Adaptive Immunity and Immune Recognition

Learning Outcomes

- Outline the features of the adaptive immune response and recognise the different roles of T cells, B cells and their corresponding cell subsets
- Know and define immune recognition terms including antigen, epitope and immunogen
- Understand the key differences between innate and adaptive immune recognition
- Describe the basics of antigen recognition (T cell receptor versus Immunoglobulin)
- Understand immunoglobulin (antibody)-antigen interactions

Overview of the Adaptive Response

The adaptive immune response is a relatively recent evolutionary development, primarily found in higher-order complex organisms. As organisms become more complex, they require specialized mechanisms to protect against various infections and microorganisms. This response is highly specific, targeting particular parts of antigens, but it is slower to develop compared to the innate immune response.

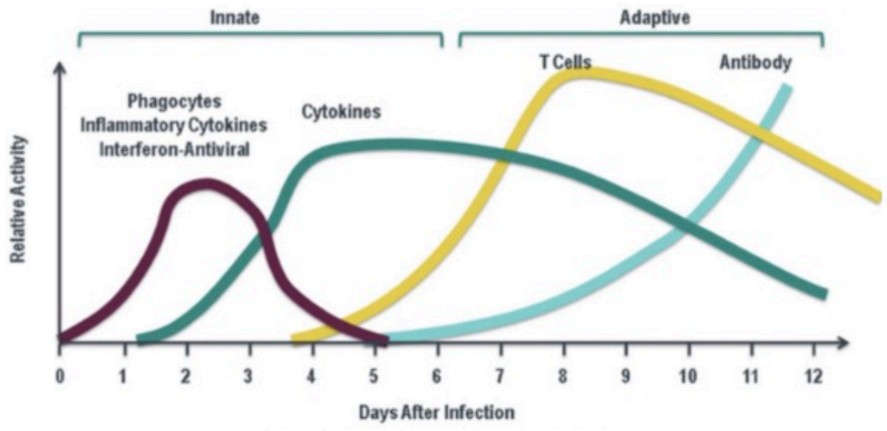
One of the hallmarks of the adaptive immune response is the formation of immunological memory. This allows for a faster and more effective response upon subsequent encounters with the same pathogen, typically taking only a few days instead of a week.

Initiation of the Immune Response

The adaptive immune response is triggered by the presence of foreign, non-self entities, which activates the innate immune response. Key components of the innate response include:

- Phagocytes that engulf pathogens
- Production of inflammatory cytokines
- Interferon, crucial for combating viral infections

Over time, these innate responses lead to the activation of adaptive immune cells, typically taking about a week for the adaptive response to begin.



Components of the Adaptive Immune Response

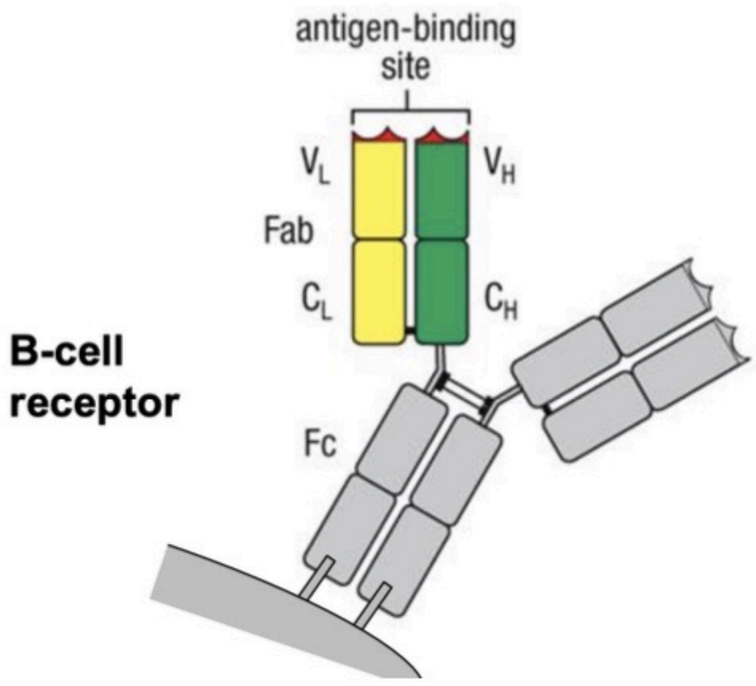
The adaptive immune response consists of various components:

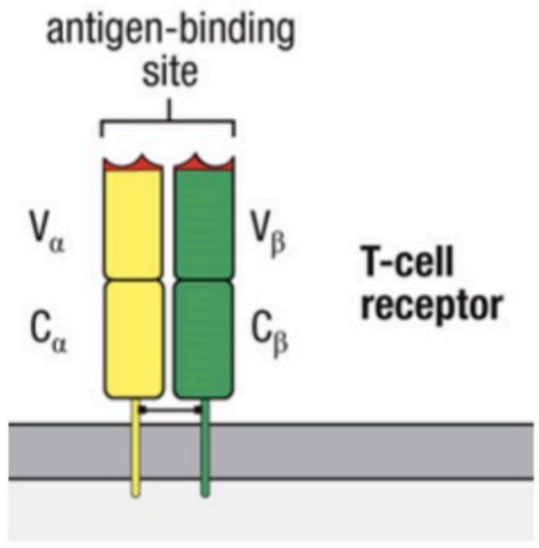
- **Antibodies:** Soluble factors produced by B cells that target specific antigens.
- **Cytokines:** Soluble factors that drive the adaptive response.
- **Cell-associated factors:** Surface proteins like B cell receptors, T cell receptors, and major histocompatibility complex (MHC) molecules that facilitate recognition and response to antigens.

Types of Lymphocytes

The two main classes of lymphocytes involved in the adaptive response are:

- **B Lymphocytes:** Responsible for antibody production and memory formation. They are divided into:
  - B2 B cells: Generate memory and respond to antigens.
  - B1 B cells: Provide a rapid response (IgM) early in life but do not form memory.
- **T Lymphocytes:** Include:
  - Helper T cells: Assist in activating B cells and other immune responses.
  - Cytotoxic T cells: Directly kill infected cells.
  - Semi-invariant T cells (NKT, MAIT), γδ T cells





Subsets of Helper T Cells

Helper T cells are categorized based on the cytokines they produce:

- T helper 1 (Th1): Involved in cellular immunity.
- T helper 2 (Th2): Associated with humoral immunity.
- T helper 17 (Th17): Produces interleukin 17, important for inflammation.
- T follicular helper (Tfh): Activates B cells.
- Regulatory T cells (Tregs): Modulate and suppress other T cell responses.