BLOOD - THE ELIXIR OF LIFE

BLOOD COMPONENTS

- 8% by weight; 4-6 liters by volume
- Plasma (55% by volume)
  - contains water, gases, proteins, salts, glucose, amino acids, lipids on carriers (ex: triglycerides), wastes, and hormones
- Formed Elements (45% by volume)
  - erythrocytes (RBCs) - move oxygen
  - thrombocytes (platelets) - clot the blood with an enzyme cascade
  - leukocytes (WBCs) - fight infection
HEMATOPOIESIS OF FORMED ELEMENTS

- Blood production starts with stem cells (hemocytoblasts) in bone marrow
- Hematopoiesis consists of 3 parts:
  - Erythropoiesis (of erythrocytes)
  - Leukopoiesis (of 5 unique leukocytes)
  - Thrombopoiesis (of thrombocytes)
- Thrombopoiesis involves fragmentation of megakaryocyte into vacuoles of enzymes

THE LIFE CYCLE OF A RBC

- The signal for erythropoiesis is decreased oxygen level in the blood
- Kidney responds by releasing the hormone erythropoietin
- Erythropoietin reception within bone marrow stimulates hemocytoblasts
- RBC synthesis requires dietary iron, protein, Vitamin B₁₂, and folic acid (mostly for hemoglobin production)
- After 120 days, damaged cells are destroyed in the spleen and liver

FOODS THAT SOURCE RICH IRON

- Meat: Beef, Lamb, Ham
- Seafood: Shrimp, Scallops, Clams
- Veggies: Spinach, Peas, Broccoli
- Meals: Bran, Oat Cereal, Whole Wheat
- Fruits: Strawberry, Watermelon, Raisins
- Beans: Lentils, Tofu, Dried Beans

<table>
<thead>
<tr>
<th>Food</th>
<th>Dietary Iron (mg)</th>
<th>Vitamin B₁₂ (mcg)</th>
<th>Folate (mcg)</th>
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<tr>
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<tr>
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<tr>
<td>Clams</td>
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<tr>
<td>Lentils</td>
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<tr>
<td>Tofu</td>
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<tr>
<td>Dried Beans</td>
<td>1.5</td>
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</tr>
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</table>

12 Foods Rich in Folate

- Kale
- Spinach
- Broccoli
- Brussel Sprouts
- Asparagus
- Broccoli Stem
- Sweet Potato
- Sweet Potato Skins
- Cauliflower
- Turnip Greens
- Bell Peppers
- Green Peppers

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**THE LIFE CYCLE OF A RBC**

- Proteins are directly recycled (globin portion) while heme is stored initially as ferritin in the liver, and then transported as bilirubin in the blood to gall bladder.
- Bilirubin is converted to biliverdin in bile, and hopefully excreted in feces.
- Excess iron not secreted as bile can create excess bilirubin in blood and can lead to jaundice (yellowing tissues).

**ERYTHROPOIESIS (RBC PRODUCTION)**

- Dropping O\(_2\) levels stimulate the kidney to release erythropoietin.
- Stem cells create excess RBCs.
- RBCs die after 120 days and hemoglobin is recycled by the liver and spleen. Excess causes jaundice.

**FORMED ELEMENTS - LEUKOCYTES**

- Granulocytes (grainy cells):
  - Basophils cause inflammation, make heparin and histamine.
  - Eosinophils reduce inflammation, kill worms.
  - Neutrophils eat invaders in acute infections.
- Agranulocytes (no grains):
  - Lymphocytes make antibodies, attack tumor cells.
  - Monocytes eat invaders in chronic infections, can leave the blood and enter other fluids.
BLOOD TYPING AND ERYTHROBLASTIS FETALIS

- Blood Type (A, B, AB, or O) depends on two alleles (A and B). Rh factor is a separate test (either Rh- or Rh+)

- You produce antibodies to foreign antigens. Excess antibody production agglutinates (clots) recipient’s blood. This produces the Universal donor (O-) and the Universal recipient (AB+)

- If mom is Rh- and baby is Rh+ (due to Dad), she may attack baby’s blood cells in erythroblastis fetalis (Rh- Disease), especially in later pregnancies. Need RhoGam to sweep blood.

ENDOCRINE GLAND LOCATIONS

- Pituitary (many items)
- Thyroid and Parathyroid (metabolism and bones)
- Adrenals (stress response, sugar, electrolytes)
- Thymus (immune responses)
- Pancreas (glucose)
- Ovaries (female characteristics)
- Testes (male characteristics)
HORMONE TYPES

- Macromolecules Differ: Proteins are linked amino acids (growth hormone, insulin, ACTH, glucagon, etc.) versus cholesterol-based lipid Steroids (testosterone, progesterone, estrone, prednisone, corticosteroids, etc.)
- Receptor Sites Differ: proteins bind to cell membrane receptors while steroids bind to DNA receptors inside the nucleus (directly affecting transcription/translation).
- Actions Differ: proteins are short-acting and easy to remove while steroids are long-acting and hard to remove. Also, proteins activate an internal molecule (often cAMP) called a second messenger.

PANCREAS AND BLOOD GLUCOSE

- We eat a meal and blood glucose rises too high
- Pancreas releases insulin
- Tissues burn more sugar and liver makes glycogen
- Our blood sugar falls
- Pancreas releases glucagon
- Liver breaks down stored glycogen and releases sugars
- Our blood glucose rises again

THYROID AND PARATHYROID

- Blood calcium falls too far between meals
- Parathyroids release PTH
- Osteoclasts eat away bones
- Blood calcium rises
- Thyroid releases calcitonin
- Osteoblasts build bone
- Blood calcium starts to fall
PITUITARY GLAND – A CASE STUDY

- Pituitary hangs on infundibulum (stalk) under the brain with control from the hypothalamus.
  - Anterior lobe
    - 7 hormones (at least)
    - Hormonal control by RFs
  - Posterior lobe
    - 2 hormones
    - Direct neural control

Hormones Include:

- GH (growth hormone, ant.): creates growth of muscles, bones, tendons, ligaments, etc.
- TSH (thyroid stimulating hormone, ant., tropic): thyroid gland; metabolism
- ACTH (adrenocorticotropic hormone, ant., tropic): adrenal glands and melanocytes;
- LH (lutetizing hormone, ant., tropic): affects gonads; alters steroid release (estrogen/testosterone)
- FSH (follicle stimulating hormone, ant.): affects gonads; controls gamete (ova/sperm) production
- PR (prolactin, ant.): breastmilk production
- MSH (melanocyte stimulating hormone, ant.): darkens skin (especially when pregnant)
- ADH (antidiuretic hormone, post.): alters walls of the kidney tubules; affects urine concentration
- OT (oxytocin, post.): breast and uterus; milk let-down
POSSIBLE JOURNAL CRITIQUE TOPICS?

- Iron-deficient, Pernicious, Sickle-cell, and Aplastic Anemia?
- Hemophilia?
- Erythroblastis Fetalis?
- Leukemia?
- Cushing’s Syndrome?
- Type I and Type II Diabetes?
- Hypothyroidism?