

MCAT® Content Checklist as derived from AAMC

Content Category 1A: Structure/function of proteins and their constituent amino acids

Amino Acids/Peptides

- ☐ Absolute configuration at the α position
- ☐ Amino acids as dipolar ions
- ☐ Acidic or basic
- ☐ Hydrophobic or hydrophilic
- ☐ Sulfur linkage for cysteine and cysteine
- ☐ Peptide linkage: polypeptides and proteins
- ☐ Hydrolysis

Proteins

- ☐ 1°, 2°, 3°, 4° structure of proteins
- ☐ Denaturing and folding
- ☐ Hydrophobic interactions
- ☐ Solvation layer (entropy)
- ☐ Role of proline, cysteine and hydrophobic bonding

Protein separation techniques

- ☐ Isoelectric point
- ☐ Electrophoresis

Non-Enzymatic Protein Function

- ☐ Binding
- ☐ Immune system
- ☐ Motors

Enzyme Structure/Function

- ☐ Enzyme function in catalyzing biological reactions
- ☐ Classification of enzymes by reaction type
- ☐ Effects of local conditions on enzyme activity
- ☐ Reduction of activation energy
- ☐ Substrates and enzyme specificity
- ☐ Active Site Model
- ☐ Induced-fit Model
- ☐ Mechanism of catalysis
- ☐ Cofactors and Coenzymes
- ☐ Water-soluble vitamins

Control of Enzyme Kinetics

- ☐ General (catalysis)
- ☐ Michaelis-Menten
- ☐ Cooperativity
- ☐ Feedback regulation

Inhibition

- ☐ Competitive and Non-competitive
- ☐ Mixed
- ☐ Uncompetitive

Enzyme regulation

- ☐ Allosteric enzymes
- ☐ Covalently-modified enzymes
- ☐ Zymogens

Content Category 1B: Transmission of genetic information from the gene to the protein

Nucleic Acid Structure and Function

- ☐ Nucleotides and nucleosides
- ☐ Sugar phosphate backbone
- ☐ Pyrimidine, purine residues
- ☐ Deoxyribonucleic acid (DNA): double helix, Watson–Crick model of DNA structure
- ☐ Base pairing specificity: A with T, G with C
- ☐ Function in transmission of genetic information
- ☐ DNA denaturation, reannealing, hybridization

DNA Replication and Repair

- ☐ Mechanism of replication: separation of strands, specific coupling of free nucleic acids
- ☐ Semi-conservative nature of replication
- ☐ Specific enzymes involved in replication
- ☐ Origins of replication, multiple origins in eukaryotes
- ☐ Replicating the ends of DNA molecules

The Genetic Code

- ☐ Central Dogma: DNA → RNA
- ☐ The triplet code
- ☐ Codon-anticodon relationship
- ☐ Degenerate code, wobble pairing
- ☐ Missense, nonsense codons
- ☐ Initiation, termination codons
- ☐ Messenger RNA (mRNA)

Transcription

- ☐ tRNA and rRNA
- ☐ Mechanism of transcription
- ☐ mRNA processing in eukaryotes, introns, exons
- ☐ Ribozymes, spliceosomes, small nuclear ribonucleoproteins, small nuclear RNA
- ☐ Evolutionary importance of introns

Translation

- ☐ Roles of mRNA, tRNA, rRNA
- ☐ Role and structure of ribosomes
- ☐ Initiation, termination co-factors
- ☐ Post-translational modification of proteins

Eukaryotic Chromosome Organization

- ☐ Chromosomal proteins
- ☐ Single copy vs. repetitive DNA
- ☐ Supercoiling
- ☐ Heterochromatin vs. euchromatin
- ☐ Telomeres, centromeres
- ☐ Repair during replication
- ☐ Repair during replication
- ☐ Repair of mutations
- ☐ Telomeres, centromeres

Gene Expression in Prokaryotes

- ☐ Jacob-Monod Model
- ☐ Gene repression in bacteria
- ☐ Positive control in bacteria

Control of Gene Expression in Eukaryotes

- ☐ Transcriptional regulation
- ☐ DNA binding proteins, transcription factors
- ☐ Gene amplification and duplication
- ☐ Post-transcriptional control, basic concept of splicing (introns, exons)
- ☐ Cancer as a failure of normal cellular controls, oncogenes, tumor suppressor genes
- ☐ Regulation of chromatin structure
- ☐ DNA methylation
- ☐ Non-coding RNAs

Recombinant DNA and Biotechnology

- ☐ Gene cloning and cloned gene expression
- ☐ Restriction enzymes
- ☐ DNA libraries
- ☐ Generation of cDNA
- ☐ Hybridization and Polymerase Chain Reaction
- ☐ Gel Electrophoresis and Southern Blotting
- ☐ DNA sequencing
- ☐ Analyzing gene expression
- ☐ Determining gene function
- ☐ Stem cells
- ☐ Applications of DNA technology: gene therapy, pharmaceuticals, forensic evidence, environmental cleanup, agriculture

Content Category 1C: Transmission of heritable information from generation to generation and the processes that increase genetic diversity

Mendelian Genetics

- ☐ Phenotype and genotype
- ☐ Gene and locus
- ☐ Allele: single and multiple
- ☐ Homozygosity and heterozygosity
- ☐ Wild-type
- ☐ Recessiveness
- ☐ Complete dominance
- ☐ Co-dominance
- ☐ Incomplete dominance, leakage, penetrance, expressivity
- ☐ Hybridization: viability
- ☐ Gene pool

Meiosis and Other Factors Affecting Genetic Variability

- ☐ Significance of meiosis
- ☐ Important differences between meiosis and mitosis
- ☐ Segregation of genes
- ☐ Independent assortment
- ☐ Linkage
- ☐ Recombination
- ☐ Single and double crossovers
- ☐ Synaptonemal complex
- ☐ Tetrad

Sex-linked characteristics

- ☐ Few genes on Y chromosome
- ☐ Sex determination
- ☐ Cytoplasmic/extranuclear inheritance

Mutation

- ☐ Error in DNA sequence
- ☐ Types of mutations: random, translation error, transcription error, base substitution, inversion, addition, deletion, translocation, mis-pairing
- ☐ Advantageous vs. deleterious mutation
- ☐ Inborn errors of metabolism
- ☐ Relationship of mutagens to carcinogens
- ☐ Genetic drift
- ☐ Synapsis or crossing-over mechanism and genetic diversity

Analytic Methods

- ☐ Hardy-Weinberg Principle
- ☐ Testcross (Backcross; parent, F1 and F2 generations)
- ☐ Gene mapping: crossover frequencies
- ☐ Biometry: statistical methods

Evolution

- ☐ Natural selection
- ☐ Fitness concept
- ☐ Selection by differential reproduction
- ☐ Concepts of natural and group selection
- ☐ Evolutionary success as increase in percent representation in the gene pool of the next generation

Speciation

- ☐ Polymorphism
- ☐ Adaptation and specialization
- ☐ Inbreeding
- ☐ Outbreeding
- ☐ Bottlenecks
- ☐ Evolutionary time as measured by gradual random changes in genome

Content Category 1D: Principles of bioenergetics and fuel molecule metabolism

Principles of Bioenergetics

- ☐ Bioenergetics/thermodynamics
- ☐ Free energy/ K_{eq} and Equilibrium constant
- ☐ Relationship of the equilibrium constant and ΔG°
- ☐ Le Châtelier's Principle
- ☐ Endothermic/exothermic reactions
- ☐ Free energy: G , Spontaneous reactions and ΔG°
- ☐ Phosphoryl group transfers and ATP
- ☐ ATP hydrolysis $\Delta G \ll 0$
- ☐ ATP group transfers
- ☐ Half-reactions in biological redox reactions
- ☐ Soluble electron carriers
- ☐ Flavoproteins

Carbohydrates

- ☐ Nomenclature and classification
- ☐ Absolute configuration
- ☐ Cyclic structure and conformation
- ☐ Epimers and anomers
- ☐ Hydrolysis of the glycoside linkage
- ☐ Mono, di and polysaccharides

Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway

- ☐ Glycolysis (aerobic), substrates and products
- ☐ Feeder pathways: glycogen, starch metabolism
- ☐ Fermentation (anaerobic glycolysis)
- ☐ Gluconeogenesis, Pentose phosphate pathway
- ☐ Net molecular and energetic results of respiration processes

Principles of Metabolic Regulation

- ☐ Regulation of metabolic pathways
- ☐ Maintenance of a dynamic steady state
- ☐ Regulation of glycolysis and gluconeogenesis
- ☐ Metabolism of glycogen
- ☐ Regulation of glycogen synthesis and breakdown of Allosteric and hormonal control
- ☐ Analysis of metabolic control

Citric Acid Cycle

- ☐ Acetyl-CoA production
- ☐ Reactions of the cycle, substrates and products
- ☐ Regulation of the cycle
- ☐ Net molecular and energetic results of respiration processes

Metabolism of Fatty Acids and Proteins

- ☐ Description of fatty acids
- ☐ Digestion, mobilization, and transport of fats
- ☐ Oxidation of fatty acids - Saturated and unsaturated fats
- ☐ Ketone bodies
- ☐ Anabolism of fats
- ☐ Biosynthesis of lipids and polysaccharides
- ☐ Metabolism of proteins

Oxidative Phosphorylation

- ☐ Electron transport chain and oxidative phosphorylation, substrates and products, general features of the pathway
- ☐ Electron transfer in mitochondria
- ☐ NADH, NADPH
- ☐ Flavoproteins
- ☐ Cytochromes
- ☐ ATP synthase, chemiosmotic coupling
- ☐ Proton motive force
- ☐ Net molecular and energetic results of respiration processes
- ☐ Regulation of oxidative phosphorylation
- ☐ Mitochondria, apoptosis, oxidative stress

Hormonal Regulation and Integration of Metabolism

- ☐ Higher level integration of hormone structure and function
- ☐ Tissue specific metabolism
- ☐ Hormonal regulation of fuel metabolism
- ☐ Obesity and regulation of body mass

Category 2A: Assemblies of molecules, cells, and groups of cells within single cellular and multicellular organisms

Plasma Membrane

- ☐ General function in cell containment
- ☐ Composition of membranes
- ☐ Lipid components
- ☐ Phospholipids (and phosphatids)
- ☐ Steroids
- ☐ Waxes
- ☐ Protein components
- ☐ Fluid mosaic model
- ☐ Membrane dynamics
- ☐ Solute transport across membranes
- ☐ Thermodynamic considerations
- ☐ Osmosis
- ☐ Colligative properties, osmotic pressure
- ☐ Passive transport
- ☐ Active transport
- ☐ Sodium/potassium pump
- ☐ Membrane channels
- ☐ Membrane potential
- ☐ Membrane receptors
- ☐ Exocytosis and endocytosis

Intercellular junctions

- ☐ Gap junctions
- ☐ Tight junctions
- ☐ Desmosomes

Membrane-Bound Organelles and Defining Characteristics of Eukaryotic Cells

- ☐ Defining characteristics of eukaryotic cells: membrane bound nucleus, presence of organelles, mitotic division

Nucleus

- ☐ Compartmentalization, storage of genetic information
- ☐ Nucleolus: location and function
- ☐ Nuclear envelope, nuclear pores

Mitochondria

- ☐ Site of ATP production
- ☐ Inner and outer membrane structure
- ☐ Self-replication
- ☐ Lysosomes: membrane-bound vesicles containing hydrolytic enzymes

Endoplasmic reticulum

- ☐ Rough and smooth components
- ☐ Rough endoplasmic reticulum site of ribosomes
- ☐ Double membrane structure
- ☐ Role in membrane biosynthesis
- ☐ Role in biosynthesis of secreted proteins
- ☐ Golgi apparatus: general structure and role in packaging and secretion
- ☐ Peroxisomes: organelles that collect peroxides

Cytoskeleton

- ☐ General function in cell support and movement
- ☐ Microfilaments: composition and role in cleavage and contractility
- ☐ Microtubules: composition and role in support and transport
- ☐ Intermediate filaments, role in support
- ☐ Composition and function of cilia and flagella
- ☐ Centrioles, microtubule organizing centers

Tissues Formed From Eukaryotic Cells

- ☐ Epithelial cells
- ☐ Connective tissue cells

Content Category 2B: The structure, growth, physiology, and genetics of prokaryotes and viruses

Cell Theory

- ☐ History, development, impact on biology

Classification and Structure of Prokaryotic Cells

- ☐ Prokaryotic domains: Archaea and Bacteria
- ☐ Major classifications of bacteria by shape: Bacilli, Spirilli or Cocci
- ☐ Lack of nuclear membrane and mitotic apparatus
- ☐ Presence of cell wall in bacteria
- ☐ Flagellar propulsion, mechanism

Growth and Physiology of Prokaryotic Cells

- ☐ Reproduction by fission
- ☐ High degree of genetic adaptability, acquisition of antibiotic resistance
- ☐ Exponential growth
- ☐ Existence of anaerobic and aerobic variants
- ☐ Parasitic and symbiotic
- ☐ Chemotaxis

Genetics of Prokaryotic Cells

- ☐ Existence of plasmids, extragenomic DNA
- ☐ Transformation: incorporation into bacterial genome of DNA fragments from external medium

- ☐ Conjugation

- ☐ Transposons (including eukaryotic cells)

Virus Structure

- ☐ General structural characteristics (nucleic acid and protein, enveloped and non-enveloped)
- ☐ Lack organelles and nucleus
- ☐ Structural aspects of typical bacteriophage
- ☐ Genomic content - RNA or DNA
- ☐ Size relative to bacteria and eukaryotic cells

Viral Life Cycle

- ☐ Self-replicating biological units that reproduce within host cell
- ☐ Generalized phage and animal virus life cycles
- ☐ Attachment to host, penetration of cell membrane or cell wall, and entry of viral genetic material
- ☐ Use of host synthetic mechanism to replicate viral components
- ☐ Self-assembly and release of new viral particles
- ☐ Transduction: transfer of genetic material by viruses
- ☐ Retrovirus life cycle: integration into host DNA, reverse transcriptase, HIV
- ☐ Prions and viroids: subviral particles

Content Category 2C: Processes of cell division, differentiation, and specialization

Mitosis and mitotic structures

- ☐ Mitotic process: prophase, metaphase, anaphase, telophase, interphase
- ☐ Centrioles, asters, spindles
- ☐ Chromatids, centromeres, kinetochores
- ☐ Nuclear membrane breakdown and reorganization
- ☐ Mechanisms of chromosome movement
- ☐ Phases of cell cycle: G0, G1, S, G2, M
- ☐ Growth arrest
- ☐ Control of cell cycle
- ☐ Loss of cell cycle controls in cancer cells

Biosignalling

- ☐ Oncogenes, apoptosis

Reproductive System

- ☐ Gametogenesis by meiosis
- ☐ Ovum and sperm - differences in formation and morphology
- ☐ Relative contribution to next generation
- ☐ Reproductive sequence: fertilization, implantation, development, birth

Embryogenesis

- ☐ Stages of early development (order and general features of each stage)
- ☐ Fertilization
- ☐ Cleavage
- ☐ Blastula formation
- ☐ Gastrulation
- ☐ First cell movements
- ☐ Formation of primary germ layers (endoderm, mesoderm, ectoderm)
- ☐ Neurulation
- ☐ Major structures arising out of primary germ layers
- ☐ Neural crest
- ☐ Environment–gene interaction in development

Development – Cell specialization

- ☐ Determination
- ☐ Differentiation
- ☐ Tissue types
- ☐ Cell–cell communication in development
- ☐ Cell migration
- ☐ Pluripotency: stem cells
- ☐ Gene regulation in development
- ☐ Programmed cell death
- ☐ Existence of regenerative capacity in various species
- ☐ Senescence and aging

Content Category 3A: Structure and functions of the nervous and endocrine systems and ways in which these systems coordinate the organ systems

Nervous System: Structure and Function

- ☐ High level control and integration of body systems
- ☐ Adaptive capability to external influences
- ☐ Organization of vertebrate nervous system
- ☐ Sensor and effector neurons
- ☐ Sympathetic and parasympathetic nervous systems: antagonistic control
- ☐ Feedback loop, reflex arc
- ☐ Role of spinal cord and supraspinal circuits
- ☐ Feedback control with endocrine system

Nerve Cell and Electrochemistry

- ☐ Cell body: site of nucleus, organelles
- ☐ Dendrites: branched extensions of cell body
- ☐ Axon: structure and function
- ☐ Myelin sheath, Schwann cells, insulation of axon
- ☐ Nodes of Ranvier: propagation of nerve impulse along axon
- ☐ Synapse: site of impulse propagation between cells
- ☐ Synaptic activity: transmitter molecules
- ☐ Resting potential: electrochemical gradient
- ☐ Action potential: threshold, all-or-none
- ☐ Sodium/potassium pump
- ☐ Excitatory and inhibitory nerve fibers: summation, frequency of firing
- ☐ Glial cells, neuroglia
- ☐ Concentration cell: direction of electron flow, Nernst equation

Bio-signaling

- ☐ Voltage and ligand gated ion channels
- ☐ Receptor enzymes
- ☐ G protein-coupled receptors

Lipids

- ☐ Structures
- ☐ Steroids
- ☐ Terpenes and terpenoids

Endocrine System

- ☐ Function of endocrine system: specific chemical control at cell, tissue, and organ level
- ☐ Definitions of endocrine gland, hormone
- ☐ Major endocrine glands: names, locations, products
- ☐ Major types of hormones
- ☐ Neuroendocrinology — relation between neurons and hormonal systems

Mechanisms of Hormone Action

- ☐ Cellular mechanisms of hormone action
- ☐ Transport of hormones: blood supply
- ☐ Specificity of hormones: target tissue
- ☒ Integration with nervous system: feedback control regulation by second messengers
- ☐ Regulation by second messengers

Category 3B: Structure and integrative functions of the main organ systems

Respiratory System - general function

- ☐ Gas exchange, thermoregulation
- ☐ Protection against disease: particulate matter
- ☐ Structure of lungs and alveoli
- ☐ Breathing mechanisms
- ☐ Diaphragm, rib cage, differential pressure
- ☐ Resiliency and surface tension effects
- ☐ Thermoregulation: nasal and tracheal capillary beds; evaporation, panting
- ☐ Particulate filtration: nasal hairs, mucus/cilia system in lungs
- ☐ Alveolar gas exchange
- ☐ Diffusion, differential partial pressure
- ☐ Henry's Law
- ☐ pH control
- ☐ Regulation by nervous control - CO₂ sensitivity

Circulatory System

- ☐ Functions: circulation of oxygen, nutrients, hormones, ions and fluids, removal of metabolic waste
- ☐ Role in thermoregulation
- ☐ Four-chambered heart: structure and function
- ☐ Endothelial cells
- ☐ Systolic and diastolic pressure
- ☐ Pulmonary and systemic circulation
- ☐ Arterial and venous systems (arteries, arterioles, venules, veins)
- ☐ Structural and functional differences, pressure and flow characteristics of arterial and venous systems

Capillary beds

- ☐ Mechanisms of gas and solute exchange
- ☐ Mechanism of heat exchange
- ☐ Source of peripheral resistance

Composition of blood

- ☐ Plasma, chemicals, blood cells
- ☐ Erythrocyte production and destruction; spleen, bone marrow
- ☐ Regulation of plasma volume
- ☐ Coagulation, clotting mechanisms

Oxygen transport by blood

- ☐ Hemoglobin, hematocrit
- ☐ Oxygen content and affinity
- ☐ Carbon dioxide transport and level in blood
- ☐ Nervous and endocrine control

Lymphatic System

- ☐ Structure of lymphatic system
- ☐ Equalization of fluid distribution

- ☐ Transport of proteins and large glycerides

- ☐ Production of lymphocytes involved in immune reactions

- ☐ Return of materials to the blood

Immune System

- ☐ Innate (non-specific) vs. adaptive (specific) immunity
- ☐ Adaptive immune system cells
- ☐ T-lymphocytes and B-lymphocytes
- ☐ Innate immune system cells - Macrophages and Phagocytes
- ☐ Tissue – Bone marrow, Spleen, Thymus and Lymph nodes
- ☐ Concept of antigen and antibody
- ☐ Antigen presentation
- ☐ Clonal selection
- ☐ Antigen-antibody recognition
- ☐ Structure of antibody molecule
- ☐ Recognition of self vs. non-self, autoimmune diseases
- ☐ Major histocompatibility complex

Digestive System

- ☐ Ingestion
- ☐ Saliva as lubrication and source of enzymes
- ☐ Ingestion; esophagus, transport function

Stomach

- ☐ Storage and churning of food
- ☐ Low pH, gastric juice, mucal protection against self-destruction
- ☐ Production of digestive enzymes, site of digestion
- ☐ Structure (gross)

Liver

- ☐ Structural relationship within gastrointestinal system
- ☐ Production of bile
- ☐ Role in blood glucose regulation, detoxification

Bile

- ☐ Storage in gall bladder
- ☐ Function

Pancreas

- ☐ Production of enzymes
- ☐ Transport of enzymes to small intestine

Small Intestine

- ☐ Absorption of food molecules and water
- ☐ Function and structure of villi
- ☐ Production of enzymes, site of digestion

- ☐ Neutralization of stomach acid
- ☐ Structure (anatomic subdivisions)

Large Intestine

- ☐ Absorption of water
- ☐ Bacterial flora
- ☐ Structure (gross)
- ☐ Rectum: storage/elimination of waste
- ☐ Muscular control: peristalsis
- ☐ Endocrine control: hormones and targets tissues
- ☐ Nervous control: the enteric nervous system

Excretory System

Roles in homeostasis

- ☐ Blood pressure
- ☐ Osmoregulation
- ☐ Acid-base balance
- ☐ Removal of soluble nitrogenous waste

Kidney structure

- ☐ Cortex
- ☐ Medulla
- ☐ Nephron structure
- ☐ Glomerulus
- ☐ Bowman's capsule
- ☐ Proximal tubule
- ☐ Loop of Henle, distal tubule, collecting duct
- ☐ Glomerular filtration
- ☐ Secretion and reabsorption of solutes
- ☐ Concentration of urine
- ☐ Counter-current multiplier mechanism
- ☐ Storage and elimination: ureter, bladder, urethra
- ☐ Osmoregulation: capillary reabsorption of H₂O, amino acids, glucose, ions
- ☐ Muscular control: sphincter muscle

Reproductive System

- ☐ Male and female reproductive structures and their functions
- ☐ Gonads
- ☐ Genitalia
- ☐ Differences between male and female structures

Hormonal control of reproduction

- ☐ Male and female sexual development
- ☐ Female reproductive cycle
- ☐ Pregnancy, parturition, lactation
- ☐ Integration with nervous control

Muscle System - Function

- ☐ Support: mobility
- ☐ Peripheral circulatory assistance
- ☐ Thermoregulation (shivering reflex)
- ☐ Structure of three basic muscle types: striated, smooth, cardiac

Muscle structure and control of contraction

- ☐ T-tubule system
- ☐ Contractile apparatus
- ☐ Sarcoplasmic reticulum
- ☐ Fiber type
- ☐ Contractile velocity of different muscle types
- ☐ Regulation of cardiac muscle contraction
- ☐ Oxygen debt: fatigue

Nervous control

- ☐ Motor neurons
- ☐ Neuromuscular junction, motor end plates
- ☐ Sympathetic and parasympathetic innervation
- ☐ Voluntary and involuntary muscles

Specialized Cell - Muscle Cell

- ☐ Structural characteristics of striated, smooth, and cardiac muscle
- ☐ Abundant mitochondria in red muscle cells: ATP source
- ☐ Actin and myosin filaments, cross-bridge cycle, sliding filament model
- ☐ Sarcomeres: "I" and "A" bands, "M" and "Z" lines, "H" zone
- ☐ Presence of troponin and tropomyosin
- ☐ Calcium regulation of contraction

Skeletal System

- ☐ Functions of Structural rigidity and support
- ☐ Calcium storage
- ☐ Physical protection
- ☐ Skeletal structure
- ☐ Specialization of bone types, structures
- ☐ Joint structures
- ☐ Endoskeleton vs. exoskeleton

Bone structure

- ☐ Calcium and protein matrix
- ☐ Cellular composition of bone
- ☐ Cartilage: structure and function
- ☐ Ligaments, tendons
- ☐ Endocrine control

Integumentary System (Skin)

- ☐ Layer differentiation, cell types
- ☐ Relative impermeability to water
- ☐ Functions in homeostasis and osmoregulation
- ☐ Functions in thermoregulation
- ☐ Hair, erectile musculature
- ☐ Fat layer for insulation
- ☐ Sweat glands, location in dermis
- ☐ Vasoconstriction and vasodilation in surface capillaries
- ☐ Nails, calluses, hair
- ☐ Protection against abrasion, disease organisms
- ☐ Hormonal control: sweating, vasodilation, and vasoconstriction

Content Category 4A: Translational motion, forces, work, energy, and equilibrium in living systems

Translational motion

- ☐ Units and dimensions
- ☐ Vectors, vector addition
- ☐ Speed, velocity, acceleration

Force and Equilibrium

- ☐ Newton's First Law, inertia
- ☐ Newton's Second Law ($F=ma$)
- ☐ Newton's Third Law, forces equal and opposite
- ☐ Torques, lever arms
- ☐ Friction, Static and kinetic, Center of mass
- ☐ Vector analysis of forces acting on a point object

Work and Energy

- ☐ Work done by a constant force ($W=Fd \cos\theta$)
- ☐ Mechanical advantage
- ☐ Work Kinetic Energy Theorem
- ☐ Kinetic Energy: $KE= \frac{1}{2} mv^2$, units
- ☐ Potential Energy ($PE=mgh, PE_c=\frac{1}{2} kx^2$ spring)
- ☐ Conservation of energy and forces
- ☐ Power, units

Periodic Motion

- ☐ Amplitude, frequency, phase
- ☐ Transverse and longitudinal waves: wavelength and propagation on speed

Content Category 4B: Fluids in blood circulation, gas movement and gas exchange

Fluids

- ☐ Density, specific gravity
- ☐ Buoyancy, Archimedes' Principle ($F_B=\rho mg$)
- ☐ Hydrostatic pressure, $P=\rho gh$ (pressure vs depth)
- ☐ Pascal's Law ($F_1/A_1 = F_2/A_2$)
- ☐ Viscosity: Poiseuille Flow
- ☐ Continuity equation ($A_v=\text{constant}$)
- ☐ Turbulence at high velocities
- ☐ Surface tension
- ☐ Bernoulli's equation
- ☐ Venturi effect, pitot tube
- ☐ Arterial and venous systems; pressure and flow characteristics

Gas Phase

- ☐ Absolute temperature, Kelvin Scale (K)
- ☐ Pressure, simple mercury barometer
- ☐ Molar volume at 0°C and 1 atm = 22.4 L/mol

Ideal gas

- ☐ Definition
- ☐ Ideal Gas Law: $PV = nRT$
- ☐ Boyle's Law: $PV = \text{constant}$
- ☐ Charles' Law: $V/T = \text{constant}$
- ☐ Avogadro's Law: $V/n = \text{constant}$
- ☐ Kinetic Molecular Theory of Gases
- ☐ Heat capacity at constant volume and at constant pressure
- ☐ Boltzmann's Constant
- ☐ Deviation of real gas behavior from Ideal Gas Law: both Qualitative and Quantitative (Van der Waals' Equation)
- ☐ Partial pressure, mole fraction
- ☐ Dalton's Law relating partial pressure to composition

Content Category 4C: Electrochemistry and electrical circuits and their elements

Electrostatics

- ☐ Charge, conductors, charge conservation
- ☐ Insulators
- ☐ Coulomb's Law
- ☐ Electric field E
- ☐ Field lines
- ☐ Field due to charge distribution
- ☐ Electrostatic energy, electric potential at point in space

Circuit elements

- ☐ Current $I = \Delta Q / \Delta t$, sign conventions, units
- ☐ Electromotive force, voltage
- ☐ Resistance and Ohm's Law: $I = V/R$
- ☐ Resistors in series and parallel
- ☐ Resistivity $\rho = RA/L$

Capacitance

- ☐ Parallel plate capacitor
- ☐ Energy of charged capacitor
- ☐ Capacitors in series
- ☐ Capacitors in parallel
- ☐ Dielectrics
- ☐ Conductivity
- ☐ Metallic
- ☐ Electrolytic
- ☐ Meters

Magnetism

- ☐ Definition of magnetic field B
- ☐ Motion of charged particles in magnetic field; Lorentz force

Electrochemistry

- ☐ Electrolytic cell
- ☐ Electrolysis
- ☐ Anode, cathode
- ☐ Electrolyte
- ☐ Faraday's Law relating to the amount of elements deposited (or gas liberated) at an electrode to current
Electron flow; oxidation, and reduction at the electrodes

Galvanic or Voltaic cells

- ☐ Half-reactions
- ☐ Reduction potentials, cell potential
- ☐ Direction of electron flow
- ☐ Concentration cell

Batteries

- ☐ Electromotive force, Voltage
- ☐ Lead-storage batteries
- ☐ Nickel-cadmium batteries

Specialized nerve cell

- ☐ Myelin sheath, Schwann cells, insulation of axon
- ☐ Nodes of Ranvier: propagation of nerve impulse along axon

4D: How light and sound interact with matter

Sound

- ☐ Production of sound
- ☐ Relative speed of sound in solids, liquids, and gases
- ☐ Intensity of sound, decibel units, log scale
- ☐ Attenuation (Damping)
- ☐ Doppler Effect: moving sound source or observer, reflection of sound from a moving object
- ☐ Pitch
- ☐ Resonance in pipes and strings
- ☐ Ultrasound
- ☐ Shock waves

Light, Electromagnetic Radiation

- ☐ Concept of Interference; Young Double-slit Experiment
- ☐ Thin films, diffraction grating, single-slit diffraction
- ☐ Other diffraction phenomena, X-ray diffraction
- ☐ Polarization of light: linear and circular
- ☐ Properties of electromagnetic radiation
- ☐ Velocity equals constant c , *in vacuo*
- ☐ Electromagnetic radiation consists of perpendicularly oscillating electric and magnetic fields; direction of propagation is perpendicular to both
- Classification of electromagnetic spectrum, photon energy $E = hf$
- ☐ Visual spectrum, color

Molecular Structure and Absorption Spectra

- ☐ Infrared region
- ☐ Intramolecular vibrations and rotations
- ☐ Recognizing common characteristic group absorptions, fingerprint region
- ☐ Visible region

- ☐ Absorption in visible region gives complementary (e.g. carotene)
- ☐ Effect of structural changes on absorption (e.g. indicators)
- ☐ Ultraviolet region
- ☐ π -electron and non-bonding electron transitions
- ☐ Conjugated systems
- ☐ NMR spectroscopy
- ☐ Protons in a magnetic field; equivalent protons
- ☐ Spin-spin splitting

Geometrical Optics

- ☐ Reflection from plane surface: angles of incidence and reflection
- ☐ Refraction, refractive index n , Snell's law:
 $n_1 \sin \theta_1 = n_2 \sin \theta_2$
- ☐ Dispersion, change of index of refraction with wavelength
- ☐ Conditions for total internal reflection
- ☐ Spherical mirrors
- ☐ Center of curvature
- ☐ Focal length
- ☐ Real and virtual images
- ☐ Thin lenses
- ☐ Converging and diverging lenses
- ☐ Use of $1/p + 1/q = 1/f$, with sign conventions
- ☐ Lens strength, diopters
- ☐ Combination of lenses
- ☐ Lens aberration
- ☐ Optical Instruments, including

Content Category 4E: Atoms, nuclear decay, electronic structure, and atomic chemical behavior

Atomic Nucleus

- ☐ Atomic number, atomic weight
- ☐ Neutrons, protons, isotopes
- ☐ Nuclear forces, binding energy
- ☐ Radioactive decay (α , β , γ)
- ☐ Half-life, exponential decay, semi-log plots
- ☐ Mass spectrometer

Electronic Structure

- ☐ Orbital structure of hydrogen atom, principal quantum number n , number of electrons per orbital
- ☐ Ground state, excited states
- ☐ Absorption and emission line spectra
- ☐ Use of Pauli Exclusion Principle
- ☐ Paramagnetism and diamagnetism
- ☐ Conventional notation for electronic structure
- ☐ Bohr atom
- ☐ Heisenberg Uncertainty Principle
- ☐ Effective nuclear charge
- ☐ Photoelectric effect

The Periodic Table

- ☐ Alkali metals
- ☐ Alkaline earth metals: their chemical characteristics
- ☐ Halogens: their chemical characteristics
- ☐ Noble gases: their physical and chemical characteristics
- ☐ Transition metals
- ☐ Representative elements

- ☐ Metals and non-metals
- ☐ Oxygen group
- ☐ Valence electrons
- ☐ First and second ionization energy: prediction of electronic structure for elements in different groups or rows
- ☐ Electron affinity and variation with group and row
- ☐ Electronegativity: Comparative values for some representative elements and important groups
- ☐ Electron shells and the sizes of atoms and ions

Stoichiometry

- ☐ Molecular weight
- ☐ Empirical versus molecular formula
- ☐ Metric units commonly used in the context of chemistry
- ☐ Description of composition by percent mass
- ☐ Mole concept, Avogadro's number N_A
- ☐ Density
- ☐ Oxidation number
- ☐ Common oxidizing and reducing agents
- ☐ Disproportionation reactions
- ☐ Description of reactions by chemical equations and writing conventions
- ☐ Balancing equation
- ☐ Limiting reactants
- ☐ Theoretical yields

Foundation 5A: Unique nature of water and its solutions

Acid/Base Equilibria

- ☐ Bronsted-Lowry acids and bases
- ☐ Ionization of water, K_w
- ☐ Definition of pH: pH of pure water
- ☐ Conjugate acids and bases (e.g. NH_4^+ and NH_3)
- ☐ Strong acids and bases (e.g. nitric, sulfuric)
- ☐ Dissociation of weak acids and bases with and without added salts
- ☐ Hydrolysis of salts of weak acids or bases
- ☐ Calculation of pH of solutions of salts of weak acids or bases
- ☐ Equilibrium constants K_a and K_b : $\text{p}K_a$, $\text{p}K_b$
- ☐ Definition and concepts of common buffer systems
- ☐ Influence on titration curves

Ions in Solutions

- ☐ Anion, cation: common names, formulas and charges for common ions
- ☐ Hydration, the hydronium ion

Solubility

- ☐ Units of concentration (e.g. molarity)
- ☐ Solubility product constant; K_{sp}
- ☐ Common-ion effect, its use in laboratory separations
- ☐ Complex ion formation and solubility
- ☐ Solubility and pH

Titration

- ☐ Indicators and Neutralization
- ☐ Interpretation of the titration curves
- ☐ Redox titration

5B: Nature of molecules and molecular interactions

Covalent Bond

- ☐ Lewis Electron Dot formulas
- ☐ Resonance structures
- ☐ Formal charge
- ☐ Lewis acids and bases
- ☐ Partial ionic character: Dipole Moment
- ☐ Role of electronegativity in charge distribution
- ☐ σ and π bonds : Hybrid orbitals; sp^3 , sp^2 , sp and respective geometries
- ☐ VSEPR theory and the predictions of shapes of molecules (e.g. NH_3 , H_2O , CO_2)
- ☐ Structural formulas for molecules involving H, C, N, O, F, S, P, Si, Cl
- ☐ Delocalized electrons and resonance in ions and molecules
- ☐ Multiple bonding

- ☐ Effect on bond length and bond energies
- ☐ Rigidity in molecular structure

Stereochemistry of covalently bonded molecules

- ☐ Structural isomers
- ☐ Stereoisomers (e.g. enantiomers, diastereomers and cis/trans isomers)
- ☐ Conformational isomers
- ☐ Polarization of light, specific rotation
- ☐ Absolute and relative configuration (R and S forms, E and Z forms)

Liquid phase-intermolecular force

- ☐ Hydrogen bonding
- ☐ Dipole interactions
- ☐ Van der Waals' forces (London dispersion forces)

5C: Separation and Purification Techniques including proteins and peptides

Separation and Purification Methods

- ☐ Extraction and Distillation
- ☐ Chromatography: Basis principles of separation
- ☐ Gas-liquid chromatography
- ☐ HPLC
- ☐ Paper and Thin-layer chromatography
- ☐ Size exclusion chromatography

- ☐ Ion exchange chromatography
- ☐ Affinity chromatography
- ☐ Electrophoresis

- ☐ Quantitative analysis

- ☐ Racemic mixtures, separation of enantiomers

5D: Structure, function, and reactivity of biologically relevant molecules

Nucleotides and Nucleic Acids

- ☐ Nucleotides and nucleosides: composition
- ☐ Sugar phosphate backbone
- ☐ Pyrimidine, purine residues
- ☐ Deoxyribonucleic acid: DNA, double helix
- ☐ Chemistry and additional functions

Amino Acids/Peptides

- ☐ Absolute configuration at the α position
- ☐ Amino acids as dipolar ions
- ☐ Acidic or basic
- ☐ Hydrophobic or hydrophilic, Hydrolysis
- ☐ Synthesis of α -amino acids: Strecker and Gabriel
- ☐ Sulfur linkage for cysteine and cysteine
- ☐ Peptide linkage: polypeptides and proteins
- ☐ Isoelectric point

Proteins

- ☐ 1°, 2°, 3°, 4° structure of proteins
- ☐ Role of proline, cystine, hydrophobic bonding
- ☐ Denaturing and folding
- ☐ Hydrophobic interactions
- ☐ Solvation layer (entropy)

Non-Enzymatic Protein Function

- ☐ Binding
- ☐ Immune system
- ☐ Motor

Types of Lipids

- ☐ Storage including triacylglycerols
- ☐ Free fatty acids: saponification

Structural

- ☐ Phospholipids and phosphatids
- ☐ Sphingolipids and Waxes

Lipids as Signaling molecules and cofactors

- ☐ Fat-soluble vitamins
- ☐ Steroids and Prostaglandins

Carbohydrates

- ☐ Nomenclature and classification, common names
- ☐ Absolute configuration
- ☐ Cyclic structure and conformations of hexoses
- ☐ Epimers and anomers
- ☐ Hydrolysis of the glycoside linkage
- ☐ Keto-enol tautomerism of monosaccharides

- ☐ Disaccharides, Polysaccharides

Aldehydes and Ketones

- ☐ Nomenclature
- ☐ Physical properties
- ☐ Nucleophilic addition reactions at C=O bond
- ☐ Formation of Acetal, hemiacetal
- ☐ Imine, enamine and Cyanohydrin
- ☐ Hydride reagents
- ☐ Oxidation of aldehydes
- ☐ Reactions at adjacent positions: enolate chemistry
- ☐ Keto-enol tautomerization (racemization)
- ☐ Aldol condensation, retro-aldol
- ☐ Kinetic versus thermodynamic enolate
- ☐ Effect of substituents on reactivity of C=O; steric hindrance
- ☐ Acidity of α -H; carbanions

Alcohols

- ☐ Nomenclature
- ☐ Physical properties (acidity, hydrogen bonding)
- ☐ Oxidation, Substitution reactions: S_N1 or S_N2
- ☐ Protection of alcohols
- ☐ Preparation of mesylates and tosylates

Carboxylic Acids

- ☐ Nomenclature
- ☐ Physical properties
- ☐ Carboxyl group reactions
- ☐ Amides (and lactam), esters (and lactone), anhydride formation
- ☐ Reductions and Decarboxylation
- ☐ Reactions at 2-position, substitution

Acid Derivatives (Anhydrides, Amides, Esters)

- ☐ Nomenclature and physical properties
- ☐ Nucleophilic substitution
- ☐ Hydrolysis of amides and Transesterification
- ☐ Relative reactivity of acid derivatives
- ☐ Steric effects
- ☐ Electronic effects
- ☐ Strain (β -lactams)

Phenols

- ☐ Oxidation and reduction (e.g., hydroquinones, ubiquinones: biological 2e⁻ redox centers)

Polycyclic and Heterocyclic Aromatic Compounds

- ☐ Biological aromatic heterocycles

5E: Principles of chemical thermodynamics and kinetics

Enzymes

- ☐ Enzyme classification by reaction type
- ☐ Substrates and specificity
- ☐ Active site model
- ☐ Induced-fit model
- ☐ Cofactors, coenzymes and vitamins
- ☐ General Kinetics and catalysis
- ☐ Michaelis-Menten
- ☐ Cooperativity
- ☐ Effects of local conditions on enzyme activity
- ☐ Inhibition
- ☐ Regulatory enzymes
- ☐ Allosteric
- ☐ Covalently modified

Principles of Bioenergetics

- ☐ Bioenergetics/thermodynamics
- ☐ Free energy/ K_{eq} , Concentration
- ☐ Phosphorylation/ATP
- ☐ ATP hydrolysis and ATP group transfers
- ☐ Biological oxidation–reduction
- ☐ Half-reactions
- ☐ Soluble electron carriers
- ☐ Flavoproteins

Energy changes in chemical reactions

- ☐ Thermodynamic system – state function
- ☐ Zeroth Law – concept of temperature
- ☐ PV diagram: work done = area under or enclosed by curve
- ☐ First Law: $\Delta E = Q - W$ (conservation of energy)
- ☐ Second Law – concept of entropy and as a measure of disorder
- ☐ Relative entropy for gas, liquid, and crystal states
- ☐ Calorimetry, heat capacity, specific heat

- ☐ Heat transfer – conduction, convection, radiation
- ☐ Endothermic/exothermic reactions
- ☐ Enthalpy, H , and standard heats of reaction and formation
- ☐ Hess' Law of Heat Summation
- ☐ Bond dissociation energy as related to heats of formation
- ☐ Free energy: G and spontaneous reactions ΔG°
- ☐ Coefficient of expansion
- ☐ Heat of fusion, heat of vaporization
- ☐ Phase diagram: pressure and temperature

Kinetics and equilibrium in chemical reactions

- ☐ Reaction rate, rate law and rate constant
- ☐ Dependence of reaction rate upon concentration of reactants
- ☐ Reaction order
- ☐ Rate determining step
- ☐ Dependence of reaction rate on temperature
- ☐ Activation energy
- ☐ Activated complex or transition state
- ☐ Interpretation of energy profiles showing energies of reactants, products, activation energy ΔH for the reaction
- ☐ Use of the Arrhenius Equation
- ☐ Kinetic control versus thermodynamic control
- ☐ Catalysts
- ☐ Equilibrium in reversible chemical reactions
- ☐ Law of Mass Action
- ☐ Equilibrium Constant
- ☐ Application of Le Chatelier's principle
- ☐ Relationship of the equilibrium constant and ΔG°

6A: Sensing the environment

Sensory Processing

- ☐ Sensation and thresholds
- ☐ Weber's Law
- ☐ Signal detection theory
- ☐ Sensory adaptation, Psychophysics
- ☐ Sensory receptors, types and pathways

Vision

- ☐ Structure and function of the eye
- ☐ Visual processing and pathways in the brain
- ☐ Parallel processing and feature detection

Hearing

- ☐ Structure and function of ear
- ☐ Auditory processing and pathways in the brain
- ☐ Sensory reception by hair cells

Other Senses

- ☐ Somatosensation and pain perception
- ☐ Taste and Taste buds/chemoreceptors
- ☐ Smell; olfactory cells/chemoreceptors
- ☐ Pheromones and olfactory pathways in the brain
- ☐ Kinesthetic sense and vestibular sense

Perception

- ☐ Bottom-up/Top-down processing
- ☐ Perceptual organization (e.g., depth, form, motion, constancy)
- ☐ Gestalt principles

6B: Making sense of the environment

Attention

- ☐ Selective and divided attention

Cognition

- ☐ Information-processing model
- ☐ Cognitive development
- ☐ Piaget's stages of cognitive development
- ☐ Cognitive changes in late adulthood
- ☐ Role of culture in cognitive development
- ☐ Influence of heredity and environment on cognitive development
- ☐ Biological factors that affect cognition
- ☐ Types of problem solving and decision making
- ☐ Barriers to effective problem solving
- ☐ Approaches to problem solving
- ☐ Heuristics, biases, intuition, and emotion
- ☐ Overconfidence and belief perseverance
- ☐ Intellectual functioning
- ☐ Theories of intelligence
- ☐ Influence of heredity and environment on intelligence
- ☐ Variations in intellectual ability

Consciousness

- ☐ States of consciousness, Alertness
- ☐ Sleep and Stages of sleep
- ☐ Sleep cycles, circadian rhythms
- ☐ Dreaming, Sleep-wake disorders

- ☐ Hypnosis and meditation
- ☐ Consciousness altering drugs and their effects on the nervous system and behavior
- ☐ Drug addiction and the reward pathway in the brain

Memory

- ☐ Encoding and processes that aid encoding memories
- ☐ Process of encoding information
- ☐ Types of memory storage (e.g., sensory, working, long-term)
- ☐ Semantic networks and spreading activation
- ☐ Recall, recognition, and relearning
- ☐ Role of emotion and memory retrieval and retrieval cues
- ☐ Aging and memory
- ☐ Memory dysfunctions (Alzheimer's disease, Korsakoff's syndrome)
- ☐ Decay and forgetting
- ☐ Interference and Long-term potentiation
- ☐ Memory construction and source monitoring
- ☐ Changes in synaptic connections underlie memory and learning
- ☐ Neural plasticity, memory and learning

Language

- ☐ Theories of language development (e.g., learning, Nativist, Interactionist)
- ☐ Influence of language on cognition
- ☐ Different brain areas control language and speech

6C: Responding to the World

Emotion

- ☐ Cognitive, physiological, and behavioral components of emotion
- ☐ Universal emotions (e.g., fear, anger, happiness, surprise, joy, disgust, sadness)
- ☐ Adaptive role of emotion

Theories of emotion

- ☐ James-Lange theory
- ☐ Cannon-Bard theory
- ☐ Schachter-Singer theory
- ☐ Biological processes and perception of emotion
- ☐ Brain regions in generation and experience of emotions
- ☐ The role of the limbic system in emotion

- ☐ Emotion and the autonomic nervous system
- ☐ Physiological markers of emotion (signatures of emotion)

Stress

- ☐ The nature of stress
- ☐ Appraisal
- ☐ Different types of stressors
- ☐ Effects of stress on psychological functions
- ☐ Stress outcomes/response to stressors
- ☐ Emotional
- ☐ Behavioral
- ☐ Stress management



7A: Individual influences on behavior - biological bases of behavior

The nervous system

- ☐ Neurons (e.g. the reflex arc)
- ☐ Neurotransmitters
- ☐ Structure and function of peripheral nervous system and central nervous system
- ☐ The brain
- ☐ The Forebrain, Midbrain, Hindbrain
- ☐ The cerebrum
- ☐ The spinal cord
- ☐ Lateralization of cortical functions
- ☐ Methods of studying the brain
- ☐ Neurons communicate and influence behavior
- ☐ Influence of neurotransmitters on behavior

The endocrine system

- ☐ Components of the endocrine system
- ☐ Role of the endocrine system in behavior
- ☐ Behavioral genetics
- ☐ Genes, temperament, and heredity
- ☐ Adaptive value of traits and behaviors
- ☐ Interaction between heredity and environmental influences

Genetic and environmental factors contribute to the development of behaviors

- ☐ Experience and behavior
- ☐ Regulatory genes and behavior
- ☐ Genetically based behavioral variation in natural populations
- ☐ Human physiological development
- ☐ Prenatal development
- ☐ Motor development
- ☐ Developmental changes in adolescence

Personality

- ☐ Theories of personality
- ☐ Psychoanalytic perspective
- ☐ Humanistic perspective
- ☐ Trait perspective
- ☐ Social cognitive perspective
- ☐ Biological perspective

- ☐ Behaviorist perspective
- ☐ Situational approach to explaining behavior

Psychological Disorders

- ☐ Biomedical vs. biopsychosocial approaches
- ☐ Classifying psychological disorders
- ☐ Rates of psychological disorders
- ☐ Anxiety disorders, Obsessive-compulsive disorder
- ☐ Somatic symptom and related disorders
- ☐ Depressive disorders
- ☐ Schizophrenia, Bipolar and related disorders
- ☐ Dissociative and Personality disorder
- ☐ Trauma and stressor related disorders

Biological bases of nervous system disorders

- ☐ Schizophrenia
- ☐ Depression
- ☐ Alzheimer's disease
- ☐ Parkinson's disease
- ☐ Stem cell-based therapy to regenerate neurons in CNS

Motivation

- ☐ Factors that influence motivation
- ☐ Instinct
- ☐ Arousal
- ☐ Drives (e.g. negative feedback systems)
- ☐ Needs
- ☐ Drive reduction theory
- ☐ Incentive theory
- ☐ Cognitive and need based theories
- ☐ Biological and Socio-cultural motivators that regulate behavior (e.g. hunger, sex-drive, substance addiction)

Attitudes

- ☐ Components of attitudes (i.e., cognitive, affective, and behavioral)
- ☐ The link between attitudes and behavior
- ☐ Processes by which behavior influences attitudes (e.g. Foot-in-the door phenomenon, Role-playing effects)
- ☐ Processes by which attitudes influence behavior
- ☐ Cognitive dissonance theory

7B: Social processes that influence human behavior

How the Presence of Others Affects Individual Behavior

- ☐ Social facilitation
- ☐ Deindividuation
- ☐ Bystander effect
- ☐ Social loafing, social control
- ☐ Peer pressure, Conformity, Obedience

Group Processes

- ☐ Group polarization
- ☐ Groupthink

Normative and Non-normative Behavior

- ☐ Social norms and Sanctions
- ☐ Folkways, mores and taboos
- ☐ Anomie
- ☐ Perspectives on deviance (e.g. differential association, labeling theory, strain theory)
- ☐ Aspects of collective behavior (e.g. fads, mass hysteria, riots)

Socialization

- ☐ Agents of socialization (e.g. family, mass media, peers, work place)

7C: Attitude and behavior change

Habituation and Dishabituation

Associative Learning

- ☐ Classical conditioning
- ☐ Neutral, conditioned, and unconditioned stimuli
- ☐ Conditioned and unconditioned response
- ☐ Processes: acquisition, extinction, spontaneous recovery, generalization, discrimination
- ☐ Operant conditioning
- ☐ Processes of shaping and extinction
- ☐ Types of reinforcement: positive, negative, primary, conditional
- ☐ Reinforcement schedules: fixed-ratio, variable-ratio, fixed-interval, variable-interval
- ☐ Punishment
- ☐ Escape and avoidance learning
- ☐ Role of cognitive process in associative learning
- ☐ Biological processes that affect associative learning (e.g. biological predisposition, instinctive drift)

Observational Learning

- ☐ Modeling
- ☐ Biological processes that affect observational learning
- ☐ Mirror neurons
- ☐ Role of the brain in experiencing vicarious emotions
- ☐ Applications of observational learning to explain individual behavior

Theories of Attitude and Behavior Change

- ☐ Elaboration Likelihood Model
- ☐ Social Cognitive theory
- ☐ Factors that affect attitude change (e.g. changing behavior, characteristics of the message and target, social factors)

8A: Self identity

Self-Concept and Identity

- ☐ Definitions of self-concept, identity, and social identity
- ☐ The role of self-esteem, self-efficacy, and locus of control in self-concept and self-identity
- ☐ Different types of identities (e.g., race/ethnicity, gender, age, sexual orientation, class)

Formation of Identity

- ☐ Theories of identity development (e.g., gender, moral, psychosexual, social)
- ☐ Influence of social factors on identity formation
- ☐ Influence of individuals (e.g., imitation, role-taking)
- ☐ Influence of group (e.g., reference group)
- ☐ Influence of culture and socialization on identity formation

8B: Social thinking

Attributing Behavior to Persons or Situations

- ☐ Attribution processes (e.g. Fundamental attribution error, role of culture in attributions)
- ☐ How self-perceptions shape our perceptions of others
- ☐ How perceptions of the environment shape our perceptions of others

Prejudice and Bias

- ☐ Stereotypes, Stigma

- ☐ Ethnocentrism vs. cultural relativism
- ☐ Power, prestige, and class
- ☐ The role of emotion in prejudice
- ☐ The role of cognition in prejudice

Processes Related to Stereotypes

- ☐ Self-fulfilling prophecy
- ☐ Stereotype threat

8C Social Interactions

Elements of Social Interaction

- ☐ Statuses (e.g. achieved, ascribed)
- ☐ Role conflict, role strain and role exit
- ☐ Groups: primary and secondary
- ☐ In-group vs. Out-group, Group size (e.g. dyads, triads)
- ☐ Networks
- ☐ Organization: Formal organization
- ☐ Characteristics of ideal bureaucracy, perspective on bureaucracy (e.g. iron law of oligarchy, McDonaldization)

Self-presentation and Interacting with Others

- ☐ Expressing and detecting emotion
- ☐ Role of gender and culture in expression and detection of emotion

Impression management

- ☐ Front stage vs. back stage self (Dramaturgical approach)
- ☐ Verbal and nonverbal communication

- ☐ Animal signals and communication

Social Behavior

- ☐ Attraction, attachment
- ☐ Aggression
- ☐ Social support

Biological explanations of social behavior in animals

- ☐ Foraging behavior
- ☐ Mating behavior and mate choice
- ☐ Applying game theory
- ☐ Altruism
- ☐ Inclusive fitness

Discrimination

- ☐ Individual vs. institutional discrimination
- ☐ Prejudice and discrimination
- ☐ How power, prestige, and class facilitate discrimination

9A: Understanding Social Structure

Theoretical Approaches

- ☐ Microsociology vs. macrosociology
- ☐ Functionalism
- ☐ Conflict theory
- ☐ Symbolic interactionism
- ☐ Social constructionism
- ☐ Exchange-rational choice
- ☐ Feminist theory

Social Institutions

- ☐ Education: hidden curriculum, teacher expectancy and educational segregation and stratification
- ☐ Family: forms of kinship, diversity in family forms
- ☐ Marriage and divorce
- ☐ Violence in family (e.g. child, elder and spousal abuse)
- ☐ Religion: religiosity
- ☐ Types of religious organizations (e.g. church, sect, cult)
- ☐ Religion and social change (e.g. modernization, secularization, fundamentalism)

- ☐ Government and economy: Power and authority
- ☐ Comparative economics, political systems and division of labor
- ☐ Health and medicine: Delivery of health care
- ☐ The sick role, illness experience
- ☐ Medicalization and social epidemiology

Culture

- ☐ Elements of culture (e.g. beliefs, language, rituals, symbols, values)
- ☐ Material vs. symbolic culture
- ☐ Culture lag, culture shock
- ☐ Assimilation and Multiculturalism
- ☐ Subculture and counterculture
- ☐ Mass media and popular culture
- ☐ Evolution and human culture
- ☐ Transmission and diffusion

9B: Demographic characteristics and processes

Demographic characteristics and processes

- ☐ Aging and the life course
- ☐ Age cohorts and social significance of aging
- ☐ Sex vs. gender
- ☐ Social construction of gender and gender segregation
- ☐ Race and ethnicity: social construction of race
- ☐ Racialization and racial formation
- ☐ Patterns of immigration and intersections with race and ethnicity
- ☐ Sexual orientation

communication technology, economic interdependence)

- ☐ Perspectives on globalization
- ☐ Social changes in globalization (e.g. civil unrest, terrorism)
- ☐ Industrialization and urban growth
- ☐ Suburbanization and urban decline
- ☐ Gentrification and urban renewal

Demographic Shifts and Social Change

- ☐ Theories of demographic change (e.g. Malthusian theory and demographic transition)
- ☐ Population growth and decline (e.g. population projections, population pyramids)
- ☐ Fertility and mortality rates (e.g. total, crude, age-specific)
- ☐ Patterns in fertility and mortality
- ☐ Push and pull factors in migration
- ☐ Organization of social movements; strategies and tactics
- ☐ Relative deprivation
- ☐ Factors contributing to globalization (e.g.

10A: Social inequality

Spatial Inequality

- ☐ Residential segregation
- ☐ Environmental justice (location and exposure to health risks)
- ☐ Neighborhood safety and violence

Social Class

- ☐ Aspects of social stratification
- ☐ Social class and socioeconomic status
- ☐ Class consciousness and false consciousness
- ☐ Cultural capital and social capital
- ☐ Social reproduction
- ☐ Power, privilege and prestige
- ☐ Intersectionality (e.g. race, gender and age)

Patterns of social mobility

- ☐ Intergenerational and intra-generational mobility
- ☐ Vertical and horizontal mobility
- ☐ Meritocracy

Poverty

- ☐ Relative and absolute
- ☐ Social exclusion (segregation and isolation)

Health Disparities

- ☐ Race, gender, and class inequalities in health

Healthcare Disparities

- ☐ Race, gender, and class inequalities in healthcare