Notes: The Blood and Lymphatic System

Composition of Blood and their Functions

- **Red Blood Cells (aka ____________)**
  - **Structure**
    - Do not have a ____________ like other cells do
    - Contain a specialized protein called ____________
      - Hemoglobin contains iron which facilitates the transport of ____________ and ____________
  - **How healthy are your RBCs?**
    - Perform a Complete Blood Count or Full Blood Count
      - Take different measurements and compare them to the rest of the hematocrit
    - **Mean Corpuscular volume (MCV):** measures the average volume of cytoplasm in a RBC
    - **Mean Corpuscular Hemoglobin (MCH):** measures the mass of hemoglobin in each RBC
    - **Mean Corpuscular Hemoglobin Concentration (MCHC):** measures the concentration of hemoglobin in an average RBC; look at intensity of the red color.
  - **Blood Type**
    - Different blood types exist because there are different ____________ on the blood cells called ____________; can be classified as either A, B, and D.
    - ____________ classifies people with varying proteins (A or B) on their red blood cells
      - ____________ has the A protein on the blood cell; also have B antibodies
      - ____________ has the B protein on the blood cell; also have A antibodies
      - ____________ has both A and B proteins on the blood cell; has no antibodies
      - ____________ has neither the A or B protein on the blood cell; have both A & B antibodies

<table>
<thead>
<tr>
<th>ABO Blood Types</th>
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<tbody>
<tr>
<td>Erythrocytes</td>
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<tr>
<td>Antigen A</td>
</tr>
<tr>
<td>Antigen B</td>
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<tr>
<td>Antigens A and B</td>
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<tr>
<td>Neither antigen A nor B</td>
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<tr>
<td>Plasma</td>
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<tr>
<td>Anti-B antibodies</td>
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<tr>
<td>Anti-A antibodies</td>
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<tr>
<td>Neither anti-A nor anti-B antibodies</td>
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<tr>
<td>Both anti-A and anti-B antibodies</td>
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<tr>
<td>Blood type</td>
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<tr>
<td>Type A</td>
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<tr>
<td>Erythrocytes with type A surface antigens and plasma with anti-B antibodies</td>
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<tr>
<td>Type B</td>
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<tr>
<td>Erythrocytes with type B surface antigens and plasma with anti-A antibodies</td>
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<td>Type AB</td>
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<td>Erythrocytes with both type A and type B surface antigens, and plasma with neither anti-A nor anti-B antibodies</td>
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<tr>
<td>Type O</td>
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<tr>
<td>Erythrocytes with neither type A nor type B surface antigens, but plasma with both anti-A and anti-B antibodies</td>
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</table>
• The D protein is called the _______________ (or Rhesus factor)
  • Rh-positive people ___________ the D protein on their blood cells
  • Rh-negative people _______________________ the D protein on their blood cells
• Successful blood transfusions depend on the combination from donor to recipient.
  • Example: Recipient with blood ___________ can only receive blood from a donor that is either blood type A or type O. If they don’t, the blood will ________________, or clump up together! Here’s why:
  
  Recipient

So... the recipient’s _________________________________ the “foreign blood”!

• It might be possible for a mother’s immune system to attack her baby’s blood because of the incompatible Rh factor. This is called ________________________________
  o Can be prevented with a drug called _______________________
  o Function: ________________________________

• This is possible because of ______________ which can carry up to ______________ at a time.

• The oxygen-carrying efficiency of hemoglobin is measured as __________________________.
  Depending on the ________________, hemoglobin will keep or release its oxygen.
White Blood Cells (aka ________________________): like RBCs, they are produced in the bone marrow

- **Granulocytes** (polymorphonuclear WBCs): contain ____________________ of ___________________________ that are released to __________________________ and __________________________ to foreign materials in the body.
  - **Neutrophils** (40-70%): most common type of white blood cell; ________________________ and _______ the remains of ________________________ and __________________________
    - __________________________: chemical that harms or **kills bacteria**
  - **Eosinophils** (5%): produce secretions that defend against large parasitic organisms in the body; contain a toxin called __________________________ that harms/kills __________________________
  - **Basophils** (0.5%): secrete __________________________, which is involved in stimulating the __________________________
    - __________________________ cause an **overproduction of histamine** leading to a runny nose, sneezing, and watery eyes.
    - Type of basophil called a __________________________ releases chemicals that start the immune response; cause __________________________ (swelling and redness) of tissues

- **Agranulocytes** (mononuclear WBCs): lack granules
  - **Monocytes** (1-5%): develop into two types of macrophages
    - **Circulating monocytes**: __________________________ (called pathogens) traveling through in the ____________; also involved in bone growth and maintenance
    - **Tissue monocytes**: __________________________ and __________________________ microorganisms that are more difficult to kill like ___________
  - **Lymphocytes** (20-50%): present in the blood and lymphatic system
    - __________________________: assists with the immune response by making antibodies; produced and __________________________.
• ______________________: responsible for __________________ the immune response and ______________________: produced in the bone marrow and _______________________

The killer T cells terminate cancer cells and cells infected by a virus or bacterium.

**Antigen Presentation**

1. A phagocyte "eats" a bacterium.
2. Parts of the bacteria (antigen) go to the surface of the phagocyte.
3. The phagocyte presents the antigen to a helper T cell.
4. The helper T cell is activated.

1. The B cell finds an antigen which matches its receptors.
2. It waits until it is activated by a helper T cell.
3. Then the B cell divides to produce plasma and memory cells.

4. Plasma cells produce antibodies that attach to the current type of invader.
5. "Eater cells," prefer invaders marked with antibodies, and "eat" loads of them.
6. If the same invader invades again, memory cells help the immune system to activate much faster.
Platelets (aka __________________________)

- **What are they?**
  - Not true cells, but are __________________________ that come from larger cells called __________________________
  - Covered with __________________________ that allow the __________________________ to __________________________ to a variety of materials
    - Stickiness helps to __________________________ to a damaged area __________________________ that break the blood vessels

- **Blood Clotting process; generally a two-step process**
  - __________________________
  - __________________________
  - When blood vessels are intact, they produce __________________________ which __________________________

- **Clotting Cascade:** a reaction that occurs when there is damage to a blood vessel or body tissue
  - __________________________ releases various tissue components into the blood
  - __________________________ and __________________________ alert other parts of the body that there is damaged tissue
  - __________________________ adhere to the damaged tissue and to each other
  - __________________________ (secreted by platelets) is converted into __________________________
  - __________________________ catalyzes the reaction to convert __________________________ into __________________________
  - Fibrin forms a __________________________ that forms a temporary barrier. This prevents __________________________ and possible __________________________ into damaged tissue
    - __________________________ helps make fibrin sticky
    - __________________________ is needed for the synthesis of all the clotting factors
  - The __________________________ is what eventually forms

- **Since clots are temporary structures, and scabs don’t last forever, healthy cells near the clot release __________________________ (TPA).**
- Initiates the conversion of _______________ into _______________. which
  _______________ and thereby dissolves the clot; _______________
  ____________________________ caused by blood clots.

Lymphatic System

- **Structures**
  - **Lymphatic vessels**: thin ducts that carry a clear fluid called _______________
    _______________ that accumulates in tissues which _______________
    - **Lymph** removes _______________ from cells; _______________
      __________ from the digestive system; _______________ mature _______________ to the
      blood
  - Lymph flow comes from _______________ or movement of _______________
  - **Lymphatic trunks**: division of the lymphatic vessels; drain lymph from _______ _______
    of the body; has collections of small regions of lymphatic tissue
    - _______ : lymphoid tissue found in the _______________
    - _______________________: lymphoid tissue found in the _______________ system
  - Lymph nodes (lymph glands): _______________ from the lymph; have 4 components
    - _______________ : enter and exit the lymph node through the hilum
    - _______________ : fluid-filled sack
    - filler tissue (___________): divided into regions by walls in the capsule called _________
    - _______________ : B and T lymphocytes are found in the stroma; help with the
      immune response
Lymph Glands:

- __________________: located in the upper left region of the abdomen near the stomach; divided into two regions
  - __________________: storage area for __________________: responsible for removing old or damaged RBCs from the circulations
  - __________________: contain B-lymphocytes and T-lymphocytes
- ________________: produces secretions that mature the T-lymphocytes; this is where the T cells are “educated” so that they __________________. This is called “________________”.

♀ Immune Response: triggered by the presence of a foreign _____________

- Innate Immunity: aka ___________________________; uses barriers that block a variety of infections to protect the body
  - Physical Barriers: ________________________________
    - __________: blocks microorganisms from entering tissues; constant shedding removes microbes; skin secretions prevent microbes from overgrowing
    - __________________________: catch incoming pathogens before they can enter the bloodstream
  - Chemical Barriers: __________, __________, __________, etc.
  - ________________: increasing the body temperature ________________________________
  - ________________: a group of proteins that “________” ________________ ________________ in the cells

♀ Acquired Immunity: occurs when the body ___________________________; it’s like the body learns about the “invader” and kills it as effectively as possible. [http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter24/animation__the_immune_response.html]
  - Macrophages __________ (eat) the invaders and __________________________ on its surface
  - A helper T-cell attaches to the macrophage and __________________________. The helper T-cell __________________________ and the immune system responds in 2 ways:
• the T cells that are activated seek out infected cells and kill them

• the B cells that are activated divide into (make lots of antibodies) and (stores information about the pathogen and initiates a faster immune response the second time around)

Inflammatory Response: an intentional action that to an affected area
  o Causes , , , or in the area of immune response

Immunization & Vaccination

  : fighting the disease the old-fashioned way (getting sick and fighting it yourself)

  : faking out your immune system to prepare it for a real attack; example: vaccines

  Immunity against a disease can be acquired through active or passive immunity
    o : exposing antigens to your immune system cells; either naturally or artificially
    o : when the antibodies are basically given to you; example would be