Review of the Immune System

View the animation:  [Viral Infection]

Discussion Questions:

- Describe the structure of a virus.
- Describe the interactions between the virus and the host cell at the cell membrane, in the cytoplasm, and in the nucleus.
- How does the virus invade additional cells?

Web Quest: [Immune System Self Quiz]
Applications of the Immune System

Discussion Questions:

Why can’t certain blood types be mixed during a transfusion or transplant?

Why doesn’t the body of a pregnant woman reject the fetus?
Cells of the Immune System

Source: http://www.biologymad.com/
Reviewing the Cells of the Immune System

- Erythrocyte
- Lymphocyte
- Basophil
- Eosinophil
- Neutrophil polymorph
- Monocyte
Lymphocytes of the Immune System

- **B Lymphocytes:**
  - Immunocompetency occurs in bone marrow
  - Produce Antibodies
  - Conduct Humoral Immunity

- **T Lymphocytes:**
  - Immunocompetency occurs in thymus
  - Non antibody producing cells
  - Conduct Cellular Immunity

www.academic.brooklyn.cuny.edu/biology/bio4f/v/page/aviruses/cellular-immune.html
Lymphocyte Maturation

Antibody Mediated Immunity
- B Cells Mature in Marrow
  - Identify Antigens
    - B Cells Replicate to form Plasma cells
      - B Memory Cells
      - Release Antibodies

Cell Mediated Immunity
- Stem Cells of the Bone Marrow
  - Released into blood, spleen, lymph
    - Macrophages carry foreign cells to T Helper cells
      - T Helper cells (Th) produce proteins
        - Secrete Interleukins
          - Replicate Cytotoxic (killer) T (Tc) Cells
            - Effector Tc Cells
            - Stimulates Phagocytosis
      - Secrete lymphokines
        - Tm Memory Cells
Forms of Immunity

- **Antibody Mediated Immunity**
  - Helper T cells recognize **non self** antigens and stimulate B cells to produce antibodies
  - B cells release antibodies which bind to **non self** antigens present on infected cells
  - B cells complete their maturation upon binding to **non self** antigens and destroying infected cells

- **Cell Mediated Immunity**
  - Macrophages phagocytize pathogens
  - Upon phagocytosis macrophages present **non self** antigens on their membranes
  - Helper T cells recognize **non self** antigens and recruit cytotoxic T cells
  - Cytotoxic T cells destroy infected cells
Antibody Mediated Immunity

- Animation of Antibody Mediated Immunity

- What kind of cell does the macrophage activate in the humoral immune response?

- What occurs during the effector phase of the humoral response?

http://press2.nci.nih.gov/sciencebehind/immune/immune00.htm
Cell Mediated Immunity:

http://press2.nci.nih.gov/sciencebehind/immune/immune00.htm
What happens when the body’s lymphocytes fail to recognize its own cells and tissues as such?
Autoimmune Diseases

- Failure of autoantibodies and T cells to recognize own cells

- Autoantibodies and T cells launch attack against own cells

- Perhaps due to overactive or an overabundance of helper T lymphocytes
Diagnosis: Autoimmune Disease

- Genetic predisposition
  - coding for the variety of MHC molecules
- Demographics
  - most common among middle aged women
- Additional viral infections
- Disease specific environmental factors
- Aging, stress, hormones, pregnancy
Possible Causes:
- Inefficient lymphocyte programming
- “Self proteins” circulate without having been exposed to system
  (ex: sperm, eye lens, thyroid)
- Reactions between self-antigens and antibody production against foreign antigens

Potential Treatments:
- Control inflammation
  (ex: diabetes mellitus)
- Immunosuppressive Medication
  (ex: corticosteroids, cyclosporin, methotrexate)
- Therapeutic Antibodies against specific T cell molecules
  (with fewer side effects)
Focus of Scientific Research:

According to the NIAID:

- Studies of the immune system during disease progression
- Analysis of genetic expression of autoimmune disease
- Role of infectious agents
- Studies on animal models
- Effects of therapeutic intervention
Examples of Autoimmune Diseases

Multiple sclerosis
Myasthenia gravis
Crohn’s disease
Grave’s disease
Type 1 Diabetes mellitus
Rheumatoid arthritis
Psoriasis
Scleroderma
Systemic lupus erythematosus
Focus of Student Research:

- Research a specific autoimmune disease relative to one of the systems studied this year in A&P. Design a PowerPoint presentation that includes:
  - Causes of Disease- identify molecules involved
  - Symptoms of Disease- identify effected cells, tissues, and organs
  - Treatments
  - Current Research
  - Statistics and Prognosis
Massachusetts State Standards:
resource www.doe.mass.edu

- 2.1 Relate cell parts/organelles to their functions.

- 3.9 Recognize that while viruses lack cellular structure they have the genetic material to invade living cells.

- 4.1 Explain how major organ systems within humans have functional units with specific anatomy that perform the function of that organ system.

- 4.2 Describe how the functions of individual systems within humans are integrated to maintain homeostatic balance within the body.
National Standards:
resource www.mcrel.org

- Knows the structures of different types of cell parts (e.g., cell wall; cell membrane; cytoplasm; cell organelles such as the nucleus, chloroplast, mitochondrion, Golgi apparatus, vacuole) and the functions they perform (e.g., transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal).

- Understands the chemical reactions involved in cell functions (e.g., food molecules taken into cells are broken down to provide the chemical constituents needed to synthesize other molecules; enzymes facilitate the breakdown and synthesis of molecules).

- Knows how cell functions are regulated through changes in the activity of the functions performed by proteins and through the selective expression of individual genes, and how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division.

- Knows that the complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism.

- Understands the processes of cell division and differentiation (e.g., meiosis, mitosis, embryo formation, cellular replication and differentiation into the many specialized cells, tissues, and organs that comprise the final organism; each cell retains the basic information needed to reproduce itself).
Resources:

- www.biology.arizona.edu/immunology/tutorials/immunology/main.html
- www.biologymad.com
- www.cdad.com/nih/immune2/index.html
- www.hhmi.org/biointeractive/disease/animations.html
- www.mayoclinic.com
- www.micro.msb.le.ac.uk/MBChB/2a.html
- www.northarundel.com/aniplayer
- www.ntri.tamuk.edu/immunology/blood.html
- www.nci.nih.gov/sciencebehind/immune/immune00.html
- www.whfreeman.com/kuby/index.html