Chapter 17 Adaptive Immunity: Specific Defenses of the Host

The adaptive immune system
- Adaptive (specific) immunity - ________, and ________ to a microbe or foreign substance
- Has ______________ component, major difference from innate immunity

Dual nature of the adaptive immune system
- Two components to adaptive immunity:
  - ______________ immunity – immunity mediated by ______________
  - ______________ immunity – immunity mediated by ______________
    - ___ cells and ____ cells

Antigens and antibodies
- Antigens – ___________ or ______________ that stimulate the immune system
  - Microbial antigens are often capsules, cell walls, flagella, fimbriae, toxins, viral coats
  - Nonmicrobial antigens include pollen, egg white, surface molecules of cells & tissues
- Antigens are recognized by ______________

The nature of antibodies
- Antibodies are aka “______________” (Ig)
- Antibodies are made in response to an ______________
  - ___________ and ___________ to an antigen

Antibody structure
- Antibodies are “Y-shaped” proteins
- Two arms of “Y” are called “______________ (___) regions”
  - ___ sites
- Stem of “Y” is the “______________ (___) region”
  - Constant = _________________ for a particular Ig class

Immunoglobulin classes
- 5 Ig classes
  - IgG, IgM, IgA, IgD, IgE
- Each has different role in immune response
- IgG
  - Monomer
  - Most _______________, 80%
  - Roams ________________, _________ and __________
  - Protect against ___________ and viruses, toxins, enhance _________________
  - Can cross into _____________ (protects fetus in womb)
  - _____________-lived
- IgM
  - 5 - 10%
  - Pentameric (5 monomers), stays in _________________ (too large)
  - _________ antibody produced in response to _____________, short-lived
    - Used in _________________ pathogen in _____________ stages of infection
  - Effective in _________________ (clumping) antigens, enhance _______________
- IgA
o 10 – 15%
o Most common form in ______ membranes and body _______ (mucus, saliva, tears)
o Usually a dimer (2 monomers)
o Prevent __________ of microbial pathogens to __________________________
  ▪ Especially respiratory infections
o __________-lived, so protection against respiratory pathogens is __________-lived
• IgD
  o 0.2%
  o No well-defined function
• IgE
  o 0.0002%
  o Bind to __________ cells, __________
  o Involved in ________________ reactions
    ▪ Simulates ________________ release
  o Attracts ____________ cells, causes ________________
  o Bind to ________________

B cells and humoral immunity
• Protection mediated by _________________
• Produced by ________________
• Production of antibodies starts with exposure to “____” or ” ________________” antigens
  Clonal selection of antibody-producing cells
• B cells carry ________________ on surface
  o 100,000+ antibodies, all bind to same ______________
  o Each B cell (antibody) binds to ________________ antigen
• ____________ of antigen “______________” B cell
  o B cell undergoes “__________________” (proliferation, cell division)
  o Clones are ______ to each other → carry ____ antibody as ______ B cell
  o Most clones become “__________ cells” → __________ producers
  o Some clones become “__________ cells” → ______-lived, provide ____________
• T-dependent antigens – require “helper T cells” (_____) to ____________ B cells
  o Generally ______________ immune response than …
• T-independent antigens – activate B cells without ________________
• B cells are capable of creating virtually an ______________ number of ____________ antibodies
  o Provides protection against ________________
• Any B cell that reacts against “______________” (own body) is ________________

Antigen-antibody binding and its results
• Antigen-antibody complex – antibody ______ to antigen
• Antibody binding is highly ________________
  o Bind to ________ antigen
• Antibody-antigen binding results in:
  o Agglutination
    ▪ __________ number of particles to ______________
    ▪ Enhances ________________
Opsonization
  • Opsonization of phagocytosis

Antibody-dependent cell-mediated cytotoxicity
  • Mediated by cells that remain ____________ to target cell

Neutralization
  • Inactivation of viruses, toxins by blocking ________________

Activation of complement
  • Causes ________________, cell ________________

**T cells and cellular immunity**

- ________________ antigens (viruses, some bacteria) are not exposed to antibodies
  - ________________ defense mechanisms

- T cells help combat ________________ pathogens
  - Also recognize “____________” cells – cancer cells, foreign tissue

- T cells specific to unique antigens via “______________” (TCR)

- Found in ________________ tissue, most likely to encounter antigens

- T cells recognize antigens processed by “______________” (APC)
  - Include ________________, ________________ cells
  - APC ________________ antigen, process it, put it on ________________
  - “______________” to T cells in lymph tissues

- Response of T cells depends on class of T cell activated

**Classes of T cells**

- Helper T cells, Th
  - Activated Th cells ________________ immune response
  - Release ________________ that ________________, activate macrophages, NK cells, Tc
  - ________________ (large parasites), ________________ (antibodies)

- Cytotoxic T cells, Tc
  - When activated, Tc become “______________” (CTL)
  - CTL ________________ and kill ________________ target cells
    - Often cells infected by ________________, ________________ cells, foreign tissue
  - Kill by inducing ________________ → programmed cell death
    - Cell essentially ________________, ________________
    - Easier to cleanup, less ________________ than cell ________________
    - Doesn’t further ________________
    - Remains digested by ________________
  - Prevents spread of viruses, intracellular pathogens

**Extracellular killing by the immune system**

- _______ cells, ________________ attack large parasites
  - Too _______ to phagocytose
  - ________________ around parasites

- Kill like ________, induce ________________

- _______ cells can also attack any “______________” cell
  - _______ cells, ________________ infected cells
  - Non-______________
Cytokines: Chemical messengers of immune cells

- Immune cells _______________ with each other via _______________
  - All immune cells make them
  - _______________ cells are important producers
- Interleukins – cytokines that serve as _______________ between _____ (leukocytes)
  - Interleukin-1 (IL-1) – _______________ T\textsubscript{H} cells
- Chemokines – induce _______________ of ___________________ to area of infection
  - IL-8 – attract immune cells, phagocyte
- Interferons – protect against _______________ cells
- Alpha-tumor necrosis factor (\(\alpha\)-TNF) – important in _______________, toxic to tumor cells

Immunological memory

- Antibody titer – _______________ of _______________ in serum
  - Indicator of _______________ of _______________ response
- Initial exposure to antigen elicits “_____________ response”
  - No antibodies for ________ days
  - ________ rise in antibody titer
    - First IgM, then IgG
  - Peaks in about ________ days
- Second exposure to antigen is much more intense
- “Secondary response” is also called “_____________”
  - Reaches peak in ________ days
  - Lasts _______________
  - ________ in magnitude
- Similar response with T cells