerprints: every different type of antigen has a characteristic shape. Animal, plant and bacterial cells and viruses are covered with antigens.

We would like to keep our bodies free of harmful bacteria and viruses, because when they enter uninvited, we can get sick or die. And these nasty microbes are always trying to get in. Luckily, our bodies know every type of antigen that belongs there, and can tell if an antigen has entered from outside the body. Our immune system does this work, identifying and fighting infections.

Our bodies recognize foreign antigens by process of elimination. As the white blood cells swim through our blood, they are exposed to all of the antigens present in the body. And while they don't mind seeing antigens that are normally present, if a molecule with a strange antigen shows up, the white blood cell will freak out and call for backup. To do so it releases chemical signals that will warn the other white blood cells that the body is in danger. This is the first shot of a war, and the invading troops are microbes fighting to set up a disease occupation!

In calling for backup, this white blood cell, or *macrophage* (MACK-row-fazh) takes a piece of incriminating evidence from the invader. It actually gobbles up the microbe entirely, and passes on a mug-shot to its fellow white blood cells, in the form of a piece of the invader. This mug-shot includes an antigen from the invader, so that other cells will know the microbe when they see it. So, a better analogy might be to say that the macrophage cuts a finger off of the invader, and passes it around so the other white blood cells can see the fingerprint. The immunity "wanted posters" have now been put up through-out the body. Also, all of the microbe's friends have the same antigen/fingerprint, so they too will be recognized by the counter-attack.

Our bodies' counter-attack uses 2 strategies to kill or capture the invading microbes, both recognizing the enemies by their antigens. One strategy is *cellular*, for

which an army of various types of white blood cells is mobilized, some of them seeking out and attacking the microbes directly, or destroying the human cells that are themselves occupied by the microbes. The other, *humoral* strategy involves the production of *antibodies* by other white blood cells. Antibodies are small molecules that circulate through the blood, looking for the antigen that they are designed to attack. In some ways they are like homing missiles, programmed to target the invading microbes by looking for their unique antigen. When the antibody finds the antigen, it holds on tightly to it. This binding can cause the microbe to clump together with other antibody-bound microbes to be destroyed later, or the antibody might just disable the microbe if the antigen is part of an important molecule. Hopefully, soon all the invading microbes will be destroyed.

The most important aspect of this active immunity is *memory*. Now that the body has gotten a good look at the microbe, it will recognize that microbe in the future and react much more quickly to it. At the cellular level, certain white blood cells will continue to hunt for those microbes' antigens for years to come. Historically, this immunity enabled people who had previously survived the Black Plague to care for those who were currently infected. However, the same type of microbe could disguise itself and launch another all-out invasion, simply by changing its antigen to an unrecognized form.

**Antigen:** A molecule that can activate an immune response. These molecules are unique to an organism and are used to recognize “self” from “non-self”. For instance, in the human body, a red blood cell will be recognized as “self”, while a virus will be recognized as “non-self”.

**White blood cell:** Cells in the bloodstream that are responsible for the recognition of and retaliation against microbe invasions. They can directly attack microbe cells or infected host cells (*cellular response*) or produce antibodies (*humoral*) to fight infections.