Domain 3 of 4

Biolo

Overview

This section tests knowledge of the processes unique to living organisms, including the biochemical and molecular mechanisms of cellular processes. It consists of 59 questions in 95 minutes and draws heavily from biology, biochemistry, and organic chemistry.

Approximately 65% of questions test biology and biochemistry, 25% test organic chemistry, and 10% test general chemistry in biological contexts.

Molecular Biology

- DNA structure: double helix, base pairing (A-T, G-C), antiparallel strands
- DNA replication: semi-conservative, leading/lagging strand, Okazaki fragments
- Transcription: RNA polymerase, promoters, mRNA processing (capping, splicing, polyadenylation)
- Translation: ribosomes, codons, tRNA, start/stop codons, post-translational modification
- Gene regulation: operons (lac, trp), transcription factors, epigenetics
- Mutations: point mutations, frameshift, silent, missense, nonsense

> ■ **Exam Tip:** Know the central dogma: DNA → RNA → Protein. Understand each step's enzymes, direction (5' to 3'), and regulation. These concepts appear in nearly every MCAT biology passage.

Metabolism

- Glycolysis: 10 steps, net 2 ATP, 2 NADH, 2 pyruvate (cytoplasm)
- Pyruvate decarboxylation: pyruvate → acetyl-CoA + CO■ + NADH
- Citric acid cycle (TCA): 8 steps, 3 NADH, 1 FADH■, 1 GTP per turn
- Electron transport chain: NADH → 2.5 ATP, FADH■ → 1.5 ATP, chemiosmosis
- Gluconeogenesis, glycogenesis, glycogenolysis, and their regulation
- Fatty acid oxidation (β-oxidation) and fatty acid synthesis
- Amino acid catabolism: transamination, urea cycle

Cell Biology

- Cell membrane: fluid mosaic model, phospholipid bilayer, membrane proteins
- Transport: simple diffusion, facilitated diffusion, active transport, endocytosis
- Cell cycle: G1, S, G2, M phases; checkpoints; cyclins and CDKs
- Mitosis vs. meiosis: stages, chromosome number, genetic variation
- Organelles: nucleus, mitochondria, ER, Golgi, lysosomes, peroxisomes
- Signal transduction: receptor tyrosine kinases, G-protein coupled receptors, second messengers

> ■ **Exam Tip:** For metabolism questions, trace the carbon atoms. Glucose (6C) → 2 pyruvate (3C each) → 2 acetyl-CoA (2C each) + 2 CO■. The 2C acetyl group enters the TCA cycle.

Genetics and Evolution

- Mendelian genetics: dominant/recessive, incomplete dominance, codominance
- Sex-linked traits, autosomal vs. X-linked inheritance patterns
- Hardy-Weinberg equilibrium: $p^2 + 2pq + q^2 = 1$
- Natural selection, genetic drift, gene flow, mutation as evolutionary forces
- Speciation: allopatric vs. sympatric, reproductive isolation mechanisms