**BSCI202 – OBRIEN FINAL REVIEW SPRING 12**
**ALL material for final exam**
**Blood**

- **Living cells called formed elements**
  - **Erythrocytes – RBCs, transport oxygen and carbon dioxide**
  - **Leukocytes – WBCs, fight infection**
  - **Platelets – cell fragments formed from megakaryocytes, important in blood clotting**
- **Nonliving – plasma is the fluid and solutes**
- Centrifuged blood
  - Hematocrit – the RBC's that sink to the bottom, compose 45% of blood
  - Buffy coat contains leukocytes and platelets (less than 1%), it is a thin, whitish layer between the erythrocytes and plasma
  - Plasma rises to the top (55% of blood)
- pH of blood: 7.35-7.45
- Blood temperature is slightly above body temperature at 38 degrees C or 100.5 degrees F
- Plasma ~ 90% water
  - 3 major classes of plasma proteins (mainly synthesized in the liver)
    - Albumins: contributor to plasma oncotic/osmotic pressure and act as carriers
    - Globulins: carriers, clotting factors, precursor proteins, immunoglobulins
    - Fibrinogen: blood clotting
  - Nutrients: glucose, amino acids, lipids, vitamins
  - Wastes: urea, bilirubin, creatine
  - Gases (dissolved): oxygen, carbon dioxide
  - Hormones
  - Electrolytes: relatively high concentrations of Na+ and Cl- and low concentrations of H+, HCO3-, K+ and Ca
- Ringer's solution: distilled water containing concentrations of electrolytes etc. that match the exact concentrations as their occurrence in body fluids – used as IVs for dehydrated patients
- Acidosis: blood becomes too acidic
- Alkalosis: blood becomes too basic
- In each scenario, the respiratory system and kidneys help restores blood pH to normal
  - Remember – carbon dioxide can dissolve in water (blood plasma) and form carbonic acid
  - $CO_2 + H_2O \rightarrow \leftarrow$ (carbonic acid) $H_2CO_3 \rightarrow \leftarrow H^+ + HCO_3$ (bicarbonate)
- Sites of blood cell formation:
  - Fetal liver and spleen are early sites of blood cell formation
  - Bone marrow takes over hematopoiesis (when precursor cells develop into mature blood cells) by the seventh month
- Fetal hemoglobin differs from hemoglobin produced after birth, fetal hemoglobin has a gamma (remember "mamma" – gamma) subunit and higher affinity for oxygen
- Physiologic jaundice results in infants in which the liver cannot breakdown products fast enough

- **Erythrocytes: (RBC's)**********
    - Main function: carry oxygen
    - Biconcave disk: large surface area favors diffusion
    - Essentially bags of hemoglobin
    - Annucleate (no nucleus)
    - Very few organelles
    - No mitochondria
    - Use anaerobic glycoloysis
    - 5-6 million RBCs per ml of blood
    - Flexible membrane
    - Maintain osmolarity of blood/plasma pH
- Hemoglobin in RBCs
    - Binds strongly but reversibly to oxygen
    - 98.5# of oxygen bound to hemoglobin and 1.5% dissolved in plasma
    - Each hemoglobin has 4 binding sites
    - Can also bind to H+ and CO2
- Imbalance of RBCs
    - Anemia: a decrease in the oxygen carrying ability of blood
    - Sickle cell anemia: results from abnormally shaped hemoglobin due to gene mutation of the Beta subunit of HB (betty got messed up)
    - Polycythemia: an excessive or abnormal increase in the number of erythrocytes
- Formation of Erythrocytes:
    - Mature RBC's are unable to divide, grow or synthesize proteins
    - Wear out in 100 to 120 days – when worn out eliminated by phagocytes in the spleen or liver
    - Lost cells – replaced by division of **hemocytoblasts** in the red bone marrow
    - Iron is a component of hemoglobin
- Controlling erythrocyte production
    - Erythropoietin: hormone that controls rate of RBC production
    - Kidneys produce erythropoietin as a response to reduced oxygen levels in the blood
    - Homeostasis is maintained by negative feedback from blood oxygen levels
- Feedback loop explained
    - Stimulus: decreased RBC count, decreased availability of oxygen to blood, or increased tissue demands for oxygen (aka exercise)
    - All this leads to reduced oxygen levels in blood
    - Kidneys then release erythropoietin
    - Stimulates red bone more to enhance erythropoiesis → more RBCs
    - Increased oxygen carrying capacity of blood
- Anemia: decreased oxygen carrying ability of blood
    - Dietary anemia
        - Iron: iron-deficiency anemia
        - Pernicious: lack of vitamin B12
    - Hemorrhagic anemia: bleeding

- Hemolytic anemia: malaria or sickle cell
- Aplastic anemia: bone marrow defect
- Renal anemia: kidney disease

- **Leukocytes (WBC's)**********
  - Crucial in body defense to disease
  - Complete cells, with nucleus and organelles
  - Diapedesis – how they move in and out of blood vessels
  - Move by amoeboid motion
  - Respond to chemicals released by damaged tissues (cytokines)
  - 4,000-11,000 WBC per cubic ml of blood
- 2 major types of leukocytes
  - Granulocytes: granules in their cytoplasm can be stained, possess lobed nuclei
    - Include (Granny's like more children aka 3): 1. Neutrophils 2. Eosinophils 3. Basophils
  - Agranulocytes: lack visible cytoplasmic granules, nuclei are lobed spherical or kidney shaped
    - Include: 1. Lymphocytes 2. Monocytes
- Leukocytes - most to least abundant
  - Never Let Monkeys Eat Bananas
  - Neutrophils – Lymphocytes – Monocytes – Eosinophils – Basophils
- Neutrophils (G): Act as phagocytes at active sites of infection, multilobed nucleus with fine granules
  - Secrete cytokines (in response to damaged tissues)
  - Circulate 7-10 hours
  - Migrate to tissues for a few days
  - Increase in number during infections
- Eosinophils (G): defend against parasitic invaders (parasitic worms)
  - Large red granules – contain toxic molecules that attack parasites
  - Phagocytes – but not main mechanism of action
- Basophils (G): initiate inflammation
  - Non-phagocytic
  - May defend against large parasites by releasing toxic substances
  - Contribute to allergic reaction: histamine and heparin
- Lymphocyte (A): nucleus fills most of cell
  - Important role in immune response
  - 3 types
    - B lymphocytes (B cells)
      - 1) Effector B cells become plasma cells and secrete antibodies (immunoglobins)
        - Life span: 4-7 days
        - Secrete 2000 antibodies specific for antigen per second
        - Antibodies circulate for several weeks binding/marking antigen for destruction (types phagocytosis, complement-mediated lysis, osponization etc)