**Anatomy and Physiology Test 1 Study Guide**

# Chapter 1 – Introduction

1. Definitions
   1. Physiology – the study of function.
   2. Anatomy – the study of structure.
   3. Organization
      1. Levels – physiology can be studied on several levels
      2. Systems – physiology can be studied based on systems and how they integrate
2. Homeostasis – “staying the same”
   1. Health is often based on homeostasis
   2. Most control systems use feedback mechanisms.
      1. Positive feedback – the product activates its maker. More rare. E.g. childbirth
      2. Negative feedback – the product inhibits its maker. More common. E.g. temperature regulation. Similar to a thermostat/heater at home.
   3. Diabetes – an example of homeostatic imbalance
      1. Blood glucose is too high: greater than 100 mg/dL
      2. Type 1 – insulin sensitive
      3. Type 2 – insulin resistant

# Molecules

1. The atom
   1. Nucleus in center – made from protons (+) and neutrons (=). Both have an atomic weight of 1
   2. Shell on outside. Made up of electrons (-) with close to zero weight. Electrons orbit the nucleus.
   3. Isotopes are atoms with a different number of neutrons. E.g. radioisotopes.
2. Bonds
   1. Atoms form bonds with each other mostly because of electron stability.
   2. Compound is a molecule made up of different types of atoms.
   3. Bonds
      1. Ionic – when electron is transferred. This results in charged atoms called ions.
      2. Covalent – when electron is shared. This is how a molecule is formed.
         1. Polar – asymmetrical, slight charge difference around molecule
         2. Non-polar – symmetrical, no charge differences.
      3. Hydrogen – polar molecules form bonds from slight – and + charges.
   4. Chemical reactions
      1. Reactants = Products, reversable
      2. Exergonic releases energy while endergonic requires energy
      3. Synthesis is a building reaction (anabolism) while decomposition is breaking down (catabolism). Exchange reactions involve both.
3. Water – polarity and size give it unique properties
   1. Liquid vs. ice
   2. Cohesive and adhesive: surface tension.
   3. Solvent – solutes dissolve in it.
   4. Heat sink – resists temperature change. Calorie is defined as energy required to raise 1 ml or g of water 1 oC. Heat is given off by evaporation, e.g. sweating.
   5. Acids and bases. Water dissociates into equal numbers of *hydrogen* ions and *hydroxide*

ions. H2O =H+ + OH-

* + 1. Buffers resist pH change.

CI. Organic molecules contain carbon and hydrogen.

1. Overview
   1. Functional groups give organic molecules different characteristics
   2. Macromolecules are made from attaching monomers into polymers.
2. Carbohydrates
   1. Chemical formula is usually (CH2O)n
   2. Monosaccharide. Making disaccharide, polysaccharide
   3. Examples
      1. Starch – a storage polysaccharide in plants
      2. Glycogen – storage in animals
      3. Cellulose – cell wall structure
3. Lipids – fats
   1. Hydrophobic – “water fearing”. Long hydrocarbon chains.
   2. Triglyceride contains 3 fatty acid and 1 glycerol. Saturated vs. unsaturated fats. Unsaturated has double bonds and is not saturated with hydrogen.
   3. Phospholipids have a polar head with a phosphate group and a non-polar tail.
   4. Steroids – four ring groups. E.g. cholesterol (precursor to other steroids and membrane component), estradiol, testosterone
4. Proteins
   1. Monomers are amino acids. Monomers are linked by peptide bonds.
   2. 20 different amino acids based on R group differences.
   3. Function related to final structure.
      1. Many types of bonds are involved
      2. Temperature, pH and salt can affect final shape. Denaturation like boiled eggs.
      3. Proteins have specific binding partners
   4. Levels of structure
      1. Primary – basic amino acid sequence
      2. Secondary – local folding motifs within protein, e.g. helix, sheet
      3. Tertiary – whole protein structure
      4. Quaternary – if more than 1 peptide is involved in final structure
5. Nucleic Acids
   1. Monomer is nucleotide (phosphate-sugar-base)
   2. DNA is string of deoxynucleotides. Has four bases ATGC. Genetic material.
   3. RNA is less stable. Has AUGC. Genetic messenger.
   4. ATP is a unit of energy. High energy phosphate bond.

# Cellular Membranes

1. Structure –
   1. Phospholipid bilayer
      1. Phospholipids have polar head and nonpolar tail
      2. Tails inside, heads face out.
   2. Proteins and other components
      1. Peripheral – on outside of bilayer. Can be involved in signaling, support, enzymes.
      2. Integral – embedded in membrane. Can be involved in transport across membrane and signaling.
2. Transport Across Membranes
   1. Passive transport – diffusion
      1. Down a concentration gradient (high  low)
      2. When across a membrane, need to apply Fick’s Law
         1. Rate of diffusion is positively affected by surface area, concentration gradient, and permeability.
         2. Rate of diffusion is negatively affected by membrane thickness.
      3. Osmosis – diffusion of water across a membrane.
         1. If there is a non-permeable solute, water will move down its concentration gradient if it exists.
         2. Tonicity – relationship of solute concentrations across a membrane Isotonic: = (solution = cell). No net movement
            1. Hypotonic < (solution is less than cell). Water moves in.
            2. Hypertonic > (solution is greater than cell). Water moves out.
      4. Facilitated diffusion – uses a protein
         1. Channel proteins form a passageway. Can be gated or just a pore. Cystic fibrosis is due to a nonfunctional Cl- channel.
         2. Carrier proteins bind to substance. This changes shape of protein.
   2. Active transport
      1. Against concentration gradient, requires energy.
      2. Primary – uses ATP as an energy source. Example: Na-K pump – an antiport
         1. Pumps Na out and K in.
         2. Mechanism
            1. 3 Na bind
            2. ATP attaches P and shape changes
            3. 3 Na are released
            4. 2 K bind
            5. P released and shape changes back to original conformation. 2 K are released.
      3. Secondary – uses the diffusion of one substance to bring another against its concentration gradient. Example: Na-glucose pump – a symport.
         1. Na binds
         2. Glucose binds, shape changes
         3. Both are released, shape resets.
      4. Phagocytosis – large particles are taken in by membrane invagination. Uses lots of ATP
      5. Endocytosis – smaller particles taken into a vesicle.
      6. Exocytosis – follows the opposite process of endocytosis.
3. Electrical Potential
   1. An electrical potential is an electrical gradient due to the different types of solutes across a membrane. This creates potential for work, like a battery.
   2. The resting membrane potential is the charge at rest before an action occurs
   3. Potential can be measured
   4. Changes in potential are an indication of work or signaling. These are due to movement of ions through channels, carriers, or pumps
      1. Depolarization – membrane potential goes down and causes a spike (more positive reading)
      2. Repolarization – membrane potential is restored.
      3. Hyperpolarization – overshooting resting membrane potential.

# Metabolism

1. Energy – ability to do work
   1. Metabolism – the sum of all reactions in a cell
      1. Catabolism – breakdown molecules
      2. Anabolism – build
      3. Energy transfer summary in the body
   2. Kinetic (motion) vs. potential (stored). Chemical is potential energy
   3. Types of reactions
      1. Endergonic – requires energy
      2. Exergonic – releases energy
      3. Coupled – use energy from an exergonic to drive an endergonic
   4. ATP
      1. ATP  ADP + Pi + energy
      2. Releases 7.3kcal/mol, enough for most reactions
      3. ATP can be restored in a coupling cycle
      4. Type of work ATP drives: mechanical, transport, chemical
2. Enzymes
   1. Are catalysts that lower energy of activation
   2. Enzyme characteristics
      1. Specific for certain substrates
      2. Reaction must be spontaneous
      3. Reusable
   3. Regulation
      1. Environmental factors
         1. Optimal pH, temperature, salt produce bell curves
      2. Activators
         1. Cofactors (non-organic)
         2. Coenzymes (organic)
      3. Inhibitors
         1. Competitive – binds active site
         2. Noncompetitive – binds allosteric site
3. Respiration
   1. Glycolysis
      1. Glucose ---> Pyruvate
      2. Yields 2 ATP and 2 NADH
         1. These ATPs are made by direct transfer of phosphate by enzymes.

Lipid and Protein Catabolism

* 1. Fats and proteins enter in different places of respiration
  2. Proteins are broken down to amino acids
  3. Triglycerides are broken down to fatty acid and glycerol
  4. Both these pathways can be reversed to produce lipids and proteins (anabolism)

1. Gene Expression
   1. Central Dogma: DNA  RNA  Protein. Transcription makes RNA by reading DNA and translation makes protein by reading RNA.
      1. DNA – uses ATGC bases
      2. RNA
         1. Uses AUGC bases
         2. mRNA, rRNA, tRNA are a few important forms
      3. Genetic Code
         1. Each triplet codes for one amino acid (or stop codon)
         2. 64 possibilites with 20 a.a., therefore redundancy
   2. Transcription
      1. Occurs in the nucleus.
      2. Occurs whenever a gene product needs to be made.
      3. RNA polymerase links together ribonucleotides
      4. mRNA will be processed and exit the nucleus
   3. Translation
      1. tRNA: one for each amino acid. Has anticodon that is complementary to mRNA and site to add the right amino acid.
      2. Ribosome is enzyme (organelle) that attaches amino acids together.
      3. aa-tRNA comes into empty site in ribosome. Polymerization occurs then shift of ribosome. Used tRNA exits.
      4. Stop codon will end the process.

Chapter 4

1. Four types of tissue
   1. Epithelial tissue: Covers exposed surfaces, Lines internal passageways , Forms glands
      1. Epithelial cells that are adapted for absorption or secretion usually have microvilli at their free surface.
      2. Epithelium is connected to underlying connective tissue by a basal lamina.
      3. Germ cells divide continually to produce new epithelial cells.
      4. Types of Epithelial Tissue
         1. Transitional epithelium is found lining the urinary bladder.
         2. The epithelium that forms air sacs in the lungs, line body cavities and blood vessels are classified as simple squamous epithelium.
         3. You would find pseudostratified columnar epithelium lining the trachea.
         4. Simple cuboidal epithelium is found in the kidneys and thyroid gland
      5. Glands: structures that produced secretions
         1. Glands that secrete hormones into the interstitial fluid are endocrine glands.
         2. Glands that have ducts are exocrine glands.
   2. Connective Tissue: provides a protective structural framework for other tissue types, Fills internal spaces, Supports other tissues, Transports materials, stores energy
      1. Types of Connective Tissue
         1. Connective tissue proper
            1. Loose: areolar tissue, adipose tissue (Cells that store fat are called adipocytes), reticular tissue
            2. Dense: collagenous fibers-tendons, libametns
         2. fluid connective tissue: Blood, lymph
         3. supporting connective tissues-protect soft tissues and support the weight of the body: bone and cartilage
   3. Muscle: Specialized for contraction, Skeletal muscle, heart muscle, and walls of hollow organs
      1. Skeletal and cardiac muscles have striations.
      2. Smooth muscle does not have striations.
   4. Nervous Tissue: Carries electrical signals from one part of the body to another

Chapter 5: Integumentary System

1. Layers of the Epidermis: provides a barrier against bacteria as well as chemical and mechanical injuries
   1. stratum corneum: The tough superficial layer of the epidermis with large amounts of keratin. Loacated in thick and thin skin.
   2. stratum lucidum: located in the thick skin of the palms and soles
   3. stratum granulosum.
   4. stratum spinosum.
   5. Stratum basale (germinativum): innermost epidermal layer, has layers of stem cells that constantly divide to renew the epidermis.
2. Melanocytes are cells located in the stratum basale, they make melanin. The differences in skin pigmentation among individuals do not reflect different numbers of melanocytes, but different layers of synthetic activity (there for people with darker skin make more melanin than people with lighter skin, but have the same number of melanocytes as people with lighter skin). Albino people have a normal amount of melanocytes, but they cells cannot produce melanin.

Chapter 6: Osseous Tissue and Bone Structure

1. Five Primary Functions of the Skeletal System
   1. Support
   2. Storage of Minerals (calcium) and Lipids (yellow marrow)
   3. Blood Cell Production (red marrow)
   4. Protection
   5. Leverage (force of motion)
2. Bone Shapes
   1. Sutural Bones: Small, irregular bones, Found between the flat bones of the skull
   2. Irregular Bones: Have complex shapes, Examples: spinal vertebrae, pelvic bones
   3. Short Bones: Small and thick, Examples: ankle and wrist bones
   4. Flat Bones: Thin with parallel surfaces, Found in the skull, sternum, ribs, and scapulae
   5. Long Bones: Long and thin, Found in arms, legs, hands, feet, fingers, and toes
   6. Sesamoid Bones: Small and flat, Develop inside tendons near joints of knees, hands, and feet
3. Structure of a Long Bone
   1. Diaphysis: The shaft , A heavy wall of compact bone, or dense bone, A central space called medullary (marrow) cavity
   2. Epiphysis : Wide part at each end, Articulation with other bones, Mostly spongy (cancellous) bone, Covered with compact bone (cortex)
   3. Metaphysis: Where diaphysis and epiphysis meet
4. Periosteum : Covers outer surfaces of bones, Consists of outer fibrous and inner cellular layers
5. Bone Cells
   1. Osteocytes : Mature bone cells that maintain the bone matrix, Live in lacunae , Are between layers (lamellae) of matrix, Connect by cytoplasmic extensions through canaliculi in lamellae, Do not divide; Two major functions of osteocytes: To maintain protein and mineral content of matrix, To help repair damaged bone
   2. Osteoblasts : Immature bone cells that secrete matrix compounds (osteogenesis), Osteoid — matrix produced by osteoblasts, but not yet calcified to form bone, Osteoblasts surrounded by bone become osteocytes,
   3. Osteoprogenitor Cells: Mesenchymal stem cells that divide to produce osteoblasts, Located in endosteum, the inner cellular layer of periosteum, Assist in fracture repair
   4. Osteoclasts: Secrete acids and protein-digesting enzymes, Giant, multinucleate cells, Dissolve bone matrix and release stored minerals (osteolysis), Derived from stem cells that produce macrophages
6. The structure of compact bone: The Osteon is the basic unit, Osteocytes are arranged in concentric lamellae., Around a central canal containing blood vessels
7. The Structure of Spongy Bone: Does not have osteons: The matrix forms an open network of trabeculae; Trabeculae have no blood vessels; The space between trabeculae is filled with red bone marrow

Chapter 7: The Axial Skelton

1. 80 bones make up the axial skeleton
2. Skull
   1. The skull contains 22 bones: 8 cranial bones, 14 facial bones
   2. Foramina: Openings for nerves and blood vessels
   3. The membranous areas between the cranial bones of the fetal skull are fontanels
3. Functions of the axial skeleton? provides an attachment for muscles that move the appendicular skeleton; provides an attachment for muscles that move the head, neck, and trunk; provides an attachment for muscles involved in respiration ; provides protection for the brain and spinal cord
4. Regions of the Vertebral Column

* Cervical (C)- 7 cervical vertebra
* Thoracic (T)-12 throacic vertebra
* Lumbar (L)-5 lumbar vertebra (also have the widest intervertebral disks)
* Sacral (S)-1 fused vertebra
* Coccygeal (Co)-1 fused vertebra

1. Ribs
   1. True ribs are ribs 1-7 (Connected to the sternum by costal cartilages)
   2. False ribs are Ribs 8–12 (Do not attach directly to the sternum); 11 and 12 are floating ribs
   3. Ribs articulate with the thoracic vertebra
2. The Sternum: A flat bone, In the midline of the thoracic wall
   1. Three parts of the sternum
      1. The manubrium
      2. The sternal body
      3. The xiphoid process

Images to Know for the Exam 



