**TEST 1- The Language of Anatomy (pp. 11–20; Figs. 1.7–1.12; Table 1.1)**

A. Anatomical Position and Directional Terms (pp. 11–13; Fig. 1.7; Table 1.1)

1. Anatomical position is a position in which the body is erect, palms face forward, and thumbs point away from the body.

a. In anatomical position, right and left refer to the right and left sides of the person viewed.

b. In anatomy, anatomical position is always assumed, regardless of the actual position of the body.

2. Directional terms are used to explain exactly where one body part is in relation to another.

Proximal/Distal:

Medial/Lateral:

Superficial/Deep

Ventral/Dorsal:

B. Regional Terms (p. 14; Fig. 1.7)

1. There are two fundamental divisions of the body.

a. The axial region includes the head, neck, and trunk

. b. The appendicular region consists of the upper and lower limbs.

2. Regional terms designate specific areas within the axial and appendicular divisions.

C. Body Plans and Sections

1. Body planes are flat surfaces that lie at right angles to each other.

a. Sagittal plane: a vertical plane that separates the body into right and left parts.

 i. Median, or midsagittal plane: lies exactly along the bodyʼs midline.

b. Frontal/ Coronal: a vertical plane that separates the body into anterior and posterior parts.

c. Transverse:a plane that runs horizontally from right to left, and divides the body into superior and inferior parts.

D. Body Cavities and Membranes (pp. 14–20; Figs. 1.9–1.12)

1. Body cavities are spaces within the body that are closed to the outside and

contain the internal organs.

2. The dorsal body cavity is the space that houses the central nervous system,

and has two subdivisions: the cranial cavity and the vertebral cavity.

3. The ventral body cavity is anterior to and larger than the dorsal cavity and has two main subdivisions: the thoracic cavity and the abdominopelvic cavity.

6. Abdominopelvic Regions

a. There are 9 abdominopelvic regions used primarily by anatomists.

b. There are four quadrants used primarily by medical personnel.

**TEST 2: BIOCHEMISTRY**

VI. Inorganic Compounds (pp. 38–41; Figs. 2.12–2.13)

A. Water (pp. 38–39)

1. Water is the most important inorganic molecule, and makes up 60–80% of the volume of most living cells.
2. Water has a high heat capacity, meaning that it absorbs and releases a great deal of heat before it changes temperature.

3. Water has a high heat of vaporization, meaning that it takes a great deal of energy (heat) to break the bonds between water molecules.

4. Water is a polar molecule and is called the universal solvent.

5. Water is an important reactant in many chemical reactions.

6. Water forms a protective cushion around organs

C. Acids and Bases (pp. 39–41; Fig. 2.13)

1. Acids are also known as proton donors, and dissociate in water to yield hydrogen ions and anions.

2. Bases are also called proton acceptors, and absorb hydrogen ions.

 3. The relative concentration of hydrogen ions is measured in concentration units called pH units.

a. The greater the concentration of hydrogen ions in a solution, the more acidic the solution is.

b. The greater the concentration of hydroxyl ions, the more basic, or alkaline, the solution is.

c. The pH scale extends from 0–14. A pH of 7 is neutral; a pH below 7 is acidic; a pH above 7 is basic or alkaline. Blood is 7.35-7.45

5. Buffers resist large fluctuations in pH that would be damaging to living tissues.

D. Salts (p. 39; Fig. 2.12)

Salts are ionic compounds containing cations other than

 B. 1. H! and anions other than the hydroxyl (OH!) ion.

 2. When salts are dissolved in water they dissociate into their component ions.

VII. Organic Compounds (pp. 42–56; Figs. 2.14–2.24; Tables 2.2–2.4)

A. Carbohydrates, lipids, proteins, and nucleic acids are molecules unique to living systems, and all contain carbon, making them organic compounds (p. 42).

B.Carbohydrates (p. 43; Figs. 2.14–2.15)

1. Carbohydrates are a group of molecules including sugars and starches.

2. Carbohydrates contain carbon, hydrogen, and oxygen.

3. The major function of carbohydrates in the body is to provide cellular fuel.

4. Monosaccharides are simple sugars that are single-chain or single-ring structures.

5. Disaccharides are formed when two monosaccharides are joined by a dehydration synthesis.

6. Polysaccharides are long chains of monosaccharides linked together by dehydration synthesis.

C.Lipids (pp. 43–47; Fig. 2.16; Table 2.2)

1. Lipids are insoluble in water but dissolve readily in nonpolar solvents.

2. Triglycerides (neutral fats) are commonly known as fats when solid and oils when liquid.

3. Phospholipids are diglycerides with a phosphorus- containing group and two fatty acid chains.

4. Steroids are flat molecules made up of four interlocking hydrocarbon rings.

5. Eicosanoids are a group of diverse lipids derived from arachidonic acid.

D. Proteins (pp. 47–53; Figs. 2.17–2.21; Table 2.3)

1.Proteins compose 10–30% of cell mass.

a. They are the basic structural material of the body.

b. They also play vital roles in cell function.

2.Proteins are long chains of amino acids connected by peptide bonds.

3.Proteins can be described in terms of four structural levels.

a. The linear sequence of amino acids is the primary structure.

b. Proteins twist and turn on themselves to form a more complex secondary structure.

c. A more complex structure is tertiary structure, resulting from protein folding upon itself to form a ball-like structure.

d. Quaternary structure results from two or more polypeptide chains grouped together to form a complex protein.

4.Fibrous and Globular Proteins

a. Fibrous proteins are extended and strandlike. They are known as structural proteins and most have only secondary structure.

b. Globular proteins are compact, spherical structures. They are water- soluble, chemically active molecules, and play an important role in vital body functions.

7.Enzymes and Enzyme Activity

a. Enzymes are globular proteins that act as biological catalysts.

b. Enzymes may be purely protein

c. Each enzyme is chemically specific.

d. Enzymes work by lowering the activation energy of a reaction.

e. temperature and pH affect the efficiency of an enzyme

E. Nucleic Acids (DNA and RNA) (pp. 53–55; Fig. 2.22; Table 2.4)

1.Nucleic acids composed of carbon, oxygen, hydrogen, nitrogen, and phosphorus are the largest molecules in the body.

2.Nucleotides are the structural units of nucleic acids

 3.Each nucleotide consists of three components: a pentose sugar, a phosphate group, and a nitrogen-containing base.

5. DNA, or Deoxyribonucleic Acid

4. There are five nitrogenous bases used in nucleic acids: Adenine (A), Guanine (G), Cytosine (C), Uracil (U), and Thymine (T).

a. DNA is the genetic material of the cell, and is found within the nucleus.

b. DNA replicates itself before cell division and provides instructions for making all of the proteins found in the body.

c. The structure of DNA is a double-stranded polymer containing the nitrogenous bases A, T, G, and C, and the sugar deoxyribose.

 d. Bonding of the nitrogenous bases in DNA is very specific; A bonds to T, and G bonds to C.

e. The bases that always bind together are known as complementary bases.

6. RNA, or Ribonucleic Acid

a. RNA is located outside the nucleus, and is used to make proteins using the instructions provided by the DNA.

b. The structure of RNA is a single-stranded polymer containing the nitrogenous bases A, G, C, and U, and the sugar ribose.

c. In RNA, G bonds with C, and A bonds with U. F.

7. ATP, or Adenosine Triphosphate (pp. 55–56; Figs. 2.23–2.24)

1. ATP is the energy currency used by the cell.

2. ATP is an adenine-containing RNA nucleotide that has two additional phosphate groups attached.

3. The additional phosphate groups are connected by high- energy bonds.

4. Breaking the high-energy bonds releases energy the cell can use to do work.

**TEST 3- The Plasma Membrane: Structure (pp. 63–67; Figs. 3.3–3.5)**

A. The Fluid Mosaic Model (pp. 63–64; Figs. 3.3–3.4)

1. The plasma membrane is composed of a double layer of phospholipids in which small amounts of cholesterol and proteins are embedded.

2. The phospolipid bilayer is composed of two layers of phospholipids lying tail to tail, with their polar heads exposed to water inside and outside the cell.

3. The inward-facing and outward-facing surfaces of the plasma membrane differ in the kinds and amounts of lipid they contain.

a. Glycolipids are found only in the outer membrane.

b. Lipid rafts are also found only in the outer membrane, and are assumed to function in cell signaling.

4. Integral proteins are firmly inserted into the plasma membrane.

a. Most integral proteins are transmembrane proteins that span the entire width of the membrane and are involved with transport as channels or carriers.

5. Peripheral proteins are not embedded in the plasma membrane, but attach to integral proteins or to phospolipids. Peripheral proteins may function as enzymes or in mechanical functions of the cell.

6. The glycocalyx is the fuzzy, sticky, carbohydrate-rich area surrounding the cell.

B. Membrane Junctions (pp. 66–67; Fig. 3.5)

1. Most body cells are bound together using glycolipids, specialized interlocking regions, or specialized membrane junctions.

2. Tight junctions are a type of membrane junction in which integral proteins on adjacent cells fuse together to form an impermeable junction in order to prevent molecules from passing through the extracellular space between cells.

**III. The Plasma Membrane: Membrane Transport (pp. 68–77; Figs. 3.6–3.14; Tables 3.1–3.2)**

A. **Passive processes do not use energy (ATP)** to move substances down their con- centration gradient (pp. 68–73; Figs. 3.6–3.9; Table 3.1).

1. Diffusion is the movement of molecules down their concentration gradient. The rate of diffusion is influenced by the size of the molecule and the tem- perature.

2. **Simple diffusion** is diffusion through the plasma membrane.

3. In **facilitated diffusion** substances are moved through the plasma membrane by binding to protein carriers in the membrane or by moving through channels.

4. **Osmosis** is the diffusion of water through a selectively permeable membrane.

B. **Active transport processes use energy (ATP)** to move substances across a mem- brane (pp. 73–77; Figs. 3.10–

3.14; Table 3.2).

1. **Active transport** uses solute pumps to move substances against a concentration gradient. The two kinds of

active transport are primary active transport and secondary active transport.

2. Vesicular transport is the means by which large particles, macromolecules, and fluids are transported across

the plasma membrane, or within the cell.

3. **Exocytosis** is a process used to move substances from inside the cell to the extracellular environment.

4. **Endocytosis**, transcytosis, and vesicular trafficking are vesicular transport processes that move molecules using

**TEST 4. The Skin (pp. 149–155; Figs. 5.1–5.4)**

**A. The hypodermis** is subcutaneous tissue beneath the skin consisting mostly of adipose tissue that anchors the skin to underlying muscle, allows skin to slide over muscle, and acts as a shock absorber and insulator (p. 149; Fig. 5.1).

**B. Epidermis (pp. 150–152; Fig. 5.2)**

1. The epidermis is a keratinized stratified squamous epithelium.

2. Cells of the Epidermis

a. The majority of epidermal cells are keratinocytes that produce a fibrous protective protein called keratin.

b. Melanocytes are epithelial cells that synthesize the pigment melanin.

c. Epidermal dendritic cells or Langerhans cells, are macrophages that help activate the immune system.

d. Tactile cells are associated with sensory nerve endings.

3. **Layers of the Epidermis**

a. The stratum basale (basal layer) is the deepest epidermal layer and is the site of mitosis.

b. The stratum spinosum (prickly layer) is several cell layers thick and con- tains keratinocytes, melanin granules, and the highest concentration of epidermal dendritic cells.

c. The stratum granulosum (granular layer) contains keratinocytes that are undergoing a great deal of physical changes, turning them into the tough outer cells of the epidermis.

d. The stratum lucidum (clear layer) is found only in thick skin and is composed of dead keratinocytes.

e. The stratum corneum (horny layer) is the outermost protective layer of the epidermis composed of a thick layer of dead keratinocytes.

**C. Dermis (pp. 152–153; Figs. 5.3–5.4)**

 1. The dermis is composed of strong, flexible connective tissue.

2. The dermis is made up of two layers: the thin, superficial papillary layer is

highly vascularized areolar connective tissue containing a woven mat of collagen and elastin fibers; and the reticular layer, accounting for 80% of the thickness of the dermis, is dense irregular connective tissue.

D. Skin color is determined by three pigments: melanin, hemoglobin, and carotene (pp. 154–155).

**TEST 5: Bones & Skeletal Tissues**

**I. Skeletal Cartilages (p. 173; Fig. 6.1)**

A. Basic Structure, Types, and Locations (p. 173; Fig. 6.1)

1. Skeletal cartilages are made from cartilage, surrounded by a layer of dense irregular connective tissue called the perichondrium. It is avascular and made mostly of water.

2. Hyaline cartilage is the most abundant skeletal cartilage, and includes the articular (joints) , costal (sternum/ribs), respiratory (lungs/resp passageways), and nasal cartilages.

3. Elastic cartilages are more flexible than hyaline, and are located only in the external ear and the epiglottis of the larynx.

4. Fibrocartilage is located in areas that must withstand a great deal of pressure or stretch, such as the cartilages of the knee and the intervertebral discs.

**II. Classification of Bones (pp. 173–175; Figs. 6.1–6.2) 206 Bones**

A. There are two main divisions of the bones of the skeleton: the axial skeleton, consisting of the skull, vertebral column, and rib cage; and the appendicular skeleton, consisting of the bones of the upper and lower limbs, and the girdles (pelvic and shoulder) that attach them to the axial skeleton (pp. 173–174; Fig. 6.1).

B. Shape (pp. 174–175; Fig. 6.2)

1. Long bones are longer than they are wide, have a definite shaft and two ends, and consist of all limb bones except patellas, carpals, and tarsals.

2. Short bones are somewhat cube shaped and include the carpals and tarsals.

3. Flat bones are thin, flattened, often curved bones that include most skull bones, the sternum, scapulae, and ribs.

4. Irregular bones have complicated shapes that do not fit in any other class, such as the vertebrae and coxae.

**III. Functions of Bones (pp. 175–176)**

1. Bones support the body and cradle the soft organs
2. protect vital organs
3. allow movement: **tendons connect muscle to bone**
4. store minerals such as calcium and phosphate
5. house hematopoietic tissue in specific marrow cavities (pp. 175–176).

**IV. Bone Structure (pp. 176–182; Figs. 6.3–6.7; Table 6.1)**

A. Gross Anatomy (pp. 176–178; Figs. 6.3, 6.5; Table 6.1)

1. Bone markings are projections, depressions, and openings found on the surface of bones that function as sites of muscle, ligament, and tendon attachment, as joint surfaces, and as openings for the passage of blood vessels and nerves.

2. **Bone Textures: Compact and Spongy Bone**

a. All bone has a dense outer layer consisting of compact bone that appears smooth and solid.

b. Internal to compact bone is spongy bone, which consists of honeycomb, needle-like, or flat pieces, called trabeculae.

3. **Structure of a Typical Long Bone**

a. Long bones have a tubular bone shaft, consisting of a bone collar surrounding a hollow medullary cavity, which is filled with yellow bone marrow in adults. Diaphysis

b. Epiphyses are at the ends of the bone, and consist of internal spongy bone covered by an outer layer of compact bone.

c. The epiphyseal line is located between the epiphyses and diaphysis, and is a remnant of the epiphyseal plate.

d. The external surface of the bone is covered by the periosteum.

e. The internal surface of the bone is lined by a connective tissue membrane called the endosteum.

**4. Structure of Short, Flat, and Irregular Bones**

a. Short, flat, and irregular bones consist of thin plates of periosteum- covered compact bone on the outside, and endosteum-covered spongy bone inside, which houses bone marrow between the trabeculae.

B. **Microscopic Anatomy of Bone (pp. 179–180; Figs. 6.3–6.7)**

1. The structural unit of compact bone is the osteon, or Haversian system, which consists of concentric tubes of bone matrix (the lamellae) surrounding a central Haversian canal that serves as a passageway for blood vessels and nerves.

a. Perforating, or Volkmann’s, canals lie at right angles to the long axis of the bone, and connect the blood and nerve supply of the periosteum to that of the central canals and medullary cavity.

b. Osteocytes occupy lacunae at the junctions of the lamellae, and are connected to each other and the central canal via a series of hairlike channels, canaliculi.

c. Circumferential lamellae are located just beneath the periosteum, extending around the entire circumference of the bone, while interstitial lamellae lie between intact osteons, filling the spaces in between.

2. Spongy bone lacks osteons but has trabeculae that align along lines of stress, which contain irregular lamellae.

C. Chemical Composition of Bone (p. 180)

1. Organic components of bone include cells (osteoblasts **bone destroying**, osteocytes **mature bone cells**, and osteoclasts **bone forming**) and osteoid (ground substance and collagen fibers), which contribute to the flexibility and tensile strength of bone.

2. Inorganic components make up 65% of bone by mass, and consist of hydroxyapatite, a mineral salt that is largely calcium phosphate, which accounts for the hardness and compression resistance of bone.

**TEST 7- Muscular System**

Overview of Muscle Tissues (pp. 276–277; Table 9.3)

A. **Types of Muscle Tissue (p. 276; Table 9.3)**

1. Skeletal muscle is associated with the bony skeleton, and consists of large cells that bear striations and are controlled voluntarily.

2. Cardiac muscle occurs only in the heart, and consists of small cells that are striated and under involuntary control.

3. Smooth muscle is found in the walls of hollow organs, and consists of small elongated cells that are not striated and are under involuntary control.

 ***II. Skeletal Muscle (pp. 277–305; Figs. 9.1–9.25; Tables 9.1–9.3)***

A. Gross Anatomy of Skeletal Muscle (pp. 277–278; Fig. 9.2; Tables 9.1, 9.3)

1. Each muscle has a nerve and blood supply that allows neural control and ensures adequate nutrient delivery and waste removal.

2. Connective tissue sheaths are found at various structural levels of each muscle: endomysium surrounds each muscle fiber, perimysium surrounds groups of muscle fibers, and epimysium surrounds whole muscles.

3. Attachments span joints and cause movement to occur from the movable bone (the muscle’s insertion) toward the less movable bone (the muscle’s origin).

4. Muscle attachments may be direct or indirect.

B. Microscopic Anatomy of a Skeletal Muscle Fiber (pp. 278–284; Figs. 9.2–9.6; Tables 9.1, 9.3)

1. Skeletal muscle fibers are long cylindrical cells with multiple nuclei beneath the sarcolemma.

2. Myofibrils account for roughly 80% of cellular volume, and contain the contractile elements of the muscle cell.

3. Striations are due to a repeating series of dark A bands and light I bands.

4. Myofilaments make up the myofibrils, and consist of thick and thin filaments.

5. Ultrastructure and Molecular Composition of the Myofilaments

a. There are two types of myofilaments in muscle cells: thick filaments composed of bundles of myosin, and thin filaments composed of strands of actin.

b. Tropomyosin and troponin are regulatory proteins present in thin filaments.

6. The sarcoplasmic reticulum is a smooth endoplasmic reticulum surrounding each myofibril.

7. T tubules are infoldings of the sarcolemma that conduct electrical impulses from the surface of the cell to the terminal cisternae.

C. The sliding filament model of muscle contraction states that during contraction, the thin filaments slide past the thick filaments. Overlap between the myofilaments increases and the sarcomere shortens (p. 284; Fig. 9.6).

D. Physiology of a Skeletal Muscle Fiber (pp. 284–289; Figs. 9.6–9.12; Table 9.3)

1. The neuromuscular junction is a connection between an axon terminal and a muscle fiber that is the route of electrical stimulation of the muscle cell.

2. A nerve impulse causes the release of acetylcholine to the synaptic cleft, which binds to receptors on the motor end plate, triggering a series of electrical events on the sarcolemma.

3. Generation of an action potential across the sarcolemma occurs in response to acetylcholine binding with receptors on the motor end plate. It involves the influx of sodium ions, which makes the membrane potential slightly less negative.

4. Excitation-contraction coupling is the sequence of events by which an action potential on the sarcolemma results in the sliding of the myofilaments.

5. Ionic calcium in muscle contraction is kept at almost undetectable levels within the cell through the regulatory action of intracellular proteins.

6. Muscle fiber contraction follows exposure of the myosin binding sites, and follows a series of events.

E. Contraction of a Skeletal Muscle (pp. 289–296; Figs. 9.13–9.18)

1. A motor unit consists of a motor neuron and all the muscle fibers it innervates. It is smaller in muscles that exhibit fine control.

2. The muscle twitch is the response of a muscle to a single action potential on its motor neuron.

3. There are three kinds of graded muscle responses: wave summation, multiple motor unit summation (recruitment), and treppe.

4. Muscle tone is the phenomenon of muscles exhibiting slight contraction, even when at rest, which keeps muscles firm, healthy, and ready to respond.

5. Isotonic contractions result in movement occurring at the joint and shortening of muscles.

6. Isometric contractions result in increases in muscle tension, but no lengthening or shortening of the muscle occurs.

F. Muscle Metabolism (pp. 296–300; Figs. 9.19–9.20)

1. Muscles contain very little stored ATP, and consumed ATP is replenished rapidly through phosphorylation by creatine phosphate, glycolysis and anaerobic respiration, and aerobic respiration.

2. Muscles will function aerobically as long as there is adequate oxygen, but when exercise demands exceed the ability of muscle metabolism to keep up with ATP demand, metabolism converts to anaerobic glycolysis.

3. Muscle fatigue is a problem in excitation-contraction coupling or within the muscle cells themselves.

4. Oxygen deficit is the extra oxygen needed to replenish oxygen reserves, glycogen stores, ATP and creatine phosphate reserves, as well as conversion of lactic acid to pyruvic acid glucose after vigorous muscle activity.

5. Heat production during muscle activity is considerable. It requires release of excess heat through homeostatic mechanisms such as sweating and radiation from the skin.

G. Force of Muscle Contraction (pp. 300–302; Figs. 9.21–9.22)

1. As the number of muscle fibers stimulated increases, force of contraction increases.

2. Large muscle fibers generate more force than smaller muscle fibers.

3. As the rate of stimulation increases, contractions sum up, ultimately producing tetanus and generating more force.

4. There is an optimal length-tension relationship when the muscle is slightly stretched and there is slight overlap between the myofibrils.

 **TEST 8 - The Eye and Vision (pp. 548–569; Figs. 15.1–15.20)**

A. Vision is our dominant sense; 70% of our body’s sensory receptors are found in the eye (p. 548).

B. Accessory Structures of the Eye (pp. 548–551; Figs. 15.1–15.3)

1. **Eyebrows** are short, coarse hairs overlying the supraorbital margins of the eye that shade the eyes and keep perspiration out.

2. **Eyelids** (palpebrae), eyelashes, and their associated glands help to protect the eye from physical danger as well as from drying out.

3. **Conjunctiva** is a transparent mucous membrane that lines the eyelids and the whites of the eyes. It produces a lubricating mucus that prevents the eye from drying out.

4. The **lacrimal gland**, which secretes a dilute saline solution that cleanses and protects the eye as it moistens it, and ducts that drain excess fluid into the nasolacrimal duct.

5. The movement of each eyeball is controlled by six **extrinsic eye muscles**

C. Structure of the Eyeball (pp. 551–556; Figs. 15.4–15.9)

1. Three layers form the wall of the eyeball.

a. **The fibrous** tunic is the outermost coat of the eye and is made of a dense avascular connective tissue with two regions: the sclera and the cornea.

b. **The vascular** tunic (uvea) is the middle layer and has three regions: the choroid, the ciliary body, and the iris.

c. **The inner layer** (retina) is the innermost layer made up of two layers: the outer pigmented layer absorbs light; the inner neural layer contains millions of photoreceptors (rods and cones) that transduce light energy.

\*Photoreception is the process by which the eye detects light energy.

Photoreceptors are modified neurons that structurally resemble tall epithelial cells.

**Rods** are highly sensitive and are best suited to **night vision**. Cones are less sensitive to light and are best adapted to bright light and color vision.

 Photoreceptors contain a light-absorbing molecule called retinal.

2. **Internal Chambers and Fluids**

a. The posterior segment (cavity) is filled with a clear gel called **vitreous humor** that transmits light, supports the posterior surface of the lens, holds the retina firmly against the pigmented layer, and contributes to intraocular pressure.

b. The anterior segment (cavity) is filled with **aqueous humor** that supplies nutrients and oxygen to the lens and cornea while carrying away wastes.

3. **The lens** is an avascular, biconcave, transparent, flexible structure that can change shape to allow precise focusing of light on the retina.

 D. Light and Optics

a. The **far point of vision is that distance beyond which no change in lens shape** is required (about 6 meters or **20 feet).**

b. Focusing for close vision demands that the eye make three adjustments: accommodation of the lens, constriction of the pupils, and convergence of the eyeballs.

c. **Myopia,** or nearsightedness, occurs when objects focus in front of the retina and results in seeing close objects without a problem but distant objects are blurred.

d. **Hyperopia,** or farsightedness, occurs when objects are focused behind the retina and results in seeing distant objects clearly but close objects are blurred.