IMMUNOLOGY

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Lac.No. 4

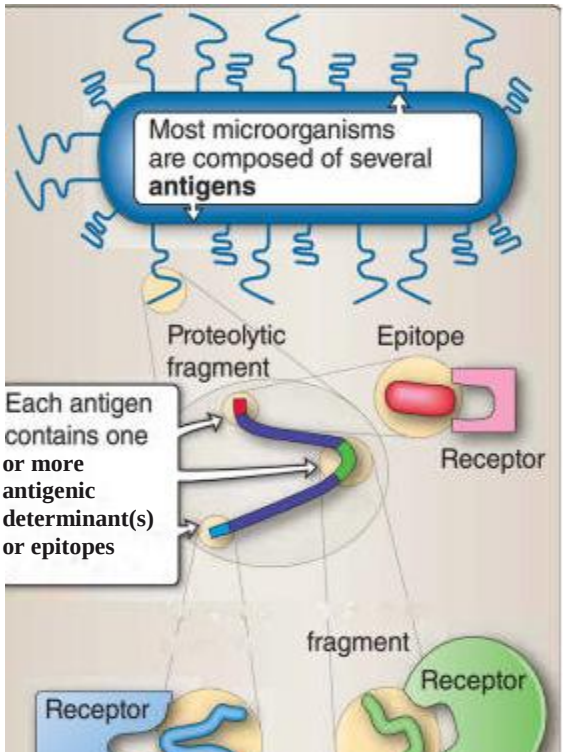
ANTIGENS

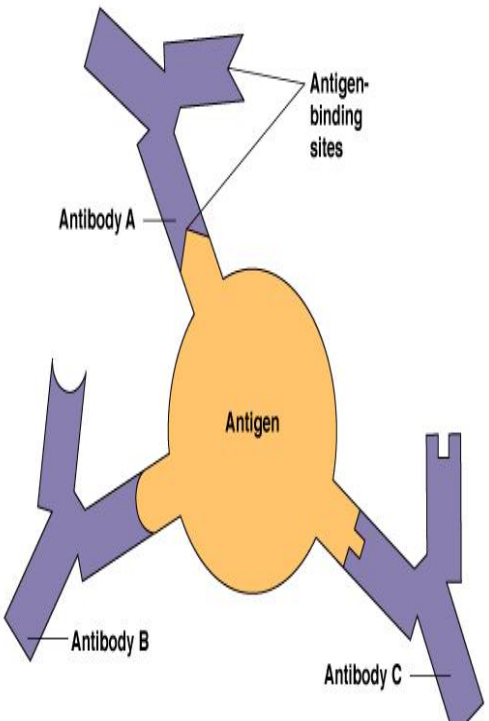
Classically, an antigen is defined as an organism, a molecule, or part of a molecule that is recognized by the immune system . Antigens may be simple or complex, protein, carbohydrate, or synthetic in origin. Often, the term is associated primarily with those molecules recognized by the extremely diverse receptors found on T and B lymphocytes.

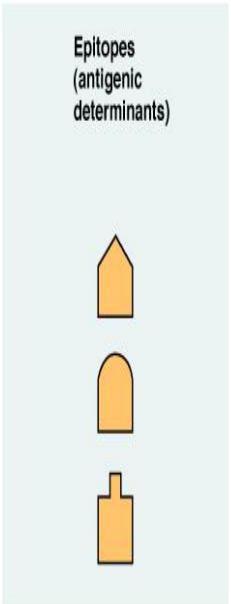
Epitopes.

Antigen receptors recognize discrete regions of molecules called **antigenic determinants or epitopes**,(large protein molecules sequences of 10 to 25 amino acid) the smallest part of an antigen that is "seen" by somatically generated B- and T-cell receptors, Different lymphocytes, each with a unique set of receptors, may recognize different epitopes on the same antigen. A cell will usually have many macromolecules on its surface each with a number of different epitopes.

Depending on the nature of the immune responses they trigger, antigens/epitopes are divided into three broad functional types: immunogens, haptens, and tolerogens.





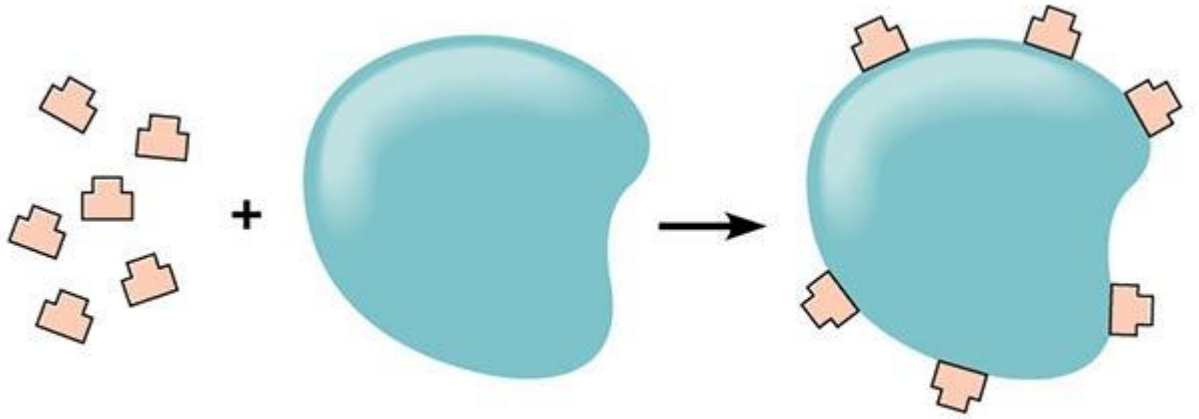


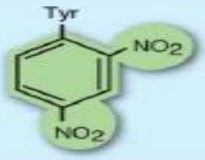
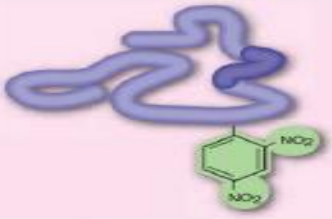
1- lmmunogens

lmmunogens contain epitopes that both induce an immune response and are the targets of that response. lmmunogens contain epitopes that both induce an immune response and are the targets of that response . The amount of the immune response by the innate system is the same, no matter how many times it encounters the same immunogen. In contrast, reexposure of the adaptive immune system to the same immunogen usually increases the intensity of the epitope-specific immune response.Although epitopes on antigens may bind to soluble or cell-surface receptors, not all antigens are immunogens.
NOT*. the terms "antigen" and "immunogen" are often used interchangeably. we use the term "immunogen" to mean a substance or antigen that evokes a specific, positive immune response and the term "antigen" to mean a molecule or cell recognized by the immune system .*

2- Haptens

Haptens are small , normally nonimmunogenic, molecules, usually of nonbiologic origin, that behave like synthetic epitopes. Haptens are antigens and can bind to immune receptors but cannot by themselves induce a specific immune response and hence are not immunogenic. However, when a hapten is chemically bound to an immunogen (also called a **carrier**) , immune responses may be generated against both the hapten and the epitopes on the immunogen.
NOT. *Penicillin has a molecular weight 350 D and is a hapten that by itself is incapable of causing immune response. In the body the penicillin is changed by enzymes so that can combine with large protein carrier molecules and causing immune response allergic reactions.*



Injection				nt
Immunogen or carrier		Yes	Not applicable	An injected protein (sometimes called a carrier) that elicits an immune response is called an immunogen
Synthetic epitope or hapten		Not applicable	No	Injection of a synthetic molecule, in this case 2,4-dinitrophenyltyrosine, by itself does not elicit an immune response and is called a hapten
Hapten–Carrier conjugate		Yes	Yes	Injection of a hapten chemically bound to a carrier elicits an immune response to both carrier epitope(s) and to the hapten
Hapten NOT conjugated to carrier		Yes	No	Injection of unconjugated hapten and carrier does not elicit a response

3- Tolerogen

A substance that invokes a specific immune non-responsive due to its molecular form. If its molecular form is changed, a tolerogen can become an immunogen.

Immunogenicity

1- Size: molecules greater than 10 kDa are usually more immunogenic.

2- Complexity: proteins and polysaccharides generally induce a strong response.

***NOT**. Complex proteins with numerous, diverse epitopes are more likely to induce an immune response than are simple peptides that contain only one or a few epitopes.*

3-Foreign (not recognizable as self)

NOT. Antigen may be virtually any substance recognized by individual's body such as bacterial cell, fungi, plant pollen, drugs, foods. For example red blood cells from other people may recognized as having foreign epitopes and be destroyed by the recipients immune system in transfusion reaction.

Adaptive immunity, specific immunity or acquired immunity

Adaptive immune responses are especially important for defense against infectious microbes that are pathogenic for humans (i.e., capable of causing disease) and may have evolved to resist innate immunity. Whereas the mechanisms of innate immunity recognize structures shared by classes of microbes, the cells of adaptive immunity (lymphocytes) express receptors that specifically recognize a much wider variety of molecules produced by microbes as well as noninfectious substances. Any substance that is specifically recognized by lymphocytes or antibodies is called an antigen. Adaptive immune responses often use the cells and molecules of the innate immune system to eliminate microbes, and adaptive immunity functions to greatly enhance these antimicrobial mechanisms of innate immunity. For example, antibodies (a component of adaptive immunity) bind to microbes, and these coated microbes avidly bind to and activate phagocytes (a component of innate immunity), which ingest and destroy the microbes.

***NOT**. The adaptive immune system consists of lymphocytes and their products, such as antibodies.*

TYPES OF ADAPTIVE IMMUNITY

The two types of adaptive immunity, called humoral immunity and cell-mediated immunity, are mediated by different cells and molecules and provide defense against extracellular microbes and intracellular microbes, respectively

Humoral immunity

is mediated by proteins called antibodies, which are produced by cells called B lymphocytes. Secreted antibodies enter the circulation and mucosal fluids, and they neutralize and eliminate microbes and microbial toxins that are present outside host cells, in the blood, extracellular fluid derived from plasma, and in the lumens of mucosal organs such as the gastrointestinal and respiratory tracts. One of the most important functions of antibodies is to stop microbes that are present at mucosal surfaces and in the blood from gaining access to and colonizing host cells and connective tissues. In this way, antibodies prevent infections from ever being established. Antibodies cannot gain access to microbes that live and divide inside infected cells.

Cell-mediated immunity

Defense against such intracellular microbes is called cell-mediated immunity because it is mediated by cells, which are called T lymphocytes. Some T lymphocytes activate phagocytes to destroy microbes that have been ingested by the phagocytes into intracellular vesicles. Other T lymphocytes kill any type of host cells that are harboring infectious microbes in the cytoplasm. In both cases, the T cells recognize microbial antigens that are displayed on host cell surfaces, which indicates there is a microbe inside the cell.

***NOT**. The specificities of B and T lymphocytes differ in important respects. Most T cells recognize only protein antigens, whereas B cells and antibodies are able to recognize many different types of molecules, including proteins, carbohydrates, nucleic acids, and lipids.*