

Antigens and Antigen Processing

An **antigen** is any molecular pattern that is capable of binding a T-cell receptor (TCR), a B cell receptor (BCR) or an antibody. Sometimes, an antigen binding these receptors will not necessarily elicit an immune response. An **immunogen** is an antigen that can trigger an immune response. These definitions explain that immunogens are always antigens, but antigens are not always immunogens.

Some molecules are too small to elicit an immune response and must be combined with something larger to become an immunogen. These small molecules are called **haptens**. A common example of a hapten is penicillin. Some of the molecular patterns of penicillin are not large enough to cause an immune response, so they must be combined with something else to be considered an immunogen. This “something else” is most often a protein found naturally in our body. Since humans tend to have slight variations on our proteins, antigens and haptens do not always trigger an immune response in everyone. This is why only some people are allergic to penicillin and some are not.

The antigenic determinant or **epitope** of an antigen is its specific molecular pattern that is bound by a specific antigen receptor (TCR, BCR or antibody). This binding only occurs if the epitope and the antigen receptor are complementary and fit together like pieces of a puzzle. If the antigen is complex, it can have many antigenic determinants that can elicit a response from several different receptors or antibodies.

The term major histocompatibility complex (MHC) was mentioned earlier in the chapter when we discussed positive and negative selection of T-cells. What are MHCs? MHCs are antigen presenting glycoproteins that exist on the membrane of our cells. There are two major types of MHCs in the body: MHC-I and MHC-II. MHC-I are expressed by all nucleated cells in the body and present endogenous antigens that originate from within the cell itself. These antigens include self-proteins and foreign proteins produced in the cell, like viral proteins expressed when a virus has taken over the cell. On the other hand, MHC-II proteins are only expressed by antigen-presenting cells (APCs). Antigen presenting cells are cells capable of engulfing foreign particles and expressing a portion of them on their membrane via MHC-II. Examples of antigen presenting cells are macrophages, dendritic cells, and B-cells. MHC-II glycoproteins expressed on these APCs present exogenous antigens that originated extracellularly. Our adaptive immune response is initiated through this processing and presentation of foreign materials by antigen presenting cells.

While MHC genes are found in many different species, the MHC genes that occur in humans are given a specific name. We call them human leukocyte antigen (HLA) genes. In other words, HLAs are a subtype of MHCs particular to humans. The three major MHC-I genes for humans are HLA-A, HLA-B and HLA-C. The three major MHC-II genes for humans are HLA-DR, HLA-DP and HLA-DQ.



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