

1 Adaptive Immunity

Adaptive immunity has specificity and memory

→ Primary mechanism for differentiation self vs. foreign antigens

⇒ Must determine if a pathogen is foreign and harmful (pathogenic) vs foreign and non-harmful (non-pathogenic)

Innate immunity is always the same while the adaptive response can change

Primary Infection

Takes a few days (3-7 days) to initiate T and B cells against antigens must be activated and expanded (proliferate) in spleen or lymph nodes

Secondary Infection

Adaptive response happens more quickly (1-3 days) because of adaptive immune memory cells

3 Tools of the Adaptive Immune Response

1. Antibodies made by B cells
2. Cytokines made by T helper cells
3. Killing of infected cells by cytotoxic T cells (CTLs)

B Cell Mediated Immunity

Antibodies produced by B-cells interact with pathogens and their toxic products in the blood or other extracellular spaces of the body

Main function of B cells is to produce antibodies

→ B cells are the only cells capable of producing antibodies

T-Cell Mediated Immunity

T cells only recognize antigens as a small peptide fragment (peptide) bound to an MHC molecule and displayed at the cell surface

Cytotoxic T Cells

Kill virally-infected cells

T helper Cells

Produce cytokines

→ Main regulators of adaptive immune responses

Needed for:

1. B cells to produce antibodies
2. Cytotoxic T cells in order to become maximally effective killers
3. Macrophages to kill off pathogens inside

Antibody Structure

Antigen Binding Region

One part of ab (Fab) binds specifically to antigens (pieces of pathogens)

The Fab part is highly variable (10^{11} different antibodies)

But the Fc (Effector function) part is the same across all humans

An individual B cell only produces a single type of antibody

Each antibody has the specific ability to bind only one antigen

Antibody Isotypes

Determined by constant region (Fc)

Only a handful of different constant regions that can be found on antibodies and they result in different “types” or isotypes of antibodies

4 main antibody types

1. IgM
2. IgG
3. IgA
4. IgE

Functions of Antibodies

1. Neutralization: Antibodies bind to antigens and block toxic function
2. Opsonization: Fc of antibody binds to FcReceptor on phagocytic cell to provide enhanced uptake
3. Complement Activation: Complement protein binds to Fc receptors
 - Leads to increased uptake: opsonization
 - Full complement pathway activation leads to cell lysis of pathogen or infected cell by pore formation

Pathogens have many antigens → Antigens have many epitopes

→ Each antibody binds to a single epitope

Major Histocompatibility (MHC)

Displays fragments of pathogens on the surface of host cells

Dendritic cells, B cells, and macrophages present antigens to T helper cells (professional antigen presenting cells)

DCs and macs engulf pathogens by phagocytosis, digesting it, and presenting it on cell surface

MHC Restriction

T cell receptor only recognizes antigen in the “context of” self MHC

MHC restriction: the fact that a peptide can only be recognized by a given T cell if it is bound to a particular self-MHC